FLORA MALESIANA

SERIES I - SPERMATOPHYTA

Flowering Plants

Vol. 7, part 1

INDEX TO REVISED FAMILIES

ICACINACEAE (H. Sleumer, Leyden)

Trees, or whether or not climbing shrubs, or lianas. *Leaves* spirally arranged, rarely opposite, simple, entire or lobed (in Mal. never crenate or serrate), penni- or palmatinerved, exstipulate. *Inflorescences* mostly axillary, sometimes terminal, rarely extra-axillary, or from old wood, in spikes or spike-like racemes, or often in cymes, both spikes and cymes not rarely collected to panicles or heads, very rarely reduced to few-flowered fascicles or to a solitary flower. *Flowers* bi- or unisexual, in the latter case at least functionally so, *i.e.* the plants dioecious, actinomorphic, (4–)5(–6)-, by reduction rarely in part 3-merous, cyclic (with sepals or calyx lobes and petals) or rarely spiral (with petals only in *Pyrenacantha*, or without petals in the ♀ flowers of *Platea* and some *spp.* of *Iodes* and *Gomphandra*). Pedicels, if any, articulated with the calyx. *Sepals* 4–6, free or mostly connate below to various degree to a 4–6-lobed calyx, the lobes imbricate or valvate, generally persistent. *Petals* 4–6, free or connate below to various degree, sometimes to a tube, the lobes valvate, very rarely subimbricate, tip inflexed, mostly caducous, sometimes persistent. *Stamens* as many as sepals or petals, episepalous, inserted basally or sometimes in the upper part of the tube; filaments subulate, fleshy, often flattened, or filiform, not rarely with clavate subglandular elongate hairs distally; anthers 2-celled, cells often diverging below, basifixed, latrorse or introrse, in *Polyporandra* dismissing the pollen from numerous operculate pores. *Disk* whether or not present, either annular or cup-like, free or adnate to the ovary, or a unilateral fleshy scale. *Ovary* free, 1-celled (in *Pseudobotrys*, *Gonocaryum* and *Citronella* 2-celled with an empty tube-like unilateral cell) (in Mal.); ovules 2 (rarely 1 abortive), apical, pendent, anatropous, apotropous, unitegmic; style 1 or none; stigma punctiform, subcapitate or peltate, entire or slightly 2–5-lobed or -crenate, often depressed to one side. *Drupe* ellipsoid to globose, often laterally compressed and almond-like; exocarp generally thin-fleshy; endocarp thin-crustaceous to thick-woody, sometimes spongious or fibrous, often veined or ribbed lengthwise or reticulate-lacunose outside, smooth or with tubercles or blunt aculei inside, the seed pitted then. *Seed* 1, exarillate, generally with abundant endosperm, which rarely is ruminate; embryo straight; cotyledons whether or not foliaceous.

Distribution. About 56 genera with *c.* 300 *spp.*, all woody, predominantly in the tropics, rapidly decreasing in number towards the subtropics; 5 genera with part of their species in the temperate zones of Africa, Asia, Australia and S. America.

In Malesia a total of *c.* 100 *spp.* in 21 genera, of which 3 are strictly endemic, *viz Cantleya* (W. Malesia), *Hartleya* and *Pseudobotrys* (both in New Guinea); 8 other genera find their main area of distribution and generally their greatest number of species in Malesia, but occur also in parts of S. and SE. Asia, *viz Gonocaryum*, *Platea* (both also in New Britain), *Codiocarpus*, *Stemonurus* (also in the Solomon Is.), *Miquelia*, *Nothapodytes*, *Phytocrene*, and *Sarcostigma*; 3 genera, *viz Apodytes*, *Iodes* and *Pyrenacantha*, are found in Africa (also Madagascar), SE. Asia and Malesia. The genus *Citronella* is amphipacific (Malesia, E. Australia, Melanesia, New Caledonia, New Hebrides, Fiji, Samoa, Tonga, Costa Rica, Venezuela, Brazil, Paraguay, N. Argentina, Bolivia, and Central Chile); 6 genera, *viz Gomphandra*, *Medusanthera*, *Merrilliodendron*, *Polyporandra*, *Rhyticaryum*, and *Stemonurus*, extend from Malesia into Micronesia and Melanesia or even W. Polynesia; of these only *Gomphandra* and *Rhyticaryum* are also found in NE. Australia. *Whitmorea*, so far known, is limited to the Solomon Is., but might occur also in SE. New Guinea.

Icacinaceae of Malesia show a strong affinity with those of tropical South Asia (SW. India, Ceylon) and Southeast Asia (Sikkim to Assam, Bengal, Burma, Thailand, Indo-China, W., Central and S. China incl. Hainan and Formosa, S. Japan). Most of the members of the family in Australia point to an Asiatic-Malesian origin; *Irvingbaileya*, limited to Queensland, is taxonomically very close to *Codio-*

carpus and *Medusanthera*. *Pennantia* in New Zealand and on Norfolk I. is more distinct from the Asiatic-Malesian bloc of genera. New Caledonia has, besides *Citronella*, 2 endemic genera, *viz Anisomallon* (allied to *Apodytes*) and *Gastrolepis* (related to the group of genera around *Medusanthera*).

Ecology. Most Malesian *spp.* occur in the substage of the primary or secondary rain-forest, a few are canopy trees (*Stemonurus*, *Platea*, *Cantleya*, *Citronella p.p.*). They are mainly found in the lowlands, but may ascend to the montane and even the mossy forest (*Platea p.p.*, *Rhyticaryum p.p.*, *Gomphandra p.p.*) up to 2400 m (higher altitudes mentioned on collector's labels being rather doubtful); several genera reach their highest altitude on Mt Kinabalu or in New Guinea. The distribution is scattered in general for the tree species, even more so for the climbers, and can cover enormous areas as for instance *Platea latifolia*, a species ranging from Sikkim, Himalaya, to New Guinea. Several species (*Stemonurus*, *Gomphandra*; *Platea* even with stilt roots) are clearly limited to peat swamp forest. Some *Icacinaceae* are found also in coastal forest, and such species may possibly derive their wide range of distribution from the floating capacity of the fruit.

Large dimensions are reached only by a few species of *Platea*, *Cantleya*, *Stemonurus*, *Citronella*, *Gomphandra*, *Apodytes*, or rarely by such of *Nothapodytes* and *Medusanthera*.

Among the rain-forest species none is reported to be dominant in any vegetation type, though occasionally single species may be locally frequent.

Few species occur in the drier, mainly seasonally dry parts of Malesia, all of them being shrubs or climbers.

Dispersal. Little is known of the dispersal of fruits, part of which are eaten by wild animals (e.g. of *Gonocaryum*, *Cantleya*, *Gomphandra*, *Medusanthera*). Buoyancy of fruits is certain for *Merrilliodendron*, less so for *Gonocaryum* and *Stemonurus*, and may have contributed to their dispersal.

Galls. No galls specific for a distinct genus or species are hitherto known from Malesian *Icacinaceae* (*cf.* DOCTERS VAN LEEUWEN, Zoocecidia, 1926, 332, f. 597–599: *Gomphandra*, *Phytocrene*, *Platea*; Ned. Kruidk. Arch. 51, 1941, 175, f. 48: *Stemonurus*).

Anatomy. Wood. Structure, properties and identification: DEN BERGER, Determinatietabel Malesië, Veenman, Wageningen (1949) (hand lens), BALAN MENON, Res. Pamphl. For. Dept Malaya 18 (1955) 1–16 (*Cantleya*), CHATTAWAY, Trop. Woods 102 (1955) 55–74, *ibid.* 104 (1956) 100–124 (crystals), DESCH, Mal. For. Rec. 15 (1941) 233 (*Cantleya*, *Stemonurus*), FEI-TAN & CHU, Malayan Forester 32 (1969) 287–293 (fibres, *Stemonurus*), GOSH, RAO *c.s.* Indian Woods 2 (1963) New Delhi (*Apodytes*, *Gomphandra*, *Nothapodytes* as '*Mappia*'), JANSSONIUS, Key to Javanese woods, Leyden (1952), and MOLL & JANSSONIUS, Mikr. 2 (1911) 234–254 (*Apodytes*, *Gomphandra*, *Platea*, *Stemonurus*), VAN DER WALT *c.s.* T. Nat. Wetensk. Suid-Afr. (1970) 173–199 (*Pyrenacantha*, anomalous growth). For general surveys also comprehensively covering the older literature see SOLEREDER, Syst. Anat. Dicot. Stuttgart (1899) 227–237 and *ibid.* (1908) 81–83, and METCALFE & CHALK, Anat. Dicot. Oxford (1950) 367–377.

The vegetative anatomy of the *Icacinaceae* is extremely diverse and no character from leaf, twig or wood anatomy is consistent or even typical for the family. Because of the enormous range in structure, anatomical characters have been extensively used in discussing the relationships and subdivisions within the family. ENGLER's wood-anatomical characterizations of the tribes *Icacineae*, *Iodeae*, *Sarcostigmateae* and *Phytocreneae* (Sitz. Ber. Preuss. Akad. Wiss. Berlin 18, 1893, 1–23) were not based on enough material and therefore inaccurate. BAILEY & HOWARD (J. Arn. Arb. 22, 1941, 125–132, 171–187, 432–442, 556–568) distinguished three groups based on a combination of the nodal anatomy and the type of vessel perforation. Group I with trilacunar nodes and exclusively scalariform vessel perforation includes *Apodytes*, *Citronella*, *Pittosporopsis* and *Platea* (all *Icacineae*), Group II with trilacunar nodes and a mixture of simple and scalariform vessel perforations includes *Cantleya*, *Gonocaryum*, *Medusanthera*, *Gomphandra* (as '*Stemonurus*') and *Stemonurus* (as '*Urandra*') (all *Icacineae*). Group III with unilacunar nodes and simple vessel perforations includes *Iodes*, *Mappianthus*, *Merrilliodendron*, *Miquelia*, *Natsiatum*, *Nothapodytes*, *Phytocrene*, *Polyporandra*, *Pyrenacantha*, *Rhyticaryum*, and *Sarcostigma* (from all four tribes *sensu* ENGLER). Other xylem characters such as vessel distribution, vessel member length, type of fibres, parenchyma arrangement and ray structure are more or less related to these groups of increasing xylem specialization. *Codiocarpus*, *Hartleya*, *Pseudobotrys* and *Whitmorea* were not included in the studies of BAILEY & HOWARD. *Whitmorea* has a trilacunar node and mixed vessel perforations and therefore belongs to group II. This observation supports SLEUMER's view that *Whitmorea* is related to *Stemonurus* (Blumea 17, 1969, 264). All data on wood anatomy provided by BAILEY & HOWARD suggest a more or less continuous range of xylem characters within *Icacinaeceae* rather than the presence of distinct boundaries.

Hairs. HEINTZELMANN & HOWARD (Amer. J. Bot. 35, 1948, 42–52) distinguish ten hair types that occur in floral parts or on leaves and young twigs of *Icacinaceae*. Noteworthy are the two-armed or Malpighiaceous hairs in *Nothapodytes* and some genera from outside Malesia. This hair type intergrades with the so-called Icacinaceous hair with one much reduced and one well developed arm occurring in a majority of the genera. *Rhyticaryum* has clustered hairs; *Platea* stellate-peltate hairs (called 'scales' in the taxonomic part) (see also UPHOF, HUMMEL & STAESCHE, Handb. Pflanzenanat. IV, 5, 1962).

Stomata are very imperfectly known in *Icacinaceae*. Both anomocytic and paracytic stomata have been recorded in literature, but actinocytic (*Merrilliodendron*) and anisocytic (*Medusanthera* and *Stemonurus*) types also occur.

The vascularization of the petiole and midrib would also merit further investigation. Species of *Apodytes*, *Citronella*, *Medusanthera*, *Phytocrene*, and *Stemonurus* have central strands with or without latero-dorsal bundles, but the range in the whole family must be much greater since *Pennantia* shows a very complex pattern (*cf.* Blumea 18, 1970, 217).

Crystals occur as druses, solitary rhomboids and crystal sand in various combinations (*cf.* HEINTZELMANN & HOWARD, *l.c.*).

The fine translucent dots of the leaves of *Merrilliodendron* are caused by large intercellular spaces in the spongy tissue of the mesophyll.

Domatia have been recorded for several Icacinaceous genera but are absent from all Malesian species. — P. BAAS.

Phytochemistry. The few chemical data available about the chemistry of this family were summarized in my 'Chemotaxonomie der Pflanzen' 4 (1966) 275–277, 494. In the meantime, oleanolic acid was isolated from the bark of *Apodytes dimidiata* E. MEYER (= *A. beddomei* MAST.). The scanty chemical information available about *Icacinaceae* at this time, prevents a chemotaxonomic discussion. — R. HEGNAUER.

Uses. In Malesia but a few tree species grow to big dimension with a clear bole (*Cantleya*, *Stemonurus*, *Platea*). Of these only *Cantleya corniculata* (BECC.) HOWARD has a marketing value and is exported from Sarawak and Brunei. *Icacinaceae* have a hard or mostly rather soft, often whitish or cream, sometimes aromatic wood, and are apparently only locally used by the natives, as can be deduced from the many vernacular names known.

The leaves of *Rhyticaryum* species are eaten as a vegetable. Medicinal use is recorded for several species but needs confirmation. The seeds of *Cantleya*, *Phytocrene*, *Stemonurus* and *Sarcostigma* are edible, but of a poor quality. The stems of lianas (*Miquelia*, *Phytocrene*) hold fresh edible water.

Taxonomy. Four of the genera found in Asia and Malesia were revised by R. A. HOWARD (*Cantleya*: J. Arn. Arb. 21, 1940, 479; *Codiocarpus*: Brittonia 5, 1943, 60; *Medusanthera*: Lloydia 6, 1943, 133; *Nothapodytes*: J. Arn. Arb. 23, 1942, 66); these revisions were based on rather scarce materials as far as Malesia is concerned. A precursory paper with revisions of most of the genera concerned and based on practically all Asiatic and Malesian specimens available today was published by myself in Blumea 17 (1969) 181–264, supplementing my previous studies on the family (Notizbl. Berl.–Dahl. 15, 1940, 228–257; *ibid.*, 1942, 359–365; in E. & P. Natl. Pfl. Fam. ed. 2, 20 b, 1942, 322–396).

KEY TO THE GENERA

1. Trees or (not climbing) shrubs.
 2. Sepals essentially free at least in their upper ¾ and imbricate.
  3. Flowers bisexual.
   4. Petals free, valvate, or subimbricate in their upper part. . . . . **1. Citronella**
   4. Petals connate below into a tube, their upper part free and valvate in bud. . **2. Pseudobotrys**
  3. Flowers unisexual. (Petals connate below.)
   5. Filaments free, fixed to the very base of the petals. Leaves with a layer of rounded to star-shaped appressed scales underneath at least in the young state. . . . . **3. Platea**
   5. Filaments adnate for almost their entire length to the lower tubular part of the petals. Scales absent. . . . . **4. Gonocaryum**
 2. Sepals connate into a cup-like calyx, its upper free part (or lobes), if any, short and not imbricate.
  6. Flowers unisexual (or functionally so).
   7. Drupe ovoid-ellipsoid or oblongoid, without a fleshy lateral appendage. Flowers in rather short cymes. . . . . **5. Gomphandra**
   7. Drupe laterally compressed (almond-like).
    8. Drupe without a fleshy lateral appendage. Flowers in spikes (very rarely in panicles composed of spikes, or almost fascicled) . . . . . **6. Rhyticaryum**
    8. Drupe with a thick fleshy, laterally borne, practically entirely adnate appendage. Flowers in cymes.
     9. Disk unilateral, thick-squamular . . . . . **7. Hartleya**
     9. Disk absent.
      10. Filaments glabrous. Fleshy appendage of drupe covering two pronounced ribs of the endocarp. **8. Codiocarpus**
      10. Filaments with apical, longish, club-shaped hairs at least in the fertile stamens. Prominent ribs under the appendage of the drupe less pronounced or absent. . . **9. Medusanthera**
  6. Flowers bisexual.
   11. Ovary with a lateral swelling which in the fruit developes into a thick succulent appendage. Disk absent. . . . . **10. Apodytes**
   11. Ovary and fruit without such an adnate appendage. Disk whether or not present.
    12. Connective surpassing the anther cells as a marked glabrous apiculus. Outer part of the endocarp finally spongious-corky and deeply irregularly lacunose. Disk absent. **11. Merrilliodendron**

12. Connective, if any, hardly or not surpassing the anther cells. Outer part of the endocarp fibrous, slightly ribbed or grooved lengthwise, or smooth outside.
13. Peduncle of inflorescence with numerous small knob-like bracts which form alveoles. Stigma peltate. Disk absent. . . . . **12. Cantleya**
13. Peduncle quite smooth. Stigma small, subcapitate or point-like. Disk ± cup-shaped.
14. Inflorescence usually terminal. Anthers glabrous. . . . . **13. Nothapodytes**
14. Inflorescence axillary. Anthers with an apical tuft of penicillate hairs.
15. Flowers sessile. Petals up to 6 mm, free to almost the base. Stigma point-like at the top of the ± attenuate (sometimes shortly style-like) part of the ovary. . . . . **14. Stemonurus**
15. Flowers 1–2 mm pedicelled. Petals (12–)13–15 mm, free in the distal part only. Stigma small on one side of the inverted, *i.e.* cup-like distal part of the ovary. . . . **15. Whitmorea**

1. Climbing shrubs, or lianas, sometimes with tendrils. Flowers unisexual or functionally so.
16. Leaves opposite.
17. Anthers broadly club-shaped to subglobular, many-celled, with numerous pollen-bearing alveoles. **16. Polyporandra**
17. Anthers, as usual, with 2 cells. . . . . **17. Iodes**
16. Leaves spirally arranged.
18. Flowers in elongate spikes or spike-like racemes, these solitary or sometimes composed to panicles.
19. Leaves markedly prominently tessellate on both faces. Sepals persistent. Albumen absent; cotyledons thick-fleshy. . . . . **18. Sarcostigma**
19. Leaves with rather lax and but slightly raised reticulation. Sepals absent. Albumen thick, ruminate; cotyledons foliaceous. . . . . **19. Pyrenacantha**
18. Flowers in peduncled heads or umbels, these solitary or composed to racemes or panicles.
20. Style absent, *i.e.* stigma sessile, thick-peltate. . . . . **20. Miquelia**
20. Style (very) shortly thick-columnar, with 2–4 stigmatic lobes. . . . . **21. Phytocrene**

1. CITRONELLA

D. DON, Edinb. New Phil. J. 13 (1832) 243; SLEUM. Blumea 17 (1969) 186. — *Villaresia* R. & P. Fl. Per. Chil. 3 (1803) 9, t. 231, *non* R. & P. 1793. — *Pleuropetalon* BL. Mus. Bot. Lugd.-Bat. 1 (1850) 248, *non* HOOK. *f.* 1845. — *Chariessa* MIQ. Fl. Ind. Bat. 1 (1856) 794. — **Fig. 1.**

Trees or shrubs, bisexual (Mal.). *Leaves* spiral, entire and slightly revolute at the edge (Mal.), petiolate. *Inflorescences* terminal and/or (supra-)axillary, paniculate or thyrsoid, cymes of secondary branches scorpioid, whether or not forked, in Mal. greyish to rusty hirsute. *Flowers* 5-merous, sessile, subtended by a minute bract. *Calyx* imbricately lobed ⅓ to ½, persistent. *Petals* free, valvate, or subimbricate in the upper part, apex inflexed, midrib inside much prominent, sometimes wing-like. *Stamens* 5, free; filaments fleshy, subulate; anthers elliptic, or ovate, or subcordate, introrse, basifixed. *Disk* 0. *Ovary* subgibbous, 1-celled, rarely 2-celled by the presence of a pseudoloculus. Style 1 (rarely 2), slender, stigma small, capitate, subbilobed. *Drupe* moderately fleshy; endocarp woody, rather thin. *Seed* 1, longitudinally plicate around the vertical pseudoloculus, hippocrepiform; embryo in the copious endosperm small.

Distr. About 21 *spp.* of which *c.* 12 occur in tropical Central and South America, and 6 *spp.* in Australia (New South Wales, Queensland), Solomon Is., New Caledonia, Loyalty Is., New Hebrides, Fiji, Samoa and Tonga Is.; in *Malesia* 3 *spp.* Fig. 2.

Ecol. Understorey of lowland and lower montane rain-forest.

Taxon. The genus was revised by R. A. HOWARD (Contr. Gray Herb. 142, 1942, 60–89, t. 4–6). The inflorescence and floral characters used there to separate the Malesian *spp.* have been found of little value after a reinvestigation on the base of much more material than seen by HOWARD. This is the reason why in the key fruit characters have been preferred for the discrimination of species. HOWARD keeps the New World *spp.* apart from the Old World ones on the sectional level; the characters given for the discrimination of these sections are rather vague or do not hold.

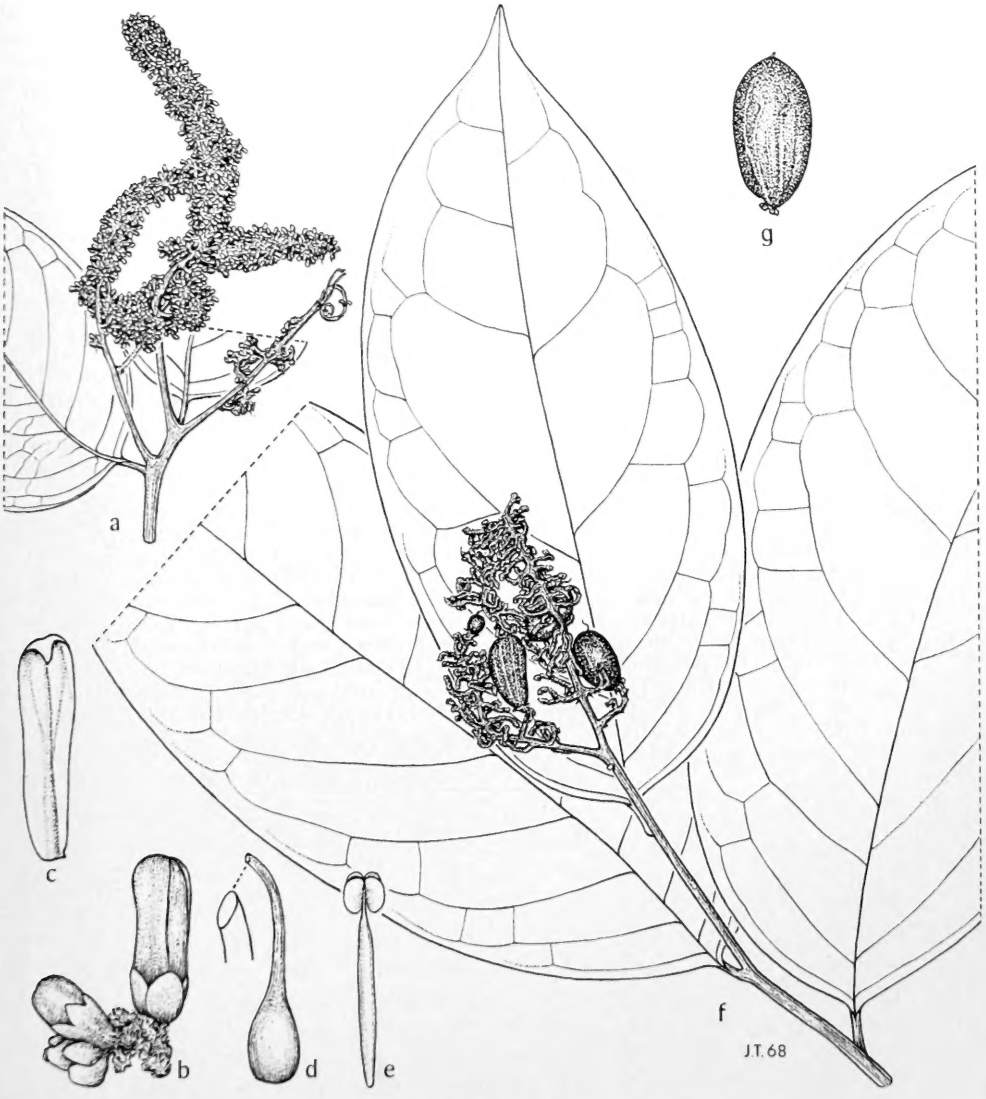

Fig. 1. *Citronella suaveolens* (BL.) HOWARD. *a*. Inflorescence, ×½, *b*. flower bud, ×5, *c*. petal from the inside, ×7½, *d*. ovary, ×7½, *e*. stamen, ×7½, *f*. habit and infructescence, ×½, *g*. drupe, ×1 (*a–e* ACHMAD 1181, *f–g* ACHMAD 220).

KEY TO THE SPECIES

1. Drupe essentially ellipsoid-oblongoid, (1.6–)1.8–2.2(–2.4) by 0.9–1.2(–1.3) cm. . **1. C. suaveolens**
1. Drupe ovoid, or ellipsoid-ovoid, or broadly ellipsoid, 2–3 by 1.8–2 cm.
2. Leaves broadly ovate, base ± obtuse to rounded. Solomon Is., Samoa, Tonga, New Hebrides. *C. samoensis* (A. GRAY) HOWARD
2. Leaves oblong- to obovate-elliptic, base ± cuneate.
3. Leaves ± obtuse or shortly and rather abruptly acuminate, tip bluntish. . . **2. C. latifolia**
3. Leaves rather gradually and ± acutely acuminate at apex. . . . . **3. C. philippinensis**

1. Citronella suaveolens (BL.) HOWARD, J. Arn. Arb. 21 (1940) 475; Contr. Gray Herb. 142 (1942) 82; BACK. & BAKH. *f.* Fl. Java 2 (1965) 59; SLEUM. Blumea 17 (1969) 187. — *Pleuropetalon suaveolens* BL. Mus. Bot. Lugd.-Bat. 1 (1850) 248. — *Chariessa suaveolens* (BL.) MIQ. Fl. Ind. Bat. 1 (1856) 794; BECC. Malesia 1 (1877) 118; SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 229; AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 2. — *Villaresia suaveolens* (BL.) VALET. Crit. Overz. Olacin. (1886) 199, t. 5, f. 32 a–g; BACK. Schoolfl. Java (1911) 228. — *C. brassii* HOWARD, Contr. Gray Herb. 142 (1942) 81. — **Fig. 1.**

Tree, (8–)15–36 m, trunk up to ½ m ø, rarely with thin buttresses; bark grey-brown, irregularly fissured. Branchlets smooth or striate, older parts lengthwise set with elongate lenticels. *Leaves* elliptic to oblong- or ovate-elliptic, variable in shape and size, apex generally short-acuminate (tip subacute and often plicate then), or obtuse-rounded, base broadly attenuate to rounded, often subequal, coriaceous, shining above, (6–)10–24(30) by (3–)5–13(–17) cm, nerves (4–)5–6 curved-ascendent and anastomosing pairs, lower 1(–2) rather close to the base of the lamina, slightly impressed above, much raised beneath, reticulation fine to rather coarse, a little prominent above, more distinctly so beneath; petiole 6–15 by 2–3 mm. *Panicles* terminal, greyish-rusty hirsutulous, mostly solitary and spike-like initially, sometimes 2 or 3 forming a ± pyramidal inflorescence, lateral branches of the single panicles of ± the same length (0.5–2 cm), mostly 2-(rarely more-) forked, each branch recurved and bearing several flowers arranged in a cyme. *Flowers* bisexual, fragrant. *Calyx c.* 1.8 mm, lobes ciliate. *Petals* elliptic-oblong, white to cream, or sometimes suffused with red, (4–)5(–6) mm at full anthesis, midrib inside raised considerably, sometimes almost wing-like in the lower ½–¾ part. *Filaments* thick-subulate, *c.* 3 mm; anthers ovate-elliptic or subcordate, 1 mm. *Ovary* ovoid, glabrous, style 1–2 mm, stigma small, a little oblique. *Drupe* ellipsoid to oblongoid (subcylindrical), sometimes a little oblique, (1.6–)1.8–2.2 (–2.4) by 0.9–1.2(–1.3) cm, smooth or irregularly lengthwise, very slightly many-ribbed in the lower part, purple when ripe, blackish when dry.

Distr. *Malesia*: NW. Sumatra (Simalur I.), W. & Central Java, N. & E. Borneo, Celebes, S. Moluccas (Kai Is.), New Guinea.

Ecol. Primary rain-forest on well drained soil, from the lowland up to 1600 m, apparently scattered.

Uses. Wood light brown, hard and heavy, not used. Known by numerous vernacular names.

Vern. Simalur: *awa iseum-iseum, iseum batu, i. iseum fatuh, i. pajo, i. sito bulung, sitenheur dělok, tutun surimanu*, M; Java: *jěrukie*, S; Celebes: *kekèr*, Menado (Tt), *balula lembo*, Tobela, *lenguru tanru, pano*, Bugin., *sokko*, Makassar; New Guinea: *garus*, Dumpu, *mara*, Faita, *pomak*, Armat, *sakohukwa*, Manikiong, *sibeer*, Hattam, *soromma rinde*, Depapre, *tambeu*, Iko (Hollandia), *ulumon*, Amele, *yewel*, Bilia.

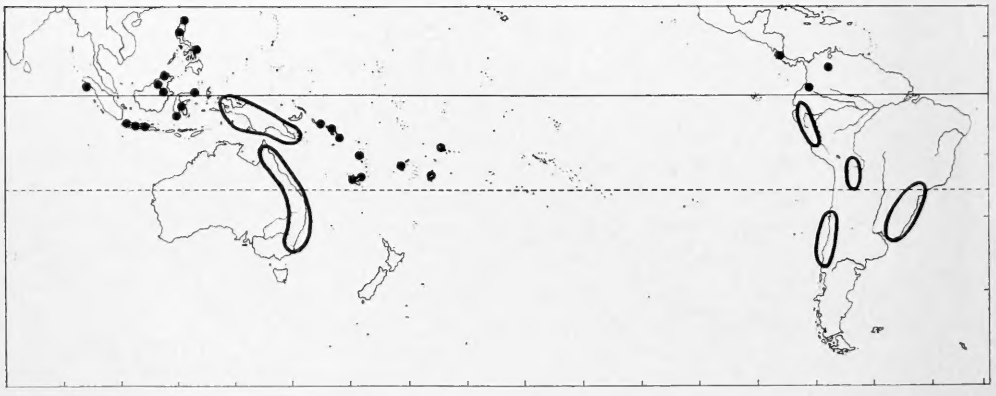

Fig. 2. Distribution of *Citronella*.

2. Citronella latifolia (MERR.) HOWARD, J. Arn. Arb. 21 (1940) 472; Contr. Gray Herb. 142 (1942) 80, t. 6, f. 9–12; SLEUM. Blumea 17 (1969) 188. — *Villaresia latifolia* MERR. Philip. J. Sc. 14 (1919) 415; En. Philip. 2 (1923) 488. — *Chariessa latifolia* (MERR.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 229.

Large tree. Branchlets dark brown, with sparse lenticels. *Leaves* obovate or oblong-elliptic, apex obtuse or rounded, the bluntish tip sometimes abruptly short-acuminate and folded, base cuneate, a little decurrent, coriaceous, shining above, (12–)14–18 by (6–)8–11 cm, nerves 5–6 anastomosing pairs, reticulation rather dense, minutely raised on both faces; petiole 1–1.5(–2.5) cm by 2(–3) mm. *Infructescence* terminal, consisting of 1 or 2, sometimes 3 almost pyramidal panicles, up to 15 cm, rusty hirsute; each panicle with

numerous racemosely arranged branches which generally are 2(–3)-forked and bear several flowers crowded at the curved end of the branches, the latter up to 5 cm in the lowest, and *c.* 1 cm (and usually not forked) in the uppermost part of the panicle. *Drupe* ovoid to broadly ellipsoid-ovoid, *c.* 2 by 1.8 cm in submature state, brown when dry, very slightly and irregularly many-ribbed lengthwise in the lower ⅔; endocarp hard, *c.* 1 mm.

Distr. *Malesia*: Philippines (Samar, in the Catubig R. area), one collection in fruit.

Ecol. Damp forest near river at low altitude.

Vern. *Malaampípi*, S. L. Bis.

3. Citronella philippinensis (MERR.) HOWARD, J. Arn. Arb. 21 (1940) 474; Contr. Gray Herb. 142 (1942) 85, t. 6, f. 1–8; DAHL, J. Arn. Arb. 33 (1952) 260, f. 20 & 20 A (pollen); SLEUM. Blumea 17 (1969) 188. — *Villaresia philippinensis* MERR. Philip. J. Sc. 14 (1919) 414; En. Philip. 2 (1923) 488. — *Chariessa philippinensis* (MERR.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 229; HATUS. Mem. Fac. Agr. Kagosh. Un. 5, 3 (1966) 38.

Tree, 4–5 m. Branchlets smooth. *Leaves* elliptic to elliptic-oblong, apex rather gradually acuminate for 1–1.5 cm and subacute, base cuneate and a little decurrent on the petiole, ± inequal, coriaceous, shining on both faces, 6–12 by (2–)4–6.5 cm, nerves 4–5 rather steeply curved-ascending pairs, reticulation dense, distinctly raised mainly on the undersurface; petiole 2(–3) cm by 2 mm. *Panicles* terminal, solitary or in twos, 5–8(–10) cm, lateral branches numerous and of equal length (*c.* 1 cm), rather crowded, each bearing at apex 5–8 crowded cymosely arranged flowers. *Calyx* 1.5 mm, lobes ciliate. *Petals* oblong, white, glabrous, 5(–6) mm, the midrib extending as a keel in the lower half of the petal. *Filaments c.* 5 mm; anthers broadly ovate-cordate, 1 mm. *Ovary* ovoid, glabrous, 5 mm, style slender, 3–4 mm, stigma capitate, minute. *Drupe* ovoid, rather oblique, blackish, 2.5–3 by 2 cm; endocarp shallowly and irregularly many-ribbed lengthwise, 1–1.5 mm ø.

Distr. *Malesia*: Philippines (N. Luzon).

Ecol. On forested slopes, *c.* 1000 m, apparently rare.

Excluded

Villaresia scandens HASSK. Nat. Tijd. N. I. 10 (1856) 152 = *Dichapetalum timoriense* (DC.) BOERL. (*Dichapetalaceae*).

2. PSEUDOBOTRYS

MOESER in Fedde, Rep. 10 (1912) 310; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 20 b (1942) 360, f. 101, A & B; Blumea 17 (1969) 248. — **Fig. 4.**

Trees. *Leaves* spirally arranged, coriaceous, entire, penninerved. *Flowers* bisexual, born in short fascicles or panicles on the trunk. Pedicel articulated with the calyx, subtended by 2 small bracteoles. *Sepals* 5, connate at base, imbricate. *Petals* 5, linear, valvate, tips a little inflexed inside, connate into a tube in the lower ⅓–¼, caducous. *Stamens* 5, almost equalling the petals in length; filaments filiform, dilated towards the base and fixed there to the petals; anthers linear, subsagittate, introrse, almost basifixed. *Ovary* ovoid-subglobose; style filiform; stigma small, depressed-subcapitate. *Drupe*: exocarp thin, fleshy, early dissoluted; endocarp woody, verrucose outside, forming a pseudoseptum along the funiculus inside. *Seed* 1; embryo small.

Distr. *Malesia* (New Guinea), 2 *spp.* Fig. 3.

KEY TO THE SPECIES

1. Ovary densely brownish-pubescent. Petals 2.8–3.2 cm. Anthers 5–6 mm. . . . . **1. P. dorae**
1. Ovary glabrous. Petals *c.* 2.2 cm. Anthers 3–4 mm. . . . . **2. P. cauliflora**

1. Pseudobotrys dorae MOESER in Fedde, Rep. 10 (1912) 310; SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 235; in E. & P. Nat. Pfl. Fam. ed. 2, 20 b (1942) 360, f. 101, A & B; Blumea 17 (1969) 249.

Treelet or shrub, 1.5–6 m, glabrous; bark grey, squamular. Branchlets terete, striate, slender. *Leaves* lanceolate to oblong or elliptic-oblong, apex gradually more shortly or long acuminate, tip blunt, base broadly cuneate to rounded, coriaceous, of a dull olivaceous-green colour and a minutely tubercled undersurface when dry, greenish yellowish in fresh specimens, entire, 16–32(–44) by 5–14(–18) cm, midrib slightly raised above, strongly so beneath, nerves (6–)8–10(–12) pairs, lower ones curved, upper ones generally more straight, faintly inarching before the edge, hardly raised or obscure above, slightly prominent beneath, veins lax, generally rather inconspicuous; petiole

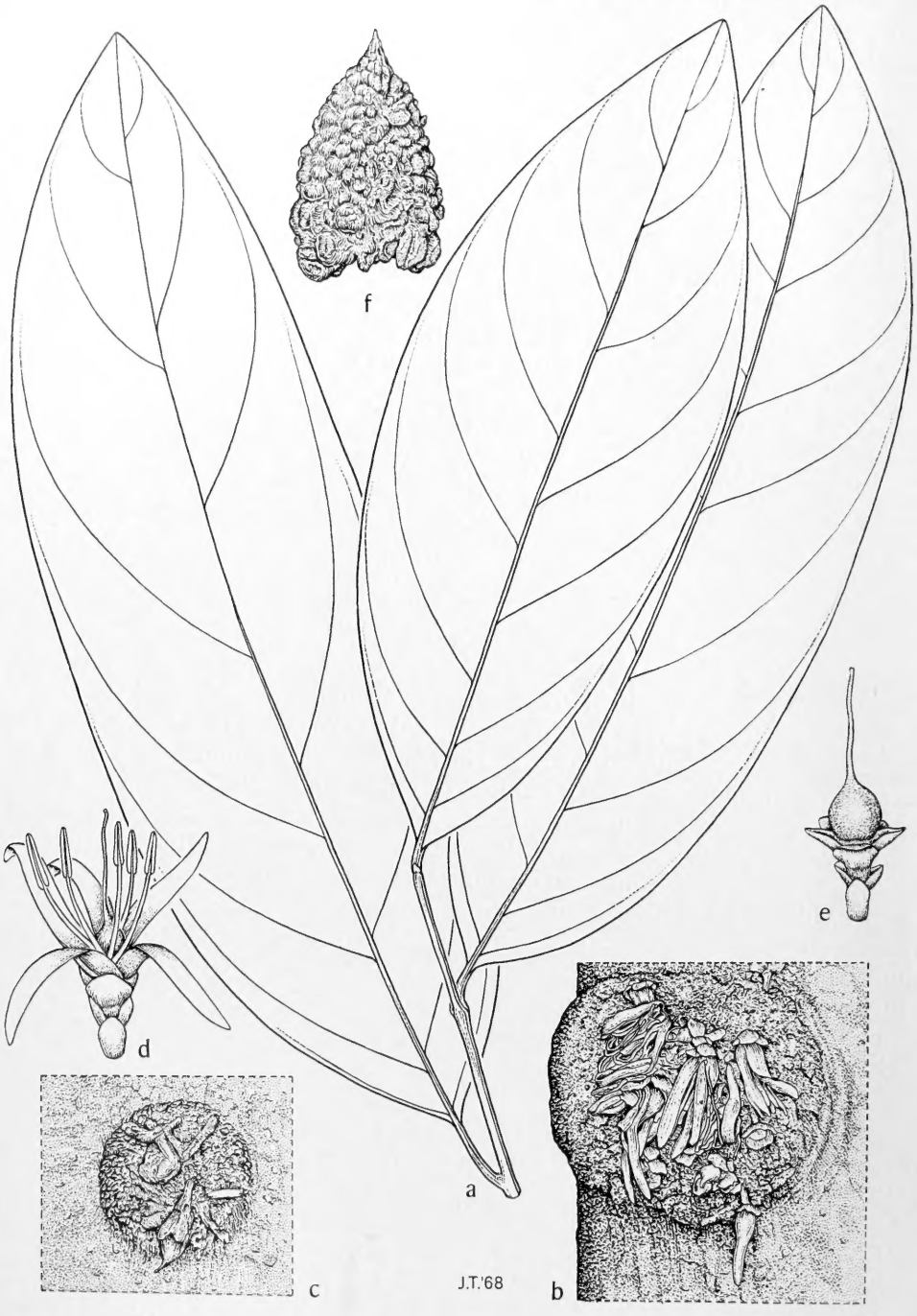

Fig. 4. *Pseudobotrys cauliflora* (PULLE) SLEUM. *a.* Habit, ×½, *b.* inflorescence, ×1, *c.* young infructescence, ×1, *d.* flower, ×1½, *e.* ovary, ×1½, *f.* endocarp of mature drupe, ×1 (*a* & *c* DOCTERS VAN LEEUWEN 9127, *b*, *d* & *e ditto* 9307, *f ditto* 11243).

rugose, 1–1.5(–2) cm by 2–3 mm. *Flowers* in short fascicles or corymbs from swollen parts of the trunk (occasionally also from the axils of leaves?). Pedicels thickish, short. *Sepals* subovate, blunt, dull purple, *c.* 3 mm. *Petals* linear, blunt, thin, connate irregularly in the lower part, *i.e.* early splitting from top after the bud stage, spreading or recurved at full anthesis, white all over, or purplish at tube, 2.8–3.2 cm by 2–2.5 mm. *Filaments* 2–2.4 cm; anthers 5–6 mm. *Ovary* 3–4 mm, densely brownish-pubescent; style 2.5–2.7 cm. *Drupe* only known in submature state, obliquely obovoid, apiculate, laterally a little compressed, *c.* 2 by 1.7 by 1.3 cm, subtended by the reflexed sepals, brownish-hairy, finely verrucose outside; endocarp hard; pseudoseptum protruding for *c.* 1 mm. *Seed* 1.

Distr. *Malesia*: New Guinea (Morobe, Central and Northern Distr.). Fig. 3.

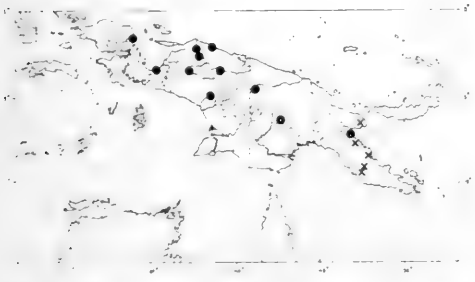

Fig. 3. Distribution of *Pseudobotrys*. *P. dorae* MOESER (crosses), *P. cauliflora* (PULLE) SLEUM. (dots).

Ecol. Primary (also swampy) forest, 30–1525 m, apparently very local. *Fl.* May–Sept., *fr.* Nov.

2. Pseudobotrys cauliflora (PULLE) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 235; DAHL, J. Arn. Arb. 36 (1955) 160, f. 1 & 1 A (pollen); SLEUM. Blumea 17 (1969) 249. — *Chariessa cauliflora* PULLE, Nova Guinea 8 (1912) 657; SCHELLENB. Bot. Jahrb. 58 (1923) 159; BIRNIE, Nova Guinea 14 (1926) 275. — **Fig. 4.**

Tree, (4–)6–18 m; bark dark grey-green; wood white, with prominent rays. *Leaves* very similar to those of *P. dorae*, though sometimes more ovate, up to 36 by 19 cm. *Flowers* massed on dome-like swellings of 1–3(–10) cm ø on lower trunk, numerous, set in small fascicles. Pedicels 1–3 mm, minutely bracteolate at base. *Sepals* ovate, ciliate, purple, 2(–3) mm. *Petals* linear, apex acute, in bud stage coherent in a tube which splits downwards at full anthesis to the lower third or less, white, or white inside and purplish outside, with 3 longitudinal darker lines, *c.* 2.2 cm by 2 mm. *Filaments c.* 1.6 cm; anthers 3–4 mm. *Ovary* glabrous, *c.* 3 mm; style slender, 16–18 mm. *Drupe* ovoid, attenuate-apiculate, 2.5–3 by 2 cm, on thickish pedicel 8–12 mm; exocarp fleshy, dark blue at full maturity, wrinkled in dry fruit; endocarp woody (2 mm), outside with knob-like emergences in numerous longitudinal rows, knobs smaller towards apex of the fruit; inside with a large woody pseudoseptum around which the seed is formed.

Distr. *Malesia*: New Guinea. Fig. 3.

Ecol. Rain-forest substage, river flood-plains, or hillsides, 3–175 m (once said to be collected at 1645 m), scattered in general, though sometimes locally common. *Fl. fr.* Jan.–Dec.

3. PLATEA

BL. Bijdr. (1826) 646; SLEUM. Blumea 17 (1969) 242. — *Platystigma* R. BR. in Wall. Cat. (1832) *n.* 7523, *nom. nud.*; *ex* BENTH. in Benth. & Hook. *f.* Gen. Pl. 3 (1880) 283, *nota*; HOOK. *f.* Ic. Pl. 18 (1887) t. 1707. — **Fig. 6.**

Trees, generally tall and with straight, angular or ± deeply grooved bole, rarely treelets or shrubs, dioecious. *Leaves* spiral, almost distichous, entire, penninerved, at least initially covered with fascicled or star-shaped, early going hairs, and/or subpersistent star-shaped, flat, finally silvery scales with a distinct darker centre, as are branchlets and inflorescences; petioles not rarely transversely wrinkled as in *Gonocaryum*. *Flowers* axillary, the ♂ ones in interrupted, glomerulose, mostly to panicles arranged spikes, sessile, subglobular in bud, each subtended by a small persistent bract, the ♀ ones in few-flowered short cymes, each on a distinct pedicel and subtended by a subpersistent bract immediately below the calyx lobes. *Calyx* lobes (4–)5, slightly imbricate, small, persistent. *Petals* (4–)5, small, valvate, glabrous, inflexed at apex, shortly connate at base, absent in the ♀ flowers. — ♂ Flowers: *Stamens* (4–)5, inserted with short filaments at the tube of the petals; anther cells ovoid–2-celled, basifixed, laterally (almost extrorsely) dehiscent. Rudiment of an *ovary* generally absent. — ♀ Flowers: *Ovary* thick-cylindric to ob-

conical, blunt, crowned by a large sessile discoid stigma. *Drupe* elongate-ovoid, crowned by the large stigma, on short pedicel; exocarp thin-fleshy, red-orange to finally purplish blackish; endocarp woody, thin, with 1 or 2 slight longitudinal grooves, reticulately wrinkled; embryo small, in the apex of the albumen.

Distr. About 5 *spp.*, one endemic in Hainan, another extending from Sikkim into SE. Asia and Malesia; in *Malesia* 4 *spp.*, of which 2 endemic in Borneo and the other 2 from the Malay Peninsula and Sumatra to New Guinea and New Britain (not known yet from the Solomon Is.). Fig. 5.

Ecol. Mainly rain-forest, from the lowland up to *c.* 2200 m (on Mt Kinabalu up to 2895 m?), often on wet soil, scattered. *Fl. fr.* Jan.–Dec.

Uses. The wood is whitish cream, available in big dimensions due to the large size of the trees, but soft and suitable only for inside house constructions.

Note. The distinction of species in this genus is mainly based on the type of indument, clearly recognizable only with a lens. This can only well be examined on young leaves, where the full set of indument characters is still present, as hairs and/or scales go rather early, and old leaves may become practically glabrous. The scales give the undersurface of the leaves a metallic silvery lustre similar to that found in leaves of certain *Myristicaceae*, *Euphorbiaceae*, *Sapotaceae*, and even *Lauraceae*, with which they are sometimes confused in sterile sheets. Young leaves may show fine, round, translucent dots against strong light (ENDERT, Med. Proefst. Boschw. Ned. Ind. 20, 1928, 193).

KEY TO THE SPECIES

1. Indumentum on the undersurface of *young* leaves giving a woolly appearance to the naked eye, and under a lens representing two distinct strata, *i.e.* an upper layer of partly flattish, though mostly obliquely erect star-shaped or fascicled *hairs* (with a very small or generally invisible dark centre), and a lower layer of *scales*.
   2. Leaves shortly cordate at base, almost peltate, lateral nerves, veins and veinlets ± distinctly impressed above, the lamina ± bullate, hairs persistent. . . . . **1. P. bullata**
   2. Leaves never properly cordate at base, nerves sometimes, veins and veinlets never impressed above, hairs generally early disappearing except along midrib and nerves. . . . . **2. P. latifolia**
1. Indumentum on the undersurface of *young* leaves giving a scaly appearance to the naked eye, seemingly representing a single layer of scales, but under the lens appearing to consist of two layers of flat star-shaped scales, *i.e.* a lower layer of ± persistent, small and densely arranged scales, and an upper layer of similar, though larger and more scattered, rather early caducous ones.
   3. Leaves (elliptic or ovate-elliptic, rarely ovate) coriaceous, rigid . . . . . **3. P. sclerophylla**
   3. Leaves (of various shape) coriaceous to subcoriaceous, ± flexible. . . . . **4. P. excelsa**

1. Platea bullata SLEUM. Blumea 17 (1969) 243.

Tree 13–14 m, *c.* 15 cm ø; bark smooth, grey-brown. Branchlets rufous-brownish tomentose and slightly many-grooved lengthwise as are petioles and rachises in dry specimens. *Leaves* lax, sub-obovate-elliptic or -oblong, apex subacutely acuminate for *c.* 1.5 cm, base rounded in general, the very base short-cordate and the lamina almost peltate, firmly chartaceous, olivaceous-brownish and dull above, more rufescent beneath in dry specimens, ± deeply bullate by nerves, veins and partly also veinlets above, these well prominent beneath, glabrous above except the short-tomentose midrib and maybe nerves, brownish-rufous-tomentose and soft to the touch by obliquely erect stellate or fascicled longish hairs all over the undersurface especially on midrib, nerves and veins, moreover covered all over beneath with a coherent greyish silvery layer of small star-shaped, flat, appressed scales each with a minute dark centre (similar to stellate flattish hairs), 14–32 by (6–)7–13 cm, nerves 7–10(–12) pairs moderately curved-ascending and looping, reticulation fine and dense, minutely raised above, rather obscure beneath; petiole 2–2.5 cm by 2–3 mm. ♂ *Inflorescences* (only known in juvenile state) axillary, paniculate, with few dense-flowered, much spaced, subspicate racemes or short-branched panicles, 1.5–3 cm; rachis 6–12 cm by 2–3 mm.

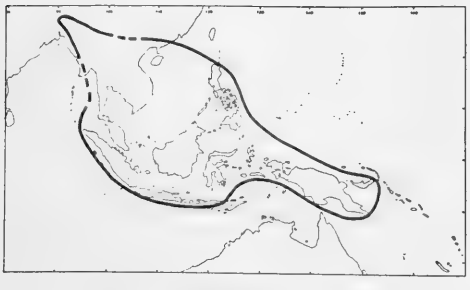

Fig. 5. Distribution of *Platea*.

Distr. *Malesia*: Borneo (Sarawak), once found.

Ecol. In mixed Dipterocarp forest of steep-sided valley on basalt beside waterfall, *c.* 900 m.

2. Platea latifolia Bl. Bijdr. (1826) 647; Walp. Rep. 1 (1842) 378; Hassk. Cat. Hort. Bog. (1844) 214; Miers, Ann. Mag. Nat. Hist. II, 10 (1852) 110, repr. Contr. Bot. 1 (1852) 97; Miq. Fl. Ind. Bat. 1 (1856) 793, *incl. var. sumatrana* (Bl.) Miq.; Becc. Malesia 1 (1877) 116; Valet. Crit. Overz. Olacin. (1886) 251, 253, t. 6, f. 40 & 41; K. & V. Bijdr. 5 (1900) 156; Hochr. Pl. Bog. Exs. (1904) 45; Bull. Inst. Bot. Btzg. 22 (1905) 50; Back. Schoolfl. Java (1911) 227; Koord. Exk. Fl. Java 2 (1912) 531; Koord.-Schum. Syst. Verz. 1, Fam. 162 (1912) 1, *p.p.*; Koord. Atlas 1 (1913) t. 119; Ridl. Fl. Mal. Pen. 1 (1922) 426; Burk. Dict. (1935) 1768; Merr. J. Arn. Arb. 19 (1938) 44; Chun, Sunyatsenia 4 (1940) 229; Gagnep. Fl. Gén. I.-C. Suppl. (1948) 754; Amsh. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 4; Heyne, Nutt. Pl. 1 (1950) 986; Back. & Bakh. *f.* Fl. Java 2 (1965) 60; Sleum. Blumea 17 (1969) 243; Fl. Thail. 2 (1970) 76. — *P. sumatrana* Bl. Mus. Bot. Lugd.-Bat. 1 (1850) 249; Walp. Ann. 2 (1851) 182; Miers, Ann. Mag. Nat. Hist. II, 10 (1852) 110, repr. Contr. Bot. 1 (1852) 97. — *Sideroxylon gamblei* C. B. Clarke in Hook. *f.* Fl. Br. Ind. 3 (1882) 538. — *Platystigma myristiceum* R. Br. in Wall. Cat. (1832) *n.* 7523, *nom. nud.*; *ex* Hook. *f.* Ic. Pl. 18 (1887) t. 1707; Fl. Br. Ind. 5 (1887) 381. — *P. excelsa* (*non* Bl.) King, J. As. Soc. Beng. 64, ii (1895) 111. — *P. fuliginea* Elm. Leafl. Philip. Bot. 8 (1915) 2790; Merr. En. Philip. 2 (1923) 489. — *P. myristicea* (R. Br. *ex* Hook. *f.*) Hall. *f.* Med. Rijksherb. 36 (1918) 5; Sleum. Notizbl. Berl.-Dahl. 15 (1940) 360. — *Planchonella gamblei* (Clarke) H. J. Lam, Bull. Jard. Bot. Btzg III, 7 (1925) 199. — *P. ledermannii* Sleum. Notizbl. Berl.-Dahl. 15 (1941) 360. — *P. hainanensis* Howard, Lloydia 6 (1943) 149, t. 2; Dahl, J. Arn. Arb. 33 (1952) 261; Chun & Chang, Fl. Hainan. 2 (1965) 449, f. 512. — *P. parviflora* (*non* K. & V.) Dahl, J. Arn. Arb. 33 (1952) 261 (pollen). — '*Gomphocarpus*' *gamblei* (Clarke) van Royen, Blumea 8 (1957) 425. — *Gomphandra gamblei* (Clarke) van Royen *ex* Ind. Kew. Suppl. 13 (1966) 61.

Large tree, (10–)20–45 m, bole columnar, angular and with shallow to rather deep grooves, up to 60 cm ø, buttresses, if any, short, rarely up to 1.5 m; crown high inserted, irregular. Bark grey to brown, rather smooth, with irregular shallow fissures and numerous lenticels, 12–16 cm thick, outer part in cross-section red, inner one yellowish white, with a peculiar aromatic agreeable smell (of cumarine?) and very bitter taste as they are also found in the leaves. Tip of branchlets, inflorescences, petioles and young blades covered with a rather coarse woolly rusty and detersile tomentum of flattish to obliquely erect star-shaped or fascicled hairs, and with minor scales, which go early. *Leaves* elliptic, or ovate-, rarely oblong-elliptic, apex generally shortly subacutely acuminate, base broadly attenuate to rounded, thin-coriaceous, at maturity glabrous and shining above, and dull yellowish-greenish-greyish to almost bluish (as in *Lauraceae* and *Myristicaceae*) beneath, still covered there with sparse flattish to obliquely erect star-shaped or fascicled hairs especially along midrib and nerves, and besides over the whole undersurface with a skin-like layer of small, thin, ± confluent, finally greyish-silvery scales (these with a minute or scarcely recognizable darker centre), which lasts for a while, finally almost glabrous even under a lens, (7–)10–20(–25) by (3–)5–11 cm, midrib and 6–10(–12) pairs of rather straight robust nerves ± sunken above, distinctly raised beneath, reticulation of veinlets dense, fine and generally more visibly raised on both faces of fully mature leaves; petiole (1.2–)2–4 cm. — ♂ *Inflorescences* ± pyramidal in circumference, (2–)4–6 cm, consisting of spikes with spaced glomeruli or short panicles. *Petals* light green, at least finally glabrous, *c.* 1.5 mm. — ♀ *Inflorescences* in 2–5(–8)-flowered cymes. Pedicel stout, 2–5 mm, slightly elongated in fruit. *Ovary* obconical, whether or not covered initially with fine stellate appressed hairs, base included by the dorsally pubescent sepals (*c.* 2 mm). *Drupe* narrowly ovoid-ellipsoid, glabrous, variable in size, 2.5–4.5 by 2–2.5 cm; fleshy exocarp first lemon yellow to reddish orange, finally purplish-blackish especially when dry, of a bitter taste; stony endocarp acuminate, with 2–3 longitudinal grooves and oblongish to subquadrangular markings between; albumen white, slimy, becoming bluish when cut.

Distr. Sikkim, East Bengal (Sylhet), Indo-China (Tonkin, Annam), China (Kwangsi, Hainan), and Thailand; in *Malesia*: Sumatra, Malay Peninsula, Banka, Java, Borneo, Philippines (Biliran, Mindanao), Celebes, and New Guinea; also in Melanesia (New Britain).

Ecol. Primary lowland and montane rainforest, also oak forest, scattered, not rare in Java, mainly on constantly wet, even swampy places, found in Borneo in heath forest up to 560 m, in Java also on volcanic sand or loam, up to 1750 m.

Uses. Timber of large size, whitish, a little lustrous, with a smell of cumarine, soft, not durable, locally used for house building in positions under the roof. For descriptions of the wood of *P. latifolia cf.* Moll & Janssonius, Mikr. 2 (1908) 248, f. 108; the description of the wood of *P. excelsa* (*l.c.* 253) also refers here, as the cited Koorders coll. no. actually belongs to *P. latifolia*.

Galls. Docters van Leeuwen (Zoocecidia, 1926, 332, f. 599) mentions a gall on the stem and the leaves caused by a gall-midge.

Vern. Sumatra: *katji pako*, Batak, *pandan*, M. (Indragiri); Banka: *kědang tjabè*, *medang tjabè*, *měnjiur*, *pajit*, M; Malay Peninsula: *kadondong*, *k. hèrong* (Pahang); Java: *huru*, *h. kapas*, *ki kadantja*, *mandalaksa*, S, *wuru*, J; Madura: *buru*; Borneo: *kaju bulu*, M, *pangak*, Kayan; Celebes: *mawi*, Ramp., *songku*, Tado, *talang laki*, Bugin.; Philippines: *caliso*, Bag.; New Guinea: *bengok*, Hattam, *kabugó*, *kaburó*, Kapauku, *siera*, Manikiong.

3. Platea sclerophylla Sleum. Blumea 17 (1969) 245.

Tree, 9–18 m, with spreading branches. Branchlets rather slender, tips lepidote. *Leaves* elliptic

or ovate-elliptic, rarely ovate, apex shortly attenuate or obtuse, sometimes emarginate, base broadly cuneate to rounded, coriaceous, rigid, brown in dry specimens, glossy above sometimes, dull beneath, early glabrous above, subdensely set with a lower layer of small substellate, almost contiguous scales, and a so to say upper layer of scattered, major stellate scales, these early disappearing, whilst the smaller scales go tardily, the undersurface too finally practically glabrous, 5–9 by (2.5–)3–6 cm, midrib and nerves slightly to more deeply impressed above, prominent beneath, nerves 6–8(–9) pairs, rather straight or more curved from the midrib, not properly looping, reticulation of veins and veinlets dense, slightly or hardly impressed above, well visibly raised beneath; petiole ± distinctly transversely rugulose, deeply grooved above, 5–10 by 2(–3) mm. — ♂ *Inflorescences* from the upper axils, paniculate, with spike-like lax-flowered 1–3 cm long branches, densely scaly on axes, more laxly so on bracts and calyx lobes; rachis angular, *c.* 1 mm ø. Pedicels almost none. *Calyx* lobes ovate-acuminate, coriaceous, ciliate, 1.5 mm. *Petals* deep red, glabrous, 2.5 mm. *Anther* cells elliptic, 1.5 mm. — ♀ *Inflorescences* raceme-like, few-flowered, (1–)2–3.5 cm. Pedicels thick, 2–5 mm. *Ovary* thick-cylindric, densely minutely stellate-lepidote.

Distr. *Malesia*: Borneo (Mt Kinabalu, twice found on the eastern shoulder).

Ecol. Forest, 2440–2895 m.

4. Platea excelsa BL. Bijdr. (1826) 697; WALP. Rep. 1 (1842) 378; HASSK. Cat. Hort. Bog. (1844) 214; MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 110, repr. Contr. Bot. 1 (1852) 97; MIQ. Fl. Ind. Bat. 1 (1856) 793; BECC. Malesia 1 (1877) 116; VALET. Crit. Overz. Olacin. (1886) 250, 253, t. 6, f. 39; K. & V. Bijdr. 5 (1900) 153; HOCHR. Pl. Bog. Exs. (1904) 45; Bull. Inst. Bot. Btzg 22 (1905) 50; BACK. Schoolfl. Java (1911) 227; KOORD. Exk. Fl. Java 2 (1912) 530; KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 1; KOORD. Atlas 1 (1913) t. 118; BAKER *f.* J. Bot. 62 (1924) Suppl. 21; AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 3; BACK. & BAKH. *f.* Fl. Java 2 (1965) 60; SLEUM. Blumea 17 (1969) 245. — **Fig. 6.**

See for synonyms under the varieties.

KEY TO THE VARIETIES

1. Leaves oblong to elliptic-lanceolate, rarely subovate-elliptic or -oblong, generally widest in the middle, and up to 4.5 (rarely –6) cm wide.
 2. Leaves ± acutely acuminate at apex, nerves 10–14 pairs, rather straight from the midrib. Drupes 3.5–4.5 by 1–2 cm. **1.** *var.* **excelsa**
 2. Leaves obtusely acuminate or rounded at apex, nerves 6–8(–10) pairs ± curved-ascending from the midrib. Drupes 2.5–3 by 1–1.3 cm.
  3. Leaves markedly finely reticulate on both faces, generally up to 6 cm wide. **2.** *var.* **riedeliana**
  3. Leaves more faintly or hardly reticulate, 2–3.5(–4.5) cm wide. **3.** *var.* **microphylla**
1. Leaves ovate or ovate-elliptic, or, if elliptic or oblong-elliptic, generally wider than 6 cm.
 4. Leaves shortly subacutely or obtusely acuminate at apex, faintly reticulate in general, nerves 10–12(–14) pairs, these usually rather straight and/or rather closely subparallel to each other, (9–)12–17(–26) by (4.5–)6–9(–12) cm . . . . . **4.** *var.* **borneensis**
 4. Leaves subcaudate-acuminate and subacute at apex, ± distinctly reticulate on both faces, nerves 6–8 pairs, these curved-ascending and rather distant from each other, 8–12 by 3.5–5.5 cm . . . . . **5.** *var.* **kinabaluensis**

1. *var.* **excelsa.**

Tall tree, (12–)25–37 m, trunk ± angular, deeply channelled or fissured, 30–60 (rarely –100) cm ø, with buttresses up to 1.5 m. Bark dark grey to brown, smooth, with fine longitudinal fissures and small lenticels, thin, with a certain aromatic smell and bitter taste. Tips of branchlets, young leaves and inflorescences densely covered with appressed star-shaped major and minor scales (each with a ± distinct dark, almost sooty centre), which disappear late. *Leaves* oblong- or elliptic-lanceolate, apex subacutely acuminate, base ± broadly cuneate, subcoriaceous or thin-coriaceous, at maturity glabrous and shining above, still rather densely scaly beneath especially on nerves and petiole, and of a dull pale yellowish-green colour in fresh state, flush deep pink, 10–17 by 3.5–4.5(–5.5) cm, midrib impressed above, bold beneath, nerves 10–14 pairs, rather straight from the midrib, ± flat above, not much raised beneath, reticulation fine, but slightly raised on both faces or beneath only; petiole 1.5–2 cm by *c.* 2 mm. — ♂ *Inflorescences* in simple spikes or by them composed (then almost pyramidal), covered with a rusty short tomentum of stellate hairs and scales, flowers glomerulose, 3–5 cm. *Petals* pale greenish yellowish or pale pink, glabrous, *c.* 2 mm. *Anther* cells elliptic, 1.5 mm. — ♀ *Inflorescences* in 2–6-flowered cymes (these sometimes reduced to a single flower). Pedicels stoutish, 5–8 mm, elongate in fruit. *Ovary* glabrous, base included by the calyx lobes (*c.* 1.5 mm). *Drupe* very similar to that of *P. latifolia*, (sub)ovoid-oblongoid, manifestly narrowed upwards, 3.5–4.5 by 1–2 cm; fleshy exocarp shiny, dark red when ripe, finally blackish, taste aromatic-bitter; endocarp hard, with the same markings found in *P. latifolia*.

Distr. *Malesia*: Sumatra (Tapanuli: Nias I., Westcoast, Bencoolen), Java (Bantam to Banjumas).

Ecol. Primary forest, often on fertile volcanic soil, scattered, 240–1800(–2200, only *c.* 6 m tall there) m.

Uses. Timber whitish, with an aromatic smell, apparently not in use.

Vern. *Běntenu, talas èndriung*, Lampong, *rasak bareh*, Minangkabau, *tjutjuho*, Nias, M; *gĕmpĕl, mĕrji*, J, *durènan, dudurènan, mandalaksa*, S.

2. *var.* **riedeliana** (BECC.) SLEUM. Blumea 17 (1969) 245. — *P. riedeliana* BECC. Malesia 1 (1877) 116; VALET. Crit. Overz. Olacin. (1886) 253. — *P. excelsa* (*non* BL. *s. str.*) ANDERSON, Gard. Bull. Sing. 20 (1963) 166.

Tree, up to 24 m, up to 45 cm ø. *Leaves* elliptic to subovate-elliptic, apex obtuse or rounded, rarely subemarginate, 7–15(–21) by 4.5–6 (in sterile specimens or suckers rarely up to 8.5) cm, nerves 6–8(–10) pairs, curved-ascending and rather spaced from each other, reticulation fine and dense, generally markedly raised on both faces. *Drupe c.* 3 by 1.3 cm. *Flowers* as in *var. excelsa*.

Distr. *Malesia*: Sumatra (Eastcoast), Malay Peninsula (Johore), Banka, Billiton, Borneo (Sarawak, Brunei, W. part of North Borneo).

Ecol. Generally in lowland, often (in Borneo always) in peat swamp forest (then usually with irregular spreading stilt-roots), once found on Mt Kinabalu at 1525 m.

Vern. *Mědang tjabek*, Banka, *měnpisang*, P. Kebal, *randjan antu*, Bengkalis, *sěrangop*, P. Mendol, M.

3. *var.* **microphylla** (SLEUM.) SLEUM. Blumea 17 (1969) 246. — *P. microphylla* SLEUM. Notizbl. Berl.-Dahl. 15 (1941) 360. — *P. montana* HOWARD, Lloydia 6 (1943) 150, t. 3.

Tree up to 30 m, up to 50 cm ø. *Leaves* oblong to elliptic-oblong, apex obtusely short-acuminate or obtuse, base ± broadly attenuate, thin-coriaceous, (5–)6–10 by 2–3.5(–4.5) cm, nerves 6–8 pairs, rather straight to moderately curved-ascending, subparallel to and rather distant to each other, often a little depressed above, reticulation fine, rather faintly raised, sometimes obscure even beneath. *Drupe* 2.5 by 1–1.3 cm. *Inflorescences* as in *var. excelsa*.

Distr. *Malesia*: New Guinea.

Ecol. Subcanopy tree in primary montane rainforest (Conifer-*Nothofagus*-mossy oak forest), on slopes, 700–2200 m, scattered or sometimes rather frequent locally.

Vern. *Kaderei*, *sawera*, *terori*, Ambai, *uwar*, Kebar.

4. *var.* **borneensis** (HEINE) SLEUM. Blumea 17 (1969) 246. — *P. latifolia* BL. *var. borneensis* HEINE in Fedde, Rep. 54 (1951) 238; Pfl. d. Samml. Clemens Kinabalu (1953) 58. — *P. parviflora* K. & V. Bull. Inst. Bot. Btzg 2 (1899) 3; Bijdr. 5 (1900) 155; Nat. Tijd. N. I. 60 (1901) 383; BACK. Schoolfl. Java (1911) 228; KOORD. Exk. Fl. Java 2 (1912) 530; KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 3; KOORD. Atlas 1 (1913) t. 120. — *P. latifolia* (*non* BL. *s. str.*) MERR. Philip. J. Sc. 1

Fig. 6. *Platea excelsa* BL. *var. borneensis* (HEINE) SLEUM. *a.* Habit with ♂ inflorescences, × ½, *b.* ♀ inflorescences, × ½, *c.* & *c'*. ♂ flower buds, × 10, *d.* ♀ flower, × 5, *e.* drupe, × ½ (*a*, *c* & *c'* BRASS 11564, *b* & *d* BW 6477, *e* KOSTERMANS 18753).

(1906) Suppl. 58; HALL. *f.* Med. Rijksherb. 1 (1910) 13; SCHELLENB. Bot. Jahrb. 58 (1923) 159. — *P. excelsa* (*non* BL. *s. str.*) KOORD. Junghuhn Gedenkb. (1910) 175. — *P. philippinensis* MERR. Philip. J. Sc. 9 (1914) Bot. 313; En. Philip. 2 (1923) 489; HOWARD, J. Arn. Arb. 21 (1940) 488, t. 2, f. 26; DAHL, *ibid.* 33 (1952) 260, f. 23 & 23 A (pollen). — *P. apoensis* ELM. Leafl. Philip. Bot. 8 (1915) 2789; MERR. En. Philip. 2 (1923) 489. — **Fig. 6.**

Leaves similar in shape and size to those of *P. latifolia*, elliptic or ovate-elliptic, rarely ovate, apex shortly subacutely or obtusely acuminate, thin-coriaceous, (9–)12–17(–26) by (4.5–)6–9(–12) cm, nerves 10–12(–14) pairs, generally rather straight or only slightly curved-ascending. *Flowers* as in *var. excelsa*. *Drupe* ovoid-oblongoid, much attenuate towards the apex, (2.5–)3–3.5(–4) by 1.5(–2) cm.

Distr. *Malesia*: Sumatra, Java, Lesser Sunda Is. (Bali, Lombok, Sumbawa, Flores), Borneo, Philippines, Celebes, Moluccas (Ambon, Batjan, Buru), New Guinea, and New Britain.

Ecol. Primary (or rarely secondary, also montane *Quercus* and mossy *Nothofagus*) forest or lowland (Dipterocarp) forest, from sea-level up to 2000(–2400?) m, scattered, often in water containing soil along rivers or on temporarily inundated flats.

Uses. Wood whitish or yellowish; hardly in use for house-construction anywhere. For anatomy of the wood *cf.* MOLL & JANSSONIUS, Mikr. 2 (1908) 254 (*P. parviflora* K. & V.) where is said that the wood is very similar to that of *P. latifolia*.

Vern. Sumatra: *balunan*, *hoting*, Batak, *kurungan tendi*, *sibaubakan*, Karo-Batak, *malenbu*, Nias, *mědang sěkarut*, Kubu, *sitěpu*, Toba, *tjěmpaka gading utan*, M; Java: *ki kadantja*, *ki tjěmpaka*, S, *njampoh buděng*, *rěkisi*, J; *madas*, *udu*, Bali, *tarokeli*, Endeh; Borneo: *balubug*, Labuk, *lalak*, Sampit, *maparè*, Balikpapan, *njawan*, Bulungan; Celebes: *bakalohi*, Toradja, *kapalorè*, Tado, *lari-lari*, Bela, *marasulo*, Torongkong, *talang birang*, Bugin., *wuamendu maeto*, Tobela; Philippines: *kalisan*, *kaliso*, Bag., *pagpágo*, Bon.; Moluccas: *boba*, Ambon, *mahu*, Buru; New Guinea: *bilou*, Mooi, *emmok*, *tegému*, Muju, *kidap*, Mendi, *maar*, *nokimbuwo*, Amberbaken, *mesimeski*, Arfak, *niebatek*, Kebar, *sira*, Manikiong, *subar*, Wandammen, *tindokopa*, Enga.

5. *var.* kinabaluensis (SLEUM.) SLEUM. Blumea 17 (1969) 247. — *P. kinabaluensis* SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 234. — *P. latifolia* (*non* BL.) DAHL, J. Arn. Arb. 33 (1952) 260 (pollen).

Leaves similar in texture and nervation, especially reticulation to those of *var. riedeliana*, ovate-oblong or -elliptic, apex subcaudate-acuminate and subacute, 8–12 by 3.5–5.5 cm, nerves 6–8 pairs curved-ascending and rather distant from each other. ♂ *Flowers* only known, as in *var. excelsa*.

Distr. *Malesia*: Borneo (Mt Kinabalu), in montane forest at 1430–1525 m, twice found.

Excluded

Platea oblonga KORTH. *ex* VALET. Crit. Overz. Olacin. (1886) 252, in text & t. VI, f. 42 a–d; SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 234, in text; Blumea 17 (1969) 248 = *Prunus javanica* (T. & B.) MIQ. (*Rosaceae*).

4. GONOCARYUM

MIQ. Fl. Ind. Bat. Suppl. 1 (1861) 343; SLEUM. Blumea 17 (1969) 209. — *Phlebocalymna* GRIFF. *ex* MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 109, repr. in Contr. Bot. 1 (1852) 96, *in syn. gen. Platea* BL., *nom. inval.*; *ex* BENTH. in Benth. & Hook. *f.* Gen. Pl. 1 (1862) 353, *descr.* — **Fig. 8.**

Dioecious, slender trees or shrubs, ± horizontally branching. *Leaves* spirally arranged, entire, penninerved; petiole yellow and always characteristically transversely wrinkled. *Inflorescences* axillary, often from defoliate parts of the branchlets, rarely from trunk. *Flowers* sessile or very shortly pedicelled, subtended by 1 or 2 bracts, collected to interrupted, solitary or fascicled, sometimes elongate spikes, or congested to axillary fascicles or glomerules. *Calyx* small, deeply imbricately 5-lobed, persistent. *Petals* 5, valvate in bud, either united up to the lower half and cup-like spreading, or connate more highly and forming a tube, tips inflexed, slightly keeled and sometimes papillose inside. — ♂ Flowers: *Stamens* 5; filaments adnate to the petals except at tips; anther cells oblong-elliptic, introrse, dorsifixed. Rudiment of *ovary* hairy, on a thin glabrous disk. — ♀ Flowers: *Stamens* 5, rudimentary. *Ovary* sessile; style short-conical; stigma rather large or small, pad-like or capitate, oblique, unilaterally incised or subbilobed. *Disk* thin-coriaceous, crenulate, sometimes inconspicuous. *Drupe* subglobose to ellip-

soid-oblongoid, sometimes obtusely 3 (or sub-5)-angular, with few to numerous longitudinal ribs; exocarp either thick and predominantly spongious, showing but a few fibres, or thinner and with more numerous fibres; endocarp either hard and with numerous longitudinal ± sharp crests, and ± alveolate besides, or thinner and but shallowly crested or ridged, whether or not with an inner lateral longitudinal swelling mainly in the lower part, which houses a small roundish abortive loculus. *Seed* 1, with a thin testa; endosperm copious, much corrugate-lobular or ruminate; embryo thin, with 2 foliaceous lanceolate cytoledons.

Distr. About 9 or 10 *spp.*, all in *Malesia*, eastwards to the Bismarcks, 2 *spp.* extending into SE. Asia (Burma to Kwangsi, Hainan and S. Formosa), a 10th unlocalized and cultivated in Hort. Bog., imperfectly known, and possibly 2 undescribed new *spp.*, one in New Britain, the other in Burma and Malaya. Fig. 7.

Ecol. In the understorey of lowland and montane, primary and occasionally secondary forest, rarely in swamp forest or mangrove, from sea-level up to 1220 m. *Fl. fr.* Jan.–Dec.

The drupes seem to be able to float, which may contribute to their dispersal.

Note. The *spp.* in the group with tubular flowers are very close to each other; with the materials at hand their discrimination remains rather unsatisfactory. It seems, that mature fruits allow to separate these species by such characters as form and size of the drupe and the structure of the exocarp and endocarp. Many fruits, however, are found without seeds, and thus possibly not or not always enough developed to show the above mentioned characters.

KEY TO THE SPECIES

1. Petals of the ♂ flowers almost free or united below up to the middle, cup-like expanded. Anthers as long as or longer than filaments. Drupe, as far as known, without a distinct abortive loculus*, reddish to orange at maturity; exocarp thick, almost exclusively spongious.
2. Petals of the ♂ flowers almost free, smooth inside, *c.* 2 mm. . . . . **1. G. crassifolium**
2. Petals of the ♂ flowers united below to ⅓–½ their length, with papillose emergences all over the inside, (4–)5–6 mm . . . . . **2. G. litorale**
1. Petals of the ♂ flowers united below to about ¾, forming a tube, not papillose inside. Filaments distinctly longer than the anther cells. Drupe dark green to olivaceous or turning blackish at maturity, with a distinct abortive loculus (round in ø); exocarp rather thin, spongious or predominantly fibrous.
3. Leaves suddenly narrowed at apex for *c.* 2 cm by 3–4 mm (at base), tip subacute, nerves, and generally also veins, much impressed above, sharply raised beneath. Mature drupe acuminate, tip acute, longitudinal ribs numerous and ± sharply outstanding . . . . . **3. G. impressinervium**
3. Leaves less distinctly or shortly acuminate-attenuate at apex, tip ± bluntish, nerves whether or not impressed above, veins but slightly or not so. Mature drupe short-apiculate or obtuse at apex, longitudinal ribs few to rather numerous and ± obtuse, whether or not prominent.
4. ♂ spikes solitary in general. Mature drupe obtusely trigonous in ø.
5. Spikes (both ♂ and ♀) generally elongate, up to 30 cm. Leaves (6–)8–18(–20) by 3.5–6.5(–9.5) cm, greyish green in dry specimens. Petals 5–6 mm. . . . . **4. G. gracile**
5. Spikes (both ♂ and ♀) relatively short, rarely up to 6 cm. Leaves 6–12 by 3–4(–5) cm, usually yellowish green especially beneath in dry specimens. Petals c. 4 mm. . . . . **5. G. minus**
4. ♂ Spikes generally several in a fascicle, or flowers glomerately arranged. Mature drupe ± round in ø.
6. Drupe ovoid, or rarely ellipsoid-subovoid, green at maturity, with several obtuse prominent longitudinal ribs . . . . . **6. G. cognatum**
6. Drupe oblongoid to ellipsoid, or rarely subovoid-ellipsoid or -oblongoid, dark olivaceous to ± blackish at maturity, longitudinal ribs few to numerous, all but little or hardly prominent.
7. Ovary in the ♀, or rudiment of ovary in the ♂ flower glabrous. Leaves 15–20(–25) by (5–)6–10(–14) cm, lateral nerves generally slightly impressed above, reticulation rather weakly or not prominent above. Drupe (1.5–)2–2.5 (rarely –3) by 1–1.5 cm; exocarp 1–2 mm; endocarp thin. **7. G. macrophyllum**
7. Ovary in the ♀, or rudiment of ovary in the ♂ flower densely to more sparsely hairy. Lateral nerves of leaves not impressed above. Drupe larger in general.
8. Leaves markedly finely and densely prominent-reticulate on both faces, or certainly above. Exocarp plus endocarp of well developed drupes 1–2 mm. . . . . **8. G. calleryanum**
8. Leaves rather obscurely or not prominent-reticulate above, never so beneath. Exocarp plus endocarp of well developed drupes (2–)3–4 mm . . . . . **9. G. lobbianum**

(*) *Cf.* also 10. *G. melanocarpum.*

1. Gonocaryum crassifolium RIDL. J. Str. Br. R. As. Soc. *n.* 75 (1917) 18; Fl. Mal. Pen. 1 (1922) 432; SLEUM. Blumea 17 (1969) 210.

Shrub with flexuous branches, glabrous except the inflorescence. *Leaves* reminding of those of *G. litorale*, ovate to oblong, apex ± abruptly acuminate for *c.* 2 cm, tip bluntish, base broadly cuneate to rounded, coriaceous, 15–17 by 5–9.5 cm, midrib strongly deepened above, sharply prominent beneath, nerves (5–)6–7 pairs, slightly impressed above, raised beneath, proper reticulation obscure, both faces of the lamina finely tubercled; petiole *c.* 1.5 cm by 2–3 mm. — ♂ *Spikes* solitary or several from tubercles in defoliated axils of branchlets, lax-flowered, slender, 2.5–5 cm, all over shortly appressedly hairy, not yet known in fully developed state. *Calyx* lobes ovate, obtuse, *c.* 1.5 mm. Petals ovate-oblong, subacuminate, thickish, free to almost the base, glabrous and smooth inside, *c.* 2 mm. Rudiment of *ovary* hairy. ♀ *Inflorescences* and *drupe* not yet known.

Distr. *Malesia*: Malay Peninsula (Selangor: Sempang Mines), once found.

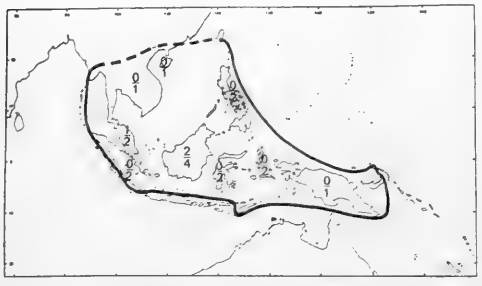

Fig. 7. Distribution of *Gonocaryum*. The figure above the hyphen indicates the number of endemic species in that island or area, the figure below the hyphen the number of non-endemic species.

2. Gonocaryum litorale (BL.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 233; Blumea 17 (1969) 211. — *Stemonurus ? litoralis* BL. Mus. Bot. Lugd.-Bat. 1 (1850) 250; WALP. Ann. 2 (1851) 182; MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 36, repr. Contr. Bot. 1 (1852) 87. — *Lasianthera ? litoralis* (BL.) MIQ. Fl. Ind. Bat. 1 (1856) 792; SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 14; BECC. Malesia 1 (1877) 111. — *Villaresia macrocarpa* SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 13; *l.c.* 102, *obs.* — *G. pyriforme* SCHEFF. Ann. Jard. Bot. Btzg. 1 (1876) 100; BECC. Malesia 1 (1877) 123; VALET. Crit. Overz. Olacin. (1886) 246; HOCHR. Pl. Bog. Exs. (1904) 43, *incl. var. corrugatum* HOCHR. *l.c. et var. planifolium* HOCHR. *l.c.* 44; Bull. Inst. Bot. Btzg 22 (1905) 39, *incl. var. corrugatum* HOCHR. *et var. planifolium* HOCHR.; Ann. Jard. Bot. Btzg Suppl. III, 2 (1910) 857, *incl. var. genuinum f. planifolium* (HOCHR.) HOCHR. *et f. corrugatum* (HOCHR.) HOCHR., *var. obovatum* (HOCHR.) HOCHR., *var. fuscum* (HOCHR.) HOCHR. *l.c. et var. fusiforme* (HOCHR.) HOCHR. *l.c.* 858; BACK. Schoolfl. Java (1911) 227; KOORD. Exk. Fl. Java 2 (1912) 532 ('*piriforme*'); PULLE, Nova Guinea 8 (1912) 659; WARB. Pflanzenwelt 2 (1916) 349, f. 231 D, 1–6; SCHELLENB. Bot. Jahrb. 58 (1923) 166; WETTSTEIN, Handb. Syst. Bot. ed. 4 (1935) 842, fig. (fr., '*pyrospermum*'); AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 2; BACK. & BAKH. *f.* Fl. Java 2 (1965) 59. — *G. selebicum* BECC. Malesia 1 (1877) 124; VALET. Crit. Overz. Olacin. (1886) 247; KOORD. Minah. (1898) 394. — *G. affine* BECC. Malesia 1 (1878) 256; VALET. Crit. Overz. Olacin. (1886) 247; PULLE, Nova Guinea 8 (1912) 659; SCHELLENB. Bot. Jahrb. 58 (1923) 166. — *G. macrocarpum* (SCHEFF.) SCHEFF. *ex* WARB. Bot. Jahrb. 13 (1891) 299; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 415. — *G. fuscum* HOCHR. Pl. Bog. Exs. (1904) 42; Bull. Inst. Bot. Btzg 22 (1905) 5, 49; BACK. Schoolfl. Java (1911) 227; DAHL, J. Arn. Arb. 33 (1952) 265 (pollen). — *G. fusiforme* HOCHR. Pl. Bog. Exs. (1904) 42; Bull. Inst. Bot. Btzg 22 (1905) 50. — *G. obovatum* HOCHR. Pl. Bog. Exs. (1904) 43; Bull. Inst. Bot. Btzg 22 (1905) 4, 51; VALET. Bull. Dép. Agr. Ind. Néerl. 10 (1907) 30. — *G. sp.*, PULLE, Nova Guinea 8 (1912) 659.

Slender tree, rarely erect shrub, (2–)6–20(–30) m, rather sparsely and ± horizontally branched; trunk with several small grooves, 3–15(–30) cm ø; bark rather smooth, mottled, light to dark greyish-brown. Branchlets slender, practically glabrous as are the leaves. *Leaves* ovate or ovate-elliptic, sometimes elliptic and even oblong, apex shortly acuminate, top blunt, base cuneate to rounded, slightly inequilateral, subcoriaceous to coriaceous, dark green to olivaceous and shining above, paler and ± dull beneath, (10–)12–20(–28) by 6–12(–19) cm, midrib a little depressed above, much prominent beneath, nerves (4–)5–7(–8) rather steeply curved-ascendent pairs, only the upper ones somewhat looping, raised within a depression in dry specimens above, prominent beneath, reticulation rather dense, often obscure in dry specimens, or slightly depressed above, or a little raised on both faces; petiole 4–8(–10) by 1.5–2(–3) mm. — ♂ *Spikes* 1–4 (rarely –8) from a foliate or mostly already defoliate axil, or from tubercles on branchlets and branches, slender, (3–)5–15(–30) cm, flowers numerous, laxly arranged, sparsely appressedly short-hairy or subglabrous. *Calyx* lobes ovate, ciliate, greenish-brown, 1.5(–2) mm. *Petals* narrowly ovate-acuminate, united in the lower third or half, cup-like expanding at full anthesis, slightly keeled and all over set with papillose emergences inside, white to cream or greenish, sometimes pinkish, fragrant, (4–)5–6 by 2–2.5 mm. *Filaments* somewhat dilated towards the base, fleshy, 1.5–2 mm; anther cells elongate-oblong, 2–2.5 mm. Rudiment of *ovary* hairy. — ♀ *Spikes* generally shorter than the ♂ ones. *Calyx* less deeply lobed, (2–)3 mm. *Petals* 6–7 by 2–2.5 mm. *Anther* cells 1 mm, devoid of pollen. *Ovary* ovoid, densely fulvous-hairy; stigma rather large, pad-like. *Drupe* ellipsoid or obovoid, or obovoid-oblongoid, some-

times almost globular, often somewhat angular or laterally compressed, finally quite glabrous and shining, orange to reddish, (3–)4–5(–6.5) by 2–3(–4.5) by 2–3.5 cm; exocarp spongious, with adstringent sap, finally dissolute, *c.* 3 mm; endocarp hard, 1(–2) mm thick, with few to numerous irregular longitudinal sharp crests 1–5 mm high, ± marked in the immature fruit by the drying process, abortive loculus practically absent. *Seed* pear-shaped or ellipsoid.

Distr. *Malesia*: Lesser Sunda Is. (Timor), Celebes incl. Buton I., Moluccas (Morotai, Halmahera, Ambon, Ceram, Kai and Tanimbar Is.), Aru, Salawati, Misoöl, New Guinea & New Britain, and Mussau I. in the Bismarcks.

Ecol. In second storey of primary rain-forest, mostly on hill slopes, also in ± open secondary growth or sunny slopes, in coastal and swamp forest, often near creeks or temporarily inundated river flats, on clayey soil, scattered, though locally common, from sea-level up to *c.* 1200, in New Guinea up to 1650 m.

Uses. Wood hard, heavy, dark cream or yellowish or light orange, with broad rays and an oak-like grain, apparently not used due to the small dimensions.

Vern. Tanimbar Is.: *twajagunmore*, Otimmer; Celebes: *balula*, Tobela, *karo*, Buton, *kondo*, Topadu; Aru Is.: *kartomadin*; New Guinea: *akwaai*, Kawerawedja, *aria*, *rasui*, Ambai (Japen), *atile*, *ulumu*, Amele, *bisip*, *sarenki*, Dumpu, *briengbas*, Karoon, *dindo*, *gadun*, *gwanawa*, Faita, *gaun*, *mobo*, Bilia, *kaffadioma*, Menawi (Japen), *kami*, Maprik, *kawènmatak*, Maibrat, *kojari*, *sakowgo matèmuk*, *wobrega*, *wobreika*, Manikiong, *kurmardi*, Japen, *kwydjarak*, Kebar, *mesobas*, Hatam, *owok*, New Britain, *sabobar*, Etnabay, *sanganiet*, Tehid, *sapiai*, Biak, *sienbal*, Mooi, *ubakka*, Matapaili.

3. Gonocaryum impressinervium SLEUM. Blumea 17 (1969) 212. — **Fig. 8.**

Shrub or treelet, (2–)3–8 m, trunk *c.* 5 cm ø; bark smooth. Branchlets obtusangular, slender, practically glabrous. *Leaves* oblong-elliptic, apex subabruptly acuminate for *c.* 2 cm and 3–4 mm wide at base of acumen, base broadly attenuate, subinequilateral, thin-coriaceous, glabrous with age, dilutely green-olivaceous in dry specimens, (12–)15–23 by 5–10 cm, midrib, nerves and veins distinctly impressed above in dry specimens, well raised beneath, nerves 6–8 pairs curved-anastomosing and markedly looping, reticulation of veinlets dense and prominent on both faces, or sometimes almost obscure; petiole 8–10 by *c.* 2 mm. *Spikes* axillary, solitary or more rarely in twos, erecto-patent, (2–)3–8 cm, laxly many-flowered, lower flowers pedicelled up to 2 mm; rachis slender, 1 mm ø, puberulous. *Calyx* 5-lobed to almost the base, lobes ciliate, *c.* 2 mm. — ♂ *Flowers*: *Petals* connate to a tube for their lower ¾, 5–6 mm, white in fresh, reddish in dry state. *Filaments* 3 mm; anther cells 1.5 mm. Rudiment of *ovary* hirsute. — ♀ *Flowers* only known in developed state. *Calyx* lobes 2.5 mm. *Petals* not known. *Ovary* short-pubescent. *Drupe* (possibly not quite mature) obliquely elongate-ovoid, subtrigonous, slightly compressed laterally, more attenuate towards the apex than the base, acute, sparsely hairy, green with 12–15 subirregular longitudinal subacute and 1–2 mm high ribs, 5–5.5 by (2–)2.5 cm; exocarp spongious, 1–1.5 mm, with longitudinal fibres; endocarp hard, thin, longitudinally many-ribbed.

Distr. *Malesia*: Borneo.

Ecol. Forest (*Dryobalanops*), scattered though obviously locally common, on sandy loam, 50–150 m.

4. Gonocaryum gracile MIQ. Fl. Ind. Bat. Suppl. 1 (1860) 137, *nom. nud.*; *ibid.* (1861) 343; BECC. Malesia 1 (1877) 122; VALET. Crit. Overz. Olacin. (1886) 245, *excl. syn.*; SLEUM. Blumea 17 (1969) 213. — *G. longeracemosum* KING, J. As. Soc. Beng. 64, ii (1895) 120; RIDL. Fl. Mal. Pen. 1 (1922) 431; BAKER *f.* J. Bot. 62 (1924) Suppl. 21; BURK. Dict. (1935) 1099; DAHL, J. Arn. Arb. 33 (1952) 265, f. 44 & 44 A (pollen).

Shrub or small, low-branching tree, up to 12 m; trunk up to 5 cm ø; bark smooth, light greyish brown. Branchlets slender, tips finely pubescent, lower parts glabrescent, striate, early covered with greyish cork. *Leaves* elliptic-oblong, sometimes subobovate-oblong, apex rather suddenly attenuate, mostly somewhat curved, tip blunt, base broadly cuneate, slightly inequilateral, subcoriaceous to coriaceous, practically glabrous with age, greyish green in dry specimens, shining above, dull and paler, sometimes tubercled beneath, (6–)8–18(–20) by 3.5–6.5(–9.5) cm, midrib slightly sunken above, much prominent beneath, nerves 4–5(–6) pairs, lower 2 or 3 pairs curved-ascending, upper ones more straight, all slightly or hardly raised above, more distinctly so beneath, reticulation of veins and veinlets dense, finely raised on both faces; petiole 8–10 by 1.5–2 mm. *Inflorescences* both from foliate and lower defoliate axils, erect, (3–)5–15(–30) cm, solitary or rarely in twos or threes, laxly many-flowered; rachis 1–1.5 mm ø, short-hairy as are the bracts and lower part of the calyx lobes, the latter ovate-deltoid, 1.5 mm. — ♂ *Flowers*: *Petals* 5–6 mm, high connate to a tube of 2 mm ø, greenish-white, lobes short, finally reflexed. *Filaments* as long as the tube; anther cells narrow-elliptic, 1 mm, finally a little exserted. Rudiment of *ovary* hirsute, on a thick glabrous disk. — ♀ *Flowers*: Tube of *petals* more urceolate, 3–4(–5) mm, lobes 1–1.5 mm, reflexed. *Anther* cells much reduced in size, empty. *Ovary* ovoid-conical, densely grey-pubescent, attenuate to a short ± unilateral style with a flattish or subcapitate bilobed stigma. *Disk* pubescent at upper margin. *Drupe* ellipsoid-oblongoid, sometimes subobovoid, green, obtusely trigonous, apex broadly attenuate or obtuse, rarely apiculate, each of the 3 faces with 2 or 3 longitudinal low obtuse ribs, (3–)3.5–4(–4.5) by 1.5–2(–2.8) cm; exocarp spongious; endocarp hard, thin, slightly longitudinally many-ribbed.

Distr. *Malesia*: Sumatra, Malay Peninsula (also P. Tioman), Banka.

Ecol. In forest, mainly in lowland, rarely up to 1000 m, in river valleys by streamside, scattered.

Uses. Poultices are said to be made from the fruit for application to the head for head-ache.

Vern. *Rambai ayam, r. hantu, ruai gajah, tampong bĕsi, toyoh*, M.

5. Gonocaryum minus SLEUM. Blumea 17 (1969) 213.

Treelet up to 12 m, rarely tree up to 30 m, trunk

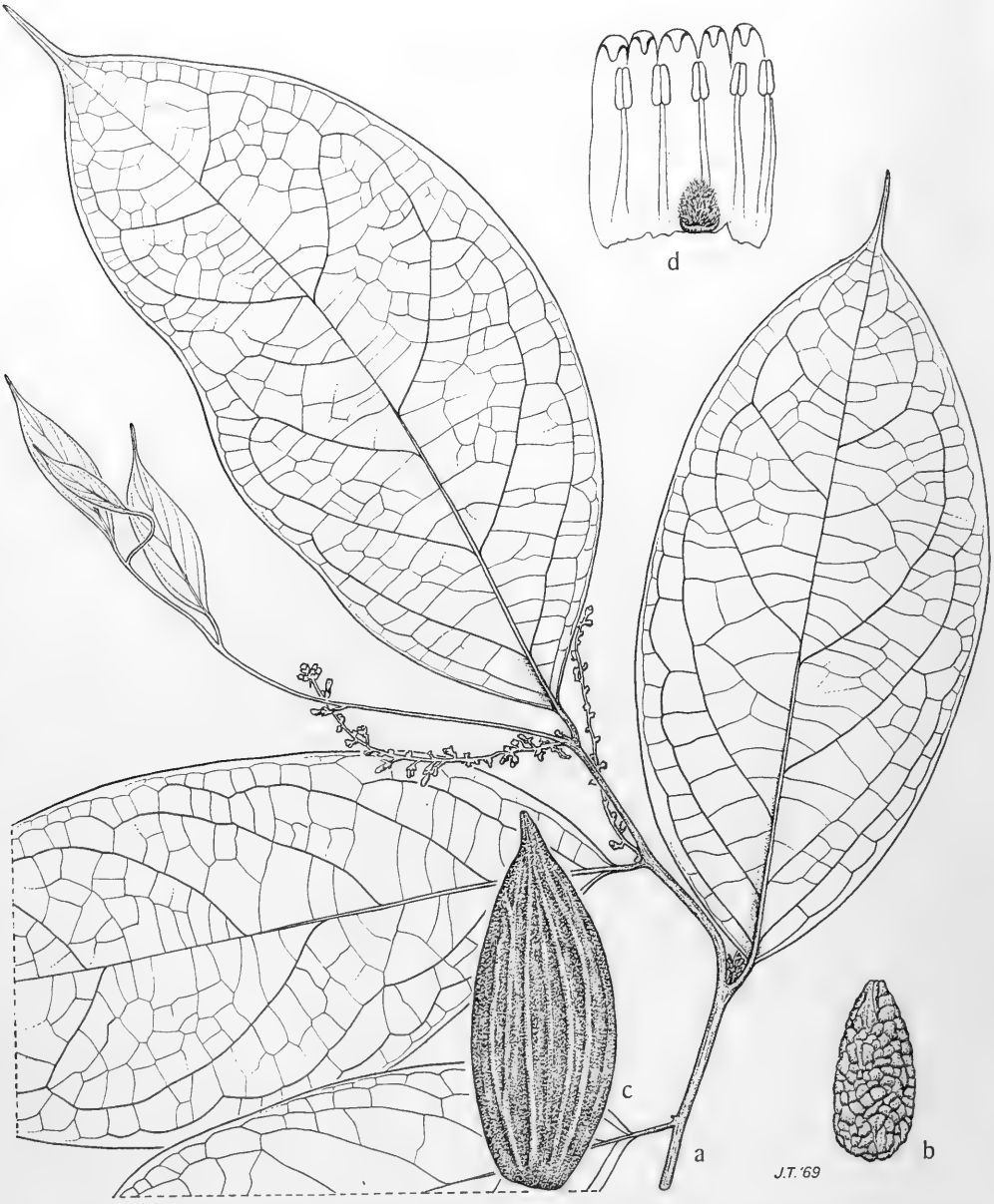

Fig. 8. *Gonocaryum impressinervium* SLEUM. *a*. Habit, ×½, *b*. seed, showing the ruminate endosperm, ×1, *c*. drupe, ×1, *d*. ♂ flower, from the inside, expanded, ×7½ (*a* & *d* KOSTERMANS 10435 (type), *b–c* KOSTERMANS 10480).

up to 18 cm ø; bark smooth or minutely fissured, greenish-grey to dark brown. Branchlets obtusangular, very slender, glabrescent. *Leaves* elliptic-oblong, subcaudate-acuminate for 5–15 mm, tip blunt, base broadly cuneate or obtuse, subcoriaceous, glabrous, paler and often yellowish-green beneath in dry specimens, 6–12 by 3–4(–5) cm, midrib slightly impressed towards the base of the lamina above, prominent beneath, nerves 4–5 irregular pairs, suberect, a little raised on both faces, reticulation of veins and veinlets dense and finely raised above, generally less so beneath; petiole *c.* 1 cm by 1–1.5 mm. *Spikes* axillary, solitary, lax-flowered; rachis slender, sparsely appressedly hairy, (1–)2–5(–6) cm. *Calyx* lobes ovate, ciliate, 1.5 mm. *Petals* greenish, connate to a tube 4 by 1–1.5 mm, free and erecto-patent for the distal 1 mm. — ♂ *Flowers*: *Filaments* 3 mm; anther cells 1 mm. Rudiment of *ovary* hairy. *Disk* thickish, hairy. — ♀ *Flowers*: *Petals* connate to an urceolate-cylindric tube for their lower ¾, *c.* 4 mm. *Ovary* ovoid, densely short-hairy; stigma capitate. *Drupe* obovoid-oblongoid, obliquely obtusely subtrigonous, apex obtuse or apiculate, green to brownish, 2.5–3.5(–4) by 1.8–2.5 cm; exocarp spongious and fibrose, 2(–3) mm; endocarp 0.5 mm, 8–10-costulate lengthwise, the ribs not much showing off in the exocarp.

Distr. *Malesia*: Borneo (northern part).

Ecol. Primary, lowland (Dipterocarp) forest, also in old secondary forest, up to 245 m, on sandy clay, on tertiary sand or sandstone, on leached soil.

Uses. Wood yellowish, soft, not used. Fruit said to be much favoured by barking deer (*kijang*).

Vern. *Kamuning*, *mělanin*, Dusun.

6. Gonocaryum cognatum ELM. Leafl. Philip. Bot. 1 (1908) 315; MERR. En. Philip. 2 (1923) 491; Pl. Elm. Born. (1929) 172; ELM. Leafl. Philip. Bot. 10 (1939) 3808; DAHL, J. Arn. Arb. 33 (1952) 265, f. 45 & 45 A (pollen); SLEUM. Blumea 17 (1969) 214. — *G. grandifolium* MERR. Philip. J. Sc. 17 (1920) 278; En. Philip. 2 (1923) 491.

Shrub or treelet, (1–)2–6 m, practically glabrous; stem 4–8 cm ø. Branchlets slender, smooth, green, older parts covered with a thin greyish-brownish longitudinally fissured cork. *Leaves* ovate- or oblong-elliptic, sometimes ovate, apex subabruptly and for 1–2 cm obtusely subacuminate or apiculate, base ± rounded, slightly inequilateral, coriaceous, lucid green above, much paler beneath, 15–20(–30) by 8–12(–18) cm, midrib grooved only in the lower part above, strongly raised beneath, nerves 4–5(–6) pairs, the lower 2 (or 3) pairs usually closer together than the upper ones and found in about the lower third of the lamina, curved-ascending and ± looping, slightly raised above, more distinctly so beneath, reticulation of veins and veinlets dense and finely prominent on both faces; petiole 8–15(–20) by *c.* 3 mm. — ♂ *Flowers* (B.S. 44073) glomerate on slightly supra-axillary swellings, tubercles or very short axes, sessile or almost so. *Calyx* lobes ovate, ciliate, *c.* 2 mm. *Petals* united to their lower ¾ into a tube, white, *c.* 5 mm. *Filaments* 3 mm; anther cells elliptic, 1.5 mm. Rudiment of *ovary* cylindric with a broadened base, glabrous as is the thick crenulate *disk*. — ♀ *Flowers* solitary or few (rarely up to 8), details not known. *Drupe* ovoid, or rarely ellipsoid-subovoid, (2–)2.5–3 by (1.5–)2–2.5 cm, round in ø, green, with *c.* 5 prominent obtuse ridges from base to the subtruncate or very shortly apiculate apex, and may be with a few less distinct ones between; exocarp thin, predominantly spongious; endocarp hard, 1–1.5 mm, with *c.* 5 obtuse longitudinal crests.

Distr. *Malesia*: E. and NE. Borneo, Philippines (Luzon: Sorsogon; Samar, Leyte, Panay, Dinagat I., Mindanao, Sulu Arch.).

Ecol. Primary, rarely secondary lowland (Dipterocarp) forest, up to 300 m, along river, apparently scattered.

7. Gonocaryum macrophyllum (BL.) SLEUM. Blumea 17 (1969) 214. — *Stemonurus macrophyllus* BL. Mus. Bot. Lugd.-Bat. 1 (1850) 250; WALP. Ann. 2 (1851) 182. — *Lasianthera macrophylla* (BL.) MIQ. Fl. Ind. Bat. 1 (1856) 792; Suppl. 1 (1860) 137; BECC. Malesia 1 (1877) 111. — *G. melanocarpum* (*non* HOCHR.) WYATT-SMITH, J. Ecol. 41 (1953) 213, 214.

Treelet or shrub, 2–6(–10) m; bark brown. Branchlets slender, glabrous. *Leaves* elliptic to subobovate-elliptic, apex rather abruptly short-acuminate (1 cm), tip obtuse, base broadly cuneate, slightly inequilateral, coriaceous, ± dull on both faces in dry specimens, glabrous, 15–20(–25) by (5–)6–10(–14) cm, midrib slightly impressed above, strongly raised beneath, nerves 5–6(–7) pairs curved-ascendent, the upper ones more distinctly looped, shallowly or not sunken above, prominent beneath, reticulation of veins and veinlets finely or hardly prominent above, hardly so beneath, or obscure on both faces; petiole 10–12 by (2–)3 mm. *Inflorescences* in foliate or defoliate axils; ♂ racemes several, sometimes very short and glomerate (galled then?), ♀ ones solitary or few; rachis 0.5–1.5 (rarely –3.5) cm, slender at anthesis, stoutish and somewhat accrescent in fruit, covered with short hairs or almost glabrous; pedicels 1 mm or less. — ♂ *Flowers* (mainly from LÖRZING 5452, Sumatra): *Calyx* lobes ovate, fleshy, ciliate, 1.5 mm. *Petals* united in their lower ¾ part to a distally slightly enlarged tube, *c.* 5 mm including the erect free part, fleshy, white or greenish. *Filaments* 3 mm; anther cells elongate-elliptic, 1.5 mm. Rudiment of *ovary* cylindrical, base broadened, practically glabrous, as is the flat *disk*. — ♀ *Flowers*: *Calyx* lobes and *petals* as in ♂ flowers. *Anther* cells reduced in size. *Ovary* ovoid, glabrous, style thick, 1 mm; stigma oblique, flattish-peltate. *Disk* thin or obscure. *Drupe* subovoid-ellipsoid or oblongoid, apex obtuse or apiculate, slightly longitudinally many-ridged or -keeled (generally more distinctly so on one side), blue-black, (1.5–)2–2.5(rarely –3) by 1–1.5 cm; exocarp spongious and fibrous, 1–2 mm; endocarp hard, thin.

Distr. *Malesia*: Sumatra (Eastcoast), Mentawei

Is. (Siberut), Berhala and Jarak islets in Malacca Straits, Banka (also on Lepar I.), Borneo.

Ecol. Coastal and hillside inland lowland (also Dipterocarp) forest, sometimes on rather dry land, sandy loam soil, up to 400 m.

Vern. *Kaju napa*, Asahan, *minyak berok*, Jarak I., M.

8. Gonocaryum calleryanum (BAILL.) BECC. Malesia 1 (1877) 123; VALET. Crit. Overz. Olacin. (1886) 247; MERR. Philip. J. Sc. 3 (1908) Bot. 243, 418; BROWN, Min. Prod. Philip. For. 3 (1921) 203; MERR. En. Philip. 2 (1923) 491; BROWN, Useful Pl. Philip. (1950) 356; KRAEMER, Tr. W. Pacif. Region (1951) 208, f. 74 (wood); DAHL, J. Arn. Arb. 33 (1952) 265, f. 46 & 46 A (pollen); LI, Pac. Sci. 7 (1953) 184; LIU, SASAKI & KENG, Quart. J. Taiwan Mus. 8 (1955) 305; KAO, *l.c.* 345; HATUS. Mem. Fac. Agr. Kagosh. Un. 5, 3 (1966) 38; SLEUM. Blumea 17 (1969) 215. — *Phlebocalymna calleryana* BAILL. Adansonia 9 (1869) 147. — *G. teysmannianum* SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 98; BECC. Malesia 1 (1877) 123; VALET. Crit. Overz. Olacin. (1886) 245; HOCHR. Pl. Bog. Exs. (1904) 44, *n.* 91; Bull. Inst. Bot. Btzg 22 (1905) 51. — *G. tarlacense* VIDAL, Sinopsis Atlas (1883) 20, t. 30, f. C; Rev. Pl. Vasc. Philip. (1886) 86; CERON, Cat. Pl. Herb. Manila (1892) 46; MERR. Philip. J. Sc. 1 (1906) Suppl. 86. — *G. diospyrosifolium* HAYATA, Ic. 2 (1912) 106 ('*diospyrifolia*'); KANEH. Formos. Tr. (1917) 119; *ibid.* (1936) 400, f. 359; ITO, Ill. Formos. Pl. (1927) t. 12; SASAKI, Cat. Gov. Herb. Formosa (1930) 324.

Treelet or slender tree, 5–12-(20) m, trunk rarely up to 25 cm ø, with greyish bark. Branchlets slender, glabrous. *Leaves* elliptic to elliptic-ovate, apex obtusely apiculate, often plicate, base broadly cuneate to rounded, coriaceous, glabrous, shining above, paler and rather dull beneath in dry specimens, (7–)10–18 by (4–)5–8(–10) cm, midrib very slightly grooved above, strongly raised beneath, nerves 4–5(–6) rather steeply curved-ascending pairs, the lower 2(–3) ones closer together than the upper ones and often ± bending downwards to the petiole in a narrow angle, a little prominent above, more distinctly so beneath, reticulation of veins and veinlets rather dense and markedly raised on both faces especially above; petiole 12–20 by *c.* 2 mm. *Racemes* spiciform, solitary or several in a fascicle, from foliate and/or defoliate axils, slender, few- to many-flowered, laxly appressedly hairy, (1–)2(–4) cm. Pedicels 0.5–1.5(–2) mm. *Calyx* lobes ovate, dorsally ± glabrous, ciliate, 1.5–2(–2.5) mm. *Petals* (4–)5 mm, whitish, or light green, united to a tube for ¾ their length, lobes suberect. — ♂ *Flowers*: *Filaments* 3 mm; anther cells elliptic, 1.2–1.5 mm. Rudiment of *ovary* cylindric, sparsely hairy, on a thick broadened glabrous *disk*. — ♀ *Flowers*: *Anther* cells rudimentary. *Ovary* ovoid-subconical, densely short-hairy, on a thick glabrous cushion-like *disk*; style hardly 1 mm; stigma peltate, oblique, attenuate towards one side. *Drupe* subovoid-oblongoid, or generally ellipsoid, apex obtuse or usually attenuate-apiculate, 2.5–3.5(–4.5) by 1.5–2(–2.5) cm, with numerous longitudinal slightly raised lines or ribs, purplish-blackish when ripe; exocarp spongious-fibrous, 1–1.5 mm; endocarp thin-woody, with numerous longitudinal low ribs which but slightly appear as such through the exocarp, and with may be one shallow deeper lateral groove. *Seed* white, hard.

Distr. S. Formosa (incl. also Lan Yu = Botel Tobago I.); in *Malesia*: Philippines (Babyuan & Alabat Is., Luzon, and Samar), Moluccas (Morotai, Halmahera, Batjan), N. Celebes (Gorontalo), and SW. Borneo (Sampit region).

Ecol. Primary littoral or lowland (Dipterocarp) forest, also secondary growth, from sea-level up to *c.* 750 m, on clayey, sometimes volcanic soil.

Uses. The plant is said to be used as a cure for stomach troubles in the Philippines. Wood durable for interior work.

Vern. Philippines: *ampáleng*, *gohan*, *malagohan*, Klg., *angkak*, *malatapái*, Bik., *basa-basa*, *busigan*, *gozzáng-kalinga*, *karasóko*, *maragauák*, *maragauéd*, Ibn., *lunàs*, *malapínggan*, *malasámat*, *rogrogsó*, *saling-bato*, *taingan-bábui*, Tag., *malasitúm*, Pamp., *uratán*, Ilk., *yáya*, Ibn. & Neg.

9. Gonocaryum lobbianum (MIERS) KURZ, J. As. Soc. Beng. 39, ii (1870) 72; Prel. Rep. For. & Veg. Pegu (1875) 37; PIERRE, Fl. For. Cochinch. (1892) *in obs. sub* t. 268; CRAIB, Fl. Siam. En. 1 (1926) 274; SLEUM. Blumea 17 (1969) 215; Fl. Thail. 2 (1970) 80. — *Stemonurus macrocarpus* BL. Mus. Bot. Lugd.-Bat. 1 (1850) 250; WALP. Ann. 2 (1851) 182; MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 36, repr. Contr. Bot. 1 (1852) 86, *non G. macrocarpum* (SCHEFF.) SCHEFF. *ex* WARB. 1891. — *Platea lobbiana* MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 111, repr. Contr. Bot. 1 (1852) 97, t. 17. — *Platea griffithiana* MIERS, *l.c.* 110, repr. *l.c.* 97. — *Lasianthera macrocarpa* (BL.) MIQ. Fl. Ind. Bat. 1 (1856) 792. — *G. gracile* (*non* MIQ.) KURZ, J. As. Soc. Beng. 39, ii (1870) 72; *ibid.* 44, ii (1875) 155; For. Fl. Burma 1 (1877) 240; KING, J. As. Soc. Beng. 64, ii (1895) 120; BRANDIS, Ind. Trees (1906) 152. — *G. griffithianum* (MIERS) KURZ, J. As. Soc. Beng. 44, ii (1875) 155; For. Fl. Burma 1 (1877) 241; PIERRE, Fl. For. Cochinch. (1892) *in obs. sub* t. 268. — *Phlebocalymna lobbiana* (MIERS) MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 590. — *Phlebocalymna griffithiana* (MIERS) MAST. *l.c.*; BRANDIS, Ind. Trees (1906) 152. — *G. wallichii* MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 590. — *G. subrostratum* PIERRE, Fl. For. Cochinch. (1892) t. 268 B; GAGNEP. Fl. Gén I.-C. 1 (1911) 828, f. 97, 5–10; CRAIB, Fl. Siam. En. 1 (1926) 275; GAGNEP. Fl. Gén. I.-C. Suppl. (1948) 755. — *G. harmandianum* PIERRE, Fl. For. Cochinch. (1892) t. 268 A; GAGNEP. Fl. Gén. I.-C. 1 (1911) 829; Suppl. (1948) 755. — *G. siamense* WARB. in Fedde, Rep. 16 (1919) 254. — *G. maclurei* MERR. Philip. J. Sc. 21 (1922) 348; Lingn. J. Sc. 5 (1927) 116; CHUN & HOW, Act. Phytotax. Sin. 7 (1958) 59, f. 5; CHUN & CHANG, Fl. Hainan. 2 (1965) 448, f. 510. — *G. sp.*, CRAIB, Fl. Siam. En. 1 (1926) 275. — *G. poilanei* GAGNEP. Fl. Gén. I.-C.

Suppl. (1948) 755. — *G. pavieanum* GAGNEP. *l.c.* 755, f. 89, 8–9.

Shrub or tree (2–)3–7(–15) m; bark smooth, grey to brown. Branches slender, tips puberulous, glabrescent. *Leaves* oblong to elliptic, sometimes subobovately so, apex shortly (*c.* 1 cm) obtusely and rather suddenly acuminate, base cuneate, rarely almost rounded, slightly inequilateral, coriaceous, glabrous, often somewhat shining above, greyish-greenish-olivaceous in dry specimens, (8–)10–16 by (2.5–)3–8(–11) cm, midrib slightly impressed above, bold below, nerves 4–6(–7) pairs, rather straight-ascending, upper ones looping, a little raised on both faces, veins and veinlets forming a coarse reticulation which is slightly raised or obscure above, mostly indistinct beneath; petiole 1–1.5 cm by *c.* 2 mm. *Inflorescences* axillary, solitary or 2–3(–4) in a cluster, generally rather few-flowered, sparsely appressedly hairy; rachis slender, 0.3–1.5(–3) cm. *Calyx* lobes subovate, blunt, ciliate, 1.5 mm. *Petals* greenish white, connate to a tube in their lower ¾ part, (4–)5–6(–7) by 2 mm in the ♂, and by *c.* 2.5 mm in the ♀ flowers. — ♂ *Flowers*: *Filaments* 3 mm; anther cells oblong-ovate, 1.2–1.5 mm. Rudiment of *ovary* thick-cylindric, sparsely to subdensely hairy, on a broadened almost glabrous subcrenulate *disk*. — ♀ *Flowers* (KERR 5832): *Anther* cells hardly 1 mm. *Ovary* ovoid, rather densely hairy especially at apex; style a little lateral, short; stigma small. *Drupe* in mature state ± oblongoid or ellipsoid, rarely subovoid-oblongoid, ± round in ø, 3–4(–5) by 2–2.7(–3) cm, apex and base roundish or ± attenuate, though apex even shortly apiculate or subrostrate especially in immature or empty drupes, green for a long time, finally becoming bluish-purplish or -blackish, smooth, *i.e.* ribs of the endocarp in the dry fruit merely showing as shallow grooves or low ribs, with one deeper apical lateral groove or flattish part opposite the lateral style rudiment; exocarp spongious-fibrous, 2–3(–4) mm; endocarp hard, 1–1.5 mm. *Seed* whitish, ovoid-acuminate.

Distr. S. China (Hainan), Burma (from Pegu southwards), Thailand, Indo-China; in *Malesia*: Malay Peninsula (Perlis), S. and SE. Borneo.

Ecol. Primary lowland rain-forest or dry evergreen forest, in mixed moist woods, woody ravines, scrub jungle, often near river-banks, rarely up to 1200 m.

Uses. Kernel of drupe bitter, much liked by wild animals, apparently not eaten by natives.

Imperfectly known

10. Gonocaryum melanocarpum HOCHR. Pl. Bog. Exs. (1904) 42, *n.* 87; Bull. Inst. Bot. Btzg 22 (1905) 49; Ann. Jard. Bot. Btzg Suppl. III, 2 (1910) 855; SLEUM. Blumea 17 (1969) 217.

Tree, 6–8 m, with ± conical crown and short trunk *c.* 15 cm ø; bark grey with numerous horizontal small lenticels. Branchlets brownish, glabrous. *Leaves* ovate, shortly subacutely or more bluntly acuminate, base rounded, thin-coriaceous, shining above, greenish-olivaceous when dry, 13–18 by 7–12.5 cm, midrib shallowly depressed above, much prominent beneath, nerves 5–6(–8) curved-ascending pairs, slightly prominent above, more distinctly so beneath, reticulation of veins and veinlets dense, finely raised on both faces especially above; petiole *c.* 1 cm by 2(–3) mm. — ♂ *Inflorescences* not known. — ♀ *Inflorescences* axillary, solitary, spike-like, nodding, flowers 6–10, spaced; rachis slender, practically glabrous, 6–11 cm by 1 mm; pedicels hairy, *c.* 1 mm. *Calyx* lobes ovate, subacuminate, dorsally hairy, ciliate, *c.* 2 mm. *Petals* 5, fleshy, green, glabrous outside, papillose inside, 6 mm, connate about halfway to a subcampanulate tube, lobes spreading. *Staminodes* void of pollen, hardly 1 mm. *Ovary* ovoid, tomentose, 3 mm; stigma large, peltate. *Drupe* ellipsoid, a little flattened on one or two sides, attenuate at both ends, apex subacute, *c.* 6 by 3.2 by 2.8 cm, black at full maturity, with several low longitudinal ribs; abortive loculus absent; exocarp plus endocarp *c.* 2 mm.

Distr. Cultivated in Hort. Bogor, but origin not known; apparently from Malesia.

Note. Certainly related to *G. litorale* in flower characters and the absence of an abortive loculus, though drupes are blackish and the leaves are more similar to those of *G. calleryanum*.

Excluded

Gonocaryum monostachyum K. SCH. & LAUT. Fl. Schutzgeb. (1900) 415; SCHELLENB. Bot. Jahrb. 58 (1923) 166; SLEUM. Blumea 17 (1969) 217.

To guess from the description, the species must be excluded from *Gonocaryum* by its very short (5–6 mm), almost terete petioles, and the very short (2 mm) petals, which besides are hairy inside, characters all absent from the genus so far known. The type specimen, which was collected in New Guinea, Sattelberg area, is apparently lost.

5. GOMPHANDRA

WALL. *ex* LINDL. Nat. Syst. ed. 2 (1836) 439; *em.* BECC. Malesia 1 (1877) 109; SLEUM. Blumea 17 (1969) 189. — *Stemonurus* BL. Bijdr. (1826) 648, *p.p.* — *Platea* (*non* BL.) MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 108, *p.p.* — *Lasianthera* (*non* P. BEAUV.) MIQ. Fl. Ind. Bat. 1 (1856) 790, *p.p.* — **Fig. 10.**

Dioecious trees, rarely shrubs. Branchlets usually slender, smooth, without lenticels. *Leaves* spirally arranged, entire, chartaceous to coriaceous, generally

dark green above and paler beneath in fresh, often olivaceous or brownish, rarely blackish in dry specimens, often tubercled on the undersurface, generally pinnate-, exceptionally tripli-nerved, midrib and nerves often a little sunk above, reticulation generally absent; petiole often somewhat decurrent on branchlet, stoutish. *Flowers* functionally unisexual, articulate with the short, often distally thickened pedicel, in cymes loose to subcapitate, these 2–3(–4)-chotomously arranged on top of a peduncle, normally in the axils of leaves, rarely (also) opposite a leaf, or from defoliate branchlets, generally many-flowered in the ♂, few-flowered in the ♀ specimens; bracts small. *Calyx* cupular, minute, 4–5-toothed to almost entire, subpersistent. *Petals* 4 or 5 (rarely –7), valvate in bud, either remaining united below and forming a cup or distally dilated tube, or free to almost the base, tips inflexed, midrib on the inside rather obscure, caducous. *Disk* 0 or obscure. — ♂ *Flowers*: *Stamens* 4 or 5 (rarely –7), free, often exserted; filaments thick, flattened, dilated upwards, apex attenuate, generally bearing shorter papillose or longer clavate hairs in front below the cells, or (also) on the back or connective; anther cells ovate-elliptic, basifixed, cells slightly or hardly divergent downwards. Rudiment of *ovary* conspicuous. — ♀ *Flowers*: *Calyx* and *petals* as in the ♂ flowers, the petals sometimes absent. *Staminodes* present or absent; filaments linear, hairs shorter and less dense than in the ♂ flowers, cells reduced in size and void of pollen. *Ovary* cylindric; stigma large, thick-discoid, slightly 4- or 5-lobed or -crenate. *Drupe* ± oblongoid or ellipsoid, sometimes shortly attenuate (beaked) distally and slightly swollen (almost apophysate) and a little asymmetrical at base, crowned by the large persistent stigma; pericarp smooth, thin, fleshy or juicy; endocarp crustaceous or hard, smooth or generally with 8–10(–14) longitudinal ridges outstanding especially in the dry fruit. *Seed* 1; embryo minute in the top of the fleshy albumen.

Distr. About 33 *spp.*, of which 6 *spp.* in SE. Asia (SW. India and Ceylon to Burma, Thailand, Indo-China, and S. China incl. Hainan); in *Malesia* 27 *spp.*, one of which extends to the Solomon and St. Cruz Is. Fig. 9.

Ecol. Primary and secondary forest, often as substage trees, both in lowland and in the montane zone up to *c.* 1800 m, occasionally also in mossy forest up to 2200 m (on Mt Kinabalu possibly higher), generally on clayey soil, very rarely limited to peat-swamp forest. *Fl. fr.* Jan.–Dec.

Disp. Many species have a wide range. There is no evidence yet, that the fruits are eaten by animals or of the possibility of buoyancy.

Uses. The wood is whitish-creamy and apparently not durable enough to be generally used; besides, sizes are usually small.

Note. Specific distinction is in the present state far from satisfactory, mainly due to the still rather scarce specimens collected and their incompleteness. Too many species have been described either from ♂ or fruiting specimens only, and their pertaining ♀ flowers or fruits are not yet known. Collectors should care to obtain as complete as possible materials and make ample field notes.

KEY TO THE SPECIES

1. Leaves persistently velutinous or tomentose all over the undersurface, soft to the touch (*cf.* also 5. *G. papuana*).
2. Nerves 2(–3) pairs . . . . . **1. G. fuliginea**
2. Nerves 6–7(–8) pairs . . . . . **2. G. velutina**
1. Leaves covered with scattered hairs underneath, ± glabrescent with age, or glabrous from the beginning.
3. Ovary in ♀ flowers laxly to densely hairy. (Rudiment of ovary in ♂ flowers whether or not hairy).
4. Inflorescence conspicuously head-like, its branches (especially in the ♂ specimens) very short.
5. Leaves elliptic or oblong-, rarely ovate-elliptic, 12–20 by 4–8 cm, nerves 5–6(–7) pairs. Drupe (1.8–)2–2.4 by (0.6–)0.7–0.8 cm . . . . . **3. G. capitulata**
5. Leaves oblong, rarely ovate-lanceolate, 5–8(–9) by 1.5–3 cm, nerves 3–4(–5) pairs. Drupe 1–1.3 by 0.5–0.7 cm . . . . . **4. G. lysipetala**

4. Inflorescence (especially in the ♂ specimens) generally more loose, its branches distinct and divergent
6. Petals hairy in their upper part, 5–7(–10) mm. Rudiment of ovary in the ♂ flowers hairy on top. Drupe 3.5–4 by *c.* 1.5 cm . . . . . **5. G. papuana**
6. Petals glabrous or practically so, rarely up to 5 mm. Drupe much smaller.
7. Both ♂ and ♀ inflorescences many-flowered, cymes together on top of a peduncle, 1.5–2 cm (Rudiment of ovary in the ♂ flowers glabrous). Leaves coriaceous. . . . . **6. G. simalurensis**
7. ♂ Inflorescences rather many-, ♀ ones few-flowered, cymes together on top of a generally rather short peduncle. Leaves chartaceous to coriaceous.
8. Leaves ± laxly covered underneath for a long time with appressed weak hairs, nerves 5–7 pairs.
9. Rudiment of ovary in the ♂ flowers with a tuft of hairs on top. Very base of drupe not swollen. **7. G. cumingiana**
9. Rudiment of ovary in the ♂ flowers glabrous or practically so. Base of drupe swollen to almost apophysate for *c.* 1 mm . . . . . **8. G. pseudojavanica**
8. Leaves practically glabrous from the beginning. (Rudiment of ovary in the ♂ flowers glabrous).
10. Leaves with (5–)6–8 pairs of nerves. Base of drupe not swollen . . . . . **9. G. javanica**
10. Leaves with 8–10 pairs of nerves. Base of drupe distinctly swollen . . . **10. G. fusiformis**
3. Ovary (and rudiment of ovary in the ♂ flowers) glabrous or practically so.
11. Filaments glabrous or practically so.
12. Filaments widened upwards and relatively short, *i.e. c.* 2 times as long as are the anther cells. **11. G. australiana**
12. Filaments elongate-linear, at least 3 times as long as are the anther cells . . . . **12. G. pallida**
11. Filaments ventrally and/or dorsally hairy.
13. Filaments with short-clavate or papillose hairs, these never surpassing the anther cell.
14. Drupe (1.6–)1.8–2(–2.2) by 0.8–1 cm . . . . . **13. G. mappioides**
14. Drupe as far as known 1.3–1.6 by 0.5–0.6 cm.
15. Leaves practically glabrous. Calyx ± obconical, entire, glabrous . . . . . **14. G. apoensis**
15. Leaves ± densely short-pubescent all over the undersurface, especially at midrib and nerves. Calyx cup-shaped, dented, hairy . . . . . **15. G. flavicarpa**
13. Filaments with elongate-clavate ('glandular') or penicillate hairs (those from the connective often surpassing the anther cell).
16. Inflorescence very lax, peduncle and branches elongate, slender and rather few-flowered both in ♂ and ♀ specimens . . . . . **16. G. oligantha**
16. Inflorescence lax to dense, peduncle and branches relatively short at least in the ♂ specimens, generally many-, rarely few-flowered.
17. Petals ± densely appressedly hairy outside . . . . . **17. G. sawiensis**
17. Petals sparsely hairy on top (in bud), or glabrous.
18. Drupe (2–)2.5–3(–4) cm long.
19. Inflorescence rather compact, umbelliform. Drupe fusiform, 3.5–4 by 0.5–0.6 mm ø. **18. G. dolichocarpa**
19. Inflorescence rather lax. Drupe obovoid-oblongoid-ellipsoid, at least 0.8 cm ø.
20. Leaves narrow-lanceolate, chartaceous to subcoriaceous, nerves 3(–4) pairs. **19. G. lancifolia**
20. Leaves (obovate-) elliptoc to oblong or lanceolate-oblong, ± coriaceous, nerves 4 or more pairs.
21. Leaves elliptic to obovate-elliptic . . . . . **20. G. luzoniensis**
21. Leaves elliptic- to lanceolate-oblong . . . . . **21. G. montana**
18. Drupe as far as known 1–2 (rarely –2.2) cm long.
22. Inflorescence (at least in the ♂ specimens) rather compact, ± umbelliform, on peduncle up to 5 mm. Leaves ± chartaceous, nerves (8–)10–12(–14) pairs. Very base of drupe swollen and smooth . . . . . **22. G. parviflora**
22. Inflorescence (at least in the ♂ specimens) with more laxly arranged and diverging branches, generally on peduncle longer than 5 mm.
23. Drupe ovoid- to oblong-ellipsoid, base generally swollen. Inflorescences (at least in the ♂ specimens) much-branched, generally many-flowered and distinctly scorpioid (*i.e.* flowers arranged on one side), rarely with fewer flowers and rather obscurely scorpioid then.
24. Leaves dark to blackish brown in dry state, and rufous- to rusty-tomentellous on midrib and nerves beneath, as are the branchlets. . . . . **23. G. subrostrata**
24. Leaves green to greenish-brownish in dry state, and practically glabrous beneath, as are the branchlets. . . . . **24. G. quadrifida**
23. Drupe as far as known in mature state, oblongoid-ellipsoid, base broadly attenuate and not swollen. Inflorescences never scorpioid.
25. Leaves brittle and blackish in dry specimens, nerves and veins ± obscure on both faces. Inflorescence with red-brown hairs. . . . . **25. G. schoepfiifolia**
25. Leaves greenish-brownish and generally not brittle in dry specimens, with a finely impressed reticulation above in fully mature state. . . . . **26. G. pseudoprasina**

1. Gomphandra fuliginea (ELM.) MERR. En. Philip.2 (1923) 490; SLEUM. Blumea 17 (1969) 192. — *Urandra fuliginea* ELM. Leafl. Philip. Bot. 2 (1908) 491. — *Stemonurus fuligineus* (ELM.) HOWARD, J. Arn. Arb. 21 (1940) 468.

Shrub or small tree. Branchlets with brownish-velutinous tips. *Leaves* lanceolate- to obovate-elliptic, apex shortly obliquely acuminate, tip bluntish, base attenuate and a little decurrent on the petiole, slightly inequilateral, subcoriaceous, lucid and glabrous above, evenly short fuligineous-pubescent and soft to the touch beneath, 7–12(–14) by 2.5–5 cm, nerves 2 or 3 steeply ascending pairs, the lowest pair from a little above the base, other pairs distant, slightly raised beneath; petiole pubescent, 6–10 by 1.5–2 mm. *Flowers* unknown. *Infructescence* pubescent, on 1 cm long peduncle, which bears 2 or 3 branches (3 mm). *Drupe* ± ellipsoid, slightly oblique, with 12–15 low ridges of the hard endocarp, 1.7–2 by 0.9–1.2 cm.

Distr. *Malesia*: Philippines (N. Luzon: Benguet).

Ecol. In thickets, 1400–1700 m.

Vern. *Danka*, Ig.

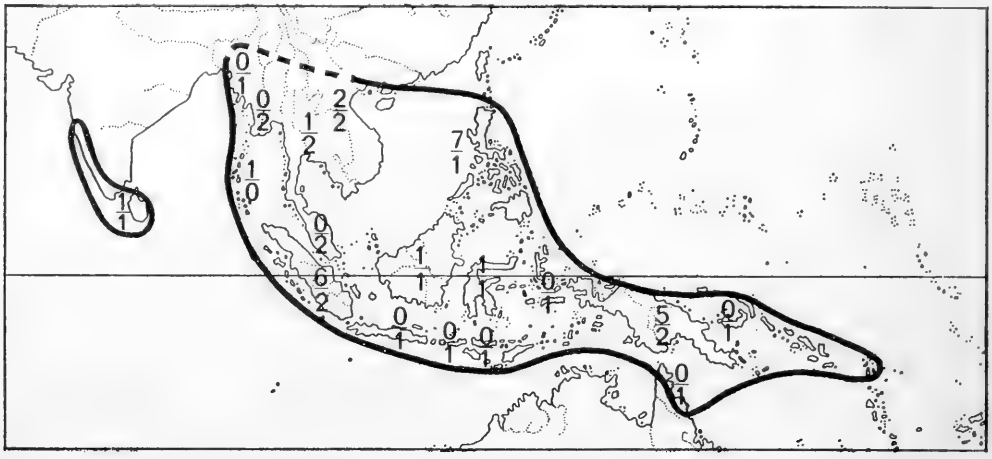

Fig. 9. Distribution of *Gomphandra*. The figure above the hyphen indicates the number of endemic species in the island or area, the figure below the hyphen the number of non-endemic species.

2. Gomphandra velutina SLEUM. Blumea 17 (1969) 192.

Tree *c.* 10 m. Branchlets fulvous-velutinous. *Leaves* lanceolate to oblong, apex shortly acutely acuminate, base cuneate, chartaceous, glabrous above, fulvous- or ferrugineous-velutinous all over beneath, dark brown in dry state, 12–17 by (3–)4–6 cm, nerves 6–7(–8) curved pairs, slightly raised beneath; petiole velutinous, 8–13 by 1.5 mm. — ♂ *Flowers* in *c.* 15-flowered peduncled (5 mm) heads composed of several abbreviate cymes, fulvous-tomentellous, the lower ⅔ of the petals excepted. *Calyx* cupular, 2.5 mm. *Petals* 5, forming a campanulate tube which slits irregularly, 4.5–5.5 mm. *Stamens* 5, hardly exserted; filaments bearded below the anther cells on the inside and dorsally at connective. Rudiment of *ovary* with erect hairs. — ♀ *Flowers*: *Calyx* and *petals* as in ♂ flowers. *Filaments* bearded distally only. *Ovary* short-tomentose. *Drupe* unknown.

Distr. *Malesia*: Central E. Celebes (Porema at base of Mt Mengkoka), one collection.

Ecol. Rain-forest, 1200 m.

3. Gomphandra capitulata (JUNGH. & DE VRIESE) BECC. Malesia 1 (1877) 111; SLEUM. Blumea 17 (1969) 193. — *Aralia capitulata* JUNGH. & DE VRIESE, Ned. Kruidk. Arch. 1 (1846) 17. — *Lasianthera capitulata* (JUNGH. & DE VRIESE) MIQ. Fl. Ind. Bat. 1 (1856) 791; Suppl. 1 (1860) 137; WARB. Pflanzenwelt 2 (1916) 349, f. 231 B, 1–4. — *Stemonurus capitulatus* (JUNGH. & DE VRIESE) O. KTZE, Rev. Gen. Pl. 1 (1891) 112. — *G. nyssifolia* KING, J. As. Soc. Beng. 64, ii (1895) 114; RIDL. Fl. Mal. Pen. 1 (1922) 427; BAKER *f.* J. Bot. 62 (1924) Suppl. 21. — *Nyssa sessiliflora* (*non* HOOK.) KOORD. Pl. Jungh. ined. *n.* 57, *cf.* HALL. *f.* Med. Rijksherb. 1 (1910) 13. — *Stemonurus nyssifolius* (KING) HOWARD, J. Arn. Arb. 21 (1940) 468.

Tree, 5–20(–28) m, up to 40 cm ø. Branchlets slightly winged below the insertion of the petioles, tips puberulous. *Leaves* elliptic or oblong-, rarely ovate-elliptic, apex shortly subabruptly and acutely acuminate, base cuneate, the very base folded and decurrent to the grooved petiole, subcoriaceous to firmly chartaceous, dark olive-brownish and the edge slightly revolute in dry specimens, glabrous, 12–20 by 4–8 cm, nerves 5–6(–7) pairs rather straight-ascending, much paler than the lamina in dry specimens beneath, transverse veins distinct beneath; petiole 7–12 by 1.5–2 mm. *Inflorescences* all over short-pubescent, on top of a slender peduncle (1–2 cm), consisting of several short cymes

crowded into a kind of head or umbel, which bear up to 15 flowers in the ♂, up to 7 flowers in the ♀ ones. — ♂ *Flower*: *Calyx* cupular, ciliate, 1 mm. *Petals* 5, coherent to a narrow tube, whitish, laxly hairy distally only, *c.* 4 mm. *Stamens* 5, much exserted; filaments long-hairy in the upper half below the anther cells on the ventral side only. Rudiment of *ovary* short-hairy. — ♀ *Flower*: *Calyx* and *petals* as in ♂ flowers. *Staminodes* 5, hairy. *Ovary* short-hairy except the glabrous base. *Drupe* ellipsoid-oblongoid, apex shortly attenuate, slightly or not curved, the very base swollen and smooth, whilst the endocarp shows numerous outstanding ridges above, (1.8–)2–2.4 by (0.6–) 0.7–0.8 cm; exocarp pale pink or greenish-white.

Distr. *Malesia*: Sumatra (incl. Simalur I.), Malay Peninsula (Perak, Pahang).

Ecol. Forest, in Sumatra at 150–915 m, in the Malay Peninsula at 1065–1370 m.

Vern. Sumatra: *simarsimata*, Batak; Simalur: *awa suki*, *pului*, *p. pajo*, *samsam dotan*, *surin uding*, *tutun ansan dĕlok*, M.

4. Gomphandra lysipetala STAPF, Trans. Linn. Soc. II, Bot. 4 (1894) 139; SLEUM. Blumea 17 (1969) 194. — *Stemonurus lysipetalus* (STAPF) MERR. En. Born. (1921) 356.

Tree up to 30 m high, trunk up to 45 cm ø; bark dark grey. *Leaves* oblong, or sometimes more ovate-lanceolate, apex shortly obtusely attenuate or subacuminate, base ± abruptly narrowed to the grooved petiole, (sub)coriaceous, glabrous at maturity, dark brown when dry, 5–8(–9) by 1.5–3 cm, nerves 3–4(–5) curved-ascendent pairs, slightly raised beneath; petiole 7–10(–12) by *c.* 1 mm. — ♂ *Cymes* 2 or 3, very shortly peduncled, all condensed into a head-like or subumbellate inflorescence on top of a slender peduncle (5–10 mm). *Calyx* cup-shaped, minutely 5-dented, hardly 1 mm. *Petals* 5, becoming free from each other both from top and base at the same time, whitish-greyish, *c.* 3 mm. *Stamens* 5, hardly exserted; filaments with numerous short-papillose hairs in the middle of the ventral, glabrous on the dorsal side. Rudiment of *ovary* laxly hairy. — ♀ *Cymes* similarly arranged, though few-flowered. *Calyx* and *petals* as in ♂ flowers. *Staminodes* with numerous papillose hairs in front. *Ovary* densely set with whitish short hairs. *Drupe* ellipsoid-oblongoid, apex (sometimes a little oblique) and base gradually attenuate, 1–1.3 by 0.5–0.7 cm; exocarp thin-fleshy, cream; endocarp with several longitudinal shallow ridges.

Distr. *Malesia*: Borneo (Mt Kinabalu area).

Ecol. Primary and secondary forest, on slopes, 1220–1830 m.

5. Gomphandra papuana (BECC.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 238; SLEUM. Blumea 17 (1969) 194. — *Lasianthera litoralis* (*non* MIQ.) F. v. M. Descr. Not. 2 (1877) 53. — *Platea papuana* BECC. Malesia 1 (1883) 257; VALET. Crit. Overz. Olacin. (1886) 254. — *Stemonurus puberulus* K. SCH. & LAUT. Fl. Schutzgeb. (1900) 414. — *Stemonurus zygomorphus* PULLE, Nova Guinea 8 (1912) 658; SCHELLENB. Bot. Jahrb. 58 (1923) 162. — *Stemonurus papuanus* (BECC.) SCHELLENB. *l.c.* 161. — *G. zygomorpha* (PULLE) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 239.

Tree, 5–10(–30) m, up to 20 cm ø; bark smooth, mottled grey-brown. Branchlets short-pubescent to tomentulose distally, glabrate below, pith hollow. *Leaves* elliptic to oblong-, rarely subovate-elliptic, apex generally shortly, rather abruptly and often obliquely acuminate, base cuneate, rarely almost rounded, stiff-chartaceous or subcoriaceous, greyish-green to pale olivaceous-brownish in the dry state, early glabrescent above, ± persistently covered with numerous short hairs and rather soft to the touch all over beneath, finally partly glabrescent there, 15–25 by (5–)6–11.5 cm, nerves 5–7(–8) curved-ascending and beneath somewhat prominent pairs, transverse veins subparallel to and distant from each other, slightly raised beneath, reticulation obsolete; petiole deeply grooved above, glabrescent, 10–12 by 2(–3) mm. — ♂ *Inflorescences* consisting of 2 or 3 short-branched 2–5-flowered cymes on top of a common peduncle (3–6 by 1 mm), all over densely covered with appressed ferrugineous hairs, the lower part of the petals excepted. *Calyx* cup-shaped, green, 4(–5)-denticulate, 2 by 3 mm. *Petals* 4 or 5 (rarely –7), coherent in the lower ⅔, though partially free from each other by 1 or 2 slits, thickish, greenish to white, 5–7 mm. *Stamens* 5(–7), much exserted; filaments densely hairy both in front below the anther cells (1 mm) and dorsally on connective. Rudiment of *ovary* with erect hairs on top. — ♀ *Inflorescences* 2–3-flowered, together on 3–5 mm long peduncle. *Calyx* and *petals* (7–10 mm) as in ♂ flowers. *Staminodes* slightly exserted. *Ovary* ± laxly appressedly hairy. *Drupe* obovoid-oblongoid, strongly beaked in immature, much less so in mature state, yellow, 3.5–4 by *c.* 1.5 cm, somewhat hairy distally only; endocarp rather thin, with *c.* 8 obtuse longitudinal ridges.

Distr. *Malesia*: New Guinea.

Ecol. Primary and secondary forest, also on flooded plains, 25–450 m, locally common in undergrowth.

Vern. *Assúei*, Astrolabe Bay area, *behwah*, *sinagapa*, Orokaiva (Mumuni), *numinti*, Rawa, *sisinam*, Koropa.

6. Gomphandra simalurensis SLEUM. Blumea 17 (1969) 194.

Tree, 13–25 m. Branchlets robust, tips laxly appressedly hairy. *Leaves* elliptic, sometimes subobovate-elliptic, apex shortly and bluntly acuminate, base cuneate and a little decurrent on the petiole, coriaceous, dark brown when dry, glabrous at full age, 10–17(–21) by (4–)4.5–9(–11) cm, nerves 5–6(–7) pairs, lower ones rather straight, upper ones more curved-ascendent, almost flat above, raised beneath, transverse veins rather obscure beneath; petiole 1–1.8(–2.3) by *c.* 2.5 mm. ♂ & ♀ *Inflorescences* consisting of 3–5 many-flowered cymes collected on top of a rather slender peduncle (1.5–2 cm), pale rusty-tomentellous except the petals. — ♂ *Flowers*: *Calyx* cupular, 4–5-dented, sparsely pubescent, ciliate, 1

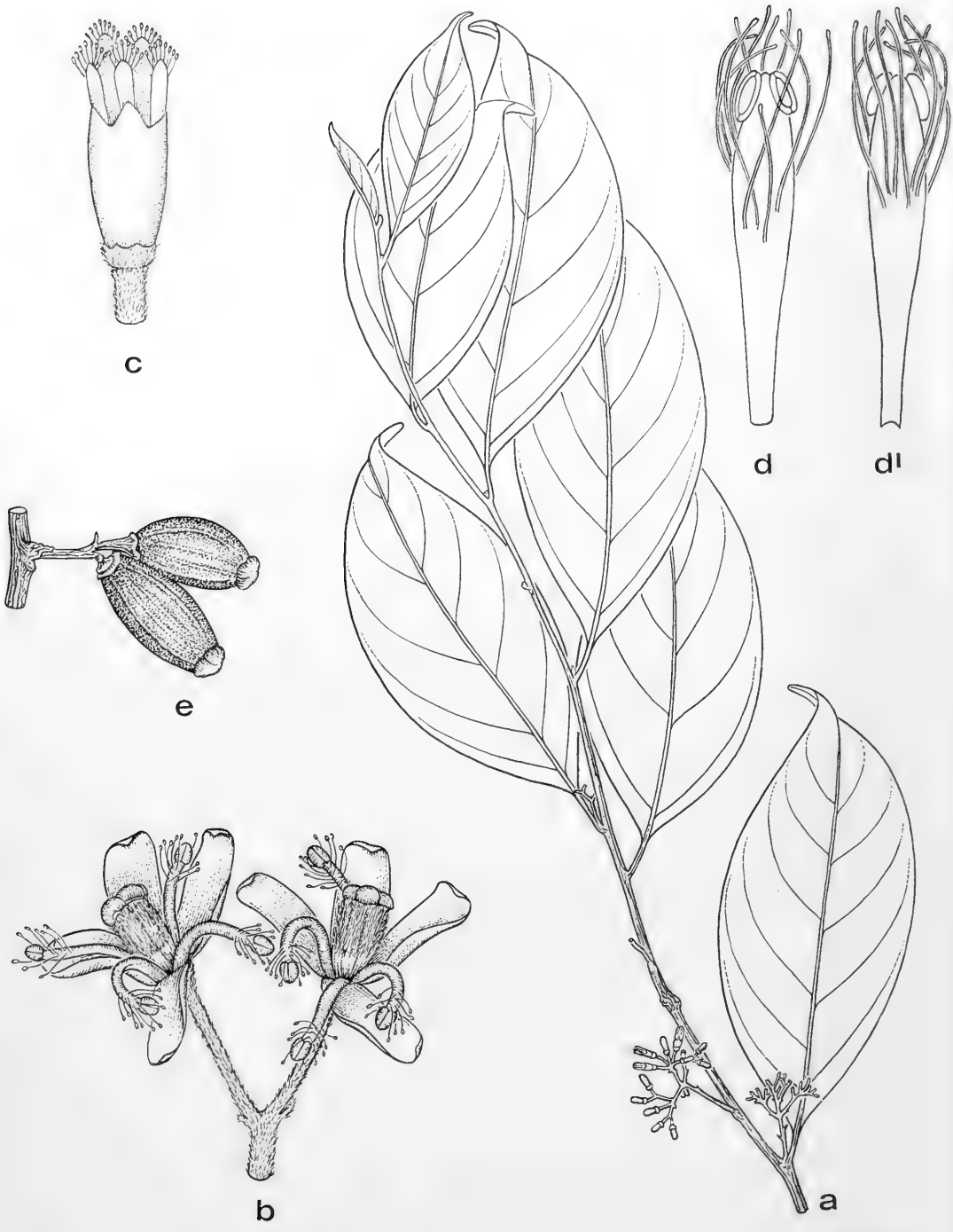

Fig. 10. *Gomphandra javanica* (BL.) VALET. *a.* Habit, with ♂ inflorescence, ×½, *b.* ♀ inflorescence, ×3½, *c.* ♂ flower, ×5, *d.* stamen, ventral side, ×10, *d'. ditto*, dorsal side, ×10, *e.* drupe, ×1 (*a*, *c–d* KOSTERMANS & VAN WOERDEN 128, *b* WINCKEL 336, *e* JACOBS 4797).

mm. *Petals* 4 or 5, white or greenish, still connate at anthesis to a 4- or 5-lobed distally dilated tube, 4.5 mm. *Stamens* 4 or 5, much exserted; filaments laxly set with elongate-clavate hairs ventrally below the anther cells, and penicillate dorsally at connective. Rudiment of *ovary* glabrous. — ♀ *Flowers*: *Calyx* and *petals* as in ♂ flowers. *Staminodes* present. *Ovary* glabrous at the very base, otherwise densely set with forward directed hairs. *Drupe* oblongoid, a little oblique, slightly rostrate, pale yellow, 1.6–1.8(–2) by 0.7–0.8 cm; endocarp longitudinally 10–12-costulate.

Distr. *Malesia*: Simalur I. (off the coast of NW. Sumatra).

Ecol. Primary lowland forest.

Vern. *Bajut uding*, *rubi silai*, *tutun bahuhu alafai*, *t. b. dělok*, *t. b. dotan*, *t. b. uding*, M.

7. Gomphandra cumingiana (MIERS) F.-VILL. Nov. App. (1880) 46; VIDAL, Phan. Cuming. Philip. (1885) 102; Rev. Pl. Vasc. Filip. (1886) 86; VALET. Crit. Overz. Olacin. (1886) 229; MERR. En. Philip. 2 (1923) 490; SLEUM. Blumea 17 (1969) 194. — *Stemonurus cumingianus* MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 42, repr. Contr. Bot. 1 (1852) 92; O. KTZE, Rev. Gen. Pl. 1 (1891) 112; DAHL, J. Arn. Arb. 33 (1952) 268, f. 50 & 50 A (pollen). — *Stemonurus agusanensis* ELM. Leafl. Philip. Bot. 7 (1915) 2689. — *G. agusanensis* (ELM.) MERR. En. Philip. 2 (1923) 489.

Tree (3–)5–15 m, up to 30 cm ø; bark smooth, yellowish-brown. Branchlets flexuous, tips rusty-tomentellous. *Leaves* oblong to ovate- or elliptic-, rarely subobovate-oblong, apex shortly rather abruptly and sometimes obliquely acuminate, tip blunt, base broadly attenuate, slightly inequilateral, very base ± abruptly narrowed to the petiole, membranous to chartaceous, dark brown above, much paler beneath when dry, dull, glabrous above, the midrib and nerves excepted, undersurface all over set with scattered short ± appressed soft fine hairs, more densely so at midrib and nerves, (7.5–)9–16(–24) by 5–8(–10) cm, nerves in 5–7 generally strictly, or rarely more curvedly ascending pairs, slightly raised beneath, cross veins faintly prominent beneath; petiole puberulent, 1–1.5 cm by *c.* 1.5 mm. — ♂ *Inflorescences* composed of several divaricate few-flowered cymes, together on top of slender peduncle (0.5–1.5 cm), all over rusty-puberulent, the petals excepted. *Calyx* cup-shaped, hardly dented, ciliate, 1 mm. *Petals* (4–)5, connate to a tube for their lower ⅔, glabrous except some hairs on top in bud stage, yellowish-white, (4–)5 mm. *Stamens* 5, exserted; filaments with numerous club-shaped hairs ventrally below the anther cells and penicillate dorsally at connective. Rudiment of *ovary* with erect hairs on top. — ♀ *Inflorescences* more lax-flowered. *Calyx* and *petals* as in ♂ flowers. *Staminodes* (4–)5, penicillate. *Ovary* ferrugineous-tomentellous. *Drupe* subovoid-oblongoid, either equally attenuate on both ends, or generally slightly beaked distally, still laxly pubescent for quite a while, (1.3–)1.5–1.7 (rarely –2) by 0.7–0.8 cm; whitish-yellowish, pinkish or salmon-coloured; endocarp with 10–12 shallow longitudinal ribs.

Distr. *Malesia*: Borneo, Philippines.

Ecol. Primary (also mixed Dipterocarp) forest at low and medium altitude, in the Mt Kinabalu area up to 1525 m.

Vern. Philippines: *Baróbo*, Mang., *bayanotan*, S. L. Bis., *lambuan*, Mbo., *lipid*, Sul., *mañgoi*, Bik.

8. Gomphandra pseudojavanica SLEUM. Blumea 17 (1969) 195.

Tree 4–15 m. Branchlets puberulous at tips. *Leaves* oblong-elliptic, apex ± abruptly acuminate for 1–2 cm, tip bluntish, base broadly attenuate, subcoriaceous, olivaceous-brown above, paler beneath in dry state, glabrous above, sparsely set with short hairs initially, more laxly so or at the lower part of the midrib only at maturity and minutely tubercled beneath, (8–)10–16 by (4–)4.5–8(–10) cm, nerves 5–6(–7) pairs, curved-ascendent, distinctly looping before the edge, slightly raised beneath; petiole puberulous initially, 1–1.5(–2) cm by 1.5–2 mm. — ♂ *Inflorescences* composed of 3 or 4 divergent, rather dense flowered cymes together on top of a slender peduncle (0.5–1.3 cm), short-hairy on peduncle and branches. *Calyx* cup-shaped, minutely 5-dented, tube glabrous, hardly 1 mm. *Petals* connate in a distally widened and shortly 5-lobed tube, whitish-greenish, glabrous, *c.* 3.5 mm. *Stamens* 5, exserted for *c.* 1 mm; filaments laxly penicillate below the anther cells ventrally and at connective dorsally. Rudiment of *ovary* glabrous or practically so. — ♀ *Inflorescences* not known. Immature infructescences 1–3-flowered, peduncle *c.* 5 mm, pedicels (branches of the reduced cyme) 3–5 mm. Developed *ovary* densely appressedly hairy. *Drupe* ellipsoid-oblongoid, a little curved, shortly and rather narrowly attenuate at apex, more broadly so at base, very base swollen or subapophysate for *c.* 1 mm, 1.7–1.9 by 0.6–0.7 cm, whitish; exocarp with few and rather low longitudinal ridges.

Distr. *Malesia*: Simalur I. (off the coast of NW. Sumatra).

Ecol. Primary lowland forest.

Vern. *Ansan dělok*, *a. d. uding*, *bajut uding*, *bělujan ètěm*, *pului silai*, *sosot manu*, *surimanu uding*, *tutun surimanu dělok*, M.

9. Gomphandra javanica (BL.) VALET. Crit. Overz. Olacin. (1886) 217, t. 4, f. 1–9c, t. 5, f. 23a, t. 6, f. 46; K. & V. Bijdr. 5 (1900) 150; HOCHR. Bull. Inst. Bot. Btzg 22 (1905) 42; MOLL & JANSS. Mikr. 2 (1908) 238, f. 106 (wood-anat.); BACK. Schoolfl. Java (1911) 225; KOORD. Exk. Fl. Java 2 (1912) 531; KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 3; KOORD. Atlas 1 (1913) t. 116; DOCT. v. LEEUWEN, Zoocecidia (1926) 332, f. 597 (galls); AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 4; BACK. & BAKH. *f.* Fl. Java 2 (1965) 60; SLEUM. Blumea 17 (1969) 196. — *Stemonurus javanicus* BL. Bijdr. (1826)) 649, *incl. var.*; WALP. Rep. 1 (1842) 378; HASSK. Cat. Hort. Bog. (1844) 214; MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 36, repr. Contr. Bot. 1 (1852) 86, *incl. var.*; DAHL, J. Arn. Arb. 33 (1952) 268 (pollen).

— *Stemonurus pauciflorus* BL. Bijdr. (1826) 648; WALP. Rep. 1 (1842) 378; MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 35, repr. Contr. Bot. 1 (1852) 86. — *Lasianthera javanica* (BL.) MIQ. Fl. Ind. Bat. 1 (1856) 790, *incl. var. pauciflora* (BL.) MIQ. *l.c.* 791; Suppl. 1 (1860) 137. — *G. javanica* (BL.) VALET. *var. lanceolata* K. & V. Bijdr. 5 (1900) 151; HOCHR. Pl. Bog. Exs. (1904) 41; Bull. Inst. Bot. Btzg 22 (1905) 42; MOLL & JANSS. Mikr. 2 (1908) 243 (wood-anat.); KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 4. — *G. javanica* (BL.) VALET. *var. dolichocarpa* K. & V. Bijdr. 5 (1900) 151; MOLL & JANSS. Mikr. 2 (1908) 243 (wood-anat.); KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 4. — *G. comosa* (*non* KING) BAKER *f.* J. Bot. 62 (1924) Suppl. 21. — **Fig. 10.**

Tree, (3–)5–15 m, suberect, rarely up to 40 cm ø; bark olive green. Branchlets appressedly puberulous at tips as are the petioles and may be the young leaves. *Leaves* variable in form and size, generally elliptic to oblong, sometimes obovate-elliptic or lanceolate, apex shortly acuminate to subcaudate, base ± acutely attenuate, subcoriaceous, shining, glabrous or very early so, 5–12(–16) by 2.5–6.5 cm, nerves (5–)6–8 pairs, lower ones more erect, upper ones more spreading and mostly rather straight from the midrib, ± obscurely inarching before the edge, moderately raised beneath, veins lax, generally obsolete; petiole 8–15 by 1–1.5 mm. — ♂ *Inflorescences* consisting of 2–3-chotomously arranged cymes, (5–)10–15-flowered, finely pubescent, on common slender peduncle 0.5–1.5 cm. *Calyx* cupular-patelliform, minutely 4–5-dented, puberulous, 1 mm. *Petals* connate to a distally widened tube, free in the upper third, a little fragrant, light green, glabrous, 4–5 mm. *Stamens* 4 or 5, a little exserted; filaments long-hairy below the anther cells ventrally, and more laxly so at connective dorsally. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* 2–3-chotomous, 3–5-flowered. *Calyx* and *petals* as in the ♂ flowers. *Staminodes* 5, hairy mainly on the ventral side below the anther cells. *Ovary* ± densely appressed-pubescent. *Drupe* narrowly to broadly ellipsoid, rather variable, gradually or more abruptly narrowed at both ends, 1.5–2 by 0.6–0.8 cm in dry state, said to measure 1.7–2 by 1–1.5 cm in fresh state; exocarp fleshy, milky-white, almost vanishing at full maturity; endocarp fibrous, longitudinal ribs numerous, low.

Distr. *Malesia*: Java and Lesser Sunda Is. (Bali, Lombok).

Ecol. Primary and secondary forest, scattered in the lowland, more frequent in montane forest, (50–)600–1200(–1700) m.

Vern. *Baröböj, harèndeuj, ki johonn, ki sèkèl, ki tangkil, mitongèrrèt*, S, *djirak ireng*, J, *tès katèsan*, Mad.

10. Gomphandra fusiformis SLEUM. Blumea 17 (1969) 196.

Treelet, 3 m, stem 2–4 cm ø. Branchlets very slender, tips shortly fuscous-hairy. *Leaves* oblong, apex per 1–2 cm subabruptly and narrowly acuminate (tip often curved and bluntish), base cuneate, chartaceous, lead-coloured greenish, but slightly brownish, dull, glabrous, 8–13 by 2.5–3.5 cm, nerves 8–10 pairs, lowest pair slightly suprabasal and high curved-ascendent, upper pairs from the midrib in a wider angle, more straight and looping, forming an intramarginal nerve with the basal pair, hardly raised beneath; petiole 6–10 by *c.* 1 mm. — ♂ *Inflorescences* consisting of 1 or 2 few-flowered cymes, together on top of a slender peduncle (1 cm), very shortly pubescent. *Calyx* cupular, minutely 4-dented, ciliate, 1 mm. *Petals* connate for their lower ¾ part into a distally widened tube, glabrous, white, 3.5 mm. *Stamens* 4, shortly exserted; filaments penicillate on upper ventral side. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* reduced to a few-flowered, almost umbelliform and shortly peduncled cyme. *Calyx* and *petals* as in ♂ flowers. *Staminodes* 4, laxly penicillate. *Ovary* densely shortly rusty-pubescent, the glabrous very base excepted. *Drupe* fusiform, subabruptly rostrate-attenuate at apex, more gradually so at base, very base somewhat cupuliform-inflated and quite smooth, whilst above the endocarp shows several longitudinal low ridges, (2–)2.3–2.5 by 0.6–0.7 cm.

Distr. *Malesia*: Central W. Sumatra (Mt Sago near Pajakumbuh).

Ecol. Forest, 900–1200 m.

11. Gomphandra australiana F. v. M. Fragm. Phyt. Austr. 6 (1867) 3; VALET. Crit. Overz. Olacin. (1886) 226, t. 4, f. 20 a–h, t. 5, f. 23b; F. M. BAILEY, Compr. Cat. Q. Pl. (1913) 93; C. T. WHITE, Proc. R. Soc. Queensl. 53 (1942) 212; SLEUM. Blumea 17 (1969) 197. — *G. axillaris* (*non* WALL.) BECC. Malesia 1 (1877) 110, *pr. specim. papuan.*: t. 4, f. 8–13. — *Stemonurus australianus* (F. v. M.) O. KTZE, Rev. Gen. Pl. 1 (1891) 112. — *G. polymorpha* (*non* WIGHT) F. M. BAILEY, Bot. Bull. Queensl. Dep. Agr. Brisbane 8 (1893) 71; Compr. Cat. Q. Pl. (1913) 93. — *Stemonurus ramuensis* LAUT. in K. Sch. & Laut. Nachtr. (1905) 305; SCHELLENB. Bot. Jahrb. 58 (1923) 163; BIRNIE, Nova Guinea 14, 2 (1926) 275. — ? *Stemonurus viridis* SCHELLENB. Bot. Jahrb. 58 (1923) 163. — *G. ramuensis* (SCHELLENB.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 238. — ? *G. viridis* (SCHELLENB.) SLEUM. *l.c.* 239.

Tree, 6–25 m, sometimes with buttresses up to 3 m high. Branchlets generally quite glabrous. *Leaves* oblong- to ovate-elliptic, apex shortly, bluntly and gradually, more rarely ± abruptly acuminate, base broadly cuneate to almost rounded slightly inequilateral, coriaceous, practically glabrous, (6–)10–17(–20) by 5–7(–8) cm, dull greenish-olivaceous when dry, the undersurface often minutely tubercled, nerves (4–)5–6 curved-ascending pairs, hardly depressed above, slightly prominent beneath, veins lax, rather obscure; petiole (0.7–)1–1.5 cm by 1.5–2 mm. — ♂ *Inflorescences* consisting of 2 or 3 divaricate (3–)5–7-flowered cymes, together on peduncle 0.5–1 cm, covered with short substrigose hairs, the petals excepted. *Calyx* cup-shaped, hardly dented, 1–1.3 mm. *Petals* white

or greenish, coherent in the lower ⅔ for a long time into a narrow-campanulate tube 2.5–3 mm. *Stamens* hardly or not exserted; filaments widened upwards, 2–2.3 mm, glabrous; anther cells 1 mm. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* with 2–4 flowers on top of slender peduncle (*c.* 1 cm). *Calyx* and *petals* as in ♂ flowers. *Staminodes* present. *Ovary* glabrous. *Drupe* ellipsoid, obtuse at both ends, pale reddish, with 12–15 rather marked longitudinal ridges down to the very base, 1.8–2 (–2.3) by 1–1.2 cm.

Distr. Australia (North Queensland); in *Malesia*: Kai Is. and New Guinea.

Ecol. Primary forest, scattered from the lowland up to 500 m.

12. Gomphandra pallida SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 238; Blumea 17 (1969) 197. — *Stemonurus gracilis* SCHELLENB. Bot. Jahrb. 58 (1923) 164, *non G. gracilis* KING, 1895.

Shrub or treelet, 5–7 m. Branchlets quite glabrous. *Leaves* oblong-elliptic or elliptic, apex subabruptly acuminate for 1–2 cm, base broadly cuneate, slightly inequilateral, subcoriaceous or firmly chartaceous, glabrous, dull olivaceous in dry state, minutely tubercled beneath, 8–18 by (3.5–)4–6(–7) cm, nerves 4–5(–6) curved-ascendent pairs, a little raised beneath only, veins and veinlets faintly prominent-reticulate in fully mature leaves; petiole 1–1.5 cm by 1–1.5 mm. — ♂ *Inflorescences* with 2 or 3 few-flowered cymes together on top of slender peduncle (0.5–1 cm), very shortly pubescent, the petals excepted. *Calyx* cup-shaped, hardly dented, 0.5 mm. *Petals* 5, thin, white, connate in the lower ⅔ to a slightly dilated tube, 3.5 mm. *Stamens* 5, widely exserted; filaments elongate-linear, glabrous, 4.5 mm; anther cells 0.5 mm. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* few-flowered; flowers unknown. Juvenile *drupe* glabrous.

Distr. *Malesia*: New Guinea (Sepik Distr.), twice found.

Ecol. Swampy alluvial forest, 20–50 m.

13. Gomphandra mappioides VALET. Crit. Overz. Olacin. (1886) 227, f. 21, a–f; SLEUM. Blumea 17 (1969) 198. — *Stemonurus mappioides* (VALET.) O. KTZE, Rev. Gen. Pl. 1 (1891) 112. — *G. australiana* F. v. M. *var. celebica* VALET. in Koord. Minah. (1898) 392; Ic. Bog. 1 (1908) t. 89; HOLTH. & LAM, Blumea 5 (1942) 205. — *G.* ? *javanica* [*non* (BL.) VALET.] HOLTH. & LAM *l.c.* 205.

Tree, up to 25 m, up to 45 cm ø; bark olive green. Branchlets appressedly puberulous in their younger parts, as are petioles and inflorescences. *Leaves* lanceolate to oblong-lanceolate or elliptic, rarely oblong-elliptic, apex attenuate-acuminate, tip acutish, base ± broadly narrowed, firmly subcoriaceous, dark olivaceous and a little shining above, paler, more brownish and dull beneath in dry specimens, glabrous above, shortly appressedly hairy all over the undersurface initially, finally glabrescent there, the midrib excepted, finely tubercled underneath, (10–)12–16 by (2.5–)3–4.5(–8) cm, nerves 4–6(–8) spreading to rather steeply ascendent pairs, obscurely inarching before the edge, reticulation obsolete; petiole 1–1.5 cm by *c.* 1 mm. — ♂ *Inflorescences* with (2–)3 or 4 cymes together on top of slender peduncle (1–2 cm), each cyme expanded and ± recurved, dense flowered, very shortly branched distally, the flowers rather laxly arranged. *Calyx* widely cup-shaped, subtruncate or shortly 5-dented, laxly hairy, 1–1.5 mm. *Petals* 5, connate for *c.* ¾ their length to a subcampanulate tube, white, glabrous, 3 mm. *Stamens* 5, slightly exserted; filaments densely set with rather short glandular hairs below the anther cells ventrally and dorsally at the connective, the hairs not exceeding the anther cells. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* with 3–5 cymes on top of a slender peduncle (0.5–1 cm), each cyme reduced to a single flower, the latter pedicelled for 3–5 mm and arranged in a kind of umbel. *Calyx* and *petals* as in ♂ flowers. *Staminodes* 5, short-hairy below the void anther cells. *Ovary* cylindric, becoming ovoid, glabrous. *Infructescences* with 2–3(–5) branches (0.5–1 cm) together on top of a peduncle (1–1.5 cm). *Drupe* subovoid-ellipsoid or ellipsoid, yellowish, (1.6–) 1.8–2(–2.2) by 0.8–1 cm, apex broadly attenuate and slightly curved, rounded, rarely attenuate; endocarp with numerous longitudinal low ribs.

Distr. *Malesia*: Lesser Sunda Is. (Sumba, Flores, Wetar, Timor), Celebes, Moluccas (Morotai, Talaud, Halmahera, Ternate, Tidore, and Tanimbar Is.).

Ecol. Forests, from lowland to the montane region, occasionally up to 1600 m.

Vern. Flores: *saka*, Endeh, *te-ù*, Manggarai; Celebes: *danoan*, *makapojáan*, *makuranga* (Ts.), *sansalan*, Minahasa (Tl.), *lowa putè*, *taluha*, Malili (Tb.), *tohaka*, Makassar, *benu*, Buton; Moluccas: *anuwuka*, Talaud, *mali mali*, Tidore, *mador*, Morotai, *momodja*, *obu banga*, Ternate.

14. Gomphandra apoensis (ELM.) MERR. En. Philip. 2 (1923) 490; SLEUM. Blumea 17 (1969) 198. — *Stemonurus apoensis* ELM. Leafl. Philip. Bot. 7 (1915) 2690; HOWARD, J. Arn. Arb. 21 (1940) 487, t. 1, f. 11–14; DAHL, *ibid.* 33 (1952) 268 (pollen).

Tree, 15–20 m, trunk up to 45 cm ø. Branchlets puberulent distally. *Leaves* oblong, apex short-acuminate, tip often bluntish, base broadly attenuate to roundish, subcoriaceous, rather dark brown when dry especially above, initially sparsely set with short ± appressed pale hairs at midrib and nerves beneath, glabrous with age, 6–13 by 2.5–4.5 cm, nerves 5–7 pairs, rather straight, obscurely inarched before the edge, slightly raised beneath, net of veins coarse and rather obscure; petiole *c.* 1 cm by 1–1.5 mm. — ♂ *Inflorescences* 2(–3) cm long, consisting of 2 or 3 shortly branched cymes on top of common peduncle (0.5–1 cm), subdensely 5–12-flowered, short-hairy except calyx and petals. *Calyx* ± obconical, entire or almost so, 1.5(–2) mm. *Petals* 5, connate for the lower ⅔ to a narrowly campanulate tube, white or yellowish green, 3.5–4 mm. *Stamens* 5, a little or hardly exserted; filaments with short-clavate or papillose

hairs both in front below the anther cells and on connective. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* and *drupe* unknown.

Distr. *Malesia*: Philippines (Luzon, Negros, Mindanao; possibly also Bohol).

Ecol. Primary forest on slopes and along streams, 900 m.

Vern. *Marumai*, Bag.

15. Gomphandra flavicarpa (ELM.) MERR. En. Philip. 2 (1923) 490; SLEUM. Blumea 17 (1969) 198. — *Stemonurus flavicarpus* ELM. Leafl. Philip. Bot. 7 (1915) 2691; DAHL, J. Arn. Arb. 33 (1952) 268 (pollen).

Shrub-like or slender tree, 3–5 m, 2–10 cm ø; bark smooth, brown. Branchlets short-pubescent. *Leaves* almost distichous, oblong to obovate-oblong, apex shortly and ± bluntly acuminate, base broadly attenuate to almost rounded, firmly chartaceous to subcoriaceous, dark brown above, much paler beneath when dry, initially sparsely hairy along lower part of the midrib, with age practically glabrous above, shortly subappressedly pubescent all over the undersurface especially on midrib and nerves (though less obviously than in *G. cumingiana*), 8–14 by 2.5–4(–5.5) cm, nerves 5–6 ascendently curved and obscurely inarching pairs, slightly raised beneath, net of veins coarse, faintly prominent beneath; petiole puberulent, 0.8–1 cm by 1 mm. *Inflorescences* from foliate and defoliate axils, both ♂ and ♀ ones composed of 2(–3) few-flowered cymes on common peduncle (*c.* 5 mm), short-brownish-pubescent, the petals excepted. — ♂ *Flowers*: *Calyx* cup-shaped, 4(–5)-denticulate, 1 mm. *Petals* 4 or 5, united for the lower ⅔ to a subcampanulate tube, white or cream, 3–4 mm. *Stamens* 4 or 5, exserted for 1.5–2 mm; filaments with rather few papillose hairs in front below the anther cells and at connective. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* 2–3-flowered. *Calyx* and *petals* as in ♂ flowers. *Staminodes* 4 or 5, papillose. *Ovary* glabrous. *Drupe* oblongoid-fusiform, apex slightly oblique and a little beaked, base gradually attenuate, pale yellow when fresh, 1.3–1.6 by 0.5–0.6 cm; endocarp thin, with several slightly outstanding longitudinal ribs.

Distr. *Malesia*: Philippines (Mindanao).

Ecol. Montane, also mossy forest, (700–)1200–2200 m.

Vern. *Mantangali*, Manobo, *maramai*, *matamatá*, Bag.

16. Gomphandra oligantha SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 238; Blumea 17 (1969) 199. — *Urandra pauciflora* MERR. Philip. J. Sc. 3 (1908) Bot. 243. — *G. pauciflora* (MERR.) MERR. En. Philip. 2 (1923) 491, *non* CRAIB, 1914.

Small tree, glabrous except the slightly puberulent tips of branchlets, the young petioles and the inflorescences. *Leaves* almost distichous, ovate to ovate-elliptic, or elliptic, apex ± abruptly narrowed to a subcaudate bluntish acumen (1–2 cm), base broadly cuneate, the very base often contracted and a little decurrent on the petiole, membranous to subchartaceous, dark olive-brownish when dry, 6–10 by 2.5–5 cm, nerves 5–6 moderately curved-ascendent pairs, minutely raised beneath, veins ± obscure; petiole 5–10 by hardly 1 mm. Both ♂ and ♀ *inflorescences* very lax, slender as are the peduncles (2–3 cm) and the branches. — ♂ *Flowers* (ELMER 12508) in a 3–5-flowered very lax cyme; pedicels in fully developed inflorescences 2–3 mm. *Calyx* cup-shaped, base truncate, laxly ciliate, hardly 4-dented, 1 mm. *Petals* 4, glabrous, coherent in the lower ¾, glabrous, 3 mm. *Stamens* 4; filaments glabrous on the ventral, and with a few penicillate hairs on the dorsal side at the connective. Rudiment of *ovary* glabrous or maybe with a few hairs along edges. — ♀ *Flowers* in 2 or 3 very lax cymes, each cyme reduced to one flower; branches (simulating pedicels) 1–2 cm. *Calyx* and *petals* as in ♂ flowers. *Staminodes* 4; filaments laxly long-hairy on ventral side immediately below the anther cells and at connective. *Ovary* sparsely hairy in upper part, practically glabrous. Submature *drupe* ovoid-oblongoid, apex very shortly subabruptly attenuate and maybe very sparsely hairy, base rounded, seen up to 1.3 by 0.7 cm; endocarp thin, with numerous low longitudinal ridges.

Distr. *Malesia*: Philippines (Mindoro, Sibuyan).

Ecol. Primary forest at low altitudes.

17. Gomphandra sawiensis (BIRNIE) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 238; Blumea 17 (1969) 199. — *Stemonurus sawiensis* BIRNIE, Nova Guinea 14, 2 (1926) 275.

Tree, *c.* 6 m. Branchlets fulvous-tomentellous at tips. *Leaves* oblong, apex shortly acuminate or sometimes obtuse, base cuneate, chartaceous, initially sparsely appressedly long-hairy all over especially beneath, at maturity practically glabrous, brownish when dry, with numerous pale tubercles on both faces, 10–15(–18) by 3–5(–7) cm, nerves 7–8(–9) pairs, spreading and rather straight, raised beneath, transverse veins visible, no reticulation; petiole descending on the branchlet as a slight ridge to the next leaf, 1–1.5 cm by 1.5–2 mm. — ♂ *Inflorescences* few-flowered cymes on very short common peduncle, all over densely appressedly fulvous-pubescent, 1–1.5 cm long in all. *Calyx* widely cup-shaped, base truncate, edge subentire, 2 mm. *Petals* 4, remaining connate for their lower ⅔ at anthesis, ± densely appressedly hairy outside, 5–5.5 mm. *Stamens* 4, a little exserted; filaments densely clavate-hairy in the upper half on the ventral, less so on the dorsal side. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* and *drupe* unknown.

Distr. *Malesia*: West New Guinea (Hollandia), once found.

Ecol. Forest, 100 m.

18. Gomphandra dolichocarpa MERR. Pap. Mich. Ac. Sc. 23 (1938) 183; SLEUM. Blumea 17 (1969) 199. — *Stemonurus dolichocarpus* (MERR.) HOWARD, J. Arn. Arb. 21 (1940) 468; DAHL, *ibid.* 33 (1952) 268 (pollen).

Tree or treelet. Branchlets densely short-hairy in youngest parts. *Leaves* oblong, rarely elliptic-oblong, apex rather suddenly narrow-acuminate for 1–2 cm, tip bluntish, base cuneate to the petiole, a little inequilateral, firmly chartaceous to subcoriaceous, olivaceous to brown above, paler beneath when dry, (12–)16–25 by 5–8 cm, glabrous above, hairy at midrib and nerves, glabrous otherwise beneath, nerves 10–12 pairs, the lowest pair generally more steeply ascending than the other ones, all nerves markedly looping before the edge, generally a little impressed above, raised beneath, transverse veins finely prominent beneath, no reticulation; petiole hairy initially, *c.* 1 cm by 1.5–2 mm. — ♂ *Inflorescences* composed from several short few-flowered cymes on top of a peduncle (5–8 mm), densely fuscous short-hairy all over, the petals excepted. *Calyx* cup-shaped, base truncate, obscurely 4–5-dented, 1.5 mm. *Petals* forming a narrow-campanulate tube 4–5-lobed halfway or partly further down, glabrous, 3.5 mm. *Stamens* 4(–5), slightly exserted; filaments with penicillate hairs in upper half of the ventral, less densely so on dorsal side. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* bearing 3–4 flowers clustered on top of peduncle (5 mm). *Calyx* and *petals* as in ♂ flowers. *Staminodes* not seen. *Ovary* glabrous. *Drupes* 2 or 3 per infructescence, known only in submature state, fusiform, 3.5–4 by 0.5–0.6 cm, the much attenuate distal rostrate and the basal part each *c.* 5 mm.

Distr. *Malesia*: Sumatra (Eastcoast).

Ecol. Apparently in montane forest, no altitude given by the collectors.

Vern. *Kaju atimang*, *k. barik*, *k. rawet*, M.

19. Gomphandra lancifolia MERR. Philip. J. Sc. 17 (1920) 277; En. Philip. 2 (1923) 490; SLEUM. Blumea 17 (1969) 199. — *Stemonurus lancifolius* (MERR.) HOWARD, J. Arn. Arb. 21 (1940) 468.

Tree, *c.* 6 m, practically glabrous. *Leaves* narrow-lanceolate, apex subcaudate-acuminate, tip bluntish, base acuminate-attenuate to the petiole, chartaceous to subcoriaceous, brown when dry, 7–10.5 by (1.5–)2–2.8 cm, nerves 3(–4) pairs, the lowest pair from *c.* 5 mm above the base and steeply ascending halfway the blade, upper ones more curved and shorter, all slightly raised beneath; petiole *c.* 1 cm by 1.5 mm. *Inflorescences* not known. *Drupe* 1 or 2 per infructescence, each on 5–10 mm long branches, these on a common robust almost glabrous peduncle (5 mm), obovoid-oblongoid, 2.5–3 cm by *c.* 1 cm; fleshy exocarp salmon; endocarp with several coarse longitudinal ridges.

Distr. *Malesia*: Philippines (Luzon: Mt Dingalang in Tayabas Prov.), once found.

Ecol. Primary forest, 200 m.

Vern. *Paranuyog*, Neg.

20. Gomphandra luzoniensis (MERR.) MERR. En. Philip. 2 (1923) 490; SLEUM. Blumea 17 (1969) 199. — *Elaeocarpus? integrifolius* BLANCO, Fl. Filip. ed. 2 (1845) 306; *ibid.* ed. 3, 2 (1878) 202, *non* LAMK, 1788. — *Urandra luzoniensis* MERR. Philip. J. Sc. 3 (1908) Bot. 242; Spec. Blanc. (1918) 237. — *Stemonurus luzoniensis* (MERR.) HOWARD, J. Arn. Arb. 21 (1940) 468; DAHL, *ibid.* 33 (1952) 268 (pollen).

Tree, (5–)12–30 m, up to 40 cm ø. Branchlets usually reddish-brown in dry specimens, glabrous. *Leaves* elliptic to obovate-elliptic, apex ± abruptly acuminate for *c.* 1 cm, tip generally bluntish, base gradually cuneate-acuminate to the petiole, coriaceous, dark brown and shining above when dry, practically glabrous with age, 7–15 by 4–6(–8) cm, nerves *c.* 5 (rarely –7) pairs, rather straight in the lower, curved ascending in the distal part, slightly raised beneath, reticulation almost obsolete; petiole strongly grooved above, 1–1.5 cm by 1.5–2 mm. — ♂ *Inflorescences* with 3–5 cymes on a common stoutish peduncle (1–3 cm), the rather numerous flowers ± scorpioidly arranged along the branches (5–10 mm), subdensely set with rusty appressed hairs on peduncle and branches. *Calyx* widely cup-shaped, base truncate, edge minutely 5-dented (sometimes more deeply disrupted), subglabrous, 1–1.5 mm. *Petals* 4, greenish-whitish, glabrous, connate in their lower ⅔ part, 4–5 mm. *Stamens* 5, finally somewhat exserted; filaments with long clavate-penicillate hairs on the inner side below the anther cells and on the connective. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* more lax and with fewer flowers. *Calyx* and *petals* as in ♂ flowers. *Staminodes* 5, less densely hairy than in ♂ flowers. *Ovary* glabrous. *Drupe* oblongoid to broadly ellipsoid, very apex a little oblique, otherwise equally rounded at both ends, 2–2.5 by (0.8–)1–1.2 cm; exocarp thin-coriaceous, becoming blackish when dry; endocarp with numerous longitudinal low ridges down to the very base, thin-woody.

Distr. *Malesia*: Philippines (Luzon, Mindoro, Marinduque, Panay, Palawan).

Ecol. Primary forest under partial shade or forest edge, at low altitudes, rarely up to 850 m, locally common.

Vern. *Bibisläkin*, *imus*, *rogrogsó*, Ilk., *bitlag*, *mabúnot*, *manankálau*, Tag., *maratúba*, Ibn.

21. Gomphandra montana (SCHELLENB.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 238; Blumea 17 (1969) 200. — *Stemonurus montanus* SCHELLENB. Bot. Jahrb. 58 (1923) 162. — *G. carrii* SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 239. — *G. sp.*, WALKER, For. Fl. Br. Solomon Is. (1948) 127.

Shrubby treelet or tree, 3–20 m, up to 25 cm ø; bark smooth, light grey to creamy brown. Branchlets appressedly hairy at tips. *Leaves* elliptic to lanceolate-oblong, apex short-acuminate to subcaudate (2–3 cm), tip acutish, base attenuate, thin-coriaceous, glabrous above, laxly short-hairy initially and early glabrescent beneath, dark to olivaceous-brown, dull and often minutely tubercled above, paler and usually more greenish-olivaceous beneath in dry specimens, (8–)10–16 (–18) by (3.5–)4–6(rarely –8) cm, nerves 5–6(–7) rather straight ascending pairs, raised beneath, no reticulation; petiole 1–1.5 cm by *c.* 2 mm. — ♂ *Inflorescences* consisting of 2 or 3(–4) few-

to many-flowered cymes, together on a rather stoutish peduncle (1–2 cm by 1 mm), fulvous-puberulous. *Calyx* widely cup-shaped, subentire, mostly laxly hairy, 1–1.5 mm. *Petals* 5, remaining connate to a subcampanulate tube for their lower ¾ part, greenish-whitish, glabrous (maybe with a few hairs at apex), (3–)4–5 mm. *Stamens* 5, exserted for 1–2 mm; filaments set with few to numerous longish hairs ventrally below the anther cells, much less or not so dorsally at connective. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* with 3 or 4 one-flowered branches (3–6 mm) on top of a common peduncle (*c.* 1 cm). *Calyx* and *petals* as in ♂ flowers. *Staminodes* 5, laxly or not hairy. *Ovary* glabrous. *Drupe* subelliptic-oblongoid, slightly asymmetrical, ± obtuse at both ends, base sometimes slightly (or unilaterally) swollen, pale yellowish green, sometimes with reddish or orange tinge, 2–2.5(rarely –3.2) by (0.9–)1–1.2(–1.5) cm, ribs of endocarp marked and down to or almost to the very base.

Distr. Melanesia (New Britain, New Ireland, Solomon Is. and Santa Cruz Group); in *Malesia*: New Guinea.

Ecol. Primary lowland and montane, also swampy, sometimes secondary or devastated forest, usually in understorey, locally not rare, from sea-level up to 1675 m.

Uses. Wood creamy to whitish, rays prominent, no use known, apparently due to its small dimensions.

Vern. *Aiyalo*, Kwara'ae.

Note. Difficult to separate from *G. australiana* F. v. M. in leaf and fruit characters, though certainly different in flower structure.

22. Gomphandra parviflora (BL.) VALET. Crit. Overz. Olacin. (1886) 218, t. 4, f. 10 & 11; SLEUM. Blumea 17 (1969) 200. — *Stemonurus parviflorus* BL. Mus. Bot. Lugd.-Bat. 1 (1850) 250; WALP. Ann. 2 (1851) 182; MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 36, repr. Contr. Bot. 1 (1852) 87; O. KTZE, Rev. Gen. Pl. 1 (1891) 112. — *Lasianthera parviflora* (BL.) MIQ. Fl. Ind. Bat. 1 (1856) 791; Suppl. (1860) 137.

Treelet. Branchlets with minutely pubescent tips. *Leaves* oblong to elliptic-oblong, rarely lanceolate or oblanceolate-oblong, apex shortly rather abruptly acuminate for 1–2 cm, base broadly cuneate and slightly inequilateral, firmly membranous to subchartaceous, glabrous, greenish-greyish to olivaceous and dull in dry specimens, (10–)15–22(–30) by 4–8 cm, nerves (8–)10–12(–14) rather straight and spreading pairs, ± parallel to each other and looping before the edge, the lowest pair in part of the leaves (in the same specimen!) ascending in a more acute angle from the midrib, reticulation none; petiole often yellowish as is the midrib beneath in dry specimens, 1–1.3 cm by 1.5 mm. — ♂ *Inflorescences* with 2(–3) few-flowered cymes, these ± umbellately arranged on top of a slender peduncle (*c.* 5 mm), shortly appressedly rusty-pubescent on peduncle and branches. *Calyx* cup-shaped, base truncate, laxly short-hairy, minutely 5-dented, 1 mm. *Petals* 5, united to a cup-shaped tube for their lower ⅔, glabrous, *c.* 3 mm. *Stamens* 5, slightly exserted; filaments practically glabrous ventrally, but set with penicillate hairs dorsally at connective. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* with 2 or 3 shortly pedicellate flowers on top of a common peduncle (3–5 mm). *Calyx*, *petals* and *staminodes* not known. *Ovary* glabrous. *Drupe* subfusiform-oblongoid, apex broadly attenuate and a little oblique, base more slenderly narrowed, very base cup-like swollen for *c.* 1.5 mm and smooth, *i.e.* the rather low longitudinal ridges of the endocarp ending there, 1.7–2(–2.2) by 0.6 cm.

Distr. *Malesia*: Central W. Sumatra (Mt Singgalang area), twice found.

23. Gomphandra subrostrata MERR. Pap. Mich. Ac. Sc. 19 (1934) 164, t. 27; SLEUM. Blumea 17 (1969) 200. — *Stemonurus subrostratus* (MERR.) HOWARD J. Arn. Arb. 21 (1940) 469.

Treelet or tree, 2.5–7 m. Branchlets rusty- to rufous-tomentellous at the younger parts, as are the petiole and midrib and nerves of mature leaves beneath, older parts glabrate. *Leaves* oblong to elliptic-oblong, apex gradually or more abruptly acuminate (often slightly falcate) for 1–3 cm, base broadly attenuate to rounded, a little inequilateral, firmly chartaceous, dark brown to blackish brown and somewhat shining above, paler and dull beneath in dry specimens, 15–25 by 4.5–9 cm, nerves 8–10 pairs, rather straight below, more curved and ± obscurely inarching before edge, raised beneath, veins obsolete; petiole 5–8(–10) by 2 mm. — ♂ *Inflorescences* with 2 or 3 ± scorpioid several-flowered cymes together on top of peduncle (0.5–1 cm), peduncle and branches rusty-tomentellous except the uppermost part of branches (or pedicels) immediately below the calyx which is glabrous and black in dry specimens. *Calyx* (LÖRZING 6690) cup-shaped, base truncate, sparsely short-hairy in upper half, ciliate, 4–5-dented, 1.3 mm. *Petals* 4 or 5 connate about halfway to a narrow-campanulate tube, glabrous, whitish or greenish, 3.5 mm. *Stamens* 4 or 5, exserted for *c.* 1 mm; filaments penicillate both below the anther ventrally and dorsally. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* with 1 or 2 few-flowered cymes on top of a common peduncle (*c.* 5 mm). *Calyx* and *petals* as in ♂ flowers. *Staminodes* not observed. *Ovary* glabrous. Submature *drupe* oblong-ovoid, apex shortly rather abruptly attenuate or subrostrate (beak erect), base rounded, 10–15 by 5–6 mm; exocarp glaucous, paler on both ends of drupe; endocarp with very low longitudinal ridges.

Distr. *Malesia*: Sumatra (Eastcoast).

Ecol. Primary forest, rare, 350–850 m.

24. Gomphandra quadrifida (BL.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 238; Blumea 17 (1969) 200; Fl. Thail. 2 (1970) 78. — *Stemonurus quadrifidus* BL. Mus. Bot. Lugd.-Bat. 1 (1850) 249; WALP. Ann. 2 (1851) 182; MIERS, Ann. Mag. Nat. Hist.

II, 10 (1852) 36, repr. Contr. Bot. 1 (1852) 86. — *Stemonurus prasinus* Bl. Mus. Bot. Lugd.-Bat. 1 (1850) 249; Walp. Ann. 2 (1851) 182; Miers, Ann. Mag. Nat. Hist. II, 10 (1852) 36, repr. Contr. Bot. 1 (1852) 86; O. Ktze, Rev. Gen. Pl. 1 (1891) 112. — *Stemonurus penangianus* Miers, Ann. Mag. Nat. Hist. II, 10 (1852) 39, repr. Contr. Bot. 1 (1852) 90; Kurz, J. As. Soc. Beng. 44, ii (1875) 155; For. Fl. Burma 1 (1877) 239; O. Ktze, Rev. Gen. Pl. 1 (1891) 112. — *Lasianthera javanica* (Bl.) Miq. *var. quadrifida* (Bl.) Miq. Fl. Ind. Bat. 1 (1856) 790. — *Lasianthera prasina* (Bl.) Miq. *l.c.* 791; Suppl. 1 (1860) 137. — *Lasianthera* ? *ovalifolia* Miq. Fl. Ind. Bat. Suppl. 1 (1860) 137, 342; Becc. Malesia 1 (1877) 111. — *G. penangiana* Wall. Cat. (1832) *n.* 7204, *nom. nud.*; *ex* Mast. in Hook. *f.* Fl. Br. Ind. 1 (1875) 587; Valet. Crit. Overz. Olacin. (1886) 223; King, J. As. Soc. Beng. 64, ii (1895) 113; Brandis, Ind. Trees (1906) 151; Ridl. Fl. Mal. Pen. 1 (1922) 427; Burk. Dict. (1935) 1096. — *G. prasina* (Bl.) Becc. Malesia 1 (1877) 110; Valet. Crit. Overz. Olacin. (1886) 228, *incl. var. ovalifolia* (Miq.) Valet. *l.c.* 225, t. 4, f. 17, a–b. — *G. oppositifolia* Pierre *ex* Gagnep. Not. Syst. 1 (1910) 198; Fl. Gén. I.–C. 1 (1911) 825. — *G. puberula* Ridl. J. Fed. Mal. St. Mus. 6 (1915) 142. — *G. affinis sensu* Ridl. Fl. Mal. Pen. 1 (1922) 427, *incl. var. floribunda* Ridl.; Burk. Dict. (1935) 1096; Dahl, J. Arn. Arb. 33 (1952) 268 (pollen). — *G. maingayi* King *var. pubescens* Ridl. Fl. Mal. Pen. 1 (1922) 429. — *G. lanceolata* (Mast.) King *var. tenuifolia* Craib, Fl. Siam. En. 1 (1926) 273. — *Stemonurus oppositifolius* (Pierre *ex* Gagnep.) Howard, J. Arn. Arb. 21 (1940) 469. — *G. scorpioidea* Gagnep. Not. Syst. 13 (1947) 133; Fl. Gén. I.–C. Suppl. (1948) 749, f. 89, 7.

See for further synonyms under the varieties.

KEY TO THE VARIETIES

1. Leaves oblong to elliptic-oblong, rarely elliptic or subovate-oblong, 10–15(–25) by 4–6(–11) cm, nerves 6–8(–10, rarely more) pairs, ± markedly looping before the edge. **1.** *var.* **quadrifida**
1. Leaves often smaller, nerves (3–)4–5(–6) pairs.
2. Leaves with a pair of slightly suprabasal, high curved-ascending 'melastomaceous' nerves, other nerves ± rectangularly from the midrib faint or obscure. **2.** *var.* **triplinervis**
2. Leaves with more numerous, straight or more curved pairs of nerves subparallel to each other.
3. Leaves narrowly oblong-lanceolate, sometimes almost linear, 5–12(–18) by (0.5–)0.8–2 cm . . . . . **3.** *var.* **angustifolia**
3. Leaves lanceolate to oblong, rarely subovate-lanceolate, (4–)5–10(–14) by (1.5–)2–4 cm.
4. Nerves ± spreading except the basal pair, generally obscurely looping before the edge. **4.** *var.* **ovalifolia**
4. Nerves all steeply ascending, prominent and markedly looping before the edge. **5.** *var.* **maingayi**

1. *var.* **quadrifida.**

Shrub or treelet, 0.7–5 m. Branchlets often yellowish in dry specimens, tips only appressedly short-hairy. *Leaves* oblong to elliptic-oblong, rarely elliptic or subovate-oblong, apex subacutely or obtusely and rather abruptly acuminate for 1–2 cm, base broadly attenuate, generally slightly inequilateral, membranous to chartaceous, green or greenish brownish and rather dull in the dry state, glabrous, 10–15(–25) by (3–)4–6(–11) cm, nerves 6–8(–10, rarely more) pairs, rather straight and subparallel below, markedly looping before the edge, a little raised beneath, veins subinconspicuous, reticulation obscure or generally none; petiole 10(–15) by 1.5 mm. — ♂ *Inflorescences* consisting of 3–6 (rarely more) shortly peduncled and repeatedly branched ± scorpioid cymes, these subumbellately collected on top of a rather slender short-hairy peduncle (1–2 cm), each cyme rarely few-, generally rather many-flowered, the flowers in the latter case more distinctly inserted on one side. *Calyx* widely cup-shaped, shortly 4–5-dented, hardly 1 mm. *Petals* 4(–5), connate to a tube for the lower ¾ part, white or cream, glabrous, (3–)4(–5) mm. *Stamens* 4(–5), slightly to more manifestly exserted; filaments densely covered with longish clavate hairs ventrally below the anther cells and dorsally at connective. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* similar to the ♂ ones, though generally less branched and few-flowered. *Calyx* and *petals* as in ♂ flowers. *Staminodes* 4(–5), hairy. *Ovary* glabrous. *Drupe* in immature state ± ovoid, its apex markedly attenuate and the base suddenly contracted into a kind of (very) short foot, in mature state ellipsoid to subovoid-ellipsoid, rarely more oblongoid-ellipsoid, apex gradually attenuate or subapiculate, base broadly narrowed, the very base generally distinctly swollen and smooth, whilst the upper part of the endocarp bears several longitudinal ribs, 0.8–1 (–1.2, –1.4) by 0.6–0.7(–0.8) cm.

Distr. Lower Burma, Thailand, and Indo-China; in *Malesia*: Sumatra (incl. also Mentawei Is.) and Malay Peninsula.

Ecol. Primary, also swampy forest, from lowland up to 900 (in S. Thailand up to 1200) m, occasionally on limestone, locally common.

Uses. A decoction of the root is used in Malaya after childbirth (Burkill & Haniff, Gard. Bull. S. S. 6, 1930, 184), as is that of *var. angustifolia*.

Vern. Sumatra (Asahan): *kaju barik barik, k. minak minak, k. topu lisak, k. si topu minak*; Malaya: *akar taring pĕlandok, hĕmpedu jawa, ulan hitam*, M.

2. *var.* **triplinervis** (King) Sleum. Blumea 17 (1969) 202. — *G. lanceolata* (Mast.) King *var. triplinervis* King, J. As. Soc. Beng. 64, ii (1895) 112; Ridl. Fl. Mal. Pen. 1 (1922) 428.

Leaves oblong to elliptic, rarely subovate-oblong, 10–15(–18) by 2–4(–6) cm, with a slightly suprabasal nerve on either side of the midrib, steeply ascending to almost the top of the blade, other lateral nerves straight from the midrib, numerous and subparallel, obscure above, rather faint beneath.

Distr. *Malesia*: Sumatra (W. Indragiri), Malay Peninsula (Kedah incl. also Langkawi, Penang, Perak, Trengganu).

Ecol. Primary lowland (Dipterocarp) forest, up to 150 m.

3. *var.* **angustifolia** (KING) SLEUM. Blumea 17 (1969) 202; Fl. Thail. 2 (1970) 79. — *G. lanceolata* (MAST.) KING *var. angustifolia* KING, J. As. Soc. Beng. 64, ii (1895) 113; RIDL. Fl. Mal. Pen. 1 (1922) 428. — *G. salicifolia* RIDL. Fl. Mal. Pen. 1 (1922) 429; BURK. Dict. (1935) 1097. — *Stemonurus salicifolius* (RIDL.) HOWARD, J. Arn. Arb. 21 (1940) 469.

Shrub or small tree (rarely up to 20 m tall) with wiry branches. *Leaves* narrowly (oblong-) lanceolate, sometimes almost linear, thinly subcoriaceous, 5–12 (rarely –18) by (0.5–)0.8–2 cm, nerves 4–5 pairs rather inconspicuous beneath. *Flowers* and *drupe* apparently slightly smaller than in *var. quadrifida*.

Distr. S.Thailand; in *Malesia*: Malay Peninsula.

Ecol. Lowland and mainly montane forest, often along riverside, 100–1220 m.

Vern. *Daun ekur bukit dĕrimba*, M.

4. *var.* **ovalifolia** (RIDL.) SLEUM. Blumea 17 (1969) 203; Fl. Thail. 2 (1970) 79. — *G. lanceolata* (MAST.) KING *var. ovalifolia* RIDL. Fl. Mal. Pen. 1 (1922) 428. — *Stemonurus affinis* MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 44, repr. Contr. Bot. 1 (1852) 94, t. 15. — *G. affinis* (MIERS) MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 586. — *Lasianthera lanceolata* MAST. *l.c.* 585. — *Stemonurus* ? *tomentellus* VALET. Crit. Overz. Olacin. (1886) 237. — *G. lanceolata* (MAST.) KING, J. As. Soc. Beng. 64, ii (1895) 112; RIDL. Fl. Mal. Pen. 1 (1922) 428; BURK. Dict. (1935) 1096. — *G. pubescens* RIDL. Fl. Mal. Pen. 1 (1922) 429. — *G. ophirensis* RIDL. *l.c.* 427, *nom. illeg.*

Small tree or shrub. *Leaves* lanceolate to oblong- or subovate-lanceolate, firmly membranous to subcoriaceous, sometimes sparingly pubescent beneath, (5–)8–14 by 2–4 cm, nerves (3–)4–5(–6) ± spreading and generally obscurely looping pairs. *Inflorescence* mostly with less numerous flowers than and not as manifestly scorpioid as in *var. quadrifida*, with which it shares the characters of flowers and fruits.

Distr. Thailand; in *Malesia*: Malay Peninsula.

Ecol. Primary rain-forest, and also rather dry *Dryobalanops* forest, from lowland up to 1200 (–1525) m, locally not rare.

Uses. A decoction of the roots is said to be administered for rheumatism, and wood-tar, made from the stems, to be used to blacken teeth.

Vern. *Bĕdara, bua sa puteh, chĕmperai ayam, ch. batu, ch. hitam, kayu gĕrang jantan, k. kĕsturi hutan, k. mĕnghilang api, k. mĕrĕsĕk hitam, k. sĕrĕndah, lada lada, lambas, lĕmpĕdu tanah jantan, pokok lilan hitom, sĕbasah paya*, M.

5. *var.* **maingayi** (MAST.) SLEUM. Blumea 17 (1969) 203. — *Lasianthera maingayi* MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 585. — *Stemonurus* ? *maingayi* (MAST.) VALET. Crit. Overz. Olacin. (1886) 236. — *Urandra maingayi* (MAST.) O. KTZE, Rev. Gen. Pl. 1 (1891) 113. — *G. maingayi* (MAST.) KING, J. As. Soc. Beng. 64, ii (1895) 114; RIDL. Fl. Mal. Pen. 1 (1922) 429.

Leaves lanceolate to subovate-lanceolate, apex subcaudate, subcoriaceous, nerves *c.* 6 steeply ascending pairs, shallowly or hardly impressed above, raised beneath, manifestly looping before the edge, the veins more visible than in *var. ovalifolia*, (4–)5–8 by (1.5–)2–3(–4) cm. *Flowers* and *drupes* apparently matching those of *var. quadrifida*.

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

Ecol. Forest on hillsides, 900–1500 m.

25. Gomphandra schoepfiifolia SLEUM. Notizbl. Berl. — Dahl. 15 (1940) 241; Blumea 17 (1969) 204.

Tree, 7–20 m, trunk 10–30 cm ø. Branchlets puberulent at tips, becoming blackish in dry state. *Leaves* oblong, apex rather abruptly acuminate for *c.* 1 cm, tip bluntish, base cuneate, firmly chartaceous to subcoriaceous, blackish above, brownish-blackish beneath, dull and brittle in dry specimens, 6–9(–10) by 2–4 cm, nerves 5(–6) pairs, curved-ascending, a little raised beneath, no reticulation; petiole 6–8 by 1 mm, glabrescent. — ♂ *Inflorescences* with 3–4(–5) branches (0.5–1 cm) together on top of slender peduncle (1–1.5 cm), each branch bearing a 3–5-flowered cyme, densely covered with minute red brown appressed hairs. *Calyx* obconical, minutely 5-dented, laxly hairy, 1.5 mm. *Petals* 5, firm in texture, whitish, remaining connate in the lower ¾ part, glabrous, *c.* 4 mm. *Stamens* 5, hardly or not exserted; filaments with rather few longish hairs ventrally below the anther cells. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* shorter than ♂ ones and with less numerous flowers. *Calyx* and *petals* as in ♂ flowers. *Staminodes* 5, subglabrous. *Ovary* glabrous. *Drupe* elongate-ellipsoid, known only in immature state.

Distr. *Malesia*: New Guinea (Central & Morobe Distr.).

Ecol. In montane rain-forest, 1500–1950 m.

26. Gomphandra pseudoprasina SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 240; Blumea 17 (1969) 204. — *G. prasina* [*non* (BL.) BECC.] WARB. Bot. Jahrb. 13 (1891) 299. — *Stemonurus prasinus* (*non* BL.) K. SCH. & LAUT. Fl. Schutzgeb. (1900) 414; SCHELLENB. Bot. Jahrb. 58 (1923) 163.

Tree, 5–10 m. Branchlets practically glabrous. *Leaves* oblong, apex shortly acuminate, subacute, base ± broadly cuneate, coriaceous, olivaceous-brownish and dull in dry specimens, glabrous except some sparse hairs on midrib and finely tubercled beneath, 10–17(–22) by 4–6(–8) cm, nerves 5–6 curved or more straight pairs, obscurely or not anastomosing, a little raised beneath, gen-

erally no reticulation visible, though fully mature leaves show a very fine impressed reticulation above; petiole 0.7–1 cm by 1.5–2 mm. — ♂ *Inflorescences* composed of several few-flowered shortly branched cymes together on a stoutish peduncle, 1.5–2.5 cm long in all, covered with minute rusty hairs. *Calyx* cup-shaped, 5-denticulate, 1.5 mm. *Petals* 5, free only in their upper part at full anthesis, fleshy, very laxly short-hairy to practically glabrous, 4 mm. *Stamens* 5, a little exserted; filaments hairy ventrally below the anther cells. Rudiment of *ovary* glabrous. — ♀ *Inflorescences* with 3–4 one-flowered branches (*c.* 5 mm) together on top of stoutish peduncle (1–1.5 cm). *Calyx* and *petals* as in ♂ flowers. *Staminodes* 5. *Ovary* glabrous. *Drupe* subovoid-ellipsoid in submature state, apex ± abruptly attenuate and a little curved, almost beaked, base attenuate, the endocarp slightly ribbed longitudinally, *c.* 1.9 by 0.9 cm, probably somewhat longer and more markedly ribbed in fully mature state.

Distr. *Malesia*: New Guinea (Morobe & Madang Distr.: Sattelberg and Kani Mts).

Ecol. Montane rain-forest, 600–1500 m.

Imperfectly known

27. Gomphandra oblongifolia MERR. Philip. J. Sc. 17 (1920) 276; En. Philip. 2 (1923) 491; SLEUM. Blumea 17 (1969) 206. — *G. sorsogonensis* ELM. Leafl. Philip. Bot. 10 (1939) 3748. — *Stemonurus oblongifolius* (MERR.) HOWARD, J. Arn. Arb. 21 (1940) 469.

Tree or treelet, up to 10 m. Branchlets puberulent at tips. *Leaves* oblong to oblong-elliptic, apex shortly acute to acuminate, base subequally narrowed, subacute to obtuse, firmly chartaceous to subcoriaceous, glabrous, brownish, shining and with flattish tubercles above, paler and dull beneath when dry, (6–)7–15 by (2.7–)3.5–6 cm, nerves 4–5(–6) pairs, curved-ascending, the upper ones obscurely anastomosing, slightly raised beneath, no reticulation; petiole *c.* 1 cm by 1.5 mm. *Inflorescences* not known. *Infructescences* sparingly pubescent, with 2 or 3 cymose branches (0.5–1 cm, each with 1 or 3, rarely 3 fruits) on a common stoutish peduncle (1–1.5 cm). *Drupe* oblongoid-ellipsoid to slightly obovoid-ellipsoid, *i.e.* the base more attenuate than apex, very base swollen, 1.5–1.8 by 0.7–0.9 cm; endocarp with low longitudinal ridges which end before the smooth swollen base.

Distr. *Malesia*: Philippines (Luzon: Camarines and Sorsogon Prov.; Catanduanes; Mindanao: Davao).

Ecol. Primary, also Dipterocarp forest at low altitude.

Vern. *Laing*, Bik.

Note. Possibly related to *G. quadrifida* (BL.) SLEUM.

Excluded

Gomphandra impressa RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 29. — *Stemonurus impressus* (RIDL.) SCHELLENB. Bot. Jahrb. 58 (1923) 163 = *Pittosporum ramiflorum* (Z. & M.) ZOLL. *ex* MIQ. (*Pittosporaceae*).

6. RHYTICARYUM

BECC. Malesia 1 (1877) 120, t. 5, f. 18–25 ('*Ryticaryum*'); *ibid.* (1878) 256, corr.: *Rhyticaryum*; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 415 ('*Rhytidocaryum*'); SLEUM. Blumea 17 (1969) 249. — *Pocillaria* RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 28. — **Fig. 12.**

Dioecious shrubs or trees. *Leaves* spiral, entire, not rarely with sparse appressed (strigose) hairs, midrib raised on both faces, nerves ± markedly looping before the edge. *Flowers* in axillary spikes, these rarely also composed to panicles in the same specimen, or very rarely reduced to such extent that the (few) flowers seem to be fascicled, small, sessile, each subtended by a small bract. *Calyx* cup-shaped, subentire or 4–5-dented to various degree. *Petals* 4 or 5, connate ½ to ¾ their length to a ± open, sometimes campanulate cup, free part or lobes valvate, apex inflexed. — ♂ *Flowers*: *Stamens* 4 or 5, free, fixed to the connate part of the tube; filaments short, anthers basifixed, oblong-elliptic to subsagittate, introrse. Rudiment of *ovary* ovoid or more cylindrical, always hairy. — ♀ *Flowers*: *Staminodes* very small, often absent, no anther cells. *Ovary* conical to subglobose, densely set with erect hairs; stigma sessile, flattened. *Drupe* generally ovoid-ellipsoid, much compressed laterally and almond-like, with a sharp crest, and sometimes another less marked crest on the flattened side; exocarp fleshy, thin, red to orange; endocarp thin-woody, rather coarsely reticulate-alveolate or -lacunose. *Seed* 1, testa thin; albumen fleshy; embryo almost of the length of the albumen, with broad flat cordate cotyledons.

Distr. About 12 *spp.* in all, in NE. Australia (Queensland: Cape York Peninsula) 1 *sp.*, Melanesia (Solomons, Bismarcks: New Britain, New Ireland, Admiralty Is.) 1 *sp.*, and *East Malesia*: New Guinea and Moluccas, 12 *spp.* Fig. 11.

Ecol. Primary, rarely also secondary forests in the substage, scattered, from the lowland up to *c.* 2500 m.

Uses. The leaves are locally cooked and eaten by the people as a vegetable.

Note. Species are rare and still inadequately known and difficult to delimit; several types are lost.

KEY TO THE SPECIES

1. Flowers both in axillary (rather lax-flowered) spikes *and* panicles composed of such spikes in the same specimen. . . . . **1. R. novoguineense**
1. Flowers exclusively in axillary spikes (these sometimes very short in ♀ specimens, the flowers seemingly fascicled then).
2. Both ♂ and ♀ inflorescences very laxly appressedly hairy, *i.e.* practically glabrous to the naked eye.
3. Leaves becoming purplish when dried. ♂ Spikes longer than 20 cm. . . . . **2. R. purpurascens**
3. Leaves becoming brownish or blackish-green, or remaining green-yellowish when dried. ♂ Spikes usually shorter than 20 cm.
4. Base of leaves properly rounded. . . . . **3. R. rotundatum**
4. Base of leaves attenuate, rarely almost rounded and cuneate in the same specimen.
5. Drupe 3.5–4.3 by 2.5–3 by *c.* 1.5 cm. . . . . **4. R. macrocarpum**
5. Drupe much smaller, rarely up to 2.6 by 1.5 cm.
6. Leaves blackish-green and hardly reticulate above in the dry state, nerves 6–7 pairs. ♀ Spikes lax-flowered, laxly hairy. . . . . **5. R. lucidum**
6. Leaves greenish-yellowish, or maybe greenish-greyish in the dry state, reticulation generally distinct (at least slightly prominent) above.
7. Flowers laxly arranged, *i.e.* (much) spaced. Basal pair of nerves curved-ascendent, upper pairs ± rectangularly from the midrib and straight. . . . . **6. R. elegans**
7. Flowers (sub)densely arranged. Nerves of leaves all ± distinctly curved-ascendent.
8. Leaves membranous to chartaceous, with a very fine and very dense prominent reticulation on both faces, nerves (10–)12–14 pairs. . . . . **7. R. oleraceum**
8. Leaves subcoriaceous to thin-coriaceous, reticulation more coarse, nerves 6–8(–10) pairs. **8. R. oxycarpum**
2. Both ♂ and ♀ inflorescences ± densely set with brownish substrigose hairs (tomentose in juvenile state) to the naked eye.
9. ♂ Flowers ± distant from each other along the rachis.
10. Rachis filiform. Leaves with 6–8 pairs of nerves. . . . . **9. R. gracile**
10. Rachis slender. Leaves with 8–10 pairs of nerves. . . . . **10. R. racemosum**
9. ♂ Flowers close to each other along the ± stoutish rachis.
11. Spikes very short (*c.* 6 mm), the few flowers together almost in a fascicle. Leaves thin. **11. R. fasciculatum**
11. Spikes longer to elongate (rachis at least 1 cm) and with numerous flowers. Leaves firm. **12. R. longifolium**

1. Rhyticaryum novoguineense (WARB.) SLEUM. Blumea 17 (1969) 250. — *Buchanania novoguineensis* WARB. Bot. Jahrb. 13 (1891) 363. — *Rhyticaryum sp.*, LAUT. *ibid.* 56 (1921) 349.

Treelet or small shrub. Branchlets slender, tips appressedly sparsely hairy, older parts early glabrous and covered with greyish cork and bearing whitish-brownish elliptic prominent lenticels. *Leaves* oblong, apex slenderly cuspidate-acuminate (acumen 1.5 by 0.5 cm at base, tip subacute or bluntish, generally slightly curved), chartaceous, with substrigose hairs here and there on midrib and nerves beneath, practically glabrous, dark green when fresh, greyish-green and a little shining when dry, 9–14(–16) by (2.5–)3–4.5(–5.5) cm, nerves 8–10(–12) pairs, the intercalar ones included, slightly raised above, rather sharply prominent beneath as is the rather coarse reticulation to a minor degree; petiole hairy initially, 8–10(–13) by 1–1.5 mm, transversely lenticelled with age. ♂ *Spikes* axillary, both solitary and composed to panicles (each of the pertaining spikes with a basal subtending bract), pendent, 4–10 cm in all, lower branches 3–5 cm; rachis ± densely set with yellowish appressed setulose hairs, slender (0.5 mm ø), the flowers markedly distant from each other. — ♂ *Flowers* (NGF 8386): *Calyx* cupular, 1 mm, 5-lobed halfway, tips sparsely strigose. *Petals* 5, connate halfway, forming an open cup, pale brownish, 2–2.5 mm, lobes ± reflexed. *Filaments* 1–1.5 mm; anthers subsagittate, 0.8–1 mm. Rudiment of *ovary* hirsute. — ♀ *Flowers* unknown. *Drupe* (*ex* WARBURG) ovoid-rhomboid, compressed laterally, 1.7 by 1.5 by 0.5 cm; exocarp fleshy, thin, red.

Distr. *Malesia*: E. New Guinea (Madang & Morobe Distr.), thrice found.

Ecol. Primary forest, 600 and 1645 m.

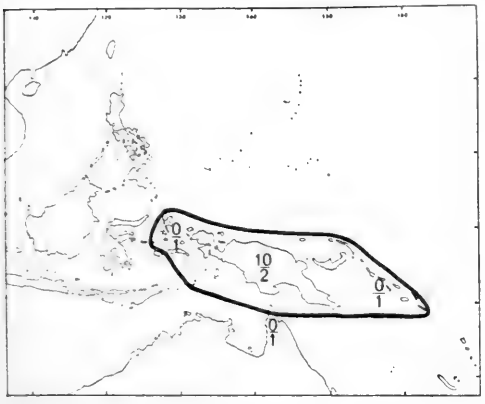

Fig. 11. Distribution of *Rhyticaryum*. The figure above the hyphen indicates the number of endemic species in the island or area, the figure below the hyphen the number of non-endemic species.

2. Rhyticaryum purpurascens SCHELLENB. Bot. Jahrb. 58 (1923) 172; SLEUM. Blumea 17 (1969) 251.

"Shrub, 2–3 m. Branchlets glabrous. *Leaves* elliptic, apex gradually acuminate for 1.5–2 cm, tip obtuse, base narrowed to the petiole, pergamaceous, glabrous, shining above, blackish-green with pale midrib in fresh, purplish in dry specimens, 15.5–20 by 5–9.5 cm, nerves *c.* 10 pairs, impressed above, raised beneath, reticulation very fine; petiole glabrous, 1.5–2 cm. ♂ *Spikes* 1 or 2 per axil, lax-flowered, 20 cm long or more, peduncle and rachis minutely and very laxly hairy (lens!). *Flowers* yellow when fresh, purplish when dry, 1.5 mm. *Calyx* glabrous, ciliolate. *Petals* connate ± halfway, minutely very laxly hairy outside. Otherwise unknown."

Distr. *Malesia*: New Guinea (Sepik Distr.: Leonhardt Schultze R. area), once found.

Ecol. Alluvial riverine forest at 20–50 m.

Note. Translation of the original Latin description, as the type material is lost.

3. Rhyticaryum rotundatum SCHELLENB. Bot. Jahrb. 58 (1923) 172; SLEUM. Blumea 17 (1969) 251.

"Treelet. Branchlets glabrous or a little hairy. *Leaves* oval, apex broadly and gradually acuminate, tip bluntish, base rounded, thick-pergamaceous, glabrous, shining, green in dry state above, paler beneath, 10–16.5 by 4–8 cm, nerves *c.* 6 pairs, looping, not much prominent, reticulation fine. ♂ *Spikes* solitary, lax-flowered, 3.5 cm; peduncle (5 mm) and rachis minutely and very laxly hairy (lens!). ♂ *Flowers* yellow, 4–5-merous, 1.5 mm. *Calyx* and *petals* obscurely hairy, the latter connate halfway. Otherwise unknown."

Distr. *Malesia*: New Guinea (Sepik R. area), once found.

Ecol. Alluvial riverine forest, 20–30 m.

Note. Translation from the original Latin description, as the type material is lost.

4. Rhyticaryum macrocarpum BECC. Malesia 1 (1878) 256; VALET. Crit. Overz. Olacin. (1886) 257; SCHELLENB. Bot. Jahrb. 58 (1923) 173; SLEUM. Blumea 17 (1969) 251.

Erect shrub or small tree, up to 13 m, up to 18 cm ø; bark grey-green, with numerous brown pustular lenticels. Tips of branchlets obtusangular, very laxly strigose, older parts terete, glabrous. *Leaves* elliptic-oblong, or elliptic, apex rather abruptly acuminate for 1–1.5 cm, tip blunt, base narrowed and a little decurrent to the slender petiole, chartaceous, glabrous, with numerous pellucid fine points against strong light, brownish especially beneath when dry, (12–)15–20 by 4–7(–9) cm, nerves 8–10 pairs, curved-ascending and anastomosing, slightly raised mainly beneath, reticulation very dense and finely prominent on both faces; petiole striate lengthwise, glabrous, 1–1.5 cm by *c.* 1 mm. — ♂ *Spikes* (BW 11366) 10–13 cm, rachis *c.* 1 mm ø, glabrous except some strigose hairs, flowers for their majority distant from each other. *Calyx* broadly cup-shaped, 5-dented, hardly 0.5 mm. *Petals* 5, fleshy, glabrous except some strigose hairs outside distally, connate about halfway, *c.* 2 mm. *Stamens* 5; filaments short. Rudiment of *ovary* hairy. — ♀ *Spikes* very laxly strigose, (2–)3–7 cm, lax-flowered, rachis slender, practically glabrous in fruiting time. ♀ *Flowers* to judge from specimen with developed ovary (NGF 3816): *Calyx* and *petals* as in ♂ flowers. *Ovary* subdensely hairy. *Drupe* almond-like, a little oblique, broadly attenuate towards the base, the very base obtuse, apex broadly attenuate, much compressed laterally, the two main crests rather sharp, with one or two less pronounced crests on the flattish sides, 3.5–4.3 by 2.5–3 by *c.* 1.5 cm; exocarp red or orange red, practically glabrous; endocarp ligneous, irregularly shallowly reticulate-costulate outside. *Seed* elliptic, compressed, 2.5–3 cm.

Distr. *Malesia*: New Guinea.

Ecol. Second storey of primary lowland, also swampy forest, apparently scattered, up to 475 m.

Vern. *Paitjerak*, Kebar.

5. Rhyticaryum lucidum SCHELLENB. Bot. Jahrb. 58 (1923) 175; SLEUM. Blumea 17 (1969) 251.

"Treelet, 4–5 m, bark greyish. Branchlets laxly or hardly strigose. *Leaves* elliptic, apex gradually attenuate to a bluntish acumen for 1.5–2 cm, base cuneate, rigidly chartaceous, glabrous, blackish-green above, paler beneath, shining on both faces, 9–15 by 2.7–5.5 cm, nerves 6–7 pairs, curved, distinctly raised beneath, reticulation obscure above; petiole 4–10 mm. ♂ *Flowers* not known. ♀ *Spikes* lax-flowered, *c.* 6 cm incl. the peduncle (7 mm), rachis laxly hairy (lens!). Flowers yellowish, *c.* 2 mm. *Calyx* lobes barbulate. *Petals* connate less than halfway, hairy outside. *Ovary* subglobose, densely set with erect hairs. *Drupe* *c.* 2.3 by 1.5 cm; endocarp tesselate-rugose."

Distr. *Malesia*: E. New Guinea (Hunstein Mts), once found.

Ecol. Mossy forest at 1300 m.

Note. Description a translation of the original Latin diagnosis, as the type specimen is lost.

6. Rhyticaryum elegans SCHELLENB. Bot. Jahrb. 58 (1923) 174; BIRNIE, Nova Guinea 14, 2 (1926) 276; DAHL, J. Arn. Arb. 33 (1952) 276 (pollen); SLEUM. Blumea 17 (1969) 251.

Shrub, 1–3 m. Branchlets slender, tips sparsely setulose, older parts early covered with greyish or brownish cork, lenticels elliptic. *Leaves* oblong- or elongate-elliptic, apex (rather) abruptly narrowed to a slender bluntish or subacute, often curved acumen (1–3 cm by 5–8 mm at base), base cuneate to almost rounded, olivaceous-brownish when dry, generally shining on both faces, practically glabrous, 8–16 by 3–5(–7) cm, nerves (6–)8–10 pairs, the lower pair curved-ascendent, the upper ones ± rectangularly from the midrib and straight, all looping and a little prominent above, sharply so beneath, reticulation fine and dense, generally slightly raised on both sides, sometimes rather obscure above; petiole (4–)7–10 by 1 mm. ♂ & ♀ *Spikes* solitary, rarely in twos, lax-flowered, (4–)5–7 (in the ♂ ones up to 14) cm, rachis *c.* 1 mm ø, very sparsely strigose, or glabrous. — ♂ *Flowers*: *Calyx* low, cup-shaped, 4- or 5-dented, edge strigose, 1 mm. *Petals* 4 or 5, fleshy, yellowish, sparsely strigose distally or glabrous, connate in the lower ½–¾ to a campanulate cup, 3–4 mm. *Filaments* 1 mm; anthers subovate, 1 mm. Rudiment of *ovary* strigose. — ♀ *Flowers*: *Calyx* and *petals* as in ♂ flowers. *Ovary* ovoid-conical, with large stigma, densely strigose, 2 mm. Immature *drupe* compressedly ovoid, apex obtuse, laxly strigose, 1.7 by 0.8 by 0.6 cm; endocarp wrinkled.

Distr. *Malesia*: New Guinea.

Ecol. Montane forest undergrowth, scattered, 800–2300 m.

7. Rhyticaryum oleraceum BECC. Malesia 1 (1877) 121, t. 4, f. 18–21; VALET. Crit. Overz. Olacin. (1886) 257; SCHELLENB. Bot. Jahrb. 58 (1923) 173; SLEUM. Blumea 17 (1969) 251. — *R. parviflorum* PULLE, Nova Guinea 8 (1912) 659; SCHELLENB. Bot. Jahrb. 58 (1923) 173. — *R. oncocarpum* (*non* K. SCH. & LAUT.) BIRNIE, Nova Guinea 14, 2 (1926) 276.

Shrub or treelet, 0.7–5 m. Branchlets laxly strigose, early glabrescent and covered with cork. *Leaves* elliptic or usually lanceolate-elliptic or oblong-lanceolate, apex rather gradually or more abruptly and slenderly acuminate for 1–1.5 cm, tip bluntish, base attenuate or rarely obtuse, thinly to firmly chartaceous green or yellowish-green when dry, shining and glabrous on both faces except some strigose hairs which may occur on midrib and nerves, 15–25 by 4–7(–10) cm, nerves (10–)12–14 pairs, curved-ascending, slightly raised above, more distinctly so beneath, looping, reticulation very fine and very dense, conspicuously raised on both faces; petiole 0.8–1.5 cm by *c.* 1.5 mm. — ♂ *Spikes* slender, rather dense-flowered, 3–7(–10) cm, laxly substrigose or glabrescent. *Calyx* a low cup, hardly lobed, edge hairy. *Petals* 4 or 5, connate for a little more than halfway, fleshy, greenish or yellowish, sparsely hairy distally outside or glabrous, *c.* 2 mm. *Stamens* 4 or 5; filaments very short. Rudiment of *ovary* hirsute. — ♀ *Spikes* more stoutish, 1–3 cm. *Calyx* and *petals* as in ♂ flowers. *Staminodes* whether or not present. *Ovary* ovoid, substrigose, 1.5 mm. *Drupe* obliquely ovoid-ellipsoid, much compressed laterally, crest bluntish, other ridges on flat side irregular and less pronounced, orange red, glabrous, (1.7–)2–2.3(–2.6) by (1–)1.5 by 1 cm; endocarp coarsely reticulate-lacunose.

Distr. *Malesia*: Moluccas (Morotai; Sula Is.: Mangoli I.; Ceram, Batjan, Amboina, Tanimbar Is.: Jamdena I.; Kai Is.) and W. New Guinea (Geelvink Bay and Southcoast).

Ecol. Primary lowland forest, rarely montane forest, up to 1900 m, scattered.

Uses. BECCARI noted the young shoots are eaten as a vegetable in the Kai Is. and VORDERMAN recorded the same for Batjan.

Vern. *Dodofó*, Morotai (Alfur.), *sajor mambos*, Batjan.

8. Rhyticaryum oxycarpum K. SCH. & LAUT. Fl. Schutzgeb. (1900) 416; SCHELLENB. Bot. Jahrb. 58 (1923) 175; SLEUM. Blumea 17 (1969) 251. — *R. pulchrum* SCHELLENB. Bot. Jahrb. 58 (1923) 173. — *R. urophyllum* SCHELLENB. *l.c.* 174.

Shrub or slender tree, 6–8(–20) m; bark grey or brownish. Branchlets sparsely strigose. *Leaves* elliptic-oblong, sometimes elliptic, apex rather abruptly acuminate for 1–1.5 cm, tip bluntish, base cuneate, slightly inequilateral, pergamaceous or firmly chartaceous, greenish-brownish when dry, glabrous except some scattered hairs on midrib and nerves underneath, (7.5–)9–15(–20) by 3.5–5.5(–7) cm, nerves 6–8(–10) pairs, patently arcuate and ascending (though sometimes rather straight below), looping, the lowest pair very close to the edge, prominent beneath, reticulation dense, usually finely raised on both faces; petiole 8–13 by 1(–1.5) mm. — ♂ *Spikes* (LEDERMANN 7564) dense-flowered, slender, laxly strigose or subglabrous, up to 18 cm. *Calyx* a low cup, 0.5 mm, its 4 or 5 tooth barbulate. *Petals* 4 or 5, connate ± halfway, 2 mm, lobes laxly strigose outside. *Stamens* 4 or 5; filaments short. Rudiment of *ovary* hairy. — ♀ *Spikes* (LEDERMANN 10211), *calyx* and *petals* as in ♂ flowers. *Ovary* hairy. *Drupe* (LAUTERBACH 2502) ovoid-ellipsoid, much compressed laterally, 1.8–2.2 by 1.2–1.4 by 0.6–0.7 cm, coarsely reticulate-lacunose.

Distr. *Malesia*: New Guinea (April and Ramu R. area).

Ecol. Lowland and montane, also swampy and secondary forest, on alluvial soil, scattered, up to 1000 m.

9. Rhyticaryum gracile SCHELLENB. Bot. Jahrb. 58 (1923) 170; SLEUM. Blumea 17 (1969) 252.

Divaricate shrub, 1–1.5 m. Branchlets very

slender, tips and petioles subdensely to more sparsely strigose, older parts early covered with greyish cork. *Leaves* elliptic-, or sometimes slightly obovate-oblong, abruptly narrowed to an acumen, 1.5–2 cm by 3–5 mm at base, tip subacute, base cuneate, thin-pergamaceous, green when dry, a little shining, laxly covered with long pale strigose hairs along midrib, nerves and maybe veins on the undersurface of younger leaves, glabrescent, 9.5–22 by (3.5–)5–7.5 cm, nerves 6–8 pairs, curved-ascending, hardly raised above, distinctly so beneath, reticulation very dense and finely raised above, more coarse or less prominent beneath, petiole 5–7 by 1 mm. ♂ *Spikes* known in juvenile state only, solitary, the flowers spaced a little, hirsute all over, rachis filiform, 4 cm (or maybe more in fully developed state). *Flowers* 5-merous, too young for description. Otherwise unknown.

Distr. *Malesia*: New Guinea (Sepik-April R. area), twice found.

Ecol. Forest at 200 and 1000 m.

10. Rhyticaryum racemosum BECC. Malesia 1 (1877) 121, t. 4, f. 22 & 23; VALET. Crit. Overz. Olacin. (1886) 257; SCHELLENB. Bot. Jahrb. 58 (1923) 168, as to type; SLEUM. Blumea 17 (1969) 252.

Shrub or treelet, *c.* 1 m, up to 5 cm ø. Branchlets slender, laxly short-strigose. *Leaves* oblong to subobovate-oblong, apex ± abruptly acuminate for 1–2 by 0.5 cm at base, tip subacute, base cuneate and a little decurrent to the petiole, membranous to thin-pergamaceous, greenish to yellowish when dry, sparsely setulose at midrib and part of the nerves beneath, otherwise glabrous, somewhat shining on both faces, (12–)15–24 by (4–)5–9 cm, nerves 8–10 pairs, curved-ascending and looping, hardly raised above, distinct beneath, reticulation rather coarse, finely raised on both faces; petiole setulose, 1–1.5 cm by 1.5 mm. — ♂ *Spikes* (PLEYTE 574) slender, subdensely strigose, 3–5 cm incl. the short peduncle, the flowers spaced. *Calyx* cupular, 0.5 mm, densely strigose. *Petals* 5, connate in the lower ⅔, greenish, laxly strigose at apex outside, 1.5–2 mm. Rudiment of *ovary* subcylindric, hairy. — ♀ *Inflorescence* only known in fruiting stage: rachis subdensely strigose, 3–4(–5) cm, slender (hardly 1 mm ø), *drupes* laxly arranged. Remnants of *calyx* densely, of *petals* laxly strigose. *Drupe* ovoid-ellipsoid, much compressed laterally, lateral crests rather sharp, laxly setulose, 1.5 by 1–1.3 by 0.8–1 cm in dry, said to measure 4 by 2 cm in fresh state; exocarp fleshy, yellow with orange hue, or reddish.

Distr. *Malesia*: W. New Guinea (Vogelkop Peninsula).

Ecol. Primary forest, also along creek in periodically flooded forest dominated by *Inocarpus*, from sea-level up to 45 m.

11. Rhyticaryum fasciculatum BECC. Malesia 1 (1877) 121, t. 4, f. 24 & 25 (fl. ♀); VALET. Crit. Overz. Olacin. (1886) 257; SCHELLENB. Bot. Jahrb. 58 (1923) 168; SLEUM. Blumea 17 (1969) 252.

Shrub, 1–2 m. Branchlets slender, youngest parts densely yellowish-substrigose. *Leaves* oblong to subovate-oblong, apex abruptly acuminate for 1, rarely up to 2 cm, tip rather blunt, base broadly cuneate, membranous to chartaceous, laxly to very laxly strigose on midrib and nerves, rarely also on veins beneath, glabrous otherwise, green or yellowish when dry, shining on both faces, 12–24 by 5–9 cm, nerves 8(–10) curved-ascending and looping pairs, prominent mainly on the undersurface, reticulation fine and rather dense, moderately raised on both sides; petiole strigose, 6–12 by 1.5 mm. — ♂ *Inflorescence* unknown. — ♀ *Flowers* 3–5(–7) very close to each other along a stout *c.* 6 mm long rachis, seemingly fascicled, densely strigose in all parts. *Calyx* cup-shaped, 1 mm incl. the short teeth. *Petals* fleshy, connate almost halfway, 1.8 mm. *Ovary* subconical, densely strigose, 1.5 mm. *Drupe* ± obliquely subovoid-ellipsoid, much flattened laterally and distinctly crested, laxly strigose, red, (1.3–)1.7–2 by (1–)1.5 by 0.7–0.9 cm; endocarp irregularly coarsely reticulate-alveolate.

Distr. *Malesia*: W. New Guinea (Vogelkop Peninsula).

Ecol. Lowland forest, apparently rare.

12. Rhyticaryum longifolium K. SCH. & LAUT. Fl. Schutzgeb. (1900) 415; Nachtr. (1905) 306; SLEUM. Blumea 17 (1969) 252. — *R. oncocarpum* K. SCH. & LAUT. Fl. Schutzgeb. (1900) 416; SCHELLENB. Bot. Jahrb. 58 (1923) 171. — *R.* ? *oxycarpum* (*non* K. SCH. & LAUT.) VALET. Bull. Dép. Agr. Ind. Néerl. 10 (1907) 30. — *Pocillaria pubescens* RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 28. — *R. bullatum* SCHELLENB. Bot. Jahrb. 58 (1923) 169. — *R. oblongum* SCHELLENB. *l.c.* 169. — *R. elongatum* SCHELLENB. *l.c.* 170. — *R. ovale* SCHELLENB. *l.c.* 171. — *R. racemosum* (*non* BECC.) SCHELLENB. *l.c.* 168; BIRNIE, Nova Guinea 14, 2 (1926) 276. — *Antidesma megalocarpum* SP. MOORE, J. Bot. 61 (1923) Suppl. 46. — *R. pubescens* (RIDL.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 250. — **Fig. 12.**

Sprawling shrub or small tree, 1–5 (rarely up to 15) m; bark greyish-brownish. Branchlets with laxly to subdensely strigose tips. *Leaves* oblanceolate, or oblong, or obovate-, sometimes elliptic-oblong, apex rather suddenly acuminate for 1–2 cm by 5 mm at base, tip acute or mostly bluntish, base cuneate to almost rounded, firmly chartaceous to subcoriaceous (more stiff at higher altitudes), usually olivaceous-green and somewhat shining on both faces in the dry state, glabrous except maybe some scattered appressed hairs on midrib and nerves of the undersurface, (6.5–)8–17(–25) by (2.5–)3–7(–10) cm, nerves 6–8(–10) pairs, curved-ascending and generally markedly looping, a little raised above, more distinctly so beneath, not rarely raised within a shallow depression above (the lamina not properly bullate, as the veins are never sunken above too), reticulation rather dense, considerably or usually

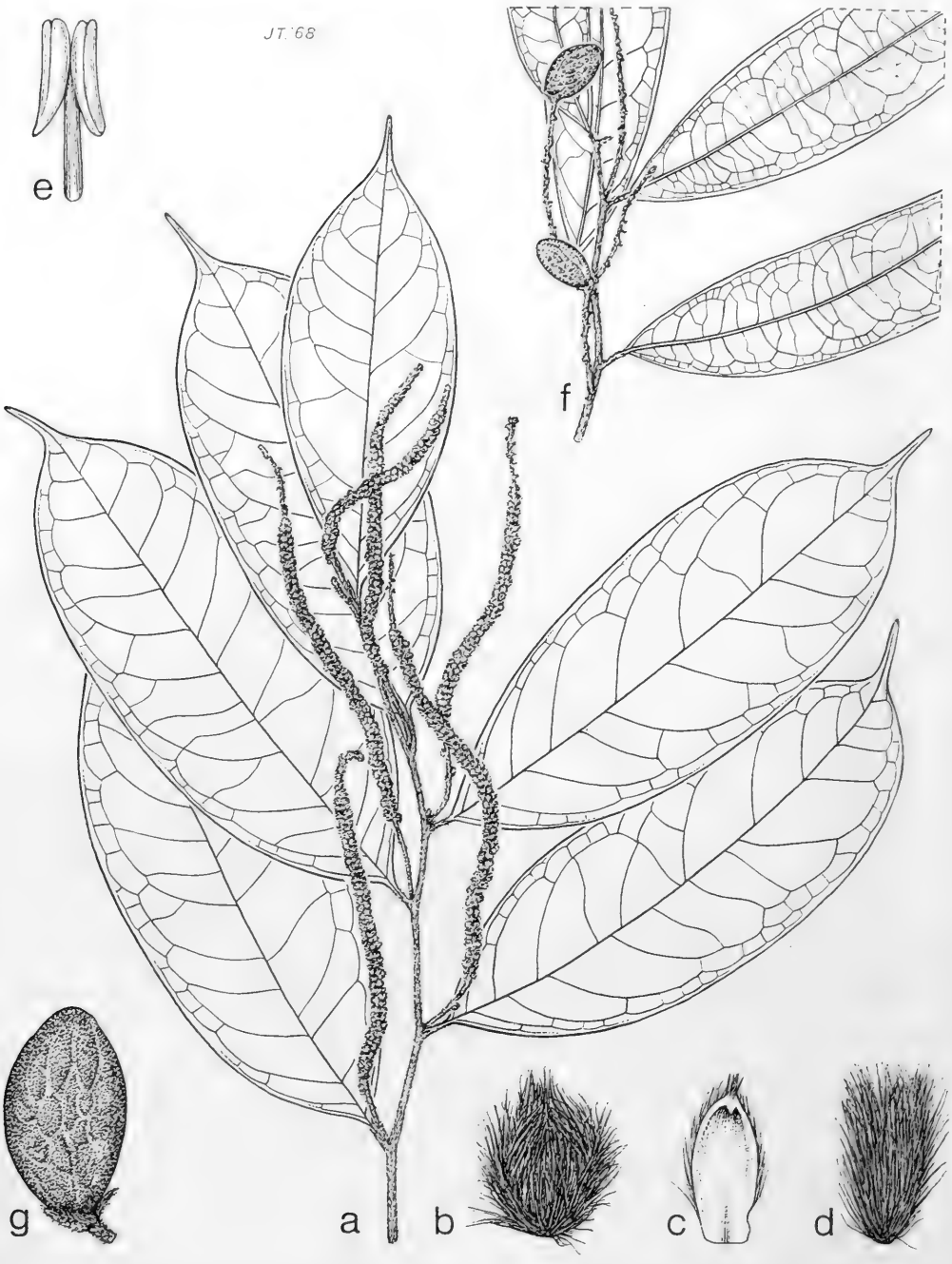

Fig. 12. *Rhyticaryum longifolium* K. SCH. & LAUT. *a.* Habit, ♂ specimen, ×½, *b.* ♂ flower bud, ×20, *c.* petal from inside, ×20, *d.* ♂ more developed flower, ×20, *e.* stamen, ×30, *f.* habit of ♀ specimen with fruits, ×½, *g.* fruit, ×1½ (*a–e* BW 10666, *f–g* VAN ROYEN & SLEUMER 6136).

more slightly raised on both faces; petiole (4–)6–17 by *c.* 1.5 mm. — ♂ *Spikes* solitary or sometimes few from the same axil, rather dense-flowered, (2–)4–10(–18) cm, in juvenile state all over pale rusty tomentose, in later stages densely short-strigose; rachis slender to more stoutish. *Calyx* cupular, 5-dented, low. *Petals* 4 or 5, connate halfway, yellow or greenish, sparsely to more densely strigose in the upper half outside, *c.* 2 mm. *Stamens* 4 or 5; filaments short. Rudiment of *ovary* with erect hairs. — ♀ *Spikes* generally shorter than the ♂ ones, and the rachis more stoutish. *Calyx* and *petals* as in ♂ flowers. *Ovary* ovoid-conical, densely strigose. *Drupe* ovoid-ellipsoid, much compressed laterally and crested, 2–2.3(–2.5) by 1.5(–1.7) by 0.8–1 cm, red to orange; endocarp hard, coarsely lacunose-reticulate.

Distr. NE. Australia (Queensland: Cape York Peninsula), Melanesia (Solomons); in *Malesia*: New Guinea.

Ecol. Substage of primary, sometimes also secondary forest, from lowland up to 1800 (–2500?) m, scattered.

Uses. The leaves are cooked and eaten by the natives in the Solomon Is.

Vern. *Aicaruar*, Wandammen, *badzehkiziwo*, Orokaiva, *beniros*, Wagau, *hahamen*, Kole, *kame game*, Kaugel, *kamokum*, Enga, *namsi*, Orne. In the Solomon Is.: *aiavea*, Kwara'ae.

7. HARTLEYA

SLEUM. Blumea 17 (1969) 218. — **Fig. 13.**

Dioecious tree. *Leaves* spirally arranged, entire, coriaceous, penninerved, petioled. *Inflorescences* axillary, 3–5 peduncled cymes arranged to a panicle. — ♂ *Flowers* unknown. — ♀ *Flowers* subsessile, crowded at the apex of the ultimate branches of the inflorescence; bracts minute, caducous. *Calyx* cup-shaped, 4–6-lobed halfway, lobes valvate. *Petals* 4, valvate, smooth inside. *Staminodes* 4, of the habit of apparently normal stamina, but without pollen; filaments flattened, glabrous; anther cells elliptic, medifixed, the connective between not produced beyond them. *Ovary* with a lateral gibbosity; stigma sessile, subcapitate, papillose, clearly set off from the ovary, subbilobed or depressed to one side. *Disk* unilateral, free, opposite the gibbosity of the ovary, a semiorbicular low truncate or subcrenate fleshy scale. *Drupe* curved, ovate-acuminate when seen from one side, exocarp thin, endocarp with numerous prominent nerves on the concave, and a thick median rib on the convex side, the latter covered with a fleshy appendage, the very apex excepted, and with a low semiorbicular fleshy free scale opposite the appendage, subtended by the remnants of the calyx. *Seed* not yet known.

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

Ecol. Montane forest.

Note. Closely allied to *Gastrolepis* TIEGH., a monotypic genus from New Caledonia, from which it differs by the subcapitate stigma, clearly set off from the ovary (in *Gastrolepis* rather small and on top of the gradually attenuate ovary), the large midrib on the concave side of the endocarp (which is not present in *Gastrolepis*), the squamular disk which is adnate only to the very base of the ovary, and otherwise free (adnate at base and both sides such as to form a pocket in *Gastrolepis*), and the unisexual flowers and glabrous filaments (bisexual and with numerous hairs in *Gastrolepis*).

1. Hartleya inopinata SLEUM. Blumea 17 (1969) 218. — **Fig. 13.**

Tree, 20–35 m, spreading, 60–120 cm ø; bark grey-brown, fissured lengthwise. Branchlets rather short, irregular, early corticate, 3–8 mm ø. *Leaves* elliptic or oblong-elliptic, apex short-acuminate, or obtuse, base cuneate to the petiole, subequal, coriaceous, brittle and brownish-blackish in dry specimens, dark shiny green above, yellowish-green or pale glaucous beneath in fresh state, glabrous, 5–8 by 2.5–4.5 cm, edge a little revolute, midrib slightly impressed above, bold beneath, nerves 5–6 pairs rather obscure on both faces, no reticulation; petiole 1 cm by 2 mm. *Inflorescences* panicled, branches (*c.* 1 cm) rather straight-horizontal, each ending with a cluster of cymosely arranged flowers, 3–4 cm, the short peduncle included, subdensely yellowish-pubescent especially apically. *Flowers* subsessile, ♀ only known. *Calyx* *c.* 1 mm. *Petals* oblong, glabrous, yellowish green, *c.* 3 mm. *Stamens* seemingly well-developed, but anther cells without pollen, 1 mm; filaments glabrous, *c.* 3 mm. *Ovary* ovoid, glabrous, with a lateral gibbosity, and a fleshy subtruncate semiorbicular free scale. *Drupe* curved, ovate-acuminate seen from one side, *c.* 1 cm by 4–5 mm;

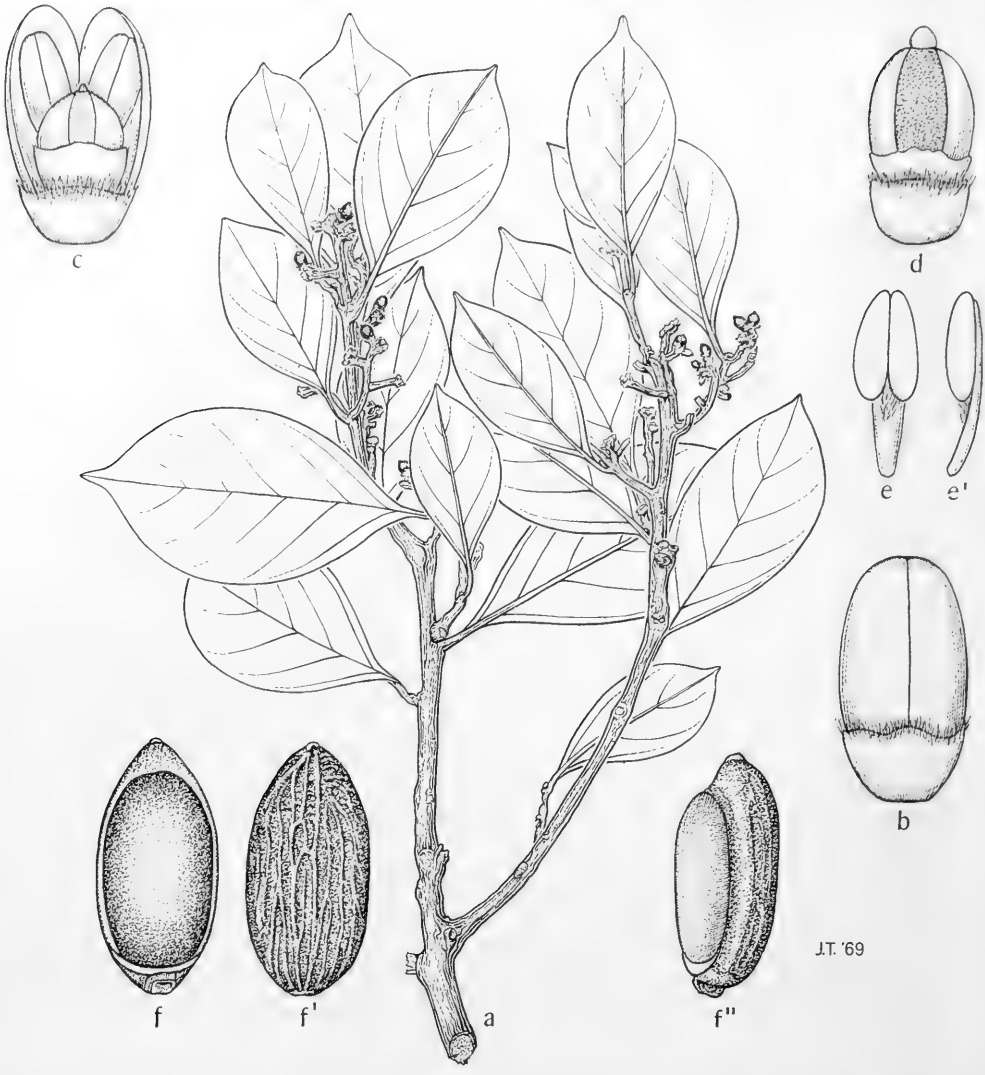

Fig. 13. *Hartleya inopinata* SLEUM. *a.* Habit, ×½, *b.* flower bud, ×7, *c. ditto*, with 2 petals removed, ×7, *d.* developed ovary, showing the vertical fleshy appendix and the basal scaly disk, ×5, *e.* sterile stamen from adaxial side, *e'. ditto*, laterally seen, ×7, *f.* submature fruit, adaxial view with large fleshy appendix, *f'. ditto*, dorsal view, *f''. ditto*, laterally seen, ×3 (*a–e* HARTLEY 12501 (type), *f* HARTLEY 11836).

exocarp thin, becoming blackish; endocarp with numerous longitudinal prominent nerves on the convex, and a strong mediane rib on the concave side, the latter almost completely covered with a fleshy flattened appendix, subtended at base by the lateral scale and the remnants of the calyx.

Distr. *Malesia*: New Guinea (Morobe Distr., twice found; possibly present in the Vogelkop Peninsula (sterile specimens only known)).

Ecol. Montane (also mossy) rain-forest, 1830–2400 m.

8. CODIOCARPUS

HOWARD, Brittonia 5 (1943) 53, f. 2, 3 e-f; SLEUM. Blumea 17 (1969) 188. — **Fig. 14.**

Dioecious tree. *Leaves* spirally arranged, entire, penninerved. *Inflorescence* axillary, generally solitary, the one-bracteate peduncle with several dichotomously branched distal branches, each branchlet with a several-flowered compact cyme of sessile small flowers, which are articulated at the base of the calyx. *Calyx* cup-shaped, shortly 5(–6)-dented. *Petals* 5(–6), valvate, apex minutely inflexed, shorter in the ♀ flower. — ♂ *Flowers*: *Stamens* 5(–6), exserted; filaments filiform, glabrous; anthers versatile, the cells oblong, slightly diverging below, dehiscing introrsally. Rudiment of *ovary* present. — ♀ *Flowers*: *Staminodes* 5(–6); filaments shorter than ovary; anthers much reduced in size, cells empty. *Ovary* subcylindric (upper part curved and contracted), with a lateral oblong swelling; stigma disk-like, obscurely 3-lobed. *Drupe* oblong, attenuate upwards, flattened, slightly curved; sarcocarp thin; endocarp thin, hard, with 3–5 (or more) ridges running the length of the convex surface, and a longitudinal mediane furrow, *i.e.* the funiculus with a pair of woody ribs on either side of the funiculus on the concave surface, both funiculus and ribs surmounted by an oblong fleshy appendix extending over the whole length of the fruit, or even surpassing it a little. *Seed* 1, with copious endosperm and a minute embryo.

Distr. Two very closely related *spp.*, one in the Andaman and Nicobar Is., the other in *Malesia*: Philippines (Mindoro, Palawan). Fig. 15.

Ecol. Lowland primary forest.

1. Codiocarpus merrittii (MERR.) HOWARD, Brittonia 5 (1943) 56, f. 2, 3 e–f (wood anat.); DAHL, J. Arn. Arb. 33 (1952) 267, f. 47 & 47 A (pollen); SLEUM. Blumea 17 (1969) 189. — *Stemonurus merrittii* MERR. Philip. J. Sc. 3 (1908) Bot. 240. — *Tylecarpus merrittii* (MERR.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 237. — *Medusanthera merrittii* (MERR.) SLEUM. *ibid.* (1941) 364. — **Fig. 14.**

Tree, 5–15(–30) m, up to 25 cm ø, sometimes fluted. Branches horizontally spreading. Branchlets and petioles (1–2 cm) shortly appressedly yellowish-pubescent, glabrate. *Leaves* oblong-elliptic to elliptic, apex shortly rather abruptly acuminate, tip obtuse, base broadly cuneate to rounded, slightly inequilateral and decurrent on the petiole, thin-coriaceous to almost chartaceous, glabrous above, finely appressedly yellowish-hairy beneath, ultimately glabrate, lower surface often minutely tuberculate in dry, apparently yellowish-green in fresh specimens, with numerous fine pellucid points against strong light, 15–20(–28) by 5–10 cm, midrib grooved above, much raised beneath, nerves 8–10 rather straight to curved-ascending pairs, obscurely inarching before the edge, generally prominent beneath; petiole (1.5–)2–2.5 cm by 2–2.5 mm. *Inflorescence* with a rather thick peduncle 1–2.5 cm, 2–3-chotomous, the branches short, thickish, each with several cymosely and compactly arranged sessile flowers, all over covered with yellowish-greyish and ± appressed hairs. *Calyx c.* 1.5 mm, lobes very short. *Petals* oblong, a little fleshy, white, hairy outside and at the thickened inflexed apex inside, otherwise glabrous, 4–5 mm in the ♂, *c.* 3 mm in the ♀ flowers. — ♂ *Flowers*: *Filaments c.* 5 mm; anthers *c.* 1 mm. Rudiment of *ovary* elongate-conical, *c.* 2 mm. — ♀ *Flowers*: *Staminodes* a little shorter than the ovary; filaments weak; anther cells much reduced in size, empty. *Ovary* subcylindrical, glabrous. *Drupe* oblong, though narrowed gradually upwards, (1.8–)2–2.5 by 0.6–0.8 cm, greenish-whitish, with 3–5 prominent longitudinal and several oblique short ribs on the dorsal convex, and a creamy-white fleshy oblong appendage on the much deepened ventral surface.

Distr. *Malesia*: Philippines (Mindoro, Palawan). Fig. 15.

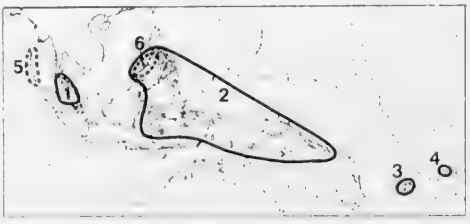

Fig. 15. Distribution of the species of *Medusanthera* (———) and *Codiocarpus* (– – –). 1. *M. gracilis* (KING) SLEUM., 2. *M. laxiflora* (MIERS) HOWARD, 3. *M. samoensis* (REINECKE) HOWARD and *M. ovata* HOWARD, 4. *M. vitiensis* SEEM., 5. *C. andamanicus* (KURZ) HOWARD, 6. *C. merrittii* (MERR.) HOWARD.

Ecol. Dense lowland forest, under partial shade up to 200 m, on clayey soil or fertile humus. *Fl. fr.* Jan.–Dec.

Uses. Wood dense and hard, yellowish-white, used for house posts.

Vern. Palawan: *apitong*, *kalas-kalas*, *panabâ*, *tibalao*, Tagb.

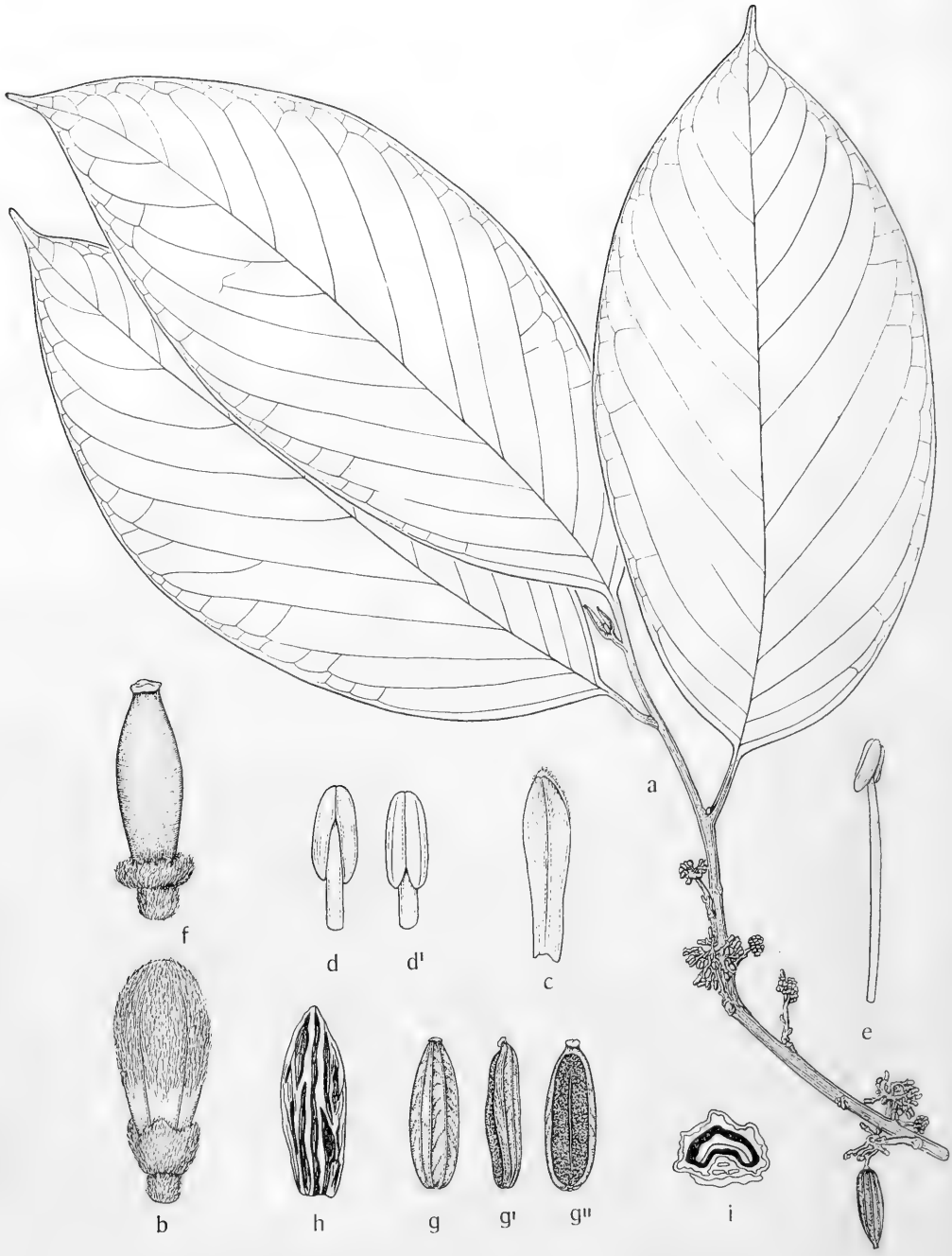

Fig. 14. *Codiocarpus merrittii* (MERR.) HOWARD. *a.* Habit, ×½, *b.* flower bud, ×7½, *c.* petal inside, ×7½, *d.* anther, dorsal side, ×10, *d'.* anther, ventral side, ×10, *e.* stamen, ×7½, *f.* ovary, ×7½, *g.* drupe, dorsal side, ×1, *g'.* drupe, lateral view, ×1, *g''.* drupe, ventral side with fleshy appendage, ×1, *h.* endocarp (exocarp removed) showing the two free ribs on the ventral side, ×1½, *i.* drupe in cross-section, showing the two free ribs of the ventral side covered by the appendage, ×1½ (*a–f* EIMER 12622, *g–i* ELMER 12842).

9. MEDUSANTHERA

SEEM. J. Bot. 2 (1864) 74; HOWARD, J. Arn. Arb. 21 (1940) 469; Lloydia 6 (1943) 133; SLEUM. Blumea 17 (1969) 226. — *Tylecarpus* ENGL. in E. & P. Nat. Pfl. Fam. 3, 5 (1893) 247; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 413 ('*Tilecarpus*'); SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 246; in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 362, f. 103, A & B. — **Fig. 16.**

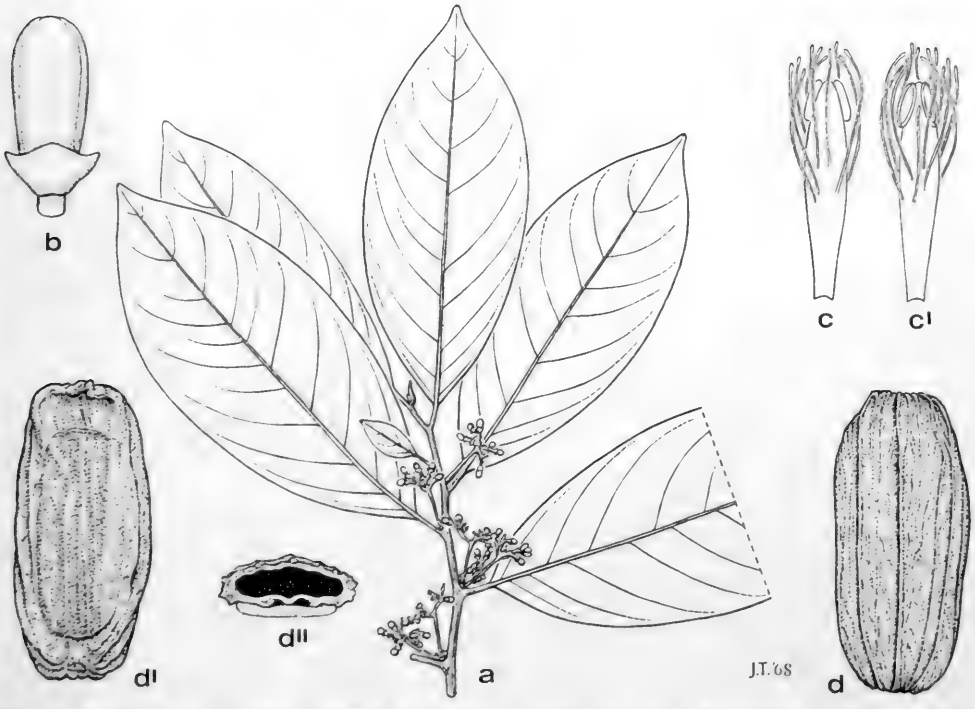

Fig. 16. *Medusanthera laxiflora* (MIERS) HOWARD. *a.* Habit, ×½, *b.* ♂ flower bud, ×7½, *c.* stamen, dorsal view, ×10, *c'. ditto*, ventral view, ×10, *d.* drupe in dry state, dorsal view, showing the prominent ribs of the endocarp, ×2½, *d'. ditto*, ventral view with large appendage, ×2½, *d''. ditto*, cross-section, showing a low rib on either side of the median depression of the ventral side covered by the appendage, ×2½ (*a–c* BSIP 61 WALKER & WHITE, *d–d''* BW 3686 KALKMAN).

Dioecious trees. *Leaves* spirally arranged, subdistichous, entire, penninerved. *Panicles* 1–2(–3) per axil, 2–3-chotomized, the branches cymose, peduncled; pedicels short, articulated with the calyx. *Calyx* cupular, small, obscurely 5-toothed. *Petals* 5, valvate, lanceolate-oblong, apex inflexed. — ♂ *Flowers*: Flower bud clavate. *Stamens* 5; filaments flattened and fleshy, rather abruptly narrowed to the connective, at least the ones of the functional stamens bearing few to numerous long-clavate hairs dorsally at the connective and ventrally below the anther; anthers elliptic-oblong, slightly surpassing the connective, the cells diverging below. *Ovary* rudimentary, with a generally rather distinct lateral swelling. — ♀ *Flowers*: Flower bud cucullate. *Staminodes* with filaments reduced in size and generally glabrous, the anther cells minute, void of pollen. *Ovary* subcy-

lindrical, early curved, with a distinct lateral swelling; stigma sessile, umbilicate-subcapitate, lobes 3–5, very short. *Drupe* oblong to elliptic, rounded-truncate at both ends, or subovate and attenuate upwards, flattened and curved, the concave side with a large oblong pulviniform fleshy appendage superficial to the sarcocarp, the latter rather thin, also filling the groove on the concave side of the tenuous or almost woody thin endocarp, which bears 1–3(–5) prominent longitudinal ridges on the convex and maybe two fainter ones on the concave or flat side. *Seed* 1; endosperm abundant; embryo apical, minute.

Distr. About 4 or 5 *spp.*, 2 (or 3) in Fiji and Samoa, in *Malesia* 2 *spp.*, one in Sumatra and Malaya and one from the Philippines and Celebes to the Carolines, Bismarcks and Solomons. Fig. 15.

Ecol. Primary and secondary lowland (also coastal) and lower montane rain-forest.

KEY TO THE SPECIES

1. Leaves with (4–)5–6 (rarely –8) pairs of lateral nerves. Petals 2–2.5 mm. Drupe subovate-oblong, apex gradually attenuate and subacute, base obtuse-truncate, 1.2–1.5 by 0.5–0.6(–0.7) cm. **1. M. gracilis**

1. Leaves with (6–)8–10(–12) pairs of lateral nerves. Petals 3–4 mm. Drupe broad-oblong, obtuse-truncate at both ends, 1–1.5(–2) by 0.6–0.8(–1) cm. . . . . **2. M. laxiflora**

1. Medusanthera gracilis (KING) SLEUM. Blumea 17 (1969) 226; Fl. Thail. 2 (1970) 77. — *Gomphandra gracilis* KING, J. As. Soc. Beng. 64, ii (1895) 115; RIDL. Fl. Mal. Pen. 1 (1922) 429, *incl. var. gracillima* RIDL. *l.c.* 430. — *Gomphandra lanceolata* (MAST.) KING *var. angustifolia* KING *ap.* RIDL. Fl. Mal. Pen. 1 (1922) 429, *p.p.* — *Gomphandra yatesii* MERR. Pap. Mich. Ac. Sc. 19 (1934) 165, t. 28. — *Stemonurus yatesii* (MERR.) HOWARD, J. Arn. Arb. 21 (1940) 469; DAHL, *ibid.* 33 (1952) 268 (pollen).

Shrub or small tree, rarely up to 10 m and 20 cm ø; bark smooth, grey-green. Branches hanging. Branchlets striately-angular, early corticate, tips slender and short-pubescent. *Leaves* lanceolate or oblong-lanceolate, sometimes oblong, apex subacutely acuminate and often falcate for 2–3 cm, base much narrowed, membranous, light green, dull, glabrous or sometimes with sparse fine short hairs on the undersurface and/or the midrib, showing numerous fine pores against strong light, the undersurface mostly set with fine tubercles, (5–)8–13(–20) by (1–)2–4(–8) cm, variable in size, edge subentire, midrib distinctly, nerves slightly impressed above, prominent beneath, nerves (4–)5–6 (rarely –8) spreading pairs, reticulation practically obscure; petiole slender, (0.6–)1–1.5 cm. Peduncles axillary and pseudoterminal, very slender, 2–4(–7) cm, short-hairy as are the partial inflorescences, these cymose, ultimate ones umbellate and few-flowered, pedicels very short. — ♂ *Flowers*: Buds obovate. *Calyx* cupular, 1 mm. *Petals* oblong, finally reflexed, glabrous, greenish-whitish, 2(–2.5) mm. — ♀ *Flowers*: Buds subglobose. *Calyx* and *petals* as in ♂ flowers. *Ovary* oblongoid, 2 mm. *Drupe* subovate-oblong, flat and curved, base obtuse-truncate and hollow, apex gradually attenuate and subacute, 1.2–1.5 by 0.5–0.6(–0.7) cm, glossy, with a fleshy oblong whitish appendage on the much depressed ventral, and a marked longitudinal distinct rib parallel with a few lateral less distinct ones on the dorsal (convex) face.

Distr. S. Thailand; in *Malesia*: Sumatra (Eastcoast, Tapanuli), Malay Peninsula. Fig. 15.

Ecol. Dense lowland jungle or hillside, also open bamboo forest, rarely up to 1840 m. *Fl. fr.* Jan.–Dec.

Vern. *Kaju si gorga*, Asahan, *sampin kris*, Kelantan, M.

2. Medusanthera laxiflora (MIERS) HOWARD, J. Arn. Arb. 21 (1940) 470; Lloydia 6 (1943) 142; DAHL, J. Arn. Arb. 33 (1952) 269, f. 53 and 53 A (pollen); SLEUM. Blumea 17 (1969) 227. — *Platea laxiflora* MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 111, repr. Contr. Bot. 1 (1852) 98, t. 16; VALET. Crit. Overz. Olacin. (1886) 255. — *Stemonurus laxiflorus* MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 111, repr. Contr. Bot. 1 (1852) 98, *nom. event.*; MERR. Philip. J. Sc. 3 (1908) Bot. 240. — *Cissus flexuosa* TURCZ. Bull. Soc. Nat. Moscou 31, i (1858) 415; PLANCH. in DC. Monogr. Phan. 5 (1887) 624. — *Lasianthera papuana* BECC. Malesia 1 (1877) 108, t. 3; VALET. Crit. Overz. Olacin. (1886) 240; BOERL. Handl. 1, 1 (1890) 212. — *Gomphandra laxiflora* (MIERS) ROLFE, J. Bot. 23 (1885) 211; VIDAL, Phan. Cuming. Philip. (1885) 25, 103; Rev. Pl. Vasc. Filip. (1886) 86; MERR. En. Philip. 2 (1923) 490. — *Tylecarpus papuanus* (BECC.) ENGL. in E. & P. Nat. Pfl. Fam. 3, 5 (1893) 247, f. 138, A & B; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 413; SCHELLENB. Bot. Jahrb. 58 (1923) 159; BIRNIE, Nova Guinea 14, 2 (1926) 275. — *Tylecarpus sp.*, PULLE, Nova Guinea 8 (1912) 658. — *Gomphandra glabra* MERR. Philip. J. Sc. 17 (1920) 277; En. Philip. 2 (1923) 490. — *Gomphandra carolinensis* KANEH. Fl. Micron. (1933) 198 (*japon.*) f. 85, *nom. seminud.*; Bot. Mag. Tokyo 47 (1933) 673; J. Dep.

Agr. Kyushu Imp. Un. 4 (1935) 358. — *Tylecarpus carolinensis* (KANEH.) KANEH. & HATUS. Bot. Mag. Tokyo 50 (1936) 605. — *M. glabra* (MERR.) HOWARD, J. Arn. Arb. 21 (1940) 469, t. 2, f. 8–15; Lloydia 6 (1943) 140, t. 11, f. 1–4; Brittonia 5 (1943) 55, f. 3 a (wood anat.); DAHL, J. Arn. Arb. 33 (1952) 269, f. 55 & 55 A (pollen). — *M. carolinensis* (KANEH.) HOWARD, J. Arn. Arb. 21 (1940) 469; Lloydia 6 (1943) 142; WALKER, For. Fl. Br. Solomon Is. (1948) 127; DAHL, J. Arn. Arb. 33 (1952) 269, f. 56 & 56 A (pollen). — *M. papuana* (BECC.) HOWARD, J. Arn. Arb. 21 (1940) 469; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 363, f. 103, A & B; HOWARD, Lloydia 6 (1943) 137; DAHL, J. Arn. Arb. 33 (1952) 269, f. 52 (pollen). — *Tylecarpus coriifolius* SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 236. — *Tylecarpus peekelii* SLEUM. *l.c.* 237. — *M. coriifolia* (SLEUM.) SLEUM. *ibid.* (1941) 364; HOWARD, Lloydia 6 (1943) 138. — *M. peekelii* (SLEUM.) SLEUM. Notizbl. Berl.-Dahl. 15 (1941) 364; HOWARD, Lloydia 6 (1943) 138. — **Fig. 16.**

Tree, rarely shrub, (3–)7–15(–27) m, bole straight, terete, 5–25(–30) cm ø, branches spreading ± horizontally; buttresses generally absent, rarely up to 1.2 m; bark smooth, with shallow longitudinal cracks, greenish-grey to brownish. Branchlets and petioles sparsely appressed-hirsutulous to glabrate. *Leaves* elliptic to oblong or obovate-elliptic, apex generally shortly and ± abruptly acuminate, rarely obtuse, base cuneate to rounded, thin-coriaceous to chartaceous, dark green and glossy above, greyish-green below when fresh, with very numerous round minute pellucid pores against strong light, lower surface minutely granular in dried specimens, glabrous, (9–)12–21 by (3–)4.5–8 cm, midrib sulcate above, prominent and maybe sparsely appressedly hairy beneath, nerves (6–)8–10(–12) pairs (with some shorter additional sometimes between them), rather straight to curved-ascending, ± distinctly anastomosing before the edge, sunken above, slightly raised beneath, veins rather obscure; petioles 1–1.5(–2) cm. *Panicles* generally solitary and with a slender peduncle (0.5–3 cm), 2–3-chotomized, each branch bearing one to several cymes, all over ± densely appressedly hirsutulous, the calyx and petals generally excepted. Pedicels slender, short. *Calyx* cup-shaped, tube ± contracted at base, 1 mm, limb spreading, 1 mm, minutely 5-dented. *Petals* oblong, 3–4 by *c.* 1 mm, sordid-white to greenish. — ♂ *Flowers*: *Filaments* 2–3 mm, persistently clavate-hairy to barbate in the upper part; anthers *c.* 1 mm. Rudiment of *ovary* conical. — ♀ *Flowers*: Sterile *stamens* frequently glabrate, not much smaller than in the ♂ flowers; cells empty. *Ovary* subcylindrical, *c.* 3 mm, curved, with a basal minute swelling; stigma subcapitate, with 2–3 minute rounded lobes initially, and numerous very short lobules in later stages. *Drupe* broad-oblong obtuse at both ends, curved, base hollow, 1–1.5(–2) by 0.6–0.8(–1) cm, sarcocarp thin, green to purplish, bearing on the convex side an oblong fleshy white to pinkish (rarely yellowish or purplish) pad for almost the entire length, which is thin in the dry state; endocarp thin, hard, bearing at the concave side 3(–5) longitudinal ridges ± sharply prominent in the dry fruit.

Distr. Micronesia (Carolines: Palau) and Melanesia (Solomons); in *Malesia*: Philippines (S. Luzon, Mindoro, Leyte, Samar, Mindanao, Palawan), Central & SE. Celebes, Moluccas (Halmahera, Obi and Kai Is.), and all over New Guinea. Fig. 15.

Ecol. Understorey of lowland primary and secondary rain-forest, also in coastal plain forest and swamp forest, on sandy and clayey soil, on limestone and coral, 0–300(–900) m, once found in the Western Highlands at 1740 m. *Fl. fr.* Jan.–Dec.

Disp. The fruits are reported to be favoured by cassowary.

Uses. The wood is whitish to yellowish, medium hard and heavy, with coarse prominent rays, apparently used only as firewood. The leaves are used orally by natives against malaria in New Guinea (Tufi Distr.).

Vern. Celebes: *tambai*, Tobela; Moluccas: *modo*, Halmahera; New Guinea: *assi*, Ramu, *balapi*, Dumpu, *bieroow*, Kebar, *bobowè*, Manikiong, *guarom*, *sukumisip*, Sepik, *kenè*, Biak, *labak*, Mooi, *mont*, Faita, *nodag*, Bilia, *siganapa*, Orokaiwa (Mumuni), *sisimal*, Amele, *surupa*, Baruba, *turin*, Onjob (Naukwate), *wagewageia*, *wanigela*, Minufia, (Kabubu), *wom*, Numfur, *wugatep*, Sepik (Maprik); New Britain: *lamoro*; Solomon Is.: *aialo*, *aikunu*, *aimaemae*, *aimalmal*, *mae mae*, Kwara'ae; Bougainville: *diroka*, *diroma*, *guam*, *kiana*, *yemollew*.

Note. The species is understood here in a wide sense as the great amount of specimens at hand effaces differences formerly regarded as sufficient for the discrimination of species. *M. glabra* was based on a specimen with unripe fruits.

10. APODYTES

E. MEYER *ex* ARN. in Hook. J. Bot. 3 (1840) 155; SLEUM. Blumea 17 (1969) 184. — **Fig. 17.**

Trees. *Leaves* spirally arranged, entire, penninerved, nigrescent. *Flowers* bisexual, in terminal and axillary corymbs (in Mal.), small, cylindric in bud, articulate with the short pedicel. *Calyx* cup-shaped, (4–)5-denticulate, persistent. *Petals* (4–)5, free or a little coherent at base, valvate in bud, finally spreading,

Fig. 17. *Apodytes dimidiata* E. MEYER *ex* ARN. *a.* Habit, ×⅔, *b.* petal inside, ×6⅔, *c.* ovary, ×6⅔, *d.* anther, back side, ×3⅓, *d'.* anther, front side, ×3⅓, *e.* drupe, ×1⅓ (*a–d* KOSTERMANS *c.s.* 289, *e* BON 4861).

linear, glabrous, obscurely keeled on the inner side, with a shortly inflexed apex. *Stamens* 5, almost as long as the petals; filaments subulate, glabrous; anther cells linear-oblong, sagittate below, introrse, medifixed, dehiscing by lateral slits. *Disk* absent. *Ovary* oblique, with an unilateral swelling; style thick, ± excentric, ending in a small slightly oblique stigma. *Drupe* ± unilaterally developed, obliquely ellipsoid and ± compressed, the style finally lateral to almost basal and the lateral appendage large and succulent; endocarp crustaceous; embryo in the top of the albumen, small. *Seed* 1, compressed, ovate-reniform, testa thin.

Distr. Two *spp.*, one in Queensland, one from *Malesia* through SE. Asia to Africa.

1. Apodytes dimidiata E. MEYER *ex* ARN. in Hook. J. Bot. 3 (1840) 155; BENTH. Trans. Linn. Soc. 18 (1841) 680, 683, t. 41, *sens. lat.*; SLEUM. Blumea 17 (1969) 185 (with synonyms of *spp.* in S. and SE. Asia); Fl. Thail. 2 (1970) 81. — *A. cambodiana* PIERRE, Fl. For. Cochinch. (1892) t. 267, f. A; GAGNEP. Fl. Gén. I.–C. 1 (1911) 834; KOORD. Atlas 1 (1913) t. 117; MERR. J. Arn. Arb. 6 (1925) 136; CRAIB, Fl. Siam. En. 1 (1926) 273; SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 243; HOWARD, J. Arn. Arb. 23 (1942) 73; GAGNEP. Fl. Gén. I.–C. Suppl. (1948) 756; AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 5; DAHL, J. Arn. Arb. 33 (1952) 263, f. 36 & 36 A (pollen); BACK. & BAKH. *f.* Fl. Java 2 (1965) 61. — *A. javanica* K. & V. Bull. Inst. Bot. Btzg 2 (1899) 3; Bijdr. 5 (1900) 159; KOORD. Nat. Tijd. N. I. 60 (1901) 383; Jungh. Gedenkb. (1910) 175; BACK. Schoolfl. Java (1911) 226; KOORD. Exk. Fl. Java 2 (1912) 531; KOORD.-SCHUM. Syst. Verz. 1,

Fam. 162 (1912) 5. — *Mappia philippinensis* MERR. Philip. J. Sc. 26 (1925) 467; En. Philip. 4 (1926) 249. — *Neoleretia philippinensis* (MERR.) BAEHNI, Candollea 7 (1936) 180. — *Nothapodytes philippinensis* (MERR.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 247. — *A. sp.*, ENDERT, Med. Proefst. Boschw. Ned. Ind. 20 (1928) 211, 216. — **Fig. 17.**

Tree, (10–)15–30 m, bole clear, crown high and lax, trunk (20–)40–70 cm ø; bark rough, dark grey to brown, thin. Branchlets with sparse oblong small lenticels. *Leaves* oblong- to ovate-elliptic, apex mostly shortly acutely acuminate, rarely obtuse, base often unequal, acute or unilaterally obtuse-rounded, a little decurrent on the petiole, herbaceous to thin-coriaceous, dark green and shining when fresh, brownish-blackish when dry, with fine ± appressed and crisped yellowish hairs on midrib above, petioles and inflorescences, otherwise practically glabrous, entire, (5–)6–13 by (2.5–)3–6 cm, midrib slightly impressed above, prominent beneath, nerves 6–10 spreading pairs, a little raised beneath only, the finest veins mostly ending with free ends within the network of finer nerves; petiole 1–2 cm. *Corymbs* many-flowered, 3–8 cm incl. the 1–3 cm long peduncle, their branches in a ± right angle. Flower buds oblong. *Calyx* cup-shaped, almost glabrous, *c.* ¾ mm, teeth short, pubescent outside. *Petals* oblong, white to yellowish, fragrant, 5–6 mm. *Filaments* 1.5 mm; anther cells oblong, yellow, 3.5 mm. *Ovary* narrow-ovoid, ± densely pubescent; style thick, white, 2.5 mm. *Drupe* obliquely ellipsoid, compressed, veined, first dark purple, in fully mature state blackish and shining, *c.* 5 by 9 mm, with a lateral juicy greenish, finally scarlet appendage, and the lateral style almost at its base.

Distr. Tropical and subtropical NE. to S. Africa & Angola, Madagascar, Comores, Réunion, Mauritius, Ceylon, S. India, Annam, Burma, Thailand, Indo-China, Hainan, Yunnan; in *Malesia*: Sumatra (Eastcoast), Malay Peninsula, Java (extreme western part), Lesser Sunda Is. (E. Sumba, Flores, W. Timor), N. Borneo (Mt Kinabalu, Mt Trusmadi), Philippines (Mindanao: Bukidnon), Moluccas (Batjan: Mt Sibela). Fig. 18.

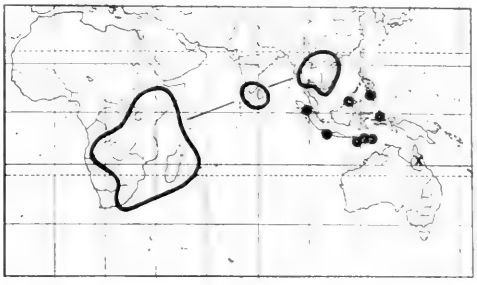

Fig. 18. Distribution of *Apodytes*. *A. dimidiata* E. MEYER *ex* ARN.: ——— approximate area in Africa and SE. Asia, ● localities in Malesia. × *A. brachystylis* F.v.M.

Ecol. Primary rain-forest, on steep slopes or in ravines, edge of stream, on rich maybe volcanic soil, rare, 800–2000 m. *Fl.* Febr.–Sept., *fr.* April–Nov.

Uses. The leaves are of a bitter and adstringent taste. Wood light brown or yellowish, used in Indo-China for cabinet work, described by MOLL & JANSSONIUS, Mikr. 2 (1908) 244, f. 107 (*A. javanica*).

Vern. *Ki badak*, S, *kakomba*, Sumba, *simarbilalang*, Batak.

Note. The species is conceived here in a broad sense. The special form occurring in Malesia, described above, is almost matched by forms or varieties found in Africa and Madagascar. Pending a revision of the genus, it seems advisable not to give a proper name on the varietal level to the Malesian specimens.

11. MERRILLIODENDRON

KANEH. Bot. Mag. Tokyo 48 (1934) 920, f. 7; *l.c.* 956 (*japon.*); SLEUM. Blumea 17 (1969) 228. — *Peekeliodendron* SLEUM. Notizbl. Berl.-Dahl. 13 (1937) 509. — **Fig. 19.**

Shrub or generally tree. *Leaves* spiral, entire, penninerved. *Flowers* bisexual, arranged in lax cymes to elongate panicles, these 1–3 in foliate or defoliate axils, or from older branches resp. from trunk. Pedicels articulated with calyx. *Sepals* (3–)4–5, connate to a cup in the lower, free (and not imbricate) in the upper half. *Petals* (4–)5, free, valvate, tip inflexed, villous inside, reflexed in anthesis, early caducous. *Stamens* 5; filament dilated, short, glabrous; anthers elliptic, cells introrsely and longitudinally dehiscent, exceeded by the connective in form of subulate glabrous apiculus. *Ovary* ovoid, tapering to a thick-filiform style; stigma punctiform. *Drupe* large; exocarp thin-coriaceous, smooth, early decaying; endocarp first coriaceous and hard, becoming corky and irregularly ± longi-

tudinally lacunose in its outer, and woody (not hollowed) in its inner part in later stages. *Seed* 1, large; endosperm copious, fibrous, starchy; embryo foliaceous.

Distr. Monotypic, scattered over Micronesia, Melanesia, and *E. Malesia*. Fig. 20.

1. Merrilliodendron megacarpum (HEMSL.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 243; in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 366, f. 104 (fr.); BALGOOY in Steen. & Balgooy, Pac. Pl. Areas 2 (1966) 176 (distr. map); SLEUM. Blumea 17 (1969) 228. — *Stemonurus* ? *megacarpus* HEMSL. in Hook. Ic. Pl. 24 (June 1895) t. 2398; Kew Bull. (June/July 1895) 133; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 414; SCHELLENB. Bot. Jahrb. 58 (1923) 164. — *Mangifera xylocarpa* LAUT. Bot. Jahrb. 56 (1921) 354. — *M. rotense* KANEH. Bot. Mag. Tokyo 48 (1934) 920, f. 7; *l.c.* 956 (*japon.*); J. Dep. Agr. Kyushu Imp. Un. 4 (1935) 359; KANEH. & HATUS. Bot. Mag. Tokyo 54 (1940) 435, f. 82 & 83 (phot., fl. & fr.); HOSOKAWA, J. Jap. Bot. 16 (1940) 540; MERR. & PERRY, J. Arn. Arb. 27 (1946) 324; DAHL, *ibid.* 33 (1952) 265 (pollen). — *Peekeliodendron missionariorum* SLEUM. Notizbl. Berl.-Dahl. 13 (1937) 510. — **Fig. 19.**

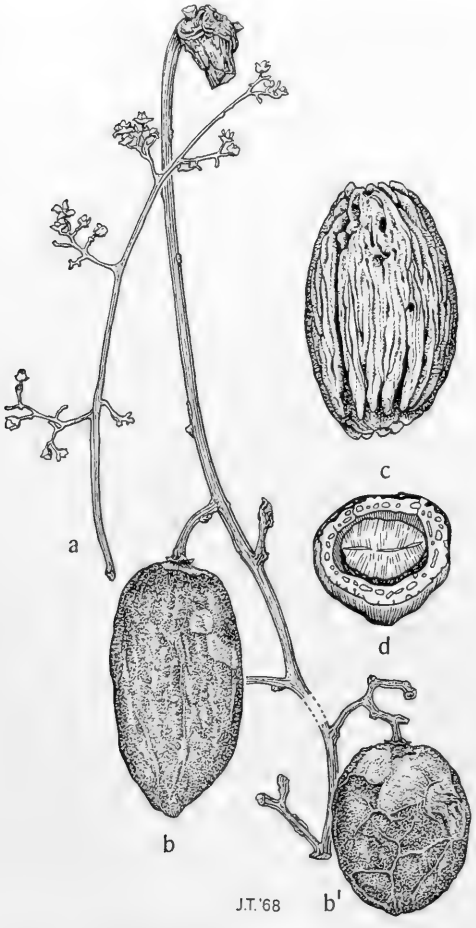

Fig. 19. *Merrilliodendron megacarpum* (HEMSL.) SLEUM. *a.* Inflorescence, *b* & *b'*. infructescence, the drupes still covered with the thin-leathery exocarp, *c.* old weatherbeaten fruit, showing the spongious endocarp, *d. ditto*, transverse section, all ×½ (*a* BSIP 2017, *b* BSIP 4827, *b'* NGF 27224, *c–d* NGF 10925).

Shrub, or generally tree, (3–)6–15(–25) m, bole straight, sometimes fluted, up to 55 cm ø; bark green-grey to light brown, smooth, shed in irregular soft flakes; blaze yellow with orange streaks. *Leaves* oblong to oblong-ovate, apex shortly attenuate, mostly blunt, rarely acutish, base broadly cuneate to rounded, thin-coriaceous, glabrous, showing numerous minute pellucid points against strong light, (15–)20–30 by 7–11(–16) cm, in suckers or young shoots up to 36 by 17 cm, entire, midrib strongly obtusely prominent beneath, nerves (8–)10–12 curved-ascendent pairs faintly looping before the edge, veins obliquely transverse, reticulation rather indistinct; petiole 1.5–2 cm. *Panicles* composed of short lateral cymes, laxly many-flowered, 1–3 in foliate or already defoliate axils, or from the wood of old branches and/or trunk, 7–20 cm, lower branches up to 9 cm, upper ones 2–4 cm; peduncle 2–5 cm, with a basal swelling, glabrous or sparsely appressedly and coarsely hairy, slender in anthesis, stout (2 mm ø) in fruiting stage as is the rachis. Pedicels slender and 4–6 mm in anthesis, stoutish and *c.* 1 cm in fruit. *Sepals* suborbicular, connate in the lower half, lobes 1–1.5 mm. *Petals* ovate-oblong, a little fleshy, dull cream or yellow to purplish, 3–4 by 1.5 mm, glabrous outside, ± densely yellowish-villous inside. *Stamens* 2–3 mm; filaments *c.* 0.7 mm; connective hairy, exceeding the oblong anther cells (1.5 mm) by *c.* 0.8 mm. *Ovary* 2.5 mm. *Drupe* pendulous, oblongoid to ellipsoid, rarely ovoid-oblongoid, slightly laterally or subquadrangularly compressed, (4–)6–10 by (2–)3–6 cm, exocarp coriaceous, whitish or yellow to purplish when fresh and already fully ripe, becoming purplish to blackish in older stages or when dry, smooth, thin, early dissoluted; endocarp remaining woody and massive in the inner part (1–2 mm), becoming corky or spongious and irregularly longitudinally grooved and/or lacunose-excavated in the outer part (3–5 mm) when exposed to sea-water. *Seed* starchy, 4–6 by 2–2.5 cm.

Distr. Micronesia (Marianas: Rota & Guam; Carolines: Kusaie), in Melanesia scattered on New Ireland, New Britain, the Solomons, and the Santa Cruz Is. (Vanikoro I.); in *Malesia*: Philippines (once in Palawan), SE. Celebes (Muna I.),

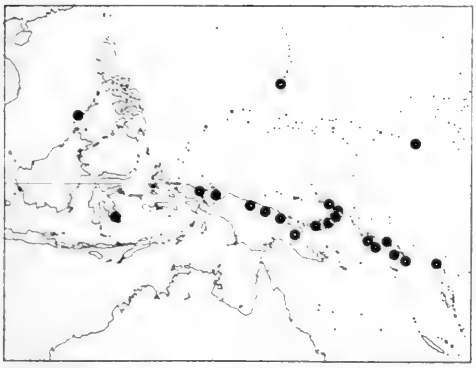

Fig. 20. Distribution *Merrilliodendron megacarpum* (HEMSL.) SLEUM.

and scattered in Northern New Guinea. Fig. 20.

Ecol. Generally coastal and lowland partly swampy rain-forest, at 3–30 m (on Japen I. said to occur at 700 m), on the inland edge of mangrove, on sandy or coral beaches, also on volcanic soil, in moist places, often near streams or in freshwater swamp forest, locally not rare, though apparently scattered in general. *Fl. fr.* Jan.–Dec.

Disp. The corky or spongious part of the endocarp gives the fruit its power of buoyancy, and dispersal is obviously effected or facilitated by sea-currents and freshwater streams.

Uses. Wood yellowish, straight-grained, apparently not used. For wood anatomy *cf.* SLEUM. Notizbl. Berl.-Dahl. 13 (1937) 511. Fruit said to be edible.

Vern. Celebes: *pake-saukatibu*, Muna; New Guinea: *manggaresi*, Japen (Ambai), *semna wen*, Sekoli (Kemtuk); New Britain: *vabilii*; New Ireland: *idalu*, Pala, *varunatun*, Uquana; Solomon Is.: *abu*, *aibo*, *aiebo*, *aiembuembe*, *sasa su*, Kwara'ae.

12. CANTLEYA

RIDL. Fl. Mal. Pen. 1 (1922) 436; HOWARD, J. Arn. Arb. 21 (1940) 479, t. 2, f. 1–7; SLEUM. Blumea 17 (1969) 186. — **Fig. 21–23.**

Tree. *Leaves* spirally arranged, entire, inconspicuously penninerved. *Cymes* axillary and solitary; peduncle completely covered with obtuse small thick spirallly arranged bracts forming alveoli, from the upper 2 or 3 of which rise short branches, these articulated with the peduncle and branched dichotomously, each branch bearing at the end a cluster of 3–5(–8) sessile bisexual flowers. *Calyx* thick-cupular, shortly subimbricately 5-parted. *Petals* (4–)5, valvate, oblong, with a longitudinal ridge and the apex inflexed inside. *Stamens* (4–)5; filaments fleshy, broadened upwards, with a dense clavate-penicillate pubescence distally; anther cells almost horseshoe-shaped, diverging at the base, introrsely and longitudinally dehiscent, affixed at the apex. *Ovary* elongate-conical; stigma a fleshy reversed cup; ovules 2, pendent from near the apex of the cavity. *Fruit* fusiform; exocarp thin, pulpy; endocarp rather thin though firm, fibrous-corky, extending as a thick longitudinal pad (similar to a second cavity) inside, finally with a lengthwise split from the base up to the middle. *Seed* 1.

Distr. Monotypic; in *Malesia*. Fig. 24.

1. Cantleya corniculata (BECC.) HOWARD, J. Arn. Arb. 21 (1940) 479, t. 2, f. 1–7; DAHL, *ibid.* 33 (1952) 270, f. 61 & 61 A (pollen); BROWNE, For. Tr. Sarawak & Brunei (1955) 199; SMYTHIES, Common Sarawak Trees (1965) 71; SLEUM. Blumea 17 (1969) 186. — *Platea corniculata* BECC. Malesia 1 (1877) 117; VALET. Crit. Overz. Olacin. (1886) 254. — *Urandra sp.*, FOXW. Philip. J. Sc. 4 (1909) Bot. 492, 542, f. 47. — *Urandra corniculata* (BECC.) FOXW. Philip. J. Sc. 6 (1911) Bot. 179; MERR. En. Born. (1921) 356; MEAD, Emp. For. J. 4 (1925) 95; DEN BERGER, Hand. 4e N. I. Wet. Congr. Batavia 1926 (1927) 401 (wood anat.); FOXW. J. Mal. Br. R. As. Soc. 5, 2 (1927) 339; Mal. For. Rec. 3 (1927) 173; *ibid.* 8 (1930) 13; BURK. Dict. (1935) 2205; HEYNE, Nutt. Pl. 1 (1950) 986. — *C. johorica* RIDL. Fl. Mal. Pen. 1 (1922) 436. — *Stemonurus corniculatus* (BECC.) RIDL. *ibid.* 5 (1925) 297; BURGESS, Timbers of Sabah (1966) 320. — **Fig. 21-23.**

Tree, 15–40 m, trunk straight, slender, terete, 30–60(–150) cm ø, expanded at base, buttresses generally not distinct, rarely up to 150 by 50 cm; crown high, dense, with numerous small branches; bark grey or greenish to brownish, sometimes with brightly coloured patches, rather smooth,

Fig. 21. *Cantleya corniculata* (BECC.) HOWARD. *a.* Habit, ×½, *b.* peduncle with bracts, ×1½, *c.* petal inside, ×10, *d.* stamen, front side, ×10, *d'. ditto*, back side, ×10, *e.* calyx and ovary, ×7½ (*a–e* ENDERT 56 E. 2 P. 664).

finely, shallowly and rather irregularly fissured lengthwise. Branchlets striate-angular when dry. *Leaves* elliptic to subobovate-, rarely almost oblong-elliptic, shortly rather abruptly subacutely acuminate, base cuneate to rounded, slightly inequilateral, coriaceous, glabrous, minutely papillose beneath, drying dark brown, edge slightly revolute, 5–9(–13) by 3–4(–5) cm, midrib narrowly sunken above, strongly raised beneath, nerves 8–10 pairs, straight and parallel to each other, rather indistinct; petiole 8–13(–20) mm. *Inflorescence* 1–3.5 cm; flowers crowded at the end of short dichotomous branches, these 2 or 3 on top of a 1–2(–3) cm long peduncle which is covered all over with short obtuse thickish bracts (each forming an alveole), sessile, small, greenish to white or yellowish, pale puberulent except the petals. *Calyx c.* 1 mm. *Petals* oblong, green, 4–5 by 2 mm, fragrant to almost fetid and of a bitter taste. *Stamens c.* 4 mm, finally a little exserted, caducous as are the petals; filaments 3–4 mm, glabrous below, upper part penicillate by subclavate white hairs; anther cells *c.* 1 mm. *Ovary* glabrous, 2 mm. *Fruit* fusiform, more attenuate distally, first green, later brown to blackish, *c.* 3.5 by (0.6–)0.8–1 cm; exocarp thin, pulpy, of an acid and adstringent taste; endocarp fibrous-corky, *c.* 1 mm, finally splitting from below on one side up to the middle, extending as a thick pad for the whole length inside. *Seed* 1, oblong, *c.* 2.5 cm.

Distr. *Malesia*: Sumatra, Malay Peninsula (Johore, Singapore), Riouw & Lingga Arch., Banka, Borneo (not yet known N of the line Labuan-Tarakan). Fig. 24.

Ecol. Drier parts of primary freshwater swamp forest, or drier hill forest, from sea-level to *c.* 300 m, apparently local and scattered, on marshy or sandy soil. *Fl. fr.* Jan.–Dec.

Uses. Timber highly valued, much sought and marketed, heavy and hard, brownish-yellow, close grained, fragrant and therefore used as a substitute for sandal wood, very durable in the ground. Used for house and ship building, heavy constructions, likely to shrink and warp and suitable for furniture or turnery only if fully seasoned. The fruit can be eaten, but is said to be of a rather poor quality. Fig. 22–23.

Fig. 22. *Cantleya corniculata* (BECC.) HOWARD. Tree-shape, with buttresses. S. Sumatra (Palembang) (Photogr. ENDERT).

Vern. Generally known as *bědaru*, *daru*, *dědaru*, *ĕndaru*, *garu*, *pědaru*, *tempilai*, M; local names in Sumatra: *garu bětina*, *g. buaja*, *tarai pahang*, Indragiri, *tulang*, Kedongong, *tusam*; on Banka known as *mĕndaru*; Borneo: *kaddo*, *mĕrore*, Dajak, *kakal*, Sampit, *pĕrupok*, Iban, *samala*, Brunei (Kedayan), *sĕranai tjĕndana*, Berau.

Fig. 23. *Cantleya corniculata* (BECC.) HOWARD. Stem-base. S. Sumatra (Palembang) (Photogr. ENDERT).

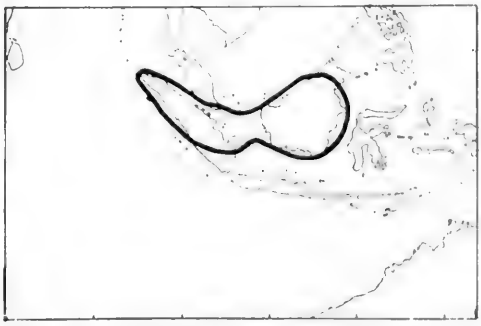

Fig. 24. Distribution of *Cantleya corniculata* (BECC.) HOWARD.

13. NOTHAPODYTES

BL. Mus. Bot. Lugd.-Bat. 1 (1850) 248; HOWARD, J. Arn. Arb. 23 (1942) 66; SLEUM. Blumea 17 (1969) 232. — *Mappia* JACQ. *sect. Trichocrater* MIERS, Ann. Mag. Nat. Hist. II, 9 (1852) 395, repr. Contr. Bot. 1 (1852) 64. *Mappia* JACQ.

sect. Nothapodytes (BL.) O. KTZE in Post & Ktze, Lex. Gen. Phan. (1904) 350. — *Neoleretia* BAEHNI, C. R. Soc. Phys. Hist. Nat. Genève 53, 1 (1936) 33; Candollea 7 (1936) 177. — **Fig. 25.**

Fig. 25. *Nothapodytes montana* BL. *a.* Habit, ×½, *b.* inflorescence, ×1, *c.* flower bud, ×5, *d.* petal, ×5, *e.* ovary, ×7½, *f.* stamen, adaxial side, ×7½, *f'. ditto*, dorsal side, ×7½ (*a–f* KOSTERMANS & KUSWATA 53).

Trees or treelets. Branches usually angular, with large leaf-scars. *Leaves* spirally arranged or partly (the upper ones) subopposite, entire, appearing very finely pellucid-punctate against strong light, penninerved. *Flowers* bisexual, in terminal, rarely axillary cymes collected to corymbs, articulate with the short ebracteate pedicels. *Calyx* cupular, 5-lobed or sinuate-dented to about ⅓, persistent. *Petals* 5, valvate in bud, linear-oblong, a little cohering at base, apex slightly inflexed, short-strigose without, villose or rarely almost glabrous within. *Stamens* 5, free, ± as long as the petals; filaments fleshy, somewhat flattened below, more slender distally, glabrous; anther cells subovate- to elliptic-oblong, diverging at base, introrse, with a basal abaxial reflexed pulviniform appendage ± cohering to the filament, medifixed; connective as long as the cells. *Disk* cup-shaped, shallowly 5- or 10-crenulate, fleshy to foliaceous, glabrous without, generally with some hairs within and on the edge. *Ovary* symmetrical, hirsute, ovoid to subconical, tapering to a short stoutish or more slender, slightly elongate, hairy or glabrous (apparently slightly dimorphic) style; stigma subcapitate, truncate or mostly

oblique, sometimes slightly bilobed or concave. *Drupe* ± ellipsoid, exocarp thin, juicy; endocarp thin-crustaceous, smooth or rugose. *Seed* 1, albuminous; embryo large, almost as long as the albumen.

Distr. Four *spp.*, 3 of which in S. India, Ceylon, Assam, Burma, Thailand, Cambodge, Tonkin, SW. to SE. China incl. also Hainan, on Lan Yu. I. (= Botel Tobago or Kôtyôsyo) SE. of Formosa, Ryu Kyu Is. (Yaeyama group); in *Malesia* 2 *spp.*, of which *N. foetida* has a wide distribution in SE. Asia, and *N. montana* is very close to *N. pittosporoides* (OLIV.) SLEUM. in SW. and Central China. Fig. 26.

Ecol. Primary and secondary rain-forest, also mixed deciduous forest, from sea-level to *c.* 2000 m.

KEY TO THE SPECIES

1. Leaves ± unequal at base; petiole (2–)3–6 cm. Petals densely to more sparsely whitish-villose within. **1. N. foetida**
1. Leaves ± equal at base; petiole 1–2 (rarely –2.5) cm. Petals glabrous or with few hairs in the lower half within. . . . . **2. N. montana**

1. Nothapodytes foetida (WIGHT) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 247; HOWARD, J. Arn. Arb. 23 (1942) 70; DAHL, *ibid.* 33 (1952) 273 (pollen); SLEUM. Blumea 17 (1969) 232 (with extra-Malesian synonyms and literature); Fl. Thail. 2 (1970) 82. — *Stemonurus foetidus* WIGHT, Ic. 3 (1845) t. 955. — *Neoleretia foetida* (WIGHT) BAEHNI, Candollea 7 (1936) 177, t. 4, f. 2, D–F.

Tree or treelet, (5–)10–15 m, 10–20 cm ø. Branchlets conspicuously angled, early covered with straw cork (wrinkled in dry specimens), large leaf-scars, youngest parts laxly to densely covered with yellowish appressed ± substrigose or more softer hairs as are the petioles, the undersurface of the leaves, the inflorescences and the fruit, the tomentum however, variable in density or fading early. *Leaves* variably elliptic-ovate to -oblong, apex short-acuminate, base broadly cuneate to rounded, unequal, membranous (and subglabrous in the Philippines), or chartaceous (and tomentulose beneath in Sumatra), 9–22 by 4–12 cm, nerves (5–)6–10(–12) pairs rather steeply curved-ascendent, raised beneath, reticulation ± obscure; petiole slender to stoutish, (2–)3–6 cm. Corymbosely arranged *cymes* long peduncled, many-flowered, 5–10 cm across, peduncles and axes ± flattened or angled, all over crisped- to substrigose-hairy. Pedicels 1(–2) mm. *Calyx c.* 1.5 mm incl. the short subacute lobes. *Petals* oblong-linear, subacuminate, white, densely to more sparsely hairy within, 4–5(–6) by *c.* 1.5 mm. *Filaments* (2–)3–4 mm, apparently accrescent during anthesis; anther-sacs 1–1.3 mm. *Ovary* ovoid to pear-shaped, hirsute, gradually narrowed to the stouter or more slender, short or up to 3 mm elongate style, which sometimes is completely glabrous. *Drupe* oblong-ovoid or ellipsoid, 1–2 by 0.8–1 cm, black, generally short-pubescent; endocarp thin-woody, shallowly rugose to lacunose-reticulate; endosperm with a fetid odor.

Distr. S. India, Ceylon, Assam, Burma, Cambodge, Thailand, Lan Yu I. (SE. of Formosa), Ryu Kyu Is. (Yaeyama group); in *Malesia*: W. Sumatra (once on Mt Sago near Pajakumbuh), Philippines (N. Luzon: Ilocos Norte & Isabela Prov.). Fig. 26.

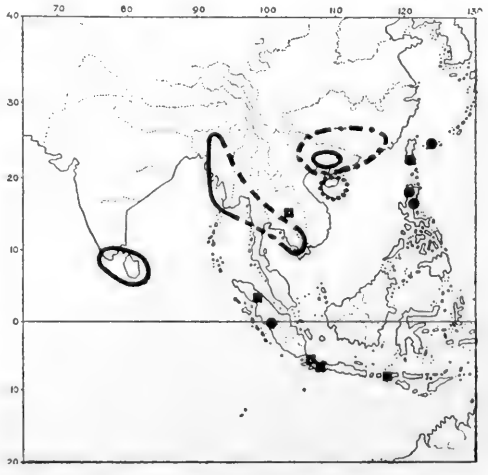

Fig. 26. Distribution of *Nothapodytes*. *N. foetida* (unbroken line and dots), *N. montana* (squares), *N. obtusifolia* (. . .), *N. pittosporoides* (– . – . –).

Ecol. Rain-forest, on Mt Sago at *c.* 1000 m, in the Philippines between 100 and 300 m (outside Malesia up to 2000 m, occurring also in mixed deciduous forest). *Fl.* Febr.–March, *fr.* June (Malesia).

2. Nothapodytes montana BL. Mus. Bot. Lugd.-Bat. 1 (1850) 248; SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 247; HOWARD, J. Arn. Arb. 23 (1942) 67; AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 6; BACK. & BAKH. *f.* Fl. Java 2 (1965) 61; SLEUM. Blumea 17 (1969) 233; Fl. Thail. 2 (1970) 83. — *Mappia montana* (BL.) MIERS, Ann. Mag. Nat. Hist. II, 9 (1852) 398, repr. Contr. Bot. 1 (1852) 67; MIQ. Fl. Ind. Bat. 1 (1856) 790; Suppl. 1 (1860) 136; BECC. Malesia 1 (1877) 118; VALET. Crit. Overz. Olacin. (1886) 183, t. 5, f. 28 (fl.); K. & V. Bijdr. 5 (1900) 143; BACK. Schoolfl. Java (1911) 226; KOORD. Exk. Fl. Java 2 (1912) 532. — Fig. 25.

Tree or treelet, 5–8(–20) m, 10–15(–20) cm ø; bark smooth, light brown. Branchlets slender, obtusangular, early covered with pale brown cork and wrinkled in dry specimens. *Leaves* lanceolate to obovate-oblong, apex obliquely acuminate (1–2 cm), subacute, base cuneate, ± equilateral, herbaceous to chartaceous, shining above, practically glabrous, often laxly tubercled beneath, 8–16 by 3–6.5 cm, midrib raised beneath, nerves in 6–9 pairs, curved or more strict, widely patent, rather indistinctly looping before the edge, reticulation of veinlets rather dense, finely raised on both faces; petiole slender, 1–2 (rarely –2.5) cm. *Corymbs* rather few-flowered, 2–4 cm across, peduncle slender, 2–4 cm, densely appressedly yellowish hairy in all outer parts. *Calyx* 1.5–2 mm incl. lobes. *Petals* oblong-linear, subacuminate distally, finally recurved, a little fleshy, greenish-white, glabrous or with few hairs in the lower half within, 4–5 by 1.5–2(–3) mm. *Filaments* linear below, filiform above, 3–4 mm; anther cells elliptic, 1.5 mm. *Ovary* ovoid, gradually tapering to a shorter or more slender style (*c.* 2 mm) which at least in its lower half is appressedly hairy as is the ovary; stigma oblique. *Drupe* ellipsoid, greenish-brown when fresh, blackish when dry, rather smooth, *c.* 1.5 by 1 cm.

Distr. Thailand (Prachinburi); in *Malesia*: Sumatra (Eastcoast: Karo Highlands), extreme W. and SW. Java, Lesser Sunda Is. (W. Sumbawa, W. Flores). Fig. 26.

Ecol. Primary and secondary forest, almost from sea-level to *c.* 1650 m, also on coral limestone. *Fl.* Jan.–Aug., *fr.* April.

Vern. *Kihadji*, S.

14. STEMONURUS

BL. Bijdr. (1826) 648, *p.p. lectotyp.*; HASSK. Cat. Hort. Bog. (1844) 214 ('*Stemonura*'); BL. Mus. Bot. Lugd.-Bat. 1 (1850) 249, *p.p.*; *em.* BECC. Malesia 1 (1877) 108, 109, 111; SLEUM. Blumea 17 (1969) 255. — *Urandra* THW. in Hook. J. Bot. Kew Misc. 7 (1855) 211. — *Lasianthera* (*non* P. BEAUV.) MIQ. Fl. Ind. Bat. 1 (1856) 790, *p.p.*; KING, J. As. Soc. Beng. 64, ii (1895) 116. — **Fig. 28–31.**

Trees, sometimes with buttresses or with pneumatophores, glabrous except a fine subglandular puberulence on the inflorescences, the petals excluded. Branchlets and buds often vernicose. *Leaves* spiral, entire, coriaceous to various degrees, dark green to yellowish green above, paler beneath, sometimes tubercled on the undersurface, midrib narrowly sunken above, bold beneath, nerves pinnate, looping; petiole robust. *Umbels* axillary and generally solitary, peduncled, each branch of the umbel bearing the flowers either distally and crowded, or uni- or biseriately (scorpioid) along its upper, mostly ± recurved part; bracteoles at the base of the umbel conspicuous, sometimes persistent. *Flowers* bisexual, sessile, white to yellowish, fragrant. *Calyx* cup-shaped, base ± truncate, limb truncate or 5-lobed to various degree, persistent. *Petals* (4–)5, valvate in bud, connate at base only, oblong, apex inflexed, midrib or keel often raised on both faces, caducous. *Stamens* (4–)5; filaments fleshy, flat, widened upwards, shortly bearded below the anther on the ventral side, and long-penicillate distally on the backside, the penicilli inflexed in bud, at full anthesis erect and much exserted; cells ovate-elliptic, basifixed, a little diverging downwards. *Disk* rim-like or patellar, or mostly a short, whether or not shallowly lobed cup, surrounding the very base of the ovary, the latter ovoid-conical much attenuate towards the very short slender style and the punctiform stigma, unilocular, with 2 pendant ovules. *Drupe* ovoid, ellipsoid or oblongoid-fusiform; exocarp thin, the lower ⅓ part dark red to purple, the upper part white to cream or greenish; endocarp firm, coriaceous to woody, its outer part fibrous. *Seed* 1; embryo small, in the top of the albumen.

Distr. About 12 *spp.*, 2 of which in Cochinchina and Annam, 1 in Ceylon; in *Malesia* 9 *spp.*, one of which extends to the Solomon and Palau Is. Fig. 27.

Ecol. In dry hilly land or in peat swamp forest (part of the species apparently restricted to the latter), mostly scattered, though widespread in lowland, rarely up to 1750 m.

Disp. The ripe fruits with their fibrous outer and hard inner endocarp are apparently able to float. This may explain the wide area of distribution of *S. ammui* (Palau Is., northcoast of New Guinea, New Britain, Solomon Is.) which occurs both in lowland hillside and in coastal swamp forest, even in the mangrove.

Uses. Wood aromatic, not durable and no commercial use known in Malesia (ENDERT, Med. Proefst. Boschw. Ned. Ind. 20, 1928, 198, 199, 201).

Note. The genus comprises two groups of species, one with uni- or biseriately arranged flowers around *S. secundiflorus* BL. (W. Malesia incl. Celebes), the other with flowers crowded at the end of the branches of the umbel around *S. umbellata* BECC. (W. to E. Malesia, Solomon and Palau Is.). Within these two groups the species must be distinguished mainly by calyx and fruit characters, as their leaf and other flower characters overlap to rather great extent.

KEY TO THE SPECIES

1. Flowers uni- or biseriate along the whole or at least the upper (in *S. grandifolius* thickened) part of the branches of the umbel, generally 5–12 per branch.
 2. Bracts at the base of the umbel persistent for a while during anthesis, (3–)4–5 by *c.* 1 mm.
  3. Leaves (18–)26–36 by 7–11(–13) cm, very coriaceous, generally a little shining above only in the dry state, nerves 15–20 pairs generally very slightly or hardly raised on both faces, veins ± obscure. Drupe ellipsoid-ovoid, 2–2.4 by 1.2–1.5 cm. . . . . **1. S. grandifolius**
  3. Leaves 11–23(–30) by 6–9(–11) cm, coriaceous, generally shining on both faces in the dry state, nerves 15–20 pairs slightly though markedly raised on both faces as are the rather lax veins. Drupe ovoid-ellipsoid, 4.5–5.5(–6.5) by 2–2.5(–3) cm. . . . . **2. S. scorpioides**
 2. Bracts at the base of the umbel early caducous, 1–2 by *c.* 0.5 mm.
  4. Inflorescences robust, peduncle *c.* 3 mm ø. Calyx shallowly lobed or almost entire. Petals 5–6(–7) mm. Drupe ovoid to oblong-ovoid, 2.5–3(–4) by (1.6–)2 cm. . . . . **3. S. celebicus**
  4. Inflorescences relatively slender, peduncle 1–2 mm ø. Calyx lobed ± halfway. Petals *c.* 4 mm. Drupe oblong-ellipsoid, 4.5–5.5 by 1–1.5 cm. . . . . **4. S. secundiflorus**
1. Flowers clustered at the end of the branches of the umbel or even at the end of the peduncle when the branches of the umbel are very short. (Bracts at the base of the umbel generally small, fugacious or rarely subpersistent).
 5. Drupe subovoid-oblongoid to almost fusiform, at least 2 times as long as (or mostly longer than) across. (Leaves generally smooth on the undersurface, maybe except some tubercles found close to and along the midrib).
  6. Calyx rather deeply obtusely lobed. Petals (2.5–)3(–4) mm. Disk cup-shaped. Drupe 4.5–5 by (1–)1.5–2.2 cm. . . . . **5. S. malaccensis**
  6. Calyx shallowly lobed. Petals (4–)5 mm. Disk low, almost patellar. Drupe (4.3–)4.5–5 by 1.5–1.7 cm. **6. S. ammui**
 5. Drupe ovoid to ellipsoid-ovoid, up to *c.* 2 times as long as across.
  7. Leaves practically smooth on the undersurface; petiole (2–)2.5–3 cm. Calyx rather distinctly lobed. **7. S. gitingensis**
  7. Leaves generally rather ± densely tubercled all over the undersurface or at least in a broad stripe along the midrib; petiole 1–2 (very rarely up to 3) cm.
   8. Calyx ± distinctly obtusely lobed. Petals 3(–4, very rarely –4.5) mm. . . **8. S. monticolus**
   8. Calyx truncate or very shallowly (apiculately) lobed. Petals (4–)5(–6) mm. . **9. S. umbellatus**

1. Stemonurus grandifolius BECC. Malesia 1 (1877) 114, t. 5, f. 1; VALET. Crit. Overz. Olacin. (1886) 235; MERR. En. Born. (1921) 356; SLEUM. Blumea 17 (1969) 257. — *Urandra grandifolia* (BECC.) O. KTZE, Rev. Gen. Pl. 1 (1891) 113. — *S. dolichophyllus* MERR. Un. Calif. Publ. Bot. 15 (1929) 171. — *Urandra dolichophylla* (MERR.) HOWARD, J. Arn. Arb. 21 (1940) 468; DAHL, *ibid.* 33 (1952) 270 (pollen).

Tree, (7–)25–30(–40) m, bole (6–)10–15 m, 10–30(–40) cm ø; crown dense; bark greyish to brownish, smooth or superficially fissured, yellow-brown mottled. Branchlets robust (5–10 cm ø), often finely warted and vernicose. *Leaves* lanceolate or elliptic-oblong, apex very shortly acuminate, or merely ± abruptly apiculate, base broadly cuneate to rounded, very coriaceous, stiff, a little shining above in the dry state, dull beneath, (18–)26–36 by 7–11(–13) cm, the extreme margin slightly and narrowly revolute, nerves 15–20 pairs, generally very slightly raised on both faces, veins ± obscure; petiole rugulose, 1.5–2(–3) by 0.3–0.5 cm. Peduncle of the *umbel* 3–5 cm by 2–3 mm, with 4–8(–12) shorter or longer (*c.* 10 mm) robust and a little flattened branches, which bear 3–4(–5) flowers crowded at the thickened end of each branch, or, as normally more (up to 8) flowers are present, these close together and uni- or biseriate on the recurved and thickened upper part of the respective branch. Bracteoles at base of the umbel broad-subulate, (3–)4–5 by 1 mm, ± persistent. *Calyx* cup-shaped, 2 mm, lobed to ⅓. *Petals c.* 5 by 2 mm, light yellow or white. *Drupe* ellipsoid-ovoid, apex gradually attenuate, obtuse, 2–2.4 by 1.2–1.5 cm.

Distr. *Malesia*: Borneo.

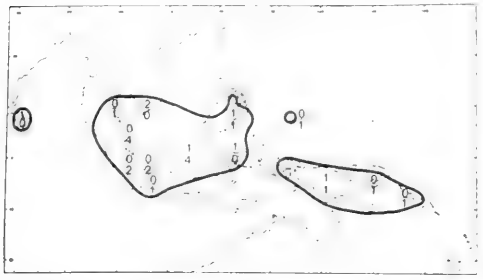

Fig. 27. Distribution of *Stemonurus*. The figure above the hyphen indicates the number of endemic species in the island or area, the figure below the hyphen the number of non-endemic species.

Ecol. Primary lowland (Dipterocarp) forest, on hills or low ridges, not rare on sandstone or sandy soil, or coastal kerangas, never in peat swamp, from sea-level-100(–680, a form with narrower leaves in *Tristania* forest on Mt Kinabalu at 1220) m. *Fl. fr.* Jan.–Dec.

Uses. The pale brown wood is apparently not used.

Vern. *Baru tuas*, Bulungan, *kambong*, Kinabatangan, *kapal-kapal*, Kedayan, *katak*, Dusun, *mersaut*, Kutei.

2. Stemonurus scorpioides BECC. Malesia 1 (1877) 113, t. 6; VALET. Crit. Overz. Olacin. (1886) 234; HOCHR. Bull. Inst. Bot. Btzg 22 (1905) 6 (*var.*); MERR. En. Born. (1921) 356 ('*scorpiurus*'); RIDL. Fl. Mal. Pen. 5 (1925) 296; BURK. Dict. (1935) 2074; HEYNE, Nutt. Pl. 1 (1950) 986; ANDERSON, Gard. Bull. Sing. 20 (1963) 166; SLEUM. Blumea 17 (1969) 257. — *Urandra scorpioides* (BECC.) O. KTZE, Rev. Gen. Pl. 1 (1891) 113 ('*scorpiodes*'); DAHL, J. Arn. Arb. 33 (1952) 270, f. 58 & 58 A (pollen). — *Lasianthera secundiflora* [*non* (BL.) MIQ.] KING, J. As. Soc. Beng. 64, ii (1895) 177, *p.p.* — *S. secundiflorus* (*non* BL.) RIDL. Fl. Mal. Pen. 1 (1922) 430, *p.p.* — **Fig. 28.**

Tree 10–30(–35) m, clear bole up to 24 m and 15–30(–60) cm ø; bark thin, whitish to greyish brownish, smooth or pustular. Blunt asparagus-like pneumatophores sometimes present. Branchlets robust, often vernicose as are the buds. *Leaves* elliptic-oblong, apex shortly and ± abruptly acuminate, or apiculate, tip bluntish, base broadly cuneate, coriaceous, stiff, dark green above, paler beneath, glossy on both faces also in the dry state, the very margin often slightly revolute, 11–23(–30) by 6–9(–11) cm, nerves 15–20 subregular pairs, slightly though distinctly raised on both faces as are the rather lax veins, veinlets finely and prominently reticulate above only; petiole 1.5–2 cm by *c.* 3 mm. Scorpioid *cymes* 4–6 in an umbel on a robust 3–5(–6) cm long axillary peduncle, branches of the umbel 3–5 cm, each with 6–10 sessile flowers biseriate on each side; bracts at base of umbel several, subulate, rather persistent, (3–)4–5 by 1 mm. *Calyx* cup-shaped, 1.8 mm, obtusely lobed in the upper spreading ⅓. *Petals* (4–)5 by 1.5 mm, white to cream or greenish. *Drupe* ovoid-ellipsoid, obliquely attenuate towards the apex, 4.5–5.5(–6.5) by 2–2.5(–3) cm, whitish above, dark green-purplish in the lower third, with numerous slight vertical grooves, able to float when dry.

Fig. 28. *Stemonurus scorpioides* BECC. Seedling, *a.* with the first leaves, *b.* preceding stage with the cotyledons still enclosed by the longitudinal fibres of the endocarp, both ×⅓ (KEP 99938).

Distr. *Malesia*: Sumatra (incl. also Simalur I.), Lingga and Riouw Arch., Banka, Malay Peninsula, Borneo.

Ecol. In *Shorea albida* peat swamp forest in Borneo, generally in maybe seasonally swampy, also in secondary vegetation, on peaty or sandy soil, locally frequent, in lowland up to 45 m. *Fl. fr.* Jan.–Dec.

Uses. Timber soft, not durable, cracking,

locally used for planks and household utensils. Pounded bark used as medicine. The fruit is said to be edible.

Vern. *S. scorpioides* has remarkably numerous native names in the Malay; part of them, however, are used also for other species of the genus, and the name *bědaru* is commonly in use for *Cantleya corniculata* (BECC.) HOWARD outside North Borneo. — Sumatra: *kaju longgaha*, *k. pasir*, *sitobal*, Eastcoast, *sebungku*, *siburuk*, P. Bengkalis, *sibungkuk*, Indragiri, *setebal*, Djambi, *bahuhu-ětěm*, Simalur, *banol*, Banka, *daru daru daun lebar*, P. Singkep; Malay Peninsula: *bungkok*, *pěrěpat paya*, Pahang; *batang torong*, Manggu; Borneo: *ampasir*, W. Borneo, *bedaru*, *hantu burok*, *katok*; *medang katuk*, *m. telor* (Benuni); N. Borneo & Brunei, Sarawak: *entaburok*, Iban, *jerumit*, Milanau, *katop*, Dusun, *semburok*; *kaju malam*, Kuching, *pasir-pasir*, Pontianak.

3. Stemonurus celebicus VALET. in Koord. Minah. (1898) 394; Ic. Bog. 1 (1901) t. 88; HOCHR. Pl. Bog. Exs. (1904) 45; Bull. Inst. Bot. Btzg 22 (1905) 48; SLEUM. Blumea 17 (1969) 258. — *Urandra celebica* (VALET.) HOWARD, J. Arn. Arb. 21 (1940) 468.

Tree, 20–30 m tall, up to 45 cm ø. Branchlets robust, smooth or finely rugulose, vernicose, 5–12 mm ø. *Leaves* elliptic to obovate-elliptic, apex broadly subacuminate-attenuate or obtusely apiculate, sometimes rounded, base broadly cuneate, coriaceous, a little glossy above, dull beneath when dry, (10–)12–16(–22) by 5–8(–10.5) cm, edge somewhat revolute in dry specimens, nerves 10–14(–16) erecto-patent pairs, slightly or hardly raised on both faces, veins ± obscure; petiole 1.5–2 cm by *c.* 2.5 mm. *Umbels* solitary, robust, on peduncle 3–5 cm by 3 mm, branchlets of the umbel (4–)5–7, more slender, though thickened distally, (2–)3–4 cm, their basal bracts ovate, obtuse, 2 mm, early caducous. *Flowers* sometimes only 3 or 4 and crowded at the apex, generally 5–6(–8), close together and biseriate in the upper half of each branchlet of the umbel, secund. *Calyx* broadly cup-shaped, 2 mm, shallowly lobed or almost entire. *Petals* 5–6(–7) by 2.5 mm, keeled, white-greenish. *Drupe* ovoid to oblong-ovoid, apex gradually attenuate, obtuse, 2.5–3(–4) by (1.6–)2 cm, darker in the lower ⅔. *Seed* oblong, a little flattened.

Distr. *Malesia*: NE. and Central Celebes.

Ecol. Primary forest, rarely in swamps, 20–1000 m. *Fl.* April–July, *fr.* June–Nov.

Vern. *Bilulang*, Luwu, *palontanggasi*, Padu, *simbelan*, Minahasa (Tl.), *simpaga tanru*, Bugin., *woliausa*, Tobela.

4. Stemonurus secundiflorus BL. Bijdr. (1826) 649; WALP. Rep. 1 (1842) 378; HASSK. Cat. Hort. Bog. (1844) 214; BL. Mus. Bot. Lugd.-Bat. 1 (1850) fig. 45; MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 36, repr. Contr. Bot. 1 (1852) 86; SCHNIZL. Ic. 3 (1866/70) t. 223; BECC. Malesia 1 (1877) 112, t. 4, f. 16–17; VALET. Crit. Overz. Olacin. (1886) 234; K. & V. Bijdr. 5 (1900) 145; HOCHR. Pl. Bog. Exs. (1904) 46, *incl. var. valetonii* HOCHR.; Bull. Inst. Bot. Btzg 22 (1905) 41, *incl. var. valetonii* HOCHR.; MOLL & JANSS. Mikr. 2 (1908) 234, f. 105 (wood anat.); BACK. Schoolfl. Java (1911) 226; KOORD. Exk. Fl. Java 2 (1912) 531; KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 3; KOORD. Atlas 1 (1913) t. 121; RIDL. Fl. Mal. Pen. 1 (1922) 430, *p.p.*; BAKER *f.* J. Bot. 62 (1924) Suppl. 21; RIDL. Fl. Mal. Pen. 5 (1925) 296; BURK. Dict. (1935) 2074; DOCT. v. LEEUWEN, Ned. Kruidk. Arch. 51 (1941) 175, f. 48 (gall); AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 5; BACK. & BAKH. *f.* Fl. Java 2 (1965) 60; SLEUM. Blumea 17 (1969) 258. — *Croton laurifolius* NOR. Verh. Bat. Gen. 5 (1790) ed. 1 Art. IV, 13, *nom. nud.* — *Lasianthera secundiflora* (BL.) MIQ. Fl. Ind. Bat. 1 (1856) 792, *incl. var. sumatrana* MIQ. *l.c.* (1858) 1097; Suppl. 1 (1860) 137, *incl. var. sumatrana*; *ibid.* (1861) 342, *incl. f. sumatrana* MIQ. *l.c.*, t. 2; KING, J. As. Soc. Beng. 64, ii (1895) 177, *p.p.* — *Urandra secundiflora* (BL.) O. KTZE, Rev. Gen. Pl. 1 (1891) 113; ENGL. in E. & P. Nat. Pfl. Fam. 3, 5 (1893) 248; HEYNE, Nutt. Pl. 1 (1950) 987. — *S. pauciflorus* RIDL. Kew Bull. (1926) 61, *non* BL. 1826; HOWARD, J. Arn. Arb. 21 (1940) 481, *in text.* — *S. ridleyanus* SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 243.

KEY TO THE VARIETIES

1. Leaves (subcoriaceous to coriaceous) generally oblong to elliptic- or obovate-oblong, nerves (8–)10–12(–14) pairs, ± distant from each other, slightly or hardly raised, veins ± obscure. **1.** *var.* **secundiflorus**
1. Leaves with 14–16(–18) pairs of nerves, these ± close together and generally a little raised on both faces as are the lax veins.
2. Leaves elliptic, rigidly coriaceous. **2.** *var.* **hosei**
2. Leaves lanceolate-oblong or -elliptic, coriaceous. . . . . **3.** *var.* **lanceolatus**

1. *var.* **secundiflorus.**

Tree, 10–24(–32) m, trunk cylindric, up to 40 cm ø, sometimes with pneumatophores in swampy places; bark rather smooth, whitish grey-green. Branches ± horizontal. Tips of branchlets and buds vernicose. *Leaves* rather variable in shape and size, oblong-obovate, sometimes elliptic-oblong or oblong, apex obtusely apiculate or short-acuminate, base acutely or more rarely obtusely cuneate, subcoriaceous to coriaceous, shining above, much paler beneath, (6–)10–17 (–20) by (3–)4–8.5 cm, nerves (8–)10–12(–14) slender and ± distantly subparallel, rather indistinctly inarching pairs, slightly or hardly raised on both faces, veins ± obscure; petiole 1.5–2(–3) cm. *Cymes* arranged in an solitary umbel, rarely in two umbels per axil, peduncle rather slender, *c.* 3 cm by 1–2 mm, branchlets of the umbel 3–5, slender, ± recurved, 2–2.5 cm, bearing in the upper part 3–5(–7) flowers close together in a row on each side; bracts at base of the umbel ovate or oblong,

minute, early caducous, leaving blunt scars. *Calyx* cupular, 2–2.5 mm, obtusely lobed almost halfway. *Petals c.* 4 by 1.5 mm, white or yellowish, fragrant. *Drupe* oblongoid-ellipsoid, attenuate towards the bluntish apex, 4.5–5.5 by 1–1.5 cm.

Distr. *Malesia*: Sumatra (incl. also Simalur, Mentawei & Enggano Is.), Banka, Billiton, Malay Peninsula, W. Java.

Ecol. Rain-forest, 30–700(–1000) m, sometimes in peat swamp forest or seasonal swamp forest near sea-level, scattered. *Fl. fr.* Jan.–Dec.

Uses. Timber light brown, of inferior quality, used in places under the house-roof. Medicinal use for the cure of swellings doubtful. Seeds have a bitter taste and are edible only after repeated cooking.

Vern. Sumatra: *lokan*, Westcoast, *sĕbungku*, Eastcoast, *ganggaram*, P. Bengkalis, *katur*, *sĕbonku*, *si bĕnjiet*, Indragiri, *sĕhring*, Bencoolen, *bahuhu uding*, *suwahar uding*, Simalur, *mangguguk*, Mentawei, *kaju bĕmban*, Enggano, *gĕlam kataju*, Minangkabau; *saběr bubu*, Banka, *krikis ayĕr*, Billiton; Malay Peninsula: *bĕrlat*, Pahang, M, *kalapa siong*, *kimeong*, *sintok lantjang*, S.

2. *var.* **hosei** SLEUM. Blumea 17 (1969) 259. — *S. labuanensis* STAPF, Kew Bull. (1906) 71, *p.p.*; MERR. En. Born. (1921) 356, *p.p.*

Leaves elliptic, very shortly acuminate, stiff-coriaceous, nerves close together and numerous (*c.* 18 pairs), slightly prominent on both faces as is the net of veins. *Inflorescence* as in *var. lanceolatus*. Branchlets of the umbel 3 or 4. *Fruit* not known.

Distr. *Malesia*: Borneo (Baram R. area in Sarawak), once found.

3. *var.* **lanceolatus** (BECC.) SLEUM. Blumea 17 (1969) 259. — *S. lanceolatus* BECC. Malesia 1 (1877) 114, t. 5, f. 2–4; VALET. Crit. Overz. Olacin. (1886) 235; MERR. En. Born. (1921) 356. — *Urandra lanceolata* (BECC.) O. KTZE, Rev. Gen. Pl. 1 (1891) 113; HOWARD, J. Arn. Arb. 21 (1940) 468, t. 1, f. 1–6. — *Urandra* '*secundiflora*', DAHL, J. Arn. Arb. 33 (1952) 270, f. 57 & 57 A (pollen). — *S. umbellatus* (*non* BECC.) ANDERSON, Gard. Bull. Sing. 20 (1963) 166.

Tree; bark greyish brown. *Leaves* lanceolate-oblong to narrowly elliptic, coriaceous, nerves 14–16 pairs, slightly raised on both faces as is the lax network of veins. *Umbels* with 2 or 3 branches. *Drupe* similar to that of *var. secundiflorus*, oblongoid, 3.5–4.5 by 1–1.5 cm, apex attenuate and slightly curved.

Distr. *Malesia*: Borneo.

Ecol. Generally mixed swamp or peat swamp forest, or border of swamp forest with *Agathis* forest, low country. *Fl. fr.* Jan.–Dec.

Vern. *Entaburok*, Iban, *kepot bĕdjuku*, Dajak, *sĕmantĕn*, Sampit, *ĕnsurok*, *sĕmburok*, M.

5. Stemonurus malaccensis (MAST.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 243; Blumea 17 (1969) 260; Fl. Thail. 2 (1970) 85. — *Lasianthera apicalis* (THW.) BENTH. in MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 584, as to the Labuan plant only. — *Lasianthera malaccensis* MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 584; BECC. Malesia 1 (1883) 257; KING, J. As. Soc. Beng. 64, ii (1895) 118. — *S. capitatus* BECC. Malesia 1 (1877) 114, t. 5, f. 7–11; VALET. Crit. Overz. Olacin. (1886) 236; MERR. En. Born. (1921) 355; RIDL. Fl. Mal. Pen. 1 (1922) 431; CRAIB, Fl. Siam. En. 1 (1926) 272; BURK. Dict. (1935) 2074. — *Urandra capitata* (BECC.) O. KTZE, Rev. Gen. Pl. 1 (1891) 113. — *S. labuanensis* STAPF, Kew Bull. (1906) 71, *p. p. lectotyp.*; MERR. En. Born. (1921) 356, *p. p.* — *Urandra nitida* HOWARD, Lloydia 6 (1943) 147, t. 1, f. 3–6. — **Fig. 29.**

Treelet or tree, (2.5–)6–15(–20) m, bole up to 10 m and 20 cm ø; bark smooth, brownish-grey, shallowly lengthwise fissured. Branchlets with pustules on older parts. *Leaves* variable in shape and size, oblong to subobovate-oblong, sometimes obovate, short-acuminate or obtusely apiculate, rarely rounded, base cuneate, subcoriaceous to coriaceous, smooth, *i.e.* practically not tubercled, a little shining above, dull beneath both in the fresh and dry state, (6–)8–12.5(–14) by (2–)2.5–4 (rarely –7) cm, nerves *c.* 15 pairs, with other shorter ones between, rather straight and subparallel, very slightly prominent on both faces, or not rarely almost obscure beneath, similar to those of *S. secundiflorus var. secundiflorus*, reticulation of veins faintly visible above only, or obscure at all; petiole 1–1.5(–1.8) cm by (1–)1.5–2 (rarely –2.5) mm. Peduncle of the umbel-like *inflorescence* generally rather slender (1 mm, rarely up to 2 mm ø), 1–2 cm long, with 3–5 branchlets of the umbel (2–)3–10 mm long, each bearing (3–)4–6 flowers crowded at the very end, the flowers seemingly on top of the peduncle when the branches of the umbel are very short; bracts at the base of the umbel ovate-oblong or broadly linear, obtuse, persisting during anthesis only, *c.* 2 by 2 mm. *Calyx* cup-shaped, *c.* 2 mm, rather deeply and obtusely lobed. *Petals* (2.5–)3(–4) mm, white-yellowish to dull pink, fragrant. *Disk* cup-shaped. *Drupe* subovoid-oblongoid, attenuate and sometimes a little curved distally, 4.5–5 by (1–)1.5–2.2 cm, pink or pale brown below, merging into pale green in the upper part.

Distr. Lower Burma, southern Peninsular Thailand; in *Malesia*: Malay Peninsula, Borneo.

Ecol. Primary rain-forest, also bamboo forest, generally in lowland up to 150 m, more rarely on hillside or ridge tops up to 1370 m, never in peat swamp forest, apparently on fertile soil, but once reported from *Shorea materialis* heath forest in Trengganu; scattered. *Fl. fr.* Jan.–Dec.

Uses. Apparently not used, possibly due to the small size of the trees, contrary to most other species of the genus, which reach fair dimensions.

Vern. *Alau daan*, Murut Bokan, *gigi buntol*, Selangor, *baruas*, *pasir pasir*, Kinabatangan, *pĕropot*, Dusun, *pĕtom*, Pahang, *tarung pĕlandok*, Perak, M.

6. Stemonurus ammui (KANEH.) SLEUM. Blumea 17 (1969) 260. — *Urandra elliptica* SCHELLENB. Bot.

Fig. 29. *Stemonurus malaccensis* (MAST.) SLEUM. *a.* Habit, ×½, *b.* flower, ×5, *c.* petal inside, ×5, *d.* stamen, ×5, *e.* calyx and ovary, ×7½. *f.* fruit, ×¾ (*a* N. BORNEO FOR. DEP. 7685, *b–e* SAN 30985, *f* KEP 76124).

Jahrb. 59 (1924) 17, *non* MERR. 1910. — *Urandra ammui* KANEH. Bot. Mag. Tokyo 45 (1931) 293; Fl. Micron. (1933) 199, f. 86; J. Dep. Agr. Kyushu Imp. Un. 4 (1935) 359. — *S. ellipticus* (SCHELLENB). SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 242.

Tree, 10–24(–33) m, sometimes with buttresses or slenderly cylindrical pneumatophores, bole straight, 10–25(–30) cm ø; bark smooth or with fine longitudinal fissures or pustules, whitish-grey to pale or dark brown. *Leaves* oblong- to obovate-elliptic, apex shortly (1–2 cm) ± abruptly and obtusely acuminate, sometimes rounded, very rarely slightly emarginate, coriaceous, shining above, rather dull beneath in dry specimens, margin slightly revolute, 9–16(–19) by 4–8(–9) cm, smooth on both faces or practically so (a few tubercles maybe present along the midrib underneath), nerves 12–14(–18) slightly curved pairs, generally a little raised or at least visible above, much less or hardly so beneath, reticulation of veins faint and above only; petiole 1.5–2 cm by *c.* 2 mm. Peduncles of umbel-like *inflorescence* 3–5 cm, stoutish, bearing 5–7 (rarely –9) branches, these 1–1.5 cm long, each with a subulate subpersistent basal bract *c.* 1 by 0.5 mm. *Calyx* cup-shaped, 2 mm, shallowly subacutely lobed. *Petals* (4–)5 by 2 mm, slightly keeled outside, yellowish-white, with a strong lemon scent. *Disk* low, almost patellar, slightly or hardly lobed. *Drupe* oblongoid-subfusiform, much attenuate at both ends, (4.3–)4.5–5 by 1.5–1.7 cm.

Distr. Micronesia (Palau Is.), Melanesia (New Britain, Solomons); in *Malesia*: eastern part of New Guinea.

Ecol. Primary forest, generally on well-drained hilly slopes up to 200 m, occasionally in fresh-water swamp forest or mangrove along the coast. *Fl. fr.* Jan.–Dec.

Vern. *Aikunu, ailalo, aimarako, ainunura, mala sata*, Solomon Is. (Kwara'ae), *ammui*, Palau Is.

7. Stemonurus gitingensis (ELM.) SLEUM. Blumea 17 (1969) 261. — *Urandra gitingensis* ELM. Leafl. Philip. Bot. 4 (1912) 1476. — *S. secundiflorus* (*non* BL.) MERR. En. Philip. 2 (1923) 489.

Tree, 13 m or higher, up to 60 cm ø; bark thick, yellowish or greyish, brittle, rough with lenticels. *Leaves* elliptic or obovately so, apex rounded, base broadly attenuate and obtuse, or sometimes rounded, dark green and shining above, dull and much paler beneath, coriaceous and rather stiff, smooth, *i.e.* practically not tubercled beneath, edge a little revolute, 7–13 by 4–7 cm, nerves (12–)15–17 (rarely more) pairs, rather straight, subparallel and close together, slightly raised above, hardly so beneath, reticulation obscure; petiole stout, (2–)2.5–3 cm. *Inflorescence* not known. *Infructescence* an umbel of 3–4 branches (*c.* 1 cm) on a robust peduncle (2–4 cm), bracts at base of the umbel according to the scars small and apparently early caducous. *Flowers*, as seen from the left scars, 2–4 clustered at the end of each branch of the umbel, certainly not in a row as in *S. secundiflora*. *Calyx* on immature fruit

cup-shaped, 2 mm, rather distinctly lobed. *Drupe* ovoid-ellipsoid, short-apiculate, 3.2–3.7 by 2–2.3 cm. *Seed* said to be surrounded with a soft white sourish tasting layer.

Distr. *Malesia*: Philippines (Sibuyan: Mt Gitinggiting; after MERRILL also on Panay).

Ecol. Primary forest at 750–1750 m. *Fr.* March–April.

Vern. *Tugbák*, P. Bis.

8. Stemonurus monticolus (SCHELLENB.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 243 ('*monticola*'); Blumea 17 (1969) 261. — ? *Urandra scorpioides* [*non* (BECC.) O. KTZE] PULLE, Nova Guinea 8 (1912) 659; SCHELLENB. Bot. Jahrb. 58 (1923) 165. — *Urandra monticola* SCHELLENB. Bot. Jahrb. 58 (1923) 164. — *Urandra umbellata* (*non* BECC.) PULLE, Nova Guinea 8 (1912) 658; SCHELLENB. Bot. Jahrb. 58 (1923) 165. — *Urandra brassii* HOWARD, Lloydia 6 (1943) 146, t. 1, f. 1 & 2; DAHL, J. Arn. Arb. 33 (1952) 270 (pollen).

Tree, 10–30(–40) m, bole up to 18 m and 10–30 (–60) cm ø; bark grey to pale brown, smooth, maybe with a few longitudinal fissures, a little or not peeling; buttresses sometimes present, up to 1.5 by 1 by 0.1 m. *Leaves* elliptic to obovate-, sometimes lanceolate- or oblong-elliptic, apex shortly obtusely acuminate, or mostly blunt, sometimes rounded and maybe a little emarginate, base ± broadly attenuate, coriaceous, dark green to yellowish green above, paler beneath, generally rather dull on both faces, smooth above, ± densely tubercled all over the undersurface, or at least so in a broad stripe along the midrib, very rarely smooth beneath, the edge a little recurved in dry specimens, (5–)6–10(–18) by (2.5–)3–6(–9) cm, nerves (12–)14–16 rather straight pairs, looping before the edge, very slightly or hardly raised or visible above and/or beneath, generally obscure beneath; petiole (1–)1.5–2 cm by 1–2 mm. Umbel-like *inflorescences* peduncled (2–4, rarely –4 cm by 1–1.5 mm), branches 4–6 rather slender, each bearing 3–4(–5) flowers crowded distally; bracts at the base of the umbel ovate-subacuminate, 1–2 by 1 mm, subpersistent during anthesis. *Calyx* cup-shaped, 2 mm, ± distinctly obtusely lobed. *Petals* 3(–4, rarely –4.5) by 1.5 mm. *Disk* a flattish slightly 5-lobed cup. *Drupe* subellipsoid-ovoid, 3–3.5 by 1.6 cm, apex subabruptly attenuate or apiculate.

Distr. *Malesia*: New Guinea.

Ecol. Primary (and occasionally also secondary) rain-forest or forest substage, on slopes, from sea-level to 850(–1000) m, on clayey or sandy soil, sometimes on limestone with clay cover, locally common. *Fl. fr.* Jan.–Dec.

Uses. Wood yellowish or light orange, apparently not used. Scrapings of bark heated in hot ashes are used for wounds in the Vogelkop Peninsula.

Vern. *Běram*, *bramsos*, *ěmpam*, *keferan maper*, *mansěran*, *sandawer*, *sapuduper*, Biak, *duwili*, Kapauku, *harihoh*, *korappi*, *korowapi*, *ukipi*, *wapapi*, Japen, *karmuk*, *karmu-u*, *lakobiliem*, *lobak*, Mooi, *kuwat*, Amberbaken, *nikoboa*, Kebar, *permeh*, *pirmir*, Asmat, *sakokohom*, *sakokom*, Manikiong, *tafus*, Berik, *tifus*, Mander, *weijan*, Meosnum (Wanapi).

9. Stemonurus umbellatus BECC. Malesia 1 (1877) 115, t. 5, f. 5 & 6, *incl. var. ovalifolius* BECC. *l.c.* t. 4, f. 14 & 15; VALET. Crit. Overz. Olacin. (1886) 235; RIDL. Fl. Mal. Pen. 1 (1922) 431, *p.p.*; BURK. Dict. (1935) 2074, *p.p.*; SLEUM. Blumea 17 (1969) 262. — *Urandra umbellata* (BECC.) O. KTZE, Rev. Gen. Pl. 1 (1891) 113; DAHL, J. Arn. Arb. 33 (1952) 270, f. 59 & 59 A (pollen). — *Lasianthera umbellata* (BECC.) KING, J. As. Soc. Beng. 64, ii (1895) 117, *excl. specim. cit.* (= *S. malaccensis*); MERR. En. Born. (1921) 355, *incl. var. ovalifolia* (BECC.) MERR. — *S. evenius* STAPF, Kew Bull. (1906) 71; MERR. En. Born. (1921) 355. — *Urandra hallieri* MERR. Philip. J. Sc. 5 (1910) Bot. 194; DAHL, J. Arn. Arb. 33 (1952) 270 (pollen). — *S. hallieri* (MERR.) MERR. En. Philip. 2 (1923) 489. — *Urandra evenia* (STAPF) HOWARD, J. Arn. Arb. 21 (1940) 468. — *S. intercedens* HEINE in Fedde, Rep. 54 (1951) 237; Pfl. d. Samml. Clemens Kinabalu (1953) 57, 114. — **Fig. 30-31.**

Tree, (8-)12–24(–37) m, (15–)20–35 cm ø; bark smooth or finely cracked or hooped, sometimes patchy, whitish-greyish to greenish or greyish-brownish. Branchlets dark by resinous

Fig. 30. *Stemonurus umbellatus* BECC. Fruiting twig, Mt Blumut, Johore (FRI 8841) (WHITMORE, 1968).

excretion. *Leaves* oblong to obovate, sometimes elliptic, apex generally rounded or obtusely apiculate, sometimes slightly retuse, rarely shortly bluntly acuminate, base cuneate, coriaceous, sometimes very stiffly so, shining above, rather dull beneath, the whole undersurface or at least the parts closer to the midrib set with fine epidermal tubercles, margin a little revolute, (6–)7–12(–16) by (3–)4–7(–9) cm, nerves numerous (20–25) straight subparallel pairs, generally slightly raised above only, rather obscure though visible beneath, reticulation, if any, remarkable above only; petiole 1.2–2 (very rarely –3) cm by 2(–3) mm. *Cymes* arranged in an umbel, its peduncle robust, 1–2(–3) cm by 2 mm, the (4–)5–6(–8) branches (3–)5–8 mm long and *c.* 1.5 mm ø, each branch bearing (1–)3–4(–5) distally crowded flowers; bract at base of umbel ovate-subulate, *c.* 2 mm, subpersistent. *Calyx* broadly obconical, 3 mm, base rugulose, margin truncate or very shallowly (apiculately) lobed, the very edge almost pellucid and ciliolate (lens!). *Petals* broad-oblong, slightly keeled, (4–)5(–6) by 2(–2.5) mm, white or light brown, scented. *Disk* cup-shaped and shallowly lobed. *Drupe* ovoid, very apex rather abruptly attenuate, lower half glossy green, upper one dull grey, 3–3.5(–4) by 1.5–2.2 cm, the fibrous part of the endocarp 1 mm thick.

Distr. *Malesia*: Malay Peninsula, Borneo.

Ecol. Primary forest, generally on hillside or high level alluvium, occasionally in swamp between hills, also in peat swamp forest, in coastal and high inland kerangas, on padang and on cliffs, generally in lowland up to 900 m, in the Cameron Highlands up to 1465 m, on Mt Murud in Sarawak at 1700 m, and on Mt Pagon Periok in Brunei at 1800 m; on Mt Kinabalu up to 1220 m, on sandy, maybe waterlogged soil (*Agathis* forest), sandy peat soil or sandy loam, rarely on sandstone. *Fl. fr.* Jan.–Dec.

Uses. Wood pale orange-brown or honey-coloured, apparently not used, the value of the timber not known.

Vern. *Sampin kris, sampit kris*, M; Borneo: *djadjar*, Dajak (Tajan), *čntaburok, sčmburok*, Iban, *kakuli*, Dusun; Philippines: *malatadu*, Mbo.

Fig. 31. *Stemonurus umbellatus* BECC. Stem, Mt Blumut, Johore (FRI 8841) (WHITMORE, 1968).

15. WHITMOREA

SLEUM. Blumea 17 (1969) 263. — **Fig. 32.**

Tree. *Leaves* spirally arranged, entire, coriaceous, penninerved, petioled. *Flowers* bisexual, generally pedicelled, uni- or biseriate towards the ± recurved end of secondary peduncles, the latter 3 or 4 as a cross-like umbel on top of a common axillary and solitary peduncle. *Calyx* cup-shaped, entire, persistent and ± flattened below fruit. *Petals* (4–)5, oblong, valvate, free in the uppermost part, remaining connate below at full anthesis, apex inflexed, with a conspicuous midrib inside, caducous. *Stamens* (4–)5, inserted at the very base of the petals; filaments linear, fleshy, with longish subclavate white hairs below the anther cells inside and at the connective outside; anther cells linear, thecae diverging below, basifixed. *Disk* annular, flat, rather obscure. *Ovary* ovoid-conical, apex truncate, *i.e.* inverted there and forming a kind of cup, with the small hardly bilobed unilateral stigma on its inner edge. *Drupe* oblong-ellipsoid, smooth and reddish in the lower ¾,

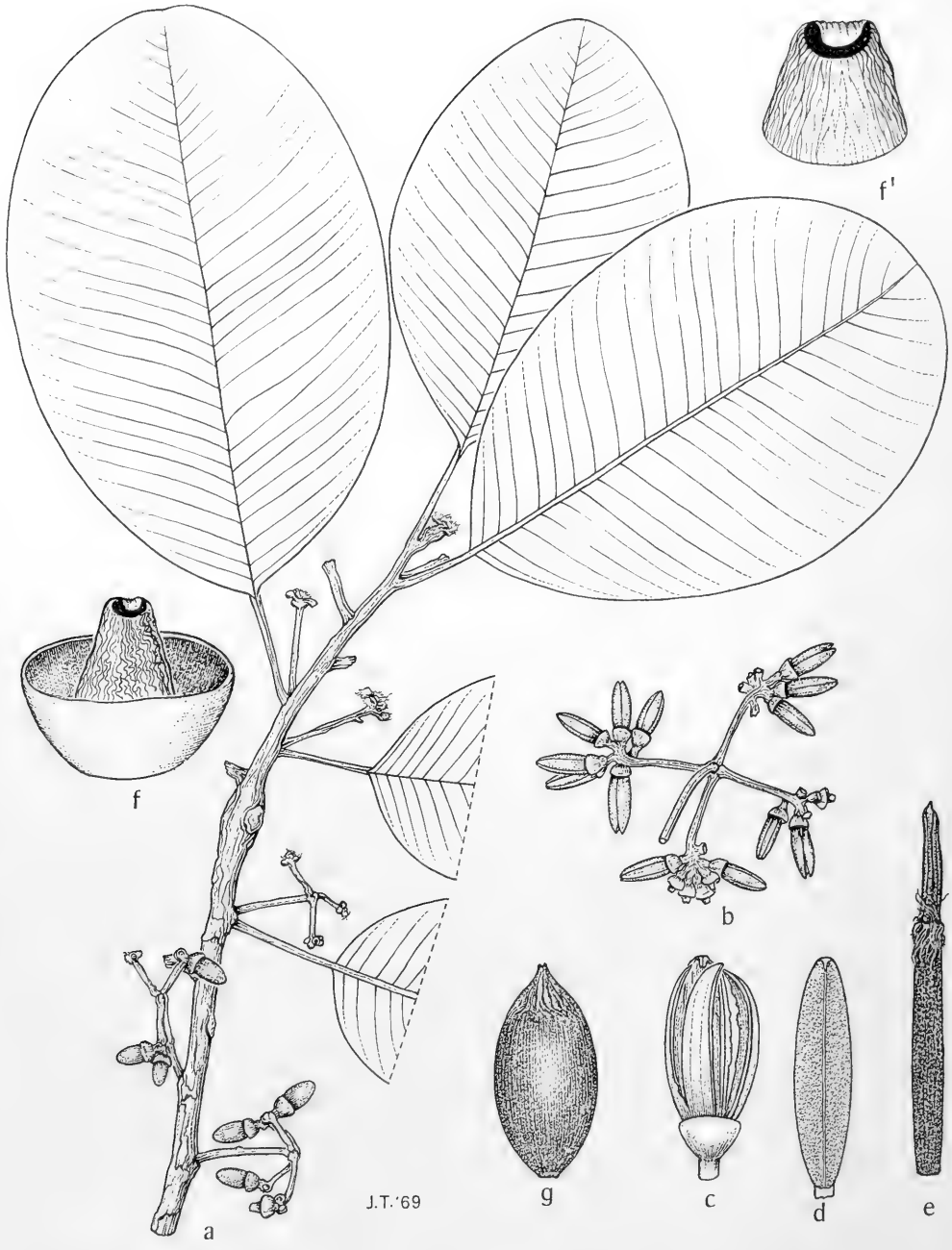

Fig. 32. *Whitmorea grandiflora* SLEUM. *a.* Habit, ×½, *b.* inflorescence, ×½, *c.* open flower, ×1½, *d.* petal inside, ×2, *e.* stamen, ×4, *f.* ovary and calyx, ×5, *f'.* upper part of ovary obliquely seen from above to show the stigma turned inside the apical cavity of the ovary, ×10, *g.* submature fruit, ×¾ (*a–f* BRASS 3418A, *g* BSIP 5212 WHITMORE, type).

papillose and greyish-yellowish in the upper ¼ part, exocarp thin, with an outer fibrous, and an inner crustaceous layer. *Seed* 1, ellipsoid-subquadrangular, with a lengthwise depression around the middle; embryo small, in the apex of the copious albumen.

Distr. Monotypic, hitherto only known from the Solomon Islands.

1. Whitmorea grandiflora SLEUM. Blumea 17 (1969) 264. — *Urandra umbellata* [*non* (BECC.) O. KTZE] WALKER, For. Fl. Br. Solomon Is. (1948) 127. — **Fig. 32.**

Spreading canopy tree, 6–25(–30) m, bole straight, up to 12 m, up to 50 cm ø, with slender and weak pneumatophores in wet places; bark grey to brown, smooth or cracked. Branchlets robust, often covered with resinous exudation as are the inflorescences. *Leaves* elliptic or oblong-elliptic, apex obtuse or slightly emarginate, base broadly cuneate to rounded, coriaceous, firm, shining green above, dull and greyish or yellowish green beneath, glabrous, 14–22 by 4–8(–12) cm, nerves in 20–25 pairs, straight and parallel to each other, slightly raised on both faces, reticulation dense, visibly raised above only; petiole 2–3(–4) cm by 2(–3) mm, minutely transversely wrinkled. *Inflorescences* axillary, solitary, with 3 or 4 secondary peduncles (1–3 cm) crosswise and umbellately spreading from top of main peduncle (2.5–4 cm by 1.5–2 mm), flowers several, close together, scorpioid, uni- or biseriate, on the upper ± recurved part of the secondary peduncles, thick-pedicelled for 0.5–2(–3) mm; bracts at base of secondary peduncles knob-like, rather obscure. *Calyx* obconical-cupular, maybe suddenly narrowed at base for 1–2 mm to a kind of foot for 1–2 mm, rugose, persistent and more spreading or almost patellar under the ripe fruit, 4–5 by 6–7 mm. *Petals* chartaceous, glabrous, veined lengthwise, becoming free only in uppermost part, remaining connate for the rest, oblong, white with cream centre or greenish-yellowish, with sweet smell, (12–)13–15 by 3–4 mm. *Filaments* linear, fleshy, 9–10 by 1 mm, with longish white hairs below the anthers inside and at connective outside; anthers linear, thecae spreading below, 4 by 1 mm. *Ovary* ovoid-conical, truncate, hollow at apex, its edge folded in dry specimens, 3.5–4 by 2–2.5 mm. *Drupe* oblong-ellipsoid, apiculate, reddish and smooth in the lower ¾, papillate and greyish-yellowish in the upper ¼ part, 3.5–4 by 2–2.5 cm.

Distr. Melanesia: Solomon Is. (Bougainville to San Cristobal).

Ecol. Primary and secondary rain-forest, both on well drained slopes or ridge top and in swampy valley bottoms, though locally not rare, from lowland up to 950 m.

Uses. Wood rather hard, moderately heavy, cream to brownish, used for planting sticks, suitable for not too heavy constructions.

Vern. *Aialo, aikuma, aikuni, aikunu, arifanatia,* Kwara'ae, *duleke,* Kolombangara, *porutolo,* Faro I.

16. POLYPORANDRA

BECC. Malesia 1 (1877) 125; SLEUM. Blumea 17 (1969) 248. — **Fig. 33.**

Dioecious climber, whether or not with extra-axillary or intrapetiolar tendrils. *Leaves* opposite, entire, penninerved. Panicles axillary, composed of short cymes. *Flowers* small, 5–6(–7)-merous. Pedicels articulated with calyx. — ♂ *Flowers*: *Calyx* cup-shaped, shortly dented. *Petals* valvate, inflexed appendiculate distally inside in bud. *Stamens* sessile; anthers thick, clavate-subglobose, with numerous small pollen-bearing alveoles, each of which is covered with a caducous membrane. Rudiment of *ovary* conical. — ♀ *Flowers*: *Calyx* deeply dented. *Petals* very short, connate in the lower ⅓. *Stamens* 0. *Ovary* subglobose-cylindric, stigma large, disk-shaped, the centre depressed, crenulate or very shortly many-lobed in later stages. *Fruit* compressed-ellipsoid; exocarp thin; endocarp firm, irregularly foveolate-reticulate outside when the exocarp is gone, wrinkled inside. *Seed* 1; cotyledons foliaceous.

Distr. Monotypic, Solomon Is. and *East Malesia*. Fig. 34.

Fig. 33. *Polyporandra scandens* BECC. *a.* Habit, ×½, *b.* ♂ inflorescence, ×½, *c.* ♂ flower, ×5, *d.* ♀ flower ×10, *e.* anther, ×20, *f.* drupe, ×1 (*a, c, e* VAN ROYEN & SLEUMER 6696, *b ditto* 6830, *d* CARR 12610 *f ditto* 16435).

1. Polyporandra scandens BECC. Malesia 1 (1877) 125, t. 7; PULLE, Nova Guinea 8 (1912) 660; SCHELLENB. Bot. Jahrb. 58 (1923) 176; BIRNIE, Nova Guinea 14, 2 (1926) 277; WHITE, J. Arn. Arb. 10 (1929) 235; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 379, f. 109; DAHL, J. Arn. Arb. 33 (1952) 275, f. 70 (pollen); STEEN. Nova Guinea, Bot. *n.* 23 (1965) 495; SLEUM. Blumea 17 (1969) 248. — ? *Iodes ovalis* (*non* BL.) WARB. Bot. Jahrb. 13 (1891) 299. — *P. hansemannii* ENGL. Bot. Jahrb. 16, Beibl. 39 (1893) 13 ('*hausemanni*'); in E. & P. Nat. Pfl. Fam. 3, 5 (1895) 253; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 418. — *Iodes sogerensis* BAKER *f.* J. Bot. 61 (1923) Suppl. 10. — **Fig. 33.**

Scandent shrub or branched liana, climbing to

35 m, stem up to 8 cm ø. Branchlets slender, divaricate, pubescent initially; nodes thickened; internodes 4–10 cm. *Leaves* opposite, ovate to elliptic, apex shortly ± abruptly acuminate to cuspidate, base broadly attenuate to rounded, slightly inequilateral, chartaceous to subcoriaceous, glabrous above, covered with scattered short appressed hairs all over beneath, 7–15(–17) by 3.5–9 cm, margin slightly revolute, entire, midrib a little impressed above, strongly prominent beneath, nerves (4–)6–8 curved-ascendent pairs, prominent beneath only as is the rather dense network of veins; petiole 8–15(–20) mm; tendrils whether or not present at the upper axils, elongate, bifurcate. *Panicles* 1–3 from the same axil, few- to many-flowered, (2–)3–9 cm, ascending or recurved, all over covered with short appressed hairs. Peduncle 1–3 cm, bearing several few-flowered cymes. Pedicels slender in the ♂, thicker in the ♀ flowers. — ♂ *Flowers*: *Calyx* tube short, lobes ovate-acuminate, *c.* 1 mm. *Petals* ovate-caudate, ± expanded, white to cream or yellow, 4–5(–6) mm, acumen abruptly narrowed, ± inflexed, glabrous, 2 mm, tip blunt. *Anthers c.* 1 mm ø. Rudiment of *ovary* hardly 1 mm. — ♀ *Flowers*: *Calyx* as in ♂ flowers. *Petals* only 1–1.5 mm. *Stamens* 0. *Ovary* densely hairy, *c.* 1.3 mm. *Fruit* compressed-ovoid-ellipsoid, *c.* 2 by 1.5 by 1.5 cm, appressed-pubescent; exocarp rather soft and smooth, 1 mm, apparently going early; endocarp hard, 0.5 mm, coarsely reticulate-foveolate.

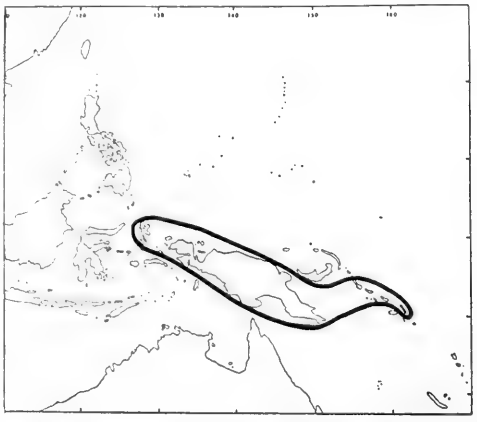

Fig. 34. Distribution of *Polyporandra scandens* BECC.

Distr. Solomon Is.; in *Malesia*: New Guinea, Moluccas (Halmahera, Batjan). Fig. 34.

Ecol. Climber over shrubs or high liana in primary and secondary rain-forest, from sea-level to 700 (possibly to 1000) m. *Fl. fr.* Jan.–Dec.

Uses. On Bougainville young leaves are cooked and eaten or added to taros to give these a flavor.

Vern. *Dodofu*, Halmahera.

17. IODES

BL. Bijdr. (1825) 29 ('*Iödes*'); SLEUM. Blumea 17 (1969) 219. — *Mappianthus* HAND.-MAZZ. Anz. Ak. Wiss. Wien M.-N. Kl. 58 (1921) 150; SLEUM. Blumea 17 (1969) 225. — **Fig. 36.**

Dioecious climbing shrubs or lianas. Branchlets hairy, generally bearing shortly bifid tendrils at or closely to the nodes (but not axillary!). *Leaves* decussate, entire, apiculate by a somewhat projecting midrib, penninerved, with ± appressed and strigose and/or softer, erect or obliquely spreading coarse hairs on midrib, nerves, veins and veinlets, and sometimes besides with a tomentum of very short fine substellate hairs which covers the intervenium beneath. *Inflorescences* in peduncled cymes which may be combined to panicles, axillary, supra-axillary or a little lateral from the nodes, sometimes terminal, solitary, the ♂ ones often elongate and many-flowered, the ♀ ones generally shorter and rather few-flowered; lower peduncles often sterile and becoming tendrils. *Flowers* small, white to cream or yellowish, fragrant. Pedicels articulate with the calyx and often dilated distally; bracts and bracteoles minute. *Calyx* cup-shaped, 4- or 5-lobed halfway or up to ¾ of its total length (Malesia), persistent in ♀. *Petals* 4 or 5, or sometimes wanting in ♀, valvate in bud, generally connate at base only, rarely and only in ♂ connate to ½ to ¾ of their length into a tube, only the reflexed lobes free, a little keeled inside, tips sometimes narrowed and inflexed already in bud, persistent in ♀. — ♂ *Flowers*: *Stamens* (3–)4 or 5; filaments very short and fixed either to the base of the (then shortly connate) petals or to the end of the corolla tube between the lobes,

or elongate and fixed to the base of the corolla tube; anther cells almost basifixed, introrse. *Ovary* rudimentary. — ♀ *Flowers*: *Staminodes* sometimes present. *Ovary* sessile; stigma sessile, discoid, cut on one side, or faintly 2–5-lobed. *Drupe* ovoid-ellipsoid or oblong-obovoid (Malesia), or almond-like, generally laterally compressed and longitudinally grooved or crested; exocarp thin, fleshy, yellow to red; endocarp crustaceous to thin-woody, irregularly ribbed or reticulately lacunose, or warty outside, smooth inside. *Seed* 1, albuminous; cotyledons large, foliaceous.

Distr. About 16 *spp.* in tropical Africa (and Madagascar), 3 *spp.* in SE. Asia (Assam and Burma to SW.–SE. China, Hainan, Indo-China, and Thailand), throughout *Malesia* (7 *spp.*), but in New Guinea only questionably known from a single old collection; 2 Malesian *spp.* also known from SE. Asia. Fig. 35.

Anat. ROBINSON (Ann. Inst. Bot. Btzg 8, 1890, 111, t. 18 & 19, f. 1–5) has investigated the anatomy of the stem of *I. cirrhosa* TURCZ. Vascular strands are formed here also in the pith, though the bast and wood elements are inversed.

Notes. For the determination of the various species the indumentum plays an important role. The use of a lens is necessary, and only leaves of ± the same state of maturity should be investigated or compared.

Mappianthus differs from *Iodes* only by rather vague characters such as filaments rather long in proportion to the length of the petals and a drupe with a finely grooved and tubercled exocarp. It is regarded here as congeneric, a point of view already expressed by BAILLON, who, however, created for *I. hookeriana* a proper *sect. Lasiodes* (Adansonia 10, 1872, 268).

KEY TO THE SPECIES

1. Petals in the ♂ flowers practically free, *i.e.* united only at the base.
 2. Indument on the undersurface of ± mature leaves consisting almost exclusively of rather sparse to more dense manifestly appressed stiff hairs.
  3. Flowers 5-merous. Pedicels of the ♂ flowers swollen and ± plate-like dilated distally when the flower has gone. ♀ Flowers without staminodes. Veinlets of leaves rather faintly reticulate. **1. I. ovalis**
  3. Flowers 4-merous. Pedicels of ♂ flowers not swollen distally. ♀ Flowers whether or not with 4 staminodes. Veinlets of leaves strongly reticulate. . . . . **2. I. yatesii**
 2. Indument on the undersurface of ± mature leaves consisting exclusively either of numerous fine and soft ± erect hairs, or of both such hairs and more robust, stiff and generally ± appressed (rarely obliquely spreading) hairs of various density.
  4. Flowers 4-merous. Hairs on undersurface of leaves rather sparse. Petals present in ♀ flowers. Drupe 2.5–3 by 1.5 by 1 cm. . . . . **3. I. reticulata**
  4. Flowers 5-merous. Hairs on undersurface of leaves (rather) dense. Petals absent in ♀ flowers. Drupe up to 2 by 1.2(–1.5) by 1 cm. . . . . **4. I. cirrhosa**
1. Petals in the ♂ flowers united into a tube for about their lower ⅔ (the tube at least 3 mm long).
 5. Drupe oblong-ellipsoid, ± obtuse at both ends, 1.2–1.5 by 0.8–1.2 by 0.8–1 cm. **5. I. philippinensis**
 5. Drupe larger.
  6. Drupe oblong-ovoid, apex broadly obtuse, base narrowed, 2.8–3.3 by 1.3–1.5 by 0.8–1.2 cm; crustaceous endocarp laxly coarsely lacunose. . . . . **6. I. velutina**
  6. Drupe almond-like, 2.3–3.5(–4.5) by 1.6–2 by 0.7–1 cm; crustaceous endocarp with several longitudinal shallow furrows and numerous flattish warts. . . . . **7. I. hookeriana**

1. Iodes ovalis BL. Bijdr. (1825) 30; MIQ. Fl. Ind. Bat. 1 (1856) 795, *p.p.*; BAILL. Adansonia 3 (1863) 364 *in text*, *p.p.*; in DC. Prod. 17 (1873) 22, *incl. var. genuina* BAILL. *l.c.* 23, *p.p.*; BECC. Malesia 1 (1877) 124, *p.p.*; SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 14; HALL. *f.* Med. Rijksherb. 1 (1910) 13; BACK. Schoolfl. Java (1911) 230 & Addenda; KOORD. Exk. Fl. Java 2 (1912) 532; KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 5; AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 7; BACK. & BAKH. *f.* Fl. Java 2 (1965) 61; SLEUM. Blumea 17 (1969) 220. — *I. horsfieldii* BAILL. Adansonia 10 (1872) 267; in DC. Prod. 17 (1873) 24. — *Polyporandra junghuhnii* KOORD. Kon. Ak. A'dam Versl. Verg. Wis- & Natuurk. 17 (1909) 780. — *I. oblonga* PLANCH. in MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 597; KING, J. As. Soc. Beng. 64, ii (1895) 128; RIDL. Fl. Mal. Pen. 1 (1922) 435.

Slender shrub, scandent with tendrils, up to 5 m. *Leaves* oblong-lanceolate to -elliptic or -obovate, apex acuminate to rounded, though minutely cuspidate by the protruding midrib, base rounded to subcordate, slightly inequilateral, thin chartaceous, glabrous above the midrib excepted, which is covered on both faces with a pale rusty short villous tomentum equally found on the branchlets and petioles, undersurface ± densely covered with stiff appressed hairs on nerves, veins and veinlets, the proper intervenium glabrous, (5–)6–15 by (2.5–)3–6.5 cm, midrib and nerves generally slightly impressed above, prominent

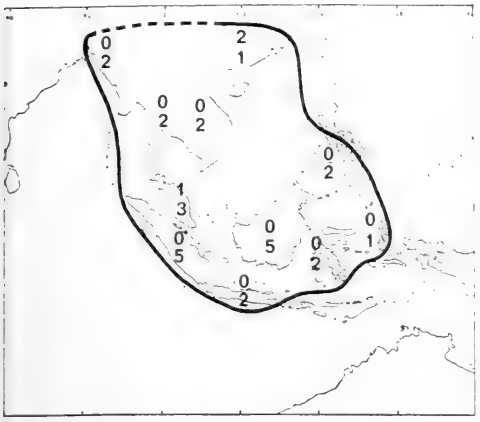

Fig. 35. Distribution of *Iodes* (incl. *Mappianthus*). The figure above the hyphen indicates the number of endemic species in the island or area, the figure below the hyphen the number of non-endemic species.

beneath, nerves 6–8 pairs, curved-ascending and inarching, reticulation of veins rather coarse, that of the veinlets more dense though rather faintly raised beneath; petiole 3–15 mm. *Inflorescences* all over covered with both rusty short strigose and softer hairs, the ♂ ones repeatedly dichotomous, many-flowered, up to 10 cm, the ♀ ones consisting of 8–16-flowered cymes and only 1.5–4 cm (incl. peduncle). Pedicels slender, swollen distally, the very end finally plate-like dilated when the flower has gone, 1–3 mm. *Calyx* 5-lobed to ½–⅔, *c.* 1.5 mm. *Petals* 5, oblong, white or light yellow, tip extended and inflexed, *c.* 2.5 mm in the ♂, lanceolate and acute (not inflexed) and *c.* 2 mm in the ♀ flowers, laxly appressed-strigose outside as is the calyx. — ♂ *Flowers*: *Stamens* 5; filaments slender, *c.* 0.6 mm; anthers subovate-oblong, *c.* 1 mm, cells with crenate-lobed margin. Rudiment of *ovary* hairy. — ♀ *Flowers*: *Staminodes* 0. *Ovary* thick-cylindric, all over densely appressedly hairy, 2 mm; stigma discoid, wider than the ovary, deeply incised on one side, margin crenulate, glabrous. *Drupe* inequally ovoid-compressed, said to be scarlet and to attain 1.5–2.5 cm in length (seen in immature state only up to 1 cm); endocarp with slightly prominent, not properly keeled ribs.

Distr. *Malesia*: Sumatra (Eastcoast), Malay Peninsula (Penang to Singapore), W. Java, Central Java (Pekalongan: Margasari, once).

Ecol. Along border of woods, in shrubberies, along roads or riversides, often in secondary vegetation, once in teak-forest (Margasari), sometimes on limestone, 50–300(–800) m. *Fl. fr.* Jan.–Dec.

Notes. What has been understood as *I. ovalis* in numerous floras of SE. Asia and Malesia, belongs partly to other species of the genus, mainly to *I. cirrhosa* TURCZ., *I. philippinensis* MERR. and *I. vitiginea* HANCE.

I. ovalis BL. was mentioned by K. SCH. & LAUT. Fl. Schutzgeb. (1900) 417 and SCHELLENB. Bot. Jahrb. 58 (1923) 176 for New Guinea (Morobe Distr., once found by WARBURG), but the specimen is lost and its identity remains uncertain. There is no recent record of *Iodes* from New Guinea.

2. Iodes yatesii MERR. Pap. Mich. Ac. Sc. 19 (1934) 165; SLEUM. Blumea 17 (1969) 221.

var. **yatesii.**

Scandent shrub. Branchlets weak, sparsely pubescent; tendrils up to 15 cm. *Leaves* ovate- or oblong-elliptic, apex abruptly acuminate for 1–1.5 cm, tip acute, base rounded to subcordate, chartaceous, ± shining on both sides, glabrous above, the midrib excepted, subdensely covered beneath with appressed strigose hairs on veins and veinlets, and besides with softer hairs on midrib and nerves, the proper intervenium hairless, (5–)7–12 by 3–6 cm, midrib a little sunken above, much prominent beneath, nerves 5–6 curved-ascending and inarching pairs, raised beneath, veins coarsely reticulated and but little prominent beneath, reticulation of veinlets dense, finely raised on both surfaces; petiole slender, subdensely hairy, 0.5–1.2 cm. *Cymes* 3–8 cm incl. peduncle, few- to many-flowered, very slender, all over covered with short substrigose and brownish softer hairs. Pedicels slightly dilated distally in the ♀, hardly so in the ♂ flowers, very slender, 2–5 mm. *Calyx c.* 0.8 mm, 4-lobed to ⅔, lobes spreading. *Petals* 4, oblong-acuminate, tip not extended and hardly inflexed, appressedly strigose outside as is the calyx, glabrous inside, *c.* 1.2 mm. — ♂ *Flowers*: *Stamens* 4; filaments 0.6 mm; anther cells ovate, margin not crenulate, *c.* 0.4 mm. Rudiment of *ovary* subglobular, hairy, minute. — ♀ *Flowers*: *Sepals* and *petals* as in ♂ flowers, persistent. *Staminodes* 4. *Ovary* ovoid, densely hairy; stigma flat, subglabrous. *Drupe* elongate-oblong-ovoid, laterally compressed, brownish-substrigose-tomentose, 2.5–3 by 1.5 by 1.3 cm, slightly keeled; endocarp shallowly and coarsely reticulate-impressed on both faces.

Distr. *Malesia*: Sumatra (Eastcoast; Riouw: Indragiri Uplands).

Ecol. Forest (also secondary) along river or roadside. *Fl. fr.* March-Nov.

var. **glabrescens** (RIDL.) SLEUM. Blumea 17 (1969) 221. — *I. reticulata* KING *var. glabrescens* RIDL. Kew Bull. (1931) 35.

Appressed hairs on the undersurface of leaves sparse. ♀ Flowers without staminodes.

Distr. *Malesia*: Borneo (Sarawak: Kuching), once found.

3. Iodes reticulata KING, J. As. Soc. Beng. 64, ii (1895) 126; RIDL. Fl. Mal. Pen. 1 (1922) 434; SLEUM. Blumea 17 (1969) 221.

Woody climber, up to 9 m. Branchlets slender, striate, with a broad line of dilutely ferrugineous tomentum on one side, changing sides at the nodes;

tendrils up to 15 cm. *Leaves* ovate-elliptic, sometimes subobovate, apex abruptly acuminate for 0.5–1.5 cm, acute, base generally slightly cordate, a little inequilateral, thin-coriaceous, glabrous and shining above, the hairy midrib excepted, all over the undersurface covered with rather sparse obliquely or patently spreading hairs, soft to the touch, 5–12 by 3–6.5 cm, midrib and nerves slightly impressed above, boldly prominent beneath, nerves 4–5 curved high-ascending and looping pairs, reticulation of veins and veinlets finely raised above, strongly so beneath; petiole densely hairy, 1–1.5 mm. *Cymes* lax, the ♂ many-flowered and usually exceeding the leaves in length, the ♀ ones few-flowered and generally shorter, ± patently soft-rusty-pubescent in all outer parts. Pedicels very slender in the ♂, thicker and swollen distally only in the ♀. — ♂ *Flowers*: *Calyx* cup-shaped, 1 mm, 4-lobed to ½–⅔. *Petals* 4, ovate-acuminate, a little fleshy, densely hairy outside, glabrous inside, 0.8 mm. *Stamens* 4, subsessile; anther cells subcordate, 0.2 mm. Rudiment of *ovary* minute, glabrous. — ♀ *Flowers*: *Calyx* as in ♂ flowers. *Petals* 4, subovate-oblong, united at the very base, tip acute, hairy outside as is the calyx, reflexed, 2–2.5 mm. *Staminodes* 0. *Ovary* thick-cylindrical or barrel-shaped, all over densely appressedly hairy, 1.5 mm; stigma discoid, deeply cut on one side, margin hardly crenulated. *Drupe* ellipsoid, compressed, base narrowed, ferrugineous-velvety, 2.5–3 by 1.5 by 1 cm, on stoutish pedicel, 5–8 mm; endocarp bony, coarsely furrowed outside.

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

Ecol. Open jungle, at low altitudes up to 250 m. *Fl.* May–Nov., *fr.* May–June.

4. Iodes cirrhosa TURCZ. Bull. Soc. Nat. Moscou 27, ii (1854) 281; SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 250; HEINE, Pfl. d. Samml. Clemens Kinabalu (1953) 58; AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 7; HEINE in Fedde, Rep. 54 (1951) 238; BACK. & BAKH. *f.* Fl. Java 2 (1965) 62 ('*cirrosa*'); SLEUM. Blumea 17 (1969) 221; Fl. Thail. 2 (1970) 86. — *I. ovalis* (*non* BL.) HASSK. Cat. Hort. Bog. (1844) 172; R. BR. in Benn. & Brown, Pl. Jav. Rar. (1852) 243, t. 48; MIQ. Fl. Ind. Bat. 1 (1856) 795, *p.p.*; BAILL. Adansonia 3 (1863) 364, *in text*, *p.p.*; in DC. Prod. 17 (1873) 22, *incl. var. genuina* BAILL. *l.c.* 23, *p.p. et var. miquelii* BAILL. *l.c.* 23; MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 596; BECC. Malesia 1 (1877) 124, *p.p.*; KING, J. As. Soc. Beng. 64, ii (1895) 128; HOCHR. Pl. Bog. Exs. (1904) 18; Bull. Inst. Bot. Btzg 19 (1904) 40; *ibid.* 22 (1905) 106 (as *var. genuina*); BRANDIS, Ind. Trees (1906) 154; GAGNEP. Fl. Gén. I.–C. 1 (1911) 844, *incl. var. cochinchinensis* PIERRE *ex* GAGNEP. *l.c.* 845; MERR. En. Born. (1921) 356; RIDL. Fl. Mal. Pen. 1 (1922) 435; CRAIB, Fl. Siam. En. 1 (1926) 276; GAGNEP. Fl. Gén. I.–C. Suppl. (1948) 757; DAHL, J. Arn. Arb. 33 (1952) 274 (pollen). — *Natsiatum oppositifolium* PLANCH. in Hook. Lond. J. Bot. 5 (1846) 247, *nom. nud.* — *I. tomentella* MIQ. Fl. Ind. Bat. 1 (1856) 796; KURZ, J. As. Soc. Beng. 44, ii (1875) 137; For. Fl. Burma 1 (1877) 243; BECC. Malesia 1 (1877) 124, *p.p.*; KOORD. Minah. (1898) 393; BACK. Schoolfl. Java (1911) Addenda *ad* p. 229; KOORD. Exk. Fl. Java 2 (1912) 532; KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 5; DAHL, J. Arn. Arb. 33 (1952) 274 (pollen). — *I. brandisii* KURZ, J. As. Soc. Beng. 41, ii (1872) 298; *ibid.* 44, ii (1875) 156; MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 596; KURZ, For. Fl. Burma 1 (1877) 243. — *I. horsfieldii* BAILL. Adansonia 10 (1872) 267; in DC. Prod. 17 (1873) 24. — *I. floribunda* MERR. Pap. Mich. Ac. Sc. 19 (1934) 166, t. 29; DAHL, J. Arn. Arb. 33 (1952) 274, f. 65 (pollen). — **Fig. 36a–d.**

Woody climber, 5–10(–18) m tall, stem up to 8 cm ø. Branchlets slender, rusty-tomentellous. *Leaves* ovate to ovate-elliptic, rarely oblong- or obovate-elliptic, apex shortly acuminate and acute by the slightly protruding midrib, base rounded or subcordate, firmly chartaceous, upper surface glabrous except midrib and nerves which bear rather dense soft yellowish erect or obliquely spreading hairs as are found all over the undersurface on midrib, nerves, veins and veinlets (the proper intervenium hairless), forming a velutinous tomentum, 5–15(–18) by 3.5–8(–11.5) cm, nerves 4–6 curved and rather steeply ascending pairs, prominent beneath as are midrib and the transverse veins, reticulation of veinlets dense, a little raised beneath only; petiole 1–2(–3.5) cm, tomentellous. *Inflorescence* all over covered with a short soft rusty tomentum, the ♂ in much branched and many-flowered, rather lax cymes, 5–15 cm incl. the peduncle (1.5–5 cm), the ♀ ones shorter and mostly rather few-flowered, 2–12 cm incl. the peduncle (1–4 cm). — ♂ *Flowers* not rarely transformed into globular hirsute galls (2–3 mm ø). Pedicels slender, 1–2 mm, not swollen distally towards the end of anthesis. *Calyx* 5-lobed to almost the base, densely set with substrigose hairs outside, lobes narrow-lanceolate, ½–¾ mm. *Petals* oblong-lanceolate, tip filiform and inflexed, thin, white or yellowish, fragrant, laxly substrigose-pubescent outside, 2–3 by 0.8 mm. *Stamens* 5; anthers practically sessile, ovate-elliptic, margin entire, 0.6–0.8 mm. Rudiment of *ovary* cylindric, hairy, 0.5 mm. — ♀ *Flowers*: Pedicels thickish, *c.* 1 mm, accrescent in fruit to *c.* 3 mm, hardly dilated distally. *Calyx* as in ♂ flowers, lobes *c.* 1 mm. *Petals* 0. *Staminodes* 0. *Ovary* cylindric, densely substrigose-hairy, 1 mm; stigma a dark bilobed or subreniform pad, hairy, glabrescent in later stages. *Drupe* obliquely ovoid, laterally compressed and crested, shortly ± appressedly rusty- or rufous-tomentose, 1.2–1.5(–2) by 1–1.2(–1.5) by 0.7–1 cm; exocarp thin, reddish; endocarp hard, coarsely lacunose-reticulate outside, smooth inside.

Distr. SE. Asia (Khasia, Burma, Thailand, Indo-China); in *Malesia*: Sumatra (East & Westcoast, Padang), Banka, Malay Peninsula (Perak, Selangor, Johore, Malacca), W. & E. Java, Borneo (Sarawak, W. & N. Borneo), Philippines

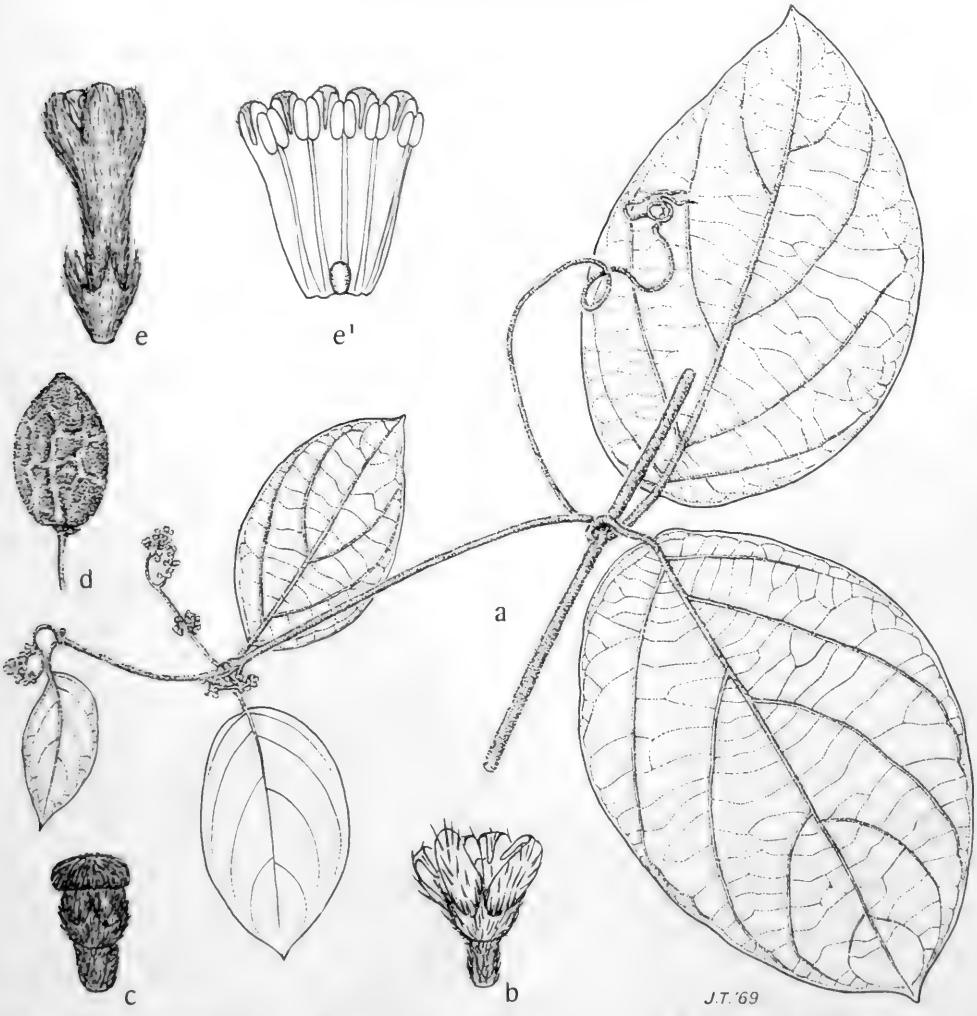

Fig. 36. *Iodes cirrhosa* TURCZ. *a.* Habit, ×½, *b.* ♂ flower, ×5, *c.* ♀ flower, ×5, *d.* drupe, ×1. — *I. philippinensis* MERR. *e.* ♂ flower from the outside, ×5, *e'. ditto* from the inside, expanded, ×5 (*a–b* SINCLAIR 9875, *c* VAN STEENIS 12717, *d* KING's Coll. 6783, *e–e'* SANTOS 4356).

(Palawan), Celebes, possibly in the Moluccas.

Ecol. Light primary and often secondary forest, forest borders, shrubberies, scattered, also in open vegetation on limestone rocks, sometimes rather dry places, in Java in regions with at least 20 or more rainy days in the 4 consecutive driest months, 10–1100 m. *Fl. fr.* Jan.–Dec.

Vern. *Akar mengkunyit* (Selangor), M, *arey balilandak, ki kurip*, S, *jagal kédang, jungetan*, J, *sasir kétè*, Minahasa.

5. Iodes philippinensis MERR. Philip. J. Sc. 3 (1908) Bot. 241; C. B. ROB. *ibid.* 6 (1911) Bot. 209; HOLTH. & H. J. LAM, Blumea 5 (1942) 205; DAHL, J. Arn. Arb. 33 (1952) 274, f. 68 (pollen); SLEUM. Blumea 17 (1969) 224. — *I. ovalis* (*non* BL.) BAILL. in DC. Prod. 17 (1873) 22, *quoad Philip.*; F.-VILL. Nov. App. (1880) 46; VIDAL, Phan. Cuming. Philip. (1885) 103; Rev. Pl. Vasc. Filip. (1886) 86; MERR. Philip. J. Sc. 30 (1926) 408; HOLTH. & H. J. LAM, Blumea 5 (1942) 205. — *I. tomentella* (*non* MIQ.) BECC. Malesia 1 (1877) 124, *quoad Philip.* — *I. oblonga* PLANCH. *ex* MAST. *var. moluccana* HOCHR. Pl. Bog. Exs. (1904) 18; Bull. Inst. Bot. Btzg 19 (1904) 40; *ibid.* 22 (1905) 107; Ann. Jard. Bot. Btzg Suppl. III, 2 (1910) 855. — **Fig. 36e-e'.**

Woody climber, up to 6 m. Branchlets slender, striate, soft villous by ferrugineous fine rather short hairs as are the petioles; tendrils slender, up

to 15 cm. *Leaves* ovate-elliptic to -oblong, apex short acuminate, the midrib hardly projected beyond the lamina, base rounded or mostly slightly cordate, thin chartaceous, upper surface finally glabrous except the midrib, undersurface all over soft tomentose, more densely so on midrib and nerves, the hairs being of two markedly different types, *i.e.* stoutish substrigose ± appressed, and much finer, soft and ± erect ones, the latter sometimes rather scarce, the space between the veinlets hairless, (3–)5–9 by 2.5–5(–7) cm, midrib and 4–6 pairs of ascendent and ± looping nerves plain above, ± strongly raised beneath, less so the veins, reticulation of veinlets not very distinct; petiole 0.6–1(–1.5) cm. — ♂ *Inflorescences*: Panicle; composed of several cymes, rather lax and relatively few-flowered, 2–4(–5) cm incl. the long peduncle, covered with ± crisped and appressed rusty substrigose hairs. Pedicels slender, 1–2 mm, the end glabrous and a little dilated when the flower is gone. *Calyx* cup-shaped, 1.5 mm, acutely 5-lobed halfway. *Petals* subglobose in bud, rapidly accrescent to 6–7(–8) mm at full anthesis, united into a narrow tube for the lower ⅔, free at the 5 lobes, the latter acuminate, narrow, tip inflexed in bud stage, ultimately reflexed or spreading, hairy outside and at the mouth inside, white or cream. *Stamens* 5, inserted at the end of the tube, alternating with the lobes; filaments flattened, very short; anther-sacs narrowly subovate-oblong, not crenulate, 0.8–1 mm. Rudiment of *ovary* cylindric, glabrous, *c.* 1.5 mm. — ♀ *Inflorescences* 3–5 (rarely –12)-flowered, 2–3 cm incl. the peduncle, hairy as are the ♂ ones. Pedicel slender, 3(–4) mm, not swollen distally. *Calyx* cup-shaped, 1.8 mm, 5-lobed halfway or a little more. *Petals* (4–)5, narrow-oblong, connate at the base, white or cream, thin, finally reflexed, glabrous inside, 2.5–3 by 0.6–0.8 mm. *Staminodes* 0. *Ovary* cylindric, all over clad with stiff forward directed hairs, 2 mm; stigma thick, bilobed, glabrous. *Drupe* obliquely oblongoid-ellipsoid, laterally compressed and rather sharply crested, ± obtuse at both ends, red to orange, 1.2–1.5 by 0.8–1.2 by 0.8–1 cm, densely rusty hairy; endocarp coarsely reticulate-lacunose; pedicels stoutish, 2–5 mm, a little swollen distally. Sepals and petals persistent on the fruit for a long time.

Distr. *Malesia*: N. Borneo, Philippines (all islands), Central E. Celebes (once found), Moluccas (Talaud, Morotai, Halmahera, Ternate, Ambon).

Ecol. Edge of forests or thickets, also secondary growths, in the lowland up to 200 m, but ascending in the foothills of Mt Kinabalu up to 1525 m, often near rivers.

Vern. *Kogopusut*, Dusun (Sambunan).

6. Iodes velutina KING, J. As. Soc. Beng. 64, ii (1895) 127; RIDL. Fl. Mal. Pen. 1 (1922) 434; BURK. Dict. (1935) 1245; SLEUM. Blumea 17 (1969) 224.

***var.* velutina.**

Climber, similar in leaves and flowers to *I. philippinensis*. Branchlets shortly rufous-pubescent especially so on one side; tendrils glabrescent. *Leaves* ovate, apex short acuminate and subacute by a glandular tip, *i.e.* the protruding midrib, base rounded or generally subcordate, firmly chartaceous, upper surface initially ± densely short pubescent, soft to the touch, glabrescent except the midrib, undersurface velvety by numerous ± appressed substrigose and even more numerous softer ± erect hairs, the tomentum rusty-olivaceous in dry, said to be whitish in fresh specimens, the intervenium, *i.e.* the proper space between the veinlets glabrous and thus green, (3–)4–10 by 2–5.5(–8) cm, nerves 4–5 rather steeply curved-ascendent pairs, a little raised beneath only, veins and reticulation of veinlets ± hidden by the tomentum underneath; petiole slender, tomentose, 0.5–1.5(–2) cm. — ♂ *Inflorescences*: Cymes few- to rather many-flowered, all over rusty-pubescent, 2–4 cm (incl. peduncle). Pedicels slender, 2–3 mm, finally a little swollen distally and glabrous at the very tip. *Calyx* cup-shaped, *c.* 1.3 mm, 4- or 5-lobed for ⅓ to almost ½. *Petals* 4 or 5, bud club-shaped, at full anthesis 5–7 mm and connate to a tube in the lower 2/3, lobes finally reflexed, their tip inflexed, subdensely ± appressedly hairy outside as is the calyx, long-hairy at the throat inside. *Stamens* 4 or 5, inserted at the throat; filaments laxly hairy, *c.* 1 mm; anther-sacs ovate-oblong, 0.8–1 mm. Rudiment of *ovary* conical-cylindric, glabrous, 0.5 mm. — ♀ *Inflorescences*: Cymes 2–5-flowered, 2–3 cm incl. the rather robust peduncle. Pedicels rather slender and 3–5 mm in anthesis, a little accrescent and more robust in fruit. *Calyx* cup-shaped, *c.* 1 mm, 4- or 5-lobed halfway, appressedly hairy as are the petals outside. *Petals* 4 or 5, subobovate-oblong, free to almost their base, 4–5 mm. *Staminodes* 0. *Ovary* cylindric, densely hairy; stigma slightly 4- or 5-lobed. Ripe *drupe* oblong-obovoid, apex broadly obtuse, base attenuate, much compressed laterally and manifestly crested, with a less obvious crest on each of the flat sides, tomentose initially, finally subglabrous, 2.8–3.3 by 1.3–1.5 by 0.8–1.2 cm, the thin exocarp blackish when dry; endocarp laxly coarsely lacunose; stigma slightly 5-lobed, 2 mm ø. *Seed* solitary, compressed.

Distr. *Malesia*: Malay Peninsula (Perak, Negri Sembilan, Malacca, Singapore).

Ecol. Woods and hedges, at low elevation.

Vern. *Akar china bukit*, *a. salupat*, M.

***var.* subvillosa** SLEUM. Blumea 17 (1969) 224. — *I. tomentella* (*non* MIQ.) SCHELLENB. Bot. Jahrb. 58 (1923) 176.

Undersurface of leaves covered with a felt of small substellate hairs (and thus greyish) on the space between the veinlets. In flower and fruit characters not distinguishable from *var. velutina*.

Distr. *Malesia*: Sumatra (Eastcoast, Bencoolen), Borneo (Amai Ambit and area S. of Kuching). Questionable for New Guinea by an old specimen said to have been collected by ZIPPELIUS.

Ecol. Primary forest both on sand- and lime-

stone in Borneo, 100–1000 m. *Fl. fr.* Aug.

7. Iodes hookeriana BAILL. Adansonia 10 (1872) 268; in DC. Prod. 17 (1873) 23; MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 596; KURZ, J. As. Soc. Beng. 44, ii (1875) 157; For. Fl. Burma 1 (1877) 244; BRANDIS, Ind. Trees (1906) 154; KANJILAL *c.s.* Fl. Assam 1 (1936) 254. — *I. thomsoniana* BAILL. Adansonia 10 (1872) 270; in DC. Prod. 17 (1873) 25; MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 596; BRANDIS, Ind. Trees (1906) 154. — *L. reticulata* KING *var. glabrescens* RIDL. Kew Bull. (1931) 35. — *Mappianthus borneensis* MERR. Webbia 7 (1950) 317. — *Mappianthus hookerianus* (BAILL.) SLEUM. Blumea 17 (1969) 225.

Fairly large woody climber, sometimes with tendrils, branchlets, undersurface of leaves along nerves and midrib, petioles and inflorescences subdensely clothed with substrigose, appressed hairs. *Leaves* elliptic- to ovate-oblong, apex abruptly shortly (maybe bluntly) acuminate, or almost cuspidate, base ± rounded, rarely subcordate, thin-coriaceous, shining on both faces, margin slightly revolute, entire (seemingly crenulate or denticulate in dry specimens with crisped edge), (8–)10–15 (–20) by (3.5–)5–8 cm, midrib narrowly impressed above, strongly raised beneath, nerves 7–8(–9) pairs, moderately curved-ascending and inarching before the edge, faintly raised above, distinctly so beneath as are the ± transverse veins, reticulation of veinlets dense and finely raised on both faces; petiole 1–1.5 cm. *Inflorescences* slightly extra-axillary dichasia, the ♂ ones rather many-, the ♀ ones few-flowered, often reduced in the lower axils to tendrils. Pedicels *c.* 1 mm, slender in the ♂, stoutish in the ♀ flowers. *Calyx* cup-shaped, *c.* 1 mm, edge minutely 5-dented to almost entire. — ♂ *Flowers: Petals* oblong, fleshy, *c.* 3 mm, connate to *c.* ¾, densely and shortly yellowish-substrigose outside, glabrous inside. *Filaments* filiform, *c.* 2 mm; anther cells linear-oblong, *c.* 1.8 mm. Rudiment of *ovary* cylindric, all over shortly strigose-tomentose. — ♀ *Flowers* unknown. *Drupe* almond-like, 2.3–3.5(–4.5) by 1.6–2 by 0.7–1 cm, on thick pedicel *c.* 2 mm; stigma rather small, faintly 5-lobed; exocarp fleshy, orange red, appressedly short-strigose; endocarp crustaceous, outside with several longitudinal shallow furrows and numerous flattish warts, inside smooth.

Distr. SE. Asia (Assam, E. Bengal); in *Malesia:* Sumatra (once found, Westcoast) and Borneo (Sarawak: Kuching area; N. Borneo: foothills of Mt Kinabalu, *c.* 900 m, twice found).

Ecol. Forests. *Fr.* Sept.–Nov.

Note. Closely related to and possibly conspecific with *Mappianthus iodoides* HAND.-MAZZ. (N. of Tonkin and adjacent China, eastwards to Hunan and Fukien).

Excluded

Iodes ferruginea K. SCH. & LAUT. Fl. Schutzgeb. (1900) 418; SCHELLENB. Bot. Jahrb. 58 (1923) 176, *nota sub I. tomentella*; SLEUM. Blumea 17 (1969) 225 = *Alangium villosum* (BL.) WANG. (*Alangiaceae*).

18. SARCOSTIGMA

W. & A. Edinb. New Phil. J. 14 (1833) 299; SLEUM. Blumea 17 (1969) 253. — **Fig. 38.**

Dioecious climbers. *Leaves* spirally arranged, entire, penninerved, strongly reticulate; petiole curved or twisted, lengthwise striate and transversely wrinkled, leaving a raised elliptic white scar. *Flowers* sessile or sometimes pedicellate (♀ only), clustered (or fascicled) or solitary along the rachis of long, pendulous interrupted or spike-like racemes, these simple or composed to panicles, (4–)5(–6)-merous. *Calyx* small, cupular, shortly dented, persistent. *Petals* shortly connate at base, valvate in bud, afterwards recurved, oblong, persistent in ♀ flowers. — ♂ *Flowers*: *Stamens* 5, exserted; filaments linear; anthers small, elliptic, medifixed, cells slightly divergent downwards. Rudiment of *ovary* hirsute. — ♀ *Flowers*: *Staminodes* filiform, whether or not present. *Ovary* ovoid-oblongoid, hirsute; stigma almost sessile, thick, umbonate. *Drupe*: exocarp coriaceous, thin; endocarp woody, thin, smooth or slightly verrucose and covered with a white membrane inside, sometimes a little reticulate-foveolate outside in fully mature fruits. *Seed* 1, testa thin; albumen none; cotyledons fleshy.

Distr. Two *spp.*, India (Western Ghats from N. Kanara to Travancore), Lower Burma, Andamans, Cochinchina, Annam; in *Malesia*: Sumatra, Malay Peninsula, Java, Borneo, Philippines. Fig. 37.

KEY TO THE SPECIES

1. Flowers in interrupted spikes; rachis stout. Petals 3–4 mm. . . . . **1. S. kleinii**
1. Flowers in slender panicles. Petals *c.* 2.5 mm. . . . . **2. S. paniculata**

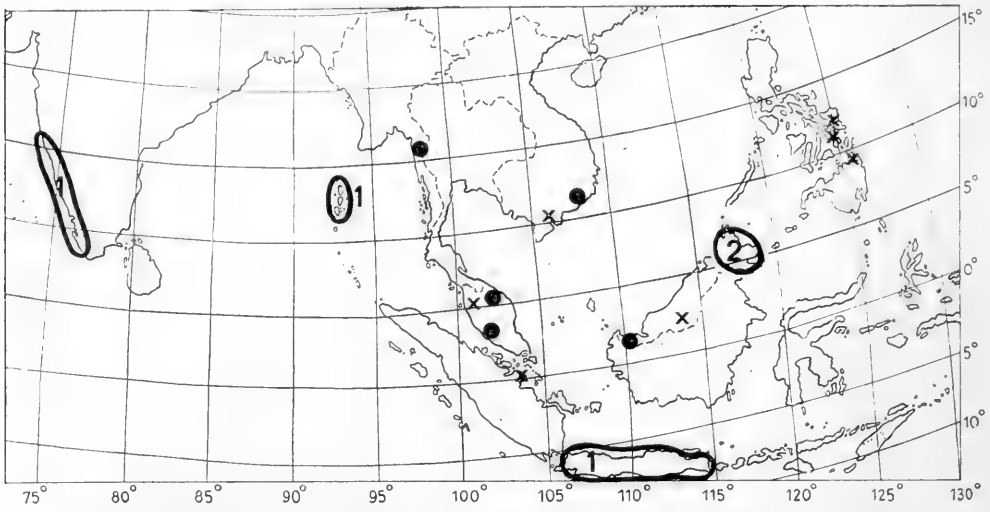

Fig. 37. Distribution of *Sarcostigma*. 1 and dots *S. kleinii*, 2 and crosses *S. paniculata*.

1. Sarcostigma kleinii W. & A. Edinb. New Phil. J. 14 (1833) 299; MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 116, repr. Contr. Bot. 1 (1852) 103, t. 18; SLEUM. Blumea 17 (1969) 254 (with further synonyms). — *S. horsfieldii* R. BR. in Benn. & Brown, Pl. Jav. Rar. (1852) 241, t. 47; MIERS, Ann. Mag. Nat. Hist. II, 10 (1852) 118, repr. Contr. Bot. 1 (1852) 105; MIQ. Fl. Ind. Bat. 1 (1856) 795; SCHNIZL. Ic. 3 (1857/65) t. 172, f. 32 & 33; HASSK. Retzia ed. nov. (1858) 360; BAILL. in DC. Prod. 17 (1873) 16; BECC. Malesia 1 (1877) 125; HOCHR. Bull. Inst. Bot. Btzg 19 (1904) 39; Pl. Bog. Exs. (1904) 16; KOORD. Jungh. Gedenkb. (1910) 175; BACK. Schoolfl. Java (1911) 229; KOORD. Exk. Fl. Java 2 (1912) 533; KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 5; AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 7; DAHL, J. Arn. Arb. 33 (1952) 276 (pollen); BACK. & BAKH. *f.* Fl. Java 2 (1965) 62.

Much branched liana, up to 26 m, stem up to 8 cm ø, sometimes leafless during anthesis; wood hard. Branchlets slender. *Leaves* oblong to oblong-obovate or -elliptic, rarely lanceolate, apex shortly rather abruptly and generally bluntly acuminate, or obtuse, base broadly cuneate to rounded, subcoriaceous to coriaceous, glabrous on both sides, or rarely with some hairs beneath, yellowish-green when dry, (7–)9–25 by 4–7(–11.5) cm, midrib slightly depressed above, strongly raised beneath, nerves (4–)6–8 pairs, curved-ascendent and inarching before the edge, prominent beneath, reticulation dense and very prominent (sometimes almost foveolate) on both faces, or more distinct beneath; petiole 1–1.5(–2) cm, often recurved, striate as is the midrib beneath and transversely wrinkled in dry specimens. *Spikes* usually 1–3(–5), fascicled, slightly supra-axillary from partly already defoliate axils, or from old wood, pendent, densely shortly brown-hairy to -hirsutulous, ♂ 15–25, ♀ up to 40 cm, the flowers in numerous clusters or fascicles with flowerless parts of the rachis between, generally sessile, rarely (only in the ♀) pedicelled (0.5–1.5, in fruit up to 5 mm), fetid. *Calyx* 1–1.5 mm, obtusely lobed halfway, hairy below. *Petals* linear-oblong, subacute, densely brown-hairy outside, glabrous and with a slight median ridge inside, greenish-yellow, 3–4 mm. — ♂ *Flowers*: *Filaments* strap-shaped, glabrous, *c.* 5 mm; anthers elliptic, *c.* 0.8 mm. Rudiment of *ovary* elongate-conical, hirsute. — ♀ *Flowers*: *Staminodes* whether or not present. *Ovary* ellipsoid-obovoid, hirsute; stigma a reversed subconical or flattish cup. *Drupe* unequally subovoid-ellipsoid or -oblongoid, laterally compressed and almond-like, 2.5–3.5 by 1.7–2 by 1–1.5 cm, very base suddenly contracted and hidden by the persistent calyx and petals, apex crowned by the thickish small (1 mm) stigma; exocarp very thin, with numerous vertical thick lines standing out in the dry fruit, bright orange red or yellow, brownish-hirsute, glabrescent at length; endocarp thin, 0.5 mm, hard, a little reticulate-lacunose outside, smooth or faintly verrucose and shiny white in the fresh state inside. *Seed* 1, with a thin edible sweetish pulp round the nut inside.

Distr. India (Western Ghats S. to Travancore), Lower Burma, Andamans, Indo-China (Annam); in *Malesia*: Malay Peninsula, W. &. E. Java, Borneo (Sarawak: Semengoh F. R.). Fig. 37.

Ecol. Forests (also teak-forests), scattered, in Java largely under seasonal climatic conditions, up to 550 m. *Fl. fr.* Febr.–Oct.

Uses. In India the oil of the seeds is highly esteemed in the treatment of rheumatism; this use is not known from Malesia.

Vern. *Kamaras, tangkilan*, J, *buah pĕlay tĕdong*, M.

2. Sarcostigma paniculata PIERRE, Bull. Soc. Linn. Paris 2 (1897) 1319; GAGNEP. Fl. Gén. I.-C. 1 (1911) 841, f. 102, 1–3, *incl. var. angustifolia* (PIERRE) GAGNEP. *l.c.* 842; RIDL. Fl. Mal. Pen. 5 (1925) 298; SLEUM. Blumea 17 (1969) 254. — *S. angustifolia* PIERRE, Bull. Soc. Lin. Paris 2 (1897) 1320. — *S. philippinensis* MERR. Philip. J. Sc. 10 (1915) Bot. 276; En. Philip. 2 (1923) 492; DAHL, J. Arn. Arb. 33 (1952) 276, f. 71 (pollen). — *S. surigaoensis* ELM. Leafl. Philip. Bot. 10 (1939) 3749; DAHL, J. Arn. Arb. 33 (1952) 277 (pollen). — **Fig. 38.**

Climbing to 30 m, stem up to 10 cm ø, crooked, branched toward top and forming hanging masses; wood very soft, coarsely porous, ± yellow in the centre, watery, with a large whitish pith; bark grey to brown, smooth, rather thin. Branches divaricate, laxly rebranched, the free ends pendent. *Leaves* scattered along the slender branchlets, oblong or ovate- to elliptic-oblong, rarely lanceolate, apex broadly attenuate, bluntly subacuminate or obtuse, base broadly cuneate to rounded, thin-coriaceous, paler (greyish) green beneath, glabrous, shining on both faces, (8–)12–20 by (2.5–)4–9 cm, midrib slightly raised above, prominent and longitudinally striate beneath, nerves 4–6 pairs, steeply curved-ascending, rather obscurely looping, raised beneath, reticulation dense, finely tessellate on both sides; petiole 1.5–2(–4) cm. — ♂ *Panicles* axillary or terminal, descending, slender and flexible, much-branched and many-flowered, tomentose initially, early glabrate, 30–60 cm, the lower branches up to 16 cm; flowers 3–5 per cluster, these spicately arranged at intervals of 5–15 mm, with brownish appressed hairs on rachis and more densely around the clusters. *Calyx* widely cup-shaped, membranous, indistinctly denticulate, 0.6 mm. *Petals* narrowly oblong, apex attenuate and slightly inflexed inside, thin, whitish or yellow, practically glabrous, with 3 longitudinal veins, *c.* 2.5 mm. *Filaments* slender, glabrous, 1–1.5 mm; anthers elliptic-ovate, 0.7 mm. Rudiment of *ovary* columnar, hairy. — ♀ *Inflorescences* (PNH 14563) panicled, glabrate. Flowers sessile, spaced along a rather slender rachis. *Calyx* cup-shaped, hardly dented, 0.8 mm. *Petals* oblong, subglabrous, 3 mm. *Staminodes* 1 mm, no anthers. *Ovary* oblongoid, densely hairy, 2 mm; stigma a large pad depressed in centre. *Infructescence* paniculate, stoutish, hairy, *c.* 10 cm, lower branches up to 4 cm; pedicels *c.* 2 mm long and across. *Drupe* (subovoid-)ellipsoid, maybe somewhat compressed, laxly hairy, glabrescent, 3–3.5 by 1.5–2 cm; exocarp blackish-brownish and wrinkled on dry fruit; endocarp thin, woody, smooth inside. *Seed* 1, white-coated.

Distr. Cochinchina; in *Malesia*: Sumatra (Riouw), Malay Peninsula (Perak), Borneo, Philippines (Leyte, Samar, Mindanao). Fig. 37.

Ecol. Primary lowland forest, from sea-level up to 500 m (twice found at 1065 m in Mindanao), on sandy loam, scattered. *Fl. fr.* Jan.–Dec.

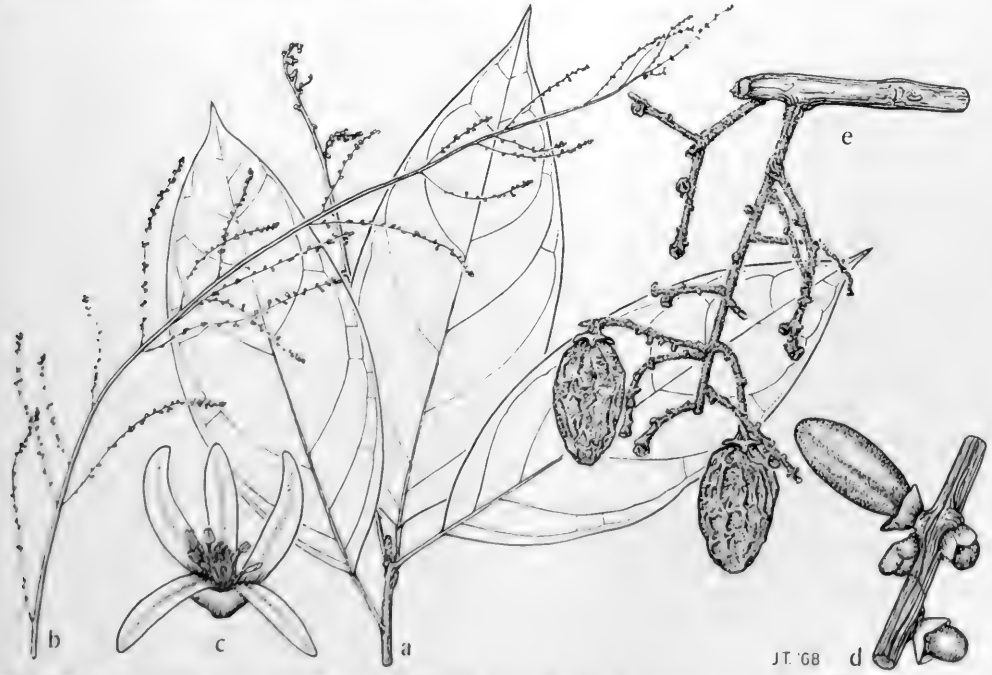

Fig. 38. *Sarcostigma paniculata* PIERRE, *a.* Habit, ×½, *b.* ♂ inflorescence, ×½, *c.* ♂ flower, ×10, *d.* ♂ flower bud, ×10, *e.* fructification with almost mature fruits in dry state, ×½ (*a–d* SAN 24459, *e* SAN 17107).

19. PYRENACANTHA

WIGHT in Hook. Bot. Misc. 2, 4 (1830) 107, Suppl. t. 9 & 10, *nom. cons.*; SLEUM. Blumea 17 (1969) 249. — *Freeria* MERR. Philip. J. Sc. 7 (1912) Bot. 292.

Dioecious scandent shrubs or lianas. *Leaves* spirally arranged, glandular-repand-dentate and penninerved. *Flowers* small, sessile, bracteate, in lax supra-axillary spikes. *Sepals* or *calyx* 0. *Petals* connate at base, valvate in bud, persistent in ♀ flowers. — ♂ *Flowers*: *Stamens* (3–)4(–5); filaments very short; anthers minute. Rudiment of *ovary* present. — ♀ *Flowers*: *Staminodes* very short or absent. *Ovary* sessile; stigma sessile, thick, truncate. *Drupe* laterally compressed; exocarp fleshy; endocarp crustaceous, punctate outside, verrucose-papillose inside, the papillae projecting into the interstices of the deeply ruminate and pitted albumen. *Seed* 1.

Distr. About 20 *spp.*, most of them in tropical and subtropical Africa & Madagascar, 1 *sp.* (*P. volubilis* WIGHT) in S. India and Ceylon, Indo-China and Hainan; in *Malesia*: 1 *sp.* in the Philippines.

1. Pyrenacantha repanda (MERR.) MERR. En. Philip. 2 (1923) 492; SLEUM. Blumea 17 (1969) 249; SHAW, Kew Bull. 23 (1969) 113. — *P. sp.*, CERON, Cat. Pl. Herb. Manila (1892) 46. — *Freeria repanda* MERR. Philip. J. Sc. 7 (1912) Bot. 292. — *Tragia luzoniensis* MERR. Philip. J. Sc. 16 (1920) 564.

Woody vine, up to 8 m. Branchlets slender, minutely verrucose, the growing parts short-pubescent. *Leaves* oblong to oblong-lanceolate, apex slenderly acuminate, bluntish, base narrowed, very base cordate, subcoriaceous, glabrous and smooth above (though very finely papillate under the lens), set with scattered appressed strigose hairs (whose rounded bases are partly pellucid against strong light) and scabrid to the touch beneath, 6–14 by 1.5–4(–5) cm, margin ± repand with a short glandular tooth at the excurrent end of each lateral nerve, midrib and nerves prominent on both faces, the latter in 5–6 curved-ascendent and anastomosing pairs, reticulation rather lax and slightly raised on both sides; petiole usually strongly curved, glabrescent, 5–15(–30) mm. *Spikes* supra-axillary, slender, minutely substrigose-pubescent, (2–)4–8 cm; flowers scattered in the upper half or less, each flower subtended by an oblong acuminate small bracteole. *Petals* 4, ovate-oblong, pubescent outside, 1.5–2 mm. — ♂ *Flowers*: *Filaments* very short; anther cells ovate-elliptic, hardly 0.5 mm. Rudiment of *ovary* hirsute, subglobose. — ♀ *Flowers*: *Staminodes* minute. *Ovary* ellipsoid, densely pubescent, 1 mm; stigma round, truncate, minutely papillate. *Drupe* elliptic-oblong, laterally compressed to rather sharp edges, glabrous, yellowish or red, 1.8–3 by 1–1.5 by *c.* 0.8 cm; exocarp pulpy or fleshy, rather thin, wrinkled in dry fruits. *Seed* 1; endosperm ruminate, yellow, oily, externally deeply pitted by the protuberances on the inside of the thin endocarp.

Distr. *Malesia*: Philippines (Luzon: Ilocos Norte, Bulacan, Tayabas, Sorsogon; Samar, Mindanao).

Ecol. Primary forest at low altitudes, scattered. *Fl.* March–May, *fr.* Sept.

Note. Apparently close to *P. volubilis* HOOK. and to certain species from Madagascar in leaf-characters, distinguishable from the first by its larger fruits.

20. MIQUELIA

MEISN. Pl. Vasc. Gen. 1 (Sept. 1838) 152; *ibid.* 2 (Sept. 1838) 109; SLEUM. Taxon 17 (1968) 449 *et ibid.* 18 (1969) 479, *nom. cons. prop.*; Blumea 17 (1969) 229, *non* BL. June 1838 (= *Stauranthera* BENTH. 1835). — *Jenkinsia* GRIFF. Calc. J. Nat. Hist. 4 (1843) 231; *ibid.* (1844) t. 12, *non* HOOK. Gen. Fil. (1842) text opp. t. 75 b. — **Fig. 39.**

Dioecious climbing or twining shrubs, the wood with large porous vessels. *Leaves* spirally arranged, entire or coarsely lobed (Mal.), generally minutely papillose-tubercled on both faces, nerves palmate to pinnate. *Flowers* sessile, arranged in heads or umbels; these on ± elongate, distally ± thickened peduncles, from defoliate or foliate axils; inflorescences solitary or several in lax racemes, panicles or fascicles. *Calyx* small, ± deeply 4- or 5-lobed. — ♂ *Flowers*: *Petals* 4

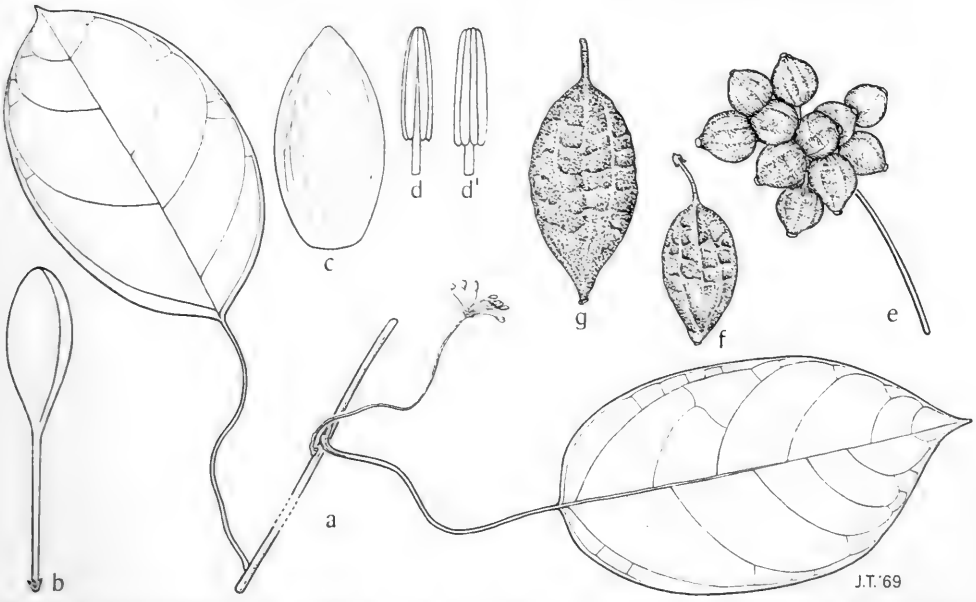

Fig. 39. *Miquelia celebica* BL. *a.* Habit, ×½, *b.* ♂ flower bud, ×5, *c.* petal, ×7½, *d.* & *d'.* stamen, ×7½, *e.* submature infructescence, ×½, *f.* mature fruit, with remnants of the petals at the very base, ×1. — *M. caudata* KING. *g.* Fruit, ×1 (*a–d* ELMER 9894, *e* KRUYFF 23, *f* KOORDERS 19594, *g* CLEMENS 27608).

or 5, united into a short or mostly elongate-filiform tube adnate to the flower axis, upper part or lobes free, valvate in bud, apex a little inflexed, patent or ± reflexed in anthesis. *Stamens* 4 or 5; filaments short-linear; anthers elongate-linear-oblong to (sub)sagittate, exceeding the filaments in length, dorsifixed a little above the base, introrse. Rudiment of *ovary* minute. — ♀ *Flowers*: *Calyx* and lobes of the petals either distant from each other by the elongate flower axis, or close together, *i.e.* practically no flower axis present. *Staminodes* flattish, very short. *Ovary* thick-cylindric, hairy; stigma sessile, disk-shaped, its centre a little depressed. *Drupe* oblongoid to subovoid-ellipsoid, laterally compressed, whether or not narrowed into a stalk-like base, either sessile or on a pedicel-like flower-axis; mesocarp thin; endocarp crustaceous, rugose or shallowly lacunose, ± manifestly verrucose inside, the warts causing small pits in the flattened ovoid *seed* which is surrounded by a juicy pulp; testa thin; albumen fleshy, rugulose; cotyledons elliptic, thick-foliaceous.

Distr. About 8 *spp.* in SE. Asia (India: Western Ghats; Assam, Burma?, Thailand, Laos); in *Malesia*: 4 *spp.* (Sumatra, Malay Peninsula, Borneo, Philippines, Celebes). Fig. 40.
Ecol. Mainly lowland forest, rarely up to 1980 m (Mt Kinabalu).

KEY TO THE SPECIES

1. Calyx and lobes of the petals distinctly spaced both in the ♀ and ♂ flowers by the elongate flower-axis (= the basal connate tube-like part of the petals). Drupe 'pseudopedicelled' by this axis (and besides much narrowed towards the base into a kind of stalk).
2. Leaves oblong to subovate-oblong, (10–)12–17 by 4–6.5 cm; inner basal pair of nerves ascending to the lower third of the lamina. Umbels *c.* 10-flowered. . . . . **1. M. reticulata**
2. Leaves ovate, 7–11 by 5–9 cm; inner basal pair of nerves ascending to ½ or ¾ the length of the lamina. Umbels *c.* 5-flowered. . . . . **2. M. philippinensis**

1. Calyx and lobes of the petals close to each other in the ♀ flowers and drupe, spaced in the ♂ flowers. Drupe not 'pseudopedicelled' (but much narrowed towards the base into a kind of stalk).
3. Drupe 2.3–3.3 by 1.3–1.8 by 0.7–1 cm, narrowed at apex into a shorter or longer rather slender beak; endocarp coarsely lacunose. . . . . **3. M. caudata**
3. Drupe (0.8–)1–1.2(–1.7) by 0.7–0.8(–1.2) by 0.6 cm, shortly and rather gradually narrowed at apex; endocarp more finely lacunose. . . . . **4. M. celebica**

1. Miquelia reticulata MERR. Philip. J. Sc. 9 (1914) Bot. 312; En. Philip. 2 (1923) 493; SLEUM. Blumea 17 (1969) 230.

Scandent. Branchlets slender, sparingly hirsute with short hairs, as are the petioles. *Leaves* oblong to subovate-oblong, apex gradually attenuate or subacuminate, base rounded and a little oblique, very base shortly cordate, membranous, glabrous and smooth above, set with scattered hairs all over the undersurface and somewhat rough to the touch, entire, (10–)12–17 by 4–6.5 cm, midrib prominent beneath, nerves 2 basal pairs, the outer pair short, the inner one ascending to the lower third of the lamina, other higher nerves from the midrib 3–4(–5) pairs curved-anastomosing, slightly depressed above, raised beneath, reticulation coarse and faint above, a little prominent beneath; petiole (1–)1.5–2.5(–5.5) cm by 1–2 mm. — ♂ *Inflorescences* unknown. — ♀ *Flowers* umbellately arranged on top of a slender peduncle, the latter either solitary and axillary, or mostly 2–4 peduncles from a short thickened rachis on defoliate stem, 3–10 cm, with about 10 flowers per umbel. *Calyx* 4-lobed to almost the base, lobes hairy, *c.* 1 mm. *Petals* 4, greenish-yellow, fleshy, lobes elongate-oblong, subacuminate, laxly puberulous outside, glabrous inside, *c.* 3 by 1.5 mm, tubular basal part of the petals 5–7 mm at full anthesis. *Stamens* 4, flattened, very short. *Ovary* hairy, crowned by a thick pad-like stigma. *Drupe* narrowly ovoid in general, somewhat compressed, *c.* 2 by 1.3 by 0.8 cm, wrinkled when dry, suddenly attenuate at the very base into a kind of stipe (5–8 mm), on the base of which the lobes of the petals persist for some time; flower-axis below these lobes 6–8 mm, slightly more slender than the basal stipe of the drupe; exocarp thin, densely hairy; endocarp thin, coarsely foveolate outside, finely tubercled inside.

Distr. *Malesia*: Philippines (Camiguin and Bohol Is.), twice found. Fig. 40.

Ecol. Forest at low altitudes, up to 600 m.

2. Miquelia philippinensis MERR. Philip. J. Sc. 14 (1919) Bot. 416; En. Philip. 2 (1923) 493; SLEUM. Blumea 17 (1969) 230.

Scandent shrub. Branchlets slender, laxly hirsute with shorter and longer hairs, as are the petioles. *Leaves* ovate, apex broadly subacuminate-attenuate, base rounded and very shallowly or hardly cordate, membranous, glabrous and olivaceous in dry state above, rather laxly and finely short-hairy on the undersurface, entire, somewhat repand or shortly (*c.* 5 mm) 1–2-lobed on each side, 7–11 by 5–9 cm, midrib and nerves faint above, a little raised beneath, 2 pairs of basal nerves, the outer pair rather short, the inner one

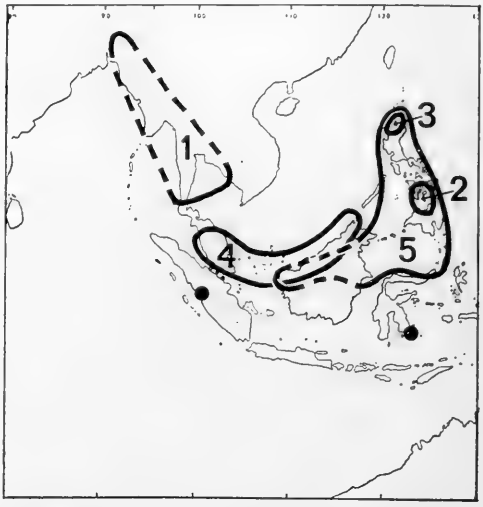

Fig. 40. Distribution of *Miquelia*. 1. *M. kleinii*, 2. *M. reticulata*, 3. *M. philippinensis*, 4. *M. caudata*, 5 and 2 dots *M. celebica*.

ascending to ½–¾ the length of the lamina, upper lateral ones *c.* 3 pairs, curved-anastomosing, reticulation coarse and faint, less obvious than in *M. reticulata*; petiole 2–3 cm by 0.5–1 mm. — ♂ *Inflorescence* unknown. — ♀ *Inflorescence* axillary, solitary peduncles *c.* 3 cm, each bearing *c.* 5 umbellately arranged flowers. *Calyx* lobes ovate-acuminate, hairy, 1–1.5 mm. *Petals* united below into a *c.* 5 mm long tube, free lobes oblong, subglabrous, 2.5 mm. Submature *drupe* oblongoid-ellipsoid, slightly hairy, 1–1.3 cm long, narrowed downwards to a slender stalk as long as the fruit proper.

Distr. *Malesia*: Philippines (Luzon: Ilocos Norte Prov.), once found. Fig. 40.

Ecol. Forest at low altitude.

3. Miquelia caudata KING, J. As. Soc. Beng. 64, ii (1895) 124; RIDL. Fl. Mal. Pen. 1 (1922) 433; BURK. Dict. (1935) 1478; SLEUM. Blumea 17 (1969) 230. — **Fig. 39g.**

A slender climber up to 6 m. Branchlets pale, striate, early glabrescent and corticate, 2–5 mm ø. *Leaves* oblong-lanceolate to elliptic-oblong, apex shortly, sometimes rather abruptly acuminate, base broadly cuneate to rounded, thin-chartaceous to membranaceous, glabrous above, laxly puberulous all over the surface and soft to the touch beneath, glabrescent, entire, (10–)12–20 by

(4–)5–8 cm, midrib and nerves moderately raised beneath, nerves 1 or 2 basal and 5–6 upper pairs, equally curved-ascending and rather obscurely anastomosing, reticulation generally lax and but slightly prominent; petiole pubescent, 1.2–3(–4) cm. — Umbels of ♂ *inflorescences* solitary or mostly several, in fascicles or along a short rachis from hairy tubercles of foliate or defoliate axils of the branchlets; peduncle filiform, 1.5–3 cm, the whole inflorescence set with short almost scabrid hairs. *Calyx* cup-shaped, 1 mm, 4(–5)-lobed halfway. *Petals* 4 (or 5) united to a filiform elongate basal tube-like (4–10 mm), free in the upper oblong and ± spreading part (2 mm), white. *Stamens* 4 or 5; filaments short; anther cells elongate-linear, subsagittate, 1.5 mm. Rudiment of *ovary* hirsute. — ♀ *Flowers* 8–15 together in capitules on top of axillary, solitary stoutish peduncles, these glabrescent and accrescent in fruiting stage up to 11 cm. *Calyx* as in ♂ flowers. *Petals* without a markedly elongate basal part, *i.e.* close to the calyx, somewhat leathery and glabrous, 2.5 mm. *Ovary* tomentose; stigma discoid, wider than the ovary. *Drupe* broadly ovoid, laterally much compressed, rounded at base in general, though abruptly narrowed to a slender stipe for 5–7 mm, at the base of which the remnants of the petals and calyx are found, tapering upwards to a tail or beak for (5–)6–10 mm, crowned by a small stigma, 2.3–3 (–3.3) by 1.3–1.8 by 0.7–1 cm; exocarp thin, rusty-pubescent, ripening to a tomato or orange red; endocarp bony, rather deeply (1–2 mm) and coarsely reticulate-lacunose outside, tubercled all over inside.

Distr. *Malesia*: Malay Peninsula, Borneo. Fig. 40.

Ecol. Primary forest, also mossy forest, from the lowland up to 1980 m on Mt Kinabalu.

Uses. The stem holds a reservoir of potable water. VAUGHAN-STEFFENS stated that the red fruits are added to *Antiaris* latex in making 'sakai (pangan)' dart-poison (RIDL. Agr. Bull. Mal. Pen. 8, 1898, 209), but no confirmation of this has been available.

Vern. *Pisang-pisang bulu*, M, *sělowung*, Pangan.

4. Miquelia celebica BL. Rumphia 4 (1849) 37; Mus. Bot. Lugd.-Bat. 1 (1849) 42, f. 8; WALP. Ann. 2 (1851) 22; MIQ. Fl. Ind. Bat. 1 (1856) 798; SCHNIZL. Ic. 3 (1857/65) t. 172, f. 22–31; BAILL. in DC. Prod. 17 (1873) 14; BECC. Malesia 1 (1877) 124; KOORD. Minah. (1898) 393; SLEUM. Blumea 17 (1969) 231. — *M. cumingii* BAILL. Adansonia 10 (1872) 278; in DC. Prod. 17 (1873) 14; VIDAL, Phan. Cuming Philip. (1885) 103; Rev. Pl. Vasc. Filip. (1886) 86; MERR. En. Philip. 2 (1923) 492; DAHL, J. Arn. Arb. 33 (1952) 275, f. 74 (pollen). — *M. rostrata* MERR. Pl. Elm. Born. (1929) 172. — **Fig. 39a-f.**

High climbing shrub, much ramified. Branchlets slender, green-olivaceous when dry, striate, subglabrous. *Leaves* elliptic-, sometimes ovate-, rarely lanceolate-oblong, apex shortly acuminate, tip submucronate by the protruding midrib, base a little oblique, broadly cuneate to truncate-rounded, sometimes shallowly cordate, thin-chartaceous, entire, or rarely obsoletely repand to coarsely few-lobed, initially with scattered rather scabrid short hairs (also found on the inflorescence) underneath, early glabrescent, 9–15(–20) by 4–7.5(–10) cm, midrib and nerves slightly raised beneath only, lateral nerves 1–2 basal and 4–6 higher pairs, all curved-ascendent and rather obscurely inarching before the edge, no proper reticulation; petiole slender, 1.5–5(–7) cm. — ♂ *Umbels* subglobose, many-flowered, slenderly long-peduncled, axillary or slightly supra-axillary, rarely cauline, either solitary or 2–3 very laxly racemosely arranged on a rachis of 1–3 cm by *c.* 2 mm. *Calyx* shortly 4(–5)-lobed, very small. *Petals* 4(–5), united for 5–7 mm to a filiform tube below, free for the uppermost 2 mm, greenish yellow. *Stamens* 4(–5); filaments 1 mm; anther cells linear-oblong, base slightly divergent, 1.5 mm. Rudiment of *ovary* 4-gibbous, glabrous. — ♀ *Flowers* arranged to many- and dense-flowered subglobose heads, these generally solitary from the axil on a slender peduncle 5–10 cm, rarely 2 or 3 laxly racemosely arranged along a short rachis, each head then very slenderly elongately peduncled. *Calyx* very small. *Petals* 4, not elongate into a tube below as in the ♂, oblong, thickish, 2 mm. *Staminodes* 4. *Ovary* subcylindric, densely hairy, crowned by the thick stigmatic pad. *Drupe* obliquely ellipsoid-ovoid, laterally compressed, (0.8–)1–1.2(–1.7) by 0.7–0.8(–1.2) by 0.6 cm, apex shortly and rather gradually attenuate, base suddenly narrowed to a kind of stipe 5–7 by 1 mm (bearing the persistent petals on its base); exocarp thin, laxly set with short strigose hairs, yellow to reddish; endocarp crustaceous, outside with numerous vertical low ridges and transverse connections, shallowly lacunose-reticulate in the dry fruit, inside with numerous low warts which leave their mark in the thus pitted seed.

Distr. *Malesia*: W. Sumatra (Padang, once found), Borneo, Philippines (Luzon to Mindanao), Celebes (Minahasa, Buton I.). Fig. 40.

Ecol. Primary forest, sometimes along streams, generally in the lowland, rarely up to 700 m, in Buton I. on coralline limestone, apparently scattered or rare.

Vern. *Lalai in tasik*, *sumbilan makanteh*, Minahasa (Tt.).

21. PHYTOCRENE

WALL. Pl. As. Rar. 3 (1831) 11, t. 16; SLEUM. Taxon 17 (1968) 448 *et ibid.* 18 (1969) 479, *nom. cons. prop.*; Blumea 17 (1969) 234. — *Gynocephalum* BL. Bijdr. (1825) 483; ENDL. Gen. (1837) 281 ('*Gynocephalium*'); REICHB. Nom. (1841)

67 ('*Gyrocephalium*'); HASSK. Cat. Hort. Bog. (1844) 78 ('*Gynaecocephalium*'); BL. Rumphia 4 (1849) 36, *nota* ('*Gynocephalium*'); BENTH. in Benth. & Hook. *f.* Gen. Pl. 1 (1862) 354 ('*Gynocephala*'). — **Fig. 42.**

High climbing dioecious shrubs or lianas, sometimes with a robust stem, younger parts of the latter usually hairy and prickly, youngest parts slender and striate, sometimes rolled-in, and simulating tendrils, which are wanting. *Leaves* remotely spirally arranged, entire or palmately 3–7-lobed, subpalmately 3–7-nerved; petiole from a thickened and depressedly cup-like part of the stem, ± torted, never swollen basally or distally. — ♂ *Flowers* in globose clusters, these either solitary at the end of an axillary peduncle, or several spaced and racemosely arranged then, or generally very numerous in long repeatedly branching spike-like racemes or panicles both axillary and/or stem-borne. *Calyx* segments 3–5, ± free. *Petals* 3–4, ± united below, valvate, alternating with the calyx lobes. *Stamens* 3–4 (rarely -6), finally exserted; filaments filiform, ± connate at base into a column which bears the hirsute rudiment of the ovary; anther cells ovate-elliptic, small. — ♀ *Flowers* in large solitary either cauline or mostly axillary peduncled globose heads. *Calyx* segments 3–5, free to almost the base. *Petals* 3–4(–5) as in the ♂ flowers. *Staminodes* absent. *Ovary* subovoid-columnar, tapering to an equally thick and short columnar style with several 2-lobed stigmas which form a kind of funnel. *Drupes* numerous, collected in generally large, globose heads, each drupe tipped by the style, ± reversely setulose by brittle irritant hairs; exocarp thin, larger than the endocarp and ± hollow in the upper extended part at full maturity; endocarp rather thick, ligneous, pitted to deeply lacunose outside, smooth or warty inside. *Seed* 1, large, with a thin almost juicy coat which exudes a kind of clear gum; endosperm fleshy, strongly furrowed or lobulated; cotyledons very large, flat, foliaceous, double-folded or tortuous.

Distr. About 11 *spp.*, of which 4 both in SE. Asia and Malesia, and 7 confined to *Malesia* from Sumatra to New Guinea. Fig. 41.

Ecol. Scattered in primary and secondary lowland forest, occasionally up to 1200 m, also in open places, as rarely found on limestone rocks.

Uses. The wood has very large porous vessels which contain water, used by the natives, hence the generic name; for its anatomy see the comprehensive study made by TIMMERMANS, Ann. Jard. Bot. Btzg 41 (1931) 65–104, t. 23–34, and the review given by SLEUMER in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 332–336, f. 90–93.

Note. Leaves of *Phytocrene* are similar in shape and nervation to those of various genera in the *Menispermaceae*; besides the petiole emerges from a shallow cup-like thickening of the stem which also occurs often in *Menispermaceae*. In the latter, however, generally the petiole is swollen in the uppermost and maybe also in its basal part, which is never the case in *Phytocrene*.

KEY TO THE SPECIES

1. ♂ Flower heads solitary, each on top of an axillary or slightly supra-axillary peduncle (as is always the case with the ♀ ones) on younger foliate parts of the branchlets. . . . . **1. P. anomala**
1. ♂ Flower heads several together, composed to an inflorescence, the latter either from foliate or defoliate axils, or from tubercles on the stem.
2. ♂ Flower heads rather few, composed to a true raceme, *i.e.* the peduncled heads spaced along a rachis. . . . . **2. P. racemosa**
2. ♂ Flower heads numerous, composed to a spike-like panicle.
3. ♂ Flower heads in fascicles or glomerules, these markedly spaced at least in the lower half of the rachis.
4. Leaves broadly oblong, base slightly cordate, flat in dry specimens. . . . . **3. P. interrupta**
4. Leaves ovate, base rounded, ± bullate by impressed nerves and veins in dry specimens. **4. P. malacothrix**
3. ♂ Flower heads in short-peduncled cymes, secondary racemes or panicles, these generally close together (rarely spaced) along the rachis.

5. Bracts in the ♂ inflorescences persistent, markedly plumed by ± spreading hairs.
6. Basal part of bracts hardly or not widened. . . . . **5. P. trichura**
6. Basal part of bracts widened up to 5 mm. . . . . **6. P. borneensis**
5. Bracts in the ♂ inflorescences wanting (already gone in full anthesis), or if persistent, filiform to narrow-subulate, and not markedly plumed.
7. ♂ Inflorescences rather short, 2.5–5 by (0.5–)1–1.5 cm. Leaves normally oblong or oblong-lanceolate, early glabrescent. . . . . **7. P. oblonga**
7. ♂ Inflorescences elongate to caudate, *i.e.* markedly longer and at least 2 cm ø. Leaves oblong to ovate-cordate, or palmate, generally tardily or hardly glabrescent.
8. Leaves normally palmate, *i.e.* deeply and narrowly (3–)5(–7)-lobed in flowering specimens. **8. P. palmata**
8. Leaves normally entire or ± broadly 3-lobed in flowering specimens (sometimes palmate in sterile juvenile specimens).
9. ♂ Inflorescences slender, *c.* 2 cm ø. Bracts ± persistent, numerous, much exserted beyond the partial inflorescences. Drupe 4.5–8 by 1.5–2.3 cm incl. the hollow beak of the exocarp. **9. P. bracteata**
9. ♂ Inflorescences thickish, (2.5–)3 cm or more ø. Bracts, if persistent, rather few and less exserted.
10. Mature drupe 3–4(–4.5) by 1.5–2 cm incl. the hollow short beak of the exocarp; hard endocarp (2–)2.5–3(–3.5) cm long. . . . . **10. P. hirsuta**
10. Mature drupe (5.5–)6–10(–13) cm long incl. the hollow elongate beak of the exocarp. **11. P. macrophylla** *s.l.*

1. Phytocrene anomala MERR. J. Str. Br. R. As. Soc. *n.* 86 (1922) 325; SLEUM. Blumea 17 (1969) 235.

Woody vine. Branchlets (slender, up to 5 mm ø, their distal part often curved and similar to a tendril), petioles, peduncles and leaves (mainly on the nerves of the undersurface) hirsute by short greyish and longer (1–2 mm) rufous and more spreading hairs, ultimately glabrescent. *Leaves* oblong to broadly oblong, or lanceolate, apex short-acuminate, subacute, base slightly cordate, chartaceous, olivaceous, glabrous or almost so except the hirsute midrib above, the tomentum on the undersurface rather soft to the touch, denticulate by protruding veins in young, entire in mature leaves, 10–22(–30) by (2.5–)3–10 cm, nerves 6–8(–10) pairs, two of them ± basal, short and spreading, the other ones curved-ascending, raised beneath only as is the coarse net of veins and veinlets; petiole 1–2(–3) cm by 2–3(–4) mm. — ♂ *Inflorescences* in globular peduncled heads, solitary, from a little above the axils of subsequent leaves of the distal part of a branchlet; peduncle slender, *c.* 1 cm; heads covered with a pale ferrugineous tomentum of short bristly hairs, 5–8 mm ø. *Calyx* segments 4 or 5, linear-spathulate, *c.* 2.5 mm. *Petals* 4, elongate-obovate, connate halfway to ¾, hirsute dorsally, *c.* 3 mm. *Stamens* 4; filaments 1.5–2 mm; anther cells subovate-elliptic, 1 mm. — ♀ *Inflorescences* as the ♂ ones on young branchlets in axillary solitary heads, on peduncle *c.* 2 cm by 2 mm. *Calyx* segments and petals as in ♂. *Ovary* ovoid, short-attenuate to a conical very shortly lobed stigma, hirsute. *Drupes* collected to heads of *c.* 4 cm ø, each drupe ovoid, hirsute by simple bristly hairs all of the same type, known up to 2.5 by 1.5 cm, apparently larger at full maturity, accrescent petals seen up to 6 mm. Form, size and type of pits of the endocarp not yet known.

Distr. *Malesia*: Borneo (Upper Baram R. and Sandakan area, Berau).

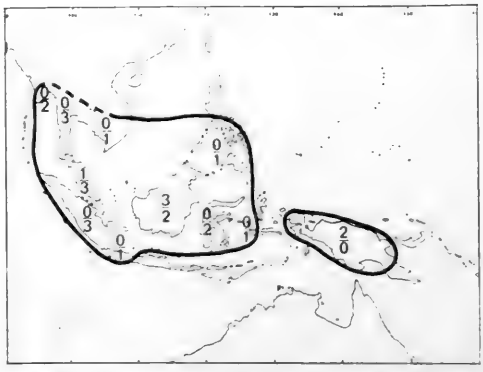

Fig. 41. Distribution of *Phytocrene*. The figure above the hyphen indicates the number of endemic species in the island or area, the figure below the hyphen the number of non-endemic species.

Ecol. Primary and secondary lowland forest, apparently rare.

2. Phytocrene racemosa SLEUM. Blumea 17 (1969) 236. — **Fig. 42.**

Tall woody climber, up to 40 m, stem *c.* 1.5 cm ø covered with thin longitudinally striate and finely fissured brown bark which bears a few transverse linear lenticels; branchlets and petioles with a short fawn tomentum. *Leaves* oblong-obovate, apex abruptly (*c.* 1.5 cm) acuminate, acutish, base broadly cuneate and shallowly cordate, chartaceous to subcoriaceous, glabrous except the nerves which are hairy in their basal part above, ± densely set with short subappressed or more spreading pale rusty hairs especially on nerves and veins and soft to the touch beneath, edge slightly sinuate-denticulate, or entire, 18–32 by 7–20 cm, nerves

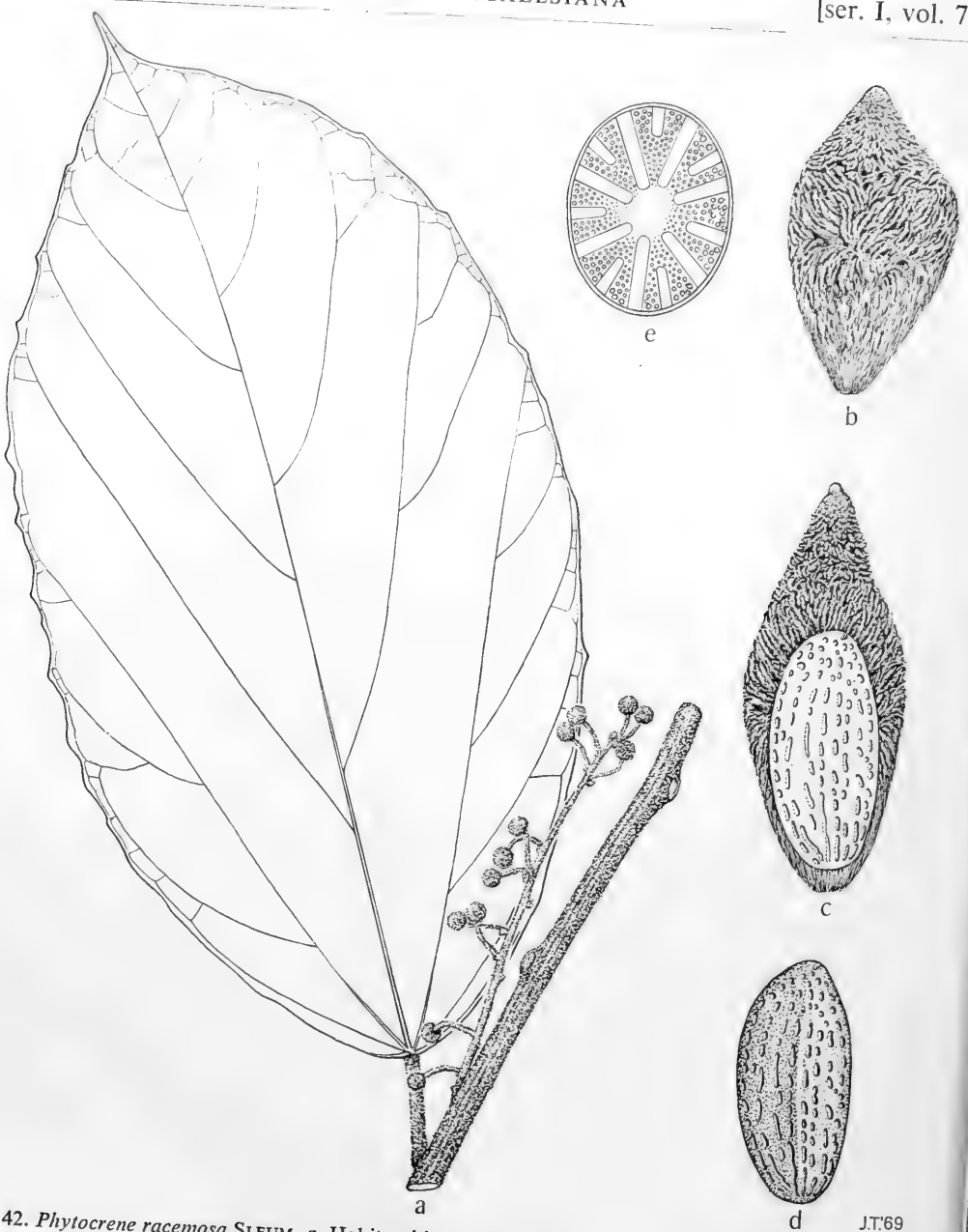

Fig. 42. *Phytocrene racemosa* SLEUM. *a.* Habit, with ♂ inflorescence, ×½, *b.* fruit, ×¾, *c. ditto*, part of the exocarp removed, showing the endocarp, ×1, *d.* pitted endocarp, ×1, *e.* cross-section of stem, ×1½ (*a*, *e* MURTHY & ASHTON S 22325, *b* SMYTHIES S 17155, *c–d* S 19513). J.T.'69

flat above, much prominent beneath as is the rather coarse reticulation of veins and veinlets, nerves 2 basal pairs, the outer pair short, the inner one rather straight-ascending to the middle of the lamina, upper *c.* 4 pairs from the midrib also rather steeply curved-ascendent; petiole 1.5–3 cm by 2–4 mm. — ♂ *Racemes* from tubercles of the stem or from slightly above foliate or defoliate axils, all over fawny, tomentose, peduncled (1 cm) heads (5–10, *c.* 5 mm ø), these laxly arranged along the 6–12 cm long rachis. *Calyx* segments 5, linear spathulate, long-haired, 2 mm. *Petals* 4, linear-

oblanceolate, free to almost the base, long-haired dorsally, 2.5 mm. *Stamens* 4; anther cells 0.4 mm. — ♀ *Racemes* from *c.* 1 cm above defoliate axils, with about 5 laxly arranged heads, fulvous-hirsute at peduncles and the *c.* 4 cm long rachis. Flower heads globose, *c.* 5 mm ø, on thick peduncles 1.5–2 cm. *Calyx* segments and petals as in ♂ flowers. *Ovary* cylindric, hirsute, *c.* 2 mm. Developed *ovary* or immature *drupe* (*c.* 1 cm long) densely covered with short and shortly hirsute emergences in the upper, and longer and longish-hirsute ones in the lower half. Mature *drupe* arranged to a globose head of *c.* 8 cm ø, each drupe showing the same shorter and longer emergences of the exocarp as already found in the very young state, subelliptic-oblongoid, attenuate at both ends, 4–5 by 2–3 cm; endocarp oblongoid-ellipsoid, obtuse at both ends, much compressed laterally, smooth, with numerous almost linear rather deep pits, which appear on the inner side as flat warts, *c.* 3 by 1.5 by 1.3 cm.

Distr. *Malesia*: Borneo (Sarawak), 3 collections.

Ecol. Mixed Dipterocarp forest, from low elevation up to 250 m, apparently very scattered.

Vern. *Buah pisang munsang*, Kapit.

3. Phytocrene interrupta SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 252; Blumea 17 (1969) 236.

Climber. Branchlets slender (5–7 mm ø), deeply striate and brownish-hirsute, older parts laxly set with hardly pungent small emergences. *Leaves* broadly oblong, apex for 3–10 mm subabruptly acuminate, base slightly cordate, firmly chartaceous, glabrous above except nerves, covered with soft hairs all over the undersurface, and with stiffer ones on midrib and nerves, soft to the touch, entire, 7–17 by 4–8(–9) cm, midrib and nerves flat or a little impressed above, markedly prominent beneath, nerves 2 basal pairs (of which the outer pair is short, the inner one ascending to the lower ⅓ of the length of the lamina), other pinnate nerves 6–8 pairs, rather straight and subparallel to each other and the inner basal pair, reticulation of veins and veinlets fine and hardly raised above, more coarse and much raised beneath; petiole 2–3.5 cm by 2–3 mm, hirsutulous. — ♂ *Inflorescences* spike-like, several in a fascicle from a tubercle of the stem (*c.* 1.5 cm ø), pendent, the heads of flowers sessile or very shortly peduncled and (2–)3–6 of them fascicled, these fascicles spaced in the lower, less or not so in the upper half of the rachis (10–30 cm by 2 mm), the whole inflorescence covered with shorter soft and longer stiff-brownish hairs; peduncle of flower heads slender, up to 4 mm, the basal bract subulate, 2–3 mm, apparently early going. *Calyx* segments 4, ovate, fleshy, concave, hirsute, 0.8 mm. *Petals* 3 or 4, connate to the lower ⅓ to ½, ovate-oblong, subacuminate, green, ± densely substrigose dorsally, *c.* 1.5 mm. *Stamens* 3 or 4; anther cells ovate-elliptic, 0.4 mm. — ♀ *Inflorescences* and *drupe* unknown yet.

Distr. *Malesia*: New Guinea (Central Distr. in ascent from Port Moresby to Mt Victoria), once found.

Ecol. Forest at *c.* 450 m.

4. Phytocrene malacothrix SLEUM. Notizbl. Berl.-Dahl. 15 (1941) 361; Blumea 17 (1969) 237.

"Scandent. Branchlets soft-olivaceous-tomentose in the younger parts, glabrescent below. *Leaves* ovate, apex subabruptly acuminate for 1 cm, tip obtuse, base rounded, thin-chartaceous, glabrous above, softly brownish-tomentose all over beneath especially on midrib and nerves, 16–18 by 8–10 cm, midrib raised on both faces, nerves curved-ascendent, ± distinctly impressed as are the veins above (the lamina bullate in dry specimens), much raised beneath, reticulation rather dense, slightly prominent beneath only; petiole tomentose, 3–4 cm. ♂ *Spikes* only known in a poorly developed state, brownish-tomentose, solitary from the axils of the upper leaves, the flower heads composed to glomerules, the latter spaced on a rachis *c.* 5 cm long."

Distr. *Malesia*: New Guinea (Morobe Distr.: Boana), at 1030 m, once found.

Note. Imperfectly known species, said to be related to *P. interrupta* SLEUM. in the original diagnosis, from which the description given above was made; type material lost.

5. Phytocrene trichura RIDL. Fl. Mal. Pen. 1 (1922) 433; SLEUM. Blumea 17 (1969) 237.

Tall woody climber. Stem of branchlets shallowly striate, patently rufous-setose distally as are the petioles, corky and with numerous roundish lenticels (no prickles) downwards, 4–6 mm ø. *Leaves* ovate in circumference, whether or not 3-lobed to ½–⅔, lateral lobes acutish, base shallowly cordate, thin-coriaceous, subdensely short-tomentulose on both faces initially, glabrescent and a little rough above, soft to the touch beneath, 12–19 by 8–11 cm, palmately 5-nerved, midrib and inner pair of basal nerves more prominent than the other basal and the few upper lateral ones beneath, reticulation coarse, strongly raised beneath; petiole 3–6 cm by 2–3 mm. — ♂ *Panicles* from bare lower part of stem (1.5 cm ø), sessile, pendulous, grey-green, squirreltail-like, 12–23 by 3.5–4 cm, formed by numerous peduncled dichasia, the ultimate pedicels (3–6 mm) bearing globular heads consisting of numerous flowers, all densely shortly greyish-pubescent; bract of each globule partly connate with pedicel, slender, almost filiform, persistent, spreading, its basal part hardly or not widened, short-pubescent, upper part plumose by spreading rufous 2–3 mm long hairs. *Calyx* segments 4 or 5, irregularly obcuneate, 1 mm, free, apex fringed with long hairs. *Petals* 4, ovate-oblong, connate to the lower ⅓, sparsely short-hairy or papillose outside, 1.5 mm. *Stamens* 4, slightly exserted; anther cells elliptic, 0.5 mm. — ♀ *Inflorescences* and *drupe* not yet known.

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

Ecol. Dense forest, ascending the top of lofty trees, apparently very rare.

6. Phytocrene borneensis BECC. Malesia 1 (1877) 128; MERR. En. Born. (1921) 356; SLEUM. Blumea 17 (1969) 237. — *P. porphyrea* STAPF, Kew Bull. (1906) 72.

Big woody climber. Stem robust (seen up to 2.5 cm ø), longitudinally ribbed (2–3 mm) and with distant transverse linear lenticellar cracks. Branchlets ± patently rufous-setose and striate at distal part (3–6 mm ø). *Leaves* ovate in circumference, simple, or subtrilobed, or deeply obtusely 3-lobed, base cordate, edge very shortly denticulate by protruding veins, chartaceous to subcoriaceous, young ones soft-tomentulose all over both faces, mature ones finally glabrous above, ± densely covered with appressed to suberect rather stiff hairs especially on nerves, and soft to the touch beneath, 15–25(–30) by (8–)10–18(–22) cm, nerves slightly sunken above, strongly raised beneath, basal palmate nerves 7–9 pairs, branched mainly outward, upper ones from the midrib 3–4 pairs of entire, and 4–6 ones in the central lobe of lobed leaves, all these nerves curved-ascending, connected by numerous straight and ± transverse veins and a coarse reticulation markedly prominent underneath only; petiole subappressedly rufous to ferrugineous-setulose, (3–)4–8(–12) by 2–4 mm. — ♂ *Inflorescences* pendent from old wood, tail-like as in *P. trichura*, sessile, compact, consisting of numerous repeatedly branched and shortly pedicelled dichasia, all over covered with greyish to brownish softer and coarse, in part hooked hairs, (12–)15–25(–50) by 3–4(–5) cm, most of the ultimate pedicels bearing a narrowly to broadly subulate-caudate, (1.2–)2–3.5 cm long and at base (1–)2–5 mm broad persistent bract, the latter covered with the same short tomentum and besides with longer, spreading, often dark red or brownish hairs which give the bracts a ± plumose appearance; flowers in globular pedicelled heads (3–4 mm ø). *Calyx* segments 4 or 5, irregularly obcuneate to spathulate, distally densely hairy outside, glabrous inside, 1 mm. *Petals* 4, oblong-obovate, acutish, fleshy, slightly to densely hairy outside only especially below, 1.5 mm. *Stamens* 4; anther cells oblong-elliptic, 0.5 mm. — ♀ *Inflorescence* and *drupe* unknown.

Distr. *Malesia*: Borneo.

Ecol. Lowland forest, up to 1065 m.

Uses. Water from the stem is used for drinking.

Vern. *Bilis akar*, S. Kinabatangan.

7. Phytocrene oblonga WALL. Pl. As. Rar. 3 (1831) 12; Cat. (1832) *n.* 4948; WALP. Rep. 1 (1842) 98; BAILL. in DC. Prod. 17 (1873) 13; MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 592; KING, J. As. Soc. Beng. 64, ii (1895) 122; GAGNEP. Fl. Gén. I.–C. 1 (1911) 839, f. 102, 4–8; RIDL. Fl. Mal. Pen. 1 (1922) 432; CRAIB, Fl. Siam. En. 1 (1926) 275; GAGNEP. Fl. Gén. I.–C. Suppl. (1948) 757; SLEUM. Blumea 17 (1969) 237; Fl. Thail. 2 (1970) 90. — *Gynocephalum oblongum* (WALL.) TRÉCUL, Ann. Sc. Nat. III, 8 (1847) 149. — *Miquelia cancellata* KURZ, J. As. Soc. Beng. 44, ii (1875) 201.

Climber to top of tall trees, with rather slender stem (up to 1.5 cm ø); bark brownish, rather rough, striate, not prickly. Branchlets densely set with fine retrorse prickly lenticels, tip short-pubescent. *Leaves* oblong or oblong-lanceolate, ± abruptly and shortly acuminate, acumen rather slender and slightly curved, subacute, base cuneate to rounded, coriaceous, glabrous and shining above, rather densely stiffly short-hairy and a little rough to the touch beneath, early glabrescent, entire or undulate-subdentate, (10–)12–22 by (4–)5–9 cm, nerves 5–7 pairs, one of which basal, ascending and ± manifestly inarching before the edge, prominent as is the rather dense reticulation beneath; petiole rugose, 1–2.5 cm by 2–3 mm. — ♂ *Panicles* axillary, or mostly clustered on woody tubercles on the stem or larger branches, consisting of numerous pedicelled few-flowered, more laxly or densely arranged umbellules, all over patently rusty to rufous-tomentose, 2.5–5 cm by (0.5–)1–1.5 cm; pedicels slender to more stoutish, 2–5 mm, each subtended by a subulate bract as long as or shorter than the pedicel, which is generally hidden in the cluster of flowers. *Calyx* segments 4 or 5, oblong-ovate, free, 1 mm. *Petals* 4, almost free, oblong-ovate to obovate, glabrous and yellow-green inside, rufous-sericeous outside, *c.* 1.8 mm. *Stamens* 4; anther cells 0.3–0.5 mm. — ♀ *Flowers* (often diseased) in peduncled globose heads (*c.* 8 mm ø), borne on stem and branches, peduncle stout, set with subulate bracts, *c.* 1 cm, all parts of the inflorescence brownish-rufous-tomentose as are the ♂ ones. *Calyx* segments linear, 2 mm. *Petals* subspathulate, base slightly connate, 3 mm. *Ovary* cylindric, apex somewhat contracted into a very short thick style, tomentose; stigmas (2–)3–4, flattish, glabrous, spreading. *Drupes* in globular orange coloured clusters 6–9(–11) cm ø, each drupe ovoid to ovoid-oblongoid, obtuse, the very apex only ± apiculate by the style, covered especially in the upper part with stout straight reddish-brown subulate prickles (5–8 mm) which after falling leave numerous circular pits (*c.* 1 mm ø) in the endocarp, (3–)3.5(–4) by 2–2.5 cm incl. the prickles; exocarp coriaceous; endocarp crustaceous, slightly tubercled inside, *c.* 2.5 by 1.5 cm.

Distr. Lower Burma, Thailand (Pattani), Indo-China (Annam, Cochinchina); in *Malesia*: Malay Peninsula (Penang to Malacca and Johore).

Ecol. Lowland forests, up to 150 m.

Uses. The leaves are used by Malay natives for fever headache. The caustic seed is reported to be edible.

Vern. *Akar chumprai*, M.

8. Phytocrene palmata WALL. Pl. As. Rar. 3 (1831) 12; Cat. (1832) *n.* 4949; WALP. Rep. 1 (1842) 98; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 248; BAILL. in DC. Prod. 17 (1873) 11; MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 592; BECC. Malesia 1 (1877) 127; KING, J. As. Soc. Beng. 64, ii (1895) 123; RIDL. Fl. Mal. Pen. 1 (1922) 433; BURK. Dict. (1935) 1722; SLEUM. Blumea 17 (1969) 237; Fl. Thail. 2 (1970) 91. — *Gynocephalum palmatum* (WALL.) TRÉCUL, Ann. Sc. Nat. III, 8 (1847) 149.

— *P. stylocarpa* GRIFF. Not. (1854) 320; Ic. (1854) t. 489, I.

Liana; stem generally not branched, younger parts with prickles (1 mm), striate, tips rufous-hispid. *Leaves* limited to the upper part of the branches, orbicular to reniform in outline, deeply palmately (3–)5–(rarely –7)-lobed, lobes oblong to oblong-obovate, acute or acuminate, base of lamina deeply cordate, entire or shallowly wavy, upper surface glabrous and shining, lower surface densely covered with longish coarse subappressed rufous to yellowish hairs especially on midrib and nerves, soft to the touch, 15–30 cm long, breadth about the same, main nerves 5(–7), palmate, lateral nerves per lobe 3–4 pairs, curved-ascending and looping, with more numerous coarse transverse veins in a ± right angle from the main nerve, reticulation coarse, ± deeply impressed above, much raised beneath as are all nerves, the lamina not rarely almost bullate in dry specimens; petiole stout, often twisted, rufous- to rusty-tomentose, 7–12.5 cm. — *Panicles* of ♂ *flowers* subcylindric, axillary or from lower part of stem, (6–)15–40 by *c.* 3.5 cm, all over covered with a tomentum of short soft rufous to ferrugineous hairs, the ultimate branches (*c.* 1 cm) bearing small, 12–15-flowered, pedicelled (2–4 mm) umbellules or heads (*c.* 2.5 mm ø), part of them subtended by a ± caducous subulate bract (2–4 mm). *Calyx* segments 3 or 4, obovate, hairy, 0.8 mm. *Petals* (3–)4, oblong-lanceolate, pale green, glabrous inside, hairy outside, *c.* 1.5 mm. *Stamens* 4; anther cells linear-oblong, 1 mm. — ♀ *Flowers* in peduncled (*c.* 6 mm) axillary ovoid heads, *c.* 1 cm ø. *Ovary* ovoid, hirsute. *Drupes* numerous, collected in subglobular heads 7–10 cm ø, elongate-ellipsoid, or slightly obovoid, much tapering to the base, apiculate by the conical style, all over ± densely covered with yellowish shining stiff hairs, (3.5–)4–5.5 by 1.6–2(–2.5) cm; exocarp thin; endocarp bony, rather smooth outside where the hairs are gone, laxly pitted outside, low-papillate inside respectively.

Distr. Thailand (Pattani); in *Malesia*: Malay Peninsula, Sumatra (Palembang; Riouw Arch.: P. Bintan).

Ecol. Hilly lowland forest, up to 500 m.

Vern. *Akar pisang pisang bulu*, Malay Peninsula, *kĕpajang akar*, Palembang, M.

9. Phytocrene bracteata WALL. Pl. As. Rar. 3 (1831) 12; Cat. (1832) *n.* 4947; WALP. Rep. 1 (1842) 98; BAILL. in DC. Prod. 17 (1873) 12; MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 592; BECC. Malesia 1 (1877) 127; MERR. En. Born. (1921) 357, *p.p.*; RIDL. Fl. Mal. Pen. 1 (1922) 432; BAKER *f.* J. Bot. 62 (1924) Suppl. 21; MERR. Pl. Elm. Born. (1929) 172; DAHL, J. Arn. Arb. 33 (1952) 275 (pollen); SLEUM. Blumea 17 (1969) 238; Fl. Thail. 2 (1970) 91. — *Gynocephalum bracteatum* (WALL.) TRÉCUL, Ann. Sc. Nat. III, 8 (1847) 149. — *P. macrocarpa* GRIFF. Not. (1854) 322; Ic. (1854) t. 487 (fl. ♀) & t. 488 (fr.).

High climbing liana; stem up to 2.5 cm ø, with spiny tubercles 1 mm. Branchlets ± deeply striate, setose and minutely prickly in younger parts. *Leaves* broadly ovate, often 3-lobed and obscurely dentate then, apex acute, base cordate, coriaceous, glabrous and a little asperulous above, the nerves excepted, densely covered all over the undersurface with short brownish hairs and soft to the touch, and the nerves moreover set with bristle-like stiffer hairs beneath, 10–20(–25) by 7–15(–20) cm, 7 pairs of basal palmate nerves and 2–3 pairs of upper nerves, curved-ascending, slightly sunken above, prominent beneath, reticulation low though distinct on the undersurface; petiole hairy and bristly, ± torted, 3–7(–9) cm by 2–3 mm. — *Panicles* of ♂ *flowers* mainly axillary, rarely from older branches, solitary or 2–3, spike-like, all over shortly greyish to brownish tomentose, 10–20 by *c.* 2 cm, rachis and peduncles of main branches slender, ultimate branches consisting of minute clustered, (3–)6–10-flowered pedicellate (2–5 mm) umbellules, each pedicel subtended by a filiform appressed-hispid, not properly plumed ± persistent bract (1 cm), which is partly connate to the pedicel and exserted from the mass of flower heads. *Calyx* segments 3–5, free, obcuneate, villous outside, hardly 0.6 mm. *Petals* generally 3 (rarely 4), ovate-oblong or lanceolate, slightly hairy outside only, practically free, finally reflexed, 1–1.2 mm. *Stamens* 3(–4); anther cells oblong-elliptic, 0.6 mm. — ♀ *Flowers* in oblong to spherical peduncled heads, either solitary or 2–3 per axil. *Calyx* segments 4, spathulate. *Petals* 4, short-strigose outside as are the calyx segments. *Ovary* strigose; style very short, 3–4-partite. *Drupes* in pendulous globose clusters up to 20 cm ø, each drupe ovoid-oblongoid, tapering to both ends, densely covered with appressed long soft yellowish bristles, 4.5–8 by 1.5–2.3 cm at full maturity; exocarp fleshy especially in the upper part of the drupe which bears a short beak of the former style; endocarp ligneous, ovoid-oblongoid, up to 4 by 2 by 1.5 cm, rather smooth and minutely pitted outside, faintly tubercled inside. *Seed* testa sparsely and shallowly pitted.

Distr. Thailand (Surat, Nakawn Sritamarat), in *Malesia*: Sumatra (Eastcoast, Palembang), Malay Peninsula, Lingga Arch., possibly in Borneo.

Ecol. Lowland hillside woods and hedges.

Vern. *Akar pisang pisang*, M (as *P. palmata*).

Note. All investigated Bornean specimens apparently belonging to *P. bracteata* bear immature inflorescences, or are sterile, and could possibly belong to *P. borneensis*.

10. Phytocrene hirsuta BL. Rumphia 4 (1849) 37; Mus. Bot. Lugd.-Bat. 1 (1849) 42; WALP. Ann. 2 (1851) 22; MIQ. Fl. Ind. Bat. 1 (1856) 797; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 247; BAILL. in DC. Prod. 17 (1873) 12; BECC. Malesia 1 (1877) 127; KOORD. Minah. (1898) 629; HALL. *f.* Med. Rijksherb. 1 (1910) 14; SLEUM. Blumea 17 (1969) 238, *non* TEYSM. & BINN. Hort. Bog. (1866) 207. — *P. crinipes* BAILL. *ex* BUREAU, Mon. Bign. (1864) 146, *in text, nom. nud.* — *P. minahassae*

KOORD. Minah. (1898) 394, *nom. nud.* — *P. dasycarpa* (*non* MIQ.) DAHL, J. Arn. Arb. 33 (1952) 275 (pollen).

Climber; stem (1 cm or more ø) smooth. Branchlets slender, set with longish rufous subsetose and ± spreading hairs, older parts also laxly with very short pale retrorse prickles. *Leaves* ovate, or ovate- or elliptic-oblong, apex acuminate, the midrib characteristically protruding up to 8 mm beyond the leaf margin as a hirsute breakable thread in young leaves, base rounded to slightly cordate, firmly chartaceous, finally glabrous above except the nerves, remaining hirsute or tomentose by shorter and longer rufous to ferrugineous hairs and soft to the touch beneath, entire or shallowly sinuate-dented, or obscurely repand especially in the lower half, 12–17 by 6–9 cm, midrib and nerves very slightly immersed or flat above, prominent beneath, nerves 2 pairs palmately from the base of the lamina (outer pair short, inner one rather straight ascending to ± half the length of the blade), other 3(–4) pairs of nerves from the upper ⅔ of the midrib generally more curved, reticulation dense and finely raised above, coarser and more prominent beneath; petiole thickened at base, rufous-hirsute, 3.5–4 cm by *c.* 2 mm. — ♂ *Inflorescences* in spike-like panicles, solitary in the axils of lower leaves, up to 25 by 3 cm, composed of numerous shortly peduncled cymes, the ultimate peduncle (2–3 mm) bearing numerous flowers in a head (*c.* 4 mm ø) and provided at base with a subulate ± persistent bract (1–1.5 mm), the whole inflorescence covered with shorter greyish and longer rufous, bristle-like and ± spreading hairs. *Calyx* segments 3 or 4, connate below, obcuneate, hirsute, 1.3 mm. *Petals* 3 or 4, almost free, oblong, dirty yellow, with a few hairs inside, hirsute outside, *c.* 2 mm. *Stamens* 3 or 4; anther cells 0.5 mm. — ♀ *Flowers* in heads *c.* 8 mm ø, on stout peduncle 2–3 cm, generally from old wood. *Calyx* segments and *petals* as in ♂ flowers. *Ovary* glabrous below, hirsute above; stigmas 4 or 5, short, acuminate. *Drupes* collected in subglobular masses, each drupe ovoid-oblongoid to -ellipsoid, laterally much compressed, apex ± broadly attenuate, densely set with retrorse setose bristle-like stiff hairs, 3–4(–4.5) by 1.5–2 by 1.5 cm, incl. the short hollow beak of the exocarp; endocarp hard, with minute scattered roundish pits, (2–)2.5–3.5 by 1.5–2 cm.

Distr. *Malesia*: Celebes (incl. Buton I.), Moluccas (Buru).

Ecol. Primary and secondary lowland forest, up to 800 m, also in rather dry places, even on limestone rocks.

Vern. *Kunět ri sasap*, Minahasa (Tl.), *pitji pitji lantjeh*, Makassar, *sapět kulo*, Minahassa (Tt.).

11. Phytocrene macrophylla (BL.) BL. Rumphia 4 (1849) 36; Mus. Bot. Lugd.-Bat. 1 (1849) 41, f. 7; WALP. Ann. 2 (1851) 22; ZOLL. Syst. Verz. 2 (1854) 112; MIQ. Fl. Ind. Bat. 1 (1856) 796; Suppl. 1 (1860) 137; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 247; BAILL. in DC. Prod. 17 (1873) 10; Hist. Pl. 5 (1874) 282 (fl.); BECC. Malesia 1 (1877) 127; C. B. ROB. Bot. Z. 47 (1889) 645 (wood anat.); ENGL. in E. & P. Nat. Pfl. Fam. 3, 5 (1893) 255, f. 140; RACIB. Flora 87 (1900) 13 (foliar biology); HOCHR. Pl. Bog. Exs. (1904) 17; Bull. Inst. Bot. Btzg 19 (1904) 39; *ibid.* 22 (1905) 114; BACK. Schoolfl. Java (1911) 229 ('*macrocarpa*'); KOORD. Exk. Fl. Java 2 (1912) 533; KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 6; WARB. Pflanzenwelt 2 (1916) 348, f. 231 A, 1–9, f. 232 (phot.); DOCT. V. LEEUWEN, Zoocecidia (1926) 332 (galls); UITTIEN, Réc. Trav. Bot. Néerl. 25 (1929) 464 (veg.); AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 8; BACK. & BAKH. *f.* Fl. Java 2 (1965) 62; SLEUM. Blumea 17 (1969) 239. — *Gynocephalum macrophyllum* BL. Bijdr. (1825) 483; TRÉCUL, Ann. Sc. Nat. III, 8 (1847) 148. — *P. gigantea* WALL. Phil. Mag. N.S. 3 (1828) 223, *nom. nud.*; Pl. As. Rar. 3 (1831) 11, t. 216; Cat. (1832) *n.* 4946; WALP. Rep. 1 (1842) 98; BL. Rumphia 4 (1849) 36; Ann. Mus. Bot. Lugd.-Bat. 1 (1849) 41; ZOLL. Syst. Verz. 2 (1854) 112; GRIFF. Not. (1854) 329; Ic. (1854) t. 490, f. II (fl. ♂ & anat.); MIQ. Fl. Ind. Bat. 1 (1856) 796; SCHNIZL. Ic. 3 (1857/65) t. 172, f. 1–21; BAILL. in DC. Prod. 17 (1873) 9; MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 591; KURZ, J. As. Soc. Beng. 44, ii (1875) 156; For. Fl. Burma 1 (1877) 241; BECC. Malesia 1 (1877) 127; BRANDIS, Ind. Trees (1906) 152. — *Kadsura blancoi* AZAOLA in Blanco, Fl. Filip. ed. 2 (1845) 594; ed. 3, 3 (1879) 118. — *Gynocephalum giganteum* (WALL.) TRÉCUL, Ann. Sc. Nat. III, 8 (1847) 149. — *P. calicarpa* GRIFF. Not. (1854) 327; Ic. (1854) t. 490, f. I (fr.). — *Gynocephalum luzoniense* LLANOS, Rev. Progr. Cienc. 15 (1865) 55. — *P. dasycarpa* MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 248, t. 7, as to fruits only. — *P. luzoniensis* (LLANOS) BAILL. Adansonia 10 (1872) 281; in DC. Prod. 17 (1873) 10; Hist. Pl. 5 (1874) 283 (fr.); F.-VILL. & NAVES in Blanco, Fl. Filip. ed. 3, 4 (1880) 86; F.-VILL. Nov. App. (1880) 46; CERON, Cat. Pl. Herb. Manila (1892) 46. — *P. blancoi* (AZAOLA) MERR. Philip. J. Sc. 2 (1907) Bot. 432; Spec. Blanc. (1918) 237; En. Philip. 2 (1923) 492; DAHL, J. Arn. Arb. 33 (1952) 275, f. 75 (pollen). — *P. obovoidea* MERR. Philip. J. Sc. 10 (1915) Bot. 322; En. Philip. 2 (1923) 492. — *P. forbesii* BAKER *f.* J. Bot. 62 (1924) Suppl. 21.

See for further synonyms under the varieties.

KEY TO THE VARIETIES

1. Drupe (7–)7.5–10(–13) by 3–3.5 cm; endocarp (4–)5–6 by 2–2.5 cm. . . **1.** *var.* **macrophylla**
1. Drupe (5.5–)6–6.5(–7) by 1.5–2 cm.
2. Endocarp 4–4.5 by *c.* 1.5 cm. **2.** *var.* **caudigera**
2. Endocarp *c.* 2.5 by 1 cm. . **3.** *var.* **dasycarpa**

1. *var.* **macrophylla.**

High climbing, often much branched shrub or liana, up to 25 m; stem up to 10 cm ø, not spiny. Branchlets striate, younger parts with appressed or somewhat spreading shorter and longer rufous or ferrugineous hairs, and besides ± densely set

with pale conical prickles (0.5 mm), older parts glabrescent and smooth, the cork with transverse lenticellar cracks. *Leaves* of young shoots often orbicular with rather deeply cordate base, and broadly and ± obtusely 3–5-lobed, such of older parts generally ovate-oblong from a subcordate base and subacuminate, tip obtuse, firmly subcoriaceous, entire, glabrous above, the nerves excepted, the whole undersurface with a tomentum of short, weak rather pale rusty (partly almost stellate) hairs, and less numerous longer strigose rufous hairs especially on nerves and veins, soft to the touch, ± glabrescent at full age, 14–30(–33) by 9–12(–20) cm, palmately 5–7-nerved, outer pair(s) of nerves short, inner one(s) ascending to ½ and even ¾ of the length of the lamina, other 3–4 pairs from upper part of the midrib, all nerves almost flat above, well raised beneath, reticulation dense and very fine above, moderately raised beneath; petiole 5–15 cm by 2–3 mm. — ♂ *Inflorescences* spike-like panicles, from old branches or stem, generally several together, cylindric, dense or rarely more loose, all over shortly greyish-brownish-tomentose, up to 25 cm long and (2.5–)3(–5) cm ø, composed of lateral racemes or panicles up to 4 cm long which bear the flowers in heads 4–6 mm ø. *Calyx* segments 3–5, ± narrowly obcuneate, apex truncate, hirsute outside, 0.7–1.2 mm. *Petals* 3 or 4, light green to yellowish, connate ± halfway, lobes recurved, densely appressedly hairy outside, 1.5–2 mm. *Stamens* 3 or 4 (in the same inflorescence!); anther cells ovate-elliptic, *c.* 0.4 mm, often devoid of pollen. — ♀ *Inflorescences* collected in large, solitary or fascicled heads, each head on a thick peduncle (3–10 cm) and *c.* 1.5 cm ø, all over short-tomentose. *Calyx* segments as in ♂ flower. *Petals* 2.5–3.5 mm. *Ovary* columnar, tomentose with forward directed hairs, *c.* 4 mm, stigma 2–4-lobed. Fruit heads 20–25 cm ø. *Drupe* obovoid-oblongoid, (7–)7.5–10(–13) cm long incl. the hollow beak and the basal narrowed part of the exocarp, 3–3.5 cm wide, slightly variously compressed or round in ø, rusty-tomentose by normally forward directed hairs (sometimes reversely so in specimens from Sumatra and the Philippines), these hairs ± appressed, stiff, shining, easily going; endocarp oblongoid, bony, laterally flattened, the crests less marked on the flattened side, with numerous roundish pits (1 mm), (4–)5–6 by 2–2.5 by (1.5–)2 cm.

Distr. Burma; in *Malesia*: Sumatra, Java, Philippines (Luzon, Polillo, Samar, Biliran, Leyte, Bohol, Mindanao, Palawan).

Ecol. Lowland thickets and forests from sea-level to *c.* 1200 m, also in secondary and in swamp forest, in the Philippines also in Dipterocarp forest, scattered.

Galls. DOCTERS VAN LEEUWEN mentions a leaf-gall caused by a gall-midge.

Uses. Fruits said to be used on Palawan as '*talang*', *i.e.* fish poison. In Java used against stomach pain and tumors.

Vern. *Akar pisang*, Sumatra Westcoast, M, *labu kumbung silai*, *olor delos*, Simalur, *areuj pitjung tjèlèng*, *hondjé bu-ut areuj*, *undjéwut*, S; Philippines: *olo-olo*, Bag.

2. *var.* **caudigera** (SLEUM.) Blumea 17 (1969) 240. — *P. caudigera* SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 253; HEINE, Pfl. d. Samml. Clemens Kinabalu (1953) 57.

Differs from *var. macrophylla* by generally smaller leaves 7–15 by 5–8 cm, and mainly by the oblongoid, slightly 4–6-angled minor drupes, (5.5–)6–6.5(–7) by *c.* 2 cm; endocarp 4–4.5 by *c.* 1.5 cm, the pits much smaller than in *var. macrophylla*. The hairs on the drupe are strigose and retrorse.

Distr. *Malesia*: Borneo, only known from the Mt Kinabalu area, in forest around Dallas at 915–1370 m.

3. *var.* **dasycarpa** (MIQ.) SLEUM. Blumea 17 (1969) 240. — *P. dasycarpa* MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 248, t. 7, the fruit excluded (which is *var. macrocarpa*); BAILL. in DC. Prod. 17 (1873) 11; BECC. Malesia 1 (1877) 127; KOORD. Minah. (1898) 394; HOCHR. Pl. Bog. Exs. (1904) *n.* 92; Bull. Inst. Bot. Btzg 22 (1905) 114; Ic. Bog. 2 (1906) t. 108; KOORD.-SCHUM. Syst. Verz. 3 (1914) 74; KOORD. Minah. Suppl. 2 (1922) t. 49; Suppl. 3 (1922) 25. — *P. hirsuta* (*non* BL. 1849) TEYSM. & BINN. Hort. Bog. (1866) 207. — *P. ovalifolia* KOORD. Minah. (1898) 394, *nom. nud.*, 629, *descr.*; KOORD.-SCHUM. Syst. Verz. 3 (1914) 74; KOORD. Minah. Suppl. 2 (1922) t. 50; Suppl. 3 (1922) 26. — *P. tinosporifolia* KOORD. Minah. (1898) 394, 629; KOORD.-SCHUM. Syst. Verz. 3 (1914) 74; KOORD. Minah. Suppl. 2 (1922) t. 51; Suppl. 3 (1922) 26.

Differs from *var. macrophylla* by its smaller drupes, (5.5–)6–6.5 by 1.5–2 cm; endocarp *c.* 2.5 by 1 cm.

Distr. *Malesia*: Celebes.

Ecol. Lowland forest, up to 350 m.

Vern. *Apo*, Tontembuan, *samadan*, Tonsea, *sapet kulo*, Tt., *s. putih*, Tl., *tali tali utan*, Bt.

Excluded

Phytocrene loheri MERR. Philip. J. Sc. 7 (1912) Bot. 293; En. Philip. 2 (1923) 492, *mixtum*, *nom. illeg.*

The leaves belong to a *Menispermacea* (probably *Hypserpa*), and the loose fruits to *Phytocrene macrophylla var. macrophylla*, *cf.* SLEUM. Blumea 17 (1969) 241.

Excluded

Leucocorema RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 29 = *Trichadenia* THW. (*Flacourtiaceae*), *cf.* STEEN. Bull. Jard. Bot. Brux. 27 (1957) 114.

Pentastira RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 27 = *Dichapetalum* THOU. (*Dichapetalaceae*), *cf.* LEENHOUTS, Fl. Mal. I, 5 (1957) 305.

LOPHOPYXIDACEAE (H. Sleumer, Leyden)

1. LOPHOPYXIS

HOOK. *f.* Ic. Pl. 18 (1887) t. 1714; SLEUM. Blumea 16 (1969) 322. — *Combretopsis* K. SCH. in K. Sch. & Hollr. Fl. Kais. Wilh. Land (1889) 69. — *Treubia* PIERRE *ex* BOERL. Handl. 1, 2 (1890) 445. — **Fig. 1.**

Scandent or liana-like shrubs or small trees, with interxylary bast elements, watch-spring tendrils (modified leaves or subtending leaves of inflorescences), and umbrella-like branching. *Leaves* spiral, simple, serrulate to crenulate, stipulate. *Flowers* small, regular, monoecious, in glomerules on the branches of loose axillary panicles. *Sepals* 5, valvate, shortly united basally, persistent. *Petals* 5(–6), much smaller than the sepals, free. *Stamens* 5(–6), opposite to the sepals, with filiform filaments and subglobose introrse, almost basifixed anthers, alternating with 5(–6) oppositipetalous cordate glands, these in the ♂ ± adnate to the subtending petal, and in the ♀ ± concrescent into a 5(–6)-lobed disk (the glands or lobes opposite the ovary cells); pollen grains ± ellipsoidal, tricolporate, exine reticulate. *Ovary* superior, conical, shallowly 5-ribbed, 5(–4)-celled, with 5(–4) sessile subulate stigmas; ovules 2 per cell, pendulous, apical, axile, anatropous, epitropous, bitegmic, each surmounted at the micropyle by a small obturator-like appendage coming from the funicle. *Fruit* obovoid or ellipsoid, indehiscent, fusiform, 1-locular, 1-seeded, with 5 broad stramineous wings. *Seed* oblong, with endosperm; embryo erect, with oblong cotyledons and a short erect radicle.

Distribution. Monotypic, in *Malesia*, Melanesia, and Micronesia. Fig. 2.

Anatomy. Stem. Anomalous secondary growth: ENGLER, Sitz. Ber. Preuss. Ak. Wiss. Berl. 18 (1893) 265–266; HANDA, Bot. Mag. Tokyo 54 (1940) 41–47; PFEIFFER, Rev. Sudam. Bot. 10 (1951) 3–6; SLEUMER in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 393, f. 118.

The young stem has five ribs with a continuous xylem cylinder enclosing a pentagonal pith with a central portion of thick-walled parenchyma cells and a marginal area of thin-walled cells, erroneously referred to by ENGLER (*l.c.*) as intraxylary phloem. This thin-walled tissue may become caducous, at least in herbarium specimens. Between the ribs the secondary xylem has numerous vessels; in the ribs the vessels are narrower and scarcer. Vessel perforations are simple. Through anomalous activity of the cambium, 5 phloem strands become enclosed within xylem in the young shoot. Later interxylary phloem is formed as continuous bands alternating with secondary xylem. The phloem is stratified into soft and fibrous portions. Axial xylem parenchyma is scarce and paratracheal (only seen in young twigs). The ground tissue of the xylem is composed of fibres with numerous minutely bordered pits. Rays vary from 1–6-seriate in the young stem. The outer phloem is surrounded by a cylinder of fibres and stone cells. Cork arises in the layer below the epidermis.

The anatomy of the leaf has hitherto never been described. The petiole shows a strongly incurved arc of separate vascular bundles and two additional latero-dorsal bundles as seen in transverse section through the distal end. The vascular system forms a closed flattened cylinder in the midrib. The stomata, confined to the abaxial surface, are paracytic. Crystals are present as solitary rhomboids and clusters. The hairs are unicellular.

To evaluate the taxonomic significance of the vegetative anatomy of *Lophopyxis* with regard to the affinities of the genus more research is still needed. The only straightforward conclusion to be drawn at present is that *Lophopyxis* is anatomically entirely different from *Gouania* (*Rhamnaceae*), to which AIRY SHAW (in Willis Dict. ed. 7, 1966, 668) related it. *Gouania* differs *e.g.* in having anomocytic stomata, styloids, unlignified perivascular fibres and exclusively narrow rays. Dr. C. R. METCALFE (Kew) kindly put slides and anatomical information of *Lophopyxis* and *Gouania* at my disposal. — P. BAAS.

Taxonomy. This genus was tentatively ascribed to the *Euphorbiaceae* by HOOKER *f.*, but removed from this family by PAX (1890). ENGLER (1893) accommodated it as a distinct subfamily *Lophopyxidoideae* within *Icacinaceae*, from which I rejected it in 1942. HUTCHINSON (Fam. Flow. Pl. 1959) placed it in the *Celastraceae*.

Its gross morphology, wood anatomy, embryology and pollen morphology is well known and it is

Fig. 1. *Lophopyxis maingayi* HOOK. *f. a.* Habit, ×½, *a'.* showing domatia in the axils of lateral nerves, ×2½, *b.* ♀ flower, ×7, *c.* ovary, cross-section, ×7, *d.* ovary, longit. section, ×7, *e.* ♂ flower buds, ×2½, *f.* ♂ flower, ×5, *g.* stamen, front view, × 15, *g'.* stamen, back view, ×15, *h.* infructescence, ×$^{3}/_{5}$, *i.* fruit, ×$^{6}/_{5}$ (*a–d, h–i* KANEHIRA (1938), partly altered, *e–g* SLEUMER (1942)).

now apparent that it should be placed within the *Geraniales-Sapindales-Celastrales*. It seems, however, that it does not fit in any of the established families of these orders. Its relation to *Rhamnaceae*, suggested by SHAW (1966) rests on a superficial habit similarity with *Gouania*, as shown by BAKHUIZEN & VAN STEENIS, Fl. Mal. Bull. 21 (1966) 1426 (see also *sub* Anatomy).

The best solution is to regard it as the type of a family of its own, as has been casually proposed by VAN TIEGHEM (1897) and PIERRE (1897), and formally by PFEIFFER (1951). I have this more fully explained in my precursory paper in Blumea 16 (1969) 320.

1. Lophopyxis maingayi HOOK. *f.* Ic. Pl. 18 (1887) t. 1714; Fl. Br. Ind. 5 (1888) 673; PAX in E. & P. Nat. Pfl. Fam. III, 5 (1890) 117; ENGL. *ibid.* (1893) 238, 257; HALL. *f.* Med. Rijksherb. 1 (1910) 9; RIDL. Fl. Mal. Pen. 1 (1922) 435; SLOOT. Bull. Jard. Bot. Btzg III, 7 (1925) 364; HOLTH. & H. J. LAM, Blumea 5 (1942) 205, f. 7; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 393; Fl. Males. I, 5 (1954) 63; Blumea 16 (1969) 322, with extensive bibliogr. — *Combretopsis pentaptera* K. SCH. in K. Sch. & Hollr. Fl. Kais. Wilh. Land (1889) 69. — *Treubia combretocarpa* PIERRE *ex* BOERL. Handl. 1, 2 (1890) 445. — *L. pierrei* BOERL. *l.c.* 673, *nom. ill.*; HEYNE, Nutt. Pl. 1 (1950) 987. — *L. schumannii* BOERL. Handl. 1, 2 (1890) 674, *nom. ill.* — *L. combretocarpa* (BOERL.) ENGL. in E. & P. Nat. Pfl. Fam. III, 5 (1893) 257. — *L. pentaptera* (K. SCH.) ENGL. Sitz. Ber. Kön. Preuss. Ak. Wiss. (1893) 265, t. 2, f. 6 & 7; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 393, f. 117 (habit) & 118 (wood anat., embryol.); DAHL, J. Arn. Arb. 36 (1955) 160, 161 f. 2 & 2A (pollen); PEEKEL, Fl. Bismarck Arch. MS p. 1083, fig. — *Homalium gilgianum* LAUT. in K. Sch. & Laut. Nachtr. (1905) 320. — *Sinapistrum* RUMPH. Herb. Amb. 5 (1747) 73, t. 39, f. 1. — **Fig. 1.**

Vigorous woody vine or climbing shrub, 3–8(–30) m; stem up to 7 cm ø, bark whitish. Branches virgate, youngest parts longitudinally grooved, with elliptic lenticels in the grooves, puberulent. *Leaves* ovate to oblong, apex ± acuminate, acutish, base cuneate to obtuse, rarely rounded or subcordate, subequal, chartaceous to subcoriaceous, caducous-puberulous especially at the nerves beneath, the hairs persisting in the nerve axils as domatia, serrulate-crenulate or crenate, sometimes subentire, 8–18(–24) by 4–8(–10) cm, nerves 1(–2) basal or slightly suprabasal, and 3–4 upper pairs, all arched and steeply ascending, veins and veinlets densely reticulate, slender but prominent on both faces; petiole *c.* 10 by 1 mm. Stipules small, knob-like. Axillary branchlets metamorphosed into strong woody tendrils coiled only at the end, often bearing a bud. *Panicles* loose, composed of a few axillary or terminal spike-like racemes, pendent, puberulous, 10–25 cm. *Flowers* solitary, or mostly crowded into glomerules, these spaced along the slender to filiform rachis. Pedicels very slender, up to 2 mm. Bract at the base of the inflorescences often metamorphosed into a weak flat completely coiled tendril. *Sepals* ovate, greenish white or yellowish, hairy on both sides, *c.* 1.5 mm. *Petals* ovate, thin, *c.* 1 mm. Disk yellowish. — ♂ *Flowers*: filaments hairy, 2 mm; anthers subglobose, 0.5 mm; rudiment of ovary subglobose, shallowly 5-ribbed, hairy. — ♀ *Flowers*: ovary ovoid, whitish-yellowish puberulent, 2 mm. *Capsule* obovoid-ellipsoid in outline, 5-winged, green, later dark brown, caducous-pubescent, 2.2–3(–3.5) by 1.3–1.8 cm; wings chartaceous, 5–8 mm wide, with irregularly crenulate margin; pedicel short, subtended by the non-accrescent calyx. *Seed* 1, subcylindrical, acuminate, lengthwise grooved, 12–15 by 5–6 mm.

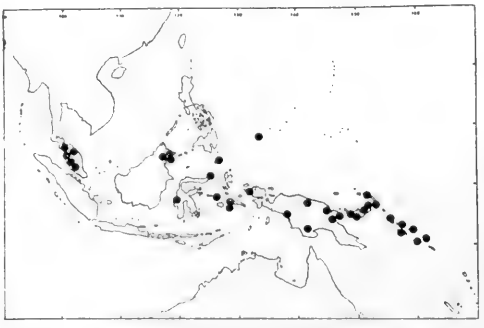

Fig. 2. Distribution of *Lophopyxis maingayi* HOOK. *f.*

Distr. Micronesia (Palau Is.), Melanesia (New Ireland, Duke of York I., New Britain, Solomon Is.), in *Malesia*: Malay Peninsula (Penang to Malacca), North Borneo, W. Central and N. Celebes, Moluccas (Talaud Is., Ceram, Sula Is., Ambon), New Guinea. Fig. 2.

Ecol. Straggling climber in canopy or edge of primary lowland forest, both in well drained and in swampy riverine forest, in littoral forest and even sometimes in the mangrove, also in disturbed gully forest or forest regrowths, seaside scrub; scattered, though locally not too rare, from sea-level up to *c.* 300 m, often on alluvial soil.

Uses. The rather hard stem splits easily into pieces, and apparently for this reason is used in New Britain for tying thatch. RUMPHIUS under his '*Sinapistrum*' says, that crumpled leaves give a strong smell of mustard, and are used to cure ulcers.

Vern. *Akar bĕlimbing hutan*, Brunei (Kinabatangan), *simpuru*, Celebes, *taburuh*, Talaud, *tali sasawi*, Ambon (*sec.* RUMPHIUS).

CARDIOPTERIDACEAE (H. Sleumer, Leyden)

1. CARDIOPTERIS

[WALL. *ex*] ROYLE, Ill. Bot. Himal. Mts (1834) 136, *in text*; *em.* BL. Rumphia 3 (1847 or 1849) 205; *ibid.* 4 (1849) t. 177; HASSK. Flora 30 (1847) 110, *in adnot.*; Nat. Tijd. N. I. 10 (1855) 64; ENGL. in E. & P. Nat. Pfl. Fam. 3, 5 (1893) 239, 257 ('*Cardiopteryx*'); BAKH. *f.* & STEEN. Fl. Mal. Bull. 15 (1960) 725; Taxon 11 (1962) 28; BACK. & BAKH. *f.* Fl. Java 2 (1965) 62. — *Sioja* BUCH.-HAM. *ex* LINDL. Nat. Syst. ed. 2 (1836) 82, *nom. nud.* — *Peripterygium* HASSK. Tijd. Nat. Gesch. Phys. 10 (1843) 142; Cat. Hort. Bog. (1844) 235; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 400; AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 9. — **Fig. 1.**

Sinistrorsely twining herbs with white milky juice. *Leaves* spirally arranged, simple or lobed to varying degrees, cordate, palmatinerved, long-petioled, glabrous as is the stem, exstipulate. *Flowers* bisexual, or polygamous (andromonoecious), small, subsessile, in unilateral repeatedly forked cincinni, composed of loose axillary panicles, ebracteate. *Calyx* deeply (4–)5-partite, lobes imbricate in bud, whether or not slightly accrescent in fruit, persistent. *Petals* (4–)5, caducous, lower half forming a widely funnel-shaped corolla, lobes imbricate in bud. *Stamens* (4–)5 inserted on the upper part of the corolla tube, alternate with its lobes; filaments very short, glabrous; anthers medifixed, introrse; pollen grains oblate, triangular in polar view, tricolporate. *Disk* absent. *Ovary* oblong-ovoid, subquadrangular (rudimentary in ♂), 1-celled; styles 2, one with a deep longitudinal groove, and two inequal ovate rather obtuse distal divisions, accrescent in fruit and becoming linear and succulent then, the other short-curved, capitate at apex, deciduous; ovules 2 (often one of them aborted), pendent from apex of cavity, anatropous, with dorsal raphe. *Fruit* indehiscent, compressed, with 2 longitudinal broad and transversely striate stramineous wings, obovate-elliptic to orbicular in outline, apex emarginate, crowned by the columnar accrescent soft and green stigma, base very shortly or hardly (Mal.), sometimes elongately contracted into a kind of stipe. *Seed* 1, linear, sulcate; testa thin; embryo minute, conical, in top of granular fleshy albumen.

Distr. Two *spp.*, one in SE. Asia and W. Malesia, and one in E. Malesia.

Ecol. Climber on edge of (mostly secondary) forest and thickets, in open places as limestone rocks.

Uses. The leaves are eaten as a vegetable.

Taxon. *Cardiopteris* was conceived as type of a monogeneric family by BLUME (1847 or 1849) and R. BROWN (1852); it was considered to constitute a subfamily of the *Icacinaceae* by ENGLER (1893) and POST & KUNTZE (1904), and again as a distinct family within the *Celastrales* by KING (1893), WILLIAMS (1915, as *Peripterygiaceae*), GAGNEPAIN (1910, 1911), SLEUMER (1942, as *Peripterygiaceae*), HUTCHINSON (1959) and TAKHTAJAN (1966).

The pollen of the genus shows no distinctive features against *Icacinaceae* and resembles very much that of the Afro-Malagasian genus *Cassinopsis* SONDER.

Note. The family name *Cardiopteridaceae* is derived from the original spelling *Cardiopteris* used by WALLICH and later by BLUME and others. ENGLER changed the name to *Cardiopteryx*, which would be more correct as an allusion to the winged fruit, a substitute name, however, which cannot be used according to the Code; for this reason, the family name '*Cardiopterygaceae*', proposed recently, has not been used.

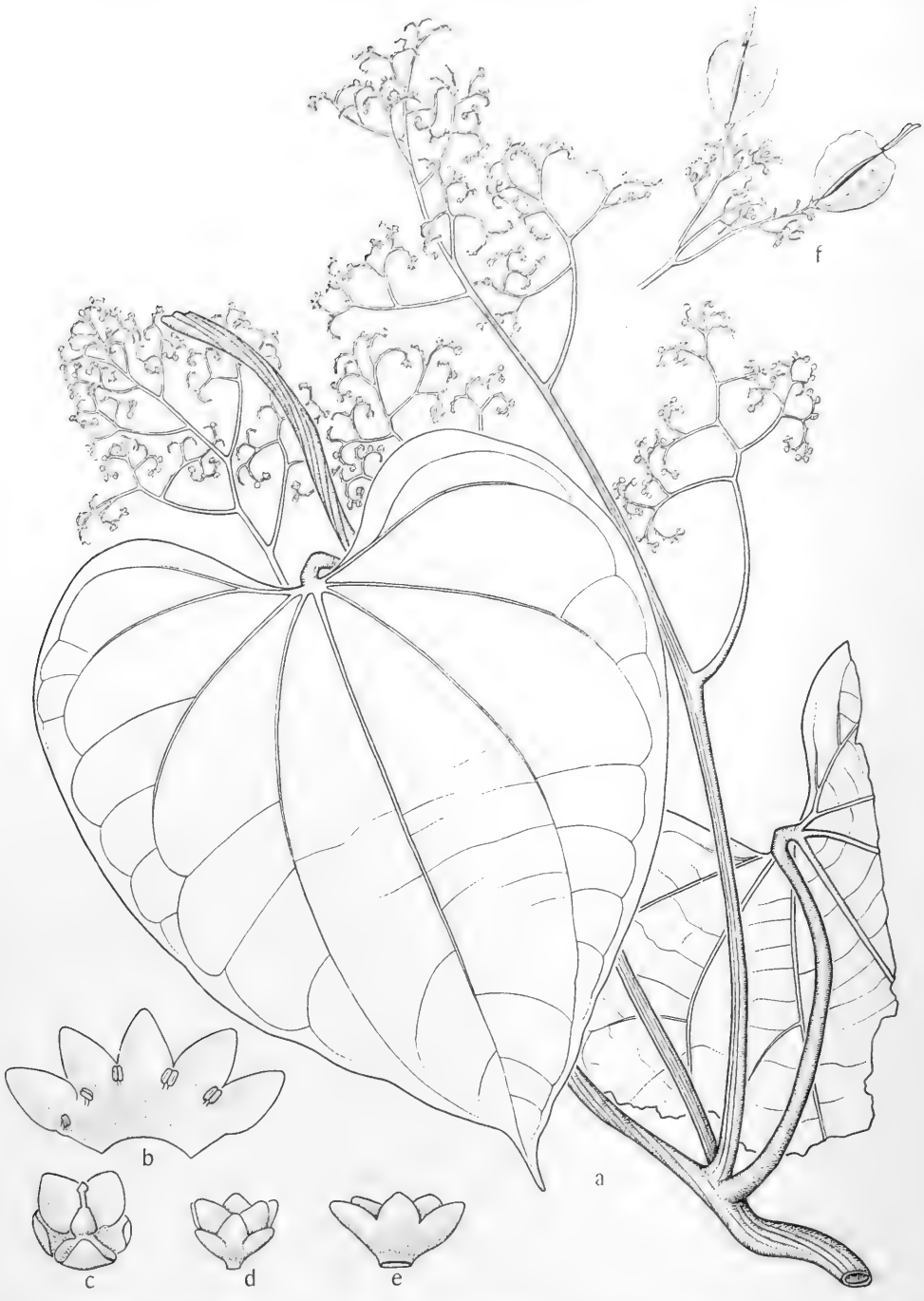

Fig. 1. *Cardiopteris moluccana* BL. *a.* Habit, with ♂ inflorescence, ×½, *b.* ♂ flower, corolla and stamens, ×15, *c.* ♀ flower, corolla and ovary, ×15, *d.* flower, lateral view with calyx and corolla, ×7, *e.* flower calyx, ×10, *f.* infructescence, ×½ (*a–f* BLUME).

KEY TO THE SPECIES

1. Leaves membranous, generally ± deeply and ± acutely 3–5(–9)-lobed, very rarely (sub)entire. Inflorescence 1–2(–3)-forked, cincinni rather few-flowered. . . . . **1. C. quinqueloba**
1. Leaves firmly chartaceous, entire. Inflorescences with more numerous forks, cincinni rather many-flowered. . . . . **2. C. moluccana**

1. Cardiopteris quinqueloba (HASSK.) HASSK. Nat. Tijd. N. I. 10 (1855) 64. — *Peripterygium quinquelobum* HASSK. Tijd. Nat. Gesch. Phys. 10 (1843) 142; Cat. Hort. Bog. (1844) 235; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 400, f. 120 F–G; AMSH. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 135, p. 9. — *C. javanica* BL.Rumphia 3 (1847 or 1849) 206, *nom. illeg.*; *ibid.* 4 (1849) t. 177, f. 1A; BACK. & BAKH. *f.* Fl. Java 2 (1965) 63. — *C. lobata* R. BR. [in WALL. Cat. (1847) *n.* 8033] in Benn. & Br. Pl. Jav. Rar. (1852) 246, t. 49, *nom. illeg.*; MIQ. Fl. Ind. Bat. 1 (1856) 799; MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 597; KURZ, J. As. Soc. Beng. 44, ii (1875) 157; BECC. Malesia 1 (1877) 131; KING, J. As. Soc. Beng. 64, ii (1895) 131; GAGNEP. Fl. Gén. I.–C. 1 (1912) 849; BACK. Schoolfl. Java (1911) 230; KOORD.-SCHUM. Syst. Verz. 1, Fam. 162 (1912) 6; MERR. En. Born. (1921) 357; RIDL. Fl. Mal. Pen. 2 (1923) 464; CRAIB, Fl. Siam. En. 1 (1926) 276; BURK. Dict. (1935) 456; KANJILAL *c.s.* Fl. Assam 1, 2 (1936) 254; HENDERS. J. Mal. Br. R. As. Soc. 17 (1939) 59; GAGNEP. Fl. Gén. I.–C. Suppl. (1948) 759; HEYNE, Nutt. Pl. 1 (1950) 987; WU & WANG, Act. Phytotax. Sin. 6 (1957) 284; LARSEN, Dansk Bot. Ark. 23 (1963) 71. — *C. rumphii* BAILL. Adansonia 10 (1872) 280, *nom. illeg.*, *incl. var. lobata* BAILL. *et var. subhamata* BAILL. *l.c.* 281; DC. Prod. 17 (1873) 26; SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 14. — *C. platycarpa* GAGNEP. Not. Syst. 1 (1910) 198; Fl. Gén. I.–C. 1 (1911) 847, f. 104, *p.p.*, f. 105. — *Peripterygium platycarpum* (GAGNEP.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 257; in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 400. — *C. moluccana* (*non* BL.) WU & WANG, Act. Phytotax. Sin. 6 (1957) 284.

Much branched with twining terete stems, which often preserve their freshness after the fall of the leaves and are loaded with fruits then, 2–5(–9) m. *Leaves* widely spaced, polymorphous, broadly ovate in outline, with a cordate base, generally ± deeply or irregularly 3–5(–9)-lobed, apex generally acutish, lateral lobes acute or obtuse, very rarely entire or almost so, herbaceous, caducous, pale green, (4–)6–12(–17) by (3–)4–7(–16) cm, main nerves 7–9 radiating from apex of the petiole, slightly raised beneath, veins rather obscure; petiole (3–)5–12 cm. *Panicles* solitary on 3–5(–10) cm long peduncles, 1–2(–3)-forked, cincinni rather few-flowered, glandular-puberulous or almost glabrous, 5–10 cm, accrescent in fruiting stage. *Flowers* distant from each other along rachis, on short pedicels (1 mm, accrescent to 5 mm in fruit). *Calyx* lobes 2 mm. *Petals* white, 2.5(–3.5) mm. *Fruit* obovate-elliptic in outline, the wings included, apex emarginate, base cuneate and suddenly contracted to a kind of foot up to 2 mm, on the very base of which the persistent calyx is found, wings glossy yellow or light stramineous colour, tipped by the accrescent style which remains green and fleshy for a long time.

Distr. SE. Asia (W. Bengal and Assam to Burma, Thailand, Indo-China and Yunnan); in *Malesia*: N. & NE. Sumatra, Malay Peninsula (Kedah, Perlis, Perak), SE. Borneo (twice found), Java (incl. also Bawean & Kangean Is. and Madura), Lesser Sunda Is. (Lombok, Sumbawa, Sumba, Alor), Celebes (incl. also Saleijer Is.), Moluccas (Tenimber Is.).

Ecol. Primary and secondary (also seasonal, deciduous) forest edge, scrub jungle, bamboo forest, hedges around villages, open waste places, even on open limestone rock, generally at low elevations, rarely up to 1000 m, scattered.

Uses. Locally the leaves are used as a vegetable.

Vern. *Angi anginan, iri iri, kanjar kawang, parianom, rindengan, serintil, sobowengi, wiwi wiwo*, J, *oke oke*, Mad., *gambas kawaong, riru ruruan, saburung*, S, *kokrah*, Alor.

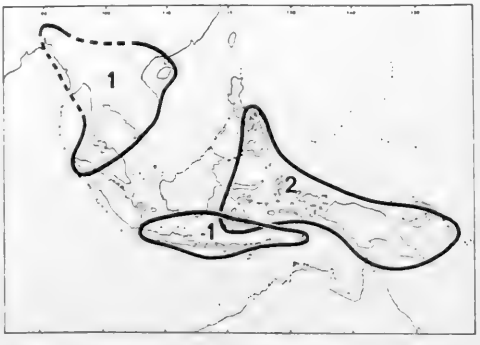

Fig. 2. Distribution of *Cardiopteris*. 1. *C. quinqueloba* (HASSK.) HASSK., 2. *C. moluccana* BL.

2. Cardiopteris moluccana BL. Rumphia 3 (1847 or 1849) 207; *ibid.* 4 (1849) t. 177, f. 1 B, f. 2 A & B, *incl. var.*; MIQ. Fl. Ind. Bat. 1 (1856) 799; BECC. Malesia 1 (1877) 131; K. SCH. Notizbl. Berl. 2 (1898) 130; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 418; MERR. Philip. J. Sc. 2 (1907) Bot. 423; SCHELLENB. Bot. Jahrb. 58 (1923) 176; MERR. En. Philip. 2 (1923) 493; HEYNE, Nutt. Pl. 1 (1950) 987. — *Dioscorea sativa* L. Amoen. Ac. 4 (1759) 133, *pr. pl. Amboin.* — *C. rumphii* BAILL. *var. blumeana* BAILL. Adansonia 10 (1872) 281, *incl. var. integrifolia* BAILL. *l.c.* 280; DC. Prod. 17 (1873) 26. — *C. lobata* R. BR. *var. moluccana* (BL.) MAST. in Hook. *f.* Fl. Br. Ind. 1 (1875) 597. — *C. lobata* (*non* R. BR.) BECC. Nuov. Giorn. Bot. Ital. 9 (1877) 100, t. 8; F.-VILL. Nov. App. (1880) 46;

F. M. BAILEY, Queensl. Agric. J. 24 (1910) 20. — *C. celebica* R. BR. *ex* KOORD. Minah. (1898) 392, *nom. nud.* — *Aspidocarya kelidophylla* K. SCH. & LAUT. Fl. Schutzgeb. (1900) 313, *sec.* DIELS, Menisp. (1910) 320. — *Peripterygium moluccanum* (BL.) SLEUM. Notizbl. Berl.-Dahl. 15 (1940) 257; in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 400, f. 120 A-E; DAHL, J. Arn. Arb. 36 (1955) 161 (pollen). — *Olus sanguinis* RUMPH. Herb. Amb. 5 (1747) 482, t. 180. — **Fig. 1.**

Leaves ovate-cordate, entire, acutely acuminate, base ± deeply cordate, firmly chartaceous, edge often slightly recurved in dry specimens, up to 24 by 22 cm. *Panicles* generally 3- or more-forked, cincinni rather rich-flowered, flowers usually close together. Otherwise as *C. quinqueloba*.

Distr. *Malesia*: Celebes, Philippines (Luzon, Panay?, Negros, Samar, Bohol, Catanduanes, Mindanao), Moluccas (Buru, Ambon (type), Ternate, Ceram), New Guinea, and New Britain (Gazelle Peninsula).

Ecol. Climber in tall rain-forest or forest edge, also in secondary vegetation and in native gardens, generally in the lowland, ascending to 1460 m in New Guinea, scattered.

Uses. A decoction of the stem is used against hepatitis in Ternate. The leaves are eaten as a vegetable.

Vern. *Matta matta, tamatta*, Makassar, *telin teli*, Menado, *uge jabba*, Ternate, *uta lala, u. turi*, Ambon; Philippines: *bangogan*, Bik., *gurisan, sagumati*, Bag., *lila*, Buk., *tagulauai*, P. Bis.; New Guinea: *foyomangeni*, Wapi (Miwaute), *kehunghe*, Mekeo (Maipa), *swalow*, Buang.

Note. According to MIQUEL also in Bali, which is apparently erroneous.

OCHNACEAE (A. Kanis, Leyden)

Woody plants, very small undershrubs to tall trees. *Leaves* distichous or spirally arranged, stipulate, simple, glabrous; midrib prominent on either side. *Inflorescences* 1- to many-flowered, cymose, racemose, or thyrsoid, bracteate; pedicels articulate. *Flowers* actinomorphic, bisexual (rarely functionally polygamous). *Sepals* 5, free or a little connate at base, quincuncial, persistent. *Petals* 5–10, free, contort, caducous. *Staminodes* 0–∞. *Stamens* 5–10–∞; anthers basifix, ± latrorse and dehiscing lengthwise, or with 1–2 apical pores. *Carpels* 2–5–10(–15), superior, free with 1 ovule, or fused with 2–∞ ovules per carpel; styles fused, basigynous or epigynous; stigmas free or ± fused. *Fruit(s)* a drupe(s), berry, or capsule. *Seeds* 1–∞, small or large, sometimes winged, with or without albumen.

Taxonomy. There is little doubt that the family of the *Ochnaceae* represents a natural one among the more primitive in the *Guttiferales* (= *Clusiales* or *Theales s. l.*). Nonetheless, there are striking differences between the genera, even at first sight. It is not difficult to arrange them in a few distinct, supra-generic taxa. A supposed natural system, as far as relevant to the Malesian genera, is as follows:

Subfamily Ochnoideae
- Tribe Ochneae . . . . . Subtribe *Ochninae* **1. Ochna**
  2. Brackenridgea
  Subtribe *Ouratinae* **3. Gomphia**

Subfamily Sauvagesioideae
- Tribe Euthemideae . . . . . **4. Euthemis**
- Tribe Sauvagesieae . . . . . Subtribe *Sauvagesiinae* **5. Neckia**
  6. Indovethia
  7. Schuurmansiella
  8. Schuurmansia

Distribution. About 30 genera and *c.* 250 *spp.* through the tropical, rarely subtropical countries (S. Africa, N. India), chiefly in S. America and Africa. In Malesia 8 genera and 13 *spp.*; absent from Java and the Lesser Sunda Islands.

In *subfam. Ochnoideae*, the monogeneric tribe *Elvasieae* and the genus *Ouratea* are restricted to S. America. Of the 3 genera of the *Ochneae* mentioned above, only *Brackenridgea* is chiefly Malesian. *Ochna* and *Gomphia* are principally African, both reaching the western part of Malesia with one species.

In *subfam. Sauvagesioideae*, the monogeneric tribe *Lophireae* occurs only in Africa, whereas the subtribe *Luxemburgiinae* is restricted to S. America. The 5 relevant genera mentioned above are almost purely Malesian. Of the subtribe *Sauvagesiinae*, *Sinia* Diels and *Indosinia* Vidal are found in continental SE. Asia, whereas the majority of the genera is restricted to S. America, only *Sauvagesia* L. occurring both in S. America and Africa.

There is an interesting parallelism between some of the *Sauvagesioideae*, which are more or less restricted to sandstone areas in W. Malesia, and related genera found in similar areas in northern S. America (Roraima flora).

Ecology. The Malesian genera are restricted to everwet areas, except *Ochna* which is adapted to a seasonally dry climate and is deciduous. They are more or less adapted to poorer, sandy or peaty soils in relatively undisturbed areas, except *Schuurmansia* which is a genus of pioneer species.

Pollination. There is no literature on this subject. Pollination probably takes place by insects, because of the brightly coloured and (sometimes?) scented flowers. The colours of the petals are yellow in *Ochna* and *Brackenridgea sect. Notochnella*, mostly white, creamy, or tinged purple in other genera, sometimes dark purplish red in *Schuurmansia*. Only *Ochna* has flowers *c.* 3 cm across. Flowers of other genera usually do not exceed 1 cm, but they are often combined to conspicuous inflorescences. The undershrubs of *Neckia*, however, have solitary flowers with relatively small, early caducous petals.

Dispersal. The bluish or black, 1-seeded fruits of the Malesian *Ochneae* are probably mainly dispersed by birds. In *Ochna* and *Brackenridgea* they are contrasting with a purple calyx and torus. The *Euthemideae* have red or white berries on a dark red calyx, which are probably also dispersed by birds (see Ridley, Disp. 1930). The Malesian *Sauvagesieae* have many-seeded capsules. Their seeds do not show adaptations to a special mode of dispersal, except those of *Schuurmansia* with two wings like propeller blades. The latter characteristic points to wind dispersal, which fits the pioneer-like nature of the genus concerned. The sepals in *Neckia* are also turning dark purple in fruit; the meaning of this phenomenon is not understood.

Morphology. From the description of the family and the key to the genera it will be clear that the morphological differences between subfamilies and tribes are considerable. A discussion on these differences I gave in my thesis (Blumea 16, 1968, 8–15). A short note should be made here on the inflorescence types, as these may not always be easily understood.

The inflorescences in *subfam. Ochnoideae* are all considered to be of a thyrsoid nature, *viz* racemes with cymose branches. Those of *Gomphia serrata* are lateral and terminal, bearing terminal flowers which makes sympodial growth of the vegetative branches necessary. Those of *Ochna integerrima* have also terminal flowers, but they are terminal on short side branches and monopodial growth of the main branches remains possible. The inflorescences of *Brackenridgea spp.* are terminal, sometimes also lateral. A terminal flower is lacking and monopodial growth of the rachis to a vegetative shoot is still possible, although not equally frequent in all species. The cymose branches are very much shortened here, especially in *sect. Brackenridgea* where flowers are almost sessile on the rachis. In some species there are several branches per inflorescence, each bearing 3(–5) flowers. In other species there are only a few branches, each bearing 7 or more flowers in pseudo-umbels. In *sect. Notochnella* the cymose branches are not shortened so much, whereas the bracts on the rachis sometimes have a more leaf-like appearance. The inflorescences in *subfam. Sauvagesioideae* are more of a paniculate nature. They are profusely branching in *Schuurmansia*, but in the other genera most branches are very much shortened, flowers and fruits of different age standing closely together. In *Neckia* the rachis is bearing several bracts, but only one (terminal?) flower.

Anatomy. The *Ochnaceae* are characterised by the presence of cortical bundles without resin canals (GILG, Ber. Deut. Bot. Ges. 11, 1893, 20–25). The *subfam. Ochnoideae* shows typical 'cristarque' cells in branches and leaves (VAN TIEGHEM, Bull. Mus. Hist. Nat. Paris 8, 1902, 266–273). For other data, see METCALFE & CHALK, Anat. Dicot. 1 (1950) 104, 108, 333–338, 340, f. 76, 77, and DECKER, Phytomorphology 16 (1966) 39–45.

Palynology. The pollen of the *Ochnaceae* only show interesting differences at generic or higher level, but they do not differ fundamentally. See ERDTMAN, Pollen Morph. Pl. Tax. (1952) 290, and MULLER, Rev. Palaeobot. Palynol. 9 (1969) 149–173.

Phytochemistry. No data available. Some species are used locally for medicinal purposes, because of bitter components of unknown nature.

Uses. No economically important applications of Malesian *spp.* have been recorded. For properties of the wood of some species, see under *Ochna integerrima* and *Gomphia serrata*.

Note. The present revision is based on my precursory treatment of Indo-Pacific *Ochnaceae* in Blumea 16 (1968) 1–83.

KEY TO THE GENERA

1. Stamens 10–∞. Carpels (3–)5–10(–15), free. Fruits 1–5, 1-seeded drupes on a swollen torus. Leaves distichous.
 2. Anthers opening with 2 apical pores. Stipules intrapetiolarly united. Inflorescences with (1–)3–∞, ± remote flowers, usually thyrsoid, sometimes simple cymes.
  3. Stamens 12–∞; ovaries (3–)5–10(–15); embryo straight. Leaves without an intra-marginal nerve. **1. Ochna**
  3. Stamens 10; ovaries 5; embryo curved. Leaves with a distinct intra-marginal nerve. **3. Gomphia**
 2. Anthers opening with 2 longitudinal slits. Stipules free. Inflorescences of umbelloid appearance with ∞ flowers in conferted, cymose clusters of 3 or more. . . . . **2. Brackenridgea**
1. Stamens 5. Carpels 2–5, fused. Fruit a more-seeded berry or capsule; torus not distinctly enlarged in fruit. Leaves alternate, not distichous.
 5. Ovary 5-carpelled, 5-celled. Fruit a berry. Anthers opening by 1 apical pore. Leaf margin always stiffly, though sometimes very finely, denticulate. . . . . **4. Euthemis**
 5. Ovary 3-carpelled, 1-celled. Fruit a capsule. Anthers opening by 2 longitudinal slits. Leaf margin entire or (bi)serrulate.
  6. Seeds not winged. Fruit opening with 3 valves. Inflorescences simple, or compound and (nearly) all branches shortened. Leaves evenly spaced. Leaf margin (bi)serrulate. Shrubs or undershrubs.
   7. Inflorescences axillary; the rachis bearing a varying number of bracts, but only 1 flower. Undershrubs, up to 1 m, but often much smaller. . . . . **5. Neckia**
   7. Inflorescences terminal (or pseudo-axillary by sympodial growth), many-flowered. Shrublets or shrubs, up to 7 m high.
    8. Staminodes 10, in 1 whorl. Fruit subglobose. Leaf blades oblanceolate, up to 35 cm long. **6. Indovethia**
    8. Staminodes ∞, in more than 1 whorl, those of the inner whorl larger. Fruit fusiform. Leaf blades linear oblong, up to 17 cm long. . . . . **7. Schuurmansiella**
  6. Seeds winged. Fruit opening with 3 longitudinal slits under the persistent style. Inflorescences much-branched panicles. Leaves distinctly tufted. Leaf margin entire, glandular dotted. Treelets, usually not exceeding 15 m. . . . . **8. Schuurmansia**

1. OCHNA

LINNÉ, Gen. Pl. ed. 5 (1754) 229; Sp. Pl. 1 (1753) 513; KANIS, Blumea 16 (1968) 22, 83. — *Diporidium* WENDL. *f.* in Bartl. & Wendl. Beitr. Bot. 2 (1825) 24; O.K. Rev. Gen. Pl. 1 (1891) 104, *emend. illeg., incl. typ. Ochna.* — *Discladium* TIEGH. Bull. Mus. Hist. Nat. Paris 8 (1902) 214, *nom. illeg.* — *Polythecium* TIEGH. Ann. Sc. Nat. Bot. VIII, 16 (1902) 196, 366. — *Pleopetalum* TIEGH. Bull. Mus. Hist. Nat. Paris 9 (1903) 163. — *Polythecanthum* TIEGH. Ann. Sc. Nat. Bot. IX, 5 (1907) 160, 175. — **Fig. 1.**

Shrubs or treelets, sometimes undershrubs. Stipules small, intrapetiolarly united, caducous. *Leaves* shortly petioled, chartaceous or subcoriaceous; nerves curved upward, especially near the margin, not joining; veinlets ± at right angles to the nerves near the midrib and joining in irregular secondary nerves, ± transverse near the margin. *Inflorescences* lateral or terminal thyrses with a terminal flower; peduncle ± persistent, bearing many, small, distichously conferted, caducous bracts at base, leaving a distinct annulus of scars; pedicels filiform, articulate. *Flowers* with ± hemispherical torus, distinctly tumid and red in fruit. *Sepals* 5, greenish, accrescent and turning red in fruit. *Petals* 5–10, in 1–2 whorls, yellow. *Stamens* ∞ in 2 or more whorls; filaments subterete; anthers opening with 2 apical pores. *Ovaries* 5–10(–15), obovoid; ovule atropous; stigmas as many as ovaries, on short branches or ± united. *Fruits* 1–3(–5), greenish, turning black when ripe.

Distr. The majority of the species is found in Africa, south of the Sahara, and in Madagascar. In India and Ceylon 4 *spp.* occur, one of these ranging from Assam to Indo-China, Hainan, the Nicobar Is., and *Malesia*: in the North of the Malay Peninsula.

Ecol. Adapted to a seasonal climate, on poorer soils, below 1500 m. Dispersal by birds because of conspicuous black fruits on red torus and calyx (RIDLEY, Disp. 1930, 419).

1. Ochna integerrima (LOUR.) MERR. Trans. Am. Phil. Soc. n.s. 24, 2 (1935) 265, *emend.*; KANIS, Blumea 16 (1968) 36; Fl. Thail. 2 (1970) 25. — *Elaeocarpus integerrimus* LOUR. Fl. Cochinch. (1790) 338. — *O. wallichii* PLANCH. in Hook. Lond. J. Bot. 5 (1846) 650; KING, J. As. Soc. Beng. 62, ii (1893) 231; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 83; CRAIB, Fl. Siam. En. 1 (1931) 244; BURK. Dict. 2 (1935) 1569. — *O. crocea* GRIFF. Not. Pl. As. 4 (1854) 463; KURZ, J. As. Soc. Beng. 40, ii (1871) 49, *err. in syn. Gomphia sumatrana* JACK; KING, *ibid.* 62, ii (1893) 233. — *O. grandis* RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 83; Fl. Mal. Pen. 1 (1922) 365. — *Ouratea crocea* (GRIFF.) BURK. Dict. 2 (1935) 1614; Kew Bull. (1935) 318, *p.p., quoad typus.* — **Fig. 1.**

Deciduous undershrub, shrub, or treelet up to 12 m and 45 cm ø. Stipules 5–8 by 2–3 mm. *Leaves* mostly obovate-oblong or (obovate-) lanceolate, rarely obovate or linear-lanceolate, 6–20(–25) by 2–7 cm, mostly acuminate, sometimes acute or obtuse at apex, mostly acute, sometimes obtuse at base, margin finely denticulate; petiole 2–5 mm. *Inflorescences* compound, many-flowered; rachis ½–1½(–4) cm; branches 1–3-flowered, monochasial; pedicels 2–4 cm, in fruit up to 5 cm, the basal 2–8 mm persistent. *Torus* ½–1 mm high, 1½–2½ mm ø, in fruit up to 6 mm high, 10 mm ø. *Sepals* 5, ovate to ovate-oblong, 10–16 by 4–9 mm. *Petals* 5–6(–10), obovate, 15–25 by 8–15 mm, tapering at base or subunguiculate. *Stamens* (25–)30–60(–75); filaments 2½–7 mm, unequal, the outermost longest; anthers 4–6 by 0.4–0.8 mm. *Ovaries* 6–10(–15), 0.7–1.1 by 0.5–0.7 mm; style 10–15 by *c.* ½ mm, in fruit up to 20 mm; stigmas sometimes on up to 1 mm long branches. *Fruits* mostly 2–3, up to 11 by 8 mm.

Distr. NE. India, E. Pakistan, Burma, Andaman and Nicobar Is., Thailand, Laos, Cambodia, Vietnam, Hainan, in *Malesia*: Malay Peninsula (Peninsular Thailand, Perlis, Kedah, Langkawi Is.).

Ecol. From sea-level up to 1200 m in hilly country, in moist or dry, deciduous forests, often of a mixed Dipterocarp type, on loamy, sandy, or rocky soils. Tall specimens are found near river banks, small shrubs near seashores. Flowering shortly before or during development of new leaves: in the northern part of the area mainly in Febr. and March, in the southern part generally a little earlier, but less restricted, especially in the Malay Peninsula.

Fig. 1. *Ochna integerrima* (LOUR.) MERR. *a.* Fruiting twig, ×⅔, *b.* inflorescence, ×⅔, *c.* stamen, ×4, *d.* gynoecium, ×4, *e.* fruit, ×2 (*a* & *e* RIDLEY 15746, *b–d* GARRETT 1346).

Uses. The bark tastes bitter and yields a digestive tonic (Cochinchina). The wood is recorded as used for huts in the Andamans.

Properties of wood. Light brown, hard, close-grained and brittle.

Excluded

Ochna decaisnei TIEGH. Bull. Mus. Hist. Nat. Paris 8 (1902) 47–49. — *Diporidium decaisnei* TIEGH. Ann. Sc. Nat. Bot. VIII, 16 (1902) 356 = *O. mauritiana* LAMK, *fide* KANIS, Blumea 16 (1968) 80.

A species based on one collection by RIEDLÉ, erroneously recorded for Timor. The specimen must have been collected during Capt. BAUDIN's expedition on l'Ile de France (Mauritius) on the way to Timor. It must have been mislocalized later on.

2. BRACKENRIDGEA

A. GRAY, New Gen. Pl. (1853) 5, preprint of Proc. Am. Ac. Arts Sc. 3 (1857) 51; KANIS, Blumea 16 (1968) 41. — *Campylopora* TIEGH. Bull. Mus. Hist. Nat. Paris 8 (1902) 547. — *Notochnella* TIEGH. *l.c.* 549. — **Fig. 2.**

Trees or treelets. Stipules small, free, often more or less laciniate, caducous. *Leaves* shortly petioled, chartaceous, glossy above, nerves strongly curved to the apex, often some of the lower ones partly parallel to the margin, the higher ones joining successively, veinlets branching, ± transverse. *Inflorescence* thyrsoid, but of umbelloid appearance, made up of simple or compound, distichously arranged, shortened cymes, the rachis often growing on vegetatively after flowering; bracts small, broadly linguiform to triangular, ± laciniate, ± caducous, often many at base of inflorescence, leaving a distinct annulus of scars; pedicels filiform, ± accrescent and turning red in fruit, articulate at base. *Flowers* with ± hemispherical torus, distinctly tumid and red in fruit. *Sepals* 5, accrescent, fleshy and red in fruit. *Petals* 5(–10), white or yellow. *Stamens* 10 (or ∞); filaments subterete; anthers dehiscing from the apex downwards by longitudinal slits. *Ovaries* 5(–10), obovoid; ovule camptotropous, epitropous, ± annularly curved around 2 connecting intrusions of the endocarp; stigma small. *Fruits* 1–2(–5), greenish, turning black or almost so when ripe.

Distr. 2 or 3 *spp.* in tropical eastern Africa and Madagascar, probably forming a distinct section; in *Malesia* 4 *spp.* in 2 sections are found; a related species occurs in NE. Queensland and Fiji.

Ecol. Confined to the everwet tropical areas, up to *c.* 1000 m. Dispersal mainly by birds because of conspicuous, black fruits on red torus and calyx (GUPPY, Obs. Nat. Pacif. 2, 1906, 569; RIDLEY, Disp. 1930, 265). The fruits are also capable of floating because of two air-filled spaces between exocarp and endocarp; this was recorded from the Kapuas R. (BECCARI, Wand. Borneo 1904, 187) and from the New Guinea seadrift (HEMSLEY, Bot. Chall. Exp. 3, 1885, 289, t. 54). No specimen has ever been collected in beach forest.

KEY TO THE SPECIES

1. Petals 5. Stamens 10. Ovaries 5. (*Sect. Brackenridgea*).
 2. Inflorescences never axillary, but sometimes terminal on short side-branches.
  3. Inflorescences made up of many-flowered cymes, the pedicels in 2 or more tiers. Leaves mostly 7½–20 cm long. . . . . **1. B. hookeri**
  3. Inflorescences made up of 3(–5)-flowered cymes, the pedicels in 1 tier. Leaves mostly 4–12½ cm long . . . . . **2. B. palustris**
 2. Axillary inflorescences always present when in fertile state. . . . . **3. B. forbesii**
1. Petals 5–7-(10). Stamens 10–45. Ovaries 5–10. (*Sect. Notochnella*). . . . . **4. B. fascicularis**

1. Section Brackenridgea

Brackenridgea A. GRAY. — *Campylopora* TIEGH.

Cymes much conferted; peduncle and branches much shortened. *Flowers* of 1

cyme flowering simultaneously. *Corolla* regularly 5-merous, white. *Stamens* 10, in 1 whorl. *Ovaries* 5.

Distr. Chiefly Malesian with 2 *spp.* in the Malay Peninsula and Borneo, one reaching Sumatra, Palawan, and Celebes, the other reaching the Andamans and Ko Chang; another *sp.* in New Guinea. Also 1 *sp.* in NE. Queensland and Fiji.

1. Brackenridgea hookeri (PLANCH.) A. GRAY, New Gen. Pl. (1853) 6, preprint of Proc. Am. Ac. Arts Sc. 3 (1857) 51; FURTADO, Gard. Bull. Sing. 19 (1962) 182; KANIS, Blumea 16 (1968) 45; Fl. Thail. 2 (1970) 27. — *Gomphia hookeri* PLANCH. in Hook. Lond. J. Bot. 6 (1847) 3; MIQ. Fl. Ind. Bat. 1, 2 (1859) 675, *err.* '*G. glaberrima* PLANCH.'; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 525; KING, J. As. Soc. Beng. 62, ii (1893) 233, *excl. var. corymbosa*; RIDL. Fl. Mal. Pen. 1 (1922) 366. — *Ochna hookeri* (PLANCH.) O.K. Rev. Gen. Pl. 1 (1891) 106. — *B. perakensis* TIEGH. Ann. Sc. Nat. Bot. VIII, 16 (1902) 396. — *Gomphia corymbosa* (KING) RIDL. J. Str. Br. R. As. Soc. *n.* 54 (1910) 33, *p.p. excl. typus*; Fl. Mal. Pen. 1 (1922) 367. — *Ouratea hookeri* (PLANCH.) BURK. Kew Bull. (1935) 318; Dict. 2 (1935) 1615. — *B. denticulata* FURTADO, Gard. Bull. Sing. 19 (1962) 183. — **Fig. 2b[1].**

Tree, up to 33 m, 1 m ø. *Leaves* oblong to lanceolate, 7½–20 by 2½–6 cm, obtuse to acute, sometimes acuminate at apex, acute, often ± tapering at base, margin entire, ± acicular denticulate in young treelets; petiole 5–12 mm. *Inflorescences* terminal, made up of many-flowered shortened, sessile cymes, flowering successively or simultaneously, the rachis often not growing on vegetatively after flowering; pedicels 10–15 mm, up to 20 mm in fruit, those of one cyme fixed close together in *c.* 3, ± distinct tiers. *Torus c.* ½ mm high, 1 mm ø, in fruit up to 3 mm high, 5 mm ø. *Sepals* ovate to obovate, 4–5 by 1½–2 mm. *Petals* ovate to obovate, 3½–5 by 1½–1¾ mm. *Filaments* 1–1½ mm; anthers 1½–2 by *c.* ½ mm. *Ovaries c.* 0.7 by 0.5 mm; style 1½–3 mm, in fruit up to 5 mm. *Fruits* up to 6½ by 5½ mm.

Distr. India: Andamans, and Thailand: Ko Chang (NE. Gulf of Thailand); in *Malesia*: Malay Peninsula and Borneo.

Ecol. From sea-level up to 750 m, in kerangas forests on sandy soils, on dry hillocks in swampy forests, in primary lowland Dipterocarp forests and in hill forests.

Vern. Mal. Pen.: *bunga kĕlat mèrah, bunga maskam, kayu luru*, Malacca; Borneo: *ĕmpodat*, Sarawak, *sĕmukau*, P. Madjang.

2. Brackenridgea palustris BARTELL. Malpighia 15 (1901) 165, t. 10; FURTADO, Gard. Bull. Sing. 19 (1962) 183; KANIS, Blumea 16 (1968) 46; Fl. Thail. 2 (1970) 27. — *B. hookeri* (PLANCH.) A. GRAY *var. leucocarpa* SCHEFF. Nat. Tijd. N. I. 32 (1873) 411. — *Gomphia hookeri* PLANCH. *var. corymbosa* KING, J. As. Soc. Beng. 62, ii (1893) 233. — *B. serrulata* BARTELL. Malpighia 15 (1901) 163, t. 9; FURTADO, Gard. Bull. Sing. 19 (1962) 184. — *B. kingii* TIEGH. Ann. Sc. Nat. Bot. VIII, 16 (1902) 395. — *B. corymbosa* (KING) TIEGH. *l.c.* 395. — *B. rubescens* TIEGH. *l.c.* 396. — *Gomphia corymbosa* (KING) RIDL. J. Str. Br. R. As. Soc. *n.* 54 (1910) 33, *p.p.*; Fl. Mal. Pen. 1 (1922) 367. — *Ochna forworthyi* ELMER, Leafl. Philip. Bot. 5 (1913) 1823; MERR. En. Philip. 3 (1923) 68. — *B. foxworthyi* (ELMER) FURTADO, Gard. Bull. Sing. 19 (1962) 184. — **Fig. 2.**

Tree, up to 30 m, 1.2 m ø. *Leaves* (ovate-) oblong to (ovate-)lanceolate, 4–12½ by 1½–5 cm (up to 20 cm long on young treelets), mostly acute to acuminate, sometimes obtuse at apex, rounded to acute, often ± tapering at base, margin entire, ± acicular denticulate in young treelets; petiole 3–10 mm. *Inflorescences* terminal, made up of 3(–5)-flowered, shortened cymes, sessile, or with up to ½ cm long peduncle, flowering simultaneously, sometimes 2 inflorescences of different stages in close succession, the 5–10(–25) mm long rachis growing on vegetatively, sometimes branching in the lower parts; pedicels 8–15 mm, up to 20 mm in fruit, those of one cyme fixed close together in one tier. *Torus c.* ½ mm high, 1 mm ø, in fruit up to 4 mm high, 6 mm ø. *Sepals* ovate to oblong, 3½–6 by 1½–3 mm. *Petals* ovate to obovate-lanceolate, 3½–7 by 1½–3 mm. *Filaments* (½–)1–2(–2½) mm; anthers 1½–3 by *c.* ½ mm. *Ovaries c.* 0.7 by 0.5 mm; style (1–)2½–4 mm, ± accrescent. *Fruits* up to 8 by 6 mm.

Distr. *Malesia*: Sumatra, Malay Peninsula, Borneo, Philippines (Palawan), and Celebes.

KEY TO THE SUBSPECIES

1. Anthers 1½–2 mm long. Style 2½–4 mm long during anthesis. . . . . **1. *ssp.* palustris**
1. Anthers 2–3 mm long. Style 1½–2½ mm long during anthesis.
2. Filaments *c.* 2 mm long during anthesis. Ovaries *c.* 0.7 by 0.5 mm. . **2. *ssp.* foxworthyi**
2. Filaments *c.* ½ mm long during anthesis. Ovaries *c.* 0.5 by 0.3 mm. . **3. *ssp.* kjellbergii**

1. *ssp.* palustris. — All synonyms except *Ochna foxworthyi* ELMER.

Cymes 3-flowered, sessile, up to 5-flowered and with up to ½ cm long peduncle in young treelets. *Sepals* 3½–5½ by 1½–3 mm. *Petals* 3½–6 by 1½–3 mm. *Stamens* with 1–2 mm long filaments; anthers 1½–2 mm long, up to 3 mm in young treelets. *Ovaries c.* 0.7 by 0.5 mm; style 2½–4 mm during anthesis. *Fruits* up to 8 by 6 mm.

Distr. *Malesia*: Sumatra, Mentawai Is., Banka, Billiton, Malay Peninsula, Borneo.

Ecol. Usually found in the lowlands, but oc-

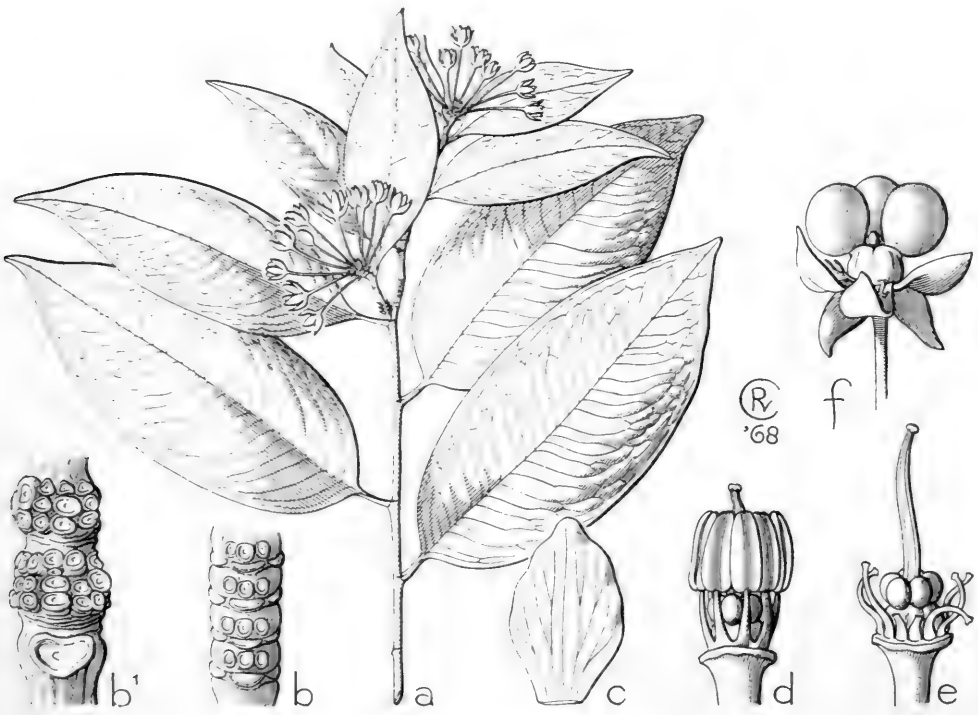

Fig. 2. *Brackenridgea palustris* BARTELL. *a*. Flowering twig, ×2⅔, *b*. part of twig with scars of flowers and bracts arranged in simple cymes, ×4 (*b'*. *ditto* of *B. hookeri* (PLANCH.) A. GRAY, scars of many flowers arranged in shortened, cymose, partial inflorescences, ×4), *c*. petal from bud, *d*. flowerbud, sepals and petals removed, *e*. flower, petals and anthers shed, sepals removed, all ×6, *f*. fruiting flower, ×2 (*a–b* & *e* RAHMAT SI TOROES 4187, *c–d ditto* 4162, *f* IBOET 214; *b'* PAIE 13589).

casionally up to 1000 m, reported from peat-swamp forests and from kerangas forests on sandy, sometimes rather rocky soils, with humic podsols.

Uses. The wood is reported twice as being used in house-building (Malacca, Sarawak).

Vern. Sumatra: *majang majang, mampat, rampat dahan, sĕniang*, M, *kaju barat laut, k. galugus badak, k. ludĕ, k. saholat, k. topa topa*, Kota Pinang Distr.; *madu luai, mensulung kaju*, Banka; *mĕnsolongang*, Billiton; Mal. Pen.: *lidah mura*, Pahang, *pĕndorah, chĕharahan*, Malacca; Borneo: *mata undang, timur bĕsih*, P. Madjang.

2. *ssp.* foxworthyi (ELMER) KANIS, Blumea 16 (1968) 48. — *Ochna foxworthyi* ELMER.

Cymes 3-flowered, sessile. *Sepals* 5–6½ by 2–3 mm. *Petals* 5–7 by 1½–2 mm. *Stamens* with 1¾–2¼ mm long filaments; anthers 2–3 mm long. *Ovaries c.* 0. 7 by 0.5 mm; style 1½–2½ mm long during anthesis. *Fruits* up to 5 by 4 mm.

Distr. *Malesia*: Philippines (Palawan).

Ecol. At sea-level, along river in forest, and from 150 m on rocky hillside near river-bank.

3. *ssp.* kjellbergii KANIS, Blumea 16 (1968) 48.

Cymes 3-flowered, sessile. *Sepals* 4–5½ by 1½–2 mm. *Petals* 4–4½ by 1¾–2¼ mm. *Stamens* with ¼–¾ mm long filaments; anthers 2½–3 mm long. *Ovaries c.* 0.5 by 0.3 mm; style 1–2 mm long during anthesis. *Fruits* up to 5 by 4 mm.

Distr. *Malesia*: Celebes.

Ecol. At sea-level in swamp and from 400 m at the edge of a lake.

3. Brackenridgea forbesii TIEGH. in Morot, J. Bot. 16 (1902) 46, *nom. nud.*; Ann. Sc. Nat. Bot. VIII, 16 (1902) 395, *descr.*; PULLE, Nova Guinea 8 (1912) 667; RENDLE, J. Bot. (1923) Suppl. 7; KANIS, Blumea 16 (1968) 49.

Tree, up to 30 m, 55 cm ø. *Leaves* oblong to lanceolate, 5–15 by 1½–5 cm, acute to acuminate at apex, acute or a little tapering at base, entire; petiole 3–5 mm. *Inflorescences* terminal and axillary, made up of a varying number of mostly 3- to 5-flowered, shortened, sessile cymes, flowering simultaneously, the 2–5(–10) mm long rachis mostly growing on vegetatively when terminal, sometimes when axillary; pedicels *c.* ½ cm, up to 1 cm in fruit, those of one cyme fixed close to each other in one tier. *Torus c.* ⅓ mm high, ½–¾ mm ø, in fruit up to 2½ mm high, 4 mm ø. *Sepals* ovate to elliptic, 3–4½ by 1¼–1¾ mm.

Petals obovate-lanceolate, 3–4½ by 1–1¼ mm, acute at apex. *Stamens* with *c.* 1½ mm long filaments; anthers *c.* 1½ by ⅓ mm. *Ovaries c.* 0.6 by 0.5 mm; style 1½–2 mm, in fruit up to 3 mm. *Fruits* up to 6 by 5 mm.

Distr. *Malesia*: New Guinea.

Ecol. Primary rain-forest on flat country to steep slopes, up to 750 m, on clay, sand, or peat, in sites which may be inundated during the wettest season.

Vern. W. New Guinea: *jobias*, Je, *obaisang*, Mooi, *serukdeho*, Manikiong.

2. Section Notochnella

(TIEGH.) KANIS, Blumea 16 (1968) 43. — *Notochnella* TIEGH.

Cymes ± remote; peduncle ± distinct; branches ± shortened, sometimes unequal in length, the longer overtopping the central flower. *Flowers* of 1 cyme flowering successively. *Corolla* irregular, yellow. *Stamens* ∞, in more than 1 whorl. *Ovaries* 5–10.

Distr. *Malesia*: Philippines (excl. Palawan), monotypic.

4. Brackenridgea fascicularis (BLANCO) F.-VILL. Nov. App. (1880) 40; KANIS, Blumea 16 (1968) 43. — *Ochna fascicularis* BLANCO, Fl. Filip. ed. 2 (1845) 245; *ibid.* ed. 3, 2 (1878) 92; VIDAL, Sinopsis (1883) 19, t. 27A; Rev. Pl. Vasc. Filip. (1886) 79; BARTELL. Malpighia 15 (1901) 162; MERR. Gov. Lab. Publ. Philip. 27 (1905) 29; Sp. Blanc. (1918) 263; En. Philip. 3 (1923) 68. — *Diporidium fasciculare* (BLANCO) O.K. Rev. Gen. Pl. 1 (1891) 105; TIEGH. in Morot, J. Bot. 16 (1902) 203. — *Notochnella fascicularis* (BLANCO) TIEGH. Bull. Mus. Hist. Nat. Paris 8 (1902) 549; Ann. Sc. Nat. Bot. VIII, 16 (1902) 403. — *Ouratea mindanaensis* MERR. Philip. J. Sc. 17 (1920) 287; En. Philip. 3 (1923) 68.

Tree up to 25 m, 30 cm ø. *Leaves* oblong to lanceolate, 5–15 by 2–5 cm, sometimes obtuse, mostly acute to ± acuminate at apex, obtuse to acute, sometimes a little attenuate at base, margin entire or ± finely denticulate; petiole 4–8 mm. *Inflorescences* terminal, made up of a varying number of many-flowered, ± shortened cymes, sometimes separate cymes in the axils of normal leaves; pedicels 1–2 cm, up to 3 cm in fruit, the basal 1–5 mm persistent. *Torus c.* 1 mm high, 1½ mm ø, in fruit up to 4 mm high, 7 mm ø. *Sepals* elliptic to obovate, 6–8 by 3–4 mm. *Petals* obovate to obovate-lanceolate, 6–8 by 2½–4½ mm. *Filaments* 1½–2½ mm; anthers 2½–3 by *c.* ½ mm. *Ovaries* 0.7–0.8 by 0.5–0.7 mm; style *c.* 4 mm, in fruit up to 7 mm. *Fruits* up to 7 by 6 mm.

Distr. *Malesia*: Philippines.

Ecol. In primary forests at low and medium altitudes, once reported from logged Dipterocarp forest and once along a stream.

KEY TO THE SUBSPECIES

1. Stamens 20–45 . Cymes with 2–5 mm long peduncles. . . . . **1.** *ssp.* **fascicularis**
1. Stamens 10–15. Cymes with 5–10(–20) mm long peduncles. . . . . **2.** *ssp.* **mindanaensis**

1. *ssp.* **fascicularis.** — *Ochna fascicularis* BLANCO.

Inflorescences with 1–2½ cm long rachis; cymes with 2–5 mm long peduncles, up to 15-flowered. *Sepals* 5. *Petals* 5–7(–10). *Stamens* 20–45. *Ovaries* 7–10.

Distr. *Malesia*: Philippines (Luzon, N. Visayas).

Vern. Philip.: *aniatan, dirigkalin, bitas, malakiting kiting, masalisi*, Luzon, Tag., *bansilai*, Visayas, Bis.

2. *ssp.* **mindanaensis** (MERR.) KANIS, Blumea 16 (1968) 44. — *Ouratea mindanaensis* MERR.

Inflorescences with 2–6 cm long rachis, often indistinct by development of bracts to normal leaves; cymes with 5–10(–20) mm long peduncles, up to 7-flowered. *Sepals* (3–)5. *Petals* (3–)5. *Stamens* (8–)10–15. *Ovaries* 6–7.

Distr. *Malesia*: Philippines (Mindanao).

Doubtful

Brackenridgea elegantissima (WALL.) KANIS, Blumea 16 (1968) 50. — *Euthemis elegantissima* WALL. in Roxb. Fl. Ind. 2 (1824) 305; in Hook. Bot. Misc. 2 (1830) 77, note; PLANCH. in Hook. Lond. J. Bot. 5 (1846) 647; *ibid.* 6 (1847) 2, *err. in syn. Gomphia sumatrana* JACK; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 526; KING, J. As. Soc. Beng. 52, ii (1893) 235; BARTELL. Malpighia 15 (1901) 160; RIDL. Fl. Mal. Pen. 1 (1922) 368. — *Euthemis* ? *pulcherrima* WALL. *ex* BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 526, *err. in syn. Gomphia sumatrana* JACK; KING, J. As. Soc. Beng. 52, ii (1893) 233; BARTELL. Malpighia 15 (1901) 160.

Based on one sterile, juvenile specimen from Singapore I. It can not be decided whether it belongs to *B. hookeri* (PLANCH.) A. GRAY or to *B. palustris* BARTELL., although it should be certainly one of these species. WALLICH's epithet is the oldest available for any of the species in *Brackenridgea*.

3. GOMPHIA

SCHREB. Gen. Pl. ed. 8 (1789) 291, *p.p.*; KANIS, Taxon 16 (1967) 420, 422; Blumea 16 (1968) 51. — *Ochna* LINNÉ, Sp. Pl. 1 (1753) 513; Gen. Pl. ed. 5 (1754) 229, *p.p. excl. typ.* — *Ouratea* [*non* AUBL. Hist. Pl. Gui. Fr. 1 (1775) 397] BAILL. Hist. Pl. 4 (1873) 367, *emend., p.p. excl. typ.* — *Meesia* GAERTN. Fruct. 1 (1788) 344, *nom. rej., non* HEDW. Sp. Musc. (1801) 173, *nom. cons.* — *Campylospermum* TIEGH. in Morot, J. Bot. 16 (1902) 40, 194, 197, *nom. superfl.* — *Cercinia* TIEGH. *l.c.* 198. — *Campylocercum* TIEGH. Bull. Mus. Hist. Nat. Paris 8 (1902) 546. — **Fig. 3.**

Shrubs or treelets. Stipules small, intrapetiolarly united, caducous. *Leaves* shortly petioled, chartaceous, nerves close, parallel, ± straight, curving upward near the margin, forming an inconspicuous marginal nerve and a conspicuous, somewhat wavy nerve parallel to the margin at some distance, veinlets reticulate, joining in irregular secondary nerves parallel to the primary ones. *Inflorescences* lateral and/or terminal thyrses with ± reduced branches; peduncle ± persistent with sometimes a few small bracts at base, not leaving a distinct annulus of scars; pedicels filiform, articulate at base. *Flowers* with a short, columnar, 5-ribbed gynophore, enlarging and sometimes turning subglobular in fruit. *Sepals* 5, tinged pinkish, accrescent. *Petals* 5, yellow, creamy or white. *Stamens* 10 in 1 whorl; filaments terete, very short; anthers opening with 2 apical pores. *Ovaries* 5, obovoid; ovule camptotropous, epitropous; stigma punctiform. *Fruits* 1–2(–5), yellowish green, turning dark purple or blue-black when ripe.

Distr. The majority of the species is found in Africa, S. of the Sahara, and in Madagascar. One *sp.* in SW. Peninsular India, Ceylon, E. Thailand, Indo-China, Hainan, and *W. Malesia.*

Ecol. Confined to tropical areas with an everwet climate or with a moderately dry monsoon, up to 1500 m. Dispersal possibly by birds, but the fruits are not as conspicuous as in *Ochna* and *Brackenridgea*, as calyx and torus are not coloured.

1. Gomphia serrata (GAERTN.) KANIS, Taxon 16 (1967) 422; Blumea 16 (1968) 53; Fl. Thail. 2 (1970) 28. — *Meesia serrata* GAERTN. Fruct. 1 (1788) 344, t. 70, f. 6. — *G. angustifolia* VAHL, Symb. Bot. Upsal. 2 (1791) 49; SCHEFF. Nat. Tijd. N. I. 32 (1873) 411; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 525; F.-VILL. Nov. App. (1880) 39; VIDAL, Sinopsis (1883) 19; Rev. Pl. Vasc. Filip. (1886) 79; Phan. Cuming. (1895) 101; BACKER, Schoolfl. (1911) 194. — *G. sumatrana* JACK, Mal. Misc. 1, 5 (1821) 29; in Hook. Bot. Misc. 2 (1830) 77; PLANCH. in Hook. Ic. Pl. II, 4 (1845) t. 712; in Hook. Lond. J. Bot. 6 (1847) 2; MIQ. Fl. Ind. Bat. 1, 2 (1859) 675; Sumatra (1860) 209, 534; SCHEFF. Nat. Tijd. N. I. 32 (1873) 411; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 525, *err.* '*sumatrensis*'; KING, J. As. Soc. Beng. 62, ii (1893) 232; RIDL. Trans. Linn. Soc. II, Bot. 3 (1893) 285; Fl. Mal. Pen. 1 (1922) 365; RENDLE, J. Bot. (1924) Suppl. 16; RIDL. Kew Bull. (1925) 79; Fl. Mal. Pen. 5 (1925) 296; MERR. J. Arn. Arb. 33 (1952) 226. — *Ouratea angustifolia* (VAHL) BAILL. *ex* LANESS. Pl. Util. Col. Fr. (1886) 607; KOORD. Exk. Fl. Java 2 (1912) 107; HALL. *f.* Beih. Bot. Centralbl. 34, 2 (1916) 34; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 387; En. Philip. 3 (1923) 68; RIDL. Kew Bull. (1930) 76. — *Ochna angustifolia* (VAHL) O.K. Rev. Gen. Pl. 1 (1891) 106. — *Ochna sumatrana* (JACK) O.K. *l.c.* 106. — *Ouratea sumatrana* (JACK) GILG in E. & P. Nat. Pfl. Fam. 3, 6 (1895) 142; BARTELL. Malpighia 15 (1901) 160; HALL. *f.* Beih. Bot. Centralbl. 34, 2 (1916) 35; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 387; RIDL. Kew Bull. (1930) 76. — *Ouratea borneensis* BARTELL. Malpighia 15 (1901) 156, t. 6; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 387; RIDL. Kew Bull. (1930) 76. — *Ouratea neriifolia* BARTELL. Malpighia 15 (1901) 158, t. 7, *sphalm.* '*neerifolia*'; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 387; AIRY SHAW, Kew Bull. (1940) 249. — *Ouratea beccariana* BARTELL. Malpighia 15 (1901) 159, t. 9; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 387; AIRY SHAW, Kew Bull. (1940) 249. — *Campylospermum sumatranum* (JACK) TIEGH. in Morot, J. Bot. 16 (1902) 197; Ann. Sc. Nat. Bot. VIII, 16 (1902) 298; *ibid.* 18 (1903) 21. — *Campylospermum borneense* (BARTELL.) TIEGH. in Morot, J. Bot. 16 (1902) 197; Ann. Sc. Nat. Bot. VIII, 16 (1902) 301. — *Campylospermum beccarianum* (BARTELL.) TIEGH. Ann. Sc. Nat. Bot. VIII, 16 (1902) 301. — *Campylocercum neriifolium* (BARTELL.) TIEGH. *l.c.* 304. — *Campylocercum*

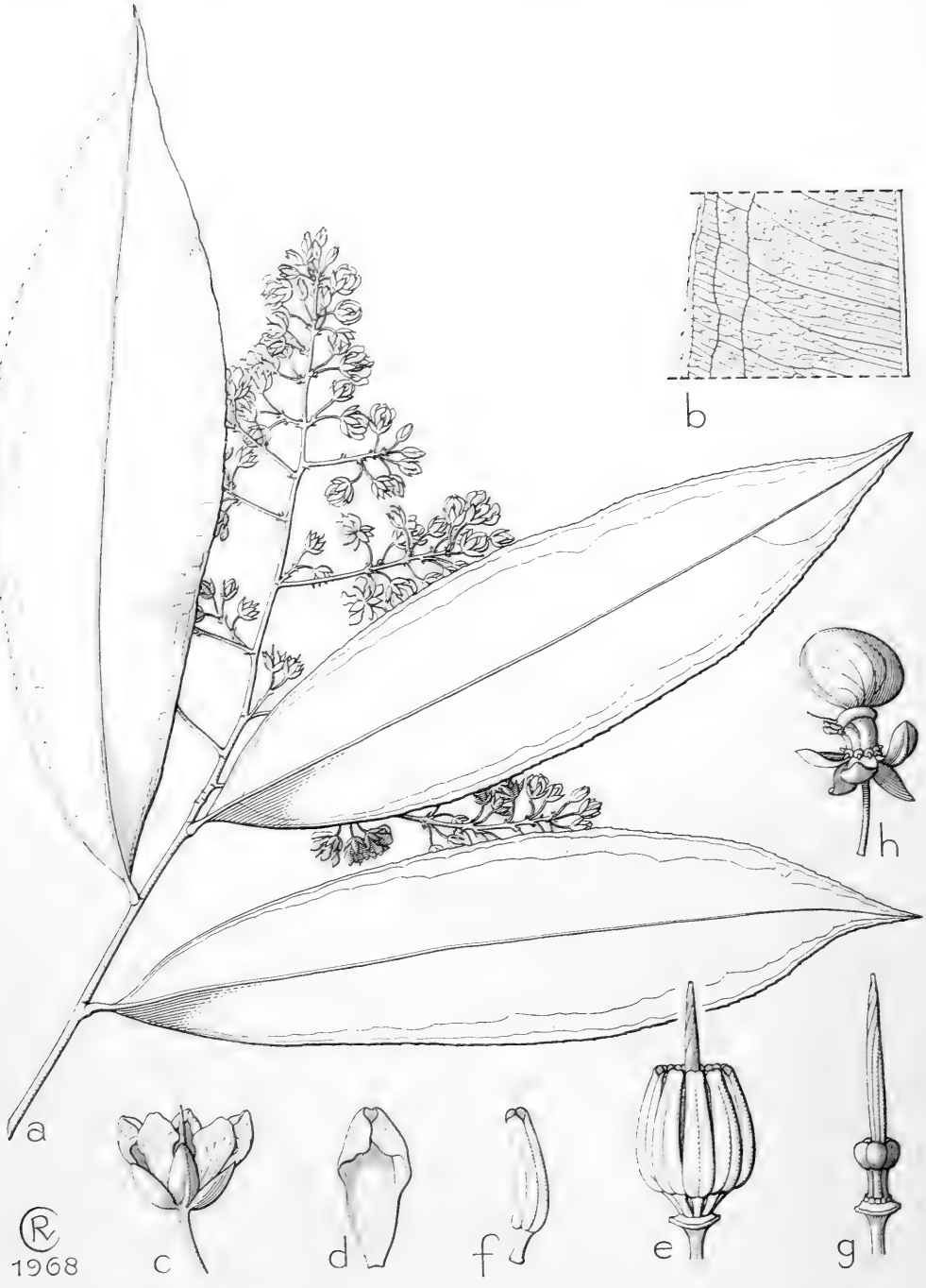

Fig. 3. *Gomphia serrata* (GAERTN.) KANIS. *a*. Flowering twig, ×⅔, *b*. part of leaf, ×1⅓, *c*. flower, ×2, *d*. petal, ×4, *e*. flower, sepals and petals removed, *f*. stamen, abaxial view, *g*. gynoecium with gynophore, all ×6, *h*. fruiting flower, ×2 (*a–g* AMPURIA 41444, *h* SAN 25040).

zollingeri TIEGH. *l.c.* 305. — *Campylospermum wallichianum* TIEGH. Bull. Mus. Hist. Nat. Paris 9 (1903) 76; Ann. Sc. Nat. Bot. VIII, 18 (1903) 17. — *Campylospermum plicatum* TIEGH. Bull. *l.c.* 78; Ann. *l.c.* 19. — *Campylospermum strictum* TIEGH. Bull. *l.c.* 79; Ann. *l.c.* 20. — *Campylospermum kingii* TIEGH. Bull. *l.c.* 79; Ann. *l.c.* 21. — *Campylospermum perakense* TIEGH. Bull. *l.c.* 80; Ann. *l.c.* 21. — *Campylospermum abbreviatum* TIEGH. Bull. *l.c.* 80; Ann. *l.c.* 21. — *Campylospermum cumingii* TIEGH. Bull. *l.c.* 80; Ann. *l.c.* 22. — *G. microphylla* RIDL. Fl. Mal. Pen. 1 (1922) 365, f. 38. — *G. oblongifolia* RIDL. Kew Bull. (1925) 281; Fl. Mal. Pen. 5 (1925) 296. — *Ouratea arcta* CRAIB, Kew Bull. (1926) 341; BACKER & BAKH. *f.* Fl. Java 1 (1963) 327. — *Ouratea megacarpa* RIDL. Kew Bull. (1930) 76. — *Ouratea microphylla* (RIDL.) CRAIB, Fl. Siam. En. 1 (1931) 245. — *Ouratea sumatrana* (JACK) GILG *var. nervosa* CRAIB, *l.c.* 245. — *Ouratea crocea* (GRIFF.) BURK. Kew Bull. (1935) 318, *p.p. excl. typ.* — **Fig. 3.**

Shrub or tree, up to 25 m, 40 cm ø. Branchlets of young plants sometimes scrambling. *Leaves* ovate- to obovate-lanceolate, 6–20 by 2–6 cm (up to 35 by 10 cm in young plants), chartaceous, mostly acute to acuminate, sometimes obtuse at apex, acute or a little tapering at base, margin finely denticulate; petiole 2½–7½ mm. *Inflorescences* many-flowered; rachis (2½–)5–20(–35) cm, primary branches of terminal inflorescences usually up to 10(–15) cm long, secondary branches or primary ones of lateral inflorescences usually reduced or up to 1 cm long, cymose, with (1–) 3–7(–∞), ± conferted flowers; pedicels ½–¾ cm, up to 1 cm in fruit. *Torus* 0.7–1 mm high, 0.7–1 mm ø, in fruit up to 5 mm high, 5 mm ø. *Sepals* mostly ovate to elliptic, sometimes obovate, 4–7 by 2½–4 mm, mostly acute to obtuse, sometimes rounded. *Petals* obliquely obovate to broad-spatulate, 4½–8 by 2½–6 mm, obtuse, rounded or truncate, mostly yellow, sometimes creamy or white. *Stamens* subsessile or with up to ½ mm long filaments; anthers 2½–5(–6) by 0.5–0.8 mm. *Ovaries* 0.7–1 by 0.4–0.6 mm; style 3–5 mm long, up to 7 mm in fruit; stigma minute. *Fruits* up to 8(–10) by 6(–8) mm.

Distr. SW. Peninsular India, Ceylon, E. Thailand, Indo-China, Hainan; in *Malesia*: Sumatra, Banka, Malay Peninsula, Karimundjawa Is., Borneo, Philippines, and Celebes.

Ecol. From sea-level up to 1200 m, up to 1500 m on Mt Kinabalu, in primary and secondary vegetation: lowland and submontane, mixed Dipterocarp forests, peat swamp forests, high kerangas forests, ridge forests, and open scrub vegetation; on level land to steep slopes, also near river-banks and on cliffs near the sea. Soils are rocky, sandy, loamy or clayish, but usually acid; limestone is reported occasionally, but it is very probable that the soils in the localities concerned have been leached out.

The flower buds are often galled by unidentified insects, especially in the Malay Peninsula, Sumatra, and the smaller islands east of Sumatra. These buds are about ovoid, with small sepals and petals somewhat sunken in an enlarged torus, whereas gynoecium and androecium are strongly suppressed.

Ripe fruits in normal flowers are often empty, which is probably also caused by insect damage, as perforations of the pericarp are sometimes clearly visible. It is recorded once that ants did attack a collector's press for these fruits (CLEMENS, Indo-China). Seeds are rare in herbarium specimens of Malesian collections.

Uses. The wood is reported as being used as poles or planks for the construction of houses in Ceylon, Vietnam, Sumatra, Malay Peninsula, and Sarawak. The leaves are chewed by jungle tribes in Malaya. Roots and leaves are bitter and are decocted in S. India for a stomachic and antiemetic tonic. Young branches are used against tooth-ache in Cambodia.

Properties of wood: dull red or red-brown, hard and strong, apt to split in drying.

Vern. Sumatra, North: *kaju ndolak*, Batak; West: *kalèk djambak*, *sébalusi*, Minangkabau; South: *kaju mat*, *k. sépah*, *lakodjong*, *madjang madjang*; Banka: *méntungging*, *mésulung putih*; Mal. Pen., Thailand: *tong pling*; Malaya: *bunga kélimbing bésí*, *chinta mula*, *lidah mura*, *mata kétam batu*, *mémbatu*, *ménarah*, *méndapor*, *méramong*, *murmagong*, *pénarah*, *péngling*, *pokok lébah*, *p. luas*, *tampang bésí*; several compound names were recorded occasionally with *géronggang* (= *Cratoxylon*), *jambu* and *kélat* (= *Eugenia*); Borneo, Sarawak: *kéladang*, *kélutak*, Iban, *aam*, Kenyah; compound names with *ubah* or *ubar* (= *Eugenia*) were recorded occasionally; Brunei: *chénaga lampong*, Iban, *pinis*, Malay; Sabah: *majang majang*, *quintalai*, Kadazan, *antimagas gimbaan*, Murut, *kolambang*, Rungus Dusun, *posoon*, *tulangkara*, Kinabatangan, *alas*, *tampalanuk*, Tidong, *bakan bitanag*, *biobi*, *malatangor*, *ondogong*, Malay; West Borneo: *mélindingan*, Dayak; East Borneo: *amir burgang*, Dayak, *batu batu*, *mulak*, *téngkédjing kéring*, Malay; Philip., Palawan: *anduyong*, *bibingo*, *huisac*; Luzon: *salactoc*, Zambales, *simahima*, Bicol, *sasahit*, Tagalog; Visayas: *bulocauan*, *caranan*, Panay, *minsaray*, Mindoro; Celebes: *lébani*, *parasinga tjila*, Bugi, *mampa*, Rangkas, *morosisio*, *wulisi mapute*, Tobela.

Notes. As this species grows under rather different ecological conditions, the variation in its morphological characters is not surprising. Apart from these variations, some geographically more or less separated 'races' can be recognized. This is the reason why in certain Floras two or three different species have been recognized although the distinctive characters can hardly be used at a specific level. Over a large area it is impossible to make a key to these 'races', because the same differences occur in remote parts of the specific area. In Sumatra and the Malay Peninsula plants are relatively uniform, the greatest variation occurring in Borneo, especially in Sarawak. In more exposed habitats, on cliffs and on poor kerangas soils, specimens often have small leaves. On

limestone in the Langkawi Islands a race '*microphylla*' is found with small leaves and very reduced inflorescences. Similar, but less reduced forms are found elsewhere along the coasts of the Malay Peninsula.

Excluded

Gomphia magnoliaefolia ZIPP. *ex* SPAN. Linnaea 15 (1841) 186, *nom. nud.* = *Pycnarrhena longifolia* (DECNE) BECC. (*Menispermaceae*), *fide* DIELS, Pflanzenreich, Heft 46 (1910) 51.

4. EUTHEMIS

JACK, Mal. Misc. 1, 5 (1821) 15; KANIS, Blumea 16 (1968) 62. — **Fig. 4.**

Shrubs or shrublets, sparsely branched. Stipules free, caducous. *Leaves* coriaceous, glabrous, denticulate, nerves numerous, parallel, from the midrib curving sidewards, straightly ascending to the marginal veins at an angle of *c.* 80°; petiole ± winged. *Inflorescences* terminal, many-flowered, compound racemes; bracts small, caducous. *Flowers* ☿ or polygamous. *Sepals* 5, turning purplish red in fruit. *Petals* 5, white or pinkish. *Staminodes* 0(–5), filamentous. *Stamens* 5, free; anthers subsessile, rostrate. *Ovary* 5-celled; ovules 2 per cell, pendulous, axile; stigma minute. *Fruit* a berry with 5 pyrenes. *Seeds* 1 (2) per cell.

Distr. SW. Cambodia, in *Malesia*: Sumatra, Malay Peninsula, Borneo.

Ecol. Everwet tropical forest below 1250 m, in kerangas forests, on low ridges in peat-swamp forests, and in open ridge forests, on poor, mostly sandy soils. Dispersal probably by birds because of conspicuous, white, rose-pink or red berries (RIDLEY, Disp. 1930, 410).

KEY TO THE SPECIES

1. Inflorescence a panicle, branches well developed with scattered flowers. Leaves 8–40 cm long, margin distinctly denticulate. Mature fruit white. . . . . **1. E. leucocarpa**
1. Inflorescence a very slender, often cernuous raceme, nearly all branches reduced with conferted flowers. Leaves 4–15 cm long, margin faintly denticulate. Mature fruit red. . . . . **2. E. minor**

1. Euthemis leucocarpa JACK, Mal. Misc. 1, 5 (1821) 16; WALL. in Roxb. Fl. Ind. 2 (1824) 303; JACK in Hook. Bot. Misc. 2 (1830) 69; PLANCH. in Hook. Ic. Pl. II, 4 (1845) t. 711; MIQ. Fl. Ind. Bat. 1, 2 (1859) 675; Sumatra (1860) 208, 533, *incl. var. latifolia*; SCHEFF. Nat. Tijd. N. I. 32 (1873) 411; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 526; KING, J. As. Soc. Beng. 62, ii (1893) 234; RIDL. Trans. Linn. Soc. II, Bot. 3 (1893) 285; BARTELL. Malpighia 15 (1901) 167; HALL. *f.* Beih. Bot. Centralbl. 34, 2 (1917) 30; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 388; RIDL. Fl. Mal. Pen. 1 (1922) 368; DIELS, Bot. Jahrb. 60 (1926) 311; BURK. Dict. 1 (1935) 987; AIRY SHAW, Kew Bull. (1940) 249; MERR. J. Arn. Arb. 33 (1952) 224; VIDAL, Adansonia 1 (1961) 60; KANIS, Blumea 16 (1968) 62; Fl. Thail. 2 (1970) 29. — *E. robusta* HOOK. *f.* Trans. Linn. Soc. 23 (1862) 163; BARTELL. Malpighia 15 (1901) 168; HALL. *f.* Beih. Bot. Centralbl. 34, 2 (1917) 32; RIDL. Fl. Mal. Pen. 1 (1922) 368.

Shrub up to 6 m. Branchlets stout, green. Stipules ovate, 4–6 by *c.* 2 mm, acute to acuminate, ciliate. *Leaves* oblong to linear oblong, 8–40 by 2–10 cm, acute at apex, tapering at base, margin distinctly and irregularly denticulate, nerves 1–2 mm apart; petiole 2–5 cm. *Panicles* erect, 8–20 cm; pedicels 4–10 mm, articulate at base; bracts 8–10 by 2–4 mm, lanceolate, acute. *Flowers* ☿, erect, often in pairs. *Sepals* obliquely ovate to elliptic, unequal, 4–7 by 2–3½ mm, ciliate. *Petals* obliquely obovate to spatulate, 4–10 by 2½–5 mm. *Anthers* 3–5 by *c.* 1 mm, yellow. *Ovary* ovoid to bottle-shaped, 2–4 by *c.* 1 mm, style 1½–3 mm. *Fruit* globular, up to 1 cm ø, fleshy, via red turning white. *Seeds* like sectors of a sphere, *c.* 4 by 2 mm.

Distr. SW. Cambodia; in *Malesia*: Sumatra, Riouw & Lingga Is., Banka, Billiton, Malay Peninsula, Anambas Is., Borneo.

Ecol. From sea-level up to 1000 m, on poor soils, preferably in moist, shady places (see also under the genus).

Uses. Medical applications of the roots is reported from Malaya. In Brunei the fruits are used against eye-diseases.

Vern. Sumatra: *bělusung putih, kaju padang, mata pělanduk*, Banka; *balong*, Billiton; Malaya: *pělawan bĕrok*; Borneo: *tambu*, Sarawak, *ranggas hutan*, Sabah, *iur iur*, W. Borneo.

2. Euthemis minor JACK, Mal. Misc. 1, 5 (1821) 18; WALL. in Roxb. Fl. Ind. 2 (1824) 304; JACK in Hook. Bot. Misc. 2 (1830) 69; MIQ. Fl. Ind. Bat. 1, 2 (1859) 675; Sumatra (1860) 209, 534; SCHEFF. Nat. Tijd. N. I. 32 (1873) 412; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 526; KING, J. As. Soc. Beng. 62, ii (1893) 235; BARTELL. Malpighia 15

Fig. 4. *Euthemis minor* JACK. *a.* Fertile twig, ×⅔, *b.* detail of leaf margin, ×4, *c.* flowerbud, *d.* open ♂ flower, both ×4, *e. ditto*, stamen, ad- and abaxial view, *f. ditto*, reduced pistil, both ×6, *g.* pistil of ♀ or ☿ flower, ×4, *h.* fruit, ×2, *i.* seed, ×4 (*a–c* MEIJER 21807, *d–f* KOSTERMANS & ANTA 1256, *g* Hans WINKLER 1421, *h–i* HALLIER *f.* 1445).

(1901) 168; RIDL. J. Str. Br. R. As. Soc. *n.* 54 (1910) 34; HALL. *f.* Beih. Bot. Centralbl. 34, 2 (1917) 32; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 388; RIDL. Fl. Mal. Pen. 1 (1922) 368; AIRY SHAW, Kew Bull. (1940) 250; MERR. J. Arn. Arb. 33 (1952) 224; KANIS, Blumea 16 (1968) 65. — *E. obtusifolia* HOOK. *f.* Trans. Linn. Soc. 23 (1862) 163; BARTELL. Malpighia 15 (1901) 169; HALL. *f.* Beih. Bot. Centralbl. 34, 2 (1917) 33; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 389; AIRY SHAW, Kew Bull. (1940) 250. — *E. engleri* GILG in E. & P. Nat. Pfl. Fam. 3, 6 (1895) 152, f. 78; BARTELL. Malpighia 15 (1901) 169; HALL. *f.* BEIH. Bot. Centralbl. 34, 2 (1917) 33; AIRY SHAW, Kew Bull. (1940) 250. — *E. ciliata* PEARSON, Kew Bull. (1906) 3; HALL. *f.* Beih. Bot. Centralbl. 34, 2 (1917) 33. — *E. hackenbergii* DIELS, Bot. Jahrb. 60 (1926) 310; AIRY SHAW, Kew Bull. (1940) 250. — **Fig. 4.**

Shrublet up to 3(–5?) m. Branchlets slender, blackish. Stipules *c.* 3 by 1 mm, acuminate, serrulate. *Leaves* oblong to oblanceolate, 4–15 by 1½–4 cm, obtuse at apex, mucronate, tapering at base, margin faintly denticulate, nerves *c.* 1 mm apart; petiole to 1½ cm. *Racemes* lax, 5–30 cm long, often pseudolateral, sometimes drooping, rachis slender, branches ± shortened; bracts on the rachis 5–12 by 1–2 mm, caducous, on branches trigonous, *c.* 1 mm long, acuminate. *Flowers* functionally polygamous, complete, often 2 or more conferted. *Sepals* obovate, unequal, 4–4½ by 2½–3½ mm, ciliate near the apex, acuminate. *Petals* lanceolate, 6–8 by 2½–3 mm, distinctly reflexed in ♂ flowers. *Anthers* 3½–4½ by *c.* 1 mm, yellow. *Ovary* in ♀ or ☿ flowers obovoid, 5-ribbed, *c.* 2½ by 1⅓ mm; style *c.* 2½ mm long, widening into the ovary; ovary in ♂ flowers very much reduced, depressed-globular, shallowly 5-lobed, *c.* 0.2 by 0.4 mm; style *c.* 0.2 mm, broadly conical at base. *Fruit* globular, up to 6 mm ø, acuminate, 5-ribbed, red. *Seeds* semi-annular, *c.* 4 by 2½ mm.

Distr. *Malesia*: Central E. Sumatra, Riouw & Lingga Is., Banka, Billiton, S. Malay Peninsula (?), Borneo.

Ecol. From sea-level up to 1250 m, often found with the previous species, but generally in drier and more exposed places (see also under the genus).

Vern. Sumatra: *bělusung mèrah*, *kětjing pělanduk*, Banka; Borneo: *buah itěk*, Sarawak, *pětikawo*, Sabah, Kedayan, *mata pělandok*, W. Borneo.

Notes. Many specimens are doubtlessly functionally male. I am not certain whether fruiting specimens generally have bisexual or functionally female flowers, but these possibilities are probably both realised.

This species was never recorded from the mainland of the Malay Peninsula. Three older collections are known to me from Singapore I., where it is probably now extinct.

5. NECKIA

KORTH. Ned. Kruidk. Arch. 1 (1848) 358; KANIS, Blumea 16 (1968) 69. — **Fig. 5.**

Shrublets or undershrubs. Stipules pectinate. *Leaves* with short petioles, nerves ascending at an angle of 70–80°, slightly curved. *Inflorescences* axillary, much reduced, the rachis bearing some small bracts, but only 1 terminal flower; pedicels articulate. *Flowers* ☿, 5-merous. *Staminodes* ∽, of 2 types, the inner ones forming a tube at base. *Stamens* adnate to the tube. *Ovary* 3-carpelled; stigma 1. Style of ripe fruit splitting into 3 parts. *Seeds* not winged.

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

1. Neckia serrata KORTH. Ned. Kruidk. Arch. 1 (1848) 358; MIQ. Fl. Ind. Bat. 1, 2 (1859) 118; Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 218; BOERL. & KOORD. Ic. Bog. 1, 4 (1901) 1, t. 76; RIDL. J. Str. Br. R. As. Soc. *n.* 49 (1908) 13, 14; MERR. *ibid. n.* 86 (1921) 388; KANIS, Blumea 16 (1968) 69. — *N. lancifolia* HOOK. *f.* Trans. Linn. Soc. 23 (1862) 158; RIDL. J. Str. Br. R. As. Soc. *n.* 49 (1908) 13; AIRY SHAW, Kew Bull. (1940) 252, *incl. f. major* (RIDL.) AIRY SHAW. — *N. humilis* HOOK. *f.* Trans. Linn. Soc. 23 (1862) 159; RIDL. J. Str. Br. R. As. Soc. *n.* 49 (1908) 14. — *N. malayana* RIDL. *l.c.* 11, *incl. var. angustifolia* RIDL.; Fl. Mal. Pen. 1 (1922) 134, f. 13, *incl. f. major* RIDL. *et f. minor* RIDL. — *N. distans* RIDL. J. Str. Br. R. As. Soc. *n.* 49 (1908) 12; MERR. *ibid. n.* 86 (1921) 388; AIRY SHAW, Kew Bull. (1940) 250. — *N. klossii* RIDL. J. Str. Br. R. As. Soc. *n.* 49 (1908) 13; AIRY SHAW, Kew Bull. (1940) 251, *incl. var. borneensis* AIRY SHAW. — *N. parviflora* RIDL. J. Str. Br. R. As. Soc. *n.* 49 (1908) 14; MERR. *ibid. n.* 86 (1921) 388. — *N. ovalifolia* CAPIT. Bull. Soc. Bot. Fr. 57 (1910) 397, t. 13; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 388; AIRY SHAW, Kew Bull. (1940) 252. — *Sauvagesia jaheriana* CAPIT. Bull. Soc. Bot. Fr. 57 (1910) 397, t. 13; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 388. — *N. grandifolia* RIDL. Kew Bull. (1925) 77. — *N. obovata* AIRY SHAW, Kew Bull. (1940) 251. — *N. philippinensis* MERR. & QUIS. Philip. J. Sc. 82 (1954) 329, t. 2. — **Fig. 5.**

Shrublet up to 1 m, often much smaller, often unbranched. Stipules compound, 1–3 mm wide, the segments unequal, acicular, ½–1 cm long,

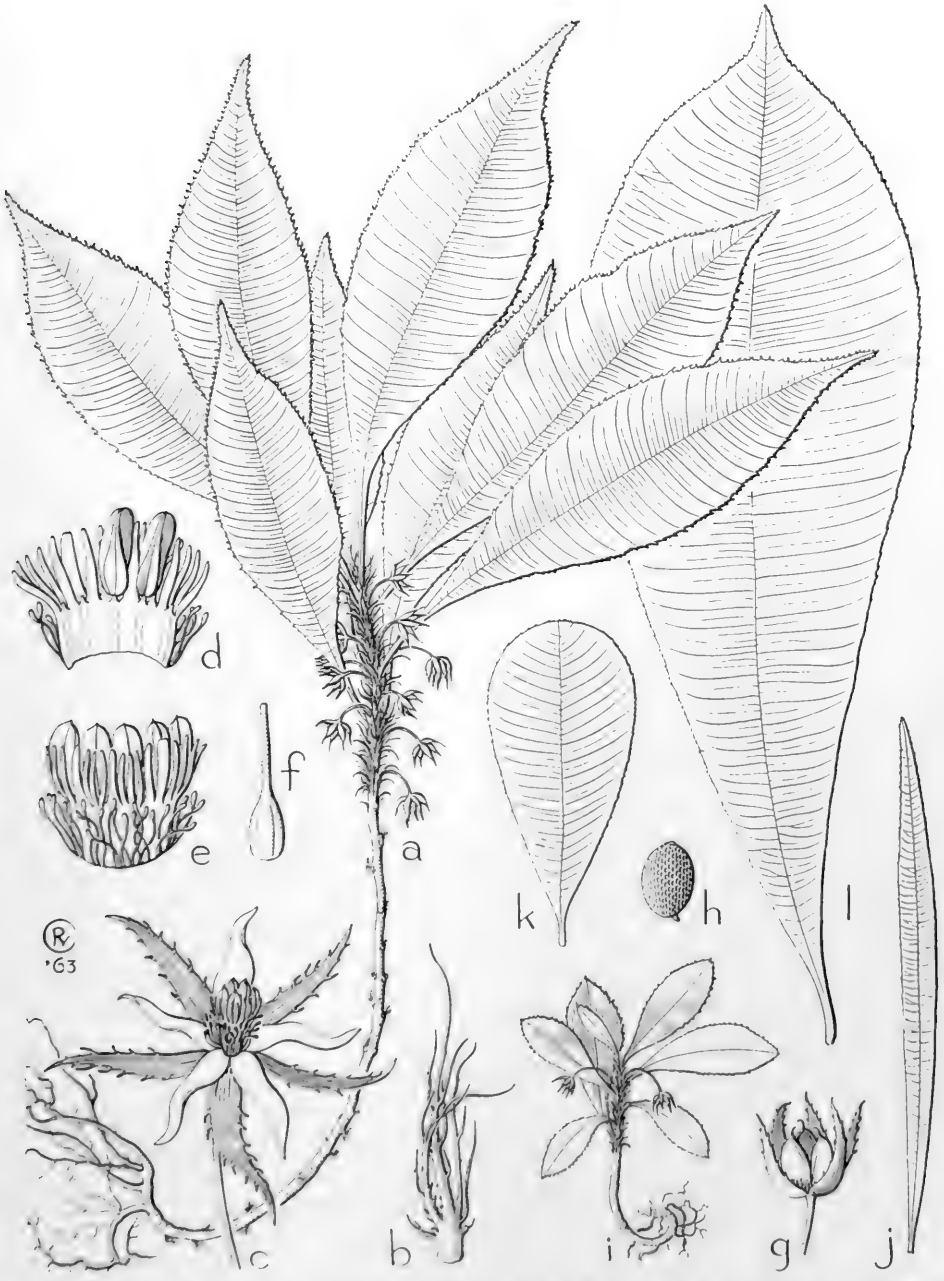

Fig. 5. *Neckia serrata* KORTH. *a.* Habit, ×⅔, *b.* stipule, ×4, *c.* flower, ×4, *d.* androecium, inner view of opened tube, 3 anthers removed, *e. ditto*, outer view, complete, both ×8, *f.* pistil, ×6, *g.* fruit, ×2, *h.* seed, ×20, *i.* habit of a dwarfed form, ×⅔, *j.* leaf of a narrow type, ×⅔, *k.* leaf of a rounded type, ×⅔, *l.* leaf of a large type, ×⅔ (*a–f* MEIJER 6854, *g–h* BROOKE 9613, *i* KOSTERMANS 9087, *j* BROOKE 10610, *k* BROOKE 10006, *l* POSTHUMUS 600).

lacerate. *Leaves* obovate to long obovate-lanceolate, 3–15(–25) by ¾–2½(–7½) cm, mostly acute to acuminate, sometimes obtuse, tapering at base, biserrulate, membranous to chartaceous, nerves 1½–3 mm apart. *Inflorescences* with filiform rachis, 1–5 cm; bracts up to 10, linear, *c.* 2 mm; sometimes with small stipules; pedicels filiform 8–15 mm. *Flowers* pendulous. *Sepals* lanceolate, 4–7½ by 1–3 mm, acute, margins dentate. *Petals* elliptic, 2½–5 by 1¼–2 mm. Outer *staminodes* ∞, unequal, long spatulate or gland-like, ¼–1 mm long; inner staminodes 15–25, 1–1¾ mm long, ± half connate, the free lobes spatulate, the 5 lobes alternating with the stamens longer. *Stamens* with terete filaments, the free part up to 1 mm; anthers lanceolate, 1–1½ by *c.* ½ mm, yellow. *Ovary* ovoid, 1–1.2 by 0.5–0.6 mm, style *c.* 1 mm long; stigma clavate. *Fruit* subtrigonous in cross-section, *c.* 5 by 2½ mm. *Seeds* ellipsoid, *c.* 0.5 by 0.3 mm, areolate.

Distr. *Malesia*: Sumatra, Mentawei Is., Riouw & Lingga Is., SE. Malay Peninsula (S. Trengganu, Pahang, Johore), Borneo, and Philippines (Samar). Monotypic.

Ecol. Found up to 1200 m, in moist, shady places in kerangas forests as well as in richer rainforests, especially on boulders, cliffs and wet slopes, along brooklets and small rivers, sometimes near waterfalls or subject to occasional inundation. Soils are reported as sandstone, acid sand, sandy loam, loam, or tuff.

Notes. The variability in shape and size of this species must primarily be due to variation in ecological conditions. The plants need moist, shady places and will be capable to germinate and to produce a few flowers even while growing in a moss carpet over boulders. The smaller specimens are dwarfed by lack of nutrition. Shade, water-supply, occasional inundation, or other ecological circumstances may also exert influence upon the habit of the plants.

There will probably be genetic differences between local populations, but it seems impracticable to distinguish infra-specific taxa, since no useful differences are found in the geographical distribution of morphological characters. The greatest variability is found among Bornean specimens, whereas the plants with the largest leaves are found in Sumatra.

6. INDOVETHIA

BOERL. Feestbundel P. J. Veth (1894) 89; Ic. Bog. 1 (1897) 9; KANIS, Blumea 16 (1968) 72. — **Fig. 6.**

Shrublets. Stipules pectinate. *Leaves* subsessile, nerves ascending at an angle of 60–70°, slightly curved. *Inflorescences* terminal, many-flowered, compound racemes; mostly some lower branches well developed, the other ones much shortened with a few flowers; bracts small. *Flowers* ☿. *Sepals* 5. *Petals* 5, white. *Staminodes* 10 in 2 alternating whorls, mutually and with the stamens connate at base. *Ovary* 3-carpelled; stigma 1. Style of ripe fruits splitting into 3 parts. *Seeds* not winged.

Distr. *Malesia*: Central E. Sumatra and NW. Borneo. Monotypic.

1. Indovethia calophylla BOERL. Feestbundel P. J. Veth (1894) 90, plate; Ic. Bog. 1 (1897) 10, t. 1; BARTELL. Malpighia 15 (1901) 173; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 388; KANIS, Blumea 16 (1968) 72. — *I. beccariana* BARTELL. Malpighia 15 (1901) 172, t. 11; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 388. — **Fig. 6.**

Shrublet *c.* 1 m. Stipules compound, the segments unequal, lanceolate, 5–10 by 2–4 mm, margin lacerate. *Leaves* oblanceolate, 10–35 by 2½–8½ cm, acute to acuminate at apex, tapering at base, biserrulate, membranous, stouter nerves 3–7½ mm apart. *Inflorescences* 5–20 cm long; rachis *c.* 2 mm ø; pedicels filiform, mostly short, up to 12 mm when fruiting; bracts with small stipules, lanceolate, the lower ones up to 8 by 2 mm, the higher ones smaller, shortly pubescent underneath. *Flowers* erect. *Sepals* suborbicular to obovate, 3½–5 by 3–3½ mm, margins denticulate. *Petals* obovate, 3–4 by 2–3 mm. *Staminodes* spatulate, those opposite to the stamens 1¾–2½ by *c.* ¾ mm, with 3 ± distinct, parallel nerves, the alternating ones 1½–2 by *c.* ½ mm, with 1 distinct nerve. *Stamens* with flattened filaments 0.2–0.4 mm long; anthers 1¼–1¾ by 0.5–0.8 mm, the anther-cells basally separated by the cuneate connective provided with a *c.* ½ mm long mucro. *Ovary* subglobose, *c.* 1 mm ø; style *c.* 1 mm long; stigma minute, trigonous. *Fruit* subglobose, up to 12 mm ø, papillate. *Seeds c.* 0.8 by 0.2 mm, areolate.

Distr. *Malesia*: Central E. Sumatra (Riouw Prov.), NW. Borneo (Sarawak, 1st Div.; W. Borneo, NE. of Pontianak).

Ecol. A rare, local lowland species, reported from moist, shady places, in primary or secondary (Dipterocarp) forests, on richer (loamy) soils. Occasionally reported from the edge of a lake and above a torrent in the forest. Also once collected under rubber.

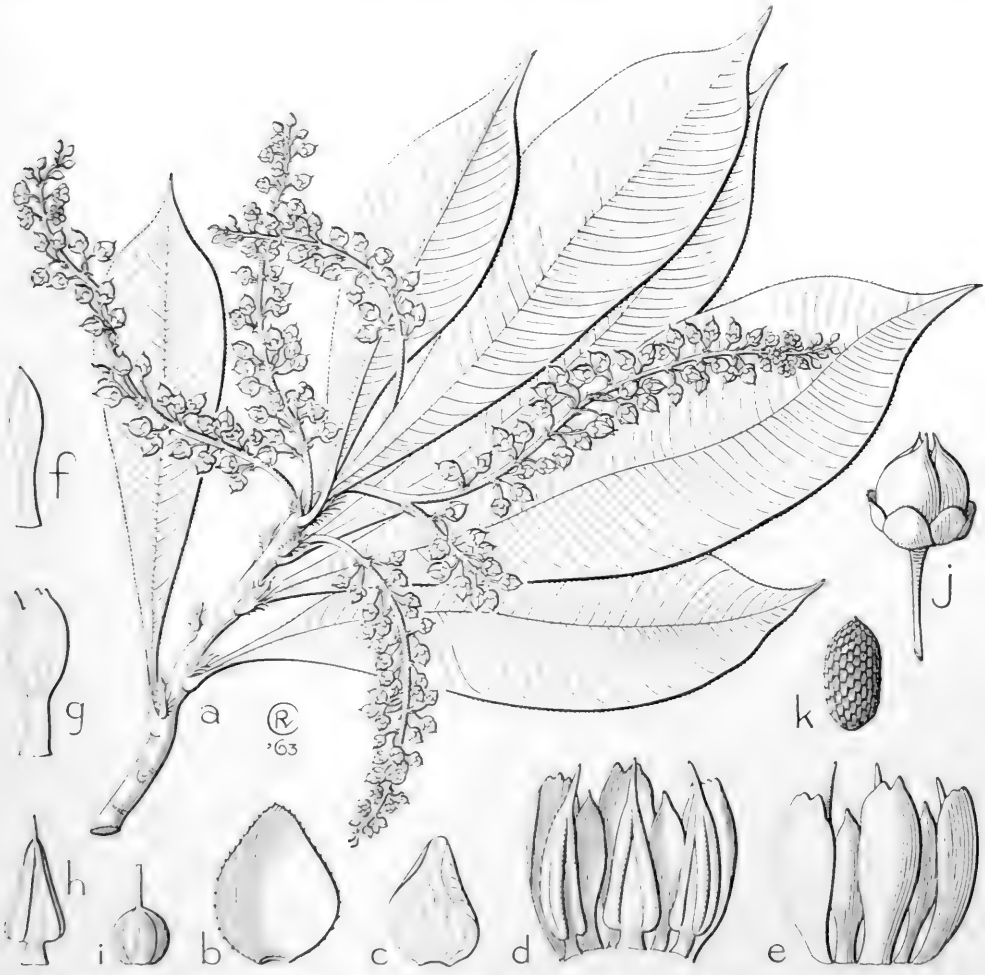

Fig. 6. *Indovethia calophylla* BOERL. *a.* Fertile twig, ×⅓, *b.* sepal from bud, *c. ditto*, petal, both ×6, *d. ditto*, part of androecium, inner view, *e. ditto*, outer view, both ×20, *f.* inner staminode from flower, *g. ditto*, outer staminode, *h. ditto*, stamen, *i. ditto*, pistil, all ×6, *j.* fruit, ×2, *k.* seed, ×10 (*a* after Ic. Bog. 1, t. 1, *b–g* BUWALDA 6256, *h–j* TEYSMANN HB 10893, *k* BROOKE 9455).

7. SCHUURMANSIELLA

HALL. *f.* Rec. Trav. Bot. Néerl. 10 (1913) 344; KANIS, Blumea 16 (1968) 73. — **Fig. 7.**

Shrubs with slender branchlets. Stipules acicular. *Leaves* short-petioled, nerves ascending at an angle of *c.* 80°. *Inflorescences* terminal, many-flowered, compound racemes; branches much shortened, with flowers of successive age; bracts small, those of one branch conferted. *Flowers* ☿. *Sepals* 5. *Petals* 5, white or pinkish, purplish at base, in anthesis soon surpassing the sepals in size. *Staminodes* ∽, of 2 types, the inner ones mutually and with the stamens connate at base. *Ovary* 3-carpelled; stigma 1. Style of ripe fruits also splitting into 3 parts. *Seeds* not winged.

Distr. *Malesia*: NW. Borneo. Monotypic.

Fig. 7. *Schuurmansiella angustifolia* (HOOK. *f.*) HALL. *f. a.* Fertile twig, ×⅔, *b.* flowerbud, ×4, *c.* flower, petals shed, ×4, *d.* part of androecium, inner view, ×6, *e.* pistil, ×8, *f.* fruit, *g.* open fruit, both ×2, *h.* seed, ×6 (*a–f* ABANG MUAS 5139, *g* ANDERSON 8368, *h* BUJANG 12990).

1. Schuurmansiella angustifolia (HOOK. *f.*) HALL. *f.* Rec. Trav. Bot. Néerl. 10 (1913) 345, t. 7; MERR. J. Str. Br. R. As. Soc. *n.* 86 (1921) 387; KANIS, Blumea 16 (1968) 73. — *Schuurmansia angustifolia* HOOK. *f.* Trans. Linn. Soc. 23 (1862) 157. — **Fig. 7.**

Shrub up to 7 m high. Stipules up to 12 by *c.* ½ mm. *Leaves* linear-oblong, 8–17 by ¾–1½ cm, long acuminate at apex, ± tapering at base, chartaceous, margin serrulate, nerves ½–1 mm apart. *Inflorescences c.* 15 cm long; rachis *c.* 1 mm ø; branches with up to 5 flowers; pedicels filiform, up to 12 mm in fruit; bracts acicular, 2–3 mm under the branches, smaller at base of pedicels. *Flowers*

erect. *Sepals* ± linguiform, 1–1¼ by ¾–1 mm. *Petals* ovate, 3½–4½ by 1¾–2¼ mm, distinctly reflexed. Outer *staminodes* ∞, small; inner ones 25–30, linear, 2–3 mm, purplish. *Stamens* with flattened filaments ½–1 mm long, purplish; anthers lanceolate, 1½'–2½ by 0.3–0.6 mm. *Ovary* ovoid, *c.* 1.2 by 0.7 mm; style *c.* 0.3 mm, purplish; stigma capitate. *Fruit* ellipsoid, subtrigonous in cross-section, *c.* 8½ by 3 mm. *Seeds* 0.5–1 by 0.2–0.5 mm, tomentose.

Distr. *Malesia*: NW. Borneo (Sarawak, 1st and 4th Div.).

Ecol. A lowland species, reported from up to 600 m, in moist places, especially in kerangas forests on poor soils, and on sandstone cliffs, even near the sea.

8. SCHUURMANSIA

BLUME, Mus. Bot. Lugd. Bat. 1 (1850) 177, t. 32; KANIS, Nova Guinea, Bot. 6 (1961) 63; Blumea 16 (1968) 74. — **Fig. 8–10.**

Trees or treelets with stout, often hollow branches. Stipules entire. *Leaves* conferted at intervals (fig. 10), glandular along the margins, nerves almost straightly ascending at an angle of 60–70°. *Inflorescences* terminal, many-flowered, panicles often with many hypsophylls at base; peduncle and branches distinctly ribbed, often with con- or recaulescences. *Flowers* ☿ or polygamous. *Sepals* 5. *Petals* 5, white, creamy or purplish. *Staminodes* ∞, in 1 or 2 whorls, the inner ones mutually and with the stamens connate at base. *Ovary* 3-carpelled; stigmas 1 or 3. *Fruit* opening with 3 longitudinal slits, the style usually not splitting. *Seeds* winged like a propeller with 2 blades.

Distr. Solomons and Bismarcks; in *Malesia:* Borneo, Philippines, Celebes, Moluccas, and New Guinea.

Ecol. Pioneer plants, from sea-level up to 3000 m, especially in natural or anthropogenous secondary vegetation.

KEY TO THE SPECIES

1. Style as long as the ovary or longer; stigma capitate or punctiform. . . . . **1. S. elegans**
1. Style half as long as the ovary or shorter; stigma 3-lobed.
 2. Filaments ± twice the length of the anthers. . . . . **2. S. vidalii**
 2. Filaments as long as the anthers or shorter. . . . . **3. S. henningsii**

1. Schuurmansia elegans BLUME, Mus. Bot. Lugd. Bat. 1 (1850) 178, t. 32; MIQ. Fl. Ind. Bat. 1, 2 (1859) 118; Illustr. 1 (1871) 66, t. 29; CAPIT. Bull. Soc. Bot. Fr. 57 (1910) 397; HALL. *f.* Rec. Trav. Bot. Néerl. 10 (1913) 346; MERR. Philip. J. Sc. 11 (1916) Bot. 19; En. Philip. 3 (1923) 68; HEINE in Fedde, Rep. 54 (1951) 240; Pfl. Samml. Clemens Kinab. (1953) 63; KANIS, Nova Guinea, Bot. 6 (1961) 64, f. 1a; Blumea 16 (1968) 75. — *S. parviflora* RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 18. — *S. borneensis* RIDL. Kew Bull. (1930) 77.

Treelet or tree, up to 15(–30?) m, sometimes with low stiltroots. Stipules linguiform, 1½–4 by 1½–2½ mm, sometimes shortly ciliate. *Leaves* obovate-oblong to -lanceolate, 10–30 by 2½–10 cm, rounded or somewhat acuminate at apex, ± tapering at base, margins ± involute, chartaceous, nerves 1–1½ mm apart; surface of dried leaves very finely reticulate by protruding intercellular walls of epidermal cells, giving an impression of striation parallel to the nerves; petiole 1½–6 cm. *Inflorescences* 10–25 cm; peduncle 2–5 mm ø; pedicels filiform, 3–6 mm; bracts broadly linguiform, up to 2 mm long, sometimes shortly ciliate. *Flowers* bisexual, erect. *Sepals* elliptic to obovate, 3–6 by 1½–4 mm. *Petals* obovate, 4–8 by 2–5 mm. Outer *staminodes* 0–∞, linear, 1–1½ mm long; inner ones 15–25, linear to spatulate, 2½–5 mm long, with 1 distinct nerve. *Filaments* 1–2 mm; anthers 1¼–2 by *c.* ½ mm, connective distinctly protruding. *Ovary* subovoid, 1½–3 by 1¼–2 mm, papillate, sometimes with a few glandular-capitate hairs; style 1½–3 mm, growing in fruit, widening into the ovary; stigma small, capitate or punctiform. *Fruit* fusiform, up to 2½ by ½ cm, acuminate. *Seeds c.* ¾ by ¼ mm, with *c.* 3 mm long, slender wings.

Distr. *Malesia*: Borneo, Philippines (Mindanao, only 1 collection of uncertain identity reported from Agusan), Celebes, Moluccas, and New Guinea.

Ecol. From sea-level up to 2000 m, in primary and secondary forests, on level land to steep slopes, sometimes near river-banks or in swampy localities; on clay or more sandy or rocky soils. Probably not uncommon locally, but rarely flowering.

Vern. Philip., Mindanao: *tanang*, Manobo;

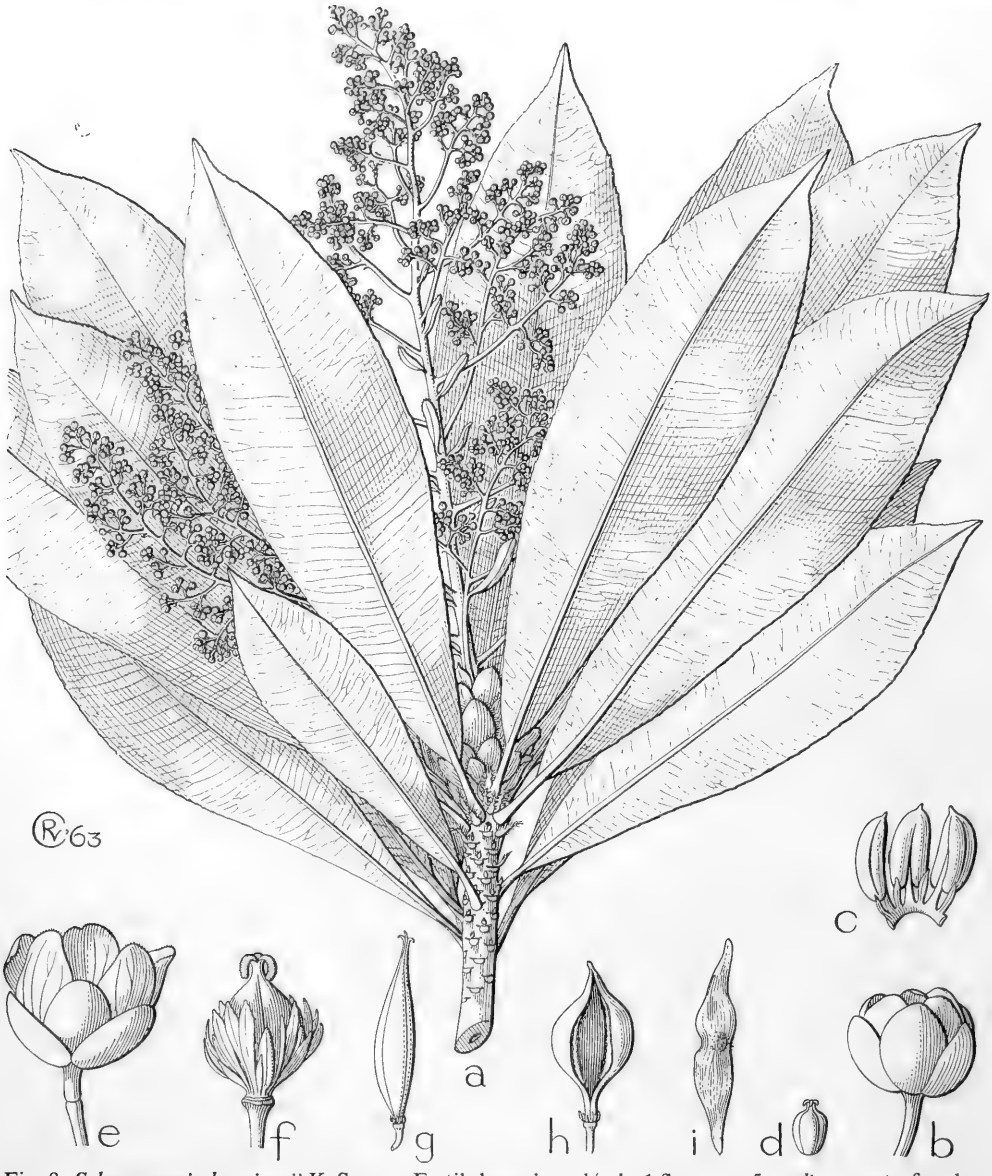

Fig. 8. *Schuurmansia henningsii* K. SCH. *a.* Fertile branch, ×½, *b.* ♂ flower, ×5, *c. ditto*, part of androecium, inner view, *d. ditto*, reduced pistil, both ×8, *e.* ♀ flower, ×5, *f. ditto*, sepals and petals removed, ×8, *g.* fruit, *h.* open fruit, both ×1½, *i.* seed, ×5 (*a–d* HOOGLAND & PULLEN 5356, *e–f* BRASS 29335, *g* HOOGLAND 3507, *h–i* BW 4987).

Celebes: *labo labo*, Toradja; Ambon: *wat lopu*; New Guinea, Vogelkop Pen.: *hikselah*, Tehid.

2. Schuurmansia vidalii (F.-VILL.) MERR. Philip. J. Sc. 11 (1916) Bot. 19; En. Philip. 3 (1923) 69; KANIS, Nova Guinea, Bot. 6 (1961) 69, f. 1c; Blumea 16 (1968) 76. — *Calophyllum vidalii* F.-VILL. in Ceron, Cat. Pl. Herb. Manila (1892) 229, plate. — *S. parvifolia* MERR. Philip. J. Sc. 11 (1916) Bot. 19.

Treelet up to 7 m. Stipules 1–2½ by 1–2 mm, shortly ciliate. *Leaves* obovate-lanceolate, 5–11 by 1½–4 cm, obtuse to obtusely acuminate at apex, tapering at base, margins somewhat involute, strongest nerves *c.* 1 mm apart, papyraceous to chartaceous; petiole ½–2 cm. *Inflorescences* 7–15

Fig. 9. *Schuurmansia henningsii* K. SCH. After anthesis, Cycloop Mts (Photogr. SLEUMER, July 1961).

cm; peduncle 1½–3½ mm ø; pedicels 1–2 mm; bracts very small, semi-annular to triangular. *Flowers* ♂, erect. *Sepals* obovate, 2–2¾ by 1½–2 mm. *Petals* obovate, *c.* 3½ by 2½ mm, white or pink. Outer *staminodes* 10–∞, filiform, ¾–1 mm long; inner staminodes *c.* 25, linear, 1½–2 mm, *c.* ½ mm connate at base. *Filaments c.* 1¾ mm; anthers ¾–1 by 0.4–0.5 mm. *Ovary* subglobular, 3-lobed, 0.4–0.5 mm ø, glabrous; stigma 3-lobed, subsessile. *Fruit* fusiform, *c.* 10 by 3 mm, acuminate. *Seeds c.* 0.6 by 0.4 mm, with *c.* 2 mm long, basally connate wings.

Distr. *Malesia*: Philippines (Luzon: Aurora, Camarines Sur & Sorsogon Prov., 3 collections).

Ecol. In (mossy) forest, from 500 to well over 1000 m, possibly also at sea-level.

3. Schuurmansia henningsii K. SCH. Bot. Jahrb. 9 (1888) 210; K. SCH. & HOLLR. Fl. Kais. Wilh. Land (1889) 50; WARB. Bot. Jahrb. 13 (1891) 283; E. & P. Nat. Pfl. Fam. 3, 6 (1895) f. 75; K. SCH. & LAUT. Fl. Schutzgeb. (1901) 448; PULLE, Nova Guinea 8 (1912) 667; HALL. *f.* Rec. Trav. Bot. Néerl. 10 (1913) 346; E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) f. 41; LANE POOLE, For. Res. (1925) 116; WHITE & FRANCIS, Proc. R. Soc. Queensl. 38 (1927) 247; WHITE, J. Arn. Arb. 10 (1929) 241; KANIS, Nova Guinea, Bot. 6 (1961) 65, f. 1b; Blumea 16 (1968) 76. — *S. bamleri* K. SCH. & LAUT. Fl. Schutzgeb. (1901) 448; Nachtr. (1905) 318, *incl. var. longifolia* LAUT.; HALL. *f.* Rec. Trav. Bot. Néerl. 10 (1913) 350. — *S. gilgiana* LAUT. in K. Sch. & Laut. Fl. Schutzgeb. Nachtr.

(1905) 319; HALL. *f.* Rec. Trav. Bot. Néerl. 10 (1913) 348. — *S. microcarpa* CAPIT. Bull. Soc. Bot. Fr. 57 (1910) 398, t. 11, 12, 17; BAKER, J. Bot. 61 (1923) Suppl. 4. — *S. theophrasta* HALL. *f.* Rec. Trav. Bot. Néerl. 10 (1913) 346; HOLTH. & LAM, Blumea 5 (1942) 213. — *S. pseudopalma* HALL. *f.* Rec. Trav. Bot. Néerl. 10 (1913) 347. — *S. rauwolfioides* HALL. *f. l.c.* 349; K. SCH. Bot. Jahrb. 9 (1888) 211, *sine nomen.* — *S. longifolia* (LAUT.) GILG in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 80; A. C. SMITH, J. Arn. Arb. 22 (1941) 524. — ? *S. lophiroides* GILG, *l.c.* 80. — ? *S. oreophila* GILG, *l.c.* 80. — ? *S. schlechteri* GILG, *l.c.* 80. — ? *S. crassinervia* GILG, *l.c.* 80. — *S. coriacea* A. C. SMITH, J. Arn. Arb. 22 (1941) 525. — *S. montana* A. C. SMITH, *l. c.* 526. — *S. grandiflora* A. C. SMITH, *l.c.* 527. — **Fig. 8-10.**

Treelet or tree, up to 15(–20?) m, sometimes with stiltroots up to 1 m high. Stipules ½–5 by ½–3 mm, often up to 3 mm long, ciliate. *Leaves* obovate-lanceolate, 6–85 by 1½–15 cm, obtuse to acuminate at apex, tapering at base, margins somewhat involute, nerves 2–7 mm apart, chartaceous or subcoriaceous; petiole up to 4 cm. *Inflorescences* 7–65cm; peduncle 1½–8 mm ø; pedicels filiform, 2–5 mm; bracts usually very small, ± triangular, sometimes larger and transitional to leaves. *Flowers* ☿ or functionally unisexual, erect. *Sepals* obovate to elliptic, 3–5 by 1½–3 mm, greenish, sometimes purplish. *Petals* obovate-oblong, 4–7½ by 1½–4 mm, white, creamy, pink or purplish red. Outer *staminodes* 0–∞, filiform, *c.* 1 mm long; inner ones 5–30, filiform to linear, 1½–2 mm long. *Stamens* in ♂ flowers with ¾–2½ mm long filaments; anthers 1½–2½ by ½–¾ mm; in ♀ flowers with ¼–½ mm long filaments; anthers *c.* 1 by ⅓ mm. *Ovary* subglobular to ovoid, ± 3-lobed, glabrous, in ♂ flowers ½–1 by ⅓–¾ mm, in ♀ flowers *c.* 3 by 2 mm; style cylindric, up to 1 mm; stigma 3-lobed. *Fruit* fusiform, up to 1½ by ¾ cm, acuminate. *Seeds c.* 1 by ⅓ mm with *c.* 2½ mm long, slender wings.

Distr. Solomons and Bismarcks; in *Malesia*: Moluccas (Talaud Is., Halmahera, Ceram), New Guinea.

Ecol. From sea-level up to 3000 m, in primary and secondary forests, on landslides and in secondary grasslands, on level land to steep slopes, sometimes near river-banks or in swampy localities, on clay or more sandy or rocky soils; scattered or locally common in open habitats.

Vern. Moluccas, Talaud Is.: *arisusu uruně*; Tidore: *malětopě*; Ambon: *ut lapu*, *was lapu*; W. New Guinea, Ajamaru: *batsjevak*, Maibrat; Biak I.: *rambuan*; NE. New Guinea, Wabag: *opaga*, *orpach*; Hagen: *pappai*, *popai*, *porkai*, *pupai*; Minj: *bubar*, *bubus*; Chimbu: *akèssa*, *a'ulareh*, *hahèssa*, *mènmèn*; Aiyura: *arebi*; Budemu: *sipulund*; Huon Pen., Sambui: *pelip*; Sattelberg: *(m)beli*; Andarora: *haiwinge*, Nauti, *yatsiga*, Manki; SE. New Guinea, Tari: *obbo*; Kutubu: *karadéwa*; Mendi: *op*; Kairuku: *engefukenge*; Buna: *kembusa*; Bausa: *wèrawèra*.

Notes. The striking variation in vegetative characters is for the greater part due to differences in ecological conditions. The greatest influence is exercised by the altitude. Papuan material, arranged according to increasing altitude, shows a very regular decrease in leaf size, especially between 1000 and 3000 m. At the same time the leaves become more coriaceous and more distinctly petioled. Exposition and age of the plants play a less important role in the determination of the leaf size.

Fig. 10. *Schuurmansia henningsii* K. SCH. Small-leaved, young plant, Edie Creek, Morobe Distr., *c.* 2000 m, MICHAEL holding the twig (NGF 13949) (Photogr. SLEUMER, 1961).

The dimensions and colours of flower parts are also rather variable, but less easy to correlate with other data. These variations probably indicate genetical differences between local populations. More detailed local studies will be necessary to decide whether any infraspecific taxa can be distinguished.

A majority of the specimens has relatively large anthers and small pistils, whereas a minority has relatively small anthers and large pistils. It was observed once, that most specimens in a profusely flowering stand had proportionally large anthers and did not set fruit. It is not certain, however, that the flowers are always functionally unisexual. Polygamy is likely to occur, as the reduction of either stamens or ovary is never complete.

Excluded

Sauvagesia erecta LINNÉ, Sp. Pl. 1 (1753) 203; MIQ. Fl. Ind. Bat. 1, 2 (1857) 118; KOORD. Exk. Fl. Java 2 (1912) 607; BACKER & BAKH. *f.* Fl. Java 1 (1963) 327; KANIS, Blumea 16 (1968) 80.

Erroneously recorded for Java by MIQUEL without reference to material or other source of information. His error might be caused by a collection of *Sauvagesia erecta* L. in G, which is labelled: 'Perrottet, Java, 1819'. Although Perrottet visited the eastern part of Java in that particular year, it is clear that the specimen concerned was mislabelled and in fact was collected in Cayenne on the same voyage.

Tetramerista MIQ. Fl. Ind. Bat. Suppl. (1860) 534 belongs to the *Theaceae*, *fide* GILG, Ber. Deut. Bot. Ges. 11 (1893) 22, *et auct. div.*

PORTULACACEAE (R. Geesink, Leyden)

Annual to perennial, erect or creeping, mostly branched herbs or shrubs, occasionally woody at the base, often with a tuberous or swollen main root, occasionally rooting at the nodes. *Leaves* spirally arranged to opposite, subsessile, occasionally with axillary hairs or scales (in Mal. only in *Portulaca*), nervation pinnate or reticulate. *Flowers* bisexual, actinomorphous (occasionally cleistogamous), in axillary and/or terminal thyrsi, dichasia, in terminal capitules or solitary (terminal or axillary). Bracts leaf-like or membranous. *Sepals* 2 (4–8 in extra-Mal. *Lewisia* and *Grahamia*), boat-shaped, deltoid to obovate at base shortly connate and confluent with petals and stamens. *Petals* (3–)4–6(–8), mostly obovate and unequal, shortly connate. *Stamens* (1-)3-∞, in 1–∞ ± distinct whorls; filaments basally shortly connate; anthers 2- or 4-celled, dorsifixed, dehiscing lengthwise. *Ovary* superior or half-inferior, originally 2–20-celled, soon becoming 1-celled; style with 2–20 mostly papillous arms. *Ovules* 4–∞ on a central, dendroid placenta, campylotropous. *Capsule* 3–7-valved or with a caducous operculum, occasionally surrounded by the persistent calyx. *Seeds* 1–∞, smooth or ornamented, kidney-shaped to ± globular, laterally compressed, mostly with a caruncle. Embryo curved, almost filling the ripe seed.

Distribution. About 15 genera with possibly 200 *spp.* Cosmopolitan, with some tropical species occurring as adventives in temperate regions. In *Malesia* 4 genera with 11 *spp.*

Ecology. The Malesian species are all more or less succulent herbs or semi-shrubs, the aquatic *Montia fontana* excepted. Only two genera are native, *Portulaca* and *Montia*.

All *Portulacas* occur at low altitude, preferably in disturbed vegetation, waste places, or on the coast. Most are indifferent to climate, only *P. macrorhiza* and *P. pilosa ssp. sundaensis* are restricted to the seasonal climate of the Lesser Sunda Is. The sandy beach is tolerated by *P. oleracea*, *P. lutea*, and *P. pilosa ssp. pilosa* (*race tuberosa*).

The occurrence of *Montia fontana* in the high mountain bogs of New Guinea is singularly interesting, as it is the only tropical montane occurrence in the Old World between its range in the temperate northern hemisphere and the southern counterpart in the SE. Australian Alps (at *c.* 36° SL), SE. Australia (Mt Lofty Ranges), Tasmania, and New Zealand, an almost bipolar type of distribution.

Flower-biology. As far as known all *Portulacaceae* are self-pollinating.

Whether cross-pollination occurs, deserves further study. Self-pollination results in genetically constant local populations, representing pure lines in nature.

The production of seeds is profuse; seeds can usually stand a long time of drought.

Man has doubtless been responsible for the dispersal of several *Portulacaceae*. Seed can be transported with cargo; some species are used as food or as ornamentals, and they easily escape as adventives and maintain in warm regions. For these reasons the native range of certain species cannot any longer be ascertained, notably of *Portulaca oleracea*, *P. pilosa*, *P. quadrifida*, *Talinum paniculatum*, and *T. triangulare*.

The structure of the inflorescence in this family is mostly, possibly always, of a cymose nature. Through contraction and reduction several modifications are represented; some derivations are schematically depicted in figures 1 & 2. *Talinum* has in principle a thyrse (fig. 1a, 1b & 2) of which a full explanation is given in the notes under the genus. At first sight *Calandrinia* would seem to possess a true raceme (fig. 1d) but this could also well be a reduced thyrse. *Montia* has also probably a reduced cymose inflorescence (fig. 1c). The inflorescences in *Portulaca* are in *subg. Portulacella* (Australia) the most primitive and are compound dichasia from which the structure in the capituliform inflorescences of the other subgenus can be derived, as I have explained in my precursor (Blumea 17, 1969, 277).

Phytochemistry. Red betacyanins (replacing anthocyanins) and yellow betaxanthins form an outstanding chemical character of the family. Such nitrogen-containing pigments (chromoalkaloids) were demonstrated to be present in members of the genera *Anacampseros*, *Calandrinia*, *Claytonia*, *Montia*, *Portulaca*, *Spraguea*, and *Talinum*. Saponins seem to occur frequently in the family; their chemistry, however, is not yet known. The seeds store starch in the perisperm and fatty oil in embryos; at the same time they contain appreciable amounts of protein. The chemical features known at present from this family confirm its intimate relationships with other members of the centrospermous alliance. A summary of phytochemical literature is to be found in HEGNAUER, Chemotax. d. Pfl. 5 (1969) 383–387. — R. HEGNAUER.

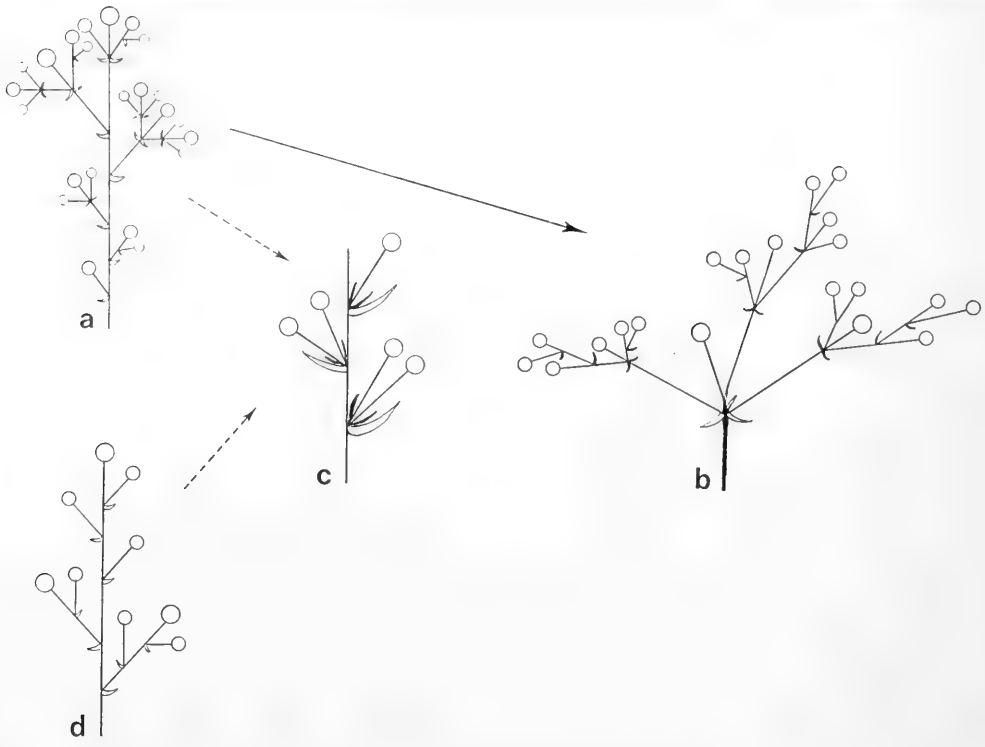

Fig. 1. Scheme of the inflorescences of some *Portulacaceae* and their morphological relations. *a*. Thyrsus in *Talinum paniculatum*, *b*. corymboid thyrsus, resembling a pleiochasium, in *Talinum triangulare*, *c*. raceme-like inflorescence, cymose or racemose, in *Montia fontana*, *d*. raceme with terminal flower in *Calandrinia grandiflora*.

Morphology. VON POELLNITZ (in Fedde, Rep. 37, 1934, 240, and other papers) called the sepals "Involucralblätter", suggesting their homology with the involucral leaves surrounding the capituli, the latter being called by him "falsche Involucralblätter". Also LEGRAND (in Com. Bot. Mus. Hist. Nat. Montevideo 31, 1, 1953, 1, and other papers) called the calyx lobes "pseudosepalos".

Taking into account, that the calyx normally is considered as (metamorphosed) leaves and that in *Portulacaceae* the phyllotaxal position of the sepals is so distinctly set off against the bracts, it seems to me that there is no morphological argument to accept the flower as being monochlamydeous.

Anatomy. See also my precursory paper (Blumea 17, 1969, 276–279) on the axillary hairs; METCALFE & CHALK, Anat. Dicot. 1 (1950) 153; KOWAL, Monogr. Bot. 12 (1961); CHORINSKI, Oest. Bot. Z. 80 (1931) 308.

Uses. See HEYNE, Nutt. Pl. (1927); OCHSE & BAKH. Ind. Groent. (1931) 615; BURKILL, Dict. Ec. Prod. Mal. Pen. (1935); CAIUS, J. Bomb. Nat. Hist. Soc. 41 (1939) 369. See also under the species.

KEY TO THE GENERA

1. Fruit dehiscing circumscissile with an operculum. Ovary half-inferior . . . . . **4. Portulaca**
1. Fruit valved or irregularly dehiscing. Ovary superior.
2. Leaves *c*. 4 mm long, opposite . . . . . **3. Montia**
2. Leaves more than 6 mm long, the middle cauline leaves spirally arranged.
3. Seed glabrous. Fruit globular, 3–5 mm ø. Calyx caducous or not. . . . . **2. Talinum**
3. Seed hairy. Fruit obpyriform, *c*. 10 by 8 mm. Calyx persistent, distinctly accrescent. **1. Calandrinia**

1. CALANDRINIA

H.B.K. Nov. Gen. Sp. 6 (1823) 77, *nom. cons.*; POELLN. in Fedde, Rep. 35 (1934) 161–173; D.C. AÑÓN SUÁREZ DE CULLEN, Bol. Soc. Arg. Bot. 5 (1953) 1–29.

Mostly succulents, occasionally with short stems, occasionally unbranched, glabrous, pubescent or glandular. *Leaves* spirally arranged and/or in a basal rosette, occasionally with axillary hairs. *Flowers* arranged in mostly terminal, occasionally axillary thyrsi (corymboid or not), glomeruli or dichasia, or solitary. Bracts and bracteoles subulate or leaf-like, partly without an axillary axis. *Calyx* accrescent (caducous in the American *sp. C. punae*). *Sepals* glabrous, pubescent, spiny or glandular, occasionally with dentate, ciliate or glandular margin. *Petals* 5–7, persistent, twisted after anthesis. *Stamens* 3–∞, anthers linear to elliptic. *Ovary* superior; style 1 with 3–5 arms (seldom 3 simple styles). *Fruit* pyriform, globular, obpyriform or elleptic, 3–7-valved. *Seeds* at least occasionally without a caruncle.

Distr. About 150 *spp.*, native in tropical and subtropical America and Australia.

1. Calandrinia grandiflora LINDL. Bot. Reg. (1828) t. 1194; G. DON, Gard. Dict. 3 (1834) 80, t. 18; L. H. BAILEY, Man. Cult. Pl. (1949) 336; BACKER & BAKH. *f.* Fl. Java 1 (1963) 217. — **Fig. 1d.**

Erect, up to *c.* 30 cm. *Leaves* spirally arranged, obovate, up to 13 by 5 cm, without axillary hairs; petiole semi-amplexicaulous; apex acute to acuminate. *Flowers* in compound terminal racemes at least occasionally with a terminal flower; each raceme 1–6-flowered. Bracts and bracteoles ovate to elliptic, acute, up to *c.* 1 by ½ cm, apical ones smaller. *Sepals* roundish, up to *c.* 1½ cm ø, acuminate in fruit. *Petals* 5–6, ± orbicular, up to *c.* 2 cm ø, purplish. *Stamens c.* 75; filaments up to 1 cm; anthers *c.* 2 by 0.8 mm. *Style c.* 2½ mm, with several short, thick lobes. *Fruit* obpyriform, *c.* 10 by 8 mm, 3-valved. *Seeds* ∞, *c.* 1 mm ø; testa cells about hexangular, with hair-like appendages.

Distr. Native of S. America, sometimes escaped from gardens.

2. TALINUM

JUSSIEU, Gen. (1789) 312, *nom. cons. prop.*; POELLN. in Fedde, Rep. 35 (1934) 1; DANDY, Taxon 18 (1969) 464. — **Fig. 1a, b, 2.**

Herbs or semi-shrubs (in Malesia glabrous). *Leaves* spirally arranged (the lowermost sometimes opposite), linear to obovate. *Flowers* in terminal whether or not corymboid thyrsi, or cymosely arranged, seldom axillary or solitary. *Sepals* mostly caducous. *Petals* mostly 5. *Stamens* 5–∞. *Ovary* superior; style mostly with 3 arms. *Fruit* globular; mostly 3-valved or irregularly caducous.

Distr. About 50 *spp.*, native in S. and Central America and S. Africa, the two treated species now pantropically naturalized.

Morph. The inflorescences of the *Talinums* studied are explained in comparison with the vegetative ramifications, thus in agreement with C. TROLL, who assumes that there is no essential difference between the vegetative and the inflorescential ramification. Their leaves are spirally arranged, the lowermost sometimes excepted. Specimens of *T. paniculatum* grown at Leyden in winter under low light intensity and short day light produced all opposite leaves and opposite primary inflorescential branches. The flowers of *T. paniculatum* are arranged in a wide thyrse with a terminal flower (fig. 1a). A change in phyllotaxis, in contrast with the rule of TROLL mentioned, is found in the ultimate dichasial ramifications.

Superficially, *T. triangulare* is trichasial in the first ramification of the inflorescence (fig. 1b, 2b). I have tried to bring this in agreement with the inflorescence of *T. paniculatum* by the following argumentation: the vegetative branches always have 2 basal cataphylls, each with a dormant axillary bud (fig. 2a C, B). The inflorescences lack these cataphylls and buds. The cataphylls easily fall, and mostly the scars are hardly to be found. The cataphylls are also present if the axillary axis is not developed (fig. 2a′). In the cultivated specimens these dormant buds developed after the axillary axis was pinched

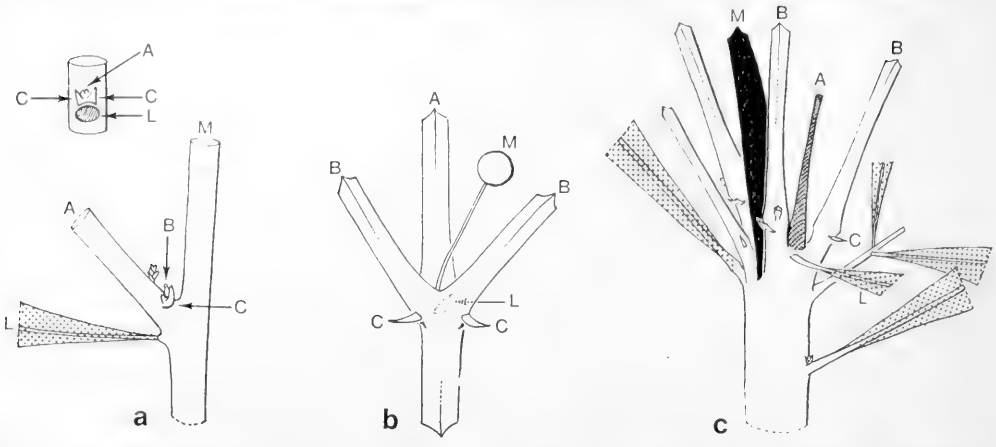

Fig. 2. *Talinum triangulare* (JACQ.) WILLD. Schematic demonstration of the homology of the vegetative ramifications and those of the inflorescence. In all three figures *L* means leaf bearing the lateral axis *A*. The main axis is indicated by *M*. Each lateral axis carries 2 cataphylls at the base indicated by *C*, each cataphyll having an axillary bud indicated by *B*, which remains normally dormant in the vegetative part (fig. a), but develops into an axis in the inflorescence (fig. b), but can by removal of the lateral axis also artificially be produced (as in fig. c). For further explanation see the text.

out (fig. 2c, A), but this only succeeded near the inflorescence. Now the inflorescence may be explained as follows: The main axis (fig. 2a, b, c M) forms the central flower. The axillary axis (fig. 2a, c A; fig. 2b A) of the leaf (fig. 2a, c L; fig. 2b L, not visible, cf. arrow), is branched cymosely. From the dormant buds (fig. 2a, c B) branches are developed, which are also branched cymosely, and are only slightly poorer than the axillary axis. So the axillary axis (fig. 2b A) is supposed to represent the first and single racemous ramification of a thyrsus.

KEY TO THE SPECIES

1. Flowering axes sharply triangular in cross-section. Branches with 2 lateral, basal buds (scars!). Stamens 20–40. . . . . **1. T. triangulare**
1. Flowering axes terete. Branches without basal buds. Stamens up to 15. . . . . **2. T. paniculatum**

1. Talinum triangulare (JACQ.) WILLD. Sp. Pl. 2 (1799) 862; HEYNE, Nutt. Pl. (1927) 612; POELLN. in Fedde, Rep. 35 (1935) 15; W. H. BROWN, Useful Pl. Philip. (1950) 520; BACKER & BAKH. *f.* Fl. Java 1 (1963) 217. — *Portulaca triangularis* JACQ. Enum. Pl. Carib. (1760) 22. — *Portulaca racemosa* L. Mant. (1771) 242. — *T. racemosum* (L.) ROHRB. in Mart. Fl. Bras. 14, 2 (1872) 297; DEN BERGER, Trop. Natuur 7 (1918) 28, t. 1–3. — **Fig. 1b, 2.**

Erect semi-shrub up to *c.* 1 m. *Leaves* elliptic to obovate, up to 15 by 5 cm, acute to acuminate; nervation pinnate. Axillary buds with 2 subulate, small cataphylls; the latter always with a dormant axillary bud up to 1½ cm in the side-axes (caducous in dried specimens leaving a scar). *Thyrsi* terminal, corymboid, up to *c.* 12 cm ø, the axes sharply triangular with 8–*c.* 28 flowers. Bracts and bracteoles subulate. *Sepals* deltoid, *c.* 4.6 by 3½ mm, acuminate. *Petals* 5, obovate, up to 10 by 4 mm, emarginate, pink. *Stamens* 20–40; filaments up to 5 mm; anthers *c.* 0.7 by ½ mm. *Style c.* 2.7 mm, 2–3-fid. *Fruit* up to 5 mm ø, 2–3-valved, yellow. *Seeds* ∾, *c.* 1.2 mm ø; testa cells radially elongated, smooth, tubercled at the edge.

Distr. Pantropic weed, still extending its range, native of tropical America. According to Dr. LEEUWENBERG it extends enormously along new-made ways in Africa.

Ecol. Waysides, waste places, edges of forests.

Uses. A commonly used vegetable, easily propagated by cuttings, profusely used in war prison camp gardens, in Java imported from Surinam (*cf.* HEYNE, Nutt. Pl. 1927, 612).

Vern. Surinam *purslane*. Malesia: *krokot blanda, poslèn*, S.

2. Talinum paniculatum (JACQ.) GAERT. Fruct. 2 (1791) 219, t. 128; HEYNE, Nutt. Pl. (1927) 612; POELLN. in Fedde, Rep. 35 (1935) 10; A. C. SMITH, Bull. Torr. Bot. Club 70 (1943) 537; GREENWOOD, J. Arn. Arb. 30 (1949) 75; BACKER & BAKH. *f.* Fl. Java 1 (1963) 217. — *Portulaca paniculatum* JACQ. Enum. Pl. Carib. (1760) 22. — *Portulaca*

patens L. Mant. (1771) 242. — *T. patens* (L.) WILLD. Sp. Pl. 2 (1799) 863; HASSK. Hort. Bog. (1858) 74; DRAKE DEL CAST. Ill. Fl. Ins. Mar. Pac. (1890) 111; F. M. BAILEY, Queensl. Fl. 1 (1899) 95; BACKER, Ann. Jard. Bot. Btzg Suppl. 3 (1910) 416; Schoolfl. (1911) 84; CRAIB, Fl. Siam. Enum. 1 (1925) 110; MERR. & CHUN, Sunyatsenia 1 (1934) 56; F. B. H. BROWN, Bern. P. Bish. Mus. Bull. 130 (1935) 77. — **Fig. 1a.**

Erect semi-shrub up to *c.* 70 cm. *Leaves* elliptic to obovate, up to 11 by 5 cm, acute to acuminate; nervation pinnate. Axillary buds with 2 subulate cataphylls. Terminal *thyrsi* up to *c.* 18 by 15 cm, with up to *c.* 10 dichasia, each with up to 30 flowers. Bracts and bracteoles subulate. *Sepals* suborbicular, *c.* 1.1 mm, acute. *Petals* (4–)5(–6), obovate, *c.* 4 by 2 mm, pink, apex emarginate. *Stamens* (4–)15; filament *c.* 2.7 mm; anthers *c.* 0.4 mm. *Style* c. 1.6 mm, 3-fid. *Fruit c.* 3 mm ø, yellow or pink, 3-valved. *Seeds c.* 1.2 mm ø; testa cells radially elongated, shortly tubercled or not, with small pits between the cells.

Distr. Pantropic weed, native of tropical America, still extending its range.

Ecol. Waysides, waste places, edges of forests.

Uses. Cultivated as an ornamental, and with edible leaves. According to HEYNE (Nutt. Pl. 1927, 611) a decoction of the roots is used by Chinese as a surrogate aphrodisiac.

Notes. 1. My cultivated specimens had pink sepals, petals, filaments, and style. According to field-labels, there are in America also forms with white and yellow petals.

2. I received at the Leyden Hortus seed of obviously two strains (pure lines?) recognizable by the seed-coat; the one has small tubercles on the cells of the testa, the other has no such tubercles. Specimens raised from these two seed types in the glass-house of the Leyden Hortus on vegetable mould showed different characters, as tabulated below:

Seed with tubercles:
Leaves up to 7 by 4 cm.
Panicle *c.* 8 cm wide.
Dichasia with up to 15 flowers.
Fruit reddish.

Seed without tubercles:
Leaves up to 11 by 5 cm.
Panicle *c.* 15 cm wide.
Dichasia with up to 30 flowers.
Fruit yellowish to olivegreen.

From the herbarium it appears that these 2 seed types occur almost throughout the range of the species. The correlating characters are difficult to observe in the herbarium, and besides are liable to be influenced by the ecology of the locality (leaves and panicle). There are no transitions and obviously these two strains keep constant as a sort of pure lines.

3. MONTIA

LINNÉ, Sp. Pl. (1753) 87; SWANSON, Brittonia 18 (1966) 229. — **Fig. 1c, 3.**

Copiously branched, succulent herbs or waterplants. Basal rosette mostly absent. *Leaves* ovate to linear, occasionally parallel-veined, without axillary hairs.

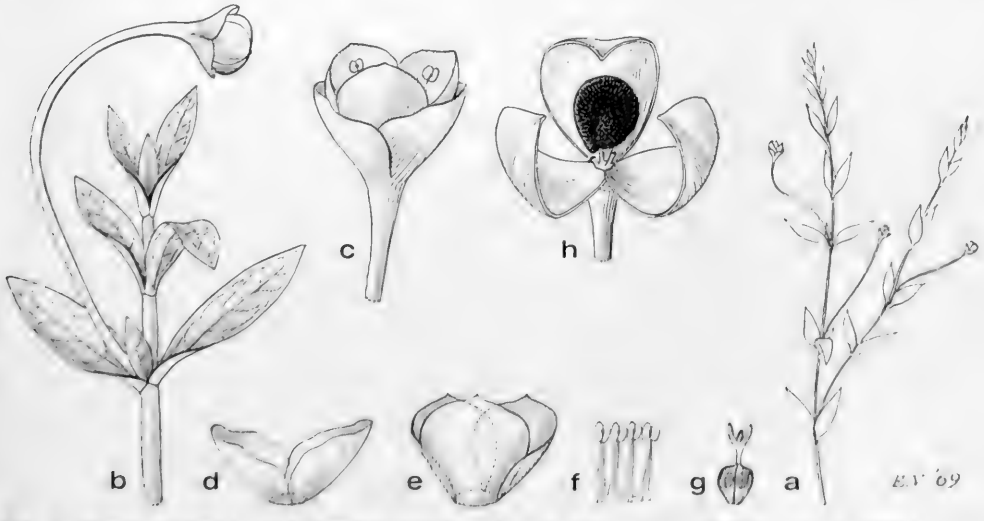

Fig. 3. *Montia fontana* L. *a.* Flowering branch, ×1½, *b. ditto*, ×5, *c.* flower, ×10, *d.* sepals, ×10, *e.* corolla, ×10, *f.* stamens, ×10, *g.* young fruit with style, ×10, *h.* burst fruit with 1 seed, ×20 (*a–h* BRASS & MEIJER DREES 9972, L).

Flowers in axillary and/or terminal cymes or solitary. *Calyx* persistent. *Petals* 5. *Stamens* 3 or 5; anthers 4-celled. *Ovary* superior; style arms 3. *Fruit* pyriform to globular, 3-valved, after dehiscence occasionally twisted. *Seeds* 1–5.

Distr. About 50 *spp.* Temperate and warm-temperate in Europe, Northern Asia, N. & S. America, Central Africa, and in Tasmania and New Zealand (the present species only!); the sole tropical localities in the Old World are on Mt Kilimanjaro in Central Africa and the high mountains of New Guinea. Generic delimitation, *e.g.* against *Claytonia*, is not very satisfactory.

1. Montia fontana LINNÉ, Sp. Pl. (1753) 87. — *M. lamprosperma* CHAM. Linnaea 6 (1831) 565; MERR. & PERRY, J. Arn. Arb. 23 (1942) 386; GEESINK, Pac. Pl. Areas map 184 (*inedit.*). — **Fig. 1c, 3.**

Aquatic herb, in patches up to *c.* 6 cm high. *Leaves* opposite, elliptic, up to 4 by 2 mm, not caducous but decaying. *Flowers* solitary or 2–3 together with a membranaceous bract, inserted in the axil of a leaf. *Sepals* suborbicular, *c.* 1.2 mm ø, acute to mucronate. *Petals* 5, obovate to spathulate, 2 larger, up to 1.6 by 1 mm, 3 smaller, up to 1.6 by 0.6 mm, the latter each with an epipetalous stamen. *Filaments* up to *c.* 1 mm; anthers *c.* 0.34 by 0.17 mm. Style arms 3, subsessile, *c.* 0.1 mm long. *Fruit* globular, *c.* 1.2 mm ø; the 3 valves twisted after dehiscence. *Seeds* 2–3, *c.* 1.2 mm ø; testa cells radially elongated.

Distr. Northern hemisphere in temperate localities, Americas (Rocky Mts, Andes), Central Africa (Mt Kilimanjaro), SE. Australia (Alps and Mt Lofty Ranges, south of 36° SL), Tasmania, and New Zealand; in *Malesia*: West New Guinea (Mt Wilhelmina) and East New Guinea (between Mt Dickson and Kuputivava). This peculiar distribution in Australasia reminds of that of *Hydrocotyle vulgaris* L. (*cf.* Fl. Mal. I, 4, 1949, 116).

Ecol. Stream banks, 3500–3650 m.

Note. A variable species of which several infraspecific taxa are distinguished, which to some have the status of species.

4. PORTULACA

LINNÉ, Sp. Pl. (1753) 445; PAX & HOFFM. in E. & P. Nat. Pfl. Fam. ed. 2, 16a (1934) 246; POELLN. in Fedde, Rep. 37 (1934) 240; LEGRAND, Com. Bot. Mus. Hist. Nat. Montevideo 31, 1 (1953) 1; *ibid.* 34, 1 (1958) 1; GEESINK, Blumea 17 (1969) 275. — **Fig. 4–6.**

Mostly succulent, copiously branched herbs. *Leaves* linear to orbicular, in most species with axillary hairs. *Flowers* in (1–)2–30-flowered, terminal capituli; receptacle infundibular, mostly with hairs or scales in the axils of the bracts (and bracteoles), surrounded by a whorl of *c.* 3–30 involucral leaves (or in some Australian *spp.* in axillary and/or terminal dichasia). *Sepals* occasionally keeled or hooded, persistent or caducous with the petals, stamens and style. *Petals* 4–6(–8), mostly obovate, occasionally emarginate or mucronate. *Stamens* 4–∞, in 1 whorl. *Ovary* half-inferior, occasionally apparently inferior; style with 2–18 arms. *Capsule* with a caducous circumscissile operculum. *Seeds* ∞ (in some Australian *spp.* 1–4).

Distr. Mainly tropical and subtropical all over the world, not more than *c.* 40 *spp.*, possibly several very polymorphous, a few worldwide anthropochorous weeds.

Ecol. Savannahs, shores, in pastures and ruderal places, along waysides, *etc.*

Uses. *P. oleracea* is a well known vegetable with cultivars, *P. quadrifida* and other species are used as medicine (see CAIUS, J. Bomb. Nat. Hist. Soc. 41, 1939, 369), *P. pilosa sens. lat.* cultivated for ornamental purpose.

Morph. In my opinion (Blumea 17, 1969, 277) the capitulum is a condensed cyme. It is surrounded by 3–18 involucral leaves, not to be confused with the "Involukralblätter" in the sense of VON POELLNITZ. The nerved scales between the flowers are considered bracts and bracteoles and have, like the vegetative leaves, axillary hairs. In *P. quadrifida* the small white tubercles at the base of a tuft of hairs are supposed to represent the bracts and bracteoles.

The axillary hairs are mostly homologized with stipulae, but in my opinion (*l.c.*) they are probably not of stipular nature. They are mostly found in 2 tufts in the leaf-axils. In Malesian *spp.* they are confluent at the base. In *P. quadrifida* they are present in a whorl around each node.

Taxon. In my precursor (*l.c.*) I have modified and simplified the infrageneric subdivision of the genus. Of the two subgenera, one is confined to Australia (*subg. Portulacella*).

As to the species concept, the one adopted here is distinctly larger than currently accepted, including that used by VON POELLNITZ and LEGRAND. As I have shown, and experimentally checked in all four genera, selfing in bud seems the rule in the family, which explains that in nature pure lines are formed, and that populations may consist of several pure lines keeping distinct for the small characters in which they differ. For those who want to give a name and rank to any constant difference there is hence ample opportunity for distinguishing varieties, subspecies, and even species, especially in variable complexes such as those of *P. oleracea* and *P. pilosa*. In view of this genetical situation it seems that according to a normal specific concept there are far less good species than distinguished by VON POELLNITZ and LEGRAND who recorded some 130 for the world and *c.* 62 (+21 varieties) for the Americas only respectively.

KEY TO THE SPECIES

1. All leaves opposite. Hairs intra- and interpetiolar. 1. SECT. NEOSSIA . . . . . **1. P. quadrifida**
1. At least the middle-cauline leaves spirally arranged. Hairs if present only axillary. 2. SECT. PORTULACA.
2. The largest leaves obovate to spathulate. Axillary hairs inconspicuous. Sepals distinctly carinate (20× magn.). 1. *Subsect. Portulaca.*
3. Mostly 1–3 involucral leaves with an axillary axis. Capituli (2–)3–30-flowered. Stamens 7–15. Fruit *c.* 4 mm long. . . . . **2. P. oleracea**
3. Involucral leaves mostly without axillary axes. Capituli (1–)2–3(–6)-flowered. Stamens 18–50. Fruit *c.* 7 mm long. . . . . **3. P. lutea**
2. The largest leaves linear to elliptic (obovate to spathulate in *P. macrorhiza* from Timor). Hairs mostly conspicuous. Sepals not carinate (20× magn.), occasionally with an apical, dorsal, about dome-shaped hood. 2. *Subsect. Stellulato-tuberculatae.*
4. Largest leaves obovate to spathulate, *c.* 8 mm wide. Timor. . . . . **4. P. macrorhiza**
4. Largest leaves linear to elliptic, less than 4 mm wide. Pantropic . . . . . **5. P. pilosa**

1. Subgenus Portulaca

GEESINK, Blumea 17 (1969) 288. — *Subg. Euportulaca* SPEGAZZINI, Ann. Soc. Ci. Argent. 82 (1917) 17; POELLN. in Fedde, Rep. 37 (1934) 242.

Leaves opposite or spirally arranged. Flowers sessile, solitary or in glomeruli.

Note. The single other subgenus *Portulacella* is exclusively Australian, and has peduncled flowers in cymes.

1. Section Neossia

LEGRAND, Com. Bot. Mus. Hist. Nat. Montevideo 34, 1 (1958) 3; GEESINK, Blumea 17 (1969) 289. — *Subsect. Tuberculatae* POELLN. in Fedde, Rep. 37 (1934) 243. — *Subg. Enantiophylla* LEGRAND, Com. Bot. Mus. Hist. Nat. Montevideo 31, 1 (1953) 5.

Leaves opposite. Hairs or scales intra- and interpetiolar. Bracts and bracteoles reduced to small, white tuberculi at the base of a tuft of hairs or scales (in the capitulum).

Distr. About 7 *spp.*, pantropic, 5 in Africa, 1 in South India and Ceylon.

1. Portulaca quadrifida L. Mant. Pl. 1 (1767) 73; DC. Prod. 3 (1828) 354; DECNE, Herb. Timor. Descr. (1835) 120; HASSK. Pl. Jav. Rar. (1848) 437; MIQ. Pl. Jungh. (1855) 396; Fl. Ind. Bat. 1, 1 (1858) 1061; DYER, Fl. Br. Ind. 1 (1874) 246; KING, J. As. Soc. Beng. 59, ii (1890) 145; BACKER, Fl. Bat. 1 (1907) 79; Voorl. (1908) 18; Schoolfl. (1911) 84; MERR. Fl. Manila (1912) 200; Int. Rumph. (1917) 217; GIBBS, Arfak (1917) 211; MERR. Sp. Blanc. (1918) 142; RIDL. Fl. Mal. Pen. 1 (1922) 151; MERR. En. Philip. 2 (1923) 136; RIDL. Fl. Mal. Pen. 5 (1925) 289; HEYNE, Nutt. Pl. (1927) 613; BACKER, Onkr. Suiker. (1930) 242, Atlas t. 255; POELLN. in Fedde, Rep. 37 (1934) 275; BACKER & BAKH. *f.* Fl. Java 1 (1963) 216; GEESINK, Blumea 17 (1969) 290. — *P. meridiana* L. *f.* Suppl. (1781) 248; BL. Bijdr. (1826) 1136; BLANCO, Fl. Filip. ed. 3, 2 (1878) 162. — *P. quadrifida var. meridiana* DC. Prod. 3 (1828) 354; DECNE, Herb. Timor. Descr. (1835) 120; BOERL. in Veth. Midd. Sumatra 4 (1884) 17. — **Fig. 4.**

Creeping herb, rooting at the nodes; nodes with a whorl of hairs. *Leaves* elliptic to cordate,

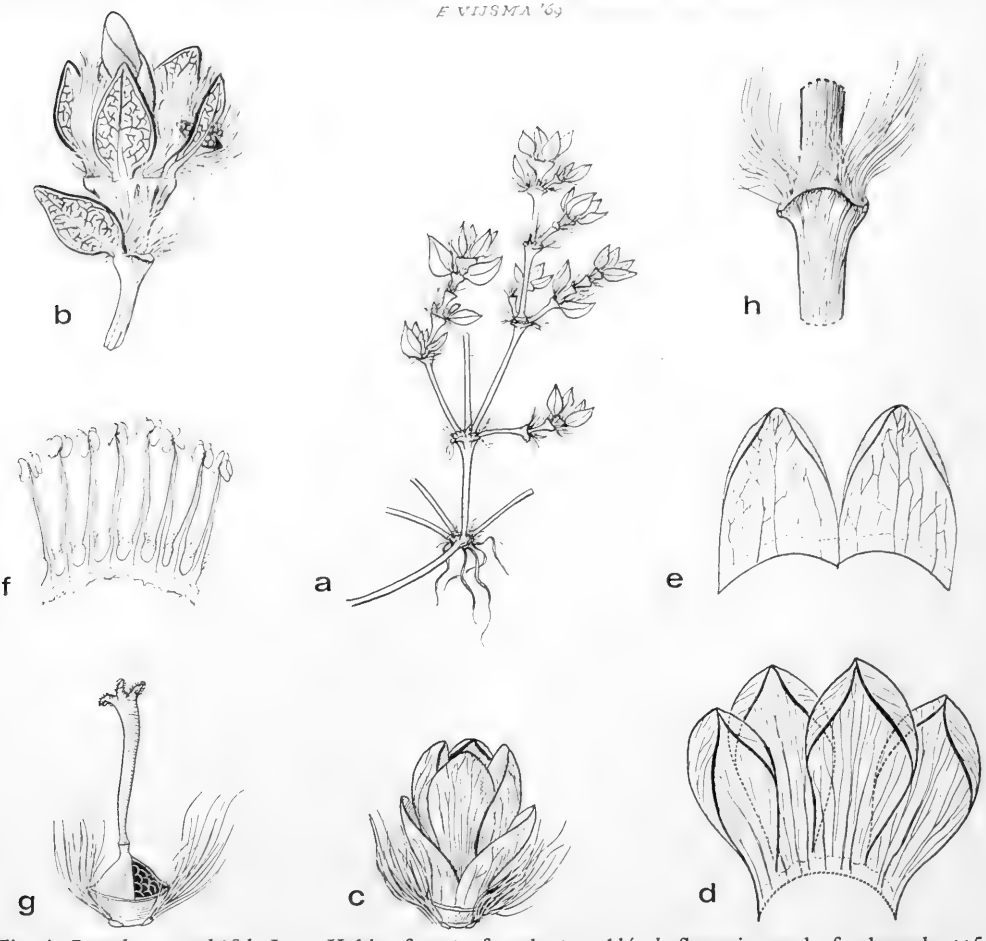

Fig. 4. *Portulaca quadrifida* L. *a.* Habit of part of a plant, ×1½, *b.* flowering end of a branch, ×5, *c.* flower, ×5, *d.* corolla, ×7, *e.* sepals, ×7, *f.* stamens, ×7, *g.* young fruit, operculum partly removed, ×7, *h.* node with a whorl of hairs, ×5 (*a–h* WEBER *s.n.*).

2–20 by 0.8–7 mm with *c.* 5 mm long axillary hairs. *Flowers* terminal, 1(–3) on an infundibuliform, profusely hairy stem-apex, at edge with 4, seldom more leaves. *Sepals c.* 3 mm long. *Petals* 4, obovate, up to 5 by 4 mm, yellow. *Stamens* 8 or 12; filaments up to 3½ mm; anthers *c.* 0.30 by 0.30 mm. *Style* up to *c.* 4 mm with (3–)4(–5) arms. *Fruit* ± obovate, up to *c.* 2–3½ by 3 mm; operculum *c.* ⅔ the height, shining, straw-yellow. *Seeds* ∞, 0.8–1 mm ø, dull; testa cells elliptic, radially arranged, the surface either convex or with a pyramidal tubercle.

Distr. Pantropic, except Australia and the Pacific east of Samoa, throughout *Malesia*.

Ecol. Waysides, deforested land, ruderal places, often between gravel or in sand, not on the sandy beach, below *c.* 300 m. *Fl. fr.* Jan.–Dec.

Uses. A native vegetable and used as a medicine. See HEYNE, Nutt. Pl. (1927) 613; CAIUS, J. Bomb. Nat. Hist. Soc. 41 (1939) 369; QUISUMBING, Med. Pl. Philip. (1951) 284; BURKILL, Dict. ed. 2, 2 (1966) 1833.

Vern. *Rumput sĕgan*, Mal. Pen.; *gèlang pasir, krĕmi*, J; Philip.: *marañgalok*, Ilk., Ib., *sayikan*, Tag.; *djalu djalu bubudo*, Ternate.

Note. Several authors have determined specimens of *P. pilosa* as *P. quadrifida*, especially in New Caledonia and in the rest of the Pacific.

2. Section Portulaca

1. *Subsection Portulaca*

GEESINK, Blumea 17 (1969) 291. — *Sect. Carinatae* POELLN. in Fedde, Rep. 37

(1934) 242. — *Sect. Portulaphiton* LEGRAND, Com. Bot. Mus. Hist. Nat. Montevideo 31, 1 (1953) 6.

At least the middle-cauline leaves spirally arranged. Hairs, if present, only axillary. Bracts and bracteoles membranous.

2. Portulaca oleracea LINNÉ, Sp. Pl. (1753) 445; BL. Bijdr. (1826) 1136; DC. Prod. 3 (1828) 353; MIQ. Pl. Jungh. (1855) 396; Fl. Ind. Bat. 1, 1 (1858) 1061; Sum. (1860) 150; BENTH. & F. v. M. Fl. Austr. 1 (1863) 169; DYER, Fl. Br. Ind. 1 (1874) 247; BLANCO, Fl. Filip. ed. 3, 2 (1878) 162, t. 164; KING, J. As. Soc. Beng. 59, ii (1890) 144; BACKER, Fl. Bat. 1 (1907) 80; Voorl. (1908) 18; Schoolfl. (1911) 84; MERR. Fl. Manila (1912) 200; Int. Rumph. (1917) 217; Sp. Blanc. (1918) 142; RIDL. Fl. Mal. Pen. 1 (1922) 151; MERR. En. Philip. 2 (1923) 136; BACKER & SLOOT. Theeonkr. (1924) 110, t. 110; HEYNE, Nutt. Pl. (1927) 612; BACKER, Onkr. Suiker. (1930) 243, Atlas t. 254; POELLN. in Fedde, Rep. 37 (1934) 258; BACKER & BAKH. *f.* Fl. Java 1 (1963) 216; GEESINK, Blumea 17 (1969) 292. — *P. diptera* ZIPP. *ex* SPAN. Linnaea 15 (1841) 207, *nom. nud.*

Herb, up to *c.* 40 cm. *Leaves* spirally arranged to subopposite, obovate to spathulate, up to 40 by 20 mm, with inconspicuous, up to *c.* 1 mm long axillary hairs. Capituli 2–30-flowered. Mostly 1–2(–3) of the 2–8 involucral leaves with an axillary axis. *Flowers* surrounded by up to *c.* 5 by 6 mm long bracteoles and inconspicuous hairs. *Sepals* up to *c.* 6 by 6 mm, carina up to *c.* 3 by 2 mm. *Petals* (4–)5, broadly obovate, up to 7 by 6 mm, yellow. *Stamens* 7–10(–15); filaments up to 4 mm; anthers 0.2–0.5 by 0.2–0.4 mm. *Style* up to *c.* 5 mm with (4–)5 arms. *Fruit* ovate, *c.* 4 by 3 mm; operculum ⅓–½, as high as the fruit, shining, straw-yellow. *Seeds* ∞, ½–1.2 mm ø, granulate; testa cells stellulate, with many fine tubercles.

Distr. Pantropic, throughout *Malesia.*

Ecol. Waysides, deforested and ruderal places, sandy shores, even on exposed rocks, up to 1800 m. *Fl. fr.* Jan.–Dec.

Uses. Eaten as a vegetable and used as a medicine. See HEYNE, Nutt. Pl. (1927) 612; OCHSE & BAKH. Ind. Groent. (1930) 615; BURKILL, Dict. (1935) 1833; CAIUS, J. Bomb. Nat. Hist. Soc. 41 (1939) 369; W. H. BROWN, Useful Pl. Philip. 1 (1950) 520.

Vern. *Purslane*, E, *postelein, porselein*, D; *gèlang*, S, M, J, *gèlang pasir, sesegan*, M, *krokot*, J, *rè-sèrèjan*, Mad., *silobar pinggan*, M (Sum.), *segan jantan, rumput bĕremi*, M (Mal. Pen.); Philip.: *alusíman, ausíman, galusíman*, Bik., *olasíman, sahíkan, ulisíman*, Bik., Tag., *golasíman, kolasíman, makabling*, Tag., *bakbakad, luñgum*, If., *dubdupil*, Bon., *ñgalug*, Ilk., *kantatába*, Pangasinan; *djalu djalu kiki*, Ternate.

Notes. Several authors distinguished the subspecies (or varieties) *oleracea* (syn. *sylvatica*) and *sativa*, the latter is the cultivated form. The difference is probably caused by a different chromosome number (according to a letter of G. TISCHLER to O. DEGENER) added to a Hawaiian specimen in the Bishop Museum: "*sativa*" would be a hexaploid with 2n = 54, "*sylvatica*" a diploid with 2n = 18. In the herbarium these two taxa cannot sharply be separated: "*sativa*" is generally tall, with large seeds, "*sylvatica*" is smaller, with smaller seeds, but they are connected by transitional specimens also.

For an anatomical comparison of the seeds of these two forms, see KOWAL, Monogr. Bot. 12 (1961) 1, who also found the characters overlapping .

3. Portulaca lutea FORSTER [Pl. Esc. (1786) 72, *nomen*] *ex* SEEMANN, Fl. Vit. (1865) 9; GEESINK, Blumea 17 (1969) 291.

Herb, up to 70(?) cm. *Leaves* spirally arranged to subopposite, obovate to orbicular, up to *c.* 30 mm long, not translucent in the dried state, with up to 6 mm long axillary hairs. Capituli 1–6-flowered. *Flowers* surrounded by up to 4 by 2 mm long bracteoles and up to *c.* 2 mm long hairs. *Sepals* suborbicular up to *c.* 9 mm long, fleshy in centre, with an up to 4 by 1½ mm long, dorsal, apical keel. *Petals* 5, broadly obovate to obovate, up to *c.* 10 mm, emarginate to mucronate, yellow. *Stamens* 18–*c.* 50; filaments up to *c.* 4 mm; anthers up to *c.* 0.7 by ½ mm, at least occasionally red. *Style* up to *c.* 5 mm with (4–)5 arms. *Fruit* ± ovate, *c.* 7 by 5 mm; operculum ⅔ as high as the fruit, shining, straw-yellow. *Seeds* ∞, up to *c.* 1 mm ø; testa cells stellulate, flat, convex, whether or not with tubercles or spines.

Distr. Pacific Islands, from Samoa and New Caledonia to the Marquesas, not yet recorded from *Malesia.*

2. *Subsection Stellulato-tuberculatae*

POELLN. in Fedde, Rep. 37 (1934) 242; GEESINK, Blumea 17 (1969) 293. — *Sect. Rotundatae* POELLN. in Fedde, Rep. 37 (1934) 242. — *Sect. Pseudohipsoclasis* LEGRAND, Com. Bot. Mus. Hist. Nat. Montevideo 31, 1 (1953) 7. — *Sect. Catoclasis* LEGRAND, Com. Bot. Mus. Hist. Nat. Montevideo 31, 1 (1953) 8; *ibid.* 34, 1 (1958) 10, *excl. subsect. Squamosae.*

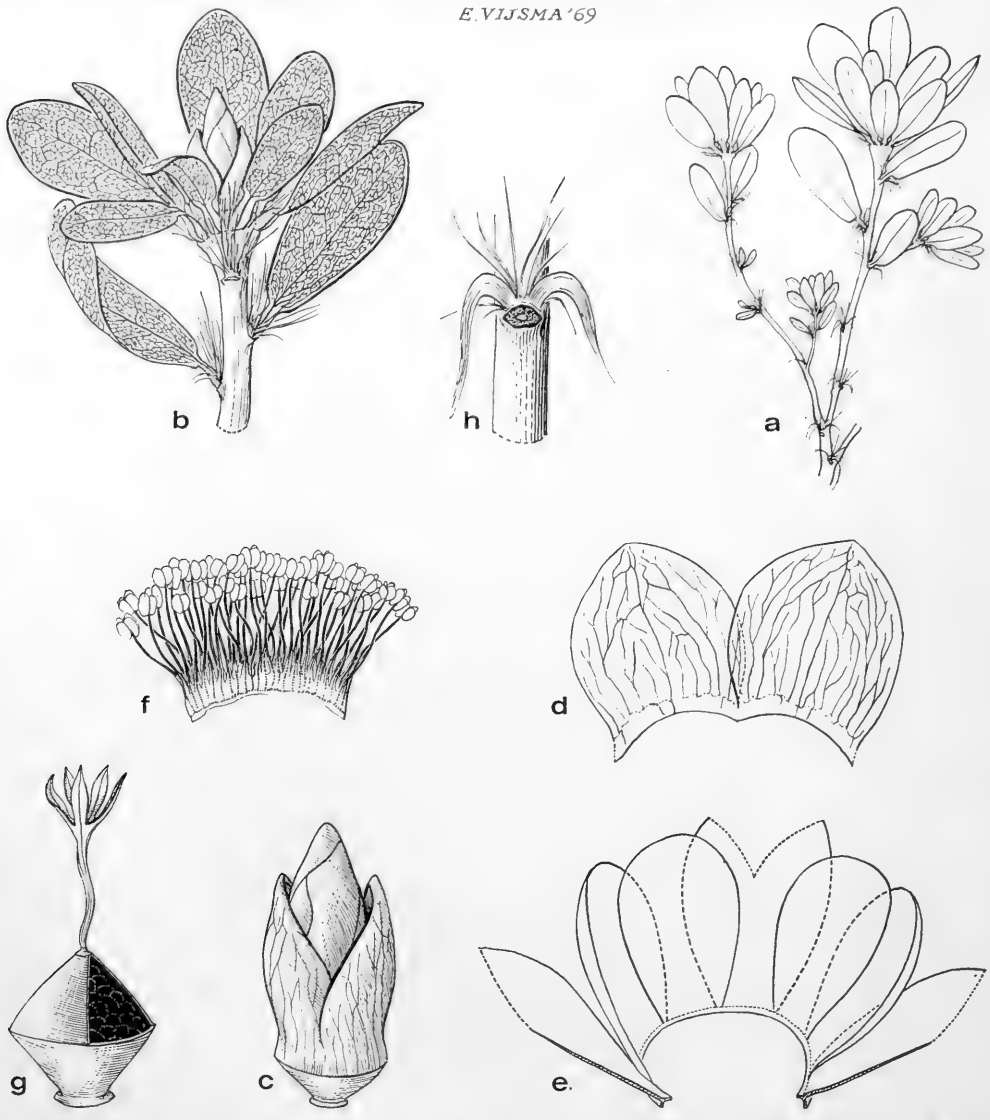

Fig. 5. *Portulaca macrorhiza* GEESINK. *a.* Branch, nat. size, *b.* flowering end of a branch, ×2, *c.* flower, ×5, *d.* sepals, ×5, *e.* corolla, the frontal petal halved, ×5, *f.* stamens, ×7, *g.* young fruit, the operculum partly removed, ×7, *h.* node with axillary hairs, ×5 (*a–h* ZIPPELIUS *s.n.*, type, HLB 200, 850, L).

4. Portulaca macrorhiza [ZIPP. *ex* SPAN. Linnaea 15 (1841) 207; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1060; PAX & HOFFM. in E. & P. Nat. Pfl. Fam. ed. 2, 16c (1934) 247, *nom. nud.*] GEESINK, Blumea 17 (1969) 293. — **Fig. 5.**

Herb, up to 10 cm. *Leaves* spirally arranged, obovate to spathulate, up to *c.* 30 by 8 mm, obtuse to truncate; axillary hairs up to *c.* 4 mm. Capituli 2–3-flowered. *Flowers* surrounded by up to *c.* 3 mm long hairs and *c.* 1½ by 1.7 mm long bracteoles. *Sepals* *c.* 5.3 mm. *Petals* broadly obovate, *c.* 7 (by 5?) mm, yellow. *Stamens c.* 60; filaments up to *c.* 4 mm; anthers *c.* 0.6 by 0.4 mm. *Style c.* 4 mm with 5 arms. *Fruit* globose, *c.* 3 mm ø; operculum about half as high as the fruit, shining, straw-yellow. *Seeds* ∞, elliptic, *c.* 0.7 by ½ mm; testa cells elliptic, ± stellulate, shining.

Distr. *Malesia*: Lesser Sunda Islands (W. and E. Timor).

Ecol. On limestone karst, *c.* 350 m, in E. Timor (Baucau), only once noted. *Fl. fr.* Dec. (one record).

Uses. As a medicine against gonorrhoea.
Vern. *Nati biti*, Timor.

5. Portulaca pilosa LINNÉ, Sp. Pl. (1753) 445; BACKER, Schoolfl. (1911) 84; MERR. Fl. Manila (1912) 235; En. Philip. 2 (1923) 136; RIDL. Fl. Mal. Pen. 5 (1925) 289; HEYNE, Nutt. Pl. (1927) 612; POELLN. in Fedde, Rep. 37 (1934) 261; HENDERSON, Mal. Wild Fl. 4 (1949) 33; BACKER & BAKH. *f.* Fl. Java 1 (1963) 216; GEESINK, Blumea 17 (1969) 294.

Variable herb. *Leaves* spirally arranged, obovate to linear, 2–30 mm long, with axillary hairs. Capituli 1–12-flowered. *Flowers* surrounded by bracteoles and hairs. *Petals* 4–6. *Stamens* (6–)10–75. Style arms 4–8. *Fruit* ovate, globular or obovate; operculum ½ to ¾ as high as the fruit. *Seeds* ∞; testa cells elliptic to stellulate.

KEY TO THE SUBSPECIES

1. Ripe seeds bluish, grey, or dull black.
2. Cells of the testa convex to pyramidal, without a nipple. Petals 2½–12 by 1.8–11 mm. **1.** *ssp.* **pilosa**
2. Cells of the testa flat, but at seed-edge nippled. Petals larger, up to *c.* 25 mm ø. **2.** *ssp.* **grandiflora**
1. Ripe seeds dark brown or shining black.
3. Cells of the testa stellate, in shape orbicular, sometimes nippled. Flowers orange to red. **3.** *ssp.* **sundaensis**

1. *ssp.* **pilosa.** — GEESINK, Blumea 17 (1969) 295. — *P. tuberosa* ROXB. Fl. Ind. ed. Carey 2 (1832) 464; DYER, Fl. Br. Ind. 1 (1874) 246; BACKER, Voorl. (1908) 19; Schoolfl. (1911) 85; POELLN. in Fedde, Rep. 37 (1934) 312; BACKER & BAKH. *f.* Fl. Java 1 (1963) 216 (*race tuberosa*). — *P. australis* ENDL. Atakta Bot. (1833) 7, t. 6; ? J. J. SMITH, Teysmannia 10 (1899) 92 (*race australis*). — *P. helianthemoides* ZIPP. *ex* SPAN. Linnaea 15 (1841) 207, *nomen* (*race tuberosa*). — *P. cincta* FENZL, Nat. Tijd. N. I. 14 (1857) 162; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1061; BOERL. Handl. 1 (1890) 85; POELLN. in Fedde, Rep. 37 (1934) 312 (*race tuberosa*). — *P. filifolia* F. v. M. Fragm. 1 (1859) 169 (*race filifolia*). — *P. sclerocarpa* [*non* GRAY, Bot. U.S. Expl. Exp. 1 (1854) 141] KOORD. Minah. (1898) 345; KOORD.-SCHUM. Syst. Verz. 3 (1914) 40, record corrected to *P. pilosa* (*race pilosa*). — *P. pachyrhiza* [*non* GAGN. Bull. Soc. Bot. Fr. 56 (1909) 41] MERR. En. Philip. 2 (1923) 136 (*race tuberosa*). — *P. samoensis* POELLN. in Fedde, Rep. 33 (1933) 163; *ibid.* 37 (1934) 300 (*race tuberosa*). — *P. javanensis* POELLN. Rev. Sudamer. Bot. 7 (1943) 273, *incl. var. grisea* POELLN. (*race tuberosa*).

Herb, 10–*c.* 30 cm. *Leaves* elliptic to linear, 4–28 by ½–4 mm; axillary hairs 1–18 mm long. Capituli (1–)2–10-flowered; more or less congested with adjacent quasi-axillary capituli. *Flowers* surrounded by 0.7–2½ by 0.7–2.2 mm long bracteoles and 3–18 mm long hairs. *Sepals* 2–6 by 1–4 mm, occasionally inconspicuously hooded at apex. *Petals* 4–6, obovate, 2½–12 by 1.8–11 mm, yellow or pink. *Stamens* (7–)20–30(–35?); filament 1–5 mm; anthers globose to elliptic, 0.35–0.7 mm. *Style* 2–8 mm, 3–7-fid. *Fruit* ± globose, *c.* 2–3(–4) mm ø; operculum ½ to ⅔ as high as the fruit, shiny, straw-yellow to olive green. *Seeds* 0.4–0.7 mm ø, dull light to dark grey, or bluish; testa cells elliptic, elliptic with lobes or stellate; pyramidal all over the seed, or not.

Distr. Pantropical, throughout *Malesia*.

Taxon. A subspecies consisting of several 'races', which are easy to distinguish as shown in the following table.

Race	Range	Petals	Stamens	Length anthers	Seed ø	Colour seed	Shape testa cells	Surface testa cells
pilosa	pantrop., excl. Austr.	pink	(7–)20–30	0.5	0.4–0.6	blue	stellate	pyramidal
tuberosa	E. Asia, Malesia, W. Pacific	yellow	(17–)25–30	0.7	0.6–0.7	dark grey	elliptic, lobed, stellate at seed edge	convex
filifolia	Australia, Java: in Hort. Bogor	yellow	12–30	0.4	0.6–0.7	bright grey	stellate	pyramidal

P. australis ENDL. is entered in the synonymy, but it remains uncertain whether this race was indeed represented by the material J. J. SMITH identified from the island Groot Kombuis (Bay of Djakarta), as no specimen is available. The Australian *race filifolia* is only represented by specimens collected in the Botanic Gardens at Bogor.

Uses. A native vegetable and used as a medicine. See OCHSE & BAKH. Ind. Groent. (1931) 615, and CAIUS, J. Bomb. Nat. Hist. Soc. 41 (1939) 369.

Vern. *Rose-flowered purslane*, E, *pĕnawar*, M (Mal. Pen.), *rebha leòkah*, Mad.; Philip.: *romrukú*, Ilk.; *njalè njalè wolanda*, Ternate.

2. *ssp.* **grandiflora** (HOOK.) GEESINK, Blumea 17 (1969) 297. — *P. grandiflora* HOOK. Bot. Mag. n.s. 3 (1829) t. 2885; BACKER, Voorl. (1908) 19;

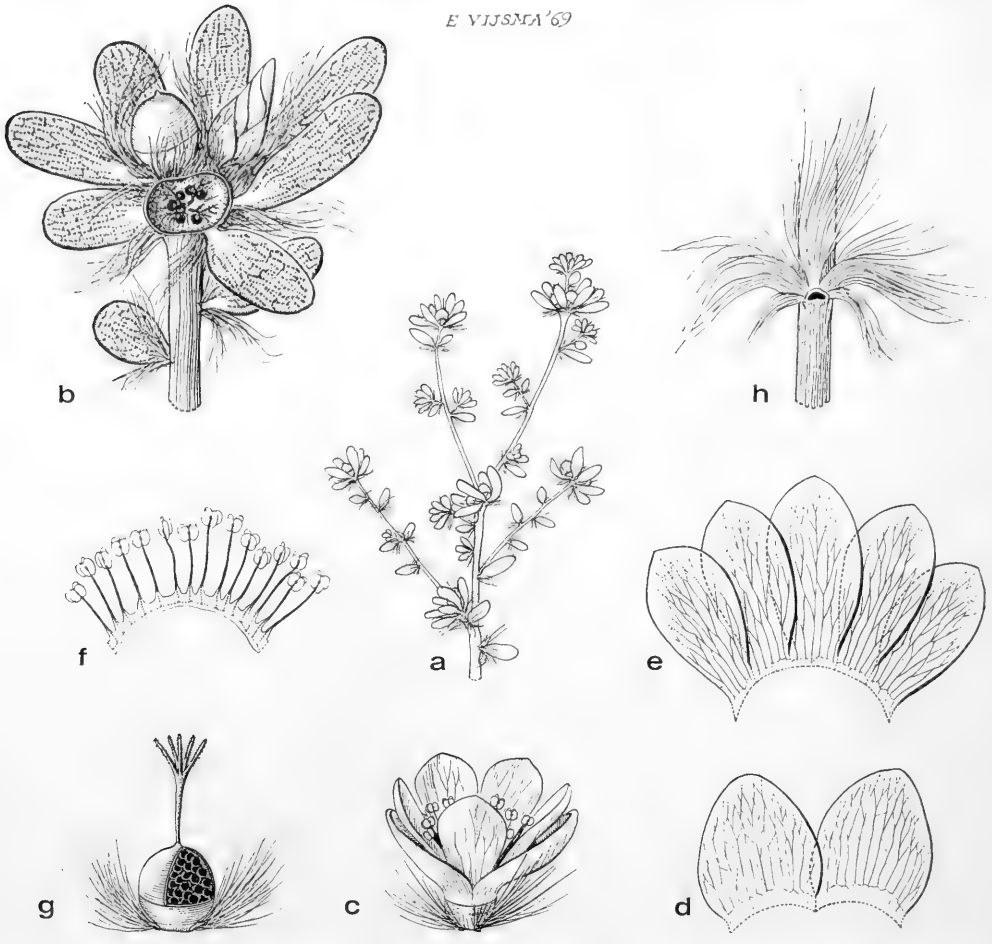

Fig. 6. *Portulaca pilosa* L. *ssp. sundaensis* (POELLN.) GEESINK. *a.* Habit, ×1½, *b.* flowering end of a branch ×5, *c.* flower, ×5, *d.* sepals, ×7, *e.* corolla, ×7, *f.* stamens, ×7, *g.* young fruit, ×7, *h.* node with axillary hairs, ×5 (*a–h* JAAG 799, L).

Schoolfl. (1911) 85; BRUGGEMAN, Ind. Tuinb. (1938) 84, t. 55; STEEN. Fl. Sch. Indon. (1949) 176; BACKER & BAKH. *f.* Fl. Java 1 (1963) 216.

Herb, up to *c.* 30 cm? *Leaves* linear, up to 25 by 3 mm, with *c.* 5 mm long axillary hairs. *Flowers* in each capitulum up to *c.* 5, flowering succedaneously, each surrounded by up to 10 mm long hairs and deltoid, up to 4.7 by 2 mm long bracteoles; transitions between leaves and bracteoles present. *Sepals c.* 8 mm long, with a very small apical keel. *Petals* ± obovate, *c.* 25 mm ø, pink, red, orange or yellow (cultivated in many colours). *Stamens c.* 40–75; filaments up to *c.* 6 mm; anthers elliptic, *c.* 1.4 by 0.3 mm, 2- and 4-celled. *Style* up to *c.* 13 mm, with 5–18 arms. *Fruit* ± globose, *c.* 5 mm ø; operculum ⅔ to ½ as high as the fruit, shining, straw-yellow. *Seeds c.* 0.7 mm ø, shining; testa cells ± stellulate, those at the edge of the seed with a central tubercle.

Distr. Native of tropical America, cultivated as an ornamental and occasionally escaped elsewhere.

3. *ssp.* sundaensis (POELLN.) GEESINK, Blumea 17 (1969) 298. — *P. sundaensis* POELLN. in Fedde, Rep. 50 (1941) 105. — **Fig. 6.**

Herb, up to *c.* 10 cm. *Leaves* oblong to obovate, up to 7 by 3 mm, with up to 6 mm long hairs. Capituli 2–3-flowered. *Flowers* surrounded by up to 0.7 by 1 mm long bracteoles and *c.* 6 mm long hairs. *Sepals* 5, *c.* 2.6 by 2.2 mm. *Petals* obovate, subacute, *c.* 2.3 by 1.7 mm, orange. *Stamens* (6–)10–15; filaments *c.* 1½ mm; anthers *c.* 0.4 by 0.35 mm. *Style c.* 1.6 mm, with 5 arms. *Fruit* ± globose, *c.* 2½ mm ø; operculum ¾ as high as

the fruit, dull, grey-brown. *Seeds c.* 0.55 mm ø, ± shining; testa cells stellulate.

Distr. *Malesia*: Lesser Sunda Islands (Sumbawa, Flores, Wetar, Alor), from each island one specimen.

Ecol. Close to the coasts, along roads, between rocks.

Vern. *Tamásiang áta*, Alor.

Excluded

Portulaca axilliflora (*non* PERS.) BLANCO, Fl. Filip. ed. 2, 2 (1845) 285 and *P. toston* BLANCO, Fl. Filip. (1837) 408 are both, according to MERRILL, En. Philip. 2 (1923) 136, *Trianthema portulacastrum* L. (*Aizoac.*).

Portulaca teretifolia L.; F.-VILL. Nov. App. (1880) 15, an American species, probably an incorrect identification.

BYBLIDACEAE (C. G. G. J. van Steenis, Leyden)

In the former century *Byblis* was mostly included in the *Droseraceae*, for example by BENTHAM & HOOKER. *f.* (Gen. Pl. 1, 1859, 220); even ENGLER had it in that position in 1912 (Syllabus ed. 7, 329). PLANCHON had in 1848 (Ann. Sc. Nat. III, 9, 1848, 80, 90) already pointed to affinity with *Cheiranthera* of the *Pittosporaceae*; HALLIER *f.* merged *Byblis* and *Roridula* with *Tremandraceae*, curiously referring this to an Ochnaceous assemblage (Abh. Gebiete Naturw. Hamburg 18, 1903, 53). About the same time LANG argued (Flora 88, 1901, 179) that on morphological and anatomical grounds *Byblis* cannot belong to *Droseraceae*, but should be referred to *Lentibulariaceae*.

DIELS (Pfl. R. Heft 26, 1907, 51) and DOMIN (Act. Bot. Bohem. 1, 1922, 1) definitely concluded to the alliance with *Pittosporaceae*, and so did HUTCHINSON (1926, 1959) and SCHULTZE-MENZ (Syllabus 1964): resemblance with *Drosera* is superficial, sympetaly unimportant. HALLIER *f.* and HUTCHINSON include the S. African genus *Roridula* also in the family *Byblidaceae*, but others regard this as an allied family.

BYBLIS

SALISB. Parad. Lond. (1808) t. 95; BTH. Fl. Austr. 2 (1864) 469; LANG, Flora 88 (1901) 179; DOMIN, Act. Bot. Bohem. 1 (1922) 1; Bibl. Bot. 22 (1929) 702; DIELS in E. & P. Nat. Pfl. Fam. ed. 2, 18a (1930) 288; VESTER, Bot. Arch. 41 (1940) 563, map 192. — **Fig. 1.**

Erect herbs, viscid, by longitudinal rows of minute, sessile glands and capitate-glandular hairs. *Leaves* linear to filiform, involute-coiled in vernation, exstipulate, spirally arranged. *Flowers* axillary, solitary, without bracteoles, 5-merous. *Sepals* imbricate, persistent, short-connate at the base. *Petals* larger than sepals, contorted, with a broad, dentate apex and cuneate base, oblique, ± connate at the very base. *Stamens* 5, sometimes unequal; anthers basifixed, alternipetalous, cells opening with a very short pore-like slit. Disk none. *Ovary* superior, 2-celled, with ∞ ovules attached to the axis of the dissepiment about the middle; integument 1; style 1, simple, with a faintly 2-lobed stigma. *Capsule* ± compressed, 2-celled, loculicid with 2 valves, sometimes the valves later splitting, the dissepiment splitting ± halfway. *Seeds* dark, rugose; embryo elongate, cylindric; cotyledons short, fleshy; albumen present.

Distr. Two *spp.*, one in SW. Australia, the other from NW. to NE. Australia, in *Malesia*: the N. Australian species in South New Guinea.

Ecol. This is the fifth genus of insectivorous plants in Malesia, the others being *Nepenthes*, *Utricularia*, *Drosera* and *Aldrovanda*. Both species grow in depressions which are swampy on poor soils or which become swampy or water-logged in the wet season. Often gregarious.

The way of catching insects (small flies, mosquitoes, moths and ants) superficially resembles that in *Drosera*, but differs in that the capitate-glandular hairs make no movement towards the prey. RICA ERICKSON (Austr. Pl. 3, 1966, 319, 321) calls it a 'flypaper trap of the passive type'. According to GRIEVE (*ibid.* 1, *n.* 9, 1961, 23) "insects are usually first caught by the sticky mucilage exuded from the gland-tipped hairs and these tend to collapse or bend as they pour out secretion. The insect is thus also brought into contact with the numerous, minute sessile glands and becomes enveloped in additional secreted fluid. The process of secretion and absorption continues until all of the soft parts of the insect are dissolved and absorbed, and only the hard, indigestible parts remain. The glands then stop secretion and the stalked ones commence to recover to their normal position. In due course the hard parts of the insect which are left dry out and fall off."

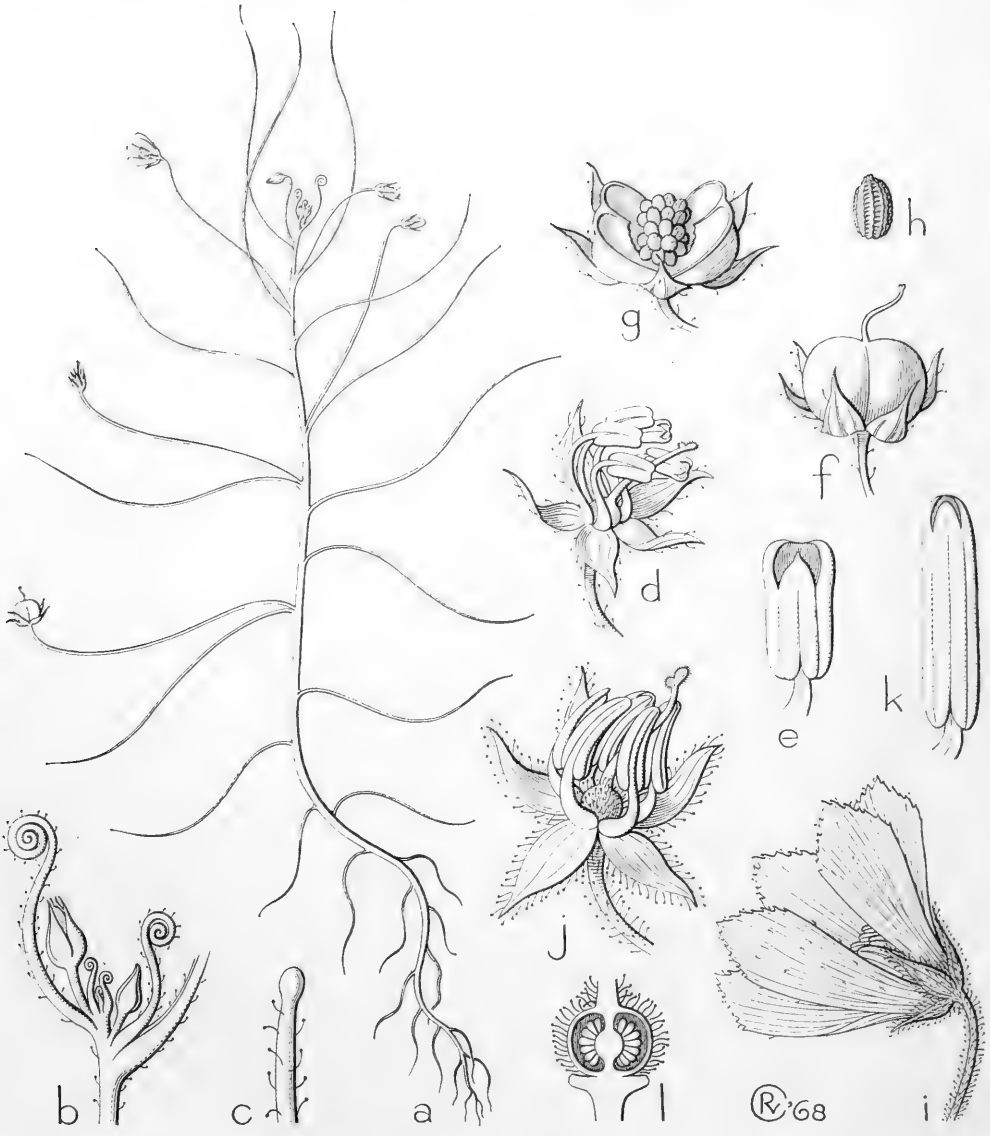

Fig. 1. *Byblis liniflora* SALISB. *a.* Habit, ×⅔, *b.* stem tip, ×4, *c.* leaf tip, ×12, *d.* flower, corolla removed ×4, *e.* anther, ×12, *f–g.* fruit, ×4, *h.* seed, ×8, *i.* flower, ×3, *j.* flower, corolla removed, ×4, *k.* anther ×12, *l.* lengthwise section of ovary (*a–h* HOOGERWERF 273, *i–l* BYRNES 230).

It has been suggested that the capitate-glandular hairs secrete a sticky mucilage, but that the secretion of the sessile ones is less sticky and would serve mainly for digesting proteins, but I have no pertinent data to sustain this opinion.

The large West Australian species, *B. gigantea*, is well-known as the 'rainbow plant', a name "believed to be derived from the fact that on looking through the plant towards the setting sun, one can see a spectrum of colours where the edges of the leaves are bordered by the shining drops of liquid on the glands."

Anat. FENNER (Flora 93, 1904, 382–388) gave a detailed account of the anatomy of the glands of *B. gigantea* LINDL.

1. Byblis liniflora SALISB. Parad. Lond. (1808) t. 95; DC. Prod. 1 (1824) 319; ENDL. Iconogr. (1841) t. 113; BTH. Fl. Austr. 2 (1864) 470; F. v. M. Fragm. 10 (1876) 81; BAILEY, Queensl. Fl. (1900) 551; Compr. Cat. (1913) 174, f. 145; BRITTEN, Ill. Pl. Banks 1 (1900) 30, t. 96; EWART & DAVIES, Fl. North. Terr. (1917) 117; DOMIN, Act. Bot. Bohem. 1 (1922) 4; Bibl. Bot. 22 (1929) 703; SPECHT, Rec. Am.-Austr. Exp. Arnhem Land 3 (1958) 231; STEEN. Blumea 16 (1968) 355. — **Fig. 1.**

Unbranched, weak herb, *c.* 15–40 cm. Rhizome thin. *Leaves* filiform, very thin, blunt, *c.* 4–6 cm, spreading. Pedicels already from the base of the plant, usually exceeding the leaves, in fruit up to *c.* 10 cm, patent, the lower ones reflexed. Pistil and stamens somewhat zygomorphic. *Sepals* ovate-lanceolate, acute, erect, 3–4 mm, with scarious margin, glabrous, *c.* 3–4 by 1½ mm. *Petals* oblanceolate, acute, with dentate upper margin, 4–8(–11) mm. *Stamens* glabrous, anthers varying from 1½–3 mm, filaments longest where anthers are shortest. *Ovary* glandular; style *c.* 3 mm. *Capsule* transversely elliptic, with 2 shallow grooves, *c.* 2 by 4 mm. *Seeds* ellipsoid, at one end ± pointed, black, 1 mm, lengthwise ribbed, ladder-like tessellate between the ribs.

Distr. Queensland to NW. Australia, in *Malesia*: South New Guinea (near Merauke: HOOGERWERF 273), one collection.

Ecol. Marsh herb of shallow, seasonal swamps in *Melaleuca-Acacia-Tristania-Eucalyptus* savannah, at very low altitude. *Fr.* March.

CLETHRACEAE (H. Sleumer, Leyden)

1. CLETHRA

LINNÉ, Gen. Pl. ed. 5 (1754) 188; Sp. Pl. (1753) 396; SLEUM. Bot. Jahrb. 87 (1967) 55. — **Fig. 1–5.**

Trees or shrubs, evergreen (Mal. *spp.*); leaf-scars large. *Leaves* crowded towards the end of the shoots, spiral, simple, exstipulate, serrate with glandular teeth, often with an apical gland, more rarely entire; nerves a little decurrent along the midrib, both midrib and nerves ± impressed above, ± prominent beneath. Indumentum of branchlets, leaves and inflorescences consisting of simple, and/or long, fascicled and ± patent, and/or minor, ± depressed stellate hairs. *Flowers* bisexual, regular, 5(–6)-merous. Inflorescences sometimes simple solitary terminal racemes, but mostly consisting of a terminal raceme and several lower approximate racemes, each of the latter from the axil of a ± reduced or caducous leaf, thus forming together a panicle-, fascicle- or umbel-like inflorescence; bracts mostly caducous during anthesis, rarely subpersistent. *Calyx lobes* 5(–6), persistent, quincuncially imbricate, united at the base only. *Petals* 5(–6), generally free, sometimes cohering to some degree, alternate with the calyx lobes, rather early caducous, generally sweet-scented. *Stamens* 10(–12) in 2 whorls of 5(–6), the outer whorl opposite the petals, the inner one opposite the calyx lobes; filaments adnate to the corolla at the extreme base; anthers dorsifixed, overturned outwards in bud, erect in anthesis, introrse, upper part of cells ± divergent, opening with apical, slit-like pores; pollen grains single, tricolporate, psilate. *Ovary* superior, 3-celled, with axile placentation; ovules ∽, small, anatropous; style simple, mostly shortly, very rarely hardly divided into three apical lobes, sometimes more deeply so and trifid, each lobe stigmatic at the top. *Fruit* a 3-valved, loculicidal capsule, the septae of which become loose from the persistent central axis, subtended or ± enclosed at maturity by the persistent calyx. *Seeds* ∽, small, subovoid to irregularly angular or subtrigonous, with a foveolate-reticulate testa (all Mal. *spp.*). Endosperm fleshy. Embryo cylindrical.

Distribution. A small, monogeneric family in the *Ericales*, of (sub)tropical Asiatic-Malesian, and temperate and tropical American distribution, and with 1 *sp.* in Macaronesia (Madeira, and formerly in Teneriffe).

Of the total of 64 *spp.*, 2 temperate *spp.* are found in North America (*C. alnifolia* L. and its *var. pubescens* AIT., and *C. acuminata* MICHX), 38 *spp.* inhabit (sub)tropical America (Cuba-Jamaica-Central America, in S. America in the Mt Roraima area and in Trinidad, in the Andes from Venezuela to SE. Bolivia and NW. Argentina, and a small separate area in SE. Brazil), 10 *spp.* are found in SE. Asia (Upper Burma, SW., Central and SE. China, Japan, Indo-China).

In Malesia 13 *spp.*, of which 2 in the Malay Peninsula, 1 in Sumatra, 1 in Java, 3 in the Lesser Sunda Islands, 4 in the Philippines, 3 in Borneo, 2 in Celebes, 1 in the Moluccas, and 4 in New Guinea. Fig. 2.

Ecology. *Clethra* occurs mainly in the lower and upper montane primary (and also secondary) forest. As to climate, the genus prefers the wet montane tropical and subtropical zone, though it extends far into the northern temperate zone, in North America to about 45°, in Japan to about 42° N, whilst its southern limit is about 29° S in SE. Brazil. As the majority of the *Ericales*, *Clethras* have preference for acid soils. They occur in Malesia from sea-level to about 3000 m; and up to *c.* 3800 m in Szechuan and Yunnan, and in the Andes. They are light-demanding, remain sterile in dense forest, and flower in forest borders with open vegetation or exclusively in the latter, also in light secondary plant communities.

Dispersal. Nothing is known about the dispersal of *Clethras*. The rather small, deeply impressed-reticulate and light seeds of the Malesian *spp.* point to dispersal by wind.

Anatomy. DEN BERGER, Determinatietabel van Malesië, Veenman, Wageningen (1941) 31 (hand

Fig. 1. *Clethra pachyphylla* MERR. *a.* Habit, ×⅔, *b.* flower, ×4, *c.* petal, ×4, *d.* stamens in bud stage, ×4, *e.* stamens at full anthesis, ×4, *f.* longitudinal section of flower, ×4, *g.* fruit, ×4, *h.* seeds, ×8 (*a–f* CHEW, CORNER & STAINTON 1845, *g–h* SINCLAIR 9082).

lens, wood); DEN BERGER & BIANCHI, Tectona 24 (1931) 894–903 (wood); HARA, Bot. Mag. Tokyo 70 (1957) 108–114 and J. Fac. Sc. Un. Tokyo, Sect. 3, Bot. 7 (1958) 367–450 (shoot apex and leaf histogenesis); LEMESLE, Bull. Soc. Pharm. Bordeaux 104 (1965) 37–48 (localization of tanniferous substances); LEMESLE & DUPUY, C. R. Ac. Sc. Paris 263 (1966) 250–253 (tannins and mucilagenous substances); SUDO, Identification of Japanese Hardwoods, Bull. Govt. Exp. Stat. Meguro 118 (1959); UPHOF, HUMMEL & STAESCHE, Plant Hairs, in Handb. Pflanzenanat. IV, 5 (1962). For general surveys of older literature see SOLEREDER, Syst. Anat. Dicot. Stuttgart (1899) 541–551 and *ibid.* (1908) 195–197 (under *Ericaceae*), and METCALFE & CHALK, Anat. Dicot. 2, Oxford (1950) 836–839.

The wood shows primitive characters such as narrow solitary vessels with scalariform vessel perforations, fibre-tracheids, apotracheal parenchyma which is diffuse or arranged in short uniseriate bands and heterogeneous rays of two sizes. The petiole is supplied with a strongly incurved to closed vascular strand. Hairs occur as multicellular stellate and uniseriate types. Stomata mainly paracytic. Crystals solitary and clustered. Secretory tanniferous cells are present in the parenchymatous tissues of petiole and stem. METCALFE & CHALK (*l.c.*) state that *Clethra* has many anatomical features in common with *Ericaceae*. — P. BAAS.

Pollination. The flowers are protandrous. The pollen is shed at least partly before the flowers are open and the stigmas are receptive.

Galls. DOCTERS VAN LEEUWEN (Zoocecid. Neth. Ind. 1926, 439, fig. 825 & 826) mentions leaf-galls on *C. sumatrana* from the Petani ravine near Medan, caused by a Psyllid and a gall mite. On the leaves of *C. canescens* in N. Celebes (Minahasa) globular galls are found.

Uses. Temperate species of *Clethra*, mainly from North America, Madeira and Japan, much less from China, are cultivated as ornamentals in many parts of the world. Not a single species from Malesia so far has been introduced in Botanic Gardens.

Phytochemistry. Leucoanthocyanins, caffeic acid, flavonols, taraxeron and ursolic acid are known to occur in species of *Clethra* (HEGNAUER, Chemotax. d. Pfl. 3, 1964, 432–433; TANABE *c.s.* J. Pharm. Soc. Japan 86, 1966, 441). This spectrum of phytoconstituents is compatible with the generally accepted relationship between *Clethraceae* and *Ericaceae*. — R. HEGNAUER.

Taxonomy. A monograph of the genus has been published by the author (Bot. Jahrb. 87, 1967, 36–175, pl. 1). In this work it was shown, that the North American and the Asiatic-Malesian species of *Clethra* belong to *sect. Clethra* by their subovoid to subtrigonous and impressedly reticulate seeds, whilst the Central and South American species and *C. arborea* in Madeira form a second section, *Cuellaria*, distinguished by flat and variously winged seeds.

For the determination of *Clethras* close observation of the indumentum with a lens is necessary. There are (i) simple, mostly rather long, appressed or patent hairs, (ii) fascicled, ± obliquely erect, generally elongated hairs, (iii) stellate hairs of generally small size and ± flattish. On most *Clethras* a combination of 2 or all 3 types of hairs is found, but their density may differ greatly on the various organs, resulting in a fine tomentellous, a thicker tomentulose or tomentose to villous tomentum of white to greyish, pale ferrugineous to dark rusty and even rufous colour. Besides the various kinds of hairs, the discrimination of species is based on floral characters. Collectors should try to collect flowering material *and* (sterile) branchlets with young, not yet glabrate leaves *from the same specimen*, and abstain from collecting sterile or fruiting material.

KEY TO THE SPECIES

1. Filaments hairy.
2. Filaments hirsutulous. Style elongate in fruit (up to 12 mm) . . . . . **1. C. sumatrana**
2. Filaments laxly set with longish hairs. Style a little or hardly elongate in fruit (up to 7 mm).
3. Leaves subcoriaceous, practically glabrous in mature state. Inflorescence dilutely rusty-tomentellous in all parts . . . . . **2. C. hendersonii**
3. Leaves coriaceous, still densely stellate-hairy along midrib and primary nerves in mature state beneath. Inflorescence rusty-villous in all parts. . . . . **3. C. symingtonii**
1. Filaments glabrous.
4. Younger, not yet glabrate leaves (which still show the full quality and quantity of the tomentum) laxly to more densely hairy only on midrib, nerves and veins, and glabrous on the intervenium beneath, mature ones glabrescent, or leaves glabrous from the beginning.
5. Lateral nerves (15–)17–20(–23) pairs, ± approximate to each other. . . . . **4. C. javanica**
5. Lateral nerves 10–12(–14, rarely up to 15) pairs, more distant from each other. **5. C. canescens**
4. Younger, not yet glabrate leaves tomentellous to tomentose all over the undersurface, mature ones but slightly or tardily glabrescent.
6. Younger leaves ± appressedly tomentellous on the intervenium beneath, *i.e.* covered there exclusively with minute, ± flattish stellate hairs.
7. Younger leaves densely covered with minute stellate hairs on the whole undersurface in a coherent layer, and besides more laxly set with stellate-fascicled and darker (generally rusty) hairs on nerves, veins and veinlets . . . . . **6. C. kebarensis**
7. Younger leaves on the undersurface set with dense minute stellate hairs, which form a coherent pale layer, other larger and/or darker stellate-fascicled hairs very few, or mostly absent.

8. Leaves regularly serrate in the upper ⅔, with (15–)17–20 pairs of lateral nerves. **7. C. sumbawaensis**
8. Leaves subserrate to entire, with 10–14 (rarely up to 15) pairs of lateral nerves.
9. Petals 2–2.2(–2.5) mm. . . . . **8. C. tomentella**
9. Petals (3.5–)4(–5) mm. . . . . **9. C. arfakana**

6. Younger leaves ± erectly tomentulose or tomentose on the intervenium beneath, *i.e.* covered there with minute and more coarse stellate (suberect), or with minute stellate *and* coarse (± erect) fascicled hairs.
10. Racemes generally more slender and elongate (flowers ± laxly arranged), and tomentellous by minor stellate, rather flattish hairs. . . . . **10. C. longispicata**
10. Racemes generally more robust and shorter (flowers ± densely arranged) and tomentulose to tomentose by a combination of minor stellate and robust, ± erect fascicled hairs.
11. Pedicels 1–2 mm at anthesis. Style 1–1.5 mm at anthesis, hardly 2 mm in fruit. Lateral nerves of leaves ± inarching before the margin . . . . . **11. C. papuana**
11. Pedicels 2–3(–5) mm at anthesis. Style 2.5–3 mm at anthesis, 3–4 mm in fruit. Lateral nerves of leaves ± excurrent along the margin.
12. Ovary tomentose by long erect hairs. . . . . **12. C. pulgarensis**
12. Ovary tomentulose by short hairs. . . . . **13. C. pachyphylla**

1. Clethra sumatrana J. J. S. Ic. Bog. 4, 1 (1910) t. 319; MERR. Philip. J. Sc. 14 (1919) 248; DOCT. v. LEEUWEN, Zoocecid. Neth. Ind. (1926) 439, f. 825 & 826; METCALFE & CHALK, Anat. Dicot. 2 (1950) 838, f. 192, F–G (anat.); SLEUM. Bot. Jahrb. 87 (1967) 77. — *C. pulcherrima* RIDL. J. Mal. Br. R. As. Soc. *n.* 87 (1923) 75; MERR. Contr. Arn. Arb. 8 (1934) 121. — *C. longipedicellata* MERR. Pap. Mich. Ac. Sc. 19 (1934) 179. — *C. pubifolia* MERR. *l.c.* 180; BURRET, Notizbl. Berl.-Dahl. 15 (1940) 188, *in text.*

Much-branched shrub, or tree with erect or crooked trunk and a dense crown, (3–)5–15 (rarely up to 25) m; bark whitish. Branchlets stoutish, younger parts covered with a rusty stellate tomentum maybe mixed with simple hairs, early glabrescent. *Leaves* lanceolate to oblong- or obovate-elliptic, apex shortly acutely acuminate, base cuneate, thin-coriaceous, young ones covered with a thick tomentum of rusty to rufous shorter stellate and longer fascicled hairs at least on midrib and nerves, older ones mostly rather persistently so by both or but one type of these hairs on the entire undersurface or only on midrib, nerves and maybe veins, generally distantly serrate with callose teeth especially in the upper part of the lamina, rarely subentire or entire, reddish when young, dark green at maturity, 4–11(–15) by (1.5–)2–4.5(–8) cm, nerves in 8–13 pairs, curved-spreading, slightly raised beneath as are the transverse veins, reticulation not conspicuous in general; petiole 6–12(–15, rarely up to 30) mm. *Racemes* elongate, erect-ascendent, 8–30 cm, usually solitary and terminal, more rarely also from the axil of 2 or 3 upper leaves, the latter mostly normal in size and ± persistent, rarely reduced and caducous during anthesis, covered by the same, but generally more dense and more persistent indumentum found in the branchlets and leaves. Pedicels rather slender, 3–10 mm (in fruit 10–20 mm), bracts lanceolate-linear, caducous, 8–15 by 1–2.5 mm. *Calyx lobes* subovate or ovate-oblong, subacute, rusty-tomentellous or -tomentose in the upper part inside and all over outside, the fascicled hairs few to numerous, (4–)5–6(–8) by 2–3 mm. *Petals* obovate, erose-crenulate at apex, glabrous, white-creamy to pinkish, (5–)6–7 (–9) by 4–5(–6) mm. Filaments linear, glabrous at both ends, longish and subappressedly hirsutulous between, 4–5 mm; anthers obsagittate, 1.5–2(–2.5) mm, base extended into an acute triangular appendix. *Ovary* subappressed-hirsute; style slender, glabrous or with a few hairs at the very base, 6–7 mm at anthesis, 8–12 mm in later stages, apex thickened and very shortly trilobed at anthesis, rarely more deeply so in fruit. *Capsule* subglobose, hirsutulous, 4–5 mm ø. *Seeds* sub-obovoid-oblong or subtrigonous, variously compressed, *c.* 1.5 mm.

Distr. *Malesia*: Sumatra (Atjeh, Eastcoast, Tapanuli, in the Westcoast Res. only at Brani near Bukit Tinggi).

Ecol. In primary and secondary forest, also in *Pinus merkusii* forest, (390–)900–3000(–3300?) m. *Fl. fr.* Jan.–Dec.

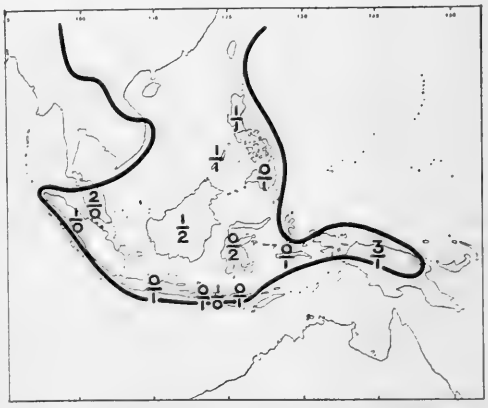

Fig. 2. Distribution of *Clethra* in Malesia and adjacent SE. Asia. The number above the hyphen indicates the number of endemic species, that below the hyphen the number of non-endemic species in each island or district.

Fig. 3. *Clethra hendersonii* SLEUM., Mt Berembán, 1720 m, Malay Peninsula, Cameron Highlands (SLEUMER 4675) (SLEUMER, 1963).

Vern. *Kumbawang*, Karo, *bodi-bodi*, *boli-boli*, *darik-darik*, *hau si martadjau*, *simar darih-darih*, Toba.

2. Clethra hendersonii SLEUM. Bot. Jahrb. 87 (1967) 79. — *C. canescens* (*non* REINW. *ex* BL.) RIDL. J. Fed. Mal. St. Mus. 6 (1915) 158. — **Fig. 3.**

Slender, small or medium-sized, few-branched tree; bark rather smooth, greyish, minutely longitudinally fissured. Branchlets rather slender, dilutely rusty-stellate-tomentellous distally. *Leaves* elliptic-oblong or elliptic, sometimes subovate-elliptic, apex shortly acuminate, base cuneate and slightly inequilateral, subcoriaceous, dark green and dull above, paler and shining below, flush reddish, denticulate-serrulate, 8–10(–12) by 4–5.5(–6) cm, young ones stellate-puberulous, early glabrate above, set with sparse simple hairs at midrib and moreover ± laxly with small stellate hairs at midrib, nerves and veins below, mature ones finally glabrous, nerves (10–)11–13 pairs, curved-ascendent, raised beneath, reticulation faint; petiole rather slender, 1.5–2.2 cm. *Racemes* 2

or 3(–5), subdensely set with flowers, up to 22 cm, tomentellous by rusty-brownish simple and paler stellate hairs in all parts. Pedicels rather robust and 3–4 mm (in fruit 6–7 mm), bracts subulate, 3–4 mm, caducous. *Calyx lobes* oblong, 4–5 by 2 mm. *Petals* obovate, apex erose, spreading, white, slightly fragrant, glabrous on both faces, sparsely fimbriate, (5–)6–7 by (3–)4–5 mm. Filaments laxly set with longish hairs, 5(–6) mm; anthers narrowly obcordate, base acute, 1.8 mm. *Ovary* subsericeous-tomentose; style glabrous, shortly trilobed, 5–6 mm in anthesis, 7 mm in fruit. *Capsule* depressed-globose, 4 by 5 mm, subtended by the spreading sepals, *Seeds* oblong-ovoid, *c.* 1.5 mm.

Distr. *Malesia*: Malay Peninsula (Pahang: Cameron Highlands and Mt Tahan; Selangor: Mt Nuang).

Ecol. Scattered in forest, often on ridges or summits, 1340–1740 m. *Fl.* April–July.

3. Clethra symingtonii SLEUM. Bot. Jahrb. 87 (1967) 80.

Shrub. Tips of branchlets and innovations shortly rufous-villous. *Leaves* elliptic-oblong, apex shortly subacutely attenuate, base cuneate, very base sometimes obtuse, slightly inequilateral, coriaceous, young ones early glabrate above, ± densely set with rather large stellate hairs on midrib, nerves and veins beneath as are the petioles, mature ones persistently so, 6–9 by (2.5–)3–4 cm, glandular-subserrate-denticulate in the upper, entire in the lower part, nerves in 9–10 pairs excurrent along the edge, well-raised beneath, veins transverse and prominent beneath, reticulation visible; petiole 2–3 cm. *Racemes* terminal and from the upper 3 or 4 axils (which are mostly defoliate in flowering time) close together forming a panicle, all over with a rusty, almost villous tomentum of numerous longer crisp fascicled and shorter stellate hairs; rachis robust. Pedicels thickish, 2–3 mm (in fruit 5–6 mm), bracts subulate, caducous, 3 mm. *Calyx lobes* oblong, *c.* 5 by 2.5 mm. *Petals* obovate, apparently cup-like converging, quite glabrous, white, scented, 6 by 3 mm. Filaments laxly long-hairy; anthers narrow-obcordate, base acute, 2 mm. *Ovary* densely set with erect hairs; style subappressedly hairy in its lower third, glabrous for the rest, 5 mm (in fruit 6 mm), stigma shortly 3-lobed. *Capsule* subglobose, *c.* 4 mm ø.

Distr. *Malesia*: Malay Peninsula (Perak: G. Kerbau For. Res.), once found.

Ecol. On open ridge top, 1830 m, not common. *Fl. fr.* July.

4. Clethra javanica TURCZ. Bull. Soc. Nat. Moscou 36, ii (1863) 232; KOORD. Album Natuurmonum. Ned. Ind. ser. 1 (1918) 3, pl. 9 (phot.); Bull. Jard. Bot. Btzg III, 1 (1919) 148, t. 10; BACK. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 161, p. 1; BACK. & BAKH. *f.* Fl. Java 2 (1965) 178; SLEUM. Bot. Jahrb. 87 (1967) 83. — *C. canescens* (*non* REINW. *ex* BL.) MIQ. Fl. Ind. Bat. 2 (1859) 1056, *p.p.*; KOORD. Jungh. Gedenkb. (1910) 184; Exk. Fl. Java 3 (1912) 1, *p.p.*; BACK. Bull. Jard. Bot. Btzg II, 12 (1913) 11; J. J. S. in K. & V. Bijdr. 13 (1914) 85, as to descr. — *C. sp.* ZOLL. Syst. Verz. 2 (1854) 138, *p.p.*

var. **javanica.**

Small tree, 3–6(–10) m, trunk up to 15 cm ø, often crooked, or much branched shrub, 2–5 m; branches up to 5 cm ø. Branchlets rather robust, covered distally with a rusty hirsute or almost lanate tomentum as are the petioles. *Leaves* lanceolate to oblong-elliptic, sometimes partly obovate in the same specimen, apex shortly acuminate, base cuneate, subcoriaceous, dark green, shining and glabrous above, much paler beneath, and set there still towards the maturity with both longish simple or fascicled rufous and fewer minor stellate hairs on midrib and nerves, whereas the veins bear only scattered stellate hairs and the intervenium is glabrous, finally glabrescent, (5–)6–10(–13) by 2.5–4(–6) cm, rather regularly and deeply (1.5–2 mm) serrate, nerves (15–)17–20(–23) pairs, spreading, ± approximate and subparallel, rather straight from the midrib and partly forked before the edge, ± sharply prominent beneath, veins transverse, ± raised beneath too; petiole robust, 1(–1.5) cm. *Racemes* panicled or subumbellate, rachis and pedicels covered with a floccose and rusty, almost hirsutulous tomentum, 5–10(–14) cm, flowers rather densely arranged, subpatent. Pedicels rather thickish, 3–5(–6) mm, bracts subulate, 2–4(–6) mm, caducous. *Calyx lobes* ovate-oblong, subacute, dorsally a little keeled and stellate-tomentellous, fimbriate, (4–)4.5–6 by 2.5 mm. *Petals* obovate, apex slightly erose, thin, glabrous, white or pinkish, (5–)6–7 by *c.* 3 mm. Filaments glabrous, 2.5 mm; anthers obcordate, base subacute, 1.3 mm. *Ovary* shortly rufous-hirsutulous; style glabrous, 3–3.5 mm, apex shortly trilobed. *Capsule* subglobose, 2.5–3 mm ø, pedicel elongate to 10 mm, style slender, 3.5–4 mm. *Seeds* ovoid, subtrigonous or variously compressed, 0.5–0.8 mm.

Distr. *Malesia*: East Java (Mt Jang).

Ecol. In mixed primary forest edges, 1830–2300 m. *Fl. fr.* April–Oct.

var. **lombokensis** SLEUM. Bot. Jahrb. 87 (1967) 84. — *C. canescens* (*non* REINW. *ex* BL.) MIQ. Fl. Ind. Bat. (1859) 1056, *p.p.* — *C. sp.* ZOLL. Syst. Verz. 2 (1854) 138, *p.p.*

Leaves very similar to those of *var. javanica*, but thinner, young ones on the undersurface sparsely clothed with fascicled hairs at midrib and nerves, and with stellate ones at the veins, becoming almost completely glabrous at maturity, up to 15 by 5 cm, more deeply (up to 4 mm) and more irregularly serrate.

Distr. *Malesia*: Lesser Sunda Islands (Lombok), in montane forest and *Casuarina* bush of Mt Rindjani, 1700–2400 m.

Ecol. On dry soil of volcanic debris. *Fl.* June–Aug.

5. Clethra canescens REINW. *ex* BL. Bijdr. (1826) 863; G. DON, Gen. Syst. 3 (1834) 842; MIQ. Fl. Ind. Bat. 2 (1859) 1056, *p.p.*; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 41; KOORD. Minah. (1898) 515; SARASIN, Reisen Celebes 1 (1905) 29, *in text.*; J. J. S. Ic. Bog. 4 (1910) 61, t. 318; KOORD.-SCHUM. Syst. Verz. 3 (1914) 100; KOORD. Bull. Jard. Bot. Btzg III, 1 (1919) 148, *in text.*; *ibid.* III, 2 (1920) 255; VON MALM in Fedde, Rep. 34 (1934) 284; SLEUM. Bot. Jahrb. 87 (1967) 85.

KEY TO THE VARIETIES

1. Racemes and pedicels ± robust. Petals 3–4 mm.
2. Leaves early glabrescent; nerves starting from the midrib at an ± acute angle. **1.** *var.* **canescens**
2. Leaves with more persistent minute rusty stellate hairs underneath; nerves starting from the midrib at ± right angles. **2.** *var.* **luzonica**
1. Racemes and pedicels slender or almost so.
3. Leaves underneath on midrib, nerves and veins more laxly to rather densely clothed with subpersistent rather large stellate hairs. Petals 3–4 mm. . . . . **3.** *var.* **clementis**
3. Leaves underneath on midrib and nerves, rarely on veins, laxly set with fascicled and/or minute stellate hairs, early glabrescent, or young ones already subglabrous.
4. Racemes generally elongate, rather dense-flowered. Petals 2–3 mm. **4.** *var.* **novoguineensis**
4. Racemes generally short, rather lax-flowered. Petals (3–)4 mm. . . . . **5.** *var.* **ledermannii**

1. *var.* **canescens.**

Tree up to 20 m, bole up to 40 cm ø, covered with greyish bark; at higher altitudes a shrub, 2–5 m. Branchlets covered with a woolly-floccose rufescent, later greyish tomentum at the tips. *Leaves* elliptic or obovate-elliptic, apex shortly subacutely acuminate, base cuneate, thin-coriaceous, entire below, regularly serrate with callose teeth *c.* 1 mm long, younger ones glabrous above, ± densely set with minute stellate ± rusty hairs on midrib, nerves, veins and veinlets, and with sparse, longer simple or fascicled hairs on the midrib beneath, glabrous on the intervenium beneath, mature ones glabrescent, generally (4–)5–8(–11) by (2–)2.5–4 cm, at higher altitudes constantly smaller, (2.5–)3–5(–6) by (1–)1.5–2 cm, nerves 10–12 (rarely up to 15) curved-ascendent pairs, which rather distinctly inarch before the edge, veins slightly prominent, veinlets rather inconspicuous beneath; petiole ± robust, 0.6–1.2(–1.5) cm. *Racemes* few to several, forming an erect panicle, all over covered with a floccose-lanate, ± rusty or finally greyish tomentum, 6–12(–16) cm, the numerous flowers rather laxly set along the thickish rachis. Pedicels robust, (3–)4–5 mm at anthesis, up to 6 mm in fruit, bract subulate, up to 6 mm, caducous. *Calyx lobes* ovate-oblong, rather abruptly acuminate, long-ciliate, pale rusty-floccose dorsally, 3–4 mm. *Petals* obovate, crenulate all along the margin, glabrous, white (or suffused with red initially), with a rather unpleasant smell, 3–4 by *c.* 2 mm. Filaments glabrous, *c.* 2.5 mm; anthers broad-obovate, base almost mucronate, 0.8 mm. *Ovary* villous; style glabrous, 3–3.5 mm (in fruit 3.5–4 mm), very shortly trilobed. *Capsule* subglobose, tomentulose, 2.5 mm ø. *Seeds* irregularly ovoid-angular, 0.8–1 mm.

Distr. *Malesia*: Celebes, Lesser Sunda Islands (Flores); slightly different forms in the Moluccas (Buru, Ceram and Ambon).

Ecol. A tree in mountain forest or forest edge, ascending into more open summit vegetation and shrub-like there, sometimes on volcanic tuff, rather common locally, (1160–)1400–2800(–3000) m. *Fl. fr.* Jan.–Dec.

Vern. *Kaju parang*, M, *madausip*, Ts. (Minahasa), *pitjisan djabong*, Makassar.

2. *var.* **luzonica** (MERR.) SLEUM. Bot. Jahrb. 87 (1967) 88. — *C. luzonica* MERR. Publ. Gov. Lab. Philip. *n.* 29 (1905) 38; Philip. J. Sc. 5 (1910) Bot. 371; En. Philip. 3 (1923) 242.

Leaves elliptic, more rarely oblong-elliptic, apex shortly subacutely acuminate, sometimes more obtuse, base broadly cuneate to obtuse, subcoriaceous, younger ones laxly set with minute stellate hairs above, densely clothed with rather small floccose stellate hairs on the prominent midrib and nerves, and more laxly so on the veins beneath, glabrous on the intervenium, moreover sparsely set with longer simple or fascicled hairs on midrib and nerves beneath, mature ones glabrescent first above, tardily beneath, subentire or minutely (rarely more deeply) serrate, (3.5–)4–7(–10) by (1.5–)2–4(–5) cm, nerves 10–12(–14) pairs, curved, rather approximate, ± parallel and anastomosing; petiole rather robust, 0.3–1(–1.3) cm. *Racemes* panicled or almost umbellate, 3–6(–11) cm, covered with a tomentum of small dark-rusty stellate floccose hairs; flowers ± dense along the thickish rachis. Pedicels robust, 1(–2) mm, slightly accrescent in fruit, bract subulate, caducous, 3–4 mm. *Petals* white or cream, irregularly erose at apex, 3–3.5 mm.

Distr. *Malesia*: Philippines (Luzon: Mountain Prov.; Isabela Prov.).

Ecol. In montane *Pinus insularis*, *Quercus* or *Podocarpus* forest, also in mossy forest or in shrubby summit vegetation, 1220–2250(–2700?) m, rather common locally. *Fl. fr.* Jan.–Dec.

Vern. *Amog*, *kamueg*, Ig., *apiit*, Bon.

3. *var.* **clementis** (MERR.) SLEUM. Bot. Jahrb. 87 (1967) 86. — *C. clementis* MERR. Philip. J. Sc. 13 (1918) Bot. 104; En. Born. (1921) 460. — *C. canescens* (*non* REINW. *ex* BL. *s. str.*) STAPF, Trans. Linn. Soc. Bot. 4 (1894) 198; GIBBS, J. Linn. Soc. Bot. 42 (1914) 105.

Leaves oblong-lanceolate to oblong, apex acutely acuminate, base cuneate-attenuate, thinly subcoriaceous, younger ones first stellate-hairy, early glabrescent above, ± densely set with fascicled and stellate, rather coarse hairs at midrib and nerves beneath, laxly or hardly so at the veins,

intervenium glabrous, mature ones quite glabrous and a little shining above, glabrescent first at the veins, more tardily so at midrib and nerves beneath, subentire or shallowly glandular-serrate, (6–)7–14 by (1.5–)2–3(–3.5–4) cm, nerves (10–)12–14 pairs, curved-ascending towards the edge, rather indistinctly inarching there, prominent beneath, veins but slightly raised beneath; petiole slender, 1–1.5(–2) cm. *Racemes* panicled, slender, 10–20 cm, covered with a dilutely rusty tomentum of both smaller and larger stellate and/or fascicled hairs; flowers rather densely arranged along the robust rachis. Pedicels slender, 1–2 mm (in fruit *c.* 3 mm). *Petals* erose-fimbriate at apex, 3–4 mm.

Distr. *Malesia*: Borneo.

Ecol. Generally in mountain (also mossy) forest or on forest edges, rarely in lowland (apparently secondary) forest, locally common, especially on Mt Kinabalu, (30–)700–1200(–1830) m. *Fl. fr.* Jan.–Dec.

Vern. *Kalintuhan, mitindike*, Dusun.

4. *var.* novoguineensis (KANEH. & HATUS.) SLEUM. Bot. Jahrb. 87 (1967) 90. — *C. longispicata* J. J. S. *var. novoguineensis* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 474, f. 3. — *C. lancifolia* TURCZ. Bull. Soc. Nat. Moscou 36, ii (1863) 231; MERR. Philip. J. Sc. 1 (1906) Suppl. 111; *ibid.* 2 (1907) Bot. 292; En. Philip. 3 (1923) 242. — *C. alnifolia* (*non* L.) BLANCO, Fl. Filip. ed. 2 (1845) 259; ed. 3, 2 (1878) 117; MERR. Sp. Blanc. (1918) 297. — *C. canescens* (*non* REINW. *ex* BL. *s. str.*) F.-VILL. Novis. App. (1880) 121; VIDAL, Sinopsis Atlas (1883) 30, t. 60, f. B; Phan. Cuming. Philip. (1885) 123; Rev. Pl. Vasc. Filip. (1886) 172; MERR. En Philip. 3 (1923) 242. — *C. williamsii* C. B. ROB. Bull. Torr. Bot. Cl. 35 (1908) 73, 75. — *C. castanea* ELM. Leafl. Philip. Bot. 9 (1934) 3182.

Leaves lanceolate to oblong, apex shortly subacutely acuminate, base ± cuneate, younger ones glabrous above, more densely or laxly set with longish simple or fascicled, ± appressed pale rusty hairs on midrib and nerves, ± laxly and minutely stellate-hairy on veins beneath, mature ones gradually glabrescent, finally sometimes quite glabrous, shortly or rarely more deeply and distantly serrate in the upper part, occasionally subentire, (4–)5–10 (–14, rarely –17) by (1.5–)2–3.5(–4.5, very rarely –8) cm, nerves (8–)10–14 (rarely –16) pairs, curved-ascending, ± joined before the edge, raised beneath, veins often obscure though a fine reticulation is visible; petiole rather slender, 0.5–1(–1.8) cm. *Racemes* panicled, (4–)6–15(–24) cm, flowers rather dense along the ± slender rachis, covered with a tomentum of longer, fascicled rusty and minor pale stellate hairs (rarely only with the latter ones). Pedicels generally rather slender, rarely more robust, 1–2 mm (in fruit 2–3 mm). *Petals* irregularly erose-crenulate mainly at apex, (2–)2.5(–3) mm.

Distr. *Malesia*: SE. Celebes, Philippines (Batan Is, Luzon, Mindoro, Samar, Leyte, Biliran, Negros, Mindanao, Catanduanes), NW. New Guinea.

Ecol. In the Philippines and in Celebes in mountain (also mossy) forest, mainly on ridges and peaks, (400–)700–2100 m, in New Guinea in open beach forest and in savannah-like thickets on dry hill (300 m) near the coast, presumably mainly in secondary vegetation. *Fl. fr.* Jan.–Dec.

Vern. *Alibuñgog*, C. Bis., *kalyapi, kayatbuntót*, Bag., *kamog*, Ilk., *kamueg*, Ig., *malaklak*, Tag., *maratuñgau*, Ibn., *tagobahi*, P. Bis., *mayaorin*, Batan.

5. *var.* ledermannii (SCHLTR) SLEUM. Bot. Jahrb. 87 (1967) 87. — *C. papuana* SCHLTR, Bot. Jahrb. 52 (1915) 219, *non* J. J. S. 1914. — *C. ledermannii* SCHLTR, *ibid.* 55 (1918) 194.

Leaves lanceolate-elliptic to lanceolate, apex acutely acuminate, base cuneate, thin-subcoriaceous, younger and submature ones glabrous above, set with sparse rather coarse rufescent simple or fascicled and/or finer stellate hairs on midrib and nerves, hardly at veins beneath, intervenium glabrous, mature ones almost completely glabrous, rather sharply serrate in the upper part, 5–8(–11) by 2–3(–4) cm, nerves 12–14(–15) pairs, ± curved, subparallel, rather indistinctly inarching before the edge, prominent beneath, veins ± obscure; petiole rather slender, (0.7–)1–1.5 cm. *Racemes* panicled, all over covered with a very short tomentum of brownish to greyish stellate hairs, in which a few larger fascicled hairs occur, rather lax-flowered, 5–12 cm. Pedicels rather slender, 2–3 mm (in fruit 3–3.5 mm). *Petals* erose-crenulate, (3–)4 mm.

Distr. *Malesia*: E. New Guinea (Sepik Distr.; Western Highlands).

Ecol. In mountain (also mossy) forest, and in regrowths, (200–)400–1830 m. *Fl.* June–Sept.

Vern. *Talellpi*, Wapi (Torricelli Mts).

6. Clethra kebarensis SLEUM. Bot. Jahrb. 87 (1967) 92. — **Fig. 4.**

Laxly branched shrub or treelet, 2–3(–6) m, trunk often blackish, 4–10 cm ø. Branchlets distally ferrugineous-tomentellous. *Leaves* obovate-oblong or -elliptic, more rarely oblong, apex ± shortly subacutely acuminate, base cuneate, rarely obtuse or even rounded in the same specimen, subcoriaceous to firmly chartaceous, young ones very laxly stellate-hairy above, subdensely covered beneath with short, fascicled rusty hairs at midrib, and all over the undersurface with very dense minute stellate hairs, which form a pale coherent layer, moreover nerves and especially veins and veinlets set with darker rusty stellate-fascicled, tardily evanescent hairs so to say on top of the pale layer mentioned above, mature leaves dark green above, yellowish rusty beneath, early glabrescent above, tardily so beneath, generally shortly to very shortly subserrate- or crenate-dentate, (4–)6–9 by (2–)2.5–4(–5.5) cm, nerves in 14–16(–17) pairs, slightly curved or rather straight from the midrib, rather obscurely inarching, prominent below, veins but slightly raised; petiole 9–14 by *c.* 1 mm. *Racemes* 3–6, ± fascicled, partly branched below, erect,

Fig. 4. *Clethra kebarensis* SLEUM., Kebar Valley, Nertoi, 700 m, NW. New Guinea (VAN ROYEN & SLEUMER 6841) (SLEUMER, 1961).

dense-flowered, 6–12 cm, covered with a short, almost villous, rusty (finally greyish) pubescence of fascicled and stellate hairs; rachis rather robust. Pedicels thickish, 1–1.5 mm at anthesis, subtending bracts subovate-subulate, 2 mm, persistent for a while. *Calyx lobes* ovate, subacuminate, 2–2.5 mm. *Petals* obovate-spathulate, often connate or coherent in the lower part, crenulate, glabrous, white or cream, (2.5–)3–3.5 by *c.* 1.5 mm. Filaments dilated downwards, glabrous, 2(–2.5) mm; anthers obcordate, *c.* 0.6 mm. *Ovary* rusty-tomentulose; style glabrous, 1.2–1.5 mm (*in* fruit to 2.5 mm). *Capsule* subglobose, *c.* 3 mm ø. *Seeds* subtrigonous-ovoid, 0.8 mm.

Distr. *Malesia*: New Guinea (Vogelkop Peninsula).

Ecol. In patches of shrubberies within grassland or fern thickets of *Gleichenia*, or in forest edges, not rarely in periodically burned vegetation, fairly common locally, sometimes forming pure loose stands on sandy or clayey soil, 700–1200 (–1950) m. *Fl. fr.* Jan.–Dec.

7. Clethra sumbawaensis SLEUM. Bot. Jahrb. 87 (1967) 94.

Treelet, 4–8 m. Branchlets distally clad with a rusty rather scabrid pubescence. *Leaves* elliptic-oblong or elliptic, apex ± shortly and acutely acuminate, base cuneate, thin-coriaceous, younger and submature ones glabrous above, subdensely set with longish simple and fascicled (or stellate) rusty hairs along midrib and nerves, sparsely so

on the veins beneath, moreover beneath all over the undersurface with a dense thin layer of minute stellate and pale (or here and there rusty), finally greyish hairs, apparently very tardily glabrescent, serrate in the upper ⅔, (5–)6–9 by 2–4 cm, nerves (15–)17–20 pairs, rather straight and subparallel, in part forked distally, reticulately dissolving before the edge, raised beneath, veins transverse, slightly prominent beneath, veinlets obscure; petiole 1–1.5(–2) cm. *Racemes* rather numerous, condensed to a panicle, 5–8(–10) cm; rachis stoutish, covered with a floccose rusty kind of wool. Pedicels rather slender, with a short stellate pubescence as are the sepals, 3–4 mm, bracts subulate, tomentulose, 8–10 mm, caducous after anthesis. *Calyx lobes* ovate-acuminate, less hairy at the fimbriate margin, glabrous inside, 3 mm. *Petals* obovate, thin, white, fragrant, glabrous, minutely fimbriate-crenulate ± all along the margin, 5 by *c.* 2.5 mm. Filaments glabrous, 2 mm; anthers broadly obovate, base apiculate, 1 mm. *Ovary* tomentose; style slenderly columnar, glabrous, 4–4.5 mm, shortly 3-lobed.

Distr. *Malesia*: Lesser Sunda Islands (Sumbawa: Mt Batulanteh; Flores: Mt Ranaka).

Ecol. In forest, (900–)1600–2400 m, on andesite soil. *Fl.* April, Oct.

8. Clethra tomentella ROLFE *ex* DUNN, Kew Bull. (1922) 185; MERR. En Philip. 3 (1923) 243; SLEUM. Bot. Jahrb. 87 (1967) 94.

Small tree or shrub. Branchlets rather slender, tips grey-tomentellous. *Leaves* lanceolate to elliptic-oblong, or oblanceolate, apex ± shortly subacutely acuminate, base attenuate, firmly chartaceous, subentire or sometimes sparsely very shortly serrate-dentate in the upper part, younger and submature ones glabrous above, appressedly greyish-stellate-tomentellous all over beneath, mature ones glabrescent tardily, first on the intervenium, finally also almost completely along midrib and nerves, 6–9(–11) by (2–)2.5–3(–3.5) cm, nerves (10–)12–14(–15) pairs, prominent beneath, reticulation visible only in the already glabrate parts; petiole rather slender, (5–)6–10(–12) mm. *Racemes* several, panicled, laxly or more densely set with flowers, 7–14(–20) cm, covered with a short, greyish or rusty-stellate tomentum; rachis slender. Pedicels slender, *c.* 2 mm (*c.* 3 mm in fruit), bracts subulate-linear, 3–5 mm, caducous in the beginning of anthesis. *Calyx lobes* ovate-acuminate, glabrous inside in part, 1.5–2 mm. *Petals* obovate-spathulate, minutely erose apically, glabrous, white, 2–2.2(–2.5) mm. Filaments dilated towards the base, glabrous, 1 mm; anthers obovate, hardly ½ mm. *Ovary* tomentellous; style thickish, glabrous, 1 mm, very shortly 3-lobed. *Capsule* subglobose, 2.5 mm ø. *Seeds* subtrigonous-ovoid, 0.7–1 mm.

Distr. *Malesia*: Philippines (Luzon: Mountain Prov. to Batangas).

Ecol. Scattered in thickets or forests on slopes, chiefly on ridges in mossy forest, 600–1800 m. *Fl. fr.* May–Sept.

Vern. *Amog*, *kamug*, *kamung*, Ig., *ayusan*, Tag.

9. Clethra arfakana SLEUM. Bot. Jahrb. 87 (1967) 95.

Shrub or erect treelet, 2–3 m, much branched. Branchlets slender, tips rusty-tomentellous. *Leaves* obovate-oblong or -elliptic, apex shortly acutely acuminate, base cuneate, slightly inequilateral, subcoriaceous to firmly chartaceous, flush reddish, younger and mature ones dark green and glabrous above, whitish greyish below, *i.e.* except the sparsely hairy or subglabrous midrib and nerves covered by a short tomentum of minute stellate hairs, very tardily glabrescent, (sub)entire or shallowly dentate, (2–)3–4.5 by (1–)1.3–2 cm, more deeply dentate and up to 7.5 by 3 cm in not flowering new shoots, nerves in 10–12 pairs, ± straight from the midrib, curved upwards, slightly prominent beneath; petiole 5–8(–10) mm. *Racemes* several, panicled, 5–7(–8) cm, rather lax-flowered, pale-rusty stellate-tomentellous in all outer parts; rachis slender. Pedicels slender, 2–3 mm, basal bracts early fugacious. *Calyx lobes* ovate-oblong, long-ciliate, 3 by 1.5 mm. *Petals* obovate-spathulate, sometimes coherent at the base, glabrous, white, shortly erose-fimbriate all along the edge, (3.5–)4(–5) by 2–2.5 mm. Filaments dilated towards the base, glabrous, 2.5 mm; anthers obcordate, about 0.5 mm. *Ovary* almost hirsute; style glabrous, 1.8 mm at anthesis, hardly accrescent in fruit. *Capsule* subglobose, 2.5–3 mm ø. *Seeds* oval to subtrigonous, *c.* 1 mm.

Distr. *Malesia*: New Guinea (Vogelkop Peninsula: Arfak Mts around the Anggi Lakes).

Ecol. In edge of *Nothofagus-Myrtaceae*-forest or in more open heath formation within devastated montane forest, 2000–2600 m, common locally. *Fl. fr.* Jan.

10. Clethra longispicata J. J. S. Bull. Jard. Bot. Btzg III, 4 (1922) 240; SLEUM. Bot. Jahrb. 87 (1967) 96. — *C. elongata* J. J. S. Bull. Jard. Bot. Btzg III, 1 (1920) 398, t. 47, *non* RUSBY, 1907.

Shrub or treelet, up to 5(–12) m, trunk up to 10 cm ø, bark green, with shallow pale brown flakes. Branchlets and petioles rusty to greyish tomentellous. *Leaves* oblong-lanceolate to elliptic-oblong, more rarely elliptic, apex rather shortly acuminate and subacute, base cuneate, rarely almost obtuse, inequilateral, subcoriaceous, younger ones glabrous above, covered all over beneath by a coherent tomentum of minor stellate cinnamomeous to greyish hairs, and of larger stellate hairs so to speak on top of that layer, mature ones tardily glabrescent beneath, furthermore sometimes with sparse fascicled hairs on the midrib beneath, (4.5–)6–11 by (1.7–)2–3.5(–4) cm, callose-denticulate or subentire, nerves 10–12(–14) pairs, generally starting at an acute angle, curved-ascending towards the edge, a little impressed above, prominent beneath, veins distinctly, veinlets rather inconspicuously raised beneath; petiole 0.6–1.3(–1.6) cm. *Racemes* panicled, rather slender, (15–)20–30(–35) cm, laxly many-flowered, with a short stellate tomentum, in which also some fascicled hairs may be found. Pedicels slender or almost so, 2–3 mm (to 4 mm in fruit),

Fig. 5. *Clethra papuana* J. J. S., Kebar Valley, Mt Nettoti, 1900 m, NW. New Guinea (VAN ROYEN & SLEUMER 7449) (SLEUMER, 1961).

bracts subulate, caducous. *Calyx lobes* narrowly ovate-subdeltoid, 1.5–2(–2.5) mm. *Petals* partly connate at base, broadly spathulate, crenulate, glabrous, white, scented, *c.* 3 by 1.5 mm. Filaments glabrous, 1.5 mm; anthers obcordate, 0.5 mm. *Ovary* appressedly hairy; style glabrous, *c.* 1.7 mm (to 2 mm in fruit), very shortly 3-lobed. *Capsule* subglobose, *c.* 2.5 mm ø. *Seeds* convex-ovoid, 0.7 mm.

Distr. *Malesia*: Borneo, Philippines (Palawan) and Central Celebes.

Ecol. Generally in mountain forest, also in secondary vegetation, on clayey ground, (60–) 500–1525 m. *Fl.* Jan.–Dec.

Vern. *Pongo*, Toradja, *lang*, Iban, *garapoi*, Dusun.

11. Clethra papuana J. J. S. Nova Guinea 12 (1914) 169, t. 53; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 476; SLEUM. Bot. Jahrb. 87 (1967) 97. — **Fig. 5.**

var. **papuana.**

Shrub or treelet, (1–)3–6(–8) m, more rarely a tree up to 15 m, bole up to 10 m by 30 cm. Branchlets at tips rusty subvillous-tomentose. *Leaves* elliptic or obovate-elliptic, sometimes oblong-elliptic, rarely elliptic-lanceolate, apex shortly subacutely acuminate, rarely rather blunt (more acutely acuminate in sterile shoots), base inequilateral, broadly cuneate to subtruncate-obtuse, coriaceous, firm, younger ones with stellate and fascicled hairs mainly along midrib

and nerves above, clothed all over beneath by a dark rusty subvillous tomentum formed by stellate and fascicled hairs, mature ones glabrate above, dark green in the fresh state there, undersurface rusty- to greyish- or (almost silvery-) tomentulose (the large fascicled hairs having mostly disappeared by then), entire or shortly irregularly serrate-dentate (more deeply and sharply serrate in sterile shoots), (4–)5–8(–12) by 2–4 (–5.5) cm, variable in size even in the same specimen, sometimes microphyllous, nerves 12–14 pairs, much spreading, ± inarching at or a little before the edge, well raised beneath, veins not much conspicuous beneath, reticulation faint; petiole rusty-tomentulose, (1–)1.2–1.6(–1.8) cm. *Racemes* panicled, erect, all over rusty-tomentose, flowers generally densely arranged, rarely up to 15 cm; rachis robust. Pedicels thickish, 1–2 mm (up to 4 mm in fruit), bracts thickish, subulate, caducous. *Calyx lobes* oblong-ovate, 3–3.5(–4) mm. *Petals* not rarely connate or coherent at base, obovate-spathulate, edge slightly erose, white, sometimes pale cream or suffused with red, glabrous, slightly scented, *c.* 3.5 by 2 mm. Filaments glabrous, hardly 2 mm; anthers ± obcordate, 0.8 mm. *Ovary* almost villous; style glabrous, shortly trilobed, (1–)1.2–1.5 mm (hardly 2 mm in fruit). *Capsule* subglobose, *c.* 3 mm ø. *Seeds* ovoid-oblong, irregularly angular, 0.8–1 mm.

Distr. *Malesia*: NW. New Guinea (Vogelkop Peninsula: Kebar Valley and Arfak Mts).

Ecol. In (mossy) *Nothofagus*-Conifer-forest edge or in open heath vegetation on crest, 1800–2600 m. *Fl.* Oct.–Jan.

var. **trichostyla** SLEUM. Bot. Jahrb. 87 (1967) 98.

Petals (3 mm) laxly hairy along the edge. Style set with a few appressed hairs at base. Otherwise as *var. papuana*.

Distr. *Malesia*: W. New Guinea (Wissel Lakes area), once found.

12. Clethra pulgarensis ELM. Leafl. Philip. Bot. 5 (1913) 1757; MERR. En. Philip. 3 (1923) 243; SLEUM. Bot. Jahrb. 87 (1967) 99.

Low, stunted tree, or shrub-like; branches ascending, rigid, covered with brown bark. Branchlets short, rather robust, short-hairy. *Leaves* oblong to subobovate-elliptic, apex shortly attenuate or subacuminate, base broadly cuneate, the very base often obtuse, subcoriaceous, firm, younger ones very densely shortly stellate-hairy above, covered all over beneath with a tomentum of minor and larger stellate, brownish greyish hairs, large fascicled hairs on petiole and midrib below few or absent, mature ones glabrous and a little shining above, rather persistently greyish tomentulose beneath, finely serrate-dentate in the upper part, tips of the serratures usually callose, 5–8 by (2–)2.5–4 cm, midrib bold beneath, nerves in 9–11(–12) pairs, curved, excurrent or divided along or before the edge, raised beneath, reticulation rather faint; petiole 0.5–1 cm by *c.* 2 mm. *Racemes* panicled, (8–)10–15 cm, covered with a fulvous-greyish tomentum of stellate and fascicled hairs; rachis stoutish. Pedicels robust, 2–3(–5) mm, bracts subulate, caducous. *Calyx lobes* ovate-oblong, 4–5 by 2(–2.5) mm. *Petals* obovate-spathulate, minutely crenulate at apex, white, glabrous, (4–)5(–6) by *c.* 2.5 mm. Filaments glabrous, 3 mm; anthers obcordate, 1 mm. *Ovary* longish erect-tomentose; style thickish, glabrous, (2.5–)3 mm (3–4 mm in fruit), shortly 3-lobed. *Capsule* depressed-globose, *c.* 3 mm ø. *Seeds* oval, 1 mm.

Distr. *Malesia*: Philippines (Palawan), in low woody vegetation on summit of Mt Pulgar near Puerto Princesa, 1200 m. *Fl. fr.* May.

13. Clethra pachyphylla MERR. Philip. J. Sc. 13 (1918) Bot. 103; En. Born. (1921) 460; SLEUM. Bot. Jahrb. 87 (1967) 99. — **Fig. 1.**

Shrub or mostly small tree, 2–4(–10) m high, trunk up to 20 cm ø, laxly branched, branches obliquely ascending to almost horizontal. Branchlets robust, rufous-ferrugineous-tomentose at apex. *Leaves* oblong or obovate-oblong, more rarely oblong-elliptic or elliptic, apex shortly subacutely acuminate, base cuneate, coriaceous, firm, younger ones subdensely floccose- or subvillous-stellate-hairy above, all over beneath with a tomentum of minor pale stellate hairs and a more coarse one of major stellate and fascicled, initially rusty, finally greyish hairs, midrib and nerves mainly with major fascicled hairs, entire or more rarely and but in part irregularly serrulate, 4–9(–14) by (2–)2.5–3.5(–4, –5) cm, midrib bold beneath, nerves (9–)10–12(–13) pairs, prominent beneath, curved and ± excurrent at the edge, veins slightly raised beneath, reticulation more distinct but in ± mature leaves; petiole 1.2–1.5(–1.8) by 1.5–2 mm. *Racemes* panicled, rather dense-flowered, robust, all over villous or almost so by minor and major stellate and coarse fascicled rusty hairs, 5–10(–12) cm; rachis stout. Pedicels thickish, 2–3(–4) mm, bracts subulate, 4–5(–8) mm, caducous. *Calyx lobes* oblong-ovate, subacuminate, (3.5–)4–5 mm. *Petals* spathulate to spathulate-oblong, irregularly erose or crenulate at apex, white to cream, scented, glabrous, (3–)4(–5) by 2.5–3 mm. Filaments glabrous, 2–2.5 mm; anthers subobovate, 0.8–1 mm. *Ovary* short-tomentulose; style thickish, glabrous, 2.5–3 mm (3.5–4 mm in fruit), shortly 3-lobed. *Capsule* depressed-globose, 3 mm ø. *Seeds* subtrigonous, 1–1.2 mm.

Distr. *Malesia*: NE. Sarawak (Mt Murud area) and North Borneo (Mt Kinabalu).

Ecol. Scattered in *Quercus havilandii* and *Tristania* forest, still not too rare in mossy *Leptospermum-Dacrydium* forest, also in secondary vegetation, (870–)1200–2500(–3050) m, on poor soil. *Fl. fr.* March–Oct.

OXALIDACEAE (J. F. Veldkamp, Leyden)

Herbs, sometimes with scaly rhizomes, bulbs, bulbils or stolons, or woody perennials, shrubs, lianas or trees. *Leaves* penninerved, digitately or pinnately trifoliolate, imparipinnate or paripinnate, basal, alternate, subopposite or apically tufted. Stipules sometimes present. Petioles with basal joint, petiolules articulated. *Inflorescences* basal, axillary or pseudoterminal, cymose to pseudumbellate, rarely racemose, 1–many-flowered, bracteate and bracteolate. *Flowers* ♀, very rarely also ♂ specimens (*Dapania*), actinomorphic, 5-merous, hetero-tri-, -di-, or homostylous, sometimes cleistogamous. Pedicels articulate. *Sepals* imbricate, free or connate at base, sometimes with apical calli (*Oxalis*), persistent. *Petals* contort, quincuncial or cochlear, free but usually cohesive above the base ('pseudosympetal'), clawed (sometimes minutely so), glabrous or inside sometimes with minute papillae or pilose. *Filaments* 10, obdiplostemonous, connate at base into an annulus, persistent, the epipetalous (shorter) sometimes with a basal gland near the insertion of the petals, or sometimes with 2 scales or dark lines on the annulus (*Dapania*), rarely without anthers; the episepalous (longer) with a dorsal tooth (*Oxalis*) or hunchbacked; anthers dorsifixed, versatile, 2-celled, dehiscing extrorsely by longitudinal slits. No *disk*. *Ovary* 5-celled, superior; styles 5, terminal, persistent, free, in LF[1] and MF erect, in SF patent to recurved, rarely reduced (♂ flowers); ovules 1–2–several per cell in 1–2 rows, epi- and anatropous, pendulous, superposed, bitegmic. *Fruit* capsular, loculicid, 5-celled, dry, rarely fleshy and indehiscent. *Seeds* usually with an aril; endosperm copious, fleshy, rarely absent; embryo straight.

Distribution. 6(7?) genera with *c.* 850 *spp.* Of the Malesian representatives *Oxalis*, the largest genus, is most numerous in S. America and S. Africa and *Biophytum* in S. America and Madagascar; *Dapania* has 2 *spp.* in Malesia and 1 in Madagascar; *Sarcotheca* (11 *spp.*) is endemic in Malesia, while *Averrhoa* (2 *spp.*) assumedly also originated here; it is now cultivated pantropically.

In Malesia there are 5 genera with 29 species, of which 14 endemic.

The generic distribution of the family offers in the Old World two remarkable patterns. First, that of *Dapania* which shows the characteristic disjunction between West Malesia and Madagascar. Second, that of *Oxalis sect. Acetosellae* which almost resembles that of *Euphrasia*, that is, a temperate genus with two stepping stones across the tropics (Luzon, New Guinea), otherwise bipolar. Fig. 2.

Ecology. Many members of the family have sensitive leaves and show sleeping movements, some being also seismonastic which is conspicuous in *Biophytum*.

Dispersal. The fleshy fruits of *Averrhoa*, *Dapania*, and *Sarcotheca* are no doubt eaten by various animals as bats, birds, and monkeys, and dispersed by them. The seeds of *Oxalis* and *Biophytum* have a peculiar ejaculative aril originally enveloping the entire seed which at maturity shoots them away for some distance (ZIEGLER, Ber. Bayer. Bot. Ges. 36, 1963, 61). The cultivated species of *Oxalis* which set no fruit in Malesia, are locally tenacious weeds through their bulbils. The native *Oxalis* species propagate also vegetatively, by stolons and root-stocks.

All *Oxalidaceae* have an arillate seed except the species of *Sarcotheca* and *Averrhoa bilimbi*.

On germination some remarks are made under the genus *Biophytum*.

Morphology. Episeptal rimae are found in some species of *Oxalis*, in most of *Dapania* and all *Sarcothecas*; in *Averrhoa* they are only inconspicuous, apical furrows. The most primitive state is probably represented in *Oxalis corniculata*. The septs fail to enlarge towards fructification, whereby the cells of the fruit are only united by their attachment to the central axis. The walls of the cells are pressed together and slits are formed, especially conspicuous by transparent ridges. These ridges are wide apart in the Malesian *Dapanias* and are slightly bent inwards. In *Sarcotheca* the septs are developed, at least in the lower half; in the upper half the rimae may be open and papillose inside, or closed and glabrous. Episeptal rimae are absent in all *Biophytums* and in *Dapania pentandra* from Madagascar.

(1) LF = long-styled form, MF = mid-styled form, SF = short-styled form.

Dehiscence of the fruits in *Biophytum* and *Dapania* is into a 5-rayed star. In *Oxalis* the valves remain united and only longitudinal loculicid slits are formed. *Sarcotheca* and *Averrhoa* have indehiscent fleshy fruits.

Anatomy. CHAUVEL, Rech. sur la famille Oxal. (1903) thesis; MOLL & JANSS. Mikr. 2 (1911) 9 (*Averrhoa*); HEIMSCH, Lilloa 8 (1942) 97, 191; METCALFE & CHALK, Anat. Dicot. 1 (1950) 299.

Phytochemistry. Few phytochemical investigations were performed with members of the family. In fact, distinct constituents have been isolated only from a few species of *Oxalis*. The tendency shown by many species of *Oxalis* to accumulate large amounts of oxalic acid in water-soluble form is known since a long time. Leucocyanidins and leucodelphinidins have been demonstrated to be present in the leaves of some species of *Oxalis* and of *Averrhoa carambola* L. This agrees with the idea that *Oxalidaceae* represent the most primitive family of *Geraniales*. Probably the species described by plant anatomists as possessing 'tannin' cells are the ones which contain leucoanthocyanins in leaves. The bright yellow flower pigments of *Oxalis cernua* THUNB. are the aurone glycosides aureusin and cernuoside. A yellow quinonoid pigment was isolated from the bulbs of one species of *Oxalis* (*O. purpurata* JACQ. ?) and later identified with rapanone, a benzoquinone occurring frequently in myrsinaceous plants. Too little phytochemical information is available at present for a chemotaxonomical appreciation of systematic relationships of *Oxalidaceae*. It might be significant, however, that rapanone does also occur in *Connaraceae*. General reference: HEGNAUER, Chemotaxonomie der Pflanzen 5 (1969) 255. — R. HEGNAUER.

Pollination. *Heterostyly* is a common feature in the family, heterotristyly is observed in *Oxalis*, *Biophytum*, and *Averrhoa bilimbi*. This must be assumed to be the primitive condition, as is found in the allied *Connaraceae*. From it is derived a heterodistylous condition in *Sarcotheca* and *Dapania*, in certain species of *Oxalis* and *Biophytum*, and in *Averrhoa carambola*. A further derived, homostylous condition is found in certain species of *Oxalis* and *Biophytum*.

DARWIN concluded that the heterotristyly in a Ceylonese *Biophytum* which he examined, was also functional in analogy with *Oxalis* while in cleistogamous flowers [1] he observed that in some way the incompatibility factor seemed to be removed (The Different Forms of Flowers, ed. 1877, 181, 323). SALTER (J. S. Afr. Bot. Suppl. 1, 1944) confirmed by experiments that functional heterotristyly occurs in *Oxalis*. This was also found in S. American species of *Oxalis*. Miss P. MAYURA DEVI (J. Genetics 59, 1964, 41) found in Indian *Biophytum* in her experiments a significant incompatibility in illegitimate crossings, except for MF selfed with pollen of the long stamens. This means a loss of compulsory heterotristyly. In a later article (*ibid.* 1966, 245) she described another mid-homostylous form which proved excellently self-compatible. It is regrettable that she did not conserve voucher specimens bound to her experiments, as the identification of Indian *Biophytum* is in distinct confusion and more than one species is cited as *B. sensitivum*. The plants used by DEVI certainly do not belong to *B. sensitivum*, as in her pictures the corolla is much longer than the calyx.

Functional heterotristyly is apparently present in the introduced species of *Oxalis*, *O. deppei* and *O. latifolia*, which in Malesia occur as SF only and have never been observed with fruit. *O. corymbosa*, although present with SF and MF, does not fruit either, but the flowers are often monstruous in this species. All three reproduce very successfully by bulbils and can become obnoxious weeds.

Biophytum fruticosum, *B. adiantoides* and *B. microphyllum* are also heterotristylous. No experiments have been done.

Biophytum sensitivum and *B. reinwardtii sens. str.* are both in India and Malesia mid-homostylous.

Reduction to a single stylar form (LF) is found in *Oxalis magellanica* and *O. acetosella ssp. griffithii*; reduction to homostyly (MF) has very far progressed in both *O. corniculata* where LF occurs rarely (6 out of 105 plants examined; *cf.* also EITEN, Am. Midl. Natur. 69, 1963, 280) and *Averrhoa bilimbi*, where LF and SF were only observed once. The introduced *Biophytum dendroides* is apparently self-compatible, as only one form (LF) has been found at Bogor and in the glasshouses of the Botanical Gardens of Leyden and Groningen, where in the apparent absence of pollinators it is fully fertile and weedy.

Heterodistyly (LF and SF) occurs in *Biophytum petersianum*, *Sarcotheca*, and *Dapania pentandra* from Madagascar. It is plausible that the ♂ flowers of the Malesian *Dapania* originated by an extreme reduction of the pistil in SF-flowers. *Averrhoa carambola* is heterodistylous for LF and MF. The latter type might well correspond with SF, as the shorter stamens are much reduced and without anthers.

More information about heterostyly and literature concerning this matter is given by ORNDUFF and by MULCAHY (Am. J. Bot. 51, 1964, 307 and 1045).

Palynology. See ERDTMAN, Pollen Morphol. & Plant Tax. 1 (1952) 302; HUANG, Taiwania 13 (1967) 70 and HUYHN, Bot. Jahrb. 89 (1969) 272.

Uses. Several species of *Oxalis* are cultivated as ornamentals, *Averrhoa* for its edible fruit. The wood of the ligneous *Oxalidaceae* is useless as timber. In Malaya the fruits of *Sarcotheca* are sometimes eaten. See also HEYNE, Nutt. Pl. (1927) 850.

Taxonomy. In Engler's Syllabus (2, 1964, 248) SCHOLZ divided the genera in two groups, A and B, on the aestivation and the number of ovules per carpel. Through this *Averrhoa* was joined to the affinity of *Oxalis* and *Biophytum*. However, the aestivation is inconstant. Moreover, the affinity of *Averrhoa* is

(1) In *Biophytum* I found also in not cleistogamous flowers opened anthers with good pollen already in bud (protrandry).

doubtless with *Sarcotheca* and *Dapania* in all other characters. These three genera form a very clear reticulate affinity.

The family is considered to be the most primitive of the *Geraniales* by HALLIER *f.* (Arch. Néerl. sér. 3B, 1, 1912, 109) and ENGLER (Nat. Pfl. Fam. ed. 2, 19a, 1931, 10). This primitive position is possibly the reason for the affinity with the *Connaraceae*, at which some authors have pointed (HALLIER *f.* New Phyt. 4, 1905, 158; Arch. Néerl. sér. 3B, 1, 1912, 109; SCHELLENBERG, Pfl. R. Heft 103, 1938, 127; TAKHTAJAN, Evol. Angiosp. 1959, 236). The latter family is usually placed near the *Leguminosae*. As a matter of fact specimens of *Rourea* and *Sarcotheca* were often confused and are very similar, the pistil and fruit excepted.

The closest allied family is *Geraniaceae* in which they were merged by BENTHAM & HOOKER *f.* In fact the American *Hypseocharis* seems to link both families. The only constant character was said by HALLIER *f.* (Beih. Bot. Centralbl. 39, ii, 1921, 172) to be the tenuinucellate ovules in *Oxalidaceae* and crassinucellate ovules in *Geraniaceae*, but *Hypseocharis* and many species of other genera have not been checked on the general validity of this character, as HALLIER *f.* himself admitted. And one must be very careful in this respect; for example HUTCHINSON (Fam. Fl. Pl. ed. 2, 1, 1959, 494) stated that *Oxalidaceae* have albuminous seeds, but some species of *Oxalis* are exalbuminous (*cf.* SALTER, J. S. Afr. Bot. Suppl. 1, 1944, 26); he stated also that *Oxalidaceae* are exstipulate, but stipules are found in all *Biophytums* and also in some species of *Oxalis* (*sect. Acetosella, O. corniculata, etc.*).

HUTCHINSON's division of *Oxalidaceae* into three different families belonging to three different orders seems not to have a reliable basis as *Averrhoa* cannot be divorced from *Sarcotheca* and *Dapania* and there is no reason for admitting a preponderant importance to their ligneous habit; besides many species of *Biophytum* and *Oxalis* are dwarf shrubs.

KEY TO THE GENERA

1. Herbs or dwarf shrubs, rarely up to 1½ m high. Leaves 3(–4)-foliolate, or paripinnate, herbaceous. Fruit a dry capsule.
2. Leaflets 3–4. Capsule with the valves remaining attached to the central axis. . . . . **1. Oxalis**
2. Leaflets 6 or more, pinnate. Capsule dehiscing into a 5-rayed star, without leaving a columella. **2. Biophytum**
1. Shrubs, trees or lianas, much higher. Leaflets 1 or 3, or leaves imparipinnate, 2-many-jugate. Fruit fleshy, dehiscent into a 5-rayed star or indehiscent.
3. Leaflets 1 or 3, chartaceous or subcoriaceous. Lateral petiolules articulate, after dropping leaving a short stalk on the rachis. Ovules 1–2 per cell.
4. Lianas. Inflorescences racemose. Petals inside glabrous. Fruit dehiscent into a 5-rayed star. Seeds arillate. . . . . **3. Dapania**
4. Shrubs or trees. Inflorescences paniculate. Petals minutely papillose inside. Fruit indehiscent (but episeptal rimae sometimes open!). Seeds exarillate . . . . . **4. Sarcotheca**
3. Leaves imparipinnate, 2-many-jugate, herbaceous to papyraceous. Lateral petiolules after dropping not leaving a stalk on the rachis. Ovules 3–7 per cell. . . . . **5. Averrhoa**

1. OXALIS

LINNÉ, Gen. Pl. ed. 5 (1754) 198; Sp. Pl. (1753) 433; Knuth, Pfl. R. Heft 95 (1930). — **Fig. 1.**

Annual or perennial herbs (or dwarf shrubs, extra-Mal.), some stemless with rhizomes or bulbs. *Leaves* digitately or pinnately 3(–4)-foliolate; leaflets in Mal. *spp.* (except *O. barrelieri*) ± sessile. Stipules when present adnate with the base of the petiole. *Peduncles* basal from bulbs or solitary and axillary. *Inflorescences* cymose to umbellate, 1-many-flowered. Bracteoles 2–several, sometimes with apical calli. Pedicels articulate at base and sometimes beneath the calyx. *Sepals* shortly connate at base, with or without apical calli. *Petals* coherent above the claw, contort, glabrous. *Filaments*: longer ones sometimes with a dorsal tooth. *Stigma* cylindric and minutely bilobed to peltate, sometimes papillose. Ovules 1 to *c.* 10, in 1–2 rows per cell. *Capsules* loculicid by longitudinal slits, sometimes with episeptal rimae. *Seeds* 1–*c.* 10 per cell, usually few; aril bivalved, ejaculatory; testa smooth, or with transverse ridges or longitudinal furrows.

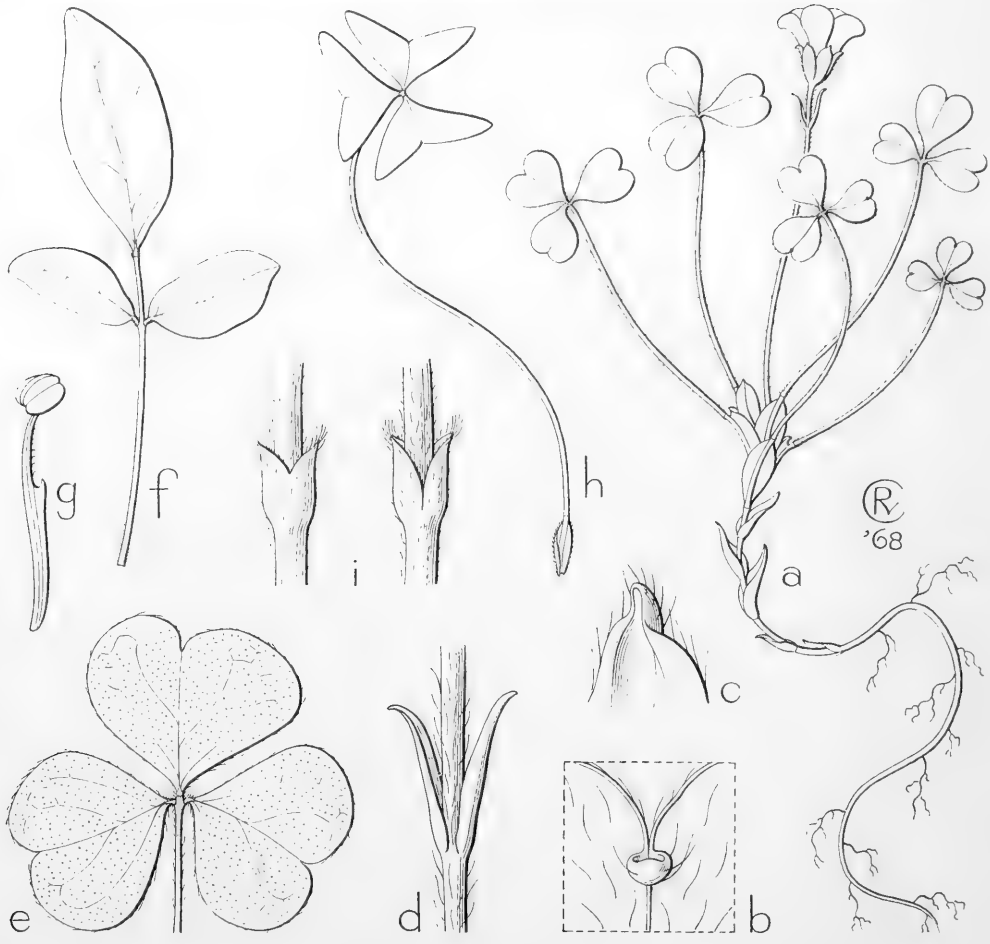

Fig. 1. *Oxalis magellanica* FORST. *f. a.* Habit, ×1, *b.* 'callus' of leaf, ×12, *c.* apex sepal, ×12, *d.* bracteoles, from both sides, ×4. — *O. corymbosa* DC. *e.* Leaf, ×1. — *O. barrelieri* L. *f.* Leaf, nat. size, *g.* dentate stamen, ×12. — *O. acetosella* L. *ssp. griffithii* HARA. *h.* Leaf, nat. size, *i.* bracteoles, from both sides, ×4 (*a–d* BALGOOY 252, *e* BACKER 37150, *f–g* BOERLAGE *s.n. a.* 1880, *h–i* STEINER 1990).

Distr. Cosmopolitan, at least 700 *spp.*, mainly from S. America and the Cape, in *Malesia* 3 native *spp.*; others introduced and escaping, sometimes becoming weedy. Fig. 2 (§ *Acetosellae*).

Ecol. *O. acetosella ssp. griffithii* and *O. magellanica* are (in Malesia) both characteristic mountain plants, above 2200 m. *O. corniculata* is rather indifferent to altitude.

Morph. The longer filaments are frequently thickened in the basal part, as in *Biophytum*. The apex of the thickening may emerge as a small tooth, *e.g.* in *O. latifolia*, *O. deppei*, and *O. barrelieri*. This tooth does not carry a vascular trace (NARAYANA, J. Jap. Bot. 41, 1966, 321).

For heterostyly see under the family.

An important study of the morphological diversity and taxonomy of the S. African species is provided by SALTER (J. S. Afr. Bot. Suppl. 1, 1944).

Notes. Pending a revision of the S. American species, Miss LOURTEIG (Paris) advised me to accept the names of the introduced species in the current sense.

Sizes of petiole and pedicels are given only for the portion above their articulation, as the part below it is too variable. The length of a 2-lobed leaflet is measured from the base to the apex of the lobe. The length of the filaments includes that of the basal, fused, annular part.

KEY TO THE SPECIES

1. Leaves along a distinct, supraterranean, creeping to erect stem. No bulbs.
 2. Shrublet. Petioles phyllodial, leaflets 0–3, often minute. Peduncles abortive. Flowers 1–9 in a fascicle, yellow. Cultivated in Java (§ *Heterophyllum*) (*O. rusciformis* MIKAN) . . . . **O. fruticosa** RADDI
 2. Herbaceous. Petioles not phyllodial, leaflets not reduced. Peduncle distinct.
  3. Leaf pinnately 3-foliolate (rachis developed under terminal leaflet). Leaflets elliptic to oblong, apex not notched. Petals pink with yellow base (§ *Thamnoxys*). . . . . **1. O. barrelieri**
  3. Leaf digitately 3-foliolate. Leaflets obcordate. Petals yellow (§ *Corniculatae*). **2. O. corniculata**
1. Stemless herbs with bulbs or subterranean rhizomes; leaves all basal.
 4. Rhizome, no bulbs. Inflorescence 1-flowered. Sepals with 0–1 greenish, round apical callus. Petals white (§ *Acetosellae*).
  5. Stipules conspicuous, much wider than the petiole. Leaflets up to 1¼ by 1¼ cm, obcordate; beneath whitish and glaucous and with a pale callus in the notch. Bracteoles 2, free, not vaginate, subglabrous. Sepals pubescent, with 1 pale apical callus. . . . . **3. O. magellanica**
  5. Stipules narrow, slightly broader than petiole, not very conspicuous. Leaflets 1–3 by 1¼–4 cm, fishtail-shaped; beneath not whitish and glaucous, ecallose. Bracteole 1, emarginate to bifid, vaginate, with an apical brown hair-tuft. Sepals subglabrous, ecallose. **4. O. acetosella** *ssp.* **griffithii**
 4. Bulbs, no rhizome. Inflorescence 2–many-flowered. Sepals with 2–4 orange apical calli. Petals red or purple with greenish to yellowish base.
  6. Outer tunics many-nerved, fibrous-withering. Leaflets 4(–6), obdeltoid, not notched, not punctate, at apex sometimes with 2 minute calli. Umbel with many bracts. Filaments crispy-ciliate, the longer with a dorsal tooth. Sepals with 4 linear calli. Petals red (bluish when dry) (§ *Polyoxalis*). **5. O. deppei**
  6. Outer tunics 3–several-nerved, not fibrous. Leaflets 3, obcordate or fishtail-shaped. Sepals with 2 oblong apical calli. Petals purple (bluish when dry) (§ *Jonoxalis*).
   7. Stolons apically bulbiferous. Outer tunics membranaceous, transparent, several-nerved. Leaflets fishtail-shaped, not punctate, notch often with 2 minute calli. Bracts of umbellate inflorescence 2, opposite. All filaments moderately ciliate, the longer with a minute tooth. . . . **6. O. latifolia**
   7. Stolons absent, bulb consisting of many small bulbils; outer tunics papyraceous, brownish, 3-nerved. Leaflets broadly obcordate, minutely punctate all over the surface, especially along the margins, ecallose. Bracts of the cymose, contracted inflorescence many. Shorter filaments glabrous, the longer ciliate, without a tooth. . . . . **7. O. corymbosa**

1. Oxalis barrelieri LINNÉ, Sp. Pl. ed. 2 (1763) 624; RIDL. Fl. Mal. Pen. 1 (1922) 330; KNUTH, Pfl. R. Heft 95 (1930) 65; HENDERSON, Mal. Wild Fl. (1959) 47, fig.; BACKER & BAKH. *f.* Fl. Java 1 (1963) 245. — *O. sepium* ST. HIL. Fl. Bras. Merid. 1 (1825) 89; PROGEL, Fl. Bras. 12, 2 (1877) 505, *incl. var. picta* PROGEL; KNUTH, Pfl. R. Heft 95 (1930) 64; HEYNE, Nutt. Pl. (1927) 151. — **Fig. 1f-g.**

Erect herb, stem up to 1½ m, without bulbs or stolons. Stem branched, sparsely patent to appressed-reflexed pubescent, glabrescent; hairs simple, straight or bent below the middle, eglandular. *Leaves* usually more or less opposite, pinnately 3-foliolate, exstipulate; petiole 2–9 cm, appressed-puberulous; leaflets elliptic to oblong, base cuneate to emarginate, apex obtuse to rounded, not notched, ecallose, glabrous above, margins strigose, especially at base, beneath pale and glaucous, sparsely to moderately appressed pubescent, terminal leaflets largest, 1–3½ by ½–2½ cm. *Peduncles* 3–5½ cm, pubescent, once or twice dichasially forked; branches up to 4½ cm, 4–16-flowered, the bracts opposite the flowers. Bracteoles minute, ciliate, ecallose. Pedicels 1½–3 mm, glabrous. *Sepals* 2–4 by ½–1¼ mm, ovate-lanceolate, acute, glabrous or with a few hairs, ecallose, 3-nerved. *Petals* 6–9 by 2–2½ mm, obovate-lanceolate, apex rounded, after anthesis rolling inwards, pink, lower half greenish with yellow spots, glabrous. *Filaments* (MF) ¾–1 and 1¾–2¼ mm, the shorter glabrous, the longer with a dorsal tooth, patent-hairy. *Ovary* 1 by ½ mm, glabrous; styles (MF) 1–1½ mm, ascendingly strigose; stigmas small, capitate; ovules 4 per cell, in 1 row. *Fruit* 5–10 by 3–5 mm, slightly ovoid, 5-angular, apex and base 5-lobed, glabrous; episeptal rimae present. *Seeds* 3–4 per cell, 1½ by 1 mm, ± flattened-ovoid; testa transversally ridged.

Distr. Native of tropical S. America, cultivated and established in many places, the oldest collected specimen from Bogor dates from BOERLAGE, *a.* 1888; in *Malesia*: Sumatra, Banka, Malaya, Java, Papua (Central Distr.).

Ecol. Around gardens, along roads, in hedges, fields, and village groves, along rivers, grassy places with shade, up to 1500 m.

Vern. *Tjalingtjing*, J, *bělimbing tanah*, Banka, *kopomani*, Tamil.

Uses. The leaves are eaten for their sour taste.

Note. Although only the MF form is found in Malesia, fertile seed is formed; there is apparently no functional heterostyly.

2. Oxalis corniculata LINNÉ, Sp. Pl. (1753) 435; ZUCC. Abh. Ak. Wiss. München. 1 (1830) 230, *incl. var. repens* (THUNB.) ZUCC.; PLANCH. in Houtte, Fl. Serres 12 (1857) 205, *incl. var. atropurpurea* PLANCH.; MIQ. Fl. Ind. Bat. 1, 2 (1859) 135; EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 436; F.-VILL. Novis. App. (1880) 32; GUILLAUMIN,

Fl. Gén. I.-C. 1 (1911) 610; BACK. Schoolfl. Java (1911) 170, *incl. var. javanica* (BL.) BACK.; KNUTH, Notizbl. Berl.-Dahl. 7 (1911) 300, *incl. var. sericea* KNUTH; RIDL. Fl. Mal. Pen. 1 (1922) 330, *incl. var. villosa* HOOK. *f. ex* RIDL. [*sphalm.* ? *var. villosa* HOHENACKER, *cf.* YOUNG, Watsonia 4 (1958) 57]; WIEGAND, Rhodora 27 (1925) 113; KNUTH, Pfl. R. Heft 95 (1930) 146; MASAMUNE, Fl. Geogr. Stud. Yakushima (1934) 257, *incl. ssp. repens* (THUNB.) MASAM.; KNUTH in Fedde, Rep. 48 (1940) 3, *incl. var. papuana* KNUTH; HARA, Enum. Sperm. Jap. 3 (1954) 8; EITEN, Taxon 4 (1955) 99; Am. Midl. Natur 69 (1963) 257; BACK. & BAKH. *f.* Fl. Java 1 (1963) 246; VELDK., Fl. Thail. 2 (1970) 17. — *O. repens* THUNB. Diss. Oxal. (1781) 16, fig.; BL. Bijdr. (1825) 243; B. L. ROBINSON, J. Bot. 44 (1906) 311; MERR. En. Born. (1921) 311; En. Philip. 2 (1923) 323. — *O. javanica* BL. Bijdr. (1825) 243; MIQ. Fl. Ind. Bat. 1, 2 (1859) 135. — *O. acetosella* (*non* L.) BLANCO, Fl. Filip. (1837) 388. — *O. boridiensis* KNUTH in Fedde, Rep. 48 (1940) 3.

Perennial herb, ascending to erect, rooting at the nodes; main root sometimes much thickened and woody; stems several from the main root, branching above the ground, puberulous to pubescent (hairs mainly 1-celled). *Leaves* scattered, distant, or in small tufts. Stipules indistinct to small, sometimes conspicuous, up to 3 by 1 mm, rectangular. Petiole 1–5½(–10) cm, appressed to patently puberulous. Leaflets broadly to elliptic-obcordate, 4–20(–25) by 5–18(–25) mm, incised up to halfway, ecallose, lobes rounded, rarely obtuse; upper surface glabrous to sericeous; beneath paler, sometimes glaucous, sparsely pubescent to sericeous. *Peduncles* up to 20 cm, usually much shorter, sparsely puberulous to sericeous. *Inflorescence* cymose to pseudo-umbellate, 1–5(–8)-flowered. *Flowers* usually MF, rarely LF. Bracts 2–several, subopposite to whorled, ovate-lanceolate, acute, puberulous, sometimes with septate hairs. Pedicels up to 20 mm, articulate at base and beneath calyx, in fruit straight to sharply bent at the articulations, but the fruit always erect. *Sepals* lanceolate, obtuse to rarely obliquely retuse with narrow pale margins, 2–6 by ½–2 mm, sparsely puberulous to sericeous, sometimes with septate hairs. *Petals* spathulate-oblong to -lanceolate, 3½-10 by 1-7 mm, apex rounded to emarginate, after anthesis apically crumpled, yellow, with darker or lighter base. *Filaments* glabrous, the longer edentate, in MF 1–4 and 3–6 mm, the shorter rarely with abortive anthers, in LF 2¾–3½ and 3½–4½ mm. *Ovary* 1½–2 by ¾–1 mm, ellipsoid to cylindric, puberulous; styles in MF 1–4 mm, in LF 3–4 mm, minutely ciliate, sometimes mixed with minute septate hairs; stigmas small, cylindric, sometimes flattened and minutely bifid, papillose; ovules (1–)5–11 per cell, in 1 row. *Fruit* 9–20(–24) by 2–4 mm, usually linear-cylindric, sometimes ellipsoid, pentagonal, acuminate, minutely puberulous, hairs reflexed or patent to ascending in upper half, mixed with patent, septate hairs; episeptal rimae closed, inconspicuous; cells inside sparsely to moderately strigose. *Seeds* (0–)5–11 per cell, 1 by ¾ mm, flattened-ovoid; testa with *c.* 3 regular rows of 7–10 transversally connected rows of ridges.

Distr. Cosmopolitan, origin unknown, in Malesia several forms occur; throughout *Malesia*, three times collected in Celebes and Borneo and scarce in Malaya (Malacca, Perak, Penang; a common weed in Singapore Bot. Gardens).

Ecol. In many islands a common weed on all sorts of disturbed soil, in grassfields, gardens estates, along roads and river-banks, on walls, *etc.*, in Java up to 2200, in New Guinea to 3000 m.

Vern. *Sikap dada*, M (Sing.), *asim-asim*, *atim-atim*, *lela*, Atjeh, *daun asĕm* (*ketjil*), (*djukut*) *tjalintjing*, *sĕmanggi*, *sĕmanggèn*, J, *tjembitjèna*, Mad., *mala mala*, Ternate, *kuja kawiana*, Alor; Philip.: *daraisig*; Bik., *iayo*, *kungi*, *malabalugbugdagis*, Pamp., *kanapa*, Ig., *marasiksik*, Ilk., *pikhik*, Iv., *salamági*, Bon., *susokoyili*, *taingangdaga*, Tag.; New Guinea: *keketi*, Tumba, *puggepagl*, Yoowi, *songongom*, Wapi, *girobi*, Musa, Safia, *jampijamp*, Enga, Yogos, *gagari*, Eng, Kapilam, *kwibant*, Maring, *kale*, Rabaul, *tenaquipo*, Jimi.

Uses. *Cf.* HEYNE, Nutt. Pl. (1927) 850. According to VINK (*n.* 16308) from Uinba, Nona-Minj Divide, Kubor Range, W. Highlands, New Guinea (20-8-1963) used 1) "In marrying ceremony the young woman takes fresh leaves and makes a gag of it with salt and cold water; the gag is chewed and the juice is spit on pigmeat, which is given to the new husband. 2) When the garden gives a bad production of sweet potato, the woman looking after the garden puts a bundle of the leaves in her girdle to get a higher production."

Note. A most complex and variable species. Many infraspecific taxa have been described, but all appear to be linked by intermediate forms. The following extremes can be recognized;

'*var. repens* THUNB.' Small, decumbent plants. Leaflets rather dark, small, glabrous to moderately strigose. Inflorescences few-flowered, flowers small. Throughout Malesia, a form of exposed, sunny places.

'*var. atropurpurea* PLANCH.' Plant brownish to purplish *in vivo*, dark green when dry; petals more or less flushed or blotched with reddish brown *in vivo*, fading to whitish or yellowish in drying. Cultivated and escaping.

'*var. sericea* KNUTH' (= '*var. trichocaulon* LÉVL.' according to HARA, 1954; no material of this seen). Large pubescent plant, foliose apices of stems erect or ascending; stipules minute, leaflets strongly pubescent, terminals large, longer than broad, incised for $^1/_9$–$^1/_5$ of leaflength, floral parts relatively large; ovules and seeds 1–5 per cell; fruit oblong, stout, pubescence ascending at least in upper half. Eastern New Guinea and New Britain (Formosa? Japan? Korea?). Shaded river-banks, open places in forest, edges of paths and trails, grassfields.

3. Oxalis magellanica FORST. *f.* Comm. Gött. 9 (1789) 33; HOOK. *f.* Fl. Nov. Zel. 1 (1853) 42, fig.; Fl. Tasm. 1 (1860) 59; BENTH. Fl. Austr. 1 (1863) 300; HOOK. *f.* Handb. N. Zeal. Fl. (1864)

38; REICHE, Fl. Chile 1 (1896) 339; KNUTH, Pfl. R. Heft 95 (1930) 230. — *O. lactea* HOOK. Comp. Bot. Mag. 1 (1836) 276; SKOTTSB. The Plant World 18 (1915) 129; CHEESEMAN, Man. N. Zeal. Fl. ed. 2 (1925) 536; CURTIS, Stud. Fl. Tasm. 1 (1956) 96; ALLAN, Fl. N. Zeal. 1 (1961) 238. — **Fig. 1a–d.**

Stemless herb with stolons, without bulbs. Rhizome pink to brownish, glabrous with distinct, amplexicaul scale-like remains of leafbases. Stipules much broader than the petiole, conspicuous, membranaceous, brown, glabrous. Petioles 1–8½ cm, reddish. *Leaflets* obcordate, 4–13 by 4–12 mm, incised up to ⅓ of the length, lobes rounded; upper surface usually glabrous; beneath pale, glaucous, appressed-strigose glabrescent, with a ± prominent, greenish to brownish callus at the notch. *Peduncles* few, below basal articulation ½–2 cm, above 1–6½ cm, sparsely appressed- to patently pubescent; bracteoles 2, subopposite, 2½–7 by 1–1½ mm, lanceolate, acute, free, very sparsely strigose to glabrous, ecallose, placed in upper $^3/_5$–$^4/_5$th. Buds erect. *Flowers* solitary, only LF. *Sepals* elliptic to obovate-oblong, 3–5 by 1½–2¼ mm, acute to truncate and minutely 3-lobed (apex or middle lobe cucullate, sometimes inconspicuous by the hairs, seemingly callose), sparsely to moderately pubescent and somewhat glaucous, margined, slightly shorter to equal to the fruit. *Petals* white, 8–11½ by 4–6 mm, spathulate, somewhat oblique, apex rounded to emarginate, glabrous to ± ciliate. *Filaments* (LF) 3–4½ and 4½–5½ mm long, glabrous, edentate. *Ovary* 1–2 by 1–2 mm, glabrous; styles 3–5 mm, glabrous; stigma disk-shaped; ovules 2–5 per cell, in 1 row. *Fruit* 3–6 by 3–5 mm, glabrous, finally nodding. *Seeds* 1–3 per cell, 1½ by 1 mm, ± flattened-ovoid, shiny, brownish, smooth to slightly lengthwise furrowed.

Distr. Southern Andine S. America, New Zealand, Tasmania, and the Victorian Alps; in *Malesia*: New Guinea, on the high mountains (Wilhelm, Otto, Kubor Range, Finisterre Range, Sarawaket Range, Wilhelmina), 2200–3700 m.

Ecol. Subalpine to alpine, on shaded, moist to wet, humous soil, among grasses and mosses, sometimes on tree-trunks or rocks. *Fl.* May–Nov.

Vern. *Chimbaemagl*, Chimbu.

Notes. According to SKOTTSBERG *l.c.* the S. American specimens would differ in having less distinctly obcordate leaflets, peduncles not exceeding 1 cm, and flowers only *c.* 5 mm across. The New Zealand botanists accordingly call the species in New Zealand *O. lactea*, but ALLAN added that some specimens from Chile (in K) approach the New Zealand form.

A comparative study of Chilean, Australasian, and Papuan specimens showed that SKOTTSBERG's differentiation does not hold and that only one species is concerned.

4. Oxalis acetosella LINNÉ, Sp. Pl. (1753) 433.

ssp. **griffithii** (EDGEW. & HOOK. *f.*) HARA, J. Jap. Bot. 30 (1955) 22; Fl. E. Him. (1966) 168, 638, 661. — *O. griffithii* EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 436; KNUTH, Pfl. R. Heft 95

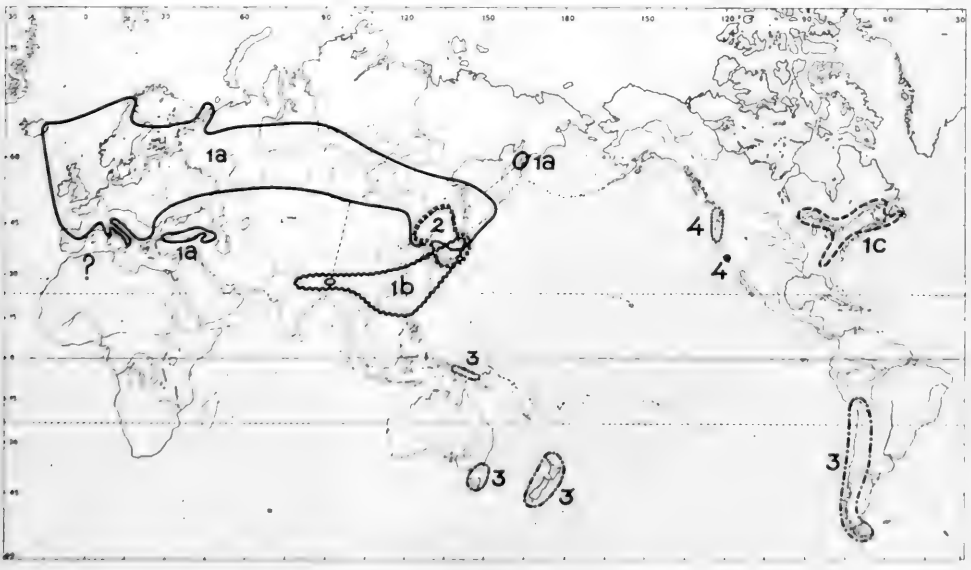

Fig. 2. Distribution of *Oxalis* § *Acetosellae*. 1a. *O. acetosella* L. *ssp. acetosella*, 1b. *ditto, ssp. griffithii* HARA, 1c. *ditto, ssp. montana* HULTÉN, 2. *O. obtriangulata* MAXIM., 3. *O. magellanica* FORST. *f.*, 4. *O. oregana* NUTT.

(1930) 234; OHWI, Fl. Japan (1965) 580. — **Fig. 1h–i.**

Stemless herb with stolons, without bulbs. Rhizome dark brown, usually scaley, sparsely pubescent to glabrous. Stipules shorter and ± broader than the basal part of the petiole. Petioles 4½–22 cm, greenish, red-tinged, pubescent; below articulation flattened, thickened, persistent, finally ± woody, brownish when dry, moderately to densely pubescent. *Leaflets* 1–3 by 1¼–4 cm, broadly obtriangular, fishtail-shaped, the straight upper edges forming a very wide angle, incised up to halfway, lobes rounded to obtuse; upper surface subglabrous to sparsely appressed-strigose; beneath paler, not glaucous and with denser pubescence, midrib ± thickened in notch. *Peduncles* 1–2, below basal articulation up to ½ cm, above 5–11 cm (shorter in cleistogamic flowers), subglabrous to densely pubescent, especially distally; bracteoles ± halfway or higher, partly connate-vaginate, midrib dorsally pubescent, apex with hairy brown tuft, ecallose. *Sepals* 3–6¾ by 1½–2½ mm, oblong, rounded to emarginate, not cucullate, ecallose, subglabrous, edge closely ciliate. *Petals* 8–19 by 4–8 mm, spathulate-oblong, truncate to emarginate, often oblique, white, often with lavender veins and yellowish base in *vivo*. *Filaments* (LF) 1¾–3½ and 3–6 mm, glabrous, edentate. *Ovary* 2–3½ by 1½ mm, glabrous; styles (LF) 3–6 mm, glabrous; stigma minute, more or less hook-like, entire; ovules 1–5 per cell. *Fruit* 6 by 5 mm, ovoid, acute, glabrous, nodding. *Seeds* 1–2 per cell, 2½ by 1½ mm, flattened-ovoid, ± smooth to lengthwise ridged, light brown.

Distr. From India (Sikkim, Bhutan, Khasia) through China to Japan and Formosa; in *Malesia*: Philippines (N. Luzon: Mt Pulog), two collections (STEINER 1990, March 1961; JACOBS 7361, Jan. 1968).

Ecol. Mossy forest ravine, probably 2500–2900 m. *Fl.* Jan-March. Fig. 2.

HARA (1966) stated that it is found more to the south and at lower altitudes than *ssp. acetosella*, both in E. Himalaya and in Japan.

Notes. FERNANDEZ-VILLAR (Novis. App. 1880, 32) recorded true *O. acetosella* L. from a medical garden at Manila.

5. Oxalis deppei LODD. Bot. Cab. 15 (1828) 1500; KNUTH, Pfl. R. Heft 95 (1930) 288; BACK. & BAKH. *f.* Fl. Java 1 (1963) 246; MATTHEW, Rec. Bot. Surv. India 20 (1969) 56. — *O. tetraphylla* (*non* CAV.) BACK. & SLOOT. Handb. Thee (1924) 157, t.; HEYNE, Nutt. Pl. (1927) 851.

Stemless herb from bulbous base, no rhizome, no stolons. Bulb up to 2½ by 2 cm, ovoid, acute, with lateral, sessile bulbils; tunics up to 2½ by 1½ cm, ovate, acute, acuminate or bilobed with terminal leaf, brown, many-nerved, outer fibrous, margins bearded, rest glabrous, inner becoming fleshy. Innovations brownish pilose. Petioles up to 40 cm, glabrous or with a few hairs. *Leaflets* 4(–6), unequal, 2½–6½ by 1¾–6½ cm, obdeltoid, entire to slightly retuse and ± apiculate (tip often ± folded and occasionally with 1–2 minute calli underneath), glabrous to sparsely pubescent, usually with dark V-shaped marking in lower third, epunctate. *Peduncles* up to 50 cm, ± glabrous. *Inflorescence* pseudo-umbellate, 6–25-flowered. Bracts many, up to 2½ mm, ovate, acute to acuminate, glabrous or with strigose margin, ecallose or with minute apical calli. Pedicels up to 3 cm, glabrous. *Sepals* 5–7(–10) by 1½–3 mm, elliptic to lanceolate, obtuse to emarginate, glabrous, ciliate on edge, *c.* 7-nerved, apical calli 2–6, usually 4, linear, inconspicuous, orange. *Petals* 1½–2½ by ½–1¼ cm, spathulate-oblong, rounded to retuse, often oblique, glabrous, dark red, when dry often bluish with greenish base. *Filaments* (SF) 3½–4½ and 6–6½ mm, (LF) 6 and 10 mm, the shorter with a few, the longer with many patent, crisped cilia, dentate. Ovary and staminal tube *c.* ½ mm stipitate. *Ovary* 1½–5 by 1–3 mm, ellipsoid, glabrous; styles (SF) 1 mm long, (LF) *c.* 15 mm, glabrous, dark when dry; stigmas cylindric, ± bilobed, later ± peltate, not papillose; ovules 3–5 per cell, in 1–2 rows.

Distr. Native of Mexico, cultivated and escaping; in *Malesia* hitherto only found in Java (Tjinjiruan); introduced before 1911, now quasi-spontaneous.

Ecol. Locally naturalized in mountain *Cinchona* estates, *c.* 1600 m, sometimes gregarious, propagating by bulbils; fruit unknown from Java. Apparently functionally heterostylous. In Malesia only the SF has been found so far. Dimensions of the LF have been taken from MATTHEW, *l.c.*

Vern. *Tjalingtjing badak*, *tj. gedé*, S.

Uses. Ornamental plant and for ground-cover, but difficult to eradicate; leaves eaten as vegetable (HEYNE, 1927).

Note. *O. tetraphylla* CAV., with which this species has often been confused, has bulbiferous stolons, emarginate, not apiculate leaflets, and smaller flowers.

6. Oxalis latifolia H. B. K. Nov. Gen. Sp. 5 (1821) 184, t. 467; KNUTH, Pfl. R. Heft 95 (1930) 273; HEYNE, Nutt. Pl. (1927) 851; SYMON, Trans. R. Soc. S. Austr. 84 (1961) 75; YOUNG, Watsonia 4 (1958) 63. — *O. intermedia* (*non* A. RICH. ?) BACK. & BAKH. *f.* Fl. Java 1 (1963) 246.

Stemless herb from bulbous base, no rootstock; bulb ovoid, up to 5 by 2 cm, acute, with numerous, basal, ± erect stolons, with a few small scales, ending in ovoid, acute bulbils pale brown when dry; tunics many, outer up to 5 by 2 cm, ovate, acuminate or with terminal leaf, membranous, transparent, white, nerves 3 to several, orange; inner becoming fleshy. Petiole up to 20 cm, ± glabrous. *Leaflets* ± equal, 1½–7½ by 2–8½ cm, broadly obdeltoid, fishtail-shaped, incised up to halfway, glabrous, beneath subglaucous, often with 2 orange calli in notch, epunctate. *Peduncles* up to 25 cm, slightly hairy. *Inflorescence* umbellate, 5–13-flowered. Bracts 2, *c.* ½ mm, ovate, margin glabrous to strigose, minutely callose or ecallose. Pedicels up to 2 cm, glabrous, filiform. *Sepals* 4–4½(–6) by 1½–2(–3) mm, oblong, obtuse, glabrous, indistinctly 3–5-nerved; apical calli

2, orange, not confluent, *c.* 1 mm long, minutely hastate. *Petals* 10–20 by 3–6(–8) mm, narrowly obtriangular, truncate, ± oblique, red-purplish with greenish base, crumpled after anthesis. *Filaments* (SF) 2½–3(–4) and 4–5(–6) mm, puberulous, the longer with a minute tooth. Ovary and staminal tube *c.* ½ mm stipitate. *Ovary* 1½ by ¾ mm, apically sparsely ciliate on the ribs; styles (SF) *c.* 1 mm, sparsely ciliate; stigma peltate, *c.* ¼ mm ø, not papillose; ovules 3–6 per cell, in 1–2 rows.

Distr. Native of Central and tropical S. America; cultivated and escaping, *e.g.* in *Malesia*: Java (Preanger Mts; W. Java: Gedeh, Lembang, Tjinjiruan).

Ecol. In gardens, fields, and estates, 1250–1550 m. No fruits are recorded from Java, the plant is apparently functionally heterostylous. It is difficult to eradicate because of the many bulbils.

Vern. *Tjalingtjing*, S.

Note. *O. intermedia* A. RICH. (Ess. Fl. Cuba, 1842, 315) is said to be more pubescent and to have edentate, longer filaments. As the teeth are minute, however, they might easily be overlooked.

7. Oxalis corymbosa DC. Prod. 1 (1824) 696; RIDL. Fl. Mal. Pen. 1 (1922) 330; BACK. & SLOOT. Handb. Thee (1924) 155, t.; HEYNE, Nutt. Pl. (1927) 851; SYMON, Trans. R. Soc. S. Austr. 84 (1961) 74; BACK. & BAKH. *f.* Fl. Java 1 (1963) 246. — *O. martiana* ZUCC. Denkschr. K. Ak. Wiss. Münch. 9 (1824) 144; BACK. Schoolfl. Java (1911) 170; MERR. En. Philip. 2 (1923) 323; KNUTH, Pfl. R. Heft 95 (1930) 250. — *O. violacea* (*non* L.) HALL. *f.* Med. Rijksherb. Leiden 12 (1912) 19. — **Fig. 1e.**

Stemless herb from bulbous base, no rhizome, no stolons; bulb globose, *c.* 1 cm ø; bulbils many, clustered, globular to ovoid, acute; outer tunics brown, papyraceous, up to 20 by 6 mm, ovate to oblong, acuminate or with terminal leaf, margins glabrous to long-bearded, distinctly 3-nerved; inner pale and fleshy. Petiole up to 30 cm, patently villose. *Leaflets* ± equal, 1½–4½ by 1¾–5½ cm, broadly obcordate, incised for ⅕, lobes rounded, sometimes ± overlapping; upper surface subglabrous, beneath appressed-puberulous; minutely orange-punctate all over the surface, especially along the margins. *Peduncle* up to 35 cm, hairy in various degree. *Inflorescence* often up to twice forked; pseudo-umbels 2–12-flowered. Bracts many, *c.* 1 mm long, elliptic, rounded, pale, with strigose margin and 0–3 orange, linear calli in the middle. Pedicels up to 2½ cm, ascendingly appressed-strigose. *Sepals* 3½–5(–6) by 1–2 mm, oblong, acute, apex minutely bifid to the 1–3 orbicular to oblong, with 2 orange, apical calli, ± puberulous, 3–5-nerved. *Petals* 11–20 by 4–7 mm, spathulate-oblong to -lanceolate, obtuse to truncate, often oblique, light reddish purple with darker veins, yellowish at base. *Filaments* (MF) 2–3 and 5–6 mm, (SF) 3½–4 and 5–6 mm; the longer dorsally ciliate, edentate. Ovary and staminal tube *c.* ¾ mm stipitate. *Ovary* 2 by 1 mm, abundantly ascendingly ciliate to glabrous; styles in MF 1¾–2 mm, in SF 1–1¼ mm long, abundantly ciliate; stigma bilobed, papillose, *c.* 1 mm ø; ovules 3–8 per cell, in 1–2 rows. Fruit not seen.

Distr. Native in tropical S. America, naturalized in many parts of the World; in *Malesia* cultivated and escaping in Java (introduced from Sydney before 1848), W. Sumatra, Malaya, and Philippines (Luzon).

Ecol. In fields, road-sides, and estates, often as a gregarious weed, 400–1450 m. No seed is set; propagation is by the many bulbils, which make it a difficult plant to eradicate.

Vern. *Tjalingtjing beureum, tj. gedé, tj. tégal*, S, *kémbang gélas*, J, *asam-puja*, Padang.

Uses. Occasionally cultivated; the leaves are sometimes used as a substitute for tamarind (HEYNE).

Terat. No fruits have been recorded, although two stylar forms occur, possibly in the same populations, but certainly in the same environment. The reason for inability of fruit-setting probably lies in the common occurrence of monstruous flowers.

Sometimes the filaments broaden and form petaloid structures, occasionally still with the anthers present in reduced state. More often there is a transition of the anthers towards carpel-like structures. In the least monstruous forms the connective is flabelliform with patent outer walls of the anthers. The next step is an apical elongation and even more developed anther-cells. The elongation may bear a stigma-like structure. Especially when there is an extra filamentous whorl between the inner (longer) filaments and the pistil extreme cases occur. These 'filaments' may finally resemble stipitate, free carpels with a full grown style and papillose stigma; they are apparently open on the introrse side. Ovules have not been seen, but may be present as they are very small and transparent even in the normal plant. It is possible that these 'filaments' fuse with the pistil, as occasionally more than 5-merous pistils carrying ovules are observed with the stipitate alongside. Thus there seem to be transitional stages between the anthers and pistil!

Once a sepal was observed to arise from the centre of a deformed pistil.

Notes. *O. articulata* SAVIGNY (in Lamarck, Encycl. Bot. 4, 1798, 686) from Argentina, is often confused with this species. *O. articulata* differs in the presence of a tuberous rhizome, by the deeper obcordate leaflets that have large spots, and the denser pubescence.

O. violacea L. (Sp. Pl. 1753, 434) from N. America, has emarginate, obdeltoid leaflets, epunctate with two brown calli at the notch.

2. BIOPHYTUM

DC. Prod. 1 (1824) 689; EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 436; KNUTH, Pfl. R. Heft 95 (1930) 391; STEEN. Bull. Jard. Bot. Btzg III, 18 (1950) 449. —

Oxalis sect. Biophytum ENDL. Gen. Pl. (1839) 1172; MIQ. Fl. Ind. Bat. 1, 2 (1859) 134; PROGEL, Fl. Bras. 12, 2 (1877) 482. — **Fig. 3–4.**

Erect annual herbs or usually sympodially branched dwarf shrubs. *Leaves* paripinnate in tufts at the end of the stem or branches, with setaceous stipules; leaflets opposite, subsessile, terminal pair mostly different from the others, their acroscopical half of base cuneate, basiscopical half rounded to truncate, rachis prolonged in a mucro. *Flowers* terminal in a usually peduncled, bracteate pseudo-umbel, heterodi-, tri- or homostylous. Pedicels articulate at base. *Sepals* glabrous inside, ± free. *Petals* contort, glabrous, coherent above the claw. *Filaments*: shorter ones with a more or less pronounced callus at base, longer ones always edentate. *Styles* in LF and MF ciliate; stigmas terminal, subulate and entire or spoon-shaped to flattened, crenate to bifid; ovules 3–6 per cell, alternating in 2 rows. *Capsule* finally loculicid to the base, forming a 5-rayed star. *Seeds* 1–6 per cell, aril white, thin, at maturity bivalved and ejaculatory.

Distr. Pantropical, possibly some 70 *spp.*, in *Malesia* 7 *spp.* among which one escaped and another introduced.

Ecol. *B. dendroides* is obviously escaped from the Bogor Botanic Garden and became naturalized in the immediate vicinity of Bogor. *B. reinwardtii* and *B. sensitivum* are weeds in anthropogenic places; it is doubtful whether the former is indigenous. The three ligneous species, *B. adiantoides*, *B. fruticosum* and *B. microphyllum* are forest dwellers. *B. petersianum* is a widely spread annual which prefers places subject to a pronounced dry season, as also shown by its absence from the great ombrogenous forest belt in Malaya, Borneo and Sumatra and scarcity in West Java (some local spots N of Bandung).

For heterostyly see under the family.

Germination is insufficiently known and seems variable. SHETTY (Proc. Symp. Recent Adv. Trop. Ecol. Varanasi, 1968, 213–224) found that in *B. sensitivum* (a name not checked by me through voucher specimens) seed collected at Varanasi (Benaras, at *c.* 25° NL) at the beginning of the (dry) winterseason failed to germinate 'under any condition' for the first 8½–9 months and showed hereby to possess a dormancy period. Germination capacity decreased again considerably after 11–12 months. During the first month of the germination period it needed thorough washing by which SHETTY concluded to the presence of a water-soluble inhibitor; besides optimal temperature needed for germination was found to be 30–40° C. Whether this behaviour holds also for Malesia is unknown; it is common in regions without a dry or cooler season.

I have made germination tests with *B. dendroides* in the Leyden Hortus where the seeds germinated in a very short time.

Morph. I have raised seedlings of *B. dendroides* of which the germination is epigaic. The first leaves, which bear successively 2, 4, 6, and more leaflets, originate from the plumule which remains between the cotyledons. Simultaneously the hypocotyl starts to lengthen, forming the initial stem carrying the leaf tuft at its apex. When this cycadoid first stage is formed, one finds below the tuft usually a collar of reflexed bristles below the leaf-scars of fallen leaves. In the annual species, characterized by a pithy (compressible) hypocotylar stem, there is usually one apical tuft, exceptionally there are two, both sessile. In the perennial ligneous species other tufts are formed, either on short-shoots or by genuine lateral distinctly sympodial branching.

The *sympodial branching* of the suffruticose species is very characteristic; it is partly by thick short-shoots on which the cortex is covered by leaf-scars, withering with age, and partly by long-shoots which carry always under the pseudo-umbel of leaves a reflexed tuft of hairs, the shoot itself showing no leaf-scars. In the tuft are many, often finally reflexed narrow to needle-like stipules. The peduncle of the inflorescence resembles the 'internode' of the long-shoots, but it carries on top a fascicle of narrow cuspidate bracts, the inner ones of which bear flowers.

In *B. reinwardtii* and *B. adiantoides* it may happen that in the pseudo-umbel some reduced leaves occur. This can be found also in *B. fruticosum* (KAUDERN 438); of this species a still more remarkable specimen has been collected at Sse Mao (Pl. Yunnan & Mekong), Prince H. d'ORLEANS (in P) where the pseudo-umbel has produced a new umbel with reduced leaves and flowers, exactly similar to a normal long-shoot. This also occasionally occurs in *B. reinwardtii* (RANT *s.n.*, 1922, *do*, 1924, BEUMÉE 4848, KOORDERS 29864). A remarkable case of proliferation difficult to account for.

'*Callus*' *of the shorter filaments.* At the base of the annulus below the shorter (epipetalous) filaments there is a usually dark coloured tumidity, sometimes cup-shaped, in front of the petals. Similar ones have already been noticed in *Hypseocharis* by BAILLON (Adansonia 10, 1873, 363; Hist. Pl. 5, 1874, 26, 41, f. 56, 57) and in some species of *Oxalis* by BAILLON (1874) and PROGEL (Fl. Bras. 12, 2, 1877, t. 111 and 113, 6). HALLIER *f.* discussed their taxonomical value as similar structures occur in *Geraniaceae*,

Limnanthaceae and *Linaceae* (Beih. Bot. Centralbl. 39, ii, 1921, 165). NARAYANA (*in litt.*) found they have no vascular trace in *B. candolleanum* (called '*B. intermedium*', in J. Jap. Bot. 41, 1966, 321). The callosities are possibly homologous with the scales found in *Dapania* on the annulus at the base of the shorter filaments (VELDKAMP, Blumea 15, 1967, 523).

The indument is made up of setaceous, simple hairs. In the inflorescences small, septate, capitate, glandular hairs and/or minute, red, club-shaped glands may be present.

Syst. I agree with VAN STEENIS that the subdivision of the genus as given by KNUTH is unsatisfactory and new criteria must be considered. The first provisionally proposed *sect. Sensitiva* (with the generic type species *B. sensitivum*) for annual species and *sect. Prolifera* (type species *B. proliferum*) for the suffructicose species. But the situation might be more complicated and a subdivision has to wait for a complete revision of the genus.

KEY TO THE SPECIES

1. Leaves 3–9-jugate; leaflets orbicular to elliptic; veins ± perpendicular to the midrib, few. Flowers sessile in centre of tuft, (in Mal.) rarely on a peduncle up to 1½ cm. Unbranched annual. **1. B. petersianum**
1. Leaves 7–32-jugate; leaflets elliptic to lanceolate; veins oblique to the midrib, many. Flowers in distinctly peduncled pseudo-umbels.
2. Midrib of leaflets (not terminal pair) at base ± median.
3. Bracts of pseudo-umbel bushy, setaceous, 3–6 mm. Calyx with long, simple hairs. Perennial, finally (always?) branched; stem woody, not compressible, old parts reflexed. Petals ± equalling the sepals. Sepals 1½–2 times as long as the fruit. . . . . **2. B. dendroides**
3. Bracts of pseudo-umbel ovate-attenuate, 1–3 mm. Calyx puberulous and with septate-glandular hairs. Annual, never branched; stem soft, pithy, compressible, old parts caducous.
4. Sepals ± equalling the petals, in fruit 4–7 mm long, longer than the pedicels, 1½–2 times as long as the fruit. . . . . **3. B. sensitivum**
4. Sepals ± half as long as the petals, in fruit 2¼–4 mm long, shorter than the pedicels, ± as long as the fruit. . . . . **4. B. reinwardtii**
2. Midrib of leaflets (not terminal pair) at base excentric, in basiscopic corner. Perennials, ligneous, at least finally branched.
5. Leaves 14–32-jugate. Terminal leaflets 3–6½ by 1½–3 mm, obovate-oblong, as long as the preceding. Sepals in fruit 3–7-nerved, 1–2 times as long as the fruit. Fruit puberulous in upper half. **5. B. microphyllum**
5. Leaves 18–27-jugate. Terminal leaflets 9–22 by 3–8 mm, oblanceolate, as long as the preceding. Sepals in fruit 5–12-nerved, 1¼–2 times as long as the fruit. Fruit glabrous. **6. B. adiantoides**
5. Leaves 7–17-jugate. Terminal leaflets 5–20 by 3–8 mm, obovate to obovate-oblong, and as long as the preceding (rarely elliptic-oblong and longer than the preceding: *var. papuanum*). Sepals in fruit 3–6-nerved, slightly exceeding the fruit or ± equalling it (*var. papuanum*). Fruit apically puberulous. . . . . **7. B. fruticosum**

1. Biophytum petersianum KLOTZSCH in Peters, Reise Mossamb. Bot. 1 (1862) 81, t. 15; STEEN. Bull. Jard. Bot. Btzg III, 18 (1950) 452; BACK. & BAKH. *f.* Fl. Java 1 (1963) 246; EXELL, Fl. Zamb. 2 (1863) 158; VELDK. Fl. Thail. 2 (1970) 18. — *Oxalis apodiscias* TURCZ. Bull. Soc. Nat. Moscou 36 (1863) 595. — *Oxalis petersianum* (KLOTZSCH) C. MUELL. in Walp. Ann. 7 (1868) 502. — *B. apodiscias* (TURCZ.) EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 437; GUILLAUMIN, Bull. Mus. Hist. Nat. Paris 15 (1909) 124; Fl. Gén. I.-C. 1 (1911) 606. — *Oxalis sessilis* BUCH.-HAM. *ex* WALL. [Cat. (1831) *n.* 4344, *nom. nud.*] *ex* BAILL. Bull. Soc. Linn. Paris 1 (1886) 598, *nom. superfl. illeg.*; BAILEY, Queensl. Fl. 1 (1899) 180. — *B. sessile* (BUCH.-HAM. *ex* BAILL.) KNUTH, Pfl. R. Heft 95 (1930) 406, *nom. illeg.* — **Fig. 3e-f.**

Small annual. Stem simple, rarely up to 15 cm long. *Leaves* 3–9-jugate; rachis ½–3½ cm, glabrous to appressed-pubescent, mainly on the nodes; leaflets often overlapping, terminals 1¼–1¾ times as long as the preceding, 2–8 by 2–5 mm, obovate, ± oblique, midrib excentric; other leaflets triangular to orbicular-elliptic, midrib ± median; apex rounded to obtuse, glabrous or with sparsely ciliate margin; nerves few, ± perpendicular to midrib, conspicuous. *Peduncle* (in Mal.) rarely present up to 1½ cm, appressed-strigose. Pedicels 1–3 mm, with some bristly hairs under calyx. *Sepals* 3–5 by ¾–1½ mm, ovate-lanceolate, acute, sparsely hairy to subglabrous, in fruit 5–8-nerved, longer than pedicel, ± exceeding the fruit. *Petals* lanceolate, 5–6 by 1 mm, apex retuse, yellow in lower half, orange and red in upper, or orange. *Filaments* glabrous, (LF) 1–1¼ and 1½–2 mm, (SF) 1 and 2 mm long. *Ovary* ½–1½ by ½–1 mm, ± glabrous; styles in LF 1–1½ mm, stigma flattened, crenate, in SF ½ mm, stigma flattened, bifid; ovules 4–5 per cell. *Fruit* 3–4 by 2–2½ mm, apically ciliate on the ribs. *Seeds* 3–4 per cell, *c.* ¾ by ½ mm, with two longitudinal ridges, in between with transverse rows of small tubercles.

Distr. Tropical Africa, Madagascar, tropical

SE. Asia (Ceylon, India, Burma, Thailand, Indo-China); in *Malesia*: all islands or island groups, except the Malay Peninsula, Sumatra, and Borneo.

Ecol. The distribution in Malesia is reflecting a distinct preference for areas subject to a fairly well pronounced dry season and besides heliophilous habitats. This explains the absence from the Malay Peninsula, Sumatra and Borneo and its scarcity in West Java (only a few spots N of Bandung). Ascending to 1500 m (Mt Kawi). *Fl. fr.* Jan.–Dec.

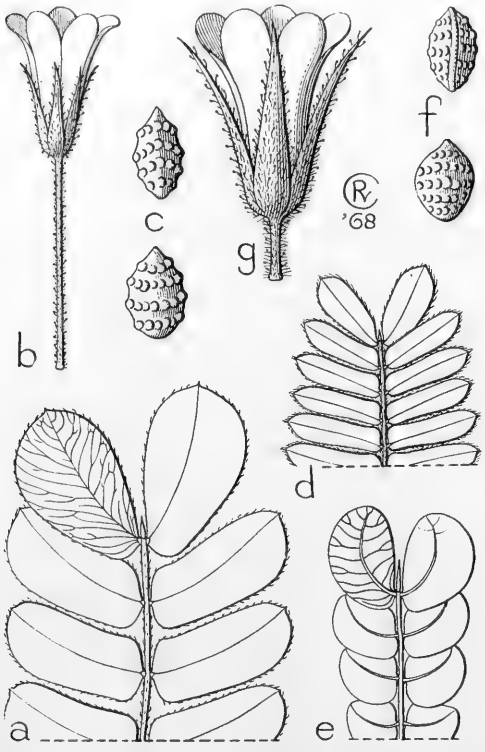

Fig. 3. *Biophytum reinwardtii* KLOTZSCH. *a.* Terminal part of leaf, ×2, *b.* flower, ×4, *c.* seeds, lateral and frontal, ×12. — *B. microphyllum* VELDK. *d.* Terminal part of leaf, ×2. — *B. petersianum* KLOTZSCH. *e.* Terminal part of leaf, ×2, *f.* seeds, lateral and frontal, ×12. — *B. sensitivum* DC. *g.* Flower, ×12 (*a, c* JUNGHUHN *s.n.*, *b* GARRETT 243, *d* CONKLIN 291, *e–f* HEURN *s.n.*, *g* BUNG PHENG 859).

Vern. *Kutjinggan*, J, *babonit*, *nibuwat-perut*, Andjai, Kebar Valley, W. New Guinea.

Uses. In the Kebar Valley eaten by women and pigs to increase their fertility (VERSTEEGH BW 738); a decoction is used in Mozambique as a remedy for snake-bite (EXELL, Fl. Zamb. 2, 1963, 159) and in the Congo as a purgative for children (WILCZEK, Fl. Congo Belge 7, 1958, 18).

Note. Malesian specimens are always small with rarely a peduncle. In Africa plants may attain 40 cm with much longer peduncles.

2. Biophytum dendroides (H. B. K.) DC. Prod. 1 (1824) 690; GUILLAUMIN, Bull. Mus. Hist. Nat. Paris 15 (1909) 125; KNUTH, Pfl. R. Heft 95 (1930) 399; STEEN. Bull. Jard. Bot. Btzg III, 18 (1950) 453; Reinwardtia 1 (1952) 477; BACK. & BAKH. *f.* Fl. Java 1 (1963) 247. — *Oxalis dendroides* H. B. K. Nov. Gen. Sp. 5 (1821) 194; PROGEL, Fl. Bras. 12, 2 (1877) 516. — **Fig. 4.**

Perennial. Stem woody, becoming coarse (not compressible), up to 15 cm, finally (always?) branched, old parts reflexed. *Leaves* 9–16-jugate; rachis 2½–7 cm, hirsute mainly at the nodes leaflets often overlapping, terminals 4–10 by 2–6 mm, asymmetric, falcate, others smaller, truncate at base, elliptic to oblong, less asymmetric, with median midrib; apex obtuse, apiculate, upper surface sparsely hairy, underneath more so; nerves many. *Peduncle* 1–3½ cm, up to 7-flowered, appressed-pubescent. Pedicels 1½–3½ mm, club-shaped, shorter than the conspicuous, setaceous, 3–6 mm long bracts. *Sepals* 6–8 by 1–3 mm, ovate, oblong to lanceolate, apex attenuate, acute, base hairy, in fruit 5–8-nerved, longer than pedicel, 1½–2 times as long as the fruit, equal to ± shorter than the corolla. *Petals* 7–8 mm, lanceolate, rounded, pink to lavender. *Filaments* (LF) 2½–3 and 3¾–5 mm, the longer ones with a few cilia. *Ovary* 2 by 1 mm, apically ciliate; styles (LF) 2–2¾ mm long; stigma subulate, entire; ovules 4–6 per cell. *Fruit* 3–5 by 2½ mm, apically puberulous on the ridges. *Seeds* 1–6 per cell, 1 by ½ mm, with two longitudinal ridges, in between with ± longitudinal rows of tubercles.

Distr. Native of tropical S. America; in *Malesia*: locally naturalized near Bogor (W. Java), *c.* 250 m.

Originally grown in the Botanic Gardens, first collection *a.* 1893, spontaneous in the Gardens *a.* 1905, in 1917 also collected in the vicinity of Bogor.

Ecol. Shady, grassy places. *Fl. fr.* Jan.-Dec.

3. Biophytum sensitivum (L.) DC. Prod. 1 (1824) 690; BL. Bijdr. (1825) 242; EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 436, *incl. var. cumingianum* (TURCZ.) EDGEW. & HOOK. *f.*; KING, J. As. Soc. Beng. 62, ii (1893) 199; GUILLAUMIN, Bull. Mus. Hist. Nat. Paris 15 (1909) 126; Fl. Gén. I.–C. 1 (1911) 608; RIDL. Fl. Mal. Pen. 1 (1922) 331; MERR. En. Philip. 2 (1923) 324; KNUTH, Pfl. R. Heft 95 (1930) 393; STEEN. Bull. Jard. Bot. Btzg III, 18 (1950) 452; BACK. & BAKH. *f.* Fl. Java 1 (1963) 247; VELDK. Fl. Thail. 2 (1970) 19. — *Herba sentiens* RUMPH. Herb. Amb. 5 (1750) 302. — *Oxalis sensitiva* LINNÉ, Sp. Pl. (1753) 434; JACQ. Oxal. Monogr. (1794) 42; WILLD. Sp. Pl. 2 (1799) 804; PERS. Syn. 1 (1805) 519; ZUCC. Abh. K. Ak. Wiss. München. 1 (1830) 273; ROXB. Fl. Ind. ed. Carey 2 (1832) 457; W. & A. Prod. 1 (1834) 142. — *Oxalis cumingiana* TURCZ. Bull. Soc. Nat. Moscou 31 (1858) 426. — *B. cumingii* KLOTZSCH in Peters, Reise Mossamb. Bot. 1

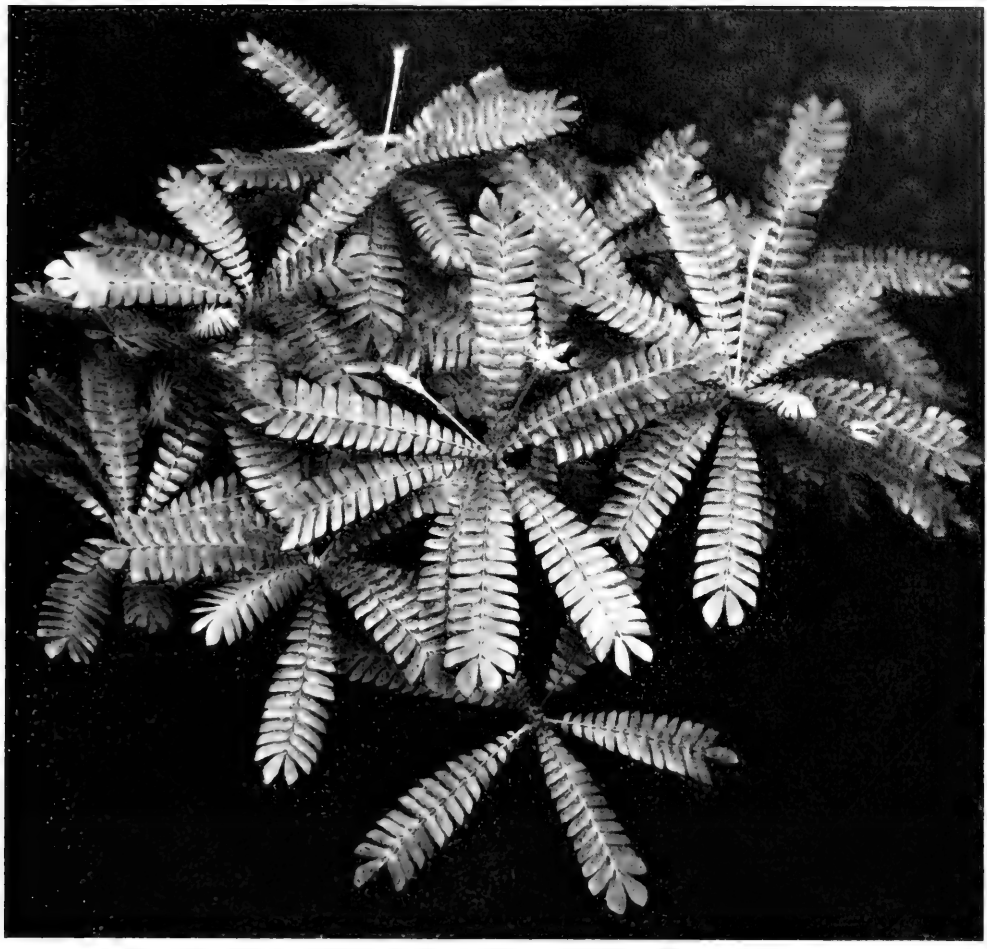

Fig. 4. *Biophytum dendroides* DC. as a weed in the Leyden Hortus (Photogr. Miss R. VAN CREVEL).

(1862) 85. — *B. cumingianum* (TURCZ.) EDGEW. in Edgew. & Hook. *f.* Fl. Br. Ind. 1 (1874) 436. — *B. sensitivum var. nervifolia* (*non* EDGEW. & HOOK. *f.*) F.-VILL. Novis. App. (1880) 33. — **Fig. 3g.**

Annual. Stem simple, up to 35 cm, pithy (compressible), smooth. *Leaves* 7–12(–14)-jugate; rachis 5–10(–16½) cm, sparsely strigose; leaflets rarely overlapping; terminals 8–18 by 3–10 mm, ± asymmetric, falcate-obovate, midrib excentric; other leaflets symmetric, elliptic, margins ± parallel, base truncate, not drawn out, midrib median; apex rounded, apiculate, ± acroscopic; ± glabrous; nerves many, little conspicuous. *Peduncles* up to 14 cm, up to 10-flowered, appressed-strigose and with patent septate-glandular hairs. Pedicels 1½–3½ mm. Bracts ovate-attenuate, 1½–3 mm. *Sepals* 4–7 by ½–1½ mm, ovate-lanceolate, acute, strigose and glandular-hairy, in fruit 5–9-nerved, longer than pedicels, 1½–2 times as long as the fruit, ± shorter than the corolla. *Petals* 5–7 by 1–2 mm, lanceolate, truncate, base yellow, limb with purplish and yellow lines. *Filaments* (MF) 1–1½ and 2–2½ mm, the longer ciliate. *Ovary* ½–¾ by ⅓–½ mm, apically ciliate; styles (MF) ½–1 mm, often clasping the anthers of the longer filaments and tearing them off; stigmas flattened, crenate to bifid; ovules 2–5 per cell. *Fruit* 3–4 by 2 mm, apically puberulous and minutely septate-glandular hairy on the ribs. *Seeds* 0–3 per cell, ¾–1 by ½–¾ mm, transversely tubercled and ridged.

Distr. Widely spread in Indo-Malesian tropics, common and throughout *Malesia* but not yet recorded for New Guinea.

Ecol. Shady places, waste land, river-banks, under damp thickets, *etc.*, up to 250 m. *Fl. fr.* Jan.–Dec.

Vern. Sumatra: *daun kutjingan, si-hirpud, si-kĕrpud*, Batak, also for *Mimosa pudica*); *krambilan, kutjingan, turularé*, J, *indja payong*, Djakarta, *kalapaan, ki-payung*, S, *tindoh-tindoh*, Patjira, Celebes, *daun hidoep, kurang-kurang, měniran utan*, Moluccas, *bulutu*, Kau, Halmahera, *gogiolo*, Galela, Halmahera, *galofino*, ? *igo-igo*, Ternate, *obat godog*, Obi, *pagègga, paginga*, Sula Is., *runtili*, Talaud; Philip.: *damóng-bingkálat, makahia, makahiang-laláki*, Tag., *damon-húya, hoya-hoya, lubi-lubi*, Bis., *guyankan*, Sub., *mahihiin*, Ilk., *niug-niug*, Sul.

Uses. In the Philippines the powdered seeds are used as a vulnerary. A decoction of the roots is used for gonorrhoea and stones in the bladder. A decoction of the plant is said to cure diabetes mellitus, in the Sula Is. it is used for pregnancy diseases (BLOEMBERGEN 4365), on the Karo Plateau of N. Sumatra to diminish the female libido (GALOENGI 49), in Ternate for chest-complaints, here the ashes with lime-juice are given for stomach-aches. A reputed medicine for tuberculosis (HEYNE, 1927, BURKILL, 1935, and QUISUMBING, Medic. Pl. Philip., 1951).

Note. It has appeared that what in African Floras has been referred to *B. sensitivum* is really a different species, *B. helenae* BUSC. & MUSCHL., which has a corolla 1½–2 times as long as the calyx, more pairs of leaflets, is not annual and is sometimes branched, and has a seed structure as in *B. petersianum* (VELDKAMP, Blumea 16 (1968) 137).

4. Biophytum reinwardtii (ZUCC.) KLOTZSCH in Peters, Reise Mossamb. Bot. 1 (1862) 85; EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 437, *incl. var. metziana* EDGEW. & HOOK. *f. l.c.* 438; RIDL. Fl. Mal. Pen. 1 (1922) 331; KNUTH, Pfl. R. Heft 95 (1930) 395; STEEN. Bull. Jard. Bot. Btzg III, 18 (1950) 453; Reinwardtia 1 (1952) 477; BACK. & BAKH. *f.* Fl. Java 1 (1963) 247; VELDK., Fl. Thail. 2 (1970) 19. — *B. sensitivum var. reinwardtii* (ZUCC.) GUILLAUMIN, Bull. Mus. Hist. Nat. Paris 15 (1909) 127. — *Oxalis reinwardtii* ZUCC. Abh. K. Ak. Wiss. München. 1 (1830) 274; MIQ. Fl. Ind. Bat. 1, 2 (1859) 134. — *B. sensitivum* (*non* L.) F. M. BAILEY, Queensl. Agric. J. 23 (1909) 262. — *Toddavaddi* RHEEDE, Hort. Mal. 9 (1689) 33. — **Fig. 3a-c.**

Annual. Stem simple, up to 35 cm, medullary, compressible, smooth. *Leaves* 6–11(–14)-jugate; rachis 2½–6(–9½) cm, sparsely puberulous; leaflets rarely overlapping, terminals largest, 7–18 by 4–7 mm, asymmetric, obovate, midrib excentric, curved; others elliptic, symmetric, base truncate, not drawn out, margin ± parallel, midrib median, straight to slightly curved; apex rounded, apiculate, ± glabrous, margins sparsely strigose; nerves many, oblique, little conspicuous. *Peduncles* up to 6½(–12½) cm, patent to appressed-strigose and septate-glandular hairy, up to 8-flowered. Pedicels up to 7 mm; bracts ovate-attenuate, 1–1½ mm. *Sepals* 2¼–4 by ½–1 mm, ovate-lanceolate, acute, in fruit 3–8-nerved, ½–⅔ as long as pedicel, ± as long as fruit, ± half as long as corolla. *Petals* 6–8 by 1–2 mm, elliptic- to oblanceolate, apex rounded to emarginate, base yellow, above with red to purplish veins. *Filaments* (MF) 1–1½ and 2–3 mm, the longer sparsely ciliate. *Ovary* ½–1 by ⅓–½ mm, glabrous; styles (MF) ½–¾ mm; stigma flattened, crenate to bifid; ovules 3–4 per cell. *Fruit* 2–3 by 2–2½ mm apically puberulous and minutely septate-glandular-hairy on the ribs. *Seeds* 1–3 per cell, *c.* 1 by ½ mm, transversely ridged and tubercled.

Distr. Tropical SE. Asia, in *Malesia*: Malay Peninsula, Java (common), SW. Celebes (Makassar, *a.* 1918, one collection), and E. New Guinea ((Boku, BAILEY, *l.c.*).

Ecol. Shady places, waste land, river-banks, under damp thickets, *etc.*, up to 800 m.

Vern. *Biskutjinggan, krambilan, kutjinggan, piskutjinggan, pis-ngeong*, J, *inger*, Nusa Kambangan, *kakalapaän, ki pajong*, Md, *indja pajung* M.

Uses. Cultivated as medicine, used against smallpox and rashes (*'sakit inja'*) (EDELING *s.n.*) and in India against fever (HOHENACKER 144).

Note. The restricted distribution might point to an early introduction, but it was in BLUME's and JUNGHUHN's time already a common plant in Java.

5. Biophytum microphyllum, *sp. nov.* — **Fig. 3d.**

Fruticulus usque ad 30 *cm altus, ramosus. Folia* 18–32*-jugata. Rachis* 4–8 *cm longa. Foliola minuta, paria terminalia* 3–6 *mm longa,* 1½–4 *mm lata, obovato-oblonga, precedentibus aequilonga; cetera lanceolata, basis parte acroscopica truncata, saepe lobata; apex centralis, rotundatus vel obtusus; costa basi excentrica. Flores ad pseudo-umbellas longe pedunculatas digesti. Sepala* 4–6½ *mm longa,* 1–2 *mm lata, ovato-lanceolata, acuminata, in fructu* 3–7*-nervosa, pedicellis* 1–1.6*-plo longiora, fructibus* 2–3*-plo longiora. Petala sepalis* 1½ *vel duplo longiora. Fructus distaliter paullo ciliatus. — Typus*: SULIT & CONCKLIN PNH 16905 (L, holo, PNH).

Perennial. Stem woody, up to 30 cm, branched. *Leaves* (5–)18–32-jugate; rachis 4–8 cm, slender, often curved, rusty puberulous, especially at the nodes; leaflets rarely overlapping, terminals 3–6 by 1½–4 mm, obovate-oblong, ± as long as the preceding, midrib ± median; others lanceolate, basiscopical half of base rounded, acroscopical half truncate, often drawn out, midrib excentric, margins ± parallel; apex central, obtuse to rounded, apiculate; upper surface appressed-puberulous, beneath ± more pubescent; nerves many. *Peduncle* 2–5¾ cm, appressed to patently pubescent, eglandular. Pedicels 5–9 mm long, appressed- to patently puberulous, eglandular. *Sepals* 4–6½ by ¾–2 mm, lanceolate, acuminate, the outer three much wider, ± half as long as the corolla, in fruit 3–7-nerved, $^3/_5$ to ± equalling the pedicel, *c.* 1⅕ times as long as the fruit (*excl.* styles). *Petals* 7–9 by 1–2½ mm, apex rounded, white to lavender. *Filaments* (MF) 2¾–3½ and 4–5¾ mm, (LF) ¾ and 1½ mm, the longer ciliate. *Ovary* 1½ by 1 mm, glabrous; styles (MF) 2½–3 mm long, (LF) not seen in anthesis; stigma minutely bifid; ovules 3–4 per cell. *Fruit* 2–3 by 2 mm, puberulous in upper half.

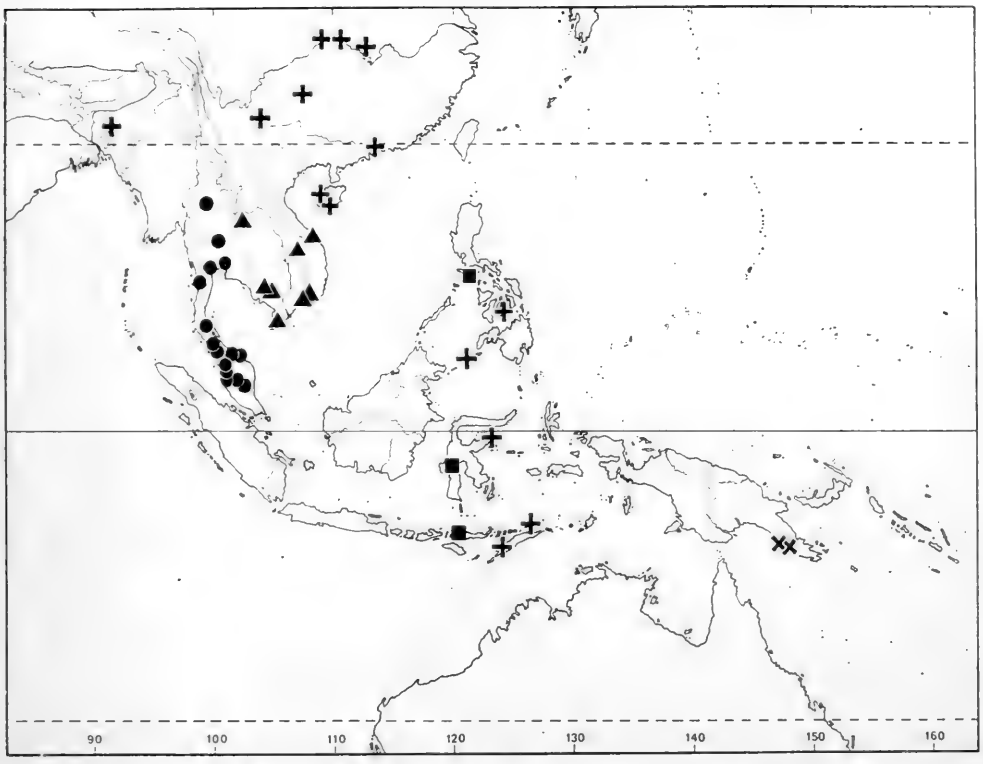

Fig. 5. Distribution of *Biophytum fruticosum* BL. *var. fruticosum* (+), *ditto, var. papuanum* VELDK. (×), *B. adiantoides* WIGHT (●), *B. thorelianum* GUILLAUMIN (▲), and *B. microphyllum* VELDK. (■).

Seeds 3–4 per cell (no ripe ones seen).

Distr. *Malesia*: Philippines (E. Mindoro: Mt Yagaw), SW. Central Celebes (Pasui), and Lesser Sunda Is. (W. Flores). Only four collections. Fig. 5.

Ecol. In crevices of rocks on forest edge, once on limestone, 400–600 m, apparently *fl.* and *fr.* all year.

Vern. *Huya-huya-ili, tagurignúk-sa-ili*, Mang., Philip.

6. Biophytum adiantoides WIGHT *ex* EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 437; KING, J. As. Soc. Beng. 62, ii (1893) 200; GUILLAUMIN, Bull. Mus. Hist. Nat. Paris 15 (1909) 124; Fl. Gén. I.–C. 1 (1911) 609; RIDL. Fl. Mal. Pen. 1 (1922) 331; KNUTH, Pfl. R. Heft 95 (1930) 397; VELDK., Fl. Thail. 2 (1970) 20.

Perennial. Stem woody, usually branched, up to 30 cm high. *Leaves* 18–27-jugate; rachis 7–17 cm, yellowish appressed to patently pubescent; leaflets rarely overlapping, terminals 9–22 by 3–8 mm, oblong to lanceolate, widest at or above the middle, ± as long as the preceding, midrib ± median; others asymmetric, elliptic to oblong, basiscopical half of base rounded, acroscopical half truncate, more or less drawn out, margins otherwise ± parallel, midrib excentric at base; apex central, rounded, apiculate; above sparsely strigose, hairs often in three rows, to glabrescent, beneath more strigose; nerves many. *Peduncle* 5–19½ cm, up to 9-flowered, puberulous, sometimes with a few septate-glandular hairs. Pedicels 5–17 mm, puberulous and with a few gland hairs. *Sepals* 4½–6 by 1–1½ mm, lanceolate, acute, sparsely strigose to glabrous, sometimes with a few septate gland hairs, ½–⅔ as long as the corolla, in fruit 5–12-nerved, half to ± equally as long as the pedicel, 1¼–2 times as long as the fruit. *Petals* 9–10 by 1–2½ mm, lanceolate, apex rounded to truncate, white with yellowish base. *Filaments* in SF 1½–3½ and 4½–6½ mm long, in MF 1½ and 5¾ mm long, in LF 1–1½ and 2¾–4 mm long, the longer ciliate. *Ovary* 1 by ½–¾ mm, glabrous; styles puberulous, in SF ½–1¼ mm, in MF 2½ mm, in LF 4–6 mm long; stigma flattened, crenate to bifid; ovules 2–4 per cell. *Fruit* 3–4 by 2–3 mm, glabrous. *Seeds* 2–3 per cell, 1–1¼ by ¾–1 mm, with transverse tuberculated ridges.

Distr. S. Vietnam, Cambodia, Thailand, Tenasserim, and in *Malesia*: northern half of the Malay Peninsula (Perlis, Perak, Pahang). Fig. 5.

Ecol. In crevices of (limestone) rocks

along rivers and in open woods, up to 300 m.

Vern. *Daun pajong, maiong, pajong ali*, M.

Uses. Given to small children against stomach trouble in Perak.

7. Biophytum fruticosum BL. Bijdr. (1825) 242; KNUTH, Pfl. R. Heft 95 (1930) 412 *in annot. sub B. nudum*; STEEN. Bull. Jard. Bot. Btzg III, 18 (1950) 454; Reinwardtia 1 (1952) 477, *p.p.* — *B. esquirolii* LÉV. in Fedde, Rep. 12 (1913) 181; KNUTH, Pfl. R. Heft 95 (1930) 413; MERR. Lingn. Sc. J. 13 (1934) 31; REHDER, J. Arn. Arb. 18 (1937) 209. — *B. thorelianum var. sinensis* GUILLAUMIN, Not. Syst. 1 (1909) 25; Bull. Mus. Hist. Nat. Paris 15 (1909) 128; KNUTH, Pfl. R. Heft 95 (1930) 413. — *Oxalis blumei* ZUCC. Abh. K. Ak. Wiss. Münch. 1 (1830) 276; MIQ. Fl. Ind. Bat. 1, 2 (1859) 134.

var. **fruticosum.**

Perennial. Stem woody, branched, up to 50 cm. *Leaves* 7–17-jugate; rachis 3–9 cm, appressed to patently strigose, especially on the upper surface; leaflets rarely overlapping; terminals 5–12 by 3–8 mm, ± as long as the preceding, obtriangular to obovate-oblong, ± symmetric, midrib median; other leaflets elliptic to lanceolate, basiscopical half of base rounded, acroscopical half truncate, more or less drawn out, midvein excentric; apex rounded, apiculate, central; above densely strigose, glabrescent, then hairs often in three rows, lower surface less strigose; nerves many. *Peduncle* up to 13 cm, strigose, no septate glandular hairs, up to 10-flowered. Pedicels up to 9 mm. *Sepals* 3½–6 by 1–1½ mm, ovate-lanceolate, densely to sparsely strigose, no septate glandular hairs, in fruit 3–7-nerved, $^3/_5$ as long as the pedicel, slightly exceeding the fruit, *c.* ⅔ as long as the corolla. *Petals* 5½–10 by 1–2½ mm, lanceolate, obtuse, white to pink. *Filaments* in SF 2–3 and 3½–4 mm, in MF 2–2½ and 3 mm, in LF 1½–4 and 2½–5 mm long, the longer always ciliate. *Ovary* ½–1 by ½–1 mm, apically with a few cilia to glabrous; styles in SF ½ mm, stigma bifid, flattened; in MF 2½–4 mm, in LF 2–5 mm, stigma subulate to slightly flattened, entire; ovules 2–4 per cell. *Fruit* 2½–4 by 2½–3 mm, puberulous but eglandular in upper half. *Seeds* 2–4 per cell, 1 by ¾ mm, transversely tuberculate and ridged.

Distr. SW. China (Yunnan, Hupeh, Kouy-Tschiou, Canton, Hainan), Indo-China (Mekong), NE. India (Silhet); in *Malesia*: Philippines (Bohol; Sulu Is.: Bengao I.), E. Celebes, and Lesser Sunda Islands (S. Central Timor; S. Wetar). Fig. 5.

Ecol. In crevices of rocks, on river-banks, in thickets and shaded cultivated areas on sand, up to 800 m.

var. **papuanum,** *var. nov.* —*Oxalis albiflora* F. v. M. Vict. Natur. 8 (1892) 164, *nom. nud.* — *B. albiflorum* F. v. M. Vict. Natur. 9 (1893) 112; J. Bot. 31 (1893) 325; KNUTH, Pfl. R. Heft 95 (1930) 397; STEEN. Bull. Jard. Bot. Btzg III, 18 (1950) 455. — *Oxalis papuana* F. v. M. Vict. Natur. 9 (1893) 112, *nom. altern.*

Terminal leaflets 14–20 by 6–8 mm, elliptic to oblong, ± 1.3 times as long as the preceding. Pedicels 9(–25) mm. Sepals in fruit ± $^2/_5$ as long as the pedicel. Fruit ± as long as the calyx.

Distr. *Malesia*: SE. New Guinea (Owen Stanley Range), two collections (type not seen). Fig. 5.

Ecol. Stony stream-banks in forests.

Note. In his preliminary revision VAN STEENIS accepted a much wider specific concept of *B. fruticosum* than handled here, in merging *B. adiantoides* with *B. fruticosum* and also referring the specimens here distinguished as *B. microphyllum* to it. In fact all three native Malesian fruticose *Biophytums* and *B. thorelianum* GUILLAUMIN from Indo-China (fig. 5) differ from allied continental species (*B. nudum, B. proliferum, B. intermedium,* and *B. polyphyllum*) in having the midrib obliquely inserted at the base and the Asian ones having them median. However, the Malesian material can be sorted into three taxa, although it must be admitted that the great scarcity of collections makes it difficult to find the parameters of their variability.

3. DAPANIA

KORTH. Ned. Kruidk. Arch. 3 (1854) 381; HALL. *f.* Beih. Bot. Centralbl. 34, ii (1917) 25; KNUTH, Pfl. R. Heft 95 (1930) 419; VELDKAMP, Blumea 15 (1967) 523. — **Fig. 7i.**

Glabrous lianas. *Leaves* estipulate, unifoliolate; petioles articulate with a constriction (in herb.). *Inflorescences* racemose, ramiflorous and axillary, solitary to fascicled. *Flowers* (in Mal.) androdioecious. *Sepals* connate in lower half, margins ciliate, glabrous inside. *Petals* apotact or paratact, rarely quincuncial, (in Mal.) free and glabrous inside, minutely clawed, red to white. *Filaments* (in Mal.) antheriferous, between the filaments with scales on the annulus, these sometimes reduced to dark lines. *Ovary* glabrous, reduced and sterile in ♂ plants. *Ovules* in ♀ 1–2 per cell, in ♂ 0–1. *Capsule* fleshy, yellowish green (red when dry),

loculicid to the base, 1–6-seeded, valves patent; (in Mal.) episeptal rimae present, open to base. *Seeds* up to 2 per cell; testa smooth, hard, yellowish red, terminally thickened around the micropyle, splitting lengthwise under pressure; aril present, enveloping the seed, attached to the entire length of the adaxial raphe, fleshy, bright to whitish yellow, margin irregular crenate, with oily drops; embryo with the cotyledon 1½–2 times as long as the straight, oblique radicle.

Distr. Madagascar (1 *sp.*), in *Malesia* (Sumatra, Malaya, Borneo) 2 *spp.*
Ecol. Lianas in forests, swamps, near rivers, obviously usually on poor soil, at low altitude.

KEY TO THE SPECIES

1. Leaves up to 15 cm, base cuneate to rounded. Sepals glabrous, except the ciliate margin. **1. D. racemosa**

1. Leaves longer than 15 cm, base deeply emarginate. Sepals puberulous outside. **2. D. grandifolia**

1. Dapania racemosa KORTH. Ned. Kruidk. Arch. 3 (1854) 381; PLANCHON, Ann. Sc. Nat. Bot. IV, 2 (1854) 266; MIQ. Fl. Ind. Bat. 1, 2 (1859) 134; STAPF in Hook. *f.* Ic. Pl. III, 10 (1891) t. 1997; HALL. *f.* Beih. Bot. Centralbl. 34, ii (1917) 25; KNUTH, Pfl. R. Heft 95 (1930) 420; VELDKAMP, Blumea 15 (1967) 552, f. 1d–g. — *D. scandens* STAPF in Hook. *f.* Ic. Pl. III, 10 (1891) t. 1997; KING, J. As. Soc. Beng. 62, ii (1893) 201; HALL. *f.* Beih. Bot. Centralbl. 34, ii (1917) 25; RIDL. Fl. Mal. Pen. 1 (1922) 334; KNUTH, Pfl. R. Heft 95 (1930) 420, f. 28a–e.

Large liana, up to 30 m long, 20 cm ø, rather profusely branched. *Leaves* 5¾–15(–25) by 2½–6¾ cm, oblong to lanceolate, pergamentaceous to subcoriaceous, acute to cuspidate, base cuneate to rounded; petiole 3–10 by 1–2 mm, petiolule 2–6 by 1–2 mm. *Racemes* solitary to fascicled, in ♀ 1–3 together, 3–13½ cm, in ♂ 1–15 together, 2–5½(–12½) cm; rachis puberulous, glabrescent. Pedicel (lower joint 0–1 mm, upper ¼–½ mm) not covered by the minute, broadly ovate, acute bract ¼–½ by ½ mm. *Calyx* 1½–2 mm high, glabrous to sparsely puberulous outside. *Sepals* ½–1½ by ¾–1¼ mm, broadly ovate to elliptic, rounded to emarginate. *Petals* 3–4 by 1–1¼ mm, obovate-oblong to -lanceolate, often rolled back at anthesis, obtuse to rounded, darker. *Filaments* in ♀ ¼–½ and ¾–1 mm, in ♂ 1–3 and 1½–4 mm long. *Pistil* in ♀ 1½–2½ mm, in ♂ ⅓–¾ mm; styles in ♀ 1–1¼ mm, in ♂ very short, acute. *Fruit* obovoid with cuneate base, 5–11 by 6–10 mm, after dehiscence 9–22 mm ø. *Seeds* 4–5 by 1½ mm; radicle 1¼–1¾ mm long, cotyledons 2–2½ by ¾–1 mm.

Distr. *Malesia*: Sumatra, Malaya, Borneo. Fig. 6.

Ecol. Dense jungle, swamp forest, on poor soils, up to 750 m. *Fl. fr.* Jan.–Dec.

Vern. *Batieg-batieg, dapan*, Sumatra; *bĕlimbing bait*, M, *jaloai*, Brunei, *kara-raka*, Iban; *paukiang*, Malacca, *sĕlambun akar*, Selangor.

Note. A large-leaved form occurs in North Sumatra.

2. Dapania grandifolia VELDKAMP, Blumea 15 (1967) 525, f. 1h–p. — **Fig. 7i.**

Fig. 6. Distribution of *Dapania racemosa* KORTH. (●) and *D. grandifolia* VELDK. (▲).

Liana, or treelet, up to 27 m, 7 cm ø. *Leaves* coriaceous, (10½–)16½–31 by 4½–11 cm, oblong to lanceolate, widest at or below the middle, base retuse to deeply emarginate, apex acute to attenuate; petiole 2–6 by 2–3½ mm, stout, petiolule 1–3 by 2–3½ mm. *Racemes* ± densely and ± patently puberulous, not glabrescent, in ♂ 1–5 fascicled, 3–5 cm long, in ♀ 1–2 together, 4–8 cm long. Bracts boat-shaped, sometimes recurved, ¾–1 by ½–1 mm, broadly ovate, acute, covering the minute (*c.* ½ mm long) pedicel, but not the base of the calyx. *Calyx* 1¾–2½ mm high, pale to brown puberulous. *Sepals* 1–1½ by ¾–1½ mm, suborbicular to ovate, acute to rounded. *Petals* 4–5 by ½–1¼ mm, obovate-lanceolate, rounded, base attenuate. *Filaments* in ♂ 2–3½ and 3–4 mm, in ♀ ½–¾ and ¾–1 mm. *Pistil* in ♂ reduced, sterile, ⅓–¾ by ¼–½ mm, ovoid; styles minute, acute; ♀: ovary 1¾ by 1 mm, styles 2 mm. *Fruit* before dehiscing 9–11 by 6–8 mm, suborbicular to ovoid, after dehiscence 20–22 mm ø. *Seeds* 4½–5 by 1½–1¾ mm; embryo 4 mm long, radicle 1¼ by ⅓ mm, cotyledons 2½ by 1¼ mm.

Distr. *Malesia*: NE. to SE. Borneo. Fig. 6.

Ecol. Primary forest, on flat to undulating land on clay near rivers. *Fl. fr.* Jan.–Dec.

Vern. *Salung kapit*, Dusun.

4. SARCOTHECA

BLUME, Mus. Bot. Lugd. Bat. 1 (1850) 241; HALL. *f.* Med. Rijksherb. Leiden 1 (1911) 1; KNUTH, Pfl. R. Heft 95 (1930) 420; VELDKAMP, Blumea 15 (1967) 527 — *Roucheria* MIQ. Fl. Ind. Bat. 1, 2 (1859) 136. — *Connaropsis* PLANCH. *ex* HOOK. *f.* Trans. Linn. Soc. 23 (1860) 166. — **Fig. 7a–h.**

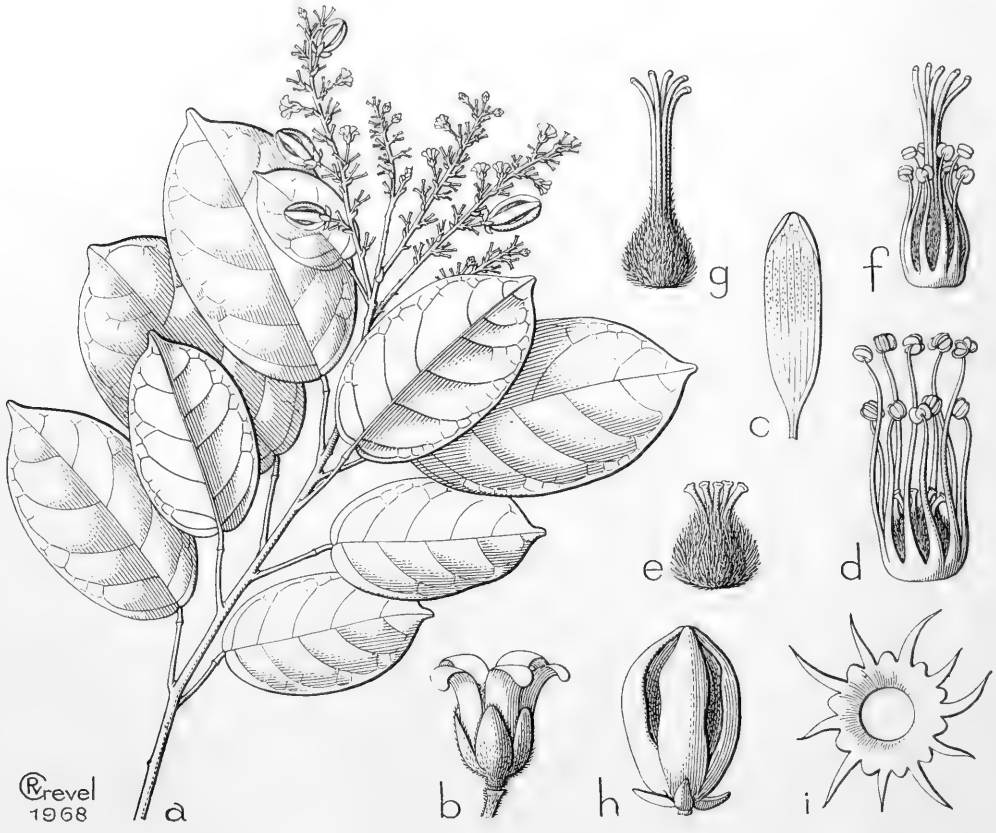

Fig. 7. *Sarcotheca glauca* HALL. *f. a.* Habit, ×⅔, *b.* flower, ×4, *c.* petal, ×6, *d.* stamens and ovary (SF), ×10, *e.* ovary (SF), ×10, *f.* stamens and ovary (LF), ×10, *g.* ovary (LF), ×10, *h.* fruit, ×2. — *Dapania grandifolia* VELDK. *i.* Annulus with scales and filaments, ×10 (*a, h* PUASA BNB 5484, *b–c, f–g* LAJANGAH SAN 33612, *d–e* MUJIN SAN 33562, *i* KOSTERMANS 10104).

Shrubs or trees; innovations pubescent. *Leaves* estipulate, 1- or 3-foliolate; petioles articulate, with a constriction (in herb). *Panicles* axillary or pseudoterminal, one to few together; flowers in more or less stalked cymes, scattered along a simple or sparsely branched rachis; cymes subtended by small caducous bracts, occasionally by a reduced petiole (petioloid), or rarely a small leaf. *Flowers* heterodistylous. *Sepals* unequal, shortly connate at base, inside appressed strigose, persistent (except in *S. diversifolia*). *Petals* contorted, sometimes paratact, inside with minute papillae in the upper half. *Filamental* annulus without scales. *Ovules*

2 per cell. *Fruit* fleshy, red at least when dry, with ± distinct episeptal rimae sometimes lighter and minutely papillose inside (at least when dry). *Seeds* exarillate; testa smooth to transversely rugose, hard, reddish, splitting irregularly by pressure; embryo with a straight radicle in line with the cotyledons which are 3–5 times as long as the radicle.

Distr. *W. Malesia*: Sumatra, Malaya, Borneo, Celebes. Fig. 8.

Ecol. Primary and secondary forest on poor soil at low altitude. *Fl. fr.* Jan.–Dec.

Uses. The fruit, although acid, is eaten in curry, sajur, and manisan and is said to be a remedy against coughing. The timber is light and of small dimension, neither very strong nor durable, sometimes used for roofs.

Notes. The genus has often been confused with *Rourea* AUBL. (*Connaraceae*) which differs from *Sarcotheca* in having free carpels, 2 collateral ovules, seeds with an aril, and a dry, indehiscent, 1-celled and 1-seeded fruit.

The species of the genus are closely related and most of them occupy small ranges; in several cases close allies show replacing areas. With a broader species concept several species would be reduced to subspecific rank, notably the triad *S. monophylla* from Malaya, *S. glauca* from Borneo, and *S. celebica* from Celebes.

KEY TO THE SPECIES

1. Leaves trifoliolate, laterals sometimes caducous, leaving a scar. Mature fruit greenish yellow when fresh (red when dry!); more than 1½ cm long.
 2. Calyx 3–5 mm high, outside pale puberulous to glabrous, not persistent in fruit. **1. S. diversifolia**
 2. Calyx 2½–3 mm high, outside brown puberulous, persistent in fruit. . . . . **2. S. griffithii**
1. Leaves unifoliolate; no lateral scars. Mature fruit red when fresh; less than 1½ cm long.
 3. Mature leaf puberulous to pubescent beneath, also between the nerves.
  4. Panicles not or barely exceeding the leaves. Petals 4–7 mm long. Rimae obscure, glabrous inside.
   5. Leaves 8–23 by 3–8½ cm, margins never paler. Calyx 1¼–2 mm high. . . . . **4. S. laxa**
   5. Leaves 5–11¼ by 2–3½cm, margins usually paler. Calyx 2–3¾ mm high. . . **8. S. ferruginea**
  4. Panicles exceeding the leaves. Calyx 3–3½ mm high. Petals 6–8 mm long. Rimae conspicuous, lighter and minutely papillose inside. . . . . **10. S. ochracea**
 3. Mature leaf beneath at most sparsely puberulous on the nerves.
  6. Calyx (and often panicle also) glabrous to finely *pale* puberulous. Rimae obscure and glabrous inside.
   7. Panicle glabrous, stout. Cymes sessile, flowers in glomerules along the rachis. **3. S. glomerula**
   7. Panicle puberulous, slender. Cymes stalked. . . . . **4. S. laxa**
  6. Calyx at least at the base (and panicle) *rusty* puberulous. Rimae conspicuous, inside lighter and minutely papillose.
   8. Leaves 4–13½ cm long. Panicle up to 13 cm, erect, ± compact (lax in *S. celebica*).
    9. Cymes not ± secund. Basal parts of pedicels all ± equal.
     10. Leaves when dry brown to reddish brown. Basal parts of pedicels 0–2 mm long. Calyx 1¾–2¼ mm high, persistently puberulous outside, reddish brown when dry.
      11. Leaves 4–10 cm long, acuminate to cuspidate. Panicle ± dense, pedicels with shorter and reduced upper joint (*c.* ⅓ mm). . . . . **6. S. monophylla**
      11. Leaves 6–13½ cm long, cuneate-acute to faintly acuminate; venation above more prominent than in the other two species. Panicle slender, lax, joints of pedicel ± equal (up to 1½ mm). **7. S. celebica**
     10. Leaves when dry palish to olive green, 4½–11 cm long, acuminate. Basal part of pedicels 2–6 mm long. Calyx 2–3 mm high, outside glabrescent in fruit, except for base and margins, crimson when dry. . . . . **5. S. glauca**
    9. Cymes ± secundly branched. Basal part of one pedicel per cyme usually elongated, up to 5 mm. Nerves of leaf beneath often reddish when dry. . . . . **9. S. rubrinervis**
   8. Leaves 7½–28½ cm long. Panicle usually pendulous, slender, usually much longer than 13 cm.
    12. Leaf widest at the middle, apex gradually acute to caudate, base obtuse to rounded. Nerves often reddish when dry. Petiolules 2–4 by 1–2 mm. Cymes ± secundly branched, basal part of one pedicel elongated, up to 5 mm. Claw of petals ⅔–1 mm long. . . . . **9. S. rubrinervis**
    12. Leaf widest at or above the middle, margins ± parallel, apex abruptly acuminate to caudate, base truncate to emarginate. Nerves concolourous with intervenium when dry. Petiolules 3–9 by 1–3 mm. Cymes not ± secundly branched, basal part of pedicels ± equal. Claw of petal ¼–½ mm long. . . . . **11. S. macrophylla**

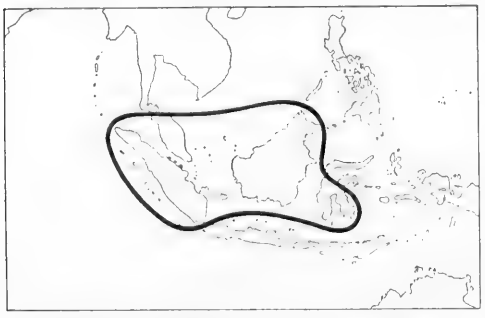

Fig. 8. Distribution of *Sarcotheca* BL.

1. Sarcotheca diversifolia (MIQ.) HALL. *f.* Med. Rijksherb. Leiden 1 (1911) 2; VELDKAMP, Blumea 15 (1967) 529, f. 2a–c. — *Rourea diversifolia* MIQ. Fl. Ind. Bat. Suppl. 1 (1860) 528. — *Connaropsis diversifolia* KURZ, J. As. Soc. Beng. 39, ii (1870) 69, *excl. syn. C. griffithii.* — *Santalodes diversifolium* O. KUNTZE, Rev. Gen. Pl. 1 (1891) 155. — *Connaropsis acuminata* PEARSON, Kew Bull. (1906) 2. — *S. acuminata* HALL. *f.* Beih. Bot. Centralbl. 34, ii (1917) 27. — *S. subtriplinervis* HALL. *f. l.c.* — *Connaropsis grandiflora* RIDL. Kew Bull. (1930) 75.

Shrub or tree, up to 27 m high, to 90 cm ø, often buttressed (90 cm high, 135 cm out, 5 cm ø). *Leaves* trifoliolate, papyraceous to subcoriaceous, ovate- to elliptic-oblong to -lanceolate, glabrous, acute to caudate, base acute to truncate, venation not very conspicuous; nerves 1–5 pairs, usually ± prominent, veinlets not as finely reticulate as in *S. griffithii*; lateral leaflets 3–9½ by 1–3¾ cm, terminal ones 5½–18 by 2–6¾ cm; petiole 6–25 by 1–2½ mm, rachis (5–)9–27 by ¾–2 mm; petiolules 4–7 by ¾–2 mm. *Panicles* shorter than subtending leaf, 1–4 together, loosely branched, 1–8½(–13½) cm, ferrugineous-puberulous, glabrescent; branches flattened, 2–30(–40) mm long; bract or petioloid ovate, acute, up to 7 mm. Pedicels: lower joint 2½–5 mm, upper 1–3 mm; *Calyx* 3–5 mm high, outside pale puberulous to glabrous, purplish, ± caducous in fruit. *Sepals* 2¼–5 by 1¼–3 mm, broadly ovate to oblong, acute to emarginate. *Petals* 7–11 by 2–5 mm, obovate-oblong to -lanceolate, rounded to emarginate, 1–2 mm clawed, lilac or pink to scarlet or red. *Filaments* in SF 2¾–3½ and 3¼–4½ mm, in LF 1½–2¼ and 2¼–3 mm, the longer occasionally without anthers. *Pistil* pale puberulous to glabrous, in SF 1¼–2½ mm, in LF 3½–5 mm; styles in SF ¼–1 mm, in LF 2½–4; ovary 1–2 by ¾–1¼ mm, ellipsoid. *Fruit* white to greenish when fresh (red when dry), ellipsoid, glabrous, 16–31 by 9–20 mm; rimae inconspicuous. *Seeds* 7½ by 5 mm, testa smooth; cotyledons 4⅔ by 4 mm, radicle 1⅓–1¾ by $^4/_5$ mm.

Distr. *Malesia*: N. Sumatra (off Sibolga: Morsala I.), Borneo.

Ecol. First and second storey of primary and secondary forest on wet, well-drained, poor soil (*e.g.* podsolized sand) on undulating to flat land, up to 900 m.

Vern. *Bělimbing bulat*, M, *buah piang*, Iban, *iba jantan*, Suluk, *kandis(-daham)*, Tidong, *kěrapa-kěrapa*, *pěrapan macas*, Tutong Dusun, *kadazan*, *tabaus*, *těbarus*, Brunei.

2. Sarcotheca griffithii (PLANCH. *ex* HOOK. *f.*) HALL. *f.* Med. Rijksherb. Leiden 1 (1911) 2; KNUTH, Pfl. R. Heft 95 (1930) 425; VELDKAMP, Blumea 15 (1967) 531, f. 2e–f. — *Connaropsis griffithii* PLANCH. *ex* HOOK. *f.* Trans. Linn. Soc. 23 (1860) 166; EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 440; KURZ, J. As. Soc. Beng. 39, ii (1870) 69; KING, *ibid.* 62, ii (1893) 200; RIDL. Fl. Mal. Pen. 1 (1922) 332, fig.; KOCHUMMEN, Res. Pamphl. (For. Res. Inst. For. Dep. Mal.) 43 (1963) 6, 38. — *Dapania griffithii* KNUTH, Bot. Jahrb. 50 (1914) 234.

Tree, up to 42 m, 1 m ø (buttresses up to 4 m, 1 m out). *Leaves* trifoliolate, glabrous, pergamentaceous, often crisped when dry, venation rather inconspicuous, veinlets above finely reticulate; leaflets elliptic-oblong to -lanceolate, occasionally ± obovate, tapering acuminate to caudate, base obtuse to acute, lateral ones 2–7 by ¾–2¾ cm, nerves 1–5 pairs; terminal leaflet 4–11½ by 1½–4 cm, nerves 4–6 pairs; petiole 5–12 by 1¼–2 mm, rachis 3–16 by ¾–1 mm; petiolules 3–7 by ¾–1¼ mm. *Panicles* shorter to ± longer than the subtending leaf, stout, densely branched, ferrugineous-puberulous, 2–10 cm; bracts small, ovate or linear, petioloid up to 2½ mm. *Flowers* pectinately clustered, subtended by minute bracts. Lower joint of pedicel 1–2½ mm, upper ½–1 mm. *Calyx* 2½–3 mm high, dark red, outside brown puberulous. *Sepals* 2–2¾ by 1½–2¼ mm, broadly ovate to -obovate, acute to emarginate. *Petals* ± glossy, blackish red, whitish at base, 4½–8¼ by 2–2½ mm, obovate-lanceolate to -oblong, rounded to obtuse. *Filaments* in SF 4–4½ and 5–5½ mm, in LF 1½ and 2 mm; the longer sometimes without anther and club-shaped, red. *Pistil* in SF 1¾ mm, in LF 3–4 mm; puberulous; styles in SF ¾ mm, in LF 2–3 mm; ovary 1 by ¾–1 mm, subglobose. *Fruit* 18–32 by 10–23 mm, ellipsoid, glabrescent, greenish yellow at maturity, inside yellow, mesocarp glassy; rimae inconspicuous. *Seeds* 5–7½ by 2–4 mm; testa smooth; radicle 1¼ by ½ mm, cotyledons 5½ by 3½ mm.

Distr. *Malesia*: Sumatra, Malay Peninsula.

Ecol. First storey of primary forest on flat to undulating sandy clay on dry to temporarily flooded land.

Vern. *As(s)am pupy* (or *pupoii*), *bělimbing* (*hutan*), *kaju manau*, Lampong, *kukui*, Oesoe, *lain jěnis*, *jintèk-jintèk*, *kupoyi*, *pandija*, N. Sumatra, *pokô pupoé*, *pupui*, *pupoi*, *pupoy*.

Notes. Leaves of seedlings are 1-foliolate.

According to EDGEWORTH & HOOKER *f.* the leaves are irritable to the touch.

3. Sarcotheca glomerula VELDKAMP, Blumea 15 (1967) 532, f. 2i–j. — *Connaropsis macrophylla* KING, J. As. Soc. Beng. 62, ii (1893) 201, *non S. macrophylla* BL. 1850; RIDL. Fl. Mal. Pen.

1 (1922) 334. — *Dapania macrophylla* (KING) KNUTH, Bot. Jahrb. 50 (1914) 234. — *S. macrophylla* (*non* BL.) KNUTH, Pfl. R. Heft 95 (1930) 424, *pro specim. malay., excl. specim. born. et syn. Miq.*

Shrub or small tree, up to 9 m, 8 cm ø. *Leaves* unifoliolate, (6–)11½–28 by (2¼–)4–9 cm, pergamentaceous to subcoriaceous, glabrous, oblong to lanceolate, margins ± parallel, contractedly acute to cuspidate, base broadly truncate to emarginate, not glaucous; nerves 8–13 pairs, branching off with wide angle (lower ± 65–90°), basals usually recurved; petiole 4–11½ by 1½–3 mm, petiolule 3–8 by 2–3 mm, glabrous. *Panicles* subterminal or axillary, 1-few together, ± erect, glabrous, stout, 4–19 cm; branches reduced, wartlike, up to 2½ mm. *Flowers* in few-flowered fascicles. Lower joint of pedicel ± absent, upper 1–3 by ¾ mm. *Calyx* 1½–2 mm high, glabrous outside except the ciliate margin. *Sepals* 1¼–1½ by 1¼–1½ mm, broadly ovate, rounded to obtuse. *Petals* 6–8½ by 1¾–2⅓ mm, lanceolate-oblong to obovate-lanceolate, rounded, red to crimson, tube lighter. *Filaments* in LF 1 and 1¾ mm, in SF 2½–3 and 3½–4 mm. *Pistil* sparsely puberulous, in SF 2 mm, in LF 4 mm; styles in SF ¾–1 mm, in LF 2½–3 mm; ovary 1 by ⅔–¾ mm, subglobose, pubescence mainly apically. *Fruit* 8–16 by 5–10 mm, ellipsoid to ovoid, acute to acuminate, recurved, glabrous, red; rimae inconspicuous, in the upper half, neither lighter nor papillose inside. *Seeds* 10 by 4 mm; testa transversely rugose; cotyledons 7¼ by 3 mm; radicle *c.* 1 mm long, stout.

Distr. *Malesia*: Malay Peninsula.

Ecol. Primary and secondary forest on flat to undulating land.

Vern. (*Asam*) (*sĕ-*)*tundok*, *bĕlimbing bĕsi*, *b. hutan*, *sĕndok*, *tĕtindok*.

4. Sarcotheca laxa (RIDL.) KNUTH, Pfl. R. Heft 95 (1930) 422; VELDKAMP, Blumea 15 (1967) 533. — *Connaropsis laxa* RIDL. J. Str. Br. R. As. Soc. *n.* 75 (1917) 9; Fl. Mal. Pen. 1 (1922) 333. — *Connaropsis glabra* RIDL. J. Str. Br. R. As. Soc. *n.* 75 (1917) 9; Fl. Mal. Pen. 1 (1922) 332. — *S. glabra* KNUTH, Pfl. R. Heft 95 (1930) 422. — *Connaropsis sericea* RIDL. J. Fed. Mal. St. Mus. 10 (1920) 121; Fl. Mal. Pen. 1 (1922) 334. — *S. sericea* KNUTH, Pfl. R. Heft 95 (1930) 424. — *Connaropsis simplicifolia* RIDL. Fl. Mal. Pen. 1 (1922) 334. — *S. simplicifolia* KNUTH, Pfl. R. Heft 95 (1930) 424.

Shrub or tree, up to 23 m high, 45 cm ø. Branches glabrous or densely ferrugineous-tomentose, glabrescent. *Leaves* unifoliolate, (5–)8–23 by (2–)3–8½ cm, oblong to lanceolate, elliptic to obovate, acuminate to caudate, base broadly cuneate to truncate, above sparsely silky pubescent, mainly at base and on the midrib, beneath sometimes subglaucous, glabrous or pale to ferrugineous pubescent; nerves 5–11 pairs, basals sometimes at 90°; petiole 5–25 by 1–3½ mm, petiolule 3–7 by 1–3 mm, glabrous or pubescent. *Panicles* 1–3 together, up to 30 cm, erect, pendent in fruit, glabrous, or finely pale puberulous, or ferrugineous velvety; branches patent to recurved in fruit, up to 14 mm, sometimes once forked near the top, subtended by a bract, a petioloid, or a small leaf. Lower and upper joints of pedicel subequal, ½–1 mm. *Calyx* 1¼–2 mm high, outside glabrous or very shortly pale puberulous or ferrugineous puberulous. *Sepals* 1¼–2 by 1–2 mm, broadly ovate to spathulate, obtuse to emarginate. *Petals* 4–7 by 1¼–2 mm, obovate-lanceolate, rounded to emarginate, whitish to dark red. *Filaments* in SF 1–2½ and 2–3½ mm, in LF ½–1 and 1–1¾ mm. *Pistil* glabrous to appressed-strigose, in SF 1–1½ mm, in LF 3–4 mm long; styles in SF ½ mm, in LF 2–3 mm long; ovary ¾–1 by ½–⅔ mm, ellipsoid. *Fruit* 6–13 by 4–9 mm, ovoid to ellipsoid, recurved, rounded to acuminate, glabrescent; rimae inconspicuous, closed not lighter nor glandular inside. *Seeds* 5–9 by 3–4 mm; testa smooth to transversely rugose; cotyledons 4–5 by 2–2½ mm, 3–4 times as long as the radicle measuring 1–1½ by ⅓ mm.

Distr. *Malesia*: Malay Peninsula, ? NE. Sumatra.

Ecol. Forest edges and swamps at low altitudes.

Note. A collection from Sumatra (Tenajan R., Upper Riouw, SOEPADMO 154) of which the leaves and also the fruit somewhat resemble the Bornean *S. rubrinervis*, but of which the panicle is like the Malayan *S. laxa var. sericea*, might be a new variety of *S. laxa*, but better material is needed to reach a definite conclusion whether this species occurs also in Sumatra.

a. *var.* **laxa.** VELDKAMP, Blumea 15 (1967) 535, f. 3a–b. — *S. laxa* (RIDL.) KNUTH. — *S. glabra* (RIDL.) KNUTH.

Nearly glabrous throughout. Nerves 5–9 pairs. Branches of panicle distinct, slender, 2–14 mm, near top once forked. Petals retuse to truncate, 4½–4¾ by 1¼–1½ mm, claw 0–½ mm, stout. Fruit 6–7 mm long. Seed 5 by 3 mm.

Distr. *Malesia*: NW. Malay Peninsula.

Vern. *Měsĕkam*.

b. *var.* **sericea** (RIDL.) VELDKAMP, Blumea 15 (1967) 535, f. 3c–d. — *S. sericea* (RIDL.) KNUTH. — *S. simplicifolia* (RIDL.) KNUTH.

Leaves glabrous above, sparsely puberulous to glabrous beneath; nerves 8–11 pairs. Panicles densely, shortly puberulous; branches reduced, not forked, 1–6 mm. Petals obtuse to truncate, 5–7 by 1⅔–2 mm, claw slender, ⅔–1 mm. Pistil mainly apically, sparsely strigose. Fruit 8–10 mm long. Seed 7½–8 by 3–4 mm.

Distr. *Malesia*: East coast of the Malay Peninsula.

Vern. *Bĕlimbing cherchek*, *b. hutan*, *gĕriji*, *mĕdang*, *sĕtundok*.

Uses. Roots for poulticing wounds externally (BURKILL & HANIFF SFN 17611).

c. *var.* **hirsuta** VELDKAMP, Blumea 15 (1967) 535, f. 3e–g.

Twigs ferrugineous-tomentose, patchily glabrescent. Leaves beneath pale- to rusty-pubescent,

above sparsely and silky so, mainly at base and along the midrib; nerves 5–8 pairs. Panicle rusty-pubescent, branches reduced, stout, 1–3 mm. Petals obtuse, sometimes notched; claw ½–1 mm. Pistil densely appressed-strigose. Fruit 9–13 mm long. Seed 9 by 4 mm.

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

Vern. *Bělimbing bĕsi, b. burong, b. hutan, rèsak rambai daun.*

5. Sarcotheca glauca (HOOK. *f.*) HALL. *f.* Med. Rijksherb. Leiden 1 (1911) 2; KNUTH, Pfl. R. Heft 95 (1930) 421, f. 28f–n.; ANDERSON, Gard. Bull. Sing. 20 (1963) 162 (ecol.); VELDKAMP, Blumea 15 (1967) 535, f. 4a–c. — *Connaropsis glauca* HOOK. *f.* Trans. Linn. Soc. 23 (1860) 166. — **Fig. 7a-h.**

Shrub or tree, up to 21 m, 30 cm ø; no buttresses. *Leaves* unifoliolate, 4½–11 by 1¾–4¾ cm (on sterile twigs larger, up to 13½ by 6½ cm), elliptic to oblong, acute to acuminate, base obtusely cuneate to emarginate, glabrous; beneath whitish green, dull, subglaucous; nerves 5–7 pairs; petiole 10–27 by ½–1 mm, petiolule 3–6 by ¾–1½ mm. *Panicles* 1–2 together, erect, 1½–13 cm, rusty-puberulous; branches up to 10 mm, usually many-flowered, rather closely placed. Pedicels pectinately clustered, lower joint 2–6 mm, upper ¼–½ mm. *Calyx* rusty-puberulous outside, glabrescent in fruit except for margins and base, 2–3 mm high, crimson when dry. *Sepals* 1¾–3 by ¾–1¼ mm, ovate to oblong. *Petals* red, darker at apex, 3¾–6 by 1–2 mm, oblong to lanceolate, sometimes obovate. *Filaments* in SF 2–2¾ and 2½–3⅔ mm, in LF 1¼–1½ and 1½–1¾ mm. *Pistil* in SF 1–1½ mm, in LF 3¼–3½ mm, appressed rusty-strigose; styles in SF ½–¾ mm, in LF 2½–3 mm; ovary ½–1 by ½–⅔ mm, ellipsoid. *Fruit* bright pink to dark red, 8–12 by 5–11 mm, subglobose to ellipsoid with obtuse to rounded apex, glabrescent; rimae open and conspicuous, inside lighter and papillose. *Seeds* 6 by 3½ mm; testa shiny, smooth; cotyledons 5 by 2½ mm, elliptic, radicle 1 mm.

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

Ecol. Rare to very rare in undisturbed forest, heath forest on well-drained humus podsols, ground-water podsols, peaty '*Hochmoors*' and sand covered clay on terraces and sand stone. Occasionally in secondary forest (BRÜNIG).

Vern. *Arémajuh*, Dajak, *asam daham, barus, bělimbing, b. daham, gitan gizu, kandis daham*, Brunei, *mĕdang, piang*, Iban, *rangkas-rangkas*, Dusun Kinabatangan, *sĕgot*, Baju, *tampusi, temposi(s)*, Kedayan.

The vernacular epithet *daham* might point at the use of this plant against coughing.

Notes. This species is closely allied to *S. rubrinervis* HALL. *f.* and differs in having a less puberulous, when dry dark red to crimson calyx, a short compact panicle with very reduced primary branches, while the way of branching in the cyme is indistinct. The pistil in LF is 3¼–3½ mm long, the filaments in SF 2–2¾ and 2½–3⅔ mm. The cotyledons are lanceolate.

6. Sarcotheca monophylla (PLANCH. *ex* HOOK. *f.*) HALL. *f.* Med. Rijksherb. Leiden 1 (1911) 2; KNUTH, Pfl. R. Heft 95 (1930) 422, f. 27; VELDKAMP, Blumea 15 (1967) 536, f. 2g–h. — *Connaropsis monophylla* PLANCH. *ex* HOOK. *f.* Trans. Linn. Soc. 23 (1860) 166; EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 440; KING, J. As. Soc. Beng. 62, ii (1893) 200; RIDL. Fl. Mal. Pen. 1 (1922) 332, f. 34. — *Dapania monophylla* KNUTH, Bot. Jahrb. 50 (1914) 648.

Shrub or tree, up to 30 m, 38 cm ø, bole occasionally buttressed and crooked. *Leaves* unifoliolate, 4–10 by 1½–3¼(–7) cm, elliptic to oblong, rarely suborbicular, acuminate to cuspidate, base rounded to cuneate, glabrous, dark when dry, subglaucous beneath; nerves 5–7 pairs; petiole 6–31 by ½–¾ mm, petiolule 3 by ⅔–1 mm. *Panicles* 1–2 together, erect, 1–9½ cm, rusty-puberulous, ± dense; branches up to 4 mm long. Pedicels pectinately clustered, upper joint up to ⅓ mm, lower 1–2 mm. *Calyx* 1¾–2 mm high, outside rusty-puberulous, apically less so, reddish-brown when dry. *Sepals* 1½–2 by 1–1½ mm, ovate to rectangular, acute to emarginate. *Petals* deep red, 3–5 by ¾–1½ mm, lanceolate, emarginate. *Filaments* in LF 1–1¼ and 1¼–1½ mm, in SF 1½ and 2 mm. *Pistil* densely appressed rusty-strigose, in LF 3–3½, in SF 1 mm; styles in LF 2–2½ mm, in SF ½ mm long; ovary ½–1 by ½–⅔ mm, ellipsoid. *Fruit* up to 13 by 13 mm, pale to bright red, subglobose to ovoid, rounded to acute; rimae conspicuous, open, lighter and papillose inside. *Seeds* 7½ by 3 mm; testa smooth; cotyledons 4 by 2¼ mm, radicle 1¼ by ⅓ mm.

Distr. *Malesia*: W. and Central Malay Peninsula.

Ecol. Secondary forest, open jungle on flat to undulating land on rich soil at low altitude.

Vern. *(Asam-)pupoy, bělimbing akar, b. bĕsih, b. bulat, b. burong, b. hutan, b. kĕris, b. k(ĕ)ra, b. pĕnjuru, b. pipit (pĕpit, pipĕt), bibit* (Sakai), *kûlat pipit, sĕtundok*.

Note. The type (CUMING 2324) came from Malaya, not from the Philippines as KNUTH supposed.

7. Sarcotheca celebica VELDKAMP, Blumea 15 (1967) 537, f. 4f–m.

Shrub or tree, up to 35 m, 17 cm ø. *Leaves* unifoliolate, (3½–)6–13½ by 2–5 cm, elliptic to lanceolate, acute-cuneate, base cuneate to ± truncate, above with prominent, rather coarse venation, glabrous, subglaucous, sparsely puberulous; nerves 5–6 pairs; petiole 6–21 by ½–1 mm, petiolule 2–5 by ½–1¼ mm, sparsely strigose. *Panicles* 1–2 together, 1–7 cm, erect, slender, rusty-puberulous; branches up to 2(–7) mm, distant. Pedicels few, close together with equal upper and lower joints, up to 1½ mm. *Calyx* 2–2¼ mm high, rusty-puberulous outside, reddish-brown when dry. *Sepals* 1½–2 by 1–1⅓ mm, ovate to rectangular, acute to truncate. *Petals* red, 4–4¼ by 1–1½ mm, lanceolate, rounded to

retuse. *Filaments* in SF 1–2 and 2–2¼ mm, in LF ¾ and 1 mm. *Pistil* appressed-strigose, in SF 1 mm, in LF 2½ mm; styles in SF ¼ mm, in LF 2 mm; ovary ½–¾ by ½–¾ mm, subglobose to ellipsoid. *Fruit* 8–13 by 6–9 mm, ellipsoid rounded to acutish, glabrescent, red; rimae open from the top to below the middle, ± conspicuous, lighter and papillose inside. *Seeds* 4–5 by 3 mm; testa slightly transversely rugose to ± smooth; cotyledons 3 by 2¾ mm, radicle 1 mm.

Distr. *Malesia*: Central Celebes (Malili) and Kabaëna I. (S of SE. Celebes).

Ecol. Rather open country, primary forest on stony to clayish, flat to undulating land at low altitude.

Vern. *Ko(e)ngilu* ((*mo-*)*puté*), To Bela, To Padoë, To Tambeë.

Note. This new species is best distinguished by its lax, narrow panicles with thin rachis and the coarser and more prominent venation on the upper side of the leaf as compared with its nearest allies *S. glauca* and *S. monophylla*.

8. Sarcotheca ferruginea MERR. Pap. Mich. Ac. Sc. 19 (1933) 160, fig.; VELDKAMP, Blumea 15 (1967) 538, f. 3h–i.

Tree. Twigs velvety rusty-pubescent, later patchily glabrescent and dark. *Leaves* shiny golden pubescent when young, upper surface soon glabrous or with a few appressed, pale hairs at the basis and along the midrib, beneath densely ferrugineous-pubescent, not glaucous, (3½–)5–11¼ by (1–)2–3½ cm, oblong to oblanceolate, acute to caudate, base broadly cuneate to rounded, margins usually paler; nerves 5–7 pairs; petiole 4–6½ by ½–1 mm, petiolule 2–4 by ¾–1½ mm, rusty-velvety, glabrescent. *Panicles* 1–2 together, short, slender, up to 7½ cm, velvety; branches distant, ½–2 mm. Pedicels with unequal lower joint, one per cyme elongated, 3–4 mm, others *c.* 1 mm; upper joint ½–1 mm. *Calyx* 2–3¾ mm high, rusty-puberulous outside. *Sepals* 1¾–3½ by ½–1 mm, ovate-lanceolate, acute. *Petals* red, 4–6 by 1½–2 mm, obovate-elliptic to -lanceolate, rounded to obtuse. *Filaments* in LF 1 and 1½ mm. *Pistil* in LF 3–3½ mm, appressed-strigose; styles in LF 2–2½ mm; ovary 1 by 1 mm, subglobose. *Fruit* 7–14 by 6–12 mm, ovoid to subglobose, rounded, somewhat shiny, reddish; rimae inconspicuous, not glandular or ligher inside. *Seeds* 7 by 4½ mm; testa transversely rugose; cotyledons 5 by 3 mm, radicle 1 mm.

Distr. *Malesia*: N. Sumatra (West and West Coast Res.), apparently local and rare.

Vern. *Kaju kandis*.

Note. I have not seen the short-styled form.

9. Sarcotheca rubrinervis HALL. *f.* Beih. Bot. Centralbl. 34, ii (1917) 29; KNUTH, Pfl. R. Heft 95 (1930) 425; VELDKAMP, Blumea 15 (1967) 539, f. 4d–e. — *S. oblongifolia* MERR. Univ. Cal. Publ. Bot. 15 (1929) 111; KNUTH, Pfl. R. Heft 95 (1930) 421.

Shrub or tree, up to 19 m, bole up to 10 m, 30 cm ø. *Leaves* unifoliolate, 5–18½ by 1¾–7 cm, oblong to lanceolate, glabrous, acute to caudate, base obtuse to rounded, beneath not or slightly glaucous; nerves 4–11 pairs, often with reddish tinge; petiole 6–20 by 1–2 mm, petiolule 2–4 by 1–2 mm. *Panicles* 1–2 together, elongated, lax, pendulous, rusty-puberulous, 7–38½ cm; branches elongated, slender, patent, ± monochasially branched, up to 8(–21) mm. Pedicels with unequal lower joint, usually one per cyme elongated to 5 mm, others up to 3 mm; upper joint ¼–1 mm. *Calyx* 2–3 mm high, rusty-puberulous, at least at base. *Sepals* 1⅔–2¾ by 1–1½ mm, ovate to lanceolate, acute to emarginate. *Petals* 3¾–5½ by 1–1½ mm, lanceolate, rounded to emarginate, pale red to red, occasionally white, apex usually darker, claw ⅔–1 mm. *Filaments* in SF 1⅔–2 and 2½–3 mm, in LF ½–⅔ and 1–1¼ mm long. *Pistil* in SF 1–1¼ mm, in LF 2¼–$2^3/_5$ mm; styles in SF ½ mm, in LF 1¾–$1^4/_5$ mm; appressed-puberulous; ovary ½–$^4/_5$ by ½–⅔ mm, subglobose, densely appressed-strigose. *Fruit* 6–10 by 5–10 mm, subglobose, rounded, glabrescent, glaucous to glossy, pink to bright red; rimae not always conspicuous, lighter and papillose inside. *Seeds* up to 6¾ by 5 mm; testa smooth to ± transversely rugose; cotyledons elliptic, 4¾ by 1½ mm, radicle 1 by $^2/_5$ mm.

Distr. *Malesia*: E. Borneo (from Tawao to Balikpapan).

Ecol. Primary and secondary forest near rivers on loam, flat to undulating land.

Vern. *Asĕm-asĕm*, Dusun Kinabatangan, *iba talon*, Bajau, *ira prumpuan*, Suluk, *kajo badjuk*, Kajam-Dajak, *kandis daham*, Brunei, *lampyos*, Dusun Penompang, *pinggoh*, *pinguh*, Klabakan, *pingo*, Tidon, *tĕnggoh*, Kutai.

Note. Sometimes difficult to distinguish from *S. glauca* (see there).

10. Sarcotheca ochracea HALL. *f.* Beih. Bot. Centralbl. 34, ii (1917) 28; KNUTH, Pfl. R. Heft 95 (1930) 424; VELDKAMP, Blumea 15 (1967) 541, f. 5c–e.

Treelet, up to 9 m, 10 cm ø. Twigs velvety, glabrescent. *Leaves* unifoliolate, 7½–23½ by 3½–10¼ cm, elliptic to oblong, abruptly acuminate to cuspidate, base obtuse to truncate, above glabrous, beneath rusty-pubescent to -velvety, sometimes subglaucous; nerves 6–11 pairs; petiole 5–24 by 1½–3 mm, petiolule 3–7 by 1½–3 mm. *Panicles* 1–2 together, 7–70 cm, erect to pendulous, rusty-velvety, compact to elongated. Branches very short to elongated, often distant, pectinately branched, many-flowered, patent to recurved, up to 30 mm long, rusty-velvety. Lower joint of pedicel 4–8 mm, upper ½–1 mm. *Calyx* (2¼–)3–3½ mm high, rusty-puberulous outside. *Sepals* suborbicular to obovate, rounded to retuse, 2¼–3 by 1⅔–3 mm. *Petals* crimson, apically darker, (4¼–)6–8 by (1–)1½–1¾ mm, obovate-lanceolate to lanceolate, obtuse to rounded. *Filaments* in SF 2½ and 3–3¼ mm, in LF 1½–2 and 2–2½ mm. *Pistil* densely rusty-strigose, in SF 1¾–2, in LF 3–4 mm; styles red, in SF ⅓–¾ mm, in LF 2–2½ mm long; ovary 1–1½ by 1 mm,

subglobose. *Fruit* 8–15 by 6–15 mm, subglobose to oblong, rounded, glabrescent, bright red; rimae conspicuous, lighter and/or papillose inside. *Seed* 1–2 per fruit, 5¼–7 by 3¼–4½ mm; testa transversely rugose. Mature embryo not seen.

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

Ecol. Along streams in forest on clay.

Vern. *Ikor mata*, Iban, *pechi mata*.

11. Sarcotheca macrophylla BLUME, Mus. Bot. Lugd. Bat. 1 (1850) 242; MIQ. Fl. Arch. Ind. Ill. (1870) 70, t. 30; BAILLON, Adansonia 10 (1873) 364; Hist. Pl. 5 (1874) 26, 47; HALL. *f.* Beih. Bot. Centralbl. 34, ii (1917) 29; KNUTH, Pfl. R. Heft 95 (1930) 424, *pro spec. Born.*; VELDKAMP, Blumea 15 (1967) 541, f. 5a–b. — *Roucheria macrophylla* MIQ. Fl. Ind. Bat. 1, 2 (1858) 136; Suppl. 1 (1860) 162.

Shrub or tree, up to 15 m, 10 cm ø. *Leaves* unifoliolate, (5–)16–28 by 6–10 cm, oblong to oblanceolate, margins ± parallel, abruptly acuminate to cuspidate, base truncate to emarginate, subcoriaceous, above glabrous, beneath puberulous on the veins, sometimes subglaucous; nerves 6–13 pairs; petiole 5–12(–25) by 1½–3 mm, petiolule 3–9 by 1–3 mm. *Panicles* 1–4 together, slender, lax, 12–85 cm, pendulous, brown-puberulous; branches elongated, 6–25(–50) mm, often flattened. Lower joint of pedicel up to 2 mm, upper ¼–1 mm. *Calyx* 1½–3 mm high, ferrugineous-puberulous outside. *Sepals* 1¼–2½ by 1–1¾ mm, obovate to ovate, rounded to obtuse. *Petals* dark red, 3¼–5 by 1–1¾ mm, obovate-oblong to -lanceolate, obtuse to emarginate, claw ¼–½ mm. *Filaments* in SF 1–2 and 1¾–3 mm, in LF ¾–1¼ mm and 1½–1¾ mm. *Pistil* appressed-strigose, in LF 2–3 mm, in SF 1¼–1¾ mm; styles in SF ¼–⅔ mm, in LF 1–2 mm; ovary ⅔–1 by ½–¾ mm, subglobose to ellipsoid. *Fruit* 6–11 by 5–8 mm, subglobose, rounded, glabrescent, shiny, dark red; rimae inside lighter, papillose, conspicuous. *Seeds* up to 9 by 4 mm; testa transversely rugose; cotyledons 4 by 2½ mm, radicle 1 mm.

Distr. *Malesia*: Borneo (Indonesian Borneo; Sarawak: Marop).

Ecol. Primary and secondary forest on sand.

Vern. *Bělimbing manik*, Bakumpai-Dajak, *kaju kim*, *krumbai mèrah*, *mim*, *pengu*, Dusun, *ram(b)-ajan*.

Notes. BLUME cited this species also to occur in Sumatra, but this seems to be erroneous.

It has been confused with *Connaropsis macrophylla* KING = *S. glomerula*.

Dubious

Sarcotheca philippica (F.-VILL.) HALL. *f.* Med. Rijksherb. Leiden 1 (1910) 2. — *Connaropsis philippica* F.-VILL. Novis. App. (1880) 33; MERR. Sp. Blanc. (1918) 19, 195; KNUTH, Pfl. R. Heft 95 (1930) 417.

Subscandent. Innovations dark purple. *Leaves* imparipinnate, 1–4-jugate; leaflets 6–10 by 2–3 cm, oblique-ovate, acute, subcoriaceous, pubescent when young, later glabrous. *Panicle* axillary and terminal, shorter than the subtending leaf. *Sepals* 2–4 mm long. *Petals* twice as long, connate at base when young, later free. *Filaments* alternatingly shorter ('*alterna breviora*'), often without anthers; styles 5, erect, adpressed; stigmas oblong, apiculate; ovary ovate, pilose, 5-locular, ovules 2 per cell. *Fruit* 2–3 by ½–1 cm, orange-red, pilose, 5-angular, 5-locular. *Seed* 1 per cell, ovate, with white aril (translated from type description).

Distr. *Malesia*: Philippines (Bugney near Igbarás, Iloilo).

Vern. *Balabangquilin, malabangquilin.*

Note. MERRILL noted that he has seen no representative of this genus in the Philippines and none is known to me. Although he is very critical of F.-VILLAR's work (*cf. l.c.* 14–18), he thinks it to be '. . . apparently a true . . . *Sarcotheca* . . .'. KNUTH referred it to *Averrhoa carambola* L., with which the description agrees for the greater part, differing, however, by the subscandent habit, the subcoriaceous leaflets, the 2 ovules per cell, and the rather small, orange-red, pilose fruit. F.-VILLAR stated he has seen the plant alive, so presumably his remarks pertaining to habit and fruit are correct; the more so as in his work this species follows the description of *Averrhoa carambola*. As long as no representative is found the status of this species will remain in doubt.

Excluded

Connaropsis rubescens RIDL. J. Bot. 62 (1924) 295 = *Rourea minor* (GAERTN.) LEENHOUTS, Blumea 12 (1963) 20 (*Connaraceae*).

Sarcotheca paniculata RIDL. Trans. Linn. Soc. III, 2 (1893) 282 = *Rourea minor* (GAERTN.) LEENHOUTS, Fl. Mal. I, 5 (1958) 515a (*Connaraceae*).

Sarcotheca pinnata MERR. J. Str. Br. R. As. Soc. *n.* 86 (1922) 314 = *Rourea pinnata* (MERR.) VELDKAMP, Blumea 15 (1967) 543 (*Connaraceae*).

Sarcotheca varians (CRAIB) KNUTH, Pfl. R. Heft 95 (1930) 425. — *Connaropsis varians* CRAIB, Kew Bull. (1926) 158 = *Rourea minor* (GAERTN.) LEENHOUTS, Fl. Mal. I, 5 (1958) 515b (*Connaraceae*).

5. AVERRHOA

LINNÉ, Gen. Pl. ed. 5 (1754) 196; Sp. Pl. (1753) 428; ENDL. Gen. Pl. (1839) 1173, *incl. sect. Bilimbi et sect. Carambola* ENDL.; KNUTH, Pfl. R. Heft 95 (1930) 417; BACK.& BAKH. *f.* Fl. Java 1 (1963) 247. — *Averrhoaceae* HUTCHINSON, Fam. Fl. Pl. ed. 2, 1 (1959) 356. — **Fig. 9.**

Evergreen shrubs or trees. Innovations pubescent, glabrescent. *Leaves* spirally arranged to terminally clustered, estipulate, imparipinnate, herbaceous; leaflets entire, subopposite, subsessile, terminal largest. *Panicles* axillary or cauliflorous. *Flowers* in scattered, stalked, loose cymes, heterodi- or -tristylous. Bracts small, caducous. *Sepals* quincuncial or paratact, shortly connate at base. *Petals* contort or paratact, free or coherent above the claw, creamy to dark red with white markings. *Ovary* appressed-strigose; ovules (2–)3–7 per cell, pendulous. *Fruit* large, yellowish green and semitransparent *in vivo*, red when dry; rimae small, reduced to absent (?). *Seeds* elliptic, flattened; aril present in one species, attached to the entire adaxial raphe, bilabiate, enveloping the seed, fleshy, with oily drops; endosperm present; cotyledons 6–8 times as long as the oblique and stout radicle.

Distr. 2 *spp.*, probably native in *Malesia*, cultivated pantropically at low altitude for their fruit trees, often escaping.

It is often assumed that *Averrhoa* is possibly of American origin. Both species are mentioned in pre-Linnean literature always from Indo-Malesia (BAUHIN, 1623, being the oldest). The closest relatives are Malesian-Malagasian. Though I can not forward proof, for or against, an Indo-Malesian origin seems most probable.

Ecol. Irritability of the leaves has been noted as early as 1785 by BRUCE (Phil. Trans. 356), while DARWIN made a detailed study of it (*A. bilimbi* L.) in his 'The Movements of Plants' (1880) 330, 447.

Uses. Mainly for the fruit; see under the species.

Syst. The two species are remarkably different in important characters which are almost of the same value as those separating the allied genera *Sarcotheca* and *Dapania* as appears from the key to the species. One is tempted to raise them to the status of sections, as ENDLICHER proposed (Gen. Pl. 1839, 1173). At the same time this shows the intimate relationship of the three genera. This defeats HUTCHINSON's rigorous attempt to assign *Averrhoa* to a separate family *Averrhoaceae*, even accommodating it to another order (Fam. Fl. Pl. ed. 2, 1, 1959, 356). The reason for this rests on the supposed presence of a disk and horizontal ovules; the first I can not find and the ovules are pendulous.

KEY TO THE SPECIES

1. Leaves 3–6-jugate. Panicles axillary, rarely some ramiflorous. Petals up to 8 mm, minutely puberulous inside, coherent above the claw. Shorter stamens without anther. Ovules 3–5 per cell. Fruit stellate in ø. Seed arillate. . . . . **1. A. carambola**
1. Leaves 7–19-jugate. Panicles cauliflorous, rarely some axillary. Petals 10–20 mm, glabrous inside, not coherent above the claw. All stamens antheriferous. Ovules 4–7 per cell. Fruit terete, slightly lobed. Seed exarillate. . . . . **2. A. bilimbi**

1. Averrhoa carambola LINNÉ, Sp. Pl. (1753) 428; CAV. Diss. 7 (1789) 374, f. 220; DC. Prod. 1 (1824) 689; BL. Bijdr. (1825) 242; W. & A. Prod. (1834) 141; BLANCO, Fl. Filip. (1837) 391; MIQ. Fl. Ind. Bat. 1, 1 (1859) 133; EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 439; PROGEL, Fl. Bras. 12, 2 (1877) 520, *incl. var. angustisepala*; TRIMEN, J. Linn. Soc. Bot. 24 (1887) 129 (typification); NINGRAT, Teysmannia 3 (1892) 754; K. & V. Bijdr. 9 (1903) 106; BACK., Fl. Bat. (1907) 229; KOORD. Atlas 4 (1918) 603; MERR. Sp. Blanc. (1918) 194; RIDL. Fl. Mal. Pen. 1 (1922) 332; HEYNE, Nutt. Pl. (1927) 853; KNUTH, Pfl. R. Heft 95 (1930) 417; OCHSE & BAKH. Vrucht. (1931) 91, tab. col.; BURK. Dict. (1935) 271; QUIS. Med. Pl. Philip. (1951) 439; BACK. & BAKH. *f.* Fl. Java 1 (1963) 247; VELDK., Fl. Thail. 2 (1970) 21. — *A. acutangula* STOKES, Bot. Mat. Med. 2 (1812) 543. — *A. pentandra* BLANCO, Fl. Filip. (1837) 392. — *Tamara tonga* RHEEDE, Hort. Mal. 3 (1682) 51, f. 43, 44. — *Prunum stellatum* RUMPH. Herb. Amb. 1 (1750) 115, f. 35. — **Fig. 9.**

Tree, up to 14 m by 30 cm. Branches often drooping. Innovations yellowish to reddish pubescent, glabrescent. *Leaves* 3–6-jugate, not crowded terminally; rachis up to 20 cm; leaflets up to 10 by 4 cm, variable in shape, lowest not reflexed, acute to acuminate, glaucous beneath; nerves 4–10 pairs. *Panicles* axillary, rarely ramiflorous, 1-few together, ascending, up to 7 cm long. *Flowers* heterodistylous (LF, MF), said to be scentless, melliferous. Pedicels 3–6 mm, articulated 1–2 mm below the flower. *Sepals* up to 4 by 2 mm, bright red, yellowish brown with pale margins when dry, obovate-oblong to triangular, acute to obliquely emarginate, subglabrous. *Petals* up to 8 by 2 mm, obovate to lanceolate, coherent, claw *c.* 1½ mm, glabrous, but inside with minute septate-glandular hairs. Shorter *stamens* ananthiferous, filaments subulate with often swollen base, up to 1¾ mm, longer ones in LF

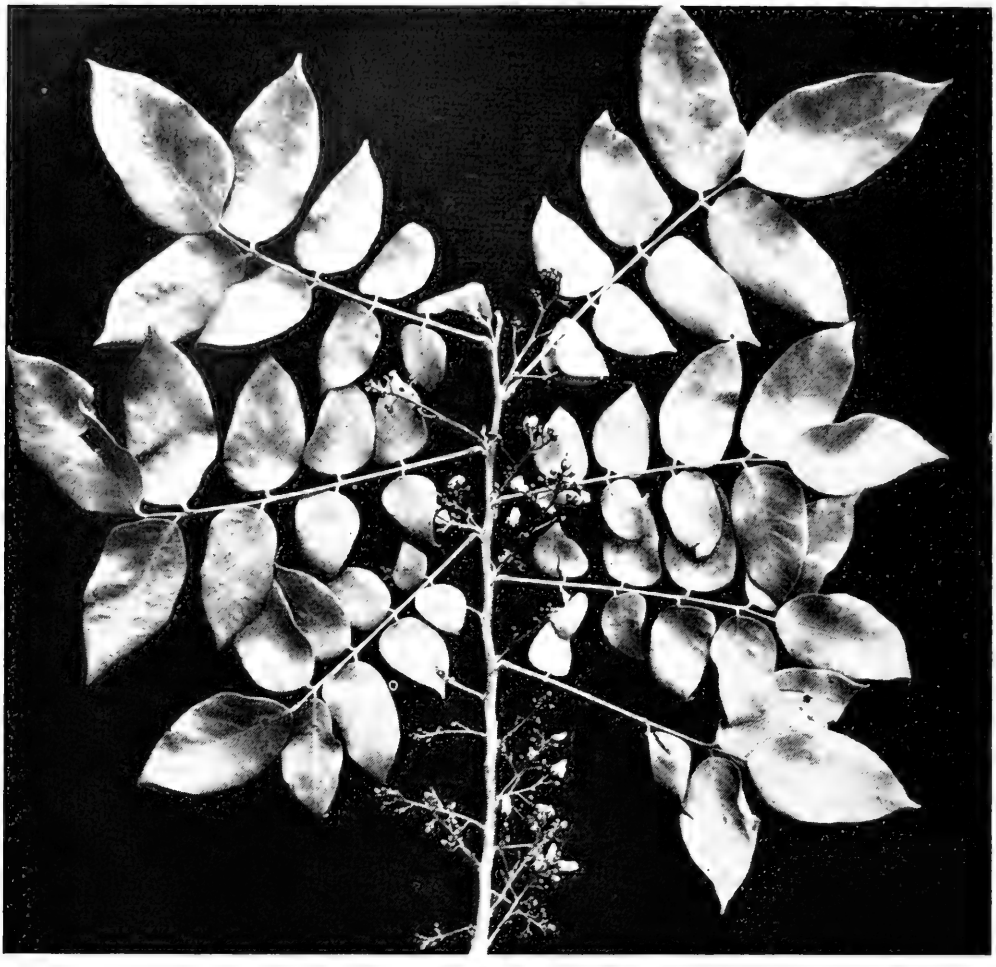

Fig. 9. *Averrhoa carambola* L. (Courtesy T. B. WORTHINGTON).

up to 3 mm, in MF up to 4½ mm. *Ovary* elliptic, up to 2½ mm long, appressed-puberulous, mainly on the ribs; styles in LF up to 2 mm, in MF ½ mm; ovules 3–5 per cell. *Fruit* up to 12½ by 6 cm, ovoid to ellipsoid, stellate in ø, lobed at both ends, apically with minute rimae on the ribs. *Seeds* up to 10, 12 by 5 mm; aril fleshy, bilabiate, enclosing the seed, lobed at base; cotyledons up to 6½ by 3½ mm, elliptic.

Distr. Native country unknown, possibly Central and East Java, but escaping freely, often a relict of former cultivation.

Ecol. At low altitude, up to 1000 m, along rivers, in ravines, primary and secondary forest.

Dispersal. Fruits eaten by bats, mice and *Calotes spp.* (*Agamidae*). *Cf.* NINGRAT (1892).

Vern. Variations on *bĕlimbing*. Sumatra: *asom djorbing*, Bat., *balimbing manis*, *b. segi*, *b. sajur*, *b. batu*, *kĕmbola*, *b. bĕsi*, *b. kĕris*, Mal., *kembang bua*, *kaping*, Palemb., *b. manih*; Java: *balingbing amis*, *tjalingtjing amis*, S, *b. lĕgi*, *b. lènger*, *b. lingir*, *b. manes*, Mad., *libi melai*, Sawu; Borneo: *b. pĕsĕgi*, *b. pĕnjura*, Kuching, *b. amamas*, Sabah; Celebes: *lumpias mamis*, Bentenan, *rumpiasa*, Bantik, *lompiat morominit*, Mongodow, *dumpias tariis*, *lopias emé*, Tonsawang, *lumpias tombal*, Tontembuan, Tonsawang, *lèmbètuë lombiata*, Goronta, *lombituko gula*, Buol, *takulè*, Barée, *bainang sulapa*, Makass., *kulirang taning*, *pulirang taning*, N. Salajar, *baknil pasaki*; Sepa, S. Ceram, *ifèl emroro*, Masareta, Buru, *malibi totofuo*, Weda, S. Halm., *balibi totofuko*, Galelas, Tobelor, *totofuko*, *t. lĕmo*, Ternate, *tufuo*, Tidore; Philip.: *daligán*, Ilk., *dalihan*, *galurán*, Ibn., *galangan*, P. Bis., *garáhan*, Bis., *malimbin*, S. L. Bis., *sirinate*, Ting.; E. New Guinea: *ibeid*, Tehid, *painayangara*, Tumbunke.

Uses. The fruit is eaten fresh or pickled. Leaves and fruits are said to be good against fevers, aphtha, angina, chickenpox, ringworm, headaches,

scurvy, dysentery, piles and affections of skin and eyes; they excite the appetite, but may cause vomiting. It is antiphlogistic and a sialogogue. The fruit removes stains from laundry, hands and weapons. See NINGRAT (1893), KOORDERS & VALETON (1903), HEYNE (1927), OCHSE (1931), BURKILL (1935), and QUISUMBING (1951).

Phytochem. DE PERALTA (Philip. Agr. 17, 1928, 334) has shown the presence of HCN in leaves, roots and stems; BATE-SMITH (J. Linn. Soc. Lond. Bot. 58, 1962, 134) the presence of cyanidin, p-cumaric acid and traces of sinapic acid, and (*ibid.* 55, 1957, 687) tannin, leucoanthocyanin and leucocyanidin.

Syst. This species is widely cultivated for a long time and many cultivars are extant (*cf.* NINGRAT, 1893), differing in taste and size of the fruit. A *f. acida* and *f. dulcis* have been described by KOORDERS & VALETON, and material bearing these names has been examined, but no characters could be found to distinguish them. PROGEL's *var. angustisepala* from S. America seems not to warrant distinction, as the shape and pubescence of the sepals in Malesia is very variable. This variety has possibly been the reason for an assumed American origin of the genus time and again found in literature.

2. Averrhoa bilimbi LINNÉ, Sp. Pl. (1753) 428; CAV. Diss. 7 (1789) 373, f. 219; DC. Prod. 1 (1824) 689; ROXB. Fl. Ind. ed. Carey 2 (1832) 451; W. & A. Prod. (1834) 142; BLANCO, Fl. Filip. (1837) 391; ENDL. Gen. Pl. (1839) 1173; MIQ. Fl. Ind. Bat. 1, 1 (1859) 139; EDGEW. & HOOK. *f.* Fl. Br. Ind. 1 (1874) 439; PROGEL, Fl. Bras. 12, 2 (1877) 520; TRIMEN, J. Linn. Soc. Bot. 24 (1887) 129 (typification); K. & V. Bijdr. 9 (1903) 111; KOORD. Atlas 4 (1918) 601, 602; MERR. Sp. Blanc. (1918) 195; En. Born. (1921) 311; RIDL. Fl. Mal. Pen. 1 (1922) 331; HEYNE, Nutt. Pl. (1927) 852; KNUTH, Pfl. R. Heft 95 (1930) 418, *incl. f. papuana* KNUTH; OCHSE & BAKH. Ind. Groenten (1931) 546; BENTHALL, Trees of Calcutta (1933) 70; BURK. Dict. (1935) 270; SORGDRAGER, Pharm. Tijd. 1 (1941) repr. 4 pp. (anat., uses); QUIS. Med. Pl. Philip. (1951) 438; BACK. & BAKH. *f.* Fl. Java 1 (1963) 247; VELDK., Fl. Thail. 2 (1970) 22. — *A. obtusangula* STOKES, Bot. Mat. Med. 2 (1812) 542. — *Bilimbi* RHEEDE, Hort. Mal. 3 (1682) 55, f. 45, 46. — *Blinbingun teres*, *Blimbing bula* RUMPH. Herb. Amb. 1 (1750) 118.

Shrub or tree, up to 15 m, 30 cm ø. Branches erect. Innovations and green parts long-persisting pale yellowish to rusty velvety. *Leaves* 7–19-jugate, usually terminally tufted; rachis 17–57 cm; leaflets up to 12 by 4 cm, variable in pubescence, size and shape, lower reflexed, acute to acuminate, not glaucous beneath; nerves 6–14 pairs. *Panicles* cauliflorous on tubercles, nearly down to ground-level, fasciculate and pendulous up to 20 cm, rarely axillary, solitary and erect. *Flowers* heterotristylous, usually MF. Pedicels 4–17 mm, articulated near or below the middle. *Sepals* 3–8 by 1½–3 mm, yellowish red to purplish, sparsely appressed-puberulous outside mainly at base, inside glabrous or subglabrous, elliptic to lanceolate or spathulate, acute to rounded. *Petals* free, 10–20 by 3–4 mm, lanceolate-spathulate, inside glabrous, claw 3–6 mm. *Stamens* all fertile, in SF 3½–4 and 7 mm, in MF 2–5 and 9–12 mm, in LF 5 and 7½ mm, bases not thickened. *Ovary* densely appressed pale strigose and with short, septate-glandular hairs, in SF 2–2½ by 1 mm, in MF 3–4 by 1–1½ mm, in LF 4 by 1 mm, elliptic; styles in SF ½–¾ mm, in MF 2–4 mm, in LF 6½–9 mm; ovules 4–7 per cell. *Fruit* terete-obtusangular, up to 10 by 5 cm, elliptic to obovate, obtuse, rimae present (?), base tapering. *Seeds* up to 14, 6–7 by 4–6 mm, exarillate; cotyledons 4–6 by 3½–5 mm, orbicular, cordate.

Distr. Native country unknown, widely cultivated, escaping freely, often a relict of former cultivation, for instance in East Malesia.

Ecol. Along rivers, lowland primary and secondary forest.

Vern. *Bělimbing* and many variations; Sumatra: *limĕng*, *sĕlimĕng*, *thlimĕng*, Atjeh, *asom*, Batak; Mal. Pen.: *b. asam*, *b. bĕsi*, *b. botol*, *b. buloh*, *b. kĕris*, *b. masam*; Borneo: *bĕliwit*, Dajak Busang, *iba*, Bajan, *blimbing puchung*, Kedayan; Java: *tjalingtjing*, *t. wulĕt*, S; *limbi*, Bima; *libi*, Sawu; *bélérang*, Sangi; Celebes: *lumpias*, Bentenan, Ponosakan, Tombulu, Tontembuan, *rumpéasa dureng*, Bantik, *lompiat litod*, Mongodow, *dumpias*, *d. tuwama*, Tonsawang, *wuli(n)dan*, Tontembuan, *lèmbètuë*, Gorontalo, *lombituko*, Buol, *sanggulèra*, Parigi, *tangkurera*, Barèe, *baïnang*, Makassar, *kulirang*, *pulirang*, N. Salajar, *tjalènè*, Bugin.; *niniloe daé lok*, Roti, *kerbol*, Timor, *baknil*, Kai, *ahurèla*, Atamano, W. Ceram, *haurèla*, Amahai, S. Ceram, *taulela*, Nuaulu, *takuréla*, Ambon, *tahuréla*, Sapurua, Ulias, *taprera*, Kajeli, Buru, *ifèl milo*, Masarete, Buru, *malibi*, Weda, S. Halm., *balibi*, N. Halm., Ternate; Philip.: *iba*, Tag., Sul., P. Bis., *ibag*, Mbo., *kalamiás*, *kalanuas*, *kamiás*, *kolonanas*, *kolonauas*, Tag., *kalingiua*, Bis., *kiling-iba*, Bik., *ibe*, Yak., *piás*, Ilk., *puis*, Ig.; New Guinea: *miri-miri*, Kapur, *utĕké*, Mimika & Atuka R., *olloloh*, Sentani.

Uses. In the Malay Peninsula the leaves are used as a paste against itches, eaten against syphilis and a decoction is drunk after childbirth. In Java the leaves are used against mumps, rheumatism and pimples, against piles; a decoction of the flowers is used against cough and thrush. The fruit juice is generally used against fevers, scurvy, beri-beri, biliousness, coughs and piles; it also removes stains from laundry, hands and weapons. See KOORDERS & VALETON (1903), HEYNE (1927), OCHSE & BAKHUIZEN (1931), BURKILL (1935), and QUISUMBING (1951). Fruits and flowers are edible but more acid than those of *A. carambola*.

Syst. The species has always been regarded as possessing only an MF flower. Short-styled or SF (ELMER 15122) and long-styled or LF (HALLIER *f. s.n.*) forms occur but very rarely so. It is doubtful whether *f. papuana* KNUTH merits distinction; his definition reads: "In omnibus partibus fere duplo major". Material showing these sizes is

found on most islands throughout its range in Malesia.

Excluded

Averrhoa acida LINNÉ, Sp. Pl. (1753) 428 = *Phyllanthus acida* (L.) SKEELS, Bull. U.S. Dep. Agr. Bur. Pl. Ind. 148 (1909) 17 (*Euphorbiaceae*).

Averrhoa frondosa SALISBURY, Prod. (1796) 318 = *Phyllanthus acida* (L.) SKEELS, Bull. U.S. Dep. Agr. Bur. Pl. Ind. 148 (1909) 17 (*Euphorbiaceae*).

Averrhoa microphylla TARDIEU-BLOT, Not. Syst. 11 (1943) 133; Fl. Gén. I.–C. 1, Suppl. (1945) 547, f. 66, is according to LEENHOUTS = *Rourea harmandiana* PIERRE (*Connaraceae*).

Averrhoa minima PERROTTET, Mém. Soc. Linn. Paris 3 (1824) 101. "Espèce nouvelle venue de la Chine, qui s'éleve à 1 mètre (3 pieds) au plus (Mascareigne)". Type-material could not be found in the Paris Herbarium. Probably it does not belong to *Oxalidaceae*, but to *Euphorbiaceae*?

Averrhoa sinica HANCE in Walp. Ann. 2 (1852) 241 = *Rourea minor* (GAERTN.) LEENHOUTS, Fl. Mal. I, 5 (1958) 514 (*Connaraceae*).

VIOLACEAE (M. Jacobs, Leyden; D. M. Moore, Reading)

Shrubs, small trees, or lianas, in Malesia evergreen, or herbs. *Stipules* present. *Leaves* in Malesia spirally arranged, sometimes distichous, simple, the margin often shallowly incised; generally stalked. *Inflorescences* axillary variously modified bundles, or racemes, or panicles, sometimes terminal, or flowers solitary in the leaf axils; bracts small; pedicels often articulated, whether in the lower or in the upper part; bracteoles, if present, small and in the lower part of the pedicel. *Flowers* bisexual or rarely dioecious, actinomorphic or zygomorphic, particularly in the corolla; the parts often persistent in fruit. *Sepals* 5, the median one adaxial (posterior), free or occasionally for a small portion connate, often ciliate. *Petals* 5, free, generally sessile, the median one abaxial (anterior), often longer and differently shaped, the base then mostly with a sac or spur. *Androecium* often cylindrical, stamens 5, episepalous; filaments often more or less connate into a tube, in the Malesian genera with zygomorphic flowers, those near the odd petal with a recurved fleshy appendage; anthers introrse, in Malesia nearly always the connective at the top produced into an approximately triangular membranous appendage converging with the others, cells sometimes with a small appendage at the top. *Gynoecium* superior, sessile, ovary small, subglobose, one-locular, with generally 3 carpels, the median one adaxial, each carpel with a parietal placenta in the middle bearing 1-many anatropous ovules; style straight or, in the zygomorphic flowers S-shaped with the stigma curved towards the odd petal and club-shaped with variations. *Fruit* in Malesia capsular, the carpels thickened to boat-shaped leathery or woody valves (in the latter eventually the endocarp separated from the pericarp) which spread and often compress upon dehiscence. *Seeds* 1-many, sessile, one to a few mm in size, often with distinct raphe, sometimes with funicular outgrowths; rich in endosperm; embryo straight.

Distribution. A pantropical family; only *Viola* is cold-loving. *Hybanthus* extends into the subtropics' so does *Melicytus* (Pacific Plant Areas *n.* 103, Blumea Suppl. 5, 1966) in Polynesia and New Zealand. *Hymenanthera* (congeneric with the former? *l.c. n.* 104) is temperate in SE. Australia and New Zealand. Number of genera 16, 8 of them American; the largest are *Viola*, currently credited with *c.* 400 *spp.*, *Rinorea* with *c.* 200, *Hybanthus* with perhaps 70, and there are about 50 more in the other genera altogether. Total number of species *c.* 720, in Malesia 31, two of these introduced.

Ecology. *Viola* is of temperate origin and occurs in Malesia in the mountains. The other Malesian genera occur in the lowlands; *Rinorea* and *Agatea* in everwet forests, *Hybanthus* in monsoon regions.

Phytochemistry. Accurate chemical information about *Violaceae* is scanty notwithstanding the fact that members of this family are used in popular medicine all over the world. The present summary of chemical characters, therefore, must be considered as a very preliminary one. Different types of crystals of oxalate of lime occur commonly. Members of the genera *Amphirrhox* and *Allexis* accumulate aluminium according to CHENEREY (Kew Bull. 1948, 173). Leaves and flowers contain rather large amounts of acidic mucilage in many instances; usually the mucilage is present in epidermal cells. In some taxa cells with a yellow or reddish 'resin-like' content replace mucilage cells; these latter cells also occur in the mesophyll and in the cortex, phloem and pith of stems. The chemical nature of the content of these idioblasts is not known. However, the fact that leucoanthocyanins are rather widespread in *Violaceae* suggests that the yellow to reddish cell contents may represent so-called 'myriophyllin' or 'incluses'. Personal observation on rhizomes of *Viola mirabilis* L. confirm this supposition. According to PECKOLT (Ber. Deut. Pharm. Ges. 7, 1897, 97) fresh leaves of *Leonia glycycarpa* R. & P. are used for the preparation of a bird-lime in Brazil; this suggests that at least some members of the family may have rubber-containing idioblasts. Roots of several species of *Hybanthus* (= *Ionidium*) store inulin-like fructans instead of starch; other *Violaceae* store essentially sugars or starch (KRAUS, Sitz. Ber. Naturf. Ges. Halle, 1879, 6).

Preliminary observations about polyphenolic constituents of leaves (LEBRETON-BOUCHEZ, Phyto-

chemistry 6, 1967, 1601) showed a wide range of compounds; leucoanthocyanins, flavonol and flavones may be present in various combination ; ellagic acid, however, was observed only in trace amount in three species of *Viola*. Saponins seem to be rather common in violaceous plants; they have been demonstrated to be present in many species of *Viola* and in some species of *Hymenanthera*, *Hybanthus*, and *Melicytus*; none of the saponins has been investigated chemically hitherto.

There is much confusion about alkaloids in literature; roots and rhizomes of species of *Hybanthus* and of *Viola odorata* L., and other species of *Viola* were used formerly as a substitute for ipecacuanha root. Some authors claimed to have detected emetin or emetin-like compounds (*e.g.* viola-emetin; violin) in such crude drugs. Other authors, however, could not find emetin though some of them isolated minor amounts of alkaloids (*e.g.* anchietin, ionidin; compare PECKOLT, *l.c.*; LINDE, Apoth. Z. 34, 1919, 37). Most probably many *Violaceae* contain small amounts of alkaloids; species of *Anchieta*, *Hybanthus*, *Hymenanthera*, *Rinorea*, and *Viola* are listed in literature as alkaloid-bearing plants; however, the structures of violaceous alkaloids are totally unknown at present.

Most chemical work has been performed with European species of *Viola*. Glycosides of delphinidin and cyanidin occur constantly in blue and purple flowers; violanin is a delphinidin-derived anthocyanin acylated by p-cumaric acid. Rutin occurs in flowers and in leaves of several species of *Viola*. From the herb of *Viola tricolor* L. HÖRHAMMER *c.s.* (Tetrahedron Letters 1965, 1707) isolated apigenin-6,8-di-C-glucoside, which was called violanthin. The flavone glycoside linarin is the main flavonoid constituent of leaves of *Viola papilionacea* PURSH (V. PLOUVIER, C. R. Ac. Sc. Paris 264 D, 1967, 145).

Violatoside is an arabinoglucoside of methyl salicylate; it occurs in species of the section *Melanium* but seems to be lacking in other sections of *Viola* (PICARD, Bull. Soc. Chim. Biol. 8, 1926, 568). From roots and rhizomes of *Viola odorata* L. PAILER and NOVOTNY (Naturwissenschaften 45, 1958, 419) isolated 0.01–0.02 % of nitropropionic acid.

Concluding this survey it must be stated that a thorough chemotaxonomic discussion of *Violaceae* is not yet possible. At present no chemical characters are known which contradict the generally accepted relationships between *Flacourtiaceae* and *Violaceae*. — R. HEGNAUER.

Notes. BENTHAM & HOOKER's subdivision of the family (Gen. Pl. 1, 1862, 115) was extended and modified by MELCHIOR in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 346; for an account in English of the latter's phylogenetic considerations, see EXELL, J. Bot. 63 (1925) 330–333.

Dr. D. M. MOORE's contribution consists of the genus *Viola*; he also checked the family description.

Indexes to the examined specimens were published in the series 'Identification Lists of Malaysian Specimens', *n.* 27 *Rinorea* (1966) and *n.* 28 *Viola* (1967).

KEY TO THE GENERA

1. Flowers actinomorphic, in axillary bundles or racemes. Seeds not winged. Shrubs or trees. **1. Rinorea**
1. Flowers zygomorphic.
2. Woody climbers. Flowers in elongate inflorescences. Seeds winged. . . . . **2. Agatea**
2. Herbs, sometimes with woody base. Flowers solitary in the leaf axils. Seeds not winged.
3. Leaves (sub)sessile. Pedicels jointed. Seeds ribbed lengthwise. . . . . **3. Hybanthus**
3. Leaves stalked. Pedicels not jointed. Seeds smooth. . . . . **4. Viola**

1. RINOREA

AUBL. Hist. Pl. Guian. Fr. 1 (1775) 235; TAUB. in E. & P. Nat. Pfl. Fam. 3, 6 (1895) 329; MELCH. *ibid.* ed. 2, 21 (1925) 349; JACOBS, Blumea 15 (1967) 127; TATON, Fl. Congo, Viol. (1969) 2. — *Pentaloba* LOUR. Fl. Cochinch. (1790) 154. — *Medusa* LOUR. *l.c.* 406. — *Alsodeia* THOUARS, Hist. Vég. Isl. Austr. Afr. (1806) 55; ENDL. Gen. Pl. (1839) p. 911, *n.* 5047; B. & H. Gen. Pl. 1 (1862) 118; BOERL. Handl. 1 (1890) 66. — *Vareca* ROXB. Fl. Ind. ed. Wall. 2 (1824) 445. — *Jürgensia* SPRENG. Syst. 3 (1826) 50. — *Prosthesia* BLUME, Bijdr. (1826) 866. — *Dioryktandra* HASSK. Retzia (1855) 125. — *Scyphellandra* THW. En. Pl. Zeyl. (1858) 21. — '*Imhofia* ZOLL.' *ex* TAUB. (1895) *l.c.*, *nomen in synon.*

Small shrubs to small trees; innovations mostly laxly pubescent, the hairs sometimes persistent; twigs pithy, generally angular when young, terete when older. *Leaves* distichous, rarely in a spiral. Petiole comparatively short, or rarely wanting, lacking distinct joints at base or top. *Stipules* caducous to long-persistent, some-

Fig. 1. *Rinorea horneri* (KORTH.) O.K. *a.* Habit, ×⅔, *b.* venation underneath, ×⅔, *c.* stipule, ×3, *d.* flower, ×4, *e.* gynoecium surrounded by stamens, ×6, *f.* stamen from inside, ×12, *g.* gynoecium, ×6, *h.* fruit, subtended by calyx and corolla, ×1, *i.* seed, ×1 (*a*, *d–g* CURTIS 1898, *b* CLEMENS 9961, *c* SAN 42087, *h* PLEYTE 232).

times quite conspicuous, often striate lengthwise. Leaf blade more or less distinctly acuminate, domatia occasionally present in the primary vein axils, the margin shallowly incised to subentire, surfaces generally dull. *Inflorescences* lateral, the flowers mostly in bundles, sometimes distichous along a short rachis, sometimes in a corymb or panicle on a short peduncle, rarely in a raceme or on brachyblasts; bracts smaller than the stipules; pedicels articulated. *Flowers* bisexual, rarely dioecious by reduction, actinomorphic, calyx quincuncial, covering the bud halfway to completely, corolla generally contorted in the same direction as the third sepal. The *sepals* (almost) equal, fimbriate. *Petals* in Malesia (sub)equal, free, sessile, thin in texture, to 9 mm long. *Androecium* nearly as long as the petals, filamental tube more or less fleshy and sometimes 5-lobed, the filaments inserted on its inner margin, or seldom the filaments free with only a pair of scales outside at their base; anthers converging, glabrous or hairy, the connective produced into an entire dorsal membranous appendage smaller to longer than the thecae, sometimes bearing each a ventral appendage at the top smaller than the dorsal one. *Gynoecium* as long as the androecium, the 3 (—4) placentas with 1–3 ovules each; style straight, with a terminal more or less distinctly 3-lobed stigma. *Fruit* capsular, approximately globose before dehiscence, ¾–4 cm ∅, generally subtended by the dried up calyx (which rarely expands), corolla, and androecium, the valves leathery, when large two-layered with reinforced apex, mostly smooth and glabrous, rarely enveloped in a mass of appendages, or hairy. *Seeds* sessile, 3–6, rarely 1 or 9, ellipsoid, glabrous, with leathery testa and often clearly defined hilum and raphe.

Distr. Pantropical, richest in Africa with *c.* 107 *spp.* on the mainland and 25 *spp.* in Madagascar; in the New World with 50–60 *spp.*; in Indo-Malesia 12–13 *spp.*, altogether extending from S. India/Ceylon, Assam, Burma, Hainan, to N. Australia, Melanesia, the Carolines; estimated total about 200 *spp.* Fig. 3.

Ecol. Predominantly in the understorey of primary rainforests, at very low altitude, occasionally up to 1000 m, on various soils including limestone.

Vern. Common and reliable names seem to be wanting. BURKILL, Dict. (1935) 1912, recorded for the Malayan species some vernacular names, and some unimportant medicinal uses.

Taxon. A satisfactory subdivision of the entire genus has not yet been made. The one in the Flora of British India is good for the present area, but is to be reconsidered when the neotropical and African species will have been comprehensively studied. *Alsodeia* is there subdivided into 3 sections, *viz.* I. *Doryctandra* (HASSK., genus, actually *Dioryktandra*) HOOK. *f.* & TH. with stamens "exserted" (not thus found by me), filaments slender (not a character), anthers cohering in a cone (notably by peculiar intertangling hairs). Contains *R. heteroclita*. II. Unnamed, with stamens included, anthers free, disk cupular (our filamental tube). Contains most of our species, and the former genera *Pentaloba* and *Prosthesia*. III. *Scyphellandra* (THW., genus) HOOK. *f.* & TH., with stamens included, anthers free, disk reduced to 5 scales, one at the base of each anther (and, we may add, dioecious). Contains our *R. virgata*.

KING, J. As. Soc. Beng. 58, ii (1889) gave another subdivision of *Alsodeia*; on page 400, Sect. I, *Prosthesia* (BL.) KING, with 7 *spp.*; on page 404, Sect. II, *Pentaloba* (WALL.) KING, with 6 *spp.*; on page 407, Sect. III, unnamed, with 1 *sp.* Various "species" placed by KING in different sections have in the present revision been merged.

Notes. The taxa in *Rinorea* east of the Indus have all been worked up in the same way, but the data have been sorted out for publication between the Flora Malesiana and its precursor in Blumea 15 (1967) 127–138. The precursor accounts for all names of all taxa, with their first references and their type specimens, but gives descriptions, distribution and ecology only of non-Malesian taxa. The Flora Malesiana accounts for Malesia as far as names and literature are concerned, later references included, but the descriptions cover the taxa found in Malesia over their full range, and the same holds for distribution and ecology. The key in the Flora Malesiana is also complete for all taxa.

Six species belonging to other families have been ascribed to *Rinorea*; see under Excluded.

KEY TO THE SPECIES

1. Stipules caducous. Seeds 6 or fewer.
2. Primary veins curving approximately parallel towards the margin at distances of 1–2 cm; secondary venation scalariform.

3. Inflorescences fasciculate (rarely stalked in *R. anguifera*).
4. Dorsal appendage of the anthers small. Style hairy. Fruit enveloped in moss-like appendages. **1. R. anguifera**
4. Dorsal appendage of the anthers distinct. Style glabrous. Fruit smooth.
5. Anthers with small ventral appendages. Ovules 3. Fruit subglobose, with 3 seeds. **2. R. bengalensis**
5. Anthers with ventral appendages about as long as the dorsal one. Ovules 6. Fruit conical, subtended by the expanded calyx, with 1 seed. . . . . **3. R. horneri**
3. Inflorescences on a peduncle (if racemose, see *R. longiracemosa*).
6. Gynoecium glabrous. Petals to 4 mm long. Anthers with small dorsal appendage. Fruit triangular with rounded corners, 1–3 cm long, valves thick. . . . . **4. R. sclerocarpa**
6. Gynoecium hairy. Petals to 9 mm long.
7. Pedicels jointed near the base. Anthers with small dorsal appendage. Fruit subglobose to ovoid, 8–11 mm long, hairy, with a hairy style remnant. . . . . **5. R. lanceolata**
7. Pedicels jointed about the middle. Anthers with a dorsal appendage 1–2 times as long as the cells. (Fruit unknown.) . . . . . **6. R. macrantha**
2. Primary veins few, independently curved towards the margin, secondary venation irregular.
8. Inflorescences more or less elongate. Anthers with distinct ventral appendages. Fruit 1¼–4 cm ø.
9. Stipules 1–3½ mm long. Inflorescence axis ½–2½ cm long. Leaves often obovate. **7. R. javanica**
9. Stipules (2–)4–21 mm long. Inflorescence axis to *c.* 10 cm long. Anthers often bearded at the base. **8. R. longiracemosa**
8. Inflorescences fasciculate, or flowers densely set on a short rachis. Anthers with small or no ventral appendages. Fruit ½–1½ cm ø.
10. Leaves petiolate, more or less concolorous. Anthers with a dorsal appendage about as long as the cells or longer.
11. Leaves 1–7(–14) cm long. Petiole 1–5 mm. Plant dioecious; in the ♂ flowers only a style, in the ♀ flowers the anther cells vestigial, ovules 6. . . . . **9. R. virgata**
11. Leaves 6–36 cm long. Petiole 5–35 mm. Flowers bisexual. Ovules 3.
12. Stipules 1½–6 mm, scarcely striate. Leaves dark-coloured in the dried state. Fruit sparsely hairy. **10. R. macrophylla**
12. Stipules 4–16 mm, distinctly striate. Leaves greenish in the dried state. Fruit glabrous. **2. R. bengalensis**
10. Leaves subsessile, discolorous, pale underneath, 3½–6 cm long. Anthers with a small dorsal appendage. Style hairy in the middle only. Ovary glabrous. Andamans, India? **R. heteroclita**
1. Stipules long-persistent. Ovules and seeds 9. . . . . **11. R. iliaspaici**

1. Rinorea anguifera (LOUR.) O.K. Rev. Gen. Pl. 1 (1891) 42; CRAIB, Fl. Siam. En. 1 (1925) 88; MERR. Comm. Lour. (1935) 270; GAGN. Fl. Gén. I.-C. Suppl. 1 (1939) 187; JACOBS, Blumea 15 (1967) 127. — *Medusa anguifera* LOUR. Fl. Cochinch. (1790) 406. — *Alsodeia echinocarpa* KORTH. Ned. Kruidk. Arch. 1 (1848) 360; MIQ. Fl. Ind. Bat. 1, 2 (1859) 116; OUDEM. in Miq. Ann. 3 (1867) 68; HOOK. *f.* & TH. in HOOK. *f.* Fl. Br. Ind. 1 (1872) 188; KING, J. As. Soc. Beng. 58, ii (1889) 406; BOISSIEU, Fl. Gén. I.-C. 1 (1909) 214, f. 20: 6; RIDL. Fl. Mal. Pen. 1 (1922) 134, f. 12. — *Pentaloba corylifolia* TURCZ. Bull. Soc. Nat. Moscou 27, ii (1854) 341. — *Alsodeia corylifolia* (TURCZ.) TURCZ. Bull. Soc. Nat. Moscou 36 (1863) i 559. — *Alsodeia capillata* KING, J. As. Soc. Beng. 58, ii (1889) 407; KING, Ann. R. Bot. Gard. Calc. 5 (1896) 127, pl. 146A; RIDL. Fl. Mal. Pen. 1 (1922) 133. — *Alsodeia comosa* KING, J. As. Soc. Beng. 58, ii (1889) 407; KING, Ann. R. Bot. Gard. Calc. 5 (1896) 127, pl. 146B; BOISSIEU, Fl. Gén. I.-C. 1 (1909) 213; RIDL. Fl. Mal. Pen. 1 (1922) 133. — *Alsodeia echinocarpa* KORTH. *var. nervosa* CAPIT. Bull. Soc. Bot. Fr. 57 (1910) 394, *et var. zollingeri* BOERL. *ex* CAPIT. *l.c.* — *R. anguifera var. nervosa* (CAPIT.) MERR. Philip. J. Sc. 11 (1916) Bot. 100. — *R. comosa* (KING) MERR. En. Born. (1921) 410. — *R. echinocarpa* BURK. Gard. Bull. S. S. 6 (1930)172.

Young twigs terete, generally straight, densely covered with a persistent brown tomentum; pith narrow. *Leaves* distichous (spirally arranged on terminal or crooked branches). *Stipules* (4–)5–9(–11) mm long, triangular, not appressed, with a distinct keel sometimes protracted into a slender tip, more or less striate, in Borneo persistent, otherwise the scars not conspicuous. Petiole (1–)2–8(–10) mm. *Blade* thin-coriaceous, to (8–)14–28(–37) by (3–)4–8(–10½) cm, widest at the middle to above, index 2.5–3.7(–4.4); base acute to (mainly in Borneo) narrowly cordate, top acuminate; midrib and veins flat above, prominent beneath, sometimes scarcely different in colour, sometimes lighter; no domatia; primary veins fairly regular and parallel, with distances in the order of 1 cm between, no smaller intermediate veins, secondary venation mostly distinct, scalariform, reticulation obscure; margin dentate, with often larger and smaller teeth alternating, to subentire; surfaces dull, brownish, often with a livid tinge, somewhat paler beneath, midrib and veins hairy beneath, to a smaller extent also

above, seldom nearly glabrous. *Flowers* with up to *c.* 20 in dense axillary (sub)sessile clusters on twigs and sometimes also on branchlets; bracts acute, resembling the sepals, pedicels very short. *Sepals c.* 4–5 mm long, fleshy, hairy, the inner ones narrower than the outer and slightly exceeding them. *Petals c.* 5–7 mm long, strap-shaped but wider in the middle, top recurved, often the whole petal S-shaped, outside with a median band of appressed silvery hairs. *Stamens* with distinct filamental tube, slender sometimes hairy filaments and small glabrous anthers; dorsal appendage ⅓ of the anther's length or shorter, ventral appendages none or vestigial. *Ovary* with its long appressed hairs obconical, ovules 6, style with patent hairs, glabrous towards the top. *Fruit* subtended by the persistent sepals, before dehiscence globose, hidden in a (mostly) dense, moss-recalling mass of more or less branched, hairy appendages on the valves, in all 1½–3½ cm ø. After dehiscence the *seeds* become visible, about 3 in number, ellipsoid, 4–7 mm long, evenly straw-coloured, glossy.

Distr. In Indo-China scattered S of the 17th parallel. In *Malesia* common in the Malay Peninsula S of 7°35′ N in Thailand; throughout Sumatra where very common in the East Coast Residency; scattered in Borneo N of the Kapuas in Kalimantan and Sarawak (all divisions) to Brunei; also at 2°50′ N, 117°40′ E in NE. Kalimantan.

Ecol. Primary forest, in humid places, sometimes recorded from heath-forest, swamp forest, light forest or forest edges, or secondary forest, mostly on sandy or loamy, rarely from calcareous soil; altitudes low, seldom up to 600 m.

Notes. A shrub 1 m to a treelet 10 m tall. Bark smooth, mottled. Flowers mostly white to sometimes yellow, facing upwards from the horizontal branches, anthers light brown. Fruit greenish at maturity. KING's collector's notes to 10084 from Perak: "in dense bamboo forest, flowers deep-red with pale reddish green, waxy tinged", do not fit in with any other data.

In RIDLEY 4824 from Singapore, the pedicels are 3 mm.

In TEIJSMANN fl. 30.VIII.1872 from Lingga, Bt. Sipindjang off Sumatra, the branchlets are slender, somewhat crooked, the leaves almost glabrous, concolorous, and not distichous, 2–3 mm petioled, *c.* 4–6 by 1½–2 cm. TEIJSMANN fl. 14.IX.1872 from Lingga, Sg. Tanda, is similar but the leaves are *c.* 7–9 by 1½ cm. Habit unknown.

In RAHMAT 1674 from Sumatra East Coast, the globose, cluster-like inflorescences are 5 mm pedunculate.

2. Rinorea bengalensis (WALL.) O.K. Rev. Gen. Pl. 1 (1891) 42; GAGN. Fl. Gén. I.–C. Suppl. 1 (1939) 190; MERR. & CHUN, Sunyatsenia 5 (1940) 127, f. 12; JACOBS, Blumea 15 (1967) 128. — *Alsodeia bengalensis* WALL. Trans. Med. Phys. Soc. Calc. 7 (1835) 224; HOOK. *f.* & TH. in Hook. *f.* Fl. Br. Ind. 1 (1872) 186; KURZ, For. Fl. Burma 1 (1877) 70; KANJ. & DAS, Fl. Assam 1 (1934) 82. — *Alsodeia obtusa* KORTH. Ned. Kruidk. Arch. 1 (1848) 359; MIQ. Fl. Ind. Bat. 1, 2 (1859) 115; OUDEM. in Miq. Ann. 4 (1869) 215. — *Pentaloba fasciculata* TURCZ. Bull. Soc. Nat. Moscou 27, ii (1854) 341. — *Pentaloba semigyrata* TURCZ. *l.c.* 342. — *Alsodeia fasciculata* (TURCZ.) TURCZ. Bull. Soc. Nat. Moscou 36 (1863) i 559. — *Alsodeia paradoxa* BL. *ex* OUDEM. in Miq. Ann. 3 (1867) 71. — *Alsodeia wallichiana* HOOK. *f.* & TH. in HOOK. *f.* Fl. Br. Ind. 1 (1872) 187; KING, J. As. Soc. Beng. 58, ii (1889) 400; RIDL. Fl. Mal. Pen. 1 (1922) 128. — *R. wallichiana* (HOOK. *f.* & TH.) O.K. Rev. Gen. Pl. 1 (1891) 42; HEND. J. Mal. Br. R. As. Soc. 17 (1939) 35. — *R. obtusa* (KORTH.) O.K. Rev. Gen. Pl. 1 (1891) 42. — *Gelonium glandulosum* ELM. Leafl. Philip. Bot. 3 (1910) 917. — *Gelonium trifidum* ELM. *l.c.* 918. — *Alsodeia lankawiense* RIDL. J. Str. Br. R. As. Soc. 59 (1911) 70; Fl. Mal. Pen. 1 (1922) 129. — *Alsodeia pruinosa* PULLE, Nova Guinea 8 (1912) 669. — *Alsodeia salomonensis* RECH. in Fedde, Rep. 11 (1912) 184; Denkschr. K. Ak. Wiss. M.–N. Kl. Wien 89 (1913) 137, t. 6, f. 11b. — *R. paradoxa* (BL. *ex* OUDEM.) J. J. SMITH in K. & V. Bijdr. 13 (1914) 67. — *Alsodeia semigyrata* (TURCZ.) J. J. SMITH, *l.c.* 72. — *R. semigyrata* (TURCZ.) J. J. SMITH, *l.c.* 73; MERR. J. Arn. Arb. 35 (1954) 145; BACK. & BAKH. *f.* Fl. Java 1 (1964) 194. — *R. fasciculata var. minor* ELM. Leafl. Philip. Bot. 8 (1915) 2877. — *R. fasciculata* (TURCZ.) MERR. Philip. J. Sc. 12 (1917) Bot. 286; En. Philip. 3 (1923) 104; J. Arn. Arb. 32 (1951) 80. — *R. glandulosa* (ELM.) MERR. Philip. J. Sc. 12 (1917) Bot. 286; En. Philip. 3 (1923) 104; J. Arn. Arb. 32 (1951) 80. — *R. lankawiensis* (RIDL.) CRAIB, Fl. Siam. En. 1 (1925) 90. — *R. pruinosa* (PULLE) MELCH. in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 352; Bot. Jahrb. 62 (1929) 369. — *R. salomonensis* (RECH.) MELCH. in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 352. — *Suregada glandulosa* (ELM.) CROIZAT, Bull. Jard. Bot Btzg III, 17 (1942) 216. — *Suregada trifida* (ELM.) CROIZAT, *l.c.*

Growth apparently in flushes, but internodes of equal length. Young parts with lax to rarely dense yellow-brown pubescence, glabrescent. Twigs greenish, furrowed when young, often zig-zag, nodes distinct, with stipular scars taking ⅓ of the twig's circumference. *Leaves* often distichous. *Stipules* appressed, triangular, slender, (4–)8–16 mm long, brown and distinctly striate. Petiole ½–2¼ (–3¼) cm, may differ in length from the stipules. *Blade* coriaceous, 6–22(–36) by 2½–9(–12½) cm, widest at the middle or slightly above, index (1.9–)2–3(–3.3); base acute, rarely to subcordate, top gradually acuminate; midrib and veins distinct, yellowish to sometimes brownish, often with hairy pit-domatia in the primary axils, major veins about 7–13 on either side, the basal one always thin; reticulation on both sides distinct, not very regular; margins shallowly crenate, rarely entire; surfaces distinctly greenish with variants, darker, glossy, glabrous above, beneath sometimes with a few hairs on the veins. *Inflorescences* on the young twigs; from an axillary rosette of caducous hypsophylls 1–2 mm long and similar in kind as the stipules, a few (seldom

one) partial inflorescences crop out like curving fingers ½–1 cm long, which grow at the top while producing flowers in two rows, the pedicels leaving distinct scars, eventually 10–30. *Flower buds* initially protected by 2 keeled brownish bracteoles (?) *c.* 1¼ mm long, the outer ones inserted on the dorsal side of the "finger" where they are to leave a broad pale scar. Sometimes the pattern is less clear, there being a cluster of flowers that may be dense and large in Philippine plants, seldom there is (in New Guinea) a stout common peduncle a few mm long. Pedicel 3–10(–20) mm, jointed at or near the base. *Sepals* ⅓–½ the length of the petals, rarely as long; fleshy, ciliate. *Petals* strap-shaped and often S-curved, (2½–)3–4(–5) mm long. *Androecium* glabrous (occasionally a few hairs at the base of the thecae), filamental tube 0.1–0.5 times as long as the stamens, the filaments 0.1–0.4, the anthers 0.4–0.8; dorsal appendage varying in size and shape, mostly broad-triangular; ventral appendages mostly small. *Ovary* sometimes hairy, with 3 ovules, style glabrous. *Fruit* at the base with the dried striate sepals and petals, before maturity globose, (½–)1–1½ cm ø, with a rest of the style, dull, glabrous. *Seeds* 3, subglobose, 3–7½ mm, yellow-brown with specks of purple to dull purple all over.

Distr. Ceylon, S. India, Assam, Burma, Indochinese Peninsula and Hainan, Andamans, scattered through *Malesia* (not in S. Sumatra and Java); Northern Queensland, Melanesia, Carolines.

Ecol. An understorey plant of mixed rainforest at low elevation; as an exception on Mt Kinabalu up to 1500 m. On various soils but often on steep limestone hills; once recorded from swampy forest; no apparent periodicity.

Notes. A shrub which may already be fertile when 2 feet tall, to a tree of *c.* 20 m by 28 cm. Wood yellow, flowers green to white, fruit orange with red seeds, or cream-brown, or pale green. Several records mention the rich green leaves. A very polymorphic species.

As the plant has never been found again in Java after BLUME's collection from Mts Salak and Burangrang, which was described as *Alsodeia paradoxa*, I think the record is apocryphous. ZOLLINGER 2979, the type of *Pentaloba semigyrata*, was from a plant in the Bogor Gardens.

3. Rinorea horneri (KORTH.) O.K. Rev. Gen. Pl. 1 (1891) 42. — *Alsodeia horneri* KORTH. Ned. Kruidk. Arch. 1 (1848) 360; MIQ. Fl. Ind. Bat. 1, 2 (1859) 116; OUDEM. in Miq. Ann. 3 (1867) 70; MIQ. Ann. 4 (1869) 214; MERR. En. Born. (1921) 410; JACOBS, Blumea 15 (1967) 130. — *Alsodeia browni* KORTH. Ned. Kruidk. Arch. 1 (1848) 361; HASSK. Retzia *ed. nov.* (1858) 33 ('*A. Brownei*'), name only, the description being of *R. lanceolata*; MIQ. Fl. Ind. Bat. 1, 2 (1859) 116 ('*A. Brownii*'); OUDEM. in Miq. Ann. 3 (1867) 70. — *Alsodeia kunstleriana* KING, J. As. Soc. Beng. 58, ii (1889) 401; KING, Ann. R. Bot. Gard. Calc. 5 (1896) 122, pl. 141; RIDL. Fl. Mal. Pen. 1 (1922) 128. — *R. brownii* (KORTH.) O.K. Rev. Gen. Pl. 1 (1891) 42. — *Alsodeia astrolabes* K. SCH. & LAUT. Fl. Schutzgeb. (1901) 451. — *R. copelandii* MERR. Philip. Gov. Lab. Bur. Bull. 35 (1906) 45; En. Philip. 3 (1923) 103. — *R. acuminata* MERR. Philip. J. Sc. 5 (1910) Bot. 201; En. Philip. 3 (1923) 103. — *Alsodeia hirtella* RIDL. Bull. Misc. Inf. Kew (1914) 377. — *R. amboinensis* MERR. Philip. J. Sc. 11 (1916) Bot. 292. — *R. hirtella* (RIDL.) MERR. En. Born. (1921) 410; Philip. J. Sc. 30 (1926) 413. — *R. castilloi* MERR. Philip. J. Sc. 21 (1922) 530. — *R. astrolabes* (K. SCH. & LAUT.) MELCH. in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 352; Bot. Jahrb. 62 (1929) 371, *incl. var. hirta* MELCH. *l.c.* 372. — *R. ledermannii* MELCH. *l.c.* 370. — *R. elmeri* MERR. Un. Calif. Publ. Bot. 15 (1929) 206. — *R. celebica* MELCH. Notizbl. Berl.-Dahl. 12 (1934) 205. — *R. hamelii* MERR. Pap. Mich. Ac. Sc. 19 (1934) 171. — **Fig. 1, 2.**

An undershrub (35–)60 cm to a treelet 5 m tall. Twigs brownish yellow, furrowed when young, pithy, laxly to densely set with a greyish to fulvous indumentum puberulous to velvety. Terminal bud not completely enveloped by the stipules, the latter (3–)6–11(–13) mm long, rather wide at the base, brown and striate, more or less hairy, leaving inconspicuous scars. *Leaves* spirally arranged. Petiole (3–)8–25(–32) mm, hairy like the twig. *Blade* thin in texture, to 11–34 by 4–9½(–11) cm, widest above the middle, sometimes about, index (2.2–)2.7–3.4(–3.8); base tapering, top acuminate; midrib and veins distinct, flat above, prominent beneath, yellowish brown, no domatia; primary veins fairly regular and parallel towards the margin at distances of *c.* 1(–2) cm, nearly always without smaller intermediate veins; secondary venation scalariform, often crossing the primary veins; reticulation distinct beneath; margins dentate to sometimes entire; surfaces fairly dull, paler beneath, some hairs on the midrib and major veins beneath often remaining, otherwise glabrous, brown-green in the dried state (yellowish when Schweinfurthed). *Inflorescences* originally subtended by a few stipule-like hypophylls in the axils of the (1st-)2nd-6th leaves of twigs, or sometimes the flowering part of a twig leafless, rarely flowering on an older branchlet, consisting of a more or less contracted (sub)sessile panicle with unequal branches, the main axis to 1½ (exceptionally to 7) cm long; flowers few-20 (rarely more spirally arranged; bracts and bracteoles *c.* 1 mm; all pedicels jointed at ¼–1 mm above their insertion, the distal part 3–10(–15) mm, thickened towards the top, puberulous. Buds and often *flowers* ovoid, but sometimes the outer sepals spreading in the dried state; calyx somewhat decurrent into the pedicel; petals converging, corolla with a narrow opening at the top. *Sepals* 2–4(–5) by 1–5(–6) mm, more or less fleshy, variously hairy, exceptionally the margins of the outer sepals recurved. *Petals* (2–)3–6(–8) mm long, sometimes S-shaped or with recurved top, mostly thin but sometimes fleshy. *Androecium* glabrous but exceptionally a few hairs at the base of the anthers or also the filaments hairy; filamental tube 0.1–0.3 part of the length of the stamens, the fila-

ments 0.1–0.3(–0.5) part, the anthers 0.4–0.7 part; dorsal and ventral appendages always well developed. *Ovary* mostly hairy, sometimes glabrous, style glabrous, rarely hairy; ovules 6(–7). Calyx enlarging with the fruit, eventually leathery, funnel-shaped, 8–12 mm ø, on a firm pedicel, about 3–5 per inflorescence. *Fruit* ovoid, 10–15 mm long, glabrous, turbinately splitting, the valves thin but firm; *seed* one, ellipsoid to ovoid, *c.* 8–11 mm long, glossy even light brown.

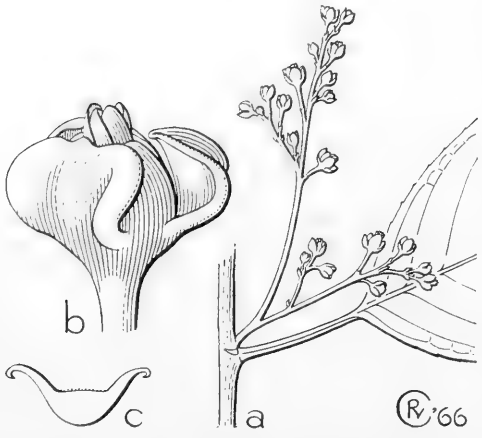

Fig. 2. *Rinorea horneri* (KORTH.) O.K., deviating specimens. *a.* An elongated inflorescence, ×⅔, *b.* flower with sepal margins recurved, *c.* such a sepal in cross-section (*a* KOSTERMANS 21471, *b–c* JACOBS 5431).

Distr. Peninsular Siam; scattered throughout *Malesia* except Java and the Lesser Sunda Is.; Solomons.

Ecol. In various kinds of primary forest, sometimes depleted, rarely in secondary forest, up to 600 m (to 1500 m on Mt Kinabalu); often on limestone, but also on sandstone or clay.

Notes. An undershrub (35–)60 cm to a treelet 5 m tall. Leaves dark green above, pale beneath; flowers weakly fragrant, white to pale green-yellow, the anthers pale brown. Fruit apparently green and hard at maturity.

For KING's remark of 1896 on the occurrence of both bisexual and ♀ flowers, I found no confirmation in the material. That "the anthers have no pollen" may be due to their very early loosing it.

The name *R. strobobas* is sometimes found as a corruption of *astrolabes*.

4. Rinorea sclerocarpa (BURGERSD.) JACOBS, Blumea 15 (1967) 131. — *Alsodeia sclerocarpa* BURGERSD. in Miq. Pl. Jungh. (1852) 122. — *Alsodeia rugosa* MIQ. Sumatra (1860) 390; Ann. 4 (1869) 215. — *Alsodeia condensa* KING, J. As. Soc. Beng. 58, ii (1889) 405; Ann. R. Bot. Gard. Calc. 5 (1896) 126, pl. 145; RIDL. Fl. Mal. Pen. 1 (1922) 132. — *Alsodeia pachycarpa* KING, J. As. Soc. Beng. 58, ii (1889) 407; RIDL. Fl. Mal. Pen. 1 (1922) 131. — *Alsodeia scortechinii* KING, J. As. Soc. Beng. 58, ii (1889) 405; Ann. R. Bot. Gard. Calc. 5 (1896) 126, pl. 144; RIDL. Fl. Mal. Pen. 1 (1922) 131. — *R. pachycarpa* (KING) CRAIB, Fl. Siam. En. 1 (1925) 91. — *R. scortechinii* (KING) CRAIB, *l.c.* — *R. sumatrana* MERR. Pap. Mich. Ac. Sc. 19 (1934) 172. — *R. condensa* (KING) MERR. *l.c.* 173.

Growth apparently in flushes; internodes of varying length. Twigs ± terete, dull greyish or sometimes purplish tinged, initially with greyish pubescence but soon glabrescent; branchlets slightly crooked, bark with faint longitudinal ribs, pith narrow. *Leaves* mostly distichous. *Stipules* (3–)4–7(–10) mm long, not appressed, triangular, with a pale-hairy keel, more or less striate, their scars not conspicuous. Petiole 5–12 mm, dull greyish, often wrinkled. *Blade* thin-coriaceous, to 13½–25(–38) by 4½–9(–11) cm, widest about the middle to sometimes above, index (2.1–)2.6–3.5 (–3.9); base acute and slightly decurrent, top acuminate; midrib and veins often in a similar colour as the surface to somewhat lighter; no domatia; primary veins fairly regular and converging within the margin, with distances between in the order of 1½ cm at the midrib, no smaller intermediate veins, secondary venation thin, scalariform, reticulation indistinct; margin shallowly dentate, entire near the base; surfaces dull, above grey-green-brown, glabrous, beneath with a characteristic chocolate-brownish colour, glabrous or seldom sparsely hairy on the main nerves. *Inflorescences* in the axil of the 2–4 latest leaves, 2–5 cm long, often rich-flowered and sometimes quite densely, peduncle mostly near the base divided into 2–4 main axes, which after anthesis may long persist as partly empty stalks; rather irregularly dichasially branched, axes laxly greyish puberulent; bracts late caducous, triangular, 1–2 mm; pedicels jointed below the middle, *i.e.* at 1–3 mm above their insertion. *Flowers* pear-shaped, the corolla converging. *Sepals* suborbicular, (2–)2½–3(–4) mm, fleshy, sparsely hairy. *Petals* 3½–4 mm long, sometimes the top slightly recurved, outside sparsely hairy towards the top. *Androecium* glabrous, filamental tube 0.3 part of the length of the stamens, filaments 0.4–0.5 part, anthers 0.2–0.3 part; dorsal appendage pale, short and narrow, no ventral appendages. *Pistil* glabrous; ovules 6. *Fruits* seldom more than 2 per inflorescence, subtended by the persistent sepals, before maturity mostly tapering to both ends, (0.9–)2.3–3 cm long, bluntly triangular with hollow sides (0.8–)1.5–2 cm wide, dull dark-purplish, the valves eventually spreading, compressed and separating into two layers, the inner one cartilaginous and straw-coloured, the outer one leathery. *Seeds* 3–6, *c.* (5–)6–8 mm long, evenly dull brownish.

Distr. *Malesia*: Malay peninsula (scattered between 6°17′ N in S. Siam and Johore), Sumatra (scattered in Atjeh and East Coast, also near Palembang).

Ecol. Primary forest, on moist slopes or by small rivers, lowlands to 1000 m. *Fl.* March, *fr.* June–Sept.

Notes. Tree, more or less crooked, sometimes shrubby, to 10(–20) m tall, bole 7–13 cm ø, fluted or buttressed at the base, bark mostly smooth, fawn or grey; slash inner bark granular, yellow or dull orange, wood cream or white. Branches brittle. Leaves above dark green, beneath light green with darker veins. Flowers white, or pale green. Ripe fruits triangular, dark green, sometimes flushed with orange, 3¼ cm ø; unripe fruits may be globose.

MIQUEL, Fl. Ind. Bat. 1, 2 (1859) 115, had it under *Alsodeia obtusa*, our *Rinorea bengalensis*; BOERLAGE, Cat. Hort. Bog. 1 (1899) 48, under *Alsodeia javanica*.

Alsodeia rugosa was described with a hairy ovary; in the buds available this was glabrous.

A CHR. SMITH specimen (BM), stated to be from Ceram, fl. II. 1802, must have been wrongly labelled.

5. Rinorea lanceolata (WALL.) O.K. Rev. Gen. Pl. 1 (1891) 42; MERR. J. Arn. Arb. 35 (1954) 145; JACOBS, Blumea 15 (1967) 133. — *Vareca lanceolata* WALL. in Roxb. Fl. Ind. ed. Wall. 2 (1824) 445; ed. Carey 1 (1832) 648. — *Pentaloba lanceolata* (WALL.) ARN. Mag. Zool. Bot. 2 (1848) 544. — *Alsodeia brownei* (*non* KORTH.) HASSK. Retzia *ed. nov.* (1858) 22. — *Alsodeia cymulosa* MIQ. Fl. Ind. Bat. 1, 2 (1859) 116, *non* WELW. 1868; BACK. Schoolfl. (1911) 67. — *Alsodeia dasypyxis* MIQ. Sum. (1860) 391; Ann. 4 (1869) 215 ('*dasyprysis*' in Kew Index). — *Alsodeia lanceolata* OUDEM. in Miq. Ann. 3 (1867) 68; Arch. Néerl. Sc. Ex. Nat. 2 (1867) 196; HOOK. *f.* & TH. in Hook. *f.* Fl. Br. Ind. 1 (1872) 188; KING, J. As. Soc. Beng. 58, ii (1889) 404; RIDL. Fl. Mal. Pen. 1 (1922) 131. — *Alsodeia maingayi* HOOK. *f.* & TH. in Hook. *f.* Fl. Br. Ind. 1 (1872) 188; KING, J. As. Soc. Beng. 58, ii (1889) 402; RIDL. Fl. Mal. Pen. 1 (1922) 130. — *Alsodeia mollis* HOOK. *f.* & TH. in Hook. *f.* Fl. Br. Ind. 1 (1872) 188; KURZ, For. Fl. Burma 1 (1877) 70. — *Alsodeia floribunda* KING, J. As. Soc. Beng. 58, ii (1889) 406; Ann. R. Bot. Gard. Calc. 5 (1896) 125, pl. 143B; RIDL. Fl. Mal. Pen. 1 (1922) 132. — *R. cymulosa* (MIQ.) O.K. Rev. Gen. Pl. 1 (1891) 42; KOORD. Exk. Fl. Java 2 (1912) 65; J. J. SMITH in K. & V. Bijdr. 13 (1914) 70; BACK. & BAKH. *f.* Fl. Java 1 (1964) 193. — *R. maingayi* (HOOK. *f.* & TH.) O.K. Rev. Gen. Pl. 1 (1891) 42; TAUB. in E. & P. Nat. Pfl. Fam. 3, 6 (1895) 329. — *R. mollis* (HOOK. *f.* & TH.) O.K. Rev. Gen. Pl. 1 (1891) 42; CRAIB, Fl. Siam. En. 1 (1925) 90. — *Alsodeia grandiflora* RIDL. Bull. Misc. Inf. Kew (1914) 377. — *R. floribunda* (KING) MERR. Pap. Mich. Ac. Sc. 19 (1934) 171.

Growth mostly in flushes; the first internodes shorter. Twigs slender, ± straight, generally purplish, terete when young, lengthwise striate, pith narrow; sometimes laxly fulvous velvety but mostly glabrous from an early stage. Terminal bud with some tips as the stipules do not completely envelop it. *Leaves* mostly spirally arranged, sometimes distichous. *Stipules* 4–11 mm long, rather wide at the base, brown and striate, leaving rather distinct scars. Petiole 2–7(–10) mm, generally dark-coloured. *Blade* thin-coriaceous in texture, to 10–29(–42) by (2.3–)3.3–9(–20) cm, widest about the middle to sometimes above, index (2–)2.5–4.8(–6.1); base tapering to obtuse, top acuminate; midrib and veins flat above, prominent beneath, mostly in a similar colour as the leaf surface; no domatia except in Java; primary veins fairly regular and converging within the margin, with distances between them in the order of ¾–1(–1½) cm at the midrib, smaller intermediate veins rare, secondary venation indistinct, scalariform, reticulation obscure; margin (often minutely) dentate; surfaces generally dull, and concolorous, green-brownish, midrib and veins on both sides hairy like the twigs, if so, sparsely hairy between the veins underneath but mostly glabrous. *Inflorescences* on the young twigs rarely also on branchlets, laxly globose to compound corymbose in shape, 1–9 cm long in all; peduncle a few mm to 3(–4½) cm long, hairy like the twig, coloured like the petioles, mostly divided into two subequal axes of about ⅓ its length; bracts *c.* 2–3 (if on a main axis to 10) mm long, lanceolate; number of *flowers* few to several dozens; pedicels to 4(–8) mm, jointed in their basal half. *Sepals* 2¼–5 by 1¾–4½ mm, suborbicular, elliptic or ovate, more or less fleshy, with thin margin, the outer sepals somewhat shorter and wider than the inner ones and sometimes with a cucullate top, somewhat hairy particulary in the centre. *Petals* 3½–7(–9) by 1¼–2 mm, widest about the middle, thin, top sometimes recurved, outside with a pale median band of hairs. *Stamens* consisting of a filamental tube of 0.2–0.3 part of the total length, a filamental of 0.4–0.5 part, and an anther of (0.2–)0.3–0.4 part; upper part of the filament and back of the connective between the thecae hairy, exceptionally glabrous; dorsal appendage triangular, ¼–½ the length of the thecae, ventral appendages up to half the length of the dorsal one, or wanting. *Pistil* hairy, ovules 6, once 3. *Fruits* subtended by the persistent sepals and petals, before dehiscence subglobose to slightly ovoid, the hairy style always persistent, 8–11 mm long, the valves leathery, brownish, more or less hairy, splitting straightly; *seeds c.* 3, *c.* 3–6 by 2–4 mm, dull evenly light brown.

Distr. Burma: S. Tenasserim; Peninsular Siam; in *Malesia*: common in Malaya, scattered in Sumatra (also Lingga Is.) and in the very SW of Java (also Peutjang I. in Sunda Straits.)

Ecol. Primary forest and (open) jungle, also forest edges, in fertile volcanic loam, also on coral limestone, below 750 m.

Notes. A shrub ½–3 m to a tree 6–13(–21) m by 4–30 cm ø, bark grey smooth thin, the twigs may be drooping at the top. Leaves light or yellowish green, once reported darker above, and once glossy. Flowers with green calyx and (waxy) white-yellow corolla. Fruits (pale) green when ripe.

In one specimen the fruits are 4-merous.

The species is quite polymorphic. All specimens from Penang (the type locality) are glabrous, with narrow leaves: index 3.3–6.1, and small inflorescence: peduncle 1½–5 mm. All specimens from Perak are hairy, with rather wide obovate leaves: index 2.6–3.3, with broad base, and large inflorescences: peduncle 2½–3 cm. All specimens from Peninsular Burma and Siam ('*R. mollis*') are hairy, with still wider leaves: index 2.4–2.8, and very wide sepals. All specimens from West Java and Peutjang are glabrous, with 1 cm stalked large leaves with domatia, and lax inflorescences 5–8 cm long in all. KOORDERS 4498 and 4499 are placed here on account of their domatia. Except for the domatia, the above forms are not restricted to the districts mentioned, and in other provinces various forms have been found.

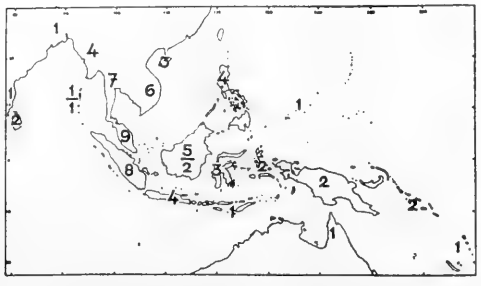

Fig. 3. *Rinorea*, number of species in Malesia and adjacent regions, the number of endemics, if any, below the hyphen.

6. Rinorea macrantha JACOBS, Blumea 15 (1967) 133, f. 1.

Twigs angular, glossy light brown, glabrous; branchlets terete, zig-zag. *Stipules* 7 mm long, brown, striate. *Leaves* probably spirally arranged, subsessile to ¾ cm petiolate; *blade* (sub)coriaceous, 15–33 by 5½–10 cm, widest about the middle; base blunt to obtuse and subcordate, top long-acuminate; midrib strong and prominent, veins regularly curved with *c.* 1½ cm between, reticulation distinct beneath, more or less scalariform; margin crenate; surfaces dull, and glabrous from the beginning. *Flowers* with several in lax lateral racemes 1–1½ cm long, bracts 2–3 mm long, pedicels 6–7 mm, jointed just above the middle. *Sepals* thin, 3½–5 by 2½–4½ mm, glabrous or nearly so. *Petals* thin, 6–9 by 2–3½ mm, glabrous. *Androecium* glabrous, filamental tube fleshy and distinctly 5-lobed, the filaments as long or shorter, anthers with a triangular dorsal appendage 1–2 times as long as the cells; ventral appendages none. *Pistil* club-shaped, brown-puberulous in the basal ½–⅔ part; ovules 6. *Fruit* unknown.

Distr. *Malesia*: W. Central Borneo.

Notes. For the slight differences between the two collections on which the above description has been based, see JACOBS, *l.c.*

A sterile collection from Singkep in the Lingga Archipelago, BÜNNEMEIJER 7384 (BO) may also belong here.

7. Rinorea javanica (BL.) O.K. Rev. Gen. Pl. 1 (1891) 42; KOORD. Exk. Fl. Java 2 (1912) 625; J. J. SMITH in K. & V. Bijdr. 13 (1914) 64; BACK. & BAKH. *f.* Fl. Java 1 (1964) 194; JACOBS, Blumea 15 (1967) 134. — *Prosthesia javanica* BL. Bijdr. (1826) 867. — *Alsodeia haplobotrys* HASSK. Versl. Kon. Ak. Wet. 4 (1856) 137; Retzia *ed. nov.* (1858) 19; MIQ. Fl. Ind. Bat. 1, 2 (1859) 116. — *Alsodeia javanica* (BL.) MIQ. Fl. Ind. Bat. 1, 2 (1859) 117; OUDEM. in Miq. Ann. 3 (1867) 71; MIQ. Ann. 4 (1869) 216; BACK. Schoolfl. (1911) 68. — *Alsodeia hookeriana* KING, J. As. Soc. Beng. 58, ii (1889) 402; Ann. R. Bot. Gard. Calc. 5 (1896) 123, pl. 142A; RIDL. Fl. Mal. Pen. 1 (1922) 130. — *Alsodeia wrayi* KING, J. As. Soc. Beng. 58, ii (1889) 403; Ann. R. Bot. Gard. Calc. 5 (1896) 124, pl. 142B; RIDL. Fl. Mal. Pen. 1 (1922) 129. — *R. haplobotrys* (HASSK.) O.K. Rev. Gen. Pl. 1 (1891) 42; KOORD. Exk. Fl. Java 2 (1912) 624. — *R. wrayi* TAUB. in E. & P. Nat. Pfl. Fam. 3, 6 (1895) 329. — *Alsodeia minahassae* KOORD. Minah. (1898) 645. — *Alsodeia formicaria* ELM. Leafl. Philip. Bot. 5 (1913) 1850. — *R. formicaria* (ELM.) MERR. Philip. J. Sc. 12 (1917) Bot. 286; En. Philip. 3 (1923) 104. — *R. hookeriana* (KING) BURK. Bull. Misc. Inf. Kew (1935) 319; Dict. (1935) 1913.

Growth in flushes, internodes rather variable in length. Young twigs grooved, purplish to light-coloured but soon with grey bark; pith narrow; glabrous almost from the beginning to sometimes rather densely short-pubescent. *Leaves* largely distichous. *Stipules* 1–3(–3½) mm long, with broad base and narrow top, keeled, sometimes late caducous. Petiole 3–15 mm, leaving a conspicuous scar. *Blade* more or less thinly coriaceous, 10–17(–20) by 2¾–5½(–7) cm, widest at the middle or often well above, index (2.5–) 2.8–3.3(–4); base cuneate and slightly decurrent to seldom rounded, top acuminate; midrib flat to subprominent above, veins 5–9(–14) on either side, converging within the margin, comparatively slender, no domatia; reticulation distinct (less so in Indo-China), without much regularity; margins more or less distinctly dentate, rarely (sub)entire; surfaces dark green-brown with variants, mostly lighter underneath, dull but sometimes very glossy above, glabrous or with some hairs on the midrib beneath. *Inflorescences* mostly on the branchlets, axillary (sometimes a whole row of them on a leafless part of a twig), generally consisting of a bracteate pubescent axis 0.5–2.6 cm long, sometimes cluster-like or rarely simple to 3 cm long and then the flowers distichous, with 3–7 lateral cymes *c.* ½ cm long with a few to several flowers each; bracts resembling the stipules; pedicels 3–5 mm, jointed about the middle. *Sepals* more or less fleshy, triangular to elliptic, 1–2 by ¾–1 mm, outside with some hairs. *Petals* thin, 3 by 1–1½ mm, sometimes in the apical half the margins like pinched together, outside often with some hairs. Filamental tube about ½ part the total

length of the *stamens*, glabrous; filaments 0.2–0.3 part, sometimes hairy; anthers 0.3–0.2 part, glabrous; dorsal appendage broad, triangular, as long as or somewhat longer than the cells, ventral appendages about half as long as the dorsal one. *Ovary* sometimes hairy, with 3–9 ovules; style glabrous. *Fruit* subtended by the dried diverging perianth, on a very short stipe, globose to elliptic before dehiscence and *c.* 1½–2½ cm long; valves glabrous or short-hairy, dark-coloured, with some veins like a man's skin, leathery with woody back and top, the latter folded inwards upon dehiscence. *Seeds* 3–6, *c.* 8–9 by 6–7 mm, with irregular pattern of dark and light colour, sometimes evenly dark-coloured, hilus distinct.

Distr. Indo-China (only in Annam near Quang-tri); Southwestern and Peninsular Siam; in *Malesia* frequent in the everwet parts of Malaya; in Sumatra very rare and not in the northern part; in W. Java in several places; in the Philippines once found in Palawan; in Celebes once found in the NE. Peninsula.

Ecol. Mostly in primary, also in light forest, sometimes in swamp or peat forest, at low elevations and on hillsides up to 1000 m. No records from calcareous soil.

Notes. Tree 5–10 m with spreading hanging branches. Leaves bright and sometimes glossy green, paler beneath. Flower white to pale green. Capsules dark greenish brown or black, *c.* 1¾ by 1 cm, dehiscing explosively.

In BLUME's type specimen and some others the outer layer of the fruit is 4–5 mm thick and corky – a malformation?

Alsodeia formicaria owes its name to the small black ants which ELMER found inhabiting the hollow and sometimes bladdery capsules, "passing in and out through the distinctly circular aperture at the top."

As the only collection from Borneo is one by KORTHALS, whose labelling was often inaccurate, this record is considered apocryphous; it may be from Sumatra.

8. Rinorea longiracemosa (KURZ) CRAIB, Fl. Siam. En. 1 (1925) 90; JACOBS, Blumea 15 (1967) 134. — *Alsodeia longiracemosa* KURZ, J. As. Soc. Beng. 39, ii (1870) 63; For. Fl. Burma 1 (1877) 70. — *Alsodeia cinerea* KING, J. As. Soc. Beng. 58, ii (1889) 403; Ann. R. Bot. Gard. Calc. 5 (1896) 124, pl. 143A; RIDL. Fl. Mal. Pen. 1 (1922) 130. — *Alsodeia cinerea var. hirsutiflora* KING, J. As. Soc. Beng. 58, ii (1889) 404; Ann. R. Bot. Gard. Calc. 5 (1896) 125; RIDL. Fl. Mal. Pen. 1 (1922) 130. — *Alsodeia macropyxis* CAPIT. Bull. Soc. Bot. Fr. 57 (1910) 395. — *R. macropyxis* (CAPIT.) MERR. En. Born. (1921) 411. — *R. gaultheriiflora* J. J. SMITH, Bull. Jard. Bot. Btzg III, 4 (1922) 231, t. 5; BACK. & BAKH. *f.* Fl. Java 1 (1964) 193. — *R. borneensis* MERR. Un. Calif. Publ. Bot. 15 (1929) 206.

Growth apparently in flushes, internodes of largely similar length. Twigs when young furrowed and more or less puberulous; branchlets somewhat crooked, the bark brownish or greyish, sometimes dull purplish, corky with faint longitudinal ribs, pith narrow. *Leaves* mostly distichous. *Stipules* with broad base, (2–)4–14(–21) mm long, striate, more or less closely appressed, often late caducous. Petiole 2–10 mm. *Blade* firmly thin-coriaceous, to (3¾–)8–18(–22) by (1¾–)2½–5½(–7½) cm, widest about the middle, index 2.3–3.4(–4); base blunt to acute, top acuminate; midrib narrow, prominent on both sides, major veins about 6–11 (–14) on either side, converging within the margins, their axils mostly with hairy domatia (not in North Borneo), secondary veins and reticulation lax and rather irregular; margin with small roundish teeth; surfaces dull, olive-green to brownish, with a greyish aspect, mostly somewhat lighter beneath, glabrous but sometimes the midrib above sparsely pubescent, rarely pilose on the veins beneath, too. *Inflorescences* axillary (sometimes the subtending leaf gone), on the mainland of Asia and in Sabang generally a simple, rather densely-flowered raceme to 9 cm long 1½ cm wide, initially resembling a cone due to the conspicuous bracts which are persistent, in Borneo and Java a lax-flowered panicle to 10 cm long, 3½ cm wide, with an occasional leaf or only stipules subtending the first branches, the bracts less conspicuous, and caducous; axes sometimes puberulous, bracts 2–3 mm, striate, pedicels 2–4 (–6) mm, jointed in the basal or apical part. *Flower* when young conical, the calyx covering the basal half. *Sepals* thin, (sub)equal, more or less triangular, surface glabrous or pubescent, margin ciliate. *Petals* thin, straight, (2½–)3½–4 (–5½) by 1–3 mm, glabrous, sometimes sparsely ciliate. *Androecium* consisting of a filamental tube 0.1–0.3 part of the total length, filaments 0.1–0.4 part, mostly glabrous, anthers 0.5–0.6 part, bearded at the base, the dorsal appendage broad, triangular, nearly as long as the thecae or somewhat longer, ventral appendages nearly reaching the top of the dorsal one. *Ovary* mostly glabrous, sometimes sparsely hairy, style glabrous, ovules 6. *Fruit* in Asia (few known) globose before dehiscence, 1¼–1½ cm ø with seeds subglobose 4 mm ø, in Borneo (well-known) on woody stalk, glabrous, before dehiscence 3-sided with blunt corners, 2¾–4 cm long, 2½ cm wide, the base not or scarcely narrowed, valves leathery, veined, mostly 2-layered after dehiscence, with woody back; the seeds obconical, *c.* 8 mm long, 7 mm ø. *Seeds* to 6 in number, with a circular depression at the place of insertion, and evenly straw-coloured.

Distr. In SE. and Peninsular Burma; Indo-China (Laos: near Vientiane, Cambodia, and Blao NE of Saigon); Hainan (one coll.); in Siam at 15° N in the West, and further S in the SW and the Peninsula, also in SE. Siam. In *Malesia* in Sabang I. (N off Sumatra), Malay Peninsula (Perak and Trengganu), W. Java, Borneo (northern central Kalimantan, Sarawak, Brunei, and very common in Sabah); scattered in all other regions mentioned.

The sole record from India, Assam, is uncertain, KANJILAL & DAS having "not found it anywhere in this Province".

Ecol. Mostly primary forest, but also from secondary, bamboo and swampy forest and forest edges, on clayey or loamy soil, also from limestone and basalt, often by streams mostly at low altitude but in Hainan from 1000 m.

In the monsoon area generally at least partly deciduous, the fresh leaves then cropping out at flowering time.

Notes. A shrub, sometimes climbing or sprawling, (½–)1½–4 m, to a treelet or small unbuttressed tree 3–12 m. Leaves light green; calyx (greenish) white, corolla (yellow) white, anthers yellow, the dorsal appendage white with brown base. Fruit green when more or less ripe, to light brown when fully ripe.

The species is very polymorphic and looks different in various parts of its area, but although in Sabah it is both strikingly common and uniform ('*borneensis*'), there is not enough reason for the recognition of subspecies. The material from Java ('*gaultheriiflora*') resembles that of Sabah, although the leaves in the former are smaller. The material of *R. macropyxis* (two out of the four collections outside Sabah) with its domatia, hairy leaves 7–9 cm long, and hairy twigs is unique for Borneo, but agrees quite well with CHEW 63 from Malaya. The Sabah type of inflorescence is also found in SCHMID anno 1961 from Blao in S. Vietnam. Moreover, throughout the area, all the examined flowers have a great mutual resemblance.

9. Rinorea virgata (THW.) O.K. Rev. Gen. Pl. 1 (1891) 42; JACOBS, Blumea 15 (1967) 135. — *Scyphellandra virgata* THW. En. Pl. Zeyl. (1858) 21. — *Alsodeia minutiflora* RIDL. J. Str. Br. R. As. Soc. 59 (1911) 71; Fl. Mal. Pen. 1 (1922) 131.

Growth apparently in flushes. Twigs mostly long, slender, but rarely crooked; when young angular, greenish, often puberulous with curved hairs. Branchlets terete, with longitudinal ridges of brown-grey bark; the very short axillary brachyblasts sometimes producing an extra, smaller leaf. *Leaves* generally distichous, on the same plant variable. *Stipules* triangular to subulate, 1–2 mm long, brownish. Petiole 1–5 mm, hairy as the twig. *Blade* firmly herbaceous to thinly coriaceous, more or less rhombic, 1–7(–13½) by ¾–3(–6) cm, index 1.7–4.7; base cuneate to rounded, top acute to obtuse or sometimes acuminate, occasionally mucronate; midrib slender, above mostly prominent, major veins 2–6 on either side, thin; no domatia; reticulation lax and irregular; margins dentate; surfaces sometimes with a few hairs on the midrib above, otherwise glabrous, dull, concolorous, greenish. Dioecious; *flowers* with a few apparently spirally arranged on the knob-like brachyblasts; bracts persistent, triangular, about ½ mm long, brownish; pedicels slender, 3–6 mm, jointed near the base, puberulous. *Sepals* more or less equal, thin, often triangular, 1–2 by ¾–1 mm, sometimes hairy. *Petals* thin, 1¾–3½ by ¾–1½ mm, glabrous, sometimes the top recurved, the margin sometimes undulate. *Androecium* about as long as the petals, glabrous, in the ♂ flowers the anthers sessile, about as wide as the petals, with outside at the base an elongate scale ¼–½ mm long; thecae 0.4–0.5 part of the total length of the anther, dorsal appendage tapering towards the top, ventral appendages none or vestigial. In the ♀ flowers the staminodes subsessile, sometimes narrower than the petals, the basal gland at the outside minute, the thecae abortive. *Gynoecium* glabrous, as long as the petals; in the ♀ flowers the ovary globose with thick style and (5–)6 ovules; in the ♂ flowers ovary none, only a slender style rising from a flat receptacle. *Fruit* before dehiscence (sub)globose, *c.* 1 cm ø, after dehiscence valves spreading, olive-green, leathery, veined. *Seeds* subglobose, 2½–3 by 2–2½ mm, even straw-coloured, with distinct raphe.

Distr. Ceylon; Burma, NE. part: LACE 5462; Siam (scattered, not in the E. part); Laos (near Pak Lay W of Vientiane: KINGDON WARD 9026); S. Vietnam (scattered S of 12°30′); Hainan. In *Malesia*: Perlis in the very NW of the Malay Peninsula.

Ecol. In more or less open evergreen forest, in thickets, in teak plantations, on dry slopes and in ravines, mostly on rocky, sometimes on sandy soil, up to 600 m.

Note. A shrub (0.2–)0.5–1.5(–4) m, rarely a tree 2 m. Leaves paler green beneath. Flowers white.

10. Rinorea macrophylla (DECNE) O.K. Rev. Gen. Pl. 1 (1891) 42; JACOBS, Blumea 15 (1967) 135. — *Alsodeia macrophylla* DECNE, Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 468, t. 19 = Herb. Timor. Descr. (1835) 100, t. 19; MIQ. Fl. Ind. Bat. 1, 2 (1859) 115; OUDEM. in Miq. Ann. 3 (1867) 69. — *Alsodeia horsfieldii* MIQ. Fl. Ind. Bat. 1, 2 (1859) 117; MIQ. Ann. 4 (1869) 216; BACK. Schoolfl. (1911) 216. — *Alsodeia dasycaula* MIQ. Sumatra (1860) 391; Ann. 4 (1869) 216; RIDL. Fl. Mal. Pen. 1 (1922) 129. — *Alsodeia horsfieldii* TURCZ. Bull. Soc. Nat. Moscou 36 (1863) i 559. — *Alsodeia membranacea* KING, J. As. Soc. Beng. 58, ii (1889) 402; Ann. R. Bot. Gard. Calc. 5 (1896) 122, pl. 140B. — *R. horsfieldii* (MIQ.) O.K. Rev. Gen. Pl. 1 (1891) 42; KOORD. Exk. Fl. Java 2 (1912) 625; J. J. SMITH in K. & V. Bijdr. 13 (1914) 68; BACK. & BAKH. *f.* Fl. Java 1 (1964) 194. — *R. palawanensis* MERR. Philip. J. Sc. 1 (1906) Suppl. 210; En. Philip. 3 (1923) 104, *incl. var. mollis.* — *Alsodeia hispida* RIDL. J. Str. Br. R. As. Soc. 6 (1912) 50. — *R. dasycaula* (MIQ.) CRAIB, Fl. Siam. En. 1 (1925) 88; GAGN. Fl. Gén. I.–C. Suppl. 1 (1939) 194. — *R. yatesii* MERR. Pap. Mich. Ac. Sc. 19 (1934) 173.

Growth apparently gradually; internodes of similar length. Young parts velvety with persistent brownish hairs to sparsely puberulous. Twigs initially dark purplish tinged, later greyish, lengthwise striate, terete, comparatively thick with wide pith, often slightly zig-zag, stipular scars indistinct. *Leaves* mostly distichous. *Stipules* not always adpressed, 1½–5(–6) mm, subulate and not visibly striate, often late caducous. Petiole ¾–2 cm. *Blade* before unfolding curved inward like a bow, of

papery texture, 10½–25 by 4–8½ cm, widest at the middle to well above, index (2.2–)2.6–3.9 (–4.2); base more or less tapering and slightly decurrent, top acuminate; midrib and particularly the veins thin, flat above, no domatia, about 7–10(–12) major veins on either side converging within the margin, secondary veins and reticulation lax and rather irregular, dark-tinged; margins from base to top more or less distinctly dentate-serrate; surfaces dull and mostly concolorous in variants of brown and green, glabrous to sparsely hairy on the midrib and veins mainly beneath. *Inflorescences* mostly densely hairy, in structure like those of *R. bengalensis* but hypsophylls more scale-like, the axes no more than 4 in number, with *c.* 5–25 *flowers* each and these but seldom in a clearly distichous arrangement, the pedicel scars mostly obscure; bracts minute, triangular; pedicels 3–10 mm, jointed near the base. *Sepals* ± equal, fleshy, 1½–3 mm long, bluntly triangular to elliptic, dark-coloured, hairy outside. *Petals* fleshy, 2½–5½ mm long, widest about the middle, more or less diverging, top sometimes recurved, more or less hairy outside. *Androecium* often glabrous, consisting of a filamental tube 0.2–0.4 part of the total length, sometimes with a few hairs, filaments up to 0.2 part, rarely hairy, and anthers 0.5–0.8 part, the dorsal appendage broad, triangular, 1–2 times as long as the thecae, ventral appendages tiny to half as long as the dorsal one, sometimes wanting; sometimes a few hairs on the base of the thecae and on the back of the connective between. *Ovary* hairy, each carpel with 1 ovule; style glabrous. *Fruit* subtended by the dry spreading or reflexed sepals and petals, before dehiscence (sub)globose, *c.* 1¼ cm ø, valves leathery, dark purplish brown, sparsely hairy; *seeds* 3, *c.* 6–7 by 5 mm, glossy brown, with distinct raphe.

Distr. Asia and *Malesia*; in the very east of Siam and in Indo-China at ± 16–17° N, SE. Siam, and Peninsular Siam southwards to Pahang in the Malay Peninsula (also Langkawi Is.); Sumatra (East Coast Res. and Lampongs, ? Palembang); Java (frequent on Nusa Kembangan, rare in Central Java, also Kangean Is.); Lesser Sunda Is. (Timor); Philippines (on the smaller islands S of the 12th parallel; Palawan, Culion, Guimaras, Cebu, Jolo). Scattered everywhere.

Ecol. Light forest, secondary forest, teak forest, jungle, forest edges, mostly on limestone, sometimes on other rich soils, below 600 m.

Notes. A shrub laxly branched often crooked (although in the herbarium many twigs are long and simple) 1–3 m tall, to a tree 6 m tall. Leaves bright green. Flowers with pale green calyx and yellow-green-white corolla. Fruits first pale green, greyish brown when ripe.

Occasionally the fruit 4-merous with 4 seeds.

11. Rinorea iliaspaiei JACOBS, *nov. sp.*

Stipulae longe-triangulares, persistentes. Folia majora angusta minute serrata, basi obtusa apice acuminata. Flores majores, staminibus glabris anthera appendice dorsale magna late triangulare appendicibusque ventralibus distinctis, ovario cylindrico dense pubescente ovulis 9. *Fructus major apicem versus pubescens seminibus* 9. — *Typus*: S 28099 ILIAS PAIE (E, K, L holo, SAR, SING), Borneo, Sarawak, Serian subdistr., Bk. Emperan Ra'a, fl. 30-IX-1968.

Branchlets straight, with short internodes and distinct leaf scars, bark greyish. *Stipules* rather adpressed, long-triangular, dull dark purple-brown, to 12–15 mm long (shorter on the smaller branchlets), base half-amplexicaul, more or less distinctly keeled and/or striate, initially with minute hairs, long persistent. Petiole 3–7 mm. *Leaf* blade coriaceous, to (10–)15–27 by (2–)3–6½ cm, widest somewhat above the middle, index (3.5–)3.8–5; base blunt and slightly unequal, top gradually and long-acuminate; midrib narrow, prominent on both sides, major veins *c.* 13–17 on either side, with often in between a secondary vein half as long, the major ones converging and connected to an intramarginal vein, reticulation rather irregular; margin with minute dark coloured teeth *c.* ⅓–½ cm apart; surfaces dull, above olive-green to brownish, beneath somewhat paler, glabrous (youngest leaves unknown); no domatia. *Inflorescences* axillary (sometimes the subtending leaf gone), axis single or branched, 2–3 cm long; bracts like the stipules but smaller; pedicel *c.* 4 mm, initially with minute hairs, jointed in the apical part. *Sepals* rather unequal, the outer ones fleshy, 4 mm ø, outside with some adpressed hairs, the inner ones membranous, 6 by 5 mm, glabrous but ciliate at the top. *Petals* not very fleshy, rather concave, glabrous, 8 by 3 mm, top slightly cucullate. *Androecium* 3 mm high, glabrous, filamental tube *c.* 0.3 part of the total length, free portion of the filaments *c.* 0.2–0.3 part, anthers 0.4–0.5 part, the dorsal appendage broad, triangular, somewhat longer than the thecae, ventral appendages nearly reaching the top of the dorsal one. *Ovary* cylindrical, densely soft white hairy; style glabrous; ovules 9. *Fruit* (only known after dehiscence) with thick leathery valves 2½–3¾ cm long, wrinkled and, especially towards the top, with short soft patent hairs. *Seeds* 9 in number, obconical, 8 by 7 by 6 mm, with a circular depression at the place of insertion, evenly straw-coloured.

Distr. *Malesia*: Borneo (Sarawak, 4 collections).

Ecol. Mixed dipterocarp and kerangas forests at 100–600 m, on sandstone or clayey soil or shale. *Fl.* Sept., *fr.* March, Aug., Nov.

Notes. Tree 2–4 m tall. Flower buds white, when open yellow with reddish white stamens. Ripe fruit green.

Close to *R. longiracemosa* (to which S 18905 and SF 35738 were reckoned in the Identification List; actually they belong here, like S 20935), and to *R. macrantha*; the differences have been pointed out in the Latin diagnosis.

Excluded

Alsodeia chrysodasys MIQ. Sumatra (1861) 390 = *Paropsia vareciformis* (GRIFF.) MAST. (*Flacourtiaceae*).

Alsodeia dubia ELM. Leafl. Philip. Bot. 8 (1915) 2875 = *Trigonopleura malayanum* HOOK. *f.* (*Euphorbiaceae*).
Alsodeia glabra BURGERSD. in Miq. Pl. Jungh. (1852) 122. — *Rinorea glabra* (BURGERSD.) O.K. Rev. Gen. Pl. 1 (1891) 42 = *Celastrus paniculatus* WILLD. (*Celastraceae*).
Alsodeia grandis MIQ. Sumatra (1861) 391 = *Eriobotrya bengalensis* (ROXB.) HOOK. *f.* (*Rosaceae*).
Rinorea pulgarensis ELM. Leafl. Philip. Bot. 5 (1913) 1849 = *Diospyros cauliflora* BL. (*Ebenaceae*).
Vareca moluccana ROXB. Fl. Ind. ed. 2, 1 (1832) 647 = *Pittosporum moluccanum* (LAMK) MIQ. (*Pittosporaceae*). In Fl. Mal. I, 5 (1954) 33 it was but tentatively assigned to *Rinorea*.

2. AGATEA

A. GRAY, Proc. Am. Ac. Arts Sc. 2 (1852) 323; Bot. U.S. Expl. Exp. 1 (1854) 89; BRONGN. Bull. Soc. Bot. Fr. 8 (1861) 80 ('*Agation*'); B. & H. Gen. Pl. 1 (1862) 118; BRONGN. & GRIS, Ann. Sc. Nat. V, 1 (1864) 346; GUILL. Ann. Mus. Col. Mars. II, 9 (1911) 98; Bull. Mus. Hist. Nat. Paris 17 (1911) 350; *ibid.* 26 (1920) 362; F. SARASIN & ROUX, Nova Caled. B I, 3 (1921) 184; BAKER *f.* J. Linn. Soc. Bot. 45 (1921) 263; MELCH. in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 360; GUILL. Bull. Soc. Bot. Fr. 89 (1942) 20; A. C. SMITH, Sargentia 1 (1942) 57.

Scandent shrubs to lianas, innovations mostly laxly pubescent, indumentum sometimes persistent. *Twigs* slender, with dull dark violet bark finely longitudinally striate. *Leaves* in a spiral, petiolate. *Stipules* deltoid, *c.* 1 mm long, persistent, often inconspicuous. *Leaf* blade thinly to thickly coriaceous, *c.* 9–13 by 4–9 cm, index *c.* 1.6–2.2(–2.6); widest about the middle to somewhat lower; base acute to rounded, top acute to abruptly acuminate with a short tip; veins (3–)5–7(–10) on either side, reticulation more or less distinct; margin entire to crenate; surfaces dull, glabrous. *Inflorescences* racemes but mostly panicles, few to 30 cm long, axillary and terminal mostly combined, pubescent; bracts small, triangular; pedicels with 2 bracteoles above the base, articulated higher up. *Flowers* bisexual, zygomorphic. *Sepals* subequal, 1–2 mm, covering a minor part of the bud, not persistent. *Petals* unequal, sessile, the posterior also outer pair *c.* 3–4 mm, symmetrical, the middle pair somewhat larger, asymmetrical, the inner, anterior one *c.* 7–10 mm, the base gibbose, the apical part wide, thus making a lip, in bud longitudinally rolled up, surface sometimes woolly above. *Androecium* equalling the smallest petals, stamens subequal, (2–)4 connate at the base and converging at the top but the posterior one apart; the two anterior ones at the base with a fleshy outgrowth into the sac of the odd petal; filaments broad, flat; inner locules longer than the outer ones, their thecal appendage small, single or bifid or double or vestigial; connective appendage about twice as long as the anther, triangular, brown-membranous. *Gynoecium* slightly exceeding the androecium, ovary subglobose, sometimes hairy, with 3 placentas and many ovules; style S-curved, glabrous, stigma anterior, clavate. *Fruit* (see note) a capsule, elongate, 1¼–5 cm, with 3 leathery to woody valves. *Seeds* many, imbricately arranged, flat, with an irregularly elliptic wing; testa with a hard black inner layer and membranous yellowish outer layer.

Distr. New Guinea, Solomons, New Caledonia, Fiji, Tonga. Number of species probably 1; see below.
Ecol. Primary rain-forest in the lowland.
Notes. The above generic description covers the whole diversity of the genus; the specific description applies to the New Guinea materials only. For the insignificant differences with the conspecific *A. salomonensis* MERR. & PERRY, J. Arn. Arb. 24 (1943) 209, see the description of the only collection, KAJEWSKI 2309 (A! BO! BRI! P!), from Bougainville.

A cursory inspection of several dozens of Fiji and New Caledonian plants revealed that no two specimens match in all details — in climbers not an unusual feature. But while all plants from Fiji were placed under *A. violaris*, in New Caledonia, where there is no more diversity than in Fiji, 7 species were described, on trifling characters and mostly without fruits; see GUILLAUMIN, Bull. Soc. Bot. Fr. 89 (1942) 20. The differences can be summarized: in Fiji generally the young parts are sometimes glabrous, the stipules sometimes wanting, the leaves acute and tending to be ovate, with (sub)entire margin, the in-

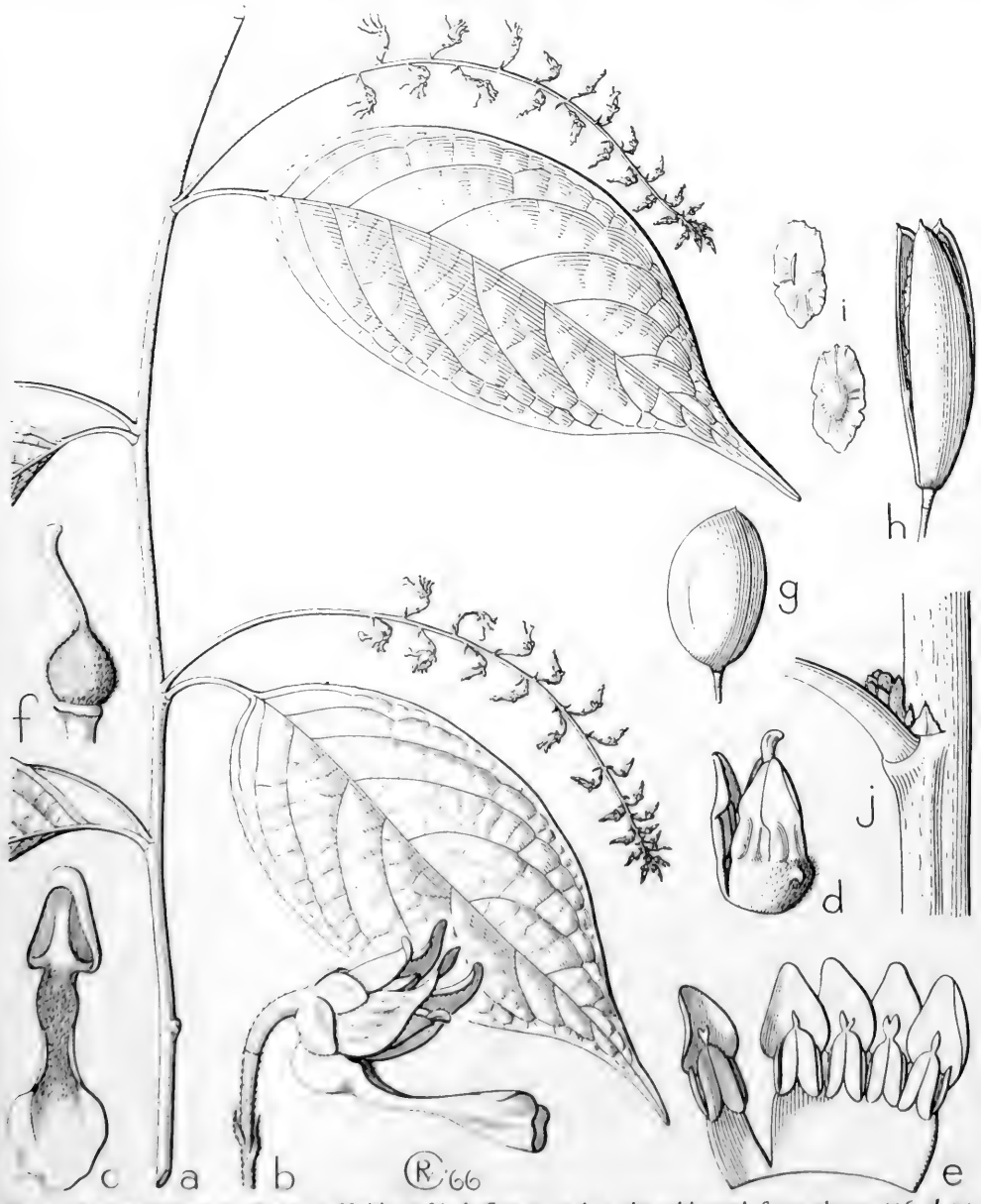

Fig. 4. *Agatea violaris* A. GRAY. *a*. Habit, ×⅔, *b*. flower, ×4, *c*. the odd petal, from above, ×6, *d*. androecium and stigma, from the right, ×6, *e*. stamens, from inside, ×8, *f*. gynoecium, from the right, ×6, *g*. fruit, immature, ×⅔, *h*. another fruit, mature, with *i*. seeds, both ×⅔, *j*. leaf axil, ×6 (*a*, *g*, *j* BRASS 14057 from New Guinea, *b–f* A. C. SMITH 66, *h–i* A. C. SMITH 6287, both from Fiji).

florescence up to 7(–14) cm, the lip 5–7 mm; in New Caledonia the young parts are mostly hairy, the stipules always present, the leaves acuminate and widest at the middle, with often an incised margin, the inflorescences up to 6–20 cm, the lip 6–9½ mm. The few fruits collected in New Caledonia are 12–34 mm long, the valves thick-coriaceous and covered with a grey felt, the seeds are *c.* 11 by 6–7 mm. The dozen or so fruiting numbers from Fiji have valves 23–50 mm long, thin-woody and mostly glabrous but in SEEMANN 12 (unripe) and A. C. SMITH 346 (ripe) they are more or less felty, too; the seeds are 13–22 by 9–10 mm, depending on the size of the fruit. As the fruit characters seem to overlap, and regional differences are so slight, a comprehensive study of this genus may well result in the retention of only one polymorphic species, *A. violaris*. MELCHIOR's sections *Macrobotrys* and *Euagatea*, based on subtle differences in the filamental gland, are to be reduced anyway.

BRONGNIART's alteration of the name to *Agation* for fear of confusion with *Agathaea* (*Compositae*) seems unnecessary.

A fine description of the ripening and dehiscence of the fruit was given by BRONGNIART, Bull. Soc. Bot. Fr. 8 (1861) 78; the same text occurs in BRONGN. & GRIS, Ann. Sc. Nat. V, 1 (1864) 346–350. The "wing" of the seed is in fact a flattened and enlarged part of its funicle, which grows out mainly towards base and top, its irregularities in shape due to cramming in the fruit. The approximately triangular seed is pressed against the outside of its wing, dull grey-brownish as is the rest of the wing outside; the wing otherwise glossy dark purple-blackish. When ripe, the valves, firm in texture and boat-shaped, split while the strap-shaped basal part of the funicles remain attached to the receptacle, tearing loose gradually towards the top.

1. Agatea violaris A. GRAY, Bot. U.S. Expl. Exp. 1 (1854) 89, t. 7. — *A. macrobotrys* K. SCH. & LAUT. Fl. Schutzgeb. (1901) 453, t. 14; MERR. & PERRY, J. Arn. Arb. 24 (1943) 208. — *A. salomonensis* MERR. & PERRY, J. Arn. Arb. 24 (1943) 209. — **Fig. 4.**

Large climber. *Twigs* laxly pubescent, glabrescent, pith narrow. *Stipules* deltoid, 1 mm, brown-purple, fimbriate. Petiole 1½–2½ cm, glabrescent. *Leaf* blade thin-coriaceous, 9–12½ by 5¼–6¾ cm; base rounded, top gradually acuminate, the tip *c.* 1 cm; midrib narrow, subprominent, veins 5–7 on either side, rather parallel and arcuating, reticulation fairly distinct on both sides; margin subserrate; surfaces dull brown-greenish, glabrous. *Inflorescences* axillary, sparsely branched racemes to 8(–20) cm long, also terminal to 17(–20) cm long, fulvous pubescent; pedicels at some mm distance, *c.* (3–)5–8 mm long. *Sepals* 1–2 by 1 mm. *Petals*: the smallest 3½–4 by 1½ mm, the middle ones 4 by 2 mm, the lip 7(–9) by 5 mm, hairy, with two extra hair tufts distally near the basal sac. *Stamens* 2–3 mm; filaments narrower than the anthers; fleshy appendages about as long as the anther cells; thecal appendage small, sometimes bifid. *Ovary* sparsely pilose, size *c.* 1 mm. *Fruit* (immature) 3¼ by 1¾ cm, ellipsoid, brown, glabrous.

Distr. Pacific: Fiji, Tonga, Solomons; in *Malesia*: northern New Guinea (West: Rouffaer and Idenburg R.; East: Bismarck Mts).

Ecol. Rain-forest, also marginal growth of flooded rain-forest, at low elevation; in Fiji up to 1000 m.

Note. Besides BRASS 14057 and DOCTERS VAN LEEUWEN 9708, I had the description of the type, RODATZ & KLINK 236, probably lost in B, from which the figures in brackets are derived.

3. HYBANTHUS

JACQ. En. Pl. Carib. (1760) 2; BAILL. Bot. Médic. 2 (1884) 841; MELCH. in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 357; DOMIN, Bibl. Bot. 89 (1928) 982–985; SCHULZE, Bot. Jahrb. 67 (1936) 437–489; MORTON, Contr. U.S. Nat. Herb. 29 (1944) 74–82; SPARRE, Lilloa 23 (1950) 522–574, 4 pl.; ROBSON, Bol. Soc. Brot. 32, ii (1958) 164–170; H. PERR. in Humb. Fl. Madag. fam. 139 (1959) 3–10, f. 1: 2–11. — *Solea* SPRENG. in Schrad. J. Bot. 4 (1800) 192. — *Ionidium* VENT. Jard. Malmais. (1803) *sub* t. 27; B. & H. Gen. Pl. 1 (1862) 117; BOERL. Handl. 1 (1890) 65.

Small gnarly shrubs or half-shrubs or herbs, rarely trees up to 8 m, in a few species the twigs thorny and microphyllous. Innovations sprouting from axillary or terminal buds, simple themselves, more or less densely covered with simple, rarely stellate hairs. *Stipules* generally small and mostly caducous. *Leaves* in a spiral or rarely (sub)opposite, often herbaceous, sometimes leathery, more or less sessile with a tapering base, to *c.* 15 by 4 cm, but mostly smaller to sometimes almost needle-shaped, margin entire to incised, rarely thickened underneath, the

Fig. 5. *Hybanthus enneaspermus* (L.) F.v.M. in Sumbawa, Lesser Sunda Islands (photogr. DE VOOGD).

teeth sometimes glandular. *Flowers* generally solitary in the leaf axils, rarely in more or less reduced axillary cymes or dichasia up to several cm long or in raceme-like elongated monochasia, rarely in a terminal leafy panicle; bracts mostly present; pedicel slender, with 2 bracteoles beneath an articulation, the top curved downwards to give the flower an horizontal position. Flower 0.3–2 cm, bisexual, but rarely cleistogamous, zygomorphic. *Sepals* subequal, small, more or less triangular, persistent, rarely the margin with deep incisions. *Petals* unequal, persistent, posterior ones small and straight, middle ones longer and falcate, anterior one extended to a lip, with a claw more or less deeply saccate to shortly spurred and distinct blade often hairy above. *Filaments* free or seldom partly connate, sometimes short; the anterior pair with a patent gland at the base outside; anthers with rounded to elongate thecae (which rarely have an appendage at the top) and a distinct membranous connective appendage. *Ovary* with 3 placentas bearing

Fig. 6. *Hybanthus enneaspermus* (L.) F.v.M. *a.*, *b.* Two different plants, ×⅔, *c.* stipules, ×8, *d.* flower, ×6, *e.* filaments and pistil, also from the right, ×8, *f.* stamen from inside, ×12, *g.* pistil, ×8, *h.* open fruit surrounded by floral parts, ×3, *i.* seed, ×8, in *j.* from above (*a*, *d–g* BRASS 8434, *b*, *c* BS 27307 RAMOS, *h-j* JENSEN 313).

3–24 ovules; style S-shaped with anterior stigma. *Fruit* subtended by the dried up flower, *c.* 1 cm in size, subglobose before maturity, capsular with 3 leathery valves. *Seeds* a few mm, ellipsoid, mostly with a small caruncula.

Distr. Tropical and subtropical regions of the world, preferring a dry period. The number of species that will stand in a critical monograph is hard to estimate; there may be about 50 in the New World, some in Africa and Madagascar, some in Australia, a few woody ones in New Caledonia. The one *Malesian* species is palaeotropical (seems not to occur in New Caledonia) and possibly pantropical.

Notes. The literature cited under the genus refers chiefly to the most recent revisions in all parts of the world. The name was in 1905 conserved over *Calceolaria* LOEFL. 1758. The above description applies to the entire genus; it was largely based on SCHULZE. The specific description below was made on material from Malesia, where only part of the diversity of the species is represented.

1. Hybanthus enneaspermus (L.) F. v. M. Fragm. Phyt. Austr. 10 (1876) 81; BACK. Onkr. Suiker. (1930) 454, pl. 429; ROBSON, Fl. Zambes. 1 (1960) 254, t. 40; TENNANT, Kew Bull. 16 (1963) 431. — *Viola enneasperma* L. Sp. Pl. (1753) 937. — *Ionidium enneaspermum* (L.) VENT. Jard. Malmais. 1 (1803) *sub* t. 27; GING. in DC. Prod. 1 (1824) 308; DALZ. & GIBS. Bombay Fl. 1 (1861) 12; OUDEM. in Miq. Ann. 3 (1867) 72; MIQ. Ann. 4 (1869) 217; MERR. En. Philip. 3 (1923) 106. — *Ionidium heterophyllum* VENT. Jard. Malmais. 1 (1803) *sub* t. 27; BACK. Schoolfl. (1911) 66. — *Ionidium frutescens* BL. Bijdr. (1825) 58. — *Ionidium thymifolium* PRESL, Rel. Haenk. 2 (1835) 97, *non* Bot. Bemerk. (1844) 11, *nec* MERR. Philip. J. Sc. 10 (1915) Bot. 191. — *Ionidium molle* TURCZ. Bull. Soc. Nat. Moscou 27, ii (1854) 338. — *Ionidium zippelii* OUDEM. in Miq. Ann. 3 (1867) 73. — *H. suffruticosus* (L.) BAILL. Bot. Médic. 2 (1884) 841; BACK. & BAKH. *f.* Fl. Java 1 (1963) 194. — **Fig. 5, 6.**

Herb 15–60 cm tall, more or less profusely branched, often woody at the base; young stems angular, more or less pubescent. *Stipules* triangular to subulate, 1–2 mm long, thin in texture and light in colour, sometimes fimbriate towards the base, the tip sometimes glandular. *Leaves* spirally arranged, herbaceous, in one plant varying somewhat in size; in different plants 2–7 cm long, 2–17 mm wide, index *c.* 2.4–20, widest sometimes above the middle becoming spathulate; base decurrent sometimes into a petiole 5–7 mm, top acutish or blunt to gradually acuminate, often with a mucro; margin entire to serrate or remotely crenate. *Flowers* solitary; pedicels filiform, ¾–2(–4) cm; bracteoles at the joint in the upper part, their tip sometimes glandular. *Sepals* subequal, triangular, membranous, 2–4 by ¾–1 mm, glabrous or ciliate. *Petals*: posterior pair 2½–3½ by ¾–1 mm, middle pair 2¾–4 by 1–1½ mm, falcate; odd one *c.* 5½–19 mm long, the lip 4–10 mm wide, the base 1–2 mm saccate. *Stamens c.* 2–3 mm long, the filaments and the dorsal appendage each *c.* 0.3 times that long, the anther *c.* 0.4 times; anterior stamens with a small recurved fleshy appendage, glabrous or hairy, sometimes their connective woolly outside. *Pistil* glabrous, ovary subglobose, ¾–1½ mm ø, the placentas each bearing 2–5 ovules attached in the middle; style 1¼–2 mm long. *Fruit* subglobose, 4–5 mm ø, valves boat-shaped, eventually compressed, light green, each with 2–3 *seeds* which are ellipsoid *c.* 2 by 1 mm, straw-coloured, lengthwise ribbed, at the base obliquely truncate, with distinct raphe, the top with a shallow crater.

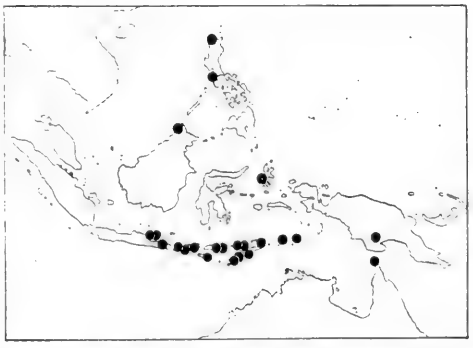

Fig. 7. Distribution of *Hybanthus enneaspermus*(L) F.v.M. in Malesia.

Distr. Widely in Africa and Madagascar, scattered in India and Ceylon, in SE. China and Hainan, a few localities in the Indochinese Peninsula, but not in Peninsular Thailand. In *Malesia*: E. Java (Sumbarwaru and Baluran in the very northeast), also Madura I.; Lesser Sunda Is.; Borneo (Kudat in NW. Sabah); the Philippines (Ilocos Norte in Luzon, Cotabato in Mindanao, Golo I.; Moluccas (Ternate, Kai Is.); New Guinea (SW. Papua) and Thursday I. in Torres Straits; tropical Australia. Fig. 7.

Ecol. With irregular frequency in monsoon areas, at roadsides, savannahs, grasslands, pastures, in the open or sometimes in shade, on sandy or calcareous or volcanic soils; generally at low altitudes, but in Timor to 750 m, in Flores to 1200 m.

Notes. After study of the type and other materials at the British Museum and Kew, I am inclined to agree with Mr J. R. TENNANT's conception of the species. With his excellent paper on African, Indian, and Chinese *Hybanthus* handy, only the names recorded for Malesia need to be evaluated here and the number of references can be restricted to a minimum.

As Mr TENNANT found out, DALZELL &

GIBSON, *l.c.*, were probably the first to make a choice between the two Linnean epithets *enneasperma* and *suffruticosa*, as early as 1861.

It seems that *Ionidium frutescens* BL. was based on *Polygala frutescens* BURM. Thes. Zeyl. (1737) 195, t. 85, or on *Ionidium frutescens* ROEM. & SCHULT. Syst. Veg. 5 (1819) 394; GING. in DC. Prod. 1 (1824) 311 (which in turn may have been based on BURMAN's species), from Ceylon and India, but BLUME refers to none of them.

4. VIOLA

LINNÉ, Gen. Pl. ed. 5 (1754) 402; Sp. Pl. (1753) 933; BL. Cat. Gew. Buitenzorg (1823) 57; Bijdr. (1825) 57; KORTHALS, Ned. Kruidk. Arch. 1 (1848) 357; BURGERSDIJK in Miq. Pl. Jungh. 1 (1852) 118; OUDEMANS in Miq. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 73; MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 217; BOISSIEU & CAPITAINE, Bull. Soc. Bot. Fr. 57 (1910) 337; BECKER, Beih. Bot. Centralbl. 34, ii (1916) 208; *ibid.* (1917) 373; Bot. Jahrb. 54 (1917) Beibl. 120, 156; Beih. Bot. Centralbl. 36, ii (1918) 15; *ibid.* 40, ii (1923) 20, 69, 119; BECKER & MELCHIOR in E. & P. Pfl. Fam. ed. 2, 21 (1925) 363; MELCHIOR, Bot. Jahrb. 62 (1929) 368; Notizbl. Berl.-Dahl. 12 (1934) 205; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 258; RIDL. J. Bot. 73 (1935) 13; LIN, Taiwania 1 (1950) 269; D. M. MOORE in Fedde, Rep. 68 (1963) 81–86; Nova Guinea, Bot. *n.* 11 (1963) 177.

Perennial, rarely annual herbs (in Mal.). *Leaves* alternate, petioled. *Stipules* free or adnate to petiole, persistent, often conspicuous, usually serrate or fimbriate. Leaves suborbicular to linear-lanceolate, the margin serrate to crenate or subentire, often glandular in indentations. *Flowers* bisexual, solitary, axillary, with a pair of bracteoles usually in the upper half of the peduncles. *Sepals* equal, entire to denticulate or fimbrio-dentate, prolonged into appendages below the point of their insertion, persistent. Corolla zygomorphic. *Petals* unequal, the lower saccate or spurred and usually broader than the others, the lateral pair smaller than the upper pair, the lateral petals often, the others more rarely, bearded inside. *Androecium* shorter than the petals; filaments connivent around the gynoecium; anthers 2-celled, subsessile, the 2 lower with appendages projecting into the spur; connective produced into an apical appendage. *Gynoecium* as long as the androecium or longer, the ovary glabrous or pubescent, with 3 placentas and ∞ ovules; style straight, curved or geniculate, filiform to conspicuously clavate, often lobed at apex; with the stigma terminal or anterior and subterminal. *Fruit* a 3-valved loculicidal capsule, subtended by dried-up calyx, globose to cylindrical or ellipsoidal, 4–16 mm long; valves boat-shaped, usually with thick rigid keels and thin sides so that on drying they contract and forcibly discharge the seeds, glabrous or pubescent. *Seeds* ∞, usually ellipsoidal, glabrous, with leathery testa, usually with terminal elaiosome.

Distr. About 400 *spp.* occurring in temperate regions throughout the world.

Ecol. Terrestrial, generally in open or lightly shaded places in the mountains above 1000 m, exceptionally descending to *c.* 250 m.

The elaiosome may contain oils attractive to dispersal of seeds by ants.

Notes. With the exception of *V. biflora* (*sect. Dischidium* GING.) and the introduced *V. tricolor* (*sect. Melanium* GING.), all species occurring in Malesia may be included in *sect. Viola* (*sect. Nomimium* GING.). The separation of *V. hederacea* and its allies into *sect. Erpetion* (SWEET) BECKER (in E. & P. Nat. Pfl. Fam. ed. 2, 21, 1925, 376) does not appear to be justified in view of the intermediates between this and *sect. Viola*. The various subsectional groupings within *sect. Viola* (see BECKER in E. & P. *l.c.*) prove impossible to apply effectively and have been omitted in this account. Any useful subsectional treatment must await a monographic revision of the whole genus.

Chromosomes. There has been little cytological work on Malesian violets, and chromosome numbers

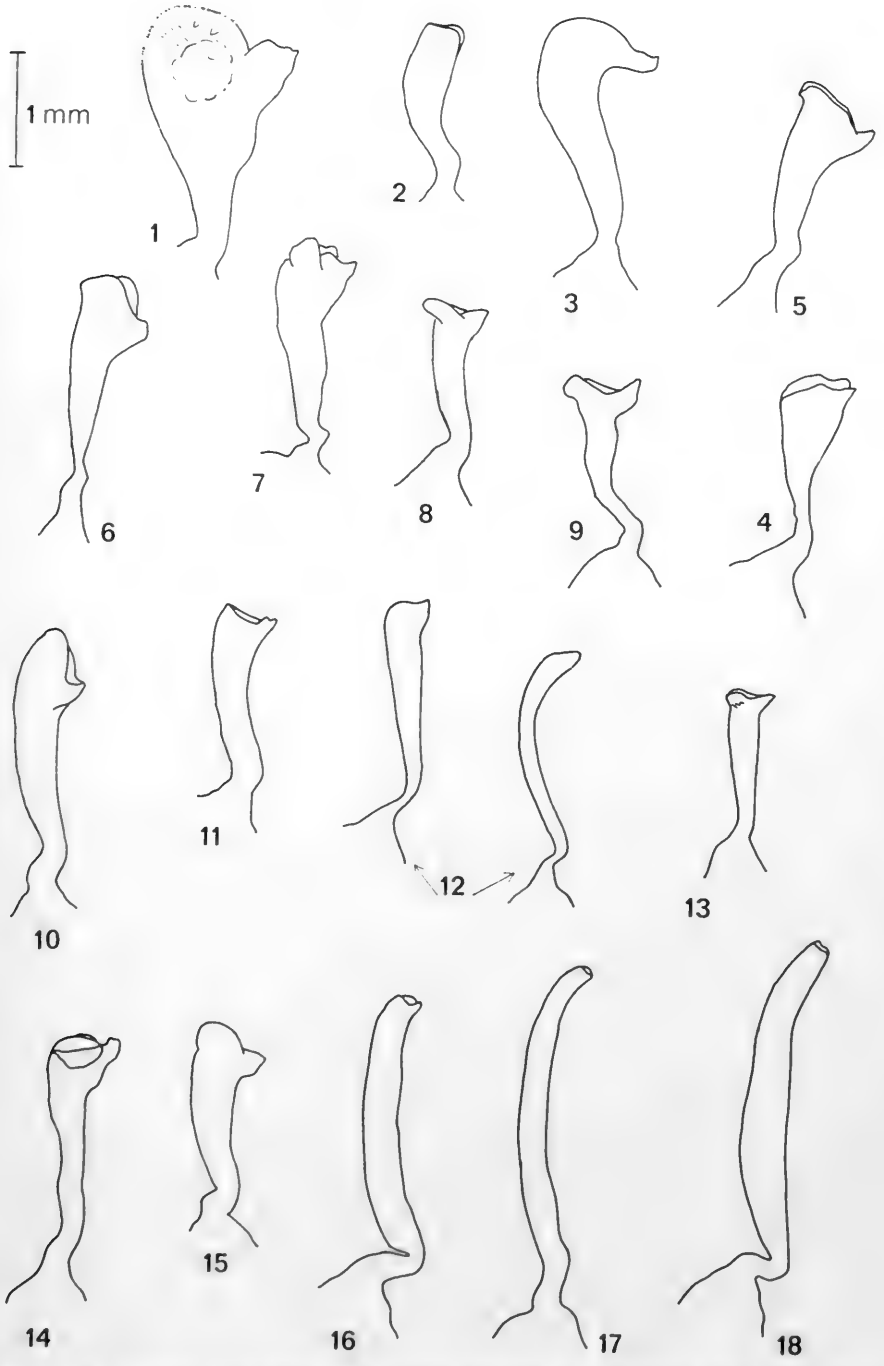

Fig. 8. Style of all Malesian *Viola* species. The number sequence is the same as in the text, 1 referring to 1. *V. tricolor, etc.*

are available for only 5 of the 16 native species. The counts on Malesian material were all made on plants from New Guinea and were published by MOORE in Fedde, Rep. 68 (1963) 81 and BORGMANN, Z. Bot. 52 (1964) 118. Chromosome numbers based on extra-Malesian material are indicated in the text.

Cleistogamous flowers. Except for *V. tricolor*, the species in Malesia produce during some, usually the later, part of the growing season or under abnormal environmental conditions so-called cleistogamous flowers. These have a shorter peduncle, a reduced corolla not expanded beyond the calyx; up to 3 anthers may be aborted and the amount of pollen produced is greatly reduced, while the style is usually much shorter than in chasmogamous flowers and may be much contorted. Such flowers produce plenty of seed, from self-pollination. The variation within species resulting from this sort of reproduction often does not conform to a pattern amenable to formal taxonomic recognition, and may partly explain the multiplicity of names applied to some taxa.

Chasmogamous (*i.e.* normal, expanding) flowers are essential for the reliable determination of most violets. In the absence of suites of flowering specimens for comparison, fruiting or cleistogamous material can rarely be confidently identified, particularly since, in such material, related species often show convergence in leaf characters.

KEY TO THE SPECIES

(*see fig. 8 for the shape of the styles*)

1. Stipules, at least the upper ones, pinnatifid or palmatifid. Style expanded above into a globose head. **1. V. tricolor**

1. Stipules entire to long-fimbriate. Style not as above.
 2. Style hooked at apex to give stigmatic beak about as long as the diameter of the style. Capsule on decumbent peduncle, not explosive. . . . . **3. V. odorata**
 2. Style not markedly hooked, stigmatic beak much shorter than the diameter of the style. Capsule on erect peduncle, explosive.
  3. Flowers yellow. Leaves reniform to broadly ovate, apex rounded or obtuse. Stipules entire or sparsely denticulate. Style with apex lobes fused behind, no stigmatic beak. . . . . **2. V. biflora**
  3. Flowers purple or white, rarely yellow (*sp.* 13).
   4. Stems or stolons absent.
    5. Spur 2½–6 mm, 2–4 times as long as wide, generally downwards curving, 2–5 times as long as calycine appendages. . . . . **7. V. philippica**
    5. Spur up to 3½ mm, up to 1½ times as long as wide, straight or slightly upcurved, up to 3 times as long as calycine appendages.
     6. Calycine appendages (1–)2–4.8 mm, incised, often conspicuous, ½–¾(–1) as long as sepal. **6. V. inconspicua**
     6. Calycine appendages 0–2(–2½) mm, rounded or subdentate, not conspicuous, up to ⅓ (rarely ½) as long as sepal.
      7. Leaves at least 16 mm, long-decurrent on petiole, glabrous. . . . . **5. V. betonicifolia**
      7. Leaves up to 16 mm, not or scarcely decurrent on petiole, with clusters of hairs in marginal dentations on upper side. . . . . **9. V. mearnsii**
   4. Well-developed decumbent or ascending stems or stolons.
    8. Style filiform.
     9. Spur at least 3 mm. . . . . **18. V. papuana**
     9. Spur up to 2½ mm.
      10. Stipules long-fimbriate. Calycine appendages at least 0.8 mm, pointed or denticulate, usually hirsute. . . . . **12. V. pilosa**
      10. Stipules sparsely fimbrio-dentate. Calycine appendages up to 1 mm, rounded, glabrous.
       11. Leaves and flowers grouped in distinct rosettes at intervals along stolons. Stipules free. **17. V. hederacea**
       11. Leaves and flowers not grouped in distinct rosettes. Stipules half-adnate to petiole. **16. V. kjellbergii**
    8. Style clavate.
     12. Leaves usually broader than long, arcuate or ovate, usually with prominent upturned basal lobes, crenulate or dentate.
      13. Style with separate rounded marginal lobes at apex. Stipules usually entire or shortly fimbrio-dentate. . . . . **10. V. arcuata**
      13. Style with apex having flattened marginal lobes which are fused posteriorally. Stipules long-fimbriate. . . . . **11. V. javanica**
     12. Leaves usually longer than broad, if broader than long then with rounded apex and prominently round-crenate (see *V. diffusa*).
      14. Leaves with hairs on upperside confined to zone towards margins, glabrous in central portion. **8. V. merrilliana**
      14. Leaves glabrous or, if hairy, hairs not distributed as above.

15. Leaves ± twice or more as long as broad, elliptical to lanceolate-ovate. **14. V. curvistylis**
15. Leaves up to 1¾ times as long as broad, suborbicular to ovate or elliptical.
16. Petiole conspicuously winged. Leaves orbicular to orbicular-ovate, rarely elliptical when base cuneate to subcordate. . . . . **4. V. diffusa**
16. Petiole not or scarcely winged. Leaves ovate to triangular-ovate, rarely elliptical when base with narrow deep sinus.
17. Style not or slightly marginate at apex. . . . . **12. V. pilosa**
17. Style distinctly marginate at apex.
18. Leaves white-hirsute above and beneath, elliptical to ovate. . . . . **15. V. rupicola**
18. Leaves glabrous or sparsely hirsute in marginal indentations or on veins, especially below, ovate to triangular-ovate.
19. Lateral petals not bearded. . . . . **13. V. sumatrana**
19. Lateral petals bearded.
20. Sepals at least 4 by 1 mm, margins entire, appendages rounded or denticulate. Leaves subcoriaceous, glabrous or sparsely hirsute on veins towards base. **11. V. javanica**
20. Sepals *c.* 3 by 1 mm, margins denticulate, appendages dentate. Leaves herbaceous, sparsely hirsute in crenations. . . . . **9. V. mearnsii**

1. Viola tricolor LINNÉ, Sp. Pl. (1753) 935; BACK. & BAKH. *f.* Fl. Java 1 (1963) 195. — **Fig. 8.**

Annual, biennial or perennial; rhizome short or none. Stems 10–40 cm, ascending or erect, usually branched. *Leaves* ovate-lanceolate to -elliptical, cuneate or subcordate at base, obtuse, crenate. *Stipules* deeply and pinnately lobed, terminal segment larger than the others, lanceolate, entire or crenate, leaf-like. *Flowers* *c.* 2–3 cm, violet, yellow or parti-coloured, very variable in colour and size; peduncle 3–10 cm, exceeding leaves. *Sepals* 7–14 by 2–5 mm, linear-lanceolate, acute, glabrous; appendage 3–5 mm, prominent. *Petals* obovate, 1–2 times as long as broad; spur 4–6 mm, variable up to twice as long as calycine appendages. *Style* 2–2½ mm, geniculate at the base, clavate distally with globose apex having prominent broad, anterior stigmatic beak. *Capsule* 8–14 mm, ellipsoid, glabrous.

Distr. Widespread throughout Europe extending to Asia Minor and Himalayas, in *Malesia*: garden-ornamental in mountain regions of Java and the Philippines (Luzon), not known to be naturalized. *Fl.* Jan.–Dec.

Note. These garden forms probably represent derivatives [*V.* × *wittrockiana* (= *V. hortensis auct.*)] from hybridization with *V. lutea* HUDS. and *V. altaica* KER-GAWLER.

2. Viola biflora LINNÉ, Sp. Pl. (1753) 936; BECKER Bot. Centralbl. 36, ii (1918) 39; LIN, Taiwania 1 (1950) 280. — **Fig. 8.**

Perennial; rhizome horizontal or oblique, more or less stout, roots on lower surface, leaves and stems at apex. Stems up to 8 cm, slender, ascending to erect, with leaves along their length and flowers distally. *Leaves* ¾–1¼ by 1–2½ cm, 1¼–2 times as broad as long, reniform to broadly ovate, more or less deeply cordate, rounded to broadly obtuse, subcrenate to repand-dentate, especially on lobes, subcoriaceous, glabrous beneath, sparsely hirsute towards margins and on veins above, dark green; petiole ½–5 cm, slender. *Stipules* 2–4 by 2–3 mm, ovate, acute, entire to sparsely denticulate, glabrous, fuscous, free. *Flowers* 8–12 mm, yellow with brownish-purple veins; peduncle 1.4–8 cm, much exceeding leaves, slender. *Sepals* 3–4 by *c.* 1 mm, linear to linear-oblong, acute, glabrous or shortly ciliate on margin, fuscous, with margin scarious; appendage up to ½ mm, rounded, glabrous. *Petals* 2–3 times as long as broad, obovate to almost oblong, basal exceeding the others, laterals not bearded; spur 1–1½ mm, cylindrical, obtuse. *Style* 1.2–1½ mm, slightly geniculate at base, clavate distally, apex with 2 lateral lobes fused behind, no stigmatic beak. *Capsule* 4–6 mm, oblong to ellipsoid, glabrous.

Distr. Circumboreal, south to 40° N in North America, to *c.* 38° N in Europe. Through Himalayas to Japan, China, Korea, and Formosa, in *Malesia*: N. Sumatra (Mts Losir and Kemiri). Fig. 9.

Ecol. Alpine grassland, among rocks and grass tussocks, 3000–3500 m. *Fl.* Oct.–March.

3. Viola odorata LINNÉ, Sp. Pl. (1753) 934; BACK. & SLOOT. Handb. Theeonkr. (1924) 178, t. 178; BACK. & BAKH. *f.* Fl. Java 1 (1963) 195. — **Fig. 8.**

Perennial; rhizome vertical, stout, bearing rosette of leaves and usually long, procumbent rooting stems at apex. *Leaves* 2½–6 by 2½–6½ cm, orbicular-reniform to -ovate, deeply cordate, rounded to obtuse, shallowly crenate to crenate-serrate, glabrous or sparsely pubescent on veins and margins; petiole up to 20 cm. *Stipules* 8–12 by 3–5 mm, ovate to ovate-lanceolate, usually glandular-fimbriate, glabrous, free. *Flowers* 10–15 mm, purple or white; peduncles 5–14 cm, slender. *Sepals* *c.* 5 by *c.* 2 mm, ovate, obtuse, entire, with ciliate margins; appendage 1–2 mm, dentate. *Petals* broadly obovate, laterals bearded or not; spur *c.* 4 mm, straight or slightly upcurved. *Style* *c.* 2 mm, uncinate at apex. *Capsule* globose, pubescent.

Distr. Throughout Europe except the extreme north, Asia Minor, Caucasus, in *Malesia*: garden-ornamental in mountain regions of Java and the Philippines (Luzon); not known to be naturalized but BACKER & BAKHUIZEN *f.* stated that "it is planted to prevent erosion by rain-wash". *Fl.* May–Oct., perhaps all the year.

4. Viola diffusa GINGINS in DC. Prod. 1 (1824) 298. — **Fig. 8.**

See for synonyms under the subspecies.

Perennial or annual; rhizome vertical, rather thin, fibrillose, bearing rosette of leaves and flowers and procumbent rooting stems. Stems up to 12 cm, rooting at ends and producing dense rosettes of leaves and flowers. *Leaves* ½–3½ by 1–2 cm, smaller on stolons, suborbicular to ovate or elliptic, cordate to cuneate at base, subacute to obtuse or rounded, crenate to serrate-crenate on margin, long-decurrent on petiole; hirsute or rarely glabrous; petiole 1–7 cm. *Stipules* 5–9 by *c.* 1 mm, lanceolate or ovate-lanceolate, long-acute, dentate to fimbriate, green or pale brown, free. *Flowers* up to 9 mm, pale violet to almost white; peduncle 1½–6 cm. *Sepals* 3–6 by 1–1½ mm, lanceolate to ovate, acute, sparsely hairy, fimbrio-ciliate, green; appendage *c.* ½ mm, rounded, sparsely fimbrio-ciliate. *Petals* 1½–2 times as long as broad, obovate, the basal smaller than the others, the laterals not bearded; spur 0.4 to *c.* 1 mm, obtuse. *Style c.* 1½ mm, slightly geniculate at base, clavate distally, apex with 2 lateral lobes, with small anterior beak between lobes. *Capsule* 4–6 mm, ellipsoid, glabrous.

Distr. Himalayas, China, Indo-China, Japan, Formosa, in *Malesia*: Philippines, New Guinea. Fig. 9.

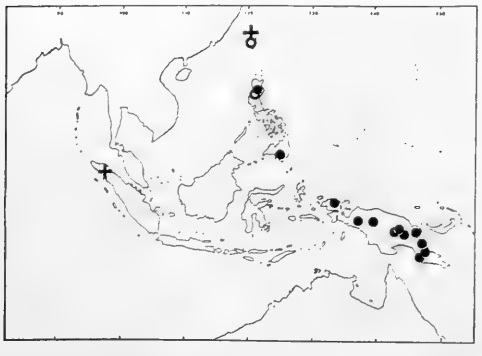

Fig. 9. Distribution in Malesia of *Viola diffusa* GING. *ssp. diffusa* (circles), *ssp. apoensis* (ELM.) D. M. MOORE (dots), and *V. biflora* L. (+).

Ecol. Open places in montane forest and grassy clearings, often along tracks and other disturbed places, a weed of cultivation, 1400–2500 m. *Fl.* Aug.–March, probably later.

This species comprises two subspecies, as follows:

***ssp.* diffusa.** — *V. diffusa* GING.; MERR. Philip. J. Sc. 5 (1910) Bot. 201; BECKER, Philip. J. Sc. 19(1921) 713; Beih. Bot. Centralbl. 40, ii (1923) 114; LIN, Taiwania 1 (1950) 271. — *V. tenuis* BENTH. in Hook. Lond. J. Bot. 1 (1842) 482. — *V. diffusa* GING. *ssp. tenuis* (BENTH.) BECKER, Philip. J. Sc. 19 (1921) 714, *pro parte.*

Leaves (1½–)1¾–3½ by (0.9–)1–2 cm, ovate to ovate-elliptic, cuneate to shallowly cordate at base, obtuse to acute, rarely rounded, with crenate-serrate to serrate margins; petiole 1–1½ times as long as the blade. Chromosome number: 2n = 26 (Japan, MIYAJI, Cytologia 1, 1929, 28).

Distr. Himalayas, China, Indo-China, Japan, Formosa, in *Malesia*: Philippines (Luzon: Mts Data and Pukis).

***ssp.* apoensis** (ELM.) D. M. MOORE, *comb. nov.* — *V. apoense* ELM. Leafl. Philip. Bot. 8 (1915) 2878. — *V. diffusa* GING. *ssp. tenuis* (BENTH.) BECKER, Philip. J. Sc. 19 (1921) 714, *pro parte*; D. M. MOORE, Nova Guinea, Bot. *n.* 11 (1963) 181.

Leaves ¾–1½(–2) by 1–1½ cm, suborbicular to broadly ovate, deeply, rarely shallowly, cordate at base, rounded at apex, with round-crenate margins; petiole 1–3.2 times as long as the blade.

Distr. *Malesia*: Philippines (Luzon: Mt Data; Mindanao: Mt Apo), New Guinea.

Note. It is not known whether the two subspecies occupy different habitats on Mt Data, but some hybridization is likely since these populations, although readily distinguished, are closer morphologically than other populations of the two taxa. It is possible that they have come into contact by recent introduction of one of the subspecies, in view of the weedy habitats favoured by the species.

5. Viola betonicifolia J. E. SMITH in Rees, Cyclop. 37, I (1817) *n.* 7. — **Fig. 8.**

See for synonyms under the subspecies.

Perennial; rhizome short, oblique or vertical, rather stout, bearing rosette of leaves and flowers at apex, acaulescent. *Leaves* 1½–7½ by ½–3 cm, 1–19 times as long as broad, linear-lanceolate to triangular-hastate or triangular-ovate, cuneate, truncate or widely and shallowly cordate with basal lobes often laterally prominent, acute or sometimes roundish obtuse, shallowly and distantly crenate, sometimes dentate on basal lobes, usually long-decurrent on petiole, glabrous; petiole 1–10½ cm. *Stipules* 2–7 by ½–1 mm, ovate-lanceolate, acuminate, sparsely short-fimbriate, glabrous, fuscous, adnate to petiole to ¾ length. *Flowers* 6–14½ mm, white to purple with darker veins; peduncle equalling or exceeding leaves, glabrous. *Sepals* 3–6½ by 0.6–2.5 mm, ovate to ovate-lanceolate, acute or acuminate, glabrous or ciliate, green with scarious margins; appendage 0.2–2½ mm, or absent, (½–)⅓–1/7 as long as sepal, rounded to squarish or somewhat subdentate, glabrous. *Petals* 1½–3.4 times as long as broad, obovate, laterals usually bearded; spur 0.6–3½ mm, half to twice as long as broad, cylindrical, obtuse, straight or slightly upcurved. *Style* 1½–2½ mm, geniculate at base, clavate distally, apex with prominent marginal lobes fused behind, anterior stigmatic beak. *Capsule* 7–10 mm, ellipsoid to oblong, glabrous.

Distr. Himalayas, India, Ceylon, China, Japan, Indo-China, Australia, in *Malesia*: Sumatra, E. Java (Mts Tengger and Idjen), Lesser Sunda

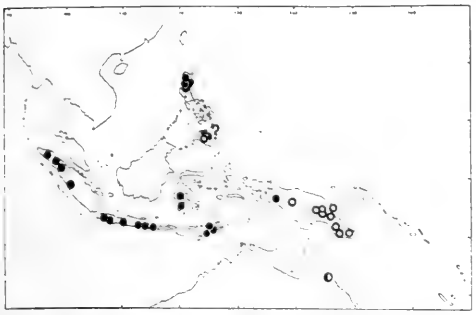

Fig. 10. Distribution in Malesia of *Viola betonicifolia* J. E. SMITH *ssp. betonicifolia* (dots), an intermediate in N. Queensland, and *ssp. novaguineensis* D. M. MOORE (circles).

Islands (Alor, Bali, Timor), Celebes, Philippines (Mindanao, Luzon), and New Guinea. Fig. 10.

Ecol. Usually in grasslands, sometimes in open montane woodland of *Eucalyptus*, (650–)1100–2100(–2700) m. Apparently sometimes a ruderal and occurring along path margins and in cultivated ground. *Fl.* Jan.–Dec.

Notes. This species shows considerable variation in leaf-shape, on the basis of which two subspecies have been recorded.

V. betonicifolia differs from *V. inconspicua* in having the calycine appendages less than half as long as the sepals, in leaf-shape and in the lamina generally being long-decurrent on the petiole. It differs from *V. philippica* by its generally shorter spur which is less than twice as broad as long, by the heavy bearding of the lateral petals, and by its leaf-shape.

The widespread references to *V. patrinii* in Malesian literature concern *V. betonicifolia* and *V. inconspicua*. In an analysis of this group BECKER (Bot. Jahrb. 54, Beibl. 120, 1917, 156) has shown that the name *V. patrinii* DC. should be restricted to the plant from northern E. Asia. This species appears to be diploid (MIYAJI, Cytologia 1, 1929, 28) and some of the taxonomic difficulties may be due to its genome being present in the species further south, of which those known cytologically are tetraploid or hexaploid.

ssp. **betonicifolia.** — *V. betonicifolia* J. E. SM. — *V. betonicifolia* J. E. SM. *ssp. australis* BECKER, Bot. Jahrb. 54 (1917) Beibl. 120, 166. — *V. betonicifolia* J. E. SM. *ssp. nepalensis* BECKER, *l.c.*; Philip. J. Sc. 19 (1921) 716; MERR. En. Philip. 3 (1923) 105; OOSTSTR. & H. J. LAM, Blumea 5 (1945) 594. — *V. patrinii* DC. *var. napaulensis* DC. Prod. 1 (1824) 293. — *V. caespitosa* D. DON, Prod. Fl. Nepal. (1825) 205. — *V. patrinii* DC. *var. caespitosa* RIDL. J. Bot. 73 (1935) 17. — *V. patrinii* (*non* DC.) MERR. Philip. J. Sc. 5 (1910) Bot. 200, *pro parte*; BOISSIEU & CAPITAINE, Bull. Soc. Bot. Fr. 57 (1910) 337; KOORD. Exk. Fl. Java 2 (1912) 627, *pro parte*.

Leaves linear-lanceolate to triangular-ovate. Chromosome number: 2n = 48, 72 (Australia, MOORE in Fedde, Rep. 68, 1963, 84).

Distr. As the species but in New Guinea only in extreme west.

Notes. The northernmost (including the type of *ssp. nepalensis*) and southernmost (including the type of *ssp. betonicifolia*) populations cannot be differentiated and intergrade continuously with the various leaf-forms present throughout much of Malesia, though there is a tendency for more definitely triangular cordate forms in the centre of the range. Confusion between this and the next subspecies may result partly from hybridization with *V. inconspicua*. Populations from N. Sumatra have a conspicuously narrow cuneate leaf which is 4–19 times as long as broad.

ssp. **nova-guineensis** D. M. MOORE in Fedde, Rep. 68 (1963) 82.

Leaves triangular-hastate with basal lobes prominent laterally, even deltoid. Chromosome number: 2n = 72.

Distr. *Malesia*: Sumatra, Timor, Philippines, Celebes, New Guinea (except extreme west).

Note. This subspecies, which is centred in New Guinea, intergrades with *ssp. betonicifolia* in N. Queensland, and it is possible that many of the triangular-leaved forms north from New Guinea represent intermediates between the two subspecies.

6. Viola inconspicua BLUME, Cat. Gew. Buitenzorg (1823) 57; Bijdr. 1 (1825) 58; KORTH. Ned. Kruidk. Arch. 1 (1848) 357; MIQ. Fl. Ind. Bat. 1, 2 (1858) 112; BECKER, Bot. Jahrb. 54(1917) 167; Philip. J. Sc. 19 (1921) 718; MERR. En. Philip. 3 (1923) 105; RIDL. J. Bot. 73 (1935) 14; BACK. & BAKH. *f.* Fl. Java 1 (1963) 195. — *V. trinervis* KORTH. Ned. Kruidk. Arch. 1 (1848) 357; MIQ. Fl. Ind. Bat. 1, 2 (1858) 112. — *V. confusa* CHAMP. *ex* BENTH. in Hook. J. Bot. Kew Misc. 3 (1851) 260, *pro parte*; RIDL. J. Bot. 73 (1935) 14. — *V. patrinii* (*non* DC.) BOISSIEU & CAPITAINE, Bull. Soc. Bot. Fr. 57 (1910) 340; MERR. Philip. J. Sc. 5 (1910) Bot. 200, *pro parte*; KOORD. Exk. Fl. Java 2 (1912) 627, *pro parte*; BACK. & SLOOT. Handb. Theeonkr. (1924) 179, t. 179. — *V. serpens* (*non* WALL.) RIDL. Fl. Mal. Pen. 1 (1922) 126, *pro parte*. — **Fig. 8.**

Perennial; rhizome vertical or oblique, rather short and stout, with rosette of leaves and flowers at apex, acaulescent. *Leaves* 1¾–9 by 1–7½ cm, 1-2.2 times as long as broad, broadest at base, triangular-ovate, cordate at base with usually prominent, rounded basal lobes, acute, crenate to subdentate, sometimes dentate on basal lobes, decurrent to ⅓ length of petiole, glabrous or sparsely pubescent in sinus; petiole 1–10 cm. *Stipules* 3–10 by 1–2 mm, ovate-lanceolate, acute, sparsely short-fimbriate, glabrous, fuscous, adnate to petiole to ¾ of length. *Flowers* 9–11 mm, pale purple with darker veins; peduncle shorter than to somewhat exceeding leaves, glabrous or pubescent distally. *Sepals* 2½–7 by 1–1.8 mm, ovate-lanceolate, acute, glabrous or sometimes ciliate,

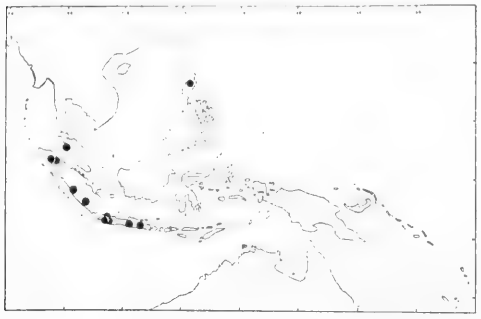

Fig. 11. Distribution of *Viola inconspicua* BL.

green with scarious margin; appendage (1½–)2–4.9 mm, at least half as long as sepal, incised. *Petals* 2–3 times as long as broad, obovate, the laterals bearded; spur 1.8–2.6 mm, 1.1–1.3 times as long as broad, ²/₅ to ½ as long as calycine appendages, cylindrical, straight, obtuse. *Style c.* 2 mm, geniculate at base, clavate distally, apex with large marginal lobes fused behind, anterior stigmatic beak. *Capsule* 9–16 mm, oblong, glabrous.

Distr. Himalayas, Burma, China, in *Malesia*: Sumatra, Malay Peninsula (Penang), Java, Philippines (Luzon). Fig. 11.

Ecol. Grasslands, fallow lands, path margins; apparently normally ruderal, 500–1700 m. *Fl.* Nov.–Febr.

Notes. Closely related to *V. betonicifolia* but differing by its shortly decurrent lamina and by the conspicuous leaf-like calycine appendages which are more than half as long as the sepals. Intermediates between the two species occur in several places throughout the range of *V. inconspicua*. These are considered to be hybrids rather than clinal variants, because no geographical pattern can be discerned, because the weedy habitats preferred by both species are conducive to interspecific crossing, and both species occur sympatrically in some Philippine and Sumatran localities. Only occasional collections, from Sumatra and the Philippines, have chasmogamous flowers and this, together with the apparently weedy nature of *V. inconspicua*, supports the suggestion of BECKER (1917) and of BACKER & BAKHUIZEN *f.* (1963) that the species is a relatively recent immigrant from continental Asia.

7. Viola philippica CAVANILLES, Icon. Descr. 6 (1801) 19; MIQ. Fl. Ind. Bat. 1, 2 (1858) 113; BECKER, Bot. Jahrb. 54 (1917) 174, *incl. ssp.*; Philip. J. Sc. 19 (1921) 719; MERR. En. Philip. 3 (1923) 105; BACK. & BAKH. *f.* Fl. Java 1 (1963) 195. — *V. confusa* CHAMP. *ex* BENTH. in Hook. J. Bot. Kew Misc. 3 (1851) 260, *pro parte*; BACK. Schoolfl. (1911) 66. — *V. selkirkii* (*non* PURSH) BOUISSIEU & CAPITAINE, Bull. Soc. Bot. Fr. 57 (1910) 337. — *V. edanoii* BECKER, Philip. J. Sc. 19 (1921) 722; MERR. En. Philip. 3 (1923) 105. — **Fig. 8.**

Perennial; rhizome vertical or suboblique, rather slender, bearing rosette of leaves and flowers at apex, acaulescent. *Leaves* 1–4 by ½–3 cm, 1–2 times as long as broad, ovate-elliptic to ovate or triangular-hastate, deeply to shallowly cordate to subtruncate at base, with the basal lobes usually somewhat converging, obtuse to rounded, round-crenate to crenate-serrate, usually long-decurrent on petiole, glabrous or puberulent beneath on veins and margins; petiole 1–6 cm. *Stipules* 2–8 by 0.8–3 mm, ovate-lanceolate, acute, shortly fimbrio-dentate, glabrous or sparsely pubescent, green to rather fuscous, adnate to petiole to ¾ length. *Flowers* 9½–14½ mm, pale to dark violet; peduncle usually much exceeding leaves, glabrous or puberulent distally. *Sepals* 3–5.2 by 0.7–1.8 mm, ovate to ovate-lanceolate, acute or rounded entire, glabrous or ciliolate, green with scarious margin; appendage ½–2 mm, (½–)⅓–⅙ as long as sepal, rounded to denticulate, glabrous or sparsely pubescent. *Petals* 1.2–3½ times as long as broad, obovate, the laterals not or lightly bearded; spur 2½–6 mm, 2–4 times as long as broad, 2–5 times as long as calycine appendages, usually slightly tapering and downwards curving. *Style* 1½–2.4 mm, geniculate at base, clavate distally, apex with prominent lateral lobes partially fused behind, anterior stigmatic beak. *Capsule* 5–8 mm, ellipsoid, glabrous.

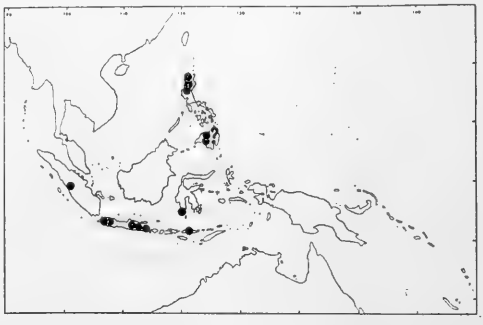

Fig. 12. Distribution of *Viola philippica* CAV.

Distr. Himalayas, India, Mongolia, China, Burma, Korea, Japan, in *Malesia*: Sumatra, Java, Lesser Sunda Islands (Flores), Celebes (Loha), Philippines (Luzon, Mindanao). Fig. 12.

Ecol. Grasslands; path margins; sometimes ruderal, 250–1700 m. *Fl.* Oct.–July, probably all year.

Notes. BECKER (1917, *l.c.*) recognized two subspecies distinguished mainly on leaf-shape, *viz ssp. munda* BECKER, lamina lanceolate or oblong, cuneate to subcordate at base, and *ssp. malesica* BECKER, lamina broader and shorter with cordate base. The type material contains leaves referable to both these entities, as do collections from a variety of areas (*cf.* STEWARD, Man. Vasc. Pl. Lower Yangtze Valley, 1958, Corvallis), and no subspecific differentiation seems justified on present knowledge. *V. philippica* is only likely to be con-

fused with *V. betonicifolia* and the distinguishing characters are summarized under that species.

8. Viola merrilliana BECKER, Beih. Bot. Centralbl. 34, ii (1916) 234; Philip. J. Sc. 19 (1921) 712; MERR. En. Philip. 3 (1923) 105. — **Fig. 8.**

Perennial; rhizome vertical to oblique, rarely horizontal, bearing leaves and stems at apex. Stems up to 15 cm, creeping to ascending, rooted at some nodes, with leaves and flowers at some nodes. *Leaves* ½–2½ by ½–1¾ cm, (1–)1¼ times as long as broad, ovate, with cordate base, and rounded basal lobes, acute, crenulate or crenate-serrate, especially on basal lobes, upper surface with hairy zone towards margin and glabrous in central portion, glabrous or sparsely pubescent on veins beneath; petiole 1–8 cm, slender, glabrous. *Stipules* 3–6 by 1–1½ mm, the lower ovate-lanceolate, fimbrio-dentate, the upper lanceolate, dentate near base, all glabrous or sparsely pubescent, fuscous or greenish, adnate to petiole to ½ length or more. *Flowers* 10–15 mm, white or pale purple, with darker veins; peduncle 4–9 cm, usually exceeding the leaves. *Sepals* 3–5 by 0.6–1.7 mm, lanceolate, acute, entire, glabrous; appendage 0.4–0.8 mm, rounded, glabrous. *Petals* 2–3 times as long as broad; the basal obovate; the laterals oblanceolate, bearded; spur 1½–2 mm, exceeding calycine appendages, cylindrical, obtuse. *Style* 1.2–1.6 mm, geniculate at base, clavate distally, apex with lateral margins fused behind, with stigmatic beak projecting anteriorally and somewhat upcurved. *Capsule* 5–7 mm, oblong, glabrous.

Distr. *Malesia*: Philippines (Luzon). Fig. 13.

Ecol. Damp places along streams and in mossy forest, *c.* 2100 m. *Fl.* March–June.

Notes. Distinguished from *V. mearnsii* by the distribution of hairs on its upper surface of the leaf, the narrower and deeper basal leaf sinus, the larger flowers, the entire sepals and the small rounded calycine appendages. *V. merrilliana* appears to be sympatric with *V. rupicola* on Mt Pulog but the latter species differs in its hairy petioles, completely hairy uppersides of the leaves, ciliate sepals and free or slightly adnate stipules.

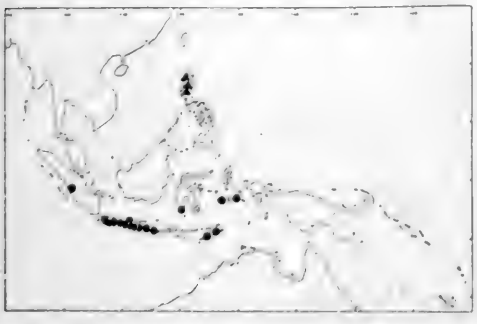

Fig. 13. Distribution of *Viola pilosa* BL. (dots) and *V. merrilliana* BECKER (triangles).

9. Viola mearnsii MERRILL, Philip. J. Sc. 5 (1910) Bot. 200; BECKER, Beih. Bot. Centralbl. 34, ii (1916) 411; Philip. J. Sc. 19 (1921) 715; MERR. En. Philip. 3 (1923) 105; MELCHIOR, Notizbl. Berl.-Dahl. 12 (1934) 206. — **Fig. 8.**

Perennial; rhizome vertical or oblique, slender, bearing rosette of leaves, flowers and sometimes stems at apex. Stems, when present, up to 3 cm, rooted at terminal node. *Leaves* ½–1½ by ¾–1½ cm, about as long as broad, triangular-ovate, broadly and shallowly cordate at base, obtuse, rarely acute, crenulate or serrate-crenate, pubescent in crenations above, glabrous beneath, herbaceous; petiole 1–4 cm, slender, glabrous. *Stipules* 3–5 by *c.* 1 mm, linear-lanceolate, acute, fimbrio-dentate, fuscous or greenish, slightly adnate to petiole. *Flowers* 7–11½ mm, whitish with purple veins; peduncle 3–9 cm, slender, glabrous. *Sepals c.* 3 by *c.* 1 mm, lanceolate, acute, glabrous or ciliate near base, sparingly denticulate on margin; appendage *c.* 1 mm, dentate. *Petals* 2–2½ times as long as broad; basal obovate, shorter than others; laterals oblanceolate, bearded; spur 1½–2½ mm, exceeding calycine appendages, cylindrical, obtuse. *Style c.* 1½ mm, geniculate at base, clavate distally, apex with margins fused behind and stigmatic beak projecting anteriorally. *Capsule c.* 6 mm, globose, glabrous.

Distr. *Malesia*: Philippines (Luzon, Negros, Mindanao), Celebes. Fig. 18.

Ecol. Along streams and in montane forest, *c.* 2200 m. *Fl.* April–May.

Notes. Differs from *V. merrilliana* in its more triangular, shallowly cordate leaves which have hairs only in the marginal crenations on the upper side, smaller flowers, denticulate sepals and dentate calycine appendages. The occurrence in Celebes is based on a single collection (KJELLBERG 2658) which differs from Philippine material in having glabrous leaves, and entire glabrous sepals and calycine appendages. The terminal portion of the style is absent. Further material is required to confirm this determination.

10. Viola arcuata BLUME, Bijdr. (1825) 58; KORTH. Ned. Kruidk. Arch. 1 (1848) 357; MIQ. Fl. Ind. Bat. 1, 2 (1858) 114; KOORD. Exk. Fl. Java 2 (1912) 629; BECKER, Beih. Bot. Centralbl. 34, ii (1916) 226; Philip. J. Sc. 19 (1921) 710; MERR. En. Philip. 3 (1923) 104; BACK. & SLOOT. Handb. Theeonkr. (1924) 177, t. 177; RIDL. J. Bot. 73 (1935) 14; BACK. & BAKH. *f.* Fl. Java 1 (1963) 195; D. M. MOORE, Nova Guinea, Bot. *n.* 11 (1963) 178. — *V. distans* WALL. [Cat. (1831) *n.* 4022] Trans. Med. Soc. Calc. 7 (1835) 227; BACK. Schoolfl. (1911) 66. — *V. japonica* (*non* LANGSD.) KORTH. Ned. Kruidk. Arch. 1 (1848) 357. — *V. alata* BURGERSDIJK in Miq. Pl. Jungh. 1 (1852) 121; MIQ. Fl. Ind. Bat. 1, 2 (1858) 114; BACK. Schoolfl. (1911) 65; KOORD. Exk. Fl. Java 2 (1912) 629; BECKER, Beih. Bot. Centralbl. 34, ii (1916) 227; RIDL. J. Bot. 73 (1935) 13. — *V. toppingii* ELM. Leafl. Philip. Bot. 2 (1908) 504. — *V. semilunaris* (MAXIM.) BECKER *var. philip-*

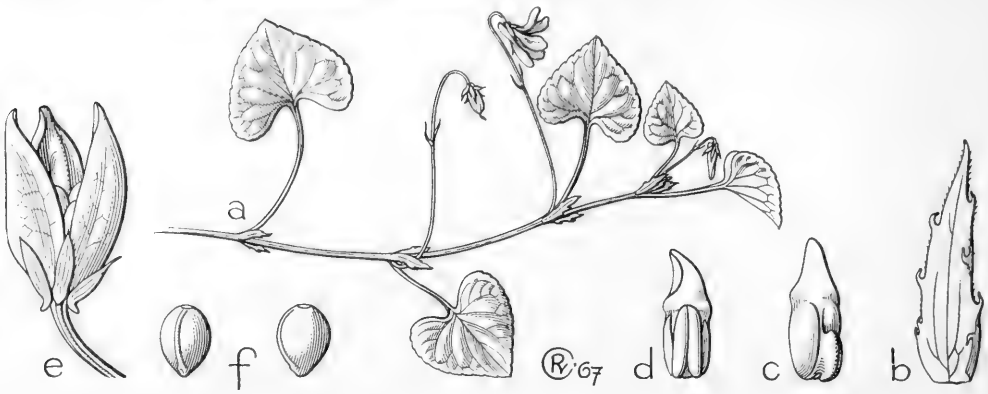

Fig. 14. *Viola arcuata* BL. *a.* Habit, ×⅔, *b.* stipule, ×4, *c.* & *d.* stamens, ×6, *e.* fruit, ×3, *f.* seeds, ×6 (*a* VAN STEENIS 7446, *b*, *e* BÜNNEMEIJER 9595, *c–d* VAN STEENIS 4306, *f* BACKER 12848).

pinarum BECKER, Beih. Bot. Centralbl. 34, ii (1916) 231; Philip. J. Sc. 19 (1921) 712; MERR. En. Philip. 3 (1923) 106. — *V. lunata* RIDL. Trans. Linn. Soc., Bot. 9 (1916) 18. — *V. herbivaga* RIDL. J. Bot. 73 (1935) 17. — **Fig. 8, 14.**

Perennial; rhizome vertical to oblique, slender to rather stout, bearing stems and leaves at apex. Stems up to 80 cm, slender, procumbent to ascending or erect, often rooted at lower nodes, with leaves and flowers along their length. *Leaves* ½–3¾ by ¾–4¼ cm, (1.1–)1.3–2.3 times as broad as long, broadly hastate, sometimes ovate, broadly and deeply to shallowly cordate, with prominent basal lobes which are (3–)6–21 mm long, typically curved upwards and usually rounded, cuspidate to obtuse at apex, crenulate, rarely dentate on basal lobes, glabrous, rarely sparsely ciliate or pubescent on veins beneath, usually herbaceous, sometimes thicker and darker green; petiole 1–14 cm, slender. *Stipules* 4–14 by 1–3(–6) mm, generally prominent and sometimes leaf-like, lanceolate to oblong-lanceolate, acute to mucronate, dentate to shortly fimbrio-dentate, glabrous or rarely white to pale purple, with darker veins; peduncle 2–15 cm, slender. *Sepals* 2½–5 by 1.2–2 mm, ovate-lanceolate to lanceolate, acute, entire, glabrous, green or fuscous with scarious margins; appendage *c.* 1 mm, rounded, glabrous. *Petals* (1½–)2–4(–4½) times as long as broad, oblong to oblanceolate; the basal shorter than the others; laterals not or lightly bearded; spur ½–2 mm, equalling or slightly exceeding calycine appendages, cylindrical, obtuse. *Style* 1–2 mm, geniculate at base, clavate distally, with rounded marginal lobes at apex not joined behind, stigmatic beak projecting anteriorally. *Capsule* 4–10 mm, oblong, glabrous. Chromosome number: 2n = 24.

Distr. India, N. Burma, China, Indo-China, in *Malesia*: Sumatra, Java, Philippines (Luzon), Moluccas (Buru), New Guinea. Fig. 15.

Ecol. Typically a plant of wet meadows, marshes, stream and lake margins, ditches and grassy clearings, 1000–3000 m. *Fl.* Jan.–Dec.

Notes. In its typical, widespread form *V. arcuata* is readily recognised by its glabrous, arcuate leaves and long prostrate stems. It varies in the size and marginal dissection of the stipules and in the presence or absence of bearding on the lateral petals, while some forms have thicker, more pubescent and deeply cordate leaves than is usual. Variation in these characters cannot be correlated with each other, or with any distributional pattern, and intermediates occur. No formal recognition of such variation is possible and much of it may be due to plants which occupy drier habitats than usual.

11. Viola javanica BECKER, Beih. Bot. Centralbl. 34, ii (1916) 260; BACK. & BAKH. *f.* Fl. Java 1 (1963) 195. — *V. arcuata* (*non* BL.) MIQ. Fl. Ind. Bat. 1, 2 (1859) 686; RIDL. J. Bot. 73 (1935) 14. — **Fig. 8.**

Perennial; rhizome vertical, rather stout, bearing leaves and stems at apex. Stems up to 26 cm, rather slender, creeping or somewhat ascending, rooted at some nodes, bearing leaves along their length and flowers usually distally. *Leaves* ½–2½ by ¾–3 cm, 1–1.6 times as broad as long, triangular-ovate, rarely subhastate, shallowly and rather broadly cordate at base, acute to obtuse or rounded, crenate or subdentate, glabrous or sparsely pubescent on veins towards sinus, subcoriaceous, dark green. *Stipules* 5–10 by 1–2 mm, lanceolate, acute, fimbriate, glabrous, fuscous, free. *Flowers* 6–12 mm, purple with darker veins; peduncle 2–9 cm, exceeding leaves, sparsely hirsute distally. *Sepals* 4–5½ by 1½–1.8 mm, ovate-lanceolate, acute, entire, glabrous or sparsely pubescent near base, green with scarious margin; appendage ½–1 mm, rounded or slightly dentate. *Petals* about 3 times as long as broad, oblong to obovate-oblanceolate; laterals heavily, rarely lightly bearded; spur ½–1½ mm, shorter than to slightly exceeding calycine appendages, cylindrical, obtuse. *Style* 1½–2 mm,

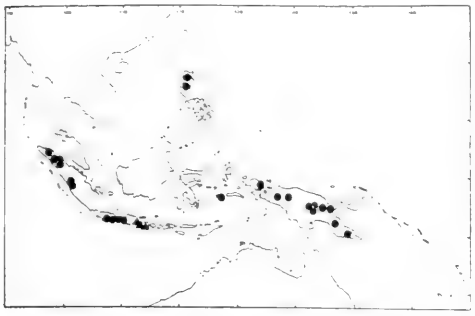

Fig. 15. Distribution of *Viola arcuata* BL. in Malesia (dots) and *V. javanica* BECKER (triangles).

geniculate at base, clavate distally, apex with flattish marginal lobes fused behind and anterior stigmatic beak. *Capsule* 5–9 mm, oblong, glabrous.

Distr. *Malesia*: E. Java (Mts Ardjuno, Tengger & Jang). Fig. 15.

Ecol. Grasslands, 2000–3000 m. *Fl.* Jan.–Nov., probably all year.

Notes. Closely related to *V. arcuata* but readily distinguished from typical forms of that species by its subcoriaceous, strongly crenate, ovate leaves and its long-fimbriate stipules. Some forms of *V. arcuata*, particularly in drier habitats, approach *V. javanica* in these characters but the stigma has the rounded separate lobes of *V. arcuata* and not the posteriorally fused, flatter margin of *V. javanica*. There is a superficial resemblance to some forms of *V. pilosa* but in that species the style is scarcely clavate and the stigma is emarginate.

12. Viola pilosa BLUME, Cat. Gew. Buitenzorg (1823) 57; Bijdr. (1825) 57; KORTH. Ned. Kruidk. Arch. 1 (1848) 357; MIQ. Fl. Ind. Bat. 1, 2 (1858) 113; BACK. & SLOOT. Handb. Theeonkr. (1924) 180, t. 180; DOCTERS VAN LEEUWEN, Trop. Natuur 16 (1927) 187; Verh. Kon. Ak. Wet. A'dam II, 31 (1933) 184. — *V. serpens* WALL. *ex* GING. in DC. Prod. 1 (1824) 296; MIQ. Fl. Ind. Bat. 1, 2 (1858) 113; BACK. Schoolfl. (1911) 66; KOORD. Exk. Fl. Java 2 (1912) 628, *pro parte*; BECKER, Beih. Bot. Centralbl. 40, ii (1923) 103; OOSTSTR. & H. J. LAM, Blumea 5 (1945) 594; BACK. & BAKH. *f.* Fl. Java 1 (1963) 195. — *V. palmaris* BUCH.-HAM. *ex* GING. in DC. Prod. 1 (1824) 298; BURGERSDIJK in Miq. Pl. Jungh. 1

Fig. 16. *Viola pilosa* BL. on Mt Gedeh in W. Java (photogr. VAN WOERDEN).

(1852) 120; MIQ. Fl. Ind. Bat. 1, 2 (1858) 113. — *V. hamiltoniana* D. DON, Prod. Fl. Nepal. (1825) 206; BOISSIEU & CAPITAINE, Bull. Soc. Bot. Fr. 57 (1910) 340. — *V. sarmentosa* BURGERSDIJK in Miq. Pl. Jungh. 1 (1852) 120; MIQ. Fl. Ind. Bat. 1, 2 (1858) 114. — *V. burgersdijkii* OUDEMANS in Miq. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 77; BOISSIEU & CAPITAINE, Bull. Soc. Bot. Fr. 57 (1910) 337, *incl. f. nodosa* BOISS. & CAPIT. *l.c.* 338; BECKER, Beih. Bot. Centralbl. 40, ii (1923) 106; RIDL. J. Bot. 73 (1935) 16, *incl. var. timorensis* RIDL. — *V. glaucescens* OUDEMANS in Miq. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 74; BECKER, Beih. Bot. Centralbl. 40, ii (1923) 109. — *V. confusa* (*non* CHAMP.) BOISSIEU & CAPITAINE, Bull. Soc. Bot. Fr. 57 1910) 339. — *V. canescens* (*non* WALL.) BOISSIEU & CAPITAINE, *l.c.* 338; BECKER, Beih. Bot. Centralbl. 34, ii (1916) 256. — ? *V. celebica* BECKER in Fedde, Rep. 14 (1916) 321; Beih. Bot. Centralbl. 34, ii (1916) 416. — **Fig. 8, 16, 17.**

Perennial; rhizome vertical to oblique, 1½–4 mm ø, bearing leaves and stems at apex. Stems up to 1 m, slender, rooted at some nodes, leafy, with flowers at some nodes. *Leaves* 1–10 by 1–6½ cm, 1–2 times as long as broad, ovate, deeply cordate at base, acute to acuminate, serrate or serrate-crenate, pubescent to hirsute above and beneath, especially on veins, rarely glabrous, usually pale green; petiole 1–17 cm, pilose especially distally, rarely glabrous. *Stipules* 7–30 by 1½–5 mm, lanceolate, long-acute, long-fimbriate, pubescent, fuscous or green. *Flowers* (5–)8–14 mm long, purple to white with darker veins; peduncle 4–12 cm, pilose especially distally, rarely glabrous. *Sepals* 3½–9 by 1–2 mm, linear-lanceolate, acute, entire or denticulate, usually pilose especially near base, ciliate; appendage 0.8–2½(–3) mm, pointed or denticulate, rarely rounded, pilose or rarely glabrous. *Petals* 1½–4 times as long as broad; basal obovate, sometimes slightly bearded; laterals oblanceolate, bearded; upper pair usually lightly bearded; spur 1–2½ mm, slightly shorter than to just exceeding calycine appendages, cylindrical, obtuse. *Style* 1½–3 mm, geniculate at base, somewhat thickened distally, apex gently or strongly curved to appear flattened or sometimes hooked, with simple emarginate stigma. *Capsule* 5–10 mm, ellipsoid, glabrous or pubescent in centre of valves.

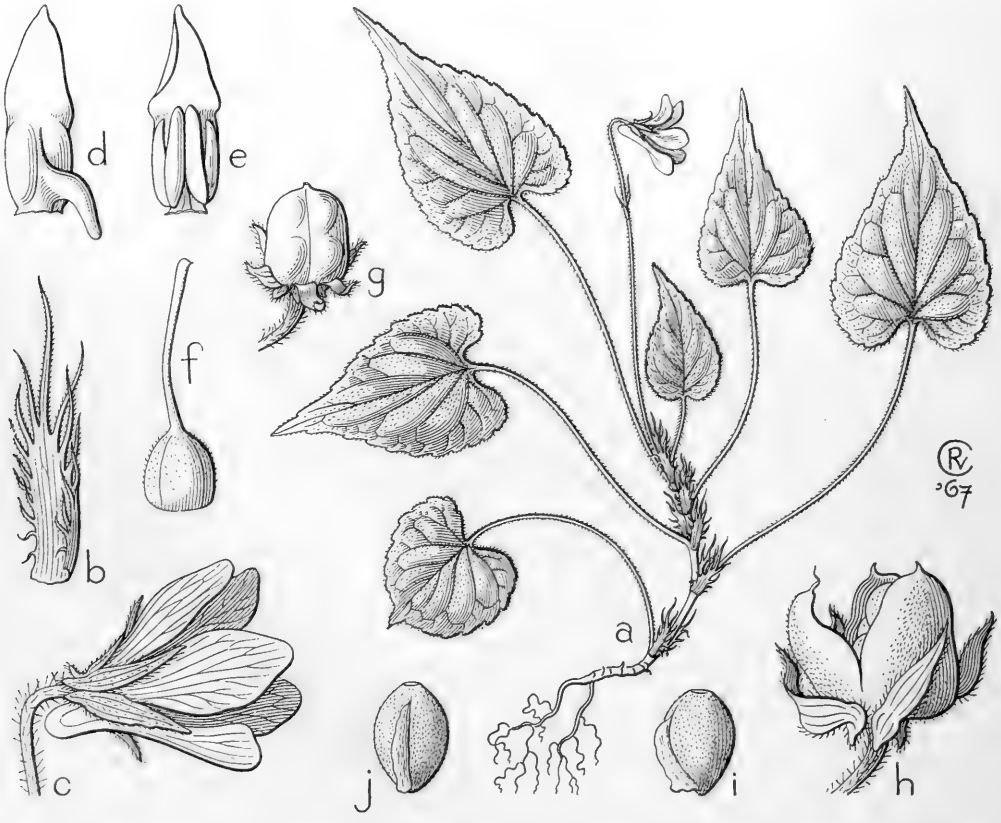

Fig. 17. *Viola pilosa* BL. *a.* Habit, ×⅔, *b.* stipule, ×2, *c.* flower, ×2, *d.* & *e.* stamens, ×6, *f.* pistil, ×6, *g.* young fruit, ×3, *h.* ripe fruit, ×3, *i.* & *j.* seed, ×6 (*a–f* KOORDERS 43653, *g–j* KUHL *s.n.*).

Distr. Himalayas, India, Burma, Thailand, China, in *Malesia*: Central Sumatra (Mt Kerintji), Java, Lesser Sunda Islands (Bali, Timor), SW. Celebes (Mt Bonthain), Moluccas (Buru, Ceram). Fig. 13.

Ecol. Grasslands, alpine woods, pathsides, 1100–3300 m. *Fl.* Jan.–Dec.

Notes. This is a rather variable species within which no satisfactory formal subdivision seems possible at present. The variation is principally in such characters as size, leaf-shape and indumentum, which are notoriously subject to environmental modification in this genus and no correlation can be detected between such variation and distribution. Conspicuously large and robust specimens, undoubtedly the result of particularly sheltered habitats, have been separated as *V. burgersdijkii* and *V. sarmentosa*. The most distinctive populations within *V. pilosa* are those from the Moluccas. Two collections from Buru (TOXOPEUS on 1 and 3 III 1922), at different elevations on Mt Fakal, superficially resemble *V. sumatrana* in leaf-colour, and in having glabrous, more or less entire calycine appendages; they are undoubtedly, however, subglabrous forms of *V. pilosa*. Material from Mt Pinaia in Ceram (STRESEMANN 302, EYMA 2259) is superficially like *V. papuana* in its coriaceous leaves and like *V. kjellbergii* in its rounded calycine appendages; it differs from both in having free stipules and from each in other characters. It is possible that these populations are worthy of subspecific status, but further material would be desirable since some of these characters are undoubtedly the result of the exposed alpine habitat which the species occupies in Ceram.

V. celebica BECKER was described from a SARASIN collection on Mt Bonthain in SW. Celebes. The undistributed collection was destroyed at Berlin, but the subsequent extensive collections by BÜNNEMEIJER from Mt Bonthain leave little doubt that it is referable to *V. pilosa*.

It may be that a fragment of the type is present in the diary of the SARASINS which is preserved at the Botanical Institute at Basel, but it has not been possible to examine this.

13. Viola sumatrana MIQUEL, Sum. (1860) 389; BECKER, Beih. Bot. Centralbl. 40, ii (1923) 108; RIDL. J. Bot. 73 (1935) 18. — *V. sumatrana* MIQ. *var. caerulescens* BOISSIEU & CAPITAINE, Bull. Soc. Bot. Fr. 57 (1910) 341. — *V. hossei* BECKER, Beih. Bot. Centralbl. 34, ii (1916) 257, *pro parte*; RIDL. J. Bot. 73 (1935) 18. — *V. sikkimensis* BECKER *var. acuminatifolia* BECKER, Beih. Bot. Centralbl. 34, ii (1916) 260. — *V. serpens* (*non* WALL.) RIDL. Fl. Mal. Pen. 1 (1922) 126. — *V. korinchensis* RIDL. J. Bot. 73 (1935) 15. — *V. robinsonii* RIDL. *l.c.* 16. — *V. jugalis* RIDL. *l.c.* 18. — **Fig. 8.**

Perennial; rhizome vertical to oblique, 1½–6 mm ø, bearing leaves and stems at apex. Stems up to 60 cm, slender, rooted at some nodes, with leaves and flowers at many nodes. *Leaves* ¾–7 by ¾–4 cm, 1–1¾ times as long as broad, ovate, moderately to deeply cordate at base, acute, serrate, glabrous or rarely with scattered hairs below, especially on veins, dark green or purplish above, glaucous below; petiole 1–15 cm, glabrous. *Stipules* 6–14 by 1–3 mm, linear-lanceolate, long-acute, long-fimbriate, fuscous. *Flowers* 10–14½ mm, purple to creamy white, with darker veins; peduncle 5–13 cm, glabrous or rarely hispid distally. *Sepals* 5–7 by *c.* 1 mm, linear-lanceolate, acute, entire, glabrous or sparsely pubescent, rarely ciliate; appendage 0.4–1(–1.4) mm, rounded or slightly denticulate, glabrous or rarely hispidulous. *Petals* 2–4 times as long as broad; basal rather shorter than the others, obovate; laterals oblanceolate, not bearded; spur 1–2 mm, usually twice as long as calycine appendages, cylindrical, obtuse. *Style* 1.7–2 mm, geniculate at base, clavate distally, apex with two lateral lobes and anterior stigmatic beak. *Capsule* 7–11 mm, ellipsoid, glabrous.

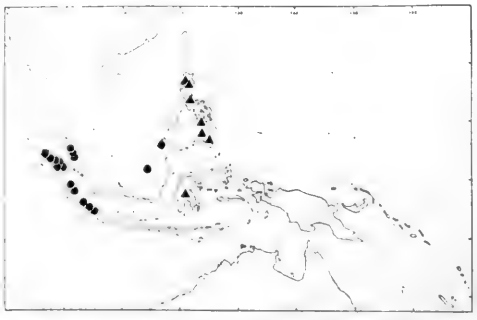

Fig. 18. Distribution of *Viola sumatrana* MIQ. (dots) and *V. mearnsii* MERR. (triangles).

Distr. China, Burma, Thailand, Indo-China, in *Malesia*: Sumatra, Malay Peninsula, Borneo (Sarawak: Batu Tibang; North Borneo: Mt Kinabalu). Fig. 18.

Ecol. River banks, pathsides, openings in montane woodland, 900–2800 m. *Fl.* Jan.–Dec.

Notes. This species has close affinities with *V. pilosa* and *V. curvistylis*. It differs from *V. pilosa* in the marginate stigma, unbearded lateral petals, short rounded calycine appendages, entire and usually glabrous sepals, and the generally glabrous leaves which are usually much darker on the upper side and which have glandular-serrate margins. *V. curvistylis* differs in its leaf-shape, bearded lateral petals, frequently hirsute sepals and its pale green, usually pilose leaves. *V. sumatrana* is apparently sympatric with *V. curvistylis* in the Malay Peninsula (Pahang), North Borneo (Mt Kinabalu) and Sumatra (Mt Kerintji), and with *V. pilosa* in Sumatra (Mt Kerintji).

The type description gives flower colour as yellowish, hence the recognition of *var. caerulescens* by BOISSIEU & CAPITAINE to account for their purple-flowered specimens. Plants with yellowish

or whitish flowers have been encountered sporadically throughout the range of the species, sometimes with the typical purple-flowered form. These specimens cannot otherwise be distinguished from the rest of the material examined and are undoubtedly colour mutants which do not merit formal taxonomic recognition.

14. Viola curvistylis BOISSIEU & CAPITAINE, Bull Soc. Bot. Fr. 57 (1910) 339; BECKER, Beih. Bot. Centralbl. 40, ii (1923) 168. — *V. ovalifolia* BECKER, Beih. Bot. Centralbl. 34, ii (1916) 256; RIDL. J. Bot. 73 (1935) 15. — *V. malvina* RIDL. J. Fed. Mal. St. Mus. 15 (1917) 135. — *V. serpens* (*non* WALL.) RIDL. Fl. Mal. Pen. 1 (1922) 126, *pro parte*. — *V. lecomteana* BECKER *ex* GAGNEP. Suppl. Fl. Gén. I.–C. 1 (1939) 181, *descr. gall., illeg.* — **Fig. 8.**

Perennial; rhizome vertical to oblique, slender to rather stout (4 mm ø), bearing leaves and stems at apex. Stems up to 35 cm, slender, creeping, bearing rooted rosettes of leaves and flowers at some nodes. *Leaves* 1–9 by ½–5 cm, about twice as long as broad, elliptic to lanceolate-ovate, shallowly cordate to cuneate at base, acute, serrate or crenate-serrate, hirsute on both sides, rarely pubescent or glabrous, pale green; petiole 0.6–10 cm, pubescent or scabrid, especially distally, rarely glabrous. *Stipules* 7–11 by 1–5 mm, linear-lanceolate, long-acute, long-fimbriate, glabrous, green or fuscous, free. *Flowers* 8–11 mm, violet or white with darker veins; peduncle 2–13 cm, slender, pubescent or scabrid, especially distally, sometimes glabrous. *Sepals* 4–6 by 0.6–1 mm, triangular- to linear-lanceolate, acuminate, entire, sometimes pubescent near base, usually ciliate; appendage ½–1 mm, rounded or slightly denticulate, glabrous or scabrid. *Petals* 2–3 times as long as broad; basal ⅔ as long as others, obovate; laterals oblanceolate, bearded; spur 1–1½ mm, exceeding calycine appendages, cylindrical, obtuse. *Style* 1½–2 mm, geniculate at base, clavate distally, with two large marginal lobes and anterior stigmatic beak at apex. *Capsule* 6–10 mm, globose to oblong, glabrous or pubescent.

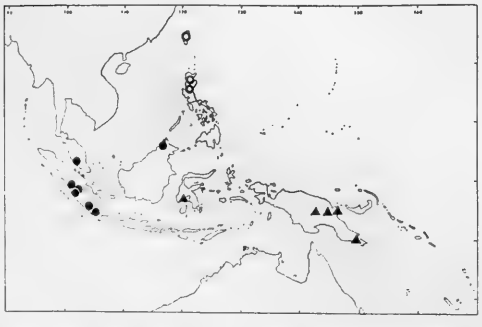

Fig. 19. Distribution of *Viola curvistylis* BOISS. & CAPIT. in Malesia (dots), *V. rupicola* ELM. (circles), and *V. kjellbergii* MELCH. (triangles).

Distr. Indo-China, Burma, in *Malesia*: Sumatra, Malay Peninsula, North Borneo (Mt Kinabalu). Fig. 19.

Ecol. Openings in montane woodlands, river banks, (600–)1000–3000 m. *Fl.* Jan.–Dec.

Notes. Differs from *V. sumatrana* in having bearded lateral petals and usually pilose leaves, and from *V. pilosa* in the prominent lateral margin of the style apex and in the usually rounded short calycine appendages, and from both species in leaf-shape. It is apparently sympatric with *V. sumatrana* in the Malay Peninsula (Pahang) and North Borneo (Mt Kinabalu), and with both *V. sumatrana* and *V. pilosa* on Mt Kerintji, Central Sumatra. The specific name derives from the curved, short style in the cleistogamous flowers of the type specimen; the species would be much better designated by BECKER's epithet *ovalifolia*.

15. Viola rupicola ELMER, Leafl. Philip. Bot. 1 (1908) 324; BECKER, Beih. Bot. Centralbl. 34, ii (1916) 415; Philip. J. Sc. 19 (1921) 712; Beih. Bot. Centralbl. 40, ii (1923) 171; MERR. En. Philip. 3 (1923) 106; LIN, Taiwania 1 (1950) 273. — *V. adenothrix* HAYATA, Ic. Pl. Formos. 3 (1913) 23. — *V. effusa* BECKER, Beih. Bot. Centralbl. 34, ii (1916) 424. — **Fig. 8.**

Perennial; rhizome vertical to oblique, rather stout, bearing leaves and usually stems at apex. Stems up to 25 cm, creeping to ascending, sometimes rooted at lower nodes. *Leaves* ¾–2½ by ¾–1¾ cm, (1–)1¼–1½ times as long as broad, elliptical to elliptic-ovate, cordate at base with narrow sinus and basal lobes rounded and somewhat converging, acute to subobtuse, shallowly crenate, subdentate on lobes, pubescent, often densely so; petiole ¾–12½ cm, slender, hirsute. *Stipules* 3–9 by 0.6 to *c.* 1 mm, lanceolate, acute, fimbriate to dentate, glabrous, fuscous. *Flowers* 9–12 mm, pale purple with darker veins; peduncle 4–9 cm, exceeding leaves, slender. *Sepals* 2–4 by *c.* 1 mm, ovate-lanceolate, acute, entire, sparsely pubescent on back and margin; appendage *c.* ½ mm, rounded, ciliate. *Petals* 2–3 times as long as broad, obovate to oblanceolate; basal usually shorter than the others; laterals and usually upper bearded; spur 0.8–2 mm, exceeding calycine appendages, cylindrical, obtuse. *Style* 1.2–1.4 mm, geniculate at base, clavate distally, with apex distinctly lobed on both sides and anterior stigmatic beak. *Capsule* 4–5 mm, globose to oblong, glabrous.

Distr. Formosa, in *Malesia*: Philippines (Luzon). Fig. 19.

Ecol. Damp ravines, rocky ledges and stream margins, *c.* 2000–2500 m. *Fl.* Febr.–May.

Note. Sympatric with *V. merrilliana* on Mt Pulog.

16. Viola kjellbergii MELCHIOR, Notizbl. Berl.-Dahl- 12 (1934) 206. — *V. arcuata* (*non* BL.) OOSTSTR. & H. J. LAM, Blumea 5 (1945) 594. — *V. lagaipensis* D. M. MOORE, Nova Guinea, Bot. *n.* 11 (1963) 182. — **Fig. 8.**

Perennial; rhizome more or less vertical, up to

2½ cm, bearing leaves, flowers and stems at apex. Stems up to 25 cm, slender, glabrous, leafy, with flowers and rooted at some nodes. *Leaves* 0.4–3 by 0.6–2.8 cm, ovate to somewhat reniform, shallowly to deeply cordate at base, obtuse to acute, crenate to distantly dentate, glabrous, sometimes sparsely pilose near sinus; petiole 0.2–8 cm, glabrous or pubescent, especially distally. *Stipules* 2–3 mm, ovate-lanceolate to lanceolate, acute, sparsely dentate or dentate-fimbriate, glanduliferous on margin and apex, glabrous or slightly ciliate, fuscous, adnate to petiole for ½ length. *Flowers* 4–10 mm, pale purple to white, with darker veins; peduncle 2½–25 cm, glabrous or sparsely pubescent distally. *Sepals* 2½–6½ by ½–1½ mm, lanceolate to ovate-lanceolate, acute, entire or sparsely fimbriodentate, glabrous, green or fuscous, with scarious margin; appendage up to 1 mm, rounded. *Petals* 1½–2 times as long as broad; basal obovate; others oblanceolate; laterals bearded; spur 0.2–2.4 mm, shorter than to slightly exceeding calycine appendages, rounded. *Style* 1.8–2½ mm, geniculate at base, somewhat curved, filiform; stigma simple, somewhat cupuliform at maturity. *Capsule* 5–7 mm, ellipsoid, glabrous, purple to green. Chromosome number: 2n = 48.

Distr. *Malesia*: SW. Central Celebes (Latimodjong Range), E. New Guinea. Fig. 19.

Ecol. Alpine heath and grasslands, occasionally wood margins, *c.* 2000–3540 m. *Fl.* June–March.

Notes. Superficially similar to the populations of *V. pilosa* from Ceram but differing in its adnate, shorter fimbriate stipules and in stigma shape. This species is related to *V. papuana* from which it is distinguished by the short spur, smaller flowers, shorter style and bearded lateral petals (occasionally so in *papuana*), and to *V. hederacea* from which it differs in the adnate stipules, the absence of leaves grouped in distinct rosettes, and in the much less marked bearding of the lateral petals.

17. Viola hederacea LABILL. Pl. Nov. Holl. 1 (1804) 66, t. 91; BECKER, Beih. Bot. Centralbl. 34, ii (1916) 428; D. M. MOORE, Blumea 11 (1963) 535, map. — **Fig. 8.**

Perennial; rhizome horizontal to oblique or vertical, rather stout, bearing leaves, flowers and stems at apex. Stems up to 25 cm, slender, prostrate, with rosettes of leaves and flowers at some nodes, rooted at some nodes. *Leaves* 0.9–2 by 0.9–3 cm, (1–)1.2–1½ times as broad as long, reniform to suborbicular, cordate, broadly obtuse, distinctly repand-crenate, sparsely pubescent beneath, more heavily above, subcoriaceous, dark green; petiole 0.8–9 cm, glabrous or sparsely pilose. *Stipules* 2–3 by 1–2 mm, ovate-lanceolate, acute, fimbrio-dentate to fimbriate, glabrous, green to fuscous, free. *Flowers* 7–9 mm, white with purple centre; peduncle 2–19 cm, much exceeding leaves, slender. *Sepals* 4–6 by *c.* 1½ mm, linear-lanceolate, acute, entire, glabrous, green with scarious margin; appendage up to ½ mm, rounded, glabrous. *Petals* about twice as long as broad, obovate-oblong; laterals bearded; spur absent or rudimentary. *Style c.* 2½ mm, geniculate at base, slightly curved, filiform; stigma terminal, simple. *Capsule c.* 8 mm, ellipsoid, glabrous.

Distr. Tasmania, Australia (S. Australia, Victoria, New South Wales, Queensland), in *Malesia*: Malay Peninsula (Cameron Highlands, Pahang). Fig. 20.

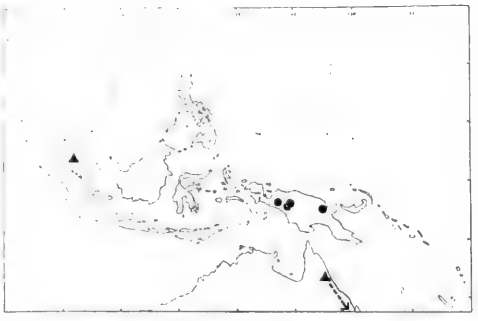

Fig. 20. Distribution of *Viola hederacea* LABILL. in Malesia (triangles) and *V. papuana* BECKER & PULLE (dots).

Ecol. Montane grassland, 2030 m. *Fl.* Sept.–Nov.

Note. The isolated occurrence in Malaya of this Australian species is surprising, and falls outside the accepted migration track of cold-loving plants from the southern hemisphere into Malesia. However, in view of its relatively recent discovery in the Cameron Highlands, an area which has been well-collected in the past, in a locality close to the radio station on Batu Brinchang, it is possible that this species has been introduced by man.

18. Viola papuana BECKER & PULLE, Nova Guinea 8 (1912) 670; BECKER, Beih. Bot. Centralbl. 34, ii (1916) 431; D. M. MOORE, Nova Guinea, Bot. *n.* 11 (1963) 184. — *V. klossii* RIDL. Trans. Linn. Soc., Bot. 9 (1916) 18. — **Fig. 8.**

Perennial; rhizome more or less vertical, stout, bearing leaves and stems at apex. Stems up to 24 cm, rather slender, rooting at nodes with leaves and flowers along their length. *Leaves* 0.4–1.4 by 0.6–1.8 cm, ovate, rather deeply cordate at base with rounded basal lobes, acute to subobtuse, more or less repandate to undulate-serrate, glabrous or sparsely pubescent on veins above and sparsely ciliate, rather coriaceous, dark green and often purple-tinged; petiole ½–4 cm. *Stipules* 3–4 by *c.* 1 mm, lanceolate to ovate-lanceolate, acuminate, subentire to sparsely fimbriate, sometimes glanduliferous, glabrous, fuscous. *Flowers* (excluding spur) 8–13 mm, pale violet to white with violet centre; peduncle 4–14 cm, glabrous. *Sepals* 3–6 by *c.* 1 mm, lanceolate to ovate-lanceolate,

acute, sparsely fimbrio-dentate; appendage *c.* ½ mm, rounded, glabrous. *Petals* 2–3 times as long as broad; basal obovate, slightly shorter than others; laterals oblanceolate to obovate, usually not bearded; spur (3–)4–9 mm, cylindrical, straight or slightly upcurved, obtuse. *Style* 2½–3 mm, geniculate at base, slightly curved, filiform; stigma simple, more or less indistinctly cupuliform. *Capsule* 7–9 mm, oblong-ellipsoid, glabrous. Chromosome number 2n = 48.

Distr. *Malesia*: New Guinea. Fig. 20.

Ecol. Pathsides and open places in montane forest and among rocks of alpine areas, 2100–3350 m. *Fl.* Oct.–Febr.

Doubtful

Viola ramosiana BECKER, Philip. J. Sc. 19 (1921) 716. Based on a fruiting specimen from "c. 1350 m, along streams, Mt. Masingit, Lubuagan, Kalinga Subprovince, Luzon, Philippines, on ii. 1920, by RAMOS & EDAÑO, Bur. Sci. 37548". The holotype was destroyed in the Manila herbarium. An isotype (US) does not agree with the description in that it is not stoloniferous, the stipules are partially adnate to the petiole, and some of the leaves are sparsely pubescent. This material may be referable to *V. philippica*, which is known from the same locality, but it differs from that species in the well-developed glands on the marginal crenations of some leaves. This, together with the absence of flowers and the firm reference to stolons in the destroyed holotype, precludes any definite application of this specific name.

Excluded

Tribe *Sauvagesieae*, including the genera *Neckia* KORTH., *Sauvagesia* L., *Schuurmansia* BL., and *Indovethia* BOERL. were sometimes arranged in *Violaceae*, but are now unanimously classified in *Ochnaceae*.

Gestroa BECC. Malesia 1 (1877) 184 is, according to SLEUMER, Fl. Mal. I, 5 (1954) 6, a synonym of *Erythrospermum* (*Flacourtiaceae*).

Perissandra GAGNEP. Bull. Soc. Bot. Fr. 95 (1948) 27, from Indo-China is, according to JACOBS, Blumea 15 (1967) 138, a synonym of *Vatica* (*Dipterocarpaceae*).

APONOGETONACEAE (H. W. E. van Bruggen, Heemskerk)

1. APONOGETON

LINNÉ *f.* Suppl. (1781) 32; ENGLER & KRAUSE, Pfl. R. Heft 24 (1906); STEEN. Fl. Mal. I, 4 (1948) 11; BRUGGEN, Blumea 18 (1970) 457–486. — **Fig. 1–5.**

Perennial waterplants with a tuberous, elongate or cylindrical and often branched rootstock or rhizome which produces a tuft of leaves and the inflorescences. *Leaves* submerged and/or floating (very seldom emerged), with a mostly distinct midrib and one or more pairs of parallel main nerves, connected by numerous cross-veins. *Inflorescence* long-peduncled, emerging above the water surface, in bud enveloped by a caducous or rarely persistent spathe, composed of 1 (in Mal.) or 2–11 spikes. Flowers (in Mal.) bisexual, spirally arranged, turned towards all directions. *Tepals* 2, mostly persistent, rarely caducous. *Stamens* 6, in 2 whorls. *Ovaries* 3(–4–5), free, sessile, narrowed into the style with a stigmatic ridge on the inner side; ovules 2–8 per carpel. *Fruits* with a mostly distinct, lateral or terminal, often curved beak. *Seeds* without endosperm; testa mostly a single envelope, sometimes, however, split into two envelopes, the inner one, brown and closely fitting the embryo, the outer loose, transparent and reticulately veined; embryo with the plumule fitting in a groove or not, or without plumule (the embryos of all species with a double testa seem to have no plumule).

Distr. About 40 *spp.* described, from Africa (Ethiopia to the Cape), Madagascar, India & Ceylon, through SE. Asia (to *c.* 30° NL) and Malesia to SW., N. and E. Australia (to 34° SL), centering in Africa and Madagascar.

Ecol. In stagnant and running, shallow water, mostly in the lowlands, ascending to *c.* 1000 m; *A. crispus* THUNB. in Ceylon 1000–2300 m, also in Africa and Madagascar some species to *c.* 2500 m.

Phytochem. Very little is known about the chemistry of this highly interesting family. Since no recent chemical investigations were published, the reader is referred to the discussion of *Aponogetonaceae* in HEGNAUER, Chemotax. d. Pfl. 2 (1963) 70–73. — R. HEGNAUER.

Uses. In Malesia none. The starchy tuberous rootstock of most species is edible and seems to be in some areas an important food source in times of famine. The leaves and inflorescences can serve as a vegetable. Many species are in cultivation with aquarists.

KEY TO THE SPECIES

1. Tepals longer than 5 mm, caducous. Ovules 2. Plant stoloniferous. . . . . **1. A. undulatus**
1. Tepals shorter than *c.* 3 mm, persistent. Ovules 4–8. Plant not stoloniferous.
2. Testa double. Tepals yellow. . . . . **2. A. lakhonensis**
2. Testa simple.
3. Cross-veins at a ± 50° angle. Tepals yellow. Filaments only slightly widening towards the base. Fruit with a terminal beak. . . . . **3. A. loriae**
3. Cross-veins at a ± 70° angle. Tepals white or cream. Filaments strongly widened and applanate. Fruit with a short lateral beak. . . . . **4. A. womersleyi**

1. Aponogeton undulatus ROXB. [Hort. Beng. (1814) 26, *nomen*] Fl. Ind. ed. Carey 2 (1832) 211; ENGLER & KRAUSE, Pfl. R. Heft 24 (1906) 11, *pro nomen, excl. descr.*; BRUGGEN, Blumea 18 (1970) 465, f. 2[8], t. I–II. — *Spathium undulatum* EDGEW. Calc. J. 3 (1843) 534, f. 15. — *Ouvirandra undulata* EDGEW. in Hook. Lond. J. Bot. 3 (1844) 404, f. 18. — *A. microphyllum* ROXB. Fl. Ind. ed. Carey 2 (1832) 211; HOOK. *f.* Fl. Br. Ind. 6 (1894) 565. — *A. stachyosporus* DE WIT, Med. Landb. Hogeschool Wagen. 2 (1958) 96, f. 1–3. — *A. crispus* (*non* THUNB.) HOOK. *f.* Fl. Br. Ind. 6 (1898) 564, *pro parte*; TRIM. Fl. Ceyl. 4 (1898) 372; GAMBLE, Fl. Pres. Madras 3 (1931) 1597. — *A. monostachyon* (*non* L. *f.*) ANDR. Bot. Rep. 6 (1797) t. 406. — **Fig. 1[1], 2.**

Tuber globular, obovoid, or elongate, 6–25 mm ø, smooth. *Submerged leaves* 10–25 by ¾–4¼ cm, alternately transparent or opaque in an irregular pattern; base (narrowly) cuneate or rounded,

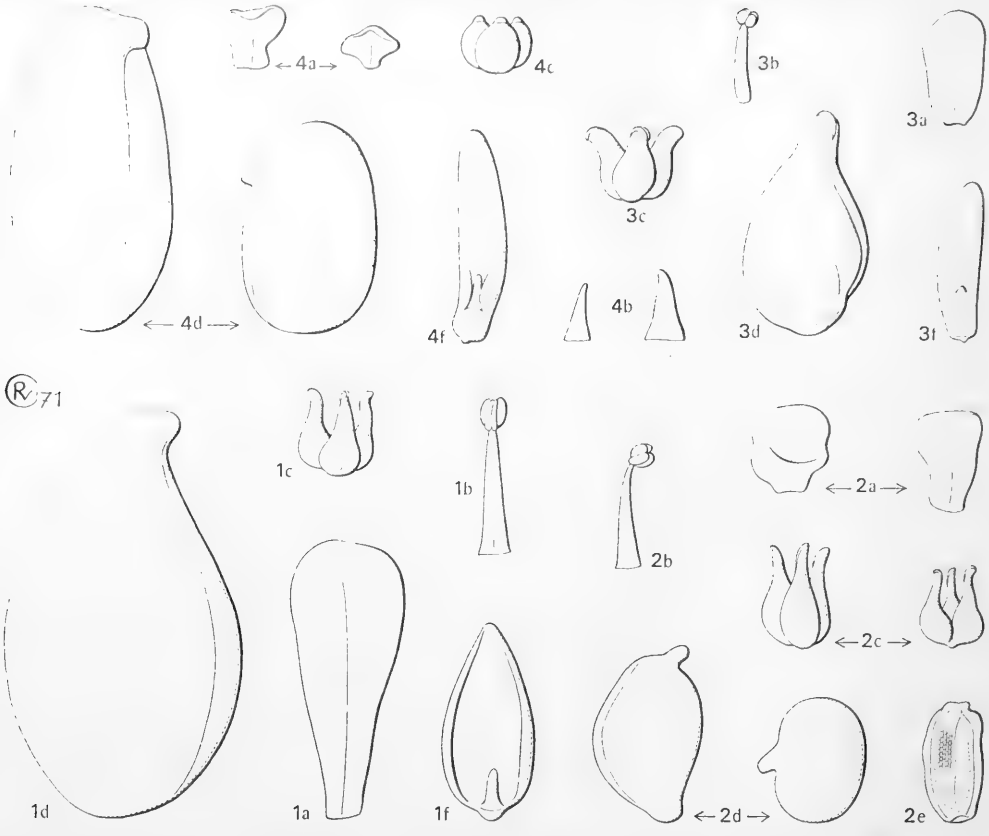

Fig. 1. Floral details of *Aponogeton*. — 1. *A. undulatus* ROXB. — 2. *A. lakhonensis* A. CAMUS. — 3. *A. loriae* MARTELLI. — 4. *A. womersleyi* BRUGGEN.
In all figures *a* = tepal(s), *b* = stamen, *c* = ovaries, *d* = fruit(s), *e* = seed, *f* = embryo. All ×7 (Courtesy Blumea).

apex (narrowly) cuneate or rounded, seldom emarginate, tip blunt; margin undulate, midrib wide with (2–)3(–4) main nerves on either side; petiole 10–35 cm. *Floating leaves* rather rare, up to 20 by 3½ cm; base rounded or cordate, apex cuneate with a blunt tip; main nerves 5 or 7; petiole up to 70 cm. *Peduncle* up to 55 cm, thickening towards the inflorescence. Spathe up to 17 mm, persistent or caducous. Spike up to 10 cm, laxly flowered. *Tepals* (1–)2(–3), caducous, spathulate or obovate, 1(–2–3)-nerved, white or pinkish, (2–)3½–6(–12) by 1–2½(–4) mm. *Filaments* slightly widening towards the base, white or pinkish; anthers light yellow, pollen yellow. *Ovaries* 3(–4), light pink, 1¼–2 by ½–1 mm; ovules 2. Infructescence up to 16 cm. *Fruit* 5–7 by 4 mm with a short, terminal, curved beak. *Seeds* with a simple testa; embryo up to 5 by 2 mm; plumule attached near the base of the embryo and lying in a very wide groove.

Runners resembling peduncles, ascending, up to 35 cm, not or slightly thickened towards the tip. The plantlet is developed at the tip of the runner, in an early stage it is enveloped by a persistent spathe of up to 20 mm. The young plant itself may also put forth one or two short runners, and by repeating this up to 7 plantlets may be produced.

Distr. NW., N. and NE. India, E. Pakistan, Burma, ?Thailand; in *Malesia*: ?Malay Peninsula (Johore: Sg. Sedili at Mawai).

Ecol. Ponds and ditches, 300 m. *Fl.* July–Aug. and Nov.

Notes. There are no specimens which specimens proved to come from Malaya. The only have been I have seen were collected in the Van Cleef Aquarium at Singapore. They are said to have been collected in the Sg. Sedili at Mawai, but I am not convinced that this record is reliable. These specimens have been described as *A. stachyosporus*. Also the occurrence in Thailand has not yet been proved. Yearly many thousands of corms are exported from Bangkok for aquarium purposes. They are claimed to have been collected near Chanthaburi and Haadyai (close by the Ma-

Fig. 2. *Aponogeton undulatus* ROXB. Drawn at Singapore after a living specimen in the Van Kleef Aquarium, said to have been collected originally in the Sg. Sedili, Johore, by ERNEST TOFT, ×½.

layan frontier), but up till now I have not seen herbarium specimens collected in Thailand either.

It is remarkable that *A. undulatus* flowers very seldom in cultivation. I have been cultivating specimens from different localities for more than twelve years, but up till now only once an inflorescence has developed.

It seems that in the eastern part of its range the leaves are more narrow than in the western part; moreover, the eastern populations seem not to tend to develop floating leaves.

2. Aponogeton lakhonensis A. CAMUS, Not. Syst. 1 (1909) 273, f. 18; Fl. Gén. I.-C. 6 (1942) 1226; BRUGGEN, Blumea 18 (1970) 479, f. 2¹², 3a. — *A. pygmaeus* KRAUSE, Bot. Jahrb. 44 (1910) Beibl. 101: 8; A. CAMUS, Fl. Gén. I.-C. 6 (1942) 1227. — *A. luteus* A. CAMUS, Not. Syst. 2 (1911) 204; Fl. Gén. I.-C. 6 (1942) 1227. — *A. monostachyon* (*non* L. *f.*) A. CAMUS, Fl. Gén. I.-C. 6 (1942) 1225; LARSEN, Dansk Bot. Ark. 20, 2 (1962) 134. — *A. loriae* (*non* MARTELLI) STEEN. Fl. Mal. I, 4 (1948) 11, *pro descr.* — **Fig. 1², 3.**

Tuber elongate or obovoid, up to 2 cm ø. *Submerged leaves* very variable in shape and size, narrowly oval to linear, up to 25 by 6 cm (*e.g.* 25 by 6 cm, 15 by 0.9 cm); base (very) narrowly cuneate, apex narrowly cuneate with a blunt tip or rounded; main nerves 7 or 9; petiole 7–35 cm. *Floating leaves* (not seen in Mal.) up to 17 by 4 cm, base cordate or (seldom) rounded; apex cuneate with a blunt tip or rounded; main nerves 7 or 9. *Peduncle* only slightly thickening towards the inflorescence. Spathe *c.* 17 mm, caducous, rarely persistent. Spike up to 8 cm, rather laxly, sometimes densely flowered. *Tepals* 2, obovate, 1–2 by ¾–1½ mm, yellow, 1-nerved. *Stamens* 6, 1½–3 mm, filaments widened towards the base. *Ovaries* 3–4(–5), 1–1¾ by ¾–1 mm; ovules 4–8. Infructescence up to 17 cm. *Fruits* up to 3 by 2 mm, with a terminal or lateral beak. *Seeds* 2–3 by 1 mm; testa double; embryo 1¼–2½ by ½ mm; plumule absent.

Fig. 3. *Aponogeton lakhonensis* A. CAMUS. Habit, with submerged leaves (HARMAND *s.n.*), ×½ (Courtesy Blumea).

Distr. SE. Asia (India: Assam, Thailand, Cambodia, Vietnam, China); in *Malesia*: SW. Celebes (Maros; Pangkadjene), two collections.

Ecol. Slow running streams, flooded rice fields and ponds, in Celebes in a stream in limestone country, not frequent but rather abundant locally, 200–800 m. *Fl.* March, May, Sept. and Oct.

Note. The Malesian specimens are very fragmentary with regard to their generative parts, and have only some almost ripe fruits. Therefore, I can not be completely certain that these specimens belong indeed to the continental *A. lakhonensis*. They share with this species the shape of the tepals and the structure of the seed, which has a double testa. This last characteristic distinguishes them from *A. loriae* from Papua, which has a single testa and with which they were confounded before. It is highly desirable to have fresh material from Celebes for further study.

3. Aponogeton loriae MARTELLI, Nuova Giorn. Bot. Ital. 2, 3 (1897) 472, t. 8; ENGLER & KRAUSE, Pfl. R. Heft 24 (1906) 12; RENDLE, J. Bot. (1923) Suppl. 58; STEEN. Fl. Mal. I, 4 (1948) 11, *excl. descr.*; BRUGGEN, Blumea 18 (1970) 473, f. 2⁹, 5b. — *A. crispus* (*non* THUNB.) F. v. M. Descr. Not. Pap. Pl. 8 (1886) 51; RIDL. J. Bot. 24 (1886) 359. — *A. monostachyon* (*non* L. *f.*) HEMSL. Kew Bull. (1899) 113. — **Fig. 1³, 4b, 5.**

Tuber up to 2½ cm ø. *Leaves submerged*, very hard in texture, greenish red, 15–65(–80) by 1–3¾ cm; base narrowly cuneate, apex (narrowly) cuneate with a blunt tip; main nerves 7–9, connected by numerous cross-veins at a 50° angle; margin flat, waved or slightly crisped; petiole 2–15(–30) cm. *Peduncle* up to 60 cm, *c.* 3½ mm ø, not or slightly thickening towards the inflorescence. Spathe up to 22 mm, persistent, seldom caducous; spike up to 12 cm, densely or rather laxly flowered, scentless. *Tepals* 2, obovate, (greenish) yellow, 1–2 by 1–1¾ mm, 1-nerved. *Stamens* 6, 1½–2 mm, filaments not or slightly widened towards the base; filaments, anthers, and pollen yellow. *Ovaries* 3, 1¼–1½ by ¾–1 mm, yellow; ovules 4–8. Infructescence cylindrical, very dense. *Fruits* up to 6 by 3½ mm, with a terminal beak, greenish brown. *Seeds* with a simple testa; embryo 2½–4 by ¾–1 mm, greenish brown; plumule very small, completely covered

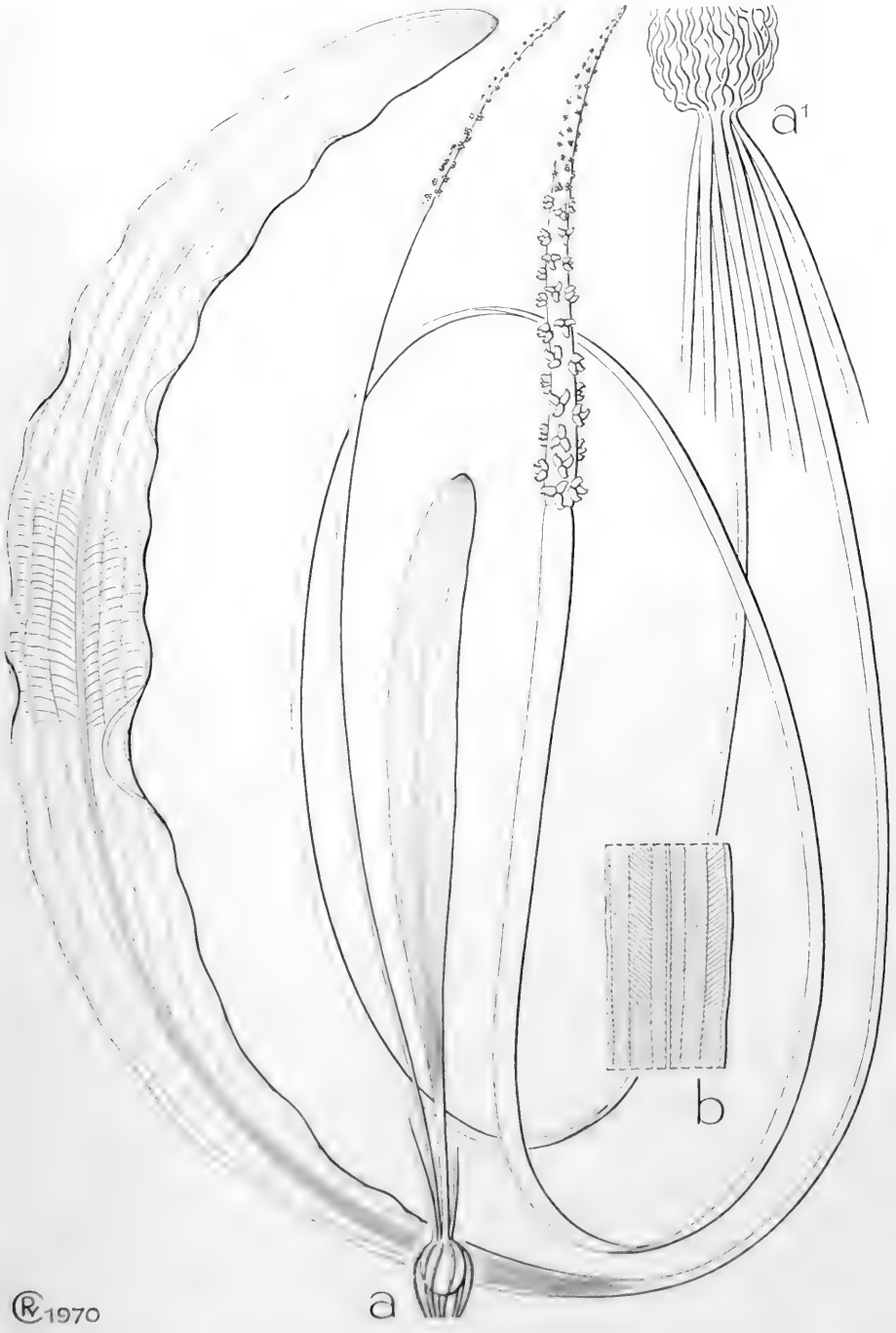

Fig. 4. *Aponogeton womersleyi* BRUGGEN. *a–a'*. Habit. — *A. loriae* MARTELLI. *b*. Fragment of leaf showing venation. All × ½ (*a* BRASS 8671, *a'* NGF 17717, *b* BRASS 5567) (Courtesy Blumea).

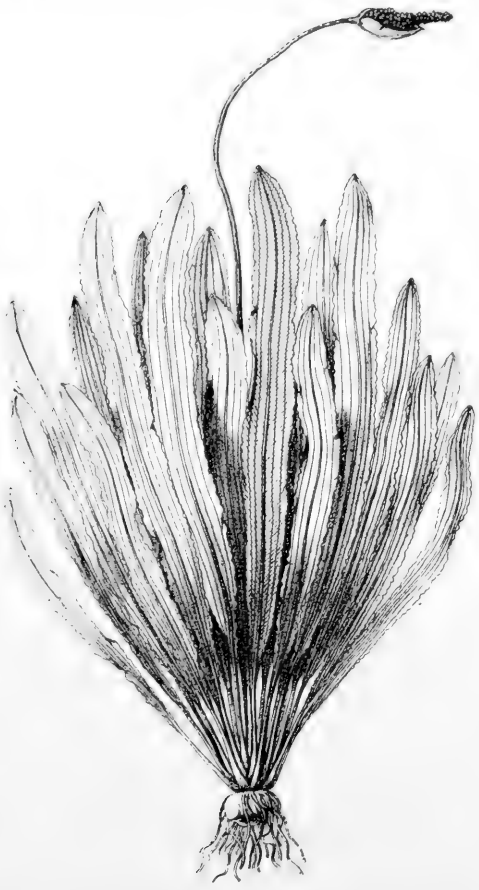

Fig. 5. *Aponogeton loriae* MARTELLI. From the type, after MARTELLI, × *c.* ½.

by the margin of the cotyledon, and therefore nearly invisible.

Distr. *Malesia*: East New Guinea (Papua, Central District: Laloki R., *c.* 3 miles E of Sogeri patrol station, 147°25′ E, 9°30′ S; Sogeri: Sirinumu area, *c.* 3 miles S of Sogeri; Kubuna; Koitaki; Magibiri; affluent of Laragi; stream near Ower's Corner).

Ecol. Common in swiftly flowing, shallow, stony streams, 100–600 m. *Fl.* June–Jan.

Note. The description is partly based on cultivated specimens from Sirinumu, I received thanks to the co-operation of Dr. ROBBINS and Mrs. PULSFORD of the University at Pt. Moresby.

4. Aponogeton womersleyi BRUGGEN, Blumea 18 (1970) 477, f. 2[10] 5a. — **Fig. 1[4], 4a.**

Tuber up to 2½ cm ø. *Leaves submerged*, 20–50 by 1½–3½ cm; base very narrowly cuneate, apex narrowly cuneate with a blunt tip; main nerves 7 or 9, connected by numerous cross-veins at a ± 70° angle; margin flat or waved; petiole 5–35 cm. *Peduncle* up to 1½ m, strongly thickened towards the inflorescence. Spathe unknown, caducous. Spike up to 15 cm, very laxly flowered. Flowers very small. *Tepals* 2, white to cream, broadly obovate or wedge-shaped, ¾–1 by 1–1¼ mm, 1-nerved. *Stamens* 6, ¾–1¼ mm, filaments strongly widened towards the base and applanate. *Ovaries* 3, up to 1 by ¾ mm, ovules 4–6. Infructescence very dense. *Fruits* greenish brown, 7–8 by 2–3 mm, laterally beaked. *Seeds* with a simple testa; embryo 4–5 by ½ mm; plumule *c.* ½ mm, attached at ± 1/6 of the length of the embryo and partly covered by the margins of the cotyledon.

Distr. *Malesia*: East New Guinea (Papua, Western District: Oriomo R., mouth of Yakup Creek, *c.* 64 km from sea, 143° E, 8°50′ S; Penzara, between Morehead and Wassi Kussa R.), 2 collections.

Ecol. Usually rooting on muddy bottoms in the shallower parts of lowland rivers in savannah forests. *Fl. fr.* Sept. and Dec.

Vern. *Zo-inge*, Penzara.

Note. *A. womersleyi* is clearly different from *A. loriae* from the Central District and even in a sterile state they cannot be confused, as its cross-veins are at a 70° angle (in *A. loriae* at a ± 50° angle).

LEMNACEAE (F. van der Plas, Leyden)

Monoecious, very rarely dioecious, small to minute aquatic annuals, floating at the surface of the water, or floating just below the surface whereby only a very small part of the frond is exposed to the air, or completely submerged and then rising to the surface in the flowering period. *Fronds* either solitary or connected in small groups by short to very short hyaline or rarely elongate green stipes (fig. 1 Aa, 1 Ba), symmetric or asymmetric, with reniform, round, linear-lanceolate or angular dorsal outline, green, with or without red or brown pigment cells, sometimes with both types of pigment; base symmetric or asymmetric, obtuse, emarginate or narrowing into the stipe; apex symmetric or asymmetric, round, obtuse or acute; margin entire or slightly dentate; dorsal side flat to slightly convex, smooth or with one or more small papillae; ventral side flat to strongly inflated; somewhere in the median provided with a 'node' (fig. 1 Ac). There the roots, nerves, new fronds, and flowers emerge. Nerves 0–1–∽, running towards the apex. New fronds attached to the node of the mother frond by means of a 'stipe' which is sometimes hardly visible and is connate with their ventral side. *Daughter frond* sometimes (in *Spirodela*) provided with 2 basally connate, roundish scales inserted at the base of the stipe (fig. 1 Ad, 2 e), unequal, one connate with the ventral side as far as its node. *Roots* several, one or none, unbranched, growing downward from the node; in root-producing species the root(s) closely enveloped by a sheath, which during growth is circumscissile-dehiscing, leaving a basal sheath (in some species soon hardly visible) and a 'calyptra' on top. *Budding pouches* 2 (fig. 1 Ab) or 1 (fig. 1 Cb); if there is one budding pouch this is basal, median, dorso-ventrally flattened or funnel-shaped and it produces only new fronds; when there are 2 budding pouches these are lateral, one on either side of the axis, dorso-ventrally flattened and produce new fronds, one pouch may give rise to an inflorescence. In taxa with only 1 budding pouch (fig. 1 Cj; *subfam. Wolffioideae*) the *inflorescence* is borne in a median or lateral dorsal flowering cavity (an exception is extra-Mal. *Wolffiopsis* which has 2 dorsal flowering cavities), without a spathe and consisting of 1 female and 1 male flower. In taxa with 2 budding pouches (fig. 3 k, 6 e–f) the *inflorescence* is surrounded by a spathe and consists of 1 female and 2 male flowers (female flower rarely absent). Perianth none. — *Male flower* consisting of 1 stamen, anther uni- (fig. 8 d) or bilocular (fig. 2 f), apically or transversely dehiscent; filament short or long and slender; pollen grains 17–21 $\mu\varnothing$, spinose. — *Female flower* consisting of 1 globular ovary with a short persistent style (fig. 3 k, 6 f), and containing 1–4 ovules. *Ovules* orthotropous, amphitropous or anatropous. *Fruit* symmetric (fig. 5 d–e) or asymmetric, 1–4-seeded, globose or laterally compressed, winged or without wings. *Seeds* smooth or ribbed (fig. 4 l), with little or no endosperm; operculum and chalaza prominent.

Distribution. There are 6 genera with *c.* 30 *spp.* all over the world, obviously introduced in oceanic islands (see under dispersal). The genera *Spirodela*, *Lemna*, and *Wolffia* are widely distributed in the temperate and tropical zones; the other genera have a more restricted range. *Wolffiella* occurs in the subtropical and tropical parts of America and in South Africa, *Pseudowolffia* is restricted to tropical Africa, and *Wolffiopsis* has been found in the tropics of Africa and America. See Den Hartog & Van der Plas (Blumea 18, 1970, 355–368).

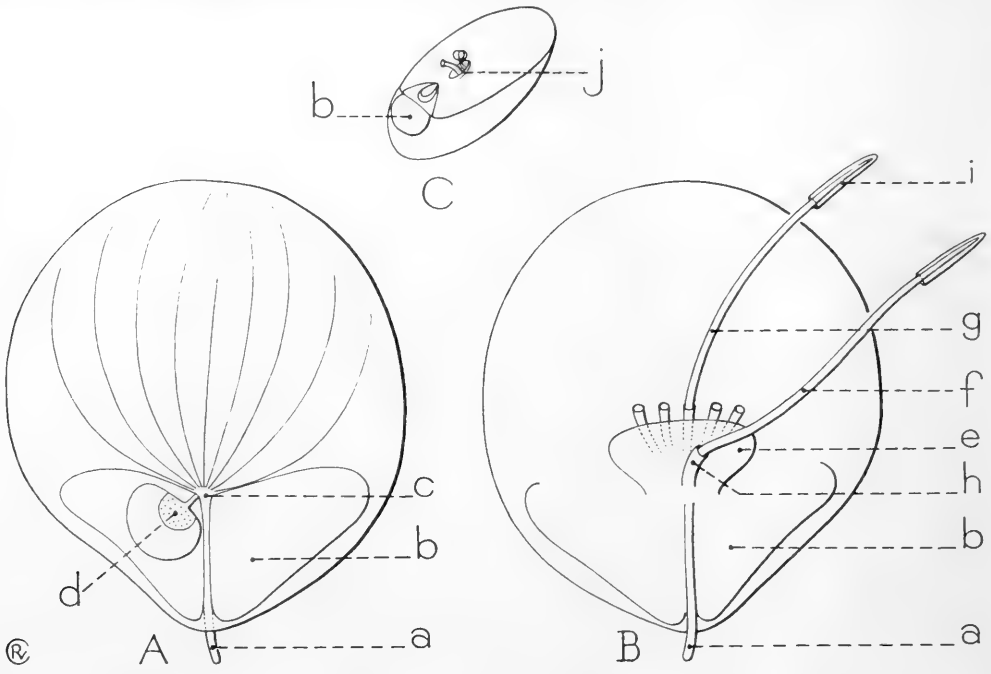

Fig. 1. Diagrams showing the external morphology of *Lemnaceae*.
A–B. *Spirodela polyrhiza* (L.) SCHLEID. A. Dorsal side of the frond, B. ventral side of the frond. — C. *Wolffia sp.*
In all figures: *a* = stipe, *b* = budding pouch, *c* = node, *d* = young frond showing the dorsal scale, *e* = ventral scale, *f* = primary root, *g* = secondary root, *h* = root sheath, *i* = root cap, *j* = flowering cavity with ♂ and ♀ flower.

In *Malesia* the first three mentioned genera occur with together 6 *spp.* As Lemnaceous plants are distinctly under-collected, their precise distribution is very incompletely known, and consequently range extensions may be expected. For this reason 3 *spp.* are added here which have not yet been found in Malesia, but which may be found in future.

In oceanic islands *Lemnaceae* are very scarce and possibly all introduced according to GUPPY. From the Pacific islands the following are known to me from collections: Hawaiian Is. *Spirodela polyrhiza* and *Lemna perpusilla* (HELLER 1895, LE ROY TOPPING and DEGENER 1927). *L. perpusilla* is, besides in Hawaii, also collected in Polynesia already during the Wilkes' Exploring Exp. from Fiji (*non vidi*), and further known from New Caledonia (last century), Samoa (1893) and Tonga (1926). *Spirodela punctata* is also known from Fiji and New Caledonia. This is also recently collected on Mahé Atoll (Maldives, Indian Ocean).

Ecology. *Lemnaceae* are found in fresh water, or sometimes in brackish water or on wet mud; in stagnant waters of canals, ditches and small ponds, sometimes also in small, sluggish streams. They usually indicate eutrophic conditions, and are generally favoured by organic pollution. In Malesia they occur up to 2100 m, outside Malesia they have been found much higher, *e.g. Lemna trisulca* up to 3000 m. They occur in monospecific growths as well as mixed with other Lemnaceous species; they associate also with other small aquatics, *e.g.* with water ferns of the genera *Salvinia* and *Azolla* or with the liverwort *Ricciocarpus natans*. Submerged *Lemnaceae* sometimes associate with liverworts of the *Riccia fluitans* complex. They mostly form a thick layer at the surface of the water or just below it, and form a nuisance when they choke drainage ditches or cover fish ponds.

The most common species in Malesia are *Spirodela polyrhiza*, *S. punctata* (Java!), *Lemna perpusilla*, and *Wolffia globosa* (Malay Peninsula).

The ecological demands of the various species are generally similar, although not exactly the same, and the tolerance to various environmental conditions differs from species to species. In India MAHESHWARI & KAPIL (Amer. J. Bot. 50, 1963, 679) only found *Wolffia microscopica* in association with *Lemna perpusilla*, while *Wolffia arrhiza* (no doubt *W. globosa* was meant) was only found together with *Spirodela polyrhiza*. In the tropics of East Asia and Australia, however, mixed populations of *Wolffia globosa* and *Lemna*

perpusilla, with or without *Spirodela polyrhiza*, are not rare. Thus the combinations of these species appear to be of local interest.

Between the roots and in the root sheaths of the *Lemnaceae* blue-green *Algae* of the genera *Nostoc* and *Anabaena* have often been found.

Lemnaceae are attacked especially by non-aquatic insects; MCCANN (J. Bomb. Nat. Hist. Soc. 43, 1942, 152) found beetles (*Curculionidae*) and the larvae of a moth (*Nymphula responsalis* WALKER) feeding on the upper parts of the fronds of *Lemna* and *Spirodela*. Eggs, larvae and cocoons were found within the fronds. Many small aquatic animals choose the fronds as a substratum but generally do not feed on them.

Vegetative and sexual reproduction. Multiplication takes place mainly by budding. Some species, *e.g. Spirodela polyrhiza*, produce specialized resting buds, *i.e.* modified fronds consisting of compact tissue filled with reserve food, for surviving less favourable periods (drought, low temperatures). In *Spirodela* and *Lemna*, the most primitive members of *Lemnaceae*, the budding pouches serve for sexual as well as for vegetative reproduction. In the more evolved genera, *Wolffia*, *Wolffiella*, *Pseudowolffia* and *Wolffiopsis* the budding pouch serves only for vegetative reproduction, while the inflorescence is borne in 1 or 2 special dorsal flowering cavities, which are only formed when the frond starts flowering.

For a number of species flowering is a rare feature, and of a few species the flowers are still unknown. However, as the flowers are small, inconspicuous and ephemeral, it is possible that flowering has often remained unobserved; only when a whole population is flowering this phenomenon is easily detected. Gregarious flowering is possibly restricted to very specific ecological conditions. In herbarium material one single flowering or fruiting plant is often to be found among many sterile ones.

Monoecious plants are most common; plants carrying flowers of one sex only have rarely been found in *Lemna gibba* (DEN HARTOG, Gorteria 4, 1968, 90–92). In *Spirodela polyrhiza* SCHLEIDEN (Beitr. Bot. 1844, 230) found "male" inflorescences, in which the male flowers were normally developed but the female flower was abortive.

The male and female flowers of one inflorescence are usually not mature at the same time; proterandry or proterogyny are more or less a rule. In *Lemna* species even the two male flowers do not grow out of the spathe at the same time (fig. 3 k, 4 i). The various types of flowering sequence may be exhibited in a single species, although the various populations are always uniform in this respect. As a consequence of this, self-pollination is excluded. Cross-pollination is possible by contact between the stamens of one plant with the stigma of another one. This contact pollination can easily be brought about by water movements (TRELEASE, Proc. Boston Soc. Nat. Hist. 21, 1882, 410–415; MCCANN, J. Bomb. Nat. Hist. Soc. 43, 1943, 151; DEN HARTOG, Gorteria 2, 1964, 68–72). MCCANN *l.c.* reports pollination by small insects. How pollination takes place in the species with a dorsal flowering cavity is not known.

In *Lemna* the seed is usually liberated from the fruit by decay or, more seldom, by splitting of the pericarp. Sometimes the fruit becomes detached from the frond and the seed remains enclosed by the pericarp. In autumn the fruits often remain attached to the dying fronds and sink with them to the bottom. When the seed germinates the pericarp is often still present (DE SLOOVER, Naturalistes Belges 47, 1966, 449). Germination (fig. 4 n) can take place immediately and sometimes starts while the fruit is still attached to the frond (LUDWIG in Kirchner, Loew & Schröter, Lebensgesch. Blütenpfl. Mitteleuropas I, 3, 1934, 59). In general the seeds germinate in the next favourable period, *i.e.* after the winter or after a period of drought. After having lain at the bottom during the resting period, the seed rises to the surface when germination starts. First the operculum is pushed off by the expanding plumule (fig. 4 n); the latter is green, rootless and does not resemble the normal frond. It gives rise to a new root-bearing frond, which in its turn gives off new fronds, and decays after some time. The first frond is slightly curved, the side that is more developed has vascular tissue and a budding pouch, both lacking on the other side. The second frond is normal, but is curved in the same way as the first frond.

All fronds arising from one seed are homodromous, *i.e.* all daughter fronds are similar to the mother frond. It appears namely that the 2 budding pouches of a frond are not exactly identical; one of them is somewhat larger and gives off more daughter fronds than the other. This better developed budding pouch may be the left one in the one population and the right in another one (DE SLOOVER, Naturalistes Belges 47, 1966, 443–456; ENGLER in E. & P. Nat. Pfl. Fam. 2, 3, 1889, 156).

Dispersal. Dispersal of the whole plant as well as the seeds over short distances may be effectuated by birds; *Wolffia brasiliensis* was found by WEDDELL on the feathers of a shot bird (Ann. Sc. Nat. 3, Bot. 1849, 155). Over very short distances transport by amphibians is possible (RIDLEY, Disp. of Pl. 1930, 542–543). Water currents transport the plants and seeds as well. Transport over long distances is restricted by the fact that desiccation of the plants is a distinctly limiting factor. Seeds sink after coming free. Several islands or groups of islands have populations which are characterized by a particular pattern of pigmentation (*Spirodela punctata* in Fiji), a large number of roots (*S. punctata* of Java), or a particular shape (*Lemna perpusilla* of New Guinea). This 'raciation' implies that there is no regular exchange between the various populations, and that the island populations have obviously largely developed from isolated clones. This, and the fact of an endemic species in India (*Wolffia microscopica*), pleads against long-distance dispersal. In the oceanic islands of the Pacific (New Caledonia and Fiji) and the Indian Ocean (Maldives) *Spirodela punctata* occurs, but this species is notorious for being dispersed by man, *e.g.* in the rice fields of northern Italy and is said by DAUBS to be introduced in America. GUPPY concluded (Nat.

Pac. 2, 1906, 407–408) to its introduction into the Pacific islands and excluded dispersal of *Lemnaceae* over wide seas.

Taxonomy. Two subfamilies can be recognized within the *Lemnaceae*, the *Lemnoideae* and the *Wolffioideae*. The *Lemnoideae* are characterized by the presence of roots, 2 budding pouches, an inflorescence with 2 male flowers and a membranous spathe. The *Wolffioideae* have only 1 budding pouch and an inflorescence with 1 male flower; roots and spathe are absent. See for our new system of *Lemnaceae* C. DEN HARTOG & F. VAN DER PLAS (Blumea 18, 1970, 355–368).

Affinity within Lemnaceae. In comparing the genera, it is clear that there is an increase in reduction from *Spirodela*, via *Lemna*, to the *Wolffioideae*, *Lemnoideae* having 2 male flowers with bilocular stamens, roots, and a spathe, against *Wolffioideae* with 1 male flower with unilocular stamens but with neither roots nor spathe. The latter appear further derived because of the differentiation of the reproductive structures, *viz* the (vegetative) budding pouch and dorsal flowering cavity.

Compared with *Spirodela*, *Lemna* seems the more reduced or specialized genus, each frond producing only one root, or none at all; the scales are connate with the root sheath (only visible as two lateral wings on the root sheath in *L. perpusilla*), the stipe is entirely merged with the daughter frond, while the budding pouches are more marginal.

As to the position of the flowers, the gynoecium is placed at the dorsal side of the pouch, the 2 anthers at the ventral side, their insertions forming a sort of triangle.

Affinity of Lemnaceae with other families. The interpretation of the flower structure has been various. EICHLER (Blüthendiagramme 1, 1875, 73–80), and recently LAWALRÉE (Bull. Soc. R. Bot. Belg. 77, 2, 1945, 27–38) homologize the spathe of *Lemnoideae* with the membranous floral envelope in *Najadaceae* and accept the floral structure of each frond to represent a single bisexual flower.

Most authors, however, homologize the floral envelope as a true spathe comparable with that found in *Araceae* (in the aquatic *Pistia* it is also membranous) and the gynoecium and stamens as representing each a reduced unisexual flower. Furthermore, the seed structure of *Lemnaceae* closely resembles that of *Araceae* according to S. C. MAHESWARI & R. N. KAPIL (J. Ind. Bot. Soc. 43, 1964, 270–277); in both groups there are 2 integuments. The same authors (Am. J. Bot. 50, 1963, 907–914) could show earlier that the endosperm in *Lemnaceae* is cellular, and not helobial as stated by LAWALRÉE, which is also in favour of affinity with *Araceae* and not with *Helobiae*. Furthermore, seeds of *Lemnaceae* have an operculum as in *Araceae* according to JOHRI (Rec. Adv. Embr. Angiosp. 1963, 398) which does not occur in *Helobiae*.

Among *Araceae*, the aquatic genus *Pistia* is possibly most related to *Lemnaceae*, in having in each spathe a single female flower and a clump-like whorl of 2–8 stamens separate from it. Furthermore, ENGLER showed (in E. & P. Nat. Pfl. Fam. 2, 3, 1889, 154–164) that the germination of the seeds in *Pistia* and *Lemna* proceeds in a rather similar way. Besides, both *Pistia* and *Lemna* have in common the occurrence of a similar vegetative reproduction. In *Pistia* stolons are developing from leaf-axils, producing at the end a new rosette. In *Lemnoideae* new fronds are produced on a stipe emitted from the budding pouch of the mother frond at the node and partly connate with it. In *Pistia* the young plant is originally surrounded by a membranous early disrupted sheath. A very comparable structure is found in *Spirodela*, where the daughter frond is basally enveloped by the partially connate dorsal and ventral scale. It seems almost impossible to escape from the impression that these scales are homologous with the envelope in *Pistia*. In passing, it may be remarked that in *Aponogeton undulatus* ROXB., which also produces runners with apical plantlets, the latter are surrounded by a membranous spathe. The morphologic interpretation of the spathe *cq.* scales is unclear.

Whereas these arguments indubitably show the affinity of *Lemnaceae* with *Araceae*, the homology of the 'frond' of *Lemnaceae* is less evident. VELENOVSKI (Vergl. Morph. Pfl. 2, 1907, 339–345) mentioned the occasional reduction of the leaves in *Pistia* to a few or even one. In both the frond of *Lemnoideae* and *Pistia* veins are curvinerved. I envisage to elaborate the idea of the homology of the Lemnaceous frond and the leaf rosette of *Pistia* in another paper.

Palynology. The palynological data give no indication about the systematic relationship of the *Lemnaceae* with other families. ERDTMAN (Pollen Morph. Pl. Tax. Angiosp. 1952, 232) found that the pollen of some *Lemnaceae* have some characters in common with the pollen of some *Araceae*, while the pollen of the *Najadaceae* seems to be less similar. THANIKAIMONI (Trav. Sect. Sc. & Tech. 5, 5, 1969, 19–26) found no affinity between *Pistia* and the *Lemnaceae*. The pollen type of the *Lemnaceae* has not been found in the genera of the *Araceae* so far studied by THANIKAIMONI.

Palaeobotany. Fossil *Lemnaceae* are very scarce; most fossils described as *Lemna* are not *Lemnaceae* at all. HENSLOW (J. Linn. Soc. Bot. 29, 1893, 486–487) reported a *Protolemna* described by SAPORTA from strata above the Later Jura. This plant resembles the present *Lemnaceae* in some respects, but it possesses an axis bearing leaves with a dicotyledon-like venation. BEATSON (New Phytol. 54, 1955, 208) reported subfossil *Lemna*-like pollen in Quarternary deposits. DARRAH (Textbook of Paleobotany, 1939, 300–302) reported a *Spirodela* from the Miocene and questioned the identity of some species reported from the Cretaceous and the Tertiary.

Phytochemistry. Oxalate of lime (raphides; clustered crystals) is present in many, but by no means in all, members of the family. So-called myriophyllin cells (see *sub Haloragaceae*) occur in species of *Spirodela*, *Wolffia* and *Wolffiella*. The flavonoid constituents were investigated thoroughly. Four main

types of flavonoid compounds occur in the family and each species and genus is said to be characterized by a distinct pattern of flavonoids. According to J. W. McCLURE & R. E. ALSTON (Am. J. Bot. 53, 1966, 849–860) and B. L. TURNER (Chemistry Nat. Prod., 4th Int. Symp. Stockh. 1966, 1967, 201–205) *Spirodela* shows the most complex pattern of flavonoid compounds; anthocyanins, flavonols, flavones and C-glycoflavones are present. In *Lemna* the property to produce flavonols is lost. The only flavonoid compounds observed in *Wolffiella* are flavonols. Three species of *Wolffia* were found to contain only flavonols and two species to produce only flavones and glycoflavones. Two lines of reductive biochemical evolution, both starting with *Spirodela* are evident: *Spirodela* → *Lemna* → *Wolffia p.p.* and *Spirodela* → *Wolffiella* → *Wolffia p.p.* The American authors assume that the evolution of taxa most probably followed the same pathway and that *Wolffia*, as defined by morphology, represents a biphyletic group. Regrettably, members of the genera *Pseudowolffia* and *Wolffiopsis* were not included in these studies. The pectic substances of cell walls of *Lemnaceae* contain galacturonic acid, apiose and xylose (E. BECK, Z. Pflanzenphys. 57, 1967, 444–461). Such apiose-containing pectines occur in all members of the family investigated hitherto. This striking chemical feature, however, seems to be linked with ecology rather than with systematics (C. F. VAN BEUSEKOM, Phytochemistry 6, 1967, 573–576).

Most authors assume intimate relationships between *Araceae* and *Lemnaceae*. The chemical characters so far known from both families (HEGNAUER, Chemotax. d. Pfl. 2, 1963, 73–99, 267–269, 483) are in perfect agreement with such a hypothesis. The fact, however, that chemical information about these families is still scanty implies that such a statement indicates lack of negative evidence, rather, than strong positive evidence. — R. HEGNAUER.

Uses. Because of their high rate of vegetative reproduction and the ease with which they can be cultured, *Lemnaceae* are often used in plant physiological experiments (HILLMAN, Bot. Rev. 27, 1961, 221–287).

Collecting & preservation. For the identification of *Wolffia* species it is necessary to know the exact shape of the fronds. Unfortunately the usual procedure of boiling dried specimens for a while is inadequate as the pressed fronds generally remain flat. Those which do not are mostly resting buds which usually have a somewhat aberrant shape. Therefore, it is recommended that when collecting the plants should be put in fluid at once. Formalin is not advisable since the plants become very fragile in it, although they keep their original form. They remain more plastic and cannot be damaged in any way when collected in FAPA (ingredients for 1 liter: 50 cc formalin 40 %, 25 cc acetic acid, 25 cc propionic acid and 900 cc spirit 50–70 %).

KEY TO THE GENERA

1. Roots present. Budding pouches 2, basal, lateral, one on either side of the axis. Inflorescence developing from one of the budding pouches, consisting of 1 ♀ and 2 ♂ flowers enclosed by a membranous spathe. Anther bilocular, transversely dehiscent. Stipe present. Raphides present.
   2. Fronds with a dorsal and a ventral scale, one to many roots and 3–15 nerves. Stipe ventrally attached. Brown pigment cells and druses in the parenchyma. . . . . **1. Spirodela**
   2. Fronds without dorsal and ventral scales, with one root (rarely none) and 1–3, often indistinct nerves. Stipe marginally attached. Brown pigment cells and druses absent. . . . . **2. Lemna**
1. Roots none. Budding pouch 1, median, never giving rise to an inflorescence. Inflorescence 1, dorsal, consisting of a cavity containing 1 ♀ and 1 ♂ flower, without a spathe. Anther unilocular, apically dehiscent. Stipe not visible to the naked eye. Raphides absent. . . . . **3. Wolffia**

1. SPIRODELA

SCHLEID. Linnaea 13 (1839) 391, *nom. gen. cons. prop.*; HEGELM. Lemnac. (1868) 147; Bot. Jahrb. 21 (1895) 283; DAUBS, Monogr. Lemnac. (1965) 8; HARTOG, Taxon 19 (1970) 647–648; HARTOG & PLAS, Blumea 18 (1970) 358. — *Lenticularia* SÉGUIER, Pl. Veron. 3 (1754) 129, *nom. gen. rejic. prop.* — *Lemna sect. Spirodela* COSS. & GERM. Fl. Env. Paris 2 (1845) 577. — *Lemna subg. Spirodela* PETERM. Deutschl. Fl. (1849) 540; ROUY, Fl. Fr. 13 (1912) 285. — **Fig. 1 A–B, 2–3.**

Small water plants, floating at the surface. *Fronds* either solitary or connected in groups of 2–5 (sometimes even more), symmetric or asymmetric, reniform to obovate, flat or distinctly inflated; dorsal side flat or slightly convex, smooth or with some small median papillae; underside often red due to pigment cells in the epidermis; brown pigment cells, raphides and druses in the parenchyma; stomata on the dorsal side; margin entire; nerves 3–15. *Stipe* hyaline, fugacious,

short or relatively long, attached to the underside of the frond. Dorsal scale present, fugacious in older plants. Ventral scale broad, often pigmented. *Roots* 1–18, more or less vascularized; root sheaths short, clustered together and covered by the ventral scale with which some of them are adnate; one or more roots perforating this scale (primary roots); root cap straight or slightly curved, acute or rarely obtuse. *Budding pouches* 2, basal, lateral, one on either side of the axis, dorso-ventrally flattened, more or less triangular in outline, opening by a transverse slit, which is ventral to the margin of the frond. *Inflorescence* 1, lateral, developing from one of the budding pouches, consisting of 1 ♀ and 2 ♂ flowers, enclosed by a membranous spathe. *Anther* bilocular, transversely dehiscent. ♀ *Flower* superior and lateral to the 2 ♂ flowers, consisting of a globular *ovary* with a short, partly persistent style and 1 amphitropous or 2–4 anatropous ovula. *Fruit* asymmetric, slightly or distinctly winged. *Seed* smooth or longitudinally ribbed.

Distr. Worldwide, the Arctic regions excepted, consisting of 4 *spp.*

KEY TO THE SPECIES

1. Fronds 5–12 mm long. Roots 7–16, one perforating the ventral scale. Nerves 7–12. Seeds smooth. **1. S. polyrhiza**
1. Fronds 2–5 mm long. Roots 1–9(–12), all perforating the ventral scale. Nerves 3–5. Seeds ribbed. **2. S. punctata**

1. Spirodela polyrhiza (L.) SCHLEID. Linnaea 13 (1839) 392; ZOLL. Nat. Geneesk. Arch. N. I. 2 (1845) 212; HASSK. Flora 30 (1847) 469; MIQ. Fl. Ind. Bat. 3 (1855) 222; KURZ, Nat. Tijd. N. I. 27 (1864) 220; HEGELM. Lemnac. (1868) 151–152; Bot. Zeit. 29 (1871) 621, 645; FRANCH. & SAV. En. Pl. Jap. 2 (1879) 13; HEGELM. Bot. Jahrb. 21 (1895) 284; THOMPSON, Rep. Mo. Bot. Gard. 9 (1897) 27; USTERI, Vierteljahrschr. Naturf. Ges. Zürich 50 (1905) 453; MERR. Fl. Manila (1912) 134; En. Philip. 1 (1923) 190; BACK. Handb. Fl. Java 3 (1924) 1; Onkruidfl. Jav. Suikerr. 1 (1928) 175; STEEN. Arch. f. Hydrobiol. Suppl. 11 (1932) 292; HAND.-MAZZ. Symb. Sin. 7 (1936) 1368; JUMELLE in Humbert, Fl. Madag. fam. 32 (1937) 3–4; MCCANN, J. Bomb. Nat. Hist. Soc. 43 (1942) 156–157; MASAMUNE, Fl. Kainantensis (1943) 394; Sc. Rep. Kanazawa Univ. 5 (1957) 92–93; DAUBS, Monogr. Lemnac. (1965) 10–13, *incl. var. masonii* DAUBS; HESS, LANDOLT & HIRZEL, Fl. Schweiz 1 (1967) 497; BACK. & BAKH. *f.* Fl. Java 3 (1968) 127; CLARK & THIERET, Mich. Botanist 7, 2 (1968) 69; HARTOG & PLAS, Blumea 18 (1970) 360. — *Lemna polyrhiza* LINNÉ, Sp. Pl. (1753) 970; KURZ, J. Linn. Soc. Lond. 9 (1866) 267–268; BENTH. Fl. Austr. 7 (1878) 164; NAVES, Novis. App. (1882) 296; HOOK. *f.* Fl. Br. Ind. 6 (1893) 557; TRIM. Handb. Fl. Ceyl. 4 (1898) 367; RIDL. J. Str. Br. R. As. Soc. *n.* 33 (1900) 179; BROWN, Fl. Trop. Afr. 8, 2 (1901) 201; COLLETT, Fl. Simlensis (1902) 545; WRIGHT, J. Linn. Soc. Bot. 36 (1903) 188; PRAIN, Bengal Pl. 2 (1903) 841; RIDL. Mat. Fl. Mal. Pen. 3 (1907) 53; F. M. BAILEY, Queensl. Agric. J. 2, 1 (1914) 78; RIDL. J. Mal. Br. R. As. Soc. 1 (1923) 106; Fl. Mal. Pen. 5 (1925) 132; HEND. Gard. Bull. S. S. 4 (1928) 352; FISCHER in Gamble, Fl. Madras 3, 9 (1931) 1593; GAGNEP. Fl. Gén. I.–C. 6 (1942) 1198; MITRA, Fl. Pl. E. India 1 (1958) 86; HUNDLEY & U CHIT KO KO, List trees etc. Burma ed. 3 (1961) 292; LARSEN, Dansk Bot. Ark. 20 (1962) 136; OHWI, Fl. Japan (1965) 264. — *Lenticula polyrhiza* (L.) LAMK, Fl. Fr. 2 (1778) 189. — *Lemna orbicularis* KIT. *ex* SCHULTES, Oesterr. Fl. ed. 2, 1 (1814) 64, *nomen seminudum.* — *Lemna thermalis* BEAUV. J. Phys. Chim. Hist. Nat. 82 (1816) 102, 113, f. 23; NUTTALL, Gen. Amer. 1 (1818) 19. — *Lemna orbiculata* ROXB. [Hort. Beng. (1814) 66, *nomen*] Fl. Ind. ed. Carey 3 (1832) 565. — *Telmatophace polyrhiza* (L.) GODR. Fl. Lorr. ed. 1, 3 (1843) 18. — *Lemna major* [C. A. MEYER, Ind. Cauc. (1831) 11, *nomen*] GRIFF. Not. 3 (1851) 216; Ic. Pl. As. 3 (1851) t. 264. — *Telmatophace orbicularis* SCHUR, En. Pl. Transs. (1866) 635. — *S. atropurpurea* MONTAND. Guide Bot. (1868) 309. — *Lemna maxima* BLATTER & HALLB. J. Ind. Bot. Soc. 2 (1921) 49. — *S. maxima* (BLATTER & HALLB.) MCCANN, J. Bomb. Nat. Hist. Soc. 43 (1942) 158. — **Fig. 1 A-B, 2.**

Fronds solitary or cohering in groups of 2–5, symmetric or asymmetric, reniform to round or obovate, 3–12 by 2½–8 mm; base obtuse; apex obtuse or round; dorsal side flat, smooth; ventral side flat to strongly inflated; green, ventral side and margin often red-purple; *nerves* 7–12; stipe hyaline, often long, prominent; dorsal scale membranous, orbicular to reniform, attached to the base, disappearing in older plants; ventral scale membranous, broad, with much brown pigment, almost centrally attached near the node, covering

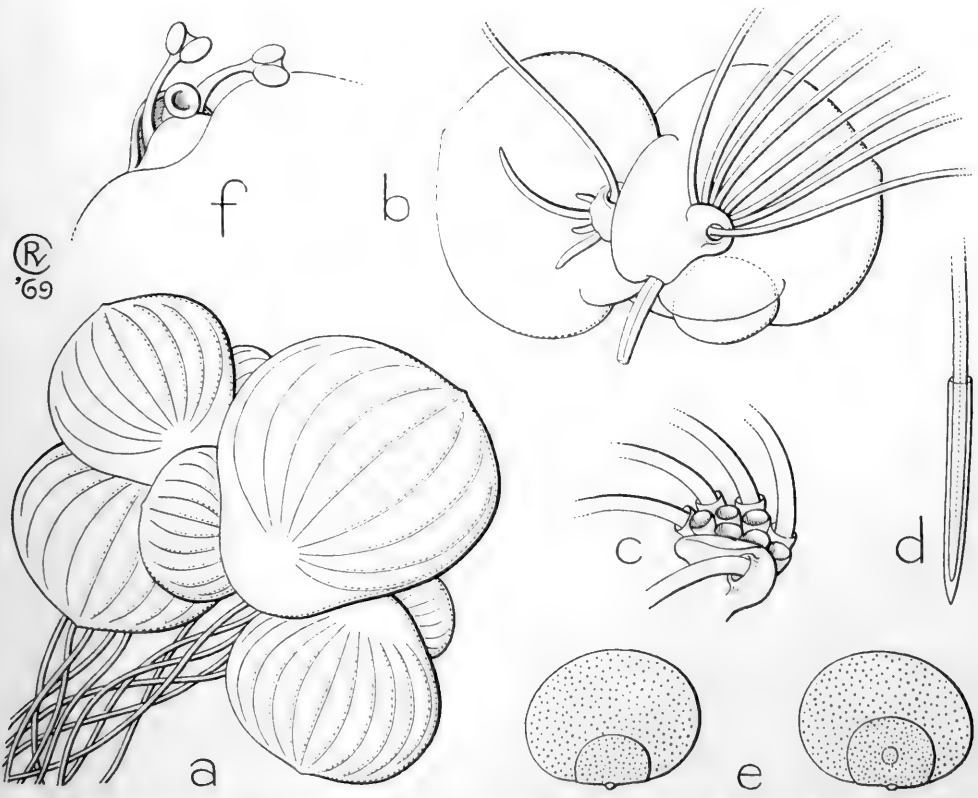

Fig. 2. *Spirodela polyrhiza* (L.) SCHLEID. *a*. Habit, mother frond with adhering offspring, dorsal view, ×6, *b*. habit, ventral view, the sheaths of the secundary roots covered by the ventral scale, ×6, *c*. detail from ventral side, the primary root piercing the ventral scale, ×12, *d*. root cap, ×12, *e*. turion, dorsal view (left) showing dorsal scale and ventral view (right) showing ventral scale, primordium of primary root, stipe a minute protuberance, ×18, *f*. detail of flowering frond, with style and 2 stamens enveloped by the spathe, ×18 (*a–d* VAN DER PLAS 23-9-69, *e* HALL Sept. 1867, *f* STALIN 451).

the bases of the roots. *Roots* 7–16, one (very rarely 2) perforating the ventral scale (primary roots), the others passing between the scale and the frond (secondary roots); primary roots appearing earlier than the secondary ones. Root cap acute. *Ovary* with 1 amphitropous ovule or 2 anatropous ones. *Fruit* a 1–2 seeded utricle, slightly winged. *Seed* smooth.

Distr. Almost cosmopolitan, common in the northern hemisphere, rather rare in Africa and Australia, in South America replaced by two closely related species; in *Malesia* common: Sumatra, Malay Peninsula, W.-E. Java, Flores Sea (Tanah Djampea, S of Celebes), N. Celebes, Philippines (Luzon to Mindanao), New Guinea. Also in the Hawaiian Is. (1895 HELLER; 1927 LE ROY TOPPING), together with *Lemna perpusilla*.

Ecol. Stagnant fresh water habitats such as sawahs, ponds and ditches, rarely in slightly brackish water, from the lowland to *c*. 2100 m.

Vern. *Kakarèwoan*, S, *mata lèlè*, J.

Notes. Like many other *Lemnaceae* this species often forms resting-buds to survive less favourable times. In *S. polyrhiza* these resting-buds are easier to distinguish from the normal fronds than in the other Lemnaceous species and are often called 'turions'. They are produced in the normal way in the budding pouch. The turion is reniform, dorso-ventrally flattened, variable in size, consisting of dense tissue. Its roots are still present but when dormant only the primary roots are visible. On both sides it bears a membranous scale as does a normal young frond.

2. Spirodela punctata (G. F. W. MEYER) THOMPSON, Rep. Mo. Bot. Gard. 9 (1897) 28; DAUBS, Monogr. Lemnac. (1965) 15; CLARK & THIERET, Mich. Bot. 7, 2 (1968) 69; HARTOG & PLAS, Blumea 18 (1970) 360. — *Lemna punctata* G. F. W. MEYER, Prim. Fl. Esseq. (1818) 262. — *Lemna gibba* (*non* L.) BLANCO, Fl. Filip. ed. 1 (1837) 672; ed. 2 (1845) 468; ed. 3, 3 (1879) 78;

NAVES, Novis. App. (1882) 296. — *Lemna oligorrhiza* KURZ, J. Linn. Soc. Lond. 9 (1866) 267, t. 5, f. 1–6; BENTH. Fl. Austr. 7 (1878) 163; NAVES, Novis. App. (1882) 296; HOOK. *f.* Fl. Br. Ind. 6 (1893) 557; PRAIN, Bengal Pl. 2 (1903) 841; GUPPY, Observ. Nat. Pac. 2 (1906) 407–408; SCHWARZ in Fedde, Rep. 24 (1928) 80; GREENWOOD Proc. Linn. Soc. 154, 2 (1943) 104; GUILLAUMIN, Fl. Nouv.-Caléd. (1948) 48; MITRA, Fl. Pl. E. India 1 (1958) 86; GUILLAUMIN, Mém. Mus. Hist. Nat. Paris n.s. sér. B, Bot. 8 (1959) 189; *ibid.* (1962) 213; PARHAM, Pl. Fiji Is. (1964) 268. — *Lemna melanorrhiza* F. v. M. *ex* KURZ, J. Bot. 5 (1867) 115. — *Lemna pleiorrhiza* F. v. M. *ex* KURZ, *l.c.* — *S. oligorrhiza* HEGELM. Lemnac. (1868) 147–150, *incl. var.* β *melanorrhiza* (F. v. M. *ex* KURZ) HEGELM., *var.* γ *pusilla* HEGELM., *var.* δ *pleiorrhiza* (F. v. M. *ex* KURZ) HEGELM., *var.* ε *javanica* HEGELM.; ENGL. Bot. Jahrb. 7 (1886) 448; HEGELM. Bot. Jahrb. 21 (1895) 287; F. M. BAILEY, Queensl. Fl. 5 (1902) 1700; MIKI, Bot. Mag. Tokyo 48 (1934) 333; MCCANN, J. Bomb. Nat. Hist. Soc. 43 (1942) 157; BLACK, Fl. S. Austr. ed. 2 (1948) 172; DAUBS, Monogr. Lemnac. (1965) 14–15; OHWI, Fl. Japan (1965) 264; MCCOMB & MCCOMB, J. R. Soc. W. Austr. 50, 4 (1967) 107; BACK. & BAKH. *f.* Fl. Java 3 (1968) 127. — *S. melanorrhiza* HEGELM. Bot. Jahrb. 21 (1895) 287. — *S. pusilla* HEGELM. *l.c.* — *S. pleiorrhiza* HEGELM. *l.c.* 288. — *S. javanica* HEGELM. *l.c.* — **Fig 3.**

Fronds solitary or cohering in groups of 2–6, asymmetric, elliptic to obovate, 2.8–4.5 by 1.4–2.6 mm, base and apex asymmetric, obtuse; mostly thick, dorsal side flat to slightly convex, smooth or with a median row of small papillae; ventral side flat to convex, sometimes slightly inflated and with relatively few large air spaces; green, sometimes red; *nerves* 3–5; stipe hyaline, often long and distinct; dorsal scale strongly reduced, fugacious; ventral scale membranous, often pigmented, perforated by the short sheaths of all (1–9, sometimes 12) *roots*; root cap straight or slightly curved, acute, with or without pigment. *Ovary* with 1 amphitropous ovule. *Fruit* asymmetric, winged. *Seed* longitudinally ribbed.

Distr. Apparently rare in Africa and South America, common in Asia and Australia, in the Indian Ocean in the Maldives (Mahé Atoll), in the Pacific Ocean in New Caledonia and Fiji; in *Malesia*: Malay Peninsula (Pahang) and Java (west to east).

According to DAUBS (1965) introduced in America, but this must then have been before 1814 when G. W. F. MEYER recorded it from there already. According to GUPPY (1906) introduced in the Pacific islands. Dispersal by man has certainly given this species a wider distribution in recent time; it is *e.g.* not rare in the rice-fields in Italy. Also its obviously local occurrence in Malesia might point to introduction.

Ecol. From sea-level to *c.* 2100 m, both in everwet areas and areas subject to a severe dry season.

Notes. *S. punctata* is a very variable species; several of its characters show considerable variations in different localities. As a result of this there are some populations which are characterized by a certain peculiarity not occurring in other populations. In some collections from Java the number of roots is extremely large (up to 12!), in other areas the number of roots rarely exceeds 5. The plants from New Caledonia and Fiji are characterized by a much heavier pigmentation than in other areas. These characters vary independently of each other, and do not seem to be constant even within one collection.

It is thus understandable that F. VON MÜLLER (*ex* KURZ, 1867) on the grounds of a small number of collections came to recognize 3 species in this complex, and that HEGELMAIER (1868) distinguished 5 varieties within *S. oligorrhiza* (raised to the rank of species in his paper of 1895). My investigation of much more material than these authors had at their disposal leads, however, to the conclusion that these taxa all belong to a single species, *S. punctata*, in which they are linked by all possible transitions.

From BLANCO's description of *Lemna gibba* it is obvious that the plant in question was in fact *S. punctata*. MERRILL (Sp. Blanc. 1918, 93) erroneously interpreted *L. gibba* 'BLANCO' as *L. paucicostata* (= *L. perpusilla*).

2. LEMNA

LINNÉ, Gen. Pl. ed. 5 (1754) 417; Sp. Pl. (1753) 970; HEGELM. Lemnac. (1868) 134; Bot. Jahrb. 21 (1895) 288; DAUBS, Monogr. Lemnac. (1965) 16; HARTOG & PLAS, Blumea 18 (1970) 360. — *Lenticula* [HILL. Brit. Herb. (1757) 530] BOEHMER in Ludwig, Def. Gen. Pl. (1760) 499. — *Hydrophace* HALL. Hist. Stirp. Indig. Helv.

Fig. 3. *Spirodela punctata* (G. F. W. MEYER) THOMPSON. *a.* Habit, mother frond with fruit and daughter frond, ×12, *b. ditto*, ×12, *c.* ventral view roots piercing ventral scale, ×12, *d.* detail of *c*, ×24, *e.* ventral view, 1-rooted frond, ×12, *f. ditto*, detail from *e*, ×24, *g.* habit, dorsal view, ×12, *h.* lateral view, ×12, *i.* ventral view of a plant from Java with many roots, ×12, *j.* ventral view of a frond with 2 roots, ×12, *k*, detail of the inflorescence, ×24 (*a* DEN HARTOG 779, *b–d* DEN HARTOG *s.n.*, *e–f*, *j–k* DEN HARTOG 1161, *g–h* DEN HARTOG 190, *i* KOORDERS 21531).

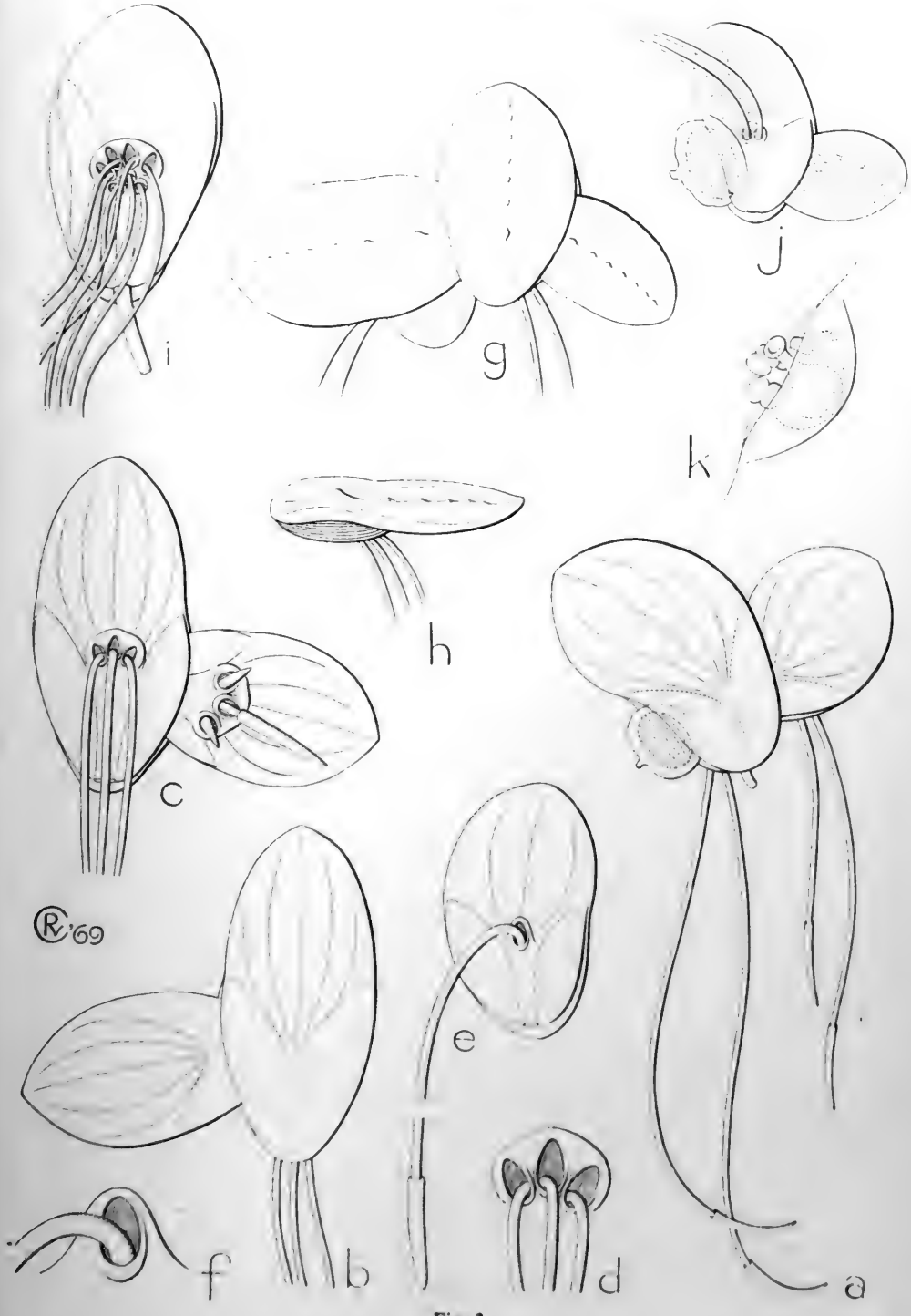

Fig. 3

3 (1768) 68. — *Telmatophace* SCHLEID. Linnaea 13 (1839) 391. — *Staurogeton* RCHB. [Consp. (1828) 288, *nomen*] Nom. (1841) 33. — *Lenticularia* MONTANDON, Guide Bot. (1868) 308, *non* SÉGUIER, Pl. Veron. 3 (1754) 129. — **Fig. 4–7.**

Small aquatics, floating at the surface or sometimes completely submerged in which case they come to the surface only in the flowering period. *Fronds* either solitary or connected in groups of 2–10 (sometimes even more), symmetric to slightly asymmetric, round, elliptic, oblong, obovate or lanceolate, flat or slightly swollen, sometimes considerably inflated at the ventral side, often with a median row of papillae on the flat or slightly convex dorsal side; with or without red pigment cells in the epidermis; raphides in the parenchyma; no brown pigment cells; druses none; stomata on the dorsal side of floating plants, but absent in the submerged plants; margin entire, rarely denticulate; nerves 1–3(–5). *Stipe* hyaline and fugacious or green and persistent, attached to the margin. Dorsal as well as ventral scale absent. *Root* 1 (rarely absent), slightly vascularized, with or without a distinct root sheath; root cap straight or curved, obtuse, mucronate or acute. *Budding pouches* 2, basal, lateral, one on either side of the axis, dorso-ventrally flattened, more or less triangular in outline, opening by a transverse slit; slit coinciding with the margin of the frond, rarely ventral or dorsal to the margin. *Inflorescence* 1, lateral, developing from one of the budding pouches, consisting of 1 ♀ and 2 ♂ flowers enclosed by a membranous spathe. *Anther* bilocular, transversely dehiscent. ♀ *Flower* superior and lateral to the 2 ♂ flowers, consisting of a globular ovary with a short, persistent style. *Ovary* with 1 orthotropous or amphitropous ovule or with 2–4 anatropous ovules. *Fruit* symmetric or asymmetric, more or less compressed, with or without wings. *Seeds* longitudinally ribbed, rarely smooth.

Distr. 9 *spp.*, worldwide with the exception of the Arctic regions.

Taxon. The genus can be subdivided into 2 subgenera:

1. *Subg. Lemna.* Floating water plants with round, elliptic, oblong or obovate fronds. Root 1, with a distinct root sheath. Slit of budding pouch coinciding with the margin of the frond, rarely ventral to the margin. Ovary with 1–4 ovules.
2. *Subg. Staurogeton* RCHB. Fl. Germ. 1 (1830) 10. Submerged water plants, only rising to the surface in the flowering period. Fronds oblong to linear-lanceolate, with or without a root. Root sheath indistinct. Slit of budding pouch just dorsal to the margin of the frond.

KEY TO THE SPECIES

1. Floating water plants. Fronds round to oblong or obovate, with 1 root. Slit of budding pouch coinciding with the margin of the frond, rarely ventral to the margin. *Subg. Lemna.*
2. Root sheath with lateral wings. Fruit asymmetric; ovule 1, orthotropous. . . . . **1. L. perpusilla**
2. Root sheath without wings. Fruit symmetric; ovules amphitropous or anatropous.

Fig. 4. *Lemna perpusilla* TORREY. *a.* Habit, mother frond with adhering offspring, dorsal view, ×18, *b.* root cap, ×36, *c.* lateral view, frond with apical and nodal papillae, ×18, *d. ditto*, only with apical papilla, ×18, *e. ditto*, without papillae, ×18, *f.* habit, plant from New Guinea, dorsal view, elongated fronds, ×18, *g.* ventral view, showing root emitted, ×18, *h.* detail of root sheath provided with 2 lateral wings, ×36, *i.* mother frond and daughter frond, both with inflorescence, ×18, *j.* detail of a flowering frond in which inflorescence and daughter frond develop simultaneously in the same reproductive pouch, ×36, *k.* frond with fruit and daughter frond, dorsal view, ×18, *l.* seed, ×40, *m. ditto*, longitudinal section, ×80, *n.* germinating seed, showing plumule and first frond, dorsal (left) and ventral view (right), ×18 (*a–c*, *i–n* DEN HARTOG 632, *d* BACKER 19104, *e* BACKER 25650, *f* BRASS 8112, *g* LÜTJEHARMS 5387, *h* DEN HARTOG 188).

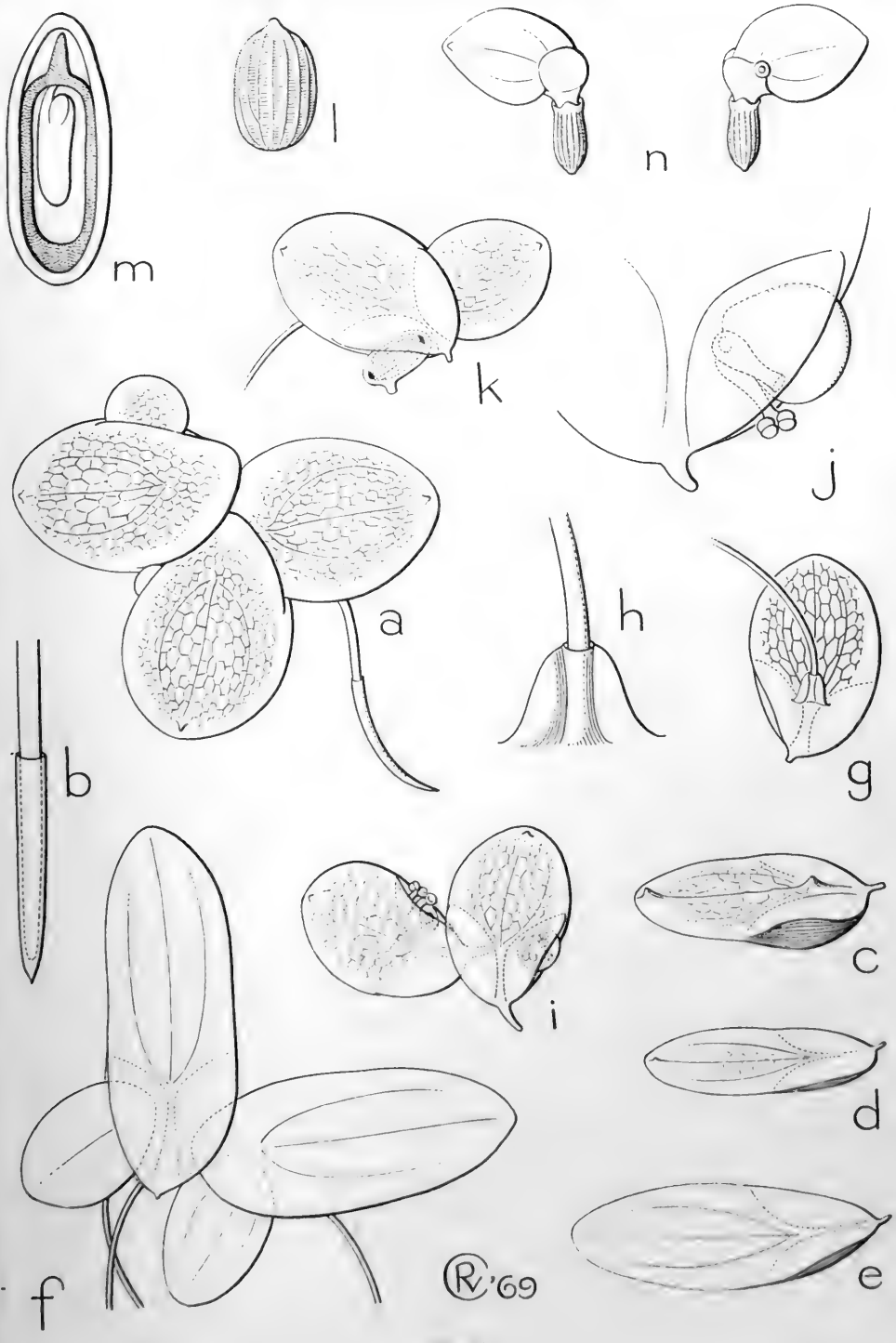

Fig. 4

3. Frond mostly symmetric, ventral side flat to slightly convex, never inflated. Cells on ventral side not visible to the naked eye. Fruit without wings. Ovule 1, amphitropous. Slit of budding pouch coinciding with the margin of the frond . . . . . **L. minor**
3. Frond mostly asymmetric, ventral side flat to strongly inflated. Cells on ventral side clearly visible to the naked eye. Fruit with lateral wings. Ovule 1, amphitropous or ovules 2–4, anatropous. Slit budding pouch ventral to the margin of the frond . . . . . **L. gibba**

1. Submerged water plants, only floating at the surface when flowering. Fronds oblong to linear-lanceolate, often without a root. Slit of budding pouch just dorsal to the margin of the frond. *Subg. Staurogeton.*
4. Margin denticulate towards the apex. Stipe usually strongly elongate, green, persistent. **2. L. trisulca**
4. Margin entire, Stipe short, hyaline, fugacious. . . . . **3. L. tenera**

1. Lemna perpusilla TORREY, Fl. N. Y. 2 (1843) 245; AUSTIN in A. Gray, Man. Bot. ed. 5 (1867) 479, *incl. var. trinervis* AUSTIN; HEGELM. Lemnac. (1868) 139; Bot. Jahrb. 21 (1895) 294; THOMPSON, Rep. Mo. Bot. Gard. 9 (1897) 33; DAUBS, Monogr. Lemnac. (1965) 25–27; BACK. & BAKH. *f.* Fl. Java 3 (1968) 127. — *L. minor* (*non* L.) LOUR. Fl. Cochinch. 2 (1790) 550; HASSK. Cat. Hort. Bog. (1844) 53, 302; JUNGH. Reisen (1845) 42; GRIFF. Not. 3 (1851) 216; MIQ. Pl. Jungh. (1852) 169; JUNGH. Java ed. 2, 1 (1853) 285–287; MIQ. Fl. Ind. Bat. 3 (1855) 221; KURZ, Nat. Tijd. N. I. 27 (1864) 220; J. Linn. Soc. Lond. 9 (1866) 266; J. Bot. 5 (1867) 115; BENTH. Fl. Austr. 7 (1878) 163, *p.p.*; NAVES, Novis. App. (1882) 296; HOOK. *f.* Fl. Br. Ind. 6 (1893) 556, *p.p.*; MASSART, Bull. Soc. R. Bot. Belg. 34 (1895) 184; KOORD. Med. Lands Plantentuin 19 (1898) 305; F. M. BAILEY, Queensl. Fl. 5 (1902) 1700, *p.p.*; GUPPY, Observ. Nat. Pac. 2 (1906) 407–408; KOORD. Exk. Fl. Java 1 (1911) 268; BOLD. Zakfl. Landbouwstr. Java (1916) 125; BURK. Dict. (1935) 1328; GAGNEP. Fl. Gén. I.-C. 6 (1942) 1197; GUILLAUMIN, Fl. Nouv.-Caléd. (1948) 48; LARSEN, Dansk Bot. Ark. 20 (1962) 136; GUILLAUMIN, Mém. Mus. Hist. Nat. Paris n.s. sér. B, Bot. 8 (1962) 213; PARHAM, Pl. Fiji Is. (1964) 268. — *L. aequinoctialis* WELW. Apontam. Phytogeogr. Fl. Prov. Angola, Ann. Conselho Ultram. Dec. 1858, *n.* 55. (1859) 578; BROWN, Fl. Trop. Afr. 8, 2 (1901) 203; GIARDELLI, Darwinia 11 (1959) 584–590. — *L. angolensis* WELW. *ex* HEGELM. J. Bot. 3 (1865) 112; HEGELM. Lemnac. (1868) 141–142; Bot. Jahrb. 21 (1895) 296. — *L. paucicostata* HEGELM. Lemnac. (1868) 139, *incl. var. membranacea* HEGELM. *l.c.* 141; KURZ, J. As. Soc. Beng. 45, ii (1876) 153; FRANCH. & SAV. En. Pl. Jap. 2 (1879) 12; HOOK. *f.* Fl. Br. Ind. 6 (1893) 556; HEGELM. Bot. Jahrb. 21 (1895) 294–296; TRIM. Handb. Fl. Ceyl. 4 (1898) 366; RIDL. J. Str. Br. R. As. Soc. *n.* 33 (1900) 179; BROWN, Fl. Trop. Afr. 8, 2 (1901) 202–203; PRAIN, Bengal Pl. 2 (1903) 841; WRIGHT, J. Linn. Soc. Bot. 36 (1903) 188; USTERI, Vierteljahrschr. Naturf. Ges. Zürich 50 (1905) 453; GUPPY, Observ. Nat. Pac. 2 (1906) 407–408; RIDL. Mat. Fl. Mal. Pen. 3 (1907) 52; MERR. Fl. Manila (1912) 134; RIDL. J. Mal. Br. R. As. Soc. 87 (1923) 106; MERR. En. Philip. 1 (1923) 190; BACK. Handb. Fl. Java 3 (1924) 2; RIDL. Fl. Mal. Pen. 5 (1925) 132; HEND. Gard. Bull. S. S. 4 (1928) 352; BACK. Onkruidfl. Jav. Suikerr. 1 (1928) 175; FISCHER in Gamble, Fl. Madras 3 (1931) 1593; STEEN. Arch. f. Hydrobiol. Suppl. 11 (1932) 291; MERR. Trans. Am. Phil. Soc. 24, 2 (1935) 100; CHRISTOPH. B. P. Bish. Mus. Bull. 128 (1935) 44; JUMELLE in Humbert, Fl. Madag. fam. 32 (1937) 2; MCCANN, J. Bomb. Nat. Hist. Soc. 43 (1942) 153; MASAMUNE, Fl. Kainantensis (1943) 394; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 226, p. 2; HEND. Mal. Wild Fl. Monocot. (1959) 210; MASAMUNE, Sc. Rep. Kanazawa Univ. 5 (1957) 94; MITRA, Fl. Pl. E. India 1 (1958) 86; HUNDLEY & U CHIT KO KO, List trees etc. Burma ed. 3 (1961) 292; LARSEN, Dansk Bot. Ark. 20 (1962) 135; OHWI, Fl. Japan (1965) 265. — *L. trinervis* (AUSTIN) SMALL, Fl. SE. U.S. (1903) 230; DAUBS, Monogr. Lemnac. (1965) 27. — *Hydrophace perpusilla* (TORREY) LUNELL, Am. Midl. Nat. 4 (1915) 237. — *L. minima* BLATT. & HALLB. J. Ind. Bot. Soc. 2 (1921) 50. — *L. blatteri* MCCANN J. Bomb. Nat. Hist. Soc. 43 (1942) 153. — *L. eleanorae* MCCANN, *l. c.* 154. — **Fig. 4.**

Small floating aquatic. *Fronds* solitary or cohering in groups of 2–5, asymmetric, ovate to obovate or sometimes obovate-oblong, 1.2–4.8 by 0.7–2.8 mm, thin, membranous to thickened, green, no red pigment cells; base strongly asymmetric, obtuse or slightly acute; apex nearly symmetric or asymmetric, obtuse to slightly acute; dorsal side slightly convex, with or without a row of median papillae, but often with a distinct, hook-shaped papilla near the apex; ventral side flat to convex, not inflated; nerves 3, sometimes indistinct; margin entire. *Stipe* hyaline, fugacious, sometimes persistent. Root sheath cylindrical with 2 lateral wings; root cap acute. Slit of budding pouch coinciding with the margin of the frond. *Ovary* with 1 orthotropous ovulum, style subapical, persistent. *Fruit* asymmetric, ellipsoid, laterally slightly compressed. *Seed* with 12–18 distinct longitudinal ribs, laterally slightly compressed.

Distr. Worldwide in the tropics and subtropics. In the Pacific islands in several Hawaiian Is. (first 1895), Samoa (1893), Tonga (1926), Fiji (1842), New Caledonia; common in *Malesia*: Sumatra (also Enggano), Malay Peninsula, W.-E. Java (also Madura & Kangean Is.), Lesser Sunda Is. (Timor), Flores Sea (Tanah Djampea), North Borneo, Philippines (Luzon to

Mindanao), Moluccas (Ambon; Aru Is.: Maikoor), and W.-E. New Guinea.

Ecol. The most common duckweed in Malesia. It occurs mostly in fresh water, but is sometimes found in slightly brackish water. In sawahs, ditches and small streams up to 2100 m, often together with other *Lemnaceae* (*Spirodela*). Flowering and fruiting occur commonly in this species.

Vern. *Kiambang*, M (Sum.), *ganggĕng*, S; Philippines: *inalia*, *lia*, *liya*, Tag.

Notes. BACKER (1924) was the first to point out that *L. minor* does not occur in Malesia; he referred this material to *L. paucicostata*.

L. perpusilla is an extremely variable species. HEGELMAIER (1868) distinguished in his monograph 3 species, *viz L. perpusilla* (seed with 30–60 ribs, restricted to the eastern part of the U.S.A.), *L. paucicostata* (seed with 12–20 ribs, occurring in the tropics of the Old and the New Worlds; also in the S. and SE. parts of the U.S.A.) and *L. angolensis* (seed with 12–15 ribs, and moreover a conspicuous apical papilla on the frond, restricted to tropical Africa). *L. angolensis*, already earlier described as *L. aequinoctialis* by WELWITSCH, is with respect to the seed character within the range of variation of *L. paucicostata*. The development of the apical papilla on the frond is subject to so much variation, even within one sample, that it is not useful as a specific character. THOMPSON (Ann. Rep. Mo. Bot. Gard. 9, 1897, 33) who investigated *L. perpusilla* and *L. paucicostata* in the U.S.A. found the number of ribs on the seeds of these species so variable that he could not distinguish the species with certainty, and for that reason he regarded them as forms of one species.

Some flat, membranous forms with a distinct venation, but otherwise not different from *L. perpusilla*, have been distinguished as *L. perpusilla var. trinervis*, *L. paucicostata var. membranacea* or as *L. trinervis*. They have been recorded from America and India. In my opinion they represent only forms of *L. perpusilla*, induced by poor environmental circumstances. MCCLURE & ALSTON (Am. J. Bot. 53, 1966, 849–860), however, found *L. trinervis* to be quite distinct from *L. perpusilla* with respect to the flavonoid chemistry. Therefore, membranous forms require re-investigation.

The fronds from New Guinea are often twice as long as wide, in contrast to those from the rest of Malesia.

MERRILL (Sp. Blanc. 1918, 93) referred *L. gibba* (*non* L.) BLANCO to *L. paucicostata* (= *L. perpusilla*). As BLANCO recorded the occurrence of 2 roots, his plants must have belonged to *Spirodela punctata*. MERRILL's representative specimen Sp. Bl. 131 belongs to *L. perpusilla*.

Lemna minor LINNÉ, Sp. Pl. (1753) 970; HEGELM. Lemnac. (1868) 142–144; HOOK. *f.* Fl. Br. Ind. 6 (1893) 556, *pro parte*; HEGELM. Bot. Jahrb. 21 (1895) 291–292; DAUBS, Monogr. Lemnac. (1965) 21–25. — **Fig. 5 f-h.**

Small floating aquatic. *Fronds* solitary or cohering in groups of 2–5 (sometimes many more), symmetric to slightly asymmetric, round-elliptic to elliptic or ovate; 1.5–4.6 by 1–2.9 mm; base ± symmetric, obtuse; apex symmetric or slightly asymmetric; margin entire; dorsal side flat to slightly convex, often with a median row of papillae; ventral side flat to slightly convex; cells on ventral side not visible to the naked eye, green; nerves 3. *Stipe* often persistent and prominent; root sheath cylindrical, without wings, root cap obtuse. *Slit of budding pouch* coinciding with the margin of the frond. *Ovary* with 1 amphitropous ovule. *Fruit* ellipsoid, symmetric, laterally compressed, without wings. *Seed* smooth.

Distr. Widely distributed in the temperate zone of the northern hemisphere, reaching as far north as Alaska and northern Scandinavia. All records of *L. minor* from tropical Asia, Malesia and tropical Australia relate to *L. perpusilla*.

Lemna gibba LINNÉ, Sp. Pl. (1753) 970; HEGELM. Lemnac. (1868) 145–147; HOOK. *f.* Fl. Br. Ind. 6 (1893) 556–557; HEGELM. Bot. Jahrb. 21 (1895) 289–290; KOORD. Exk. Fl. Java 1 (1911) 268–269; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 226, p. 2; DAUBS, Monogr. Lemnac. (1965) 17–19; BACK. & BAKH. *f.* Fl. Java 3 (1968) 127. — *Telmatophace gibba* (L.) SCHLEID. Linnaea 13 (1839) 391; MIQ. Fl. Ind. Bat. 3 (1855) 222; KURZ, J. Linn. Soc. Lond. 9 (1866) Bot. 266. — **Fig. 5 a-e.**

Small floating aquatic. *Fronds* solitary or cohering in groups of 2–4, mostly asymmetric, sometimes almost symmetric; round, ovate or obovate, 2.1–4.9 by 1.7–3.7 mm; base almost symmetric, obtuse to emarginate; apex mostly asymmetric, sometimes symmetric, obtuse to round; margin entire; dorsal side flat or convex, smooth or with a median row of papillae; ventral side flat to strongly inflated and globular, with a relatively small number of large air cavities; green or red on both sides; nerves 3–5, sometimes indistinct. *Stipe* often prominent and persistent. Root sheath cylindrical, short, without wings; root cap obtuse or sometimes acute. *Slit of budding pouch* ventral to the margin of the frond. *Ovary* with 1 amphitropous ovule or 2–4 anatropous ones. *Fruit* symmetric, ellipsoid, with lateral wings, dorso-ventrally compressed, with 1–4 seeds. *Seeds* longitudinally ribbed.

Distr. Reported from the temperate and tropical zones of the whole world, but doubtless many records relate to other species.

The records from Malesia are doubtful; among the material studied not one specimen of *L. gibba* was found. The record from the Philippines, listed by DAUBS, no doubt refers to MERRILL's Sp. Bl. 131, which is *L. perpusilla*. The Australian records of *L. gibba* probably must be referred to *L. disperma* HEGELM.

2. Lemna trisulca LINNÉ, Sp. Pl. (1753) 970; SCHLEID. Linnaea 13 (1839) 391; MIQ. Fl. Ind. Bat. 3 (1855) 222; GRISEB. Fl. Br. W. Ind. Is. (1864) 512; KURZ, J. Linn. Soc. Lond. 9 (1866) 268; J. Bot. 5 (1867) 166; HEGELM. Lemnac.

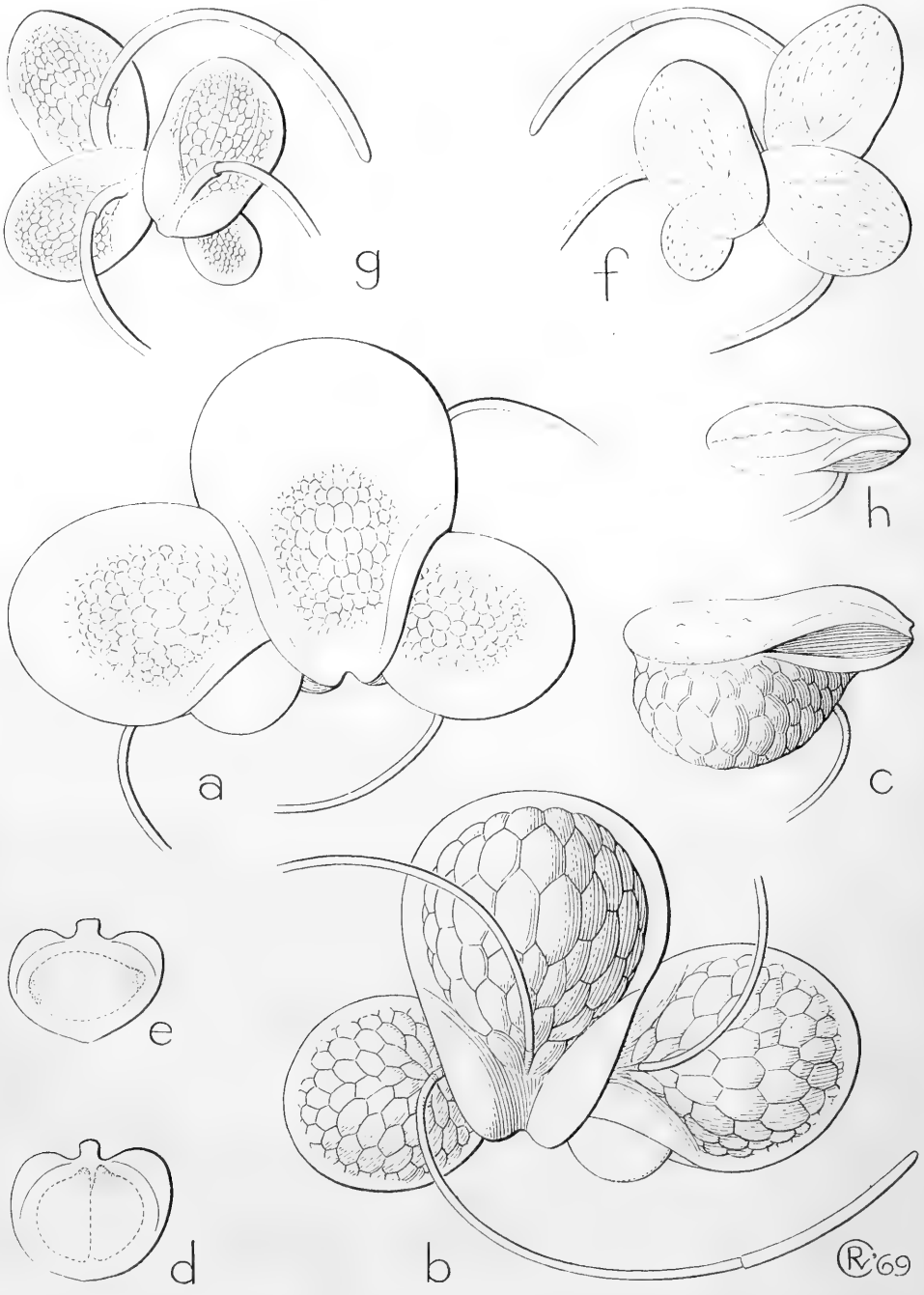

Fig. 5. *Lemna gibba* L. *a.* Habit, dorsal view, ×8, *b.* ventral view showing subepidermal air cavities, ×8, *c.* lateral view, ×8, *d.* winged fruit with 2 seeds, ×18, *e. ditto*, with 1 seed, ×18. — *L. minor* L. *f.* Habit dorsal view, ×8, *g. ditto* ventral view, ×8, *h.* lateral view, ×8 (*a–e* HELLER 5571, *f–h* VAN DER PLAS 29-4-69).

(1868) 134–136; BENTH. Fl. Austr. 7 (1878) 162; FRANCH. & SAV. En. Pl. Jap. 2 (1879) 12; HOOK. *f.* Fl. Br. Ind. 6 (1893) 557; HEGELM. Bot. Jahrb. 21 (1895) 293; MASSART, Bull. Soc. R. Bot. Belg. 34 (1895) 184; F. M. BAILEY, Queensl. Fl. 5 (1902) 1700; PRAIN, Bengal Pl. 2 (1903) 841; K. SCH. & LAUT. Nachtr. Fl. Schutzgeb. (1905) 62; KOORD. Exk. Fl. Java 1 (1911) 268; MERR. En. Philip. 1 (1923) 190; BACK. Handb. Fl. Java 3 (1924) 2; STEEN. Arch. f. Hydrobiol. Suppl. 11 (1932) 291; HAND.-MAZZ. Symb. Sin. 7 (1932) 1368; GAGNEP. Fl. Gén. I.–C. 6 (1942) 1198; MCCANN, J. Bomb. Nat. Hist. Soc. 43 (1942) 154; BLACK, Fl. S. Austr. ed. 1, 2 (1948) 172; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 226, p. 2; HERTER, Rev. Sudam. Bot. 9 (1954) 185; MITRA, Fl. Pl. E. India 1 (1958) 86; HUNDLEY & U CHIT KO KO, List trees etc. Burma ed. 3 (1961) 292; WILLIS, Handb. Pl. Vict. 1 (1962) 271; ZUTSHI & KAUL, Trop. Ecol. 4 (1963) 95–96; DAUBS, Monogr. Lemnac. (1965) 32–34; OHWI, Fl. Japan (1965) 265; HESS, LANDOLT & HIRZEL, Fl. Schweiz 1 (1967) 496; CLARK & THIERET, Mich. Bot. 7, 2 (1968) 73; BACK. & BAKH. *f.* Fl. Java 3 (1968) 127. — *Lenticula trisulca* SCOP. Fl. Carn. ed. 2 (1772) 213; MOENCH, Meth. (1794) 319; ST. HIL. Exp. fam.

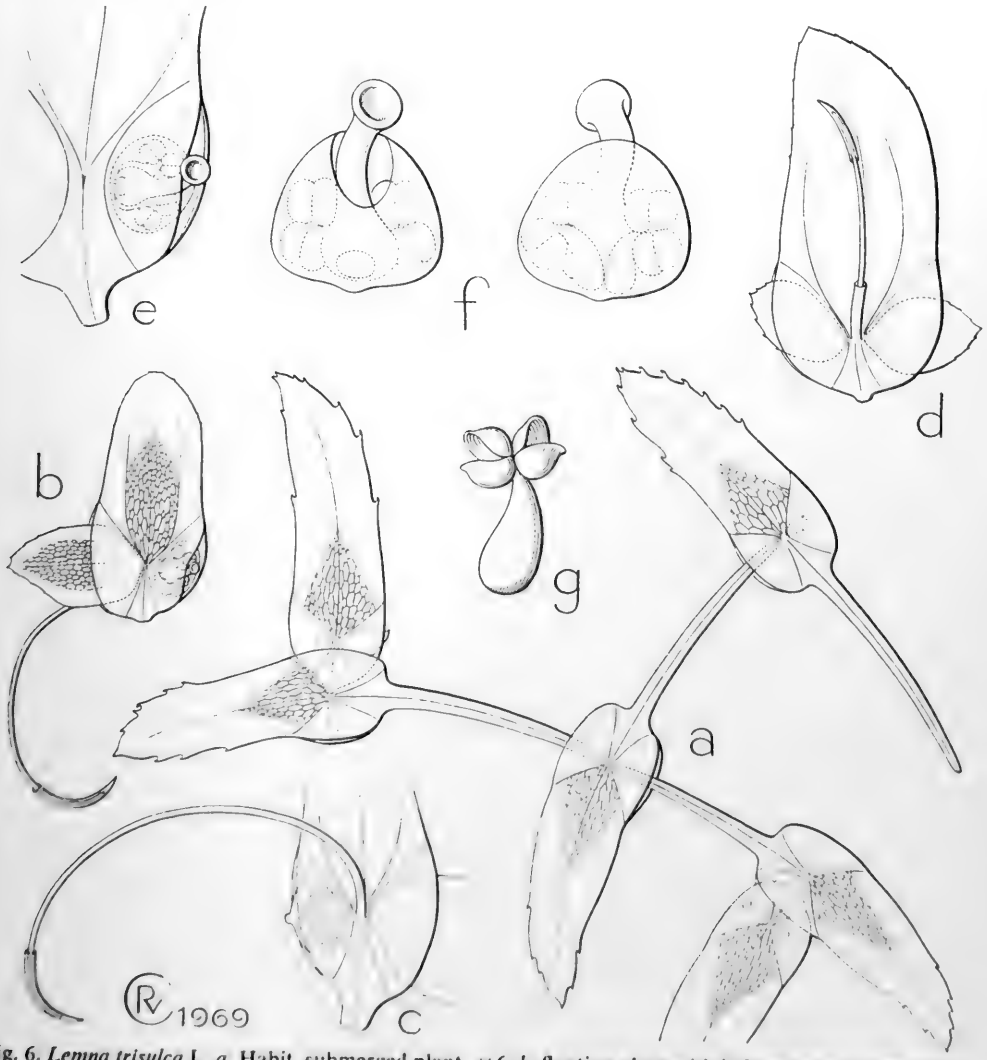

Fig. 6. *Lemna trisulca* L. *a.* Habit, submerged plant, ×6, *b.* floating plant with inflorescence, dorsal view, ×6, *c.* frond with fruit, ventral view, ×6, *d. ditto.* ×6, *e.* part of a flowering frond, dorsal view, ×12, *f.* detail of inflorescence surrounded by spathe, ×24, *g.* stamen, ×24 (*a* DEN HARTOG 1162, *b–g* HOLMBERG 453).

nat. germ. pl. 1 (1805) 53. — *Lenticula ramosa* LAMK, Fl. Fr. 2 (1778) 189. — *L. cruciata* ROXB. [Hort. Beng. (1814) 66, *nomen*] Fl. Ind. ed. Carey 3 (1832) 566. — *L. intermedia* RUTHE, Fl. Mark Brandenb. Niederlausitz, ed. 2 (1834) 277. — *L. bisulca* C. A. MEYER, Beitr. Pfl. Russ. Reich 9 (1854) 104. — *Staurogeton trisulcus* (L.) SCHUR, En. Pl. Transs. (1866) 636. — *Hydrophace trisulca* (L.) BUBANI, Fl. Pyren. 4 (1897) 23; LUNELL, Am. Midl. Natur. 4 (1915) 237. — **Fig. 6.**

Submerged aquatic, only floating at the surface when flowering; when sterile many fronds connected in large groups, when fertile only 2 fronds cohering. *Fronds* symmetric, or almost so, oblong to linear-lanceolate, 2.5–6.9 by 1.1–2.9 mm; base slightly asymmetric or symmetric, narrowing into the stipe; apex symmetric or almost so, acute to obtuse; margin distinctly or indistinctly denticulate towards the apex; frond thin or slightly thickened when flowering; dorsal side flat, smooth; ventral side flat to slightly convex; green, without red pigment; nerves 1–3, sometimes indistinct. *Stipe* strongly prolonged, flat, up to 11 by 0.2–0.3 mm, green, persistent; when flowering less distinct or not developed at all. Root often absent in submerged plants; root sheath very short, most indistinct; root cap acute. *Slit of budding pouch* just dorsal to the margin of the frond. *Ovary* with 1 amphitropous ovulum. *Fruit* broad, more or less symmetric. *Seed* ribbed.

Distr. Worldwide, but curiously absent from South America, extremely scarce in *Malesia*: North Sumatra (Toba Lake, not collected, *cf.* STEEN. 1932), Philippines (Luzon, Mindanao), S. Moluccas (Aru Is.: Maikoor I. leg. BECCARI, 26-6-73), and New Guinea.

For Java recorded from Bogor by MIQUEL (1855, *l.c.*) and again by MASSART (Un botaniste en Malaisie, 1895, 184) from inundated ricefields near Bandung and Garut. No other botanists or collectors have ever found it in Java, so that we may safely assume that these two records rest on errors.

Ecol. Stagnant waters up to 1800 m, outside Malesia even recorded from 2800–3000 m. Mostly submerged, forming a dense layer below the surface of the water, sometimes together with *Riccia spp.*

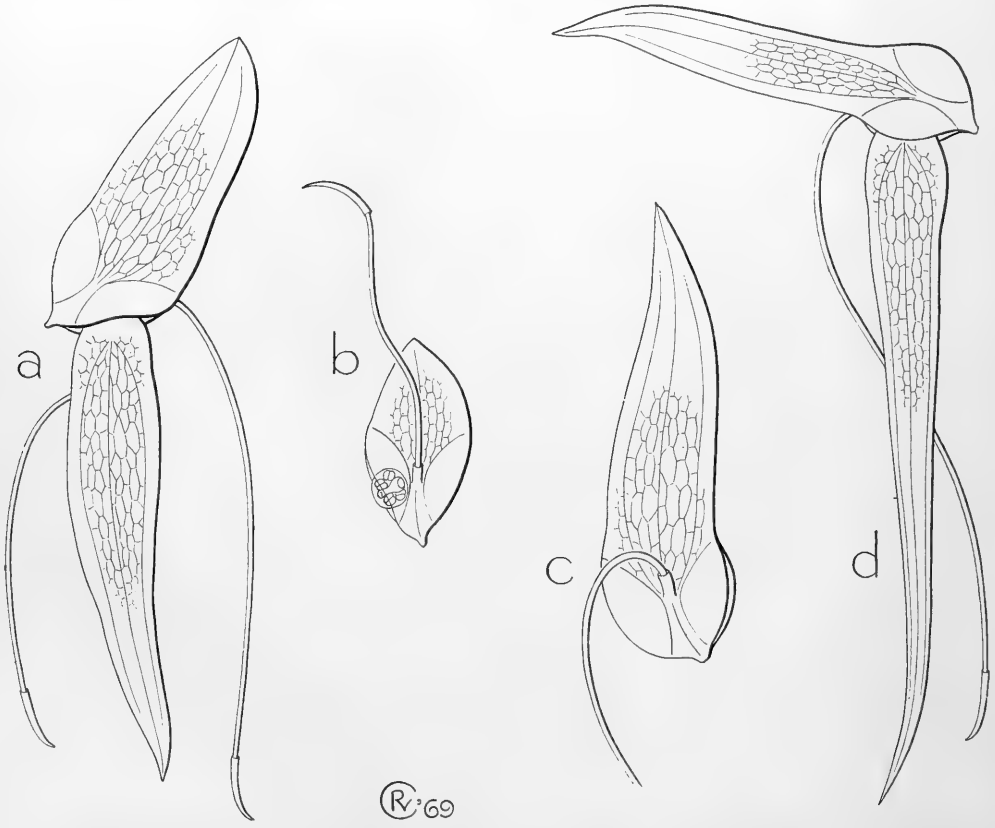

Fig. 7. *Lemna tenera* KURZ. *a.* Habit, dorsal view, ×12, *b.* ventral view of floating frond with inflorescence, ×12, *c.* ventral view, of submerged frond, ×12, *d.* habit, dorsal view of submerged plant, ×12 (*a*, *c–d* RIDLEY 10778, *b* MÖLLER 30).

3. Lemna tenera KURZ, J. As. Soc. Beng. 40, ii (1871) 78; HEGELM. Bot. Jahrb. 21 (1895) 293–294; RIDL. Mat. Fl. Mal. Pen. 3 (1907) 52; Fl. Mal. Pen. 5 (1925) 132. — *Lemna sp.* near *L. trisulca*, RIDL. J. Str. Br. R. As. Soc. *n.* 33 (1900) 179. — **Fig. 7.**

Submerged aquatic, only floating at the surface when flowering. *Fronds* solitary or connected in groups of 2, seldom 3, slightly or strongly asymmetric, often curved; oblong to linear-lanceolate; 3–7.8 by 1–2.3 mm; frond when floating slightly convex; base slightly to strongly asymmetric, attenuate; apex symmetric, acute; margin entire; dorsal side smooth or with an indistinct apical papilla; ventral side flat, or convex when floating; green without red pigment; nerves 3, sometimes indistinct. *Stipe* short, hyaline, sometimes persistent. Root 1, slender, very long; root sheath absent or most indistinct; root cap strongly curved, sometimes straight, acute. *Slit of budding pouch* just dorsal to the margin of the frond. *Fruit* unknown.

Distr. Burma (Pegu, type), in *Malesia*: Malay Peninsula (Singapore; Wellesley; Dindings), Galang (possibly Galang I. in Riouw Arch., RIDLEY 10374, Sept. 1899, SING).

Ecol. In ditches and ponds, in rice-lands often together with *L. perpusilla*, at low altitude, in swamp forest (KURZ), rare.

Note. Only one collection of flowering *L. tenera* is known (MÖLLER 30 from Singapore); although only a few plants have flowers, all the plants are thickened and it is, therefore, probable that they were floating at the surface; they have stomata at the dorsal side. Some other collections also consist of completely or partly thickened plants. They are very similar to *L. perpusilla* in their shape and in bearing an apical papilla, however, they can be recognized by their more acute apex and in the absence of a distinct root sheath. *L. tenera* can easily be distinguished from the related *L. trisulca* by its entire margin, the absence of a long stipe, and by the fact that only 2–3 fronds remain connected.

3. WOLFFIA

HORKEL *ex* SCHLEID. Beitr. Bot. 1 (1844) 233, *nom. gen. cons. prop.*; DAUBS, Monogr. Lemnac. (1965) 41, *pro parte*; HARTOG, Taxon 18 (1969) 591–592; HARTOG & PLAS, Blumea 18 (1970) 366. — *Grantia* GRIFF. *ex* VOIGT, Hort. Suburb. Calc. (1845) 692; Not. 3 (1851) 223. — *Bruniera* FRANCH. Billotia 1 (1864) 25, 30. — *Wolffia sect. Uniflorae subsect. Estipitatae* HEGELM. Lemnac. (1868) 122; Bot. Jahrb. 21 (1895) 301. — **Fig. 1 C, 8.**

Minute aquatics, floating at the surface. *Fronds* either solitary or connected in groups of 2, symmetric, thick, more or less globular, ellipsoid or ovoid, sometimes dorsally flattened, with fleshy parenchyma without air spaces, green with or without brown pigment cells in the epidermis; raphides none; stomata at the dorsal part of the frond; margin entire or with a few more or less prominent papillae; nerves and roots absent. *Vascular tissue* absent, except for an occasional trace in the stamen. *Budding pouch* basal, median, funnel-shaped with circular opening and with a rudimentary *stipe* (not visible to the naked eye). *Inflorescence* 1, dorsal, consisting of a cavity containing 1 ♂ and 1 ♀ flower, without a spathe, proterogynic. *Anther* unilocular, dehiscent along an apical, pigmented line. ♀ *Flower* situated nearer to the budding pouch than the ♂ flower, consisting of a globular ovary with a short persistent style. *Ovule* 1, orthotropous. *Fruit* globular. *Seed* globose or slightly compressed, smooth.

Distr. At least 7 *spp.* in the tropical, subtropical and temperate regions of the world.

KEY TO THE SPECIES

1. Dorsal outline of the frond round or elliptic. Ventral side inflated, globular.
2. Dorsal outline of the frond elliptic. Dorsal side flat to convex. Width greatest below the dorsal plane, at ± half the height. . . . . **1. W. globosa**
2. Dorsal outline of the frond round to ovate. Dorsal side flat. Width greatest in the dorsal plane. **W. arrhiza**

1. Dorsal outline of the frond angular. Ventral side with a central conical protuberance. **W. microscopica**

1. Wolffia globosa (ROXB.) HARTOG & PLAS, Blumea 18 (1970) 367. — *Lemna globosa* ROXB. [Hort. Beng. (1814) 66, *nomen*] Fl. Ind. ed. Carey 3 (1832) 565; GRAHAM, Cat. Bomb. Pl. (1839) 252; DALZ. & GIBS. Bomb. Fl. (1861) 281. — *Grantia globosa* (ROXB.) GRIFF. *ex* VOIGT, Hort. Suburb. Calc. (1845) 692; Not. 3 (1851) 229. — *W. schleideni* MIQ. Ned. Kruidk. Arch. 3 (1855) 428; Fl. Ind. Bat. 3 (1855) 221; Nat. Tijd. N. I. 10 (1856) 399–402; KURZ, *ibid.* 27 (1864) 220; NAVES, Novis. App. (1882) 296; BACK. Handb. Fl. Java 3 (1924) 2; *ibid.* 2 (1928) 290; Bekn. Fl. Java (em. ed.) 10 (1949) fam. 226, p. 3; BACK. & BAKH. *f.* Fl. Java 3 (1968) 128. — *W. delilii var. schleideni* (MIQ.) KURZ, J. Linn. Soc. Bot. 9 (1866) 265. — *W. arrhiza* (*non* WIMMER) MARTENS, Preuss. Exp. O.-Asien, Bot. Teil, Tange (1866) 143; HEGELM. Lemnac. (1868) 124–126, *p.p.*; HOOK. *f.* Fl. Br. Ind. 6 (1893) 557–558, *p.p.*; HEGELM. Bot. Jahrb. 21 (1895) 301–302, *p.p.*; TRIM. Handb. Fl. Ceyl. 4 (1898) 367; RIDL. J. Str. Br. R. As. Soc. *n.* 33 (1900) 79; COLLETT, Fl. Simlensis (1902) 545; PRAIN, Bengal Pl. 2 (1903) 841; RIDL. Mat. Fl. Mal. Pen. 3 (1907) 53; KOORD. Exk. Fl. Java 1 (1911) 269; MERR. Philip. J. Sc. 12 (1917) Bot. 101; En. Philip. 1 (1923) 190; BACK. Handb. Fl. Java 3 (1924) 2; RIDL. Fl. Mal. Pen. 5 (1925) 132; HEND. Gard. Bull. S. S. 4 (1928) 352; FISCHER in Gamble, Fl. Madras 9 (1931) 1593; BURK. Dict. (1935) 1328; GAGNEP. Fl. Gén. I.-C. 6 (1942) 1198; MCCANN, J. Bomb. Nat. Hist. Soc. 43 (1942) 159–160; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 226, p. 3; HEND. Mal. Wild Fl. Monocot. (1954) 210; MASAMUNE, Sc. Rep. Kanazawa Univ. 5 (1957) 94; MITRA, Fl. Pl. E. India 1 (1958) 86; LARSEN, Dansk Bot. Ark. 20 (1962) 136; OHWI, Fl. Japan (1965) 265; SHRI & NAIK, Fl. Osmanabad (1968) 682; BACK. & BAKH. *f.* Fl. Java 3 (1968) 128. — *W. cylindracea* HEGELM. Lemnac. (1868) 123; Bot. Jahrb. 21 (1895) 302; BROWN, Fl. Trop. Afr. 8, 2 (1901) 205. — *W. delilii* (*non* SCHLEID.) NAVES, Novis. App. (1882) 296. — *W. microscopica* (*non* KURZ) MATSAMURA & HAYATA, En. Pl. Form. (1906) 463; MIKI, Bot. Mag. Tokyo 48 (1934) 334. — *Lemna arrhiza* (*non* L.) BACK. Bull. Jard. Bot. Btzg II, 12 (1913) 21. — **Fig. 8 a-a²**.

Fronds with elliptic to oblong dorsal outline, *c.* 1½ times as long as wide, 0.30–0.73 by 0.20–0.33 mm, 0.23–0.55 mm high; base and apex obtuse; margin with a few papillose cells; dorsal side flat near the apex and convex near the base, with a few papillose cells; ventral side strongly inflated, globular, with large cells; width greatest below the dorsal plane, at about half the height; green, without brown pigment cells in the epidermis. *Budding pouch* often with a distinct collar of elongate cells. *Fruit* unknown.

Distr. E. Asia (Japan; China: Fukien; Ryukyu Is.), SE. Asia (Tonkin; India: Sibpur, Dehra Dun, Peshawar, etc.; Ceylon), also in Africa and Australia; in *Malesia*: Malay Peninsula (Singapore; Selangor; Kuala Lumpur; Malacca), E. Java (near Surabaja and near Redjasa E of Pasuruan), Kangean Is. (Sepandjang), Lesser Sunda Is. (Flores: Rana Mesé), Philippines (Central Luzon: Pampanga, Bulacan, Rizal).

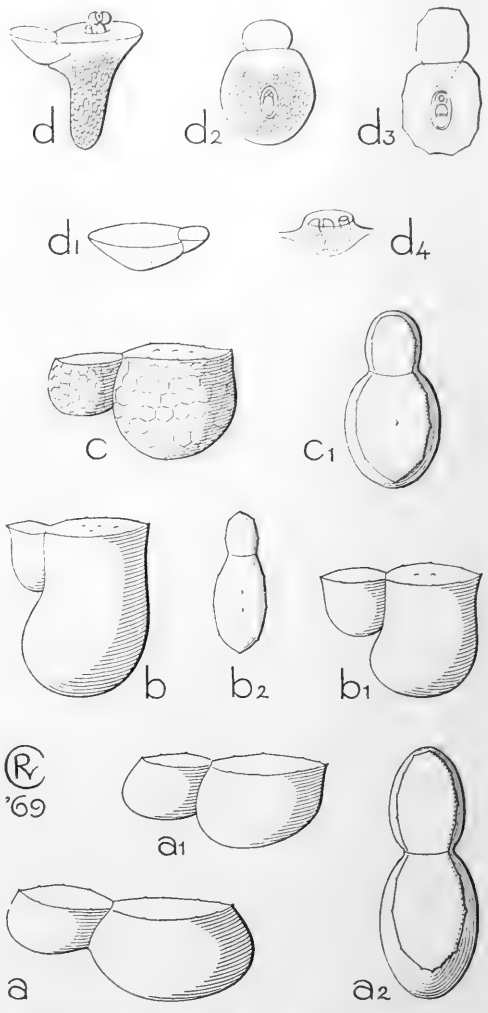

Fig. 8. *Wolffia globosa* (ROXB.) HARTOG & PLAS. *a.* Habit with a daughter frond, lateral, ×18, *a*¹. *ditto*, ×18, *a*². dorsal view, ×18. — *W. arrhiza var. australiana* BENTH. *b.* Habit, lateral view, ×18, *b*¹. *ditto*, ×18, *b*². *ditto*, dorsal view, ×18. — *W. arrhiza* (L.) HORKEL *ex* WIMMER. *c.* Habit with a daughter frond, ×18, *c*¹. *ditto*, dorsal view, ×18. — *W. microscopica* (GRIFF.) KURZ, *d.* Habit of a flowering plant with a daughter frond, showing elongated ventral side, and dorsal inflorescence, ×18, *d*¹. *ditto*, frond without protuberance, ×18, *d*². dorsal view, ×18, *d*³. *ditto*, more angular outline, ×18, *d*⁴. detail of the inflorescence (1 pistil, 1 stamen), ×36 (*a–a*² JAAG 1956, *b–b*² DEN HARTOG 1186, *c–c*¹ VAN DER PLAS 28-9-67, *d–d*⁴ DESHPANDE 1727)

BACKER & BAKHUIZEN *f.* note this also from Mts Jang & Idjen in E. Java at 2200 m, but I believe this to be an error.

Ecol. Stagnant water and ditches, once in calciferous water, in Malaya in everwet climate, in E. Java under severe monsoon conditions, all localities in Malesia at low altitude. Near Redjasa under a thick cover of *Azolla pinnata*; at 1000 m in Rana Mesé.

Vern. Philippines: *dugmán*, Bis., *liá*, Tag.

Notes. The specimens of *W. globosa* of Malesia are *c.* 1½ times as long as wide, while the Australian specimens are usually twice as long as wide. The size of both the Malesian and Australian plants of *W. globosa* is smaller than that of *W. arrhiza*. In Australia still another *Wolffia* is found with an elliptic dorsal outline and which is much higher than all other species in the genus. It is known as *W. arrhiza var. australiana* BENTH. but no doubt represents a good species (fig. 8 b-b²).

Wolffia arrhiza (L.) HORKEL *ex* WIMMER, Fl. Schles. ed. 3 (1857) 140; HEGELM. Lemnac. (1868) 124–126, *p.p.*; HOOK. *f.* Fl. Br. Ind. 6 (1893) 557–558, *p.p.*; HEGELM. Bot. Jahrb. 21 (1895) 301–302, *p.p.*; DAUBS, Monogr. Lemnac. (1965) 48–49. — *Lemna arrhiza* LINNÉ, Mant. (1771) 294. — *W. michelii* SCHLEID. Beitr. Bot. (1844) 233. — **Fig. 8 c-c¹.**

Fronds with round to ovate dorsal outline, usually as long as wide, rarely somewhat longer, 0.8–1.3 by 0.6–0.8 mm; 0.6–0.8 mm high; base and apex obtuse; margin entire or with papillae; dorsal side flat to slightly convex; ventral side strongly inflated, globular, consisting of large cells; width greatest in the dorsal plane; green, without brown pigment cells in the epidermis.

Distr. Temperate zone of the Old World, in Africa also in the tropics, not yet found in Malesia and probably absent from the whole of East Asia and Australia. Records of *W. arrhiza* from these areas seem to relate to the closely allied *W. globosa*.

Ecol. Stagnant waters, often mixed with other floating aquatics.

Wolffia microscopica (GRIFF.) KURZ, J. Linn. Soc. Bot. 9 (1866) 265; HEGELM. Lemnac. (1868) 127–128; HOOK. *f.* Fl. Br. Ind. 6 (1893) 558; HEGELM. Bot. Jahrb. 21 (1895) 301; PRAIN, Bengal Pl. 2 (1903) 841; MITRA, Fl. Pl. E. India 1 (1958) 86; DAUBS, Monogr. Lemnac. (1965) 44. — *Grantia microscopica* GRIFF. *ex* VOIGT, Hort. Suburb. Calc. (1845) 692; Not. 3 (1851) 226. — **Fig. 8 d-d¹.**

Fronds with pentagonal or hexagonal dorsal outline, 0.4–0.6 mm ø; margin entire except for the papillose corner cells; dorsal side flat; ventral side elongated into a central, conical, parenchymatic protuberance up to 1.8 mm long; green, without brown pigment cells in the epidermis.

Distr. So far this species is only known from India. It is probable that this minute plant has been often overlooked; therefore, it is expected to occur also elsewhere in East Asia and even in Malesia.

Ecol. Occurs usually mixed with other floating aquatics, especially with *Lemna perpusilla*. According to MAHESWARI and KAPIL (Am. J. Bot. 50, 1963, 679) it never co-exists with *Spirodela polyrhiza*.

Note. Records of *W. microscopica* from Formosa and Japan relate to *W. globosa*.

Doubtful

MIQUEL (Ned. Kruidk. Arch. 3, 1855, 429; Fl. Ind. Bat. 3, 1855, 221) reported that a second considerably larger *Wolffia* species was found together with *W. schleideni* near Surabaia. He thought that this species was identical or related to *W. delilii* SCHLEID., but unfortunately he restricted the description to a few remarks, which are repeated here:

'Frond complanate, slightly lenticular, 2–2½ mm long; epidermis cells gyrose.'

I have not seen this material.

Dubious

Lemna obcordata WINBERG in Thunberg, Fl. Jav. 1 (1825) 2, *nomen.*

HALORAGACEAE (R. van der Meijden & N. Caspers, Leyden)

Perennial (rarely annual) herbs, or undershrubs, terrestrial or aquatic, sometimes stoloniferous (*Gunnera*). *Leaves* opposite, spiral, or verticillate, in the terrestrial species nearly always simple, in the aquatic ones always partly pinnately divided, pinnately nerved or (in *Gunnera*) palmately nerved. Stipules 0, but the leaves often flanked by small, subulate and caducous enations. *Flowers* mostly in spike-like inflorescences, sometimes in a compound panicle, mostly solitary or (sometimes) in clusters of up to a dozen flowers in the axil of a bract or reduced leaf, ☿, monoecious, dioecious or polygamous, perigynous, actinomorphous, mostly 4-merous, or 2-, or (not in Mal.) 3-merous. *Sepals* 4 or 2, rarely (not in Mal.) 3, in ☿ flowers sometimes much reduced to 0, free or little connate, mostly persistent. *Petals* alternisepalous, 4, 2 or 0, rarely 3 (not in Mal.), free, in ♀ flowers absent or strongly reduced, often soon caducous, mostly more or less unguiculate and cochleariform, longer than the sepals. *Stamens* as many as sepals and then epi- or alternisepalous, or twice as many, 8, 4 or 2, rarely (not in Mal.) 3 fertile and 3 sterile, or 1, in ♀ flowers completely reduced; filaments mostly filiform, long and very thin, rarely (not in Mal.) short and thick; anthers 2-celled, basifixed, latrorse, mostly oblong to linear, rarely ± elliptic. Disk 0. *Ovary* 1- or 4-, rarely 2- or (not in Mal.) 3-celled, in the ♂ flowers 0 or reduced; style alternisepalous, free, mostly short, grading into the globose or subulate stigmas which spread in fruit, the stigmatic, more-celled papillae hair-like elongating towards the end of the anthesis (except in *Gunnera*). *Ovules* as many as styles, or (in *Gunnera*) single, apical, pendulous, anatropous and apotropous. *Fruit* nut-like or (in *Gunnera*) a drupe, variously sculptured, indehiscent 1-seeded or breaking up into 4(–2) 1-seeded mericarps. *Seed* with a thin testa; embryo cylindrical, surrounded by a thick, white, oily albumen, or (in *Gunnera*) obcordate and in top of a very copious and oily albumen.

Distribution. Genera 7, with *c.* 150 *spp.*, nearly all over the world, but rather rare in the tropics.

Ecology. Malesian *Haloragaceae* have a varied ecology; in general they prefer damp, often poor soils. *Myriophyllum* consists mostly of aquatics. *Myriophyllum* and *Haloragis* species grow in the lowland ascending into the hills; other representatives are decidedly restricted to the montane zone and the lower part of the alpine zone, *e.g. Gunnera macrophylla, Haloragis halconensis, H. micrantha, H. philippinensis, Laurembergia coccinea,* and *Myriophyllum pedunculatum.* There is even one restricted to the alpine zone, *viz. Myriophyllum pygmaeum.* A few species are bound to a seasonal climate, *viz Myriophyllum dicoccum, M. coronatum,* and *Haloragis acanthocarpa. Gunnera* shows a remarkable symbiosis with algae.

Flower biology of *Haloragis, Laurembergia* and *Myriophyllum.* It seems that at least the Malesian species are protandrous; in the initial stage of anthesis the stigmatic papillae are very short; at this stage the anthers grow to proportionally large size, protrude from the flower on elongating filaments, and shed their pollen; they soon wither and are caducous. In the meantime the ovary has already distinctly enlarged. Then the stigmatic papillae elongate and obviously reach the receptive stage. The structure seems to point to cross-pollination by wind, as already pointed out by Miss GIBBS (1917). Consequently, sizes of flower parts can only be compared when full-grown. The petals also reach their full size only in just opened flowers.

Taxonomy. *Haloragaceae* are generally agreed to be classified with the *Myrtales.* The circumscription of the family has differed and has included the genera *Callitriche* and *Hippuris.* These are now generally regarded as two separate families, though HUTCHINSON still includes *Hippuris* (Fam. Fl. Pl. ed. 2, 2, 1959, 448; Fvol. Phyl. Fl. Pl. 1, 1969, 546). They were sometimes placed near *Haloragaceae,* but for example PULLE (Compendium) regarded both as reduced sympetalous families and assumed the reductions to be convergent coinciding with the aquatic habitat, not expressing systematic affinity. This view is sustained by HEGNAUER (Chemotax. 4, 1966, 238; Pharm. Act. Helv. 41, 1966, 585) and WIEFFERING

(Phytochem. 5, 1966, 1064) on chemotaxonomical arguments. MELCHIOR (Engl. Syll. ed. 12, 2,1964, 438) and TAKHTAJAN (Evol. Angiosp. 1959, 228; Fl. Pl. 1969, 225) place only *Callitrichaceae* near or in *Lamiales*. HUTCHINSON *l.c.* places *Callitriche* in *Onagrales*.

Within the family *Gunnera* occupies an isolated position, in which it is mostly regarded as a separate subfamily (SCHINDLER, MELCHIOR); also HUTCHINSON includes it in the family. Others regard it to represent a separate family, placing it next to *Haloragaceae*, *e.g.* VON WETTSTEIN, PULLE, and TAKHTAJAN.

The differences between the two groups are the following:

Haloragoideae: Vessels not polystelic. Ligule-like structures absent. Hairs many-celled, rarely reduced few-celled. Bracteoles present, rarely fully absent. Stigma short, capitate or shortly ligulate, on a more or less distinct style. Ovules 2–4, as many as the styles, crassinucellate, with 2 integuments. Fruits without a stone. Endosperm nuclear. Embryo large, cylindrical, with a long radicle.

Subfam. *Gunneroideae*: Vessels polystelic. Ligule-like structure distinct, sometimes ochrea-like. Hairs one-celled. Bracteoles absent. Stigma long, subulate, sessile. Ovule 1, tenuinucellate, with 1 integument. Fruits with a stone. Endosperm cellular. Embryo small, obcordate, with a short radicle.

However, in general the floral structure is in good agreement to include both in one family. The Australian genus *Glischrocaryon* (*Loudonia*) combines characters of both *Gunnera* and *Haloragis*, being macromorphologically distinctly allied to *Haloragis*, but possessing pollen which resembles that of *Gunnera* (similar type of apertures and exine), thus giving an additional strong argument for keeping *Gunneroideae* as a subfamily of *Haloragaceae*.

Subfam. *Haloragoideae* is divided into tribe *Haloragеae* (with a 1-seeded fruit) and tribe *Myriophylleae* (with the fruit breaking up into 4(–2) 1-seeded mericarps).

Chemotaxonomy. As a consequence of the small economic importance of this family chemical information is scanty. Flavonols, leucoanthocyanins, ellagic acid and rather large amounts of tannins have definitely been demonstrated to be present in members of *Haloragaceae*. The tannins are most probably mixtures of hydrolysable and condensed tannins; this is indicated by the presence of ellagic acid and leucoanthocyanins. The terms "myriophyllin cells" and "myriophyllin" often used in anatomical literature are derived from *Myriophyllum*. Myriophyllin cells are idioblasts which are coloured purple by vanillin and hydrochloric acid and myriophyllin is their tannin-like content which gives this reaction (indicating leucoanthocyanins or catechins). Species of *Myriophyllum* bear trichomes giving the "myriophyllin" test. Two species of *Haloragis* have been found to produce prussic acid; the cyanogenic compounds, however, have not been investigated. Oxalate of lime occurs frequently, especially in the form of small clusters.

Accumulation of tannins containing ellagic acid and of condensed leucoanthocyanins fits well with the inclusion of *Haloragaceae* in *Myrtales* in the wider sense. The genera *Callitriche* and *Hippuris* have by some authors been included in or thought affiliated with *Haloragaceae*, but they are biochemically so different that such a relationship seems highly improbable; their chemical characters rather indicate affinities with sympetalous taxa. Reference: HEGNAUER, Chemotaxonomie der Pflanzen 4 (1966) 235–238. — R. HEGNAUER.

Morphology. Though the enations or trichomes occurring near the leaf-base have been sometimes interpreted as stipules, they are according to SCHINDLER (Pfl. R. Heft 23, 1905, 4) enatia to which he ascribes a gland function. However this may be, they are also found on the leaves and in other not prescribed places on the stem, showing that they are not organs in the proper sense. Recently PRAGLOWSKY (Grana 10, 1970, 159-239) revised the palynology of the family.

Uses. The only useful plant in Malesia is *Myriophyllum brasilse ien*which is cultivated in fish-ponds.

Note. The treatment of *Haloragis* was done by Mr. N. CASPERS several years ago; while working on *Gunnera* and *Laurembergia*, he fell ill and could not finish this work.

KEY TO THE GENERA

1. Leaves radical, long-petioled, palmately nerved. . . . . **4. Gunnera**
1. Leaves not radical, sessile or shortly petioled, pinnately nerved.
2. At least the lower (submersed) leaves pinnately divided, verticillate. . . . . **3. Myriophyllum**
2. All leaves entire to crenate-serrate, opposite, alternate or sometimes in whorls of 3–4.
3. Fruit breaking up into 2–4 mericarps. Leaves sessile. . . . . **3. Myriophyllum**
3. Fruit a one-seeded nutlet. Leaves mostly shortly petioled.
4. Flowers in axillary clusters, the middle one ♂ or sometimes ☿ and (in Asiatic *spp.*) very long-stalked, the other ones ♀. . . . . **2. Laurembergia**
4. Flowers solitary, all ☿, not long-stalked. . . . . **1. Haloragis**

1. HALORAGIS

J. R. & G. FORST. Char. Gen. Pl. (1776) 31, t. 31; SCHINDL. Pfl. R. Heft 23 (1905) 1–133, 36 fig. ('*Halorrhagis*'); WENT *f.* Nova Guinea 14 (1924) 105–109, t. XI. — *Gonocarpus* THUNB. Nov. Gen. Pl. 3 (1783) 55; Fl. Jap. (1784) 69, t. 15; SCHREB.

Gen. Pl. 1 (1789) 86 ('*Gonatocarpus*'); KÖN. & SIMS, Ann. Bot. 1 (1805) 546 ('*Goniocarpus*'). — *Gaura* LOUR. Fl. Coch. (1790) 225. — **Fig. 1.**

Herbs or small shrubs, prostrate or erect; stems mostly angular by the decurrent edges of the petiole. *Leaves* (in Mal.) simple, decussate or in whorls of 3–4, rarely alternate, pinnately nerved, the margin almost always dentate, serrate, or crenate. Inflorescences terminal. *Flowers* (in Mal.) solitary in the axil of a bract, bisexual, (in Mal.) 4-merous. *Sepals* (in Mal.) 4, valvate in bud, mostly triangular, persistent. *Petals* (in Mal.) 4, imbricate in bud, boat-shaped, caducous. *Stamens* (in Mal.) 8, rarely 4, in the latter case episepalous (in one extra-Mal. *sp.* epipetalous). *Ovary* (in Mal.) often 4-gonous, 8-ribbed, the mid-sepaline ribs less distinctly raised than the others, 4-celled; pericarp enlarging to fruit-size long before the seed is set; styles (in Mal.) 4, cylindric, often incurved or the stigmas sessile. *Fruit* nut-like, pericarp hard.

Distr. About 60 *spp.*, almost all in Australia (51), also in Chatham I., Carolines (Yap, Palau), a few endemic in Tasmania and New Zealand, in the Pacific eastwards in Rapa I. and Juan Fernandez, in continental SE. & E. Asia in the Himalayas, Japan, and Korea; 3 extra-Australian species in Asia and Malesia, and 1 in New Caledonia; in *Malesia* 5 *spp.*, some in the lowland, others on the mountains.

According to SKOTTSBERG (Nat. Hist. Juan Fern. 2, 1921, 151) the opinion that *H. erecta* would have been introduced in Chile rests upon a mislocalized specimen. SKOTTSBERG described three new species from the Juan Fernandez group all of the affinity of *H. erecta*.

Ecol. Three species are montane to subalpine and prefer generally damp or marshy habitats (*H. micrantha*, *H. halconensis*, *H. philippinensis*). *H. chinensis* is usually found on poor soils from sea-level up to 2200 m; *H. acanthocarpa* is bound to a lowland seasonal steppe and savannah climate on badly drained soils.

Taxon. SCHINDLER divided the genus into two subgenera by the number of stamens, *viz* 8 (or 6 in 3-merous flowers) in *subg. Haloragis*, or 4 in one W. Australian species forming a monotypic *subg. Pseudohaloragis* in which the 4 *episepalous* stamens are aborted.

However, in *H. philippinensis*, and some other extra-Malesian species, there are also only 4 stamens, but here by abortion of the *epipetalous* stamens. Furthermore, PRAGLOWSKI (Svensk Bot. Tidskr. 63, 1969, 486) observed in two Australian species sterility of anthers, 4 out of 8 stamens or 2 out of 4 stamens, hence, a sort of intermediate stage towards full abortion.

Consequently, it tends to be doubtful to distinguish subgenera on the basis of the number of stamens.

KEY TO THE SPECIES

1. Small, caespitose herb, glabrous in all parts. Stems rooting at the nodes, at least at the base, apex often ascending. Sepals with a thickened and shallowly cordate base. Anthers 0.3–0.7 mm long. **3. H. micrantha**
1. Plant hairy, at least in the younger parts. Stems not rooting at the nodes, generally erect. Base of the sepals not thickened and subcordate. Anthers 0.8–2.3 mm long.
2. Fruit with 8 longitudinal ridges alternating with 8 rows of (3–4) blunt-spiny tubercles, glabrous or appressedly hairy only at the apex. . . . . **4. H. acanthocarpa**
2. Fruit without rows of intercostal tubercles, or occasionally with 1(–3) blunt, low tubercles between the ribs, and then the fruit covered with appressed, curved hairs.
3. Robust plants with semi-woody, stiff stems, mostly very much branched. Leaves decussate or, especially in the middle of a branch, in whorls of 3–4; if decussate, then the index of the leaves of the main stem 1.5–2.2. . . . . **5. H. halconensis**
3. Perennial, slender herbs, the stem mostly branched only at the base, rather thin. Leaves always decussate; leaf-index (2–)2.8–4(–5.5).
4. Anthers 8. Ripe fruit erecto-patent to patent, mostly not thickened below the sepals, 0.7–1 by 0.8–1 mm (excluding the sepals), with a granular surface, the ribs often ± tuberculate, sometimes with 1(–3) intercostal tubercle(s). Inflorescence mostly much branched. . . . . **2. H. chinensis**
4. Anthers 4. Ripe fruit nodding, with a distinct, ± triangular thickening at the base of the sepals, 1.3–1.6 by 1–1.3 mm (excluding the sepals), the ribs smooth, the surface in between smooth or granular. Inflorescence little or not branched. . . . . **1. H. philippinensis**

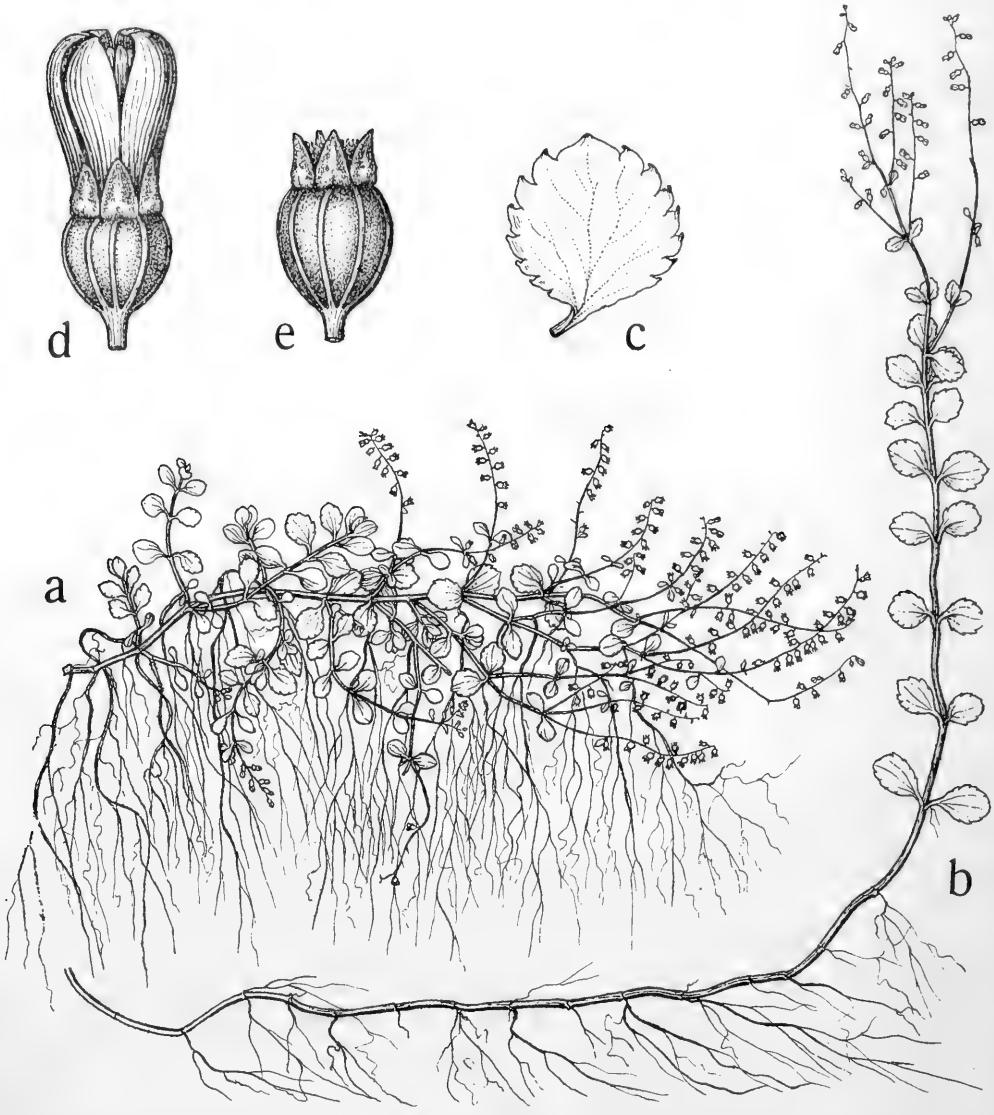

Fig. 1. *Haloragis micrantha* (THUNB.) S. & Z. *a–b*. Habit, *a* in exposed, *b* in shaded situation, nat. size, *c*. leaf, ×7, *d*. flower, ×15, *e*. fruit, ×15 (W. Java, Papandajan, VAN STEENIS 4246, 4296).

1. Haloragis philippinensis MERR. Philip. J. Sc. 1 (1906) Suppl. 216; En. Philip. 3 (1923) 221. — *H. tetragyna* (*non* HOOK. *f.*) CLARKE, Fl. Br. Ind. 2 (1878) 430, *pro specim. khasyan.* — *H. scabra var. abbreviata* SCHINDL. Pfl. R. Heft 23 (1905) 29; ? GUILLAUMIN, Fl. Gén. I.-C. 2 (1920) 715, *var.* '*attenuata*' (*sic*). — *H. isomera* PARKER in Fedde, Rep. 29 (1931) 104; HUNDLEY & U CHIT KO KO, List Trees Burma (1961) 98; TARDIEU-BLOT, Fl. Laos, Camb. & Vietn. 4 (1965) 119, t. 1 f. 11–13.

Perennial herb, 9–30 cm, not or little branched, with a number of stems from the base, each appressed-hairy and with ascending apex. *Leaves* decussate, ovate- to obovate-oblong, or lanceolate, 4–25 by 2½–7 mm, often appressed-hairy on both sides or the upper surface glabrous, margin on both sides with 2–10 small teeth; petiole 0–2 mm. *Racemes* not or hardly branched, 2½–12 cm. Bracts ovate-elliptic to lanceolate, the lower ones almost as large as the upper leaves, gradually diminishing in size upwards, 12–1½ mm, with 1–6 teeth on either side. Bracteoles of various shape, ½–1 mm, widened at the base. Pedicel 0–¾ mm,

glabrous or hairy. *Sepals* ¾–1 by ½ mm, at the base often somewhat thickened, glabrous. *Petals* 1¼–2 mm, the midrib dorsally mostly hairy. *Stamens* 4, episepalous; filaments *c.* 0.2–0.3 mm; anthers *c.* 1–1½ mm. Styles 4, 0.2–0.5 mm. *Fruit* nodding, ovoid to broad-ellipsoid, rarely globular, *c.* 1¼–1½ by 1–1¼ mm, with a distinct, ± triangular thickening at the base of the sepals, glabrous or with straight, appressed hairs, surface smooth or granular.

Distr. Assam (Khasya Mts), Burma (Tenasserim, Mergui), Thailand (Penins.: Ranong), S. Vietnam; in *Malesia*: N. Sumatra (Gajo Lands; Tapanuli: Sidikalang; Toba-Batak area) and Philippines (N. Luzon: Benguet Prov.). Fig. 2.

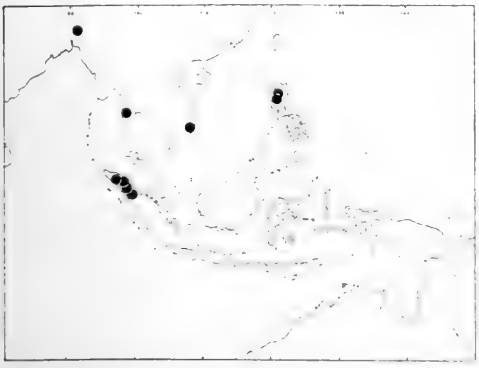

Fig. 2. Distribution of *Haloragis philippinensis* MERR. (except the Thailand locality)

Ecol. Mountain heathland and blangs, plateaus and ridges, sedge turf, *Sphagnum* bogs, and open pine forest, 1200–3400 m. *Fl. fr.* Dec.–May.

Notes. In addition to the morphological characters *H. philippinensis* has another ecology than *H. chinensis*; it is a true mountain species, although in the highest localities of *H. chinensis* the two species are found almost together (Toba-Batak Lands, Benguet).

In his original description MERRILL mentioned three syntypes of which I have examined MERRILL 4357 and 4444 (both in US, the latter also in L). Only the first fits the description and I have chosen this as lectotype; the second is wrongly identified and belongs to *H. chinensis*.

Until 1931 the Khasya specimens have always been confused with *H. scabra* by British botanists, and have been cited under *H. tetragyna var. micrantha* by those whose contention it was to merge these two species.

2. Haloragis chinensis (LOUR.) MERR. Trans. Am. Phil. Soc. n.s. 24, 2 (1935) 290, 39; TUYAMA, J. Jap. Bot. 16 (1940) 284, f. 5b, 6, *incl. var. yapensis ex descr.*; MERR. Sunyatsenia 5 (1940) 150; MERR. & PERRY, J. Arn. Arb. 23 (1942) 407; *ibid.* 29 (1948) 161; SINCLAIR, Gard. Bull. Sing. 15 (1956) 24; TARDIEU-BLOT, Fl. Laos, Camb. & Vietn. 4 (1965) 120; KENG, Mal. Nat. J. 23 (1970) 123, t. 13. — *Gaura chinensis* LOUR. Fl. Coch. (1790) 225; ed. Willd. 1 (1793) 276. — *Goniocarpus scaber* KÖN. & SIMS, Ann. Bot. 1 (1805) 547, t. 12 f. 6. — *H. scabra* BTH. Fl. Hongk. (1861) 139, *excl. specim. khasyan.*; SCHINDL. Pfl. R. Heft 23 (1905) 28, f. 9A, *incl. var. elongata*; MERR. Philip. J. Sc. 1 (1906) Suppl. 216; BRITTEN, J. Bot. 45 (1907) 135; VALET. Bull. Dép. Agr. Ind. Néerl. *n.* 10 (1907) 41, *incl. var. novaguineensis* VALET.; MERR. J. Str. Br. R. As. Soc. *n.* 76 (1917) 102; GUILLAUMIN, Fl. Gén. I.-C. 2 (1920) 715, f. 74–14; MERR. En. Born. (1921) 455; En. Philip. 3 (1923) 221; WENT *f.* Nova Guinea 14 (1924) 108; KANEH. En. Micr. (1935) 383; H. J. LAM, Blumea 5 (1945) 581. — *H. tetragyna* [*non* (LABILL.) HOOK. *f.*] BTH. Fl. Austr. 2 (1864) 484, *incl. var. micrantha, quoad specim. asiat. et mal., khasyan. except.*; CLARKE, Fl. Br. Ind. 2 (1878) 430; FORB. & HEMSL. J. Linn. Soc. Bot. 23 (1887) 292.

Erect or suberect, obviously perennial, mostly branched herb, 10–60 cm; stems appressed-hairy, mostly distinctly 4-angular with straw-coloured edges. *Leaves* decussate, ovate to narrow lanceolate, 2–26 by 1–9 mm, hairy, especially the underside of the midrib, margin on either side with 3–10 teeth; petiole 0–1½ mm. *Racemes* mostly more or less strongly branched, 2–22 by 1–7 cm. Bracts ovate to elliptic, ½–1½ by ¼–½ mm, pubescent, sometimes with 1 tooth on either side. Bracteoles 0.2–0.7 mm long, widened at base. Pedicel 0.2–0.6 mm, glabrous. *Flowers* erecto-patent to patent. *Sepals* 0.5–0.9 by 0.4–0.6 mm, glabrous, often incurved. *Petals* 1–1¾ mm, hairy on the midrib outside, mostly red to brick red, sometimes green. *Stamens* 8; filaments 0.1–0.4 mm; anthers *c.* 1 mm long. Styles incurved, 0.1–0.3 mm. *Fruit* erecto-patent to patent, globular to broadly ellipsoid, 0.7–1 by 0.8–1 mm, not thickened below the sepals, the ribs often ± tuberculate, sometimes with 1(–3) low intercostal tubercles, glabrous or with incurved and appressed hairs, surface granular and punctate.

Distr. Indo-China (Cochinchina, Tonkin, *sec.* GUILLAUMIN and TARDIEU-BLOT), S. China (also Kwangtung, Macao, Hongkong, Hainan), through

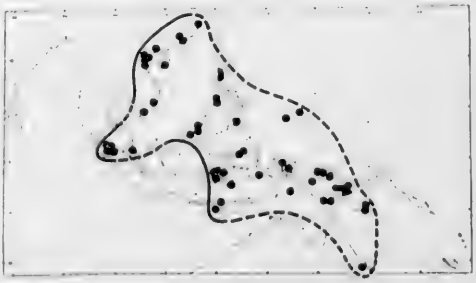

Fig. 3. Distribution of *Haloragis chinensis* (LOUR.) MERR.

Malesia to Micronesia (Carolines: Jap) and Queensland (Kelsey Creek near Proserpine; Atherton Mts, introduced in Hawaii (DEGENER 30591); in *Malesia*: N. Sumatra (Toba-Batak area), Singapore, N. Borneo (Jesselton, Labuan), Celebes, Philippines (Luzon, Calamian Is., Busuanga, Mindanao), Moluccas (Ceram, Aru Is.), Lesser Sunda Islands (Sumba, Flores), New Guinea (also Ferguson I.). Fig. 3.

Ecol. In open spots, between grass, in lalang wastes, on poor laterites, river banks, poor sandy dry places, and deforested slopes, from sea-level up to 2200 m. *Fl. fr.* Jan.–Dec.

Note. Allied to *H. philippinensis* but easily distinguishable. More closely allied to *H. tetragyna* HOOK. *f.* and by BENTHAM (1864) even united with it as *var. micrantha* BTH. *l.c.*

3. Haloragis micrantha (THUNB.) R. BR. [in Flinders, Voy. (1814) App. 550] *ex* SIEB. & ZUCC. Abh. Bay. Ak. Wiss. M.-Ph. Cl. 4² (1844) 133; repr. Fl. Jap. Fam. Nat. (1845) 25; HOOK. *f.* Fl. Tasm. 1 (1860) 121; BTH. Fl. Austr. 2 (1862) 482; HOOK. *f.* Handb. Fl. New Zeal. (1867) 66; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 100; CLARKE, Fl. Br. Ind. 2 (1878) 430; STAPF, Trans. Linn. Soc. Bot. II, 4 (1894) 149; KING, J. As. Soc. Beng. 66, ii (1897) 310; BAILEY, Queensl. Fl. 2 (1900) 555; SCHINDL. Pfl. R. Heft 23 (1905) 29; GIBBS, J. Linn. Soc. Bot. 42 (1914) 74; Arfak (1917) 159; GUILLAUMIN, Fl. Gén. I.–C. 2 (1920) 715; MERR. En. Born. (1921) 455; RIDL. Fl. Mal. Pen. 1 (1922) 692; MERR. En. Philip. 3 (1923) 221; WENT *f.* Nova Guinea 14 (1924) 107; STEEN. Trop. Natuur 21 (1932) 101–102, f. 1–2; ELMER, Leafl. Philip. Bot. 9 (1933) 3143; STEEN. Bull. Jard. Bot. Btzg. III, 13 (1934) 218; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 76, p. 2; STEEN. Endeavour 21 (1962) 187, f. 3 (map); LARSEN, Dansk Bot. Ark. 23 (1963) 68; BACK. & BAKH. *f.* Fl. Java 1 (1963) 266; TARDIEU-BLOT, Fl. Laos, Camb. & Vietn. 4 (1965) 122; CASPERS, Pac. Pl. Areas 2 (1966) 60, map 31; LARSEN, Dansk Bot. Ark. 23 (1966) 395, f. 60; KENG, Mal. Nat. J. 23 (1970) 123; MEIJDEN, Fl. Thail. 2 (1970) 3. — *Gonocarpus micranthus* THUNB. Nov. Gen. Pl. 3 (1783) 55; Fl. Jap. (1784) 69, t. 15; WILLD. Sp. Pl. 1 (1797) 690; KÖN. & SIMS, Ann. Bot. 1 (1805) 546, t. 12 f. 5; DC. Prod. 3 (1828) 66. — *H. tenella* BRONGN. in Duperrey, Voy. Coquille Bot. (1828) t. 68 f. B. — *Goniocarpus rubricaulis* GRIFF. Not. Pl. As. 4 (1854) 688, *ex descr.* — *H. paucidentata* HOSOKAWA, Trans. Nat. Hist. Soc. Form. 30 (1940) 335. — **Fig. 1.**

Prostrate, glabrous herb, 5–30 cm long; stems rooting on the nodes, ascending at the apex. *Leaves* decussate, obovate, orbicular, ovate, or oblong, 3–10 by 1½–4 mm, the margin on either side with 1–7 teeth; petiole 0–2 mm. *Racemes* erect, simple or little branched, 1–8 cm long. Bracts lanceolate, acute, ½–1½ by 0.2 mm. Bracteoles filiform or acuminate, 0.1–0.3 mm, with widened base. Pedicels ¼–¾ mm. *Flowers* scattered, erect then nodding. *Sepals* ovate-triangular, 0.3–0.6 mm, subsaccate-thickened and shallowly

Fig. 4. Distribution of *Haloragis micrantha* (THUNB.) S. & Z.

cordate at the base, often acuminate. *Petals c.* 0.9–1.3 mm, red or rosa. *Stamens* 8; filaments up to 0.6 mm; anthers 0.3–0.7 mm. Styles incurved, 0.2–0.3 mm. *Fruit* obovoid-globose to depressed-globose, *c.* 0.9–1.1 by 0.7–0.9 mm, smooth.

Distr. S. & E. Asia (E. India, N. Thailand, S. & E. China, N. Vietnam, Hainan, Taiwan, Ryukyu Is., Korea, Japan), Australia (New South Wales, Victoria), Tasmania, New Zealand; in *Malesia*: W. Java (Mt Papandajan), N. Borneo (Mt Kinabalu), Celebes, Philippines (Luzon, Mindoro, Negros, Mindanao), New Guinea. Fig. 4.

KING recorded a doubtful collection by SCORTECHINI in Perak (Malaya) of which only a field note was in the Calcutta Herbarium; it has never been found since in Malaya.

Ecol. In marshy mountain turf, moist places along mountain brooks, on wet ridges, summits and plateaus, (1000–)1600–3600 m. *Fl. fr.* Jan.–Dec.

Note. The closest allied species is *H. depressa* (A. CUNN.) WALP. from Tasmania. THUNBERG's original description obviously contains some errors (sepals absent, stamens 4).

4. Haloragis acanthocarpa BRONGN. in Duperrey, Voy. Coquille Bot. (1828) t. 70; BTH. Fl. Austr. 2 (1864) 483; BAILEY, Queensl. Fl. 2 (1900) 555; SCHINDL. Pfl. R. Heft 23 (1905) 35; EWART & DAVIES, Fl. N. Terr. (1917) 214; MERR. & PERRY, J. Arn. Arb. 23 (1942) 407; SPECHT, Rec. Arnhem Land Exp. 3 (1958) 273. — *H. leptotheca* F. v. M.

Fragm. 3 (1862) 32. — *H. palauensis* TUYAMA, J. Jap. Bot. 16 (1940) 283, f. 3–5a.

Perennial, sometimes woody at the base; stems decumbent or erect, 40–75 cm long, hairy. *Leaves* decussate, ovate, elliptic to lanceolate, on either side with 5–12 teeth, those of the main stem 1½–4½ by ½–2 cm, (often bulbous-based-) hairy; petiole 1–2½(–4) mm. *Panicle* 10–20 by 5–10 cm, hairy. Bracts ovate-lanceolate, ¾–1¼ by ¼ mm. Bracteoles ovate-acuminate, 0.2–0.3 mm. Pedicels *c.* ½ mm, glabrous. *Flowers* scattered, erect, then nodding. *Sepals c.* 0.6–0.8 by 0.5 mm, glabrous, coriaceous in fruit. *Petals c.* 1¼–1½ mm, red to brown-red, the midrib dorsally pubescent. *Stamens* 8; filaments ¼–½ mm; anthers *c.* 1 mm. Styles curved inward, *c.* 0.1–0.2 mm. *Fruit* ellipsoid-globose, *c.* 1–2 by 0.8–1.2 mm, glabrous or appressedly hairy at apex, the 8 longitudinal ribs more or less alternating with 8 rows of 3–4 blunt spiny tubercles.

Distr. Northern part of Australia, Micronesia (Carolines: Palau Is.), and *Malesia*: New Guinea and Misool I. Fig. 5.

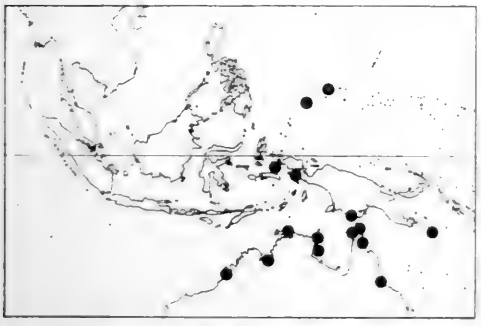

Fig. 5. Distribution of *Haloragis acanthocarpa* BRONGN.

Ecol. In steppe-like country and badly drained savannah forest, also in *Melaleuca* swamps and *Eucalyptus* woodland, surrounding termite mounds, 0–300 m. *Fl. fr.* April–Jan.

5. Haloragis halconensis MERR. Philip. J. Sc. 2 (1907) Bot. 288; En. Philip. 3 (1923) 221. — *H. secunda* RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 41. — *H. suffruticosa* GIBBS, Arfak (1917) 159; WENT *f.* Nova Guinea 14 (1924) 108–109, *incl. var. ramosa* WENT *f. et var. galioides* WENT *f.* — *H. gjellerupii* WENT *f. l.c.* 107. — *H. nemorosa* WENT *f. l.c.* 107, t. XI B; MERR. & PERRY, J. Arn. Arb. 23 (1942) 408. — *H. fruticosa* WENT *f.* Nova Guinea 14 (1924) 106, t. XI A. — *H. sanguinea* MERR. & PERRY, J. Arn. Arb. 29 (1948) 162. — *H. microphyllum* HOOGL. Blumea Suppl. 4 (1958) 228.

Erect, branched or unbranched, perennial half-shrubs or shrubs, with often thick, angular stems, up to 1½ m high. *Leaves* decussate, or in whorls of 3–4, often crowded, patent, erect or reflexed, ovate to oblong or sublanceolate, on either side with 2–13 teeth, hairy on both sides, hairs of the upper surface bulbous-based, rarely glabrous, chartaceous to coriaceous, those of the main stem(s) ½–3½ by ½–1¼ cm, of the branches 0.2–1.5 by 0.1–1 cm; petioles 0–2 mm. *Inflorescence* a wide to contracted panicle of which the lower branches are axillary in the upper leaf-axils. Bracts ovate to elliptic, often oblong, 1½–4 by ½–1½ mm. Bracteoles ½–1 mm long, with widened base. Pedicels ½–1½ mm, hairy. *Flowers* erect, then nodding, often secund. *Sepals* triangular-acuminate, ¾–1½ by ½–1 mm, glabrous (or slightly hairy on the median dorsal side, sometimes only in a few occasional flowers). *Petals* 2–3½ mm long, red, red-brown, or sometimes white or yellow, the midrib dorsally hairy. *Stamens* 8; filaments ¼–¾ mm; anthers 1–2¼ mm. Stigmas sessile, globose. *Fruit* obovoid, globose, more rarely ovoid, 1¼–1¾ by ¾–1 mm, 8-ribbed, from which 4 more distinct, appressed- to patently hairy, at least on the ribs.

Distr. *Malesia*: Philippines (Luzon; Mindoro: Mt Halcon; Negros: Mt Canlaon; Mindanao: Mt Apo), E. Celebes (G. Lumut), New Guinea, and Solomons (Bougainville; New Georgia Is.: Kolombangara; Guadalcanal). Fig. 6.

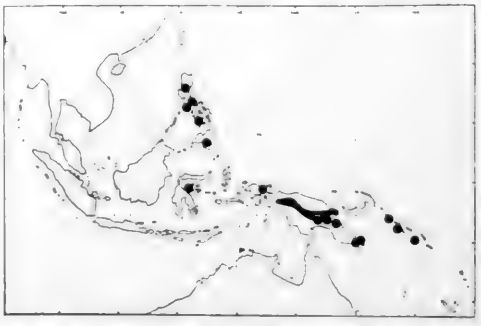

Fig. 6. Distribution of *Haloragis halconensis* MERR.

Ecol. On both dry and marshy or wet places, in peaty marshes, edges of swamps, along streams, both on sand and clayey subsoils, mostly on open heaths and cliffs in exposed situations, but also in forest and cloud-forest, 900–3800 m. *Fl. fr.* Jan.–Oct.

Notes. This species reminds in habit of *H. erecta* (MURR.) SCHINDL. and *H. exalata* F. v. M. of Australia and New Zealand, both of which have developed styles; the first has, moreover, glabrous and 4-winged nuts.

H. halconensis shows an astonishing variability, reflected in the large number of synonyms cited. These 'species' were originally described from distant places and based on one or a few specimens from one locality or mountain. With the increase of collections it appears that the characters on which they have been based are grading.

The variability is partly due to the very diverse

habitats; specimens found in shaded localities have a more rank habit with wider inflorescences, larger leaves and longer internodes than those of exposed habitats. The latter show a condensed habit and are frequently unbranched. Besides, the altitude causes dwarfing of leaves and habit with increasing height.

Apart from this, the variability must be partly ascribed to the fact that in all mountain plants there is a certain trend to local raciation of a widespread population, but on the other hand in several localities (Mt Arfak, Mt Gautier) branched and unbranched specimens occur in one locality in which the unbranched specimens occur in open places, the branched ones in less open habitat, on edges of forests and in the forest.

The variability of the species is vegetative and quantitative (degree of branching, leaf-size, hairyness, *etc.*). I cannot find qualitative differences in flowers or fruit.

From the description of *H. stokesii* F. BROWN, from Rapa I., it would appear that it has sessile stigmas which would point to affinity with *H. halconensis*, but it is described with only 2 stigmas and 4 stamens.

Excluded

Haloragis distichia JACK; *cf.* Fl. Mal. I, 5 (1958) 479 = *Anisophyllea disticha* (JACK) BAILL. (*Rhizophoraceae*).

2. LAUREMBERGIA

BERG. Descr. Pl. Cap. (Aug. 1767) 350, t. 5 f. 10; KAN. in Mart. Fl. Bras. 13, 2 (1882) 377, t. 68; SCHINDL. Pfl. R. Heft 23 (1905) 61; A. RAYNAL, Webbia 19 (1965) 683. — *Serpicula* LINNÉ, Mant. 1 (Oct. 1767) 16; MIQ. Fl. Ind. Bat. 1, 1 (1855) 631. — *Epilithes* BL. Bijdr. (1826) 734; HASSK. Cat. Hort. Bog. (1844) 86 ('*Epilithos*'). — **Fig. 8.**

Small perennial herbs, prostrate to ascending, often rooting at the nodes, mainly branched at the base. Stems terete to quadrangular, sometimes with scattered enatia as are also found on the leaves. *Leaves* opposite, or in 4, rarely in 2 rows, rarely subverticillate, simple, entire to dentate. *Flowers* polygamous, rarely monoecious, 4-merous, in axillary congested clusters of 1–11 flowers, consisting out of 1 ♂ and 2–10 ♀ and/or 1 ☿ and 2–10 ♀, rarely with either 1–3 ♂ or 1–7 ♀ flowers. — ♂ *Flowers*: long-stalked; sepals as in ♀; stamens 8 or (not in Mal.) 4; ovary rudimentary, conical, sometimes with some reduced ovules; style often rudimentary. — ☿ *Flowers*: shortly to long-stalked; petals and anthers as in ♂, for the rest as in ♀. — ♀ *Flowers*: subsessile to shortly stalked; sepals connate at the very base, mostly triangular; ovary urceolate with (4–)8 ribs, imperfectly 4-celled when young, later 1-celled with a central columella. *Fruit* nut-like, pericap hard, enlarging to fruit-size long before the seed is set.

Distr. Four *spp.*, 1 in S. Africa, 1 in S. Madagascar and Réunion, 1 in Africa, Madagascar and eastern South America, and 1 in S. India, Ceylon, Sumatra and Java. Fig. 7.

Ecol. The Malesian species is a characteristic mountain plant, generally of poor soils.

Taxon. The genus has been subdivided into 3 subgenera by RAYNAL. I refrain from any subdivision as the differential characters used for this purpose occur also in *Myriophyllum* and also in *Haloragis* in which they have not been attributed such high classificatory value. I certainly agree with RAYNAL in a rigid reduction of species proposed by SCHINDLER.

The Indo-Malesian species differs from the others in possessing 8 stamens, and in the central flower being very long-pedicelled and normally ♂.

1. Laurembergia coccinea (BL.) KAN. in Mart. Fl. Bras. 13, 2 (1882) 377, t. 68; SCHINDL. Pfl. R. Heft 23 (1905) 68; BACK. Schoolfl. Java (1911) 477; KOORD. Exk. Fl. Java 2 (1912) 705; Fl. Tjibodas 2 (1923) 217; F. BLEY, Diss. Zürich (1925) (embryol.) 1–32, f. 1–20, t. 1–2; STEEN. Arch. Hydrobiol. Suppl. 10 (1932) 315; DOCT. v. LEEUWEN, Verh. K. Ak. Wet. A'dam sect. 2, 31 (1933) 192, f. 37–39, t. 9; STEEN. Trop. Natuur 21 (1932) 102, f. 2, 163; Bull. Jard. Bot. Btzg III, 13 (1934) 218; BACK. & BAKH. *f.* Fl. Java 1 (1963) 266. — *Epilithes coccinea* BL. Bijdr. (1826) 734. — *Serpicula brevipes* W. & A. Prod. (1834) 338; FYSON, Fl. Nilg. Puln. Hilltops 3 (1920) 45, t. 330. — *Serpicula hirsuta* W. & A. Prod. (1834) 338; WIGHT, Ic. 3 (1845) t. 1001; MIQ. Fl. Ind. Bat. Suppl. (1861) 328, 128, *pro var. incisa* MIQ.; TRIM. Fl. Ceyl. 2 (1894) 148; FYSON, Fl. Nilg.

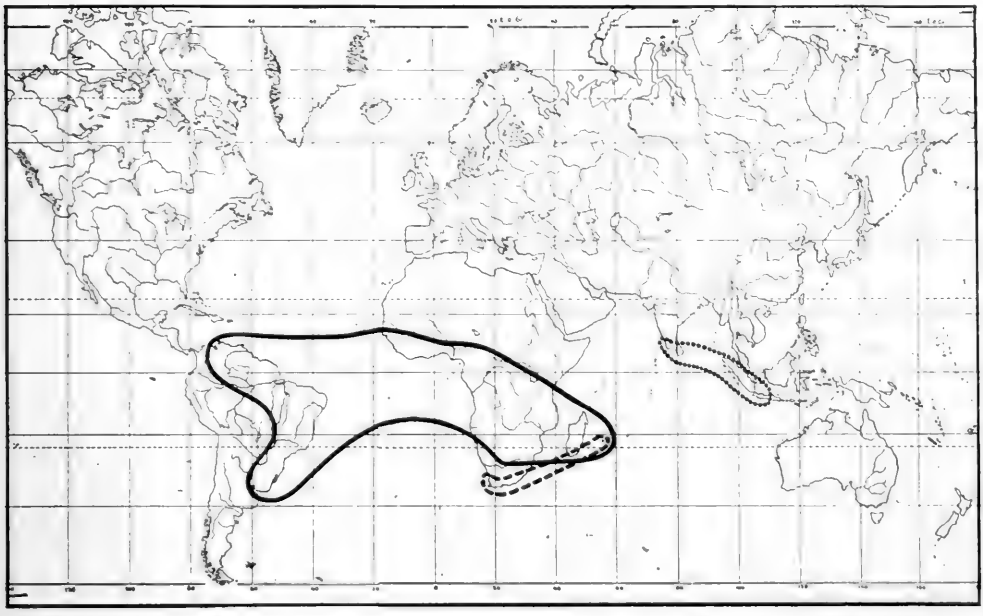

Fig. 7. Distribution of the genus *Laurembergia*; *subg. Serpiculastrum* A. RAYNAL (even line), *subg. Laurembergia* (broken line), *subg. Indolaurembergia* SCHINDL. (stippled line) (after RAYNAL, 1965, slightly corrected).

Puln. Hilltops 3 (1920) 45; Fl. S. Ind. Hill Stat. 1 (1932) 213. — *Haloragis oligantha* ARN. Nov. Act. Caes. Leop.-Car. (1836) 18, *non* W. & A. 1834. — *Serpicula epilithes* BL. Mus. Bot. Lugd.-Bat. 1 (1849) 110, *nom. illeg.*; MIQ. Fl. Ind. Bat. 1, 1 (1855) 632. — *Serpicula veronicaefolia* (*non* BORY) MIQ. Fl. Ind. Bat. 1, 1 (1855) 632. — *Serpicula javanica* MIQ. *ibid.* 1, 1 (1858) 1090; BACK. Schoolfl. Java (1911) 478. — *Serpicula indica* THW. En. Pl. Zeyl. (1859) 123, *nom. illeg.*; CLARKE, Fl. Br. Ind. 2 (1878) 431; FISCHER, Rec. Bot. Surv. India 9 (1921) 78. — *Serpicula zeylanica* ARN. *ex* CLARKE, Fl. Br. Ind. 2 (1878) 431, *incl. var. minor* THW. *ex* CLARKE; TRIM. Fl. Ceyl. 2 (1894) 147. — *L. brevipes* (W. & A.) SCHINDL. Pfl. R. Heft 23 (1905) 67. — *L. glaberrima* SCHINDL. *l.c.* 67. — *L. grandifolia* SCHINDL. *l.c.* 66. — *L. hirsuta* (W. & A.) SCHINDL. *l.c.* 64, *incl. var. angustifolia* SCHINDL., *var. rotundifolia* SCHINDL., *var. typica* SCHINDL., *l.c.* 65, = *var. hirsuta p.p.*; STEEN. Arch. Hydrobiol. Suppl. 10 (1932) 315, f. 5; Bull. Jard. Bot. Btzg III, 13 (1934) 218. — *L. indica* (THW.) SCHINDL. Pfl. R. Heft 23 (1905) 64, *nom. illeg.* — *L. javanica* (MIQ.) SCHINDL. *l.c.* 69, f. 20; BACK. Schoolfl. Java (1911) 478; KOORD. Exk. Fl. Java 2 (1912) 705, f. 89; F. BLEY, Diss. Zürich (1925); HOCHR. Candollea 6 (1936) 467. — *L. wangerinii* SCHINDL. Pfl. R. Heft 23 (1905) 65. — *L. zeylanica* (ARN. *ex* CLARKE) SCHINDL. *l.c.* 68, *incl. var. minor* (THW. *ex* CLARKE) SCHINDL. — *L. agastyamalayana* HENRY, J. Bomb. Nat. Hist. Soc. 62 (1965) 603, fig. — **Fig. 8.**

var. **coccinea.** — All synonyms, excl. those of *var. zeylanica.*

Internodes 3–6(–10) mm, in sterile branches up to 15 mm, glabrous to pilose in two rows or all round. Stems *c.* 4–40 cm long, 1–2 mm ø. Lower *leaves* always opposite, upper ones mostly irregularly alternate, subsessile, or rarely up to 2 mm long petioled; lamina elliptic to obovate-oblong, 5–8 by 2–3½ mm (in sterile branches up to 18 by 12 mm), acute at both ends, almost entire or with some coarse, obtuse to mucronate, often apically thickened teeth especially towards the apex, rather stiff, glabrous to pilose below on the midrib and along the margin. Clusters with 1 ♂ or sometimes ☿ flower, and 2–10 ♀ ones. — ♂ *Flowers*: pedicel 6–12(–20) mm long after anthesis, glabrous to thinly pilose, erecto-patent; sepals narrowly triangular to ovate, 0.4–0.8 by 0.3–0.6 mm, glabrous or with a tuft of short hairs at the apex; petals *c.* 2½ by 0.8 mm, outside wine-red; stamens 8; anthers *c.* 1½ by ½ mm; styles 4(–6), rudimentary. — ♀ *Flowers*: pedicel ½(–1) mm; sepals as in ♂. *Fruit* glabrous to densely pilose, with 8 whether or not strongly prominent ribs, episepalous ribs most distinct upwards, alternisepalous ones most distinct below the middle; between the costae often with thickenings which are confluent or consist of 2–4 distinct tubercles; styles 4(–6). *Seed* globular, *c.* 0.8–1 by 0.7–0.8 mm, brownish.

Distr. S. India (Nilgiris, Pulneys), Ceylon (Adam's Peak, Hakgalla, Pendrotallagalla) and *Malesia*: N. & Central W. Sumatra, and W. to

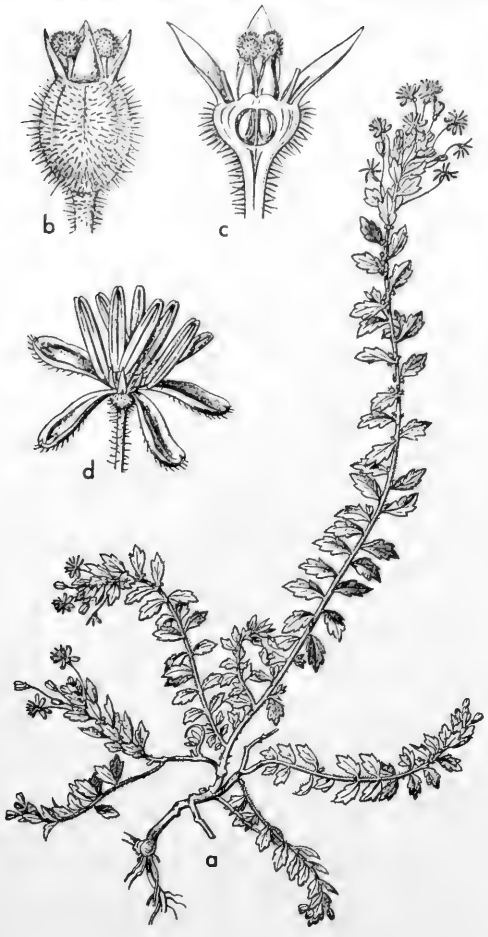

Fig. 8. *Laurembergia coccinea* (BL.) KAN. *a.* Plant, ×½, *b–d.* flowers: *b.* ♀ flower, *c.* bisexual flower, anthers removed, lengthwise section, *d.* ♂ flower, all enlarged (after KANITZ, Fl. Bras. 13, 2; the hairy form).

Central Java (Gedeh to Diëng). Fig. 7 (*subg. Indolaurembergia*).

KANITZ recorded *L. coccinea* from Brazil on the basis of a SCHOTT specimen; I have seen this (in W). This is certainly erroneously localized as SCHINDLER already noted on the label.

Ecol. Moist sunny places, often on stony poor soil, also along brooks, swamps and lake shores, often periodically partly inundated, only in the mountains, 1400–3100 m. *Fl.* Jan.–Dec.

Notes. All Javanese specimens are glabrous, all Sumatran and Ceylon specimens are hairy, but the S. Indian specimens are either hairy or glabrous. The hairiness is not combined with other differential characters, hence no taxonomical value can be attached to it.

The variation in sculpture of the fruit can be found occasionally in one specimen.

The name *Serpicula epilithes* BL. is illegitimate because it is based on *Epilithes coccinea* BL.; *Serpicula indica* THW. is illegitimate because it is superfluous by the citation of two older names in synonymy.

var. **zeylanica** (ARN. *ex* CLARKE) MEYDEN, *var. nov.* — *Serpicula zeylanica* ARN. *ex* CLARKE, Fl. Br. Ind. 2 (1878) 431, *excl. var. minor* THW. *ex* CLARKE. — *Haloragis oligantha* ARN. 1836, *non* W. & A. 1834. — *Serpicula indica* THW. *p.p., nom. illeg.* — *L. zeylanica* (ARN. *ex* CLARKE) SCHINDL., *excl. var. minor* (THW. *ex* CLARKE) SCHINDL. — *L. agastyamalayana* HENRY.

Leaves numerous, largely in 4 rows, linear-lanceolate, with mostly only 1 pair of teeth, or even none, 8–10(–25) by 1–1½(–6) mm. Clusters as in the type variety, or the upper ones consisting only of 1–3 ♂ and the lower ones only ♀.

Distr. Ceylon (Adam's Peak) and S. India (Agastyamalay Hills).

Note. In habit a clear variety, even recorded from Adam's Peak, but obviously replacing.

Excluded

Serpicula verticillata L. *f.* Suppl. (1781) 416 = *Hydrilla verticillata* (L. *f.*) ROYLE (*Hydrocharitaceae*).

3. MYRIOPHYLLUM

LINNÉ, Gen. Pl. ed. 5 (1754) 429; Sp. Pl. ed. 1 (1753) 992; DC. Prod. 3 (1828) 68; BTH. Fl. Austr. 2 (1864) 486; SCHINDL. Pfl. R. Heft 23 (1905) 77; MEIJDEN, Blumea 17 (1969) 306. — **Fig. 9, 12, 14–16.**

Aquatic or terrestrial, glabrous herbs, perennial or (not in Mal.) sometimes annual. Stems mostly branched, erect or decumbent-ascending, often freely floating in aquatic forms, sometimes creeping in terrestrial forms, often with minute outgrowths ('myriophyllin-glands') leaving brown circular scars in the older parts. *Leaves* often very constantly flanked by 1(–3) 'stipular' outgrowths, which are filiform to subulate, mostly short, becoming dark, caducous; nearly always dimorphous in aquatic forms; immersed ones nearly always whorled,

nearly always pinnately divided into long, filiform or ligulate lobes, very rarely scale-like reduced or absent; aerial leaves mostly whorled in the lower part of the stem, upwards often alternate, sometimes opposite, mostly wider than the immersed leaves and more or less entire, not rarely bract-like. *Spikes* aerial, mostly terminal, sometimes forming an apical tuft of sterile leaves after fruit setting which may or may not perpetuate growth in the next season, or pushed aside by an axillary shoot by which a sympodial structure is emerging, almost always solitary, rarely 1–4 additional axillary in the upper leaf axils. *Flowers* mostly sessile, 1 or more in the axil of a bract or leaf, each with 2 sometimes very inconspicuous bracteoles; ☿, often polygamous with the upper ♂ and the lower ♀, or plant monoecious, rarely dioecious. — ☿ *Flowers*: 4(–2)-merous. Sepals 4 or 0, mostly very small, erect. Petals 4 or 2, whether or not caducous, in the ♀ flowers strongly reduced and covered by the styles or 0. *Stamens* 8 or 4 epipetalous, or 1, in the ♀ flowers 0; anthers often mucronate, rather large. *Ovary* more or less urceolate, nearly always (mostly alternisepalous) 4-sulcate, 4–2-celled, in ♂ flowers reduced or 0; styles 4 or 2. *Fruit* mostly ± urceolate, breaking up into 4 or 2 one-seeded mericarps; pericarp often ± tuberculate, rather thin, the 4 mericarps very hard by the thick endocarp which has a soft tissue in an upper axial spot.

Distr. Almost ubiquist, except in most of the Arctic and rare in Africa, *c.* 40 *spp.* with a distinct centre in Australia; in *Malesia* 8 or 9 native *spp.* from which two endemic.

The distribution of most SE. Asiatic and Australian species is insufficiently known, as such inconspicuous aquatics are still 'under-collected'.

Ecol. Nearly all species are growing in aquatic or at least in swamp or damp habitats, locally gregarious, but dry periods are mostly tolerated. Terrestrial forms occur in most species; these are often more abundantly flowering and bear more ripe fruits than the aquatic forms.

Dispersal for most aquatic species may be vegetative, either by detached parts of stems or in temperate species by winterbuds. Endozoic dispersal of fruits by ducks and other birds is recorded from *M. verticillatum* L. and *M. spicatum* L. of which the fruits float for a short time. The hard and rather thick endocarp may stand passage of the guts.

Taxon. In the vegetative parts and habit the species are very variable: plants with immersed leaves easily produce aerial leaves when the water recedes, *vice versa*. Sizes of leaves and bracts respectively show great variation, especially towards the inflorescence. In general it is impossible to identify sterile specimens. Varieties or even species distinguished merely by vegetative or quantitative characters deserve no systematic recognition.

SCHINDLER's subdivision of the genus into 3 subgenera is unsatisfactory; this is in part caused by the fact that he did not examine material of a number of critical species, and in part by the fact that he used unreliable characters, paying amongst others too much attention to the number of stamens. Within *Myriophyllum* ('*Eumyriophyllum*') he distinguished for example 2 sections, *viz Pentapteris* DC. *em.* O.K. and *Tessaronia* SCHINDL., differing in the number of stamens, *viz* 8 and 4 respectively. However, in *M. spicatum* of § *Pentapteris* their number varies from 8 to 2. *M. indicum* with 8 and *M. tetrandrum* with 4 stamens, are certainly very closely allied, but are placed in two different sections, the first in § *Pentapteris* and the second in § *Tessaronia*. In *M. dicocum* of *subg. Dicarium* the number of stamens varies from 4 to 8.

An inadmissible procedure has been to subordinate *Pelonastes* HOOK. *f.* as a subsection to *subg. Myriophyllum* in an emended sense, although none of HOOKER's original species is attributed to it; these are arranged by SCHINDLER in the new *subg. Brachytheca* SCHINDL.

In my opinion it serves no good use to distinguish subgenera or even sections in the genus.

Notes. The sculpture of the fruits becomes only clearly visible in dried material.

Largely because of the supposed incompleteness of the knowledge on the distribution of the species, I have included 5 extra-Malesian species in the key, wich in this way covers all species from Malesia, SE. Asia, Madagascar, and Africa.

For literature on the extra-Malesian species, their distribution and ecology, I refer to my precursory paper in Blumea 17 (1969) 304–311.

Pre-identification of some species with simple opposite leaves and ♂ flowers (notably *M. pygmaeum* and *M. pedunculatum*) is rather difficult, but they can easily be assigned to the genus by the presence of dark, subulate pseudostipules and dark-tipped leaves.

KEY TO THE SPECIES

1. All leaves alternate to opposite, entire or dentate, or the lower ones pinnate.
2. ♂ Flower with 2 petals and 1 stamen. Bracteoles minute or 0.
3. ♂ Flower stalked. Fruit with 4 mericaps. North Vietnam. Fig. 15d-f. . . **M. bonii** TARDIEU-BLOT
3. ♂ Flower sessile. Fruit with 2 mericarps.
4. Fruit with rows of distinct spines at the base.
5. Spines present over the entire dorsal length of the mericarps. Madagascar. Fig. 15g. **M. mezianum** SCHINDL.
5. Spines absent in the central part of the mericarps. . . . . **11. M. coronatum**
4. Fruit with rows of tubercles at the base.. . . . . **10. M. siamense**
2. ♂ Flower with 4 petals and 4 or 8 stamens. Bracteoles small but conspicuous, at least those of the ♂ flowers.
6. Leaves 2–15 mm long, always opposite. Stamens 8.
7. Flowers (1–)2(–3) on each branchlet, strictly monoecious, on each branchlet of one sex. Stems upwardly very much sympodially branched, with very short internodes 0.3–1 mm long. Leaves caducous. Sepals in ♂ flowers 0. . . . . **1. M. pygmaeum**
7. More flowers on each branchlet, the upper ♂, the lower ♀, or plant dioecious. Stems with much longer internodes, monopodially branched. Leaves not caducous. Sepals in ♂ flower very conspicuous. . . . . **2. M. pendunculatum**
6. Leaves 10–30 mm long, mostly alternate. Stamens 4.
8. Flowers (1–)3–5 together, distinctly stalked. Fruit *c.* 1¼ by 1 mm, with dorsally rounded mericarps. S. India. Fig. 14q–t. . . . . **M. oliganthum** (W. & A.) F.v.M.
8. Flowers solitary, sessile or nearly so. Fruit *c.* 2½ by 2 mm, in transverse section ± quadrangular with sharp ribs and slightly concave sides. . . . . **8. M. tuberculatum**
1. At least the lower leaves in whorls, nearly always pinnate.
9. Leaf-base ± dilated, those of a whorl, at least in sterile branches, enclosing the stem at the nodes in the upper parts. Bracteoles subulate, sometimes with 1 or 2 lateral laciniae. . . **4. M. brasiliense**
9. Stem always visible on the nodes between the leaf-bases. Bracteoles either not subulate, or with more laciniae.
10. Bracteoles digitate or pinnate.
11. Fruit cruciform in section, finely tubercled, rarely smooth.
12. Stamens 8. Anther linear, 1½–1¾ mm. Petals 1½–2 mm. Ceylon, S. India. Fig. 14d–g. **M. indicum** WILLD.
12. Stamens 4. Anthers oblong, 0.6–0.8 mm. Petals *c.* 1(–1½) mm long.. . . **7. M. tetrandrum**
11. Fruit in transverse section quadrangular with rounded edges, smooth. . **6. M. verticillatum**
10. Bracteoles simple, not dissected: ovate, rhomboid, or lanceolate.
13. Fruit with 2(–4) mericarps, smooth or indistinctly lengthwise lineolate, stalked. **9. M. dicoccum**
13. Fruit with 4 mericarps of which sometimes 1–2 are visible but reduced and unfertile, not lineolate.
14. Flowers (1–)2–6 together in the leaf-axil; the middle flower ☿, shortly but distinctly stalked.
15. Flowers (1–)3–5(–6) together in the leaf-axil. Fruit rounded, shallowly 4-sulcate, tuberculate. Anthers *c.* 1 mm long. S. India. Fig. 14q–t. . . . . **M. oliganthum** (W. &. A) F.v.M.
15. Flowers 1–3 together. Fruit ± cruciform, dorsally narrowly winged, smooth or punctate. Anthers *c.* 2 mm long. Madagascar. Fig. 16 . . . . . **M. axilliflorum** BAKER
14. Flowers always solitary, either all sessile, or the ♂ flowers stalked.
16. ♂ Flower distinctly stalked. Stamens inserted on a 0.1–0.2 mm high androphore. Mericarps apically spreading by the cushion-like thickened style-bases.. . . . . **3. M. propinquum**
16. All flowers sessile. Androphore 0. Mericarps not spreading at apex.
17. Mericarps dorsally rounded. Sepals in ♂ flowers distinct, *c.* ½ by ½ mm. Stamens 8. Petals caducous. . . . . **5. M. spicatum**
17. Mericarps dorsally acute. Sepals indistinct. Stamens 4. Petals strongly recurved after anthesis, persistent until fruit is set. . . . . **8. M. tuberculatum**

1. Myriophyllum pygmaeum MATTF. Bot. Jahrb. 69 (1938) 275; MEIJDEN, Blumea 17 (1969) 311. — **Fig. 9a-b.**

Terrestrial or semi-aquatic, growing in dense cushions. Stems very short, very much branched, creeping or decumbent with erect branches or erect, after anthesis sympodially branched, with very short internodes, 0.3–1 mm. *Leaves* opposite, linear to subulate, entire, with a dark thickening on apex above, erecto-patent, ± fleshy, 2–6 by 0.3–½ mm. *Flowers* solitary in the leaf-axils of very short (5–10 mm long), strictly unisexual branches which are later sympodially overtopped, each bearing only (1–)2(–3) developed flowers and often besides 2–4 deficient higher flowerbuds. — ♂ *Flowers*: stalked, stalk ¼–½ by *c.* ½ mm, erect. Bracteoles oblong, obtuse, finely mucronate, 1 by 0.3 mm. Sepals 0. Petals with wide base and rounded, nearly flat, finely serrate apex, 1–1½ mm long, rose to red. Stamens 8, filaments up to 1 mm; anthers elliptic, mucronate, 1–1½ by 0.4–½ mm. Rudiment of ovary 0. – ♀ *Flowers*:

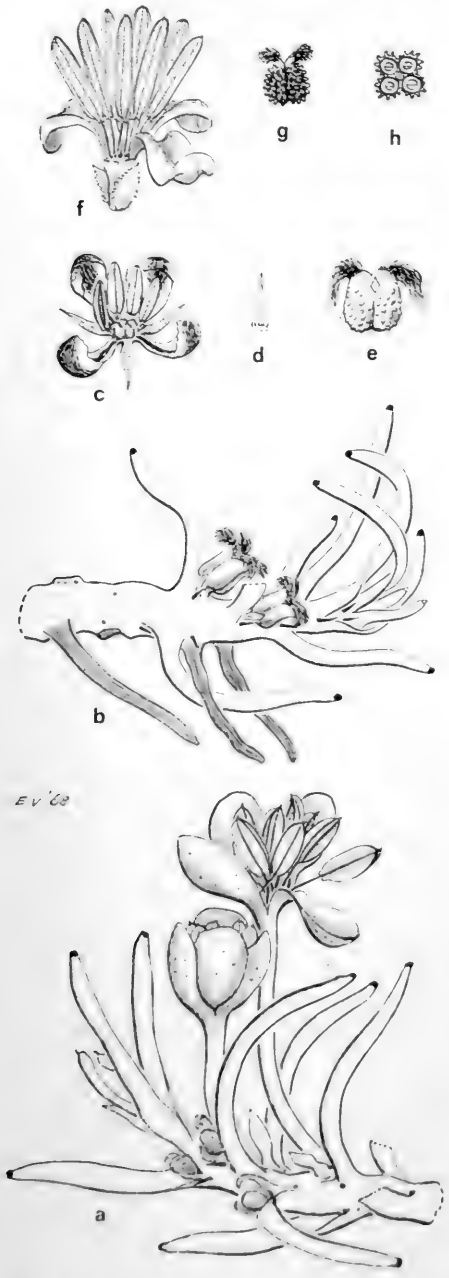

Fig. 9. *Myriophyllum pygmaeum* MATTF. *a.* Branch with ♂ flowers, *b.* branch with ♀ flowers. — *M. pedunculatum* HOOK. *f. c.* ♂ Flower, *d.* bracteole, *e.* fruit. — *M. propinquum* CUNN. *f.* ♂ Flower with bracteoles, *g.* fruit, *h.* fruit, transverse section (*a–b* HOOGLAND 9972, *c–e* ROBBINS 381, *f–h* N. MARCHANT *s.n.*). All ×5.

up to 0.2 mm stalked. Bracteoles very small, narrowly triangular, 0.2–0.4 by 0.2 mm. Sepals 0. Petals 0. Styles 0.2 by 0.3 mm. *Fruit* truncate above, shallowly 4-lobed, puncticulate, *c.* 1 by 1 mm.

Distr. *Malesia*: E. New Guinea (Morobe Distr.: Mts Sarawaket and Albert Edward). Fig. 10.

Ecol. In and along very shallow, boggy, partly dried up pools in alpine grassland, growing in dense cushions, *c.* 3500–3700 m.

2. Myriophyllum pedunculatum HOOK. *f.* in Hook. Lond. J. Bot. 6 (1847) 474; Fl. Tasm. 1 (1860) 122, t. 23; BTH. Fl. Austr. 2 (1864) 489; HOOK. *f.* Handb. New Zeal. Fl. 1 (1864) 67; SCHINDL. Pfl. R. Heft 23 (1905) 85; CHEESEMAN, Man. New Zeal. Fl. ed. 2 (1925) 625; CURTIS, Stud. Fl. Tasm. 1 (1956) 190; ALLAN, Fl. New Zeal. 1 (1961) 252; MEIJDEN, Blumea 14 (1966) 245; *ibid.* 17 (1969) 310. — *M. longibracteolatum* SCHINDL. Pfl. R. Heft 23 (1905) 84. — **Fig. 9c-e.**

Terrestrial or semi-aquatic, whether or not growing in dense cushions. Stem unbranched to much branched, decumbent or erect, after anthesis monopodially accrescent. *Leaves* opposite, erecto-patent to reflexed, entire, rarely pinnate, the entire ones linear, (2–)4–15(–25) by 0.4–1 mm, obtuse to mucronate, above at apex with an ovate, darker coloured cushion-like thickening *c.* 0.2 mm long. *Flowers* solitary in the middle and upper leaf-axils, the lower often bearing the fruits of the last season; the upper 2–4(–8) flowers ♂, the next lower 4–8(–12) flowers ♀; not rarely dioecious. Bracteoles lanceolate-oblong to linear-lanceolate, rarely ± elliptic, acute or acuminate, entire or serrate, 0.6–1.5 by 0.2–0.3(–0.6) mm. — ♂ *Flowers*: up to ½ mm stalked. Sepals lanceolate, acute, serrate, *c.* 1 by 0.4 mm, ± erect, with tiny whitish tubercles. Petals very concave in the apical part, the borders nearly flat, and finely serrate, the apex mucronate and often recurved, in anthesis erect and 1–1½ mm long, after anthesis elongating, up to 2 mm long, recurvate, persistent. Stamens 8; anthers oblong, *c.* 1–1½ mm. Ovary rudimentary, *c.* 0.3 by 0.3 mm. — ♀ *Flowers*: up to 0.2 mm stalked. Sepals lanceolate-oblong, acute, 0.3–0.8 by 0.2 mm. Petals strongly reduced, covered by the styles, shorter than 0.1 mm. Styles with thick, fleshy bases, stigmas after anthesis strongly ligulately recurved, very long papillose. *Fruit* *c.* 1.2 by 1.2 mm, with apically spreading mericarps, these terete, with distinct tubercles.

Distr. New Zealand (also Chatham and Stewart Is.), Tasmania, Australia (Victorian Alps, New South Wales, also recorded from W. Australia); in *Malesia*: New Guinea (E. Papua: Western Highlands, Morobe Distr.). Fig. 13.

Ecol. In New Guinea in the upper montane and alpine zone, from 2300–3500 m, in the Australian region often descending to the lowland. In swamps, shallow pools, alpine bogs, and inundated river banks.

Notes. In all but one collection I have seen, the leaves are entire, but in one collection from

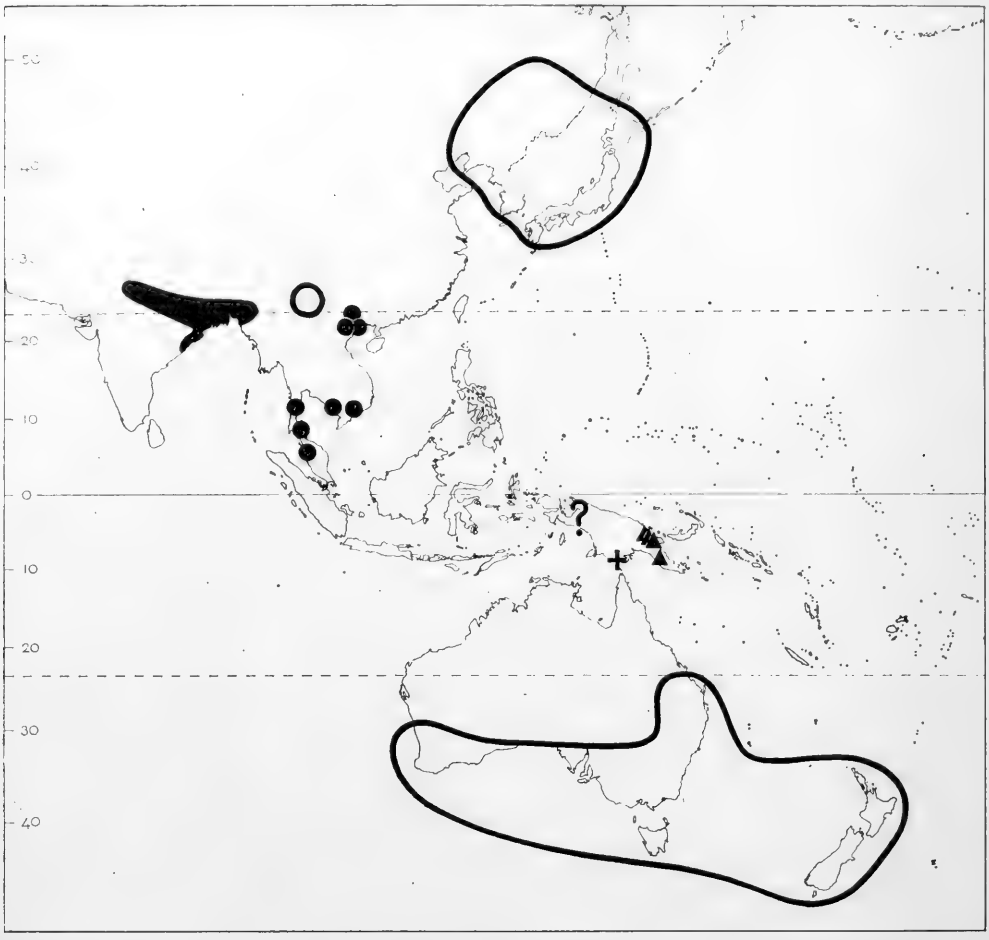

Fig. 10. Distribution of *Myriophyllum propinquum* CUNN. (full line & question mark), *M. tetrandrum* ROXB. (black area and dots), *M. pygmaeum* MATTF. (triangles), and *M. coronatum* MEIJDEN (+).

Victoria (A. C. BEAUGLEHOLE 5887) the medium and lower leaves are pinnate with few filiform lobes. This observation clearly shows the great plasticity of the leaves in this genus.

M. longibracteolatum SCHINDL. differs only in quantitative characters.

M. votschii SCHINDL. from New Zealand is closely allied and might also belong to *M. pedunculatum*.

3. Myriophyllum propinquum CUNN. Ann. Nat. Hist. I, 3 (1839) 30; SCHINDL. Pfl. R. Heft 23 (1905) 89, *incl. var. tenuifolium* SCHINDL. *l.c.* 90; CHEESEMAN, Man. New Zeal. Fl. ed. 2 (1925) 624; EWART, Fl. Vict. (1930) 886, t. 309 excl. c; BLACK, Fl. S. Austr. ed. 2, 3 (1952) 645; CURTIS, Stud. Fl. Tasm. 1 (1956) 190; ALLAN, Fl. New Zeal. 1 (1961) 253; MEIJDEN, Blumea 17 (1969) 310. — *M. variaefolium* HOOK. *f.* in Hook. Ic. Pl. 3 (1840) t. 289; BTH. Fl. Austr. 2 (1864) 487. — *M. verticillatum* L. *β ussuriense* REGEL, Tent. Fl. Ussur. (1861) 60. — *M. ussuriense* (REGEL) MAXIM. Diagn. Pl. 15 (1873) 183; SCHINDL. Pfl. R. Heft 23 (1905) 86; OHWI, Fl. Jap. (1965) 661. — *M. intermedium* (*non* DC.) CLARKE, Fl. Br. Ind. 2 (1878) 433, *pro syn. M. variaefolium*; KIRK, Stud. Fl. New Zeal. (1899) 150; CHEESEMAN, Man. New Zeal. Fl. ed. 1 (1906) 151. — **Fig. 9f-h.**

Aquatic or semiterrestrial. Stem branched or not, erect, ascending or freely floating. Immersed *leaves* mostly present, rarely absent, in whorls of (4–)5–6(–8), 1–2½ by ¾–1½ cm in outline, with *c.* 5–10 pairs of 3–25 mm long and *c.* 0.2 mm wide filiform lobes. Lowermost aerial leaves in whorls of (2–)4–5(–6), pinnate or (less often) entire, the pinnate ones as the immersed leaves, the entire ones linear to linear-lanceolate, flat,

somewhat fleshy, 5–10 by ½–1 mm, mostly patent. Upper aerial leaves entire, dentate or pinnate, patent to upwards erect, below mostly punctate, the entire ones 10–20 by 0.7–1.5 mm, the pinnate ones 15–20 by 2–7 mm in outline, with 2–7 pairs of erecto-patently incurved, up to 3 mm long lobes. *Flowers* solitary in the upper leaf-axils, the upper ♂, the lower ♀, often ☿ in between, or dioecious. — ♂ *Flowers*: stalk up- and downwards broadened, 0.6–1 by 0.3–0.5 mm. Bracteoles ovate, acuminate, serrate, *c.* 1 by 1 mm. Sepals lanceolate, acute, finely serrate, *c.* 1 by ¼ mm, soon caducous. Petals soon caducous after anthesis. Stamens 8, inserted on a 0.1–0.2 mm high, a little narrowed androphore; filaments at first mobile, later rather stiff, ± erect, not caducous; anthers oblong, obtuse, (1–)1.2–2.5 by 0.3–0.4 mm. Rudiment of ovary 0. — ♀ *Flowers*: sessile. Bracteoles ± ovate to oblong, concave, mostly appressed, entire or finely serrate, obtuse, ± mucronate, 0.3–0.5 by 0.15–0.3 mm, finally caducous. Sepals 0. Petals 0. Styles spreading at the base, *c.* 0.2 by 0.1–0.3 mm. Stigmas after anthesis strongly recurved, very long papillose, 0.1–0.4 mm. *Fruit* 0.6–1.2 by ½–1 mm, the mericarps terete, apically spreading by the cushion-like thickened style-bases, with long tubercles at least at the base, punctate.

Distr. New Zealand, Tasmania, Australia (S. Australia, Victoria, New South Wales, Queensland, W. Australia) and E. Asia: NE. China (Heilong Jang, Whusuli Jiang; Manchuria), Korea, Taiwan, Japan, S. China (S. Yunnan). Fig. 10.

Notes. Extremely variable in the Australian region, especially in vegetative parts. *M. propinquum* and *M. ussuriense* differ only in minor vegetative characters.

The area is strongly disjunct. One sterile collection from West New Guinea (Wissel Lakes, EYMA 4733, at *c.* 1600 m) might belong to this species or to *M. verticillatum*.

4. Myriophyllum brasiliense CAMBESS. in A. St. Hil. Fl. Bras. Mer. 13, 2 (1829) 182; SCHINDL. Pfl. R. Heft 23 (1905) 88; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 391; *ibid.* ed. 3 (1927) 1207; STEEN. Arch. Hydrobiol. Suppl. 10 (1932) 315; CURTIS, Stud. Fl. Tasm. 1 (1956) 190; MASON, Fl. Marshes Calif. (1957) 615, f. 280; BACK. & BAKH. *f.* Fl. Java 1 (1963) 266; ALSTON, Muelleria 1 (1967) 171; MEIJDEN, Blumea 17 (1969) 171. — *M. proserpinacoides* GILL. *ex* HOOK. & ARN. Bot. Misc. (1833) 313. — **Fig. 14a-c.**

Aquatic or semiterrestrial. Stem branched mostly at the base only, perpetuating growth after anthesis. Lower immersed *leaves* pinnate, segments thread-like. Upper immersed leaves and aerial leaves alternately in whorls of 5 (rarely 4), flanked by 2–3 *c.* 1 mm long, mostly recurved cnatia, hydrophobic and often ± glaucous. Leaf-base ± dilated, *c.* 0.6–1 mm wide, of a whorl at least in the upper sterile shoots enclosing the stem at the nodes, blade oblong in outline, *c.* 2–4 by ½–1 cm, rather stiffly patent to erecto-patent, with 8–18 pairs of subulate, mucronate lobes, 2–8 by *c.* 0.2 mm. Mostly monoecious or ± dioecious, sometimes in the middle with ☿ flowers. *Flowers* solitary in the middle and upper leaf-axils. — ♂ *Folwers* (not seen in Mal.): pedicel up to 4 by 0.4 mm, up- and downwards broadened. Bracteoles subulate, 2–3 mm long, ± flat, often with 1 or 2 lateral laciniae. Sepals narrowly triangular, acute, serrate towards the apex, *c.* 1½–2 by ½ mm, at first erect, finally recurved. Petals 4, caducous before anthesis, *c.* 4 mm long. Stamens 8; anthers linear-lanceolate, *c.* 4 by 1 mm. Ovary reduced, up to 0.3 mm long, — ♀ *Flowers*: pedicel up to 1 by 0.4 mm, cylindric, erect. Bracteoles subulate with dilated base, sometimes with 1 lacinia, 1–1½ mm long. Sepals narrowly triangular, acute, entire or scarcely serrate, 1–1½ by 0.2–0.3 mm, at first erect, finally recurved. Petals very strongly reduced, subulate, adnate to the torus, up to ½ mm long. Styles 0.2–0.3 mm. *Fruit* (*sec.* SCHINDLER) ovoid, 4-sulcate, *c.* 1.8 by 1.2 mm, shortly pedicelled, papillose.

Distr. Native in South America (E. Brazil, Uruguay, Argentina, Chile), often cultivated elsewhere in ponds or aquaria; naturalized in Japan ("Yamamoko in Settsu"), in Australia (New South Wales, Victoria, Queensland; New Zealand: North I.), in SW. and SE. North America (casually to New York), and in *Malesia*: locally abundant in W. Java.

Ecol. In Java in ditches, ponds and rice-fields, 400–1500 m, freely floating to creeping-ascending.

Uses. In Java cultivated in fish-ponds; tips are eaten as a vegetable. Easily propagated vegetatively.

Vern. *Paris*, S; *diamond-milfoil, parrot-feather*, E.

Note. All naturalized specimens are sterile or have only ♀ flowers and do not produce fruit. Also in South America fruits rarely occur. The only description of the ripe fruit was given by SCHINDLER. An illustration of an apparently ripe fruit is found in GLEASON, New Britt. & Brown Ill. Fl. 2 (1952) 601.

5. Myriophyllum spicatum LINNÉ, Sp. Pl. (1753) 992; MAXIM. Diagn. Pl. 15 (1873) 183, *incl. var. muricatum*; CLARKE, Fl. Br. Ind. 2 (1878) 433; SCHINDL. Pfl. R. Heft 23 (1905) 90; KOORD. Exk. Fl. Java 2 (1912) 708, *excl. syn. M. pusillum* BL.; GUILLAUMIN, Fl. Gén. I.-C. 2 (1920) 717; MERR. En. Philip. 3 (1923) 221; RIDL. Disp. (1930) 546; STEEN. Arch. Hydrobiol. Suppl. 10 (1932) 316; ALLAN, Handb. Fl. New Zeal. (1940) 285; PATTEN, Rhodora 56 (1954) 213; LÖVE, Rhodora 63 (1961) 139; WILD, Harmf. Pl. (1961) 42, t. 14d; SUBRAMANYAM, Aq. Ang. (1962) 17; TARDIEU-BLOT, Fl. Laos, Camb. & Vietn. 4 (1965) 125; OHWI, Fl. Japan (1965) 660; RAYNAL, Fl. Cameroun 5 (1966) 132, fig.; MEIJDEN, Blumea 17 (1969) 309. — *M. exalbescens* FERN. Rhodora 21 (1919) 120. — **Fig. 12a-c.**

Aquatic. Stem much branched. Immersed *leaves* in whorls of 4–5, 1½–2½ by *c.* 2 cm in outline, with 7–11 pairs of filiform, obtuse seg-

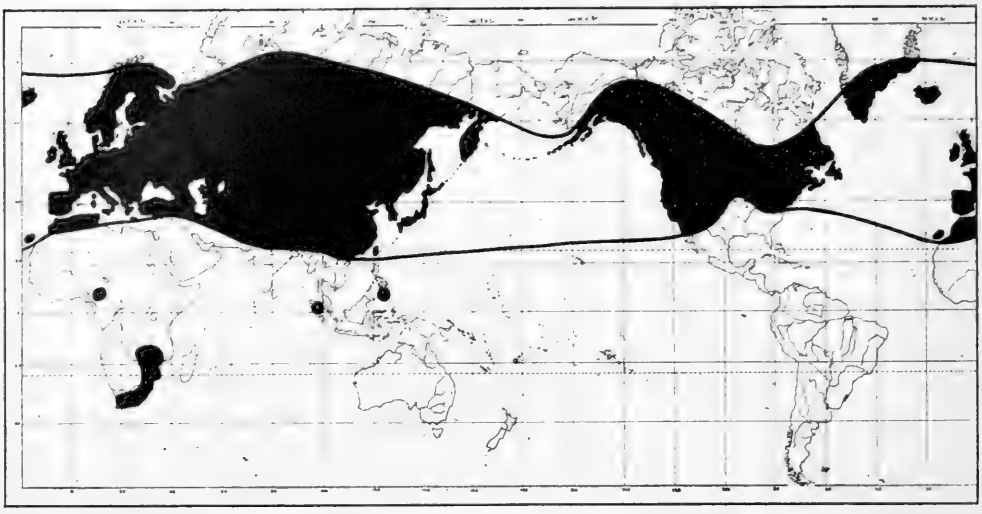

Fig. 11. Distribution of *Myriophyllum spicatum* L. (after PATTEN, 1954, emended).

ments 6–12 mm long. Aerial leaves mostly suddenly much smaller, the lowermost ones always in whorls of 4, mostly pinnate, as the immersed ones. Middle and upper leaves entire, rarely pinnate, obtuse, mostly ovate to obovate, somewhat convex, sometimes spathulate or linear, and flat, 2–10 by 1–2 mm, patent, recurved in fruit. *Flowers* solitary in the middle and upper leaf-axils, the upper ones ♂, the lower ♀, in between often ☿, sessile. Bracteoles broadly ovate, obtuse, erect, with a brown, ± serrate membranous margin, *c.* 1.2 by 1 mm. — ♂ *Flowers*: sepals ovate to triangular, with a brown membranous mucronate apex, *c.* ½ by 0.3 mm, erect. Petals at the base ± auriculate, caducous in anthesis, *c.* 2½ mm long, wine-red. Stamens 8(–2); anthers linear-lanceolate, *c.* 2 by 0.4 mm. Ovary reduced, up to 0.3 mm. — ☿ *Flowers*: below the middle of the spike with sepals and petals as in ♀, with 8 stamens, above the middle of the spike as the ♂, but often poorly setting fruit. — ♀ *Flowers*: sepals strongly reduced, semiorbicular, with a brown mucronate apex, *c.* 0.2 by 0.3 mm, erect. Petals reduced, ovate, acute, ½ by 0.3 mm, patent, covered by the stigmas, soon caducous. Styles *c.* ½ by 0.3 mm. *Fruit* 1½–3 by 1½–3 mm, terete, very deeply and alternisepally 4-sulcate or deeply 4-cleft; mericarps 4, often only 2 fully developed, dorsally rounded, with a distinct, often verrucose marginal ridge, at the back smooth or verrucose, rarely wholly smooth.

Distr. Almost ubiquist on the northern hemisphere, rare in Africa and in the tropics; in *Malesia*: N. Sumatra (Toba Lake) and Philippines (Mindanao: Lake Lanao, CLEMENS 450, *n.v.*). Fig. 11.

A record from New Zealand rests according to Miss R. MASON on an erroneous identification (LUCY B. MOORE, *in litt.*).

Ecol. Shallow banks of lakes, 670 and 900 m. Terrestrial forms are rare and sterile (*cf.* HEGI, Fl. Mitt.-Eur. ed. 2, 5, 2, 1964, 902, f. 2273) and might have been found at Lake Toba (LÖRZING 7718).

Galls are recorded from the Toba Lake by RUTTNER *c.s.* (see ZELLER, Ber. Deut. Bot. Ges. 55, 1937, 473–475, f. 1–2). The stems are malformed and have few reduced and short leaves.

Fruit-setting is often poor although ♂ and ♀ flowers are present in the Toba collections.

Notes. Very variable species. Reductions are not rare in the inflorescence, with the upper part

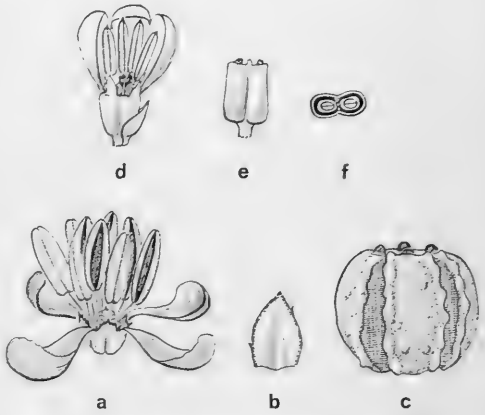

Fig. 12. *Myriophyllum spicatum* L. *a.* ♂ Flower, *b.* bracteole, *c.* fruit. — *M. dicoccum* F. v. M. *d.* Bisexual flower with bracteole, *e.* fruit, *f.* fruit, cross-section (*a* HOOKER *f.* & THOMSON *s.n.*, *b–c* Fl. Turcom. As. 1926, *d–f* BRASS 28669). All ×5.

strongly elongating, the lower part compact.

M. exalbescens FERN. is, apart from the stems which become whitish in drying, in no way otherwise qualitatively different from the European and Asiatic specimens of *M. spicatum* L. Specimens with '*exalbescens*' characters (PATTEN, 1954; LÖVE, 1961) are found scattered all over the range of the species, not only in America.

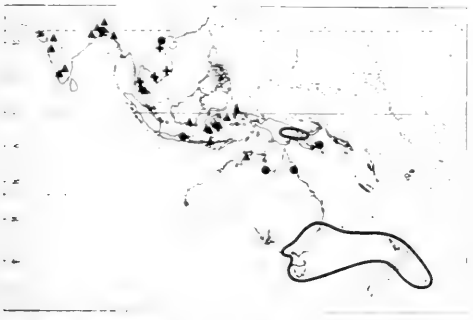

Fig. 13. Distribution of *Myriophyllum pedunculatum* HOOK. *f.* (full line), *M. tuberculatum* ROXB. (triangles), *M. dicoccum* F. v. M. (dots), and *M. siamense* (CRAIB) TARDIEU-BLOT (+).

6. Myriophyllum verticillatum LINNÉ, Sp. Pl. (1753) 992; CLARKE, Fl. Br. Ind. 2 (1878) 87; MASON, Fl. Marshes Calif. (1957) 617, f. 283; OHWI, Fl. Japan (1965) 660; SINCLAIR, Gard. Bull. Sing. 22 (1967) 230; MEIJDEN, Blumea 17 (1969) 309. — *M. spicatum* (*non* L.) GAERTN. Fruct. (1788) 331, t. 68. — **Fig. 14j-m.**

Aquatic, sometimes semiterrestrial. Stems few-branched or not, often perpetuating growth after fruit-setting. Immersed *leaves* in whorls of 4–5(–6), 1–4 by 1–4 cm in outline, with *c.* 8–16 pairs of mostly opposite, filiform segments, 10–25 mm long. Aerial leaves gradually or sometimes rather suddenly smaller, all pinnate, the lower as the immersed leaves, the upper lanceolate to linear-lanceolate with 8–10 pairs of rather stiff, ± appressed lobes, 5–15 by 2½–4 mm, mostly recurved in fruit. *Flowers* solitary in the middle and upper leaf-axils, mostly ☿, the upper sometimes ♂, the lower ones often ♀, sessile or subsessile. Bracteoles ± circular in outline, digitate, rarely ± pinniform, *c.* 1 mm long. Sepals triangular, acute, serrate, *c.* 1 by 0.8 mm, erect, in ♀ up to 0.3 by 0.4 mm. Petals *c.* 3–4 mm long, rose, erecto-patent in anthesis, caducous after anthesis, strongly reduced in ♀ flowers and covered by the styles. Stamens 8; anthers linear-lanceolate, *c.* 2½ by ½ mm. Styles *c.* ½ by 0.3 mm. *Fruit* ovoid, in section ± quadrangular with dorsally rounded, smooth mericarps, *c.* 3 by 3 mm.

Distr. Europe (north to Lapland, not in Iceland and Greenland; including the African Mediterranean), Asia (temperate and boreal, east to Kamchatka and Japan, south to Afghanistan and Kashmir), North America (Canada, from British Columbia to New Foundland, south to Maryland and California); in *Malesia*: possibly found in W. New Guinea (Wissel Lakes, 1600 m.)

Notes. The New Guinean collection (EYMA 4733) is sterile. Identification of vegetative plants is extremely difficult in this genus. I share the opinion of SINCLAIR, *l.c.*, that this collection may belong to *M. verticillatum*, although it is not impossible that it should turn out to belong to *M. propinquum*.

Flower characters in the description are taken from extra-Malesian material.

7. Myriophyllum tetrandrum ROXB. Fl. Ind. 1 (1820) 470; DC. Prod. 3 (1828) 69; ROXB. Fl. Ind. ed. Carey 1 (1832) 451; W. & A. Prod. (1834) 399; SCHINDL. Pfl. R. Heft 23 (1905) 96; GUILLAUMIN, Fl. Gén. I.-C. 2 (1920) 717; CRAIB, Fl. Siam. En. 1 (1931) 591; TARDIEU-BLOT, Fl. Laos, Camb. & Vietn. 4 (1965) 125; MEIJDEN, Blumea 17 (1969) 308; Fl. Thail. 2 (1970) 2. — *M. indicum* (*non* WILLD.) PRAIN, Beng. Pl. (1903) 474; Rec. Bot. Surv. India 3 (1908) 210; SUBRAMANYAM, Aq. Ang. (1962) 17; S. R. BENNET, Tax. Stud. Fl. Howrah (Thesis) (1968) 651. — *M. indicum ssp. tetrandrum* (ROXB.) MEIJDEN, Ident. Lists 30 (1960) 426, *nomen et in sched.*; KENG, Mal. Nat. J. 23 (1970) 123. — **Fig. 14h-i.**

Aquatic or semiterrestrial. Stem branched, erect. Immersed *leaves* in whorls of (4–)5–6, 2–5 by 1½–4 cm in outline, with *c.* 12–24 pairs of *c.* 10–20 mm long, filiform, acute, brown-tipped segments. Lowermost aerial leaves mostly pinnate and rather stiffly spreading with short spreading lobes. Middle and upper aerial leaves mostly narrowly triangular in outline, 2–4 by ½–1 mm, with 6–12 pairs of erecto-patent, subulate, brown-tipped, very acute lobes, more rarely lanceolate to linear-lanceolate, 6–12 by 1–1½ mm long, with few, ± appressed subulate teeth, or almost entire, at first erecto-patent, in fruit recurved. *Flowers* solitary, ± sessile in the middle and upper leaf-axils, ☿, or the upper ♂. Bracteoles digitate or sometimes ± pinniform, 0.6–1 mm long, both with *c.* 5 subulate lobes. Sepals triangular, 0.1–0.3 by 0.1–0.3 mm, entire or finely serrate, acute, erect. Petals almost entire, *c.* 1(–1½) mm long, caducous after anthesis. Stamens 4; anthers ± oblong, 0.6–0.8 by 0.2–0.25 mm, obtuse. *Fruit* cruciform, *c.* 2 by 2 mm, mericarps ± ovate, with convex back and ± flattened sides, irregularly and finely tuberculate to smooth.

Distr. N. & E. India (Kashmir, Uttar Pradesh, Bihar, W. Bengal, Assam, Agartala, Manipur, Eastcoast from Ganjam southwards), S. Thailand (Bangtapan Noi: Ta Samet), North Vietnam; in *Malesia*: Malay Peninsula (Kangar; Perlis). Fig. 10.

Ecol. In rather shallow open water of ditches and canals.

Notes. The species was in the past seldom recognized by Indian botanists and mostly reduced to *M. indicum*, following CLARKE (in Fl. Br. Ind. 2, 1878, 433), sometimes to *M. tuberculatum*. Although they differ in the number of stamens,

I believe it to be much closer allied to *M. indicum* WILLD. than to *M. tuberculatum* ROXB., which has the same number of stamens. *M. tetrandrum* and *M. indicum* can only be distinguished in flowering material, the fruits and bracteoles showing no differences. As *M. indicum* and *M. tetrandrum* are replacing, *M. indicum* being confined to Ceylon and the South Deccan and *M. tetrandrum* to NE. India and Indo-China, I have originally assigned them subspecific rank, but as according to PRAGLOWSKI (Grana 10, 1970, 234) their pollen shows distinct differences, I have concluded that they are closely allied but distinct species.

A record from Java (ZOLL. Syst. Verz. 2, 1854, 86, ZOLLINGER 883) belongs to *Limnophila* (*Scrophulariaceae*).

8. Myriophyllum tuberculatum ROXB. Fl. Ind. 1 (1820) 471; DC. Prod. 3 (1828) 69; ROXB. Fl. Ind. ed. Carey 1 (1832) 451; MIQ. Fl. Ind. Bat. 1, 1 (1855) 635; KURZ, J. As. Soc. Beng. 40, ii (1871) 52; CLARKE, Fl. Br. Ind. 2 (1878) 432; SCHINDL. Pfl. R. Heft 23 (1905) 96; SINCLAIR, Bull. Bot. Soc. Beng. 9, 2 (1955) 94; SUBRAMANYAM, Aq. Ang. (1962) 17; SINCLAIR, Gard. Bull. Sing. 22 (1967) 230; VASUDEVAN & KESAN NAIR, J. Bomb. Nat. Hist. Soc. 64 (1967) 391, f. 1–22; MEIJDEN, Blumea 17 (1969) 308. — *M. tetrandrum* (*non* ROXB.) GRAH. Cat. Pl. Bomb. (1839) 76; STEEN. Webbia 8 (1952) 435. — *M. indicum* GRIFF. Not. 4 (1845) 687, *non* WILLD. 1805, *nom. illeg.* — *M. spathulatum* BLATT. & HALLBL. J. Ind. Bot. Soc. 2 (1921) 44, fig. (*ex descr.*); SUBRAMANYAM, Aq. Ang. (1962) 17, f. 11. — **Fig. 14 n-p.**

Aquatic or semi-aquatic. Stems mostly much branched. Immersed *leaves* in whorls of 4–5, 2½–4 by 1–1½ cm in outline, with 8–25 pairs of rather weak, ligulate, acute or shortly mucronate segments 10–20 mm long. Aerial leaves in the lower part as the immersed ones, upper ones finally alternate, with less and shorter lobes, uppermost almost entire, 5–20 by 1–3 mm, patent or recurved. *Flowers* solitary, sessile, in the middle and upper leaf-axils, mostly all ☿, rarely the upper flowers ♂, sometimes the lower ♀. Bracteoles ±

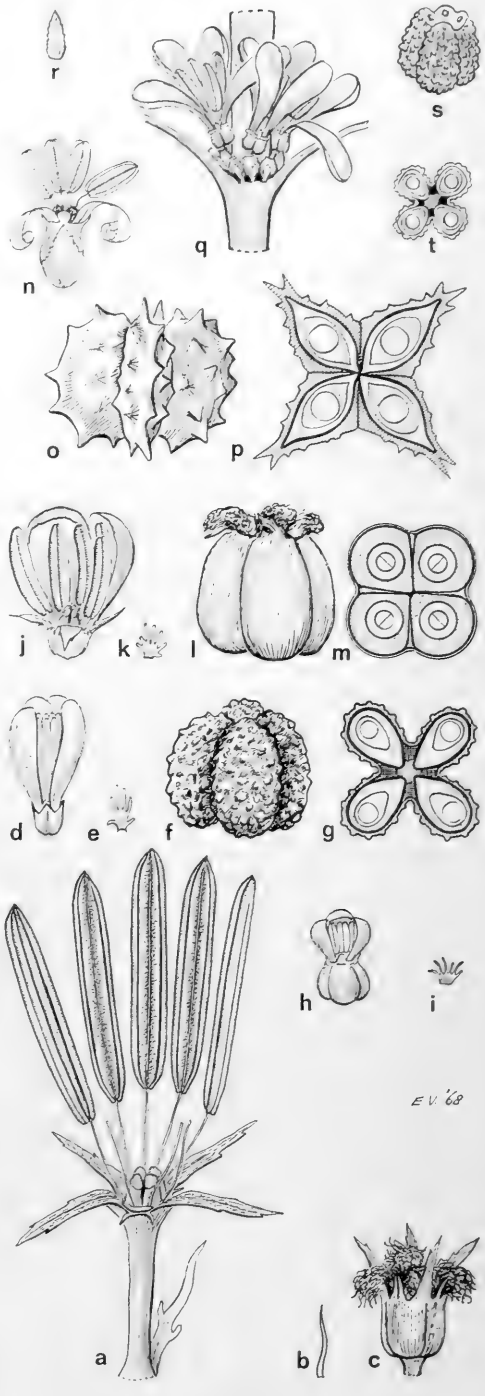

Fig. 14

Fig. 14. *Myriophyllum brasiliense* CAMBESS. *a.* ♂ Flower with bracteole, *b.* bracteole of ♀ flower, *c.* ♀ flower. — *M. indicum* WILLD. *d.* Flower, *e.* bracteole, *f.* fruit, *g.* fruit, transverse section. — *M. tetrandrum* ROXB. *h.* ☿ Flower, *i.* bracteole. — *M. verticillatum* L. *j.* Young ☿ flower, *k.* bracteole, *l.* fruit, *m.* fruit, transverse section. — *M. tuberculatum* ROXB. *n.* Young ☿ flower with bracteole, *o.* fruit, *p.* fruit, transverse section. — *M. oliganthum* (W. & A.) F. v. M. *q.* Part of inflorescence with ☿ flowers and young fruits, *r.* bracteole, *s.* fruit, *t.* fruit, transverse section (*a–c* O. BUCHTIEN *s.n.*, *d–g* THWAITES CP 1549, *h–i* J. THOMSON *s.n.*, *j–m* HLB 903.364–343, *n–p* Herb. GRIFFITH 2441, *q–t* HOHENACKER 1563).
All ×5, except *q* which is ×2½.

rhomboid, serrate, acute, *c.* 1.2 by 0.8 mm. Sepals very small, ± orbicular, entire or finely serrate, erect, 0.1–0.25 by 0.1–0.25 mm. Petals in and after anthesis patent and finally recurved-circinnate, not soon caducous, *c.* ½–1½ mm long. Stamens 4; anthers elliptic-oblong, *c.* ½–1 by 0.2–0.3 mm. Styles 0.1–0.2 by 0.2 mm, scarcely recurved, with capitate stigmas. *Fruit* quadrangular, between the sharp and alternisepalous ribs slightly concave, indistinctly 4-sulcate, aculeate, finely foveolate, *c.* 2–3½ by 2–3½ mm.

Distr. India (Kerala: Alwaye; Mysore; Bombay: Bombay, Khandala; Madhya Pradesh: Sagor; Orissa; W. Bengal; Assam; Khasya), E. Pakistan (Cox's Bazar), Australia (Northern Territory: Fog Dam Sanctuary); in *Malesia*: N. Malay Peninsula (Kedah, Perlis), SE. Borneo (Bandjermasin), SW. (Pangkadjene) & SE. Celebes (Kendari), Moluccas (Halmahera; Sulu Is.: Mangoli), and Lesser Sunda Islands (W. Flores: Ruteng). Fig. 13.

Ecol. In shallow, stagnant water at low altitude.

Note. See for the differences with *M. indicum* and *M. tetrandrum* the key, the figures, and note under the preceding species.

9. Myriophyllum dicoccum F. v. M. Trans. Phil. Inst. Vict. 3 (1859) 41; BTH. Fl. Austr. 2 (1864) 489; F. v. M. Fragm. 8 (1874) 161; SCHINDL. Pfl. R. Heft 23 (1905) 104; BACK. & BAKH. *f.* Fl. Java 1 (1963) 266; MEIJDEN, Blumea 17 (1969) 307. — *M. humile* (*non* MORONG) SCHINDL. Pfl. R. Heft 23 (1905) 101, *pro coll. ind.*; GUILLAUMIN, Fl. Gén. I.-C. 2 (1920) 718. — *M. intermedium* (*non* DC.) TARDIEU-BLOT, Fl. Laos, Camb. & Vietn. 4 (1965) 126, for the cited BALANSA specimen only. — **Fig. 12d-f.**

Aquatic. Stem branched, freely floating. Immersed *leaves* in whorls of 4–5, 1½–2½ by *c.* 1 cm in outline, patent to recurved, with 4–7(–10) pairs of filiform, rather weak, brown-tipped, finely mucronate, 5–10 mm long segments. Lower aerial leaves verticillate or alternate, pinnate, the upper ones obovate-oblong to linear-lanceolate, above the middle with 2–4(–7) pairs of dark mucronate teeth, sometimes entire, patent, upward erecto-patent, 10–25 by 1–3 mm. *Flowers* solitary in the middle and upper leaf-axils, or together with 1 or more reduced, cleistogamous flower(s), ☿, on a shortly cylindrical, up to ½ mm long pedicel. Bracteoles ± elliptic, with appressed, brown, serrate teeth, acute, with 1–3 nerves, 1½–2 by 0.4–0.8 mm. Sepals ± ovate obtuse or acute, serrate, with a brown margin, erect, 0.2–0.5 by 0.2–0.5 mm. Petals patent to recurved in anthesis, finally caducous, *c.* 2 mm long. Stamens 4, rarely 8; anthers stiffly erect, linear lanceolate, *c.* 1½ by 0.3 mm, with brown mucronate apex. *Ovary* 2-celled, with 1(–2) ovules in each cell, sometimes 3–4-celled with 1 ovule in each cell. Styles 2(–4), 0.2–0.4 by 0.2 mm. Stigma not or slightly recurved. *Fruit c.* 1½ by 1 mm, with 2, sometimes 3 or 4 mericarps, smooth or indistinctly lengthwise lineolate, with a *c.* ½ by 0.4 mm long, erect or patent stalk. *Cleistogamous flowers*: without perianth segments, ovary 2-celled, ± circular, laterally flattened, with 2 ovules, fruit *c.* ½ by ½ mm, with 2 elliptic seeds; bracteoles ovate, *c.* ½ by 0.4 mm; pedicel up to 4 mm in fruit.

Distr. Australia (Northern Territory: Robinson R.; Queensland: Mareeba R.), E. India (Calcutta Yeels, T. THOMSON), N. Vietnam (Haiphong, BALANSA 1428); in *Malesia*: NE. Java (Madura I.: Burnih Lake). Fig. 13.

Ecol. In lake, at 15 m.

Note. Two specimens from SE. Asia have erroneously been referred to the North American *M. humile* MORONG, which seems more closely allied to *M. dicoccum* than suggested by SCHINDLER, who places them in different subgenera. The description and figure of '*M. intermedium*' by TARDIEU-BLOT fits *M. oliganthum* (W. & A.) F. v. M., but the cited collection of BALANSA belongs to *M. dicoccum*.

10. Myriophyllum siamense (CRAIB) TARDIEU-BLOT, Adansonia 5 (1965) 37, f. 1–4; Fl. Laos, Camb. & Vietn. 4 (1965) 128, f. 1–4; MEIJDEN, Blumea 17 (1969) 307, f. 1e; Fl. Thail. 2 (1970) 2. — *M. mezianum var. siamense* CRAIB, Fl. Siam. En. 1 (1931) 591. — **Fig. 15h.**

Semi-terrestrial. Stem much branched, not more than 5 cm high, rooting at the nodes. *Leaves* alternate, rarely subopposite. Immersed leaves not known. Aerial leaves entire or rarely ± pinnate with 1–2 filiform segments, 2–4 by 0.2–0.4 mm, with a dark cushion-like thickening above at apex. *Flowers* solitary in the upper leaf-axils, the upper ♂, the lower ♀. Bracteoles inconspicuous or absent. — ♂ *Flower* nearly sessile. Sepals 0. Petals 2, oblong to lanceolate, flat, entire, acute, erect before anthesis and up to 1 mm long, strongly recurved after anthesis. Stamen 1; filament up to ½ mm; anther elliptic, 0.5–0.9 by 0.3–0.5 mm, mucronate. Rudiment of ovary 0. — ♀ *Flower* sessile. Sepals and petals 0. Styles shortly conical, distally set with long hairs. *Fruit* 0.5–0.9 mm long. Mericarps 2, oblong, with mostly 2 distinct dorsal crests of 5–7 tubercles over the entire length and some rows of lower tubercles laterally, with a rather indistinct crown of *c.* 7 short, ± spiny tubercles.

Distr. Vietnam (Prov. Than Hoa; Prov. Lang Bian: Danhim; Prov. Phu Quoc); in *Malesia*: S. Thailand (Nakhon Si Thammarat: Songkhla). Fig. 13.

Ecol. In small mats on damp, sandy ground at borders of ponds and marshes near the coast.

11. Myriophyllum coronatum MEIJDEN, Blumea 17 (1969) 305, f. 1a–c. — **Fig. 15a-c.**

Terrestrial or semi-aquatic. Stem much branched. *Leaves* opposite, the upper ones semi-opposite to alternate; immersed leaves opposite, pinnate, 0.5–1.2 by 0.6–1.5 mm in outline, with 2–5 *c.* 0.1 mm wide, filiform lobes; aerial leaves linear, entire or less often ± pinnate, 3–10 mm long, the entire ones 0.3–1.2 mm wide, with a dark

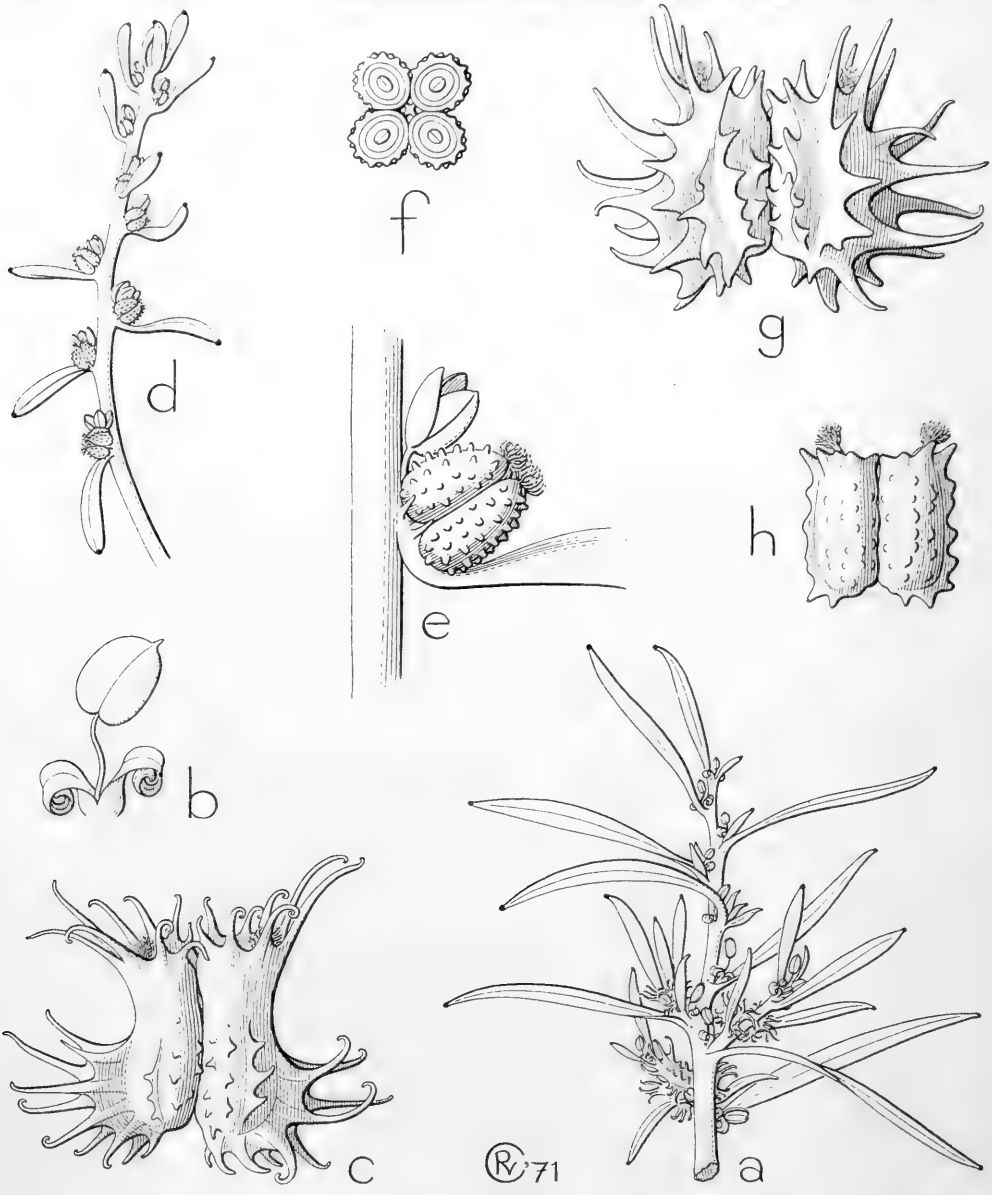

Fig. 15. *Myriophyllum coronatum* MEIJDEN. *a.* Habit, ×7, *b.* ♂ flower, ×25, *c.* fruit, ×25. — *M. bonii* TARDIEU-BLOT. *d.* Habit, ×7, *e.* fruit and ♂ flower, ×25, *f.* cross-section of fruit, ×25. — *M. mezianum* SCHINDL. *g.* Fruit. — *M. siamense* (CRAIB) TARDIEU-BLOT. *h.* Fruit, ×25 (*a–c* RIDSDALE NGF 33585, *d–f* BON 5897, *g* PERRIER DE LA BÂTHIE 19310, *h* BON 5290).

cushion-like thickening above at apex, flat, patent. *Flowers* solitary in the upper leaf-axils, the upper ♂, the lower ♀. Bracteoles inconspicuous or 0. — ♂ *Flowers* nearly sessile. Sepals 0. Petals 2, linear, flat, entire, acute, erect before anthesis and up to 1 mm long, strongly recurvate after anthesis. Stamen 1; filament up to ½ mm; anther elliptic, 0.2–0.6 by 0.1–0.4 mm, mucronate. Rudiment of ovary 0. — ♀ *Flowers* sessile. Sepals and petals 0. Styles shortly conical, distally set with long hairs. *Fruit c.* 1 mm long. Mericarps 2, ± oblong, at the base with *c.* 3 dorsal crests, these with 3–5 thin long spines curved upwards, and laterally with some irregular rows of tubercles, upwards slightly

narrowing, smooth or with some tubercles, widening at the top in an asymmetrical crown of *c.* 8–12 ± patent spines with recurvate tips, which are dorsally distinctly longer than laterally, the longest up to 0.8 mm long.

Distr. *Malesia*: E. New Guinea (Papua, Western Distr.: near Weam). Fig. 10.

Ecol. Wet depression in savannah, *c.* 30 m.

Doubtful record

Myriophyllum indicum WILLD.: JUNGH. Java, 2nd Dutch ed., 1 (1853) 470, 'Java (Bandung, abundant)'.

No material could be traced; almost certainly a mis-identification.

Dubious

Ammania pinnatifida LINNÉ *f.* Suppl. (1781) 127, 'Java'.

The name is cited by DC. Prod. 3 (1828) 69, as possibly synonymous with *Myriophyllum intermedium* DC. No material could be found in Swedish herbaria. See MEIJDEN, Blumea 17 (1969) 311.

Myriophyllum pusillum BL. Mus. Bot. Lugd.-Bat. 1 (1849) 111; MIQ. Fl. Ind. Bat. 1, 1 (1855) 634; Suppl. (1860) 328; Sumatra (1862) 128, 328; KURZ, Nat. Tijd. N. I. 27 (1864) 167; WARB. Bot. Jahrb. 13 (1891) 395; K. SCH. & LAUT. Fl. Schutzgeb. (1901) 483.

Although the description is very brief, the said provenance said to be 'Archip. Ind.', it is not improbable that *M. pusillum* is indeed a *Myriophyllum*, possibly *M. tetrandrum* ROXB. Unfortunately the type material could even as early as 1900 not be located. All later records refer to sterile specimens, those by MIQUEL (1860) and KURZ are according to Mr PHILCOX (*in litt.*) probably *Limnophila* (*Scrophulariaceae*).

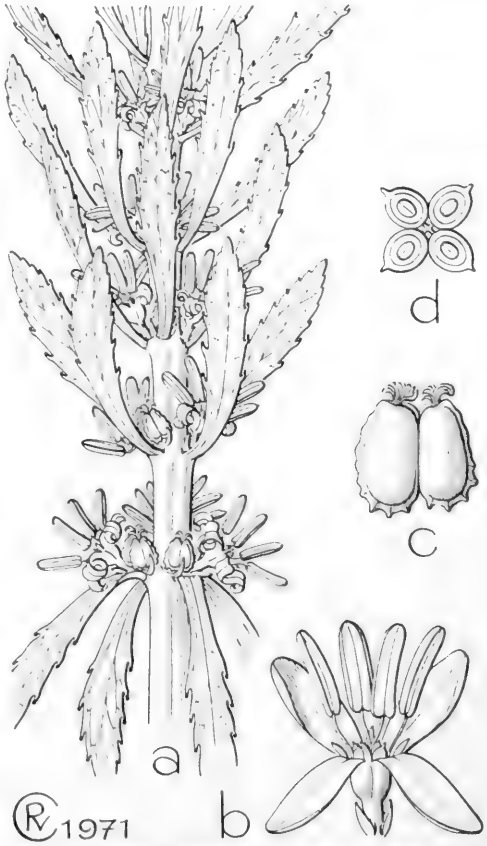

Fig. 16. *Myriophyllum axilliflorum* BAKER. *a.* Habit, ×3, *b.* bisexual flower, ×7, *c.* fruit, ×13, *d.* cross-section of fruit, ×13 (*a–d* HILDEBRANDT 4030).

4. GUNNERA

LINNÉ, Syst. Nat. ed. 12 (1767) 597; Mant. 1 (1767) 16; SCHINDL. Pfl. R. Heft. 23 (1905) 104; MATTFELD, Ostenia (1933) 102; BADER, Bot. Jahrb. 80 (1961) 281, maps. — *Pseudogunnera* ÖRSTED, Naturh. För. Vidensk. Medd. Kjöbenhavn (1857) 193. — **Fig. 17–18.**

Perennial, ± acaulous (sometimes colossal herbs with a stem up to 6 m by 20 cm ⌀ in extra-Mal. *spp.*), (in Mal.) stoloniferous, with more or less creeping, sub- or slightly supraterranean, thick rhizome. *Leaves* radical (or in non-Mal. *spp.* tufted at the end of the stem), reniform-cordate to ovate-truncate, simple to lobed, crenate to compound-dentate, rarely entire, palminerved, often rugose, with more or less conspicuous, simple to much divided, sometimes ochrea-like 'cataphylls' in the very leaf-axil. *Panicle*, raceme or spike mostly 1, axillary or pseudoterminal, simple or compound. *Flowers* ebracteolate, bisexual or unisexual, monoecious (or dioecious), if monoecious with ♂ flowers upwards and ♀ ones

Fig. 17. *Gunnera macrophylla* BL. on summit of Mt Kaba, Bencoolen, April 1932 (DE VOOGD).

downwards and sometimes with ☿ in between. *Sepals* 2 (rarely in some flowers 3), or 0, equal or unequal, often cuspidate, whether or not caducous. *Petals* 2(–0), in ♀ 0, oblong to spathulate, more or less convex outside, glabrous to pilose, often soon caducous, longer than the sepals. *Stamens* 2; anthers elliptic to oblong. *Ovary* 1-celled, urceolate to compressed-ovoid; styles subulate to filiform, entirely papillose, exserted in anthesis. Ovule 1. *Fruit* a drupe or nut-like, coriaceous to more or less fleshy or juicy, almost globular to 3-gonous; stone crustaceous; perisperm copious, oily; embryo apical, very small, pear-shaped to obcordate.

Distr. About 30–50 *spp.*, in South and tropical Africa and Madagascar, Malesia, Tasmania, New Zealand, Antarctica, the Hawaiian Islands, and South and Central America; not in continental Asia and Australia; in *Malesia*: not found in the Malay Peninsula and the Lesser Sunda Islands. Fig. 19.

Ecol. Cold or cool, everwet localities, often on marshy soil, in the tropics only in the mountains, in Malesia above (750–)1000 m.

Symbiosis with Cyanophyceae. — *Gunnera* represents a remarkable case of true symbiosis which seems inherent to all species. Though I am not aware of experiments proving it to be obligatory, this seems likely. The stem and petiole-bases are provided with mucilage producing glands which offer obviously the entrance of the *Nostoc* or *Chroococcus* species, or hydathodes may serve this purpose and the algal cells form fairly large and regular intracellular colonies, as REINKE described (Unters. Morph. Veg.-Organe Gunnera, 1873). See also H. SCHNEGG (Flora 90, 1902, 161–208). Infection seems to take place very early. For the Malesian *G. macrophylla* excellent details are described and depicted by BAAS BECKING (Dodonaea 14, 1947, 93–96). Each of the equitant petiole-bases is provided with three warts, one central highest and two lateral basal, immediately *below* which a root emerges; the *Nostoc* colonies are confined to the warts.

BAAS BECKING suggested that the phycome contained a substance of 'auxin' character, but no later communication followed. Recently, in a preliminary paper, SILVESTER & SMITH (Nature 224, 1969, 1231) found that *Nostoc* in cultures is able to fix nitrogen and that the *Gunnera-Nostoc* symbiosis is capable of nitrogen fixation. It is made certain that the nitrogen absorbed by the *Gunnera* (*arenaria*) plants in pure cultures on nitrogen-free media came from *Nostoc*. *Gunnera* plants raised from seed and grown on media free of both *Nostoc* and nitrogen compounds showed at the 6 leaf stage yellow chlorotic leaves and poor growth. No experiments were yet made to grow *Nostoc*-free *Gunnera* on media containing combined nitrogen to check whether the symbiosis is obligarory for *Gunnera*; SILVESTER (*in litt.*) suspects perhaps it is not. As *Nostoc* is ubiquist, all *Gunnera* plants in nature contain *Nostoc* and this may be favourable indeed for its growth on nitrogen deficient soils.

Morph. The evaluation of the so-called 'ligule' or 'stipules' is still under dispute. Their development is various but specific; in *G. magellanica* they are very large, in the New Zealand species they are absent (SCHNEGG, *l.c.*). SKOTTSBERG (Svensk Bot. Tidskr. 22, 1928, 392–415) regarded them as cataphylls. The latter opinion seems unlikely as they are not contained in the leaf spiral as remarked by MATTFELD (Ostenia 1933, 109), but axillary.

Taxon. SCHINDLER subdivided the genus into 5 subgenera, to which MATTFELD added a sixth monotypic one from E. South America, *Ostenigunnera* MATTFELD (1933, *l.c.*) which is very distinct and deserves clearly subgeneric rank. The others are *Misandra* in South America, *Panke* in South America, Juan Fernandez, and Hawaii (20–30 *spp.*), *Milligania* in New Zealand and Tasmania (9 *spp.*), *Pseudogunnera* in Malesia (1 *sp.*), and *Gunnera* (*subg. Perpensum*) in Madagascar and East Africa (1 *sp.*).

The characters SCHINDLER used for this classification are the occurrence of stolons, the distribution of the sexes, the structure and size of the 'cataphylls', and the size of the plant. It seems to me that, *Ostenigunnera* excepted, the mutual similarity is so large that distinguishable taxa at most deserve sectional rank, the more so as distinctions are less sharp than presented by SCHINDLER. For example: within *Milligania* occur both species with monoecious and with monoecious or dioecious flowers. In *Perpensum* with bisexual flowers sometimes the upper are ♂, whereas in *Pseudogunnera* between the upper ♂ and lower ♀ sometimes ☿ flowers are found. As to size of leaves *Pseudogunnera* (*G. macrophylla*) displays an enormous variability in New Guinea, from 2½–70 cm, depending either on altitude or habitat, so that small specimens of *G. macrophylla* from New Guinea so much resemble *Milligania* that RIDLEY, who described such small specimens as a separate species, *G. reniformis*, promptly declared them to be allied to the Tasmanian *G. cordifolia* HOOK. *f.* of *subg. Milligania*.

I believe that the subdivision of *Gunnera* could be improved if only 2 subgenera are recognized: *subg. Gunnera* and *subg. Ostenigunnera*. The first might then be distinguished into two or three sections, *viz sect. Gunnera*, including *subg. Perpensum*, *Pseudogunnera*, and *Milligania*, and occurring in Africa, Madagscar, Malesia, Tasmania, and New Zealand, and *sect. Panke*, including *subg. Panke*, occurring in Central and South America, Juan Fernandez, and the Hawaiian Is. The affinity of the South American *subg. Misandra* is uncertain to me, it may be kept separate, or may be included within *sect. Gunnera*.

Nomencl. The name *Panke* which is still used as the name of a South American subgenus of *Gunnera* already occurs in a work by L. FEUILLÉE (Journ. Obs. 1, 1714, t. 30), as part of a phrase name. This was post-Linnean literatim translated into German by G. L. HUTH (Beschreib. Arnzey Pfl. 1, Nürnberg, 1756, 42, t. 30). In this rare work all plants are beautifully depicted and accompanied by phrase names preceding their description. There is of course no question that FEUILLÉE adhered to the binomial system, *i.e.* that he distinguished genera and species. The German literatim translation does neither, and from the introduction by HUTH appears that he merely published it as a translation, without himself having the intention to make any changes towards framing it according to the binomal nomenclature. Therefore, this translation has no nomenclature standing.

It must be admitted, though, that not long ago a 'generic' name from this work was rejected nomenclaturally, *viz Urceolaria*, obviously because D. L. DENHAM (Taxon 10, 1961, 247) stated in his proposal that HUTH's names are effectively and validly published and 'must' be accepted. The members of the Committee on nomina generica conservanda have obviously not verified DENHAM's statement on this rare work and were thus misled. In HUTH's translation neither genera nor species were indicated as such; each single species had a different phrase name, or better, was indicated by a phrase indication. Nomenclaturally this translation cannot be used for post-Linnean validation and should be discarded. Consequently we have refrained from proposing *Panke* to be rejected in favour of *Gunnera*.

Fig. 18. *Gunnera macrophylla* BL. group above waterfall Tjibeureum, Mt Gedeh, W. Java, 1750 m (VAN STEENIS).

1. Gunnera macrophylla BL. Bijdr. (1826) 513; BENN. Pl. Jav. Rar. (1828) 70, t. 15; MIQ. Pl. Jungh. (1851) 70; Fl. Ind. Bat. 1, 1 (1856) 769, *incl. var. sumatrana* MIQ. *l.c.* 770; BL. Mus. Bot. Lugd.-Bat. 2 (1856) 101; DC. Prod. 16, 2 (1868) 598; WARB. Bot. Jahrb. 16 (1893) 15, 24, *var. papuana* WARB.; KOORD. Minah. (1898) 451; K. SCH. & LAUT. Fl. Schutzgeb. (1901) 483; SCHINDL. Pfl. R. Heft 23 (1905) 114, f. 33; BACK. Schoolfl. Java (1911) 477; RIDL. J. Fed. Mal. St. Mus. 8, 4 (1917) 33; HEYNE, Nutt. Pl. ed. 3 (1927) 1207; C. T. WHITE, Proc. R. Soc. Queensl. 34 (1922) 483; KOORD. Fl. Tjibodas 2 (1923) 217; BAKER, J. Bot. (1924) Suppl. 35; WENT, Nova Guinea 14 (1924) 105; JOCHEMS, Trop. Natuur 15 (1926) 68, f. 4; DE VOOGD, *ibid.* 22 (1933) 226; ELM. Leafl. Philip. Bot. 9 (1933) 3143; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 217; Trop. Natuur 30 (1941) 172, f. 4; Bull. Jard. Bot. Btzg III, 17 (1948) 463; BACK. & BAKH. *f.* Fl. Java 1 (1963) 266. — *G. erosa* BL. Verh. Bat. Gen. 10 (1825) 81, *nom. nud.*; DC. Prod. 16, 2 (1868) 599. — *Pseudogunnera macrophylla* (BL.) ÖRSTED, Naturh. För. Vidensk. Medd. Kjöbenhavn (1857) 599. — *Sarcospermum petasites* REINW. MS., in De Vriese, Reinw. Reise (1858) 576, *nomen.* — *G. reniformis* RIDL. Trans. Linn. Soc. Lond. II, 9 (1916) 40, *ex descr.*; WENT, Nova Guinea 14 (1924) 105; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 217. — **Fig. 17-18.**

Perennial, stoloniferous, pilose herb. Stem very short, *c.* 1–2 cm ø, pilose; rhizome sublignose, elongated, dark. *Stolons* often numerous, ± terete, the internodes very long, up to *c.* 40 cm, *c.* 3 mm ø, with 2 opposite, caducous, small bud-scales, soon producing a new flowering plant at each node. *Leaves* reniform to cordate, angular, rarely irregularly (2–)3-lobed, acutely irregularly sphacelate-dentate, bullate, venation strongly prominent, reticulate beneath, 2½–70 by 2½–70 cm;

petiole up to 70 cm, 3–10 mm ø, ± terete, widely channelled above, costate, ± sheath-like at base, shortly decurrent, each of the lower equitant petiole-bases provided with 3 warts, 1 central highest and 2 lateral lower, below which an adventitious root emerges. *Panicles* 1(–3) subterminal, shortly peduncled or sessile, often hidden under the leaves, in fruit accrescent to 25–60 cm; lateral spikes very numerous, each in the axil of a bract ½–1½ by ¼–1 cm, the lower ones 2½–9 cm, with ♀ flowers, the upper ones with ♂ or intermixed with ☿ flowers. — ♂ *Flowers*: sepals triangular to broadly triangular, with acuminate or cuspidate, sphacelate apex, erect, 0.6–1.2 by *c.* 1 mm, glabrous; petals spathulate, mucronate, glabrous or pilose outside, glabrous inside, ± densely pilose on the margin, caducous before anthesis; filaments up to *c.* 2 mm, *c.* 0.3 mm ø, erecto-patent, stiffish; anthers ± elliptic, obtuse or shortly mucronate, 1½–2 by 1¼–1½ mm. — ♀ *Flowers*: sepals as in ♂; petals 0; stigmas sessile, subulate, up to 2 mm long. *Drupe* ± globose, glabrous, juicy, *c.* 2 mm; stone flattened globular, *c.* 1 mm ø.

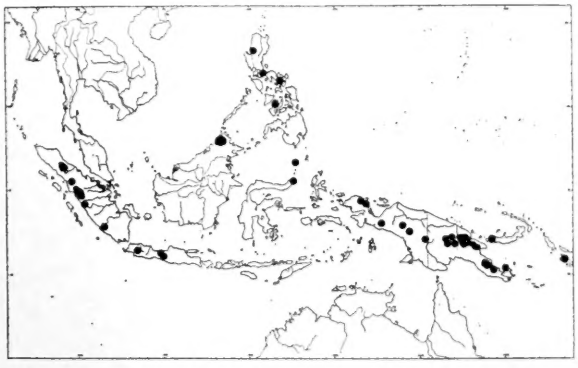

Fig. 19. Distribution of *Gunnera macrophylla* BL.

Distr. *Malesia*: Sumatra, W. & Central Java, N. Borneo (Mt Kinabalu), Philippines (Luzon, Negros), NE. Celebes (Mt Klabat), Sangihe I., New Guinea (incl. also Goodenough I. & New Britain: Mt Talawe), and Solomon Is. (Kolombangara). Fig. 19.

Ecol. In the mountains from (750–)1250–3000 m. Wet or damp places, along brooks, river banks, near waterfalls, wells and seepage, mostly on open or lightly shaded places in disturbed habitats, pioneering on bare lands, along paths and in light places in secondary forests, often gregarious.

Vern. *Tĕraté gunung*, S; Philippines: *balai*, *baloi*, Ig., Bon.

Morph. The so-called sphacelate teeth on the leaves and the inflorescence-scales are probably hydathodes.

Numerous semiglobular gland-like outgrowths are found especially on the young leaves, on and near the nerves.

Coalescence of parts of the inflorescence occurs frequently.

Notes. The small specimen described from Mt Carstensz in New Guinea as *G. reniformis* RIDL. is presumably an early flowering juvenile individual developed on a stolon; such specimens have also been collected elsewhere in New Guinea.

Sterile specimens have sometimes erroneously been referred to *Petasites* (*Compositae*) by resemblance of the leaf (VAN STEENIS, 1948, *l.c.*).

Excluded

Hydrospondylus (*submersus*) HASSK. Flora 25 (1842) Beibl. 2, 33 = *Hydrilla verticillata* (L. *f.*) ROYLE (*Hydrocharitaceae*).

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