ANACARDIACEAE (Ding Hou, Leyden)[1]

Trees, erect or scandent shrubs, or climbers, very rarely epiphytic shrubs; usually with acrid, often turpentine smelling sap becoming black when exposed to the air. Buttresses sometimes present. Stipules absent. *Leaves* often crowded at the (thickened) end of twigs, spiral or alternate (only opposite or decussate in *Bouea*), sometimes subverticillate; simple, uni- or tri-foliolate, imparipinnate, rarely paripinnate (*Euroschinus*) (bipinnate in *extra*-Mal. *Spondias sp.*); margin entire (rarely crenate-dentate in *Rhus spp.*); petioled (petiole often thickened at the basal part), rarely subsessile or sessile. *Inflorescences* terminal and/or axillary, rarely cauliflorous, paniculiform (panicles or thyrses), sometimes racemose or spiciform, rarely flowers solitary; bracts and bracteoles usually caducous, sometimes persistent; pedicels distinct, obscure, or 0, often articulated. *Flowers* regular, bisexual, or unisexual by abortion (plants monoecious, dioecious, or polygamous). *Hypanthium* sometimes present (*Melanochyla*). Floral axis (between calyx and stamens) often obscure, sometimes distinct and elongated (*Gluta & Swintonia*). *Calyx* 5- or 4- (rarely 3-)lobed (or perianth bract-like, in *Pistacia*), sometimes calyptriform (*Gluta*), caducous or persistent, rarely accrescent (*Parishia*). *Petals* 5 or 4, or 0 (in *Pistacia*), free, sometimes the basal part longitudinally adnate to the floral axis, imbricate or valvate, rarely contorted, caducous or persistent, sometimes accrescent (*Swintonia & Gluta spp.*). *Stamens* equal or twice the number of calyx lobes or petals, rarely more or ∞ (*Gluta spp.*), inserted on the margin of disk, or just outside or inside of this margin, or on an enlarged torus (*Gluta*); all (sometimes 1 or more) fertile in ♂ or bisexual flowers, imperfect or sterile, rarely rudimentary, or wanting (*Pistacia*) in ♀ flowers; filaments subulate or filiform, free or infrequently basally connate, glabrous, sometimes hairy or papillate; anthers dorsi- or basifixed, or dorsobasifixed, longitudinally dehiscent, seemingly 2-celled (with 4 pollen sacs) at anthesis, usually introrse; connective rarely prolonged, dilated and apically 2-lobed (*Androtium*). Torus prominent (*Gluta*). *Disk* usually present and distinct (rarely obscure or none), persistent (caducous in *Androtium & Buchanania*), often fleshy, sometimes thin; round, flat or concave above, pulvinate, rim-like, short-cupular, or consisting of 5 gland-like lobes (*Swintonia*), rarely stipiform (*Mangifera spp.*), often slightly crenulate or notched, rarely lobed. *Ovary* free, or the basal part connate with disk or receptacle, superior, sometimes partly or wholly immersed in disk or receptacle and seemingly semi-inferior or inferior (*Pegia, Melanochyla & Semecarpus spp.*), rarely really inferior (*Drimycarpus & extra*-Mal. *Holigarna*), usually sessile, sometimes stiped (*Gluta*); 1-carpellate and 1-celled, or syncarpous and 2–5(–12)-celled (if 1-celled there are 3 styles), apocarpous (4–6-carpellate in *Buchanania & Androtium*), or carpels incompletely connate (5-carpellate in *Dracontomelon & Koordersiodendron*), usually 1 carpel fertile; styles 1–5(–12), distinct or obscure, terminal or excentric; stigmas 1–5(–12), distinct or obscure; rudimentary pistil small, obscure, or absent in ♂. *Ovule* 1 in each carpel or cell, pendulous, apotropous. *Fruits* drupaceous, sometimes subtended by enlarged calyx lobes (*Parishia*) or petals (*Swintonia & Gluta spp.*), or an enlarged fleshy hypocarp (pedicel, receptacle; in *Anacardium & Semecarpus*), 1–5(–12)-celled, 1–5(–12)-

(1) A grant from the Netherlands Foundation for the Advancement of Tropical Research (WOTRO), enabling me to acquire field knowledge on this family in West Malesia in 1966, is gratefully acknowledged.

seeded; exocarp thin; mesocarp usually fleshy and resinous, sometimes waxy or oily; endocarp or stone fibrous, crustaceous, woody, or almost bony. *Seed* exalbuminous or with scanty endosperm, rarely labyrinthine (*Mangifera spp.*); testa membranous or chartaceous, sometimes adherent to the endocarp; raphe or chalazal vascular bundles sparsely or profusely branched, often distinctly shown on the testa; embryo straight or curved; cotyledons free, rarely partly or incompletely united (*Gluta spp.*), plano-convex, rarely unequal (fig. 7 l), radicle short.

Distribution. About 70 genera with *c.* 600 *spp.*, distributed chiefly throughout the tropics and subtropics. Malesia is the richest major tropical area for this family, with more genera represented than in any other area; even though *Rhus* is not richly represented in species.

Within Malesia occurrence is mainly in West Malesia. The richest endemic development is in Malaya and Borneo; as usual Sumatra has a fair number of species but few endemics. Fig. 1 & 2.

Only few genera occur in the temperate zone, *e.g. Rhus*, which is largely warm-temperate; *Pistacia* is mainly extra-tropical, but occurs with a few species in the tropics.

Species of several genera are widely cultivated for their fruit, *viz Anacardium*, *Bouea*, *Mangifera*, and *Spondias*. They may run wild and become naturalized, *e.g. Anacardium*, the cashew nut, which is according to CORNER common in villages in Malaya, especially on the East Coast, where it is so thoroughly established to appear indigenous. The same holds for cultivars or semi-domesticated forms of *Mangifera*, *Spondias*, *etc.* in Borneo and other islands. For this reason it is in some cases even impossible to establish with certainty the really indigenous occurrence of some species, especially if they are found both in continental SE. Asia and in Malesia.

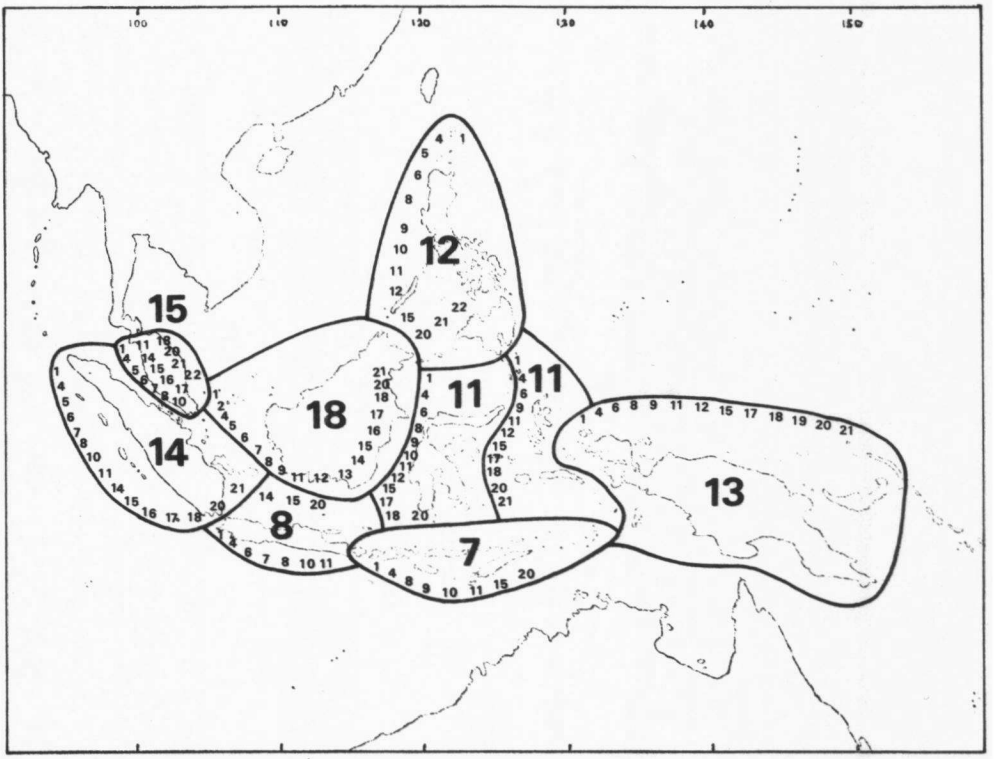

Fig. 1. Map showing the occurrence of indigenous genera in the main divisions of Malesia; genera indicated by their number, totals in large numerals (omitting 3. *Anacardium* and 10. *Lannea*, which are introduced).

Of the genera treated here *Anacardium* and assumedly *Lannea* are definitely introduced and naturalized.

Androtium, *Koordersiodendron*, and *Melanochyla* are confined, so far known, to Malesia. *Bouea*, *Drimycarpus*, *Parishia*, *Pegia*, and *Swintonia* are found in Malesia and continental SE. Asia.

Most of the following genera occur in the southeastern part of continental Asia and Malesia with only one or a few species distributed in other areas: *Buchanania* (also found in Australia and as far east as in Polynesia), *Dracontomelon* (also occurring in Solomon Is., eastwards to the Fiji Is.), *Gluta* (with also 1 sp. found in Madagascar), *Mangifera* and *Pentaspadon* (distributed as far east as the Solomon Is.), and *Semecarpus* (also occurring in Australia, Micronesia, Melanesia, and as far east as the Fiji Is.).

Lannea is chiefly an African genus with only 1 *sp.* recorded to occur in tropical Asia, and obviously introduced in Malesia. The big genus *Rhus* (*sens. lat.*: *c.* 150 *spp.*) occurs mainly in the warm-temperate zones of both hemispheres and extends also into the tropics; there are 8 *spp.* of it in Malesia.

Spondias appears to have two centres of distribution: tropical America and Indo-Malesia.

Each of the following two small genera has only one species in Malesia: *Pleiogynium* consists of *c.* 3 *spp.* distributed in the Pacific Is., Fiji, Solomons, Australia, and Malesia, and *Euroschinus* has 6 *spp.*: 4 in New Caledonia, one in Australia, and one in New Britain and Malesia.

The following two genera, each consisting of *c.* 10 *spp.*, have a rather wide and interesting distribution. *Campnosperma* is known from Madagascar, the Seychelles, Ceylon, Thailand through Malesia (with 5 *spp.*), Micronesia & Melanesia, and Latin America. *Pistacia* is disjunctly distributed in the Canary Is., the Mediterranean, Asia Minor, SE.–E. Asia, Malesia (with 2 *spp.*), and North and Central America (Texas; Mexico).

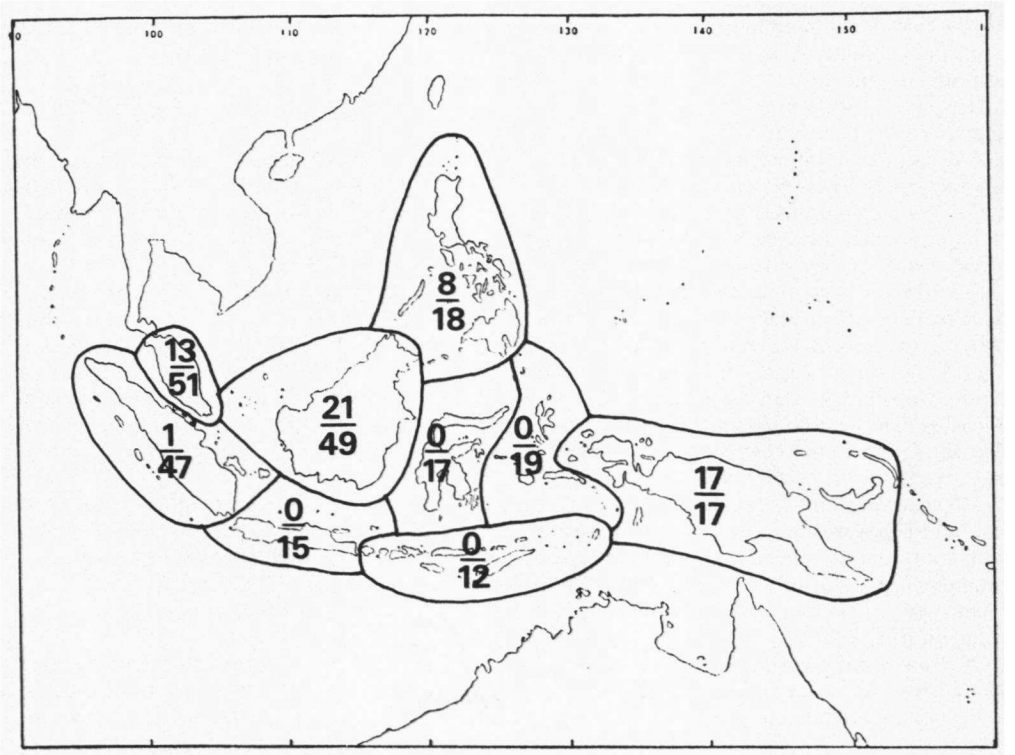

Fig. 2. Species density of *Anacardiaceae* in Malesia: above the hyphen the number of endemic, below it the number of non-endemic species in each island (group).

Anacardium is an American genus and one of its species, *A. occidentale*, is widely cultivated in the tropics and naturalized in places.

Ecology. In Malesia, species of the *Anacardiaceae* occur mainly in primary rain-forest, rarely in secondary and seasonal forest, or cleared areas.

In the forest *Anacardiaceae* usually occur scattered in the undergrowth and lower strata, with the exception of the large trees mentioned below under 'habit', which make part of the canopy. But also the latter are hardly ever common and never gregarious.

Gregarious or very common occurrence is almost only found in swamp- and peat-forest, and in riparian forest by species of *Gluta*, *Pentaspadon*, *Mangifera*, *Dracontomelon*, *Melanochyla*, *Androtium*, *Swintonia*, and especially *Campnosperma* (fig. 60).

Gregarious occurrence is also on record of two trees on limestone in the Langkawi Is. (NW. Malaya), *viz* on P. Langgung of *Pentaspadon curtisii* and on G. Raya, Langkawi, of *Swintonia floribunda*, both forming almost pure stands.

Furthermore, *Swintonia robinsonii* was found dominating a stretch of forest on a steep ridge at *c.* 1450 m altitude on G. Rabong, S. Kelantan.

As to *altitude* the great majority of species is found at low and medium altitude, below 1000 m; about two dozen *spp.* ascend between 1000 and *c.* 1500 m, some 6 *spp.* even ascending to 1500–2000 m (*Semecarpus bracteatus*, *S. heterophyllus*, *Rhus taitensis*, *R. lamprocarpa*, *Mangifera indica*, *M. foetida*), but sometimes only with one collection. True montane species are extremely rare: *Rhus succedanea* (900–2400 m), *R. borneensis* (1200–2000 m), *R. caudata* (900–2400 m), *R. linguata* (1100–1770 m), and *Swintonia robinsonii* (1050–1650 m). It is remarkable that *Rhus chinensis* ascends in extratropical Yunnan to much higher altitude than in Malesia, *viz* to 3200 m, in Malesia to 1350 m.

Climatic conditions. Most Malesian *Anacardiaceae* are constituents of the primary rain-forest, but quite a number tolerate or even prefer a seasonal climate; for example *Semecarpus heterophyllus* is very common in the teak forests in Java. *Lannea coromandelica* is also characteristic for a seasonal climate. Also for the cultivation of the better species of *Mangifera* a seasonal climate is more suitable.

During the dry season these species are frequently leaf-shedding, flowers and young foliage appear on the bare branches with the onset of the rainy season.

A deciduous habit occurs in proportionally many Anacardiaceous genera, *e.g.* in some *spp.* of *Gluta* (*G. pubescens*, *G. malayana*), in *Parishia*, some *spp.* of *Spondias*, and in most *spp.* of *Rhus* and *Pentaspadon*. In most cases the deciduous habit is not especially bound to a distinct seasonal climate; a small decrease in rainy days or a prolonged dry spell seems also under everwet rain-forest conditions a sufficient impetus.

Substratum. Several species are characteristic constituents of swamp- and peat-forests, tidal river-banks or temporary overflowed areas or swamps, *e.g. Androtium astylum*, *Campnosperma spp.*, *Gluta renghas*, *G. velutina*, *Mangifera gedebe*, *Melanochyla auriculata*, *Pentaspadon motleyi* (fig. 58), *Swintonia glauca*, *etc.* Trees of such permanently or temporarily inundated habitats may produce prominent buttresses. But large buttresses may also occur in dryland species, *e.g.* in *Spondias pinnata*, *Koordersiodendron pinnatum*, *Gluta malayana* (fig. 19), and *Dracontomelon dao* (fig. 32). Other genera may lack buttresses in all species, *e.g. Mangifera*, although *M. gedebe* is a true swamp-forest species.

A few swamp-forest species may have stilt-roots, *e.g. Melanochyla bracteata* (fig. 46), *M. auriculata*, and *Gluta velutina* (fig. 25). *Campnosperma coriaceum* develops in deep swamps apart from prop-roots slender-kneed pneumatophores or loop-roots over 1 m high (fig. 62). Also in deep swamps *Gluta renghas* develops a conically thickened stem-base (fig. 27).

One species, *Pentaspadon curtisii*, is confined to limestone; other species may sporadically occur on this bedrock.

Of *Semecarpus* one species, *S. stenophyllus*, is from the Philippines recorded to be confined to streambeds. As usual with such rheophytic plants, growing on gravel and rocks along mostly swift-running streams at low altitude and subject to sudden overflow, it has the stenophyllous habit.

Habit. As to habit, most Malesian species are trees of small to medium size, but *spp.* of *Gluta*, *Buchanania*, *Bouea*, *Dracontomelon*, *Mangifera*, *Koordersiodendron*, *Parishia*, *Spondias* and

Swintonia can attain large sizes, sometimes with massive crowns, and reach a height of 30–55 m and a stem diameter of $^3/_4$–1(–$1^1/_2$) m.

The only true genus of lianas is *Pegia*.

Climbing habit has also been mentioned in some *Rhus* and *Semecarpus spp.* which are recorded either as a shrub or as an epiphyte. This observation of variable habit is also recorded from *Spondias philippinensis*, which is even cited to be a shrub, a small tree, a liana, an epiphyte, and a big tree. This variability is doubtless due to the fact that these species may be erect and terrestrial, but may also begin their life as a 'hemi-epiphyte', which means that they start as an epiphyte and by sending roots down along a host tree may reach the soil and become terrestrial and may eventually outlive their host tree. This change of habit has been described for species of several other rain-forest genera, *Vaccinium*, *Fagraea*, *Ficus*, and others, and has been described and explained in full for *Wightia* (*Scroph.*) by VAN STEENIS (Bull. Jard. Bot. Btzg III, 18, 1949, 213–227).

Some species of *Semecarpus* exhibit a characteristic *cycadoid* or 'Schopfbaum' habit, that is: they remain unbranched for a long time and carry an apical tuft of large, often sessile pseudo-whorled leaves, as a sort of nest; sometimes they produce several such nests in succession. This is characteristic for *Semecarpus magnificus* and *S. nidificans* in Papua, the latter's epithet being even derived from this peculiar habit. Also young plants of *S. bunburyanus* and *S. curtisii* (fig. 53) show this growth mode.

Pollination. The plants of most species in this family are dioecious or polygamous and bear many-flowered inflorescences. The flowers possess nectary organs or disks and are sometimes fragrant. They are cross-pollinated and are evidently entomophilous.

Myrmecophyly. Twigs of several species may be hollowed out by ants removing the pith and making slitwise openings, the twigs thus becoming spindle-shaped swollen and inhabited by ants. This is found especially in New Guinea, in several species of *Semecarpus*, *viz S. australiensis*, *S. brachystachys*, *S. cassuvium*, and *S. schlechteri*; a synonym of the latter species derived even its epithet from its ant-inhabited twigs (*S. myrmecophila*). This phenomenon is also found in *Euroschinus papuanus*. In some of these species the occurrence seems to be rare, in others more common, but the general impression is that it is in none of the cases peculiar to the species, as is the case with true myrmecophilous plants in which almost every specimen is inhabited by ants which are entirely adapted to this kind of shelter.

An interesting case in this respect occurs in *Semecarpus aruensis*, of which some specimens have young fruits with a shallow cavity at the basal part on the surface just above the hypocarp. In one such cavity I found sixteen insect eggs (possibly of ants). Fig. 48a–c. The fruits were gradually deformed by the presence of these insects: the basal part of these fruits seems flattened and its margins laterally curved to form a pocket or pit leaving an opening to the outside. Field observations are needed to clarify whether it is a matter of galls or a symbiosis with ants.

Galls. Leaf-galls observed in species of *Buchanania*, *Dracontomelon*, *Gluta*, *Mangifera*, *Semecarpus*, *Melanochyla* and *Spondias* are usually hemispherical or conical, 1–3(–10) mm high and broad. They are caused chiefly by gall-midges, sometimes by acarids, and rarely by *Psyllidae* (*cf.* DOCTERS VAN LEEUWEN, Zoocecidia, 1926, 321–326, f. 570–582; Ned. Kruidk. Arch. 51, 1941, 171–174, f. 46). The galls on the leaves and branchlets of *Rhus chinensis* (syn. *R. semialata*) are very irregularly shaped and are caused by *Aphis chinensis* (*cf.* SCHENK, Flora 33, 1850, 289–292; ENGLER in E. & P. Nat. Pfl. Fam. 3, 5, 1892, 169, f. 107 B & C; SHIRAI, Bot. Mag. Tokyo 9, 1895, 1–6, t. 1 & 2).

Galled fruits have been observed in some specimens of *Campnosperma montanum* and *Semecarpus albicans* (see notes under the species).

Dispersal. The fruits of *Anacardiaceae* are drupaceous and vary considerably in size: from less than $1^1/_2$ cm long (*e.g.* in *Buchanania*, *Campnosperma*, *Euroschinus*, *Rhus*, *etc.*) to 25 cm (*e.g.* in *Mangifera*); embryos of some species of the latter genus belong to the largest in the world. The drupes or sometimes their stones (endocarps) have been reported to be dispersed in various ways.

Some fruits are eaten and dispersed by birds and/or other animals (bats, squirrels, monkeys, elephants, *etc.*). In Djambi (Central Sumatra) the fruiting season is Jan.–Febr., attracting game, pigs, elephants, *etc.* By end March RUTTEN (Trop. Natuur 28, 1939, 19, fig.) observed numerous seedlings of *Durio* and *Mangifera odorata* (*ambatjan*) in the excrements of elephants. ASHTON told me that he saw squirrels in Sarawak eating the fruits of *Dracontomelon*. Sometimes one

would find plenty of the fruits under the tree with only part of the pulp eaten; pigs consumed such dropped fruits, but the hard stones, which remained internally intact, were carried away and thus disseminated.

Also fruits may be washed away to some distance by rain into places suitable for germination and growth. Some species of *Dracontomelon*, *Campnosperma*, *Gluta*, *etc.* growing in peat-swamp forests, on tidal river-banks or occasionally in inundated areas, are dispersed by water. Fruits of the cultivated *Anacardium* and *Spondias* were found drifting along the sea-coast or floating in the sea.

Many species of *Parishia* (fig. 68h), *Gluta* (incl. *Melanorrhoea*), and *Swintonia* (fig. 13i) bear fruits possessing rather long accrescent calyx lobes or (wing-like) petals sometimes reaching more than 10 by $1^1/_4$ cm. Such winged fruits turn upside-down when they fall from the tree and rotate away in their descent (*cf.* RIDL. Disp. 1930).

Except for the small-fruited drupaceous genera which may be carried by birds over some distance, there are no devices leading to accept long-distance dispersal in *Anacardiaceae*, except that fruit of swamp inhabiting species may be carried by the water of rivers.

Germination & Seedlings. In *Anacardiaceae* several seedling types occur. These have been arranged in the following survey, partly derived from literature, partly from my own experience, in which also seedlings from *non*-Malesian species are arranged. The terminology is in agreement with that used in my forthcoming book.

(i) *Macaranga type:* Cotyledons thin, elevated above the soil on a stretching hypocotyl, ultimately shedding the envelopes and exposed, and then with photosynthetic function. Leaves are almost always spirally arranged. — This is found *e.g.* in *Rhus ovata* S. WATS. and *R. nodosa*. Seedlings of *Lannea coromandelica* and *Rhus typhina* L. may belong to this type, or could belong to the *Sloanea* type, but their descriptions are insufficient to make a decision.

(ii) *Sloanea type:* Cotyledons thick, food-storing, elevated above the soil on a stretching hypocotyl, ultimately shedding the envelopes and exposed. The first two leaves are mostly opposite while the subsequent ones are spirally arranged. — This is for instance found in *Anacardium excelsum* SKEELS, *A. occidentale*, *Buchanania arborescens*, *B. latifolia* ROXB., *Dracontomelon dao*, *Parishia insignis*, *Rhus aromatica* AIT., *Spondias mombin*, *S. pinnata*, and *S. purpurea*. *Lannea coromandelica* and *Rhus typhina* L. may also belong to this type, but descriptions are insufficient for making a decision.

(iii) *Heliciopsis type/subtype:* Cotyledons either thick and of the food-storing type, or thin haustoria covered by the persistent pericarp and testa, secund at soil level. The shoot withdraws from the envelopes and stretches. Leaves are almost always all spirally arranged, the lower ones being often scale-like (cataphylls) and gradually pass into developed leaves. — To this type belong for example *Gluta macrocarpa*, *G. renghas* and *G. usitata* (WALL.) DING HOU (syn. *Melanorrhoea usitata* WALL.), *Mangifera gedebe*, *M. indica*, *Melanochyla fulvinervis*, *Rhus glauca* THUNB. (syn. *R. thunbergiana* SCHULT.). *Semecarpus curtisii* seems also to belong to this type, but there the first internode elongates and the first two leaves are opposite.

(iv) *Heliciopsis type/Koordersiodendron subtype:* Cotyledons either thick, of the food-storing type, or thin haustoria covered by the persistent fruit-wall and testa, secund above the soil on an elongated hypocotyl. The shoot withdraws from the envelopes and stretches. Either all leaves spirally arranged, or the first two opposite and subsequent ones spirally arranged. — To this type belong for instance *Koordersiodendron pinnatum* and *Swintonia sp.*

According to the shape and phyllotaxis of leaves in advanced seedlings they may be classified as follows:

A. *Leaves all spirally arranged*

(a) Lowest leaves scale-like (cataphylls), all higher leaves simple. This is *e.g.* found in *Gluta macrocarpa*, *G. renghas*, *G. usitata* (WALL.) DING HOU (syn. *Melanorrhoea usitata* WALL.), and *Melanochyla fulvinervis*. This situation can occur also in *Mangifera indica*, but in this species it is variable; see below.

(b) Lowest leaves scale-like (cataphylls), higher leaves simple, ultimate leaves compound. This is *e.g.* found in *Rhus glauca* THUNB. (syn. *R. thunbergiana* SCHULT.).

(c) All leaves simple. This occurs in *Mangifera gedebe* and *Rhus ovata* S. WATS. (in which it varies, see *sub* d). It can also occur in *Mangifera indica*.

(d) First leaves simple, higher ones compound. This occurs *e.g.* in *Rhus nodosa* and can also occur in *R. ovata* S. WATS.

(e) All leaves compound. This can be found in *Rhus typhina* L., but varies in that species.

B. *First two leaves opposite, next leaves spirally arranged*

(f) All leaves simple. This is *e.g.* found in *Anacardium excelsum* SKEELS, *A. occidentale* (both with 4 lowest leaves in 2 decussate pairs), *Buchanania arborescens*, *B. latifolia* ROXB., sometimes in *Mangifera indica*, and furthermore in *Semecarpus curtisii* and *Swintonia sp.*

(g) First two leaves simple, higher ones compound. This occurs *e.g.* sometimes in *Rhus typhina* L.

(h) All leaves compound. This is found for example in *Dracontomelon dao*, *D. lenticulatum*, *Koordersiodendron pinnatum*, *Parishia insignis*, *Rhus aromatica* AIT., *R. typhina* L., *Spondias mombin*, *S. pinnata*, and *S. purpurea*.

Literature: PIERRE, Flore forestière de Cochinchine 5 (1892) pl. 361; LUBBOCK, A contribution to our knowledge of seedlings (1892) 369–380, f. 255–260; TROUP, Silviculture of Indian trees 1 (1921) 235–249, f. 99–102; DUKE, Ann. Mo. Bot. Gard. 52 (1965) 314, 318–320, f. 90, 93 & 94; DE LA MENSBRUGE, La germination et les plantules des essences arborées de la forêt dense humide de la Côte d'Ivoire (1966) 233–238, pl.; WILKINSON, J. Nat. Hist. 1967(4), p. 508, f. 3; CSAPODY, Keimlingsbestimmungsbuch der Dikotyledonen (1968) 47, t. 49; MEIJER, Bot. Bull. Sandakan 11 (1968) 112, pl.; DUKE, Ann. Mo. Bot. Gard. 56 (1969) 152, f. 38; GILLIS, Rhodora 73 (1971) 172; BURGER, Seedlings of some tropical trees and shrubs mainly of South East Asia (1972) 32–37, f. 1–3; SCHOPMEYER, Seeds of woody plants in the United States (1974) 718, f. 4–5; DE VOGEL, Germination and seedlings in Malesian woody plants (in press), pl. 2–8. — E. F. DE VOGEL.

Taxonomy. In the latest monographic treatment of the *Anacardiaceae* LINDLEY (Intr. Nat. Syst. 1830, 127) by ENGLER (in DC. Mon. Phan. 4, 1883, 171–500, t. 4–15), this family was divided into four tribes, *i.e. Mangifereae*, *Spondieae*, *Rhoideae*, and *Semecarpeae*. In 1892, ENGLER (in E. & P. Nat. Pfl. Fam. ed. 1, 3, 5: 138–178, f. 88–178) added one more tribe, *Dobineeae*. His subdivision into tribes has, except for the additional tribe *Dobineeae*, generally been followed (*cf.* BARKLEY, Am. Midl. Nat. 28, 1942, 465–474; Lloydia 20, 1957, 255–265).

In the position of the tribe *Dobineeae* ENGL., which consists of two *extra*-Malesian genera (both perennial herbs or subshrubs): *Dobinea* BUCH.-HAM. *ex* DON and *Campylopetalum* FORMAN, opinions differ. According to ERDTMAN (Pollen Morph. & Pl. Taxon., Angiosperms, 1952, 48), pollen morphology is in favour of excluding *Dobinea* from the *Anacardiaceae*. FORMAN (Kew Bull. 1954, 555–564, f. 1–2) considered, however, with good reasons, that these two genera for the present would be best placed in *Anacardiaceae* (tribe *Dobineeae*). This tribe has also been proposed as a separate family, *Podoaceae* BAILL. *ex* FRANCH. (corr. HUTCH.) by AIRY SHAW in Willis, Dict. Fl. Pl. & Ferns, 7th ed. (1966).

The Australian genus *Blepharocarya* F.v.M. has also been segregated from the *Anacardiaceae* as the type of a new family, *Blepharocaryaceae*, by AIRY SHAW (Kew Bull. 18, 1965, 254; in Willis, *l.c.*). The only character for this distinction is the concrescent, cupule-like axes of the ♀ inflorescence which seems insufficient for raising this genus to family rank. The coralloid inflorescence of the S. African genus *Laurophyllus* is morphologically halfway such contraction to a cupule-like structure.

Furthermore, the genus *Pistacia* has been proposed to represent a monotypic family, *Pistaciaceae* (MARCH.) CARUEL (*cf.* WILLIS, *l.c.*). It differs from other *Anacardiaceae* by a single perianth of which the segments are bract-like and are indeed by COPELAND Jr (Phytomorph. 5, 1955, 440–449) suggested to be bracteal in nature, which would make the flowers apetalous. In addition KUPRIANOVA (Bot. Zhurn. SSSR 46, 1961, 803–814, 2 tab.) stated that *Pistacia* would have a different pollen morphology although ERDTMAN *l.c.* had earlier advanced that pollen morphology supports that *Julianiaceae* should be referred to *Anacardiaceae* near *Pistacia*. From his detailed study of the reproductive structure of *Pistacia chinensis* COPELAND Jr concluded that many of its distinctive details are characteristic of *Anacardiaceae* and he added that also *Julianiaceae* agree in many details with this family. Also the gross morphology and the occurrence of resinous ducts make it reasonable to include *Pistacia* in *Anacardiaceae*, as was done by HUTCHINSON (Evol. Phyl. Fl. Pl. 1969, 409; Fam. Fl. Pl. ed. 3, 1, 1973, 451).

In agreement with the subdivision by ENGLER, the main characters of each tribe occurring in

Malesia with the Malesian genera belonging to it are given below. For the etymological spelling of the tribal names, I have followed that of AIRY SHAW in Willis' Dictionary, 8th ed. (1973).

Tribe **Anacardieae** — *Mangifereae* MARCH. Rév. Anacard. (1869) 185, *excl. Solenocarpus* W. & A.; ENGL. in DC. Mon. Phan. 4 (1883) 179; in E. & P. Nat. Pfl. Fam. 3, 5 (1892) 144. — Type genus: *Anacardium* L.

Leaves simple, spiral or alternate (opposite in *Bouea*). Stamens 5-∞, in 1 or more whorls, sometimes 1–4 by abortion. Carpels solitary, or 5, free, with only one fertile (*Buchanania* & *Androtium*); style often lateral, gynobasic; ovule pendulous from a basal funicle. — (*Buchanania, Androtium, Anacardium, Mangifera, Swintonia, Gluta, Bouea*).

Tribe **Spondiadeae** DC. Prod. 2 (1825) 74 ('*Spondiaceae*'); ENGL. *l.c.* (1883) 175 & 242; *l.c.* (1892) 149. — Type genus: *Spondias* L.

Leaves mostly compound, usually imparipinnate, trifoliolate, rarely simple (*extra*-Mal. *sp.*). Stamens twice the number of petals. Carpels united, mostly 5 or 4, sometimes more (*Pleiogynium*), or only 3, very rarely only 1; styles terminal; ovule pendulous from the apex of the locule. Fruits 3- to 5-celled, rarely more, or only 1-celled. — (*Dracontomelon, Pleiogynium, Lannea, Spondias, Koordersiodendron, Pegia*).

Tribe **Semecarpeae** MARCH. Rév. Anacard. (1869) 168; ENGL. *l.c.* (1883) 178; *l.c.* (1892) 174. — Type genus: *Semecarpus* L.

Leaves simple. Stamens in one whorl, same number as the petals. Ovary consisting of (assumedly 3) united carpels, unilocular, usually partly immersed in and adnate to the fleshy, discoid, cupular or tubular disk; styles 3; ovule suspended from a funicle from the wall of the ovary above its middle or just below the apex. Fruit 1-seeded, usually with an enlarged, fleshy hypocarp. — (*Melanochyla, Semecarpus, Drimycarpus*).

Tribe **Rhoeae** MARCH. Rév. Anacard. (1869) 179 ('*Rhoideae*'); ENGL. *l.c.* (1883) 176; *l.c.* (1892) 154. — Type genus: *Rhus* L.

Leaves usually imparipinnate, trifoliolate, or simple. Stamens in 1 or 2 whorls. Ovary consisting of 1 carpel or (assumedly 3) united carpels, 1-celled; styles 3 (2 or 1), terminal or lateral, free or united below; ovule attached on a short funicle from the base or suspended from the wall near the apex. Fruit 1-celled, in *Campnosperma* incompletely 2-celled by a pseudoseptum (2-celled in *extra*-Mal. genus). — (*Pentaspadon, Campnosperma, Euroschinus, Rhus, Parishia, Pistacia*).

Affinities of the family. Anacardiaceae sens. lat. is a coherent and natural family which is most closely allied to *Burseraceae*, especially expressed in the macromorphological characters as agreed by LEENHOUTS (Fl. Males. I, 5², 1956, 210), who already pointed out the similarities and differences between them. Besides, *Anacardiaceae* are assumed to be related in a greater or lesser degree to *Sapindaceae, Meliaceae, Sabiaceae, Rutaceae, Simaroubaceae, Zygophyllaceae, Julianiaceae, etc.* — *Literature:* HOOK. *f.* in B. & H. Gen. Pl. 1 (1862) 416; MARCHAND, Rév. Anacard. (1869) 134–136; ENGL. in DC. Mon. Phan. 4 (1883) 173–174; HUTCH. Evol. Phyl. Fl. Pl. (1969) 402–412; Fam. Fl. Pl. ed. 3, 1 (1973) 436–459; THORNE, Aliso 6 (1968) 62; CRONQUIST, Evol. Class. Fl. Pl. (1969) 262–269.

Anacardiaceae can be distinguished from the related families by a combination of the following characters: (1) leaves exstipulate; (2) presence of resin-ducts with resinous sap usually quickly turning black when exposed to the air; (3) usual presence of a distinct disk; (4) ovary usually 1-celled and with only 1 ovule; (5) ovule apotropous; (6) drupaceous fruits; (7) seeds usually exalbuminous.

Morphology. *Domatia.* As exposed by JACOBS (Proc. R. Ac. Sc. A'dam ser. C, 69, 1966, 275–316, fig.) domatia are usually found in or near the axils of nerves on the undersurface of leaves or leaflets in some species of the following genera: *Dracontomelon, Pegia, Pentaspadon, Pleiogynium*, and *Rhus*. They appear as pits or cavities and are usually roofed over by hairs. Fig. 34b, 57b, 65c. Their presence or absence in some taxa of the *Anacardiaceae* can sometimes be used as a supporting character for distinguishing related genera or species, which is especially useful in naming sterile material.

Domatia are marsupiform (*i.e.* pocket-shaped) in *Pleiogynium timorense* and *Anacardium*

occidentale, and some African *spp.* of *Lannea*; marsupiform-lebetiform (between basin- and pocket-shaped) in *Pentaspadon motleyi*; lebetiform (with a basin-shaped cavity) in *Pleiogynium timorense*; cavernose in *Swintonia schwenkii*; or consist of axillary hair tufts in *Dracontomelon*.

Indumentum. Besides normal hairs, scales occur in *Campnosperma* and stellate hairs are found in *Lannea* and some *Semecarpus spp.* In *Melanochyla* and *Semecarpus* papillae are a feature of the underside of the leaves (fig. 45).

Venation. Besides the normal reticulate veins there occur in several species reticulate-scalariform venation or clear crossbar veins. A marginal nerve or intramarginal vein is found in the leaves of *e.g. Drimycarpus* and some species of *Spondias*, respectively, while in *Buchanania* between each pair of nerves an intermediary vein (shorter than the nerves but parallel to them) is found, here called 'internerval vein'. In most genera the areolae have one dendroid vein; in *Rhus* there are no areolae as the veins end blind.

Unifoliolate leaves. In *Rhus* leaves are almost always compound, but *R. borneensis* has simple leaves, without any trace of articulation. In *R. linguata* leaves are also simple but clearly unifoliolate with a distinct articulation at the apex of the petiole.

Teratology. COSTERUS & SMITH (Ann. Jard. Bot. Btzg 24, 1911, 110, t. 20, f. 14; *ibid.* 28, 1914, 137) recorded a seed of *Mangifera indica* having germinated within the fruit and one double-fruit of *Mangifera sp.* MASTERS (J. Proc. Linn. Soc. Bot. 6, 1862, 24–26, f. 1–3) found the following terata in the seeds of *Mangifera indica*: (a) the complete absence of one of the cotyledons, (b) the plumule in the one case giving off no shoot at all, in the other giving rise to three shoots from its side, and (c) the production of adventitious roots from the 'scooped-out' portion of the cotyledon.

In *Mangifera decandra* I observed one stamen with the filament broadened gradually at about the upper half and the anther attached on one side (*cf.* Reinwardtia 8, 1972, 324, f. 1h). In *Euroschinus papuanus* two stamens were found with their filaments united.

Palynology. The pollen grains in *Anacardiaceae* are of small to medium size and suboblate to prolate in shape. The majority of the genera are characterized by the *Rhus* pollen type, which is tricolporate with a perforate or finely reticulate-striate sculpture. The distribution of sculpture is generally isopolar, but in *Gluta* a few species occur with heteropolar sculpture. Pollen closely similar to the *Rhus*-type occurs in *Burseraceae* (ERDTMAN, Pollen morph. plant taxon. I, 1952, 47–48; BAKSI, Linn. Soc. Symp. Ser. 1, 1976, 379–405).

In a few genera the pollen is quite different, however. *Parishia* has a pollen type characterized by fairly large size, spherical shape, three large, but indistinctly outlined, pores and a coarsely reticulate sculpture with high and thin, sinuously winding muri and intraluminal verrucae. *Dobinea* also has a deviating pollen type which is small, suboblate, and tricolporate with a coarsely reticulate sculpture; this has formed one of the arguments for segregation as a separate family, *Podoaceae*. The most distinct pollen type is that of the genus *Pistacia*, separated by AIRY SHAW as *Pistaciaceae*. It is spherical, periporate with 3–8 irregularly outlined and slightly elliptical pores which are closed by a granulate membrane. Sculpture is finely reticulate. The type resembles the pollen of *Juliania* (*Julianiaceae*), which SHAW assumes closely related to *Anacardiaceae*.

The tribe *Rhoeae* contains the *Rhus* pollen type together with the aberrant *Parishia* and *Pistacia* pollen types, while in *Anacardieae*, *Spondiadeae* and *Semecarpeae* only the *Rhus* pollen type is found. The tribe *Dobineeae* is characterized by the *Dobinea* pollen type. — J. MULLER.

Anatomy. Most relevant anatomical data on the Malesian *Anacardiaceae* are given for the wood by DADSWELL & INGLE (1948) and for the leaf by WILKINSON (1971) (the results of her thesis together with additional observations will be published later in separate instalments). The wood anatomy of *Androtium* and *Pegia* is unknown, as well as the leaf anatomy of *Pegia*. Of the other genera usually only a small portion of the species has been investigated anatomically.

Characteristic wood anatomical features of the family are large, half-bordered to almost simple, rounded to irregularly shaped, vessel-ray pits (in all Malesian genera), simple to minutely bordered pits to the fibres, and the presence of horizontal gum- or resin-canals in the rays of most genera (but not in *Anacardium*, *Bouea*, *Dracontomelon*, *Drimycarpus*, *Mangifera p.p.*, *Rhus*, and *Semecarpus*). Vessel perforations are exclusively simple except in *Campnosperma* in which they are partly scalariform, and in *Euroschinus* in which they are occasionally reticulate.

The fibres are predominantly septate in *Dracontomelon*, *Koordersiodendron*, *Lannea*, *Pentaspa-*

don, and *Spondias*; only sparsely septate in *Anacardium*, *Buchanania p.p.*, *Campnosperma*, *Euroschinus*, *Pleiogynium*, and *Rhus p.p.*; and non-septate in the remaining Malesian genera studied thoroughly so far. The rays are usually narrow (however, in some genera up to 5–7 cells wide) and clearly heterogeneous, except in *Gluta* (including *Melanorrhoea*) and *Swintonia* in which they are weakly heterogeneous to homogeneous. Siliceous inclusions have been noted in the rays of *Gluta s.l.*, *Parishia*, and *Swintonia*. Solitary crystals are of common occurrence in the rays of most genera, whilst they occur only rarely in the axial parenchyma of a few genera. The parenchyma is typically paratracheal, but additional apotracheal bands occur in *Bouea*, *Gluta s.l.*, *Mangifera*, and *Swintonia*. The paratracheal parenchyma is aliform to confluent in *Anacardium*, *Buchanania*, *Dracontomelon*, *Drimycarpus*, *Koordersiodendron*, *Melanochyla*, *Pleiogynium*, *Semecarpus*, and *Spondias*. It is more scanty, vasicentric in *Campnosperma* (± absent), *Euroschinus*, *Lannea*, *Parishia*, *Pentaspadon*, *Pistacia*, and *Rhus*. DADSWELL & INGLE (1948) emphasized the high degree of correlation between the occurrence of these three (not always easily separable) types of parenchyma distribution and current tribal subdivision of the family. The groupings do, however, not exactly coincide. Similar findings were discussed by HEIMSCH (1942) who studied also *extra*-Malesian genera and noted that there are only some trends for each tribe of the *Anacardiaceae* to show a particular wood anatomical feature more frequently than others. MOLL & JANSSONIUS' (1911) wood anatomical grouping of Javanese genera is probably artificial because it is based on too few genera, and because their interpretation of the fibre-type (with bordered pits) in *Melanochyla*, *Semecarpus*, and *Spondias* is questionable.

WILKINSON's study (1971) has demonstrated the great diversity of leaf anatomical characters of considerable diagnostic and systematic significance. Only the main leaf anatomical characters can be mentioned here briefly. The trichomes in *Anacardiaceae* include simple unicellular or multicellular, uniseriate hairs (single or in groups); stalked, branched trichomes (the 'stellate hairs' of macromorphologists, in *Lannea*); peltate scales (in *Campnosperma* only) and a diversity of glandular hairs. These glands may be emergent or sunken, their stalks may be unicellular (as in the tribes *Anacardieae*, *Semecarpeae* and *Rhoeae*, except in *Pentaspadon motleyi* and *Parishia maingayi*) or multicellular (as in the *Spondiadeae*). The bodies of these hairs may be globose, ovoid, cylindrical or intermediate in shape. The adaxial epidermis contains glandular cells (probably mucilage cells) in the genera *Buchanania* and *Campnosperma*. Abaxial epidermal papillae of diverse but often highly characteristic morphology occur in many species of *Drimycarpus*, *Melanochyla*, *Semecarpus*, and *Swintonia* and in *Rhus chinensis*. DING HOU (Blumea 24, 1978, 3–4) made a key to the papillose genera and species based on appearance and distribution of the papillae at low magnification. The stomatal complex is predominantly cyclocytic in *Anacardiaceae*, but anomocytic stomata or anomocytic to cyclocytic stomata predominate in most genera of the *Rhoeae* and in *Androtium* and *Swintonia p.p.* Paracytic stomata characterize the genera *Anacardium* and *Dracontomelon*. The latter genus moreover shows columnar hydathode stomata. The stomatal complex in *Buchanania* and *Spondias* is rather variable and includes cyclocytic, anomocytic, paracytic and intermediate types. Columnar sclereids occur throughout the mesophyll in *Bouea* and in some species of *Mangifera*. The occurrence of secretory canals in the phloem of all *Anacardiaceae* is an outstanding feature. Such canals occur moreover in cortex and pith of a great number of genera and may also occur in the corresponding parts of petiole and midrib. The vascularization of midrib and petiole is fairly constant with a large, solid or disected, arc-shaped abaxial system and a flat adaxial plate. In some species of *Lannea* the adaxial plate is absent.

As with the wood anatomical diversity, there are trends for each tribe of *Anacardiaceae* to show a particular leaf anatomical character complex more frequently than others, but it is impossible to characterize each tribe unambiguously using leaf anatomical characters only. The reduction of *Melanorrhoea* to *Gluta* can be supported by anatomical evidence, although the absence of simple trichomes in *Gluta renghas* and *G. velutina*, and their presence in 4 species formerly referred to *Melanorrhoea* as reported by WILKINSON (1971) invites further studies to see whether the indumentum supports the recognition of at least two infrageneric taxa within *Gluta s.l.*

The entire evidence from wood and leaf anatomy unambiguously supports suggestions of affinities of *Anacardiaceae* with *Burseraceae* and *Julianiaceae*.

Literature: For general surveys also covering the older literature see SOLEREDER, Syst. Anat.

Dicot. Stuttgart (1899) 278–283, Ergänz. Bd (1908) 109–110; METCALFE & CHALK, Anat. Dicot. Oxford (1950) 452–462. Selected and additional references: GORIS, Ann. Sc. Nat. Bot. IX, 11 (1910) 1–29 (leaf anatomy in tribe *Anacardieae* and inter-relationships); MOLL & JANSSONIUS, Mikr. 2, Leiden (1911) 438–512 (wood anatomy, Java); DEN BERGER, Med. Proefst. Boschwezen 13 (1926) 87–93 (wood, Java and E. Sumatra); HEIMSCH, Lilloa 8 (1942) 83–198 (wood anatomy and affinities); DADSWELL & INGLE, Austr. J. Sc. Res. ser. B–1 (1948) 391–415 (wood anatomy, relationships, SW. Pacific, including Malesia); CHATTAWAY, Trop. Woods 102 (1955) 55–74; *ibid.* (1956) 100–124 (crystals in wood); DESCH, Mal. For. Rec. 15 (1957) 6–29 (wood, Malaya); KONING-VROLIJK *c.s.* Nova Guinea n.s. 10 (1959) 137–175 (*Koordersiodendron*, wood properties); ZAHUR, Mem. Agr. Exp. Sta. Cornell Univ. 358 (1959) 70–71 (bark anatomy); UPHOF *c.s.* Plant Hairs, in Handb. Pfl.-Anat. 4, V, Berlin (1962); GHOSH & PURKAYASTHA in Indian Woods 2, Dehra Dun (1963) 264–323; BURGESS, Timbers of Sabah, Sandakan (1966) 3–34; KRIBS, Commercial Foreign Woods on the American Market, New York (1968) 5–10; WILKINSON, Leaf anatomy of various *Anacardiaceae* with special reference to the epidermis. Thesis, Univ. London (1971) 626 pp. (unpublished); PRAKASH, Notes Jodrell Lab. 7 (1972) 1–19 (root wood anatomy of *Mangifera* and *Spondias*); HAYASHI *c.s.* Micrographic Atlas of Southeast Asian Timber, Kyoto (1973) 1–6; VAN DER GRAAFF & BAAS, Blumea 22 (1974) 101–121 (wood anatomy *Rhus*); PARAMESWARAN & LIESE, Wood Sc. Techn. 6 (1974) 81–90 (cell length wood & bark, *Mangifera*); Bull. Govt For. Exp. Sta. Meguro 269 (1974) 1–95 (wood properties, *Spondias*); SCURFIELD *c.s.* Austr. J. Bot. 22 (1974) 211–231 (silica, *Anacardium* and *Melanorrhoea*); OKANO *c.s.* Bull. Tokyo Univ. For. 67 (1975) 20–50 (*Campnosperma* wood); PURKAYASTHA *c.s.* Ind. For. Rec. n.s. 2, i (1976) 48 pp. (wood anatomy, Andaman Is.); DING HOU, Blumea 24 (1978) in the press (leaf epidermal papillae). — P. BAAS.

Phytochemistry. The chemical characters of *Anacardiaceae* were discussed more than 10 years ago in my 'Chemotaxonomie der Pflanzen' (vol. 3, 1964, 90–115, 631–632, 667).

The family yields many valuable products. Examples are: (a) important tanning materials such as sumac (= sumach = dried and ground leaves of several species of *Rhus*), quebracho (= heartwood extracts of species of *Schinopsis*) and Chinese galls (= very tannin-rich galls of *Rhus chinensis* MILL., syn. *R. semialata* MURR.); (b) mastic (an oleoresin obtained from *Pistacia lentiscus* L.; (c) the varnish producing latices of a number of so-called lacquer trees (*e.g. Rhus verniciflua* STOKES, syn. *R. vernicifera* DC.; and *Gluta usitata* (WALL.) DING HOU, syn. *Melanorrhoea usitata* WALL.); (d) cashew nut shell liquid from *Anacardium occidentale* L. which is used for the manufacture of plastic resins; (e) tropical fruits such as mango (*Mangifera indica* L.), hog-plum (*Spondias spp.*) and cashew apple (*Anacardium occidentale* L.); (f) edible seed kernels like cashew nuts (*Anacardium occidentale* L.) and pistachio nuts (*Pistacia vera* L.); (g) woods used for furniture and other purposes (*e.g.* species of *Campnosperma*, *Dracontomelon*, *Gluta*, *Koordersiodendron*, *Swintonia*). Phytochemical research was much stimulated by the manifold uses of members of the family and by the severe allergenic skin disease caused by species like poison ivy (*Rhus radicans* L.), poison sumac (*Rhus vernix* L.), poison oak (*Rhus diversiloba* TORR. & GRAY) and poison wood (*Metopium toxiferum* (L.) KRUG & URBAN), and various trees of several genera in Malesia known by the vernacular name *rengas*.

Formerly (1964) *Anacardiaceae* were chemically characterized as follows: (1) There is a strong tendency to deposit silicic acid in leaves, especially in *Mangifereae* and *Spondiadeae*. (2) The contents of the secretory canals occurring in the phloem of all species represent an outstanding feature; depending upon the taxa, these canals store mainly oleoresins (= essential oils + triterpenic resins; *e.g.* mastic) or latices containing mucilages, phenol oxidases (= laccases) and alkylated phenols. The technical and toxic properties of these latices are mainly governed by structural details of the predominating phenolic constituents; the strongly allergenic urushiols of the Japanese lacquer trees and of poison ivy are alkylated *o*-dihydroxyphenols. (3) There is a strong tendency to accumulate gallitannins in leaves, galls and barks and condensed tannins in heartwoods. (4) There is a tendency to produce 5-desoxyflavonoids (*e.g.* leucofisetinidine, fustin, fisetin, sulphuretin, robinetin, dihydrorobinetin) in heartwoods. (5) The flavonols kaempferol, puercetin and myricetin and the proanthocyanidins (formerly called leucoanthocyanidins) brocyanidin and prodelphinidin are common phenolics of leaves; the compounds with a trihydroxylated B-ring (myricetin, prodelphinidin), however, are possibly restricted to *Rhoeae*.

(6) Leaf juices of *Anacardiaceae* are very acid; quinic acid (mainly in young leaves) and shikimic acid contribute in a high degree to the acidity of the cell saps.

Recent phytochemical research added much to our knowledge of the chemistry of several tannins, of the triterpenic resins (*Mangifera indica* L., several species of *Pistacia*, *Schinus terebinthifolius* RADDI) and of mucilages (*Anacardium occidentale* L., species of *Lannea* and *Loxopterygium*, *Mangifera indica* L., latex of Japanese lacquer trees). M. GROSS *c.s.* (Phytochemistry 14, 1975, 2263) analyzed very carefully the urushiol fractions of several toxic American *Anacardiaceae*; they are mixtures of *o*-diphenolic compounds with straight C_{15} or C_{17} lateral chains; the compounds with di- to tetraenoic alkyle residues are much more toxic than those with saturated or mono-unsaturated lateral chains.

Totally new chemical constituents of *Anacardiaceae* are alkaloids and biflavonoids. S. R. JOHNS *c.s.* (Austr. J. Chem. 19, 1966, 1951) isolated an indolic alkaloid from the leaves of *Dracontomelon dao* (BLANCO) MERR. & ROLFE (syn. *D. mangiferum* BL.) and suggested that it is biogenetically related to canthinone and related rutaceous alkaloids. Biflavanones (*e.g.* rhusflavanone, succedaneaflavanone) and biflavones (*e.g.* agathisflavone, amentoflavone, hinokiflavone and robustaflavone) have been isolated from fruits and seeds of *Rhus succedanea* L. (L.-C. CHEN *c.s.* Phytochemistry 13, 1974, 276, 657, 1571, 1617; *ibid.* 14, 1975, 1644; J. C. S. Perkin I, 1976, 98) and *Semecarpus anacardium* L. *f.* (N. S. PRAKASA RAO & L. R. ROW, Phytochemistry 12, 1973, 671). Biflavonoids were formerly considered to be characteristic of Gymnosperms but were detected later in some *Anacardiaceae*, *Euphorbiaceae*, *Guttiferae* and in the genus *Viburnum*; hence they seem to be much more wide-spread than it was originally presumed.

Concluding it may be stated that much has been contributed since 1964 to our knowledge of the chemical characters of anacardiaceous plants. The detection of an indolic alkaloid and of biflavonoids implies that really new biochemical trends of *Anacardiaceae* became known in recent time. This does not add much to our understanding of the true affinities of the family, however, because all the presently known striking biochemical features of *Anacardiaceae* (hydrolizable and condensed tannins, triterpenoid resins, alkenylated phenols, 5-desoxyflavonoids, biflavonoids and canthinone-like indolic alkaloids) doubtlessly evolved more than once within Angiosperms. For tracing phylogenetic relationships between taxa of family rank and higher ranks such characters are of little value unless all facts needed for an unambiguous interpretation of their systematic meaning are available; this is not yet the case with the chemical characters of *Anacardiaceae*. — R. HEGNAUER.

Chromosomes. Chromosome numbers of about 50 species belonging to about 17 genera were reported with somatic numbers: 2n = 24, 28, 30, 32, 40, 48, 60, which clearly points to the occurrence of polyploidy. Of the following genera, which have their representatives (including cultivated ones) in Malesia, chromosome numbers have been recorded: *Anacardium* (2n = 40), *Lannea* (2n = 28, 30, 40), *Mangifera* (2n = 40), *Pistacia* (2n = 24, 28, 30), *Rhus* (incl. *Toxicodendron*) (2n = 30, once reported as 2n = 32), *Semecarpus* (2n = 60), and *Spondias* (2n = 32). In view of the economic importance of mango (*Mangifera indica*) it would be highly desirable to obtain information on chromosomes of the (indigenous) species from Malesia. Taking the family as a whole, more information on chromosomes is needed, especially for those taxa found in Indo-Malesia. — *Literature:* C. D. DARLINGTON & A. P. WYLIE, Chromosome Atlas of Flowering Plants, ed. 2 (1955) 198–199; A. A. FEDOROV (ed.), Chromosome Numbers of Flowering Plants (1969) 30; R. J. MOORE (ed.), Index to Plant Chromosome Numbers (1967–71), Regn. Veget. 90 (1973) 264–265.

Uses. *Anacardiaceae* produce some of the best known, economically important, tropical fruits, nuts and other products. For more detailed information, readers should consult the following publications: HEYNE, Nutt. Pl. (1927) 965–981; BURKILL, Dict. (1935); H. R. SWEET & F. A. BARKLEY, Bull. Mo. Bot. Gard. 24 (1936) 216–229; W. H. BROWN, Useful Pl. Philip. 2 (1950) 331–353; QUISUMBING, Medic. Pl. Philip. (1951) 535–546.

Fruits and nuts. The renowned *Mangifera indica* (mango), *Spondias cytherea* (hog-plum) and *Anacardium occidentale* (cashew-nut) are widely cultivated in the tropics. *Pistacia vera* L. (pistachio nut or green almond) is grown in the Mediterranean region, especially in Sicily. There are also others cultivated locally in Malesia for their edible fruits: *Mangifera caesia*, *M. foetida*, and *M. odorata*; *Spondias pinnata* and *S. purpurea*; *Bouea macrophylla*, and *Dracontomelon spp.*

Timber. In Malesia some species of *Dracontomelon, Swintonia, Gluta, Buchanania, Campnosperma,* and *Koordersiodendron* can grow into big trees. The heartwood of some of these species is hard, durable, excellent for furniture, building, *etc.* Planks or boards of these timbers have irregular, beautiful, black markings. It is desirable and urgently needed to do research to find some means to remove the irritant sap, so one can safely handle and use these valuable timbers. *Cf.* FOXWORTHY, Mal. For. Rec. 3 (1927) 140–144, photogr.; DESCH, *ibid.* 15 (1957) 6–29, photogr.; LOMIBAO & MENIADO, Forpride Digest 3 (1974) 69–70.

Lacquers. The Oriental lacquer is economically important in China and Japan; it is a natural product obtained from the resinous sap of *Rhus verniciflua* STOKES and *R. succedanea.* The Burmese lacquer is the product of *Gluta usitata* (WALL.) DING HOU (syn. *Melanorrhoea usitata* WALL.).

Tannins. The South Americans pecies of *Schinopsis,* especially *S. quebracho-colorado* (SCHLECHT.) BARKLEY & MEYER is one of the world's most important sources of tannin (*cf.* BARKLEY, Proc. Iraq. Sc. Soc. 5, 1962, 44–69). Tannins are also obtained from some members of *Rhus*: *R. coriaria* L. (Sicilian sumac); *R. glabra* L., *R. typhina* L. and *R. copallina* L. (American sumac); and *R. chinensis* (using the nut-galls).

Other minor uses. There are some further miscellaneous uses of bark, leaves, flowers, kernels, *etc.* which are in local use as medicine, vegetable, food, *etc.* There are also some other economic products (oils, dyes, varnishes, gums, *etc.*) which are used only on a limited scale and for local consumption. See for these under the species.

Dermatitis. *Anacardiaceae* have usually secretory ducts in both vegetative and reproductive parts. The resinous liquid substance is colourless or pale yellow and clear, more rarely thick and greyish brown, hardening and turning black when exposed to the air. Fig. 22, 57h. In some species this resinous sap is mild and causes only a slight itching of the skin on contact, but in others the irritant sap is of a powerfully caustic nature and blisters the skin. The poisonous quality varies with the species. The susceptibility to such resinous sap varies according to the sensitivity of the person involved. Even eating mango fruit may cause mild skin-itching in very susceptible persons.

In the temperate zone the poisonous qualities are best known from species of *Rhus* in North America, the so-called *poison ivies* and *poison oaks.* Also in Malesia *Rhus spp.* may contain poisonous qualities, *e.g. R. succedanea.*

Similarly or even more dangerous trees are found in the Malesian tropics where they are known under the collective name *rengas*; they belong to the following genera: *Gluta* (incl. *Melanorrhoea*), *Melanochyla, Semecarpus,* and *Swintonia.* See discussion by BURKILL, Dict. (1935) 1435–1437.

The poisonous constituent of the resinous sap is volatile and will gradually disappear. For this reason timber of *rengas* trees must be dried and exposed for several years as it is otherwise dangerous to handle. Lacquered articles or furniture made from dried timber just mentioned may be still toxic to persons who are especially susceptible (*cf.* O. AMES, J. Arn. Arb. 12, 1931, 1–3, t. 27).

In the lowland forests in Malesia *rengas* trees are common and it is important that one should be able to recognize such trees. It is undesirable to shelter under a *rengas* tree during a tropical shower, because raindrops may carry the poison from the leaves (*cf.* CORNER, Ways. Trees, 1940, 116). CORNER commented on recognition of *rengas* trees in the field "that the inner bark of all *rengas* trees is bright pinkish or reddish brown, in contrast with the white sapwood; and on the surface of the trunk and the limbs there are nearly always a few black stains where the sap has oozed out and darkened. These stains are the surest guide to the recognition of the trees. Black lines may also be seen in the freshly cut sapwood or just beneath the bark and, if the bark has been extensively injured some hours or days previously, the wound will be covered with a pitch-black smear. In a few species the sap darkens quickly but in most it takes about half an hour." CORNER added that "it is doubtful whether animals suffer from the poison; monkeys and squirrels appear to be immune, for they will eat the *rengas* fruits; and certain kinds of insects feed on sap, their bodies becoming lacquered."

RIDLEY (Disp. 1930, 270–271) quoted from a report that once two whole companies of a military expedition were affected by serious injuries to the feet caused by wading across rivers which had fallen *rengas* fruits in the water.

The volatile poisonous substance, a hitherto unidentified aromatic compound, may be conveyed to some distance by the smoke and flakes of burning material, or by saw dust, of the *Anacardiaceae*. The fumes arising from the roasting cashew-nuts are very irritating (*cf.* R. N. CHOPRA *c.s.* Poisonous Plants of India ed. 2, 1, 1965, 270–282). It has occurred that inhaling smoke around camp-fires of careless wood-cutters in Borneo had fatal results; this is fortunately rare as native peoples are usually aware of the danger involved with *rengas* trees.

I witnessed victims of *rengas* poisoning during my field trip on *Anacardiaceae* to Malesia and Singapore in 1966. One collector, who chopped down a tree (*c.* 15 m tall) of *Semecarpus bunburyanus* on Mt Kinabalu for obtaining fruiting material, and another, who in Malaya climbed a low-branched tree of *Swintonia spicifera* to collect specimens, had painful effects of itching, or a swollen face, ears and eyes. I was with them there preparing the collections; fortunately, I was not affected.

A surveyor of a timber company in Sarawak had inflamed arms and legs and suffered painful itching when he came back from his work in the forest. It was found that he wore short-sleeved shirt and shorts, and incidentally had touched the wet leaves of young *Melanochyla* plants.

In Malaya, I met persons who said that they would not be affected by the *rengas* sap. One labourer was felling a (big) tree of *Gluta wallichii*; he posed for a photograph to show that he was immune (fig. 21).

The remedy for the sap-poison is to apply weak solutions of mild alkali or active reducing agents, such as formalin, sulphites, 'hypo', or 'potash' (CORNER, Ways. Trees, 1940, 117), or using antihistamine tablets or injections followed by medical advice (VAN ROYEN, Man. For. Trees Papua New Guinea 4, 1964, 3). If one has severe reaction on contact with the poisonous plants, it is advisable to see a doctor.

Mr. ANTA, one of the excellent Indonesian professional collectors of Herbarium Bogoriense severely suffered from *rengas* poisoning on hands and arms when returning from an expedition to New Guinea. At the advice of the dermatologist Professor VERBUNT, at Djakarta, he was efficiently cured by bathing his blistered hands in a weak solution of tannin (crystals of which can be had cheaply from any druggist) for some 5–10 minutes each day and later less frequently. Mr. ANTA experienced also that new outbreaks could be expected after many months (even a year), but could be immediately suppressed in this way; on later expeditions he always carried tannin crystals in his outfit (comm. VAN STEENIS).

Identification of Anacardiaceae

In the field and especially in the herbarium *Anacardiaceae* can be spotted by black spots where twigs are cut, scars of flowers, fruits, twigs, or leaves, and other bruised places, which result from coagulated and blackened resin which is characteristic for the family.

As collections are mostly either in flower or in fruit, two keys have been offered for identification of the genera. Fertile material can in this way fairly easily be named to the genus.

With incomplete material identification is more difficult, *e.g.* with very young fruit, or flowers with one sex only, and especially with sterile material. For this reason some additional information is provided in three lists of spotting characters which may be helpful to facilitate identification of inadequate material.

I. Vegetative characters

(1) Deciduous habit occurs in *spp.* of 6. *Gluta*, 10. *Lannea*, 21. *Parishia*, 17. *Pentaspadon*, 20. *Rhus*, 11. *Spondias*.
(2) A true climbing habit is only peculiar to 13. *Pegia*.
(3) Hemi-epiphytes occur in *spp.* of the genera 20. *Rhus*, 15. *Semecarpus*, 11. *Spondias philippinensis*.
(4) Twigs inhabited by ants in 19. *Euroschinus* and 15. *Semecarpus*.
(5) Leaves simple, decussate: 7. *Bouea*.
(6) Leaves always simple, spirally arranged: 3. *Anacardium*, 2. *Androtium*, 1. *Buchanania*, 18. *Campnosperma*, 16. *Drimycarpus*, 6. *Gluta*, 4. *Mangifera*, 14. *Melanochyla*, 20. *Rhus borneensis*, 15. *Semecarpus*, 5. *Swintonia*.

(7) Leaves always compound (incl. unifoliolate): 8. *Dracontomelon*, 19. *Euroschinus*, 12. *Koordersiodendron*, 10. *Lannea*, 21. *Parishia*, 13. *Pegia*, 17. *Pentaspadon*, 22. *Pistacia*, 9. *Pleiogynium*, 20. *Rhus* (except *R. borneensis*, several *spp.* also unifoliolate), 11. *Spondias*.
(8) Inter-nerval veins are found *e.g.* in *spp.* of 1. *Buchanania* and 16. *Drimycarpus*.
(9) A marginal nerve is found in 5. *Swintonia*, 16. *Drimycarpus*, and intramarginal veins occur in 11. *Spondias* (except *S. philippinensis*).
(10) Stellate hairs occur in 10. *Lannea* (this deciduous tree produces also often large masses of white, hardening exudate of gum) and some *spp.* of 15. *Semecarpus*.
(11) Leaves unifoliolate or trifoliolate: 20. *Rhus, p.p.*
(12) Leaflets crenate-dentate, tomentose on the lower surface: 20. *Rhus chinensis*.
(13) Leaflets (3–)5–6(–8) pairs, the terminal one usually very small, reduced or not developed, or obscure (the leaf paripinnate): 19. *Euroschinus*.
(14) Leaves with hair-like fibers shown upon breaking: 4. *Mangifera spp.*
(15) Lower surface of leaves (all simple) with distinct papillae: most *spp.* of 14. *Melanochyla*, 15. *Semecarpus*, 16. *Drimycarpus*, and some *spp.* of 5. *Swintonia*.
(16) Lower surface of leaves with dense or sparse, peltate, or lobed, red-centered scales: 18. *Campnosperma, p.p.*
(17) Lower surface of leaves or leaflets with hairy or glabrous domatia: some *spp.* of 8. *Dracontomelon*, 13. *Pegia*, 17. *Pentaspadon*, 9. *Pleiogynium*, 20. *Rhus*.
(18) Veins not reticulate; no areolae: 20. *Rhus*.

II. Flowering characters

(1) Calyx calyptriform: 6. *Gluta*.
(2) Petals valvate: 15. *Semecarpus spp.*, 11. *Spondias*.
(3) Petals villous or woolly on the inner surface; filaments villous: 14. *Melanochyla*.
(4) Petals with thickened glandular ridge(s) on the inner surfaces: most *spp.* of 4. *Mangifera*.
(5) Petals 0: 22. *Pistacia*.
(6) Stamens 20–∞: most *spp.* of 6. *Gluta*.
(7) Stamens unequal, usually 1 or 2 much stouter and longer than the others: 3. *Anacardium* and most *spp.* of 4. *Mangifera*.
(8) Ovary apocarpous, carpels 4–6, free; leaves simple: 2. *Androtium*, 1. *Buchanania*.
(9) Carpels 5, connate at the apex and base; leaves imparipinnate: 8. *Dracontomelon*.
(10) Disk usually hairy. (Leaf simple, lower surface usually distinctly papillose): 15. *Semecarpus*.

III. Characters of fruits and seeds

(1) Fruit seated on a fleshy hypocarp formed by the enlarged disk, calyx, and floral axis: 3. *Anacardium*, 15. *Semecarpus*.
(2) Fruit with dense, rusty-hairy processes (insect-gall-like): 14. *Melanochyla, M. fulvinervis*.
(3) Fruit crowned with persistent floral parts and developed from an inferior ovary: 16. *Drimycarpus*.
(4) Fruit with (much) enlarged (wing-like) calyx lobes: 21. *Parishia*.
(5) Fruit with (much) enlarged (wing-like) petals: 6. *Gluta, p.p.*, 5. *Swintonia*.
(6) Fruit more than 5 cm ∅, with a rather thick layer of pulp and a one-celled stone: 4. *Mangifera, p.p.*
(7) Fruit with 5–12 scars or bases of styles at the middle or at the upper half on its surface; 5–12-celled: 8. *Dracontomelon*, 9. *Pleiogynium*.
(8) Fruit 1–5-celled; endocarp (stone) hard, each cell covered with an operculum: 8. *Dracontomelon*, 10. *Lannea*.
(9) Fruit ± oblong, *c.* 1 by $^1/_2$ cm, the scar of the style or its base on one side at the upper $^1/_3$: 11. *Spondias, S. philippinensis*.
(10) Fruit 5- or 4-celled; endocarp 5- or 4-lobed, each lobe usually with irregular processes: 11. *Spondias, p.p.*
(11) Fruit 5- or 4-celled, with interlocular cavities shown on a medium, transection: 11. *Spondias, p.p.*

(12) Fruit incompletely 2-celled, with a seed curved around the incomplete septum: 18. *Campnosperma.*
(13) Cotyledons in a greater or lesser degree united: 6. *Gluta, p.p.*
(14) Seed labyrinthine (testa present in the crevices of lobes or folds of cotyledons): 4. *Mangifera, p.p.*

KEY TO THE GENERA

Based on flowering material

1. Inflorescences appearing before leaves or accompanied by some young ones (specimens collected from deciduous trees sometimes only consisting of bare inflorescences).
2. Calyx calyptriform. Stamens ∞ . . . . . **6. Gluta**
2. Calyx distinctly 4-lobed.
3. Stamens or staminodes 8 . . . . . **10. Lannea**
3. Stamens or staminodes 4 . . . . . **21. Parishia**
1. Inflorescences appearing at the same time as the leaves or accompanied by leaves.
4. Leaves simple.
5. Leaves decussate. . . . . **7. Bouea**
5. Leaves spiral, alternate, or sometimes subverticillate.
6. Calyx calyptriform, at anthesis breaking away transversally at the base, often also bursting and opening irregularly, or splitting on one side . . . . . **6. Gluta**
6. Calyx distinctly 5- or 4-lobed.
7. Petals villous or woolly on the inner surface. Stamens with villous filaments . **14. Melanochyla**
7. Petals not villous or woolly on the inner surface, often glabrous, sometimes with thickened glandular ridges (*Mangifera*), or puberulous on the inner surface. Stamens with glabrous or very rarely papillose filaments.
8. Carpels 4–6, free. Stamens usually 10, all fertile.
9. Anther cells not separate, dehiscing latrorse; connective not prolonged . . **1. Buchanania**
9. Anther cells separate, dehiscing introrse; connective prolonged, dilated and apically 2-lobed **2. Androtium**
8. Carpels 1–3, united into a 1- or imperfectly 2-celled ovary. Stamens usually 5, sometimes 6–10 (–12, *extra*-Mal.).
10. Stamens 6–10(–12), one to all of them fertile.
11. Flowers bisexual. Stamens 6–10, almost all equal in length and fertile. Ovary imperfectly 2-celled. Leaves often with dense or sparse, minute, peltate or lobed scales on both surfaces **18. Campnosperma**
11. Flowers ♂ and bisexual. Stamens (7–)10, unequal, 1–5 (rarely more) fertile. Ovary 1-celled. Leaves without the scales like above.
12. Petals narrow-lanceolate to linear, 7–15 mm long. Leaves without hair-like fibers shown upon breaking . . . . . **3. Anacardium**
12. Petals elliptic or elliptic-oblong, oblong or oblanceolate, $4^1/_2$–6 mm long. Leaves with hair-like fibers shown upon breaking. . . . . **4. Mangifera**
10. Stamens 5, one to all of them fertile.
13. Disk short-cupular, pulvinate, or stipe-like, distinct or obsolete, or consisting of 5 gland-like lobes and confluent with the base of filaments. Ovary with 1 style and/or 1 stigma.
14. Petals often with thickened glandular ridges on the inner surface. Stamens unequal, usually only 1 (rarely more) fertile (but all fertile in *M. superba*) . . . . . **4. Mangifera**
14. Petals without such glandular ridges on the inner surface. Stamens equal and all fertile **5. Swintonia**
13. Disk usually round, flat or slightly concave above, rarely short-cupular. Ovary with 3 styles and/or 3 stigmas (except 1 style and 1 stigma in *Drimycarpus*).
15. Disk usually hairy; rudimentary pistil very small or 0 in ♂. Ovary usually hairy. Leaf beneath often papillose . . . . . **15. Semecarpus**
15. Disk glabrous; rudimentary pistil distinct in ♂. Ovary glabrous. Leaf beneath not papillose, or rarely with rather compact papillae in *Drimycarpus*.
16. Petiole 0–$^1/_2$ cm. ♀ Flower with a superior ovary . . . . . **20. Rhus**
16. Petiole $1^1/_2$–$2^1/_2$ cm. ♀ Flower with an inferior ovary . . . . . **16. Drimycarpus**
4. Leaves compound: uni- or trifoliolate, or imparipinnate, very rarely pseudoparipinnate or paripinnate.
17. Flowers with one perianth whorl . . . . . **22. Pistacia**
17. Flowers with distinct calyx and petals.
18. Stamens or staminodes the same number as the petals (4 or 5).
19. Flowers 4-merous. Disk hairy. Calyx accrescent . . . . . **21. Parishia**
19. Flowers 5-merous. Disk glabrous. Calyx not accrescent . . . . . **20. Rhus**
18. Stamens or staminodes twice the number as the petals (8 or 10).
20. Petals valvate. Leaflets with a distinct, continuous, intra-marginal vein (except *S. philippinensis*) **11. Spondias**

20. Petals imbricate, at least at the apex. Leaflets without such intra-marginal vein.
21. Ovary 1-celled.
22. Terminal leaflet similar to the lateral ones. Stamens 10: 5 fertile and 5 staminodes. Ovary hairy **17. Pentaspadon**
22. Terminal leaflet usually very small, reduced or not developed. Stamens in ♂ or bisexual flowers 10, all fertile. Ovary glabrous . . . . . **19. Euroschinus**
21. Ovary 5–12-celled.
23. Leaflets 10–16 pairs, without domatia. (Ovary with incompletely connate carpels) **12. Koordersiodendron**
23. Leaflets (1–)3–9 pairs, often with hairy domatia (except *Dracontomelon costatum*).
24. Ovary with incompletely connate carpels. Petals 4–10 mm long . . . **8. Dracontomelon**
24. Ovary with completely connate carpels. Petals smaller, $1^1/_4$–3 mm long.
25. Climbers. Disk *c.* 1 mm ∅. Stamens $^3/_4$–1 mm . . . . . **13. Pegia**
25. Trees. Disk $1^1/_2$–$1^3/_4$ mm ∅. Stamens 2–3 mm . . . . . **9. Pleiogynium**

KEY TO THE GENERA

Based on fruiting material

1. Leaves simple.
2. Leaves decussate . . . . . **7. Bouea**
2. Leaves spiral or alternate.
3. Calyx caducous, calyptriform. Petals caducous, or persistent and enlarged (wing-like) in fruit **6. Gluta**
3. Calyx persistent (except in some specimens of *Buchanania*), distinctly 4- or 5-lobed.
4. Fruit developed from an inferior ovary and crowned with persistent floral parts . **16. Drimycarpus**
4. Ovary and fruit superior and subtained by the persistent floral parts.
5. Petals persistent, usually (much) enlarged, wing-like, and reflexed in fruit . . . . . **5. Swintonia**
5. Petals usually caducous and not enlarged in fruit.
6. Fruit with a distinct or conspicuous hypocarp.
7. Leaf lower surface not papillose. Fruits reniform . . . . . **3. Anacardium**
7. Leaf lower surface often papillose. Fruits not reniform . . . . . **15. Semecarpus**
6. Fruit without a hypocarp.
8. Fruits incompletely 2-celled. Seed curved. Leaves usually with dense or sparse, minute, peltate or lobed scales on both surfaces . . . . . **18. Campnosperma**
8. Fruits 1-celled. Seed or embryo (if testa confluent with endocarp) straight. Leaves without scales like above.
9. Fruit with 3–5 stigmas or vestiges of undeveloped carpels close to one side at the base **1. Buchanania, 2. Androtium**
9. Fruit without stigmas or such vestiges of undeveloped carpels.
10. Fruits subglobose, $^1/_2$–$^2/_3$ cm ∅ . . . . . **20. Rhus**
10. Fruits larger, usually longer than wide; if globose or subglobose then (1–)$2^1/_2$ or more cm ∅.
11. Fruits glabrous; flesh juicy and without black varnish. Leaves glabrous, not papillose beneath . . . . . **4. Mangifera**
11. Fruits hairy; flesh thin and full of black varnish. Leaves often hairy and/or papillose beneath in most species . . . . . **14. Melanochyla**

1. Leaves compound, usually imparipinnate, sometimes tri- or unifoliolate, rarely pseudoparipinnate or paripinnate.
12. Leaflets with a distinct, continuous, intra-marginal vein . . . . . **11. Spondias**
12. Leaflets without such intra-marginal vein.
13. Calyx (much) enlarged and lobes wing-like in fruit . . . . . **21. Parishia**
13. Calyx not enlarged in fruit.
14. Lower surface of leaflets with domatia.
15. Domatia not hairy, each of them like a pit or cavity. Fruits obliquely subglobose, less than 1 cm ∅ . . . . . **20. Rhus**
15. Domatia hairy, each of them consisting of a tuft of hairs.
16. Climbers. Fruits broad-ellipsoid or slightly reniform, $1^1/_4$–$1^1/_2$ by *c.* $^4/_5$ cm; flesh full of black varnish . . . . . **13. Pegia**
16. Trees.
17. Fruits 1-celled; endocarp coriaceous, not hard . . . . . **17. Pentaspadon**
17. Fruits 5–12-celled; endocarp woody and hard.
18. Endocarp with an operculum covering each cell . . . . . **8. Dracontomelon**
18. Endocarp without such opercula . . . . . **9. Pleiogynium**
14. Lower surface of leaflets without domatia.
19. Leaflets usually 10–16 pairs. Fruits broad-ellipsoid, obtuse at both ends, $2^1/_2$–4 by $1^1/_2$–$2^1/_2$ cm **12. Koordersiodendron**
19. Leaflets usually 2–7 pairs, sometimes tri- or unifoliolate.
20. Endocarp with 1 (or 2) distinct operculum (opercula) at the apical end.

21. Fruits *c.* 1 cm long. Seed reniform. Young twigs, leaflets, and inflorescences with stellate hairs **10. Lannea**
21. Fruits larger, 2–2½ cm long. Seed oblong. Young twigs, leaflets, and inflorescences with simple hairs . . . . . **8. Dracontomelon**
20. Endocarp without distinct operculum (opercula).
22. Fruits scurfy outside, lanceolate, 2½ by 1 cm. Leaflets velutinous on the lower surface **17. Pentaspadon**
22. Fruits glabrous, variously shaped but not lanceolate, less than 1½ by ⅔ cm.
23. Fruits ± oblong, or obliquely broad-ellipsoid; style or its scar excentric.
24. Fruit with style or its scar on one side at the upper ⅓. Terminal leaflet similar to the lateral ones . . . . . **11. Spondias**
24. Fruit with style or its scar lateral at the apical end. Terminal leaflet usually very small, reduced, or not developed . . . . . **19. Euroschinus**
23. Fruits obliquely subglobose, or globose; style or its scar terminal.
25. Leaves distinctly imparipinnate, tri- or unifoliolate. Endocarp free from exocarp and mesocarp when ripe . . . . . **20. Rhus**
25. Leaves pseudoparipinnate or paripinnate. Endocarp united with exocarp and mesocarp when ripe . . . . . **22. Pistacia**

1. BUCHANANIA

SPRENG. in Schrader, J. Bot. (1800) 2 (1801) 234; ROXB. Pl. Corom. 3 (1819) 58; KUNTH, Ann. Sc. Nat. Bot. 2 (1824) 338; HOOK. *f.* in B. & H. Gen. Pl. 1 (1862) 421; MARCH. Rév. Anacard. (1869) 116 & 191; ENGL. in DC. Mon. Phan. 4 (1883) 179; DING HOU, Blumea 24 (1978) 4. — *Coniogeton* BL. Bijdr. (1826) 1156. — **Fig. 3–5.**

Trees. *Leaves* spiral, simple, subcoriaceous, entire, petioled or sessile, mostly with internerval vein(s). *Inflorescences* axillary (also terminal?), paniculate. *Flowers* bisexual. *Calyx* 5-(rarely 4- or 6-)lobed, persistent or caducous. *Petals* 5 (rarely 4 or 6), imbricate, glabrous. *Stamens* twice the number of petals; filaments subulate, glabrous (except papillose in *B. sessifolia*); anthers basifixed, lanceolate or oblong, sagittate in most of the species. *Disk* shortly cupular, usually sulcate outside (impressions of the filaments), upper margin crenulate. *Carpels* 4–6, free, each 1-ovuled, usually only one fertile. *Ovary* ellipsoid, hairy or glabrous; style short; stigma oblique, truncate; sterile carpels smaller. *Drupe* 1-celled, often with an undeveloped seed; stone thick, woody or bony. *Seed* with testa free from the endocarp; cotyledons free, plano-convex.

Distr. About 25 *spp.*, distributed in tropical Asia, Malesia, Australia, Micronesia, Melanesia, and Polynesia (Samoa).

Ecol. In primary forests, on dryland, temporarily inundated areas, or in peat-swamps, sometimes in secondary forest or on limestone hills; mainly in the lowland, up to *c.* 600 m.

Nomencl. BUCHANAN (Asiatick Researches 5, 1798, 123–126), in his "Description of the tree called, by the Burmese, Launzan", gave a detailed Latin description for the plant and stated: "I believe it will be found to constitute a new genus; but I do not venture to give it a name, till the European botanists have ascertained, whether or not it be reducible to any known genus of plants". *Launzan* was evaluated two years later by SPRENGEL *l.c.* who based himself on BUCHANAN's description and named this tree *Buchanania lanzan*.

The vernacular name *launzan* was listed by Index Kewensis in the synonymy of *Buchanania*. BARKLEY (Am. Midl. Nat. 28, 1942, 474; Lloydia 2, 1957, 265) proposed to conserve the generic name *Buchanania* over *Launzan*, but this is clearly unnecessary; *cf.* BACK. & BAKH. *f.* Fl. Java 2 (1965) 147.

Uses. The wood of some species is used for light construction, interior finishing, household implements, canoes (Papua), *etc.* (*cf.* VAN ROYEN, Man. For. Trees Papua New Guinea 4, 1964, 9 & 13; LOMIBAO & MENIADO, Forpride Digest 3, 1974, 69).

KEY TO THE SPECIES

Based on flowering material

1. Anthers not versatile, not sagittate (thecae connate at the base). Leaves reticulately veined. *Ser. Adnatae.*

2. Leaves 8–25 by 3–8 cm; apex acuminate, rarely short-acuminate. Pedicels articulated **1. B. splendens**
2. Leaves $3^1/_2$–$10^1/_2$ by $2^1/_4$–$4^3/_4$ cm; apex obtuse, sometimes emarginate. Pedicels not articulated **2. B. microphylla**

1. Anthers versatile, sagittate (thecae separate at the base). Veins reticulate-scalariform (also reticulate in *B. arborescens*). *Ser. Sagittatae.*
3. Filaments bicoloured, contracted and whitish at the apical part (*c.* $^1/_5$ of the length).
4. Flowers $^3/_4$–4 mm pedicelled.
5. Leaf apex short-acuminate or acuminate; blade 9–40 by 3–$12^1/_2$ cm, veins reticulate-scalariform. Pedicels articulated, $^3/_4$–2 mm . . . . . **3. B. insignis**
5. Leaf apex usually obtuse or rounded, rarely apiculate, acute, acuminate, or emarginate; blade $4^1/_2$–26(–35) by $1^3/_4$–7(–9) cm; veins reticulate or reticulate-scalariform. Pedicels usually not articulated, (1–)2–4 mm . . . . . **4. B. arborescens**
4. Flowers sessile, articulated at the base. Leaf apex usually obtuse or rounded, rarely apiculate, acute, acuminate or emarginate, (12–)26–80 by ($4^1/_2$–)$6^1/_2$–16 cm; veins reticulate-scalariform.
6. Petiole usually 0 or very short (*c.* $^1/_2$ cm) . . . . . **5. B. amboinensis**
6. Petiole distinct, ($1^1/_2$–)3–6 cm . . . . . **6. B. macrocarpa**
3. Filaments concolorous, gradually narrowed towards the apex and not whitish at the apical part.
7. Filaments smooth. Leaves oblanceolate to narrowly oblanceolate, (16–)30–80 by (5–)$6^1/_2$–16 cm; petiole distinct, 2–3(–6) cm . . . . . **7. B. nitida**
7. Filaments papillose. Leaves smaller, obovate-oblong, oblanceolate or spathulate, $7^1/_2$–31 by 4–$10^1/_2$ cm; petiole usually 0, sometimes up to $1^1/_2$(–3) cm . . . . . **8. B. sessifolia**

KEY TO THE SPECIES

Based on fruiting material

1. Leaf apex acuminate or short-acuminate, rarely apiculate, obtuse, or emarginate.
2. Leaves usually sessile, sometimes with a petiole up to $1^1/_2$(–3) cm. Fruits obliquely subobcordate, 10–13 by 8–11 mm, slightly longer than wide . . . . . **8. B. sessifolia**
2. Leaves distinctly petioled; petiole $^1/_2$–4(–6) cm. Fruits sublentiform, 7–12 mm ∅.
3. Leaf veins reticulate-scalariform.
4. Leaves (16–)30–80 by (5–)$6^1/_2$–16 cm; nerves 31–52 pairs. Fruits *c.* $12^1/_2$ mm ∅. Calyx usually persistent. Pedicels usually not articulated or articulation obscure . . . . . **7. B. nitida**
4. Leaves 9–40 by 3–$12^1/_2$ cm; nerves 10–25 pairs. Fruits 7–10 mm ∅. Calyx caducous. Pedicels distinctly articulated . . . . . **3. B. insignis**
3. Leaf veins reticulate; nerves 8–13 pairs. Fruits *c.* 11 mm ∅. Calyx caducous. Articulation of pedicels obscure . . . . . **1. B. splendens**

1. Leaf apex usually obtuse or rounded, rarely apiculate, acute, acuminate, or emarginate.
5. Fruits distinctly pedicelled, usually not articulated at base. Leaves $3^1/_2$–26(–35) by $1^3/_4$–7(–9) cm; nerves 7–18(–30) pairs.
6. Remaining stamens (if they can be found at the base of fruit) with anthers not versatile, not sagittate (thecae connate at the base) . . . . . **2. B. microphylla**
6. Remaining stamens with anthers versatile, sagittate (thecae separate at the base) . **4. B. arborescens**
5. Fruits sessile, articulated at base. Leaves (large) (12–)26–80 by ($4^1/_2$–)$6^1/_2$–$16^1/_4$ cm; nerves 14–27 pairs.
7. Petiole 0 or very short (*c.* $^1/_2$ cm). Fruits 8–11 mm ∅ . . . . . **5. B. amboinensis**
7. Petiole distinct, ($1^1/_2$–)3–6 cm. Fruits larger, 16–21 mm ∅ . . . . . **6. B. macrocarpa**

1. Buchanania splendens MIQ. Sum. (1861) 524. — *B. platyneura* KURZ, J. As. Soc. Beng. 46, ii (1876) 125; KING, *ibid.* 65, ii (1896) 462. — *B. fragrans* RIDL. Kew Bull. (1933) 195, *incl. var. oblanceolata* RIDL.

Tree up to 30 m. *Leaves* elliptic-lanceolate, ovate-oblong, or oblanceolate, 8–25 by 3–8 cm, slightly hairy on both surfaces when young, glabrescent, and sometimes seemingly glabrous on older ones; base cuneate; apex acuminate, rarely short-acuminate; nerves 8–13 pairs; veins reticulate; petiole $^1/_2$–3 cm. *Panicles* $6^1/_2$–10 cm long, hairy, glabrescent; bracts $^2/_3$–1 mm long, hairy outside; pedicels 1–$1^1/_2$ mm, articulated, articulation obscure in fruit. *Flowers* white. *Calyx* caducous, lobes triangular, *c.* $^2/_3$ mm long, puberulous outside. *Petals* elliptic-oblong, 2–$3^1/_2$ by $1^1/_4$–$1^1/_2$ mm. *Stamens* $1^1/_2$–$2^1/_2$ mm; filaments 1–$1^3/_4$ mm, not contracted and whitish in apical part; anthers $^1/_2$–$^2/_3$ mm, not sagittate. *Disk* $^2/_3$ mm long. *Carpels* $1^1/_4$ mm long. *Drupe* sublentiform, *c.* 11 mm ∅.

Distr. Andaman and Nicobar Is., and in *Malesia:* Sumatra (Asahan, Bencoolen, Simalur) and Borneo (SE. Borneo: Martapura; Sabah: Lahad Datu; Sarawak: Kuching).

Ecol. Lowland forest up to 150 m, once on ultrabasic ridge in secondary forest. *Fl.* Jan.–May, Aug., Dec.; *fr.* March, May.

Vern. Sumatra: *awa bonan bonan, bonan-bonan-pajo, bona ètěn, tutun bonan,* Simalur; Borneo: *djingah burung,* Martapura, *hajawak gunung,* Pleihari.

2. Buchanania microphylla ENGL. in DC. Mon. Phan. 4 (1883) 185; VIDAL, Phan. Cuming. (1885) 106; Rev. Pl. Vasc. Filip. (1886) 100; PERK. Fragm. Fl. Philip. (1904) 24; MERR. En. Philip. 2 (1923) 466; LOMIBAO & MENIADO, Forpride Digest 3 (1974)

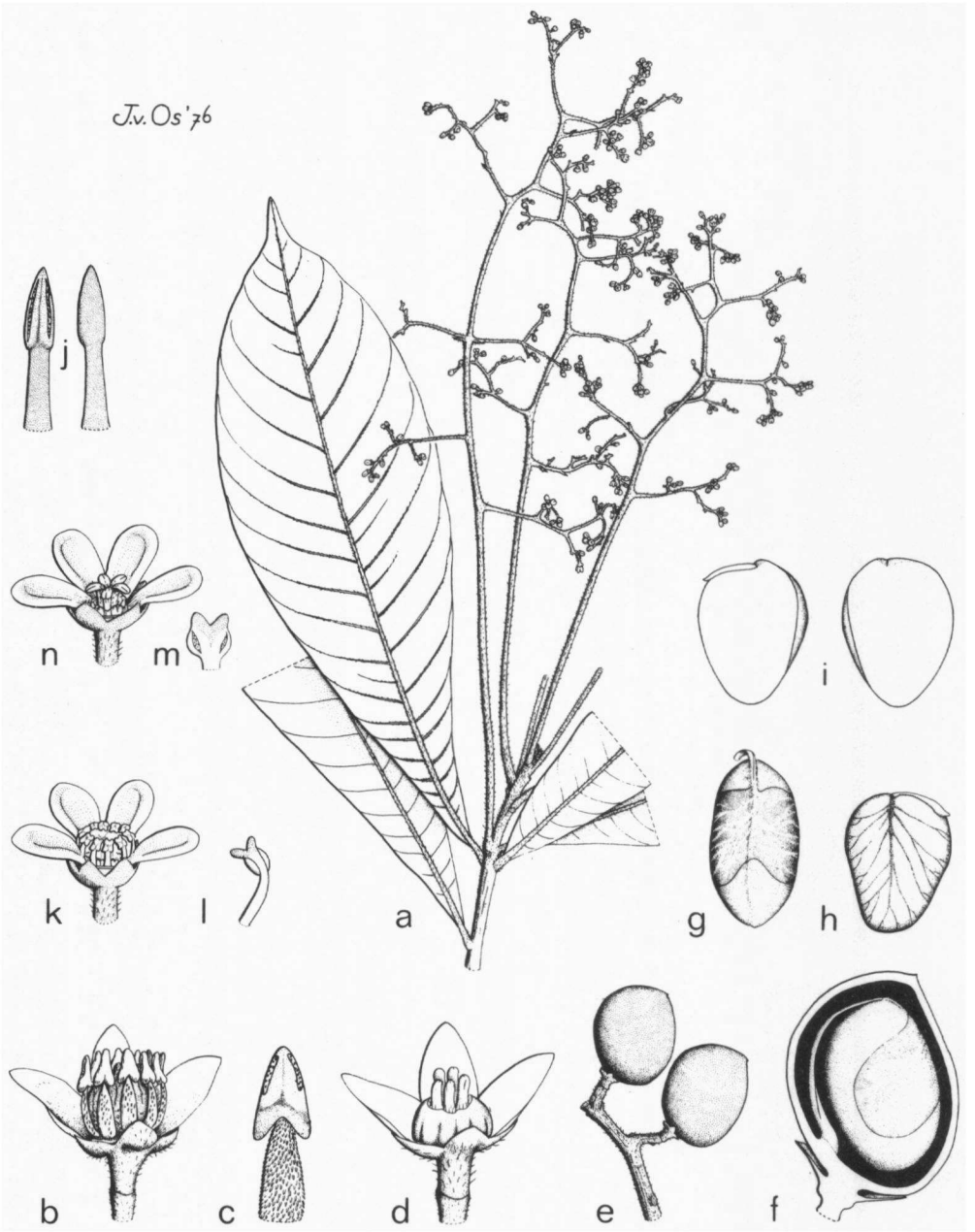

Fig. 3. *Buchanania sessifolia* BL. *a*. Habit, × ½, *b*. flower, 2 petals removed, × 7, *c*. stamen, with papillose filament, × 14, *d*. flower, 2 petals and all stamens removed, × 7, *e*. fruits, × 2, *f*. fruit, half of pericarp removed showing seed, *g*. seed, viewed from raphe side, *h*. embryo, side view, *i*. *ditto*, opened out, all × 3½. — *B. microphylla* ENGL. *j*. Stamens, × 14. — *Androtium astylum* STAPF. *k*. Flower, 1 petal removed, × 7, *l*. stamen, side view, × 14, *m*. apical part of stamen, inner face view, × 14, *n*. flower with 1 petal and all stamens removed, × 7 (*a–d* SAN 40540, *e–i* SAN 38391, *j* BS 44652, *k–n* J. A. R. ANDERSON 4313).

69 (*sphalm.* '*T. macrophylla*'); DING HOU, Blumea 24 (1978) 4. — Fig. 3j.

Tree. *Leaves* elliptic, elliptic-oblong, broad elliptic, rarely obovate, $3^1/_2$–$10^1/_2$ by $2^1/_4$–$4^3/_4$ cm, slightly hairy towards the basal part especially on the midrib on both surfaces, glabrescent; base acute or cuneate; apex obtuse, sometimes emarginate; nerves 8–14 pairs, veins reticulate; petiole $1^1/_2$–2 cm. *Panicles* $1^1/_2$–10 cm long, shortly hairy, sometimes glabrescent; bracts ovate to ovate-oblong, sparsely hairy outside; pedicels 1–4 mm, not articulated. *Calyx* caducous, lobes ovate, $^2/_3$–1 mm long, sparsely hairy outside. *Petals* ovate, or elliptic-oblong, $2^1/_2$–$2^3/_4$ by $1^1/_4$–$1^3/_4$ mm. *Stamens* $1^1/_2$–$2^1/_2$ mm; filaments 1–$1^3/_4$ mm, not contracted and whitish in apical part; anthers $^1/_2$–$^2/_3$ mm, not sagittate. *Disk* $^2/_3$ mm long. *Carpels* 1–$1^1/_2$ mm long. *Drupe* sublentiform, *c.* 9 mm ∅.

Distr. China (Hainan) and *Malesia:* Philippines (Palawan, Luzon, Cebu, Panay, and Guimaras).

Ecol. On dry slopes in thickets and secondary forest at low altitude. *Fl.* Jan., April, June, Dec.; *fr.* Jan.–March.

Vern. *Dodokdóken, lañglangós, riñgas,* Ilk., *kalapini, palinlin,* Tag., *malakok,* Pamp., *palilin, paminlin, paninglón,* Sbl., *pau,* Pang., *passi,* P.Bis.

NOTES. Fruiting and sterile specimens of *B. microphylla* are quite similar to rather 'small' leaved ones of *B. arborescens*; such material cannot be identified with certainty. Fortunately, *B. microphylla* is not common, and is so far known only from the Philippines; besides, fertile material of these two species may sometimes have both flowers and fruits on the same specimen, or fruits with remaining stamens at the base, to facilitate identification.

Some Philippine specimens were wrongly referred to this species (*cf.* DING HOU, Blumea 24, 1978, 4).

3. Buchanania insignis BL. Mus. Bot. 1 (1850) 184; MIQ. Fl. Ind. Bat. 1, 2 (1859) 636; ENGL. in DC. Mon. Phan. 4 (1883) 191. — *B. acuminatissima* MERR. Philip. J. Sc. 10 (1915) Bot. 34; En. Philip. 2 (1923) 465.

Tree 10–35 m high and 20–70 cm ∅; occasionally with buttresses up to 4 m high. *Leaves* oblanceolate, obovate-oblong, or elliptic-lanceolate, 9–40 by 3–$12^1/_2$ cm, slightly hairy beneath especially on the midrib, glabrescent; base attenuate; apex short-acuminate or acuminate; nerves 10–25 pairs, veins reticulate-scalariform; petiole $1^1/_2$–4(–6) cm. *Panicles* 7–24 cm long, hairy, glabrescent; bracts broad-ovate, or lanceolate, *c.* $^2/_3$ mm long, slightly hairy outside; pedicels $^3/_4$–2 mm, articulated. *Flowers* white. *Calyx* caducous, lobes broad-ovate, or subrotund, $^2/_3$–1 mm long. *Petals* oblong, ovate- or elliptic-oblong, 3–4 by 1–$1^1/_2$ mm. *Stamens* 2–$3^1/_2$ mm; filaments $1^1/_2$–2 mm, apical part contracted and whitish; anthers $^3/_4$–1 mm, sagittate, lower $^1/_4$–$^1/_3$ sterile. *Disk* $^2/_3$–1 mm long. *Carpels* $1^1/_2$–2 mm long. *Drupe* red when ripe (KOSTERMANS 5980), sublentiform, 7–10 mm ∅.

Distr. *Malesia:* Borneo (Kalimantan: Kutai, Martapura, Bengkenang, Berauw, Bulungan Mara, Samarinda; Sabah: Lahad Datu) and Philippines (Luzon: Prov. Laguna, Quezon, Tayabas & Camarines; Catanduanes; Bucas Grande I.).

Ecol. In forest, occasionally on limestone, chiefly in the lowland, sometimes up to 400 m. *Fl.* March–Sept.; *fr.* May–Dec.

Vern. Kalimantan: *bindjai,* Martapura, Bengkenang, *ntahurang, tĕrantang,* Kutai; Philippines: *balayóhot, balihúd, baliñgáhud, baliñghásai, magulíok,* Tag.

4. Buchanania arborescens (BL.) BL. Mus. Bot. 1 (1850) 183, *incl. var. obovata* BL.; MIQ. Fl. Ind. Bat. 1, 2 (1859) 636; F.-VILL. Nov. App. (1880) 55; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 108; MERR. Fl. Manila (1912) 300; Philip. J. Sc. 10 (1915) Bot. 35 & 190; HALL. *f.* Beih. Bot. Centralbl. 34, II (1916) 24; MERR. Sp. Blanc. (1918) 232; En. Philip. 2 (1923) 465; CRAIB, Fl. Siam. En. 1 (1926) 348; KANEH. Form. Trees rev. ed. (1936) 362, f. 318; WHITE, Proc. R. Soc. Queensl. 61 (1950) 56,; TARD. Fl. C. L. & V. 2 (1962) 76; LIU, Ill. Pl. Taiwan 2 (1962) 934, f. 769; LI, Woody Fl. Taiwan (1963) 445, f. 172; BACK. & BAKH. *f.* Fl. Java 2 (1965) 147; KALKMAN, Blumea 13 (1965) 107; ROYEN, Man. For. Trees Papua & N. G. 4 (1966) 9, f. 1; WHITMORE, Guide For. Brit. Solom. Is. (1966) 33; Gard. Bull. Sing. 22 (1967) 3 & 4; MEIJER, Bot. News Bull. F. D. Sandakan 8 (1967) 20, pl.; VERSTEEGH, Med. Landb. Hogesch. Wageningen 71–19 (1971) 22; LOMIBAO & MENIADO, Forpride Digest 3 (1974) 69. — *Coniogeton arborescens* BL. Bijdr. (1826) 1156. — *Prunus? laurifolia* DECNE, Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 458; MIQ. Fl. Ind. Bat. 1, 1 (1855) 366; *ibid.* 1, 2 (1859) 458. — *B. decandra* BLANCO, Fl. Filip. (1837) 66, ed. 2 (1845) 48, ed. 3, 1 (1877) 89, t. 63. — *B. longifolia* SPAN. Linnaea 15 (1841) 188; WALP. Rep. 1 (1842) 556; BL. Mus. Bot. 1 (1850) 184; MIQ. Fl. Ind. Bat. 1, 2 (1859) 636; ENGL. in DC. Mon. Phan. 4 (1883) 188. — *B. florida* SCHAU. Nov. Act. Ac. Caes. Leop.-Car. 19, Suppl. 1 (1843) 481; WALP. Rep. 5 (1845) 416; A. GRAY, Bot. Wilkes U.S. Explor. Exped. (1854) 366, t. 44; MIQ. Fl. Ind. Bat. 1, 2 (1859) 638; ENGL. in DC. Mon. Phan. 4 (1883) 188, *incl. var. arborescens* ENGL., *var. cumingii* ENGL., *var. lucida* (BL.) ENGL. *et var. petiolaris* (MIQ.) ENGL.; VIDAL, Sinopsis Atlas (1883) 22, t. 26, f. C; Phan. Cuming. (1885) 106; Rev. Pl. Vasc. Filip. (1886) 100; KING, J. As. Soc. Beng. 65, ii (1896) 463; K. & V. Bijdr. 4 (1896) 70; KOORD. Minah. (1898) 409; PIERRE, Fl. For. Coch. (1898) t. 378B; MERR. Bull. Bur. For. Philip. 1 (1903) 33; PERK. Fragm. Fl. Philip. (1904) 24; MERR. Philip. J. Sc. 1 (1906) Suppl. 84; BACK. Fl. Bat. (1907) 358; Schoolfl. (1911) 277; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 89; LAUT. Bot. Jahrb. 56 (1920) 349. — *Laurocerasus laurifolia* (DECNE) ROEM. Synops. 3 (1847) 91. — *B. lucida* BL. Mus. Bot. 1 (1850) 184; MIQ. Fl. Ind. Bat. 1, 2 (1859) 636, *incl. var. palembanica* (BL.) MIQ.; Sum. (1861) 523; HOOK. *f.* Fl. Br. Ind. 2 (1876) 23; PIERRE, Fl. For. Coch. (1898) t. 371B; LECOMTE, Fl. Gén. I.-C. 1 (1908) 9; RIDL. Fl. Mal. Pen. 1 (1922) 518, *incl. var. laxiflora* RIDL.; CRAIB, Fl. Siam. En. 1 (1926) 348; BURK. Dict. (1935) 378; CORNER, Ways. Trees (1940) 102, f. 19, Atlas pl. 3; TARD. Fl. C. L. & V. 2 (1962) 73; KOCHUM. Mal. For. Rec. 17 (1964) 212. — *B.? palembanica* BL. Mus. Bot. 1 (1850) 186; TURCZ. Bull. Soc. Nat. Mosc. 31, i (1858) 473. — *B. subobovata* GRIFF. Notul. 4 (1854) 413. — *B. longifolia* TURCZ. Bull. Soc. Nat. Mosc. 31, i (1858) 472, *non* SPAN. 1841;

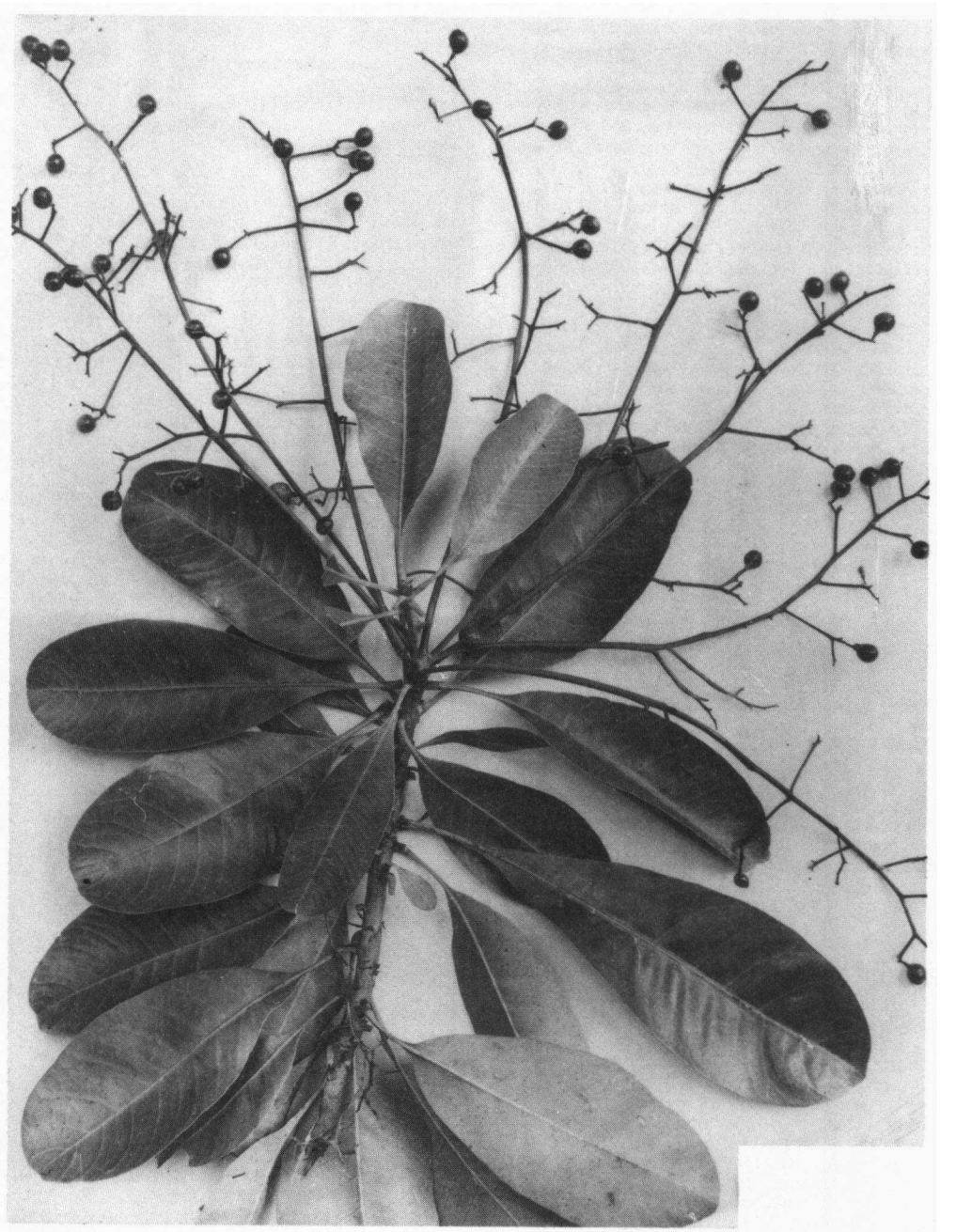

Fig. 4. *Buchanania arborescens* (BL.) BL. Courtesy and photogr. CORNER. Magnification × 1/5.

F.-VILL. Nov. App. (1880) 55. — *B. petiolaris* MIQ. Fl. Ind. Bat. 1, 2 (1859) 637. — *B. polybotrya* MIQ. *l.c.* 638. — *B. bancana* MIQ. Sum. (1861) 523. — *B. pseudoflorida* PERK. Fragm. Fl. Philip. (1904) 24. — *B. platyphylla* MERR. Philip. J. Sc. 10 (1915) Bot. 33. — *B. novo-hibernica* LAUT. Bot. Jahrb. 56 (1920) 349. — *B. scandens* LAUT. *l.c.* 351. — *B. papuana* C. T. WHITE, Proc. R. Soc. Queensl. 34 (1922) 40. — *B. glaberrima* RIDL. Kew Bull. (1933) 195. — *B. solomonensis* MERR. & PERRY, J. Arn. Arb. 22 (1941) 530. — *B. versteeghii* MERR. & PERRY, *l.c.* 531. — *B. nabirensis* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 166. — *B. monticola* KANEH. & HATUS. *l.c.* — Fig. 4.

Tree 4–35 m high and 10–75(–120) cm ∅; buttresses sometimes present, low, rounded, rarely up to 1 m high, 2 m extending outward from the trunk, and 10 cm thick. *Leaves* obovate to oblanceolate, or elliptic-oblong, $4^1/_2$–26(–35) by $1^3/_4$–7(–9) cm, hairy beneath especially on the midrib when young, glabrescent; base cuneate to attenuate; apex usually obtuse or rounded, rarely apiculate, acute, or emarginate, rarely acuminate; nerves 7–18(–30) pairs, veins reticulate or reticulate-scalariform; petiole 1–3(–4) cm. *Panicles* $5^1/_2$–22 cm long, hairy, glabrescent; bracts ovate or subrotund, $^1/_3$–$^2/_3$ mm long, sparsely hairy outside and ciliate on the margin, glabrescent, or glabrous; pedicels (1–)2–4 mm, usually not articulated. *Flowers* white. *Calyx* usually caducous, lobes broad-ovate or subrotund, $^2/_3$–1 mm long. *Petals* elliptic, $2^1/_2$–$3^1/_2$ by $1^1/_4$–$1^3/_4$ mm. *Stamens* $2^1/_2$–3 mm; filaments $1^3/_4$–$2^1/_2$ mm, apically contracted and whitish; anthers $^2/_3$–1 mm, sagittate, lower $^1/_3$(–$^1/_2$) sterile. *Disk* $^2/_3$–1 mm long. *Carpels* $1^1/_2$–2 mm long. *Drupe* sublentiform, *c.* 10 mm ∅.

Distr. Tenasserim, Andamans, Thailand, Indo-China, Formosa, widely distributed throughout *Malesia* to New Britain, the Solomons, and Australia.

Ecol. Chiefly in lowland forest, along river-banks, near the beach, peat-swamps and dryland, sometimes on limestone hills and in secondary forest, up to 300 m, rarely at 540 m (Sabah). *Fl. fr.* Jan.–Dec., in Malaya mainly *fl.* April–June. In flower the crown becomes cream-white and very conspicuous (CORNER).

Uses. The wood is used for interior finishing, light construction, joints, rafters, furniture, boxes, cases, and veneers, all in all of rather inferior quality (HEYNE, Nutt. Pl. 1927, 965). Common names: *balinghasai*, Philippines, *satin-wood*, Papua New Guinea (*cf.* ROYEN, *l.c.*; LOMIBAO & MENIADO, *l.c.*). BURKILL *l.c.* added a few minor uses on tannin bark and leaves for curing head-ache.

Vern. Sumatra: *kělumpang, rěngas poja, samah*, M, *rěngas manuk*, Lampongs, *těrěntang burung*, Palembang; Banka: *měmpao, njuth bunga, rěngas manok, sisil padang*, M; Billiton: *pao*, M; Malay Peninsula: *katak hudang, kělumpang kěras, kětak udang, lěmak kětam, otak hudang* (*daun tumpul*), *pauh pipit, puan, rěngas ayěr, rěngas pasir, těrěntang tikus, tinggi burong*, M; Java: *gětasan, kokohan, opawa, pokopoah, wuru-gěni*, J, *kaju putil, kitandjung, ki salim, rěngas lalaki, rěngas manuk, rěngas piit*, S, *popohan*, J & S; Karimon Djawa I.: *buah ingas*; Lesser Sunda Is.: *kěmalapau, upěkei*, Sumba, *ěmpau*, Flores; Borneo: Brunei: *kěpala tundang, rěngas ayom*; Sarawak: *rěngas laut*, Similajau, *utak udang*, Kuching; Sabah: *balono-balono, bingkurud, manuk-manuk, nanka-nanka, salangawan*, Bajau, *baunobono, baunu-baunu*, Suluk, *bĕluno-bĕluno*, M & Suluk, *borong bangolo*, Banggi, *budu-budu*, Sungei, *kapala tundang*, Brunei & M, *kasat*, Brunei & Sungei, *kĕpala tundang*, Kedayan, *madsabundu, manga-manga, samondu*, Dusun, *manga utan*, M, *masa mundu*, Kudat, *salingkawang*, Brunei, Dusun & M, *tangawan*, Brunei, Dusun & Sipitan; Kalimantan: *djinga burung, mata undang, njatoh bunga, otak udang, rawa rawa pipit*, M, *djingah pĕrkusa, moruang, rĕngas bakei*, Kuala Kapuas, *kopèng, mataorang, rarangasan*, Kutai, *rawa pipit*, Martapura; Philippines: *anagas, bálañga, tagangtáng, unkan*, P.Bis., *alitagtag, baliñgóhot, baliohod, kalampuso, upong-upong*, Bik., *anan, balins'ud*, Mang., *anam, pasig*, Bis., *anugas, beobayanó, butu-butu*, C.Bis., *antèng, langlanges, páuan, rangsá*, Ilk., *araká, gañgá*, Ibn., *arenges*, Isabela, *bagilibas, bahai-uhod, baliñghásai, balitantáng, balithód, kaming, hingas, maguliok, malaybóhod*, Tag., *balingásai*, Ilk., Tag., Sbl., *balehod*, Camarines, *balinhásai*, Ibn., Ilk., Tag., Ig., *balinh'ai, kamiing*, Sbl., *balitatag*, Camarines, Tayabas, *balunug, diláan, malabalúno, mangapuli, manbalúno*, Sul., *boróan, bulúan, kaming, pakaran*, Pang., *garantang*, Tagb., *gimbulon*, Mindanao, *havan*, Nueva Vizcaya, *hongas, malaligas na lalake*, Tayabas, *kalantang, malapog*, Palawan, *kaligpo*, Sub., *kanteng*, Ting., *kasabang*, Neg., *lagindiñgan*, Mag., *maománga*, Sml., *palang, papagan*, Cagayan, *palankomog*, Mt Prov., *tarangnisig*, Bag., *uyok*, Ig.; Celebes: *kaléla, makuranga*, Minah., *kapofo, lokinako, morantoboea, ninifo*; Moluccas: *marisin karéa'a, taniruán'a*, Talaud Is.; New Guinea: *bahoör*, Animanhasin, *bilou*, Mooi, *korgier*, Tehid, *weekar*, Tor, *woökoi*, Manikiong.

5. Buchanania amboinensis MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 117; MERR. Philip. J. Sc. 11 (1917) Bot. 285. — *B. heterophylla* K.SCH. in K.Sch. & Laut. Nachtr. (1905) 300; LAUT. Bot. Jahrb. 56 (1920) 351, f. 1; WHITE, J. Arn. Arb. 10 (1929) 234; MERR. & PERRY, *ibid.* 22 (1941) 531, *incl. var. pubescens* MERR. & PERRY; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 11, f. 2. — *B. aruensis* RIDL. Kew Bull. (1933) 195.

Tree 15–30 m high and 20–30 cm ∅. *Leaves* obovate-oblong to oblanceolate, 26–64 by 8–16 cm, hairy on both surfaces, especially on the midrib and nerves, glabrescent; base attenuate; apex obtuse or rounded, rarely apiculate; nerves 19–27 pairs, veins reticulate-scalariform; petiole 0 or very short (*c.* 5 mm). *Panicles* 14–30 cm long, densely hairy, sometimes glabrescent; bracts ovate-oblong to lanceolate, 1–$1^1/_2$ mm long, hairy outside. *Flowers* white, sessile, articulated at the base. *Calyx* persistent, lobes broad-ovate or subrotund, $^2/_3$–$1^1/_4$ mm long, sparsely hairy outside. *Petals* elliptic or elliptic-oblong, $2^3/_4$–$3^1/_4$ by $1^1/_2$ mm. *Stamens* $2^1/_2$–3 mm; filaments $1^1/_2$–$2^1/_4$ mm, contracted and apically whitish; anthers $^2/_3$–1 mm, sagittate, lower $^1/_4$–$^1/_3$ sterile. *Disk* $^2/_5$ mm long. *Carpels* $1^1/_2$ mm long. *Drupe* red when ripe, sublentiform, 8–11 mm ∅.

Distr. *Malesia:* Moluccas (Morotai, Halmaheira, Buru, Ceram, Ambon), Aru Is., and New Guinea (scattered).

Ecol. In lowland primary forest up to 200 m, once at 600 m. *Fl.* April–Dec.; *fr.* May–Dec.

Vern. Moluccas: *basarar*, Onjob, *fitenu*, Bembi, *hutong utan*, Ambon, *kara*, Kaigori, *karukaruru*, Miniafia, *kumu*, Mawan, *litoco*, Morotai, *niranira*, Rawa, *tjiwiwedjai*, Kawerawedje.

6. Buchanania macrocarpa LAUT. Bot. Jahrb. 56 (1920) 350; MERR. & PERRY, J. Arn. Arb. 22 (1941) 530; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 13, f. 3; VERSTEEGH, Med. Landb. Hogesch. Wageningen 71–19 (1971) 22. — *B. mollis* LAUT. Nova Guinea 8 (1912) 829; Bot. Jahrb. 56 (1920) 349; KANEH. & HATUS. Bot. Mag. Tokyo 52 (1938) 413; MERR. & PERRY, J. Arn. Arb. 22 (1941) 529; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 14, f. 4. — *B. montana* LAUT. Bot. Jahrb. 56 (1920) 350. — **Fig. 5c–h.**

Tree 6–37 m high and 8–87 cm ∅, occasionally buttressed. *Leaves* obovate-oblong or oblanceolate, (12–)26–45 by (4¼–)9–16¼ cm, sparsely to densely hairy beneath, sometimes on both surfaces, glabrescent; base cuneate or attenuate; apex obtuse or rounded, rarely apiculate, acute, or emarginate; nerves 14–20 pairs, veins reticulate-scalariform; petiole (1½–)3–6 cm. *Panicles* 8½–25 cm long, hairy, glabrescent; bracts lanceolate, ¾ mm long, pubescent outside. *Flowers* creamish or white, sessile, articulated at the base. *Calyx* persistent, lobes subrotund, ⅔–1 mm long. *Petals* ovate-oblong, 2–2½ by 1–1½ mm. *Stamens* 1½–1¾ mm; filaments 1–1¼ mm, apically contracted and whitish; anthers ¾–1 mm sagittate, lower ¼–⅓ mm sterile. *Disk c.* ½ mm long. *Carpels* 1½ mm long. *Drupe* brown, sublentiform, 16–21 mm ∅.

Distr. *Malesia:* Moluccas (Ceram) and New Guinea (scattered; including adjacent islands: Normanby, New Britain, Numfoor, Salawati, Misool, Biak, Aru, and Rossel) & Solomons.

Ecol. In primary forest of low dry or temporarily inundated areas, up to 450 m, once at 900 m (Morobe). *Fl.* Jan.–Oct.; *fr.* Jan.–Dec.

Uses. Similar to those mentioned under *B. arborescens*; sometimes used also for canoes in Sepik and Gulf Distr., Papua New Guinea, but reported to be durable only for a short time (*cf.* ROYEN, *l.c.*).

Vern. New Guinea *etc.*: *ala*, Bilia, *barrabarra*, Usino, *běngèng*, Manokwari, *bienier*, Asmat, *dam* = *damtaris*, Kwèsten, *diomo*, Kiwai, *fitum*, Biembi, *floboen*, *klobum*, Mooi, *hěrakuba*, *kěrapuka*, Gulf Distr., *inaandoi*, Biak, *kara*, Dumpu & Kaigori, *karukaruru*, Minafia, *kurus*, Amele, *lagobe*, W. Nakanai, *langara*, Aru, *mekkinghoog*, Sidei, *mekogo*, Arfak, *mutum*, Muju, *nisriu*, Amberbakan, *uruk*, Mandobo, *porokko*, Manikiong, *sieriew*, Kebar, *sunem*, Madang, *ta'ugapa*, Orokaiwa, *waw-waw*, Karas, *yapa*, Faita.

7. Buchanania nitida ENGL. in DC. Mon. Phan. 4 (1883) 193; VIDAL, Phan. Cuming. (1885) 106; Rev. Pl. Vasc. Filip. (1886) 100; PERK. Fragm. Fl. Philip. (1904) 24; MERR. En. Philip. 2 (1923) 466; MERR. & PERRY, J. Arn. Arb. 22 (1941) 533. — *Campnosperma philippinense* MERR. Philip. J. Sc. 60 (1936) 31, *cf.* STEEN. *ibid.* 91 (1962) 508. — *B. conglomerata* ELMER (*ex* MERR. En. Philip. 2 (1923) 467, *nom. in syn.*) Leafl. Philip. Bot. 10 (1939) 3679, *descr. angl.* — *B. sorsogonensis* ELMER, *l.c.* 3681, *descr. angl.* — **Fig. 5a–b.**

Tree 8–15(–28) m high and 20–30(–35) cm ∅. *Leaves* oblanceolate to narrow-oblanceolate, (16–)30–80 by (5–)6½–16 cm; base cuneate or attenuate; apex acuminate or short-acuminate, rarely apiculate, obtuse, or emarginate; nerves 31–52 pairs, veins reticulate-scalariform; petiole 2–3(–6) cm. *Panicles* up to 40 cm long, pubescent; bracts obovate to oblanceolate, 1¾–2¼ mm, sparsely hairy outside; pedicels 1–1½ mm, usually not articulated, or articulation obscure. *Flowers* yellowish. *Calyx* usually persistent, lobes broad-ovate or -elliptic, ⅔–1 mm long, sparsely hairy outside. *Petals* elliptic-oblong, 2½–3 by ¾–1¼ mm. *Stamens* 2–3 mm; filaments 1¼–2 mm, gradually narrowed towards the apex and not whitish at the apical part; anthers 1–1¼ mm, sagittate, lower ¼–⅕ sterile. *Disk* ½–1 mm long. *Carpels* 1½–2 mm long. *Drupe* red when ripe, sublentiform, *c.* 12 mm ∅.

Distr. *Malesia:* Philippines (Mindoro, Luzon, Polillo, Masbate, Samar, Leyte, Biliran, Negros Or., Basilan, Mindanao) and Moluccas (Morotai).

Ecol. In primary forest, rarely in second growth or forest, at low altitude up to 450 m. *Fr.* April–July.

Vern. Philippines: *anam*, *balitangtang*, *liok*, *maguliók*, Tag., *lubilubi*, P.Bis., *managas*, *talagabanug*, Mbo.

8. Buchanania sessifolia BL. Mus. Bot. 1 (1850) 184; MIQ. Fl. Ind. Bat. 1, 2 (1859) 637 ('*sessilifolia*'); Sum. (1861) 523; ENGL. in DC. Mon. Phan. 4 (1883) 191; KING, J. As. Soc. Beng. 65, ii (1896) 463; K. & V. Bijdr. 4 (1896) 74; BACK. Schoolfl. (1911) 277; RIDL. Fl. Mal. Pen. 1 (1922) 519; MERR. Pl. Elm. Born. (1929) 166; BURK. Dict. (1935) 378; KOCHUM. Mal. For. Rec. 17 (1964) 213; BACK. & BAKH. *f.* Fl. Java 2 (1965) 148; DING HOU, Blumea 24 (1978) 5. — *B. acuminata* TURCZ. Bull. Soc. Nat. Mosc. 31, i (1858) 472; HOOK. *f.* Fl. Br. Ind. 2 (1876) 24; BAKER, J. Bot. 62 (1924) Suppl. 30. — *B. oxyphylla* MIQ. Sum. (1861) 522. — **Fig. 3a–i.**

Tree up to 42 m high and 80 cm ∅, sometimes buttressed. *Leaves* obovate-oblong, oblanceolate or spathulate, 7½–31 by 4–10½ cm, hairy beneath especially on midrib and nerves, rarely on both surfaces, usually glabrescent; base cuneate or attenuate; apex acuminate or short-acuminate, rarely apiculate; nerves 12–25 pairs, veins reticulate-scalariform; petiole usually 0, sometimes up to 1½(–3) cm. *Panicles* 4½–34 cm long, hairy, sometimes glabrescent; bracts lanceolate, *c.* 1 mm long, hairy on both surfaces; pedicels ½–1 mm, articulated. *Flowers* white or whitish yellow. *Calyx* persistent, lobes semiorbicular or triangular, ½–1 mm long, hairy outside. *Petals* elliptic, oblong, or ovate-oblong, 2–2½ by 1–1½ mm. *Stamens* 1½–2 mm; filaments 1–1¼ mm, papillose, gradually narrowed towards the apex and not whitish in the apical part; anthers ⅔–¾ mm, sagittate, lower ¼–½ sterile. *Disk* ½–⅔ mm long. *Carpels c.* 1 mm long. *Drupe* obliquely subobcordate, 10–13 by 8–11 mm.

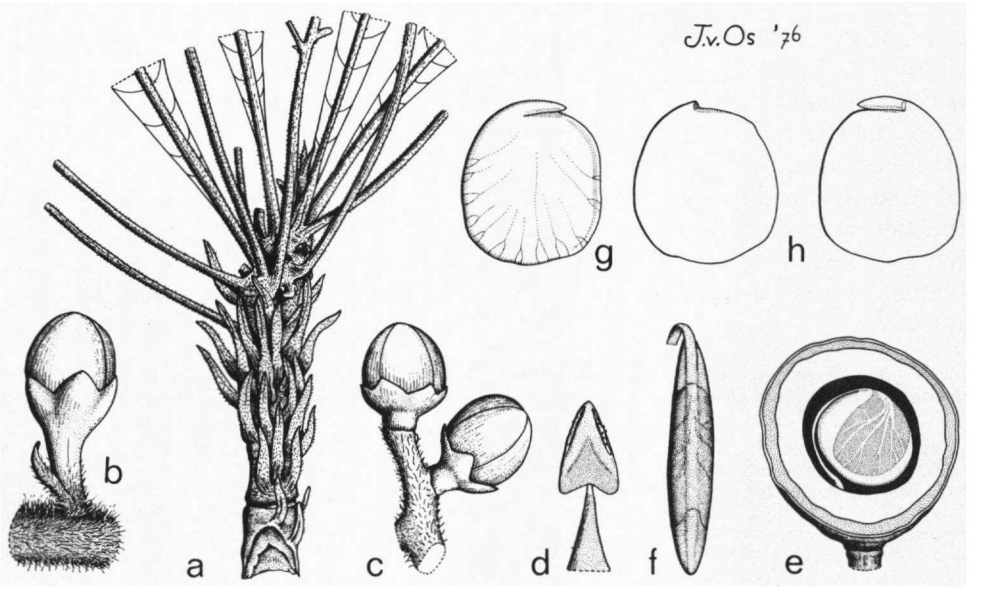

Fig. 5. *Buchanania nitida* ENGL. *a*. Apical part of twig with many scales, × 1/2, *b*. flower-bud, pedicel not articulated, × 7. — *B. macrocarpa* LAUT. *c*. Two flower-buds, pedicels articulated, × 7, *d*. stamen, × 14, *e*. fruit, half of pericarp removed, × 1 1/2, *f*. seed, viewed from raphe side, × 3 1/2, *g*. embryo, lateral view, × 2, *h*. embryo, cotyledons separated, × 2 (*a–b* RAMOS 1617, *c–d* BW 9472, *e–h* BW 1912).

Distr. Peninsular Thailand, Laos, and *Malesia:* Sumatra (incl. Simalur & Banka), Malay Peninsula, and Borneo (Brunei, Sarawak, Sabah, SE. Borneo, and incl. Anambas & Natuna Is.).

Ecol. Chiefly in forests on dryland, sometimes along river-banks, in wet places or in freshwater swamps, mainly in the lowland, rarely up to *c.* 1000 m. *Fl.* Jan.–Nov.; *fr.* Febr.–Dec.

Uses. Though not durable used for houses (HEYNE, Nutt. Pl. 1927, 965). The sour fruit is eaten by the Jakuns in Malaya (BURKILL *l.c.*).

Vern. Sumatra: *kaju itom*, Asahan, *kětapang*, *rĕngas balang*, Lampongs, *módangbúnga*, W. Coast, *tarantang ajam*, Muara Enim, *pau pipit*, *tarantang burung*, *tarangtang munu*, *tĕrĕntang ajam*, *tjĕrĕntang*, Palembang; Malay Peninsula: *bintangos otak udang*, *bintonfar otak udang*, *gĕtak husang*, *hompos tĕba*, *kaju limpudu burong*, *katah udang*, M, *kayu ba ngo*, Temuan, *kĕlat samak*, *kĕrtah udang*, *lada lada*, *mĕntango otak udang*, *ota udang*, *poko habong ayam*, *poko la hudung*, *poko pao utan*, *pokoh paoo peepit*, *pokoh tumoohong*, *rĕngas ayam*, *rĕngas pasir*, *sĕrcutang tikus*, M; Borneo: Brunei: *tĕrĕnting tchit*, Iban; Sarawak: *labu*, *lavo*, Kayan, *ĕmpĕdu*, Baram, *tĕrĕntang chit*, Lundu; SE. Borneo: *bindjai hutan*, Tanah Bumbu, *djinga*, Balikpapan, *tohontang*, Dajak; Sabah: *bauno*, Suluk, *bawang-bawang*, *kĕpala tundang*, *tĕrĕntang*, M, *kepsia tundang*, Tawau, *kalut*, *rĕngas bunkit*, Dusun.

Dubious & Excluded

Buchanania latifolia ROXB. Fl. Ind. ed. Wall. 2 (1824) 385; HOOK. *f.* Fl. Br. Ind. 2 (1876) 23; ENGL. in DC. Mon. Phan. 4 (1883) 182; KURZ, Fl. Burma 1 (1887) 307; PIERRE, Fl. For. Coch. (1898) t. 370B; LECOMTE, Fl. Gén. I.-C. 2 (1908) 10; CRAIB, Fl. Siam. En. 1 (1926) 348; TARD. Fl. C. L. & V. 2 (1962) 77.

HOOKER (*l.c.*) mentioned under *B. latifolia* ROXB. that "There is a specimen marked from Malacca in Griffith's Herbarium". ENGLER (*l.c.*) cited "Birma vel Malacca (Griff., n. 1114 in Herb. Kew)" under the same species.

I examined the specimen in question in the Kew Herbarium. It was correctly identified. On it there are two printed labels "Birma and Malacca" and "Malacca", respectively. Therefore, I presume that this specimen was collected in Burma.

B. latifolia is characterized by usually broad elliptic to elliptic-oblong leaves, villose beneath and obtuse or emarginate at the apex. So far I have not seen any collection of it from Malesia.

NAVES & FERNANDEZ-VILLAR (Nov. App. 1880, 55) recorded it as occurring in the Philippines, but MERRILL (En. Philip. 2, 1923, 467) excluded it from the flora of this region.

Buchanania novo-guineensis WARB. Bot. Jahrb. 13 (1891) 363 = *Rhyticaryum novoguineense* (WARB.) SLEUMER, Blumea 17 (1969) 250 (*Icacinaceae*).

2. ANDROTIUM

STAPF, Hook. Ic. Pl. (1903) t. 2763. — **Fig. 3k–n.**

Tree. *Leaves* spiral, simple, entire, petioled. *Inflorescences* axillary, paniculate. *Flowers* bisexual. *Calyx* 5-(or 4-)lobed. *Petals* 5 (or 4), imbricate, glabrous except the sparsely hairy margin. *Stamens* twice the number of petals; filaments subulate; anthers basifixed, with 2 separated anther-cells, overtopped by prolonged, dilated and apically two-lobed connective, lobes pustular especially when young. *Disk* intrastaminal, shortly cupular, crenulate on the margin, glabrous. *Carpels* 5, free, each 1-ovuled, only one fertile. *Ovary* subglobose, pilose; style obscure; stigma oblique; sterile carpels smaller, bent outward. *Drupe* (very young) lentiform (STAPF, *l.c.*).

Distr. Monotypic; so far known only from *Malesia:* Malay Peninsula and Borneo.
Ecol. In primary and swamp forests at low altitude.

1. Androtium astylum STAPF, Hook. Ic. Pl. (1903) t. 2763; MERR. En. Born. (1921) 349; ANDERSON, Gard. Bull. Sing. 20 (1963) 169. — **Fig. 3k–n.**

Tree up to 16 m high and *c.* 17 cm ∅. *Leaves* subcoriaceous, elliptic, broadly ovate, or obovate, $4^1/_2$–10 by 2–$5^1/_2$ cm, glabrous, sometimes sparsely hairy underneath and glabrescent; base cuneate or obtuse; apex acuminate, rarely emarginate; nerves 5–9 pairs, veins reticulate; petiole 4–8 mm. *Panicles* 1–$8^1/_2$ cm long, puberulous; floral bracts broadly ovate or ovate, $^1/_2$–1 mm long; pedicels $^2/_3$–1 mm. *Calyx* lobes broadly ovate, $^1/_2$–$^3/_4$ mm long. *Petals* white tipped otherwise pink, ovate-oblong or slightly elliptic, 2–3 by $^2/_3$–1 mm. *Stamens* $^1/_2$–1 mm; anthers *c.* $^1/_3$ mm long. *Disk* *c.* $1^1/_4$ mm ∅. Fertile *ovary* *c.* $^1/_2$ mm ∅, sterile ones smaller.

Distr. *Malesia:* Malay Peninsula (Kluang For. Res.) and Borneo (Sarawak: Lambir Hills, Miri; Loba Kabang, Sibu; Kuching; Semengoh Arboretum; Sampadi; Melinan Gorge, Baram; Kalimantan: W. part, P. Pandan; S. part: Sampit R. region near Kuala Kuajan).

Ecol. In primary and swamp forests at low altitude. *Fl.* April–Sept.

Vern. Borneo: *merambang*, Iban.

Note. It is noteworthy that the only fruit described is by STAPF, and that immature; I have seen 11 collections.

3. ANACARDIUM

LINNÉ, Gen. Pl. ed. 5 (1754) 180; Sp. Pl. (1753) 383; MARCH. Rév. Anacard. (1869) 105 & 189; ENGL. in DC. Mon. Phan. 4 (1883) 215. — *Cassuvium* RUMPH. Herb. Amb. 1 (1741) 177, t. 69. — *Acajou* MILLER, Gard. Dict. Abr. ed. 4 (1754). — **Fig. 6.**

Trees or shrubs. *Leaves* spiral or alternate, simple, petioled. *Inflorescences* terminal, sometimes also in the upper leaf axils, paniculate or sometimes corymbose. *Flowers* unisexual (♂) or bisexual (plants polygamous). *Calyx* 5-lobed. *Petals* 5, imbricate, puberulous on both surfaces. *Stamens* 7–10, unequal, 1 (rarely 2) much stouter and longer, the rest reduced, smaller, all fertile, sometimes some of them imperfect or sterile; filaments subulate, basally connate into a short tube, puberulous with minute glandular hairs; anthers basifixed, ovoid or broadly ellipsoid. *Disk* none. *Ovary* slightly obovoid, glabrous, 1-celled and 1-ovuled, abortive and rudimentary in ♂; style filiform; stigma obscure. *Drupe* 1-celled, on a fleshy, pyriform hypocarp (enlarged receptacle and pedicel). *Seed* with testa free from endocarp; embryo reniform, cotyledons free, plano-convex.

Distr. About 8 *spp.* in tropical America; one, *A. occidentale* L., widely cultivated in the tropics.
Uses. The fruits of *A. occidentale* are the source of cashew nuts; the fleshy pear-shaped hypocarp known as cashew apple is also edible.

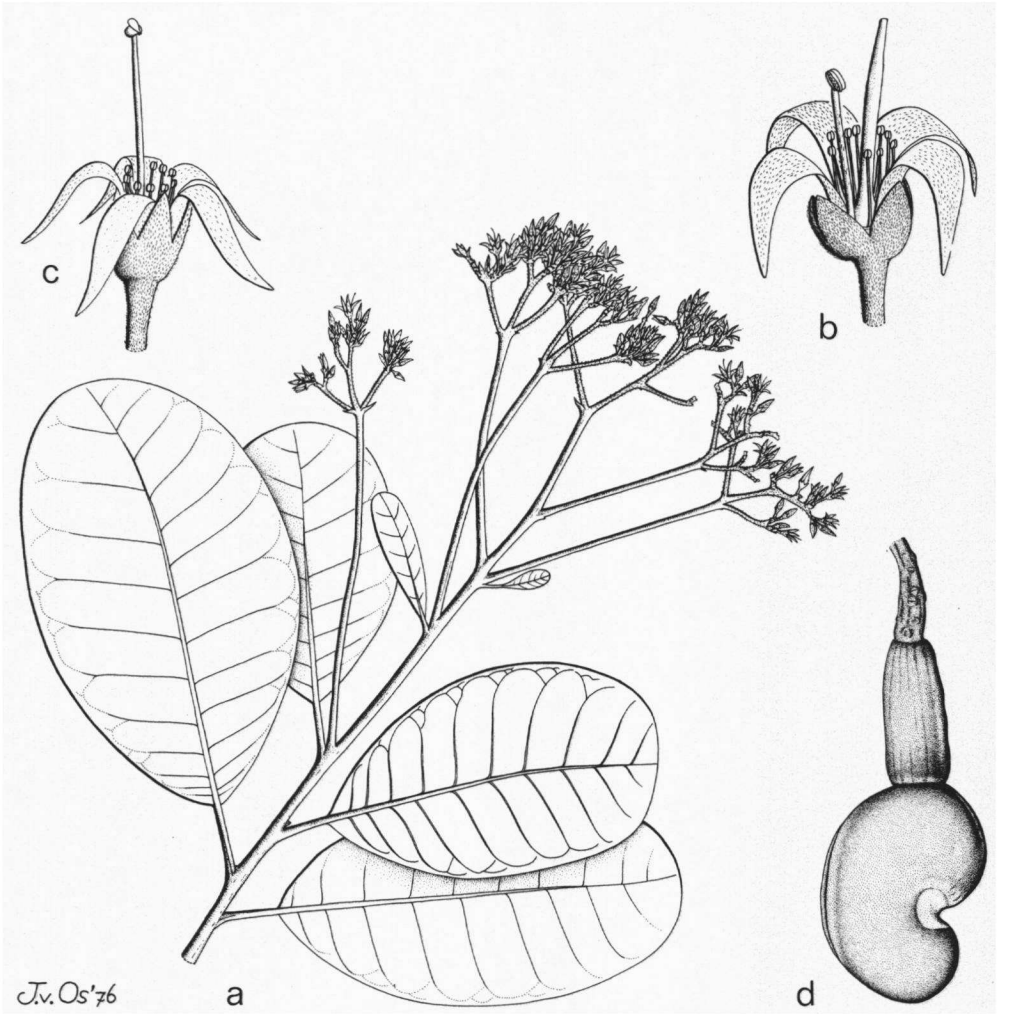

Fig. 6. *Anacardium occidentale* L. *a.* Habit, × 1/2, *b.* bisexual flower, × 3 1/2, *c.* ♂ flower, × 3 1/2, *d.* young (dried) fruit, nat. size (*a–c* FRI 5188, *d.* DING HOU 571).

1. Anacardium occidentale LINNÉ, Sp. Pl. (1753) 383; DC. Prod. 2 (1825) 62, *incl. var. indicum* DC.; BL. Bijdr. (1826) 1155; HASSK. Flora 27 (1844) 623; MIQ. Fl. Ind. Bat. 1, 2 (1859) 624; HOOK. *f.* Fl. Br. Ind. 2 (1876) 20; F.-VILL. Nov. App. (1880) 54; ENGL. in DC. Mon. Phan. 4 (1883) 219; VIDAL, Sinopsis Atlas (1883) 22, t. 36, f. B; Phan. Cuming. (1885) 106; Rev. Pl. Vasc. Filip. (1886) 100; ENGL. in E. & P. Nat. Pfl. Fam. 3, 5 (1892) 147, f. 94; KING, J. As. Soc. Beng. 65, ii (1896) 479; KOORD. Minah. (1898) 409; MERR. Bull. Bur. For. Philip. 1 (1903) 33; Philip. J. Sc. 1 (1906) Suppl. 84; BACK. Fl. Bat. (1907) 365; LECOMTE, Fl. Gén. I.-C. 2 (1908) 12; BACK. Schoolfl. (1911) 279; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 89; MERR. Fl. Manila (1912) 299; Int. Rumph. (1917) 333; Sp. Blanc. (1918) 233; RIDL. Fl. Mal. Pen. 1 (1922) 526; MERR. En. Philip. 2 (1923) 469; CRAIB, Fl. Siam. En. 1 (1926) 345; HEYNE, Nutt. Pl. (1927) 970; BURK. Dict. (1935) 143; CORNER, Ways. Trees (1940) 100, Atlas t. 2; DE WIT, Rumph. Mem. Vol. (1959) 346; TARD. Fl. C. L. & V. 2 (1962) 100, t. 2, f. 5–11; H. F. COPELAND, Phytomorph. 11 (1962) 315, f. 1–25; PURSEGLOVE, Trop. Crops 1 (1968) 19, f. 1; WALKER, Fl. Okin. & S. Ryu Kyu Is. (1976) 663. — *Cassuvium pomiferum* LAMK, Encycl. 1 (1783) 22. — *Cassuvium reniforme* BLANCO, Fl. Filip. (1837) 322; ed. 2 (1845) 227; ed. 3, 2 (1878) 60, t. 116. — Fig. 6.

Tree up to 12 m high and 40 cm ∅, trunk usually crooked. Bark brown, rather smooth. *Leaves* coriaceous, obovate, sometimes broadly elliptic,

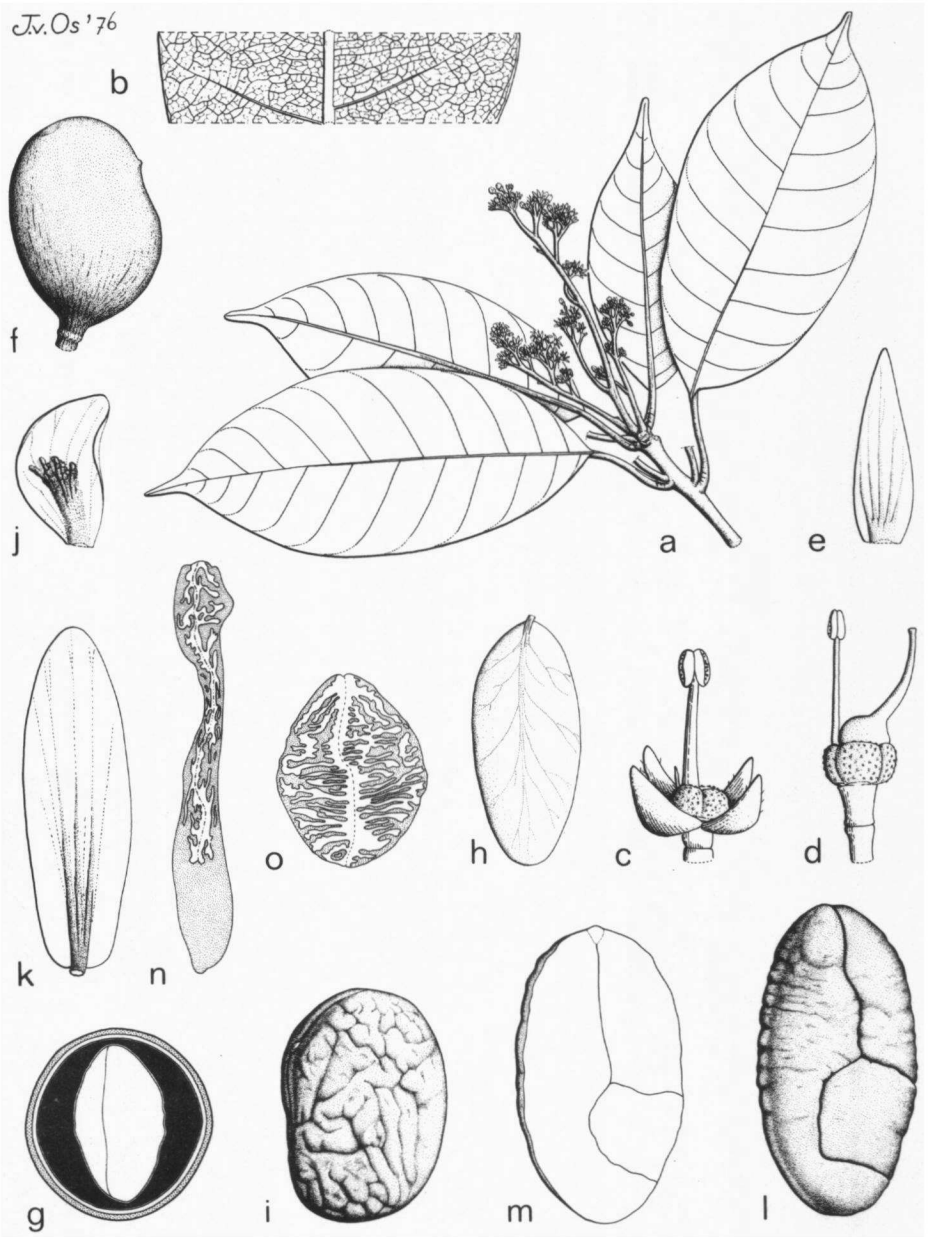

Fig. 7. *Mangifera havilandii* RIDL. *a*. Habit, × 1/2, *b*. leaf venation on lower surface, nat. size, *c*. ♂ flower, petals removed, *d*. ♀ flower, calyx and petals removed, *e*. petal, inner surface, all × 7, *f*. young fruit, nat. size, *g*. *ditto* in CS, *h*. seed, raphe-side view, *i*. young embryo (wrinkled), all × 1 1/2. — *M. quadrifida* JACK. *j*. Petal, showing free apical ends of ridges on inner surface, × 7. — *M. pajang* KOSTERMANS. *k*. Petal, inner surface, showing confluent ridges stipe-like extending beyond the base, × 7, *l*. embryo, side view, with unequal lobed cotyledons, × 1/2, *m*. cotyledon, inner surface, × 1/2. — *M. gedebe* MIQ. *n*. CS of labyrinthine young seed (with lobed or folded cotyledons), × 1 1/2. — *M. inocarpoides* MERR. & PERRY. *o*. CS of labyrinthine seed (with lobed or folded cotyledons), nat. size (*a–e* HAVILAND & HOSE 3368, *f–i* S 16238, *j* KOSTERMANS *s.n. sub*. HLB 954.287–095, *k* KOSTERMANS 12534, *l–m* SAN 34859, *n* KOSTERMANS 14103, *o* BRASS 8462).

4–22½ by 2½–15 cm, glabrous; base cuneate, or obtuse; apex rounded, sometimes slightly emarginate; nerves 8–20 pairs, veins reticulate; petiole ½–2 cm. *Panicles* or sometimes corymbs up to 26 cm long, pubescent, glabrescent; floral bracts ovate-oblong, 5–10 mm long; pedicels 2–5 mm. *Flowers* fragrant, unisexual (♂) and bisexual ones on the same plant. *Calyx* lobes unequal, ovate-lanceolate, 3–5 mm long. *Petals* linear, 7–15 mm long, reflexed at anthesis, at first pale greenish-cream with red stripes, soon turning red. *Stamens* 2–12 mm; anthers ⅔–1 mm long. *Disk* none. *Ovary c.* 1 mm ∅; style 4–12 mm; rudimentary pistil in ♂ 2–3 mm. *Drupe* reniform, 2½–3½ by 1½–2 cm, greyish brown when fresh; hypocarp fleshy, pyriform, 2–3 by 1–2 cm (in fresh state 3–4 times the length of the fruit, shiny, red or yellow, 10–20 by 4–8 cm). *Seed* reniform, 1½–2 by 1 cm.

Distr. Tropical America; widely cultivated in the tropics as a fruit tree; in *Malesia* in some places naturalized, for example on the east coast of Malaya (CORNER).

Ecol. Often cultivated on sandy soil in dry areas in the villages near the sea coast at low and medium altitude, in some places naturalized on the sandy coast or hills near the sea. *Fl.* Jan.–Dec.; *fr.* Febr.–Nov.

Uses. All parts of the plant contain an irritant skin poison, but particularly the seed, or kernel of the nut (CORNER *l.c.*). On heating this substance is destroyed, hence cashew nuts must be roasted before being eaten; the raw nut would sear the lips and cannot be swallowed. The fleshy pear-like cushion on which the nut is so characteristically placed, can be eaten raw: it has a delightful fragrance, but in Malayan varieties the taste is poor and the juice sets up a slight irritation in the throat, obliging one to cough. Much better varieties occur in tropical America, where the pulpy part of the cashew apple is extensively eaten.

Various parts of the tree are used in native medicine, *etc.*; for more detailed information on uses, *cf.* HEYNE, BURKILL, and PURSEGLOVE, *ll.cc.*

Vern. *Cashew*, E; Indonesia: *djambu gadjus, djambu monjèt, d. parang, d. sempal, d. séran, djanggus, gadjus*, M; Malay Peninsula: *gajus, jambu golok, kětěrek*, Kelantan & Trengganu; Sumatra: *djambu érang, d. monjè*, Minangk., *gadju*, Lamp.; Java: *djambu mèdè, d. siki*, S, *djambu mété*, J, *djhambhu monjèt*, Md.; Lesser Sunda Is.: *djambu djipang, d. dwipa, njambu monjèt*, Bali, *njambuk njèbèt*, Lombok, *buwah monjèt*, Timor; Borneo: *djambu dipa*, Bandj.; Philippines: *balógo, bolúgo, kológo, sambalduke*, Ilk., *bálubad, balúbag, balúbar, balúbat, batúban, kachúi*, Tag., *kasói*, Ibn. & Tag., *kasúi*, Ilk. & Tag., *kasul*, Sulu, *kosing*, Ig.; Celebes: *buwa jakis, wojakis*; *djambu daré*, Mak., *djampu sèrěng, d. tapěsi*, Bug., *kanoké*, Nuaulu, *masapana*, Sepa; Moluccas: *buwa jakis*, Halmaheira, *buwa jaki*, Ternate, Tidore.

Note. COPELAND Jr (*l.c.*) studied the reproductive structure. According to him the summit of the obconical pedicel (the receptacle) bears the floral parts, there is no disk in the flower, and all anthers are fertile. After the study of the vascular system he suggested that the pistil is tricarpellate, but it is so reduced as to have the outward appearance of a single carpel.

4. MANGIFERA

LINNÉ, Gen. Pl. ed. 5 (1754) 93; Sp. Pl. (1753) 200; HOOK. *f.* in B. & H. Gen. Pl. 1 (1862) 420; MARCH. Rév. Anacard. (1869) 102 & 188; HOOK. *f.* Fl. Br. Ind. 2 (1876) 13; ENGL. in DC. Mon. Phan. 4 (1883) 195; PIERRE, Fl. For. Coch. (1897) *sub expl.* t. 364 & 365; CORNER, Ways. Trees (1940) 106; MUKHERJI, Lloydia 12 (1949) 77; DING HOU, Blumea 24 (1978) 21. — **Fig. 7–12.**

Trees. *Leaves* spiral, simple, entire, glabrous, petioled. *Inflorescences* paniculate, terminal and/or axillary, often crowded at the apex of twigs, sometimes seemingly fasciculate. *Flowers* ♂ or bisexual on the same plant (plants andromonoecious); pedicels articulated. *Calyx* 4- or 5-lobed. *Petals* 4 or 5, imbricate, rarely contorted, glabrous outside, often with excrescences from the glands thickened into ridges on the inner surface, free (except in *M. superba* where they are partly adnate to the disk). *Disk* usually extra-, rarely intrastaminal, short-cupular, pulvinate, or stipe-like, sometimes obsolete in ♂, rarely cylindric and torus-like (*M. superba*), often lobed, sometimes notched or furrowed, papillose or not. *Stamens* usually 5, rarely 10(–12, *extra*-Mal.), usually 1–2 fertile, the others much shorter and smaller (with imperfect or sterile anthers) or filamentous, very rarely 3–5, or all 5 fertile; filaments free or connate at the base; anthers dorsifixed. *Ovary* 1-celled, glabrous, abortive in ♂; style excentric or lateral; stigma simple, often slightly thicker than the style. *Drupe* 1-celled, resinous; mesocarp often fleshy and thick especially in cultivated *spp.*; endocarp (or stone) ligneous or fibrous. *Seed* with testa (1 or 2

layers) free from the endocarp, in a few species labyrinthine (testa present in the crevices of lobes or folds of cotyledons); embryo(s) straight; cotyledons plano-convex, mostly smooth, sometimes lobed or folded.

Distr. About 35 *spp.*, in Ceylon, India, Burma, Thailand, Indo-China, and China (Yunnan); throughout *Malesia* to the Solomons. Fig. 8.

One species, *M. indica*, the mango, is widely cultivated in the tropics; several others are cultivated locally in Malesia in villages, and may have naturalized beyond their proper native range, so that it is for some species almost impossible to indicate their proper place of origin. The polymorphous *M. odorata* may be a hybrid swarm, originated from hybridization of *M. foetida* and *M. indica*.

Ecol. In forests, usually scattered, chiefly from sea-level to 600 m, more rarely up to 1000 m, occasionally recorded between 1000 and 1800 m. Cultivated *spp.* are grown usually below 600 m.

Mango trees have generally rather thick trunks and often a massive dark-green crown. The largest tree ever recorded is of *M. altissima*, and was collected in Guadalcanal (Solomons), the easternmost limit of the genus; it measured 54 m, with a clear bole of 27 m.

In the forest they occur generally scattered and some appear to be by no means common, some even very rare. *M. gedebe* can occur as a sub-codominant in the *rapak* type of swamp forest; *N. inocarpoides* is recorded as sometimes common in riverine forest.

Taxon. In my precursor (Blumea 24, 1978, 22) I have discussed the subdivision of the genus and concluded that the species can be arranged into two sections.

Poly-embryony of mango. The seed of mango, *M. indica*, contains usually only one embryo (mono-embryonic), sometimes more than one (poly-embryonic). In the latter type one seed frequently produces 6–8 seedlings and sometimes as many as 30 have been observed. The extra embryos are adventitious and originate either from the nucellus or by budding from the cotyledons or the hypocotyl. It has been reported that poly-embryonic stocks induce more scion vigour than the mono-embryonic ones and poly-embryonic seedlings transmit their characters to their offspring in a remarkable degree. Poly-embryonic cultivars are reported growing in Burma, Java, Malay Peninsula, the Philippines, Florida, Hawaii, Cuba, Puerto Rico, Jamaica and South Africa. *Cf.* WESTER, Bull. Bur. Agr. Philip. 18 (1920) 17; SINGH, The Mango (1960, repr. 1968) 22–25.

Morph. So far known the seeds of three species are labyrinthine: the testa of these labyrinth seeds fills the crevices between the transverse folds and lobes of the cotyledons which closely adhere together. See fig. 7n–o. Labyrinth seeds occur in *M. camptosperma* PIERRE (Indo-China), *M. gedebe* (Sumatra, W. Java, Borneo), and *M. inocarpoides* (New Guinea). *Cf.* VAN HEEL, Blumea 19 (1971) 109.

In *M. pajang* the cotyledons are unequal, one partly embracing the other. Fig. 7l–m.

In several *Mangifera spp.* the leaves have fibers which show upon breaking dried leaves, *e.g. M. caesia*, *M. decandra*, *M. lagenifera*, and *M. superba*.

Uses. One species of *Mangifera*, *M. indica*, is widely cultivated in the tropics for the popular fruit commonly called 'mango'; it has many cultivars. Besides the Indian mango, *M. foetida*, *M. caesia*, and *M. odorata* are in Malesia often planted for edible fruits or just as village trees; some other species are cultivated locally, *e.g. M. griffithii*, *M. lagenifera*, *M. longipes*, *M. minor*, *M. pajang*, *M. similis*, *etc.*

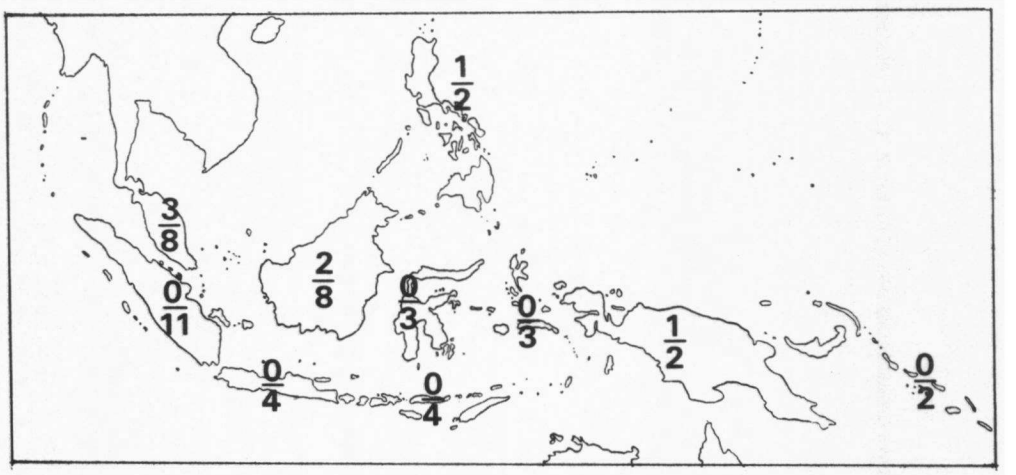

Fig. 8. Density of *Mangifera spp.* in Malesia, the number of endemic *spp.* of each island (group) above the hyphen, the number of non-endemic ones below the hyphen. *M. indica* and *M. odorata* left out of consideration as their precise native distribution is unknown.

M. pajang, described by KOSTERMANS (Reinwardtia 7, 1965, 20) from Borneo, has globose to ellipsoid fruits *c.* 15 cm ∅ (often more), with yellowish white, sweet-acid pulp. According to him, it "is a well-known cultivated and wild one, related to *Mangifera foetida*". The thick rind of the fruit can be peeled off like a banana when eaten. So far known the fruits "are the largest of the genus *Mangifera* and may reach dimensions of a small coconut". This species deserves special mention here for future experimental breeding in order to improve the quality of the fruit.

The ripe fruits of *M. indica* and some other species are eaten raw. They are also used for making jams, jellies, and preserves. Unripe fruits are used for making pickles, chutneys, vinegar, *etc.* and sometimes are sliced and sun-dried for grinding into powder or making other preparations.

In *Mangifera* the rind of unripe fruits and sometimes also some other parts of the trees may contain irritant sap and may cause inflammation when touched by susceptible persons. Because of the irritant sap the young fruits of *M. foetida* and *M. odorata* are not eaten by the people. The sap of the barks, even the vapour of freshly bruised tissues, the smoke from a bonfire of their leaves or raindrops from the crown of the following species may affect the skin: *M. caesia*, *M. foetida*, *M. lagenifera*, and *M. odorata*; *cf.* K. & V. Bijdr. 4 (1896) 97; CORNER, Ways. Trees (1940) 107.

In Java the young leaves of some races of *M. indica* are used as vegetable with the rice.

Trees of some *Mangifera spp.* can attain a large size, *e.g. M. caesia*, *M. foetida*, *M. pajang*, *M. similis*, *etc.* The timber is used in many ways, *e.g.* for boards, doors, boxes, planking, *etc.*, but it is not durable.

For more details on uses see HEYNE, Nutt. Pl. (1927) 966–970; BURK. Dict. (1935) 1400–1407; BALAN MENON, Mal. For. 21 (1968) 38.

Vern. Malaysian standard timber name: *machang*.

Notes. Unfortunately the fruit of several species is inadequately known, so no separate key can be provided for fruiting material. Its characters are of different sources, sometimes on dried fruit in the herbarium, sometimes derived from material in liquid, data of field notes, or literature. In this genus it is mostly impossible to identify single fruits or sterile material. Also collections made of fallen fruits combined with twigs from the lower branches may be deceptive, as leaves vary considerably on a single tree; see the note under *M. griffithii*.

In collecting fruiting material it is useful to make notes on colour, smell, size, *etc.*, to section the fruit in various directions and to make notes on the structure of the embryo, and add slices *c.* 1 cm thick to the herbarium material.

KEY TO THE SPECIES

Based mainly on flowering specimens, occasionally using fruit characters

1. Disk short-cupular, rarely pulvinate and concave above, (partly or completely surrounding the ovary in bisexual flowers), usually 4- or 5-lobed, papillose. Filaments free . . . . 1. SECT. MANGIFERA
2. Stamens 5, 3–5 fertile . . . . . **1. M. pentandra**
2. Stamens 5 or 4, only 1 (rarely 2) fertile.
3. Flowers 5-merous, very rarely associated with some 4-merous ones.
4. Inflorescences usually densely branched and flowered, tomentose. Calyx lobes densely puberulous on both surfaces especially outside . . . . . **2. M. indica**
4. Inflorescences laxly branched and flowered, puberulous or sparsely puberulous, glabrescent, or glabrous. Calyx lobes sparsely puberulous only outside or glabrous.
5. Inflorescences and calyx lobes puberulous, rarely glabrescent. Pedicels $1^1/_2$–$2^1/_2$ mm. Disk pulvinate and concave above. Petals lanceolate. Fruits obliquely subglobose . . . . . **3. M. longipes**
5. Inflorescences and calyx lobes glabrous. Pedicels longer, 3–4 mm. Disk short-cupular. Petals narrowly elliptic, or linear. Fruits obliquely oblong . . . . . **4. M. minor**
3. Flowers 4-merous, very rarely associated with some 5-merous ones.
6. Petals with apical parts of ridges free from the inner surface.
7. Free parts of ridges parallel to the surface. Fruits (fresh) yellowish green, globose **5. M. similis**
7. Free parts of ridges bent away from the surface. Fruits (fresh) dark purple, broadly ellipsoid **6. M. quadrifida**
6. Petals with apical parts of ridges not free from the inner surface.
8. Inflorescences puberulous or pubescent, sometimes glabrescent. Fruits (fresh) $5^1/_2$–9 by 4–9 cm (but smaller in *M. griffithii*).
9. Inflorescences terminal and sometimes also in the apical leaf axils, usually crowded at the apex of the twigs.
10. Petals ovate- or elliptic-oblong, $1^1/_2$–2 mm wide . . . . . **7. M. altissima**
10. Petals lanceolate, $^2/_3$–$1^1/_4$ mm wide.
11. Ridges on the inner surface of the petals merged only at the very base. Seed not labyrinthine **8. M. griffithii**
11. Ridges on the inner surface of petals merged at the lower 1–2 mm.
12. Petals with 3 ridges on the inner surface. Seed with transverse lobes or folds (shown on cross-section) . . . . . **9. M. inocarpoides**
12. Petals with 3(–5) ridges on the inner surface. Seed with very irregular lobes or folds (shown on cross-section) . . . . . **10. M. gedebe**
9. Inflorescences axillary only, often in several successive leaf axils. . . . . **11. M. parvifolia**

8. Inflorescences glabrous. Fruits smaller (fresh or dried), $2^1/_2$–$3^1/_2$ by $1^3/_4$–$2^1/_2$ cm (not known in *M. gracilipes*).
13. Inflorescences terminal sometimes also in the uppermost leaf axil, distinctly paniculate and pyramidal.
14. Petals lanceolate, $1^1/_4$ mm wide; ridges 3(–5) on the inner surface. Leaves with 8–12 pairs of nerves; apex acuminate . . . . . **12. M. havilandii**
14. Petals elliptic, rarely ovate, $1^1/_2$–$2^1/_2$ mm wide; ridges (3–)5(–7) on the inner surface. Leaves with 14–23 pairs of nerves; apex acute or obtuse . . . . . **13. M. timorensis**
13. Inflorescences terminal and also in the apical leaf axils, crowded at the apex of the twigs, seemingly fasciculate.
15. Leaves elliptic to elliptic-oblong, obovate-oblong or oblanceolate, (7–)13–19 cm long; veins distinct beneath, faint above . . . . . **14. M. monandra**
15. Leaves elliptic-lanceolate, 7–10 cm long; veins obscure on both surfaces **15. M. gracilipes**

1. Disk pulvinate, rarely cylindric and torus-like, often reduced and stipe-like, (at the base of ovary in bisexual flowers), usually not lobed, not papillose, rarely obsolete in ♂. Filaments often connate at the base, sometimes free . . . . . 2. SECT. LIMUS
16. Leaves elliptic to narrowly lanceolate, or obovate to oblanceolate, or spathulate, 5–43 by 2–16 cm, leaf-index usually less than 4.
17. Petals not ridged on the inner surface. Stamens 10: 5 fertile and 5 sterile.
18. Leaves large (usually 27–38 by 12–15 cm); apex mucronate. Flowers reddish or pink. Fertile stamens with one much longer than the others. Fruits ellipsoid . . . . . **16. M. decandra**
18. Leaves small (8–18 by $2^1/_2$–$4^1/_2$ cm); apex obtuse or rounded. Flowers deep violet. Fertile stamens ± equal. Fruits pyriform . . . . . **17. M. lagenifera**
17. Petals distinctly ridged on the inner surface. Stamens 5: 1 (or 2) fertile, 4 (or 3) imperfect or sterile, or all fertile (*M. superba*).
19. Leaves without hair-like fibers shown upon breaking; petiole not flattened. Inflorescences usually glabrous. Petals with 3(–5) ridges confluent at the basal part.
20. Leaves rigidly coriaceous; apex obtuse, rounded, notched, acute, or mucronate; veins invisible or obscure on both surfaces.
21. When fresh: Inner surface of petals pinkish. Ovary ochraceous. Fruits obliquely ovoid, yellowish or greyish green, smooth . . . . . **18. M. foetida**
21. When fresh: Inner surface of petals purple. Ovary white. Fruits broadly ovoid or globose, brownish, roughish . . . . . **19. M. pajang**
20. Leaves subcoriaceous, not rigid; apex short-acuminate, acute, rarely obtuse; veins distinct on both surfaces. Fruits dark green, obliquely ovoid or broad-ellipsoid . . . . **20. M. odorata**
19. Leaves with hair-like fibers shown upon breaking; petiole flattened. Inflorescences pubescent or tomentose. Petals with only one ridge.
22. Petals 5–8 mm long. Fertile stamens 1 (or 2) . . . . . **21. M. caesia**
22. Petals 20–25 mm long. Fertile stamens 5 . . . . . **22. M. superba**
16. Leaves linear, sometimes linear-lanceolate, rarely spathulate, (9–)15–60 by $(1^1/_4$–$)3^1/_2$–5 cm, leaf-index more than (7–)10 . . . . . **23. M. macrocarpa**

1. Section Mangifera

DING HOU, Blumea 24 (1978) 23.

Disk short-cupular, rarely pulvinate and concave above, (partly or completely surrounding the ovary in bisexual flowers), usually 4- or 5-lobed, papillose. Filaments free at the base.

1. Mangifera pentandra HOOK. *f.* Fl. Br. Ind. 2 (1876) 14; ENGL. in DC. Mon. Phan. 4 (1883) 198; KING, J. As. Soc. Beng. 65, ii (1896) 472; PIERRE, Fl. For. Coch. (1897) t. 364F; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 89; Fl. Mal. Pen. 1 (1922) 522; CORNER, Ways. Trees (1940) 111; MUKHERJI, Lloydia 12 (1949) 81. — *M. lanceolata* RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 90; Fl. Mal. Pen. 1 (1922) 522; MUKHERJI, Lloydia 12 (1949) 81; DING HOU, Blumea 24 (1978) 28.

Tree up to 24 m high. *Leaves* coriaceous, oblong, oblong-lanceolate, or lanceolate, 12–$30^1/_2$ by $3^3/_4$–11 cm; base obtuse or rounded; apex shortly acuminate or acuminate; nerves 12–23 pairs, elevated beneath, distinct above; veins reticulate, distinct on both surfaces; petiole $1^1/_2$–$3^1/_2$ cm, biconvex, or flat above. *Panicles* terminal, pyramidal, 15–30 cm long, pubescent; lateral branches up to $12^1/_2$ cm, densely flowered; floral bracts ovate, 1–2 mm long; pedicels $^1/_2$ mm. *Flowers* cream-white. *Calyx* 5-lobed, lobes ovate, 2–3 mm long, pubescent outside. *Petals* 5, elliptic-oblong, 3–$4^1/_2$ by $1^1/_2$–2 mm; ridges 5(–7), *c.* $^2/_3$ the length of petals, confluent at the basal $^1/_3$. *Disk* short-cupular, $^1/_2$–1 mm high, $1^1/_2$–2 mm wide, 5-lobed, papillose. *Stamens* 5, 3–5 fertile, 1–$3^3/_4$ mm; filaments free; anthers oblong, $^2/_3$ mm long; staminodes if present very small. *Ovary* subglobose, $1^3/_4$ mm ∅; style subterminal, 2 mm. Sterile pistil in ♂ $^1/_2$ mm. *Drupe* (fresh, CORNER, *l.c.*) oblong, $7^1/_2$–10 by 5–$6^1/_4$ cm, ripening green, rather fragrant, flesh watery, pale orange, rather sweet with fewer fibers.

Distr. *Malesia:* Malay Peninsula (Kedah, Perak, Pahang, Johore, and Singapore).

A common village tree in Kedah.

Ecol. In lowland areas and forest near the sea. *Fl.* Febr.; *fr.* Febr.–March.

Vern. *Manga dodol, mempelam bemban, pauh, pauh damar,* M.

2. Mangifera indica LINNÉ, Sp. Pl. (1753) 200; BURM. *f.* Fl. Ind. (1768) 62; LINNÉ, Syst. Veg. (1774) 242; ROXB. Fl. Ind. ed. Wall. 2 (1824) 435; ed. Carey 1 (1832) 641; BLANCO, Fl. Filip. (1837) 179; ed. 2 (1845) 127; ed. 3, 1 (1877) 229; WALP. Rep. 1 (1842) 555; BL. Mus. Bot. 1 (1850) 193; MIQ. Fl. Ind. Bat. 1, 2 (1859) 628; HOOK. *f.* Fl. Br. Ind. 2 (1876) 13; F.-VILL. Nov. App. (1880) 54; ENGL. in DC. Mon. Phan. 4 (1883) 199; VIDAL, Sinopsis Atlas (1883) 22, t. 36, f. D; Phan. Cuming. (1885) 106; Rev. Pl. Vasc. Filip. (1886) 99; KING, J. As. Soc. Beng. 65, ii (1896) 472; K & V. Bijdr. 4 (1896) 79; PIERRE, Fl. For. Coch. (1897) t. 361; MERR. Philip. J. Sc. 1 (1906) Suppl. 84; BACK. Fl. Bat. (1907) 361; LECOMTE, Fl. Gén. I.-C. 2 (1908) 18, f. 4; MERR. Philip. J. Sc. 3 (1908) Bot. 80; BACK. Schoolfl. (1911) 279; MERR. Fl. Manila (1912) 300; Int. Rumph. (1917) 331; Sp. Blanc. (1918) 232; En. Born. (1921) 349; LAUT. Bot. Jahrb. 56 (1921) 353; RIDL. Fl. Mal. Pen. 1 (1922) 523; MERR. En. Philip. 2 (1923) 468; CRAIB, Fl. Siam. En. 1 (1926) 344; HEYNE, Nutt. Pl. (1927) 967; HOLTTUM, Gard. Bull. S. S. 5 (1931) 199; OCHSE & BAKH. Fruit (1931) 9, t. 4–6; KANEH. Bot. Mag. Tokyo 45 (1931) 292; Fl. Micronesica (1933) 185; BURK. Dict. (1935) 1402; CORNER, Ways. Trees (1940) 109, f. 22, Atlas t. 11; MUKHERJI, Lloydia 12 (1949) 83; BROWN, Useful Pl. Philip. 2 (1950) 340, f. 165–166; QUIS. Medic. Pl. Philip. (1951) 538; SHARMA, Phytomorph. 4 (1954) 201; DE WIT, Rumph. Mem. Vol. (1959) 386; SINGH, The Mango (1960, repr. 1968) 13, many figs.; TARD. Fl. C. L. & V. 2 (1962) 90; LIU, Ill. Pl. Taiwan 2 (1962) 935, f. 770; KOCHUM. Mal. For. Rec. 17 (1964) 295; BACK. & BAKH. *f.* Fl. Java 2 (1965) 149; PURSEGLOVE, Trop. Crops 1 (1968) 24, f. 2; WALKER, Fl. Okin. & S. Ryu Kyu Is. (1976) 662, f. 102. — *M. arbor* HERMANN, Mus. Zeyl. (1717) 59–66; BURM. Thes. Zeyl. (1731) 152; LINNÉ, Fl. Zeyl. (1747) 211. — *Manga domestica* RUMPH. Herb. Amb. 1 (1747) 93, t. 25. — *Manga calappa* RUMPH. *l.c.* 96. — *Manga simiarum* RUMPH. *l.c.* — *M. domestica* GAERTN. Fruct. 2 (1790) 95, t. 100. — *M. indica* (*non* L.) BL. Bijdr. (1826) 1157. — *M. linnaei* KORTH. *ex* HASSK. Cat. Hort. Bog. (1844) 245. — *M. anisodora* BLANCO, Fl. Filip. ed. 2 (1845) 129, ed. 3, 1 (1877) 229. — *M. rostrata* BLANCO, *l.c.* 129, *l.c.* 231, t. 62. — *M. laurina* BL. Mus. Bot. 1 (1850) 195; MIQ. Fl. Ind. Bat. 1, 2 (1859) 629; ENGL. in DC. Mon. Phan. 4 (1883) 202; PIERRE, Fl. For. Coch. (1897) t. 364A; MERR. Int. Rumph. (1917) 331. — *M. kukula* BL. Mus. Bot. 1 (1850) 192, *cum var. num.*

Tree 10–30(–45) m high and up to 60(–120) cm ∅. Bark grey, greyish brown, longitudinally fissured. *Leaves* subcoriaceous, chartaceous, or membranaceous, variable in size and shape, usually lanceolate, elliptic to narrowly elliptic, 10–30 by 2–9½ cm, glabrous; base acute or cuneate; apex acute to acuminate; nerves 12–30 pairs, elevated on both surfaces; veins reticulate, distinct on both surfaces; petiole 1½–7½ cm, convex beneath, grooved or flat above. *Panicles* terminal, sometimes also in the uppermost leaf axil, pyramidal, 6–44 cm long, tomentose; lateral branches up to 15 cm, densely flowered; floral bracts ovate-oblong, 3–5 mm long; pedicels *c.* 1 mm. *Flowers* usually greenish yellow or pale cream. *Calyx* 5-lobed, lobes ovate-oblong or elliptic, densely puberulous on both surfaces especially on the outside. *Petals* 5, elliptic, elliptic-oblong, or ovate-oblong, 3–5 by 1½–2 mm, ½–⅔ the length of petals, confluent often at the lower half. *Disk* short-cupular, 1–1½ mm high, 1½ mm ∅, 5-lobed or -notched, papillate. *Stamens* 5, 1 (rarely 2) fertile, 2–3 mm; filaments free; anthers ovoid, *c.* ⅔ mm long; staminodes 1–1½ mm. *Ovary* obliquely ovoid or subglobose, 1–1½ mm ∅; style excentric, 1½–2 mm. Sterile pistil in ♂ obscure or absent. *Drupe* (fresh) (OCHSE & BAKH. *l.c.*) very variable as to shape, size, and colour, usually ovoid-oblong, very unequal-sided, 4–25 by 1½–10 cm, yellowish green, yellow, or red in many shades when ripe; flesh yellow or orange coloured, juicy, savoury; stone rather thick, with a fibrous coat, very hard. *Seed* not labyrinthine.

Distr. Probably a native of Indo-Burma region (*cf.* MUKHERJEE, J. Linn. Soc. Lond. 55, 1953, 65–83), and widely cultivated throughout the tropics of both hemispheres.

In *Malesia* generally planted as a village tree and cultivated commercially in Malay Peninsula, Java, and the Philippines. Seemingly indigenous or naturalized found in India, Burma, Thailand, Indo-China, and some islands of West Malesia.

Ecol. Generally cultivated below 500 m, escaped or naturalized, or indigenous trees occurring in (primary) forest from the lowland up to 1700 m. CORNER noted that mango trees fruit in the fourth year from seed. *Fl. fr.* Jan.–Dec.

Morph. From the study of the vascular anatomy of the flower of *M. indica*, SHARMA (Phytomorph. 4, 1954, 201–207, f. 1–36) concluded, besides other findings, that (1) the glandular disk "appears to be a receptacular outgrowth", (2) "the ancestral mango flower had at least two whorls of stamens", and (3) ". . . the monocarpellary condition appears to have been derived from a tricarpellary condition".

Nomencl. BLUME distinguished many varieties of *M. indica* and *M. laurina* (Mus. Bot. 1, 1850, 193–197). I have refrained from evaluating these.

Uses. In India the mango has been cultivated for over 4000 years and is now said to have nearly 1000 horticultural varieties or cultivars. There are several institutes and experimental stations for research on this economically important fruit tree. For detailed information on its botany, classification of cultivars, names of (important) cultivars, uses, *etc.*, I refer to the following publications which contain also extensive literature: P. J. WESTER, The Mango. Bull. Bur. Agr. Philip. 18 (1920) 1–70, figs.; K. HEYNE, Nuttige Planten (1927) 967–969; S. K. MUKHERJEE, The Mango. Econ. Bot. 7 (1953) 130–160, figs.; L. B. SINGH, The Mango (1960, repr. 1968) 1–438, figs., Leonard Hill, London.

In Java and Malaya the number of races or varieties *cq.* cultivars is legion, mostly unfixed: that is to say, they do not reproduce themselves truly

from seed, which is why mango growers rely on grafting for retaining valuable trees.

Mango trees fruit in the fourth year from seed, but OCHSE said after 6–8 years.

Vern. (*cf.* OCHSE & BAKH. Fruit, 1931, 9) Sumatra: *balĕm, manggi, mĕmplan*, Simalur, *bem*, Palembang, *eesem, hampĕlom, isĕm, kapĕlam, kapĕlom, pĕlĕm, pĕlom*, Lampongs, *lĕmpĕlam*, Alas, Gajo, *mamplan*, Atjeh & Simalur, *mangga*, Batak & Lampongs, *morpolom, pauh*, Batak, *maga*, Nias, *pègun, pèigu*, Mentawai; Malay Peninsula: *mangga, mempĕlam, pauh*; Java: *booah, mangga bapang, m. daging, m. dòdòl, m. gajam, m. gĕdung, m. gepeng, m. hurang, m. klapa, m. kopijor, m. manggala, m. pari, m. roti, m. sĕngir, m. sĕngir gadung, m. taj kuda, m. takulu, m. tjĕngkir, m. tjupu, m. wangi, pari*, S, *djongkoh, mangga daging, m. endòg, pao, pĕlĕm, p. bapang, p. bĕtu, p. dòdòl wangi, p. endòg, p. gandĕ, p. gadung, p. gandik, p. gĕtas, p. kèjong, p. kidang, p. kòpjòr, p. lĕrak, p. madu, p. poh, p. santòk, p. sĕngir*, J, *kadĕper, mangga, m. bĕngala, m. daging, m. dòdòl, m. madu, m. ubi, m. udang*, M, *pao gĕlèk, p. kĕtjipet, p. kòlèh, p. kòtjòr, p. tĕlor*, Md; Lesser Sunda Is.: *amplĕm, poh, gĕtas*, Bali, *dodo maja, maja malieng, mopalai, palela*, Alor, *oopo, pauh, porgo*, Sumba, *mo, pau*, Flores; Borneo: Sabah: *ba-ab*, Dusun, *mangga ayĕr, m. malina, m. suluk, m. tĕlor, pulau manila*, M, *mĕmpalang, mampallam*, Suluk, *ampalam, hampalam, mang(g)a, tĕkorang*, Dajak; Philippines: *manga chupadera*, Spanish, *mampalam, mampalang*, Sulu, *mánga*, Ilk., Ig., Tag. & Mag., *manggan duluhan*, If., *mañgang kalabán*, Tag., *mangka*, Ig., *páho*, C.Bis., *páo*, Bontoc; Celebes: *ooai*, Sangir, *pao*, Mandar & Salajar; Moluccas: *aoo hoowané, apalam, apalané, ayaer, balamo, haoo, mabĕlang, mampalang, manggo utam, mapoolané, pota-pota*, Ceram, *mangka kĕtjil*, Obi I., *maplane, maplangé, pawĕn*, Ambon, *guawè, lèlit, walè*, Halmaheira, *guwaè*, Ternate, Tidore; W. New Guinea: *manilja, pagĕr, peebèrèkari*.

3. Mangifera longipes GRIFF. Notul. 4 (1854) 419; HOOK. *f.* Fl. Br. Ind. 2 (1876) 15; KURZ, Fl. Burma 1 (1877) 303; ENGL. in DC. Mon. Phan. 4 (1883) 201; KING, J. As. Soc. Beng. 65, ii (1896) 473; PIERRE, Fl. For. Coch. (1897) t. 365A; BACK. Schoolfl. (1911) 278; RIDL. Fl. Mal. Pen. 1 (1922) 523; MERR. En. Philip. 2 (1923) 468; BURK. Dict. (1935) 1406; MUKHERJI, Lloydia 12 (1949) 88, f. 1, *incl. var. glabrescens* MUKHERJI, *l.c.* 89, f. 2 & 27; TARD. Fl. C. L. & V. 2 (1962) 95, t. 3, f. 9–11; KOCHUM. Mal. For. Rec. 17 (1964) 295; BACK. & BAKH. *f.* Fl. Java 2 (1965) 148. — *M. sumatrana* MIQ. Fl. Ind. Bat. 1, 2 (1859) 630. — *M. parish* MIQ *l.c.* 631.

Tree up to 20–30(–35) m high and 40–90 cm ∅, very rarely up to 130–150 cm ∅. Buttresses occasionally present, 1–2 m high, 1 m wide. Bark blackish brown, lenticellate, longitudinally cracked. *Leaves* chartaceous to subcoriaceous, elliptic-lanceolate or lanceolate, $6^1/_2$–$24^1/_2$ by $2^1/_2$–6 cm; base cuneate to attenuate; apex acuminate; nerves 10–20 pairs, slightly elevated beneath, distinct above; veins reticulate, faint; petiole $1^1/_2$–$3^1/_2$(–6–8) cm, convex beneath, bisulcate or flat above. *Panicles* terminal and sometimes also in the uppermost leaf axils, pyramidal, 10–40 cm long, puberulous, rarely glabrescent; lateral branches up to 20 cm, laxly flowered; floral bracts ovate to lanceolate, $1^1/_2$–2 mm long; pedicels $1^1/_2$–$2^1/_2$ mm. *Flowers* greenish white. *Calyx* 5-lobed, lobes ovate, 2–$2^1/_2$ mm long, sparsely puberulous outside, rarely glabrescent. *Petals* 5, lanceolate, $3^1/_2$–$5^1/_2$ by 1–$1^1/_2$ mm; ridges 3(–5), *c.* $^1/_2$ the length of the petals, confluent at the basal 1–$1^1/_2$ mm. *Disk* pulvinate and concave above, $^2/_3$–1 mm high, $1^1/_2$–2 mm wide, 5-lobed, papillose. *Stamens* 5, 1 fertile, 2–4 mm; filaments free; anthers ovoid, *c.* $^2/_3$ mm; staminodes up to $^2/_3$ mm. *Ovary* subglobose, $1^1/_4$–$1^3/_4$ mm ∅; style excentric, 1–$2^3/_4$ mm. Sterile pistil in ♂ *c.* $^1/_3$ mm. *Drupe* (fresh or dried) obliquely subglobose, 5–10 by 4–8 cm, flesh thin, with one big stone. *Seed* not labyrinthine.

Distr. *Malesia:* Sumatra, Malay Peninsula, Java, Lesser Sunda Is., Borneo, and Philippines.

Sometimes also cultivated near villages.

Ecol. In lowland primary forest, sometimes also in secondary forest, rarely on coral limestone, usually up to 400 m, occasionally at 1000–1500 m. *Fl. fr.* Febr.–Nov.

Vern. Sumatra: *asam pan*, Kaju Agung, *asam tais*, M, *ampĕlam dotan, awa mampalam* (*uding*), Simalur, *gĕrat*, Batak, *kaju mangga bogor*, Tapanuli, *kĕdĕpir, pau*, Palembang, *mangga tiakar, pauh gadang*, W. Sum.; Malay Peninsula: *boa pow*, M; Java: *mangga pari, parih, parii kumbang*, S, *pĕlĕm kĕtjik*, J, *plĕm plĕm*, M, *pau alas*, Kangean; Lesser Sunda Is.: *manga utan, opossui*, Timor, *pau deamang, pĕlam, pĕlam buset*, Sumbawa; Borneo: Sarawak: *kuini*, Baran; Kalimantan: *asam hurang, a. pĕlipisan*, M, *asam kĕpaeng, repies*, Bassap, *asam pau*, Pontianak; Sabah: *lagawa*, Dusun, *mangga ayĕr, m. manila, m. tĕlor, mĕmpĕlam, pauh hutan*, M, *pauh kijang*, Tawau; Philippines: *apali*, Tagb.

4. Mangifera minor BL. Mus. Bot. 1 (1850) 198; MIQ. Fl. Ind. Bat. 1, 2 (1859) 631; ENGL. in DC. Mon. Phan. 4 (1883) 202; WARB. Bot. Jahrb. 13 (1891) 361; LECOMTE, Fl. Gén. I.-C. 2 (1908) 17; MERR. Int. Rumph. (1917) 331; LAUT. Bot. Jahrb. 56 (1921) 353; LANE-POOLE, For. Res. (1925) 107; WHITE & FRANCIS, Proc. R. Soc. Queensl. 38 (1927) 237; WHITE, J. Arn. Arb. 10 (1929) 234; MERR. & PERRY, J. Arn. Arb. 22 (1941) 532; WALKER, For. Brit. Solomon Isl. Protect. (1948) 92; MUKHERJI, Lloydia 12 (1949) 96; KRAEMER, Trees West. Pacif. Reg. (1951) 200, f. 70; DE WIT, Rumph. Mem. Vol. (1959) 386; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 28, f. 10. — *Manga domestica minor* RUMPH. Herb. Amb. 1 (1741) 94.

Tree up to 18–32 m high and 30–90(–120) cm ∅, once recorded with buttresses up to 5 m high, 2 m wide, 5 cm thick (BW 7272). Bark grey, light brown, or brown, deeply vertically fissured, broadly ridged. *Leaves* chartaceous to subcoriaceous, elliptic-lanceolate to narrowly elliptic, sometimes oblanceolate, 12–19 by $3^1/_2$–$5^1/_2$ cm; base cuneate; apex acuminate, obtuse, or acute; nerves 10–20 pairs, slightly elevated beneath, distinct above; veins reticulate, faint or obscure; petiole 1–3 cm, biconvex, or slightly concave above. *Panicles* terminal, sometimes also in the uppermost leaf axil, pyramidal, up to 30 cm long, glabrous; lateral branches up to 16 cm, laxly flowered; floral bracts ovate or lanceolate, 1–2 mm long; pedicels

3–4 mm. *Flowers* yellowish, fragrant. *Calyx* 5-lobed, lobes ovate or ovate-oblong, 2–2¹/₂ mm long, glabrous. *Petals* narrowly elliptic, or linear, 5–6 by 1–1¹/₂ mm; ridges 3(–5), *c.* ²/₃ the length of petals, confluent at the basal 2–2¹/₂ mm. *Disk* short-cupular, 1–1¹/₂ mm high, 1–2 mm wide, 5-lobed, papillose. *Stamens* 5, 1 fertile, 2¹/₂–5 mm; filaments free; anthers oblong, *c.* ²/₃ mm long; staminodes ¹/₆–²/₃ mm. *Ovary* subglobose, 1¹/₂ mm ∅; style excentric, 4 mm. Sterile pistil in ♂ *c.* ¹/₃ mm. *Drupe* (fresh or dried) obliquely oblong, 5–10 by 4–6¹/₂ cm, flesh thin or nearly fleshless, with one fibrous, large stone. *Seed* not labyrinthine.

Distr. Solomons (Guadalcanal, Malaita, San Cristóbal, Santa Isabel, Bougainville) and New Britain; in *Malesia:* New Guinea (scattered throughout), Moluccas (Aru, Ceram, Ambon), Celebes (throughout, incl. Muna & Buton Is.), and Lesser Sunda Is. (Flores, Timor), Micronesia.

Sometimes also planted near villages.

Ecol. In lowland primary, sometimes also secondary forest, sometimes up to 400–750 m, occasionally up to 1000–1350 m. *Fl. fr.* Febr.–Dec.

Uses. The wood is intermediate hard. It is used for light construction and furniture (*cf.* ROYEN, *l.c.*).

Vern. Solomon Is.: *asai*, Kwara'ae name; Lesser Sunda Is.: *upusuplia*, Timor, *pao kodé*; Celebes: *fo karuku*, Muna, *kayu taipa dare*, Sirondjong, *taipa dondri*, Bonthain, *taipa wana*, Malili; New Guinea: *auroro*, Vailala, *awu*, *awuk*, *kau*, Mooi, *bagitza*, Garaina, *bebi*, Hewa, *bibue*, Dumpu, *bush-mango*, Wanigela, *dua*, Yalu, *ewa*, Buna, *gaja*, *kwasi*, Aru, *ihara*, Suku, *kawij*, *kusig* or *kusieg*, *kust*, *kuti*, *kuwia*, *kuwij*, *leosi*, *puoba*, Manokwari, *mangga utan*, *wasumar*, Rauna, *mogari*, Tapio, *velu*, Amele, *wai*, Karoon, *wewe*, Faita, *wiwo*, Bilia, *yuwi*, Morobe.

5. Mangifera similis BL. Mus. Bot. 1 (1850) 200; MIQ. Fl. Ind. Bat. 1, 2 (1859) 633; ENGL. in DC. Mon. Phan. 4 (1883) 207; K. & V. Bijdr. 4 (1896) 84; BACK. Schoolfl. (1911) 277; MUKHERJI, Lloydia 12 (1949) 105, f. 12; BACK. & BAKH. *f.* Fl. Java 2 (1965) 148; DING HOU, Blumea 24 (1978) 29. — *M. torquenda* KOSTERMANS, Reinwardtia 7 (1965) 21, f. 2.

Tree up to 32 m high and 53(–100) cm ∅. Bark light brownish, smooth. *Leaves* coriaceous, elliptic-oblong, lanceolate, or obovate-oblong, 7–21 by 2³/₄–9 cm; base cuneate or attenuate; apex acute to shortly acuminate, rarely acuminate; nerves 14–20 pairs, distinct; veins reticulate, distinct beneath, obscure above; petiole 1–4¹/₂(–8¹/₂) cm, convex beneath, concave or flat above. *Panicles* terminal, pyramidal, 8–28 cm long, puberulous, sometimes glabrescent; lateral branches up to 10 cm, laxly flowered; floral bracts ovate-oblong, 4 mm long; pedicels ¹/₂–1 mm. *Flowers* greenish white, sweetly fragrant. *Calyx* 4-lobed, lobes triangular or ovate, 1¹/₂–2¹/₂ mm long, puberulous and glabrescent outside. *Petals* 4, ovate, broadly elliptic, or elliptic, 3¹/₄–4 by 1¹/₂–2 mm; ridges 3(–5), half the length of petals, merged, apical parts free from the surface and parallel to it. *Disk* short-cupular, *c.* ³/₄ mm high, 1¹/₂ mm wide, 4-lobed, papillose. *Stamens* 4, 1 fertile, 2–5 mm; filaments free; anthers ovoid, ²/₃ mm long; staminodes *c.* ¹/₂ mm. *Ovary* subglobose, ³/₄ mm ∅; style lateral, 1¹/₂ mm. Sterile pistil in ♂ *c.* ¹/₃ mm. *Drupe* (fresh) (KOSTERMANS, *l.c.*) globose, smooth, yellowish green, *c.* 10 cm ∅, flesh pale yellowish, sweet acid. *Seed* not labyrinthine.

Distr. *Malesia:* Sumatra (?Gajolands, Bengkalis I., E. Coast, and Palembang), Banka, Kalimantan (Kutai, Balikpapan, Martapura, and Samarinda).

Cultivated in Java and introduced from Banka in Hort. Bog. *sub n.* VI–d–8.

Ecol. Lowland forest up to 150 m, once at 1500 m (a doubtful specimen from the Gajolands). *Fl.* Aug.; *fr.* April, July, Sept., Dec.

Vern. Sumatra: *fais*, *fajas*, *masam humbang*, *mĕmbaljang bubuk*, *paias*, *tajas*, M, Palembang, *pĕlem kĕra* = *pĕnkatjang utan*, Bengkalis; Banka: *asĕm rawa*, *asĕm tĕlor*; Borneo: *pipit*, *putaram*, Kutei.

Note. *Mangifera similis* is vegetatively similar to *M. quadrifida* but differs from the latter by (1) the puberulous (not glabrous) inflorescences, (2) the free apical parts of the ridges on the petals parallel to the surface (not bent away from the surface), and (3) yellowish green and globose (not dark purple and ellipsoid) fruits.

6. Mangifera quadrifida JACK in Roxb. Fl. Ind. ed. Wall. 2 (1824) 440; WALP. Ann. 1 (1848) 200; HOOK. *f.* Fl. Br. Ind. 2 (1876) 16; ENGL. in DC. Mon. Phan. 4 (1883) 206, *incl. var. spathulaefolia* (BL.) ENGL. *l.c.* 207; KING, J. As. Soc. Beng. 65, ii (1896) 471; PIERRE, Fl. For. Coch. (1897) t. 364H; MERR. En. Born. (1921) 349; RIDL. Fl. Mal. Pen. 1 (1922) 522; CORNER, Ways. Trees (1940) 111; MUKHERJI, Lloydia 12 (1949) 112, f. 17; KOCHUM. Mal. For. Rec. 17 (1964) 295; DING HOU, Blumea 24 (1978) 28. — *M. rigida* BL. Mus. Bot. 1 (1850) 200; MIQ. Fl. Ind. Bat. 1, 2 (1859) 633; ENGL. in DC. Mon. Phan. 4 (1883) 207, f. 16. — *M. spathulaefolia* BL. Mus. Bot. 1 (1850) 200; MIQ. Fl. Ind. Bat. 1, 2 (1859) 633; MUKHERJI, Lloydia 12 (1949) 113. — *M. langong* MIQ. Sum. (1861) 521; ENGL. in DC. Mon. Phan. 4 (1883) 215; MUKHERJI, Lloydia 12 (1949) 129. — *M. maingayi* HOOK. *f.* Fl. Br. Ind. 2 (1876) 17; ENGL. in DC. Mon. Phan. 4 (1883) 208; KING, J. As. Soc. Beng. 65, ii (1896) 469; RIDL. Fl. Mal. Pen. 1 (1922) 522; BURK. Dict. (1935) 1406; CORNER, Ways. Trees (1940) 109, *in obs.*; MUKHERJI, Lloydia 12 (1949) 111. — *M. longipetiolata* KING, J. As. Soc. Beng. 65, ii (1896) 470; RIDL. Fl. Mal. Pen. 1 (1922) 522; CORNER, Ways. Trees (1940) 110, f. 22; MUKHERJI, Lloydia 12 (1949) 112; KOCHUM. Mal. For. Rec. 17 (1964) 295. — Fig. 7j.

Tree 10–35 m high and 25–90 cm ∅, once recorded with broad buttresses ¹/₂ m high. Bark light brown, rather smooth, or slightly scaly. *Leaves* coriaceous, elliptic to elliptic-lanceolate, ovate-oblong, sometimes oblanceolate, 6¹/₂–30 by 3–9 cm; base rounded or cuneate; apex acute, obtuse, rarely acuminate; nerves 7–22 pairs, elevated beneath, faint or distinct above; veins reticulate, rather faint; petiole 1–7 cm (in saplings up to 12¹/₂ cm), convex beneath, bicanaliculate, concave, or flat above. *Panicles* terminal and sometimes also in the uppermost leaf axils, pyramidal, up to 25 cm long, glabrous; lateral branches up to 15 cm long, laxly flowered; floral bracts ovate, 3 mm long; pedicels ¹/₂–1¹/₂ mm. *Flowers* white or

pale greenish white. *Calyx* 4-lobed, lobes ovate to ovate-oblong, 2–3½ mm long, glabrous. *Petals* 4, ovate-oblong or elliptic, 3½–4½ by 1½–2½ mm; ridges 3(–5), half the length of petals, apical parts free from the surface and bent away from it, confluent or close together at the lower ⅔ (sometimes distinct and slightly united at the base when young). *Disk* pulvinate and concave above, ⅔ mm high, 2 mm wide, obscurely shallowly 4-furrowed in bisexual flowers, 4-lobed in ♂. *Stamens* 4, 1 fertile, 2–2½ mm; filaments free; anthers oblong, 1 mm long; staminodes ¾ mm. *Ovary* subglobose, 1½–2 mm ∅; style excentric, 1½–2 mm. Sterile pistil in ♂ ¾ mm. *Drupe* (fresh) dark purple when ripe, broadly ellipsoid, 8–10 by 5½–7 cm, flesh fibrous. *Seed* not labyrinthine.

Distr. *Malesia:* Sumatra (Atjeh, Simalur I., Balai Selasa, Rau, and Pelem Bay), Malay Peninsula (Kedah, Perak, Pahang, Johore, and Penang), and Borneo (Sabah, Brunei, and Kalimantan).

Ecol. Lowland forest, on inundated land or along riversides, rarely on limestone ridges, sometimes up to 900 m, once at 1380 m (in Pahang). *Fl.* Jan.–Nov., *fr.* Febr.–Aug.

Vern. Sumatra: *ambatjang rawanghalus*, Balai Selasa, *batjang utan*, M, *bonau*, *b. fuluh*, *b. uding*, Simalur, *putiran*, Palembang; Malay Peninsula: *asam kumbang*, *lĕkub*, *pauh*, M; Borneo: *asam putarum*, Kalimantan, *ranch ranch*, Brunei.

7. Mangifera altissima BLANCO, Fl. Filip. (1837) 181; ed. 2 (1845) 129; ed. 3, 1 (1877) 230; BL. Mus. Bot. 1 (1850) 199; MIQ. Fl. Ind. Bat. 1, 2 (1859) 632; MARCH. Rév. Anacard. (1869) 189; ENGL. in DC. Mon. Phan. 4 (1883) 214; PIERRE, Fl. For. Coch. (1897) t. 364E; MERR. Publ. Gov. Lab. Philip. *n.* 17 (1904) 27; *ibid. n.* 27 (1905) 35; Philip. J. Sc. 1 (1906) Suppl. 84; *ibid.* 10 (1915) Bot. 35; Sp. Blanc. (1918) 232; WESTER, Bull. Bur. Agr. Philip. 18 (1920) 16; MERR. En. Philip. 2 (1923) 467; MUKHERJI, Lloydia 12 (1949) 106; BROWN, Useful Pl. Philip. 2 (1950) 336, f. 164; DING HOU. Blumea 24 (1978) 24. — *Pauw I. Maxima*, *II. Media*, *III. Minima* RUMPH. Herb. Amb. Auct, (1755) 18, t. 11. — *M. mucronulata* BL. Mus. Bot. 1 (1850) 201; MIQ. Fl. Ind. Bat. 1, 2 (1859) 633; ENGL. in DC. Mon. Phan. 4 (1883) 215; MUKHERJI, Lloydia 12 (1949) 129. — *M. longipes* (*non* GRIFF.) F.-VILL. Nov. App. (1880) 54. — *M. rumphii* PIERRE, Fl. For. Coch. (1897) *sub* t. 364E; MERR. Int. Rumph. (1917) 331; HEYNE, Nutt. Pl. (1927) 969; MUKHERJI, Lloydia 12 (1949) 107; DE WIT, Rumph. Mem. Vol. (1959) 386. — *Buchanania reticulata* ELMER, Leafl. Philip. Bot. 4 (1912) 1499. — *M. parvifolia* MERR. Philip. J. Sc. 20 (1922) 401; En. Philip. 2 (1923) 469, *non* BOERL. & KOORD. 1910. — *M. salomonensis* C. T. WHITE (*ex* F. S. WALKER, For. Brit. Solomon Isl. Protect. (1948) 92, *sine descr. lat.*) J. Arn. Arb. 31 (1950) 95. — *M. merrillii* MUKHERJI, Lloydia 12 (1949) 104, f. 11, new name for *M. parvifolia* MERR.

Tree 12–35(–54) m high and 35–80(–100) cm ∅. Bark dark brown, smooth; branchlets angular with prominent leaf-scars. *Leaves* subcoriaceous or coriaceous, elliptic to narrowly elliptic, or oblanceolate, (5–)15½–43 by (2–)3½–11 cm; base cuneate or attenuate; apex acute to acuminate, mucronate, or obtuse; nerves (10–)16–23 pairs, slightly elevated on both surfaces, sometimes more prominent beneath; veins reticulate, distinct beneath and faint above; petiole 1½–5(–9) cm, slightly biconvex near the base of blade, or flat above. *Panicles* terminal, sometimes also in the apical leaf axils, crowded at the apex of twigs, pyramidal, sometimes seemingly fasciculate, 10–25 cm long, sparsely puberulous, glabrescent; lateral branches up to 14 cm long; floral bracts triangular, 1–1½ mm long; pedicels ⅔–1¼ mm. *Flowers* white or cream-white, fragrant. *Calyx* 4-lobed, lobes ovate or ovate-oblong, 2½–3 mm long, sparsely puberulous outside, glabrescent, or glabrous. *Petals* 4, ovate-oblong, or elliptic, 3½–5 by 1½–2 mm; ridges (3–)5, ½–⅗ the length of petals, confluent at the lower ⅔. *Disk* pulvinate and concave above, or short-cupular, ⅔–1 mm high, 1½–2¼ mm wide, 4-lobed and papillose. *Stamens* 5, 1 fertile, 2–3 mm; filaments free; anthers oblong, *c.* ¾ mm long; staminodes up to ¾ mm. *Ovary* subglobose, 1–1¼ mm ∅; style 2–3 mm, excentric. Sterile pistil in ♂ ⅔ mm. *Drupe* (fresh) (WESTER, *l.c.*) green to yellowish, semireniform, ellipsoid, or ovoid, 5½–8 by 4–6 cm; flesh fibrous, resinous, acid. *Seed* not labyrinthine.

Distr. Solomons (Guadalcanal) and South New Britain; in *Malesia:* New Guinea (scattered in western and northern parts), Moluccas (Tenimber, Key, Halmaheira, Ceram), Philippines (N. Luzon, Mindoro, Sibuyan I.), Celebes (Malili; Baleh Angin), and Lesser Sunda Is. (Alor).

Ecol. Chiefly in primary, lowland, inland forest, sometimes in coastal forest, rarely up to 400 m. *Fl.* Jan.–Dec.; *fr.* April–Dec.

Uses. The fruits are used in the Philippines for making pickles (WESTER, *l.c.*; BROWN, *l.c.*).

Vern. Lesser Sunda Is.: *majakang*, Alor; Celebes: *lumisi*, *manddi*, Tabela; Philippines (*fide* MERRILL, 1923): *appán*, *banítan*, Ibn., *bunutan*, Neg., *pahahútan*, *páho*, *pahohótan*, *pahótan*, *pangahútan*, Tag., *malapáho*, Tag., P.Bis., *páho*, Bik., P.Bis., *manga-poli*, Sub., *pahútan*, Sbl., Tag., *páo*, Sbl., *pahuhútan*, Tag., Bik., *pangmanggaén*, Ilk., *popouan*, Pamp.; Moluccas: *kabawa*, Sula I., *ponga ma mali*, Halmaheira; New Guinea: *binap*, Kebar, *mewiejetnik*, Arfak, *wa-wa*, Karas, *wail mango*, Pidgin, *waromet*, Amberbaken, *weli*, Madang, *yanggemas*, Sepik.

Note. The angular branchlets and prominent leaf-scars, in combination with leaf characters, are useful for recognizing (sterile) collections.

8. Mangifera griffithii HOOK. *f.* Trans. Linn. Soc. 23 (1860) 168; Fl. Br. Ind. 2 (1876) 14; ENGL. in DC. Mon. Phan. 4 (1883) 203; KING, J. As Soc. Beng. 65, ii (1896) 468; PIERRE, Fl. For. Coch. (1897) t. 364K; RIDL. Fl. Mal. Pen. 1 (1922) 521; BAKER, J. Bot. 62 (1924) Suppl. 30; MUKHERJI, Lloydia 12 (1949) 103;* DING HOU, Blumea 24 (1978) 25. — *M. microphylla* GRIFF. *ex* HOOK. *f.* Fl. Br. Ind. 2 (1876) 17; ENGL. in DC. Mon. Phan. 4 (1883) 209; KING, J. As. Soc. Beng. 65, ii (1896) 468; PIERRE, Fl. For. Coch. (1897) t. 364L; RIDL. Fl. Mal. Pen. 1 (1922) 521; BURK. Dict. (1935) 1407; CORNER, Ways. Trees 1 (1940) 111; MUKHERJI, Lloydia 12 (1949) 102. — *M. sclerophylla* HOOK. *f.* Fl. Br. Ind. 2 (1876) 15; ENGL. in DC. Mon. Phan. 4 (1883) 205; KING, J. As. Soc. Beng. 65, ii (1896) 469; RIDL. Fl. Mal. Pen. 1 (1922) 521; Kew Bull. (1933) 194; MUKHERJI, Lloydia 12

(1949) 103. — *M. beccarii* RIDL. Kew Bull. (1933) 194; MUKHERJI, Lloydia 12 (1949) 105.

Tree up to 30 m high and 100 cm ∅. *Leaves* chartaceous, subcoriaceous, or coriaceous, elliptic or broadly elliptic, elliptic- or obovate-oblong, 5–23 by $2^1/_2$–9 cm; base cuneate or obtuse; apex acute, rarely cuspidate or obtuse; nerves 6–16 pairs, elevated on both surfaces; veins reticulate, distinct below and faint or obscure above; petiole ($^1/_2$–)1–3(–6) cm, convex beneath, concave above. *Panicles* terminal and also in the apical leaf axils, 10–24 cm long, puberulous, crowded at the apex of twigs with the appearance of fascicles, laxly flowered; floral bracts ovate, 2 mm long; pedicels *c.* $^1/_2$ mm. *Flowers* cream-white. *Calyx* 4- (rarely 5-)lobed, lobes broadly ovate, $1^1/_2$–2 mm long, puberulous outside. *Petals* 4 (rarely 5), lanceolate (sometimes ovate when young), 2–3 by $^2/_3$–$1^1/_4$ mm; ridges 3(–5), $^1/_2$–$^2/_3$ the length of petals, confluent at the base. *Disk* short-cupular, *c.* 1 mm high, $1^1/_2$ mm wide, 2–4-lobed, papillose. *Stamens* 4 (rarely 5), 1 fertile, 1–$2^1/_2$ mm; filaments free; anthers ovoid, $^1/_2$–$^2/_3$ mm long; staminodes up to $^1/_2$ mm. *Ovary* subglobose, *c.* $1^1/_2$ mm ∅; style excentric, $1^1/_2$ mm. Sterile pistil in ♂ $^1/_2$ mm. *Drupe* (fresh) (CORNER, *l.c.*) yellow to rose red and finally blackish, broadly ellipsoid or obovoid, $2^1/_2$–$3^1/_2$ by $1^1/_2$–$2^1/_2$ cm; flesh pale orange yellow, rather watery, fibrous, sour–sweet. *Seed* not labyrinthine.

Distr. *Malesia:* Sumatra (Palembang), Malay Peninsula (Perak, Pahang, Selangor, Johore, Malacca, Singapore), and Borneo (Sabah, Sarawak).

Cutlivated in villages in the Malay Peninsula.

Ecol. Scattered in lowland forest, up to 360 m. *Fl.* Oct., Nov., March; *fr.* Jan.–Oct.

Vern. Malay Peninsula: *labuk, raba-raba, rawa,* M.

Note. CORNER carefully collected specimens from various heights on a single tree to check the individual variation. The leaves on the lower branches measured 23 by 9 cm and a petiole of $6^1/_2$ cm, those from the upper branches were 7 by 4 cm with a petiole of *c.* 1 cm.

9. Mangifera inocarpoides MERR. & PERRY, J. Arn. Arb. 22 (1941) 532; VAN HEEL, Blumea 19 (1971) 109; DING HOU, Blumea 24 (1978) 25. — *M. indica* (*non* L.) LAUT. Nova Guinea 8 (1910) 297. — **Fig. 7o.**

Tree up to 12 m high. *Leaves* subcoriaceous, elliptic-lanceolate or narrowly elliptic, $11^1/_2$–26 by $4^1/_2$–$7^1/_2$ cm; base cuneate to attenuate; apex shortly acuminate to acuminate; nerves 18–27 pairs, slightly elevated on both surfaces; veins reticulate, distinct on both surfaces; petiole $1^1/_2$–$4^1/_2$ cm, convex beneath, flat above. *Panicles* terminal and sometimes also in the apical leaf-axils, pyramidal, up to 22 cm long, crowded at the apex of twigs, puberulous; lateral branches up to 7 cm long, laxly flowered; floral bracts ovate, 2–$2^1/_2$ mm long; pedicels $^1/_2$–$^2/_3$ mm. *Flowers* white. *Calyx* 4-lobed, lobes ovate or ovate-oblong, $1^1/_2$–2 mm long, slightly hairy at the apical part outside. *Petals* 4, lanceolate, $2^1/_2$–4 by $^2/_3$–$1^1/_4$ mm; ridges 3, $^1/_3$–$^1/_2$ the length of the petal, confluent at the lower 1–$1^1/_2$ mm. *Disk* short-cupular, $^2/_3$–1 mm high, $1^1/_2$ mm wide, 4-lobed, papillose. *Stamens* 4, 1 fertile, $1^1/_2$–2 mm; filaments free; anthers ovoid, $^1/_2$–$^2/_3$ mm long; staminodes up to 1 mm. *Ovary* obliquely subglobose, *c.* 1 mm ∅; style lateral, 2 mm. Sterile pistil in ♂ obscure. *Drupe* (fresh or dried) obliquely subrotund, much compressed, $6^1/_2$–8 by 6 cm; flesh fibrous. *Seed* labyrinthine.

Distr. *Malesia:* New Guinea (southern part).

Ecol. Lowland forest along creeks and rivers at low altitude. *Fl.* July, Dec.; *fr.* Dec.

Vern. *Begbegere,* Cocodala, *wabmu,* Pomboa.

Note. *M. inocarpoides* is closely allied to the West Malesian *M. gedebe,* which has also labyrinthine seeds (VAN HEEL, *l.c.*).

10. Mangifera gedebe MIQ. Sum. (1861) 522; ENGL. in DC. Mon. Phan. 4 (1883) 209; ENDERT, Versl. M.O. Born. Exp. 1925 (1927) 217; Tectona 25 (1932) 976; MUKHERJI, Lloydia 12 (1949) 100, f. 9; BACK. & BAKH. *f.* Fl. Java 2 (1965) 149. — **Fig. 7n.**

Tree up to 30 m high and 60 cm ∅. Bark grey or light brown, smooth or cracked. *Leaves* subcoriaceous, elliptic-oblong or narrowly elliptic, $5^1/_2$–23 by $2^1/_2$–6 cm; base cuneate; apex acuminate; nerves 16–30 pairs, rather fine, slightly thicker than the veins, sometimes hardly distinct from them on the lower surface; veins reticulate, distinct on both surfaces; petiole $^1/_2$–4 cm, convex beneath, concave above. *Panicles* terminal, sometimes also in the apical leaf axils, pyramidal, up to 27 cm long, crowded at the apex of twigs, densely pubescent when young, glabrescent; lateral branches up to 16 cm long, laxly flowered; floral bracts lanceolate, 3–4 mm long; pedicels $^1/_3$–$^1/_2$ mm. *Flowers* white. *Calyx* 4(–6)-lobed, lobes ovate-oblong, 2–3 mm long, sparsely puberulous outside. *Petals* 4 (rarely 5), lanceolate, $3^1/_4$–$4^1/_2$ by 1–$1^1/_4$ mm; ridges 3(–5), *c.* $^1/_2$ the length of petals, confluent at the lower $1^1/_2$–2 mm. *Disk* short-cupular, $^1/_2$–1 mm high, 1–$1^1/_2$ mm wide, 4-lobed, papillose. *Stamens* 5, 1 fertile, 2–3 mm; filaments free; anthers broad-ovoid, $^1/_2$ mm long; staminodes $^1/_4$–$^2/_3$ mm. *Ovary* subglobose, *c.* 1 mm ∅; style excentric, $1^1/_2$–$2^1/_2$ mm. Sterile pistil in ♂ *c.* $^1/_3$ mm. *Drupe* (fresh) (BACK. & BAKH. *f. l.c.*) obliquely subrotund, compressed, 8–9 cm ∅; flesh thin, fibrous. *Seed* labyrinthine, with testa present in the crevices of the very irregular lobes or folds.

Distr. *Malesia:* Sumatra (Riouw and Lampongs), Borneo (W. Kutai), and W. Java (Bantam: Danu swamp).

Cultivated in Hort. Bog. *sub n.* VII–D–5 (origin from Sumatra).

Ecol. River-banks and lowland forest, below 100 m. *M. gedebe* is a distinct constituent of the so-called '*rapak*' type of swamp forest, which is inundated during most of the year. In such forest there is no peat formation. Associates are *Gluta renghas, Ficus retusa, Alstonia spathulata, etc. Fl.* June–Sept.; *fr.* Aug., Nov.

Vern. Sumatra: *gadépér* or *gédébé, tajas* = *putaram,* M; Borneo: *képih, répih,* Kutai; W. Java: *kédépir.*

Note. According to KOSTERMANS (*in sched.*) the fruits are only edible (very sour) when unripe; when ripe, the pulp is too scanty and too hard to be edible.

11. Mangifera parvifolia BOERL. & KOORD. in Koord.-Schum. Syst. Verz. 2 (1910) 31; MUKHERJI, Lloydia 12 (1949) 130; DING HOU, Blumea 24 (1978) 28.

Tree up to 29 m high and 55 cm ∅, once recorded 100 cm ∅ (BEGUIN 485, BO). *Leaves* subcoriaceous, elliptic or elliptic-oblong, ovate-oblong, or obovate-oblong, $5^1/_2$–$11(-15^1/_2)$ by 2–4(–6) cm; base cuneate or obtuse; apex acuminate, rarely obtuse; nerves 6–10 pairs, slightly elevated beneath, rather faint above; veins obscure, sometimes reticulate and distinct beneath; petiole $^1/_2$–2(–6) cm, convex beneath, bicanaliculate or flat above. *Panicles* axillary only, often in several successive leaf axils, up to 7 cm long, puberulous; lateral branches up to $2^1/_2$ cm long, laxly flowered; floral bracts caducous, not seen; pedicels $^2/_3$ mm. *Flowers* greenish white or white. *Calyx* 4-lobed, lobes ovate-oblong, $1^1/_2$–2 mm long, sparsely puberulous outside. *Petals* 4, lanceolate, 3–$4^1/_2$ by 1 mm; ridges 3, half the length of petals, confluent at the basal part. *Disk* short-cupular, *c.* $^1/_2$ mm high, $1^1/_4$ mm wide, 4-lobed, papillose. *Stamens* 4, 1 fertile, 2–4 mm; filaments free; anthers ovoid, $^1/_2$–$^2/_3$ mm long; staminodes up to 2 mm. *Ovary* subglobose, *c.* 1 mm ∅; style $3^1/_2$ mm, excentric. *Drupe* (dried) broadly ellipsoid, $3^1/_2$ by 2 cm. *Seed* not labyrinthine.

Distr. *Malesia:* Sumatra (Bengkalis: P. Rang Sang; Indragiri; Palembang; Batu Is.; Banka) and the Malay Peninsula (Singapore).

Ecol. In forest on dryland or in temporarily (peat-water-)inundated areas, chiefly occurring a few metres above sea-level, sometimes up to 60 m. *Fl.* Oct.; *fr.* Nov.

Vern. Sumatra: *ĕmbatjang hutan, gading, mĕmpĕlĕm kĕra, pĕlam kara, rawa(h), sĕkira,* M.

Note. *M. parvifolia* is allied to *M. griffithii* from Malaya and *M. havilandii* from Borneo, especially in vegetative characters; sterile specimens of these three species are difficult to identify with certainty. When fertile, the axillary, puberulous panicles often occurring in several successive leaf-axils, it is easy to recognize.

12. Mangifera havilandii RIDL. Kew Bull. (1933) 194; MUKHERJI, Lloydia 12 (1949) 110, f. 15; ANDERSON, Gard. Bull. Sing. 20 (1963) 170; SMYTHIES, Common Sarawak Trees (1965) 5. — **Fig. 7a–i.**

Tree up to 35 m high and 80 cm ∅, occasionally with buttresses up to $1^1/_2$ m high. Bark greyish or light brown, smooth or scaly. *Leaves* coriaceous, elliptic to elliptic-lanceolate, sometimes obovate-oblong, 8–18 by 3–$6^3/_4$ cm; base cuneate or attenuate; apex acuminate; nerves 8–12 pairs, distinct on both surfaces, sometimes faint above; veins reticulate, faint, sometimes distinct on both surfaces; petiole ($^1/_2$–)$1^1/_2$–$4^1/_2$ cm, biconvex, concave or bicanaliculate above. *Panicles* terminal and sometimes also in the uppermost leaf axils, pyramidal, up to 25 cm long, puberulous; lateral branches up to 7 cm long, rather laxly flowered; floral bracts triangular, *c.* $^2/_3$ mm long; pedicels 1 mm. *Flowers* white. *Calyx* 4-lobed, lobes ovate, $1^1/_2$–2 mm long, slightly hairy on the margin especially near the apex. *Petals* 4, lanceolate, $3^1/_2$–4 by $1^1/_4$ mm; ridges 3(–5), $^1/_2$–$^2/_3$ the length of petals, confluent at the basal 1 mm. *Disk* short-cupular, $^2/_3$–1 mm high, *c.* $^3/_4$ mm wide, 4-lobed, papillose. *Stamens* 4, 1 fertile; filaments free; anthers broadly ellipsoid, $^1/_2$–$^2/_3$ mm long; staminodes absent or minute. *Ovary* broadly obovoid, $^2/_3$ mm ∅; style excentric, 2–$2^1/_2$ mm. Sterile pistil in ♂ *c.* $^1/_2$ mm. *Drupe* (dried) broad-ovoid or -ellipsoid, $3^1/_4$–$3^1/_2$ by $2^1/_4$ cm, (once recorded the ripe drupe rotund, 3–4 cm ∅, black; flesh pale pink, sweet, KOSTERMANS *in sched.*). *Seed* not labyrinthine.

Distr. *Malesia:* Borneo (widely distributed but scarce).

Ecol. Freshwater swamp forest or inundated areas, also in primary lowland forest on dryland, up to 300 m, once at 1500 m (Mt Kinabalu). *Fl.* Oct., Nov.; *fr.* March–Oct.

Vern. Sarawak: *asam raba,* Sadong Distr., *buah raba,* M, *raba,* Kuching; Sabah: *asam damaran,* Tungku, *rancha rancha,* Ranau; Kalimantan: *asam bulitisan,* Balikpapan, *asam pipit, manga rawa, rèsak rawa, tawun,* M, *asam rawa,* Kutai, *bajam lian, bar,* Dajak.

13. Mangifera timorensis BL. Mus. Bot. 1 (1850) 199; MIQ. Fl. Ind. Bat. 1, 2 (1859) 633; ENGL. in DC. Mon. Phan. 4 (1883) 208; DOCT. V. LEEUWEN, Zoocecidia (1926) 325, f. 580; MUKHERJI, Lloydia 12 (1949) 114, f. 19.— *M. glauca* (*non* BL.) SPAN. Linnaea 15 (1841) 188.

Tree up to 30 m high and 80 cm ∅. Buttresses occasionally present, 2 m high, $^1/_2$ m wide. Bark yellowish to dark brown, rough, deeply fissured. *Leaves* subcoriaceous, elliptic-oblong to narrowly elliptic, rarely oblanceolate or lanceolate, ($4^1/_2$–) 16–35 by (2–)4–9 cm; base cuneate; apex acute or obtuse; nerves 14–23 pairs, distinct beneath, faint above; veins obscure, or reticulate and faint on both surfaces; petiole (1–)$1^1/_2$–$3^1/_2$(–5) cm, convex beneath, concave above. *Panicles* terminal and sometimes also in the apical leaf axils, crowded at the apex of twigs, pyramidal, up to 20 cm long, glabrous; lateral branches up to $10^1/_2$ cm long; floral bracts triangular or ovate, *c.* 1 mm long; pedicels $^1/_3$ mm. *Flowers* white. *Calyx* 4-lobed, lobes ovate or elliptic, 2–$2^1/_2$ mm long, glabrous. *Petals* elliptic, rarely ovate, 3–$4^1/_2$ by $1^1/_2$–$2^1/_2$ mm; ridges (3–)5(–7), *c.* $^2/_3$ the length of petals, confluent at the basal $^2/_3$–1 mm. *Disk* short-cupular, $1^1/_2$ mm high, $2^1/_2$ mm wide, 4-lobed, papillose. *Stamens* 4, 1 (rarely 2) fertile; filaments free; anthers oblong, $^2/_3$ mm long; staminodes up to 1 mm. *Ovary* subglobose, *c.* 2 mm ∅; style lateral, 2 mm. Sterile pistil in ♂ $^1/_2$ mm. *Drupe* (dried) yellowish when ripe, globose or subglobose, $3^1/_2$–$4^1/_4$ cm ∅ (hard, not edible, KOSTERMANS *in sched.*). *Seed* not labyrinthine.

Distr. *Malesia:* Lesser Sunda Is. (Sumbawa, Flores, Sumba, Alor, Timor, Wetar, Leti), Central Celebes (Malili), and Moluccas (Banda and Tenimber Is.).

Ecol. In forest, 300–1000 m, rarely in beach forest. *Fl.* March–Dec.; *fr.* Jan., March.

Vern. Lesser Sunda Is.: *majakang,* Alor, *manggo latar,* W. Sumbawa, *pautah,* Flores, *upaentui,* Dowong; Celebes: *lumisi, morotoiba, tamba,* Tobela.

14. Mangifera monandra MERR. Publ. Gov. Lab. Philip. *n.* 17 (1904) 28; WESTER, Bull. Bur. Agr. Philip. 18 (1920) 16; MERR. En. Philip. 2 (1923) 468; MUKHERJI, Lloydia 12 (1949) 114, f. 20 & 30, *incl. var. fasciculata* MUKHERJI, *l.c.* 116, f. 31. — *M. philippinensis* MUKHERJI, *l.c.* 108, f. 15a–b & 29.

Medium-sized tree. *Leaves* subcoriaceous, elliptic,

elliptic-oblong, obovate-oblong or oblanceolate, (7–)13–19 by $2^3/_4$–$4^3/_4$(–$8^1/_4$) cm; base cuneate; apex acute, shortly acuminate, sometimes obtuse; nerves 8–12 pairs, slightly elevated on both surfaces; veins reticulate, distinct beneath, faint above; petiole $^3/_4$–$3^1/_2$(–$5^1/_2$) cm, convex beneath, concave above. *Panicles* terminal and also in the apical leaf axils, crowded at the apex of twigs and seemingly fasciculate, up to 19 cm long, glabrous; lateral branches up to 5 cm long, laxly flowered; floral bracts caducous, not seen. Pedicels $^1/_2$–$^3/_4$ mm. *Flowers* white. *Calyx* 4-lobed, lobes ovate or ovate-oblong, $1^3/_4$–$2^1/_4$ mm long, glabrous. *Petals* 4, ovate-oblong, 3–$4^1/_2$ by $1^1/_2$–2 mm; ridges 5(–7), $^1/_2$–$^2/_3$ the length of petals, confluent at the basal $^1/_2$–$1^1/_2$ mm. *Disk* short-cupular, $^3/_4$–1 mm high, 1–$1^1/_2$ mm wide, slightly 4-lobed, papillose. *Stamens* 4 (or 5), 1 fertile, $1^1/_2$–$3^1/_2$ mm; filaments free; anthers ovoid-oblong, $^2/_3$ mm long; staminodes up to 1 mm. *Ovary* subglobose, *c.* $^2/_3$ mm ∅; style excentric, $1^1/_2$–3 mm. Sterile pistil in ♂ *c.* $^1/_2$ mm. *Drupe* (MERRILL, 1904, *l.c.*) ellipsoid, subcompressed, inequilateral, $3^1/_2$ by $1^3/_4$ cm; flesh very thin.

Distr. *Malesia:* Philippines (Luzon, Samar, Leyte, Ticao, Guimaras Is.).

Ecol. Lowland primary forest. *Fl.* Febr.–April; *fr.* June–July.

Vern. *Kalamansánai, kárig,* Tag., *kurig,* Sambali, *malapáho,* Bik., *paglumbáyan, páo,* Ilk., *paglumbóyen,* Pang., *pagsagon, pounan,* S.L.Bis.

15. Mangifera gracilipes HOOK. *f.* Fl. Br. Ind. 2 (1876) 16; ENGL. in DC. Mon. Phan. 4 (1883) 203; KING, J. As. Soc. Beng. 65, ii (1896) 474; RIDL. Fl. Mal. Pen. 1 (1922) 523; MUKHERJI, Lloydia 12 (1949) 98.

Large tree. *Leaves* subcoriaceous, elliptic-lanceolate, 7–10 by $2^1/_2$–3 cm; base attenuate; apex acuminate; nerves 10–14 pairs, rather faint on both surfaces; veins obscure on both surfaces; petiole $^3/_4$–$2^3/_4$ cm, convex beneath, concave above. *Panicles* terminal and also in the apical leaf axils, up to 15 cm long, glabrous, crowded at the apex of twigs and seemingly fasciculate; lateral branches up to 2 cm long; pedicels $^1/_2$–1 mm. *Calyx* 4-(rarely 5-)lobed, lobes ovate or broadly ovate, sometimes triangular, $1^1/_2$–2 mm long. *Petals* 4 (rarely 5), ovate-oblong, $3^1/_2$–4 by $1^1/_4$–$1^1/_2$ mm; ridges 5(–7), *c.* $^1/_2$ the length of petals, confluent at the lower half. *Disk* short-cupular, $^2/_3$ mm high, 1–$1^1/_2$ mm wide. *Stamens* 4 (rarely 5), 1 fertile, $1^1/_2$–$2^1/_2$ mm; filaments free; anthers ovoid, $^2/_3$ mm long; staminodes very small. *Ovary* subglobose, $1^1/_2$ mm ∅; style excentric, 2 mm. Sterile pistil in ♂ *c.* $^1/_3$ mm. *Drupe* unknown.

Distr. *Malesia:* Malay Peninsula (Malacca), known only from the type.

2. Section Limus

MARCH. Rév. Anacard. (1869) 104 & 188; DING HOU, Blumea 24 (1978) 24.

Disk pulvinate, rarely cylindric and torus-like, often reduced and stipe-like, (at the base of ovary in bisexual flowers), usually not lobed, not papillose, rarely obsolete in ♂. Filaments often connate at the base, sometimes free.

16. Mangifera decandra DING HOU, Reinwardtia 8 (1972) 323, f. 1.

Tree up to 30 m high and 90 cm ∅. Bark reddish brown, cracked. *Leaves* coriaceous, elliptic- or obovate-oblong, or oblanceolate, (17–)27–38 by (7–)12–15 cm; base cuneate or attenuate; apex mucronate; nerves (14–)21–36 pairs, prominent on both surfaces; veins hardly visible; petiole convex beneath, plane above, ($1^1/_2$–)$3^1/_2$–6 cm. *Panicles* terminal, pyramidal, 16–57 cm long, puberulous; lateral branches up to 20 cm long; floral bracts ovate, 3–6 mm long; pedicels 1–2 mm. *Flowers* reddish or pink. *Calyx* 5-lobed, lobes broad-ovate or elliptic, $1^1/_2$–2 mm long, puberulous outside. *Petals* 5, elliptic- or obovate-oblong, $4^1/_2$–6 by $1^1/_2$–2 mm, without ridges on the inner surface. *Disk* cylindric, stipe-like, *c.* $^3/_4$ mm high in ♀, obsolete on ♂. *Stamens* 10, 5 fertile, always one long (3–6 mm) and 4 short (2–$3^1/_2$ mm); filaments connate at the base; anthers broad-ovoid or -ellipsoid, $^1/_2$–$^3/_4$ mm; staminodes 1–2 mm. *Ovary* subglobose, $1^1/_2$–2 mm; style excentric, 3–5 mm. Sterile pistil in ♂ *c.* 1 mm. *Drupe* (dried) ellipsoid, 9–$9^1/_2$ by $4^1/_2$ cm. *Seed* not labyrinthine.

Distr. *Malesia:* Sumatra (Karimun, Pakanbaru, Palembang) and Borneo (Sabah: Sandakan, Lungmanis, Sibuga, Tawau, Elphinstone, Kuala Belait, Beluran; Brunei; Kalimantan: near Mahakam R.; Sarawak: Bintulu).

Ecol. Lowland primary forest, sometimes in freshwater swamp forest, occasionally in secondary forest, up to 100 m, once at *c.* 340 m. *Fl.* March–May; *fr.* March–Sept.

Vern. Sumatra: *biendjai,* M, *komang bakad,* Palembang; Borneo: Sabah: *beluno,* Dusun, *binjay,* Tidong; Kalimantan: *bindjai,* Kutai & Bandjar, *konjot,* Benua-Dajak.

17. Mangifera lagenifera GRIFF. Notul. 4 (1854) 414, t. 567, f. 3; HOOK. *f.* Fl. Br. Ind. 2 (1876) 18; ENGL. in DC. Mon. Phan. 4 (1883) 211; KING, J. As. Soc. Beng. 65, ii (1896) 476; PIERRE, Fl. For. Coch. (1897) t. 365C; PERK. Fragm. Fl. Philip. (1904) 25, *p.p., quoad* CUMING 2330; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 108; *ibid.* 10 (1915) Bot. 190; RIDL. Fl. Mal. Pen. 1 (1922) 525; MERR. En. Philip. 2 (1923) 469; CRAIB, Fl. Siam. En. 1 (1931) 344; BURK. Dict. (1935) 1406; CORNER, Ways. Trees 1 (1940) 110, f. 22, Atlas t. 12 & 13; MUKHERJI, Lloydia 12 (1949) 118; KOCHUM. Mal. For. Rec. 17 (1964) 294; DING HOU, Blumea 24 (1978) 26. — **Fig. 9.**

Tree up to 30 (or more) m high and 75 cm ∅. Bark pale brown or fawn grey, scaly. *Leaves*

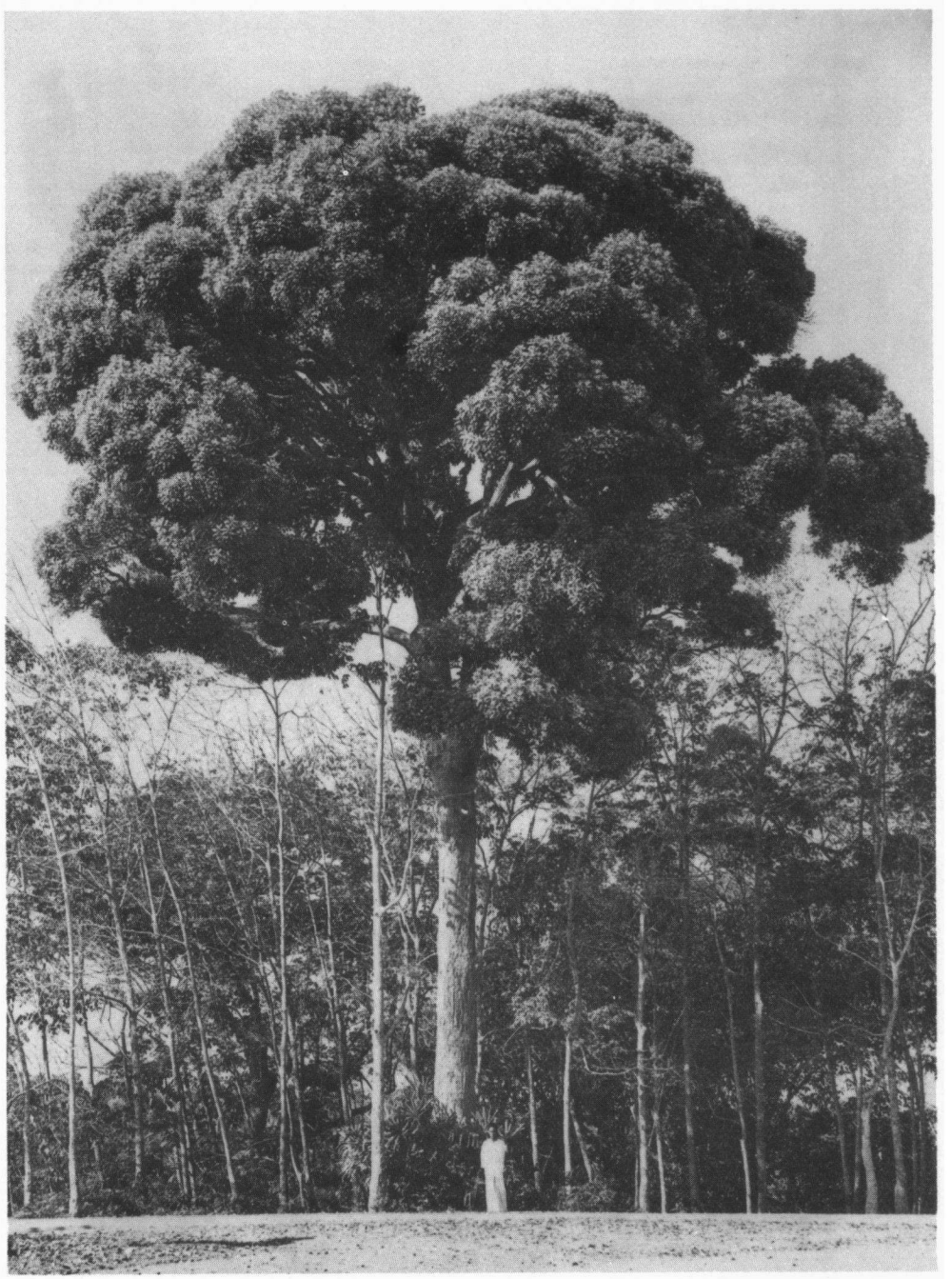

Fig. 9. *Mangifera lagenifera* GRIFF. by the main road to Merlimau, Malacca. Courtesy and photogr. CORNER.

coriaceous, obovate, oblanceolate, 8–18 by $2^1/_2$–$4^1/_2$ cm; apex obtuse or rounded; base attenuate, rarely cuneate; nerves 10–23 pairs, distinct on both surfaces, sometimes obscure above; veins obscure on both surfaces; petiole flattened, without sharp distinction from the lamina, the narrowest part 1–3 cm long. *Panicles* terminal and sometimes also in the apical leaf axils, 16–30 cm long, puberulous; sometimes crowded at the apex of twigs and seemingly fasciculate; floral bracts ovate, 2–$2^1/_2$ mm long; pedicels $^2/_3$–$1^1/_2$ mm. *Flowers* deep violet. *Calyx* 5-lobed, lobes broad-ovate or -elliptic, $1^1/_2$–2 mm long, puberulous outside. *Petals* 5, oblong, oblanceolate, or elliptic, 5–6 by $1^1/_2$–2 mm, without ridges on the inner surface. *Disk* pulvinate, stipe-like, *c.* $^2/_3$ mm high. *Stamens* 10, 5 fertile, ± equal, $3^1/_2$–5 mm; filaments connate at the base; anthers ovoid-oblong, $^1/_2$–$^2/_3$ mm long; staminodes *c.* $^2/_3$ mm. *Ovary* obovoid, $^2/_3$–$1^1/_4$ mm ∅; style excentric, *c.* 4 mm. *Drupe* pyriform, *c.* 11 by 6 cm (dried, 1 coll.); pale dull green or greyish turning brownish, the flesh dirty white to dirty pinkish, sour and stringy (CORNER, *l.c.*).

Distr. *Malesia:* Sumatra (Karimun and Lingga) and Malay Peninsula (Pahang, Perak, Johore, Malacca, and Singapore).

Ecol. Lowland forest up to 150 m, sometimes in temporarily inundated places. *Fl.* Jan.–Sept.; according to CORNER frequent in orchards in Malacca.

Uses. According to CORNER *l.c.* the coarse fruit of the *lanjut* has little to commend it, but the poisonousness of the sap will preserve, he hopes, the magnificent trees which are scattered throughout the country: a grander being than an old *lanjut* is hard to imagine.

Vern. Sumatra: *landjut*, M; Malay Peninsula: *langoot*, *lanjut*, M.

18. Mangifera foetida LOUR. Fl. Coch. (1790) 160; WILLD. Sp. Pl. 1 (1797) 199; ROXB. Fl. Ind. ed. Wall. 2 (1824) 440; DC. Prod. 2 (1825) 63; BUCH.-HAM. Mem. Wern. Nat. Hist. Soc. (Edinb.) 5 (1826) 327; HASSK. Flora 27 (1844) 622; BL. Mus. Bot. 1 (1850) 198, *incl. var. sphaeroidea* BL.; MIQ. Fl. Ind. Bat. 1, 2 (1859) 632; HOOK. *f.* Fl. Br. Ind. 2 (1876) 18; KURZ, Fl. Burma 1 (1877) 305; ENGL. in DC. Mon. Phan. 4 (1883) 212, *incl. var. leschenaultii* (MARCH.) ENGL.; WARB. Bot. Jahrb. 13 (1891) 361; KING, J. As. Soc. Beng. 65, ii (1896) 474; K. & V. Bijdr. 4 (1896) 88; BACK. Fl. Bat. (1907) 363; LECOMTE, Fl. Gén. I.-C. 2 (1908) 15; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 89; BACK. Schoolfl. (1911) 278; MERR. Int. Rumph. (1917) 329; WESTER, Bull. Bur. Agr. Philip. 18 (1920) 16; LAUT. Bot. Jahrb. 56 (1921) 354; RIDL. Fl. Mal. Pen. 1 (1922) 524; CRAIB, Fl. Siam. En. 1 (1926) 343; HEYNE, Nutt. Pl. (1927) 966; OCHSE & BAKH. Fruit (1931) 5, t. 3; RIDL. Kew Bull. (1933) 194; MERR. Comm. Lour. (1935) 160; BURK. Dict. (1935) 1402; CORNER, Ways. Trees (1940) 109, f. 22, Atlas t. 10; MUKHERJI, Lloydia 12 (1949) 120, f. 24; STEPHENS, Mal. For. 18 (1955) 205; DE WIT, Rumph. Mem. Vol. (1959) 386; TARD. Fl. C. L. & V. 2 (1962) 97; KOCHUM. Mal. For. Rec. 17 (1964) 294; BACK. & BAKH. *f.* Fl. Java 2 (1965) 149; SMYTHIES, Common Sarawak Trees (1965) 5, pl. 1. — *Manga foetida I* RUMPH. Herb. Amb. 1 (1741) 98, t. 28. — *M. indica* (*non* L.) BL. Bijdr. (1826) 1157. — *M. foetida* GRIFF. Notul. 4 (1854) 419, *nom. illeg.*, *non* LOUR. 1790. — *M. horsfieldii* MIQ. Fl. Ind. Bat. 1, 2 (1859) 632. — *M. leschenaultii* MARCH. Rév. Anacard. (1869) 189. — **Fig. 10–11.**

Tree 10–40 m high and 30–100 cm ∅. Bark greenish or reddish brown, rough, fissured or scaly. *Leaves* rigidly coriaceous, oblanceolate, elliptic, elliptic-oblong, 14–35 by 6–16 cm (in vegetative or sapling state up to 37–48 by 15–$18^1/_2$ cm); base cuneate or attenuate; apex obtuse, rounded, sometimes slightly emarginate, rarely acute; nerves 15–33 pairs, prominent beneath, slightly elevated

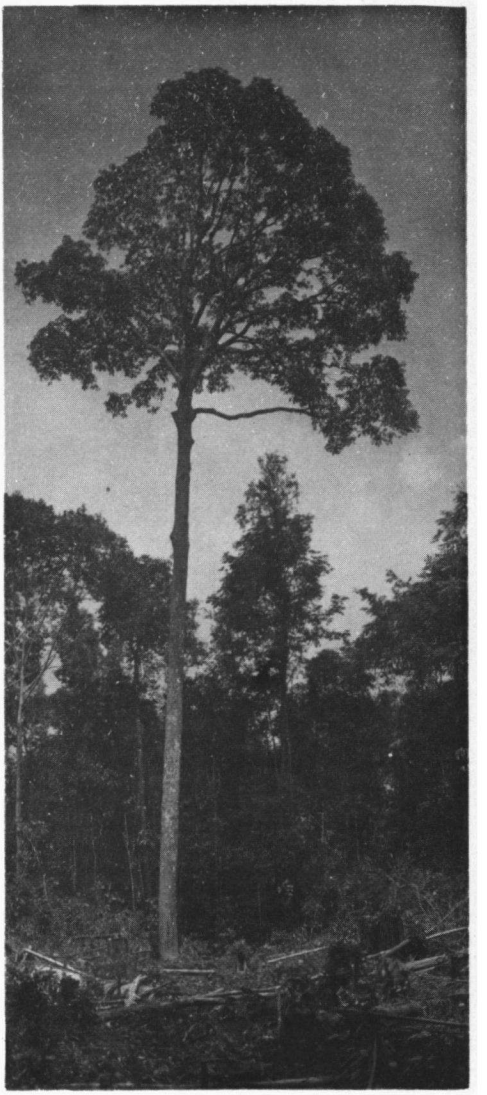

Fig. 10. *Mangifera foetida* LOUR. in the forest at Puturan, Palembang, S. Sumatra (Photogr. THORENAAR, 1925).

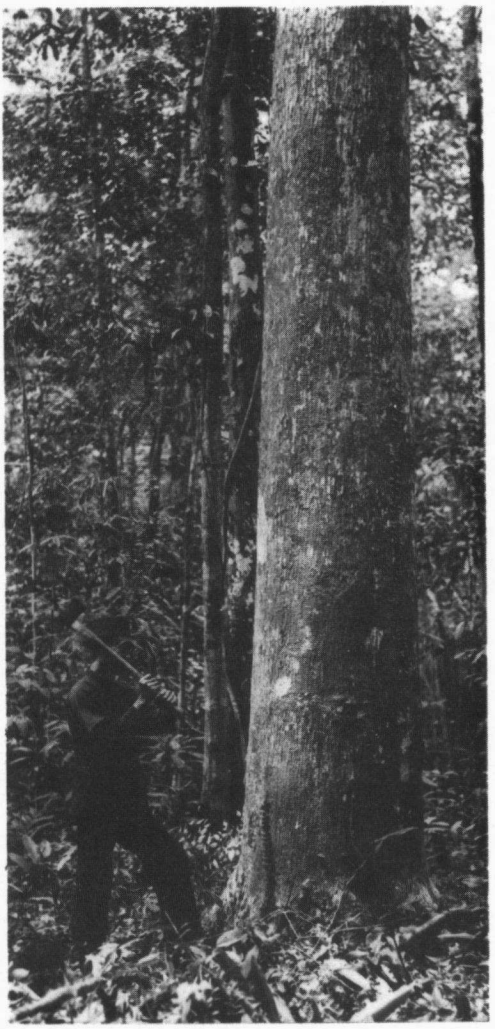

Fig. 11. *Mangifera foetida* LOUR. in the forest at Sg. Rhu Reba, Jason Bay, Johore, showing stem-base without buttresses, typical for the genus. Courtesy and photogr. CORNER.

above; veins invisible or obscure on both surfaces; petiole 2–5(–8) cm (in vegetative or sapling state up to 12 cm), convex beneath, concave or flat above. *Panicles* terminal and sometimes also in the uppermost leaf axil, pyramidal, 10–40 cm long, glabrous; lateral branches up to 20 cm long, rather densely flowered; floral bracts ovate-lanceolate, 4–5 mm long; pedicels *c.* 1 mm. *Flowers* pinkish or deep red, fragrant. *Calyx* 5-lobed, lobes broadly ovate or ovate, 3–5 mm long, often glabrous, sometimes puberulous outside. *Petals* narrowly lanceolate, 6–9 by $1^1/_2$–$2^1/_2$ mm; ridges 3, *c.* $^1/_2$ the length of petals, confluent near the base. *Disk* pulvinate, stipe-like, *c.* 1 mm high. *Stamens* 5, 1 (rarely 2) fertile, 6–10 mm; filaments connate at the lower $^1/_4$–1 mm; anthers ellipsoid, *c.* $^3/_4$ mm long; staminodes 3–5 mm. *Ovary* subglobose, 1–$1^1/_2$ mm ∅, (ochraceous when fresh, *cf.* OCHSE & BAKH. *l.c.*); style excentric, $5^1/_2$–7 mm. *Drupe* (fresh) (OCHSE & BAKH. *l.c.*) yellowish or greyish green, smelling and tasting of turpentine when ripe, obliquely ovoid, 8–10(–18) by 6–7(–12) cm; flesh yellow, fibrous, juicy, savoury, fragrant. *Seed* not labyrinthine.

Distr. Thailand, Indo-China (Vietnam), and *Malesia:* Sumatra, Malay Peninsula, ?Java, Borneo.

Usually cultivated, also in these islands, but also elsewhere in Malesia.

Ecol. Widely cultivated in Malesia, sometimes as village trees. Escaped or naturalized, or indigenous in dryland lowland forests, rarely at 650–1000 m, very occasionally at *c.* 1400 m (Pahang, Kinabalu), once at 1800 m (Gajolands).

Uses. CORNER *l.c.* says that the *bachang* can be told by stiff, dark-green leaves, like pieces of cardboard, and by copper-red panicles with inodorous flowers, or by its stinking fruits, which are used in curries or pickles; the sweet variety is palatable raw and could be improved by selection. In flower, the *bachang* is the most beautiful *Mangifera*, with its upright panicles reminding of the horse-chestnut. Trees flower generally about March–April, and again in October in Singapore. It occurs common in orchards. See further HEYNE and BURKILL, *ll.cc.*; the latter noted some minor use of the sap for tattooing and medicinal.

Vern. Sumatra: *abawang dotan*, Simalur, *ambachang*, *sitórngom*, Kesarin, *ambatjang*, Pajakumbuh, *mantjang*, Atjeh, Gajo, *batjang*, *b. maros*, *lèmus*, Batak, *bědara*, M, *bĕrhul*, Gajo, *mĕdang pĕrgam*, *pau puti*, Palembang, *rawa*, Karimon; Malay Peninsula: *bachang*, *buah bachang*, *kurau*, *machai*, *machang*, *mĕmbachang*, *mĕmpĕning*, M; Java: *asam bawang*, *batjang*, *mangga batjang*, M, *ki limus batjang*, *limus* (*tipung*), S, *pĕlĕm bawang*, *pakil*, *poh*, J; Borneo: *asampajang*, *kĕdjan lĕmah*, *thulik kaki*, Dajak, *asam hambawang*, *a. mas*, Kutai, *asam pamas*, *buah assam*, Iban, *ata*, *baya*, *pĕlam*, Kayan, *hambawang*, *mangga batjan*, *tĕmpajang*, Balikpapan, *bachang*, *machang*, Kuching, *bangbangan*, Brunei, *hambawang kambat*, Samarinda, *pauh hutan*, *pudan*, *talangtang*, M; Celebes: *dedeko*, *mangga hutan*, *umbawa*, Malili; Moluccas: *pata*, *paté*, Ambon.

19. Mangifera pajang KOSTERMANS, Reinwardtia 7 (1965) 20, f. 1a & 1b; MEIJER, Mal. For. 32 (1969) 257, f. 5; Field Guide Trees W. Mal. (1974) 108; DING HOU, Blumea 24 (1978) 27. — **Fig. 7k–m.**

Tree 15–33 m high, 30–70 cm ∅. Bark grey, rather smooth, or superficially, broadly fissured. *Leaves* rigidly coriaceous, elliptic-oblong, sometimes obovate-oblong, ($17^1/_2$–)28–45 by (7–)10–15 cm (sapling leaves up to 40 by 10 cm; petiole up to 12 cm long); base cuneate to attenuate; apex mucronate or acute; nerves 14–30 pairs, prominent; veins invisible to obscure; petiole ($2^1/_2$–)5–7 cm, convex beneath, grooved or flat above. *Panicles* terminal and sometimes also in the uppermost leaf axils, pyramidal, up to 30 cm long, glabrous; lateral branches up to 18 cm long, rather densely flowered; floral bracts ovate or ovate-oblong,

$1^1/_4$–2 mm long; pedicels *c.* 1 mm. *Calyx* 5-lobed, lobes ovate, $2^1/_2$–3 mm long, glabrous. *Petals* 5, purple on the inner surface, pinkish white outside, elliptic-oblong or -lanceolate, sometimes oblanceolate, 7–$7^1/_2$ by $2^1/_2$–3 mm; ridges 3, *c.* $^2/_3$ the length of petals, confluent at the lower 1–$1^1/_2$ mm (the united part extending beyond the base of the petal and stipe-like). *Disk* pulvinate, stipe-like, *c.* $^1/_2$ mm high. *Stamens* 5, usually 2 fertile, $6^1/_2$–7 mm; filaments connate at the base; anthers broad-ovoid, 1 mm long; staminodes up to 5 mm. *Ovary* white when fresh, ellipsoid, *c.* 1 mm ∅; style excentric, 6 mm. *Drupe* (fresh) brownish, broad-ovoid or globose, $9^1/_2$–12(–20) by $6^1/_2$–9(–15 or more) cm ∅, roughish; fresh yellowish white, fibrous. *Seed* not labyrinthine.

Distr. *Malesia:* Borneo (Sabah: Sandakan, Beaufort, and Sipitang; Brunei; Sarawak: Ulu Dapoi, Kapit; Kalimantan: Kutai and Sangkulirang).

Also cultivated, *e.g.* at Kuching.

Ecol. Chiefly in primary lowland forest, sometimes found in mixed dipterocarp forest, rarely up to 525 m. *Fl.* Febr., July; *fr.* April, May, Aug., Sept.

Uses. In high esteem for its edible fruit. When eating the fruit, the very thick rind (up to 1 cm) is peeled off the yellowish white, sweet acid pulp like with a banana (KOSTERMANS *l.c.*).

Vern. Sabah & Brunei: *banbangan, mĕmbangan,* Kedayan; Sarawak: *embàng,* Kayan; Kalimantan: *asĕm pajang,* commonly used, *limum,* Sangkulirang.

Notes. Closely related to *M. foetida* from which it is difficult to separate in the dried state. Brownish fruits are in *Mangifera* only known to occur in *M. pajang* and *M. caesia.*

M. pajang occurs both in the native state and in cultivation.

JACOBS in the field-notes of his collection *n.* 5217, from Kapit Distr. (Sarawak), vern. name *èmbang,* observed that the fruit is in high esteem, and that the trees in the forest have each their 'owner'. From this should not necessarily be concluded that such trees were originally planted in the forest: 'bee-trees' of *Koompassia* in Deli (NE. Sumatra) have, for example, also their 'owner'.

20. Mangifera odorata GRIFF. Notul. 4 (1854) 417; HOOK. *f.* Fl. Br. Ind. 2 (1876) 17; ENGL. in DC. Mon. Phan. 4 (1883) 210, *incl. var. pubescens* ENGL.; K. & V. Bijdr. 4 (1896) 85; KING, J. As. Soc. Beng. 65, ii (1896) 474; KOORD. Minah. (1898) 411; MERR. Bull. Bur. For. Philip. 1 (1903) 33; BACK. Fl. Bat. (1907) 362; Schoolfl. (1911) 278; WESTER, Bull. Bur. Agr. Philip. 18 (1920) 15; BROWN, Minor Prod. Philip. For. 2 (1921) 320; RIDL. Fl. Mal. Pen. 1 (1922) 524; MERR. En. Philip. 2 (1923) 468; OCHSE & BAKH. Fruit (1931) 15, t. 7; RIDL. Kew Bull. (1933) 194; BURK. Dict. (1935) 1407; CORNER, Ways. Trees (1940) 111, f. 22; MUKHERJI, Lloydia 12 (1949) 122, f. 25; BACK. & BAKH. *f.* Fl. Java 2 (1965) 149; DING HOU, Blumea 24 (1978) 26. — *M. foetida var. kawini* BL. Mus. Bot. 1 (1850) 199, *incl. var. mollis* BL. *et var. bombom* BL.; PIERRE, Fl. For. Coch. (1897) t. 365F (as 365E). — *M. foetida var. bakkill* MIQ. Fl. Ind. Bat. 1, 2 (1859) 632. — *M. oblongifolia* HOOK. *f.* Fl. Br. Ind. 2 (1876) 16; ENGL. in DC. Mon. Phan. 4 (1883) 204; KING, J. As. Soc. Beng. 65, ii (1896) 473; PIERRE, Fl. For. Coch. (1897) t. 364I; LECOMTE, Fl. Gén. I.-C. 2 (1908) 16; RIDL. Fl. Mal. Pen. 1 (1922) 523; CRAIB, Fl. Siam. En. 1 (1926) 344; BURK. Dict. (1935) 1407; MUKHERJI, Lloydia 12 (1949) 95. — *M. foetida var. odorata* (GRIFF.) PIERRE, Fl. For. Coch. (1897) t. 365B. — **Fig. 12.**

Tree 7–35 m high and 20–80(–100) cm ∅. Bark grey, smooth or fissured. *Leaves* coriaceous, elliptic-lanceolate or lanceolate, 9–35 by $3^1/_2$–10 cm; base cuneate or obtuse; apex short-acuminate, or acute, rarely obtuse; nerves 15–26 pairs, prominent beneath or on both surfaces; veins reticulate, distinct on both surfaces, especially beneath; petiole 2–5(–7) cm, convex beneath, grooved above. *Panicles* terminal and sometimes also in the uppermost leaf axil, pyramidal, 12–50 cm long, glabrous sometimes sparsely puberulous; lateral branches up to 18 cm long, rather densely flowered; floral bracts ovate or ovate-oblong, 1–2 mm long; pedicels $1^1/_2$–$1^3/_4$ mm. *Flowers* fragrant. *Calyx* 5-lobed, lobes ovate, elliptic, broad-elliptic, rarely lanceolate, 2–3 mm long, glabrous, rarely puberulous outside. *Petals* 5, on the outside at first yellowish white, afterwards becoming red (*cf.* OCHSE & BAKH. *l.c.*), elliptic-oblong or lanceolate, 4–6 by $1^1/_2$–$2^1/_2$ mm; ridges 3(–5), *c.* $^2/_3$ the length of petals, confluent at the lower $^2/_3$. *Disk* pulvinate, stipe-like, *c.* $^1/_2$ mm high, $1^1/_4$ mm wide, 5-lobed, not papillose. *Stamens* 5, 1 (rarely 2) fertile, 2–5 mm; filaments connate at the base; anthers ovoid or oblong, *c.* $^2/_3$ mm long; staminodes $^1/_2$–1 mm. *Ovary* subglobose, *c.* 1 mm ∅; style excentric, $2^1/_2$–3 mm. Sterile pistil in ♂ minute. *Drupe* (fresh) (OCHSE & BAKH. *l.c.*) dark green, obliquely ovoid or broadly ellipsoid, 10–13 by 7–10; flesh yellow, sweet, fibrous. *Seed* not labyrinthine.

Distr. Native country unknown, possibly of cultivated, ?hybrid origin, sometimes found in lowland forest in Sumatra, Borneo, and Java, but possibly from planted or naturalized trees. Chiefly found in cultivation.

Ecol. Lowland mixed forest. *Fl.* March–Dec.; *fr.* Sept.–Nov. In Djambi (Central Sumatra) the fruiting season is Jan.–Febr. attracting much game (pigs, elephants, *etc.*) to the forest, especially to the ladangs. End March RUTTEN (Trop. Natuur 28, 1939, 19, fig.) found numerous seedlings, with lilac young leaves, together with those of *Durio,* in the excrements of elephants.

Uses. Grown for its edible fruit, of which good cultivars exist, *cf.* OCHSE & BAKH. *l.c.*; common in orchards in Malaya (BURKILL, *l.c.*).

Vern. Sumatra: *ambasang, ambatjan, èmbasang, gorat, koowèni,* Batak, *batjang rimbo, pĕlĕm,* Palembang, *kwĕni,* Lampongs & Palembang, *mantjant,* Atjeh; Malay Peninsula: *kohini, kuini, kwini, kwining,* M, *bachang bĕto,* Semang; Java: *beené, bèni, kaèni,* Md., *bĕmbĕm, kawèni,* Md., S, *gandarasam, kĕbĕmbĕm, kewèni,* M, *kooweni, lĕngis, pakèl, pĕlĕm kuwèni, p. poh,* J; Borneo: *binjai,* Sabah, Sandakan, *palipisan,* Kalimantan, Pleihari; Philippines: *huani,* Bis., *kandopi,* Sulu, *uani,* Sulu, C.Bis.

Note. *M. odorata* is a polymorphous species and might comprise a hybrid swarm after hybridization, possibly between *M. indica* and *M. foetida,* with many minor forms. Further field studies and experimental work is required to check this assumption.

Fig. 12. *Mangifera odorata* GRIFF. at Wangi, Sabah (Photogr. MEIJER).

21. Mangifera caesia JACK in Roxb. Fl. Ind. ed. Wall. 2 (1824) 441; WALP. Ann. 1 (1848) 200; GRIFF. Not. Pl. As. 4 (1854) 415; MARCH. Rév. Anacard. (1869) 191; HOOK. *f.* Fl. Br. Ind. 2 (1876) 19; ENGL. in DC. Mon. Phan. 4 (1883) 213; KING, J. As. Soc. Beng. 65, ii (1896) 478; PIERRE, Fl. For. Coch. (1897) t. 364M; MERR. Bull. For. Bur. Philip. 1 (1903) 33; BACK. Fl. Bat. (1907) 364; Schoolfl. (1911) 278; WESTER, Bull. Bur. Agr. Philip. 18 (1920) 13; MERR. En. Born. (1921) 349; BROWN, Minor Prod. Philip. For. 2 (1921) 320, f. 50; RIDL. Fl. Mal. Pen. 1 (1922) 525; En. Philip. 2 (1923) 468; OCHSE & BAKH. Fruit (1931) 3, pl. 2; BURK. Dict. (1935) 1401; CORNER, Ways. Trees (1940) 108, f. 22, Atlas t. 9; MUKHERJI, Lloydia 12 (1949) 126, *incl. var. verticillata* (C. B. ROB.) MUKHERJI; BROWN, Useful Pl. Philip. 2 (1950) 340; BACK. & BAKH. *f.* Fl. Java 2 (1965) 149; KOSTERMANS, Reinwardtia 7 (1965) 19, *incl. var. kemanga* (BL.) KOSTERM. *et var. wanji* KOSTERM.; DING HOU, Blumea 24 (1978) 24. — *Manga foetida II* RUMPH. Herb. Amb. 1 (1741) 99. — *M. foetida* (*non* LOUR.) BL. Bijdr. (1826) 1158. — *M. kemanga* BL. Mus. Bot. 1 (1850) 202; MIQ. Fl. Ind. Bat. 1, 2 (1859) 634; HOOK. *f.* Trans. Linn. Soc. 23 (1860) 167, t. 23; KING, J. As. Soc. Beng. 65, ii (1896) 477; PIERRE, Fl. For. Coch. (1897) t. 364N; MERR. Int. Rumph. (1917) 330; RIDL. Fl. Mal. Pen. 1 (1922) 525; BURK. Dict. (1935) 1406; MUKHERJI, Lloydia 12 (1949) 124; DE WIT, Rumph. Mem. Vol. (1959) 386. — *M. polycarpa* GRIFF. Not. Pl. As. 4 (1854) 416; HOOK. *f.* Fl. Br. Ind. 2 (1876) 20; ENGL. in DC. Mon. Phan. 4 (1883) 213. — *M. verticillata* C. B. ROB. Philip. J. Sc. 6 (1911) Bot. 337; ELMER, Leafl. Philip. Bot. 6 (1914) 2381.

Tree up to 35 m high ar 75(–155) cm ∅. Buttresses occasionally present, $^1/_5$ m high, 1 m extending outward. Bark greyish brown, fissured. *Leaves* (sometimes seemingly verticillate towards the end of twigs), coriaceous, elliptic, obovate, ovate-oblong, or lanceolate, 9–30(–41$^1/_2$) by 3$^1/_2$–10 (–12) cm; base cuneate; apex short-acuminate or obtuse; nerves 14–33 pairs, slightly elevated on both surfaces; veins obscure on both surfaces; petiole flattened, 1$^1/_2$–2$^1/_2$(–6) cm. *Panicles* terminal, pyramidal, 15–45(–75) cm long, puberulous; lateral branches up to 15 cm long, densely flowered; floral bracts ovate, 2 mm long; pedicels *c.* 1 mm. *Flowers* violet or lilac. *Calyx* 5-lobed, lobes ovate, lanceolate, or elliptic, 1$^1/_2$–3 mm, puberulous outside. *Petals* 5, narrow-elliptic or -oblanceolate, 5–8 by 1–1$^1/_4$ mm; ridge 1, 2–3 mm long. *Disk* pulvinate, stipe-like, $^1/_2$–1 mm high, not papillose. *Stamens* 5, 1 (or 2) fertile, ($^1/_2$–)4–9 mm; filaments not connate at the base; anthers oblong, $^1/_2$ mm long; staminodes $^1/_3$–1$^1/_2$ mm. *Ovary* subglobose, $^1/_3$–$^1/_2$ mm ∅; style slightly excentric, 1–7 mm. Sterile pistil in ♂ up to 1 mm. *Drupe* (fresh) (*cf.* OCHSE & BAKH. *l.c.*; KOSTERMANS *l.c.*) pale brown or brownish-yellow (with rough, scaly or scurfy skin), or green-white (glossy), ellipsoid or pear-shaped, 12–19 by 6–10 cm; flesh yellowish-white, juicy, sour or sour-sweet, coarsely fibrous. *Seed* not labyrinthine.

Distr. *Malesia:* Sumatra, Malay Peninsula.

Cultivated, escaped and naturalized in many other islands of Malesia.

Ecol. In lowland primary forest, swamp forest, or in periodically inundated areas along rivers, up to 450 m. *Fl.* Febr.–Dec.; *fr.* Jan.–Dec., in Malaya April–June.

Uses. A well-known fruit tree. According to

OCHSE & BAKH. *l.c.* common in orchards in Malacca. There is a sweet fruited variety in Malaya (*binjai manis*) but the strong smell detracts from the enjoyment of it; the sour fruits are used in place of tamarind (CORNER *l.c.*).

Vern. Sumatra: *balam kĕmang*, M, *bienglu putih*, Lampongs, *bindjai*, N. region, *kĕmang*, *k. hadji*, *mĕdàng kĕmàng*, Palembang; Malay Peninsula: *topah*, Kedah, *sĕpam*, Perak & Johore, *kolah*, Johore (CORNER), *binjai*, Malacca & Singapore; Java: *bindjai*, *binglo*, *b. putih*, M, *binglu* or *kĕmang binglu*, *kĕmang*, S; Lesser Sunda Is.: *wani*, Bali; Borneo: Sabah: *balanu*, *buluno(h)*, M, *bundo*, Dusun; Sarawak: *binjai*; Brunei: *bĕluno*, *binjai*, Kedayan, *dĕndahan*, Iban, *ondo*, Duson; Kalimantan: *asam hambawang*, M; Philippines: *baluno*, *lóno*, *malóno*, Manobo, *balúnut*, *baúnu*, Sulu, *baúno*, *bayúno*, C.Bis.

22. Mangifera superba HOOK. *f.* Fl. Br. Ind. 2 (1876) 19; ENGL. in DC. Mon. Phan. 2 (1883) 214; KING, J. As. Soc. Beng. 65, ii (1896) 478; PIERRE, Fl. For. Coch. (1897) t. 365D; RIDL. Fl. Mal. Pen. 1 (1922) 525; MUKHERJI, Lloydia 12 (1949) 128.

Tree up to 30 m high. *Leaves* coriaceous, oblanceolate, spathulate, or elliptic-lanceolate, 17–40 by 5–12 cm; base attenuate; apex acute or obtuse; nerves 18–35 pairs, prominent beneath, slightly elevated above; veins obscure or invisible on both surfaces; petiole 2–4$^1/_2$ cm, flattened. *Panicles* terminal, pyramidal, up to 40(–60) cm long, pubescent; lateral branches up to 15 cm long, densely flowered; floral bracts ovate or ovate-oblong, 10–15 mm long; pedicels 0. *Flowers* lilac. *Calyx* 5-lobed, lobes lanceolate or elliptic-oblong, 11–12 mm long, puberulous outside. *Petals* spathulate or narrowly elliptic, 20–25 by 5 mm, (the central part of the lower 7–8 mm adnate to the disk); ridge only 1, *c.* 17 mm long. *Disk* cylindric, torus-like, 7–8 mm long, not lobed, not papillose. *Stamens* 5, all fertile, 8–12 mm; filaments free; anthers ovoid-oblong, $^1/_2$–$^3/_4$ mm long. *Ovary* slightly obovoid, 1$^1/_2$ mm ∅; style excentric, 8–15 mm. *Drupe* (dried, one coll.) ellipsoid or subobovoid-oblong, 10–15 by 7$^1/_2$–8$^3/_4$ cm, round in CS; flesh (when fresh) greyish white or pinkish with unpleasant rotten smell. *Seed* not labyrinthine.

Distr. *Malesia:* Malay Peninsula (Johore and Malacca).

Cultivated in Singapore.

Ecol. In lowland forest. *Fl.* June; *fr.* May.

Vern. *Beechee*, Singapore.

Notes. As already pointed out by HOOKER *f.* (*l.c.*) *M. superba* is closely allied with *M. caesia*, in both vegetative and floral characters. It has the largest flowers of *Mangifera* and seems to be a polyploid '*gigas*' form of *M. caesia*, from which it can easily be distinguished (see key).

An interesting species, very similar to some species of *Gluta*, *e.g. G. renghas*, by the attachment of the petals, the number of stamens (5, all fertile), and the cylindric, torus-like disk.

23. Mangifera macrocarpa BL. Bijdr. (1826) 1158; WALP. Rep. 1 (1842) 555; BL. Mus. Bot. 1 (1850) 201; MIQ. Fl. Ind. Bat. 1, 2 (1859) 634; ENGL. in DC. Mon. Phan. 4 (1883) 210; K. & V. Bijdr. 4 (1896) 87; PIERRE, Fl. For. Coch. (1897) t. 364D; LECOMTE, Fl. Gén. I.-C. 2 (1908) 16; BACK. Schoolfl. (1911) 277; MUKHERJI, Lloydia 12 (1949) 119; BACK. & BAKH. *f.* Fl. Java 2 (1965) 148; DING HOU, Blumea 24 (1978) 26. — *M. fragrans* MAINGAY *ex* HOOK. *f.* Fl. Br. Ind. 2 (1876) 18; KING, J. As. Soc. Beng. 65, ii (1896) 475; RIDL. Fl. Mal. Pen. 1 (1922) 524.

Tree up to 37 m high and 80 cm ∅. Bark pink, rather smooth, or fissured with strips 2–3 cm wide. *Leaves* chartaceous, linear, linear-lanceolate, rarely spathulate, (9–)15–60 by (1$^1/_4$–)3$^1/_2$–5 cm; base attenuate or acute; apex acuminate; nerves 23–44 pairs, distinct or rather faint on both surfaces; veins reticulate, faint or obscure, rarely distinct on both surfaces; petiole (1$^1/_2$–)3$^1/_2$–7(–11) cm, bicanaliculate or flat above, convex beneath. *Panicles* terminal, pyramidal, up to 20 cm long, glabrous; lateral branches up to 6 cm long, laxly flowered; floral bracts broadly ovate or triangular, 1–1$^1/_2$ mm long; pedicels *c.* 1$^1/_4$ mm. (Only ♂ flowers seen). *Calyx* 5-lobed, lobes ovate-oblong, 1$^3/_4$–4 mm, glabrous. *Petals* 5, lanceolate, 8 by 2$^3/_4$ mm; ridges 3, *c.* $^1/_4$ the length of petals, confluent at the basal 1 mm. *Disk* pulvinate, *c.* $^1/_5$ mm high, 1 mm wide, 5-lobed, not papillose. *Stamens* 5, 1 fertile, 2$^1/_2$ mm; filaments not connate at the base; anthers ovoid-oblong, 1 mm long. Sterile pistil *c.* $^1/_2$ mm. *Drupe* (HOOK. *f. l.c.* and BACK & BAKH. *f. l.c.*) obliquely broadly oblong-globose, 8–12 cm long; fresh yellow, fibrous. *Seed* not labyrinthine.

Distr. Lower Thailand (Peninsula), Cambodia (*cf.* PIERRE), and *Malesia:* Sumatra (East Coast, Palembang, Lampongs), Malay Peninsula (Kelantan, Trengganu, Pahang, Malacca), W. Java, Borneo and neighbouring islands (Sabah, Kalimantan, Anambas Is., Nunukan I.).

Cultivated in Hort. Bog. *sub* VI–B–8.

Ecol. Lowland forest, occasionally found at *c.* 700 m.

Vern. Sumatra: *hadju*, *mangga utan*, M; Malay Peninsula: *machang lavid*, M; Java: *gompohr*, S, *kipari*, J, *manga utan*, M; Borneo: *asam*, *mandubus*, M, *kayu basinku*, Sg. Kinabatangan, *jadju*, Siantan I. (Anambas Is.).

Notes. *M. macrocarpa* can be easily recognized by its chartaceous, linear, linear-lanceolate, rarely spathulate leaves, with a leaf index larger than (7–)10. All the (23) collections which I have examined are in sterile state except two.

The fruit was described by BLUME (*l.c.*) as having the size of a child's head. HOOKER *f.* (*l.c.*) quoting from MAINGAY, stated in the description of *M. fragrans* that the drupe is "obliquely broadly oblong-globose", and ENGLER (*l.c.*), based on MAINGAY's drawing in Kew, recorded its size as 10 cm ∅. Although its shape and size have been mentioned often in literature and sometimes on specimens, so far I have seen only small, young, detached immature fruits (5$^1/_4$ by 2$^3/_4$ cm) on the collection SAN 31997a.

KOSTERMANS, in a letter to VAN STEENIS (10–3–1965), stated that trees of this species are sporadic in East Borneo and that in ten years he did not see any of them in flower or fruit, and that the cultivated tree in Bogor has never flowered (*cf.* also K. & V. *l.c.*).

PIERRE (*l.c.*) recorded this species for Cambodia; however, TARDIEU-BLOT (Fl. C. L. & V. 2, 1962, 85) stated that no specimen of it could be found in the Herbarium at Paris.

Dubious

Mangifera taipa BUCH.-HAM. Mem. Wern. Nat. Hist. Soc. (Edinb.) 5 (1826) 326; MIQ. Fl. Ind. Bat. 1, 2 (1859) 631; MERR. Int. Rumph. (1917) 331; MUKHERJI, Lloydia 12 (1949) 131; DE WIT, Rumph. Mem. Vol. (1959) 386. — *Manga silvestris altera* RUMPH. Herb. Amb. 1 (1741) 97.

MERRILL *l.c.* already stated that this species was based wholly on RUMPHIUS' description and is of doubtful status. In the original literature, the fruit was described as oblong-rotund, outside so coarse or rough as leather ("van buiten zo ruig als leer"), not green but liver-coloured. This may be *M. caesia* JACK.

Mangifera utana BUCH.-HAM. Mem. Wern. Nat. Hist. Soc. (Edinb.) 5 (1826) 326; MIQ. Fl. Ind. Bat. 1, 2 (1859) 634; MERR. Int. Rumph. (1917) 330; MUKHERJI, Lloydia 12 (1949) 131; DE WIT, Rumph. Mem. Vol. (1959) 386. — *Manga sylvestris prima* RUMPH. Herb. Amb. 1 (1741) 97, t. 27. — *M. glauca* BL. Bijdr. (1826) 1158; WALP. Rep. 1 (1842) 555; BL. Mus. Bot. 1 (1850) 201; ENGL. in DC. Mon. Phan. 4 (1883) 214. — *M. membranacea* BL. Mus. Bot. 1 (1850) 195; ENGL. in DC. Mon. Phan. 4 (1883) 215; LAUT. Bot. Jahrb. 56 (1920) 354.

M. utana was based wholly on RUMPHIUS' description and his plate 27. MERRILL *l.c.* said that it is a species of doubtful status and that the figure very closely resembles the Philippine form of *M. monandra* MERR.

In the drawing, the leaves, especially their shape and arrangement, and the lax inflorescences resemble those of *M. minor* BL. It might be possible that this species represents a form of escaped *M. indica* L.

Excluded

Mangifera xylocarpa LAUT. Bot. Jahrb. 56 (1920) 354; MUKHERJI, Lloydia 12 (1949) 132, is according to SLEUMER, Fl. Males. I, 7 (1971) 50, = *Merrilliodendron megacarpum* (HEMSL.) SLEUMER (*Icacinaceae*).

5. SWINTONIA

GRIFF. Proc. Linn. Soc. Lond. 1 (1846) 283; DUCHARTRE, Rev. Bot. 2 (1847) 330; HOOK. *f.* in B. & H. Gen. Pl. 1 (1862) 421; MARCH. Rév. Anacard. (1869) 109 & 186; HOOK. *f.* Fl. Br. Ind. 2 (1876) 26; ENGL. in DC. Mon. Phan. 4 (1883) 228. — *Astropetalum* GRIFF. Notul. 4 (1854) 411. — *Anauxanopetalum* T. & B. in Miq. J. Bot. Néerl. 1 (1861) 368. — **Fig. 13–14.**

Trees. *Leaves* spiral, simple, entire, with a slightly thickened, marginal nerve, often papillose beneath, (long) petioled. *Inflorescences* axillary and terminal, paniculate. *Flowers* ♂ (usually dominant and numerous) and bisexual (plants polygamo-andromonoecious), or bisexual only. *Calyx* 5-lobed. Floral axis between calyx and stamens elongated and gynandrophore-like in 2 spp. *Petals* 5, imbricate, persistent, accrescent, usually much enlarged and reflexed in fruit, partly or wholly puberulous on both surfaces, glabrescent. *Disk* extrastaminal, consisting of 5 gland-like lobes, confluent with the base of filaments or alternating with them, glabrous. *Stamens* 5; filaments filiform or subulate, glabrous; anthers dorsifixed. *Ovary* 1-celled, sparsely hairy, abortive in ♂; style distinct, cylindric; stigma capitellate or rarely slightly thicker than the style. Abortive pistil in ♂ very small, hairy. *Drupe* 1-celled, supported by the 5 usually much enlarged, reflexed, wing-like petals; endocarp coriaceous. *Seed* with testa adherent to the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. About 12 *spp.*, distributed in the Andaman Is., Burma, Thailand, Cambodia, Laos, Vietnam, and *Malesia* (Sumatra, Malay Peninsula, Borneo, and Philippines).

Ecol. Lowland and hill forest, sometimes in swamp or peat-swamp forest, up to *c.* 750 m, only *S. robinsonii* montane (1050–1650 m).

Vern. Malaysian standard timber name: *perpauh.*

Notes. *Swintonia floribunda* GRIFF. was assigned to the monotypic new genus *Swintonia* in a combined generic and specific description.

The petals of bixesual and ♀ flowers of *Swintonia* gradually enlarge and thicken after anthesis. One should be aware of this increase in size and ascertain their growth stage.

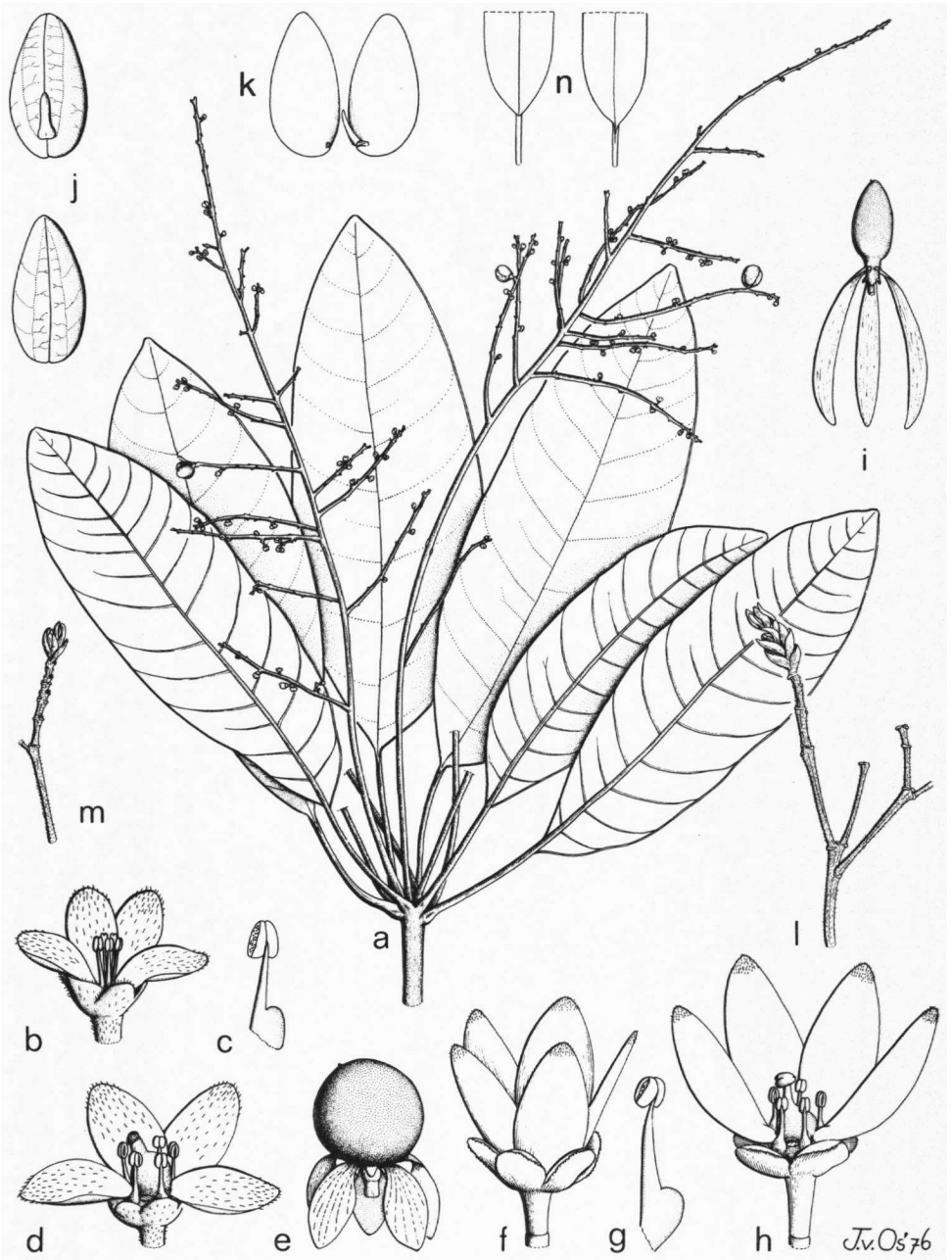

Fig. 13. *Swintonia minutalata* DING HOU. *a.* Habit, × 1/2, *b.* ♂ flower, 1 petal removed, × 7, *c.* stamen, with attached disk lobe, × 15, *d.* ♀ flower, 1 petal removed, × 7, *e.* fruit, with enlarged petals, nat. size. — *S. acuta* ENGL. *f.* ♂ flower, *g.* stamen, with attached disk lobe, *h.* ♀ flower, 1 petal removed, all × 7, *i.* fruit with much enlarged petals, 2 of them removed, × 1/2, *j.* embryo, viewed from raphe surface and its opposite side, × 1 1/2, *k.* embryo, opened, × 1 1/2. — *S. spicifera* HOOK. *f.* *l–m.* Branches of inflorescences showing rather crowded bracts or their scars, nat. size. — *S. schwenkii* (T. & B.) T. & B. *ex* HOOK. *f.* *n.* Leaf base, × 1/2 (*a–d* S 14966, *e* S 15180, *f–h* S 20927, *i–k* S 29850, *l–m* FRI 7542, *n* KOSTERMANS' Coll. 18).

KEY TO THE SPECIES

Based on flowering specimens

1. Calyx divided almost to the base or more than $^2/_3$ (or to *c.* $^1/_2$ in *S. schwenkii*) of its length. Floral axis between calyx and stamens obscure. Gland-like disk lobes confluent with the base of filaments.
 2. Papillae on the lower surface of the leaves always distinct, covering also the nerves.
  3. Petiole grooved or flat above. Petals 3–3$^1/_2$ mm long, densely puberulous on both surfaces **1. S. glauca**
  3. Petiole terete at the lower $^2/_3$–$^1/_2$ and flat above at the upper $^1/_3$–$^1/_2$. Petals 1$^1/_2$–2$^1/_2$ mm long, sparsely puberulous on both surfaces . . . . . **2. S. minutalata**
 2. Papillae on the lower surface of the leaves distinct, obscure, or indistinguishable, if present, not covering the nerves.
  4. Petals densely puberulous on both surfaces. Usually the lower $^2/_3$–$^1/_2$ of the petiole terete, more rarely wholly terete. Leaf-margins sometimes joining each other at the base . . . **3. S. schwenkii**
  4. Petals sparsely puberulous at the apical part on both surfaces. Petiole semiterete: flat, grooved, or bisulcate above, or biconvex. Leaf-margins separate from each other at the base.
   5. Petals claw-like contracted at the base . . . . . **4. S. foxworthyi**
   5. Petals cuneate or obtuse at the base . . . . . **5. S. acuta**
1. Calyx divided to $^1/_5$–$^1/_3$ of its length. Floral axis between calyx and stamens distinct, elongated, and like a gynandrophore. Gland-like disk lobes alternating with stamens.
 6. Terminal parts of branches in the inflorescences usually laxly branched, with spacious internodes, loosely flowered.
  7. Pedicels very short, up to *c.* 1 mm. Floral axis 2–2$^1/_2$ mm long. Stamens 4$^1/_2$ mm. Stigma slightly thicker than the style . . . . . **6. S. robinsonii**
  7. Pedicels distinct, (1$^1/_2$–)2$^1/_2$–4 mm. Floral axis 1$^1/_2$ mm long. Stamens 2–3$^1/_2$ mm. Stigma capitellate **7. S. floribunda**
 6. Terminal parts of branches in the inflorescences not or little branched, with very short or obscure internodes, densely flowered . . . . . **8. S. spicifera**

KEY TO THE SPECIES

Based on fruiting specimens

1. Enlarged petals below the globose drupe $^3/_4$–1$^1/_4$ cm long, not longer than the latter.
 2. Lower surface of leaves distinctly papillose. Petiole (3$^1/_2$–6$^1/_2$ cm) terete at the lower $^2/_3$–$^1/_2$ and flat above in upper $^1/_3$–$^1/_2$ . . . . . **2. S. minutalata**
 2. Lower surface of leaves not papillose. Petiole (1$^1/_2$–3$^1/_2$ cm) flat above . . . . . **6. S. robinsonii**
1. Enlarged petals below the drupe 3$^1/_2$–9 cm long, much longer than the latter.
 3. Drupe globose or subglobose.
  4. Papillae distinct on the lower surface of the leaves. Calyx divided almost to the base **4. S. foxworthyi**
  4. Papillae obscure or indistinguishable on the lower surface of the leaves. Calyx divided to $^1/_3$–$^1/_4$ of its length . . . . . **7. S. floribunda**
 3. Drupe ellipsoid or ovoid-oblong.
  5. Usually the lower $^2/_3$–$^1/_2$ of the petiole terete, rarely the whole petiole. Leaf-margins sometimes joining each other at the base . . . . . **3. S. schwenkii**
  5. Petiole semiterete: flat, grooved, or bicanaliculate above, or biconvex. Leaf-margins separate from each other at the base.
   6. Terminal parts of the branches in the infructescences usually laxly branched, with spacious internodes. Papillae distinct on the lower surface of the leaves.
    7. Nerves on the lower surface of the leaves distinctly papillose . . . . . **1. S. glauca**
    7. Nerves on the lower surface of the leaves not papillose . . . . . **5. S. acuta**
   6. Terminal parts of the branches in the infructescences not or little branched, with very short or obscure internodes. Papillae very compact, obscure or indistinguishable on the lower leaf surface **8. S. spicifera**

1. Swintonia glauca ENGL. Bot. Jahrb. 1 (1880) 44; in DC. Mon. Phan. 4 (1883) 230, t. 5, f. 13–16; MERR. En. Born. (1921) 349; ANDERSON, Gard. Bull. Sing. 20 (1963) 171.

Tree up to 18(–30) m high and 30(–49) cm ∅. Buttresses occasionally present, up to 1$^1/_2$ m high. Bark grey or pinkish brown, smooth, somewhat flaky. *Leaves* subcoriaceous, lanceolate, rarely elliptic, 6–15 by 2$^3/_4$–6 cm, glabrous; occasionally with glabrous, dome-like domatia; papillae distinct, all over the lower surface except the midrib; base cuneate or obtuse (margins separate); apex acuminate, rarely acute; nerves 8–16 pairs; veins reticulate, some slightly parallel and cross-bar-like, rather faint; petiole 2$^1/_2$–4 cm, semiterete, grooved or flat above. *Panicles* up to 30 cm long, ferruginous-puberulous; terminal parts of branches laxly branched, with spacious internodes, loosely flowered; floral bracts lanceolate to linear, 2–5$^1/_2$ mm long; pedicels *c.* 4 mm. *Flowers* white, scented. *Calyx* divided almost to the base; lobes oblong or slightly elliptic, 2–2$^1/_2$ mm long. Floral axis between calyx and stamens not elongated. *Petals* elliptic to elliptic-lanceolate, 3–3$^1/_2$ by

$1^1/_2$ mm, truncate or obtuse at the base; densely puberulous on both surfaces and also papillose inside. *Disk* lobes confluent with the base of filaments. *Stamens* 1–$1^1/_4$ mm; anthers broadly ellipsoid, *c.* $^1/_2$ mm long. Abortive pistil in ♂ *c.* 1 mm long. *Ovary* subglobose, *c.* $^2/_3$ mm ∅; style $^2/_3$ mm; stigma capitellate. *Drupe* ellipsoid, $1^3/_4$–$2^1/_2$ by $^3/_4$–$1^1/_2$ cm; enlarged petals narrowly elliptic, *c.* $5^1/_2$ by $1^3/_4$ cm.

Distr. *Malesia:* Central E. Sumatra (Indragiri) and Borneo (Brunei; Sarawak: Kuching, Bau, Lundu, Serian, Loba Kabang, Binatang, Kapit; Sabah: Beaufort, Tawau, Kuala Belait; Kalimantan: Sambas, Montalat, Bulungan, Bt Singkadjang, Mahakam Lirung).

Ecol. Primary peat-swamp forest, sometimes in undulating lowland dipterocarp forest, or on riverbanks, up to 700 m. *Fl.* May, Sept.–Dec.; *fr.* Nov., Jan.

Vern. Sumatra: *rĕngas tiong*, M; Borneo: Sarawak: *pĕtoh, pitoh, sĕlan pĕtoh, sikat tilong*, Milanau, *pitoh bukit, raba chit, rĕngas pitoh*, Iban, *sĕlano rĕngas*, Kuching; Sabah: *tĕlautjap laki*, M.

2. Swintonia minutalata DING HOU, Blumea 24 (1978) 38. — *S. spicifera* (*non* HOOK. *f.*) SMYTHIES, Common Sarawak Trees (1965) 13. — **Fig. 13a–e.**

Tree up to 25 m high and 50 cm ∅. Buttresses occasionally present, 1 m high. Bark smooth. *Leaves* subcoriaceous, elliptic-lanceolate, $11^1/_2$–$22^1/_2$ by 3–$6^1/_2$ cm, glabrous; papillae distinct, all over the lower surface except the midrib; base cuneate (margins separate); apex acuminate; nerves 12–20 pairs; veins reticulate, rather faint; petiole $3^1/_2$–$6^1/_2$ cm, terete in the lower $^2/_3$–$^1/_2$ and flat above in the upper $^1/_3$–$^1/_2$. *Panicles* 22–26 cm long, puberulous; terminal parts of branches laxly branched, with spacious internodes, loosely flowered; floral bracts ovate, $^1/_2$–$^2/_3$ mm long; pedicels *c.* 1 mm. *Calyx* divided almost to the base, lobes suborbicular, $^2/_3$–1 mm ∅. Floral axis between calyx and stamens not elongated. *Petals* broadly elliptic or elliptic, $1^1/_2$–$2^1/_2$ by 1–$1^1/_2$ mm, cuneate at the base, sparsely puberulous, glabrescent, on both surfaces, sometimes also papillose at the base inside. *Disk* lobes confluent with the base of filaments. *Stamens* $^3/_4$–$1^1/_4$ mm; anthers oblong, *c.* $^1/_3$ mm long. *Ovary* globose, 1 mm ∅; style $^1/_2$ mm; stigma capitellate. Abortive pistil in ♂ *c.* $^1/_3$ mm long. *Drupe* globose, *c.* $1^1/_2$ cm ∅; enlarged petals elliptic, or ovate-oblong, $^3/_4$–$1^1/_4$ by $^1/_3$–$^2/_3$ cm.

Distr. *Malesia:* Borneo (Sarawak: Semengoh Arboretum and Bako National Park; E. Kalimantan: Nunukan I.).

Ecol. Primary lowland forest, up to *c.* 100 m. *Fl.* June, Oct.; *fr.* Oct.–Dec.

Vern. *Njala*, Nunukan I., *pĕtoh, rĕngas*, Iban.

3. Swintonia schwenkii (T. & B.) T. & B. (Cat. Hort. Bot. (1866) 230, *nomen*; KURZ, J. As. Soc. Beng. 39, ii (1870) 75, *nomen*, in note) *ex* HOOK. *f.* Fl. Br. Ind. 2 (1876) 26; KURZ, J. As. Soc. Beng. 45, ii (1876) 207; ENGL. in DC. Mon. Phan. 4 (1883) 232, t. 5, f. 17–19; in E. & P. Nat. Pfl. Fam. 3, 5 (1892) 148; KING, J. As. Soc. Beng. 65, ii (1896) 489; MERR. En. Born. (1921) 350; RIDL. Fl. Mal. Pen. 1 (1922) 533; CRAIB, Fl. Siam. En. 1 (1926) 353; TARD. Fl. C. L. & V. 2 (1962) 108; KOCHUM. Mal. For. Rec. 17 (1964) 354; SMYTHIES, Common Sarawak Trees (1965) 13, pl. 4; MEIJER, Bot. News Bull. F. D. Sandakan 8 (1967) 32; DING HOU, Blumea 24 (1978) 39. — *Astropetalum sp. 1* GRIFF. Notul. 4 (1854) 411; Ic. Pl. As. 4 (1854) t. 565, f. 2b–d. — *Anauxanopetalum schwenkii* T. & B. in Miq. J. Bot. Néerl. 1 (1861) 368. — **Fig. 13n.**

Tree up to 45(–53) m high and 70(–120) cm ∅. Buttresses up to 3 m high, 5 m wide, 15 cm thick. Bark grey-brown, dark reddish green, smooth or dippled, sometimes deeply fissured. *Leaves* chartaceous to thin-coriaceous, narrowly elliptic, rarely elliptic, 7–12(–16) by 3–$4^1/_2$(–6) cm, glabrous; occasionally with glabrous, dome-like domatia; papillae very compact, obscure or indistinguishable (rarely distinct on young ones); base obtuse or cuneate (sometimes the margins joining with each other); apex shortly acuminate; nerves 14–21 pairs; veins reticulate, some slightly parallel and cross-bar-like, often faint; petiole $3^1/_2$–6 cm, all or usually the lower $^2/_3$–$^1/_2$ terete, sometimes flat or grooved above in the upper $^1/_3$–$^1/_2$. *Panicles* 8–14 cm long, puberulous and glabrescent; terminal parts of branches laxly branched, with spacious internodes, loosely flowered; floral bracts ovate, $^2/_3$–1 mm long; pedicels $^1/_2$ mm. *Flowers* white. *Calyx* divided to *c.* $^1/_2$ of its length, lobes slightly triangular or obovate, *c.* $^3/_4$ mm long. Floral axis between calyx and stamens not elongated. *Petals* elliptic to elliptic-lanceolate, or obovate-oblong, 2–3 by $^3/_4$–1 mm, cuneate at the base; densely puberulous on both surfaces. *Disk* lobes confluent with the base of filaments. *Stamens* $^3/_4$–$1^1/_4$ mm; anthers oblong, $^1/_3$ mm long. *Ovary* subglobose, $^2/_3$ mm ∅; style $^3/_4$–1 mm; stigma capitellate. Abortive pistil in ♂ *c.* $^1/_2$ mm long. *Drupe* ovoid-oblong or ellipsoid, $1^3/_4$–2 by $^3/_4$–1 cm; enlarged petals linear-oblong, $5^1/_2$–7 by $^3/_4$–1 cm.

Distr. Burma, Thailand, Cambodia, and *Malesia:* Sumatra (Tapanuli: P. Morsala; Pariaman, Kuantan, Indragiri, Moro I.), Malay Peninsula (Kedah, Trengganu, Pahang, Selangor, Negri Sembilan, Malacca, Johore, Penang, Singapore), Borneo (Sarawak: Serian, Lundu, Kuching, Baram; Sabah: Lahad Datu; Kalimantan: Melawi Tjatit, Bulungan, Kutai).

Cultivated in Hort. Bog. *Sub n.* XI–M–11.

Ecol. Rain-forest, rarely in secondary or kerangas forest, occasionally on ultrabasic or on coral limestone, from the lowland up to 700 m. *Fl.* Jan.–Dec.; *fr.* Febr.–March, July–Aug., Oct.

Vern. Sumatra: *ambago*, Batak, *emas, galagensa*, M, *madang buluh kasak*, Pariaman; Malay Peninsula: *bĕlang kasan, mĕnbatu, mĕrpauh, paupau, tualang*, M; Borneo: *baba chit*, Iban, *pitoh bukit, rĕngas pitoh*, Lundu, *rĕngas*, Kutai.

4. Swintonia foxworthyi ELMER, Leafl. Philip. Bot. 5 (1913) 1751; MERR. En. Philip. 2 (1923) 469.

Tree up to 40 m high and 1 m ∅. Buttresses occasionally present, up to 3 m high, $1^3/_4$ m wide, 10 cm thick. Bark reddish, dark brown, smooth, or slightly flaky. *Leaves* chartaceous to subcoriaceous, elliptic, narrowly elliptic, rarely lanceolate, 5–15 by $1^1/_2$–$5^1/_2$ cm, glabrous; occasionally with glabrous, dome-like domatia; papillae distinct on the lower surface except on the midrib and nerves; base cuneate or obtuse (margins separate); apex

acuminate, sometimes obtuse; nerves 9–16 pairs; veins reticulate, some slightly parallel and cross-bar-like, faint; petiole $1^1/_2$–$5^1/_2$ cm, subterete, usually flat above. *Panicles* up to 19 cm long, sparsely puberulous, glabrescent, or glabrous; terminal parts of branches laxly branched, with spacious internodes, loosely flowered. *Flowers* (only bisexual ones seen) white. *Calyx* divided almost to the base, lobes broadly ovate, *c.* 1 mm long. Floral axis between calyx and stamens not elongated. *Petals* obovate, rarely elliptic, 2–3 by 1–$1^1/_2$ mm, contracted at the base, sparsely puberulous on both surfaces at the apical part, usually also papillose at the base inside. *Disk* lobes confluent with the base of filaments. *Stamens c.* 1 mm; anthers oblong-ellipsoid, $^1/_2$ mm long. *Ovary* subglobose, *c.* $^2/_3$ mm ∅; style $^1/_3$ mm; stigma capitellate. *Drupe* globose or subglobose, $1^1/_4$–$1^3/_4$ cm ∅; enlarged petals pink when fresh, narrowly elliptic or oblanceolate, $5^1/_2$–$7^1/_2$ by (1–)$1^1/_2$–$1^3/_4$(–$2^1/_4$) cm.

Distr. *Malesia:* Sumatra (W. Coast), Borneo (Brunei; Sarawak: Bt Batu, Bt Gaharu, Limbang, Bintulu, Kapit; Sabah: Beaufort, Sandakan), and the Philippines (Mt Pulgar, Palawan).

Ecol. Primary forest, mixed dipterocarp forest, and kerangas forest, at 60–600 m. *Fl.* Jan., April; *fr.* Jan., May, Aug., Oct.

Fruits are sometimes galled into globose bodies $2^1/_2$ cm ∅.

Vern. Borneo: *pitoh*, Iban, *rĕngas bukit*, Brunei; Philippines: Palawan: *lomarau*, Kuy.

5. Swintonia acuta ENGL. Bot. Jahrb. 1 (1880) 44; in DC. Mon. Phan. 4 (1883) 232; MERR. En. Born. (1921) 349; SMYTHIES, Common Sarawak Trees (1965) 13. — *S. schwenkii var. beccarii* ENGL. Bot. Jahrb. 1 (1880) 44; in DC. Mon. Phan. 4 (1883) 232. — *S. luzoniensis* MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 109; MERR. En. Philip. 2 (1923) 470. — *S. acuminata* MERR. Philip. J. Sc. 10 (1915) Bot. 35; En. Philip. 2 (1923) 469. — **Fig. 13f–k.**

Tree up to 30(–45) m high and 65(–93) cm ∅. Buttresses occasionally present, 3 m high, 2–3 m wide. Bark grey, red-brown, or black, rather smooth, or narrowly and shallowly furrowed. *Leaves* chartaceous or subcoriaceous, elliptic to elliptic-lanceolate, ovate-oblong or lanceolate, (5–)7–16 by $(1^3/_4)2^3/_4$–6 cm, glabrous; occasionally with glabrous, dome-like domatia; papillae distinct, rather compact, sometimes obscure, on the lower surface except on the midrib and nerves; base cuneate or decurrent (margins separate); apex acute to acuminate; nerves 9–19 pairs; veins reticulate, some slightly parallel and cross-bar-like, often distinct; petiole $1^1/_2$–5 cm, flat, slightly concave, or bicanaliculate above, convex beneath. *Panicles* up to 27 cm long, puberulous, glabrescent, or glabrous; terminal parts of branches laxly branched, with spacious internodes, loosely flowered; floral bracts ovate to lanceolate, $^3/_4$–$1^3/_4$ mm long; pedicels $^1/_3$–2 mm. *Flowers* white. *Calyx* divided almost to the base, lobes suborbiculate or broadly obovate, 1–$1^1/_2$ mm long. Floral axis between calyx and stamens not elongated. *Petals* elliptic, obovate, or oblanceolate, $2^1/_2$–$3^1/_2$ by $^3/_4$–$1^1/_2$ mm, cuneate or obtuse at the base, sparsely puberulous at the apical part on both surfaces, usually glabrescent, sometimes also sparsely papillose at the lower half inside. *Disk* lobes confluent with the base of filaments. *Stamens* $^3/_4$–$1^3/_4$ mm; anthers broadly ovoid or ellipsoid, $^1/_3$–$^1/_2$ mm long. *Ovary* globose or subglobose, $^1/_2$–1 mm ♂: style $^1/_2$ mm; stigma capitellate. Abortive pistil in ♂ *c.* $^1/_2$ mm long. *Drupe* ellipsoid, 1–2 by $^2/_3$–$1^3/_4$ cm; enlarged petals reddish when fresh, narrowly elliptic or oblanceolate, 4–6 by $^2/_3$–$1^1/_2$ cm.

Distr. *Malesia:* Borneo (Sarawak: Baram, Kuching, Bako National Park, Apoh R., Paku, Sampadi Hill, Marudi, Stabut, Kapit, Anap, Mt Sengghai, Nanga Pelagos; Sabah: Sandakan, Sipitang, Lahad Datu; Kalimantan: Melawai, Bulungan, Sg. Tanggi, Martapura, Berouw, Sebalouw = Sebalau, Kutai, Nunukan I.) and the Philippines (Camiguin I., Luzon, Palawan).

Ecol. Lowland forest, sometimes up to 750 m, occasionally on flat swampy land, on river-banks, or on coral limestone rocks. *Fl.* April, July, Sept., Nov.; *fr.* Jan.–Dec.

Vern. Borneo: Sarawak: *maban*, Dayak, *pitoh*, *p. ai*, *rĕngas-pito*, Iban, *rĕngas*, Land Dayak, *rĕngas gunong*, *r. pĕtoh*, M; Brunei: *bitoh*, Iban,; Sabah: *mĕdang*; Kalimantan: *langhei*, Martapura; Philippines: *kalnis*, Tag.

6. Swintonia robinsonii RIDL. J. Str. Br. R. As. Soc. *n.* 54 (1910) 37; Fl. Mal. Pen. 1 (1922) 532.

Tree up to $10^1/_2$ m high and 26 cm ∅. Bark reddish brown, with shallow big dipples and loose, roundish, thin scales. *Leaves* coriaceous, elliptic or lanceolate, 10–$18^1/_2$ by $3^1/_2$–5 cm, glabrous, not papillose on the lower surface; base acute or obtuse (margins separate); apex acute or acuminate; nerves 12–17 pairs; veins reticulate, faint; petiole $1^1/_2$–$3^1/_2$ cm, semiterete, flat above. *Panicles* 8–17 cm long, puberulous, glabrescent; terminal parts of branches laxly branched, with spacious internodes, loosely flowered; floral bracts ovate to ovate-oblong, 3–$4^1/_2$ mm long; pedicels obscure or very short, up to *c.* 1 mm. *Flowers* white. *Calyx* divided to *c.* $^1/_3$ of its length, lobes triangular, *c.* 1 mm long. Floral axis between calyx and stamens elongated like a gynandrophore, 2–$2^1/_2$ mm long. *Petals* lanceolate or elliptic, 5–7 by 2–$2^1/_2$ mm, truncate or obtuse at the base; sparsely puberulous outside, densely puberulous and papillose inside. *Disk* lobes alternate with stamens. *Stamens* $4^1/_2$ mm; anthers oblong, *c.* 1 mm long. *Ovary* subglobose, *c.* $1^1/_2$ mm ∅; style $1^3/_4$–$2^1/_2$ mm; stigma slightly thicker than the style. Abortive pistil 1 mm long. *Drupe* globose, *c.* $1^1/_2$ cm ∅; enlarged petals elliptic, small, $^3/_4$–1 by $^2/_5$ cm.

Distr. *Malesia:* Malay Peninsula (Pahang: G. Tahan; S. Kelantan: G. Rabong).

Ecol. Forest on steep ridge slopes, 1050–1650 m. *Fl.* March, June, July; *fr.* June–July.

According to WHITMORE (*in sched.*) frequent on steep ridge slopes on Mt Rabong and dominating a stretch of forest there at *c.* 1450 m.

Vern. *Pauh gunong*, M.

Notes. This is one of the two species of this genus in Malesia with very small enlarged petals on the fruit, the other being *S. minutalata*, similarly as those of the Indo-Chinese *S. pierrei* HANCE (*cf.* TARD.-BLOT, Fl. C. L. & V. 2, 1962, 112, t. 5, f. 2–8).

I have seen 7 collections, of which 6 from Mt Tahan, Pahang, and one from Mt Rabong, S. Kelantan.

7. Swintonia floribunda GRIFF. Proc. Linn. Soc. Lond. 1 (1846) 283; MARCH. Rév. Anacard. (1869) 109 & 186 ('*florida*'). — *Astropetalum sp. 2* GRIFF. Notul. 4 (1854) 412. — *S. griffithii* KURZ, J. As. Soc. Beng. 39, ii (1870) 75; *ibid.* 45, ii (1876) 207; HOOK. *f.* Fl. Br. Ind. 2 (1876) 26; TARD. Fl. C. L. & V. 2 (1962) 110, t. 4, f. 1–6. — *S. helferi* HOOK. *f.* Fl. Br. Ind. 2 (1876) 26; KURZ, J. As. Soc. Beng. 45, ii (1876) 207. — *S. penangiana* KING, J. As. Soc. Beng. 65, ii (1896) 490; RIDL. Fl. Mal. Pen. 1 (1922) 533; KOCHUM. Mal. For. Rec. 17 (1964) 353. — *S. puberula* PEARSON, Kew Bull. (1906) 3; RIDL. Fl. Mal. Pen. 1 (1922) 532.

Tree up to 30(–45) m high and 50(–90) cm ∅, sometimes with steep plank buttresses up to 2 m high, often slightly sinuous or angular. Bark light greyish to reddish brown, shallowly fissured. *Leaves* chartaceous to subcoriaceous, elliptic to narrowly elliptic, oblong or obovate-oblong, $5^1/_2$–16(–25) by 2–5(–6) cm, glabrous, not papillose beneath; base cuneate (margins separate); apex acuminate; nerves 8–28 pairs; veins reticulate, faint; petiole 1–$6^1/_2$ cm, semiterete, sulcate or flat above. *Panicles* 8–18 cm long, puberulous, glabrescent, or glabrous; terminal parts of branches laxly branched, with spacious internodes, loosely flowered; floral bracts ovate, $^3/_4$–$1^1/_4$ mm long; pedicels rather long, ($1^1/_2$–)$2^1/_2$–4 mm. *Flowers* light green-yellowish or white. *Calyx* divided to $^1/_3$–$^1/_4$ of its length, lobes suborbicular, $^1/_2$–$^2/_3$ mm long. Floral axis between calyx and stamens elongated and like a gynandrophore, $1^1/_2$ mm long. *Petals* oblong or obovate-oblong, $3^1/_2$–4 by 1–2 mm, cuneate at the base, puberulous on both surfaces, sometimes glabrescent or almost glabrous outside. *Disk* lobes alternate with stamens. *Stamens* 2–$3^1/_2$ mm; anthers oblong, $^1/_2$–$^3/_4$ mm long. *Ovary* ovoid, *c.* $^1/_2$ mm ∅; style $1^1/_2$–$2^1/_2$ mm; stigma capitellate. *Drupe* globose or subglobose, $1^1/_4$–$1^3/_4$ cm ∅; enlarged petals red when fresh, narrowly oblong to linear, $3^3/_4$–9 by 1–$1^1/_4$ cm.

Distr. Burma, Andaman Is. (?), Thailand, Vietnam, and *Malesia:* Sumatra (Atjeh, E. & W. Coast, Indragiri, Riouw-Lingga Arch.) and Malay Peninsula (Kedah, Kelantan, Pahang, Negri Sembilan, Selangor, Johore, Langkawi, Penang).

Ecol. Lowland forest up to 270 m, sometimes at 850 m, occasionally on limestone; almost in a pure stand at G. Raya, Langkawi. *Fl.* May–June, Sept.–Jan.; *fr.* March–May, Aug., Dec.–Jan.

Vern. Sumatra: *bagel, mirah,* Atjeh, *kědondong rabuk,* M; Malay Peninsula: *kijang, mak pauh, mĕrpauh, mupoh, pauh,* M.

8. Swintonia spicifera HOOK. *f.* Fl. Br. Ind. 2 (1876) 27; ENGL. in DC. Mon. Phan. 4 (1833) 233, t. 5, f. 20–23; in E. & P. Nat. Pfl. Fam. 3, 5 (1892) 148, f. 93; KING, J. As. Soc. Beng. 65, ii (1896) 490, *incl. var. scortechini* KING, *l.c.* 491; RIDL. Fl. Mal. Pen. 1 (1922) 532; HEYNE, Nutt. Pl. (1927) 972; BURK. Dict. (1935) 2111; KOCHUM. Mal. For. Rec. 17 (1964) 154; MEIJER, Bot. News Bull. F. D. Sandakan 8 (1967) 32. — **Fig. 13l–m, 14.**

Tree up to 36(–54) m high and 80(–100) cm ∅, occasionally ridged (ridges 250 by 20 by 3 cm). Bark dark brown or purplish brown, dippled or fissured. *Leaves* coriaceous, elliptic-oblong, rarely ovate, or oblanceolate, $5^1/_2$–18(–23) by $2^1/_2$–5(–6) cm, glabrous, occasionally with glabrous, dome-like domatia; papillae very compact, obscure, or indistinguishable on the lower surface; base cuneate (margins separate); apex acute, acuminate, or obtuse; nerves 11–15(–22) pairs; veins reticulate, some slightly parallel and cross-bar-like, often faint; petiole $1^1/_2$–5 cm, semiterete, flat or slightly

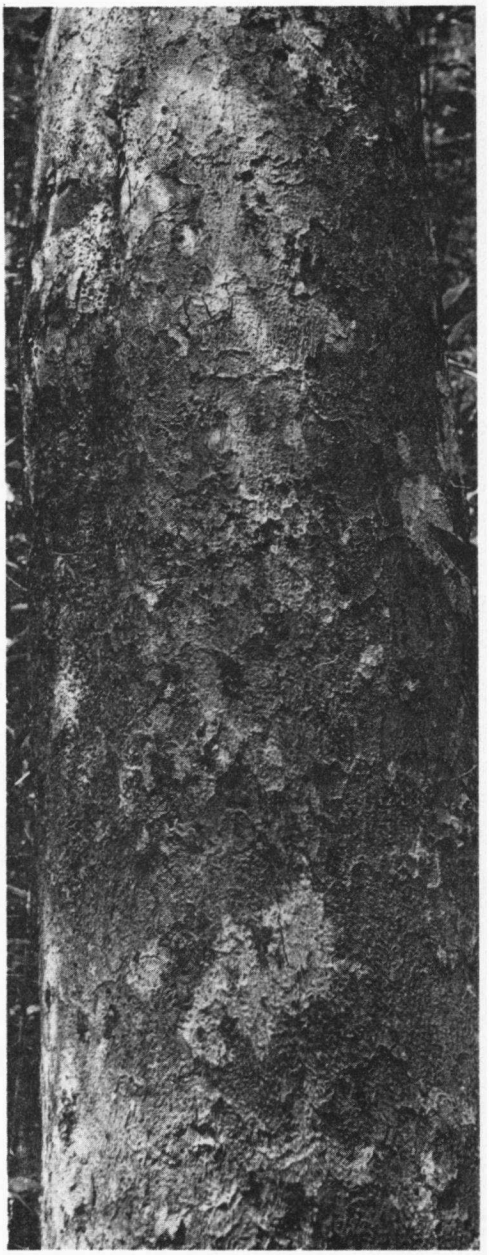

Fig. 14. *Swintonia spicifera* HOOK. *f.* Characteristic bark. In Malaya (Photogr. DING HOU).

convex above. *Panicles* 6½–22 cm long, puberulous, glabrescent, or glabrous; terminal parts of branches not or little branched, with very short or obscure internodes, densely flowered; floral bracts ovate, broadly elliptic, or suborbicular, 2–4 mm long; pedicels *c.* 1½ mm. *Flowers* pale or greenish yellow. *Calyx* divided to ⅕–⅓ of its length, lobes suborbiculate or transverse-oblong, ½–¾ mm long. Floral axis between calyx and stamens elongated and like a gynandrophore, *c.* 1 mm long. *Disk* lobes alternate with the stamens. *Stamens* 1½–2½ mm; anthers oblong, ½–⅔ mm long. *Ovary* broadly ellipsoid or obovoid, *c.* ½ mm ∅; style 2½ mm; stigma slightly thicker than the style. Abortive pistil in ♂ *c.* ⅔ mm long. *Drupe* ellipsoid, 2–2½ by 1½ cm; enlarged petals red when fresh, oblong-lanceolate, 3½ by 1–1½ cm.

Distr. *Malesia:* Sumatra (Palembang, Riouw and Lingga Arch.) and Malay Peninsula (Kedah, Perak, Negri Sembilan, Johore, Malacca, Penang).

Ecol. Lowland forests, up to 500 m. *Fl.* Febr., May, Oct., Nov.; *fr.* Febr.–April, Sept.

Uses. Furnishes a good timber (HEYNE, BURKILL).

Vern. Sumatra: *kerete*, M; Malay Peninsula: *mupus*.

6. GLUTA

LINNÉ, Mant. 2 (1771) 293; MARCH. Rév. Anacard. (1869) 110 & 187; ENGL. in DC. Mon. Phan. 4 (1883) 224; KING, J. As. Soc. Beng. 65, ii (1896) 480; BURK. Gard. Bull. S. S. 5 (1931) 224; DING HOU, Blumea 24 (1978) 8. — *Stagmaria* JACK, Descr. Mal. Pl. 3 (1822) 12, repr. in Hook. Comp. Bot. Mag. 1 (1836) 267. — *Syndesmis* WALL. in Roxb. Fl. Ind. ed. Wall. 2 (1824) 314. — *Melanorrhoea* WALL. Pl. As. Rar. 1 (1829) 9; MARCH. Rév. Anacard. (1869) 112 & 185; ENGL. in DC. Mon. Phan. 4 (1883) 234, *incl. sect.*; KING, J. As. Soc. Beng. 65, ii (1896) 483, *incl. sect.* — **Fig. 15–28.**

Trees, rarely large shrubs. *Leaves* spiral, scattered, sometimes aggregate in pseudo-whorls, simple, coriaceous, entire, petioled, rarely subsessile or sessile. *Inflorescences* axillary, paniculate; bracts and bracteoles ovate to lanceolate, usually caducous; pedicels sometimes articulated. *Flowers* bisexual. *Calyx* calyptriform, circumscissile or bursting irregularly at anthesis, caducous. Floral axis between calyx and ovary often elongated and enlarged (described as *torus* here). *Petals* (4 or) 5(–8), imbricate and/or contorted sometimes even on the same specimen, rarely valvate, caducous, or persistent and (much) enlarged in fruit. *Stamens* (4 or) 5(–7), 10, or ∞, inserted on the torus; filaments filiform, glabrous or hairy; anthers dorsifixed. *Disk* 0. *Ovary* sessile or stiped (between ovary and stamens), 1-celled, glabrous or hairy; style distinct, filiform; stigma slightly thicker than the style. *Drupe* 1-celled, sometimes stalked, sometimes supported by the much enlarged, wing-like petals. *Seed* with testa adherent to the endocarp; embryo straight, rarely slightly curved; cotyledons free, or incompletely fused and partly free only on one side.

Distr. About 30 *spp.* in Madagascar (1 *sp.*), India (Deccan Peninsula and Andaman Is.), Burma, Thailand, Indo-China, China (?Hainan), throughout *Malesia* (so far not found in the Lesser Sunda Is. and Philippines; in New Guinea only 1 *sp.*). Fig. 16.

Ecol. Mixed dryland forest, peat-swamps, and riverine forest, chiefly in the lowland and hills, by exception up to 1200 m.

G. renghas and *G. velutina* can be co-dominants in lowland swampy habitats in the lowest course of the rivers.

Recognition of *rengas* trees in the field is mostly easy by making cuts or bruises on the plant (twigs, bark, wood) after which a darkening to pitch-black coagulent resin exudes (see p. 407 under dermatitis and fig. 22).

Taxon. Originally when few species were known, the gene... *Gluta* and *Melanorrhoea* were well distinguished, although as early as 1869 MARCHAND anticipated their ultimate fusion. In the course of years this has now come true after several 'anomalous' species have been described: stamens may vary from 5, 10 to many; cotyledons may be free or partly fused; petals may be accrescent or not, with intermediate stages; the torus may be cylindric or swollen; the style is terminal or excentric; the calyx is circumscissile calyptriform or spathaceous, with an intermediate. This independent reticulate variation makes it

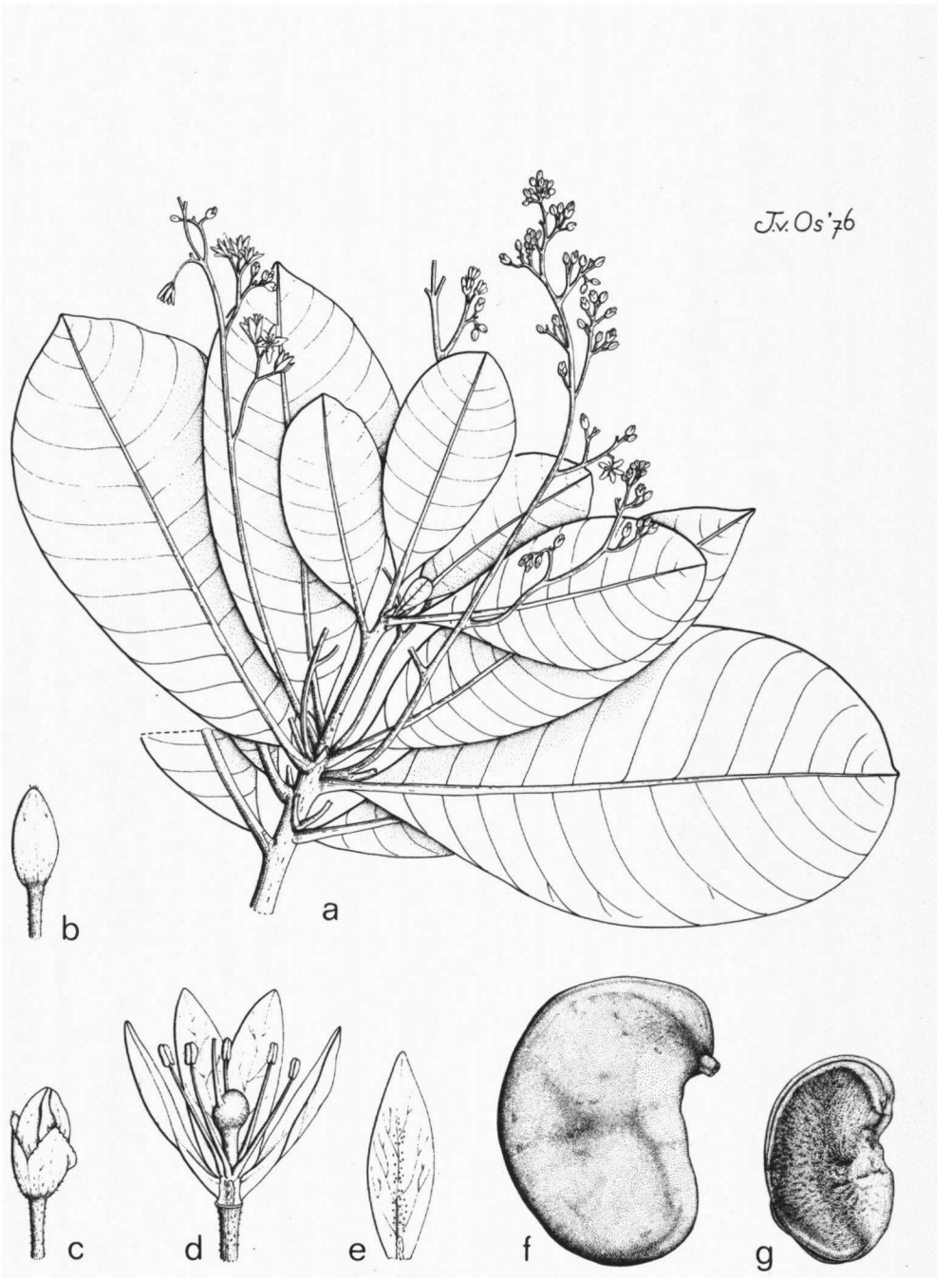

Fig. 15. *Gluta papuana* DING HOU. *a*. Habit, × 1/2, *b*. flower-bud, *c*. flower-bud showing calyx bursting into two lobes, *d*. flower (calyx fallen off) with one petal removed, *e*. petal, inside view, all × 3 1/2, *f*. fruit, × 1/2, *g*. embryo, showing cotyledons united on one side, × 1/2 (*a* SCHODDE & CRAVEN 4492, *b–e* NGF 38963, *f–g* NGF 18316).

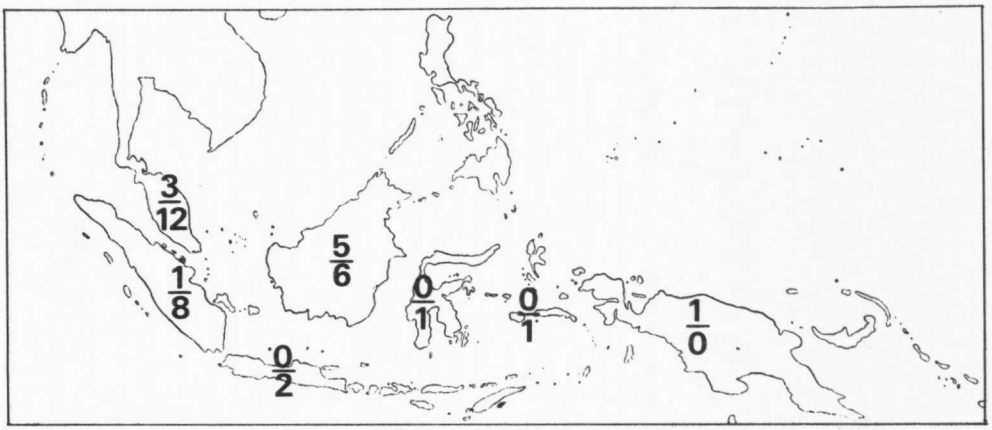

Fig. 16. Species density of *Gluta* in Malesia; above the hyphen the number of endemic *spp.*, below it the number of non-endemic ones in each island (group). Note absence in the Philippines and Lesser Sunda Is.

impossible to distinguish more than one genus and defeats also distinction of sections (*cf.* DING HOU, Blumea 24, 1978, 8–9, f. 1g–h). Wood-anatomically there is, according to Mr. L. S. V. MURTHY (Kuching), no distinction between *Gluta* and *Melanorrhoea* (DING HOU, *l.c.* 10). Also according to BAKSI (in Ferguson & Muller, ed., 'The evolutionary significance of the exine', 1976, 379–405, pl. 1–8, f. 1–2) most species of the two genera belong to one basic pollen type from which two specializations can be derived, but it is evident that the two genera cannot be distinguished palynologically (DING HOU, *l.c.* 12).

Uses. The seeds of *G. renghas* and *G. velutina* can be eaten after roasting (BURKILL, *l.c.* 230). The heartwood of some species, *e.g.* of *G. renghas*, *G. elegans*, *G. wrayi*, *etc.*, is reddish brown and beautiful for handsome furniture, but it is hardly used due to the toxic properties of the resinous exudate.

C. J. STEFELS ('Rapport inzake het onderzoek van enige Houtsoorten ten aanzien van hun weerstand tegen paalwormaantasting' Fak Fak, 1957, typed report, in Dutch) made some observations on resistance against marine borers. A log of '*Gluta*' (Fak Fak, Budidi R., BW 3135), now identified as *G. papuana*, was tested. After 7 months the sapwood was infected, while the heartwood remained sound. As in this species the sapwood/heartwood ratio is unfavourable, it is not suitable for wharf piling (extr. kindly by W. VINK).

Vern. Malaysian standard timber name: *rengas*.

KEY TO THE SPECIES

Based on flowering specimens

1. Calyx detaching at anthesis circumscissile from the base and falling off in one piece as a calyptra. Stamens ∞, except 5 or (8–)10 in 3 *spp.*
 2. Stamens ∞ (*c.* 20–100).
  3. Ovary hairy. Leaves pubescent beneath, especially on the midrib, nerves, and veins.
   4. Inflorescences accompanied by mature leaves. Petals obovate-oblong or -lanceolate **1. G. speciosa**
   4. Inflorescences appearing before the leaves or accompanied by some young ones. Petals elliptic-lanceolate or lanceolate . . . . . **2. G. pubescens**
  3. Ovary glabrous (rarely scurfy in *G. rugulosa*). Leaves glabrous, rarely slightly hairy beneath when young, glabrescent.
   5. Mature flower-bud or calyptra-shaped calyx more than 3 mm wide. Petals contorted or imbricate. Stamens more than 35.
    6. Apex of the calyptra-shaped calyx obtuse, acute, or acuminate.
     7. Pedicels not articulated. Ovary with a shorter stipe (between ovary and stamens) $^1/_2$–2 mm long.
      8. Calyx usually with a tuft of hairs at the apex, sometimes puberulous outside when young and glabrescent except the apical part. Petals oblanceolate, 11–16 mm long . . . . . **3. G. aptera**
      8. Calyx densely puberulous outside. Petals elliptic-oblong or ovate-oblong, $7^1/_2$–9 mm long **4. G. rugulosa**
     7. Pedicels articulated. Ovary with a stipe (between ovary and stamens) (2–)3–5 mm long **5. G. beccarii**
    6. Apex of the calyptra-shaped calyx rostrate . . . . . **6. G. rostrata**
   5. Mature flower-bud or calyptra-shaped calyx $1^1/_2$–2 mm wide. Petals almost valvate except at the apical part. Stamens *c.* 20(–28) . . . . . **7. G. macrocarpa**
 2. Stamens 5–10.

9. Stamens (8–)10. Leaves distinctly petioled ($^3/_4$–$2^1/_2$ cm); nerves 9–18 pairs, distinct beneath.
10. Inflorescences puberulous, glabrescent. Pedicels $1^1/_2$–$2^1/_2$ mm, articulated. Petals contorted or imbricate . . . . . **8. G. curtisii**
10. Inflorescenes glabrous. Pedicels 8–16 mm, not articulated. Petals valvate . . . . . **9. G. oba**
9. Stamens 5. Leaves with obscure or very short petiole (*c.* $^1/_3$ cm); nerves 17–27 pairs, prominent beneath . . . . . **10. G. malayana**
1. Calyx bursting irregularly at anthesis: toothed or lobed, and/or splitting on one side (spathaceous), and then detaching circumscissile. Stamens (4 or) 5 (or 6).
11. Ovary hairy.
12. Petals with the basal $^3/_4$–3 mm longitudinally adnate to the cylindric torus. Pedicels not articulated.
13. Petals 5–$7^1/_2$ mm long. Leaves usually pseudo-verticillate.
14. Petals densely puberulous on both surfaces. Torus *c.* $1^1/_2$ mm long. Stipe of the ovary 1–$1^1/_2$ mm long; style terminal . . . . . **11. G. torquata**
14. Petals puberulous outside and densely papillose usually at the lower half inside. Torus 1–$1^1/_4$ mm long. Stipe of the ovary obscure; style lateral . . . . . **12. G. sabahana**
13. Petals 8–13 mm long. Leaves scattered.
15. Petals narrowly elliptic, 8–9 by $1^1/_4$–2 mm . . . . . **13. G. laxiflora**
15. Petals narrowly oblanceolate, 10–13 by $2^1/_2$ mm . . . . . **14. G. wrayi**
12. Petals with the base attached to the base of the pulvinate torus, not adnate. Pedicels articulated **15. G. wallichii**
11. Ovary glabrous.
16. Torus $3^1/_2$–7 mm long. Pedicels not articulated. Petals puberulous outside (except in *G. elegans*).
17. Inflorescences branched from the apical part. Flowers crowded at the end of branchlets **16. G. capituliflora**
17. Inflorescences branched almost from the base. Flowers laxly arranged on the branchlets.
18. Petals with the basal 5–6 mm completely adnate to the torus . . . . . **17. G. lanceolata**
18. Petals with the central part of the basal $3^1/_2$–$5^1/_2$ mm adnate to the torus.
19. Torus $3^1/_2$ mm long. Leaves with slightly elevated nerves, sometimes hardly distinguishable from the veins on both surfaces . . . . . **18. G. tavoyana**
19. Torus 5–6 mm long. Leaves with slightly elevated nerves distinguishable from the veins on both surfaces . . . . . **19. G. elegans**
16. Torus $^2/_3$–3 mm long. Pedicels articulated. Petals glabrous outside.
20. Calyx puberulous outside. Leaf apex acuminate. Large shrub or small tree up to 10 m high **20. G. velutina**
20. Calyx glabrous except sparsely hairy at the apex. Leaf apex obtuse, rounded, or slightly emarginate, rarely cuspidate. Tall trees.
21. Torus $^2/_3$–$1^1/_4$ mm long. Petals $6^1/_2$–$7^1/_2$ mm long . . . . . **21. G. papuana**
21. Torus 2–3 mm long. Petals $7^1/_2$–13 mm long . . . . . **22. G. renghas**

KEY TO THE SPECIES

Based on fruiting specimens

1. Fruit subtended by wing-like, enlarged petals.
2. Fruit smooth.
3. Enlarged petals on the fruit 1–3 cm long.
4. Stamens or their scars *c.* 20–∞.
5. Leaves pubescent beneath and on the midrib and nerves above. Stamens or their scars ∞ **2. G. pubescens**
5. Leaves glabrous. Stamens or their scars *c.* 20(–28) . . . . . **7. G. macrocarpa**
4. Stamens or their scars 5 . . . . . **10. G. malayana**
3. Enlarged petals on the fruit 5–9 cm long.
6. Fruit globose, *c.* $1^1/_2$ cm ∅. Stamens or their scars ∞ or (8–)10.
7. Stamens or their scars ∞ . . . . . **5. G. beccarii**
7. Stamens or their scars (8–)10 . . . . . **8. G. curtisii**
6. Fruit ovoid or ellipsoid, *c.* $1^1/_2$ by 1 cm. Stamens or their scars 5 . . . . . **15. G. wallichii**
2. Fruit wrinkled and scurfy . . . . . **4. G. rugulosa**
1. Fruit usually without wing-like, enlarged petals.
8. Fruit on a centric stalk, globose or subglobose.
9. Fruit smooth.
10. Stamens or their scars 5 or 10.
11. Stamens or their scars 5.
12. Leaves 7–$13^1/_2$(–18) cm wide; petiole up to 2 cm. Fruit with a distinct stalk (*c.* 1–$1^1/_2$ cm); cotyledons free.
13. Mature leaves with pubescent midrib on both surfaces; petiole obscure or very short (*c.* $^1/_3$ cm) **10. G. malayana**
13. Mature leaves with glabrous midrib on both surfaces. Petiole $^3/_4$–2 cm . **11. G. torquata**
12. Leaves $1^3/_4$–$4^1/_2$ cm wide; petiole ($2^1/_2$–)$3^1/_2$–$7^1/_2$ cm. Fruit on an obscure stalk; cotyledons incompletely fused, free on one side . . . . . **17. G. lanceolata**

11. Stamens or their scars 10 . . . . . **9. G. oba**
10. Stamens or their scars many (*c.* 20–∞).
14. Fruit on a stalk $^3/_4$–$1^3/_4$ cm long. Stamens or their scars *c.* 20(–28). . . . . **7. G. macrocarpa**
14. Fruit on a shorter stalk *c.* $^1/_2$ cm long. Stamens or their scars more than 35.
15. Leaves pubescent beneath, especially on the midrib and veins . . . . . **1. G. speciosa**
15. Leaves usually glabrous, sometimes pubescent beneath when young, glabrescent **3. G. aptera**
9. Fruit wrinkled, lenticellate, or scurfy.
16. Fruit surface much wrinkled, with irregularly tuberculate ridges, crests, or protuberances.
17. Cotyledons free. Large shrub or small tree up to 10 m high . . . . . **20. G. velutina**
17. Cotyledons incompletely fused, free on one side. Tall tree . . . . . **22. G. renghas**
16. Fruit surface not wrinkled, but lenticellate or scurfy.
18. Fruit densely lenticellate; cotyledons free . . . . . **6. G. rostrata**
18. Fruit scurfy; cotyledons incompletely fused, free on one side . . . . . **18. G. tavoyana**
8. Fruit on an excentric stalk (except centric in *G. pubescens* and *G. wrayi*), variously shaped, often laterally flattened.
19. Fruit smooth.
20. Leaves pubescent beneath. Stamens or their scars ∞. Cotyledons free. . . . **2. G. pubescens**
20. Leaves glabrous. Stamens or their scars 5. Cotyledons incompletely fused, free on one side.
21. Leaf apex acuminate. Free part of the cotyledons $1^1/_2$–$2^1/_2$ cm deep . . . . . **19. G. elegans**
21. Leaf apex rounded, slightly emarginate, rarely cuspidate. Free part of the cotyledons 3–$3^1/_4$ cm deep . . . . . **21. G. papuana**
19. Fruit scurfy.
22. Fruit erect. (Cotyledons incompletely fused, free part $^1/_2$–$^3/_4$ cm deep; free part/solid part = *c.* 1 : 4) . . . . . **14. G. wrayi**
22. Fruit not erect but bent obliquely or horizontally.
23. Petiole usually very short, $^1/_4$–$^3/_4$ cm, sometimes some leaves with petiole up to $1^1/_2$(–2) cm. Free part of cotyledons *c.* 1 cm deep (free part/solid part = *c.* 1 : 2–$3^1/_2$) . . . . **12. G. sabahana**
23. Petiole 1–5 cm. Free part of cotyledons $1^1/_2$–$3^3/_4$ cm deep.
24. Free part of cotyledons $1^1/_2$–2 cm deep (free part/solid part = *c.* 1 : 1–2) . . **13. G. laxiflora**
24. Free part of cotyledons $2^3/_4$–$3^3/_4$ cm deep (free part/solid part = *c.* 3 : 1) **16. G. capituliflora**

1. Gluta speciosa (RIDL.) DING HOU, Blumea 24 (1978) 21. — *Melanorrhoea speciosa* RIDL. Kew Bull. (1933) 197; ANDERSON, Gard. Bull. Sing. 20 (1963) 171; SMYTHIES, Common Sarawak Trees (1965) 9.

Tree up to 40 m high and 80 cm ∅. Buttresses $1^1/_2$ m high, $^1/_3$ m wide, 5–$7^1/_2$ cm thick. Bark dark brown, irregularly fissured. *Leaves* coriaceous, obovate, 5–$17^1/_2$ by 3–9 cm; pubescent beneath, especially on the midrib and nerves, often glabrous above except pubescent on the midrib; base cuneate; apex rounded or emarginate; nerves 10–22 pairs, prominent below, flat but distinct above; veins reticulate, or transverse and parallel, often distinct on both surfaces; petiole 1–2 cm. *Panicles* up to 18 cm long, tomentose; pedicels 10–20 mm, not articulated. *Flower-buds* ellipsoid, 10–12 by 5 mm, obtuse. *Calyx* 10–12 mm long, circumscissile, densely puberulous outside. *Petals* white, red at the base, imbricate, obovate-oblong or -lanceolate, 10–15 by 3–5 mm, puberulous outside. *Stamens* pink, *c.* 100, 7–10 mm; filaments hairy; anthers oblong, $^3/_4$ mm long. *Torus* subglobose, $1^1/_2$ mm ∅. *Ovary* obovoid, $2^1/_2$ mm long, densely hairy; stipe *c.* 1 mm; style terminal, 3 mm. *Drupe* on a centric stalk (*c.* $^1/_2$ cm), subglobose, 2–3 cm ∅, smooth; without enlarged petals; embryo subglobose, $1^1/_2$–2 cm ∅; cotyledons free.

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

Ecol. Lowland forest on drylands and in swamps. *Fl.* March–May; *fr.* May–July.

Vern. *Rĕngas*, M.

2. Gluta pubescens (RIDL.) DING HOU, Blumea 24 (1978) 15. — *Melanorrhoea pubescens* RIDL. Fl. Mal. Pen. 1 (1922) 530. — *Melanorrhoea sp.* CORNER, Ways. Trees (1940) 121. — Fig. 17.

Deciduous tree, up to 24(–45) m high and 34 cm ∅, occasionally with buttresses. Bark dark rich brown, very flaky and shaggy with large elongated jagged pieces separating from below upwards and overlapping. *Leaves* coriaceous, elliptic or obovate, 9–17 by $3^1/_2$–$8^1/_2$ cm; pubescent beneath especially on the midrib, nerves and veins; glabrous above except pubescent on the midrib and nerves; base cuneate; apex rounded or emarginate; nerves 11–18 pairs, prominent beneath, distinct above; veins scalariform, distinct beneath, faint above; petiole 1–$2^1/_2$(–$3^1/_2$) cm. *Panicles* up to *c.* 14 cm long, appearing before leaves or accompanied by some young ones, pubescent; pedicels 9–14 mm long, articulated. *Flower-buds* ovoid-oblong, 11–13 by 6–7 mm, acuminate. *Calyx* 11–13 mm long, circumscissile, puberulous outside. *Petals* white, contorted, elliptic-lanceolate or lanceolate, 9–13 by 3–4 mm, puberulous outside, sparsely puberulous near the base inside. *Stamens* *c.* 60, 3–7 mm; filaments sparsely hairy; anthers oblong or broadly ellipsoid, *c.* $^2/_3$ mm long. *Torus* subglobose, $1^1/_2$–2 mm ∅. *Ovary* subglobose, $1^1/_2$–2 mm ∅, sparsely hairy; stipe $1^1/_2$–2 mm; style terminal or slightly excentric, $2^1/_4$–5 mm. *Drupe* on a centric stalk (*c.* $1^1/_2$ cm), transverse-oblong, 2–$2^1/_2$ by $3^1/_2$–$4^1/_2$ cm, smooth; sometimes with enlarged wing-like petals (narrowly elliptic, $1^1/_4$ by $^1/_4$ cm); embryo transverse-oblong, $1^1/_2$ by 3–4 cm; cotyledons free.

Distr. *Malesia:* Sumatra (Tapanuli) and Malay Peninsula (Trengganu, Pahang, Johore, Malacca).

Ecol. Dryland and swamp forest at low altitude, sometimes found up to 600 m. *Fl.* March–June; *fr.* May, July. CORNER observed in Trengganu the trees to shed their leaves in Oct.–Nov. and flower on the bare twigs before the new leaves unfold.

Vern. *Kĕrbau jalang, rĕngas, sisĕk tĕnggiling, sumpah biawak*, M.

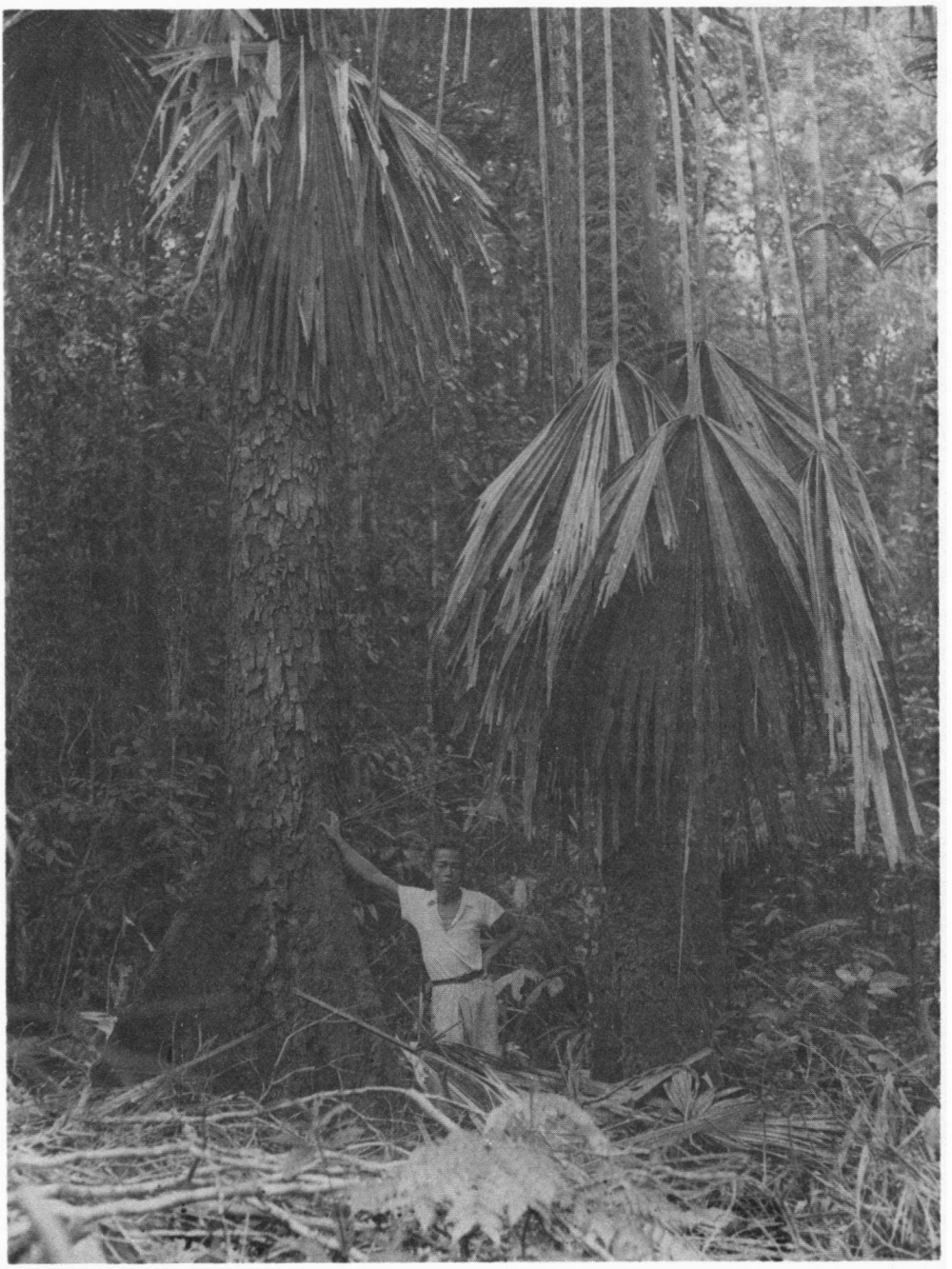

Fig. 17. *Gluta pubescens* (RIDL.) DING HOU. The scaly rengas, '*kerbau jalang*', along the Mawai–Jemaluang Road, E. Johore, alongside the palm *Pholidocarpus kingianus* RIDL. The only species with this kind of peculiar bark-shedding, mentioned as *Melanorrhoea sp.* by CORNER, Ways. Trees (1940) 121 (Photogr. CORNER).

3. Gluta aptera (KING) DING HOU, Blumea 24 (1978) 12. — *Melanorrhoea aptera* KING, J. As. Soc. Beng. 65, ii (1896) 487; RIDL. Fl. Mal. Pen. 1 (1922) 531; KOCHUM. Mal. For. Rec. 17 (1964) 297. — *Melanorrhoea inappendiculata* KING, J. As. Soc. Beng. 65, ii (1896) 488; RIDL. Fl. Mal. Pen. 1 (1922) 531; SMYTHIES, Common Sarawak Trees (1965) 9, pl. 3. — *Melanorrhoea tricolor* RIDL. Kew Bull. (1933) 196; ANDERSON, Gard. Bull. Sing. 20 (1963) 171; SMYTHIES, Common Sarawak Trees (1965) 9.

Tree up to 40 m high and 60 cm ∅. Buttresses occasionally present, up to $1^1/_2$ m high, $^1/_3$ m wide, $7^1/_2$ cm thick. Bark brown, rather smooth. *Leaves* coriaceous, obovate to obovate-oblong, or elliptic, 4–29(–$37^1/_2$) by $2^1/_2$–$10^1/_2$(–$15^1/_2$) cm; usually glabrous, sometimes the young ones pubescent beneath especially on the midrib, nerves and veins, and also on the midrib above, glabrescent; base cuneate, rarely attenuate; apex rounded, emarginate, sometimes acute; nerves 12–23 pairs, prominent beneath, distinct or faint above; veins reticulate, or transverse and parallel, slightly elevated beneath, faint above; petiole ($^1/_2$–)$1^1/_2$–$2^1/_2$ cm. *Panicles* up to 32 cm long, pubescent especially when young, glabrescent, sometimes glabrous; pedicels 10–$22^1/_2$ mm, not articulated. *Flower-buds* ovoid to ovoid-oblong, or ellipsoid, 7–15 by 5 mm, obtuse or acute. *Calyx* 7–15 mm long, circumscissile, usually with a tuft of hairs at the apex, sometimes puberulous outside when young, glabrescent except the apical part. *Petals* white, then changing to red from base upwards (*cf.* ANDERSON S 12433), imbricate or contorted, oblanceolate, 11–16 by $3^1/_2$–5 mm, puberulous outside, sparsely hairy and slightly papillose near the base inside, sometimes glabrescent. *Stamens c.* 100, 8–11 mm; filaments white, changing to bright blue (*cf.* ANDERSON 12433), hairy; anthers oblong, $^2/_3$–1 mm. *Torus* broadly ovoid, $1^1/_2$–2 mm ∅. *Ovary* broadly ellipsoid, obovoid, or obliquely subglobose, 1–$1^1/_2$ mm ∅, glabrous; stipe $^1/_2$–2 mm; style subterminal, $2^1/_2$–5 mm. *Drupe* on a centric stalk (*c.* $^1/_2$ cm), globose or subglobose, $2^1/_2$–$3^1/_2$ cm ∅, brown, smooth; usually without enlarged petals; embryo subglobose, $1^3/_4$–$2^3/_4$ cm ∅,; cotyledons free.

Distr. *Malesia:* widely distributed in Sumatra, the Malay Peninsula, and Borneo.

Ecol. Dryland and peat-swamp forest, secondary growths, sometimes on sandstone, up to 650 m, rarely up to 1200 m. *Fl. fr.* Jan.–Nov.

Vern. *Rĕngas, r. paya,* M, *ungan,* Dayak.

4. Gluta rugulosa DING HOU, Blumea 24 1(978) 16. — **Fig. 18a–d.**

Tree up to *c.* 30 m high. *Leaves* coriaceous, obovate to oblanceolate, 6–$27^1/_2$ by $4^1/_2$–$10^1/_2$ cm; glabrous on both surfaces, sometimes the lower surface slightly puberulous when young, glabrescent; base decurrent; apex rounded, sometimes slightly emarginate; nerves 11–21 pairs, prominent beneath, flat above; veins reticulate, or transverse and parallel, distinct beneath, faint above; petiole 0–1 cm. *Panicles* 5–14(–25) cm long, puberulous; pedicels 5–7 mm, not articulated. *Flower-buds* ovoid or ellipsoid, 7–8 by $3^1/_2$–4 mm, shortly acuminate. *Calyx* 7–8 mm long, circumscissile, densely puberulous outside. *Petals* imbricate, elliptic-oblong or ovate-oblong, $7^1/_2$–9 by $2^3/_4$–$3^1/_2$ mm, densely puberulous outside, papillose in the lower part inside. *Stamens* ∞ (*c.* 40); filaments $3^1/_2$–4 mm, hairy; anthers oblong, *c.* 1 mm long. *Torus* subglobose, *c.* $1^1/_2$ mm ∅. *Ovary* broadly ellipsoid, *c.* 1 mm long, scurfy; stipe 1–$1^1/_2$ mm; style terminal, 3–4 mm. *Drupe* sessile, globose, *c.* $3^1/_2$ cm ∅, light brown, scurfy, wrinkled; enlarged, wing-like petals elliptic-lanceolate, $2^1/_2$–3 by $^1/_4$–1 cm; embryo subglobose, *c.* $2^1/_2$ cm ∅; cotyledons free.

Distr. *Malesia:* Borneo (Brunei; Sabah: Sipitang, Kuala Belait; Sarawak: Baram Distr.; Kalimantan: Kuala Kapuas, Pontianak).

Ecol. Lowland forest or on forest-edges, up to 150 m. *Fl.* March, Nov.; *fr.* April, Aug., Sept.

Vern. *Hĕmbodja,* Pontianak, *umpoh,* Kuala Kapuas.

5. Gluta beccarii (ENGL.) DING HOU, Blumea 24 (1978) 13. — *Melanorrhoea beccarii* ENGL. Bot. Jahrb. 1 (1880) 45; in DC. Mon. Phan. 4 (1883) 237, t. 5, f. 6–8; ANDERSON, Gard. Bull. Sing. 20 (1963) 170; SMYTHIES, Common Sarawak Trees (1965) 9, pl. 2; MEIJER, Bot. News Bull. F. D. Sandakan (1967) 27, pl.

Tree up to 33 m high and 72 cm ∅. Buttresses up to $1^1/_4$ m high, $^1/_2$ m wide, $7^1/_2$ cm thick. Bark grey, reddish or dark brown, rather smooth. *Leaves* coriaceous, obovate, or elliptic, 7–$12^1/_2$ by $3^1/_2$–6 cm, glabrous, sometimes puberulous beneath especially on the midrib and nerves; base cuneate; apex obtuse, or emarginate, rarely acute; nerves 9–18 pairs, distinct on both surfaces; veins reticulate, some transverse, distinct beneath, rather faint above; petiole $^1/_2$–$2^1/_2$ cm. *Panicles* 9–15 cm long, puberulous; pedicels $2^3/_4$–8 mm, articulated. *Flower-buds* ovoid-oblong, 8–12 by 5–7 mm, shortly acuminate. *Calyx* pinkish-purple, 8–12 mm long, circumscissile, puberulous outside. *Petals* white, changing to dark pink, contorted, narrowly elliptic, 12–14 by 3–4 mm, puberulous outside, glabrous inside. *Stamens c.* 70, 5–10 mm; filaments sparsely hairy. *Torus* subglobose, *c.* $1^1/_2$ mm ∅. *Ovary* subglobose, *c.* 1 mm ∅, glabrous; stipe (2–)3–5 mm; style terminal, 3–5 mm. *Drupe* (bright purplish-red when fresh) on a centric stalk (1–$1^1/_4$ cm), subglobose, *c.* $1^1/_2$ cm ∅, smooth; wing-like, enlarged petals (bright pinkish or red) narrowly oblanceolate or elliptic-oblong, 5–6 by $1^1/_4$–$1^3/_4$ (–$2^1/_2$) cm; embryo subglobose, $1^1/_4$ cm ∅; cotyledons free.

Distr. *Malesia:* Malay Peninsula (Trengganu, Malacca) and Borneo (Brunei; Sabah: Beaufort, Tenom, Lahad Datu; Sarawak: Bako Nat. Park, Simanggang, Binatang, Sibu, Bintulu).

Ecol. Peat-swamps, heath forest, and dryland forest up to 100 m. *Fl.* Dec.–June; *fr.* Jan.–Oct.

Vern. *Rengas kerangas, r. paya,* Sarawak.

6. Gluta rostrata DING HOU, Blumea 24 (1978) 15.

Tree up to 20 m high and 65 cm ∅. Buttresses 2 m high, $1^1/_2$ m wide, 6 cm thick. Bark greyish red-brown, rough. *Leaves* coriaceous obovate-oblong, oblanceolate, sometimes elliptic, $7^1/_2$–16 by $2^1/_2$–$6^1/_2$ cm, glabrous; base attenuate; apex obtuse, rounded, or emarginate; nerves 9–14 pairs, slightly elevated beneath, flat and distinct above; veins reticulate, usually distinct on both surfaces, sometimes obscure above; petiole $^1/_2$–$1^3/_4$ cm. *Panicles* $9^1/_2$–$13^1/_2$ cm long, puberulous; pedicels 10–$27^1/_2$

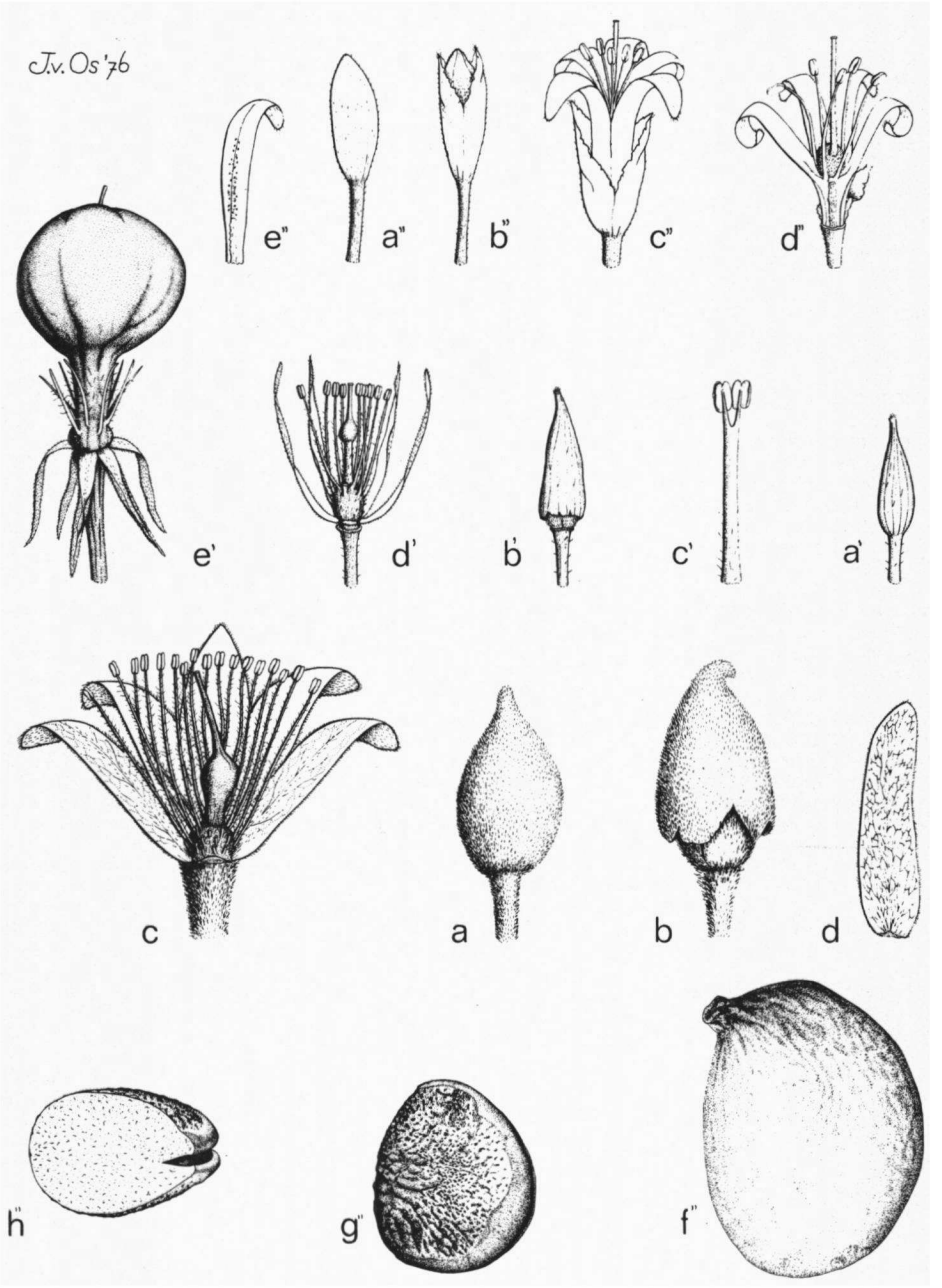

Fig. 18. *Gluta rugulosa* DING HOU. *a*. Flower-bud, *b*. flower, showing calyx splitting circumscissile, *c*. flower (calyx fallen off), 1 petal and some stamens removed, *d*. petal, all × $3^1/_2$. — *G. oba* (MERR.) DING HOU. *a'*. Flower-bud, × $3^1/_2$, *b'*. flower, showing calyx splitting circumscissile around base, × $3^1/_2$, *c'*. abnormal stamens, × 7, *d'*. flower (calyx fallen off), 1 petal and 1 stamen removed, × $3^1/_2$, *e'*. (young) fruit, × $3^1/_2$. — *G. sabahana* DING HOU. *a"*. Flower-bud, *b"*. flower, showing calyx bursting into two lobes, *c"*. open flower, *d"*. flower, a great deal of calyx and 1 petal removed, *e"*. petal, all × $3^1/_2$, *f"*. fruit, *g"*. embryo, side view, *h"*. CS of embryo, showing cotyledons free on one side, all × $^1/_2$ (*a–d* HOSE 41, *a'–b'*, *d'–e'* CHEW WEE LEK 1346, *c'* SAN 16161, *a"–e"* SAN 40615, *f"–h"* SAN 19696a).

mm, not articulated. *Flower-buds* lanceolate, 12–15 by 3½–4½ mm, rostrate. *Calyx* 12–15 mm long, circumscissile, puberulous outside. *Petals* imbricate, elliptic-oblong, sometimes lanceolate, 7–12 by 2½–4 mm, densely hairy outside, sparsely hairy and papillose at the base inside. *Stamens* ∞ (more than 100); filaments 2¾–7 mm, sparsely hairy; anthers oblong, *c.* ⅔ mm long. *Torus* subglobose, *c.* 1½ mm ∅. *Ovary* subglobose, ½–¾ mm ∅, glabrous; stipe 1–2½ mm; style 2½–3½ mm, terminal. *Drupe* sessile, globose, 3–4 cm ∅, brown, densely lenticellate; embryo depressed-globose, 1¾–2¾ cm ∅; cotyledons free.

Distr. *Malesia:* Sumatra (Atjeh, Tapanuli, Muara Pedjangki, P. Gelang, Indragiri).

Ecol. Lowland forest and marshy places, from sea-level to 60 m. *Fl.* May, June; *fr.* May–June, Sept.–Oct.

Vern. *Rĕngai, rĕngas, rĕngé*, M.

7. Gluta macrocarpa (ENGL.) DING HOU, Blumea 24 (1978) 14. — *Melanorrhoea macrocarpa* ENGL. in DC. Mon. Phan. 4 (1883) 236; RIDL. Fl. Mal. Pen. 1 (1922) 530; MERR. Pl. Elm. Born. (1929) 42.

Tree up to 45 m high and 80 cm ∅. Buttresses occasionally present, 3–6 m high, 1–2 m wide. Bark grey or rusty, smooth or scaly. *Leaves* subcoriaceous, elliptic-oblong to -lanceolate, or obovate-oblong, 10–19 by 3–8½ cm, glabrous; base cuneate; apex shortly acuminate, or rounded; nerves 12–15 pairs, elevated beneath, flat above; veins reticulate, or transverse and parallel, often faint on both surfaces; petiole 1–3 cm. *Panicles* up to 15 cm long, pubescent; pedicels 1–3½ mm, articulated. *Flower-buds* ovoid-oblong or lanceolate, 5–6 by 1½–2 mm, acuminate. *Calyx* 5–6 mm long, circumscissile, puberulous outside. *Petals* white, yellow at the base, almost valvate except at the apical part, lanceolate to linear, 4–7 by ¾–1 mm, puberulous outside, sparsely hairy and papillose at the lower half inside. *Stamens* usually *c.* 20 with a few filamentous staminodes, very rarely up to 28, 5½–6 mm; filaments sparsely hairy; anthers ovoid or oblong, *c.* ⅔ mm long. *Torus* subglobose, *c.* 1 mm ∅. *Ovary* broadly ellipsoid, *c.* 1 mm ∅, glabrous; stipe 1–3 mm; style terminal, 1¼–2½ mm. *Drupe* on a centric stalk (¾–1¾ cm), subglobose, 2–4 cm ∅, brown, reddish brown, or purplish black, smooth; wing-like, enlarged petals rarely present, narrowly elliptic or oblanceolate, up to 3 by ½ cm; embryo subglobose, 1¾–3 cm∅; cotyledons free.

Distr. *Malesia:* Malaya (Langkawi Is., Perak, Trengganu, Selangor) and Borneo (Sabah: Tawau, Nunukan I.; Sarawak: Anap; Kalimantan: Balikpapan).

Ecol. Primary and mixed dipterocarp forest, sometimes on sandy ridges, from the lowland up to 1200 m. *Fl.* May, July, Oct.; *fr.* July, Oct., Dec.–Jan.

Vern. *Rĕngas*, M.

8. Gluta curtisii (OLIV.) DING HOU, Blumea 24 (1978) 13. — *Melanorrhoea curtisii* OLIV. in Hook. Ic. Pl. 16 (1886) t. 1513; KING, J. As. Soc. Beng. 65, ii (1896) 486; RIDL. Fl. Mal. Pen. 1 (1922) 530; BURK. Dict. (1935) 1437; CORNER, Ways. Trees (1940) 120, f. 27.

Tree up to 30 m high and 80 cm ∅. Buttresses occasionally present, up to 2½ m high, 10 cm thick. Bark brown, flaky. *Leaves* coriaceous, elliptic-oblong, rarely oblanceolate, 8–14 by 2½–4½ cm, glabrous; base cuneate or attenuate; apex obtuse, sometimes shortly acuminate, rarely emarginate; nerves 9–18 pairs, slightly elevated beneath, flat, distinct or faint above; veins reticulate, or transverse and parallel, distinct beneath or on both surfaces, sometimes faint above; petiole 1½–2¼ cm. *Panicles* 6–17 cm long, puberulous, glabrescent; pedicels 1½–2½ mm, articulated. *Flower-buds* lanceolate, 5–6 by 1½–2 mm, acuminate. *Calyx* 5–6 mm long, circumscissile, sparsely puberulous outside, densely hairy at the apical part on both surfaces. *Petals* white or pale lilac, contorted or imbricate, narrowly lanceolate, or linear, 4½–6 by 1 mm, densely puberulous outside, papillose at the central part inside. *Stamens* (8–)10, 3–4 mm; filaments sparsely hairy; anthers oblong, *c.* ½ mm long. *Torus* subglobose, 1–1¼ mm ∅. *Ovary* subglobose, *c.* ½ mm ∅, glabrous; stipe 1–2 mm; style terminal. *Drupe* on a centric stalk (⅔–1½ cm); wing-like, enlarged petals narrowly oblanceolate, 5–9 by 1–1½ cm; embryo subglobose, *c.* 1 cm ∅; cotyledons free.

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

Ecol. Mixed forest, from the lowland up to 1200 m. *Fl.* March–Nov.; *fr.* May–July.

Uses. Timber is hard and red (BURKILL, *l.c.* 1437); logs are left in the forest for weathering before extraction.

Vern. *Rengas, r. marah keluang*, M.

9. Gluta oba (MERR.) DING HOU, Blumea 24 (1978) 14. — *Melanorrhoea oba* MERR. J. Str. Br. R. As. Soc. *n.* 77 (1917) 190; En. Born. (1921) 350; SMYTHIES, Common Sarawak Trees (1965) 9. — Fig. 18a′–e′.

Tree up to 30 m high, 60 cm ∅. Buttresses up to 1¼ m high, ⅔ m wide, 10 cm thick. Bark bright grey or brownish, scaly. *Leaves* coriaceous, elliptic, broadly elliptic, or obovate, 5–14 by 2¼–8 cm; glabrous; base cuneate or attenuate; apex obtuse, sometimes slightly acute; nerves 9–11 pairs, slightly elevated beneath, distinct above; veins reticulate, distinct beneath, sometimes faint above; petiole ¾–1½ cm. *Panicles* up to 20 cm long, glabrous; pedicels 8–16 mm, not articulated. *Flower-buds* lanceolate, *c.* 6 by 2 mm, acuminate. *Calyx c.* 6 mm long, circumscissile, glabrous except hairy at the apical part on both surfaces. *Petals* white, valvate, linear or spathulate, 6–7 by ¾ mm, puberulous outside. *Stamens* 10, 3–5 mm; filaments sparsely hairy; anthers oblong, ¾ mm long. *Torus* ellipsoid, 1½–2 mm long. *Ovary* subglobose, ¾–1 mm ∅, glabrous; stipe 1–1½ mm; style 1–1½ mm, terminal. *Drupe* on a centric stalk (1–1¾ cm), subglobose, 3–4 cm ∅, dark brown, smooth; without wing-like, enlarged petals; embryo subglobose, 2½–3 cm ∅; cotyledons free.

Distr. *Malesia:* Borneo (Sabah: Lahad Datu, Leila, Sepilok; Sarawak: Matang, Santubong, Semengoh Arboretum, Bako Nat. Park, Sadong).

Ecol. Lowland forest, sometimes on ultrabasic soil. *Fl.* Febr.–April; *fr.* April, Sept., Oct.

Vern. *Oba, rĕngas.*

10. Gluta malayana (CORNER) DING HOU, Blumea 24 (1978) 14. — *Melanorrhoea pilosa* RIDL. Kew Bull. (1931) 448, *nom illeg., non* LECOMTE, 1908. — *Melanorrhoea malayana* CORNER, Gard. Bull. S. S. 10 (1939) 261, *nom. nov.* for *M. pilosa* RIDL.; Ways. Trees (1940) 120; KOCHUM. Mal. For. Rec. 17 (1964) 297. — **Fig. 19.**

Big deciduous tree up to 45 m high, with heavy dome-like crown and steep and rather narrow buttresses. Bark pinkish grey to light greyish fawn, with fine, close, transverse furrows, becoming slightly dippled scaly (CORNER). *Leaves* coriaceous, obovate-oblong, elliptic, or elliptic-lanceolate, $16^1/_2$–32 by 7–14 cm, pubescent on both surfaces when young, usually glabrescent except especially on the midrib and nerves; base cuneate; apex obtuse, sometimes acute, or emarginate; nerves 17–27 pairs, prominent beneath, distinct or faint above; veins reticulate, or transverse and parallel, often distinct on both surfaces; petiole obscure or very short (*c.* $^1/_3$ cm). *Panicles* up to $23^1/_2$ cm long, appearing before or with the young leaves; pedicels $1^1/_2$–4 mm, not articulated. *Flower-buds* ovoid-oblong, $3^1/_2$–5 by $1^1/_4$–2 mm, acuminate. *Calyx* $3^1/_2$–5 mm long, circumscissile, puberulous outside.

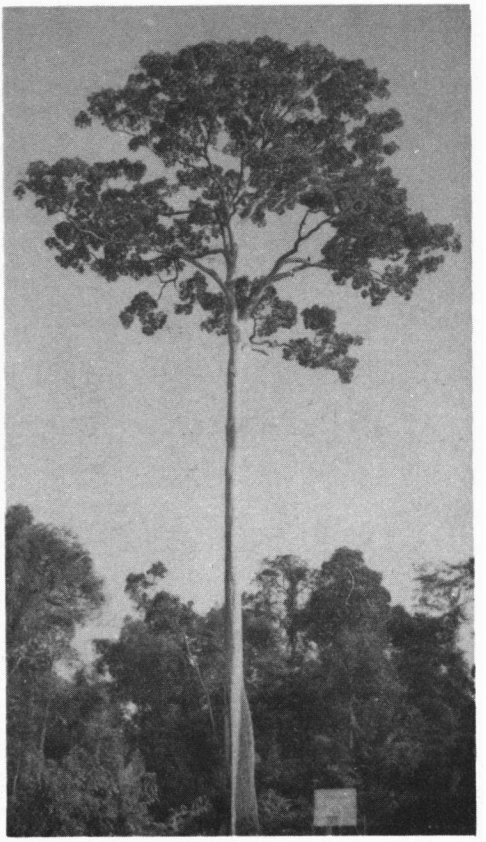

Fig. 19. *Gluta malayana* (CORNER) DING HOU. A huge tree with high buttresses at Chaar, Johore (Photogr. CORNER).

Petals imbricate, lanceolate or linear, 3–5 by 1–$1^1/_2$ mm, puberulous outside, papillose and pilose inside; the central part of the lower $^2/_3$ mm longitudinally adnate to the torus. *Stamens* 5, *c.* $2^3/_4$ mm, filaments hairy; anthers oblong, *c.* $^1/_2$ mm long. *Torus* cylindric, *c.* 1 mm long. *Ovary* subglobose, $^1/_2$–$^3/_4$ mm ∅, glabrous; stipe $^1/_3$–1 mm; style terminal, $^1/_3$–$1^1/_2$ mm. *Drupe* on a centric stalk ($1^1/_4$–$1^1/_2$ cm), subglobose, *c.* $3^1/_4$ cm ∅, brown or dark brown, smooth; sometimes with wing-like, enlarged, lanceolate petals, 1–2 by $^1/_3$ cm, rose-red when fresh: embryo subglobose, *c.* $2^1/_2$ cm ∅; cotyledons free.

Distr. *Malesia:* Sumatra (Bengkalis, Karimun) and Malay Peninsula (Pahang, Johore).

Ecol. Lowland forest. *Fl.* Febr., April; *fr.* Jan.–May.

Vern. *kĕrbau jĕlang, rĕngas,* M, *kilakap,* Bengkalis.

11. Gluta torquata (KING) TARD. Adansonia 1 (1961) 195, t. 1, f. 15. — *Melanorrhoea torquata* KING, J. As. Soc. Beng. 65, ii (1896) 486; RIDL. Fl. Mal. Pen. 1 (1922) 531; STEPHENS, Mal. For. 18 (1955) 160; KOCHUM. Mal. For. Rec. 17 (1964) 297.

Tree up to 30 m high and $1^1/_4$ m ∅. Buttresses occasionally present, steep, up to 3 m high, $^1/_2$ m wide. Bark light brown, finely dippled. *Leaves* (pseudo-whorled) coriaceous, obovate, obovate-oblong, or broadly elliptic, 15–24(–35) by 9–$13^1/_2$ (–18) cm, glabrous, sometimes puberulous on the lower surface especially on the midrib and nerves when young, glabrescent; base cuneate; apex round or slightly emarginate; nerves 16–29 pairs, prominent beneath, slightly elevated above; veins reticulate, or transverse and parallel, often faint on both surfaces, sometimes distinct beneath; petiole $^3/_4$–2 cm. *Panicles* 17–30 cm long, tomentose; pedicels $2^1/_2$–$4^1/_2$ mm, not articulated. *Flower-buds* ovoid, 2–3 by $1^1/_2$–2 mm, obtuse. *Calyx* 2–3 mm, bursting irregularly (sometimes hanging round the pedicel like a loose collar), puberulous outside. *Petals* white, imbricate, oblanceolate, lanceolate, or narrow-oblong, 5–6 by 1–$1^1/_2$ mm, densely puberulous on both surfaces; basal part $^3/_4$–1 mm longitudinally adnate to the torus. *Stamens* 5, 5 mm; filaments pilose; anthers oblong, $^3/_4$ mm long. *Torus* cylindric, *c.* $1^1/_2$ mm long. *Ovary* subglobose, *c.* 1 mm ∅, pilose; stipe 1–$1^1/_2$ mm; style terminal, $1^1/_2$–2 mm. *Drupe* on a centric stalk (*c.* 1 cm), subglobose, $3^3/_4$ cm ∅, brown, smooth; without wing-like, enlarged petals; embryo subglobose, $2^3/_4$–3 cm ∅; cotyledons free.

Distr. *Malesia:* Sumatra (Tapanuli) and Malay Peninsula (Perak, Dindings, Selangor, Johore).

Ecol. Lowland forest. *Fl.* Febr.–March; *fr.* June.

Vern. *Rĕngas tĕrbanjalang,* M, *sitorngom horbodjalang,* Tapanuli.

12. Gluta sabahana DING HOU, Blumea 24 (1978) 16. — **Fig. 18a″–h″.**

Tree up to 30 m high and 60 cm ∅. Buttresses occasionally present, up to $^1/_2$ m high, 1 m wide, 15 cm thick. Bark dark brown, smooth. *Leaves* (pseudo-whorled) coriaceous, oblanceolate, obovate-oblong, elliptic-lanceolate, or narrowly elliptic, 13–23 by 3–8 cm, glabrous; base cuneate to decurrent; apex acuminate, sometimes acute; nerves 9–15 pairs, distinct on both surfaces; veins

reticulate, often faint on both surfaces; petiole often very short, 1/4–3/4 cm, sometimes some leaves with petiole up to 1 1/2 cm. *Panicles* 7–15 cm long, puberulous; pedicels 3–6 mm, not articulated. *Flower-buds* ellipsoid, 4–5 1/2 by 1 1/2–2 mm, obtuse. *Calyx* 4–5 1/2 mm long, bursting irregularly, puberulous outside. *Petals* whitish or pale yellow, imbricate, oblanceolate, 5–7 1/2 by 1–1 1/4 mm, puberulous outside, densely papillose usually at the lower half inside; the basal *c.* 1 mm longitudinally adnate to the torus. *Stamens* 5(–7), 5–6 mm; filaments glabrous; anthers oblong, 1–1 1/4 mm. *Torus* cylindric, 1–1 1/4 mm long. *Ovary* obovoid, 1–1 1/2 mm long, puberulous; stipe obscure; style lateral, 3–4 mm. *Drupe* on an obscure, excentric stalk, obliquely broadly ellipsoid, 7 1/2–9 by 5–6 1/2 by 3 1/2–5 cm, brownish, scurfy; embryo subreniform, 3–4 1/2 by 5 cm; cotyledons incompletely fused, free on one side, free part *c.* 1 cm deep.

Distr. *Malesia:* Borneo (Sabah: Sepilok, Kinabatangan, Tawau, Mostyn).

Ecol. Lowland forest, sometimes in swampy places. *Fl.* Febr.–Sept.; *fr.* May–Dec.

Vern. *Rĕngas*, M, *rĕngas mangga*, Kadayan.

13. Gluta laxiflora RIDL. Kew Bull. (1933) 196.

Tree up to 24 m high and 60 cm ∅. Buttresses occasionally present, low and round. Bark rust brown and light grey mottled, flaky. *Leaves* coriaceous, elliptic-lanceolate, rarely oblanceolate, 9–28 by 3–9 cm, glabrous; base cuneate, sometimes unequal; apex acuminate; nerves 11–17 pairs, prominent beneath, slightly elevated or flat above; veins reticulate, usually distinct beneath, sometimes distinct on both surfaces; petiole 2–5 cm. *Panicles* up to 12 cm long, puberulous; pedicels 4–6 mm, not articulated. *Flower-buds* ellipsoid, 5 by 2 1/2 mm, obtuse. *Calyx* 5 mm long, bursting irregularly, puberulous outside. *Petals* imbricate, narrowly elliptic, 8–9 by 1 1/4–2 mm, puberulous outside, papillate inside; basal 1 1/2–2 1/2 mm longitudinally adnate to the torus. *Stamens* 5 (or 6), 4 1/2–5 1/2 mm; filaments glabrous; anthers oblong, *c.* 1 1/2 mm long. *Torus* cylindric, 2–3 mm long. *Ovary* obovoid, 1 1/2 mm long, puberulous; stipe obscure; style lateral, 4 mm. *Drupe* on an obscure, excentric stalk, obliquely ellipsoid or broadly ellipsoid, 7 1/2–9 by 5–6 cm, brown or reddish brown, scurfy; embryo subreniform, 5–6 1/2 by 3–4 1/2 cm; cotyledons incompletely fused, free on one side, free part 1 1/2–2 cm deep.

Distr. *Malesia:* Borneo (Brunei; Sarawak: Baram R., Bintulu, Kapit, Tatau).

Ecol. Lowland primary or mixed dipterocarp forest. *Fl.* March; *fr.* May, June, Dec.

Vern. *Rĕngas.*

14. Gluta wrayi KING, J. As. Soc. Beng. 65, ii (1896) 482; RIDL. J. Str. Br. R. As. Soc. *n.* 49 (1907) 16, *excl. descr. fr.*; Fl. Mal. Pen. 1 (1922) 528; BURK. Gard. Bull. S. S. 5 (1931) 226; Dict. (1935) 1080; TARD. Fl. C. L. & V. 2 (1962) 122, t. 5, f. 1; KOCHUM. Mal. For. Rec. 17 (1964) 264. — *G. virosa* RIDL. J. Str. Br. R. As. Soc. *n.* 75 (1917) 27; Fl. Mal. Pen. 1 (1922) 528. — *Mangifera sp.* KING, J. As. Soc. Beng. 65, ii (1896) 479, *in note, quoad* KING's Coll. 7744.

Tree up to 30 m high and 85 cm ∅, occasionally with steep plank buttresses up to 3 m high. Bark brown, green- or orange-brown, rugose or shallowly dippled. *Leaves* subcoriaceous, elliptic to elliptic-lanceolate, rarely oblanceolate, (6–)10–26 by (1 3/4–)3 1/2–9 cm, glabrous; base cuneate or attenuate; apex acuminate; nerves 9–14 pairs, slightly elevated beneath, faint above; veins often distinct on both surfaces; petiole 2/3–4 1/2 cm. *Panicles* up to 8 cm long, puberulous; pedicels 2–6 mm, not articulated. *Flower-buds* ellipsoid, 8–9 by 2–3 mm, acuminate. *Calyx* 8–9 mm long, bursting irregularly, puberulous outside. *Petals* white, 5 (or 6), imbricate, narrowly oblanceolate, 10–13 by 2 1/2 mm, puberulous outside, papillose on the inside; the basal 1–3 mm longitudinally adnate to the torus. *Stamens* 5 (or 6), 7 mm; filaments glabrous; anthers oblong, 1 1/4 mm long. *Torus* cylindric, 1 1/2–4 mm long. *Ovary* broadly obovoid, 2 mm long, densely puberulous; stipe obscure; style lateral, 6 mm. *Drupe* on an obscure, centric stalk, ellipsoid, 6 1/2–7 by 3–4 1/2 cm (10–12 1/2 by 7 1/2 cm, *cf.* BURKILL, *l.c.* 227), light brown or brown; scurfy; without enlarged petals; embryo ellipsoid, 3–4 1/2 by 1 3/4–3 cm; cotyledons incompletely fused, free on one side, free part 1/2–3/4 cm deep.

Distr. Peninsular Thailand, S. Vietnam, and *Malesia:* Malay Peninsula (Perak, Dindings, Kelantan, Trengganu, Selangor, Penang).

Ecol. Lowland forests, sometimes on granite ridges, up to *c.* 800 m. *Fl.* Jan.–March; *fr.* March–Nov.

Uses. The timber is beautiful deep red with black concentric bands sometimes called Straits mahogani (Burkill, *l.c.*).

Vern. *Rĕngas, r. ayĕr*, M, *r. kĕrbau jalang*, Malaya.

15. Gluta wallichii (HOOK. *f.*) DING HOU, Blumea 24 (1978) 21. — *Melanorrhoea wallichii* HOOK. *f.* Fl. Br. Ind. 2 (1876) 25; ENGL. in DC. Mon. Phan. 4 (1883) 235; KING, J. As. Soc. Beng. 65, ii (1896) 485; RIDL. Fl. Mal. Pen. 1 (1922) 529, f. 52; HEYNE, Nutt. Pl. (1927) 973; BURK. Dict. (1935) 1438; CORNER, Gard. Bull. S. S. 10 (1939) 260; Ways. Trees (1940) 120 ('*wallichiana*'); KOCHUM. Mal. For. Rec. 17 (1964) 298. — *Melanorrhoea maingayi* HOOK. *f.* Fl. Br. Ind. 2 (1876) 25; ENGL. in DC. Mon. Phan. 4 (1883) 235; KING, J. As. Soc. Beng. 65, ii (1896) 484. — *Swintonia obtusifolia* ENGL. in DC. Mon. Phan. 4 (1883) 231; MERR. En. Born. (1921) 350. — *Melanorrhoea woodsiana* SCORT. *ex* KING, J. As. Soc. Beng. 65, ii (1896) 485; RIDL. Fl. Mal. Pen. 1 (1922) 530; CORNER, Gard. Bull. S. S. 10 (1939) 261; Ways. Trees (1940) 120, f. 27; KOCHUM. Mal. For. Rec. 17 (1964) 298; SMYTHIES, Common Sarawak Trees (1965) 9. — *Swintonia elmeri* MERR. Pl. Elm. Born. (1929) 167. — **Fig. 20–22.**

Large, evergreen tree up to 45 m high and 70 cm ∅. Buttresses 1 1/2–4 m high, 1/2–1 m wide, 8–10 cm thick. Bark greyish brown, flaky, or distinctly rugose-fissured. *Leaves* coriaceous, obovate-oblong, elliptic-lanceolate, or elliptic, 8 1/2–34 1/2 by 4–14 cm, glabrous, sometimes tomentose and glabrescent beneath; base cuneate, sometimes obtuse; apex obtuse, acuminate, sometimes slightly emarginate; nerves 9–24 pairs, prominent beneath, distinct above; veins reticulato-scalariform, distinct on both surfaces; petiole 2–6 cm. *Panicles* 16 1/2–33

Fig. 20. *Gluta wallichii* (HOOK. *f.*) DING HOU. Cultivated in Hort. Bog. VII–D–75a, from Riau, March 1958.

cm long, pubescent, sometimes glabrescent; pedicels $2^1/_2$–3 mm, articulated. *Flower-buds* ovoid, 3–$3^3/_4$ by $1^3/_4$–2 mm, obtuse. *Calyx* red, 3–$3^3/_4$ mm long, bursting irregularly, puberulous outside. *Petals* white, imbricate, ovate-oblong, lanceolate, or elliptic, 4–7 by $1^3/_4$–$2^1/_2$ mm, villose on both surfaces. *Stamens* 5, $2^1/_2$–4 mm; filaments pilose, glabrescent; anthers oblong, $^3/_4$ mm long. *Torus* pulvinate, *c.* $1^1/_2$ mm ∅. *Ovary* subglobose, *c.* $1^1/_2$ mm ∅, pilose; stipe obscure; style lateral, 2–$2^1/_4$ mm. *Drupe* on an obscure, centric stalk, ovoid or ellipsoid, *c.* $1^1/_2$ by 1 cm, smooth, brownish; wing-like, enlarged petals red, elliptic-oblong or -lanceolate, $5^3/_4$–8 by $1^1/_4$–$1^3/_4$ cm; embryo ovoid or broadly ellipsoid, *c.* $1^1/_4$ by $^3/_4$ cm; cotyledons free.

Distr. *Malesia:* widely distributed in Sumatra, Malay Peninsula, and Borneo (Brunei, Sabah, Sarawak, Kalimantan).

Ecol. Swampy or dryland forest, in peat-swamp forest in Palembang often co-dominant (HEYNE), sometimes on limestone, in Malaya common on hillsides, up to 500 m. *Fl. fr.* Jan.–Dec.

In the south of Malaya trees flower early in the year, about a month after the Christmas rains have ceased. The shabby green, rather narrow crowns are then whitened with blossom and are rendered prominent throughout the forest. Trees may be deciduous, perhaps, in northern Malaya (CORNER, *l.c.*).

Uses. ENDERT (Tectona 13, 1920, 123) finds the heartwood a superior timber and in Malaya judgement is similar, but a great objection against its use is that it retains long its *renghas*-poison quality (HEYNE, *l.c.* 973). The fruit is mixed into dart-poison by the Besisi in Malaya (BURKILL, *l.c.*).

Vern. Malaya: *rĕngas, r. ayĕr, r. burung, r. kĕrbau jalang, r. manuk, r. paya, r. sumpah biawak*, M; Borneo: *r. tjujung*, Kutai.

Fig. 21. *Gluta wallichii* (HOOK. *f.*) DING HOU. Trengganu, Malaya; showing fissured bark, white sapwood with darkening resin stains and dark red-brown heartwood (Photogr. DING HOU (773)).

16. Gluta capituliflora DING HOU, Blumea 24 (1978) 13. — *G. cambodiana* (*non* PIERRE) BURK. Bull. Gard. S. S. 5 (1931) 229.

Tree up to 24 m high and 49 cm ∅, occasionally with short buttresses up to $^2/_3$ m high. Bark brown, smooth. *Leaves* subcoriaceous, elliptic to narrowly elliptic, or lanceolate, 5–17$^1/_2$ by 1–5$^1/_2$ cm; base cuneate to attenuate; apex acute to acuminate; nerves 6–14 pairs, slightly elevated on both surfaces; veins rather fine, reticulate, distinct on both surfaces; petiole 1–2(–3) cm. *Panicles* 8–10$^1/_2$ cm long, puberulous; pedicels *c.* $^1/_4$ mm, not articulated. *Flowers* crowded at the end of branchlets. *Calyx* 4–5 mm long, bursting irregularly, puberulous outside. *Petals* imbricate, narrowly elliptic, 9–10 by 1$^3/_4$–2 mm, puberulous outside, papilllose inside. *Stamens* 5, 5–7 mm; filaments glabrous; anthers oblong, $^1/_2$–$^2/_3$ mm. *Torus* cylindric, 3$^1/_2$–4 mm long. *Ovary* obliquely ellipsoid, *c.* 1 mm long, glabrous; stipe $^3/_4$–1 mm; style lateral, 3–4 mm. *Drupe* bent almost horizontally, on a lateral stalk (*c.* $^1/_2$ cm), broadly ellipsoid, 6–8$^1/_2$ by 4–5$^3/_4$ by 3$^1/_2$–4$^3/_4$ cm, light brown, scurfy; embryo subreniform, 5$^1/_2$–7 by 3$^1/_2$–4$^1/_2$ by 2$^1/_2$–3 cm; cotyledons incompletely fused, free on one side, free part 2$^3/_4$–3$^3/_4$ cm deep.

Distr. *Malesia:* Malay Peninsula (Trengganu, Kelantan).

Ecol. Primary forest, sometimes along riverbanks, up to 300 m. *Fl.* Oct.; *fr.* June, July.

17. Gluta lanceolata RIDL. J. Str. Br. R. As. Soc. *n.* 49 (1907) 17; Fl. Mal. Pen. 1 (1922) 527; BURK. Gard. Bull. S. S. 5 (1931) 228.

Fig. 22. Same as in fig. 21, cut tree with dark exudate of resin.

A big tree. *Leaves* subcoriaceous, narrowly elliptic, or lanceolate, 11–19(–27) by $1^3/_4$–$4^1/_2$ cm, glabrous; base attenuate; apex acuminate, rarely obtuse; nerves 9–15 pairs, rather fine, slightly elevated on both surfaces, sometimes hardly distinct from the veins; veins reticulate, distinct or faint on both surfaces; petiole $(2^1/_2$–$)3^1/_2$–$7^1/_2$ cm. *Panicles* 7–9 cm long, puberulous; pedicels 1–2 mm, not articulated. *Calyx* 5–$5^1/_2$ mm long, bursting irregularly, puberulous outside. *Petals* imbricate, narrowly oblanceolate, 10–$12^1/_2$ by 1–$1^1/_4$ mm, puberulous outside and at the apical part inside, papillose on the central part inside; the basal 5–6 mm narrowed and completely adnate to the torus. *Stamens* 5, 6–$7^1/_2$ mm; filaments glabrous; anthers oblong, *c.* 1 mm long. *Torus* cylindric, 6–7 mm long. *Ovary* subglobose, *c.* 1 mm ∅, glabrous; stipe obscure; style lateral, 3–4 mm. *Drupe* on an obscure, centric stalk, globose, *c.* $3^1/_2$ cm ∅, black, shining; without enlarged petals; embryo subglobose, *c.* $2^1/_2$ cm ∅; cotyledons incompletely fused, free on one side, free part *c.* 1 cm deep.

Distr. *Malesia:* Malay Peninsula (Kedah, Penang), only three collections seen.

Ecol. Mixed rain-forest, up to 450 m. *Fl.* June; *fr.* Sept.

18. Gluta tavoyana WALL. *ex* HOOK. *f.* Fl. Br. Ind. 2 (1876) 22; KURZ, Fl. Burma 1 (1877) 309; ENGL. in DC. Mon. Phan. 4 (1883) 226; CRAIB, Fl. Siam. En. 1 (1926) 347; TARD. Fl. C. L. & V. 2 (1962) 123, t. 4, f. 9–13. — *Syndesmis sp.* GRIFF. Notul. 4 (1854) 410. — *G. elegans var. helferi* HOOK. *f.* Fl. Br. Ind. 2 (1876) 22; ENGL. in DC. Mon. Phan. 4 (1883) 225; KING, J. As. Soc. Beng. 65, ii (1896) 481. — *G. elegans var. curtisii* BURK. Gard. Bull. S. S. 5 (1931) 228.

Tree up to 30 m high and 30 cm ∅. *Leaves*

subcoriaceous, obovate-oblong, elliptic-oblong, or -lanceolate, 5–16(–30) by $2^1/_2$–$5^1/_2$(–8) cm; base cuneate; apex obtuse, acute, rarely acuminate; nerves 7–20 pairs, slightly elevated, sometimes hardly distinguishable from the fine, distinct, reticulate veins on both surfaces; petiole $1^1/_2$–4 cm. *Panicles* up to $15^1/_2$ cm long, puberulous; pedicels 2–$5^1/_2$ mm, not articulated. *Flower-buds* ellipsoid, $5^1/_2$–7 by 2–3 mm, acuminate. *Calyx* scarlet, $5^1/_2$–7 mm long, bursting irregularly, puberulous outside. *Petals* white, imbricate, oblanceolate or narrowly elliptic, 9–11 by $1^3/_4$–$2^1/_4$ mm, puberulous outside, papillose on the middle part inside; the central part of the basal $3^1/_2$ mm longitudinally

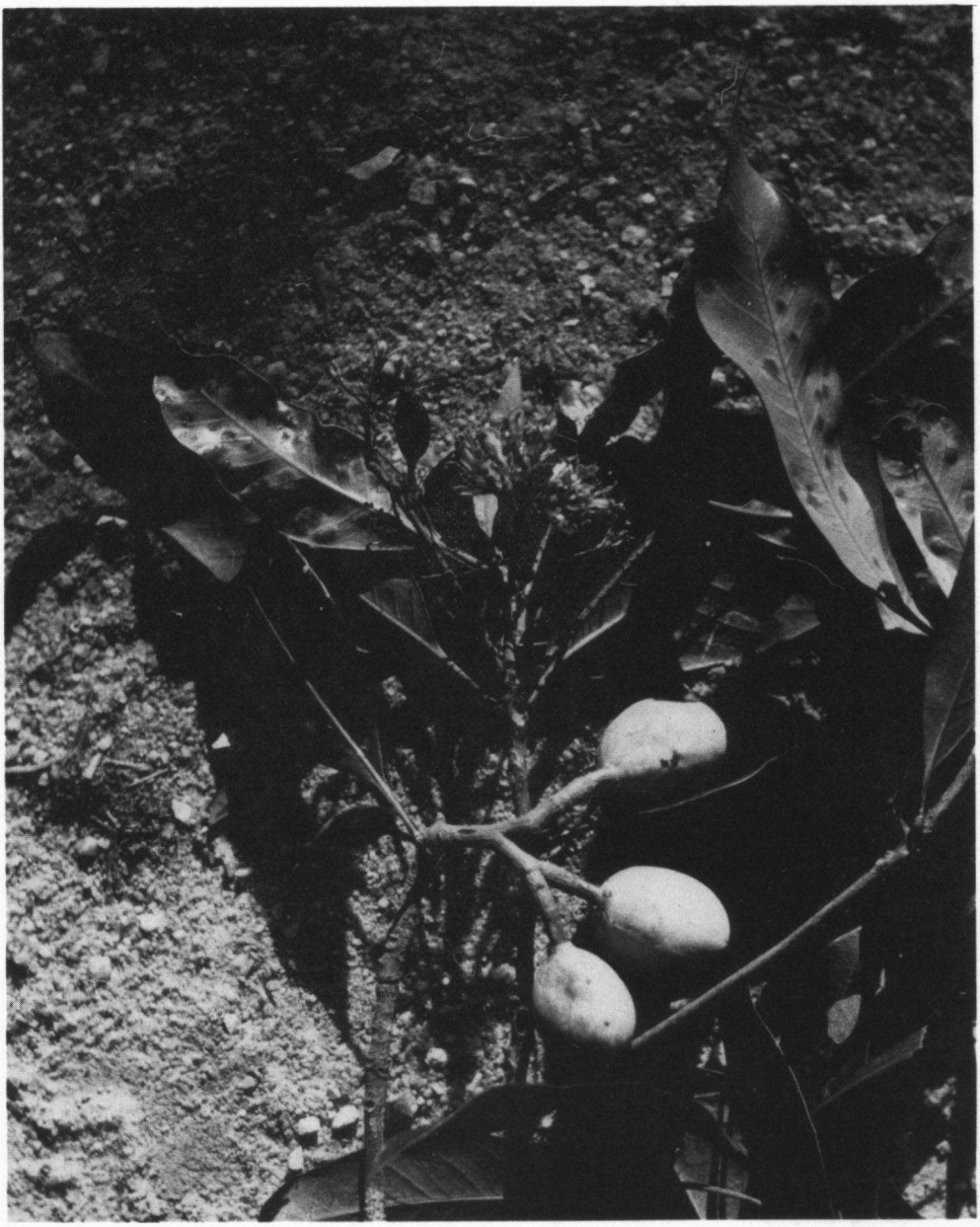

Fig. 23. *Gluta elegans* (WALL.) HOOK. *f.* at P. Langkawi, Malaysia (Photogr. VAN BALGOOY, Febr. 1975).

adnate to the torus. *Stamens* (4 or) 5, 5–8 mm; filaments glabrous; anthers oblong, *c.* 1 mm long. *Torus* cylindric, $3^1/_2$ mm long. *Ovary* broadly ellipsoid or globose, *c.* 1 mm ∅, glabrous; stipe obscure; style lateral, 4–5 mm. *Drupe* on a centric stalk (*c.* $^3/_4$ cm), globose, *c.* $3^1/_2$ cm ∅, brown, scurfy; without enlarged petals; embryo globose, *c.* $2^1/_2$ cm ∅; cotyledons imperfectly fused, free on one side, free part $^1/_2$–$^2/_3$ cm deep.

Distr. Andaman Is. (?), Burma, Thailand, Vietnam, China (?Hainan), and *Malesia:* Malay Peninsula (Johore, Penang) and E. Sumatra (Lingga and Singkep Is.).

Ecol. Lowland and beach forest, up to 300 m. *Fl.* Febr., July; *fr.* Oct.

Vern. *Mirah, k.*, M.

19. Gluta elegans (WALL.) HOOK. *f.* Fl. Br. Ind. 2 (1876) 22; KURZ, Fl. Burma 1 (1877) 310; ENGL. in DC. Mon. Phan. 4 (1883) 225; KING, J. As. Soc. Beng. 65, ii (1896) 481; RIDL. Fl. Mal. Pen. 1 (1922) 527; BURK. Gard. Bull. S. S. 5 (1931) 227, *excl. var. curtisii* BURK.; Dict. (1935) 1079; CORNER, Ways. Trees (1940) 118, f. 25; KOCHUM. Mal. For. Rec. 17 (1964) 264. — *Syndesmis elegans* WALL. in Roxb. Fl. Ind. ed. Wall. 2 (1824) 315; Cat. (1829) *n.* 1003. — **Fig. 23.**

Tree up to 20 m high and 26 cm ∅. Bark grey, smooth. Young foliage intensely violet. *Leaves* subcoriaceous or coriaceous, elliptic to elliptic-lanceolate, rarely oblanceolate, 6–$17^1/_2$ by 2–$6^1/_2$ cm, glabrous; base attenuate or acute; apex acuminate; nerves 7–14 pairs, slightly elevated on both surfaces; veins reticulate, distinct on both surfaces; petiole ($^3/_4$–)$1^1/_2$–4(–$6^1/_2$) cm. *Panicles* 4–7 cm long, sparsely puberulous; pedicels 4–7 mm, not articulated. *Flower-buds* ellipsoid, 5–$7^1/_2$ by 2–$3^1/_2$ mm, obtuse. *Calyx* red or pink, 5–$7^1/_2$ mm long, bursting irregularly, glabrous, very rarely sparsely puberulous outside. *Petals* white, imbricate, narrowly lanceolate or oblanceolate, 11–15 by $1^3/_4$–2 mm, glabrous, except the ciliate margin and papillose at the central part inside; the central part of the basal $4^1/_2$–$5^1/_2$ mm longitudinally adnate to the torus. *Stamens* 5, 6–$7^1/_2$ mm; filaments glabrous; anthers oblong, *c.* 1 mm long. *Torus* cylindric, 5–6 mm long. *Ovary* subglobose or obliquely ovoid, *c.* 1 mm ∅, glabrous; stipe *c.* 1 mm; style lateral, 5–9 mm. *Drupe* on a lateral stalk (*c.* $^3/_4$ cm), obliquely ovoid or broadly ellipsoid, rather flat, blackish, $3^1/_2$–$5^1/_2$ by 3–$4^1/_2$ by $1^3/_4$–3 cm, smooth, blackish; without enlarged petals; embryo similar the drupe in shape, $2^1/_2$–$3^1/_2$ by 2–3 by $1^1/_2$–2 cm; cotyledons incompletely fused, free on one side, free part $1^1/_2$–$2^1/_2$ cm deep.

Distr. Peninsular Thailand and *Malesia:* Malay Peninsula (Perak, Kelantan, Trengganu, Penang, Langkawi).

Ecol. Lowland forest, up to 300 m. Young foliage is intensely violet (CORNER, *l.c.*). *Fl.* July, Sept., Dec.–Febr.; *fr.* Febr., March, Oct.

Vern. *Rĕngas, r. kĕrban jalang, r. putah*, M.

Note. Flowers were deformed in some specimens; such a flower, 3–6 mm long, consists of petal-like floral parts.

20. Gluta velutina BL. Mus. Bot. 1 (1850) 183; MERR. En. Born. (1921) 349; BURK. Gard. Bull. S. S. 5 (1931) 225; Dict. (1935) 1080; CORNER, Ways. Trees (1940) 118; TARD. Fl. C. L. & V. 2 (1962) 119. — *Syndesmis coarctata* GRIFF. Notul. 4 (1854) 409; Icon. 4 (1854) t. 567, f. 1. — *G. coarctata* HOOK. *f.* Fl. Br. Ind. 2 (1876) 22; ENGL. in DC. Mon. Phan. 4 (1883) 227; KING, J. As. Soc. Beng. 65, ii (1896) 482; RIDL. J. Str. Br. R. As. Soc. *n.* 49 (1908) 16; *ibid. n.* 59 (1911) 89; LECOMTE, Fl. Gén. I.-C. 2 (1908) 21; BAKER, J. Bot. 62 (1924) Suppl. 30; CRAIB, Fl. Siam. En. 2 (1926) 346. — *Gluta sp.* ENDERT, Tectona 13 (1920) 127. — **Fig. 24–26.**

Large shrub or small tree up to 10 m high, sometimes with branched stilt-roots up to 1 m high. Bark pinkish brown, rather smooth. *Leaves* coriaceous, elliptic-oblong, narrowly elliptic, or oblanceolate, 12–32 by 5–8 cm, glabrous; base cuneate; apex acuminate; nerves 16–32 pairs, slightly elevated on both surfaces; veins reticulate, distinct below, rather faint above; petiole (0–)$^1/_3$–1 cm. *Panicles* 5–12 cm long, puberulous; pedicels

Fig. 24. *Gluta velutina* BL. at Sg. Mungkanyoh (Photogr. MEIJER, July 1966).

$^1/_2$–1 mm, articulated. *Flower-buds* ovoid-oblong or ellipsoid, 2 by 1–$1^1/_2$ mm, obtuse. *Calyx* 2 mm long, puberulous outside. *Petals* white or pink at edges, imbricate or contorted, oblanceolate or elliptic-oblong, 7–9 by 2–3 mm, glabrous; the central part of the basal $1^1/_2$–2 mm adnate to the torus. *Stamens* 5, 4–5 mm; filaments glabrous; anthers oblong, *c.* 1 mm long. *Torus* cylindric, $1^1/_2$–2 mm long. *Ovary* subglobose, 1–$1^1/_2$ mm ∅, glabrous; stipe *c.* $^1/_2$ mm; style excentric, *c.* 3 mm. *Drupe* on a centric stalk (*c.* $^1/_2$ cm), $4^1/_2$–$7^1/_2$ cm ∅, pale brown, with irregularly tuberculate ridges especially towards the base; without enlarged petals; embryo subglobose, 4–7 cm ∅; cotyledons free.

Distr. Burma, Thailand, Vietnam, and *Malesia:* Sumatra, Malay Peninsula, Borneo, and W. Java (once).

Ecol. Common along edges of tidal rivers on submerged mud-banks in the freshwater or slightly brackish zone; standing in the water, with submerged trunk except at low tide, associated with *Barringtonia conoidea* and *Pandanus helicopus*, a most characteristic bush in the tidal reaches of the river above the *Nypa* palm stands (CORNER, *l.c.*). *Fl. fr.* Jan.–Dec.

Uses. The timber is similar to that of *G. renghas* but of smaller dimension; see further BURKILL, *l.c.*

Vern. *Pong pong, rĕngas, r. ayĕr, r. pantai*, M, *r. pèndèk*, Palembang.

Note. The only collection in W. Java is FORBES 1169 which was correctly identified by E. G. BAKER, *l.c.* He collected it at Tjilaki, near Pengalengan (Priangan), at *c.* 350 m, recording it to be a great tree of which the bark exuded excoriating sap; vern. name *rĕngas djahat* or *dahu*. It is remarkable that it has never been collected again.

21. Gluta papuana DING HOU, Blumea 24 (1977) 14. — *Gluta sp.* ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 25, f. 9; VERSTEEGH, Med. Landb. Hogesch. Wageningen 71–19 (1971) 37. — **Fig. 15.**

Tree up to 31 m high and 50 cm ∅ (up to 50 by 2 m, *cf.* ROYEN, *l.c.*). Occasionally with steeply rising buttresses 1–3 m high. Bark grey brown to dark red, smooth, peeling off in small round scales. *Leaves* coriaceous, elliptic, broadly elliptic, or obovate-oblong, 7–$20^1/_2$ by 3–$10^1/_2$ cm, glabrous; base cuneate; apex rounded, slightly emarginate, rarely cuspidate; nerves 12–17 pairs, slightly elevated below, distinct above; veins reticulate, distinct or faint beneath, faint above; petiole 1–$2^1/_2$ cm. *Panicles* up to 30 cm long, puberulous when young, glabrescent, or glabrous; pedicels articulated, 1–3 mm. *Flower-buds* ovoid or ellipsoid, 3–$3^1/_2$ by $1^1/_2$–2 mm, obtuse. *Calyx* 3–$3^1/_2$ mm long, bursting irregularly, glabrous except sparsely hairy at the apex. *Petals* white, imbricate, elliptic or obovate-oblong, $6^1/_2$–$7^1/_2$ by $2^1/_2$–3 mm. *Stamens* 5 (or 6), $4^1/_2$–5 mm; filaments glabrous; anthers

Fig. 25. *Gluta velutina* BL. at low tide in tidal freshwater swamp forest, Sg. Sedili, Johore, showing its peculiar stem-base architecture (Photogr. CORNER).

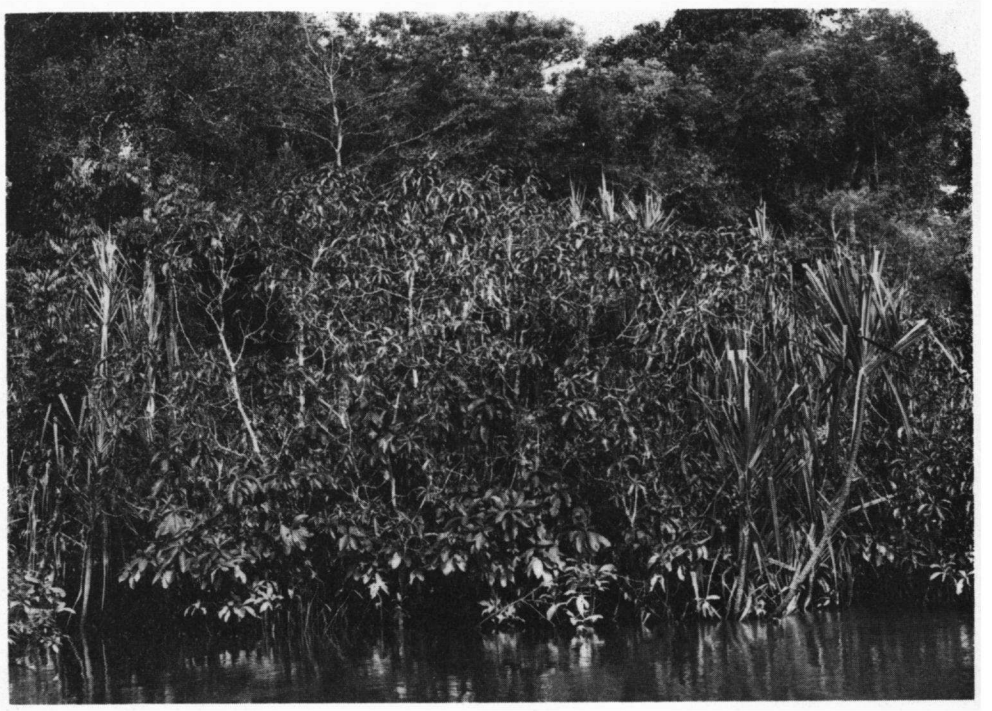

Fig. 26. *Gluta velutina* BL. on riverside, Sg. Sedili, Johore, at high tide in freshwater swamp forest, in front some *Pandanus helicopus* GRIFF. (Photogr. CORNER).

oblong, *c.* 1 mm long. *Torus* cylindric, $^2/_3$–$1^1/_4$ mm. *Ovary* subglobose, *c.* $^3/_4$ mm ∅, glabrous; stipe $^2/_3$–$1^1/_4$ mm; style lateral, 2–$2^1/_2$ mm. *Drupe* on an obscure, excentric stalk, bent almost horizontally, subreniform, $6^1/_2$–8 by 5–$5^1/_4$ by 2–$2^1/_2$ cm, light to dark brown, (recorded bluish black when fresh), smooth; without enlarged petals; embryo subreniform, $3^1/_2$–4 by $5^1/_2$–7 by $1^1/_4$–$2^1/_4$ cm; cotyledons incompletely fused, free on one side, free part 3–$3^3/_4$ cm deep.

Distr. *Malesia:* New Guinea (W. & S. Divisions of W. New Guinea and Fak-Fak; Gulf and Western Districts in E. New Guinea).

Ecol. Seasonally inundated forests along rivers, freshwater swamps, forests on well drained soils, or secondary forest. *Fl.* Febr., Oct.; *fr.* March, June, Sept.

Uses. The thin, moderately hard, reddish brown, grained heartwood has been used specially for keels of canoes and for carving, and is also suitable for corbels and sleepers (*cf.* C. L. LEEFERS, Verslag van Bosopname Boven-Digoel, typed report, 1958, appendix 1).

Vern. *Bamuri*, Kikori, dial., *dae diri*, Kiunga, *hekakoro*, Gulf Distr., *idjerah*, Asmat lang., *kiejeri*, Tehid lang., *miaré*, Mor., *mie*, Djair, *u*, Awiju.

Note. The resinous sap of this species has irritant effects and causes blisters in contact with the skin (*cf.* E. E. VAN DER ZEE, Verslag Boedidi-Waja River, typed report, 1956, p. 4, appendix 4 & 7).

22. Gluta renghas LINNÉ, Mant. 2 (1771) 293, *sphalm.* '*benghas*'; BL. Bijdr. (1826) 1159; Mus. Bot. 1 (1850) 182, f. 39; ENGL. in DC. Mon. Phan. 4 (1883) 225, t. 6, f. 1–6; K. & V. Bijdr. 4 (1896) 94, *incl. var. petiolata* K. & V.; KING, J. As. Soc. Beng. 65, ii (1896) 480; BACK. Fl. Bat. (1907) 367; Schoolfl. (1911) 280; MERR. En. Born. (1921) 346; RIDL. Fl. Mal. Pen. 1 (1922) 527; ENDERT, M. O. Born. Exp. 1925 (1927) 224, f. 84; HEYNE, Nutt. Pl. (1927) 972; BURK. Gard. Bull. S. S. 5 (1931) 224; Dict. (1935) 1079; CORNER, Ways. Trees (1940) 118, f. 26; ADELB. Blumea 6 (1948) 325, *excl. syn.*; KOCHUM. Mal. For. Rec. 17 (1964) 264; BACK. & BAKH. *f.* Fl. Java 2 (1965) 150. — *Arbor vernicis* RUMPH. Herb. Amb. 2 (1741) 259, t. 86. — *Stagmaria verniciflua* JACK *ex* HOOK. Comp. Bot. Mag. 1 (1836) 267. — **Fig. 27–28.**

Large tree up to 50 m high and 115 cm ∅, sometimes buttressed when old. Bark light fawn brown, or greyish when old, dippled scaly with small flakes. *Leaves* coriaceous, elliptic-oblong or narrowly elliptic, or oblanceolate, 12–28(–36) by 4–$7^1/_2$(–9) cm, glabrous; base cuneate, sometimes subcordate; apex obtuse; nerves 17–30 pairs, elevated on both surfaces; veins reticulate, distinct on both surfaces; petiole 0–3 cm. *Panicles* 6–25 cm long, glabrous, sometimes sparsely puberulous and glabrescent; pedicels articulated, 3–6 mm. *Flowerbuds* ellipsoid, 3–4 by $1^1/_2$–$1^3/_4$ mm, obtuse. *Calyx* 3–4 mm long, bursting irregularly, glabrous,

Fig. 27. *Gluta renghas* L. during dry season in temporary inundated swamp forest, with narrowly buttressed, thickened stem-bases, covered with dried mud to *c.* 2 m high; in front C. N. A. DE VOOGD. Rawa Bodjong, West Java (Photogr. VAN STEENIS, Oct. 1941).

sometimes sparsely puberulous at the apex. *Petals* white, contorted, elliptic-lanceolate, oblanceolate, or linear, $7^1/_2$–13 by 2–3 mm, glabrous outside, papillose inside; the central part of the basal 2–3 mm longitudinally adnate to the torus. *Stamens* 5, 4–$5^1/_2$ mm; filaments glabrous; anthers oblong, $^2/_3$–1 mm long. *Torus* cylindric, 2–3 mm long. *Ovary* subglobose, 1–$1^1/_2$ mm ∅, glabrous; stipe 0–$^3/_4$ mm; style lateral, $2^1/_2$–$3^1/_2$ mm. *Drupe* on a centric stalk (*c.* $^1/_2$ cm), subglobose, $3^1/_2$–5 cm ∅, pinkish brown, with irregular crests and protuberances; without enlarged petals; embryo subglobose, 2–$3^1/_2$ cm ∅; cotyledons incompletely fused, free on one side, free part *c.* $^1/_5$ cm deep.

Distr. *Malesia:* widely distributed in Sumatra, Malay Peninsula, Java, Borneo, and Celebes; once found in E. Ceram (Moluccas).

Ecol. Chiefly in coastal regions, in peat-swamps, occasionally inundated areas, gregarious along river-banks, at low altitude, sometimes in inland forest up to 800 m (Palembang). *Fl.* May–Dec.; *fr.* Jan.–Dec.

G. renghas is one of the important constituents of the *rapak* type of swamp forest, that is swamp forest without peat formation and sometimes temporarily seasonally with a low water level, associated with *spp.* of *Coccoceras*, *Alstonia*, other *Gluta spp.*, *Ficus retusa*, *Mangifera gedebe*, *Lagerstroemia*, *etc.* It is also very common on and near levees of sluggish downstream rivers, leaning from the river-banks in the freshwater tidal reaches. In such deep marshy places the stem-base is often conically thickened (ENDERT, *l.c.*).

Uses. The timber is very strong, durable, red-

dish brown, and with splendid markings. It has been used for building material of houses and canoes and for making handsome furniture. See HEYNE, *l.c.*

CORNER *l.c.* remarked, however, that the heartwood is not red-brown as in the other *Gluta spp.*, but pale pinkish.

The seed can be eaten after roasting (BURKILL).

Vern. *Rĕngas*, M, very commonly used name. Sumatra: *kaju rĕngas suloh*, Lampongs, *rĕngas burung*, Palembang; Malaya: *r. ayĕr*, *r. jitong*, M; Java: *ingas*, *rĕngas-tĕmbaga*, J; Borneo: *djingah*, M, *djinga rĕngas*, Sg. Kapuas, *rĕngas burung*, Kutai, *timoho*, Sg. Sabadai.

Notes. RUMPHIUS (*l.c.*) introduced plants of this species into Ambon. So far, I saw from the Moluccas only one sterile specimen (bb 25866, BO, a tree 37 m high and 45 cm ∅) collected in primary forest, E. Ceram. It was indicated on the field label as not planted. Fertile material from this area is desirable.

There are several big trees of this species cultivated in the low ground in front of the Library, University of Singapore. These may have been raised from seeds brought by RIDLEY from Pahang in 1890 (BURKILL, *l.c.*).

Excluded

Gluta orgyalis BLANCO, Fl. Filip. ed. 2 (1845) 451; ed. 3, 3 (1879) 49 is according to MERRILL, Publ. Gov. Lab. Philip. *n.* 27 (1905) 75; Sp. Blanc. (1918) 220; En. Philip. 2 (1923) 421 = *Cleistanthus orgyalis* (BLANCO) MERR. (*Euphorbiaceae*).

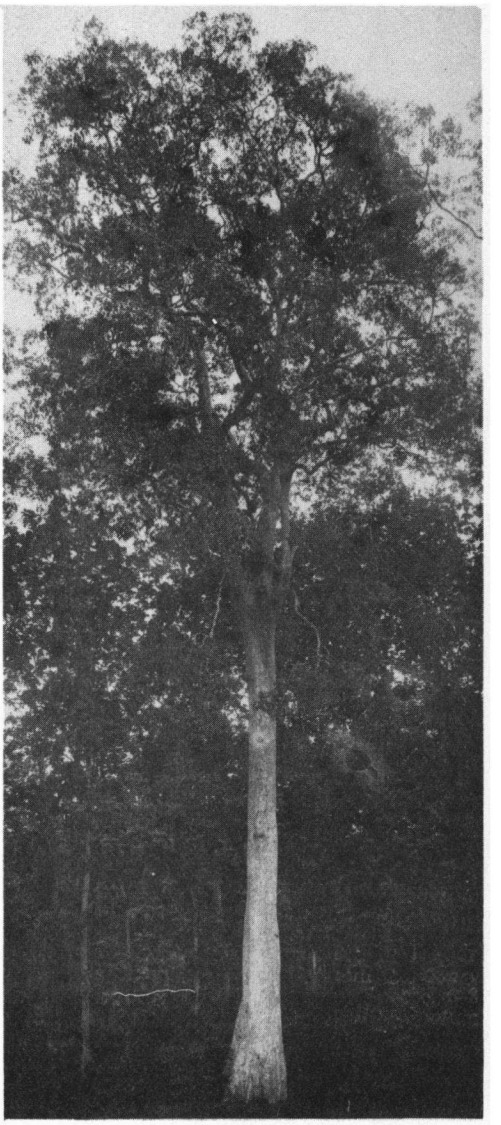

Fig. 28. Massive tree of *Gluta renghas* L. near Subah (Photogr. BEUMÉE, March 1919).

7. BOUEA

MEISN. Pl. Vasc. Gen. (1837) Tab. Diagn. 75 & Comment. 55; ENGL. in DC. Mon. Phan. 4 (1883) 238; AIRY SHAW, Kew Bull. 20 (1966) 87; DING HOU, Blumea 24 (1978) 4. — *Cambessedea* W. & A. Prod. 1 (1834) 170, *in note, non* KUNTH, 1824. — *Tropidopetalum* TURCZ. Bull. Soc. Nat. Mosc. 32, i (1859) 265, *cf.* FEDTSCHENKO, Svensk Bot. Tidskr. 19 (1926) 493. — *Matania* GAGNEP. Not. Syst. 13 (1948) 189. — **Fig. 29.**

Trees. Branchlets slightly 4-angular, usually flat towards the nodes. Terminal and axillary buds prominent. *Leaves* decussate, simple, entire, petioled. *Inflorescences* axillary, rarely also terminal, paniculate. *Flowers* ♂ and bisexual (plants polygamo-andromonoecious). *Calyx* 3–5-lobed. *Petals* 3–5, imbricate, glabrous, lengthwise keeled. *Stamens* 3–5; filaments subulate, glabrous; anthers basifixed, ovoid-oblong. *Disk* round, flat or slightly concave, sometimes obscure, glabrous. *Ovary* ovoid or subglobose, 1-celled and 1-ovuled, puberulous or glabrous; style short; stigma round and flat, sometimes 2- or 3-grooved; sterile pistil minute in ♂. *Drupe* 1-celled; endocarp fibro-crustaceous. *Seed* with testa adherent to the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. About 3 *spp.*, in tropical SE. Asia and *Malesia* (Sumatra, Malay Peninsula, W. Java, and Borneo).

Ecol. In lowland forest, up to *c.* 300 m, sometimes cultivated at higher altitude.

Notes. *Bouea* is the only genus of this family with decussate leaves. They are rather variable in size and shape and are not very useful for specific distinction; I had to reduce several names. Flower and fruit characters are fairly uniform.

I examined the pollen grains of both species; they appear to be very similar in size and structure.

CORNER (Ways. Trees, 1940) noted that, when fresh, the fruit is like a plum or small mango, yellow, pulpy, with a fibrous leathery stone showing, when cut across, the bright purple cotyledons in the big seed. He said furthermore, that sterile material might be mistaken for *Garcinia*, *Eugenia*, *Olea*, *Austrobuxus*, and *Memecylon*, but the resinous smell of the broken twigs or crushed leaves and the pointed buds at once distinguish it. *Eugenia* when dried should have pellucid dots in the leaves and *Garcinia* pellucid resinous ducts.

KEY TO THE SPECIES

1. Leaves small, usually 2–15 by 1–5 cm. Terminal (vegetative) buds lanceolate or narrowly lanceolate, 5–10 by $1^1/_2$–$2^1/_2$ mm, outer pair of scales the longest . . . . . **1. B. oppositifolia**
1. Leaves large, usually $14^1/_2$–30 by 5–8 cm. Terminal (vegetative) buds broad-ovoid or ovoid, 4–6 by $3^1/_2$–5 mm, outer pair of scales usually shorter than the total length of bud . . . **2. B. macrophylla**

1. Bouea oppositifolia (ROXB.) MEISN. Pl. Vasc. Gen. (1837) Comment. 55; WALP. Rep. 1 (1842) 556; HASSK. Flora 27 (1844) 624; BL. Mus. Bot. 1 (1850) 204; MIQ. Fl. Ind. Bat. 1, 2 (1859) 635; ADELB. Blumea 6 (1948) 326; TARD. Fl. C. L. & V. 2 (1962) 126; KOCHUM. Mal. For. Rec. 17 (1964) 211; AIRY SHAW, Kew Bull. 20 (1966) 87; MEIJER, Bot. News Bull. F. D. Sandakan 8 (1967) 19. — *Mangifera oppositifolia* ROXB. (Cat. Hort. Beng. 1814, 18, ` Fl. Ind. ed. Wall. 2 (1824) 434; ed. Carey 2 (1832) 640; DC. Prod. 2 (1825) 63; BL. Bijdr. (1826) 1157; MERR. Lingn. Sc. J. 9 (1930) 39, *incl. var. microphylla* (GRIFF.) MERR. ; TARD. Fl. C. L. & V. 2 (1962) 128, t. 8, f. 8–13, *incl. var. roxburghii* (PIERRE) TARD. — *B. angustifolia* BL. Mus. Bot. 1 (1850) 204; MIQ. Fl. Ind. Bat. 1, 2 (1859) 635; ENGL. in DC. Mon. Phan. 4 (1883) 241. — *B. myrsinoides* BL. Mus. Bot. 1 (1850) 204; MIQ. Fl. Ind. Bat. 1, 2 (1859) 635. — *B. burmanica* GRIFF. Pl. Cantor in J. As. Soc. Beng. 23 (1854) repr. p. 14; HOOK. *f.* Fl. Br. Ind. 12 (1876) 21; KURZ, Fl. Burma 1 (1877) 306; ENGL. in DC. Mon. Phan. 4 (1883) 240, *incl. var. microphylla* (GRIFF.) ENGL.; KING, J. As. Soc. Beng. 65, ii (1896) 465; K. & V. Bijdr. 4 (1896) 101; PIERRE, Fl. For. Coch. (1897) t. 366B, *incl. var. kurzii* PIERRE *et var. roxburghii* PIERRE; LECOMTE, Fl. Gén. I.-C. 2 (1908) 27; BACK. Schoolfl. (1911) 280; PARKINSON, For. Fl. Andaman Is. (1923) 141; CRAIB, Fl. Siam. En. 1 (1926) 346; HEYNE, Nutt. Pl. (1927) 973. — *B. microphylla* GRIFF. Pl. Cantor in J. As. Soc. Beng. 23 (1854) repr. p. 15; Notul. 4 (1854) 423; RIDL. Fl. Mal. Pen. 1 (1922) 519; BURK. Dict. (1935) 355; CORNER, Ways. Trees (1940) 101, f. 18. — *B. diversifolia* MIQ. Sum. (1861) 522; ENGL. in DC. Mon. Phan. 4 (1883) 241, t. 6, f. 12. — *Matania laotica* GAGNEP. Not. Syst. 13 (1948) 189, f. 89: 10–19. — **Fig. 29f–g.**

Tree up to 32 m high and 75 cm ℘. Bark grey, green, light brown to purple brown, or red, fissured.

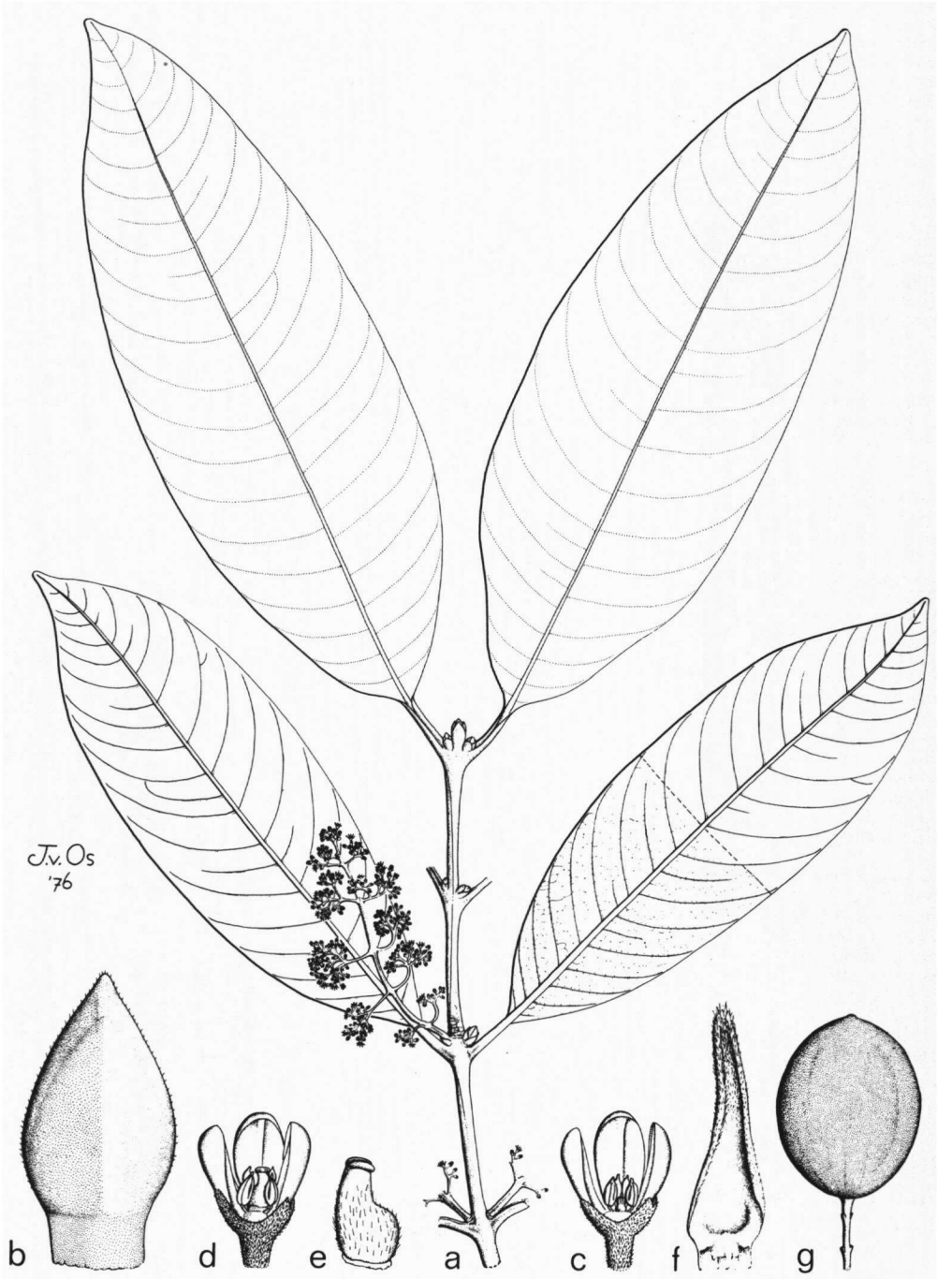

Fig. 29. *Bouea macrophylla* GRIFF. *a.* Habit, × 1/2, *b.* bud scale, *c.* ♂ flower, 1 petal removed, *d.* bisexual flower, 1 petal removed, × 7, *e.* pistil, × 14. — *B. oppositifolia* (ROXB.) MEISN. *f.* Bud scale, × 7, *g.* young fruit (*a–b* KING's Coll. 679, *c–e* JACOBS *s.n.*, *f* KOSTERMANS & ANTA 531, *g* CURTIS *s.n.*).

Terminal (vegetative) buds lanceolate to narrowly lanceolate, 5–10 by $1^1/_2$–$2^1/_2$ mm, scales of the outer pair the longest. *Leaves* coriaceous, elliptic to elliptic-oblong, lanceolate, or obovate to oblanceolate, 2–15 by 1–5 cm (on sterile specimens up to $22^1/_2$ by $5^1/_2$ cm), glabrous; base acute to cuneate, or obtuse; apex acuminate, rarely obtuse; nerves 8–14(–26) pairs, veins hardly visible, sometimes faint, reticulate; petiole $^1/_2$–1 cm. *Panicles* $2^1/_2$–6 cm long; pedicels 0–2 mm. *Flowers* white, pale yellow to yellow. *Calyx* lobes broadly ovate, $^1/_2$–$^2/_3$ mm long. *Petals* oblong or obovate-oblong, slightly variable in size, $1^1/_2$–$2^1/_4$ by $^3/_4$–1 mm. *Stamens* $^2/_3$–1 mm; anthers apiculate. *Disk* small, thin, *c.* $^2/_3$ mm ∅. *Ovary c.* $^1/_2$ mm ∅. *Drupe* (fresh) broadly ellipsoid, *c.* $2^1/_2$ by $1^1/_2$ cm, yellow, orange, or red when ripe.

Distr. Burma, Andaman Is., Thailand, Laos, Vietnam, Cambodia, China (Yunnan & Hainan), and *Malesia:* Sumatra (incl. Banka & Billiton), Malay Peninsula, and Borneo.

Ecol. In lowland forest up to 600 m. *Fl.* Jan.–Nov.; *fr.* March–Nov.

CORNER *l.c.* noted that trees of this species give, probably, the densest shade of any tree in Malaya. Growth is slow, and it is excellent for parks. Many of the young violet leaves habitually fall off, when only half-grown.

Uses. Fruits are edible and are sometimes made into preserve when in a half ripe state (*cf.* ALVINS 720).

According to HEYNE *l.c.* the timber is heavy, hard and durable and very useful for various purposes.

Vern. Sumatra: *kaju-rusun, kunangan, raman burung*, M; *raman padi, r. utan, riedèn daun*; Banka: *gandaria, raman, uris, urisan*, M; Malay Peninsula: *gĕmia, kĕmunia, kundang, kudang rumenia, mĕrapoh rumenia, pokô rummiyah, rambainyia, ramunia, romaniah, rumboi-nigor, rumenia, rumia*, M; Borneo: *asam djanar, bandjar*, M; *kĕdjauw lĕpang, tampusu*, Dayak; *ramania pipit*, Samarinda; *umpas*, SE. Borneo.

2. Bouea macrophylla GRIFF. Pl. Cantor in J. As. Soc. Beng. 23 (1854) repr. p. 15; Notul. (1854) 420; Ic. Pl. As. 4 (1854) t. 567, f. 4; ENGL. in DC. Mon. Phan. 4 (1883) 239, t. 6, f. 9–11; KING, J. As. Soc. Beng. 65, ii (1896) 465; K. & V. Bijdr. 4 (1896) 98; KOORD. Minah. (1898) 409; BACK. Fl. Bat. (1907) 369; Schoolfl. (1911) 280; RIDL. Fl. Mal. Pen. 1 (1922) 520; FEDTSCHENKO, Svensk Bot. Tidskr. 19 (1926) 493; CRAIB, Fl. Siam. En. 1 (1926) 346; HEYNE, Nutt. Pl. (1927) 973; OCHSE & BAKH. Fruit (1931) 1, t. 1; BURK. Dict. (1935) 355; CORNER, Ways. Trees (1940) 101, Atlas t. 11; KOCHUM. Mal. For. Rec. 17 (1964) 210; BACK. & BAKH. *f.* Fl. Java 2 (1965) 150. — *B. gandaria* BL. (Mus. Bot. 1, 1850, 204, proposed alternative name) *ex* MIQ. Fl. Ind. Bat. 1, 2 (1859) 635; ADELB. Blumea 6 (1948) 326. — *Tropidopetalum javanicum* TURCZ. Bull. Soc. Nat. Mosc. 32, i (1859) 265; *cf.* FEDTSCHENKO, Svensk Bot. Tidskr. 19 (1926) 493. — **Fig. 29a–e.**

Tree up to 27 m high and 55 cm ∅. Bark light greyish brown, or dark coloured, finely fissured. Terminal (vegetative) buds broadly ovoid or ovoid, 4–6 by $3^1/_2$–5 mm, scales of outer pair usually shorter than the total length of bud. *Leaves* coriaceous, ovate-oblong to lanceolate, or elliptic to narrowly elliptic, $(11^1/_2–)14^1/_2$–30 by (4–)5–8 cm (on sterile specimens up to 45 by 13 cm), glabrous; base acute to cuneate, rarely obtuse; apex acute to acuminate; nerves 15–25 pairs, veins reticulate, sometimes faint; petiole 1–$2^1/_2$ cm. *Panicles* $4^1/_2$–$10(–12^1/_2)$ cm long; pedicels 0–2 mm. *Flowers* light yellowish green or light yellow, soon becoming brown. *Calyx* lobes broadly ovate, *c.* $^2/_3$ mm long. *Petals* oblong, or oblong-obovate, 1 – 1½ by *c.* 1 mm. *Stamens* $^2/_3$–1 mm; anthers apiculate. *Disk* small, thin, *c.* $^2/_3$ mm ∅. *Ovary c.* $^1/_2$ mm ∅. *Drupe* (fresh, *cf.* OCHSE & BAKH. *l.c.*) subglobose, $3^1/_2$–5 by 3–4 cm, yellow or orange when ripe; cotyledons blue-violet.

Distr. *Malesia:* Sumatra (E. Coast: Langkat, one coll.), Malay Peninsula (Perak, Pahang, Malacca), and W. Java.

Also cultivated in Mauritius, Sumatra, the Malay Peninsula, West & Central Java, Borneo, and Ambon as a village fruit tree.

Ecol. Lowland forest up to 300 m; in cultivation up to 800 m. *Fl.* June–Nov.; *fr.* March, June.

Uses. *Gandaria* is an estimable fruit tree. In cultivation it thrives best on a light pervious soil, preferably below 500 m (OCHSE & BAKH. *l.c.*).

The ripe, yellow, plum-like fruits are eaten raw or steamed; they have a rather acid taste; they serve for an excellent compote. Young fruits are sometimes pickled and used for sambal. Young leaves are eaten with rice.

The timber of this species is not very good and only used for minor purposes (HEYNE *l.c.*), but BURKILL *l.c.* defines it as durable.

Vern. Sumatra: *ramania*, Langkat; Malay Peninsula: *asam suku, kondongan, kundang(an), k. hutan, mĕdang asam, pakô kundangan, rembunia, rĕmĕnya, rumenia, rumia, sĕrapoh, sĕrapok, sĕtar*, M; Java; *gandaria*, J, M, S, *djantakè, gunarjah, kĕndarah*, S, *djatakè*, J, S, *pao gandaria*, Md.

8. DRACONTOMELON

BL. Mus. Bot. 1 (1850) 231; ENGL. in DC. Mon. Phan. 4 (1883) 250; WILKINSON, Ann. Mag. Nat. Hist. XIII, 9 (1966) 429; J. Nat. Hist. 1967(4), p. 505; *ibid.* 1968(2), p. 39. — *Comeurya* BAILL. Adansonia 10 (1872) 329. — **Fig. 30–33.**

Trees. *Leaves* spiral, imparipinnate, petioled. *Leaflets* opposite, subopposite, or alternate, entire, often with hairy domatia. *Inflorescences* paniculate, axillary or terminal. *Flowers* bisexual. *Calyx* 5-lobed. *Petals* 5, valvate but imbricate at the apical part, puberulous outside or on both surfaces, or glabrous. *Stamens* 10, those

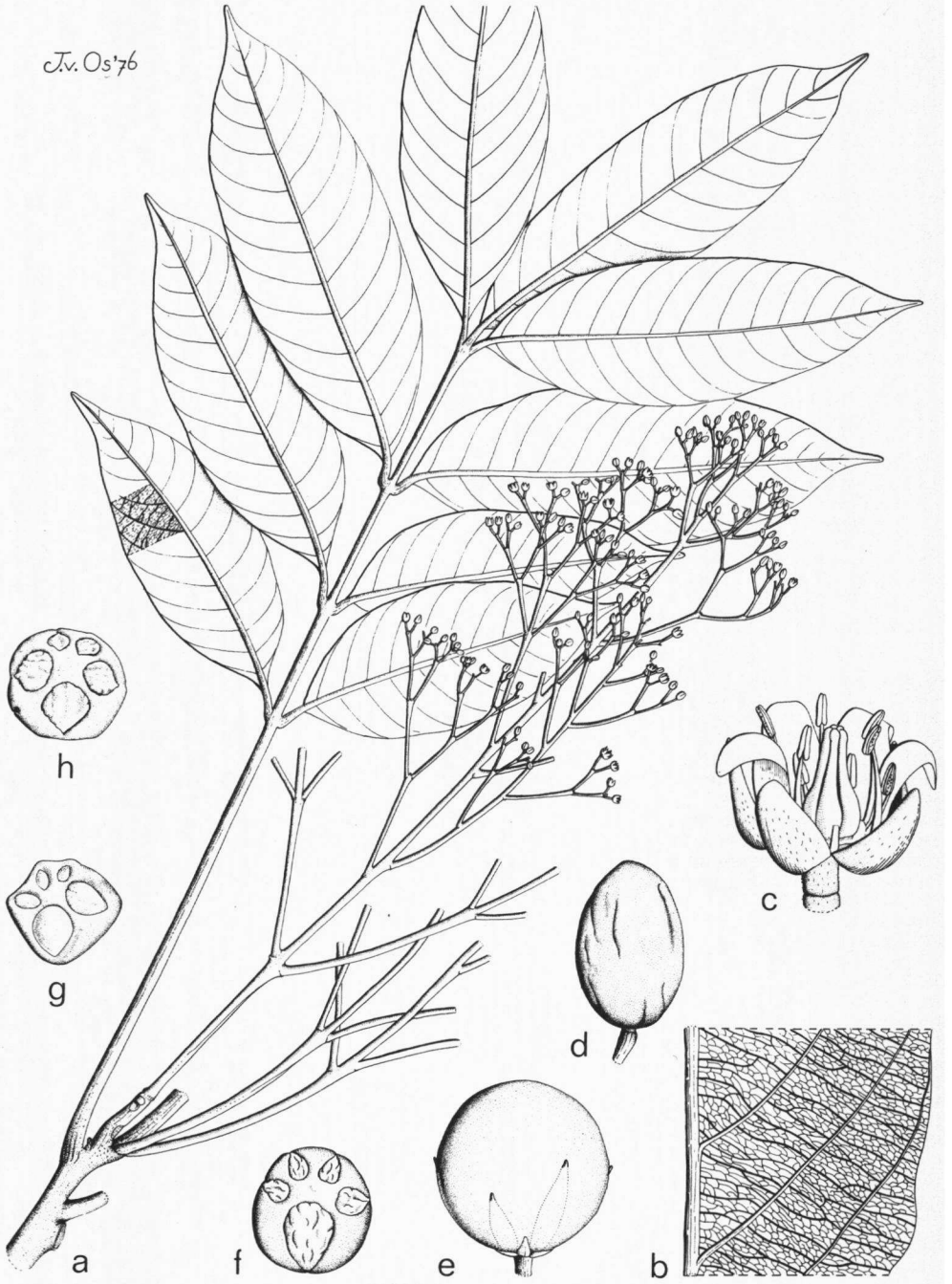

Fig. 30. *Dracontomelon costatum* BL. *a*. Habit, × 1/2, *b*. venation on lower leaf surface, × 1 1/2, *c*. flower, one stamen cut, × 7, *d*. fruit, nat. size. — *D. dao* (BLANCO) MERR. & ROLFE. *e*. Fruit, with style remains, nat. size, *f–h*. endocarp from different angles, showing opercula of large fertile loculi and abortive, small ones, nat. size (*a–c* BALAJADIA 7070, *d* KOSTERMANS 13229, *e–f* DING HOU 729, *g* ELMER 13456, *h* HB 11807).

opposite the calyx lobes longer than those alternate with them; filaments subulate, glabrous; anthers dorsifixed. *Disk* intrastaminal, discoid or shortly cupular, hairy, glabrescent, or glabrous. *Pistil* composed of 5 carpels, 1–4 of them abortive; carpels free but connate at the basal and apical parts. *Ovary* 5-celled, hairy and glabrescent; styles 5, connate at the apical part; stigmas capitate, stigmatic face lateral. *Drupe* 5-celled, or seemingly 1-celled by abortion, each cell with a distinct operculum; endocarp woody, hard. *Seed* with testa free from the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. About 8 *spp.*, distributed from continental Asia (India, Burma, Thailand, Cambodia, and China) throughout *Malesia* to W. Polynesia (Fiji).

Ecol. In forests, usually at low altitudes.

Uses. *Dracontomelon* is sometimes planted in villages because of the fruit which has a small amount of a rather acid, juicy, edible pulp around a large endocarp (stone). The trees also provide very decorative timber.

Vern. Malaysian standard timber name: *senkuang*.

KEY TO THE SPECIES

1. Leaflets with hairy domatia. Disk hairy. Drupe globose or depressed-globose, distinctly 5-celled.
 2. Petals 7–10 mm long. Ovary oblong-ellipsoid or slightly obovoid, *c.* $^2/_3$ (sometimes in young flowers *c.* $^1/_2$) the length of pistil. Drupe globose, $1^3/_4$–$2^1/_2(-3^1/_2)$ cm ∅; endocarp 1–$1^3/_4$ cm ∅, often smooth **1. D. dao**
 2. Petals $4^1/_2$–5 mm long. Ovary depressed-globose, *c.* $^1/_3$ the length of pistil. Drupe depressed-globose, 3–$5^1/_2$ cm ∅; endocarp 3–5 cm ∅, with numerous, irregular processes . . . . **2. D. lenticulatum**
1. Leaflets without domatia. Disk glabrous. Drupe ovoid or broadly ellipsoid, seemingly 1-celled (due to abortion) . . . . . **3. D. costatum**

1. Dracontomelon dao (BLANCO) MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 108 ('*Dracontomelum*'); MERR. Sp. Blanc. (1918) 234; En. Philip. 2 (1923) 471; HEYNE, Nutt. Pl. (1927) 975; BROWN, Useful Pl. Philip. 2 (1950) 334, f. 161; WILKINSON, J. Nat. Hist. 1968(2), p. 45, in text, f. 6A–C & E; RENDLE, World Timbers 3 (1970) 70; VERSTEEGH, Med. Landb. Hogesch. Wageningen 71–19 (1971) 31; DING HOU, Blumea 24 (1978) 6. — *Pomum draconum* RUMPH. Herb. Amb. 1 (1741) 157, t. 58. — *Pomum draconum silvestre* RUMPH. *l.c.* 159, t. 59. — *Poupartia mangifera* BL. Bijdr. (1826) 1160, *nom. illeg., excl. syn.* — *Paliurus dao* BLANCO, Fl. Filip. (1837) 174; ed. 2 (1845) 122; ed. 3, 1 (1877) 219. — *Paliurus edulis* BLANCO, Fl. Filip. (1837) 173. — *Paliurus lamiyo* BLANCO, Fl. Filip. ed. 2 (1845) 122; ed. 3, 1 (1877) 218, *p.p.* — *D. mangiferum* (BL.) BL. Mus. Bot. 1 (1850) 231, f. 42, *nom. illeg.*; HOOK. *f.* Fl. Br. Ind. 2 (1876) 43; ENGL. in DC. Mon. Phan. 4 (1883) 251, *incl. var. puberulum* (MIQ.) ENGL.; K. & V. Bijdr. 4 (1896) 114, *incl. var. pubescens* K. & V.; KING, J. As. Soc. Beng. 65, ii (1896) 513; PIERRE, Fl. For. Coch. (1898) t. 374A; KOORD. Minah. (1898) 410; BACK. Schoolfl. (1911) 281; RADLK. Denkschr. K. Ak. Wiss. Wien 89 (1913) 129; MERR. Int. Rumph. (1917) 333; LAUT. Bot. Jahrb. 56 (1920) 355; RIDL. Fl. Mal. Pen. 1 (1922) 543; PARKINSON, For. Fl. Andaman Is. (1923) 142; LANE-POOLE, For. Res. (1925) 106; DOCT. v. LEEUWEN, Zoocecidia (1926) 321, f. 571; HEYNE, Nutt. Pl. (1927) 976; BURK. Dict. (1935) 859; CORNER, Ways. Trees (1940) 104, f. 21, Atlas t. 5; KRAEMER, Trees W. Pac. Reg. (1951) 193; BROWNE, For. Trees Sarawak & Brunei (1955) 47; JAPING, Houtsoorten N. G. 1 (1961) 11; TARD. Adansonia 1 (1961) 55, t. 1, f. 12–16; Fl. C. L. & V. 2 (1962) 146, t. 11, f. 12–16; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 21, f. 7; KOCHUM. Mal. For. Rec. 17 (1964) 243; WILKINSON, J. Nat. Hist. 1968(2), p. 40, in text, f. 5E–F & 7A. — *D. sylvestre* BL. Mus. Bot. 1 (1850) 231; ENGL. in DC. Mon. Phan. 4 (1883) 252; MERR. Int. Rumph. (1917) 333; En. Philip. 2 (1923) 472; KRAEMER, Trees W. Pac. Reg. (1951) 195, f. 67 & 68. — *D. puberulum* MIQ. Sum. (1861) 524; BACK. & BAKH. *f.* Fl. Java 2 (1965) 151; STREIMAN, Timber Species Leafl. P.N.G. 5 (1974) f. A & B. — *Comeurya cumingianum* BAILL. Adansonia 10 (1872) 330. — *D. cumingianum* BAILL. Bull. Soc. Linn. Paris 1 (1877) 122; ENGL. in DC. Mon. Phan. 4 (1883) 254. — *D. laxum* K.SCH. in K.Sch. & Hollr. Fl. Kais. Wilh. Land (1889) 65. — *D. edule* (BLANCO) SKEELS, Bull. U.S. Dep. Agr. Bur. Pl. Ind. 261 (1912) 52; MERR. En. Philip. 2 (1923) 471; BROWN, Useful Pl. Philip. 2 (1950) 336, f. 162 & 163. — *D. edule* MERR. Philip. J. Sc. 10 (1915) Bot. 33, *non* SKEELS, 1912; KALKMAN, Timber Spec. Neth. N. G. (1959) 15. — *D. lamiyo* MERR. Sp. Blanc. (1918) 234. — *D. brachyphyllum* RIDL. Kew Bull. (1933) 202; MEIJER, Bot. News Bull. F. D. Sandakan 8 (1967) 22. — **Fig. 30e–h, 31, 32.**

Deciduous tree up to 43(–55) m high and 90 (–150) cm ∅. Buttresses up to 5 m high, $2^1/_2$ m wide, 15 cm thick. Bark greyish brown, not fissured, scaly, peels in irregularly patches. *Leaves* with 4–9 pairs of leaflets; rachis 6–25(–44) cm, petiole 3–16(–23) cm, both puberulous or pubescent, glabrescent, or glabrous. *Leaflets* chartaceous to subcoriaceous, elliptic-oblong, oblong, ovate-oblong to lanceolate, sometimes oblanceolate, $4^1/_2$–20(–27) by $2^1/_4$–7(–$10^1/_2$) cm, usually glabrous on both surfaces; lower surface with hairy domatia, sometimes pubescent (or only on the midrib),

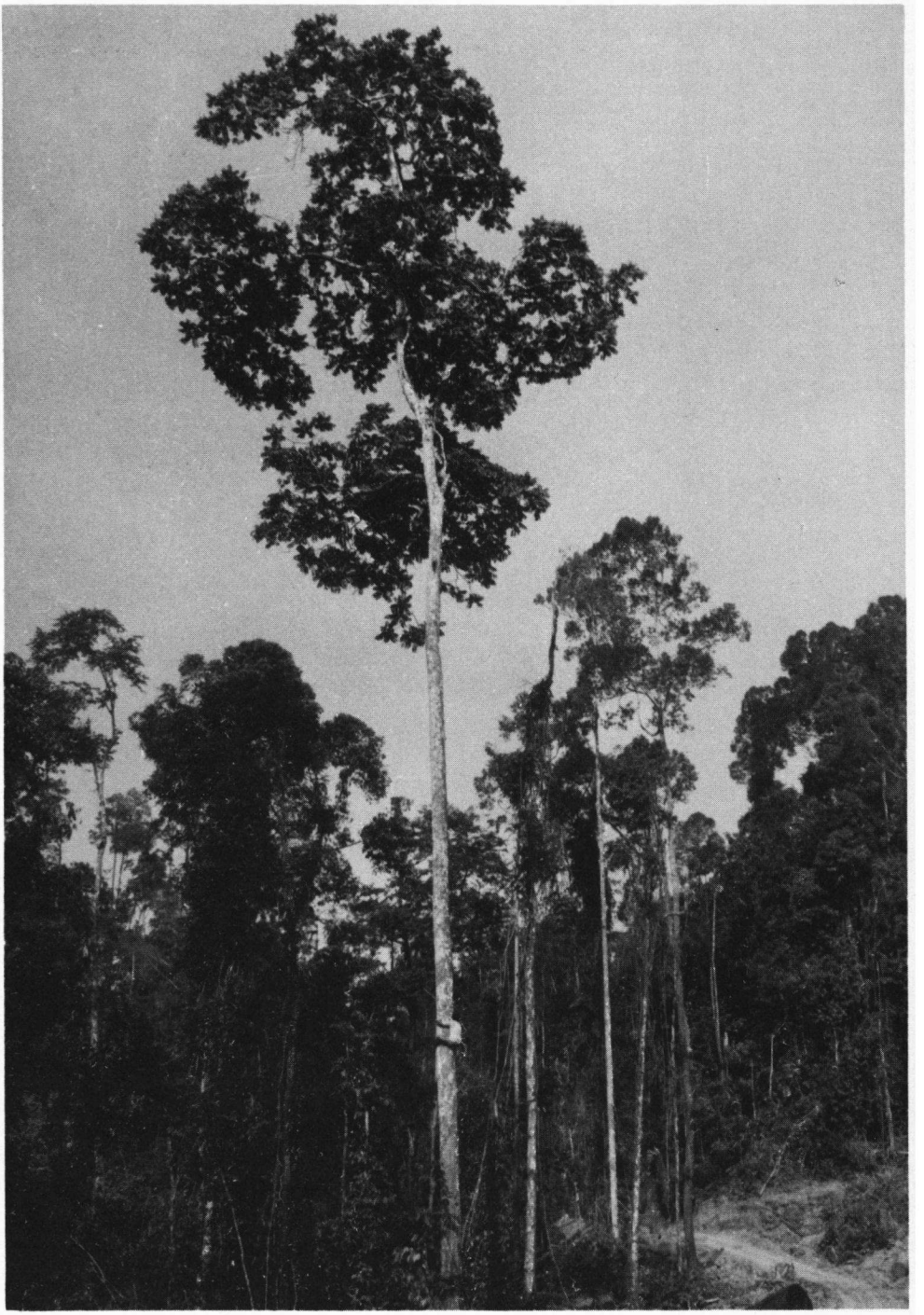

Fig. 31. *Dracontomelon dao* (BLANCO) MERR. & ROLFE. Large tree, with tree climber; Lahad Datu, Sabah (Photogr. MEIJER, April 1967).

glabrescent; base obliquely rounded, rarely subcordate; apex shortly acuminate, sometimes caudate; nerves 3–10 pairs; veins reticulate, some obliquely cross-bar-like; petiolules 0–$^1/_3$ cm, the terminal one $^1/_4$–$1^3/_4$ cm, puberulous. *Panicles* up to 50 cm long, pubescent, glabrescent; branches up to $37^1/_2$ cm long; floral bracts ovate, 1–$1^1/_2$ mm long, puberulous on both surfaces; pedicels $^1/_3$–2 mm. *Flowers* white or greenish white. *Calyx* lobes ovate-oblong, 4–5 mm long, sparsely puberulous outside. *Petals* oblanceolate, sometimes elliptic-lanceolate, 7–10 by $1^1/_2$–2 mm. *Stamens* $5^1/_2$–7 mm; anthers oblong or ovoid-oblong, 1–$1^1/_4$ mm long. *Disk c.* $2^1/_2$ mm ∅, puberulous. *Pistil* $5^1/_2$–$6^1/_2$ mm long. *Ovary* oblong-ellipsoid or slightly obovoid, *c.* $^2/_3$ (sometimes in young flowers *c.* $^1/_2$) the length of the pistil, $1^1/_2$–2 mm ∅. *Drupe* globose, $1^3/_4$–$2^1/_2$(–$3^1/_2$) cm ∅, larger when fresh; dingy brown when ripe, distinctly 5-celled; endocarp lentiform, 1–$1^3/_4$ cm ∅, often smooth, sometimes slightly irregularly 5-angular. *Seed* conical, $^3/_4$–1 cm long.

Distr. India (east part and Andaman Is.), Burma, Thailand, Cambodia, S. China, scattered all through *Malesia*, and Solomon Is.

Sometimes planted in villages.

Ecol. Only in high-rainfall areas, although sometimes with a short dry season, in evergreen to slightly deciduous forest on well-drained to poorly drained soils, in levee forest, secondary forest, rather common but mostly scattered, at low altitude, rarely at 500–1000 m. *Fl. fr.* Jan.–Dec.

According to CORNER *l.c.* the leaves are in Malaya shed after dry weather, the trees having evidently two seasons, one about July–August, the other about December–January. The buds open before all the old leaves have fallen and inflorescences are produced at the base of the new shoots (in the axils of scale leaves) before the foliage.

Nomencl. *Poupartia mangifera* BL. 1826 is an

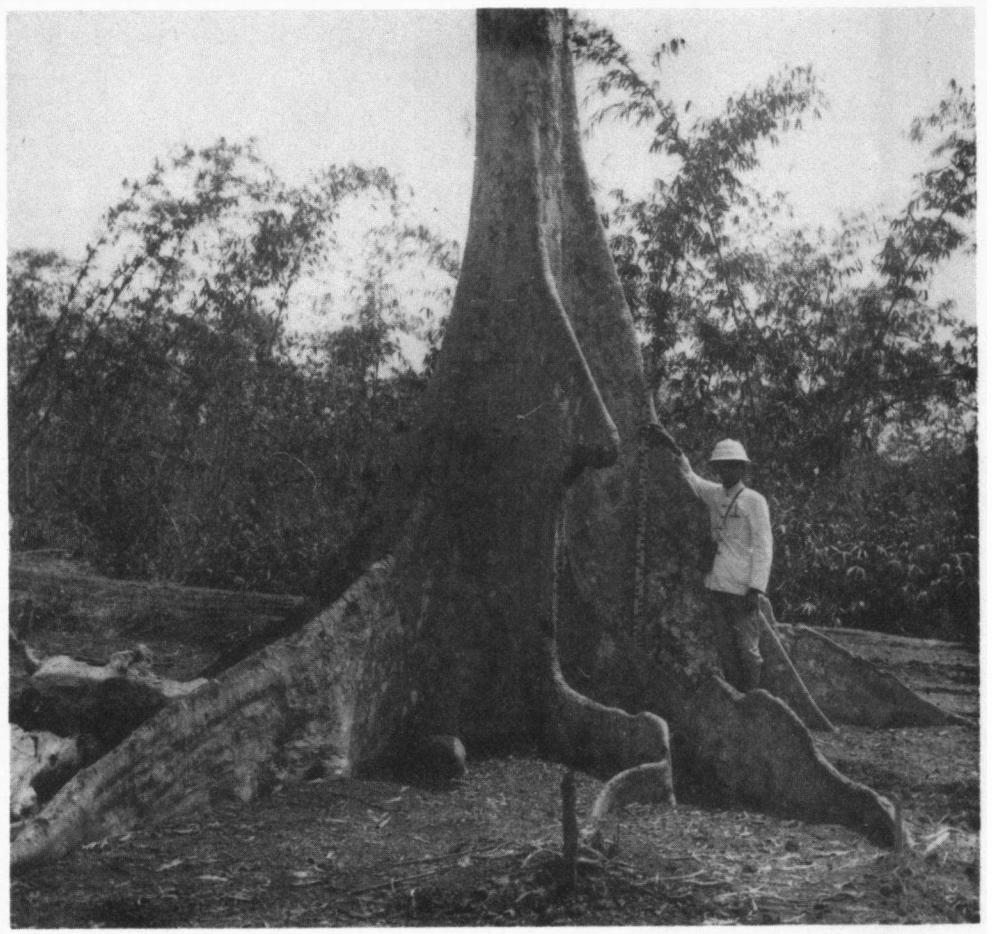

Fig. 32. *Dracontomelon dao* (BLANCO) MERR. & ROLFE. F. R. Tjuratjabe, near Bangalsari, W. of Djember, East Java. Buttresses cut for making cart-wheels (Photogr. KALSHOVEN).

illegitimate name as BLUME cited three earlier names in synonymy, *viz Mangifera pinnata* L. *f.* (1781), *Spondias mangifera* WILLD. (1799) and *Spondias amara* LAMK (1796), which all refer to *Spondias pinnata* (L. f.) KURZ. In 1850 BLUME removed these synonyms and named the species *Dracontomelon mangiferum* BL., but again mentioned under this name an older synonym (*Poupartia pinnata* BLANCO, 1837) making the combination illegitimate.

Uses. The timber is rather soft, rather light to moderately heavy, little durable. The sapwood is pale and subject to insect attack. The heartwood varies considerably from greyish brown, usually with dark grey to black bands, to almost black. Boles have a mean maximum branch-free height of 25 m, a mean maximum d.b.h. of 80–100 cm, but they are usually heavily buttressed. The timber is in demand for matched sliced veneers, but also suitable for rotary veneers; also suitable for panelling, furniture, quality cabinet work, flooring, boxes, matches. Trade names: *sengkuang* (Malaysia), *paldao* (Philippines), *dar* (West New Guinea), *New Guinea Walnut* (Papua New Guinea).

A handsome and ornamental tree which could be used effectively for avenues.

The fruit is inferior and sought mostly by children. Flowers and leaves may also be eaten as a vegetable (CORNER *l.c.*). The bark is possibly of medicinal value (BURKILL).

Vern. Sumatra: *anglip èten, dau-pajo*, Simalur, *bĕka, landur, surian kĕli*, Palembang, *kiking*, M; Malaya: *bĕngkuang, chĕngkuang, mati avak, sakal, sĕkuan, sĕngkuang, sĕpul, surgan*, M; Java; *dahu*, S & Md, *dau, langsĕp alas, theuòh*, Md, *gijubuk*, J, *rahan, rahu, rao, rau*, J & Md; Lesser Sunda Is.: *kasuang*, Sumbawa, *rau*, Flores; Borneo: Sarawak: *sangkuang*, Miri, *ungkawang*, Kuching; Sabah: *sankuang*, Iban, Kedayan & M, *sarunsab*, Dusun, *sorosob*, Jesselton, *suronsub*, Dusun Rungus, *tarosoup*, Dusun Kinabatangan, *tehrengzeb*, Kratam; Kalimantan: *djakan*, Dayak, *sangkuwang* = *urui*, Sg. Pantung, *sĕngkuang* or *singkuang, talantjap*, M; Philippines (*cf.* MERRILL, 1923, *l.c.*): *adúas, anangging-putí, lámio, malatyo, maliyan, olandág*, Tag., *alauíhau*, Bik., S.L.Bis., *anduong, makau*, Mbo, *batuan*, Bis., *bili-bili*, P.Bis., *bio*, Pang., *dáo*, Tag., Bik., P. Bis., S.L.Bis., *habas*, C.Bis., *hamárak, kamárak, makadaég*, Ilk., *kalauihau*, Bik., *kiakia* S.L.Bis., *lupígi*, Ibn., *makau*, Mag., *mamakau*, Mbo, Bag., *ulandang, ulandúg*, Kuy.; Celebes: (*bua*) *rao, dewu, lolomao, rau* = *mabiru*, Manado, *koili*, Minah., *rago*, Muna I., *wuarau takau*, Tobela, *bemagiohik, biohiki, nganin*, Morotai, *ngamè, ngawé*, Ternate, *leombawi*, Talaud I., *ngamè, taulaté*, Halmahere, *tarpati*, Banda; New Guinea: *alaisoi*, Madang, *ameu*, Nemo, *arouwsauw*, Kwèsten, *aua*, Vailala, *daa*, Amberbaken, *damoni*, Motu, *djaap* = *jaap, tjaap*, Hattam, *dorea*, W. Evara, *fa, faila*, Amele, *gain*, Jal, *imbur*, Onjob, *kumbui*, Karoon, *los*, Mooi, *mon*, Bembi, Rawa, Madang, *onomba*, Binendele, *rou*, Madang, *senai*, Manikiong, *taa*, Andai, *touv*, Sko, *touuw*, Tko, *ufaka*, Minufia, *wehm*, Bogia.

CORNER *l.c.* called this village fruit tree the Argus Pheasant Tree; it has five equatorial, oval flecks on the fruit, and because of this characteristic, resembling the markings of the feathers of the Argus pheasant, the Malays give it the vernacular name *se(n)kuan(g)*.

2. Dracontomelon lenticulatum WILKINSON, J. Nat. Hist. 1967(4), p. 505, f. 1–3. — *Dracontomelon sp.* LANE-POOLE, For. Res. (1925) 106. — *D. edule* (*non* (BLANCO) SKEELS) ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 19, f. 6.

Tree up to 37 m high and 120 cm ∅. Buttresses up to *c.* $3^1/_2$ m high, $1^3/_4$ m wide,. Bark grey-green to brown, irregularly fissured. *Leaves* with 4–9 pairs of leaflets; rachis 22–57 cm, petiole $4^1/_2$–23 cm, both pubescent, glabrescent, or glabrous. *Leaflets* chartaceous or subcoriaceous, ovate-oblong, $22^1/_2$–$32^1/_2$ by 5–$12^3/_4$ cm, glabrous except for the hairy domatia; base slightly unequally obtuse; apex shortly acuminate; nerves 7–15 pairs; veins reticulate, some obliquely cross-bar-like; petiolules $^1/_3$–1 cm, the terminal one up to $1^1/_2$ cm. *Panicles* up to 30 cm long, pubescent, glabrescent; branches up to 11 cm long; floral bracts ovate, 1–$1^1/_2$ mm long, puberulous on both surfaces; pedicels $^1/_2$–2 mm. *Flowers* whitish green. *Calyx* lobes ovate-oblong, *c.* 3 mm long, puberulous outside. *Petals* ovate-oblong, sometimes lanceolate, $4^1/_2$–5 by $1^3/_4$–$2^1/_4$ mm. *Stamens* 3–4 mm; anthers ovoid, 1–$1^1/_4$ mm long. *Disk* 3–$3^1/_2$ mm ∅, puberulous. *Pistil* $3^1/_2$–4 mm long. *Ovary* depressed-globose, *c.* $^1/_3$ the length of pistil, 2–3 mm ∅. *Drupe* depressed-globose, 2 cm long and 3–$5^1/_2$ cm ∅, up to $5^1/_2$ cm long and $6^1/_2$–7 cm ∅ when fresh, dark brown when ripe, distinctly 5-celled; endocarp lentiform, 3–5 cm ∅, with numerous, irregular processes. *Seed* broadly ovoid, $^3/_4$–1 cm long.

Distr. *Malesia:* New Guinea (West: Nabire, one coll.; East: Sepik, Central and Morobe Distr.).

Cultivated in the Botanic Garden at Lae.

Ecol. Lowland rain-forest, common on raised alluvial flats and on swampy ground. *Fl.* Sept.–Oct.; *fr.* March, July, Sept.

Vern. *Habere*, Suku, *urau*, Vailala.

3. Dracontomelon costatum BL. Mus. Bot. 1 (1850) 232; MIQ. Fl. Ind. Bat. 1, 2 (1859) 639; ENGL. in DC. Mon. Phan. 4 (1883) 252; MERR. Pl. Elm. Born. (1929) 168; WILKINSON, J. Nat. Hist. 1968(2), p. 39, f. 1–4, 5A–D, 6D. — **Fig. 30a–d.**

Tree up to 30(–35) m high and 60(–80) cm ∅. Buttresses occasionally present, up to 5 m high, *c.* 2 m wide, thin. Bark light brown, smooth. *Leaves* with 4–7 pairs of leaflets; rachis 10–35 cm long, petiole 8–25 cm, both sparsely puberulous, glabrescent, or glabrous. *Leaflets* coriaceous, elliptic-lanceolate, broad-elliptic, sometimes ovate to lanceolate, 6–22 by $3^1/_2$–$9^1/_2$ cm, glabrous above, lower surface puberulous on the midrib and nerves, glabrescent, or glabrous, without domatia; base cuneate, sometimes unequal; apex acuminate, sometimes acute, rarely obtuse; nerves 10–16 pairs; veins reticulate-scalariform; petiolules $^1/_2$–$1^3/_4$ cm, the terminal one up to 4 cm. *Panicles* up to 35(–70) cm long, puberulous, glabrescent; branches up to 30 cm long; floral bracts triangular, $^1/_3$–1 mm long, puberulous on both surfaces; pedicels *c.* $^1/_2$ mm. *Flowers* light green or pale yellow. *Calyx* lobes elliptic, 3 mm long, puberulous outside. *Petals* ovate-oblong, 4–$4^1/_2$ by $1^1/_2$–$1^3/_4$ mm. *Stamens* 2–3 mm long; anthers oblong or ovoid-oblong,

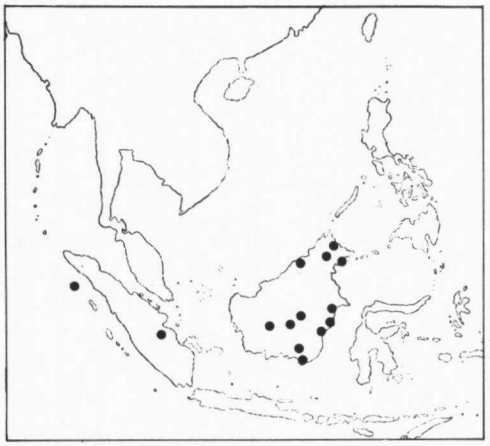

Fig. 33. Localities of *Dracontomelon costatum* BL.

c. 1 mm long. *Disk c.* 2 mm ∅, glabrous. *Pistil* 3–3½ mm long. *Ovary* oblong-ellipsoid, *c.* ½ the length of pistil, 1½ mm ∅. *Drupe* ovoid or broadly ellipsoid, 2–2½ cm long and *c.* 1½ cm ∅, black when ripe, seemingly 1-celled (due to abortion); endocarp ovoid or broadly ellipsoid, *c.* 1½ cm ∅, smooth. *Seed* oblong, *c.* ⅔ cm long.

Distr. *Malesia:* Sumatra (Djambi, Simalur) and Borneo (Sabah: Sandakan, Lung Mangis, Kinabatangan, Tawao; Brunei; Kalimantan: Kutai, Sangkulirang, Samarinda, Balikpapan, Pleihari, Muaratewe, Martapura, Melawi). Fig. 33.

Ecol. Primary forest, from the lowland up to 100 m, sometimes occurring on sandstone or limestone. *Fl.* April, Aug.–Oct.; *fr.* Jan., May–July.

Vern. Sumatra: *sĕnlang*, *s. buluk*, *s. dĕlok*, *s. ètĕm*, *s. uding*, Simalur; Borneo: *bĕsĕngkiang*, Dajak, *katĕp*, M, *landur*, Bassap Dajak, *pistanak*, Pleihari, *pitanak*, Bekumpai, *sĕnkuang*, Samarinda, *tĕkosoi*, Kutai.

Note. WILKINSON (*l.c.*) gave a detailed description and discussion on the structure of the flowers, fruits, and seeds.

Excluded

Dracontomelon? cuspidatum BL. Mus. Bot. 1 (1850) 232; MIQ. Fl. Ind. Bat. 1, 2 (1859) 640, is according to H. J. LAM, Bull. Jard. Bot. Btzg III, 12 (1932) 349, 351 = *Dacryodes rostrata* (BL.) H. J. LAM (*Burseraceae*).

Dracontomelon papuanum LAUT. in K.Sch. & Laut. Nachtr. (1905) 301; Bot. Jahrb. 56 (1920) 356, is according to LEENHOUTS, Fl. Males, I, 7 (1976) 820 = *Protium macgregorii* (F. M. BAILEY) LEENH. (*Burseraceae*).

9. PLEIOGYNIUM

ENGL. in DC. Mon. Phan. 4 (1883) 255; A. C. SMITH, Contr. U.S. Nat. Herb. 37 (1967) 76. — **Fig. 34.**

Trees. *Leaves* imparipinnate, very rarely paripinnate, petioled. *Leaflets* opposite, entire. *Inflorescences* axillary, paniculate, sometimes the ♀ racemose or spiciform. *Flowers* often unisexual (plants often dioecious). *Calyx* 5-(rarely 4- or 6-)lobed. *Petals* 5 (rarely 4 or 6), imbricate. *Stamens* 10 (rarely 8–12), twice the number of petals; filaments filiform-subulate, glabrous; anthers slightly oblong or ovoid, abortive or imperfect in ♀. *Disk* annular-pulvinate, sometimes slightly convex, crenulate. *Ovary* 5–12-celled; styles 5–12, divergent; stigmas spathulate. Abortive pistil in ♂ rudimentary. *Drupe* 5–12-celled, 5–12-seeded; endocarp hard, woody. *Seed* with testa free from the endocarp; embryo slightly curved, cotyledons free, plano-convex.

Distr. Species 2 or 3, distributed in the Pacific Is. (Tonga, Cook I., Fiji, Solomon Is.), Australia (Queensland), and *Malesia* (New Guinea, Moluccas, Lesser Sunda Is., Celebes, Philippines, Borneo).

If Australian botanists are correct in reducing *P. cerasiferum* PARKER to *P. solandri*, the genus consists of one widely distributed Indo-Australian species and one endemic in Fiji.

Ecol. Lowland forest, sometimes up to 560 m, rarely at 750–970 m.

1. Pleiogynium timoriense (DC.) LEENH. Blumea 7 (1952) 159; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 32, f. 12; A. C. SMITH, Contr. U.S. Nat. Herb. 37 (1967) 77, *in note.* — *Icica timoriensis* DC. Prod. 2 (1825) 78. — *Spondias solandri* BENTH. Fl Austr. 1 (1863) 492. — *Spondias pleiogyna* F.v.M. Fragm. 4 (1864) 78. — *P. solandri* (BENTH.) ENGL. in DC. Mon. Phan. 4 (1883) 255, t. 7, f. 1–10; BAILEY, Queensl. Fl. 1 (1899) 324, t. 12; MERR. Philip. J. Sc. 4 (1909) Bot. 284; BAILEY, Compr. Cat. Queensl. Pl. (1913) 124; MERR. En. Philip. 2 (1923) 471; PARKER, For. Fl. Punjab ed. 2 (1924) 118; LANE-POOLE, For. Res. (1925) 107; WHITE & FRANCIS, Proc. R. Soc. Queensl. 38 (1927) 237; KRAEMER, Trees W. Pac. Reg. (1951) 202, f. 71. — *Owenia cerasifera* (?*non* F.v.M. 1857)

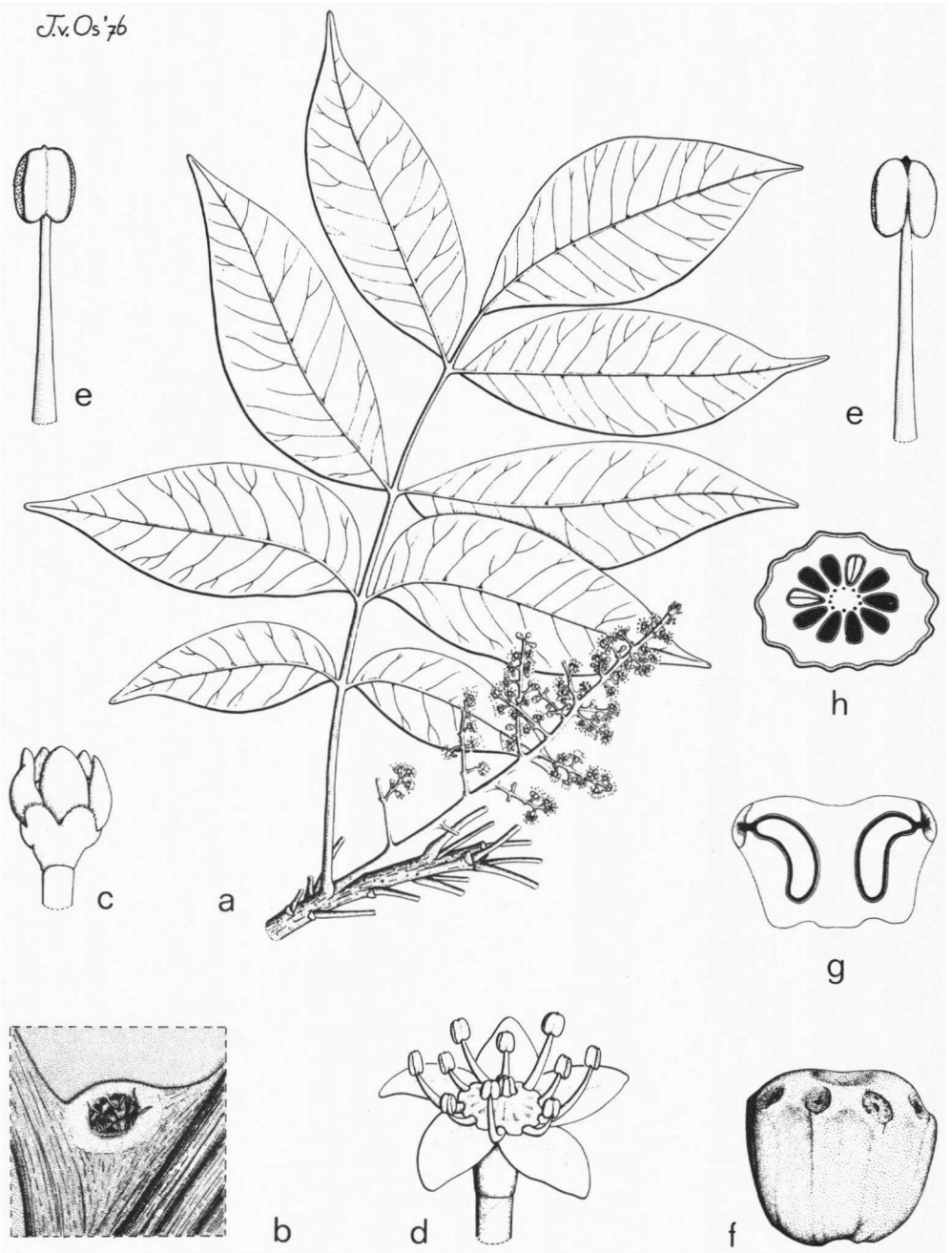

Fig. 34. *Pleiogynium timoriense* (DC.) LEENH. *a*. Habit, × 1/2, *b*. domatium, × 27, *c*. flower-bud, × 7, *d*. flower, × 7, *e*. stamens, viewed from two sides, × 14, *f*. endocarp, side view, *g*. *ditto* in LS, *h*. *ditto* in CS, all × 1 1/2 (*a–e* C.H.B. III–E–3, *f–g* C.H.B. III–E–48, *h* SLEUMER *s.n.*).

HEMSL. Bot. Chall. 1 (1885) 132; THIS.-DYER, J. Linn. Soc. Bot. 21 (1885) 373 (*'cerasifolia'*). — *P. papuanum* C. T. WHITE, Proc. R. Soc. Queensl. 45 (1933) 27, t. 3; J. Arn. Arb. 31 (1950) 95. — **Fig. 34.**

Tree up to 36(–48) m high and 75 cm ∅. Buttresses sometimes present, up to *c.* 2½ m high. Bark dark-grey or grey-brown, flaky, fissured. Young branchlets usually puberulous, pubescent, or tomentose, glabrescent. *Leaves* with 3–6 pairs of leaflets, rachis 4–30 cm, petiole 3–12 cm, both puberulous, pubescent or tomentose, sometimes glabrescent, or glabrous. *Leaflets* elliptic-oblong to -lanceolate, sometimes ovate, or obovate-oblong, 3½–13½ by 2¼–6 cm; glabrous, sometimes sparsely or moderately hairy especially on the midrib and nerves on both surfaces (rarely only on the lower surface); with hairy domatia; base unequal, cuneate, or decurrent, sometimes obtuse; apex acute, acuminate, sometimes obtuse, or cuspidate; nerves 8–11 pairs, veins reticulate; petiolules ½–1 cm, the terminal one 1–4 cm. *Inflorescences:* ♂ up to 30 cm long, branches up to 8½ cm long, many-flowered; ♀ rather simple, usually short, 2–3½ cm long, rarely up to 15 cm long, few-flowered; floral bracts triangular, ¼–1½ mm long; pedicels very short, up to *c.* ⅔ mm, articulated. *Flowers* greenish yellow. *Calyx* lobes suborbicular, ½–¾ mm long. *Petals* ovate-oblong, 1¾–3 by 1–2½ mm. *Stamens* 2–3 mm, usually those opposite the calyx lobes longer than those opposite the petals; anthers ½–⅔ mm, thecae free at the lower ⅓–½, connective distinct, brown or dark brown, sometimes slightly prolonged beyond the thecae. Sterile or imperfect *stamens* in ♀ ⅔–1 mm. *Disk* 1½–1¾ mm ∅. *Ovary* subglobose, *c.* 1 mm ∅, glabrous; styles *c.* ½ mm. Sterile pistil in ♂ ⅓–1 mm. *Drupe* broadly obovoid, 1½–1¾ by 1½–2 cm, red to dark brown when ripe, smooth and glabrous, obtuse or truncate at the top, the lower ⅔ lengthwise ridged, with distinct scars of styles at the apical end; endocarp rather smooth, slightly smaller than the dried drupe. *Seed* by ⅓ cm.

Distr. Pacific Is. (Tonga & Cook Is., *cf.* A. C. SMITH, 1967, p. 77), Solomon Is. (Santa Cruz), Fiji, Australia (Queensland), and *Malesia:* New Guinea (West: Warsamson & Hollandia; Papua New Guinea: Sepik, Madang, Morobe, Port Moresby, and Central Distr.), Moluccas (Obi, Halmaheira, Key), SE. Celebes (Kendari, 1 coll.), Philippines (Luzon, 1 coll.), Borneo (Sabah, 1 coll.), Lesser Sunda Is. (Timor, Flores, Sumba, Wetar, Tanimbar).

Cultivated in Hort. Bog. under *n.* III–E–3, 9, 48 and 48ª; III–K–21ª; XI–B–IV–19.

Ecol. Lowland forest, sometimes up to 560 m, rarely at 750–970 m. Very scattered, in many islands only once collected. *Fl. fr.* March–Dec.

Vern. Lesser Sunda Is.: *indjo wato, lindu watu,* Sumba; New Guinea: *aidzak,* Jal, Madang, *aledzula,* Kasimin, Angoram, *ameya,* Gavien, Angoram, *umbut,* Maprik, Wewak, *vasapa,* Suku, *woigiek,* Mooi.

Note. From Queensland I have seen material of this species (O'FARRELL 73, HYLAND 4822, 5644, N. H. SPECK 1687, STORY & YAPP 78). In Australian literature the species was called *P. solandri* (BENTH.) ENGL. (based on *Spondias solandri* BENTH. 1863) and more recently *P. cerasiferum* PARKER, For. Fl. Punjab ed, 2 (1924) 118, 560 (based on *Owenia cerasifera* F.v.M. 1857, cultivated in India). Australian botanists are of opinion that these refer to one species; if that is true the name adopted here is the correct one.

10. LANNEA

A. RICHARD in Guillemin *c.s.* Fl. Sénég. Tent. 1 (1831) 153, *nom. cons.* — *Haberlia* DENNST. Schlüss. Hort. Mal. (1818) 30. — *Odina* ROXB. (Hort. Beng. 1814, 29) Fl. Ind. ed. Carey 2 (1832) 293; ENGL. in DC. Mon. Phan. 4 (1883) 263. — *Wirtgenia* JUNGH. *ex* HASSK. Flora 25 (1842) Beibl. ii: 46; *ibid.* 27 (1844) 624; Cat. Hort. Bog. (1844) 247, *p.p., nom. invalid., non* SCHIMPER, 1842. — *Calesiam* ADANS. Fam. 2 (1763) 446, *nom. rejic.* — *Kokkia* ZIPP. *ex* BL. Mus. Bot. 1 (1850) 206, *pro syn.* — **Fig. 35–37.**

Trees, shrubs or undershrubs (*extra*-Mal.). Indumentum of stellate hairs. *Leaves* spiral, imparipinnate (rarely tri- or unifoliolate in *extra*-Mal. *spp.*), petioled. *Inflorescences* paniculate or ± spiciform, axillary or pseudo-terminal, appearing before (or at the same time in *extra*-Mal. *spp.* with) the leaves. *Flowers* unisexual (plants dioecious). *Calyx* 4-lobed. *Petals* 4, imbricate, glabrous. *Stamens* 8; filaments subulate, glabrous; anthers dorso-basifixed, ovoid, abortive and small in ♀. *Disk* intrastaminal, round, flat or concave. *Ovary* ovoid or oblong, 4-celled, usually 1 (or 2) fertile; styles 4, short; stigmas small, subglobose. Sterile pistil in ♂ small. *Drupe* 1–4-celled, usually 1- (or 2-)seeded; endocarp woody, with 1 (or 2) operculum (opercula). *Seed* with testa free from the endocarp; embryo straight, cotyledons free, plano-convex.

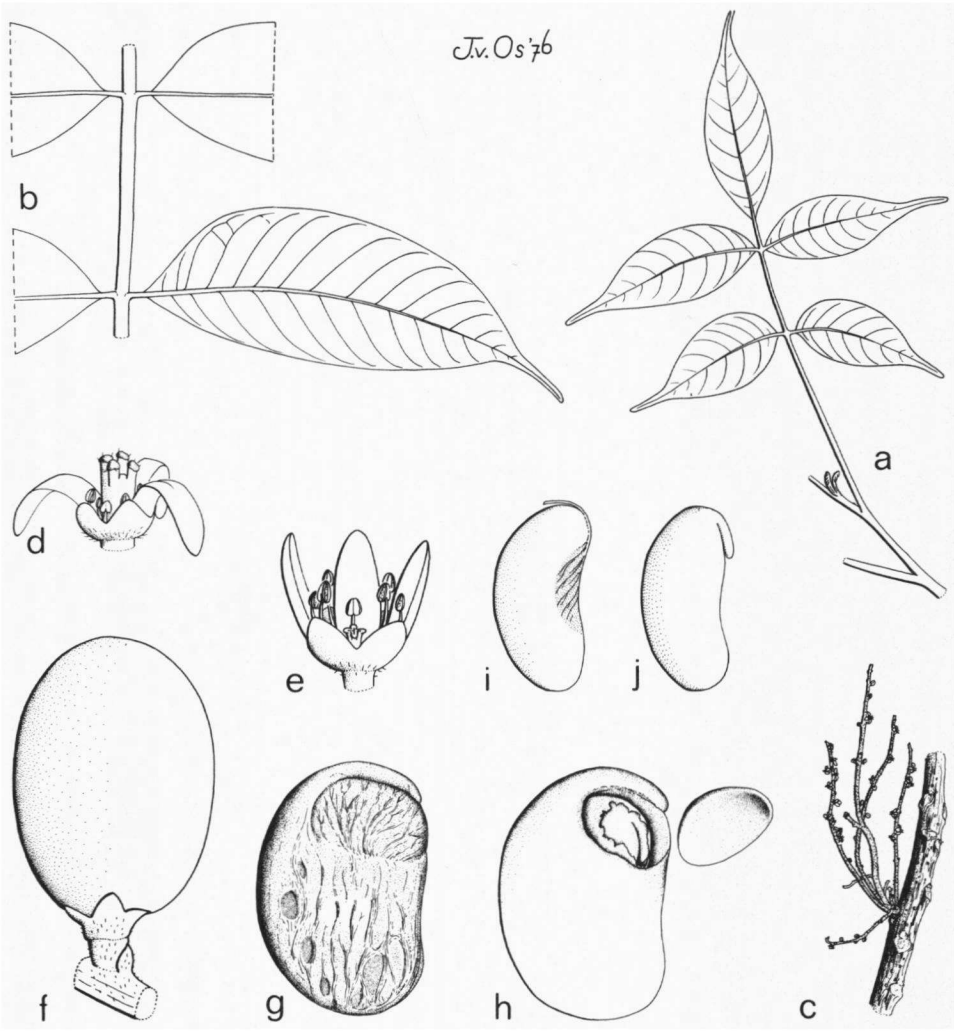

Fig. 35. *Lannea coromandelica* (HOUTT.) MERR. *a*. Young twig with one young leaf, *b*. part of leaf, *c*. flowering bare twig, all × $^1/_2$, *d*. ♀ flower, 1 petal removed, × 7, *e*. ♂ flower, 1 petal and 1 stamen removed, × 7, *f*. fruit, *g*. stone, side view, showing depressions on surface and operculum of one fertile cell, *h*. stone with operculum opened; seed with part of testa removed showing radicle, *i*. seed, side view, *j*. embryo, side view, all × $3^1/_2$ (*a*, *c*, *d* VAN SLOOTEN 2036, *b* DOCTERS VAN LEEUWEN 5138, *e* MARS LALL 17415(?), *f–j* G. PANIGRAHI 11317).

Distr. About 40 *spp.*, chiefly distributed in tropical and South Africa, 1 *sp.* in tropical Asia and *Malesia* (Sumatra, Malay Peninsula, Java, Lesser Sunda Is., Celebes).

Lannea is not indigenous in Malesia; it has been introduced from Asia.

Ecol. Along roadsides and inhabited places at low altitude, largely confined to the seasonal areas.

Nomencl. *Wirtgenia* JUNGH. *ex* HASSK. was not validly published, as HASSKARL mentioned this name only in the synonymy under *Spondias*. JUNGHUHN, who put his MSS at HASSKARL's disposal, distinguished two species, *W. octandra* which is *Lannea*, and *W. decandra* which is *Spondias pinnata*.

Note. It would be desirable to compare the Asian species with those described from Africa and check whether it is distinct from the African ones.

1. Lannea coromandelica (HOUTT.) MERR. J. Arn. Arb. 19 (1938) 353; ADELB. Reinwardtia 3 (1954) 150; BACK. & BAKH. *f.* Fl. Java 2 (1965) 152; AIRY SHAW & FORMAN, Kew Bull. 21 (1967) 19. — *Kalesiam* RHEEDE, Hort. Mal. 4 (1683) 67, t. 32. — *Dialium coromandelicum* HOUTT. Nat. Hist. II, 2 (1774) 39, t. 5, f. 2. — *Haberlia grandis* DENNST. Schlüss. Hort. Mal. (1818) 30. — *Odina wodier* ROXB. (Hort. Beng. 1814, 29, *nom. nud.*) Fl. Ind. ed. Carey 2 (1832) 293; W. & A. Prod. 1 (1834) 171; WIGHT, Ic. (1838) t. 60; THW. En. Pl. Zeyl. (1858) 78; MIQ. Fl. Ind. Bat. 1, 2 (1859) 622; BEDD. Fl. Sylv. (1871) t. 123; HOOK. *f.* Fl. Br. Ind. 2 (1876) 29; ENGL. in DC. Mon. Phan. 4 (1883) 267, t. 8, f. 27–29, *incl. var. wirtgeni*; KING, J. As. Soc. Beng. 65, ii (1896) 501; K. & V. Bijdr. 4 (1896) 140; BACK. Fl. Bat. (1907) 376; LECOMTE, Fl. Gén. I.-C. 2 (1908) 34; BACK. Schoolfl. (1911) 282; PARKINSON, For. Fl. Andaman Is. (1923) 140; CRAIB, Fl. Siam. En. 2 (1926) 352. — *Spondias wirtgenii* HASSK. Flora 25 (1842) Beibl. ii: 46; *ibid.* 27 (1844) 624; Cat. Hort. Bog. (1844) 247; MIQ. Fl. Ind. Bat. 1, 2 (1859) 622. — *Wirtgenia octandra* JUNGH. *ex* HASSK. Flora 27 (1844) 624, *nom. invalid.* — *Odina gummifera* BL. Mus. Bot. 1 (1850) 206, *nom. illeg.* — *Tapiria wodier* MARCH. Rév. Anacard. (1869) 162. — *Calesiam grande* (DENNST.) O. K. Rev. Gen. Pl. 1 (1891) 151. — *L. grandis* (DENNST.) ENGL. in E. & P. Nat. Pfl. Fam. Nachtr. 1 (1897) 213; HEYNE, Nutt. Pl. (1927) 976; BURK. Dict. (1935) 1313. — *L. wodier* ADELB. Blumea 6 (1948) 326; TARD. Fl. C. L. & V. 2 (1962) 141, t. 10, f. 7–11. — **Fig. 35–37.**

Deciduous tree, usually of small size, 6–10 m high, sometimes up to 20 m high and 45 cm ∅. Young branchlets, leaves, and inflorescences densely rusty stellate-hairy, glabrescent; twigs thick, with large leaf-scars. *Leaves* with 3–7 pairs of leaflets, 10–25 cm long. *Leaflets* opposite, elliptic-oblong, broadly elliptic, ovate, or ovate-oblong, 4–11½ by 2½–4½ cm, entire, puberulous beneath especially on midrib and nerves, glabrescent; base cuneate; apex acuminate; nerves 8–11 pairs, veins usually hardly visible, rarely faint, reticulate; petiolules very short (up to *c.* ½ cm), terminal one up to 3 cm. *Inflorescences* appearing before the leaves, crowded at the apical part of a branch, or on a short-shoot (seemingly fasciculate) in the axil of a leaf-scar, spiciform, sometimes branched and paniculiform, 7–25 cm long; floral bracts triangular, *c.* 1 mm long. *Flowers* yellowish green, tinged with red, subsessile. *Calyx* lobes triangular, *c.* 1 mm long. *Petals* elliptic or oblong, 2–2½ by 1–1¼ mm. *Stamens* 2–2½ mm, abortive ones in ♀ ⅔–1¼ mm. *Disk c.* 1 mm ∅. *Ovary c.* ⅔ mm ∅. Abortive pistil in ♂ ½–1 mm long. *Drupe* broadly ellipsoid, sometimes slightly subreniform, *c.* 1 by ⅔ cm, red when ripe. *Seed* reniform, *c.* ⅔ by ⅓ cm.

Distr. India, Ceylon, Thailand, Burma, Indo-China, China (Hainan), in *Malesia* introduced, cultivated, escaped and locally more or less naturalized.

Often cultivated in Java, in Malaya on roadsides in the Settlements (BURKILL, *l.c.*).

Ecol. In lowland forest, occasionally found up to 900(–1200) m. The leaves are shed in dry weather or in the dry season and the trees then flower on the bare twigs or as the new leaves develop, but inflorescences are very inconspicuous (CORNER, *l.c.*). *Fl.* Jan.–Dec.; *fr.* Febr., April.

BACKER (1907, 376–377) confirmed the note by VALETON that in Java fruits are almost absent, and three observed were immature. He found near Jakarta only ♂ flowers. I confirm lack of fruit

Fig. 36. *Lannea coromandelica* (HOUTT.) MERR. as a roadside tree, bare during dry season, as usual variously cut and damaged by borers; as soon as rains set in flowers appear on bare branches. Bali (Photogr. DE VOOGD).

setting in Malesia, though I have seen many ♂ flowers.

Uses. According to HEYNE (Nutt. Pl. 1927, 976) easily propagated by cuttings and used for living fences; also in the drier parts used as a roadside tree. Especially after injuries of the bark and trimmings masses of glassy-white exudate of hardening gum appear which may give leafless trees an eerie appearance. The gum is of inferior quality. Otherwise the tree has only some minor local occasional uses; the leaves can be eaten as a vegetable. In India the 'wodier wood' and also the gum is variously used (BURKILL).

Vern. Malaya: *kayu kuda, kědongdong*, M, *wodier*, Tamil.; Sumatra: *kaju-kuda*, N.Sum.; Java: *djavaran, kaju-djaran*, J, *palimphing, santěn*, M; Lesser Sunda Is.: *reo*, Timor.

Fig. 37. Maltreated stem of *Lannea coromandelica* (HOUTT.) MERR. with large clumps of exudate. Angke, near Jakarta (Photogr. VAN STEENIS, 1940).

11. SPONDIAS

LINNÉ, Gen. Pl. ed. 5 (1754) 174; Sp. Pl. (1753) 371; MARCH. Rév. Anacard. (1869) 19 & 156; ENGL. in DC. Mon. Phan. 4 (1883) 242; in E. & P. Nat. Pfl. Fam. 3, 5 (1892) 150; AIRY SHAW & FORMAN, Kew Bull. 21 (1967) 2. — *Solenocarpus* W. & A. Prod. 1 (1834) 171. — *Wirtgenia* JUNGH. *ex* HASSK. Flora 25 (1842) Beibl. ii: 46; *ibid.* 27 (1844) 624; Cat. Hort. Bog. (1844) 247, *p.p., nom. inval., non* SCHIMPER, 1842. — *Evia* COMMERS. (*ex* JUSS. Gen. Pl. 1789, 373, *pro syn.*) *ex* BL. Mus. Bot. 1 (1850) 233. — *Skoliostigma* LAUT. Bot. Jahrb. 56 (1920) 356. — **Fig. 38–40.**

Trees, wholly or partly deciduous, rarely hemi-epiphytes. *Leaves* spiral, imparipinnate, rarely bipinnate (*extra*-Mal.), or simple (*extra*-Mal.), petioled. *Leaflets* alternate, subopposite, or opposite, entire, serrate, crenate, or crenulate, in most *spp.* with a distinct and slightly thickened, intra-marginal vein. *Inflorescences* paniculate, rarely racemiform, terminal and/or axillary, appearing before the leaves or accompanied by very young ones. *Flowers* bisexual, or unisexual (*extra*-Mal.). *Calyx* 5-(or 4-)lobed. *Petals* 5 (or 4), valvate, glabrous. *Stamens* 10 (or 8); filaments subulate or filiform, glabrous, or papillose (*extra*-Mal.); anthers dorsifixed. *Disk*

Fig. 38. *Spondias philippinensis* (ELMER) AIRY SHAW & FORMAN. *a*. Habit, × 1/2, *b*. flower, × 7, *c*. fruit, × 2 1/2, *d*. CS of fruit, × 7, *e–f*. side and face views of seed, *g*. embryo, side view, *h*. *ditto*, opened, all × 3 1/2 (*a*, *c–h* S 30058, *b* S 18355).

intrastaminal, shortly cupular, or round and flat, crenulate, glabrous, or papillose (*extra*-Mal.). *Ovary* 5- (or 4-), or 1-celled, glabrous; styles 5 (or 4) and free, or 1; stigma(s) often shortly spathulate. *Drupe* 5- (or 4-), or 1-celled; endocarp woody, hard, sometimes almost bony when dry. *Seed* with testa free from the endocarp; embryo straight or slightly curved, cotyledons free, plano-convex.

Distr. Species 10, in the *Indo-Malesian* and American tropics; four of them, *i.e. S. cytherea, S. pinnata, S. purpurea*, and *S. mombin*, are often (widely or locally) cultivated in the tropics.

Ecol. Lowland forest, sometimes at higher altitude.

Uses. Cultivated for the edible fruit which is generally sour, though some varieties are sweet or have a mawkish taste; it is eaten, usually after cooking, as pickles or flavouring. All parts of the plants have a foetid smell of turpentine when broken or bruised; the smell differs in each species and is characteristic. The flowers are honey-sweet like those of mango. Hog-plum trees flower and fruit throughout the year, though chiefly after dry weather. The inflorescences develop at the ends of the bare twigs either before the new leaves or with them and the fruits dangle from the leafy twigs. Flower and fruit are generally to be seen together on the same tree (CORNER, Ways. Trees, 1940).

Notes. AIRY SHAW & FORMAN (Kew Bull. 21, 1967, 1–19, t. 1& 2, f. 1–3) in their study of the genus *Spondias* stated that in tribe *Spondiadeae* the genera *Solenocarpus, Allospondias*, and *Spondias* differ from other members by the valvate aestivation of the petals; in these three genera, *Solenocarpus* was only distinguished from the two others by having a monocarpellary ovary (against the ovary being composed of 5 or 4, occasionally more or only 3, united carpels). They concluded that "there is such a lack of correlation between the various characters that an adequate basis for the recognition of more than one genus is wanting"; therefore, they reduced *Solenocarpus* and *Allospondias* to *Spondias*.

The endocarp of most species has the most complex structure in the *Anacardiaceae*. AIRY SHAW & FORMAN already described their macromorphological structure in detail and gave illustrations for those species with material available (*l.c.* f. 1–2). According to them, the endocarp appears to consist of two zones: (1) an inner, hard, woody layer with irregular (5 or 4) flanges which are either rather smooth or bear sparse to numerous, radiating, straight or curved, spinose or fibrous processes, and (2) an outer layer which is composed of loose or dense bundles coalesced into a simple or complex network; these two layers are connected with each other by the flanges, or spinose and fibrous processes (*cf.* AIRY SHAW & FORMAN, *l.c.* f. 1–2; fig. 39 in the present revision; also note under *S. cytherea*).

KEY TO THE SPECIES

1. Leaflets with a distinct intra-marginal vein. Ovary 5-(or 4-)celled; style 5 (or 4), free. Drupe more than $1^1/_2$ by $1^1/_4$ cm in dry state, straight, 5-(or 4-)celled.
   2. Leaves and inflorescences glabrous.
      3. Flowers distinctly pedicelled (usually $1^1/_4$–4 mm). Flanges of the hard part of the endocarp often indirectly connected with the peripheral layer of meshes by numerous spinose and fibrous processes . . . . . **1. S. cytherea**
      3. Flowers sessile or subsessile. Flanges of the hard part of the endocarp partly or wholly and directly connected with the peripheral layer of meshes . . . . . **2. S. pinnata**
   2. Leaves and inflorescences puberulous.
      4. Inflorescences (accompanied by mature leaves) terminal, sometimes also in the apical leaf axils, up to 50 cm long, many-flowered. Flowers white. Drupe orange when ripe . . . . . **3. S. mombin**
      4. Inflorescences (appearing before the leaves) axillary, up to 4 cm long, few-flowered. Flowers reddish or purplish. Drupe usually purple when ripe. . . . . **4. S. purpurea**
1. Leaflets without an intra-marginal vein. Ovary 1-celled; style 1. Drupe small, *c.* 1 by $^1/_2$ cm in dry state, slightly curved, 1-celled . . . . . **5. S. philippinensis**

1. Spondias cytherea SONNERAT, Voy. Ind. Or. & Chine 3 (1782) 242, t. 123; GAERTN. Fruct. 2 (1791) 101, t. 103; OCHSE & BAKH. Fruit (1931) 19, t. 8; BURK. Dict. (1935) 2067; CORNER, Ways. Trees (1940) 115, Atlas t. 14; ADELB. Blumea 6 (1948) 326; DE WIT, Rumph. Mem. Vol. (1959) 406; AIRY SHAW & FORMAN, Kew Bull. 21 (1967) 10, f. 2: 3 & 4; VERSTEEGH, Med. Landb. Hogesch. Wageningen 71–19 (1971) 56. — *Condondum* RUMPH. Herb. Amb. 1 (1741) 161, t. 60. — *Condondum malaccense* RUMPH. *l.c.* 162, t. 61. — *S. dulcis* SOLAND. (*ex* PARKINSON, J. Voy. S. Seas, 1773, 39) *ex* FORST. *f.* Pl. Escul. (1786) 33; Prod. (1786) 34; HOOK. *f.* Fl. Br. Ind. 2 (1876) 42; ENGL. in DC. Mon. Phan. 4 (1883) 246; WARB. Bot. Jahrb. 13 (1891) 362; K. & V. Bijdr. 4 (1896) 108; KOORD. Minah. (1898) 412; K.SCH. Notizbl. Berl.-Dahl. 2 (1898) 125; K.SCH. & LAUT. Fl. Schutzgeb. (1900) 411; RIDL. J. Str. Br. R. As. Soc. *n.* 45 (1906) 186; BACK. Fl. Bat. (1907) 374; LECOMTE, Fl. Gén. I.-C. 2 (1908) 29; BACK. Schoolfl. (1911) 281; MERR. Int. Rumph. (1917) 332; LAUT. Bot. Jahrb. 56 (1920) 355; LANE-POOLE, For. Res. (1925) 108; CRAIB, Fl. Siam. En. 1 (1926) 355; WHITE & FRANCIS, Proc. R. Soc. Queensl. 38 (1927) 237; HEYNE, Nutt. Pl. (1927) 974; KRAEMER, Trees W. Pac. Reg. (1951) 206; MERR. Chron. Bot. 14 (1954) 360; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 39, f. 15; BACK. & BAKH. *f.* Fl. Java 2 (1965) 151. — *Poupartia*

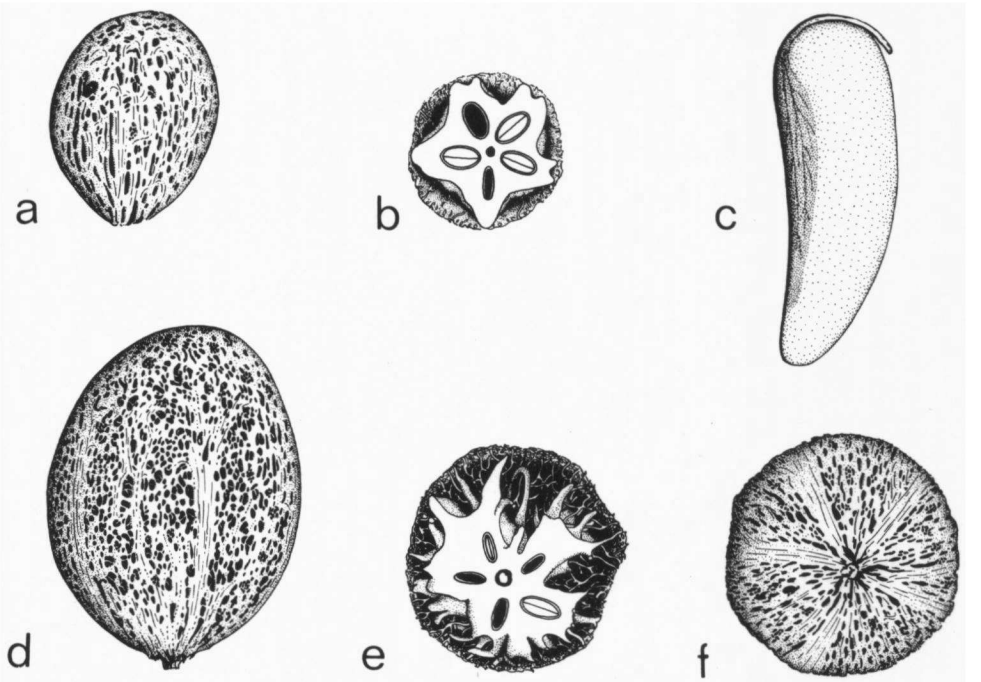

Fig. 39. *Spondias pinnata* (L. *f.*) KURZ. *a.* Endocarp, *b. ditto* in CS, both × 1.3, *c.* seed, side view, × 5. — *S. cytherea* SONNERAT. *d.* Endocarp, *e. ditto* in CS, *f. ditto*, viewed from base, all × 1.3 (*a–c* PNH 18650, *d–f* D. A. POWELL 58).

dulcis (FORST. *f.*) BL. Bijdr. (1826) 1161, *quoad nomen, nom. illeg.* — *Evia dulcis* (FORST. *f.*) COMM. *ex* BL. Mus. Bot. 1 (1850) 233. — *Evia amara var. tuberculosa* BL. *l.c.* 235; MIQ. Fl. Ind. Bat. 1, 2 (1859) 641. — *S. mangifera var. tuberculosa* (BL.) ENGL. in DC. Mon. Phan. (1883) 249. — **Fig. 39d–f.**

Tree usually up to 25 m high and 45 cm ∅, sometimes up to 45 m high and 90 cm ∅. Buttresses sometimes present, $^1/_2$–$1^1/_2$ m high, 1–$2^1/_2$ m wide, 4–10 cm thick. Bark greyish, light to reddish brown, shallowly fissured. *Leaves* with 4–10 pairs of leaflets, glabrous; rachis 11–20 cm, petiole 9–15 cm. *Leaflets* chartaceous to subcoriaceous, ovate-oblong to lanceolate, ($5^1/_2$–)$7^1/_2$ by ($1^1/_2$–)3–5 cm; base unequal, oblique, obtuse, or cuneate; apex shortly acuminate to acuminate; margin entire, serrate, or crenulate; nerves 14–24 pairs, joining with an intra-marginal vein; veins reticulate; petiolules up to $^3/_4$ cm, the terminal one 1–3 cm. *Inflorescences* appearing before leaves or accompanied by very young ones only, paniculate, terminal, up to 35 cm long, glabrous, branches up to 20 cm long; floral bracts lanceolate to linear, $^2/_3$–$1^1/_4$ mm; pedicels usually $1^1/_4$–4 mm, sometimes also some shorter ones. *Flowers* cream or white. *Calyx* lobes triangular, $^1/_2$ mm long. *Petals* ovate-oblong, $2^1/_2$–$2^3/_4$ by 1–$1^1/_4$ mm. *Stamens* 2 mm; anthers oblong, $^3/_4$–1 mm long. *Disk* shortly cupular, *c.* 1 mm ∅. *Ovary* subglobose, *c.* $^3/_4$ mm ∅, 5-(or 4-)celled; styles 5 (or 4), free, *c.* $^3/_4$ mm. *Drupe* (fresh) ellipsoid, or oblong, 4–10 by 3–8 cm, bright orange when ripe, straight, 5-(or 4-)celled; scars of styles 5 (or 4), lateral, at the apical end. Flanges of the endocarp often indirectly connected with a peripheral layer of meshes by numerous spinose and fibrous processes.

Distr. Throughout *Indo-Malesia*, also widely cultivated in the Indo-Australian and other tropics.

It is impossible to give the exact area of indigenous occurrence of the 'Otaheite Apple', as this species is so much planted, also in native clearings, that there is little means to distinguish between indigenous and naturalized occurrence. But in many islands it is found in primary forest, notably in New Guinea where such trees may be rather common and of great size (30–40 m tall).

Ecol. In New Guinea rather common in lowland primary, sometimes secondary, forest, sometimes up to 1000 m, usually occurring on well drained soil, sometimes in flood plains, rarely on limestone with a thin clay cover. *Fl.* Jan.–March, July–Nov.; *fr.* Jan.–Dec.

OVERBECK recorded (Trop. Natuur 27, 1938, 93, photogr.) severe attacks by caterpillars leading to complete leafless trees. The leaves suffer sometimes severe attacks by a specific beetle (OCHSE & BAKH. Fruit, 1931, 20).

According to OCHSE *kedongdong* flowers from June to August, and fruits are ripe from January to April.

Uses. According to HEYNE *l.c.* the timber is useless. The chief use is the fruit which is mostly used as compote. HEYNE says that it may have

perspectives to become popular if further domesticated. The tree may fruit when 4 years old (BURKILL). Young leaves are eaten steamed (OCHSE & BAKH. Veg. D.E.I. 1931, 45).

Vern. Solomon Is.: *air*, Kwar'ae. New Britain: *babe*. Sumatra: *kědongdong*, Batak, M, *kědongdong las*, Lampong Kalianda, *dudungdung-tjind*, Palembang; Malay Peninsula: *great hog-plum*, E, *kědongdong*, M; Java: *dědongdong*, *kědangdang*, M, J, S, Md, *kědongdong manis*, *klontjeng*, M, *dědongdong-sěm*, *pelentjing*, J; Lesser Sunda Is.: *ahang*, *ehé*, *léheéng*, *lédém*, Flores, *eentji*, Sumbawa, *makong*, Alor, *woa indjoong maradda*, Sumba; Celebes: *kadondo*, *kadongdong*, Manado, *golo*, Muna; Moluccas: *ustubal*, E. Ceram, *otjo*, Tidore, *tjotjo*, Ternate, *wis*, M; New Guinea: *aimeniek* = *awiminik*, Mooi, *arama*, *baramijan*, *warea*, Kaigori, *bemoi*, Manokwari, *bikato*, Waria, *dien*, Karoon, *gi*, Rawa, *gungkia*, Kaigulin, *huneg*, Madang, *hunek*, Amele, *iopeia*, Vailala, *juwut*, Kemtuk, *kanures*, Biak, *kara*, Evara, *karisi*, Wandammen Penins., *kědondong utan*, Numfoor, *maar*, *mur*, Kebar, *ona*, Mawan, *pehjet*, *wutiel*, Bembi, *sutiek*, Manikiong, *unumi*, Mekeo, *wain*, Jal, *witosu*, Nemo.

Notes. In New Guinea there is a wild form with smaller, more sour, but edible fruits ('*kedondong utan*' = *wild kedondong*).

The endocarp of good cultivars of *S. cytherea* has a rather 'small', hard, inner zone which connects to a (delicate) peripheral zone by numerous, radiating, straight or curved, spinose and fibrous processes. The outer zone can be easily torn or peeled off from the inner one. It has been illustrated without the outer or peripheral zone (*cf.* GAERTNER, *l.c.*, t. 103; ENGLER in E. & P. Nat. Pfl. Fam. 3, 5, 1892, f. 99; AIRY SHAW & FORMAN, *l.c.*, f. 2: 3 & 4); actually, it also possesses such a zone or layer. Sometimes, one may find (bare) endocarps without the peripheral layer preserved in the herbarium; such endocarpa, which might have been cleaned by eating or by washing away the parenchymatous tissue, may give a wrong impression of its structure.

Fortunately, I found some endocarps (*e.g.* POWELL 58, L), evidently cleaned by nature or by bacteria, with a beautifully preserved peripheral layer of meshes (fig. 39d–f); such a layer can also be observed from a preserved, dried fruit by carefully removing the exocarp and mesocarp. Fresh fruit can easily be cleaned by boiling in a solution of 5% NaOH to show the peripheral layer of the endocarp.

2. Spondias pinnata (L. *f.*) KURZ, Prelim. Rep. For. & Veg. Pegu (1875) App. A. xliv & B. 42; MERR. Int. Rumph. (1917) 332, *quoad nom.*; Sp. Blanc. (1918) 233; En. Philip. 2 (1923) 470; CRAIB, Fl. Siam. En. 1 (1926) 356; HEYNE, Nutt. Pl. (1927) 975; KANEH. Bot. Mag. Tokyo 45 (1931) 292; Fl. Micron. (1933) 190, t. 9, f. 2; BURK. Dict. (1935) 2067; CORNER, Ways. Trees (1940) 116; BROWN, Useful Pl. Philip. 2 (1950) 350, f. 171; KRAEMER, Trees W. Pac. Reg. (1951) 205, f. 73; DE WIT, Rumph. Mem. Vol. (1959) 407, *quoad nom.*; TARD. Fl. C. L. & V. 2 (1962) 133, t. 8, f. 1–7; AIRY Shaw & Forman, Kew Bull. 21 (1967) 8, f. 2: 1 & 2. — *Mangifera pinnata* LINNÉ *f.* Suppl. (1781) 156. — *S. mangifera* WILLD. Sp. Pl. 2 (1799) 751; WIGHT, Ill. Ind. Bot. 1 (1840) t. 76; HOOK. *f.* Fl. Br. Ind. 2 (1876) 42; ENGL. in DC. Mon. Phan. 4 (1883) 248; WARB. Bot. Jahrb. 13 (1891) 362; TRIMEN, Handb. Fl. Ceyl. 1 (1893) 327; K. & V. Bijdr. 4 (1896) 104, *incl. var. javanica* K. & V. *l.c.* 105; KOORD. Minah. (1898) 413; K.SCH. & LAUT. Fl. Schutzgeb. (1900) 411; BACK. Fl. Bat. (1907) 373; Schoolfl. (1911) 281; LAUT. Bot. Jahrb. 56 (1920) 355; PARKINSON, For. Fl. Andaman Is. (1923) 141. — *Poupartia dulcis* (*non* (FORST. *f.*) BL.) BL. Bijdr. (1826) 1161, *quoad specim., excl. syn.* — *Poupartia pinnata* BLANCO, Fl. Filip. (1837) 393; ed. 2 (1845) 274; ed. 3, 2 (1878) 146. — *Wirtgenia decandra* JUNGH. *ex* HASSK. Flora 25 (1842) Beibl. ii: 46; *ibid.* 27 (1844) 624, *nom. inval.* — *Evia acida* BL. Mus. Bot. 1 (1850) 234, f. 41; MIQ. Fl. Ind. Bat. 1, 2 (1859) 640. — *Evia amara* COMMERS. *ex* BL. Mus. Bot. 1 (1850) 234; MIQ. Fl. Ind. Bat. 1, 2 (1859) 641. — *S. dulcis var. acida* (BL.) ENGL. in DC. Mon. Phan. 4 (1883) 247. — **Fig. 39a–c, 40.**

Tree 20–25(–40) m high and 30–50(–150) cm ∅, sometimes 35–50 m high and 100–150 cm ∅. Buttresses occasionally present. Bark grey, smooth. *Leaves* (1–)5–6(–8) pairs, glabrous, rachis 5–22 cm, petiole $4^1/_2$–$15^1/_2$ cm. *Leaflets* chartaceous to subcoriaceous, elliptic-oblong, 7–15 by $2^1/_2$–5 cm; base rounded or obtuse, obliquely, abruptly cuneate to attenuate; apex abruptly acuminate; margin crenate or serrate, or entire; nerves 12–25 pairs, joining with an intra-marginal vein; veins reticulate; petiolules up to 1 cm, the terminal one up to $2^3/_4$ cm. *Inflorescences* appearing before the leaves or accompanied by very young ones only, paniculate, terminal, rarely also axillary, up to 40 cm long, glabrous, branches up to 15 cm long; floral bracts ovate to linear, 1–$3^1/_2$ mm long. *Flowers* sessile or subsessile. *Calyx* lobes triangular, *c.* $^1/_2$ mm long. *Petals* ovate-oblong or elliptic-oblong, $2^1/_2$–3 by 1–$1^1/_2$ mm. *Stamens* $1^1/_4$–$1^3/_4$ mm; anthers broadly ovoid, *c.* $^2/_3$ mm long. *Disk* shortly cupular, *c.* 1 mm ∅. *Ovary* subglobose, *c.* $^3/_4$ mm ∅, 5-(or 4-)celled; styles 5 (or 4), free, *c.* $^1/_2$ mm. *Drupe* (fresh) ellipsoid, or ellipsoid-oblong, $2^3/_4$–5 by $2^1/_2$–$3^1/_2$ cm, yellow-orange when ripe, straight, 5-(or 4-)celled; scars of styles 5 (or 4), lateral, at the apical end. Flanges of endocarp rather smooth (with some fibrous processes), partly or wholly and directly connected with a peripheral layer of meshes.

Distr. *Indo-Malesia*, especially in Java and the Philippines, but difficult to ascertain where it is precisely native because of its wide cultivation and tendency to naturalize; KOORDERS & VALETON (*l.c.* 105) recorded it as wild in Java but whether this means native is uncertain, as fruit trees are, especially in West Java, planted in clearings and humas which may be abandoned later.

Ecol. Besides in cultivated state, found in primary and mixed forests, also secondary forest, in teak-forest, savannahs, and in dry areas, sometimes on limestone, from the lowland up to 500 m, once at 900 m. *Fl.* May–Jan.; *fr.* Febr.–Nov.

CORNER recorded the fruit ripening yellow brown to orange brown or greyish brown, smelling of rotting apples.

Uses. According to HEYNE (*l.c.* 975) both timber and fruit are of inferior quality. He mentioned also some minor medicinal uses made of different parts of the plant.

Vern. Malay Peninsula: *ĕmbrah*, *ĕmrah*,

Fig. 40. *Spondias pinnata* (L. *f.*) KURZ. Fruiting, in Ceylon (Photogr. WORTHINGTON).

kědongdong, M, *grik*, Perak; Java: *kědongdong*, M, *kadongdong*, *k. leuweung*, S, *kědongdong*, *klontjing*, J, *kadungdung*, Md; Lesser Sunda Is.: *kadongdong*, *katjěmtjěm*, Bali, *intji*, Bima; Philippines: *adúas*, *alubíhon*, *libás*, Tag., *alambihód*, C.Bis., *alubihód*, Bis., *alubuid*, Kuy., *baliud*, Tagk., *kalabahid*, Mbo, *lannó*, Ibn., *lannu*, Neg. & Ibn., *libás*, P.Bis., Sulu, Mag., *lubas*, Bik.; Celebes: *liwas*, Minah., *golo*, Muna, *ontjo*, Toradja, *karungrung*, Makas., *dao katji*, *katjang*, Bugin.; Moluccas: *uriolo*, S.Ceram, *urital*, *uritolo*, Nusalaut, *goriodo*, *kris*, *ngulu*, Halmah., *ngudu*, Ternate.

3. Spondias mombin LINNÉ, Sp. Pl. (1753) 371; BURK. Dict. (1935) 2067; CORNER, Ways. Trees (1940) 115; ADELB. Blumea 6 (1948) 326; BACK. & BAKH. *f.* Fl. Java 2 (1965) 151; AIRY SHAW & FORMAN, Kew Bull. 21 (1967) 11, f. 2: 5 & 6; CROAT, Ann. Mo. Bot. Gard. 61 (1974) 487. — *S. lutea* LINNÉ, Sp. Pl. ed. 2 (1762) 613; ENGL. in DC. Mon. Phan. 4 (1883) 244; K. & V. Bijdr. 4 (1896) 111; BACK. Fl. Bat. (1907) 371; Schoolfl. (1911) 280; HEYNE, Nutt. Pl. (1927) 975.

Tree up to 25 m high and 75–80 cm ∅. Buttresses absent. Bark grey or light brown, rugged with corky, spine-like projections and knobs. *Leaves* 3–10 pairs; rachis 6–25 cm, petiole $2^1/_2$–7 cm, both puberulous. *Leaflets* chartaceous, slightly asymmetric, ovate-elliptic, elliptic, or elliptic-oblong, (3–)5–14(–20) by $(1^1/_4$–)3–6(–7) cm, puberulous on the midrib, nerves and veins below, and on the midrib above, glabrescent; base obliquely obtuse or cuneate; apex acuminate; margin entire; nerves 8–14 pairs, joining with an intra-marginal vein; veins reticulate; petiolules $^1/_3$–$^2/_3$ cm, the terminal one up to $2^1/_2$ cm. *Inflorescences* accompanied by mature leaves, paniculate, terminal, sometimes also in the apical leaf axils, up to 50 cm long, puberulous, glabrescent; branches up to 20 cm long; floral bracts ovate to lanceolate, $^1/_2$–5 mm long; pedicels 1–$2^1/_4$ mm. *Flowers* white. *Calyx* lobes triangular or deltoid, *c.* $^1/_3$ mm long. *Petals* oblanceolate or oblong, $2^1/_2$–$3^1/_2$ by $1^1/_4$–$1^1/_2$ mm. *Stamens* $2^1/_2$–3 mm; anthers ovoid, *c.* 1 mm long. *Disk* round and flat, *c.* $1^1/_4$ mm ∅. *Ovary* ovoid, *c.* 1 mm ∅, 5- (or 4-)celled; styles 5 (or 4), free,

c. 2/3 mm. *Drupe* (fresh) ellipsoid or broad-obovoid, 3–5 by *c.* 2 1/2 cm, orange when ripe, straight, 5-(or 4-)celled; scars of styles 5 (or 4), lateral, at the apical end. Flanges of the endocarp (with fibrous processes) partly or wholly and directly connected with a peripheral layer of meshes, sometimes with cavities alternating with loculi (shown in a median, transverse section).

Distr. Native of tropical America. Cultivated in the tropics; locally cultivated in *Malesia* (Sumatra, Malay Peninsula, and Java).

Ecol. Lowland forests and along the inner border of tidal forests. *Fl.* Jan.–June, Sept.–Oct.; *fr.* March, Aug.

Uses. According to HEYNE (Nutt. Pl. 1927) occasionally planted as a shade tree. The thick bark can be used for making stamps. The fruits have an acid taste and are useless.

4. Spondias purpurea LINNÉ, Sp. Pl. ed. 2 (1762) 613; F.-VILL. Nov. App. (1880) 55; ENGL. in DC. Mon. Phan. 4 (1883) 243; VIDAL, Sinopsis Atlas (1883) 22, t. 27, f. B; MERR. Publ. Gov. Lab. Philip. *n.* 6 (1904) 22; Fl. Manila (1912) 301; Sp. Blanc. (1918) 233; En. Philip. 2 (1923) 471; BROWN, Useful Pl. Philip. 2 (1950) 350, f. 172 & 173; AIRY SHAW & FORMAN, Kew Bull. 21 (1967) 12, f. 2: 7 & 8. — *S. dulcis* (*non* FORST. *f.*) BLANCO, Fl. Filip. (1837) 390; ed. 2 (1845) 273; ed. 3, 2 (1878) 143, t. 132; MERR. Publ. Gov. Lab. Philip. *n.* 27 (1905) 36. — *S. lutea* (*non* L.) ?F.-VILL. Nov. App. (1880) 55; MERR. Publ. Gov. Lab. Philip. *n.* 6 (1904) 22; Philip. J. Sc. 1 (1906) Suppl. 84; HEYNE, Nutt. Pl. (1927) 975; BURK. Dict. (1935) 2067; CORNER, Ways. Trees (1940) 115. — *S. mombin* (*non* L.) BURK. Dict. (1935) 2067; CORNER, Ways. Trees (1940) 115 ('*monbin*').

Tree up to 10(–25) m high and 30(–80) cm ∅. Buttresses absent. Bark greyish or brown, smooth. *Leaves* 4–12 pairs; rachis 6–12 cm, petiole 2 1/2–4 cm, both puberulous. *Leaflets* chartaceous, obliquely elliptic or elliptic-oblong, 2–5 1/2 by 1–2 1/2 cm; puberulous on the midrib, nerves and veins below, and on the midrib above, glabrescent; base obliquely cuneate; apex acute to acuminate; margin obscurely crenulate especially at the upper half, or entire; nerves 6–10 pairs, joining with an intramarginal vein; veins reticulate; petiolules short, 1/4–1/2 cm, the terminal one *c.* 3/4 cm. *Inflorescences* appearing before the leaves, paniculate or racemiform, axillary, up to 4 cm long, slightly puberulous; branches *c.* 1 cm long, few-flowered; floral bracts 1–1 1/2 mm long; pedicels 2–4 mm. *Flowers* reddish or purplish. *Calyx* lobes triangular, *c.* 1/2 mm long. *Petals* ovate-oblong, 3–4 by 1 1/2–2 mm. *Stamens* 3 mm; anthers ovoid, *c.* 1/2 mm long. *Disk* shortly cupular, *c.* 1 mm ∅. *Ovary* subglobose, *c.* 3/4 mm ∅, 5-(or 4-)celled; styles 5 (or 4), free, *c.* 3/4 mm. *Drupe* (fresh) oblong, obovoid, or ovoid, 2 1/2–4 by 2 cm, purple-red or dark purple, or yellow (cultivar) when ripe; scars of styles 5 (or 4), lateral, at the apical end. Flanges of the endocarp (with fibrous processes) partly or wholly and directly connected with a peripheral layer of meshes, sometimes with cavities alternating with loculi (shown in a median, transverse section).

Distr. Native of tropical America. Now pantropical in cultivation.

Ecol. Little cultivated in Malesia except in the Philippines where it was introduced by the Spaniards; now found in many provinces, especially abundant in the region immediately south of Manila. According to CORNER (*sub S. lutea l.c.*) the trunk and branches are thickly set with blunt, light brown, corky spines and knobs, the trunk of old trees becoming widely and deeply fissured with hard, narrow, uneven ridges or toothed flanges.

Uses. Cultivated for the fruit which tastes sweet, if mawkish. The fruit is pleasantly fragrant, like plums in turpentine! (CORNER). HEYNE *l.c.* noted that the solid bark is in Java used for making stamps, but the fruit is not esteemed; the latter is called *hog-plum*, E, *varkenspruim*, D.

Vern. Philippines: *saguélas*, *sarguélas*, Ilk., *saraguélas*, Ibn., *sereguélas*, C.Bis., *sineguélas*, *sirihuélas*, Tag., *siriguélas*, Bik.; all of them are corruptions of the Spanish *ciruela* = plum. Java.: *kadongdong sabrang*, *k. tjina*, *k. tjutjuk*, S.

5. Spondias philippinensis (ELMER) AIRY SHAW & FORMAN, Kew Bull. 21 (1967) 15, f. 2: 13 & 14; DING HOU, Blumea 24 (1978) 38. — *Pegia philippinensis* ELMER, Leafl. Philip. Bot. 8 (1919) 3100; STEEN. J. Bot. 72 (1934) 11. — *Skoliostigma defolians* LAUT. Bot. Jahrb. 56 (1920) 356, f. 2. — *Euroschinus ledermannii* LAUT. *l.c.* 360. — *Phlebochiton philippinense* (ELMER) MERR. En. Philip. 2 (1923) 472; Pl. Elm. Born. (1929) 168. — *Pentaspadon teleianthera* RIDL. Kew Bull. (1933) 199. — *Solenocarpus philippinensis* (ELMER) KOSTERM. New & Crit. Malays. Pl. 3 (1955) 1; JACOBS, Acta Bot. Neerl. 10 (1961) 106. — **Fig. 38.**

Hemi-epiphyte, recorded as a liana up to 30 m high and 7 cm ∅, sometimes an epiphytic shrub or a terrestrial shrub up to 2 1/2 m high and 3 cm ∅, a small tree up to 12 m high and 10 cm ∅, rarely a large tree up to 45 m high with buttresses rarely present up to 1/3 m high, 1 m wide, 10 cm thick; bark grey to blackish, smooth. *Leaves* 1–4 pairs; rachis 3 3/4–13 cm, petiole 4–12 cm, both puberulous, glabrescent. *Leaflets* chartaceous or subcoriaceous, elliptic-, ovate-oblong, or ovate, 6–13 1/2 by 3 1/2–6 cm; sparsely puberulous on midrib and nerves on both surfaces, glabrescent, or almost glabrous; base obtuse; apex acuminate; margin entire; nerves 7–9 pairs, without an intramarginal vein,; veins reticulate; petiolules up to 1/3 cm, the terminal one 1/2–1 1/2(–3) cm. *Inflorescenses* appearing before the leaves or accompanied by young leaves, paniculate, terminal and/or axillary, 8–15 cm long, puberulous, glabrescent, or almost glabrous; branches up to 10 cm long; floral bracts lanceolate, 2/3–1 1/2 mm long; pedicels 1 1/4–2 1/2 mm. *Flowers* white. *Calyx* lobes triangular, *c.* 1/3 mm long. *Petals* elliptic-lanceolate, sometimes obovate-oblong, 2 1/2–3 by 1 mm. *Stamens* 1 3/4–3 1/2 mm; anthers ellipsoid, *c.* 1 mm long. *Disk* shortly cupular, *c.* 1 mm ∅. *Ovary* subglobose, 1/2–3/4 mm ∅, 1-celled; style 1, 2/3–1 mm. *Drupes* (dried) ± oblong, slightly curved, *c.* 1 by 1/2 cm, yellowish when ripe, 1-celled; scar of the style 1, lateral, at the upper 1/3. Endocarp smooth, without flanges and a peripheral layer of meshes.

Distr. *Malesia:* Sumatra (Simalur, Sibolangit, Mt Si-anak-anak), Borneo (scattered), Philippines

(Luzon, Mindoro, Samar, Leyte, Mindanao), New Guinea (Vogelkop Peninsula, Bomberai Peninsula, Sepik Distr.).

Ecol. Primary forest, forest borders, sometimes on river-banks or on limestone, 30–400 m. *Fl.* March–May, Aug., Sept.; *fr.* April–Nov.

As mentioned, SHAW & FORMAN *l.c.* ascribe the immense variation in habit to the frequent occurrence as a hemi-epiphyte, similarly as is observed in certain species of *Fagraea*, *Ficus*, *Schefflera*, and *Wightia*.

Uses. The small fruits are edible but sour.

Vern. Borneo: Sabah: *basisihan*, *kĕkim*, *mĕmpas*, Dusun Kinabatangan; Sarawak: *rorsa rorsa*; Brunei: *kaya ala*, Iban. New Guinea: *kemba*, Tehid.

12. KOORDERSIODENDRON

ENGL. in Koord. Minah. = Med. Lands Pl. Tuin 19 (1898) 410. — *Koordersina* KUNTZE in Post & Kuntze, Lexic. Gen. Phanerog. (1903) 310, *nom. illeg.* — **Fig. 41–42.**

Trees. *Leaves* spiral, imparipinnate, petioled. *Leaflets* subopposite, entire. *Inflorescences* axillary, paniculate. *Flowers* bisexual. *Calyx* 5-lobed. *Petals* 5, imbricate, glabrous. *Stamens* 10; filaments subulate, glabrous; anthers subglobose. *Disk* intrastaminal, round and flat, 10-notched. *Ovary* subglobose, longitudinally deeply 5-furrowed (carpels incompletely connate), densely hairy, 5-celled, usually only one fertile; styles 5, short; stigmas small. *Drupe* 1(–3)-celled by abortion; endocarp cartilaginous. *Seed* with testa free from the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. Monotypic. *Malesia:* Borneo, Philippines, Celebes, Moluccas, W. New Guinea.

Ecol. In lowland forests.

Vern. Malaysian standard timber name: *ranggu*; Indo-Malesian name: *mugis*.

Note. KUNTZE (*l.c.*) changed the generic name *Koordersiodendron* into *Koordersina* because the composition of the former is very long ("*nom. del. sesquipedale*").

1. Koordersiodendron pinnatum (BLANCO) MERR. Bull. For. Bur. 1 (1903) 33; Publ. Gov. Lab. Philip. *n.* 35 (1906) 73; Philip. J. Sc. 1 (1906) Suppl. 85; Sp. Blanc. (1918) 232; En. Born. (1921) 350; En. Philip. 2 (1923) 470; HEYNE, Nutt. Pl. (1927) 974; KRAEMER, Trees W. Pac. Reg. (1951) 197, f. 69; SMYTHIES, Common Sarawak Trees (1965) 3; VERSTEEGH, Med. Landb. Hogesch. Wageningen 71–19 (1971) 41, t. 3; MEIJER, Field Guide Trees W. Malesia (1974) 107, f. 14. — *Helicteres pinnata* BLANCO, Fl. Filip. (1837) 384. — *Cyrtocarpa quinquestyla* BLANCO, Fl. Filip. ed. 2 (1845) 269; ed. 3, 2 (1878) 135. — *Odina speciosa* BL. Mus. Bot. 1 (1850) 206; MIQ. Fl. Ind. Bat. 1, 2 (1859) 623; VIDAL, Phan. Cuming. (1885) 106; Rev. Pl. Vasc. Filip. (1886) 101, *incl. var. multijuga* VIDAL. — *Odina multijuga* VIDAL, Sinopsis Atlas (1883) 22, t. 37, f. A. — *K. celebicum* ENGL. in Koord. Minah. (1898) 410; BOERL. Ic. Bog. 1, 4 (1901) 55, t. 94 & 95; PERK. Fragm. Fl. Philip. (1904) 25. — *Lannea speciosa* (BL.) ENGL. *ex* PERK. Fragm. Fl. Philip. (1904) 26; LAUT. Bot. Jahrb. 56 (1920) 356. — *K. papuanum* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 167, f. 9. — **Fig. 41–42.**

Tree up to 45 m high and 80(–150) cm ∅. Buttresses sometimes present, up to 2 m high, $1^1/_2$ m wide, 10 cm thick. Bark dark brown or black, shallowly or deeply fissured. *Leaves* (6–)10–16 pairs, 50–80 cm long (herb. specimens). *Leaflets* chartaceous, ovate-oblong to narrowly oblong, 3–20 by $1^1/_2$–$5^1/_2$ cm; pubescent when young, glabrescent; base obtuse; apex acuminate; nerves 10–24 pairs, veins reticulate; petiolules 3–5 mm, the terminal one up to 17 mm. *Panicles* up to 50 cm long, puberulous, glabrescent; floral bracts ovate or triangular, $^2/_3$–$1^1/_2$ mm long; pedicels *c.* 1 mm. *Flowers* white or yellowish green. *Calyx* lobes broadly ovate, $^2/_3$–1 mm long. *Petals* obovate-oblong or elliptic, 2–3 by 1–$1^1/_2$ mm. *Stamens* $^2/_3$–1 mm; anthers *c.* $^1/_4$ mm long, connective distinct, slightly protruding above the thecae. *Disk* $1^1/_2$–2 mm ∅. *Ovary c.* $^1/_2$ mm ∅. *Drupe* broadly ellipsoid, ± compressed, $2^1/_2$–4 by $1^1/_2$–$2^1/_2$ cm, yellowish when ripe. *Seed* ellipsoid, compressed, *c.* $2^1/_2$ by $1^1/_2$ cm.

Distr. *Malesia:* Borneo, Philippines (Luzon to Mindanao), Celebes (also Muna), Moluccas (Morotai, Talaud, Halmaheira, Sula, Ceram, Key, Aru Is.), W. New Guinea (incl. Misool).

Ecol. Lowland forest, rarely up to 460 m, once at 800 m (Malili, Central Celebes), usually on dryland, occasionally in inundated places. *Fl.* Jan.–Nov.; *fr.* Febr.–Dec.

Uses. The wood has crossed, often wavy grain and fine texture. It is fairly heavy and its specific gravity is 0.67–0.85 air dry and over 1 when green. It is moderately durable when exposed or in contact with the soil and is suitable for flooring, general house construction, furniture, and cabinet making. The exudate (gum) is used in local medicine. *Cf.* HEYNE, *l.c.*; SALVERDA, Rapport Exped. ZW. Nieuw Guinea (1937) 86; KRAEMER, *l.c.*; KALKMAN,

Fig. 41. *Koordersiodendron pinnatum* (BLANCO) MERR. *a.* Habit, × 1/2, *b.* flower, 1 petal removed, × 7, *c.* CS of gynoecium showing 5 incompletely connate carpels, × 30, *d.* fruit, upper half of pericarp removed, showing seed and resin-canals, *e.* fruit, lateral half of pericarp removed, showing seed and resin-canals, *f.* section of fruit showing two (usually only one) seeds developed, *g.* embryo, *h. ditto*, opened, all nat. size (*a*, *d–h* SAN 36433, *b–c* SAN 76303).

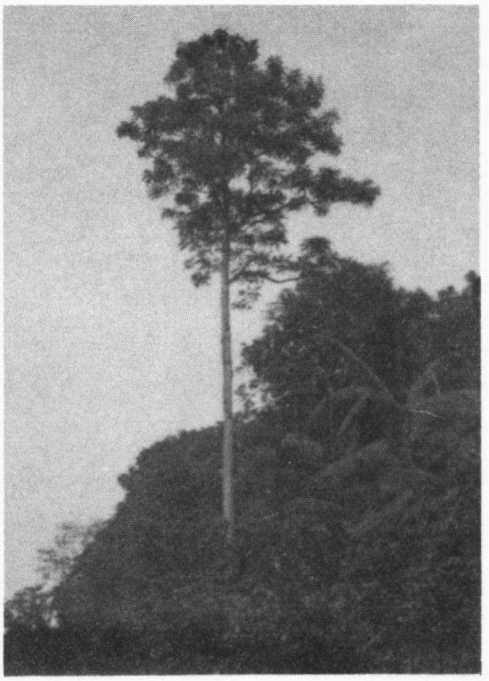

Fig. 42. Colossal tree of *Koordersiodendron pinnatum* (BLANCO) MERR. in S. Celebes (Photogr. VAN ZIJLL DE JONG).

Timber Species of Neth. New Guinea (1959) 18.

Vern. Borneo: *benjonong, kaluan, kamiding, koluon, ranggu, suren,* M; *blakai,* Bulungan; *kalamiring, maset, melimudjam, tabu hitam,* Kutai; Philippines (*cf.* MERRILL, 1923 *l.c.*; KRAEMER, *l.c.*): *amúgis,* Tag., Bik., C.Bis., *ambúgis, dangila, múgis,* Tag., *gagil, magalíbas,* Sul., *hamoges* or *hamogis, koro,* Catanduanes, *kalantas-colorado,* Cotabato, *kalumanog, lako-lako, sambalágan, sambalabúan,* Bis., *bangkási, bangkalári, kantíngen, oris, salga, sárga, taligáan, tirong, urls, urisán,* Ilk., *karogkog,* Bik., *kia-kia,* Cebu, *magmakopa,* Misamis, *bugis, maguahod,* Davao, *barok, pamalatangan,* Sorsogon, *maguyabud,* Mbo, Mand., *malabanais, marabanias, palapias,* Pang., *mariganda, samboan,* Agusan, *molato,* Abra, *orisen,* Tarlac, *sabu-uauan, sambulaúan,* Mbo, *sambuláuan,* S.L.Bis., P.Bis., *sambulúan,* P.Bis., *sinambuaóan,* C.Bis., *urisán,* Ibn.; Celebes: *gui,* Muna I., *bowang, bowis, hahito, hihito, (kaju) bugis, mawowis, nai, patago, wochis, wowis,* Minah., *ore,* Malili; Moluccas: *buwis'a,* Talaud I., *hopi,* Sula I.; *kaju buwaja,* Ceram, *krie,* Key I., *kuru,* Morotai, *kuruhu, puro,* Halmaheira; New Guinea: *dabiar,* Adi I., *murwan,* Kebar, *biepau, gerepow, grepao, grepau, marowan,* Manokwari, *itesom, jukeson, maruai babi, selbut,* Sorong.

Trade names: *ranggu,* Sabah, *amugis,* Philippines, *grepau,* W. New Guinea.

13. PEGIA

COLEBROOKE, Trans. Linn. Soc. I, 15 (1827) 364; STEEN. J. Bot. 72 (1934) 10. — *Phlebochiton* WALL. Trans. Med. Phys. Soc. Calc. 7 (1835) 230; ENGL. in DC. Mon. Phan. 4 (1883) 262. — **Fig. 43.**

Scandent shrubs or climbers. *Leaves* alternate, imparipinnate, petioled. *Leaflets* opposite or subopposite, entire, or crenate (*extra*-Mal.). *Inflorescences* paniculate, axillary and/or terminal. *Flowers* unisexual and bisexual (plants polygamous). *Calyx* (4- or) 5-lobed. *Petals* (4 or) 5, imbricate, or subvalvate (*extra*-Mal.), glabrous. *Stamens* (8–)10, 5 opposite calyx lobes and 5 opposite petals; filaments filiform, glabrous; anthers subglobose, sterile in ♀. *Disk* intrastaminal, annular, flat, slightly notched. *Ovary* immersed in the disk, (4- or) 5-celled, only one fertile; styles (4 or) 5, united; stigmas (4 or) 5, very small. Sterile pistil in ♂ small, apically (4- or) 5-lobed. *Drupe* 1-celled; endocarp crustaceous. *Seed* with testa free from the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. Species 3, distributed in India, Burma, Thailand, Laos, Vietnam, China (Kwangtung & Kwangsi), and *Malesia* (Borneo).

Ecol. In forests from lowlands up to 1500 m.

1. Pegia sarmentosa (LECOMTE) HAND.-MAZZ. Sinensia 3 (1933) 187; STEEN. J. Bot. 72 (1934) 10; TARD. Fl. C. L. & V. 2 (1962) 153, t. 9, f. 1–3. — *Phlebochiton sarmentosum* LECOMTE, Bull. Soc. Bot. Fr. 54 (1907) 528; Fl. Gén. I.-C. 2 (1908) 32. —**Fig. 43.**

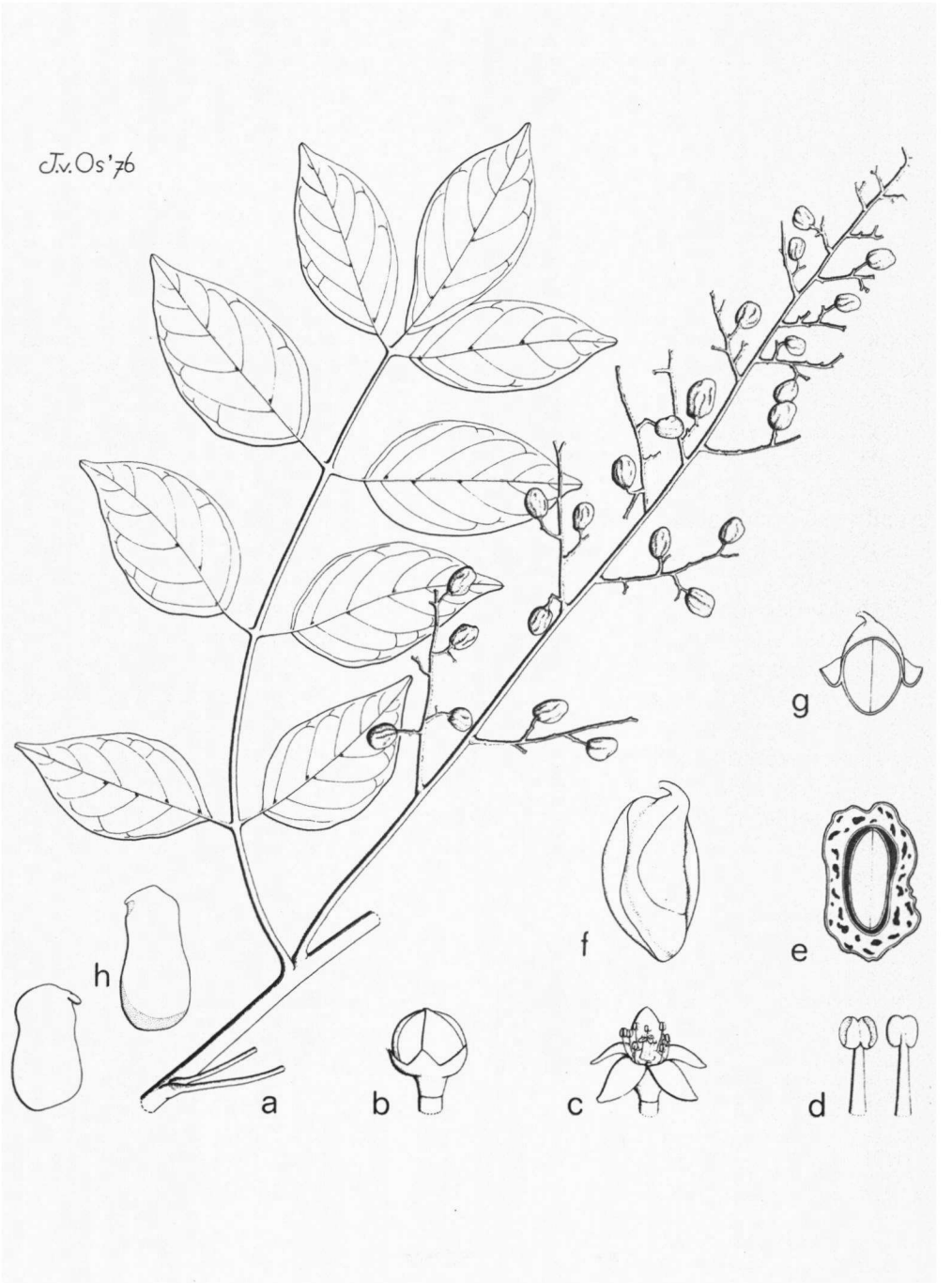

Fig. 43. *Pegia sarmentosa* (LECOMTE) HAND.-MAZZ. *a*. Habit, × 1/2, *b*. flower-bud, × 7, *c*. flower, × 7, *d*. stamens, × 14, *e*. LS of fruit, × 2 1/2, *f*. young seed, *g*. *ditto*, CS of upper half, *h*. embryo, opened, all × 3 1/2 (*a* SAN 23391, *b–d* CLEMENS 26652, *e–h* SAN 23391).

Climber. *Leaves* with a strong odour, with (1–)3–4 pairs of leaflets; petiole 4–5 cm. *Leaflets* chartaceous, ovate, elliptic, 4–12½ by 2¼–6 cm, often with hairy domatia; base obtuse, sometimes cuneate, rarely subcordate; apex acuminate; nerves 5–7 pairs, veins reticulate; petiolules ½–1 cm. *Panicles* up to 37 cm long, puberulous; floral bracts lanceolate, ⅔–¾ mm long; pedicels ⅔–1½ mm, articulate. *Flowers* cream coloured. *Calyx* lobes deltoid, ½ mm long. *Petals* ovate, 1¼–2 by ¾–1¼ mm. *Stamens* ¾–1 mm; anthers *c.* ⅓ mm long; staminodes in ♀ ⅔ mm. *Disk c.* 1 mm ∅. *Ovary* subglobose, ⅔ mm ∅. Sterile pistil in ♂ small, *c.* ½ mm long. *Drupes* broadly ellipsoid, 1¼–1½ by *c.* ⅘ cm, slightly oblique, flesh full of dark-brown sap (even in dried drupes). *Seed* subreniform, *c.* 1¼ by ⅔ cm (young seed seemingly winged).

Distr. S. China, Laos, Vietnam; *Malesia:* Borneo (Sabah: Sandakan, Elopwa, Mt Kinabalu, Tawau; Kalimantan: W. Samarinda, E. Kutai, Berau).

Ecol. In forests, from the lowland up to 1500 m.

Fl. April, Sept. –Nov.; *fr.* May–Dec.

Vern. ***Akar puteh, kobut godom,*** Sabah.

14. MELANOCHYLA

HOOK. *f.* Fl. Br. Ind. 2 (1876) 38; ENGL. in DC. Mon. Phan. 4 (1883) 469; in E. & P. Nat. Pfl. Fam. 3, 5 (1892) 176; KING, J. As. Soc. Beng. 65, ii (1896) 502; DING HOU, Blumea 24 (1978) 29. — **Fig. 44–46.**

Trees, in low-lying or swampy forest frequently with stilt-roots. *Leaves* spiral, simple, entire, beneath usually papillose, petioled. *Inflorescences* paniculate, terminal and/or axillary with bracts and bracteoles; pedicels articulated. *Flowers* usually unisexual (plants dioecious). *Hypanthium* (receptacle) cupuliform, puberulous outside, slightly accrescent in fruit and adnate to the very base of it. *Calyx* 5-(or 4-)lobed. *Petals* 5 (or 4), imbricate (at least at the upper half), sometimes slightly overlapping (and seemingly valvate), puberulous outside, villous or woolly on the inner surface. *Stamens* 5 (or 4); filaments subulate, free or the lower part laterally connate with the petals, villous; anthers oblong, dorsifixed, imperfect or abortive in ♀. *Disk* slightly intrastaminal, rim-like, 5-(or 4-)notched or -lobed, glabrous. *Ovary* superior, sometimes partly or rarely completely concealed in the cup-shaped receptacle (seemingly semi-inferior or inferior), 1-celled, usually densely hairy; style distinct, stigmas 3. Abortive pistil in ♂ very small or 0. *Drupe* 1-celled, mesocarp and endocarp full of black varnish, endocarp thick and hard. *Seed* with testa adherent to the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. *Malesia:* 17 *spp.*, in Sumatra, Malay Peninsula, Borneo, and Java.

It may occur also in Peninsular Thailand.

Ecol. Chiefly in lowland forests, sometimes occurring in swampy land, and on sandstone or limestone, rarely found in montane forest up to 1350 m.

As in *Gluta* and *Semecarpus* the sap may be very irritant to susceptible persons.

Vern. Malaysian standard timber name: *rengas.*

Notes. The petals are distinctly imbricate, but occasionally the overlapping in mature flowers is rather slight, which may have led HOOKER to describe them as valvate in the original description.

Melanochyla is the only Malesian genus of *Anacardiaceae* in which the flowers have a shorter or longer, cup-like to tubular hypanthium formed by the hollow receptacle (and calyx?); the structure of the vascular bundles invites here to study. Through this the ovary seems to be inferior, but really it is always superior.

KEY TO THE SPECIES

The characters of papillae and stomata used in the key were examined under a binocular microscope at a magnification of × 32 *or* × 64. *See fig.* 45

1. Leaves cordate or auricled, or subcordate (sometimes slightly truncate, rarely obtuse, or cuneate) at the base; petiole obscure, 0–1¼ cm.
2. Lower surface of leaves pubescent especially on nerves and veins; distinctly papillose. Drupe with dense, rusty-hairy processes (insect-gall-like) . . . . . **1. M. fulvinervis**
2. Lower surface of leaves glabrous; not papillose. Drupe without processes as above **2. M. auriculata**

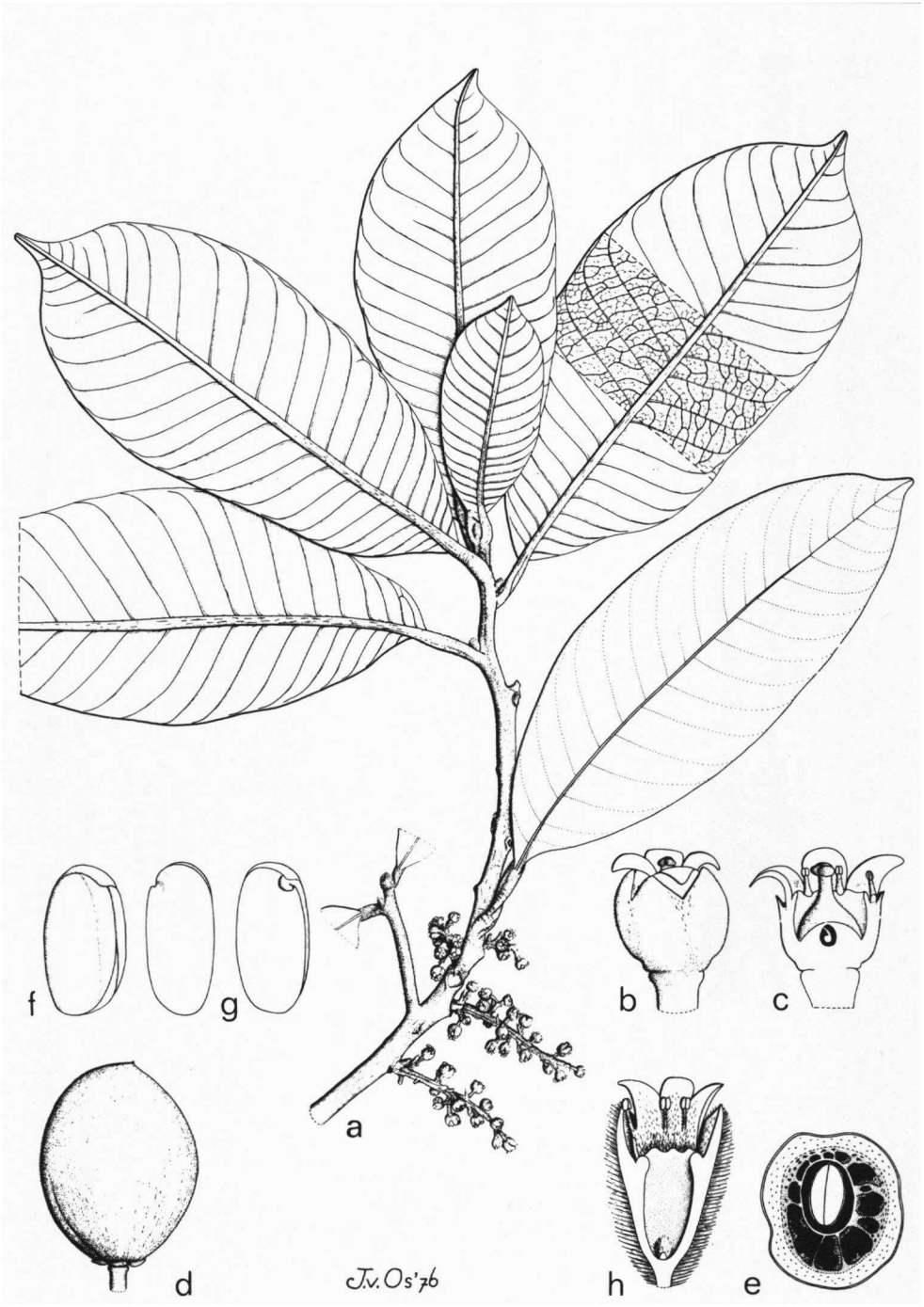

Fig. 44. *Melanochyla borneensis* (RIDL.) DING HOU. *a.* Habit, × 1/2, *b.* ♀ flower, × 3 1/2, *c. ditto* in LS, × 3 1/2, *d.* fruit, *e. ditto* in CS, both nat. size, *f.* embryo, × 1 1/2, *g. ditto*, opened, × 1 1/2. — *M. beccariana* OLIVER. *h.* ♂ Flower in LS, × 3 1/2 (*a–c* S 25369, *d–g* S 32590, *h* SAN 21255).

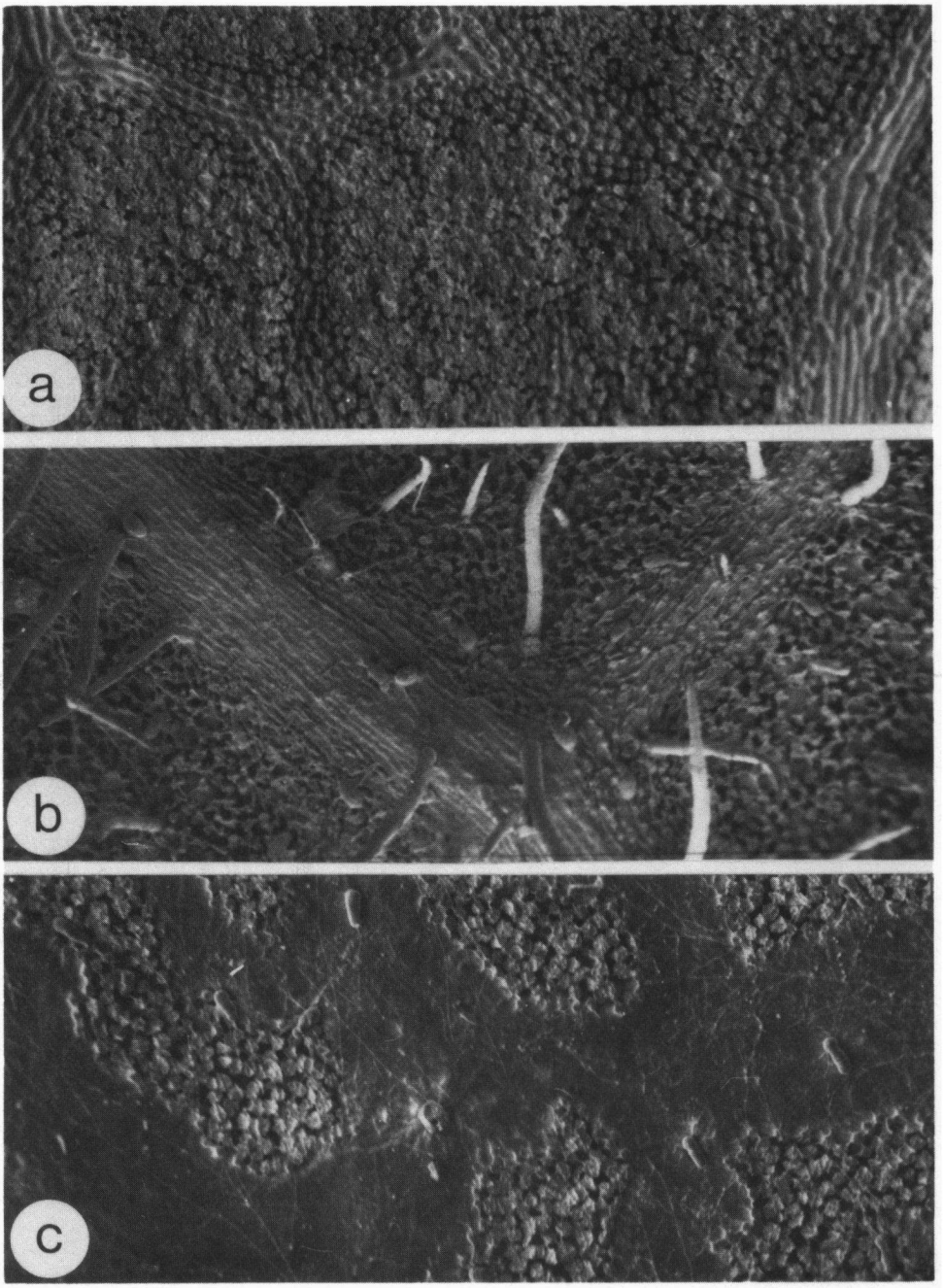

Fig. 45. Stereoscan photomicrographs showing papillae on underside of leaves of *Melanochyla* species. *a. M. caesia* (BL.) DING HOU evenly distributed, *b. M. beccariana* OLIVER only between the veins and with a few hairs, *c. M. fulvinervis* (BL.) DING HOU in groups. All × 125 (*a* SAN 36406, *b* SAN 34715, *c* SAN 22680) (Photogr. H. KAMMERAAT, Leiden Geological Institute).

1. Leaves usually cuneate to attenuate (rarely obtuse or slightly subcordate) at the base; petiole distinct, usually $1^1/_2$–8 cm ($^3/_4$–$1^1/_4$ cm in *M. minutiflora*).
3. Leaves glabrous on both surfaces.
4. Inflorescences axillary only, shorter than the petiole. Hypanthium 3–4 mm long. Papillae distinct on the lower leaf surface. Drupe broadly ellipsoid, or ovoid, 3 by 2 cm, apex apiculate . **3. M. axillaris**
4. Inflorescences terminal and axillary (rarely axillary only on ♀), much longer than the petiole. Hypanthium less than $2^1/_4$ mm long.
5. Lower surface of leaves with very distinct papillae. (Branchlets whitish. Drupe unknown) **4. M. semecarpoides**
5. Lower surface of leaves not papillose, or with very compact, obscure papillae (rarely fine and compact on young leaves in *M. castaneifolia*).
6. Inflorescences with large bracts (7–8 mm long). Petals 4–$4^1/_2$ mm long. Ovary flat and round, *c.* $2^1/_2$ mm ∅. Stomata invisible on lower leaf surface. Drupe subglobose, 2–$2^1/_2$ by $1^1/_2$–2 cm, apex rounded . . . . . **5. M. bracteata**
6. Inflorescences with small or minute bracts ($^2/_3$–4 mm long). Petals $1^1/_2$–3 mm long. Ovary subglobose or globose, *c.* 1 mm ∅. Stomata visible on the lower leaf surface.
7. Petiole puberulous at the lower $^1/_2$–$1^1/_2$ cm. Drupe ellipsoid or ovoid, 2 by 1–$1^1/_4$ cm, apex acute **6. M. angustifolia**
7. Petiole glabrous.
8. Branchlets brown or dark brown, pubescent. Leaves brown to reddish brown and shining above. Filament of the stamen brown. Drupe broadly ellipsoid, $1^1/_2$ by 1 cm, apex obtuse **7. M. nitida**
8. Branchlets light yellowish white or light greyish, glabrous. Leaves usually yellowish green and shining above. Filament of the stamen whitish at the apical part. Drupe unknown **8. M. castaneifolia**
3. Leaves densely or sparsely hairy on the lower surface, sometimes glabrescent but then always remaining sparsely hairy on the midrib and nerves.
9. Leaves bullate above; veins scalariform. Drupe thickly velvety; indumentum *c.* $3^1/_2$ mm thick **9. M. bullata**
9. Leaves not bullate, almost flat above. Veins reticulate or reticulate-scalariform. Drupe thinly velvety; indumentum less than $1^1/_4$ mm thick.
10. Leaves with densely reticulate-scalariform venation prominent on the lower surface. Lower $^1/_2$–$1^1/_2$ mm of the filaments united with the petals. Drupe broadly ellipsoid or ovoid, $1^1/_2$–$2^1/_2$ by $1^1/_4$–$2^1/_4$ cm, apex obtuse . . . . . **10. M. densiflora**
10. Leaves with loosely reticulate or reticulate-scalariform venation slightly elevated or obscure on the lower surface. Filaments free from the petals (except in *M. beccariana*).
11. Leaves not papillose on the lower surface. Flowers small, 2–$2^1/_2$ mm long. Drupe subglobose, *c.* $1^1/_4$ cm ∅ . . . . . **11. M. minutiflora**
11. Leaves distinctly papillose on the lower surface. Flowers larger, $3^1/_2$–9(–12) mm long.
12. Lower surface of leaves with papillae in prominent groups (often horse-shoe-shaped), separated by broad bands of veins and veinlets. Inflorescences axillary only. Drupe broadly ellipsoid or subglobose, $2^3/_4$–3 by 2–$2^1/_2$ cm . . . . . **12. M. borneensis**
12. Lower surface of leaves with rather uniformly distributed papillae. Inflorescences terminal, or terminal and axillary.
13. Flowers (5–)7–9(–12) mm long. Lower $^3/_4$–$1^1/_2$ mm of filaments laterally united with the petals; ovary almost completely immersed in the receptacle. (Drupe broadly ellipsoid or ovoid $2^1/_2$–3 by $1^1/_4$–$2^1/_4$ cm) . . . . . **13. M. beccariana**
13. Flowers $3^1/_2$–7 mm long. Filaments free. Ovary not immersed in the receptacle.
14. Hypanthium *c.* $^1/_2$ mm long. Anthers *c.* 1 mm long. Abortive pistil in ♂ minute, glabrous. Drupes ovoid or ellipsoid, 1–$1^3/_4$ mm ∅, indumentum $^2/_3$ mm thick . . . **14. M. elmeri**
14. Hypanthium longer, $^3/_4$–$2^1/_4$ mm long. Anthers $^1/_2$–$^3/_4$ mm long.
15. Leaves tomentose on the lower surface, especially dense on midrib and nerves. Abortive pistil in ♂ 0, replaced by a tuft of hairs. Drupe globose or subglobose, $2^3/_4$–3 cm ∅, indumentum *c.* $^1/_6$ mm thick . . . . . **15. M. tomentosa**
15. Leaves sparsely hairy on the lower surface, usually glabrescent except on midrib and nerves.
16. Hypanthium $1^3/_4$–$2^1/_4$ mm long. Abortive pistil in ♂ conical, $^1/_2$ mm long, hairy. Drupe broadly ellipsoid, $1^1/_2$–$2^1/_2$ cm ∅, indumentum *c.* $^1/_6$ mm thick . . . . **16. M. caesia**
16. Hypanthium $^3/_4$–1 mm long. Abortive pistil in ♂ minute or 0, glabrous. Drupe broadly ovoid, 2–$2^3/_4$ cm ∅, indumentum *c.* $^1/_3$ mm thick. . . . . **17. M. kunstleri**

1. Melanochyla fulvinervis (BL.) DING HOU, Blumea 24 (1978) 32, f. 1e-f. — *Semecarpus fulvinervis* BL. Mus. Bot. 1 (1850) 189; MIQ. Fl. Ind. Bat. 1, 2 (1859) 627; *cf.* STEEN. Blumea 11 (1961) 132. — *M. rugosa* KING, J. As. Soc. Beng. 65, ii (1896) 505; RIDL. Fl. Mal. Pen. 1 (1922) 540; KOCHUM. Mal. For. Rec. 17 (1964) 296. — **Fig. 45c.**

Tree up to 25 m high and 40 cm ∅, occasionally with equal plank buttresses up to $^2/_3$ m high. Bark brown or dark brown, rather smooth. Branchlets light brown and tomentose. *Leaves* subcoriaceous, obovate to oblanceolate, elliptic to narrowly elliptic, $10^1/_2$–38 by $3^1/_2$–14 cm; shining and glabrous above, pubescent especially on nerves and veins below, sometimes midrib villose below or on both surfaces; papillae distinct, separated by veins

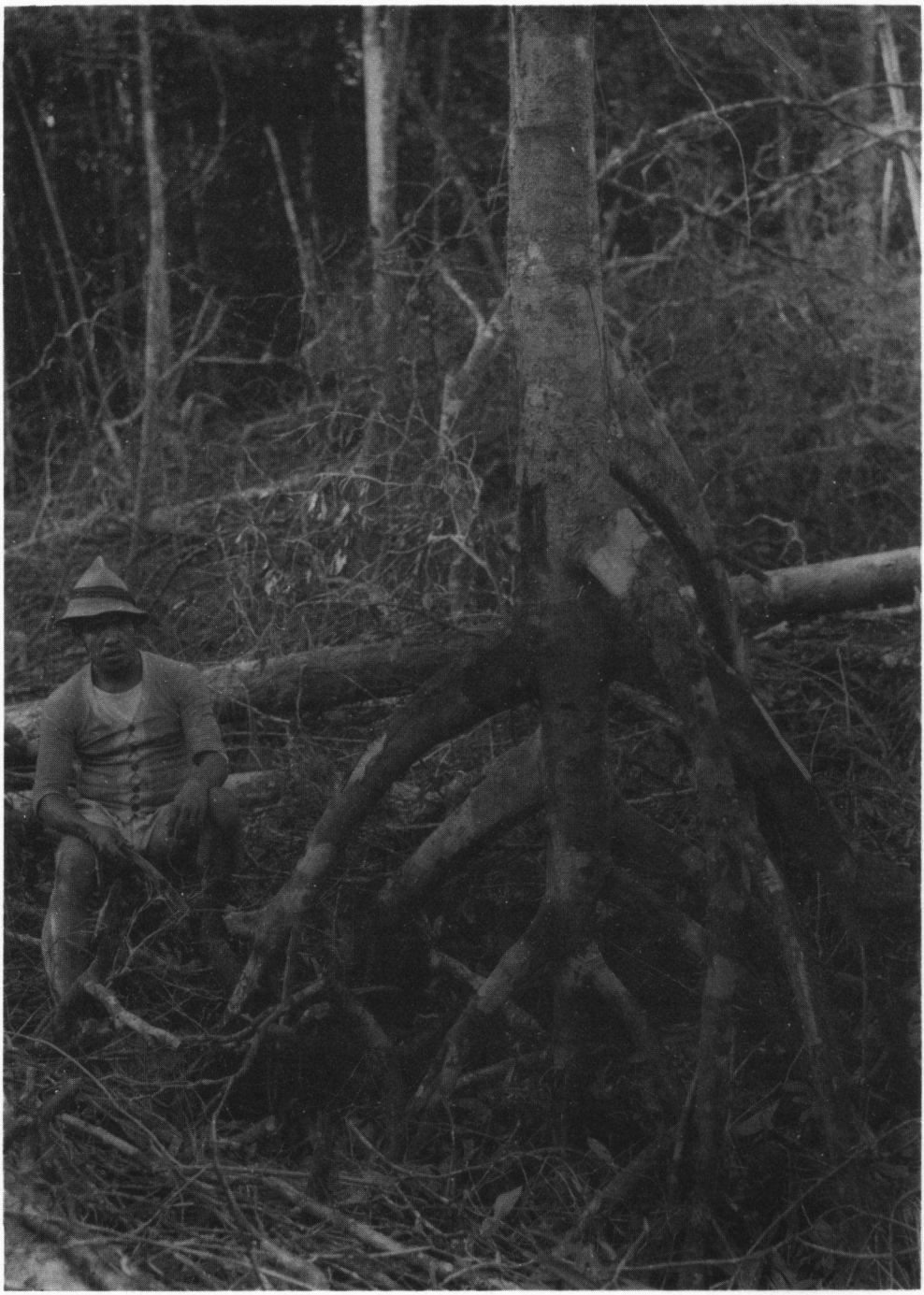

Fig. 46. *Melanochyla bracteata* KING, stilt-rooted, the trunk base tapering downwards. Sedili R., Johore (Photogr. CORNER, Febr. 1935).

and veinlets into groups on the lower surface; base subcordate, sometimes slightly truncate, rarely obtuse or cuneate; apex shortly caudate, acuminate, cuspidate, acumen up to 3 cm long; nerves 18–32 pairs, veins reticulate-scalariform, distinct below, faint or obscure above; petiole $^2/_3$–$1^1/_4$ cm, tomentose. *Panicles* terminal, up to 18 cm long, rusty pubescent; bracts triangular to linear, $^3/_4$–7 mm long; bracts triangular, $1^1/_4$–2 mm long. *Flowers* white, subsessile, 4–$4^1/_2$ mm long. *Hypanthium* $^2/_3$–1 mm long. *Calyx* lobes triangular, $^2/_3$–1 mm long. *Petals* ovate to lanceolate, $2^1/_2$–$3^1/_2$ by $1^1/_2$–2 mm, flat. *Stamens* $1^1/_2$–2 mm; filaments free; anthers $^2/_3$–$^3/_4$ mm long. Imperfect or abortive stamens in ♀ 2 mm. *Disk* obscurely 5-notched. *Ovary* conical, $1^1/_2$–2 mm ∅; style 1 mm; stigmas discoid. Abortive pistil in ♂ minute, hairy. *Drupe* ellipsoid or subglobose, 3–4 by $2^1/_2$–3 cm, with dense, rusty-hairy, insect-gall-like processes up to *c.* 7 mm long.

Distr. *Malesia:* Malay Peninsula (Perak, Trengganu, Kelantan, Pahang, Selangor, Johore) and Borneo (Sarawak: Limbang and Semengoh Arboretum; Sabah: Tawau; Kalimantan: Mt Prarawin, Sanggau, Balikpapan, Kutai, Nunukan I.).

Ecol. Lowland forest, sometimes in montane forest up to 1200 m (W. Kutai). *Fl.* Oct.; *fr.* May–June, Sept.–Nov.

Vern. *Rĕngas*, M.

Note. The fruit is very characteristic for the present species by the rusty-hairy, dense processes all over its surface. They seem, at first glance, to be insect-galls. However, the feature is a normal morphological character for this species as can be observed on either a longitudinal or transverse section of the ovary.

2. Melanochyla auriculata HOOK. *f.* Fl. Br. Ind. 2 (1876) 39; ENGL. in DC. Mon. Phan. 4 (1883) 470; KING, J. As. Soc. Beng. 65, ii (1896) 505; RIDL. Fl. Mal. Pen. 1 (1922) 540; BURK. Dict. (1935) 1434; CORNER, Ways. Trees (1940) 119; KOCHUM. Mal. For. Rec. 17 (1964) 296.

Tree up to 30 m high and 68 cm ∅. Buttresses 2 m high, 1 m wide, 10 cm thick. Bark grey to dark brown, smooth or irregularly cracked. Branchlets brown or reddish brown, pubescent, glabrescent. *Leaves* coriaceous, obovate to narrowly obovate, or narrowly elliptic, (6–)22–62(–87) by (3–)6–15 (–$16^1/_2$) cm; glabrous and shining on both surfaces; not papillose on the lower surface; base cordate or auricled, rarely obtuse, cuneate, or truncate; apex acuminate, cuspidate, rarely obtuse; nerves (8–)25–35 pairs; veins reticulate-scalariform, distinct beneath, faint above; petiole 0–1 cm, if present, puberulous. *Panicles* terminal, 15–63 cm long, pubescent, glabrescent; bracts triangular, $^1/_3$–$^2/_3$ mm long. *Flowers* white, sessile or subsessile, $3^1/_2$–4 mm long. *Hypanthium c.* $^2/_3$ mm long. *Calyx* lobes ovate-oblong, 1–$1^3/_4$ mm long. *Petals* elliptic or elliptic-lanceolate, $2^1/_2$–3 by 1–$1^1/_2$ mm, slightly longitudinally ridged inside. *Stamens c.* 2 mm; filaments free, brown; anthers $^2/_3$ mm long. *Disk* 5-(or 4-)lobed. Abortive pistil in ♂ 0, replaced by a tuft of hairs. *Ovary* subglobose, $2^1/_4$ mm ∅; style *c.* 1 mm; stigmas capitellate. Imperfect or abortive stamens in ♀ $1^3/_4$ mm. *Drupe* depressed-globose or slightly oblong, 2–$3^1/_2$ by 2–$2^1/_2$ cm, rusty-hairy; apex obtuse or rounded.

Distr. *Malesia:* Malay Peninsula (Kelantan, Pahang, Malacca, Johore, Singapore) and Borneo (Sabah: Mt Kinabalu, Beaufort, Sandakan, Mostyn, Tawau; Kalimantan: Bulungan, Sangkulirang).

Ecol. In forest on swampy or dry lowland, rarely up to 1500 m. *Fl.* March–May, Sept., Dec.; *fr.* June, Nov., Dec.

Vern. *Kĕrbau jalang*, *rĕngas lanjoh*, *r. lisang*, M.

Note. The lower leaf surface is smooth, without papillae. Under the binocular at a magnification of × 32 or × 64 one can observe the stomata or pore-like depressions each with one stoma situated at its bottom.

3. Melanochyla axillaris RIDL. Kew Bull. (1933) 198; DING HOU, Blumea 24 (1978) 29.

Tree up to 24 m high and 20 cm ∅. Buttresses sometimes present, up to $^1/_2$ m high, $^1/_2$ m wide, thin. Branchlets light brown, velvety, glabrescent. *Leaves* coriaceous, oblanceolate, 18–67 by 4–$16^1/_2$ cm, glabrous on both surfaces; papillae distinct on the lower surface; base attenuate; apex obtuse, sometimes acute; nerves 21–37 pairs; veins reticulate-scalariform, distinct below, faint above; petiole 3–8 cm, the lower $1^1/_2$–3(–5) cm thickened and rusty-velvety. *Panicles* axillary only, 1–3 cm long; bracts lanceolate, $1^1/_2$–2 mm long; pedicels 0–2 mm. *Flowers* 7–9 mm long. *Hypanthium* 3–4 mm long. *Calyx* lobes triangular or ovate, 2 mm long. *Petals* oblong or obovate-oblong, 4–5 by $1^1/_4$–$1^3/_4$ mm, flat. *Stamens* $3^1/_2$ mm; filaments brown, the lower $1^1/_2$–2 mm united with the petals; anthers $^2/_3$–$^3/_4$ mm long. *Disk* 5-lobed. Imperfect or abortive stamens in ♀ 2 mm. *Ovary* subglobose, $1^1/_2$–2 mm ∅, gradually narrowed into a very short style; stigmas capitellate. Abortive pistil 0 in ♂, replaced by a tuft of hairs. *Drupe* broadly ellipsoid, or ovoid, 3 by 2 cm, rusty-pubescent; apex apiculate.

Distr. *Malesia:* Borneo (Sarawak: Kuching and Lundu), 5 collections.

Ecol. Primary lowland or mixed dipterocarp forest, up to 450 m. *Fl.* April, Nov.; *fr.* Jan., April.

4. Melanochyla semecarpoides DING HOU, Blumea 24 (1978) 33.

Small tree 6 m high and *c.* 8 cm ∅. Branchlets whitish, glabrous. *Leaves* chartaceous, elliptic-oblong or -lanceolate, $16^1/_2$–25 by 6–10 cm, glabrous; papillae distinct on the lower surface; base cuneate; apex acuminate; nerves 11–16 pairs, veins reticulate, distinct below, obscure above; petiole $1^3/_4$–$2^1/_2$ cm, glabrous. *Panicles* terminal, 18–21 cm long, slightly puberulous; bracts triangular, $^1/_3$–2 mm long. *Flowers* (♂) pale green, subsessile, $4^3/_4$ mm long. *Hypanthium* 2 mm long. *Calyx* lobes triangular, 2 mm long. *Petals* triangular, $2^1/_3$ by 2 mm, longitudinally ridged inside. *Stamens* $1^1/_3$ mm; filaments light brown, free; anthers $^1/_2$–$^2/_3$ mm. *Disk* 5-notched. Abortive pistil in ♂ obscure, shortly hairy. ♀ Flowers and fruit unknown.

Distr. *Malesia:* Borneo (Sarawak: Ulu Mayeng, Kakus), once collected.

Ecol. In mixed dipterocarp forest on basalt hillside, up to *c.* 200 m. *Fl.* July.

5. Melanochyla bracteata KING, J. As. Soc. Beng. 65, ii (1896) 506; RIDL. Fl. Mal. Pen. 1 (1922) 540; KOCHUM. Mal. For. Rec. 17 (1964) 296. — **Fig. 46.**

Tree up to 30 m high and 65 cm ∅, occasionally with stilt-roots. Buttresses up to 2 m high. Branchlets light brown, scurfy. *Leaves* coriaceous, elliptic or oblanceolate, 6–15(–20) by $2^1/_2$–$4^1/_2$(–$10^1/_2$) cm, glabrous, shining above, dull beneath; papillae very compact, obscure on the lower surface; base cuneate, rarely slightly obtuse; apex acuminate, acute, rarely obtuse; nerves 6–14 pairs, veins reticulate, some transverse and slightly parallel; petiole ($^1/_2$–)$1^1/_2$–2(–$4^1/_2$) cm, the lower $^1/_2$–$^2/_3$ (often slightly thickened and) puberulous; bracts triangular, 7–8 mm long, floral bracts ovate, 3–5 mm long; pedicels $^1/_3$–2 mm. *Flowers* 7–9 mm long. *Hypanthium* 2 mm long. *Calyx* lobes triangular, $2^1/_2$–3 mm long. *Petals* lanceolate, 4–6 by $1^1/_4$–$1^3/_4$ mm, flat. *Stamens* 3–4 mm; filaments free, reddish brown; anthers *c.* $^2/_3$ mm long. Imperfect or abortive stamens in ♀ $2^1/_2$ mm. *Disk* obscurely 5-notched. *Ovary* flat and round, $2^1/_2$ mm ∅; style 3 mm; stigmas capitellate. Abortive pistil 0 in ♂, replaced by a tuft of hairs. *Drupe* subglobose, 2–$2^1/_2$ by $1^1/_2$–2 cm, pubescent, glabrescent; apex rounded.

Distr. *Malesia:* Sumatra (Atjeh, Tapanuli, Indragiri), Malay Peninsula (Perak, Pahang, Selangor, Johore, Singapore), and Borneo (Sarawak; Kalimantan: Landak R.).

Ecol. Lowland dryland or swampy forest. *Fl.* Dec.–March; *fr.* Febr., Sept., Dec.

Vern. *Rĕngas alus*, M, *silungham bosi*, Batak.

6. Melanochyla angustifolia HOOK. *f.* Fl. Br. Ind. 2 (1876) 39; ENGL. in DC. Mon. Phan. 4 (1883) 469; KING, J. As. Soc. Beng. 65, ii (1896) 506; RIDL. Fl. Mal. Pen. 1 (1922) 541.

Tree up to 30 m high and 1 m ∅. Buttresses up to 2 m high. Bark greenish grey or reddish brown, smooth or slightly surface cracked. Branchlets light brown, pubescent. *Leaves* subcoriaceous, oblanceolate, or elliptic to narrowly elliptic, $17^1/_2$–29 by $4^1/_2$–$11^1/_2$ cm, glabrous and shining on both surfaces, not papillose on the lower surface; base cuneate to attenuate; apex shortly acuminate to acuminate; nerves 12–22 pairs, veins reticulate-scalariform, distinct below, faint above; petiole $2^1/_2$–$6^3/_4$ cm, thickened and puberulous at the lower $^1/_2$–$1^1/_2$ cm. *Panicles* terminal, up to 32 cm long, puberulous; bracts lanceolate to linear, 1–4 mm, floral bracts triangular, $^1/_3$–$^3/_4$ mm long. *Flowers* white or yellow, subsessile, 2–$2^1/_2$ mm long. *Hypanthium* $^1/_2$–1 mm long. *Calyx* lobes triangular, $^1/_2$–$^2/_3$ mm long. *Petals* oblong, elliptic, lanceolate, or oblanceolate, $1^1/_2$–$2^1/_2$ by $^3/_4$–$1^1/_4$ mm, flat. *Stamens* $1^1/_4$–2 mm; filaments brown, free; anthers $^1/_3$ mm long. Imperfect or abortive stamens in ♀ *c.* 1 mm. *Disk* 5-(or 4-)notched. *Ovary* globose, *c.* 1 mm ∅; style 1–$1^1/_4$ mm; stigmas capitellate. Abortive pistil 0 in ♂, replaced by a tuft of hairs. *Drupe* (rather young) ellipsoid or ovoid, 2 by 1–$1^1/_4$ cm, shortly hairy, or scurfy; apex acute.

Distr. *Malesia:* Malay Peninsula (Perak, Kelantan, Trengganu, Selangor, Negri Sembilan, Malacca, Johore, Penang) and Borneo (Sarawak: Limbang, Kapit; Sabah: Beluran).

Ecol. Lowland forest, sometimes in seasonal swamp forest or in secondary forest, up to 300 m. *Fl.* May, July, Sept.–Nov.; *fr.* April–July, Dec.

Vern. *Poko kain pari pari*, *rĕngas*, M.

7. Melanochyla nitida KING, J. As. Soc. Beng, 65, ii (1896) 507; RIDL. Fl. Mal. Pen. 1 (1922) 541; KOCHUM. Mal. For. Rec. 17 (1964) 296.

Tree up to 12 m high. Branchlets brown or dark brown, pubescent. *Leaves* subcoriaceous, elliptic-oblong to narrowly elliptic, rarely oblanceolate, 6–$27^1/_2$ by 2–8 cm, shining above, rather dull beneath, glabrous; not papillose on the lower surface; base cuneate to attenuate; apex shortly acuminate, sometimes cuspidate; nerves 8–23 pairs, veins reticulate, some transverse and slightly parallel, distinct below, faint above; petiole (the lower $^1/_3$–$^1/_2$ slightly thickened) 1–3 cm, glabrous. *Panicles* terminal or axillary, up to 23 cm long, pubescent; bracts deltoid, $^2/_3$–$1^1/_2$ mm long. *Flowers* subsessile, 4 mm long. *Hypanthium* 1 mm long. *Calyx* lobes deltoid, 1 mm long. *Petals* elliptic-lanceolate, $2^1/_4$–3 by 1 mm, flat. *Stamens* 2–$2^1/_2$ mm; filaments brown, basal $^1/_2$ mm laterally united with the petals; anthers $^1/_2$ mm long. Imperfect or abortive stamens *c.* $1^1/_2$ mm. *Disk* 5-lobed. *Ovary* subglobose, *c.* 1 mm ∅; style *c.* 1 mm; stigmas capitellate. Abortive pistil in ♂ conical, *c.* $^1/_2$ mm long, hairy. *Drupe* broadly ellipsoid, $1^1/_2$ by 1 cm, pubescent or scurfy; apex obtuse.

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

Ecol. Forest up to 360 m. *Fl.* Oct.

8. Melanochyla castaneifolia DING HOU, Blumea 24 (1978) 32.

Tree 9–24 m high and $12^1/_2$–26 cm ∅. Bark smooth. Branchlets light yellowish white or light greyish, glabrous. *Leaves* chartaceous to subcoriaceous, elliptic-oblong or -lanceolate, or ovate-oblong, 6–14 by 2–5 cm, glabrous; papillae on the lower surface very compact, obscure (rarely fine and compact on young leaves); base attenuate or cuneate; apex shortly acuminate to acuminate, sometimes acute; nerves 6–15 pairs, veins reticulate, distinct beneath, rather faint above; petiole in the lower half slightly thickened, 1–$2^1/_2$ cm, glabrous. *Panicles* terminal or axillary, 6–15 cm long, puberulous; bracts triangular, $^1/_2$–1 mm long; pedicels $^1/_2$–$1^1/_2$ mm. *Flowers* yellow, 4 mm long. *Hypanthium* $^1/_3$–$^3/_4$ mm long. *Calyx* lobes triangular, 1–$1^1/_4$ mm long. *Petals* elliptic, oblong, ovate, or obovate-oblong. $1^2/_3$–3 by $^2/_3$–$1^3/_4$ mm, slightly longitudinally thickened at the central part inside. *Stamens* $2^1/_4$ mm; filaments free, brown except whitish at the apical part; anthers $^2/_3$ mm long. Imperfect or abortive stamens in ♀ *c.* 1 mm. *Disk* 5-lobed. *Ovary* globose, *c.* 1 mm ∅; style *c.* $^2/_3$ mm; stigmas capitellate. Abortive pistil in ♂ very small, *c.* $^1/_3$ mm long, glabrous. *Drupe* unknown.

Distr. *Malesia:* Borneo (Sarawak: Mt Mentagai, Bintulu; Sabah: Sandakan, Lamag).

Ecol. On ridges in lowland primary forest, up to 100 m. *Fl.* April–July.

9. Melanochyla bullata DING HOU, Blumea 24 (1978) 31, f. 1a–d.

Tree 10–30 m high and 19–83 cm ∅. Buttresses sometimes present, $2^1/_2$ m high, $1^1/_2$ m wide, thin. Bark grey-brown or brown, smooth, or scaly, rarely fissured. Branchlets light brown, tomentose, usually

glabrescent. *Leaves* coriaceous, oblanceolate or obovate-oblong, 13½–42 by 5–9 cm, glabrous and shining above, tomentose beneath; papillae distinct on the lower surface; base cuneate or attenuate; apex cuspidate or acuminate; nerves (15–)33–38 pairs, veins scalariform, elevated beneath, impressed above (leaves bullate); petiole (thickened) 1½–3 cm, tomentose, sometimes glabrescent. *Panicles* terminal, 15–17 cm long; bracts ovate to narrowly lanceolate or linear, (accrescent ?), up to 20 mm long; floral bracts ovate, *c.* 1½ mm long. *Flowers* (young) yellowish, sessile, 5⅔ mm long. *Hypanthium* ½–1 mm long. *Calyx* lobes triangular, 1½–2 mm long. *Petals* ovate or ovate-oblong, 1½–2 by ⅔ mm, thickened at the lower ⅔ mm inside. *Stamens* 1⅓ mm; filaments brown, free; anthers ⅔ mm long. *Disk* obscurely 5-notched. Abortive pistil in ♂ minute, glabrous. ♀ Flowers not seen. *Drupe* ovoid, 3½–4½ by 2–2⅓ cm, thickly velvety (*c.* 3½ mm thick); apex acute or shortly acuminate.

Distr. *Malesia:* Borneo (Sarawak: Lundu; Sabah: Tawau; Kalimantan: Berouw, Sibatic I.).

Ecol. Forest, from the lowland up to 500 m. *Fl.* April; *fr.* Oct., Dec.

Vern. *Rĕngas*, Tawau & Berouw.

10. Melanochyla densiflora KING, J. As. Soc. Beng. 65, ii (1896) 503; RIDL. Fl. Mal. Pen. 1 (1922) 539; DING HOU, Blumea 24 (1978) 32.

Tree up to 30 m high and 90 cm ∅. Bark grey-brown, smooth. Branchlets tomentose, glabrescent. *Leaves* coriaceous, elliptic-oblong, sometimes obovate-oblong to oblanceolate, 10½–21½(–47) by 4–9½(–12½) cm (on saplings up to 42 by 7½ cm), glabrous above, tomentose beneath; papillae on the lower surface often compact and obscure, sometimes distinct (powder-like); base obtuse or cuneate; apex acute or obtuse; nerves 14–25 pairs, veins (densely) reticulate-scalariform, prominent below, faint above; petiole (the lower ⅓–½ slightly thickened) 1½–3½ cm (on saplings up to 7½ cm), pubescent. *Panicles* terminal or axillary, up to 25 cm long, tomentose; bracts triangular, 2 mm long, floral bracts deltoid, *c.* ⅔ mm long. *Flowers* (♂) yellowish white, subsessile, 3½–5½ mm long. *Hypanthium* 1–1½ mm long. *Calyx* lobes triangular, 1–1½ mm long. *Petals* elliptic-oblong or oblanceolate, 2½–4 by 1–1½ mm, flat. *Stamens* 2–2½ mm; filaments brown, the lower ½–1½ mm laterally united with the petals; anthers ⅔–¾ mm. *Disk* obscurely 5-notched. Abortive pistil 0, replaced by a tuft of hairs. ♀ Flowers not seen. *Drupe* broadly ellipsoid or ovoid, 1½–3½ by 1¼–2½ cm, dark brown velvety (indumentum ½–1 mm thick); apex obtuse.

Distr. *Malesia:* Malay Peninsula (Perak, Johore) and Borneo (Sarawak: Bario, Sinrok R.; Sabah: Mt Kinabalu, Sandakan, Semporma; Kalimantan: Berouw); Sumatra (Atjeh).

Ecol. Primary forest, from the lowland up to 1350 m. *Fl.* Febr., July, Oct.–Nov.; *fr.* March, Dec.

Vern. Sarawak: *kayu lau*, Kelabit; Sabah: *rĕngas*, M.

11. Melanochyla minutiflora DING HOU, Blumea 24 (1978) 33.

Tree 9–13½ m high and 15–30 cm ∅. Bark grey or brown, scaly. Branchlets puberulous. *Leaves* chartaceous, elliptic-oblong, 10½–16⅓ by 3¼–5 cm, glabrous above, slightly puberulous on midrib and nerves beneath; not papillose beneath; base cuneate or attenuate; apex acuminate or caudate; nerves 11–15 pairs, veins reticulate-scalariform, distinct below, obscure above; petiole slightly thickened at the lower ½–⅔, ¾–1¼ cm, puberulous. *Panicles* terminal or axillary, 5–6 cm long, puberulous; bracts triangular, ½–1½ mm long. *Flowers* (♂) yellow, sessile, 2–2½ mm long. *Hypanthium* ½–¾ mm long. *Calyx* lobes triangular, *c.* ⅔ mm long. *Petals* elliptic-oblong, or oblanceolate, 1–1½ by ½–⅔ mm, slightly longitudinally thickened at the central part inside. *Stamens* 1⅓ mm; filaments free, reddish brown, sometimes whitish at the apical part; anthers ⅓–½ mm long. *Disk* 5-notched. Abortive pistil 0 in ♂, replaced by a tuft of hairs. ♀ Flowers not seen. *Drupe* subglobose, *c.* 1¼ cm ∅, thinly velvety; apex obtuse or rounded.

Distr. *Malesia:* Borneo (Sabah: Sandakan, Lamag, Tawau).

Ecol. Lowland primary forest, up to *c.* 100 m. *Fl.* June; *fr.* May.

Vern. *Rĕngas*, M.

12. Melanochyla borneensis (RIDL.) DING HOU, Blumea 24 (1978) 31, pl. II, 4. — *Nothopegia borneensis* RIDL. Kew Bull. (1933) 197. — **Fig. 44a–g.**

Tree up to 24 m high and 90 cm ∅. Bark mottled dark grey and black, smooth. Branchlets brown or dark brown, puberulous. *Leaves* coriaceous, elliptic, elliptic-oblong, or obovate, 9–28½ by 5½–12 cm; glabrous above except puberulous on the midrib and nerves below; papillae in prominent (often horse-shoe-shaped) groups separated by broad bands of veins and veinlets; base obtuse or cuneate; apex acute, acuminate, or cuspidate; nerves 18–24 pairs, veins reticulate-scalariform, distinct below, obscure above; petiole (thickened) 1–3½ cm, puberulous or tomentose. *Panicles* axillary, up to 15 cm long; bracts lanceolate, 5 mm long; floral bracts deltoid, ¾–1¼ mm long. *Flowers* (young) yellowish, sessile, *c.* 5 mm long. *Hypanthium* 2½–3 mm long. *Calyx* lobes deltoid or triangular, 1–1½ mm long. *Petals* ovate, *c.* 3 by 1¾ mm, flat. *Stamens* 2½–3 mm; filaments brown, free; anthers ½ mm long. Imperfect or abortive stamens in ♀ *c.* 2 mm. *Disk* 4-(or 5-)lobed. *Ovary* round and flat, slightly convex above, 1½–2 mm ∅; style 2 mm; stigmas discoid. Abortive pistil minute in ♂, hairy. *Drupe* broadly ellipsoid, subglobose, 2¾–3 by 2–2½ cm, puberulous (indumentum *c.* 1/6 mm thick); apex acute or obtuse.

Distr. *Malesia:* Borneo (Sarawak: Kuching and Semengoh Arboretum: trees *n.* 810, 4552, 5703).

Ecol. Lowland dipterocarp forest, up to 100 m. *Fl.* Aug.–Sept.; *fr.* Sept.–Nov.

Vern. *Rĕngas*, M.

Note. Easily distinguished from other species by the coriaceous leaves with distinct papillae on the lower surface in prominent often horse-shoe-shaped groups separated by broad bands of veins and veinlets.

13. Melanochyla beccariana OLIVER in HOOK. Ic. Pl. 24 (1894) t. 2313, *incl. var. breviflora* OLIVER;

MERR. En. Born. (1921) 351. — *M. ferruginea* MERR. J. Str. Br. R. As. Soc. *n.* 86 (1922) 322. — **Fig. 44h, 45b.**

Tree up to 25 m high and 30 cm ∅. Bark brownish or purplish, smooth. Branchlets brown to dark brown, pubescent. *Leaves* subcoriaceous or coriaceous, elliptic, elliptic-oblong, or obovate-oblong, sometimes narrowly lanceolate, 9–30(–42) by 4–14½(–17) cm, glabrous above except the pubescent midrib, pubescent beneath; papillae distinct beneath; base cuneate; apex obtuse, mucronate, sometimes emarginate; nerves 14–25 pairs, veins reticulate-scalariform, elevated beneath, rather faint above; petiole (the lower half slightly thickened) 1½–3 cm, puberulous. *Panicles* terminal and sometimes also in the upper leaf axils, up to 33 cm long, tomentose; bracts linear, up to 15 mm long; floral bracts triangular, ¾–1 mm long. *Flowers* subsessile, whitish grey, (5–)7–9(–12) mm long. *Hypanthium* (1½–)3½–5 mm long. *Calyx* lobes triangular or ovate-oblong, 1½–3 mm long. *Petals* ovate-bolong or lanceolate, 3½–5 by 1¼–1½ mm. *Stamens* 2–2¼ mm; filaments brown, the lower ¾–1½ mm united laterally with the petals; anthers 1–1¼ mm long. Imperfect or abortive stamens in ♀ 1½–2 mm. *Disk* 5-lobed. *Ovary* deeply or almost completely concealed in the receptacle (seemingly inferior); style 2–4 mm; stigmas capitellate. Abortive pistil in ♂ minute, hairy. *Drupe* broadly ellipsoid or ovoid, 2½–3 by 1¼–2¼ cm, rusty velvety (indumentum *c.* ¾ mm thick); apex obtuse or acute.

Distr. *Malesia:* Borneo (Sarawak: Kuching; Sabah: Sandakan, Kuala Belait, Mt Kinabalu; Kalimantan: western part).

Ecol. In forest from the lowland up to 1500 m, occasionally in marshy places. *Fl.* April, July; *fr.* April–May, Sept.–Nov.

Vern. *Rĕngas*, M.

14. Melanochyla elmeri MERR. Un. Cal. Publ. Bot. 15 (1929) 169.

Tree up to 30 m high and 40 cm ∅. Buttresses sometimes present, up to 2 m high, ½ m wide, 5 cm thick. Bark light brown to black, smooth or finely fissured. Branchlets brown, pubescent. *Leaves* subcoriaceous or coriaceous, obovate-oblong, oblong, or narrowly elliptic, (8½–)12–30 by (3–)5–12 cm; glabrous above except the pubescent midrib, pubescent or tomentose beneath especially dense on the midrib and nerves, glabrescent; papillae on the lower surface distinct, sometimes compact and obscure; base cuneate; apex shortly acuminate or acuminate; nerves 16–35 pairs, veins scalariform or reticulate-scalariform, distinct beneath, rather faint above; petiole in the lower ½–⅓ often slightly thickened, 1½–4½ cm, pubescent, glabrescent. *Panicles* terminal and axillary, up to 35 cm long, pubescent; bracts ovate to ovate-oblong, 1½–5 mm long; floral bracts triangular, 1–1¾ mm long. *Flowers* yellowish white or white, sessile or subsessile, 4–6½ mm long. *Hypanthium c.* ½ mm long. *Calyx* lobes ovate or ovate-oblong, 1¼–2 mm long. *Petals* oblong or oblanceolate, 3–5 by ¾–1½ mm, longitudinally ridged inside. *Stamens* 3–3½ mm; filaments brown, sometimes whitish at the apical part, free; anthers *c.* 1 mm long. Imperfect or abortive stamens in ♀ *c.* 2½ mm. *Disk* 5-lobed. *Ovary* conical, 1½ mm ∅; style 1 mm; stigmas capitellate. Abortive pistil in ♂ minute, glabrous. *Drupe* ovoid or ellipsoid, 1½–2½ by 1–1¾ cm, rusty-puberulous (indumentum ⅔ mm thick); apex acute or obtuse.

Distr. *Malesia:* Borneo (Brunei; Sarawak: Kuching, Gunong Gading; Sabah: Mt Kinabalu, Beluran, Beaufort, Sandakan, Tawau; Kalimantan: Berouw, Tandjong Banko region, Kutai, Sangkulirang, Balikpapan).

Ecol. Lowland forest, below 200 m, in Mt Kinabalu at 1500 m (2 coll.), occasionally on limestone or in swampy forest temporarily inundated by freshwater. *Fl.* May–July, Sept.–Nov.; *fr.* April–Aug.

Vern. *Rĕngas*, M, *r. hitam*, Brunei.

15. Melanochyla tomentosa HOOK. *f.* Fl. Br. Ind. 2 (1876) 38; in Hook. Ic. Pl. 13 (1879) t. 1292 & 1293; ENGL. in DC. Mon. Phan. 4 (1883) 470, *excl.* ZOLLINGER 800 from Java; KING, J. As. Soc. Beng. 65, ii (1896) 503; RIDL. Fl. Mal. Pen. 1 (1922) 539; BURK. Dict. (1935) 1434.

Tree up to 13 m high and 25 cm ∅. Buttresses occasionally present up to 1 m high. Branchlets light brown, tomentose. *Leaves* coriaceous, elliptic-lanceolate or obovate-oblong, 19–35 by 6½–10 cm; glabrous above except the pubescent midrib, tomentose beneath especially dense on the midrib and nerves; papillae distinct on the lower surface; base rounded or slightly subcordate; apex acuminate, sometimes cuspidate; nerves 20–35 pairs, veins reticulate-scalariform, distinct beneath, faint above; petiole ½–2½ cm, tomentose. *Panicles* terminal, up to 30 cm long, tomentose; bracts ovate-oblong or lanceolate, 3–4 mm long; floral bracts deltoid, ⅓ mm long. *Flowers* (♂) sessile, 3½ mm long. *Hypanthium* ¾–1 mm long. *Calyx* lobes triangular, ½–¾ mm long. *Petals* elliptic or elliptic-lanceolate, 2–3 by ¾–1 mm, flat. *Stamens* 1¼–1¾ mm; filaments brown, free; anthers ½ mm long. *Disk* 5-lobed. Abortive pistil 0 in ♂, replaced by a tuft of hairs. ♀ Flowers not seen. *Drupe* globose or subglobose, 2¾–3 cm ∅, rusty-pubescent (indumentum very thin); apex rounded.

Distr. *Malesia:* Malay Peninsula (Dindings, Malacca, Johore).

Ecol. Lowland forest. *Fl.* March; *fr.* June, Nov.

Vern. *Laga, pokô kumbal bunang, p. sulumah*, M.

16. Melanochyla caesia (BL.) DING HOU, Blumea 24 (1978) 31. — *Semecarpus caesia* BL. Mus. Bot. 1 (1850) 189; MIQ. Fl. Ind. Bat. 1, 2 (1859) 627. — *M. maingayi* HOOK. *f.* Fl. Br. Ind. 2 (1876) 39; KING, J. As. Soc. Beng. 65, ii (1896) 504; RIDL. Fl. Mal. Pen. 1 (1922) 540; BURK. Dict. (1935) 1434. — *Semecarpus heterophylla var. caesia* ENGL. in DC. Mon. Phan. 4 (1883) 487. — *M. tomentosa var. glabrescens* K. & V. Bijdr. 4 (1896) 133 & 135; BACK. Schoolfl. (1911) 283; RIDL. Fl. Mal. Pen. 1 (1922) 539. — *M. tomentosa* (non HOOK. *f.*) K. & V. Bijdr. 4 (1896) 132, *quoad syn.* & ZOLLINGER 800; BACK. & BAKH. *f.* Fl. Java 2 (1965) 154. — **Fig. 45a.**

Tree 15–27 m high and 20–26 cm ∅. Buttresses occasionally present, ⅔ m high, 1–1½ m wide, thin. Bark reddish, smooth. Brancnlets brown, pubescent, glabrescent. *Leaves* subcoriaceous or

coriaceous, oblanceolate, elliptic to narrowly elliptic, 8–41 by 2–10 cm; glabrous and shining above, sparsely pubescent below, usually glabrescent except on the midrib and nerves; papillae distinct, compact on the lower surface; base cuneate to attenuate, rarely obtuse; apex acuminate, sometimes cuspidate; nerves 16–26 pairs, veins reticulate-scalariform, distinct below, faint above; petiole in the lower $^1/_2$–$^1/_3$ slightly thickened, $^1/_2$–4 cm, pubescent, glabrescent. *Panicles* terminal or axillary, up to 26 cm long, pubescent, glabrescent; bracts triangular or linear, 2–10 mm long; floral bracts triangular, $^1/_2$–1 mm long. *Flowers* subsessile, $4^1/_2$–7 mm long. *Hypanthium* $1^3/_4$–$2^1/_4$ mm long. *Calyx* lobes triangular, 1–$1^3/_4$ mm long. *Petals* white or yellow, oblong, elliptic, ovate-oblong, rarely obovate-oblong, 2–5 by $1^1/_4$–$1^1/_2$ mm, longitudinal ridged inside. *Stamens* 2–3 mm; filaments brown, free; anthers $^1/_2$–$^2/_3$ mm. Imperfect or abortive stamens in ♀ 1–$1^3/_4$ mm. *Disk* 5-lobed. *Ovary* round and flat, $2^1/_2$–3 mm ∅; style 2 mm; stigmas capitellate. Abortive pistil in ♂ conical, $^1/_2$ mm long, hairy. *Drupe* broadly ellipsoid, 2–$3^1/_2$ by $1^1/_2$–$2^1/_2$ cm, rusty short-hairy; apex obtuse.

Distr. *Malesia:* Sumatra (Taram), Malay Peninsula (Perak, Selangor, Malacca), W. Java (scattered), Borneo (Sarawak: Anap, Kapit; Sabah: Sandakan, Lamag).

Ecol. Primary forest, mixed dipterocarp forest, sometimes on sandstone, from the lowland up to 1200 m. *Fl.* Aug.–Oct.; *fr.* Aug., Oct., Nov.

Vern. *Rĕngas*, M, S.

17. Melanochyla kunstleri KING, J. As. Soc. Beng. 65, ii (1896) 504; RIDL. Fl. Mal. Pen. 1 (1922) 539; KOCHUM. Mal. For. Rec. 17 (1964) 296.

Tree up to 30 m high and 1–$1^1/_4$ m ∅. Equal plank buttresses occasionally present, up to 1 m high. Bark grey black, smooth or shallowly fissured. Branchlets light to dark brown, puberulous, glabrescent. *Leaves* coriaceous, elliptic-oblong or -lanceolate, or oblanceolate, $8^1/_2$–18 by $2^1/_2$–$5^1/_2$ cm, shining and glabrous above, pubescent beneath especially on the midrib and nerves; papillae distinct on the lower surface; base attenuate; apex shortly acuminate; nerves 14–28 pairs, veins scalariform, distinct below, obscure above; petiole 1–2 cm, puberulous. *Panicles* terminal and axillary, 14–18 cm long, puberulous; bracts ovate to lanceolate, 3–4 mm long; floral bracts deltoid, $^1/_2$ mm long. *Flowers* (♂) white or yellow, sessile, 4–$4^1/_2$ mm long. *Hypanthium* $^3/_4$–1 mm long. *Calyx* lobes deltoid, $^3/_4$–1 mm long. *Petals* elliptic-lanceolate, 3–$3^1/_2$ by 1–$1^3/_4$ mm, longitudinally ridged inside. *Stamens* $2^1/_2$ mm; filaments brown, free; anthers $^3/_4$ mm long. *Disk* obscurely 5-notched. Abortive pistil minute or 0, glabrous or not replaced by a tuft of hairs. ♀ Flowers not seen. *Drupe* broadly ovoid, $2^1/_2$–3 by 2–$2^3/_4$ cm, golden velvety (indumentum *c.* $^1/_3$ mm thick); apex obtuse.

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

Ecol. Lowland forest, sometimes on sandstone ridges or in secondary forest, up to 150 m. *Fl.* June, Oct.–Nov.; *fr.* Oct.

Vern. *Rĕngas*, M.

15. SEMECARPUS

LINNÉ *f.* Suppl. (1781) 25; MARCH. Rév. Anacard. (1869) 69 & 168; ENGL. in DC. Mon. Phan. 4 (1883) 472; TARD. Fl. C. L. & V. 2 (1962) 156. — *Oncocarpus* ASA GRAY, Bot. U.S. Expl. Exped. 1 (1854) 364; C. B. ROB. Philip. J. Sc. 6 (1911) Bot. 339. — *Nothopegiopsis* LAUT. Bot. Jahrb. 56 (1920) 363. — *Melanocommia* RIDL. Kew Bull. (1933) 198. — **Fig. 47–55.**

Trees, sometimes treelets or shrubs, rarely unbranched (*S. magnificus*, rarely in *S. curtisii*, *S. bunburyanus*). *Leaves* simple, spiral or alternate, sometimes subverticillate, entire, often papillose on the lower surface, petioled. *Inflorescences* terminal and/or axillary, rarely cauliflorous, paniculate, rarely raceme-like; pedicels articulated, sometimes at the base. *Flowers* unisexual or rarely bisexual (plants dioecious or rarely polygamous), ♀ ones usually larger than the ♂. *Calyx* 5-(or 4-)lobed. *Petals* 5 (or 4), imbricate, or rarely valvate. *Stamens* 5 (or 4); filaments subulate, glabrous; anthers dorsifixed. Imperfect or sterile stamens in ♀ similar to fertile ones but (much) smaller and shorter. *Disk* intrastaminal, round, flat (or slightly convex above), shallowly dish-shaped, short-cupular (or rarely funnel-shaped), often 5-(or 4-)notched, usually hairy above, sometimes glabrous (except sometimes the central part or rudimentary pistil in ♂). *Ovary* superior, 1-celled, usually densely hairy, glabrescent, rarely glabrous; styles 3, often hairy near the base, terminal, divergent; stigma transverse-oblong or subreniform. Rudimentary pistil in ♂

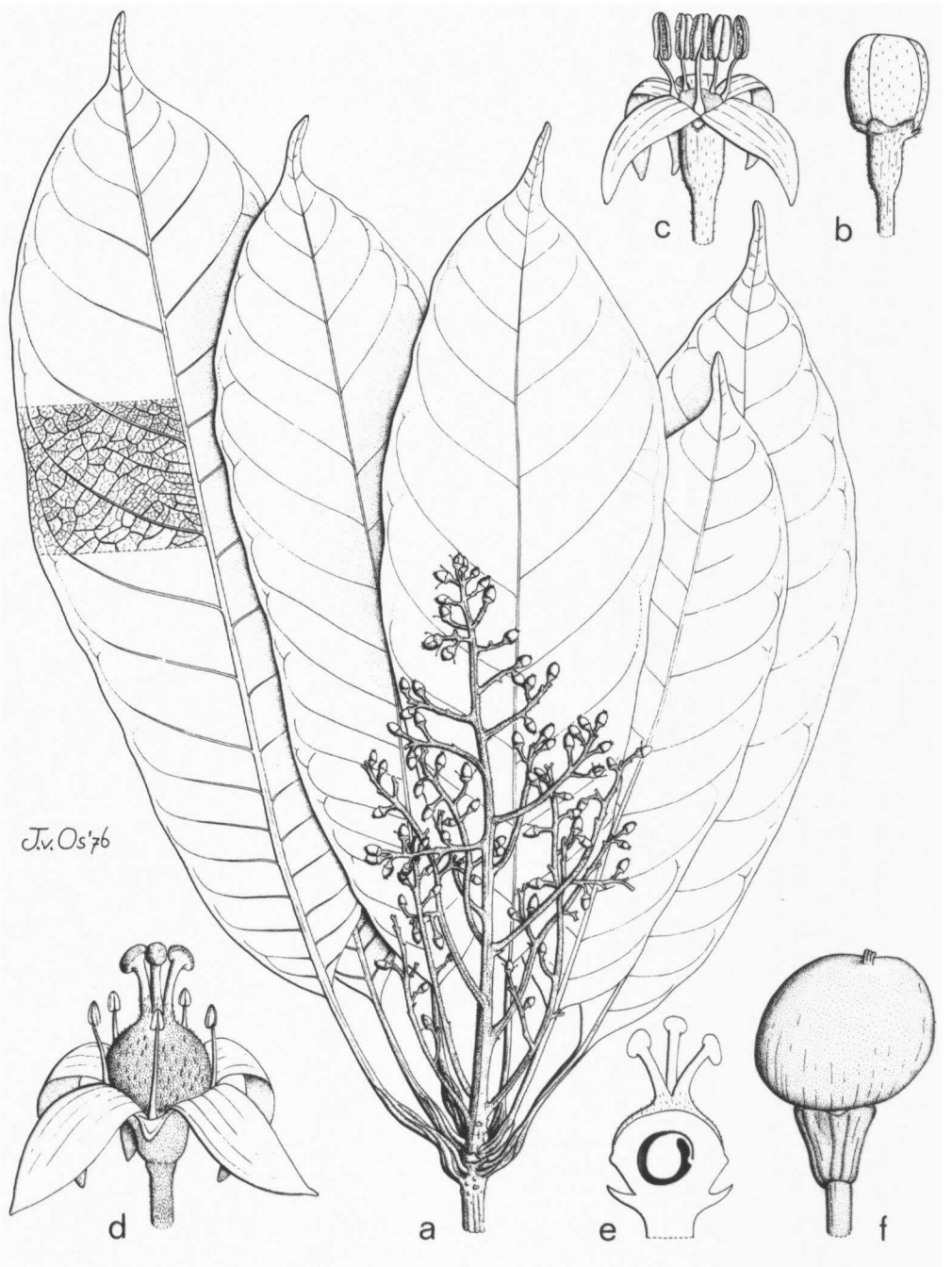

Fig. 47. *Semecarpus bunburyanus* GIBBS. *a*. Habit, × ½, *b*. flower-bud, *c*. ♂ flower, *d*. ♀ flower, *e*. pistil in LS, all × 7, *f*. fruit, × 3 (*a*, *d*, *e* AMDJAH 476, *b*–*c* SAN 12642, *f* SAN 32886).

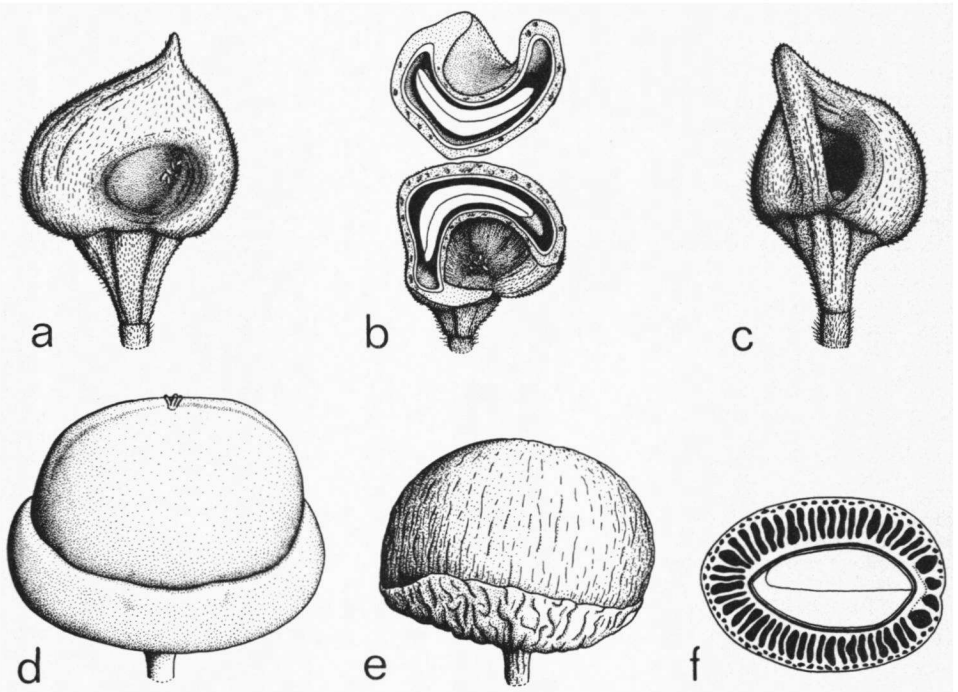

Fig. 48. *Semecarpus aruensis* ENGL. Some developmental stages of an insect shelter on the outer surface of fruit. *a*. Fruit, shallow depression on one side with several insect eggs in it, *b*. fruit, cut into halves, showing the curved pericarp and seed, and insect eggs in the depression, *c*. deformed fruit showing a cavity-like insect shelter on the outer surface formed by the incurved pericarp. All × 1.3. — *S. curtisii* KING. *d*. Fresh fruit seated on the fleshy hypocarp, *e*. dried fruit, with shrunken hypocarp, *f*. fruit in CS, showing resin-canals and cavities. All × 2 (*a* PULLEN 1092, *b–c* HOOGLAND 3956, *d–f* VAN BALGOOY 2635).

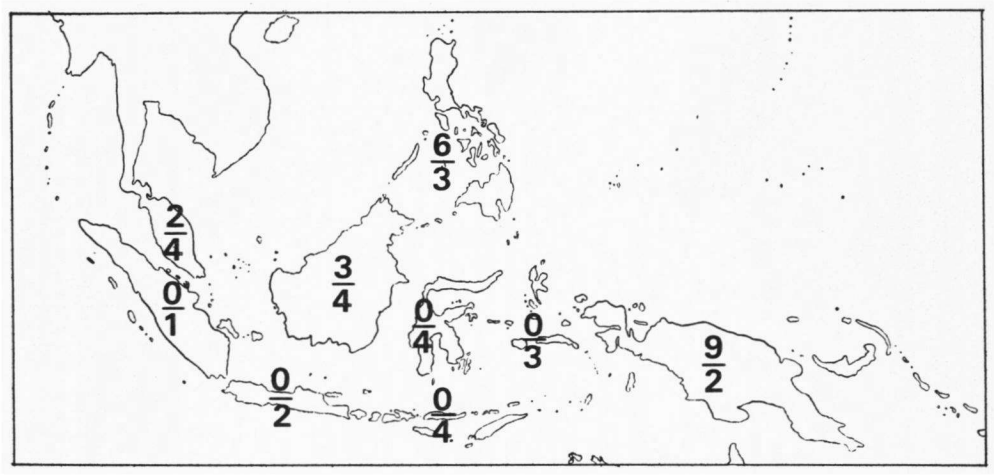

Fig. 49. Species density of *Semecarpus* L. *f*. in Malesia; above the hyphen the endemic, below it the non-endemic species in each island (group).

minute or 0, or replaced by a tuft of hairs. *Drupe* 1-celled, often laterally compressed, seated on a distinct, fleshy hypocarp (formed by the calyx and floral axis) which is sometimes cupular whereby the fruit is seemingly slightly semi-inferior; exocarp and mesocarp fleshy, loaded with acrid resin; endocarp crustaceous. *Seed* with testa free from the endocarp; embryo straight; cotyledons free, plano-convex.

Distr. A genus with *c.* 60 *spp.*, chiefly in Indo-Malesia, distributed in India, Ceylon, Burma, Thailand, Indo-China, Formosa, throughout *Malesia*, to Australia, Micronesia, the Solomon Islands, New Caledonia, and Fiji. Fig. 49.

Ecol. In primary forest at low and medium altitude, sometimes occurring in montane forest up to 1950 m, and occasionally found in periodically inundated regions or peat-swamp forest, monsoon forest, teak forest, or secondary forest, on limestone hills, or in ultrabasic areas.

Most species belong to the middle storey or attain the subcanopy, but some do not go beyond the lower storey, or are even small and unbranched (*spp.* 1 & 2) cycadoid and large-leaved. Of several *spp.* (13, 14, 27, 30) it is recorded that their twigs are hollowed and inhabited by ants, but the myrmecophilous habit is not compulsory for the plant.

Notes. Taxonomically this is a very difficult genus, for which there are two main reasons. The species are mostly dioecious, rarely polygamous, and flowering takes place simultaneous, so that herbarium specimens only represent one stage, and one has almost never flowers and fruit together. Furthermore both flowers and leaves are rather 'monotonous' and do not offer a great deal of 'characters'. A second cause is the fact that several species are fairly variable geographically.

For these reasons the framing of an overall key for the whole of Malesia based freely on flower and fruit characters appeared not very practical for identification. Instead I have provided keys for partial areas, sometimes for each area one for fruiting and another for flowering material.

In addition these keys are preceded by a short synopsis of characteristic ('spotting') characters which are diagnostic for a limited number of species.

Size of fruit in descriptions is always derived from dried specimens unless stated otherwise.

Synopsis of spotting characters

Species are indicated by their numbers

Single-stemmed (recorded on field label): 1, 15 & 17 (*p.p.*).
Leaves subverticillate: 1, 2, 17 (*p.p.*).
Leaves very narrow, 10–20 by $^1/_2$–$1^1/_2$ cm: 3.
Leaves entirely glabrous: 2, 3, 6, 8, 9.
Leaf lower surface without distinct papillae: 2, 5, 6.
Leaf lower surface with papillae in distinct groups: 18.
Inflorescences (at least in part) cauliflorous: 1, 2, 5, 6.
Flower-buds longer than wide: 17, 18, 19, 20.
Petals glabrous outside: 6, 8, 9, 18.
Petals valvate: 1, 2, 4(±), 6, 7, 9(±), 17, 19, 20, 22, 24.
Petals densely hairy (sericeous or villous) outside: 1, 5, 7, 21, 22, 23, 24, 25.
Hypocarp wider than long (cupular to discoid): 8, 16, 20, 21, 29.

KEY TO THE SPECIES

Sumatra, Malaya, Java, and neighbouring islands[1]

1. Papillae on the lower leaf surface indistinct or obscure. Petals valvate . . . . . **6. S. longifolius**
1. Papillae on the lower leaf surface usually distinct. Petals imbricate (at least at the apex in *S. prainii*).
 2. Papillae[2] usually surrounding the endings of veinlets and arranged in groups . . . **18. S. lucens**
 2. Papillae not as above, rather evenly arranged.
  3. Leaves pubescent or velutinous on the lower surface.
   4. Leaf apex obtuse, sometimes slightly emarginate, or acute. Petals with *c.* 8 longitudinal veins. Hypocarp obconical, stalk-like . . . . . **26. S. cochinchinensis**
   4. Leaf apex shortly and abruptly acuminate. Veins of petals invisible. Hypocarp short-cupular or discoid . . . . . **29. S. velutinus**
  3. Leaves glabrous, or sometimes sparsely puberulous on the lower surface.
   5. Petals only imbricate at the apex. Hypocarp obconical, stalk-like. Leaf veins reticulate **9. S. prainii**
   5. Petals imbricate. Hypocarp discoid. Leaf veins reticulate, or some cross-bar-like and subparallel.

(1) The delimitation of the areas in the partial keys is in accordance with map 1 in this Flora vol. 1 (1950) facing page C, here also reproduced in fig. 1.

(2) For the terminology of arrangement of papillae compare fig. 45.

6. Flower after falling leaving a short stalk of $^1/_2$–3 mm. (Exine of pollen grains reticulate) **15. S. curtisii**
6. Flower after falling leaving no distinct stalk. (Exine of pollen grain striate) **16. S. heterophyllus**

KEY TO THE SPECIES
Borneo and neighbouring islands

1. Inflorescences or infructescences axillary, depauperate-paniculate or racemose-like. Hypocarp stalk-like . . . . . **4. S. borneensis**
1. Inflorescences or infructescences terminal, sometimes also axillary, often much branched.
2. Leaves glabrous, sometimes sparsely puberulous or pubescent on the lower surface.
3. Papillae on the lower leaf surface concentrated in small groups in the areolae, separated by veins and veinlets. Hypocarp obconical . . . . . **10. S. forstenii**
3. Papillae on the lower leaf surface rather uniform, not concentrated into such groups in the areolae. Hypocarp discoid . . . . . **16. S. heterophyllus**
2. Leaves densely, sometimes sparsely, tomentose or pubescent, velutinous, rarely hispidulous, on the lower surface.
4. Flower-buds subglobose. Petals imbricate. Hypocarp obconical (solid) . . . **28. S. cuneiformis**
4. Flower-buds oblong or ellipsoid. Petals valvate. Hypocarp discoid, short-cupular, or funnel-shaped (hollow).
5. Petals glabrous, rarely puberulous outside. Disk round and flat in ♂. Fertile anthers (1–)$1^1/_4$–$1^1/_2$ mm long . . . . . **17. S. bunburyanus**
5. Petals puberulous outside. Disk short-cupular in ♂. Fertile anthers $^1/_2$–$^3/_4$ mm long.
6. Leaves tomentose and usually glabrescent on the lower surface. Petals elliptic-oblong, or -lanceolate, sometimes ± oblong, $3^1/_2$–5 by 1–$1^1/_2$ mm . . . . . **19. S. glaucus**
6. Leaves velutinous on the lower surface. Petals ovate-oblong or lanceolate, $2^1/_2$–$3^1/_2$ by $^2/_3$–$1^1/_4$ mm **20. S. rufovelutinus**

KEY TO THE SPECIES
Philippines

1. Papillae on the lower leaf surface indistinct or obscure. Fertile anthers 1–$1^1/_4$ mm long. Fruits glabrous; hypocarp pulvinate or obconical-cylindric . . . . . **6. S. longifolius**
1. Papillae on lower leaf surface usually distinct.
2. Leaves very narrow, $^1/_2$–$1^1/_2$ cm wide . . . . . **3. S. stenophyllus**
2. Leaves much broader, usually more than 5 cm wide.
3. Flower-buds oblong. Fertile anthers (1–)$1^1/_4$–$1^1/_2$ mm. Fruits almost glabrous; hypocarp funnel-shaped or short-cupular . . . . . **17. S. bunburyanus**
3. Flower-buds subglobose or globose. Fertile anthers $^2/_3$–$^3/_4$ mm long. Fruits hairy; hypocarp pulvinate or obconical.
4. Petals valvate. Fruit apex truncate, or slightly concave.
5. Leaves (17–)21–46(–60) by (8–)13–20 cm, lower surface pubescent . . . **24. S. macrophyllus**
5. Leaves smaller, 6–22 by $3^1/_2$–$8^1/_2$ cm, lower surface glabrous, sometimes sparsely puberulous, glabrescent . . . . . **7. S. trachyphyllus**
4. Petals imbricate. Fruit apex obtuse or rounded.
6. Petals sericeous outside. Fruits velutinous . . . . . **25. S. densiflorus**
6. Petals puberulous or sparsely puberulous outside. Fruits pubescent or sparsely hairy.
7. Leaves with 5–10 pairs of nerves. Flower or fruit after falling leaving a distinct stalk $1^1/_2$–8 mm long. Fruits *c.* $^2/_3$ cm ∅ . . . . . **12. S. paucinervius**
7. Leaves with 10–25 pairs of nerves. Flower or fruit after falling leaving no stalk or an obscure one.
8. Leaf apex acute, shortly or abruptly acuminate, obtuse, rarely retuse; lower surface densely, sometimes sparsely, tomentose or pubescent, glabrescent, or glabrous. Fruits $^3/_4$–1 cm ∅ **28. S. cuneiformis**
8. Leaf apex acuminate or subcaudate; lower surface puberulous. Fruits $1^1/_2$–$1^3/_4$ cm ∅ **31. S. glauciphyllus**

KEY TO THE SPECIES
Lesser Sunda Is., Celebes, Moluccas, and neighbouring islands
Flowering material

1. Papillae on the lower leaf surface indistinct or obscure. Petals valvate, glabrous **6. S. longifolius**
1. Papillae on the lower leaf surface usually distinct. Petals imbricate, hairy outside.
2. Papillae in small groups in the areolae . . . . . **10. S. forstenii**
2. Papillae rather uniform, not separated into groups as above.
3. Veins of leaves reticulate-scalariform . . . . . **14. S. cassuvium**
3. Veins of leaves reticulate, some cross-bar-like.
4. Leaves densely, sometimes sparsely tomentose or pubescent, glabrescent, rarely glabrous on the lower surface . . . . . **28. S. cuneiformis**
4. Leaves glabrous, sometimes sparsely puberulous beneath . . . . . **16. S. heterophyllus**

KEY TO THE SPECIES

Lesser Sunda Is., Celebes, Moluccas, and neighbouring islands

Fruiting material

1. Hypocarp discoid, wider than long.
2. Fruits subglobose, rounded at the apex; sparsely puberulous, glabrescent. Leaf veins reticulate, some cross-bar-like . . . . . **16. S. heterophyllus**
2. Fruits broadly obovoid, concave at the apex; velutinous, sometimes glabrescent. Leaf veins reticulate-scalariform . . . . . **14. S. cassuvium**
1. Hypocarp obconical or pulvinate, stalk-like, longer than wide, or ± equal in length and width.
3. Papillae on the lower leaf surface indistinct or obscure. Fruits 1–2½ by 1–2 cm, glabrous **6. S. longifolius**
3. Papillae on the lower leaf surface distinct.
4. Leaves glabrous, sometimes sparsely puberulous or pubescent on the lower surface; papillae in small groups in the areolae. Fruits 3–4 by 2–3½ cm, velutinous, glabrescent . . . **10. S. forstenii**
4. Leaves densely, sometimes sparsely tomentose or pubescent, glabrescent, rarely glabrous on the lower surface; papillae rather uniform, not separated into small groups as above. Fruits smaller, 1–1¼ by ¾–1 cm, sparsely hairy, glabrescent . . . . . **28. S. cuneiformis**

KEY TO THE SPECIES

New Guinea and neighbouring islands

Flowering material

1. Leaves subverticillate, in a terminal whorl or clustered at intervals. Inflorescences cauliflorous and/or axillary. Petals valvate.
2. Unbranched shrub-like treelet or slender tree. Papillae distinct on the lower leaf surface. Lateral branches of the inflorescences usually at right angles with the main axis . . . . **1. S. magnificus**
2. Branched shrub or tree. Papillae indistinct or obscure on the lower leaf surface. Lateral branches of the inflorescences obliquely ascending . . . . . **2. S. nidificans**
1. Leaves spaced, spiral. Inflorescences often terminal, and/or axillary, rarely also cauliflorous. Petals imbricate (except in *S. aruensis*).
3. Petals glabrous outside. Leaves (26–)40–52(–100) by 12½–17(–24) cm; apex obtuse or rounded **8. S. papuanus**
3. Petals hairy (puberulous or sericeous) outside.
4. Papillae indistinct on the lower leaf surface. Lateral branches of inflorescences ± perpendicular to the main axis . . . . . **5. S. lamii**
4. Papillae distinct on the lower leaf surface. Lateral branches of inflorescences obliquely ascending.
5. Papillae on the lower leaf surface separated into small groups by veins and veinlets **10. S. forstenii**
5. Papillae on the lower leaf surface not like above, but rather uniform.
6. Petals valvate . . . . . **22. S. aruensis**
6. Petals imbricate.
7. Petals with 15–20 longitudinal veins . . . . . **27. S. brachystachys**
7. Petals with *c.* 4–*c.* 12 longitudinal veins.
8. Petals sericeous outside.
9. Leaves with 15–32 pairs of nerves; apex rounded or slightly apiculate; veins much elevated beneath. Petals with *c.* 4 longitudinal veins . . . . . **21. S. bracteatus**
9. Leaf with 10–15 pairs of nerves; apex abruptly acuminate-rostrate; veins distinct beneath. Petals with *c.* 7 longitudinal veins . . . . . **23. S. rostratus**
8. Petals puberulous outside.
10. Leaves 5–8(–18) cm long; nerves 5–10 pairs; veins reticulate. ♀ Flower sessile, after falling leaving a short stalk 3–5 mm long . . . . . **11. S. albicans**
10. Leaves larger, 10–48 cm long; nerves 9–26 pairs; veins reticulate-scalariform, or reticulate and some cross-bar-like. ♀ Flower pedicelled (1–3 mm), after falling not leaving a short stalk.
11. Leaf apex obtuse, sometimes slightly apiculate . . . . . **13. S. australiensis**
11. Leaf apex acute or acuminate, sometimes obtuse, rarely slightly emarginate.
12. Leaves 15–22 cm long. Petals with *c.* 12 longitudinal veins. . . . . **14. S. cassuvium**
12. Leaves larger, (23½–)35–48 cm long. Petals with *c.* 8 longitudinal veins **30. S. schlechteri**

KEY TO THE SPECIES

New Guinea and neighbouring islands

Fruiting material

1. Leaves subverticillate, in a terminal whorl or clustered at intervals. Infructescences cauliflorous and/or axillary.
2. Unbranched shrub-like treelet or slender tree. Papillae distinct on the lower leaf surface. Fruit obovoid or ellipsoid, 3–3½ cm long . . . . . **1. S. magnificus**

2. Branched shrub or tree. Papillae indistinct or obscure on the lower leaf surface. Fruits unknown . . . . . **2. S. nidificans**
1. Leaves spaced, spiral. Infructescences often terminal, and/or axillary, rarely also cauliflorous.
3. Papillae indistinct or obscure on the lower leaf surface.
4. Fruits $2^1/_2$–$3^1/_2$ cm ∅; hypocarp obconical 1–$1^1/_2$ cm ∅ . . . . . **5. S. lamii**
4. Fruits wider, $4^1/_4$–5 cm ∅; hypocarp short-cupular, 3–$3^1/_4$ cm ∅ . . . . . **8. S. papuanus**
3. Papillae distinct on the lower leaf surface.
5. Hypocarp discoid, short-cupular, or funnel-shaped.
6. Fruits almost glabrous . . . . . **13. S. australiensis**
6. Fruits pubescent, puberulous, or velutinous.
7. Leaf apex rounded or slightly apiculate; veins on lower leaf surface much elevated. Fruits velutinous; apex apiculate, sometimes concave at the top . . . . . **21. S. bracteatus**
7. Leaf apex acute or acuminate, sometimes obtuse, rarely slightly emarginate.
8. Fruits velutinous; apex concave . . . . . **14. S. cassuvium**
8. Fruits pubescent, glabrescent; apex obtuse.. . . . . **30. S. schlechteri**
5. Hypocarp pulvinate or obconical.
9. Papillae on lower leaf surface separated into small groups in the areolae . . . . **10. S. forstenii**
9. Papillae rather uniform on the lower leaf surface.
10. Leaf apex obtuse, rounded, acute, sometimes shortly or abruptly acuminate.
11. Leaves with 5–10 pairs of nerves . . . . . **11. S. albicans**
11. Leaves with 22–32 pairs of nerves . . . . . **27. S. brachystachys**
10. Leaf apex shortly acuminate, slightly rostrate, or abruptly acuminate-rostrate.
12. Fruit apex shortly acuminate; hypocarp 1–$1^1/_2$ by 1–$1^1/_2(-2)$ cm . . . . . **22. S. aruensis**
12. Fruit apex acuminate-rostrate; hypocarp $2^2/_3$ by $2^1/_3$ cm . . . . . **23. S. rostratus**

1. Semecarpus magnificus K.SCH. in K.Sch. & Hollr. Fl. Kais. Wilh. Land (1889) 65; K.SCH. & LAUT. Fl. Schutzgeb. (1900) 411; LAUT. Nova Guinea 8 (1910) 299, (1912) 830; Bot. Jahrb. 56 (1920) 368, f. 5; MERR. & PERRY, J. Arn. Arb. 22 (1941) 537; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 37, f. 16; HALLÉ, Biotropica 6 (1974) 45, f. 5. — *S. undulatus* C. T. WHITE, Proc. R. Soc. Queensl. 34 (1922) 41; J. Arn. Arb. 10 (1929) 234. — **Fig. 50.**

Unbranched treelet or slender tree, (2–)4–6 (–10) m high and 5–$12^1/_2$ cm ∅. Bark grey-brown or brown, finely striate, or with fairly deep longitudinal fissures. *Leaves* subverticillate, usually in a terminal, flat spreading crown, sometimes clustered at intervals near the apex, coriaceous, obovate-lanceolate, 47–135 by 9–26 cm; above glabrous, beneath tomentose or pubescent, glabrescent, sometimes almost glabrous; papillae distinct, covering the lower surface except the midrib, nerves, and thicker veins; base attenuate or decurrent; apex acute, rarely acuminate; nerves up to 56 pairs, elevated below, distinct above; veins reticulate-scalariform, slightly elevated below, distinct or faint above; petiole (0–)2–6(–$9^1/_2$) cm, the lowest leaves with the longest petioles. *Panicles* cauliflorous, usually borne on the lower part of stem, up to 80 cm long, pubescent, glabrescent; lateral branches up to 15 cm, usually at right angles with the main axis; bracts small, lanceolate or triangular, 1–$1^1/_4$ mm long; pedicels very short. Flower-buds subglobose. *Calyx* lobes triangular, $^3/_4$–$1^1/_4$ mm long. *Petals* valvate, elliptic-oblong or -lanceolate, $2^1/_2$–3 by 1–$1^1/_2$ mm, with several longitudinal veins, sericeous outside. *Stamens* $3^3/_4$ mm; anthers ovoid, $^2/_3$ mm long. Imperfect or sterile stamens in ♀ $1^1/_2$ mm. *Disk* round, flat, 1–$1^1/_2$ mm ∅, glabrous (except the central part or rudimentary pistil densely hairy). *Ovary* subglobose, densely pubescent, *c.* 3 mm ∅; styles *c.* 1 mm long. *Drupe* obovoid or ellipsoid, 3–$3^1/_2$ by $1^1/_4$–$2^1/_4$ cm, pubescent, glabrescent; apex obtuse; hypocarp obconical, stalk-like, 1 by $1^1/_2$–$1^3/_4$ cm.

Distr. *Malesia:* New Guinea (scattered between Hollandia and Milne Bay Distr.).

Ecol. Common in forest undergrowth of dry land forest, sometimes in forest along rivers or in inundated areas, from the lowland up to 500 m, very rarely at 900 m, once at 1200 m. *Fl.* April–Sept., Dec.

Vern. *Dodoari, sowowari,* Kamtuk lang., *merwehyi,* Orne lang., *wunyub,* Sepik.

2. Semecarpus nidificans (LAUT.) DING HOU, Blumea 24 (1978) 36. — *Nothopegiopsis nidificans* LAUT. Bot. Jahrb. 56 (1920) 363, f. 4.

Shrub or small tree up to 5 m high. Bark grey to reddish brown, with fairly deep longitudinal fissures. *Leaves* subverticillate, arranged on the branches at intervals of $^1/_2$–$^3/_4$ of the length of leaves, like nests, subcoriaceous, linear or oblanceolate, 34–73 by 8–16(–$23^1/_2$) cm, glabrous on both surfaces; papillae beneath indistinct or obscure; base attenuate, obtuse or subauriculate; apex acuminate; nerves 23–50 pairs, conspicuous on both surfaces; veins reticulate, distinct on both surfaces; petiole very short, $^1/_2$–$^2/_3$ cm. *Panicles* axillary, sometimes also cauliflorous, 3–20(–55) cm long, sparsely puberulous, glabrescent, or sometimes glabrous; lateral branches obliquely ascending, up to 14 cm; bracts lanceolate, $^2/_3$–1 mm long; pedicels 0. Flower-buds globose. *Calyx* lobes deltoid, $^1/_3$–$^2/_3$ mm long. *Petals* valvate, ovate or broad-elliptic, $1^1/_2$–3 by 1–2 mm, with several longitudinal veins, puberulous outside. *Stamens c.* 1 mm; anthers oblong-ovoid, $^1/_2$ mm long. *Disk* round, flat, *c.* $^2/_3$ mm ∅ in ♂, $1^1/_2$–$2^3/_4$ mm ∅ in ♀, pilose above. Imperfect or sterile stamens in ♀ *c.* $1^1/_2$ mm. *Ovary* globose, $1^1/_4$–$2^1/_2$ mm ∅, pilose; styles $^2/_3$ mm long. Drupe unknown.

Distr. *Malesia:* New Guinea (Mamberamo R., Sepik, Central and Gulf Distr.).

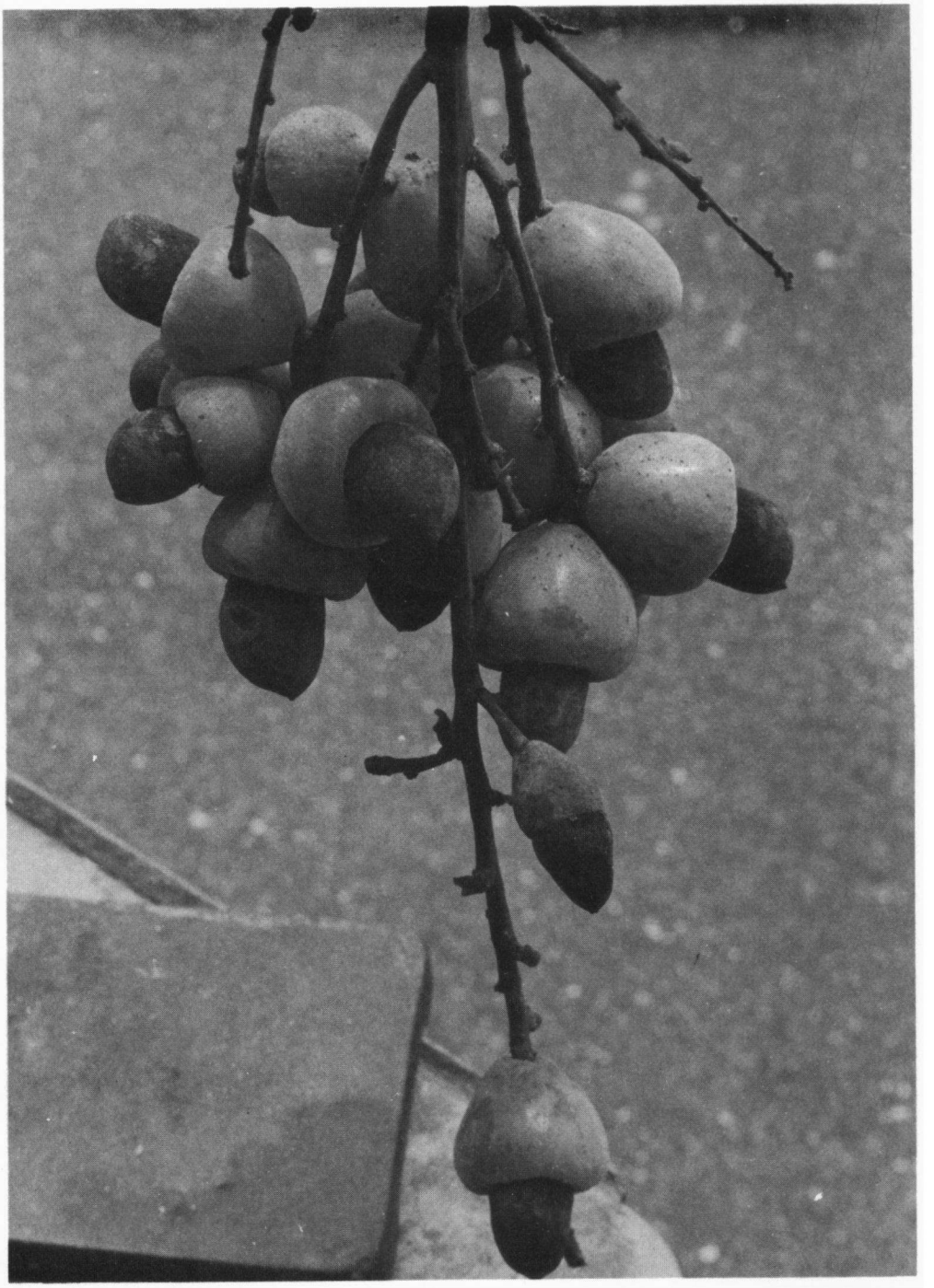

Fig. 50. *Semecarpus magnificus* K.SCH. in fruit. Morobe Distr., Papua New Guinea. Courtesy Bot. Div. Lae (NGF 46762).

Ecol. In forest of alluvium and dryland, 10–560 m. *Fl.* Jan.–March, June–July.

Vern. *Ubapull*, Sepik Distr.

3. Semecarpus stenophyllus MERR. Philip. J. Sc. 30 (1926) 407; DING HOU, Blumea 24 (1978) 37.

Shrub or small tree, up to 6 m high and 8 cm ∅. *Leaves* spaced, spiral, subcoriaceous, very narrowly elliptic, $10^1/_2$–20 by $^1/_2$–$1^1/_2$ cm, from the middle gradually narrowed towards both ends, glabrous; papillae distinct, covering the lower surface except the midrib, nerves, and thicker veins; base attenuate; apex acuminate; nerves 22–45 pairs or more, slightly elevated below, faint above; veins reticulate, distinct below, faint above; petiole $^1/_2$–$1^1/_2$ cm. *Panicles* terminal, up to *c.* 10 cm long, young parts slightly pubescent, glabrescent; lateral branches up to $3^1/_2$ cm, obliquely ascending; bracts lanceolate, $^2/_3$–1 mm long; pedicels 0. Flower-bud (only one observed, not dissected) subglobose. *Calyx* lobes triangular. *Petals* imbricate, sparsely puberulous outside. *Drupe* obliquely broad-ovoid, *c.* 1 by 1 cm, sparsely pubescent, glabrescent; apex obtuse; hypocarp red when fresh (MERRILL, *l.c.*), pulvinate, *c.* $^1/_2$ by $^2/_3$ cm.

Distr. *Malesia:* Philippines (Samar; Luzon: Isabela Prov.).

Ecol. In a thicket on a river-bank, 150 m. *Fr.* April, June.

This stenophyllous species belongs apparently to the category of rheophytes, growing along small streams in places subject to sudden and brief overflow when the streams are in spate after heavy rains (*cf.* MERRILL).

4. Semecarpus borneensis MERR. J. Str. Br. R. As. Soc. *n.* 86 (1922) 323; DING HOU, Blumea 24 (1978) 35.

Shrub or small tree, *c.* 3 m high. *Leaves* spaced, spiral, subcoriaceous, elliptic, elliptic-oblong, obovate-oblong, or oblanceolate, 7–20 by $3^1/_2$–8 cm; upper surface glabrous, sometimes sparsely hairy, lower surface tomentose; papillae distinct, covering the lower surface except the midrib, nerves, and veins; base acute; apex shortly acuminate, sometimes apiculate; nerves 10–16 pairs, prominent beneath, faint above; veins reticulate, slightly elevated below, obscure above; petiole 1–2 cm. *Panicles* axillary at the apical end of twigs, depauperate-paniculate or raceme-like, up to 20 cm long, tomentose; lateral branches obliquely ascending, up to 3 cm; bracts linear, 2–3 mm long; pedicels $^1/_3$ mm. Flower-buds globose. *Calyx* lobes triangular, $^2/_3$ mm long. *Petals* valvate, except slightly imbricate at the apex, elliptic or ovate-elliptic, *c.* 2 by 1 mm, puberulous outside. *Stamens* $1^1/_2$ mm; anthers ovoid-oblong, $^2/_3$ mm long. *Disk* round, flat, *c.* 1 mm ∅, pilose above. ♀ Flowers not seen. *Drupe* (young) broad-ellipsoid, *c.* $^3/_4$ by $^2/_3$ cm, pubescent; apex obtuse; hypocarp obconical, stalk-like, *c.* $^1/_2$ by $^1/_3$ cm.

Distr. *Malesia:* Borneo (Sabah: near Kudat, and near Ranau, Mt Kinabalu).

Ecol. One collection on a dry slope near Kudat at 20 m and another in forest at Ranau, Mt Kinabalu, at 600 m. *Fl.* July, Nov.; *fr.* July.

Vern. *Kalob-kalob*, Ranau, *rungas*, Kudat.

5. Semecarpus lamii SLIS, Nova Guinea 14 (1924) 98.

Tree 14–28 m high and 19–40 cm ∅. Bark grey, greyish green, light orange, or red, rather smooth, sometimes shallowly fissured. *Leaves* spaced, spiral, subcoriaceous, obovate- or elliptic-oblong, 9–35 by $4^1/_2$–15 cm; above pubescent on the midrib; beneath pubescent, glabrescent, papillae indistinct; base cuneate; apex acute or acuminate; nerves 10–17 pairs, prominent beneath, distinct or faint above; veins reticulate or transverse, distinct beneath, faint above; petiole 2–4 cm long. *Panicles* axillary, terminal, or cauliflorous, up to 20 cm long, densely pubescent; lateral branches up to 4 cm, ± perpendicular to the main axis; bracts triangular, ovate, $^1/_2$–1 mm long; pedicels very short. Flower-buds globose. ♂ *Flowers: Calyx* lobes triangular, *c.* $^1/_2$ mm long. *Petals* white, imbricate, elliptic, *c.* 2 by 1 mm, with several longitudinal veins, sericeous outside. *Stamens* $2^1/_2$ mm; anthers ovoid, *c.* $^2/_3$ mm long. *Disk* round, flat, *c.* $^3/_4$ mm ∅, pubescent above. ♀ Flowers not seen. *Drupe* yellow when ripe, broad-ellipsoid or -ovoid, $3^1/_2$–$5^1/_2$ by $2^1/_2$–$3^1/_2$ cm; puberulous, glabrescent; apex obtuse; hypocarp obconical, stalk-like, 1–$2^1/_4$ by 1–$1^1/_2$ cm.

Distr. *Malesia;* New Guinea (Sorong, Nabire, Pionier Bivak, Uta, Hollandia, Central and Madang Distr.).

Ecol. Lowland rain-forest and occasionally in rocky river gully, up to 200 m. *Fl.* March, July; *fr.* Febr., March, Sept., Oct.

Vern. *Ama*, Arzo, *ko*, Mooi, *siqualat*, Jal, *tamu*, Njau, *weadi*, Motu dial.

6. Semecarpus longifolius BL. Mus. Bot. 1 (1850) 188; MIQ. Fl. Ind. Bat. 1, 2 (1859) 627; ENGL. in DC. Mon. Phan. 4 (1883) 496. — *Holigarna longifolia* (*non* ROXB. 1820, *nec* W. & A. 1834) SPAN. Linnaea 15 (1841) 188. — *Buchanania halmaheirae* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 117. — *S. gigantifolia* VIDAL, Sinopsis (1883) 22, t. 36, f. A; F.-VILL. Nov. App. (1883) 350; MERR. Bull. For. Bur. Philip. 1 (1903) 33; Publ. Gov. Lab. Philip. *n.* 6 (1904) 5; PERK. Fragm. Fl. Philip. (1904) 26; MERR. Philip. J. Sc. 1 (1906) Suppl. 85; Sp. Blanc. (1918) 21; En. Philip. 2 (1923) 474; BROWN, Useful Pl. Philip. 2 (1950) 347, f. 169; LI, Pac. Sc. 7 (1953) 183; LIU, Ill. Pl. Taiwan 2 (1962) 945, f. 780; LI, Woody Fl. Taiwan (1963) 451, f. 175. — *S. euphlebia* MERR. Philip. J. Sc. 7 (1912) Bot. 283; En. Philip. 2 (1923) 473. — *S. lanceolata* MERR. Philip. J. Sc. 7 (1912) Bot. 284; En. Philip. 2 (1923) 474. — *S. vernicifera* HAYATA & KAWAKAMI in Hayata, Ic. Pl. Form. 2 (1932)108; KANEH. Form. Trees rev. ed. (1936) 367, f. 322. — *S. testaceus* ELMER, Leafl. Philip. Bot. 10 (1939) 3682, *descr. angl.*

Tree up to 20 m high and 30 cm ∅, rarely small and unbranched up to 5 m high. Bark dark brown, finely fissured. *Leaves* spaced, spiral, coriaceous, oblanceolate, elliptic-lanceolate, rarely narrowly elliptic, ($18^1/_2$–)34–85(–125) by ($4^1/_2$–)$8^1/_2$–21(–28) cm, glabrous on both surfaces; papillae indistinct or obscure beneath; base attenuate, sometimes slightly auriculate; apex acute or acuminate; nerves 20–42 pairs, prominent below, distinct above; veins reticulate-scalariform, distinct on

both surfaces, sometimes faint above; petiole (0–)1¹/₄–4¹/₂(–9) cm. *Panicles* cauliflorous, axillary, sometimes terminal, up to 34 cm long, puberulous, glabrescent; lateral branches obliquely ascending, up to 8¹/₂(–28) cm; bracts ovate or ovate-oblong, ¹/₃–1¹/₂ mm long; pedicels ²/₃–1 mm. Flowerbuds subglobose. *Flowers* white. *Calyx* lobes crescent-shaped, ¹/₂–1 mm long. *Petals* valvate, elliptic or ovate-oblong, 4–5 by 2 mm, with *c.* 8 longitudinal veins, glabrous. *Stamens* 3¹/₂–5 mm; anthers broad-ovoid or ovoid-oblong, 1–1¹/₄ mm long. Imperfect or sterile stamens 2¹/₂–3 mm. *Disk* round, flat, 1–2 mm ∅, pilose above, glabrescent, or glabrous. *Ovary* subglobose, *c.* 2 mm ∅, glabrous or sparsely pubescent; styles 1–1¹/₂ mm. *Drupe* subglobose, 1–2¹/₂ by 1–2 cm, glabrous; apex rounded or slightly apiculate; hypocarp pulvinate or obconical-cylindric, stalk-like, ¹/₂–2 by ²/₃–1³/₄ cm.

Distr. Formosa (E. & Lanyu) and *Malesia;* Philippines (Luzon, Oriental Mindoro, Mindanao), Celebes (Malili, Matana Lake, Wangiwangi, Lamangiso, Pangkadjene; Kabaena, Tukang Besi, Saleijer Is.), and Moluccas (Sula Is.: Mangoli; Halmaheira, Buru). E. Java (Tangkil, once coll.), Lesser Sunda Is. (Timor: Roti). Fig. 51.

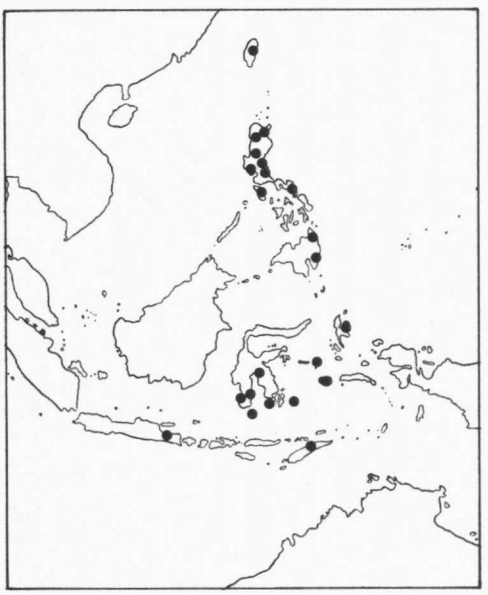

Fig. 51. Localities of *Semecarpus longifolius* BL.

Cultivated in Hort. Bog. *sub n.* VIII–E–20a.

Ecol. Lowland forest, sometimes up to 300 m. *Fl.* Jan.–March, June, July; *fr.* Jan.–Dec.

Vern. Philippines: *anagás, anagás-babáe, ligás,* Tag., *isip,* Ign., *libás, topo,* Bik., *manalú,* Sul.

7. Semecarpus trachyphyllus PERK. Fragm. Fl. Philip. (1904) 29. — *S. macrothyrsa* PERK. *l.c.* 26; MERR. En. Philip. 2 (1923) 412. — *Oncocarpus ferruginea* C. B. ROB. Philip. J. Sc. 6 (1911) Bot. 340. — *Oncocarpus trachyphylla* MERR. En. Philip. 2 (1923) 476.

Tree 10–15 m high and 12–22¹/₂ cm ∅. *Leaves* spaced, spiral, subcoriaceous or coriaceous, elliptic, elliptic-lanceolate, oblanceolate, rarely obovate, 6–22 by 3¹/₂–8¹/₂ cm; glabrous above, lower surface glabrous or sometimes sparsely puberulous (simple and stellate hairs), glabrescent; papillae distinct, rather compact, covering the lower surface except the midrib, nerves, and veins; base cuneate or attenuate; apex shortly or abruptly acuminate, rarely rounded; nerves 8–19 pairs, elevated beneath, distinct above; veins reticulate, or transverse and subparallel, distinct on both surfaces; petiole 1–3 cm. *Panicles* terminal, sometimes axillary, 10–24 cm long, densely pubescent; lateral branches obliquely ascending, up to 14 cm; bracts lanceolate, *c.* 2¹/₂ mm long; pedicels very short. Flower-buds subglobose. *Calyx* lobes crescent-shaped, ¹/₂–³/₄ mm long. *Petals* valvate, ovate-oblong or slightly elliptic, 3 by 1¹/₂ mm, with several longitudinal veins, densely pubescent outside. Stamens 3–3¹/₂ mm; anthers broadly ovoid, *c.* ²/₃ mm long. Imperfect or sterile stamens in ♀ *c.* 1¹/₂ mm. *Disk* round, flat or slightly concave above, *c.* 1¹/₂ mm ∅, pilose above. *Ovary* subglobose, *c.* 4¹/₂ mm ∅, densely pubescent; style *c.* ¹/₂ mm long. *Drupe* broadly obovoid, 1¹/₂–2¹/₂ by 1¹/₂–2¹/₂ cm, pubescent, sometimes glabrescent; apex truncate or slightly concave; hypocarp pulvinate, stalk-like, ¹/₂–1 by ¹/₂ cm.

Distr. *Malesia;* Philippines (Luzon, Samar, Mindanao).

Ecol. Primary lowland forest. *Fl.* May, June; *fr.* Jan.–Dec.

Vern. *Arangas, malaligas,* Tag., *kamírig,* Ilk., *ligas,* Bag., *núgas,* S.L.Bis., *uagotomak,* Mbo.

8. Semecarpus papuanus LAUT. Nova Guinea 8 (1912) 829; Bot. Jahrb. 56 (1920) 368; DING HOU, Blumea 24 (1978) 36.

Tree up to 29 m high and 50 cm ∅. Bark greenish grey, weakly fissured. *Leaves* spaced, spiral, coriaceous, obovate to oblanceolate, (26–)40–52 (–100) by 12¹/₂–17(–24) cm, glabrous on both surfaces; papillae often indistinct or obscure on the lower surface; base cuneate or attenuate; apex obtuse or rounded; nerves 22–24 pairs, elevated beneath, flat but distinct above; veins reticulate, or transverse to the nerves, distinct on both surfaces; petiole 2¹/₂–9¹/₂ cm. *Panicles* terminal, or cauliflorous (?), up to 52(–78) cm long, pubescent, glabrescent, or glabrous; lateral branches up to 35 cm, obliquely ascending; bracts broad-ovate, 1¹/₂ mm long; pedicels 0 or very short. Flower-buds globose or subglobose. *Calyx* lobes crescent-shaped and *c.* ¹/₂ mm long in ♂; triangular and *c.* 1¹/₂ mm long in ♀. *Petals* imbricate, broad-elliptic or elliptic, *c.* 2 by 1–1¹/₂ mm on ♂, ovate, 2¹/₄ by 1¹/₄ mm in ♀, with *c.* 6 longitudinal veins, glabrous. *Stamens c.* 1¹/₄ mm; anthers ovoid, *c.* ²/₃ mm long. Sterile or imperfect stamens in ♀ *c.* ³/₄ mm. *Disk* round, flat, 1¹/₄–1¹/₂ mm ∅, pubescent or pilose above. *Ovary* dome-shaped, *c.* ³/₄ mm ∅, pubescent; styles ¹/₂ mm. *Drupe* broad-ovoid, 5–5¹/₂ by 4¹/₄–5 cm, almost glabrous; apex obtuse; hypocarp short-cupular, *c.* 2¹/₄ by 3–3¹/₄ cm.

Distr. *Malesia;* New Guinea (Sorong, Hollandia, Lorentz R., Sepik, Morobe and Gulf Distr.).

Ecol. Primary lowland forest, also in marshy or alluvial areas, sometimes in montane forest at 750–1350 m. *Fr.* May–July, Sept.

Vern. *Ko-u*, Mooi, *santung*, Nimburam lang.

9. Semecarpus prainii KING, J. As. Soc. Beng. 65, ii (1896) 511; PARKINSON, For. Fl. Andaman Is. (1923) 140; HEND. Gard. Bull. S. S. 3 (1924) 291; RIDL. Fl. Mal. Pen. 5 (1925) 303.

Tree up to 15 m high. *Leaves* spaced, spiral, coriaceous, obovate-oblong or oblanceolate, $10^1/_2$–$15^1/_2$(–26) by $4^1/_2$–$6^1/_2$(–8) cm, glabrous on both surfaces; papillae compact, covering the lower surface except the midrib, nerves, and veins; base attenuate; apex shortly and abruptly acuminate; nerves 16–24 pairs, prominent beneath, slightly elevated above; veins reticulate, distinct on both surfaces; petiole $1^1/_2$–3 cm. *Panicles* terminal and axillary, 15–35 cm long, young parts puberulous, glabrescent; lateral branches up to 18 cm, obliquely ascending; bracts lanceolate, $^3/_4$–$3^1/_2$ mm long; pedicels 0. Flower-buds subglobose. *Calyx* lobes triangular, $^3/_4$–1 mm long. *Petals* imbricate at the apex, otherwise valvate, ovate-oblong, *c.* $3^1/_2$ by $1^1/_2$ mm, veins invisible, glabrous. *Stamens* 2 mm; anthers broad-ellipsoid, *c.* $^1/_2$ mm ∅. *Disk* round, flat, *c.* 1 mm ∅, glabrous (except the pilose central part or rudimentary pistil). *Ovary* subglobose, *c.* 1 mm ∅, densely pubescent; style *c.* $^1/_2$ mm. *Drupe* obliquely broadly obovoid, *c.* $1^1/_2$ by $1^1/_4$ cm, glabrous; apex obtuse; hypocarp obconical, *c.* $^3/_4$ by $^1/_2$ cm.

Distr. Andamans and *Malesia:* Malay Peninsula (Perak and Pahang).

Ecol. Lowland forest, up to 240 m. *Fl.* March.

10. Semecarpus forstenii BL. Mus. Bot. 1 (1850) 188; MIQ. Fl. Ind. Bat. 1, 2 (1859) 626; ENGL. in DC. Mon. Phan. 4 (1883) 486; MERR. Int. Rumph. (1917) 334; LAUT. Bot. Jahrb. 56 (1920) 370; HEYNE, Nutt. Pl. (1927) 891; DE WIT, Rumph. Mem. Vol. (1959) 405. — *Cassuvium silvestre s. Lau Lassi* (*e Ternate*) RUMPH. Herb. Amb. 1 (1741) 180. — *S. roxburghii* BL. Mus. Bot. 1 (1850) 188; MIQ. Fl. Ind. Bat. 1, 2 (1859) 629; ENGL. in DC. Mon. Phan. 4 (1883) 485. — *S. scabrida* BL. Mus. Bot. 1 (1950) 189, *incl. var. elongata* BL.; MIQ. Fl. Ind. Bat. 1, 2 (1859) 627; ENGL. in DC. Mon. Phan. 4 (1883) 485. — *S. congestiflora* K.SCH. & LAUT. Fl. Schutzgeb. (1900) 412, *p.p.* — *S. laxiflora* K.SCH. in K.Sch. & Laut. Fl. Schuztgeb. Nachtr. (1905) 302; LAUT. Bot. Jahrb. 45 (1911) 361, *incl. var. glabrescens* LAUT.; Nova Guinea 8 (1912) 830; Bot. Jahrb. 56 (1920) 372; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 169. — *S. uncata* SLIS, Nova Guinea 14 (1924) 98, t. 8; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 170. — *S. decipiens* MERR. & PERRY, J. Arn. Arb. 22 (1941) 539; KRAEMER, Trees W. Pac. Reg. (1951) 204, f. 72.

Tree 8–40 m high and 10–53 cm ∅. Bark greyish, greenish brown, or reddish brown, smooth. *Leaves* spaced, spiral, chartaceous to subcoriaceous, elliptic-oblong to -lanceolate, sometimes obovate-oblong, (7–)14–37 by $(3^1/_2$–$)5^1/_2$–$13^1/_2$ cm; upper surface glabrous; lower surface glabrous, sometimes sparsely puberulous or pubescent; papillae distinct, covering the lower surface except the midrib, nerves, veins, and veinlets (seemingly being separated into small groups); base cuneate; apex acute, sometimes obtuse, or abruptly acuminate; nerves 10–24 pairs, prominent beneath, flat and distinct above; veins reticulate, or transverse and subparallel, distinct beneath, distinct or faint above; petiole 1–$3^1/_2$ cm. *Panicles* terminal, rarely also axillary, $(4^1/_2$–$)9$–30 cm long, pubescent; lateral branches obliquely ascending, up to 22 cm; bracts lanceolate, *c.* 1 mm long; pedicels 0 or very short. Flower-buds subglobose. *Calyx* lobes triangular, $^1/_2$–$^2/_3$ mm long. *Petals* white, imbricate, ovate-oblong or slightly elliptic, 2–$2^1/_2$ by 1–$1^1/_2$ mm, puberulous outside, with *c.* 7 longitudinal veins. *Stamens* $2^1/_2$ mm; anthers broad-ovoid, $^1/_2$–$^2/_3$(–1) mm long. Imperfect or sterile stamens in ♀ $1^1/_2$ mm. *Disk* round, flat, $^2/_3$–1 mm ∅, pilose above. *Ovary* subglobose, $1^3/_4$ mm ∅, velutinous; styles *c.* $^1/_2$ mm long. *Drupe* broad-ellipsoid, or -obovoid, rarely ± transverse-oblong, 3–4 by 2–$3^1/_2$ cm, velutinous, glabrescent; apex apiculate or slightly rostrate; hypocarp obconical, $^3/_4$–1 by $^1/_2$–1 cm.

Distr. Solomon Is. (throughout but scattered); *Malesia:* Borneo, Philippines, Celebes, Moluccas, New Guinea, and Bismarck Archipelago. Fig. 52.

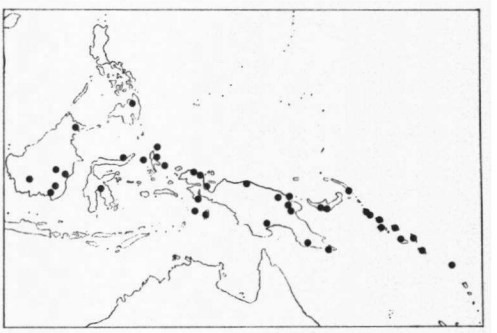

Fig. 52. Localities of *Semecarpus forstenii* BL.

Ecol. Lowland forest up to 800 m, sometimes up to 1200 m, rarely in occasionally inundated areas, or on limestone. *Fl. fr.* May–Jan.

Uses. HEYNE *l.c.* recorded the wood useful for prahus in the Moluccas.

Vern. Celebes: *sibotu*, Muna; Moluccas: *laulasi*, Ternate, *sèsè*, Halmaheira, *tafal*, Aru; New Guinea: *beng-geng*, Hattam, *ruruas*, Numfoor, *sanapajaar*, Wandammen, *sij & sijkwa*, Manikiong.

11. Semecarpus albicans LAUT. Bot. Jahrb. 59 (1925) 536.

Tree (3–)15–20 m high. Bark brownish, fissured. *Leaves* spaced, spiral, chartaceous, elliptic or elliptic-lanceolate, rarely obovate-oblong, 5–8(–18) by 2–$3^1/_2$(–$6^1/_2$) cm, glabrous except sometimes with short, stellate hairs beneath; papillae distinct, rather uniformly covering the lower surface except midrib and nerves; base cuneate; apex obtuse, acute, sometimes shortly acuminate; nerves 5–10 pairs, slightly elevated beneath, flat above; veins reticulate, rather faint beneath, obscure above; petiole 1–$1^1/_2$(–3) cm. *Panicles* terminal and/or

axillary at the upper part of the twigs, 4–11 cm long, puberulous; lateral branches obliquely ascending, 3–7 cm; bracts triangular or ovate, 1/3–1 mm long; pedicels 0 (♀ flower after falling leaving a stalk of 3–5 mm). Flower-buds globose. *Calyx* lobes triangular, *c.* 1/3 mm long. *Petals* imbricate, elliptic, 2–2 3/4 by 1–1 1/2 mm, puberulous outside, with *c.* 7 longitudinal veins. *Stamens c.* 2 mm long; anthers ovoid, *c.* 1/2 mm long. Imperfect or sterile stamens in ♀ 3/4–1 1/4 mm. *Disk* round, flat or slightly convex above, *c.* 3/4 mm ∅ in ♂ (*c.* 2 mm ∅ in ♀), pilose above. *Ovary* subglobose, *c.* 1 1/2 mm ∅, densely puberulous; styles 2/3 mm. *Drupe* depressed-globose, 2 cm long and wide, puberulous, glabrescent; apex apiculate; hypocarp 1 1/2 by 3/4–1 1/4 cm.

Distr. *Malesia:* New Guinea (Augusta R.; Babo, Rossel, and Sudest Is.).

Ecol. Forests, 10–400 m. *Fl.* Aug.; *fr.* Oct.

12. Semecarpus paucinervius MERR. Philip. J. Sc. 7 (1912) Bot. 286; En. Philip. 2 (1923) 475; DING HOU, Blumea 24 (1978) 36. — *S. obtusata* ELMER, Leafl. Philip. Bot. 5 (1913) 1752; MERR. En. Philip. 2 (1923) 475.

Tree up to 20 m high and 60 cm ∅. *Leaves* spaced, spiral, chartaceous to subcoriaceous, obovate-oblong, 5–12 1/2 by 2–5 1/2 cm, upper surface glabrous; lower surface sparsely puberulous on nerves and veins, glabrescent; papillae rather compact, covering the lower surface except the midrib, nerves, and veins; base cuneate; apex rounded or obtuse; nerves 5–10 pairs, prominent beneath, faint, sometimes distinct above; veins reticulate, distinct beneath, faint above; petiole 1/2–1 3/4 cm. *Panicles* terminal and also in the upper leaf axils, 12–22 cm long, sparsely puberulous, glabrescent; lateral branches obliquely ascending, up to 12 cm; bracts lanceolate, 3/4–1 3/4 mm long; pedicels *c.* 1/2 mm (after falling the flower leaves a distinct stalk 1 1/2–8 mm long). Flower-buds globose. *Calyx* lobes triangular, 1/2–1 mm long. *Petals* imbricate, ovate-oblong or elliptic, 2–4 by 1–2 mm, sparsely puberulous outside with several distinct, longitudinal veins. *Stamens* 3 mm; anthers broad-ovoid, 3/4 mm long. Imperfect or sterile stamens in ♀ 1 1/2–2 1/2 mm. *Disk* round, flat, 1–1 1/2 mm ∅, pilose above. *Ovary* dome-shaped, 2 mm ∅, pubescent; styles *c.* 1 1/4 mm. *Drupe* subglobose, *c.* 2/3 cm ∅, pubescent; apex obtuse or rounded; hypocarp obconical, *c.* 2/5 by 1/5 cm.

Distr. *Malesia:* Philippines (Palawan: Mt Pulgar and Mt Victoria) and Borneo (Sabah: Kudat and Kota Belud).

Ecol. Lowland primary forest, sometimes along streams, rarely in sand dunes along the seashore. *Fl.* Febr., April; *fr.* May.

Note. This species can be recognized by the obovate-oblong leaves with rounded or obtuse apex and only 5–10 pairs of nerves, and the subsessile flower which after falling leaves a distinct stalk (1 1/2–8 mm long).

13. Semecarpus australiensis ENGL. in DC. Mon. Phan. 4 (1883) 482; BAILEY, Queensl. Fl. 1 (1899) 323; LAUT. Bot. Jahrb. 56 (1920) 366; WHITE & FRANCIS, Proc. R. Soc. Queensl. 38 (1927) 237; DOMIN, Bibl. Bot. 22 (1927) 892; C. T. WHITE, J. Arn. Arb. 10 (1929) 234. — *S. congestiflora* K.SCH. & LAUT. Fl. Schutzgeb. (1900) 412, *p.p.*; LAUT, Bot. Jahrb. 56 (1920) 366.

Tree (7–)15–24(–40) m high and (8–)27–60(–80) cm ∅, occasionally with short buttresses, rarely myrmecophilous. Bark variously light grey, fawn, or brown, rather smooth, or scaly. *Leaves* spaced, spiral, coriaceous or chartaceous, elliptic-oblong, broad-elliptic, sometimes obovate-oblong, 11–32 by 7–17 cm (up to 41 by 18 cm on a vegetative branch), glabrous, sometimes sparsely hairy on the nerves and veins beneath; papillae distinct, rather compact, covering the lower surface except the midrib, nerves, and veins; base cuneate; apex obtuse, sometimes slightly apiculate; nerves 10–22 pairs, conspicuous beneath, distinct above; veins reticulate, or transverse and subparallel, distinct beneath, faint above; petiole (1–)2 1/2–3 cm. *Panicles* terminal, sometimes also in the leaf axils at the end of twigs, rarely cauligerous, 14–35 cm long, puberulous, glabrescent; lateral branches obliquely ascending, up to 12(–20) cm; bracts triangular, 2/3 mm long; pedicels up to 3 mm. Flower-buds subglobose. *Calyx* lobes triangular, 1/2–2/3 mm long. *Petals* white or cream-white, imbricate, ovate, ovate-oblong, 2 1/2–4 by 1 1/2–2 mm, puberulous outside, with *c.* 10 distinct, longitudinal veins. *Stamens* 3 mm; anthers broad-ovoid, 2/3 mm long. Imperfect or sterile stamens *c.* 2 mm. *Disk* round, flat, 1 1/2–2 mm ∅, covered sparsely with inflexed hairs except the central part or rudimentary pistil with erect hairs in ♂, or velutinous in ♀, usually glabrescent. *Ovary* subglobose, 2 mm ∅, densely pubescent; styles 1 mm. *Drupe* subglobose, 2–3 1/2 by 3–5 cm, almost glabrous; apex slightly apiculate; hypocarp funnel-shaped, 1/2–1 1/2 by 1 1/4–2 cm.

Distr. Australia (Cape York, Yirrkaka, Rockingham Bay); in *Malesia:* Aru Is., New Guinea (Gelieb, Fly R., Merauke, Isuarava, Morobe Distr., Sepik, Central Distr., Milne Bay Distr.; Normanby I.), and New Britain.

Ecol. In rain- and monsoon-forest, occasionally in secondary forest and on limestone terraces, usually in the lowland, sometimes at 450–1350 m. *Fl.* March–Aug.; *fr.* Febr., June–Nov.

Vern. New Guinea: *doga*, Gelieb, *ekipatila*, Doura, *hombigo*, Orokaiva, *huna*, Suku, *ingas*, *marint*, *nengaroro*, Sepik, *uwe*, Wapi.

Note. The size of the leaves on the flowering twig of DARBYSHIRE 282 (L) varies from 13 by 6 cm to 27 by 9 1/2 cm and one detached leaf on that specimen measures 41 by 18 cm.

14. Semecarpus cassuvium ROXB. (Hort. Beng. 1814, 22; SPRENG. Syst. Veg. 1, 1825, 936) Fl. Ind. ed. Carey 2 (1832) 85; BL. Mus. Bot. 1 (1850) 187; MIQ. Fl. Ind. Bat. 1, 2 (1859) 626; ENGL. in DC. Mon. Phan. 4 (1883) 487; C. B. ROB. Philip. J. Sc. 7 (1912) Bot. 413 & 418; MERR. Int. Rumph. (1917) 334; HEYNE, Nutt. Pl. (1927) 980; BURK. Dict. (1935) 1991; DE WIT, Rumph. Mem. Vol. (1959) 404. — *Cassuvium silvestre* RUMPH. Herb. Amb. 1 (1741) 179, t. 70. — *Anacardium longifolium* LAMK, Encycl. 1 (1783) 139, *quoad syn. Rumph.* — *S. anacardium var. angustifolium* DC. Prod. 2 (1825) 62.

Tree, sometimes treelet, 4–26 1/2 m high and 3–40 cm ∅, sometimes myrmecophilous. *Leaves* spaced, spiral, chartaceous to subcoriaceous,

elliptic, elliptic-lanceolate, or obovate-oblong, 15–22 by $7^1/_2$–$10^1/_2$ cm; upper surface glabrous; lower surface glabrous, sometimes sparsely puberulous, glabrescent; papillae distinct, covering lower surface except the midrib, nerves, and some of the veins; base cuneate; apex acute or acuminate, sometimes obtuse, rarely slightly emarginate; nerves 10–26 pairs, prominent beneath, distinct above; veins reticulate-scalariform, distinct on both surfaces, sometimes faint above; petiole 2–4 cm. *Panicles* terminal, 10–31(–60) cm long, pubescent, glabrescent; lateral branches obliquely ascending, up to 15(–28) cm; bracts triangular, 1–$1^1/_2$ mm long; pedicels 0–1 mm. Flower-buds globose. *Flowers* white. *Calyx* lobes triangular, $^3/_4$–1 mm long. *Petals* imbricate, ovate or ovate-oblong, 2 by 1–$1^1/_4$ mm in ♂ ($3^1/_2$–$4^1/_2$ by $1^1/_4$–3 mm in ♀), puberulous outside, with *c.* 12 rather faint, longitudinal veins. *Stamens* 2–$2^1/_2$ mm; anthers broad-ovoid, *c.* $^1/_2$ mm long. Imperfect or sterile stamens in ♀ *c.* 2 mm. *Disk* round, flat, or shallowly dish-shaped, *c.* 1 mm ∅ in ♂ ($3^1/_2$ mm ∅ in ♀), covered with inflexed hairs in ♂, velutinous in ♀. *Ovary* dome-shaped, *c.* $2^1/_2$ mm ∅, velutinous; styles *c.* 1 mm. *Drupe* broad-obovoid, sometimes transverse-oblong, 2–$2^3/_4$ by $1^3/_4$–3 cm, velutinous, sometimes glabrescent; concave at the top; hypocarp discoid, $^1/_2$–1 by 1–2 cm.

Distr. *Malesia:* Lesser Sunda Is. (Sumba, once), Celebes (one coll., unlocalized), Moluccas (Morotai, Sula Is., Ceram, Ambon, Buru I., Banda), and New Guinea (Lorentz R., Asmat region, Canys R., Sepik, Morobe, Northern, Eastern and Milne Bay Districts, and Normanby I.).

In Herb. Bog. there is a collection, TEYSMANN 2344 HB, said to have come from Sumatra. I assume it is mislocalized.

Ecol. In lowland primary forest, sometimes up to 600 m, occasionally found on level land inundated in the wet season, or in secondary forest at 15–60 m. *Fl.* March—June, Sept.; *fr.* June–July, Oct.

Uses. RUMPHIUS reported that the smallish hypocarp remains green and is eaten; the very young (white) leaves can be eaten raw, although otherwise the sap of every part is very poisonous; it is used as a black dye in the Moluccas (HEYNE *l.c.*).

Vern. Lesser Sunda Is.: *rotta*, Sumba; Moluccas: *enga*, Mangoli, *kayu saku, lenat, linat, rinat*, Ambon, *lewer*, Banda; New Guinea: *akah*, Asmat, *duapua*, Upper Waria, *hombigo*, Orokaiva lang., *wunyup*, Sepik Distr.

15. Semecarpus curtisii KING, J. As. Soc. Beng. 65, ii (1896) 509; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 91; HEND. Gard. Bull. S. S. 3 (1924) 290, *incl. var. brevipetiolata* HEND.; RIDL. Fl. Mal. Pen. 5 (1925) 302. — **Fig. 48d–f, 53.**

Small tree, (*c.* $3^1/_2$–)5–10 m high, rarely unbranched. *Leaves* spaced, spiral, coriaceous, obovate-oblong, oblanceolate, sometimes spathulate, (11–)$23^1/_2$–49(–100) by ($4^1/_2$–)7–12(–20) cm; upper surface glabrous; lower surface glabrous,

Fig. 53. *Semecarpus curtisii* KING, in fruit, held by Dr D. LEE, June 1975; Ulu Langat, above Pansoon, at *c.* 100 m altitude. Unbranched treelet, *c.* $3^1/_2$ m high; fruit orange-yellow, hypocarp soft, fleshy (Photogr. VAN BALGOOY (2635)).

sometimes sparsely puberulous on midrib, nerves, and veins; papillae distinct, covering the lower surface except the midrib, nerves, and thicker veins; base cuneate to attenuate; apex shortly acuminate, sometimes acute, rarely obtuse; nerves 14–38 pairs, rarely more, prominent beneath, distinct above; veins reticulate, or some transverse and subparallel, slightly elevated on both surfaces; petiole (0–)2½–7½(–10) cm. *Panicles* terminal and often also in the leaf axils at the apical part of twigs, up to 57 cm long, puberulous, sometimes glabrescent, or glabrous; lateral branches obliquely ascending, up to 32 cm; bracts linear, 1–1½ mm; pedicels ⅓–½ mm long. Flower-buds subglobose. *Calyx* lobes triangular, ⅓–½ mm long. *Petals* imbricate, ovate-oblong or elliptic-oblong, sometimes lanceolate, 2½–3 by 1–1½ mm, sparsely puberulous outside, sometimes glabrescent, with several longitudinal veins. *Stamens* 1½–3 mm; anthers broad-ovoid, ½–⅔ mm long. Imperfect or sterile stamens in ♀ 1–1½ mm. *Disk* round, flat, puberulous above, rarely glabrescent. *Ovary* subglobose, 1½–1⅔ mm ∅, densely puberulous; styles 1¼ mm. *Drupe* subglobose, or sometimes transverse-oblong, 1¼–1½ by 1½–1¾ cm, sparsely puberulous; apex rounded; hypocarp discoid or short-cupular, ¾–1¼ by 1½ cm.

Distr. Peninsular Thailand and *Malesia:* Malay Peninsula (Perlis, Kedah, Pahang, Selangor, Negri Sembilan, Johore, Singapore, and Langkawi Is.).

Ecol. Lowland forest. *Fl.* Febr.–April, Aug., Sept., Dec.; *fr.* Nov.–May.

Field-note. I made the following notes on fresh material from Ulu Langat, Selangor, sent by Dr VAN BALGOOY (his coll. 2635): Fruits light yellowish, sparsely hairy, subglobose (*c.* 2 cm long and wide), the lower ⅔ cm united with the light orange, fleshy, short-cupular hypocarp (*c.* 1 cm long and 2¼ cm ∅).

16. Semecarpus heterophyllus BL. Mus. Bot. 1 (1850) 187, *incl. var. major* BL., *var. angusta* BL. *et var. recurva* BL.; MIQ. Fl. Ind. Bat. 1, 2 (1859) 625; ENGL. in DC. Mon. Phan. 4 (1883) 486; K. & V. Bijdr. 4 (1896) 124; BACK. Schoolfl. (1911) 284; BAKER, J. Bot. 62 (1924) Suppl. 30; RIDL. Fl. Mal. Pen. 5 (1925) 302; DOCT. v. LEEUWEN, Zoocecidia (1926) 326, f. 582; HEYNE, Nutt. Pl. (1927) 981; BURK. Dict. (1935) 1992; ADELB. Blumea 6 (1948) 326; BACK. & BAKH. *f.* Fl. Java 2 (1965) 154. — *S. anacardium* (*non* L. *f.*) BL. Bijdr. (1826) 1156. — *Melanochyla tomentosa* (*non* HOOK. *f.*) ENGL. in DC. Mon. Phan. 4 (1883) 470, *quoad* ZOLLINGER 800. — *S. albescens* (*non* KURZ) K. & V. Bijdr. 4 (1896) 129; BACK. Schoolfl. (1911) 284. — *S. cinerea* H. H. W. PEARSON, Kew Bull. (1906) 4. — *S. glabrescens* HEINE in Fedde, Rep. 54 (1951) 235; MEIJER, Bot. News Bull. F. D. Sandakan 8 (1967) 31.

Tree up to 22 m high and 60 cm ∅, rarely reaching to 32 m high and 110 cm ∅. Bark greyish brown, rather smooth. *Leaves* spaced, spiral, very variable in shape, texture, and size, subcoriaceous to coriaceous, elliptic to narrow-elliptic, obovate or oblanceolate, (3½–)11–62 by (1½–)5–18 cm; usually glabrous on both surfaces, sometimes sparsely puberulous beneath; papillae distinct, rarely obscure, covering the lower surface except the midrib, nerves, and thicker veins; base cuneate, or obtuse; apex acute, obtuse, sometimes apiculate, or slightly emarginate; nerves (6–)10–25 pairs, prominent beneath, distinct above; veins reticulate, or some transverse and subparallel, slightly elevated beneath, faint above; petiole ½–6(–9) cm. *Panicles* terminal and sometimes also axillary at the end of twigs, 10–47 cm long, tomentose, glabrescent; lateral branches obliquely ascending; bracts triangular, ½–1 mm long; pedicels 0. Flower-buds globose. *Calyx* lobes triangular, ½–1 mm long. *Petals* imbricate, ovate-oblong, or slightly elliptic, 2–4 by 1¼–2½ mm, puberulous outside, with *c.* 9 distinct, longitudinal veins. *Stamens* 2½–3½ mm; anthers broad-ovoid, *c.* ⅔ mm long. Imperfect or sterile stamens 1¾–2 mm. *Disk* round, flat, *c.* 1 mm ∅ in ♂ (*c.* 3 mm ∅ in ♀). *Ovary* subglobose, 1¼–3 mm ∅, densely puberulous; styles 1½ mm. *Drupe* subglobose, 1¾–2 by 1½–2 mm, sparsely puberulous, glabrescent; apex rounded; hypocarp discoid, ¾–1 by 1½–1¾ cm.

Distr. *Malesia:* Sumatra (Simalur I., Priaman, Lampong, Palembang), Malay Peninsula (Karimon I.), Java (scattered), Lesser Sunda Is. (Flores), Borneo (Sabah: Mt Kinabalu; Kalimantan: Sg. Mandai) and SW. Celebes (Baleh Angin).

Ecol. In forest, from the lowland up to 1800 m, under everwet or seasonal climatic conditions, common in teak forest in many places in Central and East Java from 0–500 m, usually in montane forest at 800–1200 m (rarely below 900 m) in West and Central Java, in Sabah exclusively on Mt Kinabalu from 1350–1800 m. *Fl. fr.* Jan.–Dec.

Vern. Sumatra: *lungas dělok, l. pajo,* Simalur; Java: *ingas, il bogom, i. kapur, i. kěbo, i. tělik, lěntang pěrit, yělik,* J, *rěngas,* S & J, *r. putih,* M, *r. gunung, r. wubung,* S.

17. Semecarpus bunburyanus GIBBS, J. Linn. Soc. Bot. 42 (1914) 67. — *S. subsessilifolia* MERR. Philip. J. Sc. 14 (1919) 411; En. Philip. 2 (1923) 475. —*S. oblanceolatus* MERR. J. Str. R. As. Soc. *n.* 86 (1921) 272. — *S. scaberulus* MERR. Un. Cal. Publ. Bot. 15 (1929) 169. — Fig. 47.

Tree (rarely unbranched treelet or shrub), (1½–)5–15 m high and 5–21 cm ∅ (young tree sometimes with divaricate spines, 3–5 cm long, near the base). *Leaves* spaced, spiral (sometimes subverticillate on unbranched treelets or shrubs), subcoriaceous to coriaceous, obovate-oblong to oblanceolate, rarely very narrow-oblanceolate, 15–49(–100) by (3½–)7½–17(–22) cm; upper surface glabrous; lower surface puberulous, sometimes hispidulous, usually glabrescent; papillae distinct, rarely compact and obscure, covering lower surface except the midrib and nerves; base cuneate to attenuate; apex acuminate, sometimes cuspidate; nerves (6–)18–35 pairs, prominent beneath, flat or slightly elevated above; veins reticulate-scalariform, elevated below, distinct, sometimes faint above; petiole (0–)½–4(–8) cm. *Panicles* terminal, up to 35 cm long, tomentose or pubescent, glabrescent; lateral branches obliquely ascending, up to 24 cm; bracts lanceolate, ⅓–¼ mm long; pedicels ⅓–1½ mm. Flower-buds oblong. *Flowers* greenish white or white. *Calyx* lobes triangular, ½–1 mm long. *Petals* valvate, elliptic, elliptic-oblong, or lanceolate, 3½–5 by 1–1¾ mm, glabrous rarely puberulous outside, with several longitudinal veins. *Stamens* 2½ mm; anthers

ovoid-oblong, (1–)$1^1/_4$–$1^1/_2$ mm long. Imperfect or sterile stamens $1^1/_2$ mm. *Disk* in ♂: round, flat, $^2/_3$–1 mm ∅, glabrous, rarely sparsely pilose above; in ♀: short-cupular, 2–$3^3/_4$ mm ∅, glabrous. *Ovary* conical, $1^1/_2$–2 mm ∅, pilose and/or papillose; styles $^3/_4$–1 mm. *Drupe* subglobose, $^3/_4$–2 by $^2/_3$–$1^1/_2$ cm, almost glabrous; apex rounded; hypocarp funnel-shaped or short-cupular, sometimes seemingly obconical and stalk-like when young, $^1/_2$–1 by $^1/_2$–$1^1/_2$ cm.

Distr. *Malesia:* Borneo (Sabah & Sarawak; Kalimantan: G. Muara Tagal, Sebuku R., Sg. Ikang, Kelai R., Kutai, Pembliangan, Samarinda) and Philippines (Panay, Palawan).

Ecol. Forest, usually at low and medium altitude, also at 1000–1500 m (Mt Kinabalu), sometimes in periodically inundated regions, occasionally found in ultrabasic areas and on coral limestone. *Fl.* Jan.–Dec.; *fr.* June, Nov.

Vern. Borneo: Sabah: *angas, bubunsa,* Dusun, *rĕngas badiri,* Kedayan, *r. bĕduri,* Bajau, *r. bĕlukar,* Kinabatangan; Kalimantan: *dessem,* eastern part, *rĕngas burung,* Kutai.

18. Semecarpus lucens KING, J. As. Soc. Beng. 65, ii (1896) 510; RIDL. Fl. Mal. Pen. 1 (1922) 543.

Tree up to 21 m high and 50 cm ∅. *Leaves* spaced, spiral, coriaceous, broad-elliptic, or obovate, 10–17 by $5^1/_2$–$9^1/_2$ cm; glabrous above; lower surface sparsely puberulous, glabrescent; papillae distinct, covering the lower surface, except the midrib, nerves, veins, and veinlets, usually surrounding the endings of veinlets and arranged in groups; base cuneate, sometimes unequal; apex obtuse, shortly and abruptly acuminate, or mucronate, rarely emarginate; nerves 10–15 pairs, conspicuous below, distinct above; veins reticulate, some transverse to the nerves; petiole $1^1/_2$–5 cm. *Panicles* terminal and axillary, sparsely puberulous, glabrescent, up to 28 cm long; lateral branches obliquely ascending, up to 15 cm; bracts lanceolate, $^1/_2$–$2^1/_4$ mm; pedicels *c.* $^1/_3$ mm. Flower-buds ± oblong. *Flowers* yellowish white. *Calyx* lobes triangular, $^1/_3$–$^1/_2$ mm long. *Petals* imbricate, ovate-oblong, *c.* 2 by 1 mm, glabrous, with several faint, longitudinal veins. *Stamens* $1^1/_2$–2 mm; anthers oblong, $^1/_2$–$^2/_3$ mm. Imperfect or sterile stamens in ♀ $^3/_4$–1 mm. *Disk* shallowly dish-shaped, $^3/_4$–$1^3/_4$ mm ∅, puberulous above. *Ovary* conical, *c.* 1 mm ∅, densely pubescent; styles *c.* $^3/_4$ mm long. *Drupe* (very young) ovoid, densely pubescent, with a stalk-like hypocarp.

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

Ecol. Forest, from the lowland up to 900 m. *Fl.* Jan., Oct.

19. Semecarpus glaucus ENGL. in DC. Mon. Phan. 4 (1883) 478, t. 15, f. 24 & 25. — Fig. 54.

Tree (rarely treelet), up to 25 m high and 18 cm ∅. Bark grey-brown, smooth. *Leaves* spaced, spiral, subcoriaceous, elliptic-oblong or narrow-elliptic, sometimes oblanceolate, (7–)$12^1/_2$–$26^1/_2$ (–46) by ($2^1/_2$–)$4^1/_2$–$8^1/_2$(–13) cm; upper surface glabrous except the tomentose midrib; lower surface tomentose, usually glabrescent; papillae distinct, rarely obscure, covering the lower surface except the midrib and nerves; base cuneate to attenuate; apex acuminate, sometimes short-acuminate, rarely cuspidate; nerves 10–17 pairs, prominent below, distinct above; veins reticulate, distinct on both surfaces, sometimes faint above; petiole $^1/_2$–$1^1/_2$(–$4^1/_2$) cm. *Panicles* terminal, 11–35 cm long, tomentose; lateral branches obliquely ascending, $2^1/_2$–20 cm; bracts linear, $1^1/_2$–3 mm long; pedicels up to $2^1/_4$ mm. Flower-buds oblong or ellipsoid. *Flowers* yellowish green. *Calyx* lobes triangular, $^1/_3$–$^2/_3$ mm long. *Petals* valvate, elliptic-oblong or -lanceolate, sometimes ± oblong, $3^1/_2$–5 by 1–$1^1/_2$ mm, puberulous outside, with several faint or obscure, longitudinal veins. *Stamens* $3^1/_2$–5 mm; anthers oblong, $^1/_2$–$^3/_4$ mm long. Imperfect or sterile stamens $2^1/_2$ mm. *Disk* short-cupular, $^3/_4$–$1^1/_4$ mm ∅ in ♂ (*c.* 2 mm ∅ in ♀), velutinous inside. *Ovary* dome-shaped, *c.* 2 mm ∅, velutinous. *Drupe* (young) broad-ellipsoid, 1 by $^4/_5$ cm, velutinous, glabrescent; apex obtuse; hypocarp discoid, $^2/_5$ by $^1/_2$ cm.

Distr. *Malesia;* Borneo, widely distributed but scattered, in Sarawak, Sabah, and Kalimantan.

Ecol. Lowland forest, mixed peat-swamp forest, or inundated placed along river-banks, rarely on limestone hills, up to 450 m. *Fl.* Dec.–Aug.; *fr.* March, July, Sept.

Vern. *Kĕrawas kĕlulut, rĕngas,* Iban.

20. Semecarpus rufovelutinus RIDL. Kew Bull. (1933) 199. — *Melanocommia borneensis* RIDL. *l.c.* 198.

Tree up to 7 m high and 15 cm ∅, rarely up to 20 m high. Bark brownish, irregularly fissured. *Leaves* spaced, spiral, coriaceous, elliptic to elliptic-lanceolate, obovate or obovate-oblong, 10–$32^1/_2$ by 6–$11^1/_2$ cm, glabrous above, velutinous beneath; papillae distinct, covering the lower surface except the midrib and nerves; base obtuse; apex acute, short-acuminate, cuspidate, rarely rounded; nerves 10–20 pairs, conspicuous beneath, distinct above; veins reticulate, some cross-bar-like and subparallel; petiole $^1/_2$–$2^3/_4$ cm. *Panicles* terminal and sometimes also axillary, 7–34 cm long, velutinous; lateral branches obliquely ascending, $1^1/_2$–19 cm; bracts lanceolate to narrow-lanceolate, 1–4 mm long; pedicels up to 1 mm. Flower-buds oblong. *Calyx* lobes triangular, $^3/_4$–1 mm long. *Petals* valvate, ovate-oblong or lanceolate, $2^1/_2$–$3^1/_2$ by $^2/_3$–$1^1/_4$ mm, puberulous outside, with several longitudinal veins. *Stamens* $4^1/_2$ mm; anthers ovoid or oblong, $^3/_4$ mm long. Imperfect or sterile stamens in ♀ 3 mm. *Disk* short-cupular, 1–$1^1/_2$ mm ∅ in ♂ (*c.* $2^1/_4$ mm ∅ in ♀), pilose on the inner surface. *Ovary* subglobose, *c.* 2 mm ∅, velutinous; styles $1^1/_4$ mm. *Drupe* subglobose, 1–$1^1/_2$ by $1^1/_2$–$1^3/_4$ cm, velutinous; apex rounded; hypocarp discoid or short-cupular, *c.* $^1/_3$ by $1^1/_4$–$1^1/_2$ cm.

Distr. *Malesia;* Borneo (Sabah: Beaufort; Sarawak: Miri, 85 km upstream from Marudi, Upper Rejang R., Bintulu, Baram, Kapit, Bau; Kalimantan: Sanggau, Mt Kenepai, Mt Klam).

Ecol. Chiefly in lowland forest, sometimes up to *c.* 500 m, occasionally in thick secondary forest on steep slopes of river valley or on limestone. *Fl.* March, July, Sept.; *fr.* July–Aug.

Vern. *Godonong, rangas,* Iban, *nga,* Brawan.

21. Semecarpus bracteatus LAUT. Bot. Jahrb. 56 (1920) 372; DING HOU, Blumea 24 (1978) 35,

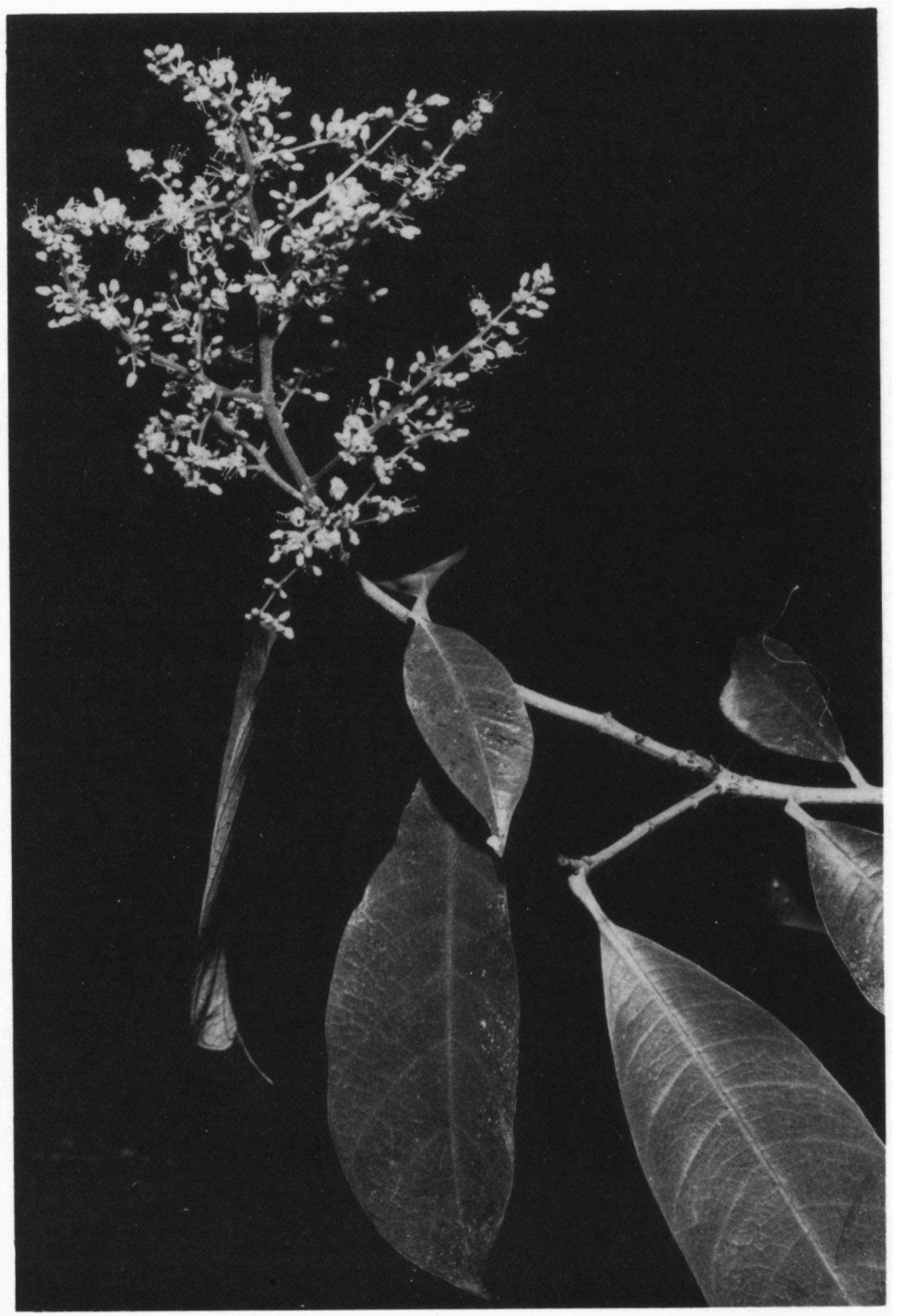

Fig. 54. *Semecarpus glaucus* ENGL. in flower. Kuching (Photogr. DING HOU (560)).

pl. III, 6. — *S. archboldianus* MERR. & PERRY, J. Arn. Arb. 22 (1941) 541.

Tree 21–32 m high and 42–80 cm ∅. Bark light yellowish brown, longitudinally fissured. *Leaves* spaced, spiral, rigidly coriaceous, rather brittle, obovate to oblanceolate, or elliptic-oblong, 9–38 by $4^1/_2$–$13^1/_2$ cm (up to 55–100 by 15–27 cm on vegetative branches); upper surface glabrous except the pubescent midrib; lower surface pubescent or puberulous; papillae distinct, covering the lower surface except the midrib, nerves, veins or veinlets; base cuneate or slightly obtuse; apex rounded or slightly apiculate; nerves 15–32 pairs, prominent beneath, impressed above; veins reticulate-scalariform, much elevated beneath, distinct above; petiole 1–$3^1/_2$(–6) cm. *Panicles* terminal, up to 30(–60) cm long, tomentose; lateral branches obliquely ascending, up to 13(–18) cm; bracts ovate or lanceolate, 2–4 mm long; pedicels 0. Flower-buds globose. *Calyx* lobes triangular, *c.* $^1/_2$ mm long in ♂ ($3^1/_2$–4 mm in ♀). *Petals* imbricate, elliptic, ovate, or ovate-oblong, *c.* 2 by 1 mm in ♂ (5 by $2^3/_4$ mm in ♀), sericeous outside, with *c.* 4 longitudinal veins. *Stamens* $3^1/_2$ mm; anthers broad-ovoid, $^2/_3$ mm long. Imperfect or sterile stamens *c.* 2 mm. *Disk* round, flat, *c.* 1 mm ∅ in (3–4 mm ∅ in ♀), pubescent above. *Ovary* globose, 3 mm ∅, velutinous; styles *c.* 2 mm *Drupe* subglobose, 2–4 by $2^1/_2$–$4^1/_2$ cm (up to $4^1/_2$–$6^1/_2$ cm ∅ in fresh state), velutinous; apex apiculate, sometimes concave at the top; hypocarp short-cupular, 1–$1^1/_4$ by 2–$2^1/_2$ cm.

Distr. *Malesia;* New Guinea (Idenburg R., Manokwari, Hollandia, Sorong, Madang Distr., Eastern Highlands Distr., Northern Distr., and Central Distr.).

Ecol. Primary lowland forest, on ridge slopes, along rivers, or in alluvial areas, up to 150 m, rarely at 1230–1950 m; occasionally in secondary forest. *Fl.* May, July, Oct.; *fr.* Febr., Aug.

There are many rusty-hairy, globose insect-galls, $^1/_3$–$^1/_2$ cm ∅, on the lower leaf surface of BW 2772.

Vern. *Bengeng*, Hattam, *inamonta*, Fore-Atigina, *nannto*, Anona, *owu*, Mooi, *rigi*, *rupei*, Nemo, *sij*, Manikiong.

22. Semecarpus aruensis ENGL. in DC. Mon. Phan. 4 (1883) 484. — *S. hirtiflora* RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 33. — *S. nubigena* LAUT. Bot. Jahrb. 56 (1920) 367. — *S. fulvo-villosa* LAUT. *l.c.* 371; MERR. & PERRY, J. Arn. Arb. 22 (1941) 538; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 169. — **Fig. 48a–c.**

Small tree, sometimes a shrub, 3–14 m high. Bark light brown, fissured. *Leaves* spaced, spiral, chartaceous or subcoriaceous, obovate to oblanceolate, sometimes narrow-oblanceolate, rarely elliptic, (10–)15–28(–$34^1/_2$) by ($3^1/_2$–)5–$8^1/_2$ (–15) cm; upper surface glabrous but sometimes pubescent on midrib, nerves, and veins; lower surface pubescent, papillae distinct, covering the surface except the midrib and nerves; base cuneate to attenuate, sometimes rounded; apex short-acuminate or slightly rostrate; nerves (10–)17–25 pairs, prominent beneath, slightly immersed or flat, sometimes faint above; veins reticulate, some oblique or perpendicular to the nerves, slightly elevated below, distinct sometimes faint above; petiole 1–2(–$3^1/_2$) cm. *Panicles* terminal and/or axillary, rarely raceme-like, $3^1/_2$–27(–38) cm long; lateral branches obliquely ascending, up to 4(–10) cm; bracts ovate or triangular, lanceolate, or linear, $1^1/_2$–$4^1/_2$ mm long; pedicels 0 or very short in ♂ (2 mm in ♀). Flower-buds subglobose. *Flowers* white. *Calyx* lobes triangular, $^1/_2$–1 mm long. *Petals* valvate, elliptic, or ovate-oblong, 2–3 by 1–$1^1/_2$ mm in ♂ (*c.* $4^1/_2$ by 2 mm in ♀), sericeous outside, with 6–10 longitudinal veins. *Stamens* $1^1/_2$–4 mm; anthers broad-ovoid, *c.* $^2/_3$ mm long. Imperfect or sterile stamens *c.* 2 mm. *Disk* round, flat, *c.* 1 mm ∅ in ♂ (*c.* $2^1/_2$ mm ∅ in ♀), densely pubescent above. *Ovary* subglobose, *c.* 2 mm ∅, velutinous; style $1^3/_4$ mm long. *Drupe* broad-ovoid or ovoid, 2–$3^1/_4$ by $1^1/_2$–2 cm, velutinous; apex short-acuminate; hypocarp obconical or pulvinate especially when young, 1–$1^1/_2$ by 1–$1^1/_2$ cm, sometimes deformed and discoid up to 2 cm ∅.

Distr. *Malesia:* Aru Is. and New Guinea (widely distributed but scattered).

Ecol. Lowland forest, sometimes on river-banks, up to 175 m, rarely up to 300 m. *Fl.* Febr.–Oct.; *fr.* Febr., March, Aug.–Nov.

The fruit has a pocket- or pit-like insect-shelter formed on the outer surface (see p. 399 and fig. 48c). So far, I found such an insect-shelter only on fruits of the present species.

23. Semecarpus rostratus VALETON, Bull. Dép. Agr. Ind. Néerl. 10 (1907) 29; Ic. Bog. 3 (1908) 151, t. 259; LAUT. Nova Guinea 8 (1910) 299; *ibid.* 8 (1912) 830; Bot. Jahrb. 56 (1920) 367; MERR. & PERRY, J. Arn. Arb. 22 (1941) 538.

Small tree up to 8 m high, or shrub 1–$1^1/_2$ m high. *Leaves* spaced, spiral, coriaceous, elliptic, obovate, or oblanceolate, 8–22(–29) by $3^1/_2$–8(–$9^1/_2$) cm; glabrous except the pubescent midrib and nerves above, densely or sparsely pubescent beneath, usually glabrescent; papillae distinct, covering the lower surface except the midrib, nerves, and veins; base cuneate; apex abruptly acuminate-rostrate (acumen up to 4 cm long); nerves 10–15 pairs, prominent below, distinct sometimes faint above; veins reticulate, some perpendicular to the nerves, distinct beneath, faint above; petiole $^3/_4$–$1^1/_4$(–3) cm. *Panicles* terminal rarely also axillary, sometimes seemingly racemose, 6–10 cm long, pubescent; lateral branches obliquely ascending, up to $4^1/_2$ cm; bracts lanceolate, $^3/_4$–$1^1/_2$ mm long; pedicels 0 or very short. Flower-buds globose. *Calyx* lobes triangular, $^1/_2$–$^2/_3$ mm long. *Petals* imbricate, ovate, sometimes elliptic, $1^3/_4$–$2^1/_2$ by 1–$1^1/_4$ mm, sericeous outside, with *c.* 7 longitudinal veins. *Stamens* $2^1/_2$–3 mm; anthers ovoid, $^1/_2$ mm long. Imperfect or sterile stamens in ♀ *c.* 2 mm. *Disk* round, flat, 1–2 mm ∅, velutinous above. *Ovary* conical, $1^1/_4$ mm ∅, velutinous; styles *c.* 1 mm. *Drupe* yellow, ovoid, $2^1/_2$ by 2 cm, velutinous, glabrescent; apex acuminate-rostrate; hypocarp obovoid, waxy yellow when fresh, $2^2/_3$ by $2^1/_3$ cm.

Distr. *Malesia:* New Guinea (Etna Bay, Fly R., Utumbuwe, Utakwa R. to Mt Carstensz, Uta, Merauke, Alkmaar, Gulf Distr.) and New Britain.

Ecol. Forest along river-banks, in swampy area, and in alluvial forest, up to 210 m. *Fl.* June–Sept.; *fr.* Dec.–Jan., May-June.

24. Semecarpus macrophyllus MERR. Bull. For. Bur. Philip. 1 (1903) 33; DING HOU, Blumea 24 (1978) 36. — *Oncocarpus macrophylla* C. B. ROB. Philip. J. Sc. 6 (1911) Bot. 340; MERR. En. Philip. 2 (1923) 476. — *S. surigaensis* MERR. Philip. J. Sc. 17 (1921) 272; En. Philip. 2 (1923) 475.

Tree up to 8 m high. *Leaves* spaced, spiral, subcoriaceous, obovate-oblong or elliptic, (17–) 21–46(–60) by (8–)13–20 cm; upper surface glabrous except the pubescent midrib and nerves; lower surface pubescent; papillae distinct, covering the lower surface, except the midrib and nerves; base cuneate; apex abruptly acuminate; nerves 16–22 pairs, prominent below, distinct above; veins reticulate, some ± perpendicular to the nerves, slightly elevated below, distinct above; petiole 1–3 cm. *Panicles* terminal, up to 50 cm long, tomentose, sometimes glabrescent; lateral branches obliquely ascending, up to 30 cm; bracts ovate, 1–2³/₄ mm long; pedicels 0 or very short. Flower-buds globose. ♂ *Flowers: Calyx* lobes triangular, ¹/₂–³/₄ mm long. *Petals* valvate, lanceolate or elliptic-lanceolate, 3 by 1 mm, sericeous outside, with *c.* 6 longitudinal veins. *Stamens* 2–3 mm; anthers ovoid, *c.* ²/₃ mm long. *Disk* shallowly dish-shaped, *c.* 1 mm ∅, pilose above. ♀ Flowers not seen. *Drupe* broadly obovoid, 2¹/₂–3¹/₂ by 2–2¹/₂ cm, velutinous; apex truncate; hypocarp pulvinate, ¹/₃ by ¹/₂ cm.

Distr. *Malesia:* Philippines (Butuan, Samar, Surigao, Mindoro).

Ecol. Forests on dryland or along streams, at low altitude. *Fl.* Oct.; *fr.* June.

25. Semecarpus densiflorus (MERR.) STEEN. Philip. J. Sc. 91 (1962) 508. — *Oncocarpus densiflorus* MERR. Philip. J. Sc. 11 (1916) Bot. 191; En. Philip. 2 (1923) 476.

Tree up to 10 m high and 50 cm ∅. *Leaves* spaced, spiral, subcoriaceous, obovate, obovate-oblong, or elliptic, 6¹/₂–15 by 3¹/₄–6 cm; above glabrous except the sparsely puberulous midrib, beneath sparsely puberulous, usually glabrescent, papillae distinct, covering the surface except the midrib, nerves, and veins; base cuneate or attenuate; apex acute, sometimes abruptly acuminate; nerves 8–12 pairs, elevated beneath, distinct above; veins reticulate, distinct beneath, rather faint above; petiole ³/₄–1¹/₄ cm. *Panicles* terminal, sometimes also axillary, 3–7 cm long, densely tomentose; lateral branches obliquely ascending, up to 2¹/₂ cm; bracts ovate, ovate-elliptic, or elliptic, ¹/₂–2 mm long; pedicels 0. Flower-buds subglobose. ♂ *Flowers: Calyx* lobes triangular, *c.* 1 mm long. *Petals* imbricate, oblong-elliptic, 2¹/₂–4 by 1–1¹/₂ mm, sericeous outside, with *c.* 5 longitudinal veins. *Stamens* 3–5 mm; anthers *c.* ²/₃ mm long. *Disk* round, flat, *c.* 1 mm ∅, pilose above. ♀ Flowers not seen. *Drupe* (young) broad-obovoid, *c.* 1¹/₄ by ³/₄ cm, velutinous; apex obtuse; hypocarp pulvinate, *c.* ²/₃ cm long and wide.

Distr. *Malesia:* Philippines (Sorsogon, Albay, San Mateo, and Surigao).

Ecol. Forest, up to 800 m. *Fl.* May, Sept., Nov.; *fr.* Febr.–March, June.

Vern. *Matapok*, Samar.

26. Semecarpus cochinchinensis ENGL. in DC. Mon. Phan. 4 (1883) 489; RIDL. Fl. Mal. Pen. 1 (1922) 542; TARD. Fl. C. L. & V. 2 (1962) 160, t. 12, f. 2–5. — *S. glomerulata* RIDL. J. Str. Br. R. As. Soc. *n.* 54 (1910) 39 & 91; *ibid. n.* 59 (1911) 91; Fl. Mal. Pen. 1 (1922) 542.

Tree 8–15 m high. *Leaves* spaced, spiral, subcoriaceous, obovate or obovate-oblong, 10–20 by 4–12¹/₂ cm; sparsely puberulous above, pubescent beneath, sometimes glabrescent; papillae distinct, covering the lower surface except the midrib, nerves, and thicker veins; base cuneate or attenuate; apex obtuse, sometimes slightly emarginate, or acute; nerves 9–16 pairs, elevated beneath, slightly elevated above; veins reticulate, distinct on both surfaces; petiole ¹/₂–2 cm. *Panicles* terminal, up to 52 cm long; densely tomentose; lateral branches obliquely ascending up to 35 cm; bracts triangular or lanceolate, ¹/₃–3 mm; pedicels very short, *c.* ¹/₆ mm. Flower-buds globose. *Calyx* lobes triangular, *c.* ¹/₂ mm long. *Petals* imbricate, ovate-oblong, 1³/₄–2¹/₂ by 1–1¹/₂ mm, glabrous rarely sparsely puberulous outside, with *c.* 8 longitudinal veins. *Stamens* 2–3 mm; anthers broad-ovoid, *c.* ¹/₂ mm long. Imperfect or sterile stamens in ♀ *c.* 1¹/₂ mm. *Disk* round, flat or slightly concave above, 1–1¹/₂ mm ∅, glabrous except the central part or rudimentary pistil pilose in ♂. *Ovary* subglobose, *c.* 1 mm ∅, pubescent; styles *c.* 1 mm. *Drupe* subglobose, ²/₃–1 by ²/₃ cm, sparsely hairy, glabrescent; apex rounded; hypocarp obconical, stalk-like, ¹/₃–¹/₂ by ²/₃ cm.

Distr. Scattered in Thailand, Cambodia, Laos, and Vietnam; in *Malesia:* Malay Peninsula (Langkawi, Perlis, Kedah).

Ecol. Lowland forest, open woods, near the shore, sometimes on limestone. *Fl.* Febr., Nov.; *fr.* March.

27. Semecarpus brachystachys MERR. & PERRY, J. Arn. Arb. 22 (1941) 540.

Tree 5–25 m high and 8–47 cm ∅, sometimes myrmecophilous. Buttresses occasionally present, thick, equal, up to *c.* 1 m high. Bark grey or light brown, flaky. *Leaves* spaced, spiral, subcoriaceous, oblanceolate, or elliptic, 15–55 by 11¹/₂–18 cm; sparsely puberulous (with short, simple and stellate hairs) or subglabrous on both surfaces; papillae distinct, covering the lower surface except the midrib, nerves, and veins; base cuneate or attenuate; apex obtuse or rounded, sometimes abruptly acuminate; nerves 22–32 pairs, conspicuous beneath, distinct above; veins reticulate, some cross-bar-like; petiole (1–)3–4¹/₂(–6) cm. *Panicles* terminal, up to 32 cm long, pubescent; lateral branches obliquely ascending, up to 23 cm; bracts triangular or lanceolate, 1¹/₄–5 mm long; pedicels 0. Flower-buds globose. *Flowers* greenish white or yellowish. *Calyx* triangular, *c.* ²/₃ mm long. *Petals* imbricate, ovate-oblong or elliptic, 2¹/₄–4¹/₂ by 1–3 mm, puberulous outside, with 15–20 longitudinal veins. *Stamens c.* 3 mm; anthers broad-ovoid, *c.* ²/₃ mm long. Imperfect or sterile stamens in ♀ *c.* 2 mm. *Disk* round, flat, *c.* 1 mm ∅ in ♂ (*c.* 3 mm ∅ in ♀), pilose above. *Ovary* dome-shaped, 3–3¹/₂ mm ∅, densely pubescent; styles *c.* 2 mm. *Drupe* orange-green when fresh, subglobose, 4¹/₂ by 3¹/₂–4¹/₂ cm, pubescent; apex rounded; hypocarp obconical, *c.* 1¹/₄ by 1 cm.

Distr. Solomon Is. (Choiseul, Vella Lavella, Gizo, Kolombangara, Santa Ysabel, Guadalcanal,

Malaita, San Cristoval) and *Malesia:* New Guinea (Nabire, Manokwari, Japen I., Lorentz R., Uta, Sepik Distr., Morobe Distr., Milne Bay Distr.).

Ecol. Well-drained lowland primary or secondary forest, sometimes on riversides and in swampy primary forest, up to 200 m. *Fl.* April–Dec.; *fr.* Aug.–Jan.

Vern. Solomon Is.: *kwailasi*, Kwara'ae name; New Guinea: *duapa*, Upper Waria, *sij*, Manikiong.

28. Semecarpus cuneiformis BLANCO, Fl. Filip. (1837) 220; ed. 2 (1845) 155; ed. 3, 1 (1877) 276, t. 75; MERR. Philip. J. Sc. 7 (1912) Bot. 279; Fl. Manila (1912) 299; Sp. Blanc. (1918) 235; BROWN, Min. Prod. Philip. For. 2 (1921) 320; MERR. En. Philip. 2 (1923) 473; BROWN, Useful Pl. Philip. 2 (1950) 344, f. 168. — *S. anacardium* (*non* L. *f.*) BLANCO, Fl. Filip. (1837) 216; ed. 2 (1845) 152; ed. 3, 1 (1877) 275. — *S. perrottetii* MARCH. Rév. Anacard. (1869) 169, *incl. var. glabra* MARCH.; ENGL. in DC. Mon. Phan. 4 (1883) 480; VIDAL, Rev. Pl. Vasc. Filip. (1886) 101; MERR. Bull. For. Bur. Philip. 1 (1903) 33; PERK. Fragm. Fl. Philip. (1904) 28. — *S. philippinensis* ENGL. in DC. Mon. Phan. 4 (1883) 481; VIDAL, Phan. Cuming. (1885) 106; Rev. Pl. Vasc. Filip. (1886) 101; MERR. Publ. Gov. Lab. Philip. *n.* 35 (1906) 75; Philip. J. Sc. 7 (1912) Bot. 290; En. Philip. 2 (1923) 475. — *S. albescens* (*non* KURZ) VIDAL, Phan. Cuming. (1885) 106; Rev. Pl. Vasc. Filip. (1886) 101; MERR. Publ. Gov. Lab. Philip. *n.* 35 (1906) 75; Philip. J. Sc. 1 (1906) Suppl. 85. — *S. elmeri* PERK. Fragm. Fl. Philip. (1904) 26; MERR. En. Philip. 2 (1923) 473. — *S. merrilliana* PERK. Fragm. Fl. Philip. (1904) 27; MERR. En. Philip. 2 (1923) 474. — *S. micrantha* PERK. Fragm. Fl. Philip. (1904) 27; MERR. Philip. J. Sc. 7 (1912) Bot. 290; En. Philip. 2 (1923) 474. — *S. taftiana* PERK. Fragm. Fl. Philip. (1904) 28. — *S. obtusifolia* MERR. Philip. J. Sc. 7 (1912) Bot. 286; En. Philip. 2 (1923) 475. — *S. whitfordii* MERR. Philip. J. Sc. 7 (1912) Bot. 288; En. Philip. 2 (1923) 475. — *S. megabotrys* MERR. Philip. J. Sc. 7 (1912) Bot. 285; En. Philip. 2 (1923) 474. — *S. pilosa* MERR. Philip. J. Sc. 7 (1912) Bot. 287. — *S. ferruginea* MERR. Philip. J. Sc. 14 (1919) 412; En. Philip. 2 (1923) 474. — *S. lanceolatus* RIDL. Kew Bull. (1933) 199 & 491, *non* MERR. 1912. —*S. thyrsoideus* ELMER, Leafl. Philip. Bot. 9 (1934) 3179. — *S. ridleyi* MERR. Webbia 6 (1950) 317, new name for *S. lanceolatus* RIDL.

Tree up to 20 m high and 50 cm ∅, rarely treelet 4 m high and 10 cm ∅. *Leaves* spaced, spiral, subcoriaceous or coriaceous, obovate-oblong or oblanceolate, elliptic or elliptic-lanceolate, rarely narrow-elliptic, 8–35 by 2–9 cm (up to 43 by 16 cm on vegetative twigs); upper surface glabrous, rarely sparsely puberulous, lower surface densely sometimes sparsely tomentose, pubescent or puberulous, glabrescent, rarely glabrous; papillae distinct, covering the lower surface except the midrib, nerves, and thicker veins; base cuneate, or obtuse; apex variable, acute, shortly and abruptly acuminate, obtuse, rounded, rarely retuse; nerves 11–25 pairs, prominent beneath, flat above; veins reticulate, some cross-bar-like, slightly elevated beneath, distinct or faint above; petiole $^1/_2$–$3^1/_2$(–5) cm. *Panicles* terminal, sometimes also axillary, up to 40 cm long, tomentose or pubescent; lateral branches obliquely ascending, up to 20 cm long; bracts ovate to linear, $^1/_3$–3 mm; pedicels 0 or very short. Flower-buds subglobose. *Flowers* greenish white. *Calyx* lobes triangular, $^1/_2$–1 mm long. *Petals* imbricate, ovate-oblong, or elliptic, $1^1/_2$–3 by $^2/_3$–$1^1/_2$ mm, puberulous outside, sometimes glabrescent, with several longitudinal veins. *Stamens* $2^1/_2$–3 mm; anthers broad-ovoid, *c.* $^2/_3$ mm long. Imperfect or sterile stamens in ♀ *c.* 1 mm. *Disk* round, flat sometimes slightly convex above, 1–2 mm ∅, pilose above. *Ovary* dome-shaped, *c.* 2 mm ∅, densely pubescent; styles *c.* 1 mm. *Drupe* ovoid or broad-ellipsoid, 1–$1^1/_4$ by $^3/_4$–1 cm, sparsely hairy, glabrescent; apex obtuse; hypocarp obconical, $^1/_2$–$^2/_3$ by $^1/_2$ cm.

Distr. *Malesia:* N. Borneo (Sabah: Lahad Datu, Mostyn, Semporna), Philippines (Palawan, Mindoro, Luzon, Romblon, Cebu, Leyte, Panay, Negros, Guimaras, Mindanao), Celebes (Manado, Gorontalo, Tomoni, Palopo, Tjamba, Bonthain, and the Kabaena, Muna & Buton Is.), and Lesser Sunda Is. (Sumbawa) and Formosa. Fig. 55.

Ecol. In dry thickets, primary and secondary forest in the lowland, sometimes up to 600–700 m, occasionally up to *c.* 1200 m. *Fl. fr.* Jan.–Dec.

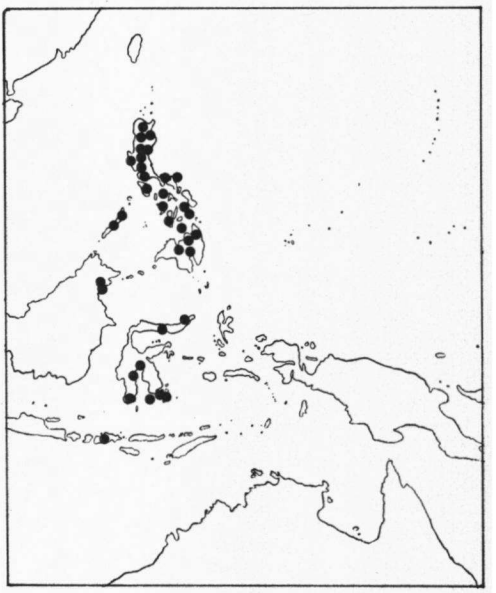

Fig. 55. Localities of *Semecarpus cuneiformis* BLANCO in Malesia.

Vern. (*fide* MERRILL, 1923) Philippines: *agás, anagás*, P.Bis., *britá*, Sub., *dañgá*, Bag., *duñgas, loñgás*, C.Bis., *hanagas, lañgás*, Bis., *ingas*, Bik., *kamling*, Sbl., *kaming, malamángga*, Pamp., *kamíding*, Ig., *kamlling*, Ting., *kamíring*, Ibn., Ilk., *libás*, Bon., Tag., *ligás*, Tag., Pamp., *pakan*, Bon.

29. Semecarpus velutinus KING, J. As. Soc. Beng. 65, ii (1896) 508; RIDL. Fl. Mal. Pen. 1 (1922) 541; TARD. Fl. C. L. & V. 2 (1962) 164.

Tree up to 18 m high. *Leaves* spaced, spiral, coriaceous, obovate-oblong, oblanceolate, rarely

elliptic, 12–29(–34½) by 6–11½ cm; glabrous above except the slightly pubescent midrib, velutinous beneath; papillae distinct, covering the lower surface except the midrib, nerves, and some thicker veins; base cuneate or attenuate; apex shortly and abruptly acuminate; nerves 15–24 pairs, prominent beneath, distinct above; veins reticulate-scalariform, elevated beneath, faint above; petiole ¾–4½ cm. *Panicles* terminal and axillary, up to 24 cm long; lateral branches obliquely ascending, up to 9 cm, tomentose; bracts triangular, ⅓–½ mm long; pedicels *c.* ⅔ mm. Flower-buds globose. ♂ *Flowers: Calyx* lobes triangular, ½ mm long. *Petals* imbricate, elliptic, *c.* 2 by 1 mm, puberulous outside, glabrescent, veins not visible. *Stamens* 2¼–3 mm; anthers broad-ovoid, *c.* ½ mm long. *Disk* round, flat, *c.* 1 mm ∅, pilose above. ♀ Flowers not seen. *Drupe* subglobose, 1–1½ by 1¼–1½ cm, velutinous; apex obtuse; hypocarp short-cupular or discoid, ¼–½ by 1–1⅓ cm.

Distr. S. Vietnam (TARDIEU, *l.c.*) and *Malesia:* Malay Peninsula (Perak, Selangor, Johore, Kemaman, Malacca) & Sumatra (E. & Riouw).

Ecol. Lowland forest. *Fl.* March–May; *fr.* March, Nov.

30. Semecarpus schlechteri LAUT. Bot. Jahrb. 56 (1920) 370. — *S. myrmecophila* LAUT. *l.c.* 366.

Tree 8–30 m high and 10–30 cm ∅, sometimes myrmecophilous. Bark fawn green, or pale brown, cracked or fissured. *Leaves* spaced, spiral, subcoriaceous or coriaceous, sometimes chartaceous, oblanceolate or obovate-oblong, (23½–)35–48 by (9–)14–18 cm; glabrous, sometimes sparsely puberulous beneath on midrib, nerves, and veins; papillae distinct, covering the lower surface except the midrib, nerves, and thicker veins; base cuneate; apex acute or acuminate, sometimes obtuse, rarely slightly emarginate; nerves 12–26 pairs, prominent beneath, slightly elevated or flat above; veins reticulate-scalariform distinct and slightly elevated on both surfaces; petiole 2½–4 cm. *Panicles* terminal, up to 55 cm long, pubescent; lateral branches obliquely ascending, up to 30 cm long; bracts triangular, ½–1 mm long; pedicels 0 in ♂ (2–3 mm in ♀). Flower-buds globose. *Flowers* pale green or cream-coloured. *Calyx* lobes triangular, *c.* ⅔ mm long. *Petals* imbricate, ovate-oblong, elliptic, or broad-ovate, 2¼ by ¾–1 mm in ♂ (4–5 by 2½–3 mm in ♀), puberulous outside, with *c.* 8 longitudinal veins. *Stamens* 2–3 mm; anthers ovoid, *c.* ⅔ mm long. Imperfect or sterile stamens in ♀ *c.* 2½ mm. *Disk* round, flat, 1–1½ mm ∅, pilose above. *Ovary* subglobose, *c.* 2 mm ∅, pubescent; styles 1¼ mm. *Drupe* obliquely obovoid, 3¼ by 1¾ cm, pubescent, glabrescent; apex obtuse; hypocarp short-cupular, *c.* 1¼ by 1½ cm.

Distr. *Malesia:* New Guinea (Obefia, Van Rees Mts, Hollandia, Mamberamo, Sepik, Madang, Morobe, Central, and Milne Bay Districts).

Ecol. Usually in lowland forest by streams, on edge of swamps, in inundated areas or on flat alluvial, sometimes in forest up to 1200 m. *Fl.* March–Nov.; *fr.* July.

Vern. *Bang*, Bembi, *barasi*, Garaina, *caube*, Dawa Dawa, *jukoh*, Rawa, *yuko*, Mongodia, *karra*, Kaigorin, *kombudane*, Gurumbu, *utur*, Mawan, *woilelesia*, Madang.

31. Semecarpus glauciphyllus ELMER, Leafl. Philip. Bot. 4 (1912) 1501; MERR. En. Philip. 2 (1923) 474; DING HOU, Blumea 24 (1978) 35. — *S. acuminatissima* MERR. Philip. J. Sc. 7 (1912) Bot. 282. — *S. oblongifolius* QUIS. Philip. J. Sc. 76 (1944) 43, *non* THW. 1859.

Undershrub or small tree, up to 3 m high and 2½ cm ∅, sometimes a tree up to 15 m high. Bark yellowish grey, smooth. *Leaves* spaced, spiral, chartaceous or subcoriaceous, elliptic-oblong to -lanceolate, sometimes obovate-oblong, or oblanceolate, (8–)20–30 by (3–)6–9 cm; glabrous rarely puberulous above, puberulous beneath; papillae rather compact, obscure, rarely distinct, covering the lower surface except the midrib, nerves, and veins; base acute or cuneate; apex acuminate or subcaudate; nerves 10–17 pairs, prominent beneath, flat above; veins reticulate, some perpendicular to nerves, slightly elevated beneath, faint above; petiole 1–2½ cm. *Panicles* terminal, 7–25 cm long, pubescent; lateral branches obliquely ascending, 2–10 cm; bracts lanceolate or linear, 1–1½ mm; pedicels ⅓ mm. Flower-buds globose. *Calyx* lobes triangular or broad-ovate, *c.* ½ mm long. *Petals* imbricate, ovate, rarely elliptic, 2–3 by 1–1½ mm, puberulous outside, with *c.* 8 longitudinal veins. *Stamens c.* 2½ mm; anthers ovoid, *c.* ⅔ mm long. Imperfect or sterile stamens in ♀ *c.* 1¼ mm. Disk round, flat, *c.* 1 mm ∅, pilose above. *Ovary* conical, densely pubescent, *c.* 1¼ mm ∅; styles *c.* 1 mm. *Drupe* subglobose, 1¼–1½ by 1½–1¾ cm, pubescent, glabrescent; apex obtuse; hypocarp pulvinate, *c.* ⅔ cm long and wide.

Distr. *Malesia:* Philippines (Tayabas, Sibuyan, Samar, Mindanao).

Ecol. Lowland forest, sometimes along rivers, up to *c.* 200 m. *Fl.* Jan.; *fr.* April–June, Dec.–Jan.

Vern. *Masukal*, Tag.

Cultivated

Semecarpus anacardium L. *f.*; *cf.* BURKILL, Dict. (1935) 1991.

An Indian tree introduced in Africa and eastwards to china. It is grown in the Botanic Garden at Singapore and may be found in cultivation in Malaya according to BURKILL, who gave abundant notes on it.

Doubtful

Semecarpus obovatus (ELMER) STEEN. Philip. J. Sc. 91 (1962) 508; DING HOU, Blumea 24 (1978) 37. — *Dichapetalum obovatum* ELMER, Leafl. Philip. Bot. 2 (1908) 483. — *Oncocarpus obovatus* MERR. Philip. J. Sc. 14 (1919) 413; En. Philip. 2 (1923) 476.

Described from a specimen with one immature fruit from Mt Banahao, Lucban, Tayabas Prov., Luzon (ELMER 7931), later supplemented with a ♂-flowered collection from the type locality (QUISUMBING 1346). It cannot be properly placed from the descriptions and no material has been traced.

Excluded

Semecarpus engleriana LAUT. in K.Sch. & Laut. Fl. Schutzgeb. Nachtr. (1905) 303; Bot. Jahrb. 55 (1920) 370; *cf.* DING HOU, Blumea 24 (1978) 38, belongs probably to a species of *Rhysotoechia* RADLK. (*Sapindaceae*).

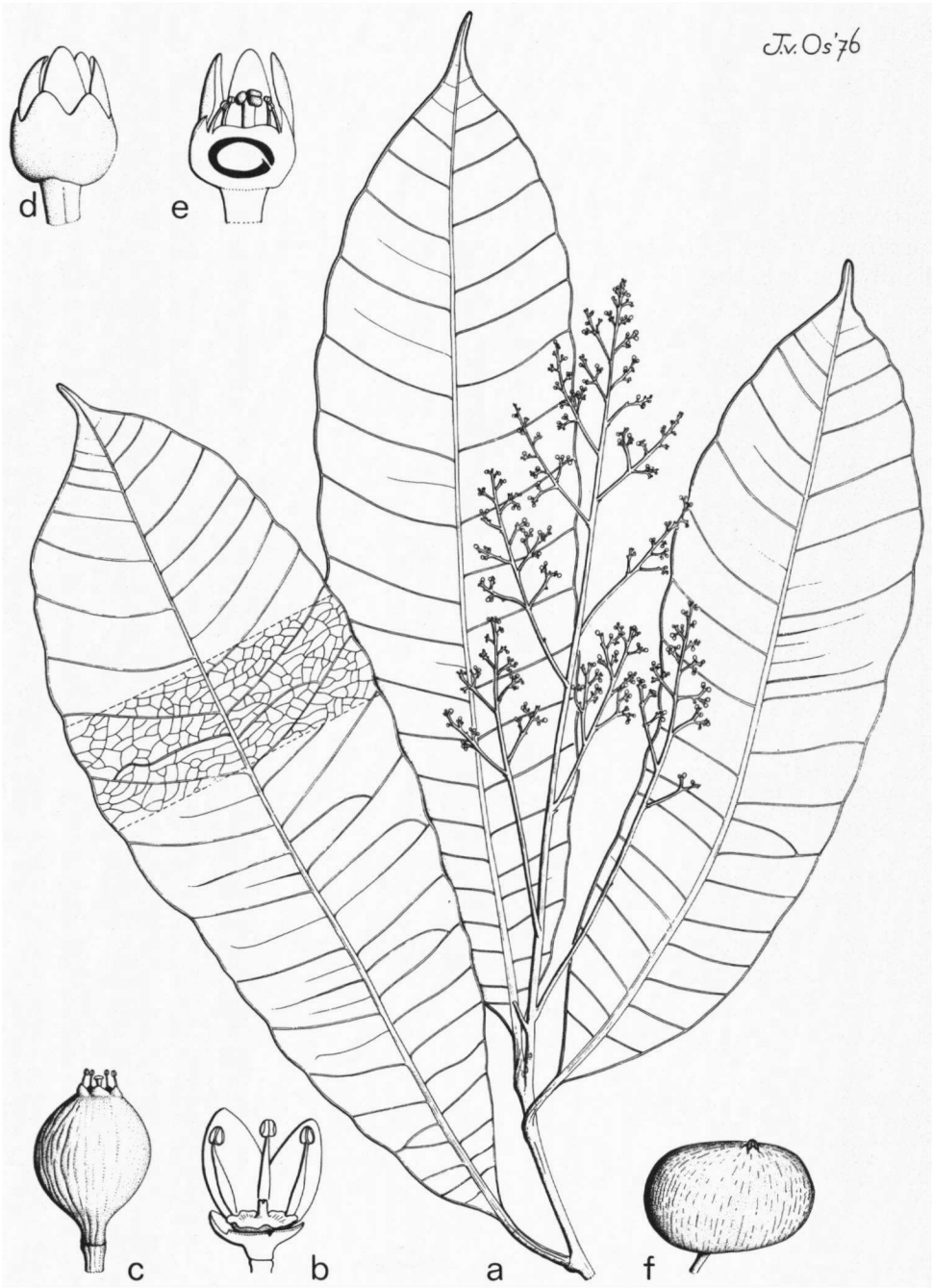

Fig. 56. *Drimycarpus luridus* (HOOK. *f.*) DING HOU. *a.* Habit, nat. size, *b.* ♂ flower (5-merous), 3 petals and 2 stamens removed, *c.* very young fruit crowned by the floral parts, 1 staminode removed, *d.* ♀ flower, *e. ditto* in LS, all × 7, *f.* young fruit, × $1^1/_2$ (*a* CURTIS 3594, *b* WRAY *f.* 3294, *c* SAN 36038, *d–e* VIDAL 5203, *f* KOSTERMANS 7231).

16. DRIMYCARPUS

HOOK. *f.* in B. & H. Gen. Pl. 1 (1862) 424; MARCH. Rév. Anacard. (1869) 67 & 171; ENGL. in DC. Mon. Phan. 4 (1883) 471. — **Fig. 56.**

Trees. *Leaves* spiral, petioled, simple, entire, with a rather thick, distinct marginal nerve, papillose beneath. *Inflorescences* axillary and/or terminal, paniculate, sometimes racemose. *Flowers* unisexual or rarely bisexual (plants dioecious or polygamous). *Calyx* 5-(or 4-)lobed. *Petals* 5 (or 4), imbricate, glabrous except sparsely short hairy on the margin. *Stamens* 5 (or 4); filaments subulate, glabrous; anthers dorsifixed, broadly ovoid, imperfect or abortive in ♀. *Disk* intrastaminal, round, slightly concave, 5-(or 4-)notched, glabrous. *Ovary* inferior, abortive and rudimentary in ♂, 1-celled and 1-ovuled; style short, cylindric; stigmas 3, capitate. *Drupe* 1-celled, crowned with remaining floral parts, mesocarp resinous; endocarp coriaceous. *Seed* with testa adherent to the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. Two or more *spp.*, distributed in India, Sikkim, Bhotan, Burma, Thailand, Vietnam, and *Malesia* (Sumatra, Malay Peninsula, Borneo).

Ecol. Forest from the lowland up to 1000 m (rarely up to 2000 m in Sikkim).

Note. In sterile state specimens of *Melanochyla*, *Mangifera*, and *Semecarpus* can hardly be distinguished to the genus. Also sterile specimens of *Drimycarpus* are very similar, but they can be sorted out by the presence of a distinct marginal nerve, which does not occur in the other genera.

1. Drimycarpus luridus (HOOK. *f.*) DING HOU, Blumea 24 (1978) 6. — *Semecarpus lurida* HOOK. *f.* Fl. Br. Ind. 2 (1876) 34; ENGL. in DC. Mon. Phan. 4 (1883) 496. — *Swintonia lurida* KING, J. As. Soc. Beng. 65, ii (1896) 491; RIDL. Fl. Mal. Pen. 1 (1923) 533. — *Semecarpus glabra* RIDL. Fl. Mal. Pen. 5 (1925) 303. — **Fig. 56.**

Tree up to 20(–30) m high and 47 cm ∅, rarely a shrub *c.* 2 m high. Bark greyish or light brown, smooth, or deeply fissured. *Leaves* subcoriaceous or coriaceous, elliptic or oblanceolate, 9–20(–28) by $2^1/_2$–5(–$8^1/_2$) cm; glabrous on both surfaces, except the lower surface with sparse, reddish brown, short trichomes; base cuneate or attenuate; apex shortly and abruptly acuminate, or caudate; nerves (9–)16–20 pairs, fused with a distinct marginal nerve, often with 1–4 internerval veins (usually shorter and weaker than the normal nerves), both slightly elevated beneath, distinct above; veins reticulate, rarely some perpendicular to the nerves, distinct on both surfaces, sometimes faint above; petiole $1^1/_2$–$2^1/_2$ cm. *Inflorescences* 4–29 cm long, often terminal, sometimes also axillary, usually profusely branched (in ♂), puberulous, glabrescent; lateral branches up to 18 cm; bracts triangular, $^1/_2$–1 mm long. ♂ *Flowers* sessile or subsessile, white, pale greenish yellow, or yellow, once recorded pink. *Calyx* lobes triangular, $^1/_2$–$^2/_3$ mm long. *Petals* ovate or ovate-oblong, $1^1/_2$–2 by $^2/_3$–1 mm, veins invisible. *Stamens* unequal in length (sometimes 2 long and 3 short), $1^1/_2$–$2^1/_2$ mm; anthers $^1/_3$–$^1/_2$ mm. Rudimentary pistil very small. ♀ Flowers not seen. *Fruit* ± transverse-oblong, 1–$1^1/_4$ by $1^1/_4$–$1^2/_3$ cm.

Distr. *Malesia:* Sumatra (East Coast, Karimun, Indragiri Uplands, Sibolangit), Malay Peninsula (Perak, Penang, Malacca), and Borneo (Sabah: Sepik, Kudat, Lahad Datu, Kinabatangan; Sarawak: Mt Mersing; Kalimantan: E. Kutai).

Ecol. Primary forest, sometimes mixed dipterocarp forest, rarely in secondary forest, from the lowland up to 1000 m. *Fl.* Febr.–June, Sept.–Dec.; *fr.* June, Sept.

Uses. The timber is used for beams and was recorded to be durable (ALVINS 899).

Vern. Malay Peninsula: *pako tanjong*, M; Borneo: Sabah: *kuduran*, Dusun-Tambunam; Sarawak: *renghas*, Iban; Kalimantan: *rengas alois*, M.

Note. This species resembles very much the SE. Asian *D. racemosus* (ROXB.) HOOK. *f. ex* MARCH. (1869); the leaves of the latter show, however, a fairly distinct cross-bar-like venation. For this reason, and the fact that I have not yet seen any specimen with ♀ flowers, and fruit has not yet been collected in Sumatra and Malaya, I have kept both species tentatively apart.

17. PENTASPADON

HOOK. *f.* Trans. Linn. Soc. 23 (1860) 168; ENGL. in DC. Mon. Phan. 4 (1883) 293; CORNER, Gard. Bull. S. S. 10 (1939) 261. — *Nothoprotium* MIQ. Sum. (1861) 527; Ann. Mus. Bot. Lugd.-Bat. 3 (1869) 89; MARCH. Rév. Anacard. (1869) 90, 183. — *Microstemon* ENGL. Bot. Jahrb. 1 (1881) 376; in DC. Mon. Phan. 4 (1883) 294; TARD. Fl. C. L. & V. 2 (1962) 190. — **Fig. 57–58.**

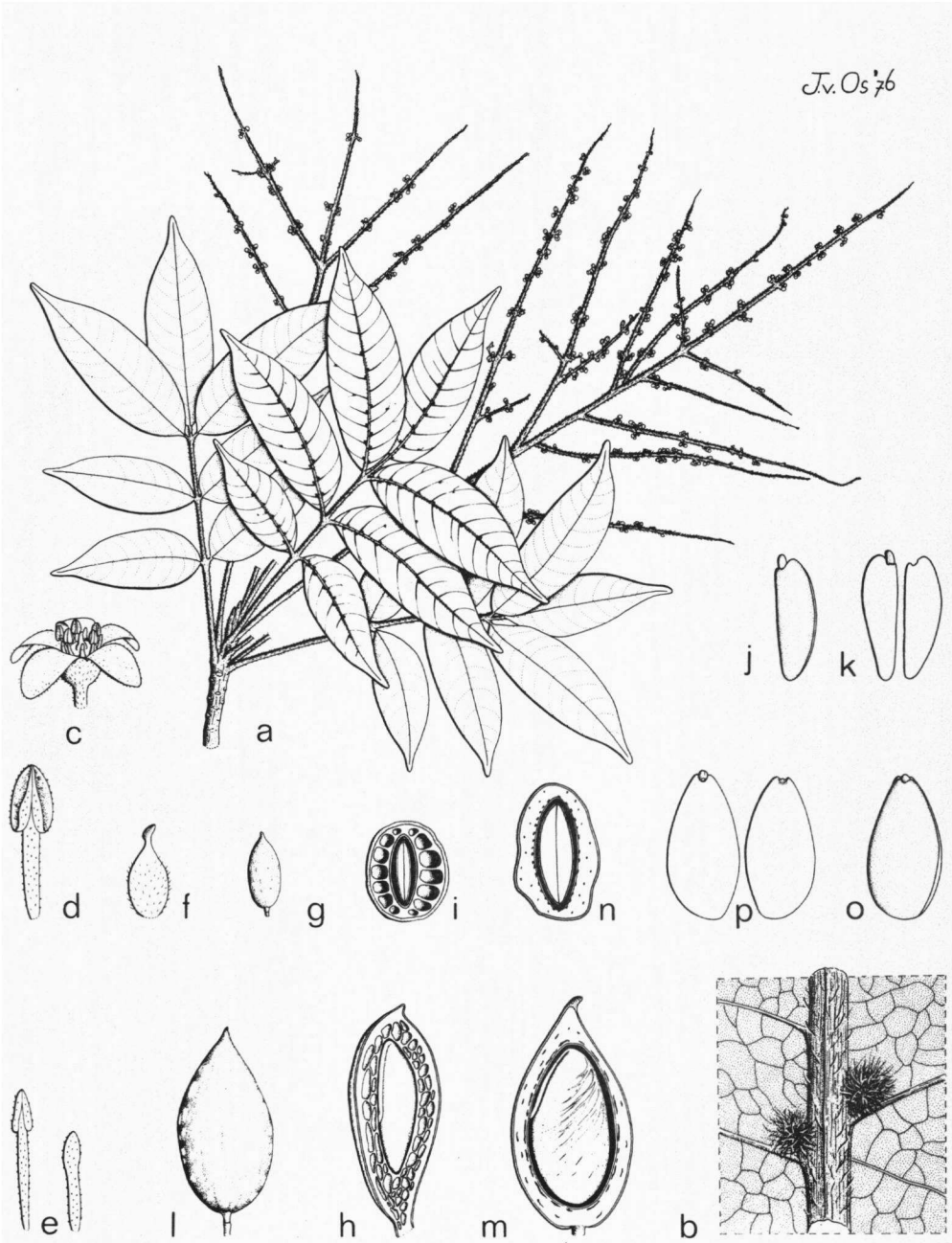

Fig. 57. *Pentaspadon curtisii* (KING) CORNER. *a*. Habit, × 1/2, *b*. small portion of lower surface of leaflet showing domatia, × 15, *c*. flower, × 7, *d*. stamen, *e*. staminodes, *f*. pistil, all × 20, *g*. fruit, × 1/2, *h. ditto* with half of pericarp removed, showing suspended seed and resin-canals, *i*. CS of fruit, *j*. embryo, side view, *k*. embryo, opened, all × 1 1/2. — *P. motleyi* HOOK. *f. l*. Fruit, × 1/2, *m. ditto* with half of pericarp removed, showing suspended seed and resin-canals, *n. ditto* in CS, *o*. embryo, side view, *p. ditto*, opened, all × 3/4 (*a–f* CURTIS 2620, *g–k* SF 21376, *l* CUADRA A1458, *m–p* SCHUT K26).

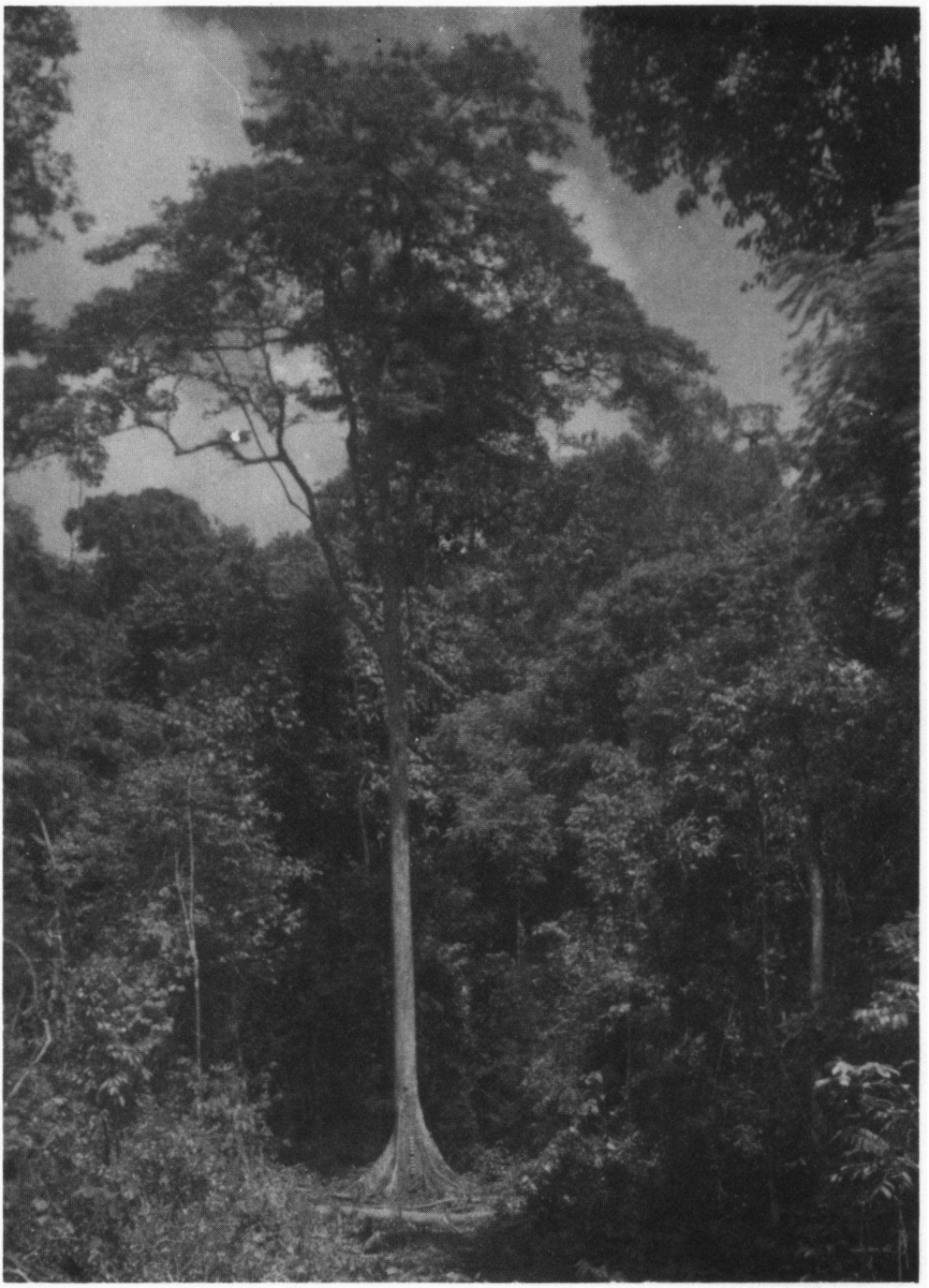

Fig. 58. *Pentaspadon motleyi* HOOK. *f.* in primary forest in Palembang, S. Sumatra (Photogr. THORENAAR, 1925).

Mostly large, deciduous trees. *Leaves* spiral, imparipinnate, petioled. *Leaflets* ± opposite, chartaceous or thinly coriaceous, entire, often with hairy domatia. *Inflorescences* axillary, paniculate. *Flowers* bisexual. *Calyx* 5-lobed. *Petals* 5, imbricate, papillose on both surfaces. *Stamens* 5, opposite the calyx lobes and alternate with 5 staminodes (absent in *extra*-Mal. *sp.*), all inserted at the outer base of the disk; filaments subulate, papillose; anthers basi- or dorsifixed, ovoid or ellipsoid; staminodes filamentous or like small stamens. *Disk* shortly cupular and 10-grooved outside, or discoid and crenulate. *Ovary* subglobose, pilose, usually glabrescent, 1-celled; style short, stigma subglobose or slightly 2-grooved or -lobed. *Drupe* 1-celled, purplish then black; endocarp thin, subcoriaceous. *Seed* with testa free from the endocarp; cotyledons free, plano-convex or flat.

Distr. Species 6, in SE. Asia (Thailand, Vietnam), *Malesia* (Sumatra, Malay Peninsula, Borneo, the Moluccas, and New Guinea), and the Solomon Is.

Ecol. Lowland forest, sometimes in seasonally inundated places.

CORNER observed that "*pelong* or *pelajau* trees are easily recognized by their graceful, feathery crowns, but it would seem difficult to identify them further were it not for their very characteristic bushy inflorescences which decay slowly and thus, as they lie on the ground beneath the trees, render them easy of recognition."

Taxon. MARCHAND *l.c.* was the first to identify *Nothoprotium* MIQ., which was assigned to *Burseraceae*, with *Pentaspadon*; he accepted the latter name, being under the impression that it had priority. CORNER (Gard. Bull. S. S. 10, 1939) demonstrated that the distinction of *Microstemon* ENGL. was due to erroneous observation.

Uses. The timber of *P. motleyi* and *P. velutinus* (trade name for both species in Malaya: *pelong*) is reported to be non-durable. The wood is moderately hard and moderately heavy and is used for cheap flooring; *cf.* DESCH, Mal. For. Rec. 15 (1957) 15–17.

An oil, obtained from *P. officinalis* (= *P. motleyi*), known as *minyak plang* in Perak, Malaya, *m. pelandjau* in Borneo, is used for curing certain skin diseases; *cf.* KING, J. As. Soc. Beng. 65, ii (1896) 500; HEYNE, Nutt. Pl. (1927) 977. CORNER (Ways. Trees, 1940, 113) says that "the oil in Malaya is obtained by hacking a basin-like cavity in one side of the trunk and allowing the oil to drain slowly into it, exactly as *damar* is collected from *Dipterocarpus* trees." LANE-POOLE (For. Res. 1925, 499) reported that the wood of *P. motleyi* contains abundant oil which is heavy and misty brown in colour and "resembles motor lubricating oil as used for cylinders". He did not mention any use of it.

The fruits of *P. motleyi* are edible after boiling.

Vern. Malaysian standard timber name: *pĕlajau.*

KEY TO THE SPECIES

1. Lower surface of leaflets velutinous, without domatia . . . . . **1. P. velutinus**
1. Lower surface of leaflets glabrous, or puberulous and usually glabrescent except sometimes on the midrib, nerves, and veins, with distinct, hairy domatia (rarely absent in *P. motleyi*).
2. Anthers bent towards the center and almost perpendicular to the filaments. Drupe ovoid or ovoid-oblong, 3–5 by 2–2¾ cm . . . . . **2. P. motleyi**
2. Anthers erect. Drupe smaller, ellipsoid, 2–2½ by ¾–1 cm . . . . . **3. P. curtisii**

1. Pentaspadon velutinus HOOK. *f.* Fl. Br. Ind. 2 (1876) 28; CORNER, Gard. Bull. S. S. 10 (1939) 262; Ways. Trees (1940) 113; JACOBS, Acta Bot. Neerl. 10 (1961) 105; KOCHUM. Mal. For. Rec. 17 (1964) 330. — *Microstemon velutina* ENGL. Bot. Jahrb. 1 (1881) 376; in DC. Mon. Phan. 4 (1883) 294, t. 9, f. 37–42; KING, J. As. Soc. Beng. 65, ii (1896) 498; CRAIB, Fl. Siam. En. (1926) 358.

Tree up to 60 m high and 45 cm ∅. Buttresses steep, up to *c.* 2½ m high. Bark grey, light yellowish brown or reddish brown, smooth, with distinct adherent scales. *Leaves* with 3–5 pairs of leaflets, reddish pink when young. *Leaflets* chartaceous, elliptic-oblong or -lanceolate, 6–11 by 2½–3½ cm; upper surface with midrib velutinous, the rest pubescent or puberulous and glabrescent, lower surface velutinous; domatia absent; base obtuse or cuneate; apex acuminate; nerves 9–12 pairs, petiolules up to *c.* 4 mm, the terminal one up to 15 mm. *Panicles* up to 22 cm long, velutinous; bracts lanceolate, ½–1 mm long; pedicels ½–1 mm. *Flowers* whitish to pink. *Calyx* lobes broadly ovate, ½–⅔ mm long. *Petals* obovate, 1½–2 by 1–1¼ mm. *Stamens* ⅔–1 mm; anthers bent towards the center and almost perpendicular to the filaments. *Disk* ⅔ mm ∅. *Ovary c.* ¼ mm ∅. *Drupe* ovoid-oblong, 2½ by 1 cm, scurfy. *Seed* ovoid-oblong, compressed, 2 by ⅔ cm.

Distr. Peninsular Thailand and *Malesia:* Sumatra (Padang Uplands, W. Indragiri, Muara Serangge, Kwantan Distr.), Malay Peninsula (Perak, Kelantan, Pahang, Negri Sembilan, Malacca).

Ecol. Lowland forest of dryland, on river-banks,

in periodically inundated places or seasonal swamps, up to 350 m. *Fl.* Jan.–May, Sept., Oct.; *fr.* May, July.

CORNER (1940) observed that on hillsides "tall trees with their crowns covered with pale flesh-pink inflorescences are to be seen scattered among the *tualang* trees (*Koompassia excelsa*); such are the pink *pelong* trees. How often they flower we do not know but believe that it is once a year contemporaneous with the *tualang* and pink *Cassia nodosa*."

Vern. Sumatra: *pĕladjau*, M; Malay Peninsula: *kayu plong, pĕlajau, pĕlang, pĕlong, pĕlong bĕludu, poko shinghe, shinghe*, M.

Note. CORNER (Gard. Bull. S. S. 10, 1939, 261) rightly pointed out that the stigma of the present species is not 3-lobed as described and shown in the drawings by ENGLER (in 1883, *cf.* t. 9, f. 39 & 40).

2. Pentaspadon motleyi HOOK. *f.* Trans. Linn. Soc. 23 (1860) 168; ENGL. in DC. Mon. Phan. 4 (1883) 294, t. 9, f. 30–36; MERR. En. Born. (1921) 351; RIDL. Fl. Mal. Pen. 1 (1922) 538; LANE-POOLE, For. Res. (1925) 109; HEYNE, Nutt. Pl. (1927) 977; JACOBS, Acta Bot. Neerl. 10 (1961) 106; BACK. & BAKH. *f.* Fl. Java 2 (1965) 152; MEIJER, Bot. News Bull. F. D. Sandakan 8 (1967) 30. — *Nothoprotium sumatranum* MIQ. Sum. (1861) 527; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 90. — *P. officinalis* HOLMES *ex* KING, J. As. Soc. Beng. 65, ii (1896) 499; RIDL. Fl. Mal. Pen. 1 (1922) 537; BURK. Dict. (1935) 1692; CORNER, Ways. Trees (1940) 113; KOCHUM. Mal. For. Rec. 17 (1964) 330. — *Rhus novoguineensis* LAUT. Nova Guinea 8 (1910) 298. — *P. moszkowskii* LAUT. Bot. Jahrb. 56 (1920) 358, f. 3. — *P. minutiflora* B. L. BURTT, Kew Bull. (1935) 305. — **Fig. 57l–p, 58.**

Tree up to 50 m high and 70 cm ∅. Buttresses up to 5 m high, 4 m wide, and 6 cm thick. Bark greyish white, light brown or brown, smooth to rough, shallowly fissured, and irregularly flaked. *Leaflets* 4–5 pairs, thinly coriaceous, ovate- or elliptic-oblong, sometimes obovate-oblong, or elliptic-lanceolate, $5^1/_2$–13(–18) by 2–$5^1/_2$(–$6^1/_2$) cm; glabrous, sometimes puberulous on both surfaces, glabrescent except on the midrib, nerves, and veins, domatia often present (rarely absent), distinct, hairy; base obtuse; apex acuminate; nerves 8–15 pairs; petiolules 3–6 mm, the terminal one up to 12 mm. *Panicles* up to 31 cm long, tomentose, glabrescent and sometimes seemingly glabrous; bracts lanceolate, $^1/_2$–$^2/_3$ mm long; pedicels $^1/_3$ mm. *Flowers* cream-coloured. *Calyx* lobes broadly ovate, $^1/_2$–$^2/_3$ mm long. *Petals* obovate-oblong, $1^1/_2$–$2^1/_2$ by 1–$1^1/_2$ mm. *Stamens* $^2/_3$–1 mm; anthers bent towards the center and almost perpendicular to the filaments. *Disk* $^2/_3$–1 mm ∅. *Ovary* $^1/_2$–$^3/_4$ mm ∅. *Drupe* ovoid or ovoid-oblong, 3–5 by 2–$2^3/_4$ cm, scurfy. *Seed* ovoid-oblong, compressed, $2^1/_2$–4 by 1–2 cm.

Distr. Solomon Is. (Bougainville, Choiseul, Ysabel) and *Malesia:* Sumatra, Malay Peninsula, Borneo, Moluccas, and New Guinea.

Ecol. Lowland forest on banks of rivers or streams, sometimes in seasonally inundated places (*cf.* ENDERT, Tectona 13, 1920, 131), in swamp forest, or in secondary forest, up to 75 m, rarely up to 300 m. *Fl.* March–Dec.; *fr.* Jan.–Dec.

CORNER observed that in Malaya "the trees shed their leaves and flower with the new foliage twice a year, about March to May and again about October to November. The crown is whitened by the fragrant blossom."

Uses. See under the genus for timber and oil. Seeds are eaten fresh or roasted (*cf.* HEYNE, *l.c.* 978). See for other uses BURKILL *l.c.*

Vern. Sumatra: *mail, pĕla(n)djau, pladjau*, M; Malay Peninsula: *kĕdondong, pahong, pĕlajau, pĕlong, pĕlong lichin, shinghe*, M; Borneo: *djuping*, Dajak, *ĕmpit, ĕmpelandjau, kĕdondong*, Tawau, *lĕtjut*, Karimata, *panjau*, Iban, *pĕlajau*, Beaufort, *pĕladjau, pilajau*, M, *plajau*, Bintulu, *polajo*, Kuching, *praju*, Serian, *tampison*, Dusun, *vpie*, Kuching; New Guinea: *ailala, auro, bowwie, ibelaka, senai, sinai*, Manikiong, *bowei*, Taniba, *darwan*, Biak, *inene*, Evara, *kwancler*, Wain, *laai, lae, laien, lain*, Mooi, *laleva*, Kikori, *lufaru*, Kiwai.

3. Pentaspadon curtisii (KING) CORNER, Gard. Bull. S. S. 10 (1939) 262. — *Microstemon curtisii* KING, J. As. Soc. Beng. 65, ii (1896) 498; RIDL. Fl. Mal. Pen. 1 (1922) 537; CRAIB, Fl. Siam. En. (1926) 358; TARD. Fl. C. L. & V. 2 (1962) *in obs.*, t. 17, f. 13. — **Fig. 57a–k.**

Tree up to *c.* 13 m high. *Leaflets* (1–)3–4(–5) pairs, chartaceous, elliptic-lanceolate or lanceolate, 6–11 by 2–$3^3/_4$ cm, puberulous on both surfaces, usually glabrescent except sometimes on the midrib, nerves and veins; base cuneate or rounded; apex acuminate; nerves 9–16 pairs, petiolules *c.* 2 mm, the terminal one longer. *Panicles* up to 23 cm long, pubescent; bracts lanceolate, $^1/_6$ mm long; pedicels *c.* $^1/_2$ mm. *Calyx* lobes broadly ovate, $^1/_3$–$^1/_2$ mm long. *Petals* broadly elliptic or ovate, $1^1/_2$ by $^3/_4$–1 mm. *Stamens c.* 1 mm; anthers erect. *Disk c.* 1 mm ∅. *Ovary c.* $^3/_4$ mm ∅. *Drupe* ellipsoid, 2–$2^1/_2$ by $^3/_4$–1 cm, scurfy. *Seed* lanceolate, compressed, $1^1/_5$ by $^1/_3$ cm.

Distr. Peninsular Thailand and *Malesia:* Malay Peninsula (Kedah: Langkawi I.), only 4 collections seen.

Ecol. On limestone at sea-level; on P. Langgun, NW. Langkawi, a complete dominant, in Dec.–Febr. conspicuous by the white stems and bare crown carrying towards the end of the dry season abundant flowers and just emerging leaves (VAN BALGOOY). *Fl.* June; *fr.* Aug., Nov.

18. CAMPNOSPERMA

THWAITES in Hook. J. Bot. Kew Misc. 6 (1854) 65, *nom. cons.*; MARCH. Rév. Anacard. (1869) 71 & 172; ENGL. in DC. Mon. Phan. 4 (1883) 316; CORNER, Gard. Bull. S. S. 10 (1939) 253; STEEN. Fl. Mal. Bull. *n.* 3 (1948) 74; DING HOU,

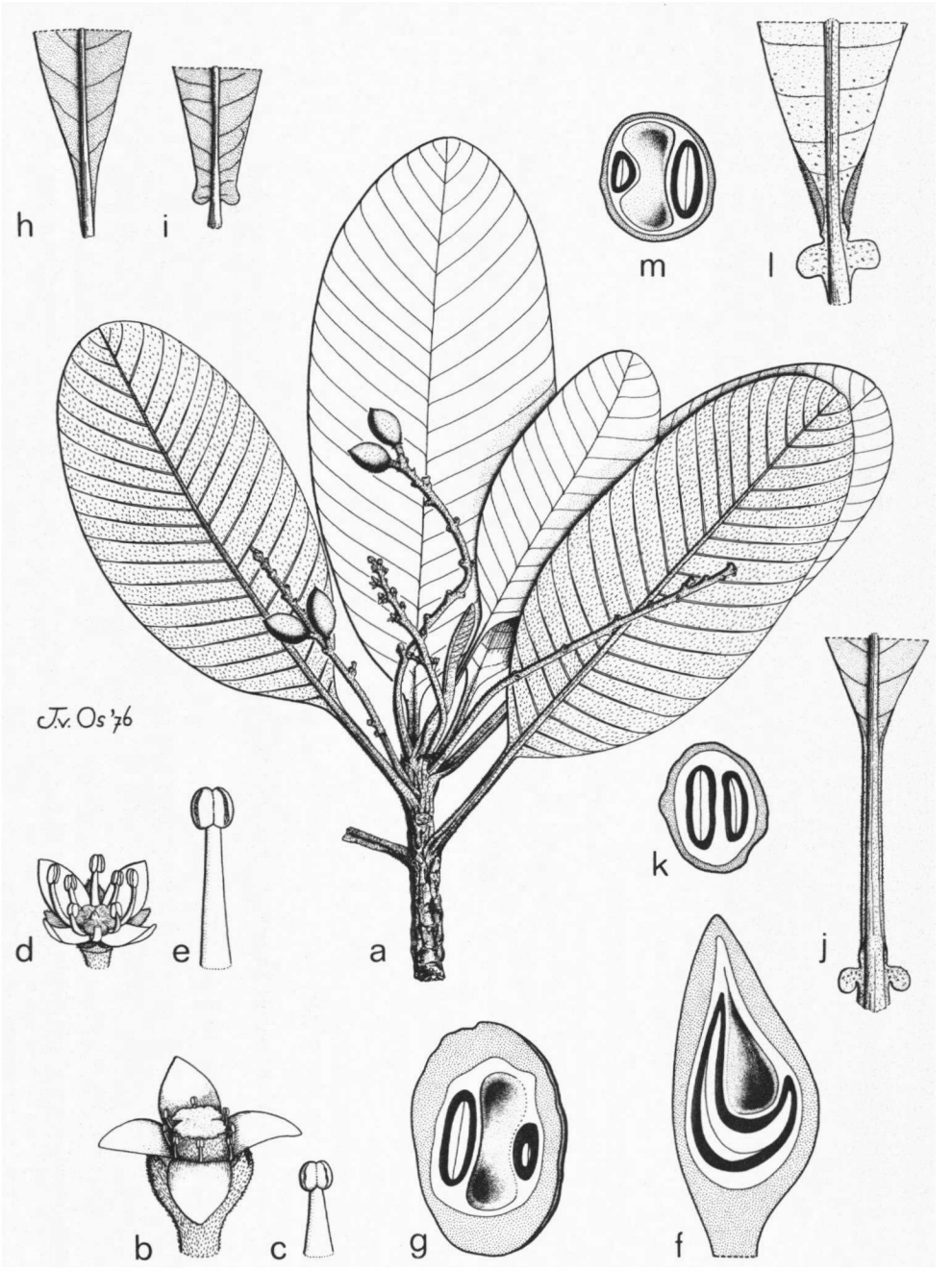

Fig. 59. *Campnosperma coriaceum* (JACK) HALL. *f. ex* STEEN. *a.* Habit, × 1/2, *b.* ♀ flower, × 7, *c.* imperfect or sterile stamen, × 14, *d.* ♂ flower, × 7, *e.* stamen, × 14, *f.* LS of fruit, × 3 1/2, *g.* CS of fruit, × 3 1/2. — *C. montanum* LAUT. *h.* Basal part of leaf, × 1/2. — *C. squamatum* RIDL. *i.* Basal part of leaf, × 1/2. — *C. auriculatum* (BL.) Hook. *f. j.* Basal part of leaf, × 1/2, *k.* CS of fruit, × 3 1/2. — *C. brevipetiolatum* VOLKENS. *l.* Basal part of leaf, × 1/2, *m.* CS of fruit, × 3 1/2 (*a–c, f–g* SCHODDE 4425, *d–e* DING HOU 780, *h* HOOGLAND & CRAVEN 10839, *i* S 24140, *j* KEP 77625, *k* KOSTERMANS 9055, *l* BW 1931, *m* BW 10515).

Blumea 24 (1978) 5. — *Coelopyrum* JACK, Mal. Misc. 2, 7 (1822) 65, *nom. rejic.* — **Fig. 59–62.**

Trees, with distinct *Terminalia*-branching (fig. 61). *Leaves* spiral, simple, coriaceous, entire, petioled, usually with minute, peltate or lobed scales on both surfaces, glabrescent; areolae with dendroid blind vein-ends. *Inflorescences* axillary, paniculiform, sometimes with rather simple, scant, short branches and seemingly racemose. *Flowers* unisexual and rarely bisexual (plants polygamo-dioecious). *Calyx* (3- or)4-(or 5-)lobed. *Petals* (3 or) 4 (or 5), imbricate, glabrous (except sometimes with lobed, hair-like scales on the outer surface). *Stamens* twice the number of petals, epipetalous ones shorter than those alternate with them; filaments subulate, glabrous; anthers dorso-basifixed, broadly ellipsoid, sterile in ♀. *Disk* round and flat in ♂, shortly cupular in ♀, angular or slightly crenulate. *Ovary* subglobose, 1-celled, scurfy; style short or obscure; stigma patent, discoid, usually irregularly lobed. Sterile pistil in ♂ very small. *Drupe* incompletely 2-celled by a vertical, solid or hollow septum protruding and elongating from the apical end; endocarp hard and woody. *Seed* 1, with testa free from the endocarp; embryo curved, cotyledons free, slightly plano-convex or rather flat.

Distr. About 10 *spp.*, in South America (Brazil) and Central America (Panama), Madagascar (1 *sp.*) and the Seychelles (1 *sp.*), SE. Asia (Ceylon, Thailand), through *Malesia* (Sumatra, Malay Peninsula, Borneo, Celebes, Moluccas, New Guinea) to Micronesia and Melanesia.

Ecol. Forming monospecific stands or (co-)dominant in (peat-, sago-)swamps (fig. 60) to common or rare in forest on well-drained soils; also in secondary forest; apparently a strong light demander and regenerating more abundantly in more open or in disturbed habitats; mostly in the lowland, but also up to 1600 m.

When growing in swamps *C. coriaceum* develops often prop-roots as well as slender-kneed pneumatophores over 1 m high.

The fruits are eaten by birds, especially by pigeons (CORNER, 1940).

In New Guinea *C. brevipetiolatum* and *C. coriaceum* occur in a wide range of habitats between 0 and 500 m. In forest on well-drained soils and on soils inundated for very short periods, these species occur with low frequencies (less than 5% of the trees). The frequency can be higher in forest which is inundated for longer periods and it increases gradually to 100% of the canopy layer in some types of swamp forest. Fig. 60.

Campnosperma-swamp forest occurs throughout the wet-tropical parts of New Guinea. In areas with a lower annual rainfall and a distinct dry season, the *Campnosperma* species are replaced by *Melaleuca* as the predominant species in swamp forest. In the Port Moresby area this replacement is distinct, whereas in the Fly River area the geographical segregation is less distinct probably due to the more gradual climatic transitions (but here *C. montanum* is also reported from *Melaleuca*-swamp!).

Where *Campnosperma* is predominant (80–100%) in the canopy, the lower story often consists of sago; the soil is inundated up to *c.* 1–1½ m for at least 5 months per year and peat formation occurs regularly; at the end of the dry season the water table is at the soil surface or only slightly below, that is, the soil is permanently waterlogged. Through a stage with an open canopy, with sago palms, and with *Thoracostachyum*, *Campnosperma* becomes scattered (with a few other species) in the margins of deeper, herbaceous swamps. In many reports on *Campnosperma*-dominated swamp forest or on pure *Campnosperma* stands the association with sago, pandans, *Thoracostachyum* (sometimes *Mapania*), *Scleria*, and *Nepenthes* is mentioned. Near the coast *Campnosperma* forest occurs only in non-tidal freshwater swamps.

According to LUNDQUIST (1941), the *Campnosperma* trees in the centre of pure stands attain a mean d.b.h. of only 25 cm and almost never exceed 40 cm; towards the margins of the stands the trees are somewhat heavier and diameters of 40 to 80 cm can be reached.

From the reports and vegetation maps it is not clear whether *C. brevipetiolatum* and *C. coriaceum* can occur together in pure '*Campnosperma*' stands, but apparently this can happen. "Some stands consist of both species in about equal proportions" (PAIJMANS, 1976).

C. montanum has a far wider altitudinal range (0–1500 m) than the species just mentioned and accordingly occurs also in several types of submontane forest.

For Malaya, WYATT-SMITH (1959) listed *C. auriculatum* as one of the species not strictly belonging to the oligotrophic peat-swamp forest, but depending on the presence of eutrophic water. This agrees with the observation by ENDERT (1920) that in the Musi Delta, Sumatra, *C. coriaceum* is predominant in the peat-swamp, whereas *C. auriculatum* prefers forests inundated seasonally by rivers. Several authors list *C. auriculatum* with species of secondary (swamp) forest.

Fig. 60. Permanent, stagnant, non-tidal freshwater swamp forest consisting of tall *Campnosperma* trees and undergrowth of sago (from CSIRO Land Res. Ser. *n.* 23, 1969, pl. 4). Kerama-Vailala area, Papua New Guinea. Courtesy CSIRO, Div. of Land Use Research.

In Malesia *Campnosperma* is sometimes associated with the very similarly looking *Terminalia copelandii* ELMER; in the Solomon Is. *C. brevipetiolatum* is often associated with *Terminalia brassii* EXELL. — W. VINK.

Literature: ENDERT, Tectona 13 (1920) 119; SALVERDA, Rapport Expl. Z.W.-Nieuw Guinea (1937) 18, 44; CORNER, Ways. Trees (1940) 103; RAND & BRASS, Bull. Am. Mus. Nat. Hist. 77 (1940) 370b, pl. XL–1; LUNDQUIST, Verslag Bosexpl. N. G. (1941) 51; ARCHBOLD, RAND & BRASS, Bull. Am. Mus. Nat. Hist. 79 (1942) 235a; BROWNE, For. Trees Sar. Brun. (1955) 46; WYATT-SMITH, Mal. For. 22 (1959) 9; PEEL, *ibid.* 22 (1959) 71, 86; *ibid.* 23 (1960) 163; ANDERSON, Gard. Bull. Sing. 20 (1963) 170; ROBBINS & PULLEN, Land Research Ser. (C.S.I.R.O.) 15 (1965) 108; ROBBINS, *ibid.* 22 (1968) 118, 121, pl. 4–1; SAUNDERS, *ibid.* 22 (1968) 127; PAIJMANS, *ibid.* 23 (1969) 102, 107, 110, 114, 158, pl. 4–1; HEYLIGERS, *ibid.* 30 (1972) 81, 87, pl. 4–2; PAIJMANS (ed.), New Guinea Vegetation. Canberra (1976) 46.

Field characters. Generally a tendency to flat-topped crowns. Main branches in tiers; tendency to divide bole into several large ascending limbs, each of which may have a sub-crown (fig. 61), but apparently this is not a specific character. *C. auriculatum* has green foliage, yellowish old leaves, and a light bark; *C. brevipetiolatum* fits this picture (old leaves not reported); *C. coriaceum* has brownish green foliage, red old leaves, and generally a darker to dark and more strongly fissured bark; *C. montanum* has dark green foliage, red old leaves, and a light bark.

Smaller limbs and branchlets with *Terminalia*-branching. Leaves clustered. Leaves on vegetative shoots much larger than those on fertile shoots.

The exudate in the bark can be absent or present and then in small drops to abundant-flowing. Its colour is variable; *C. squamatum:* pale yellowish (one record only); *C. montanum:* clear watery to white milky turning purplish or black; *C. auriculatum*, *C. brevipetiolatum*, and *C. coriaceum:* clear to milky and colourless, cream, white, or red.

Open *Campnosperma*-swamp forest, consisting of species with a sparse crown and light bark, gives from the air the impression of a forest of dead trees. — W. VINK.

Uses. The timber of all species is of the same grade; it is soft, light (specific gravity 0.3–0.5; reported as 0.7 by KRAEMER, 1951), yellowish pink to pinkish grey, easy to peel, sometimes containing some silica, planing somewhat fuzzy, easy to impregnate, not durable. Not suitable for construction work; suitable for packing cases, crates, planks, canoes, match-boxes (reports on match-sticks are disagreeing), splints, peeled veneers (not for faces?), drawing boards, and wooden shoes. Logs float.

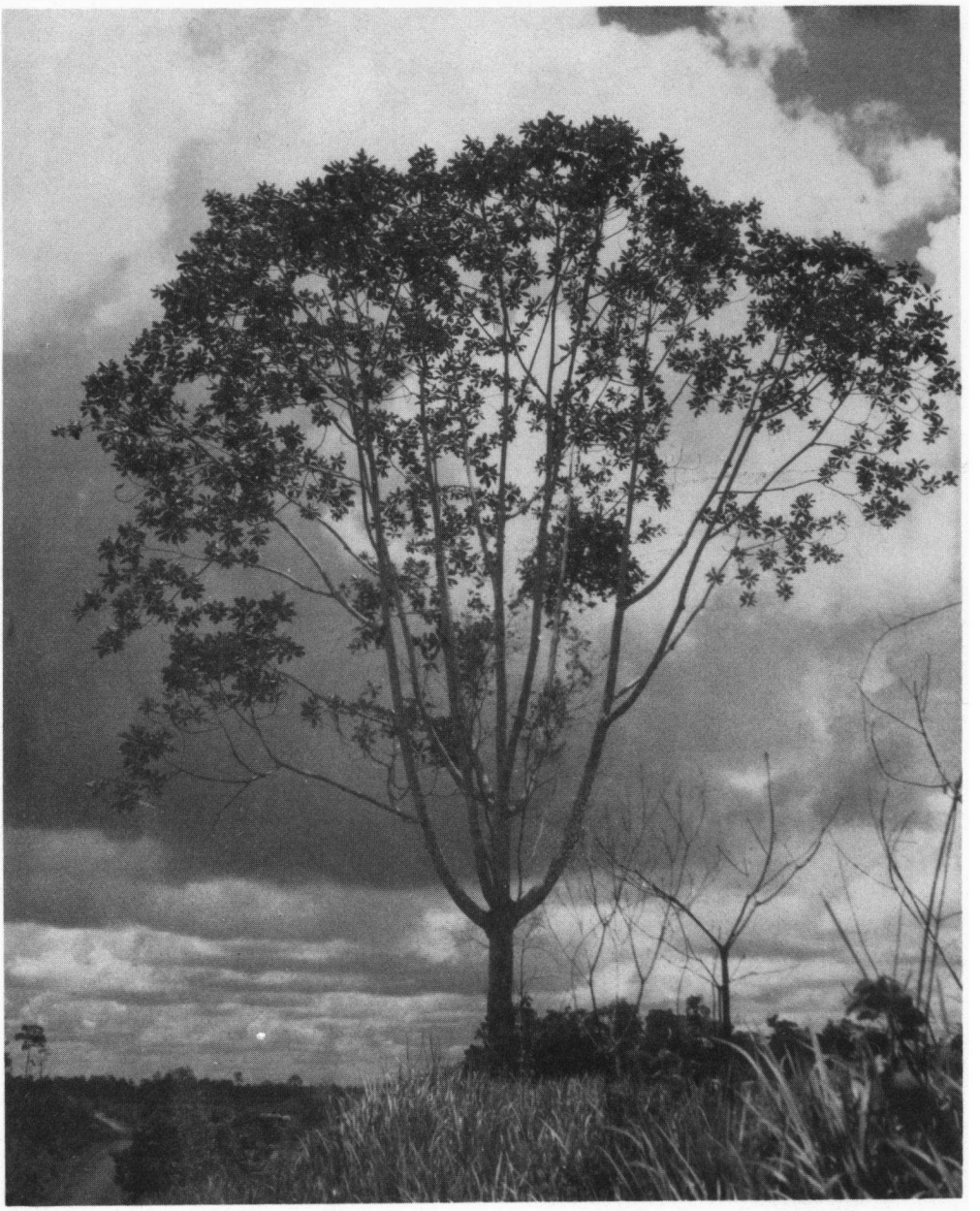

Fig. 61. *Campnosperma auriculatum* (BL.) HOOK. *f.* A fairly young *terentang* by the road from Ayer Hitam to Segamat, Johore. Courtesy and photogr. CORNER.

The wood produces oil in small quantities (see under the species; *cf.* also DING HOU, Blumea 24, 1978, 5–6).

Literature: DEN BERGER, Med. Proefstation Boschwezen 13 (1926) 88; FOXWORTHY, Mal. For. Rec. 3 (1927) 143 & 144; THOMAS, Mal. For. 13 (1950) 88–90; KRAEMER, Trees W. Pac. Reg. (1951) 191; BROWNE, For. Trees Sar. Brun. (1955) 47; DESCH, Mal. For. Rec. 15 (1957) 26–29; BALAN MENON, Mal. For. 21 (1958) 40; KALKMAN, Timber Species in Neth. New Guinea (1959) 13; JAPING, Houtsoorten N. G. 1 (1961) 9; VAN ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 18; HEGNAUER, Chemotax. Pfl. 3 (1964) 96.

Vern. Standard Indonesian/Malaysian timber name: *tĕrĕntan(g)*; New Guinea: *Campnosperma.*

KEY TO THE SPECIES

1. Leaves distinctly auricled at the base (auricles sometimes obscure on leaves of young twigs or sapling on *C. auriculatum*; sometimes obscure or wanting on leaves of young or fertile twigs in *C. brevipetiolatum*). Fruits 6–8 mm long.
2. Leaf-base gradually, narrowly decurrent, the lower very narrowly winged part petiolar between the proper blade and the auricles (fig. 59j). Fruits in transverse section showing a solid septum **1. C. auriculatum**
2. Leaf-base gradually, broadly decurrent, without such narrowly winged petiole (fig. 59 l). Fruits in transverse section showing a hollow septum . . . . . **2. C. brevipetiolatum**
1. Leaves not auricled (except forming amplexicaul auricles on sapling leaves in *C. squamatum*; sometimes (obscurely) auriculate on vegetative leaves in *C. montanum*). Fruits 11–18 mm long.
3. Leaf-base distinctly set off against a distinct petiole 2–8 cm long (fig. 59a). Fruits in transverse section showing a hollow septum . . . . . **3. C. coriaceum**
3. Leaf-base either gradually tapering towards the insertion or petiole up to $^3/_4$ cm.
4. Leaf-base broad, petiole up to $^3/_4$ cm (fig. 59i). Calyx lobed to $^1/_2$ of its length. Fruits in transverse section showing a hollow septum . . . . . **4. C. squamatum**
4. Leaf-base gradually tapering to the base (fig. 59h). Calyx lobed almost to the base. Fruits in transverse section showing a solid septum . . . . . **5. C. montanum**

1. Campnosperma auriculatum (BL.) HOOK. *f.* Fl. Br. Ind. 2 (1876) 41; ENGL. in DC. Mon. Phan. 4 (1883) 320, t. 11, f. 22–25; KING, J. As. Soc. Beng. 65, ii (1896) 495; RIDL. Fl. Mal. Pen. 1 (1922) 534, *incl. var. wallichii* (KING) RIDL.; BURK. Dict. (1935) 421; CORNER, Gard. Bull. S. S. 10 (1939) 253; Ways. Trees (1940) 104, f. 20, Atlas, t. 4; MERR. & PERRY, J. Arn. Arb. 22 (1941) 535; SETTEN, Mal. For. 19 (1956) 32; KOCHUM. Mal. For. Rec. 17 (1964) 222; SMYTHIES, Common Sarawak Trees (1965) 2; MEIJER, Field Guide Trees W. Mal. (1974) 105; DING HOU, Blumea 24 (1978) 5. — *Buchanania auriculata* BL. Mus. Bot. 1 (1850) 185; MIQ. Fl. Ind. Bat. 1, 2 (1859) 637. — *Buchanania oxyrhachis* MIQ. Sum. (1861) 524. — *C. griffithii* (*non* MARCH.) HOOK. *f.* Fl. Br. Ind. 2 (1876) 41, *excl. typ.*; ENGL. in DC. Mon. Phan. 4 (1883) 320; KING, J. As. Soc. Beng. 65, ii (1896) 494. — *C. oxyrhachis* ENGL. in DC. Mon. Phan. 4 (1883) 319; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 38; Fl. Mal. Pen. 1 (1922) 534; BURK. Dict. (1935) 421; CORNER, Gard. Bull. S. S. 10 (1939) 253. — *C. wallichii* KING, J. As. Soc. Beng. 65, ii (1896) 497; BAKER, J. Bot. 62 (1924) Suppl. 30; WYATT-SMITH, Mal. For. Rec. 3 (1927) 143, photogr.; THOMAS, Mal. For. 13 (1950) 88, t. 8. — **Fig. 59j–k, 61.**

Tree up to 38 m high and 80(–135) cm ∅. Buttresses absent or up to 1 m high, $1^1/_2$ m wide, 10–20 cm thick. Bark white to fawn, hoop-marked, smooth or shallowly fissured and/or papery flaky. Young foliage pinkish brown to brownish green, mature foliage green, old leaves withering yellow to brownish yellow. *Leaves* obovate to oblanceolate, 12–63 by 5–20 cm (up to 72(–120) by 18(–25) cm on vegetative twigs or sapling), pubescent on both surfaces when young, glabrescent and sometimes almost glabrous except the basal part; base narrowly decurrent and forming a pair of auricles (sometimes obscure on leaves of young twigs or saplings) near the insertion; apex obtuse, sometimes emarginate; nerves 16–23(–50) pairs, veins reticulate-scalariform, usually more distinct on the lower surface; petiole obscure. *Panicles* up to 50 cm long, profusely branched, branches up to 20 cm; bracts triangular, *c.* $^1/_3$ mm long; pedicels $^2/_3$–$^3/_4$ mm. *Flowers* lemon yellow. *Calyx* lobes triangular, $^1/_3$–$^1/_2$ mm long. *Petals* broadly elliptic or ovate, 1–$1^1/_2$ by $^1/_2$–$^2/_3$ mm. *Stamens* $^1/_2$–$1^1/_4$ mm; staminodes in ♀ shorter and smaller. *Disk* $^1/_2$–$1^1/_4$ mm ∅. *Ovary* subglobose, *c.* $^3/_4$ mm ∅. *Drupe* subglobose, 6–8 by 5–6 mm, dull reddish purple when ripe; septum solid.

Distr. Peninsular Thailand and *Malesia:* widely distributed in Sumatra, Banka, the Malay Peninsula, and Borneo.

Ecol. Co-dominant to rare in freshwater (peat-) swamps to common or rare in mixed primary forest on well-drained soils, also in secondary forest, from 5–1000 m, once at 1600 m (W. Kutai). *Fl. fr.* Jan.–Dec.

Uses. The timber is used for making canoes (ENDERT, Tectona 18, 1925, 80). Exudate from the wood is called *terentang-oil* (HEGNAUER, Chemotax. Pfl. 3, 1964, 96), which is harmful to some persons (CORNER, 1940).

Mr. K. M. KOCHUMMEN (Kepong, *in litt.* 25–3–76) informed me that there is no information regarding its (local) uses in Malaya. He said that one of their officers once got a bad attack of irritation similar to that of *rengas* on his hands by getting into contact with the oil.

Vern. Sumatra: *antubus, doubuho,* Tapanuli,

bajut uding silai, Simalur, (*kayu*) *tumbus*, E.Coast, *kědawan = tong*, Bencoolen, *mědang rimoeěng*, Atjeh, *tambus*, *tarantang*, W. Coast, *těrěntang*, *t. putih*, M, *tětang*, Pehal; Malay Peninsula: *napan*, *sěrěntang*, *těrěntan(g)*, *t. putih*, M; Borneo: *hamtangen*, Sampit, *manlanga*, Dajak & Kedayan, *tapau*, Dajak.

2. Campnosperma brevipetiolatum VOLKENS, Bot. Jahrb. 31 (1902) 466; LAUT. Bot. Jahrb. 56 (1920) 359; LANE-POOLE, For. Res. (1925) 106; KANEH. Bot. Mag. Tokyo 45 (1931) 292; Fl. Micron. (1933) 184, f. 75; WALKER, For. Br. Sol. Is. Prot. (1948) 90; KRAEMER, Trees W. Pac. Reg. (1951) 191; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 16, f. 5; WHITMORE, Phil. Trans. R. Soc. Lond. ser. B, 255 (1965) 265; Guide For. Br. Sol. Is. (1966) 34; Gard. Bull. Sing. 22 (1967) 4; VERSTEEGH, Med. Landb. Hogesch. Wageningen 71–19 (1971) 23; HALLÉ, Biotropica 6 (1974) 47, f. 6. — *C. brassii* MERR. & PERRY, J. Arn. Arb. 22 (1941) 535. — **Fig. 59l–m.**

Tree up to 48 m high and 120 (exceptionally to 220) cm ∅. Buttresses absent or up to $2^1/_2$(–4) m high, 2(–4) m wide, 15(–20) cm thick. Bark grey to cream, smooth but pustularly lenticellate, in large trees often fawn to light brown and scaly, less often shallowly fissured. Young leaves sometimes copper-tinted below, mature foliage green. *Leaves* oblanceolate, 14–56 by $4^1/_2$–$17^1/_2$ cm (up to 73 by 27 cm on vegetative twigs), densely pubescent on both surfaces when young, usually glabrescent except the basal part; base broadly, gradually decurrent, forming a pair of auricles (sometimes obscure or wanting on leaves of young or fertile twigs) near the insertion; apex obtuse or emarginate, sometimes shortly acuminate; nerves 17–28 pairs, veins reticulate-scalariform, distinct sometimes rather faint on both surfaces; petiole very short. *Panicles* up to 44 cm long, profusely branched, branches up to 19 cm; sometimes with rather simple, short branches and seemingly racemose; bracts triangular, *c.* 1 mm long; pedicels *c.* $^1/_3$ mm. *Flowers* cream-coloured or yellow. *Calyx* lobes triangular, *c.* $^1/_2$ mm long. *Petals* broadly ovate, 1–$1^1/_2$ by $^3/_4$–1 mm. *Stamens* $^2/_3$–$1^1/_2$ mm; staminodes in ♀ shorter and smaller. *Ovary* subglobose, *c.* $^2/_3$ mm ∅. *Drupe* subglobose or globose, 5–7 mm ∅, through red to (purplish) black when ripe; septum hollow.

Distr. Micronesia (Caroline Is.: Palau, Kusaie, Yap, Ponape), Melanesia (New Ireland, New Britain, widely distributed in the Solomon Is. and in Santa Cruz Is.), and *Malesia:* New Guinea (widely distributed), Moluccas (Talaud, Ambon), and Celebes (Malili & Muna I.).

Ecol. Dominant or co-dominant in freshwater (peat- and sago-)swamps to scattered or rare in mixed primary forest on well-drained soils, also in secondary forest; in the Solomon Is. '*Campnosperma*-forest' is also reported from slopes from the lowland up to *c.* 450 m. *Fl. fr.* Jan.–Dec.

HOSOKAWA has made extensive studies on the important role this species plays in the forests of the Carolines where it can be associated with some other co-dominants (*Pandanus*, *Elaeocarpus*, *etc.*). See his abundantly illustrated papers in Vegetatio 5 (1954) 351–360; Mem. Fac. Sc. Kyushu Un. E. 1 (1954) 199–243; Proc. 8th Pac. Sc. Congr. Manila 4 (1957) 473–481 dealing with the sociology of these *Campnosperma* forest types.

In the Solomons forests are found which are dominated by one or a few species of big trees such as *C. brevipetiolatum*, *Endospermum medullosum*, and *Gmelina moluccana*. WHITMORE *l.c.* stated that, according to recent studies in timber-felling areas and in natural high forest, "seedlings of these species cannot grow up in shade but come up gregariously and vigorously in clearings".

Uses. The timber is used for making canoes (1, 3, 4). The wood yields *diumu*-oil (Papuan Delta) or *tigaso*-oil (Lake Kutubu), which has some economic significance to the local people and is rubbed on the skin as an antiparasiticum (2, 4, 6, 7); the oil has also been used as medicine for harness sores on horses (5). — References: (1) LANE-POOLE, For. Res. Papua & N. G. (1925) 18; (2) *l.c.* 60 & 106; (3) *l.c.* 62; (4) SALVERDA, Rapport Expl. Z. W. Nieuw Guinea (1937) 18 (as '*C. ?auriculatum*'); (5) VAN ROYEN, Man. For. Trees Papua & N. G. (1964) 2; (6) HEGNAUER, Chemotax. Pfl. 3 (1964) 96; (7) PAIJMANS & PULLEN, Land Res. Ser. CSIRO 23 (1969) 128.

Vern. Solomon Is.: *ketekete*, Kwara'ae; Santa Cruz Is.: *ngolobis*, Vanikoro. Malesia: New Guinea: *aibekon*, *aibikom*, Biak, *belakwar*, Waskuk, *gral*, Wagu, *inderie*, *inderrie*, Manikiong, *iruba*, Garaina, *kuwar*, Wersar, *kwata*, Lower Sepik, *mongso*, Arfak, *nolie*, Sko, *rie*, Oransbari, *rieuw*, Hattam, *sallam*, Tor, *saram*, Berik, Kw'sten, Tor, *sari*, Wandammen, *saripi*, Samber, *seliek*, *teles*, Mooi, *singawa*, Rabaul, *siluga*, Central Sepik, *siriu*, Amberbaken, *siruga*, Buna, *sriu*, Sidei, *tjieh*, Asmat, *well*, Wewak; Moluccas: *lakuoěng*, Ambon, *taniruán'a*, Talaud; Celebes: *dalipo*, Malili.

Note. Detached leaves or those on young (sterile) twigs, without distinct auricles, of the present species are similar to big vegetative leaves of *C. montanum*, and cannot be identified with certainty.

3. Campnosperma coriaceum (JACK) HALL. *f. ex* STEEN. Fl. Mal. Bull. *n.* 3 (1948) 74; KOCHUM. Mal. For. Rec. 17 (1964) 223; SMYTHIES, Common Sarawak Trees (1965) 3; ROBBINS & PULLEN, Land Res. Ser. CSIRO 15 (1965) 108; MEIJER, Bot. News Bull. F. D. Sandakan 8 (1967) 21; DING HOU, Blumea 24 (1978) 5. — *Coelopyrum coriaceum* JACK, Mal. Misc. 2, 7 (1822) 65. — *Buchanania macrophylla* BL. Mus. Bot. 1 (1850) 185; MIQ. Fl. Ind. Bat. 1, 2 (1859) 637. — *Buchanania racemiflora* MIQ. Sum. (1861) 523. — *C. griffithii* MARCH. Rév. Anacard. (1869) 174; HOOK. *f.* Fl. Br. Ind. 2 (1876) 41, *quoad typus*; ENGL. in DC. Mon. Phan. 4 (1883) 320, *quoad typus*; KING, J. As. Soc. Beng. 65, ii (1896) 494, *quoad typus*; RIDL. Fl. Mal. Pen. 1 (1922) 534; CORNER, Gard. Bull. S. S. 10 (1939) 254. — *C. macrophylla* HOOK. *f.* Fl. Br. Ind. 2 (1876) 41; ENGL. in DC. Mon. Phan. 4 (1883) 316; LAUT. Bot. Jahrb. 56 (1920) 359; CORNER, Gard. Bull. S. S. 10 (1939) 254; Ways. Trees (1940) 104; MERR. & PERRY, J. Arn. Arb. 22 (1941) 534; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 167. — *Campnosperma? sp.* RAND & BRASS, Bull. Am. Mus. Nat. Hist. 77 (1940) 370, t. 40, f. 1. — **Fig. 59a–g, 62.**

Tree(let) up to 40 m high and 90 cm ∅, but usually smaller; occasionally with buttresses up to

$1^3/_4$ m high, $^3/_4$ m wide, 5 cm thick; when growing in swamps often with prop-roots at the base as well as with slender-kneed loop roots or pneumatophores to over 1 m high (fig. 62). Bark grey, ochre, brown, or light red to almost (purplish) black, (smooth or) vertically cracked or closely to distantly fissured, rarely scaly. *Leaves* elliptic, elliptic-oblong, rarely obovate-oblong, $5^1/_2$–40 by $2^1/_2$–19 cm; densely pubescent, sometimes glabrescent beneath, glabrous above; base acute to cuneate; apex obtuse, sometimes emarginate; nerves 10–36 pairs, veins reticulate-scalariform, distinct or sometimes rather faint beneath, faint or obscure above; petiole distinct, 2–8 cm. *Panicles* up to 35 cm long, profusely branched, branches up to 10 cm, sometimes with rather simple, scant, short branches and seemingly racemose; bracts triangular, 1–$2^1/_2$ mm long; pedicels very short or obscure. *Flowers* greenish yellow or yellow. *Calyx* lobes slightly triangular, $^3/_4$–1 mm long. *Petals* broadly ovate or ovate, *c.* $1^3/_4$ by 1–$1^1/_2$ mm. *Stamens* 1–$1^1/_2$ mm; staminodes in ♀ shorter and smaller. *Disk* $^3/_4$–$1^1/_3$ mm ∅. *Ovary* subglobose, *c.* $^3/_4$ mm ∅. *Drupe* ovoid, 12–18 by 8–$16^1/_2$ mm, black when ripe; septum hollow.

Distr. *Malesia:* widely distributed in Sumatra, Lingga, Banka, Malay Peninsula, Borneo, and New Guinea; not yet found in Celebes and the Moluccas.

Ecol. Dominant in freshwater (peat-, sago-) swamps to scattered or rare in mixed primary forest on well-drained soils, sometimes in secondary forest, from the lowland up to 500 m, once found at 1000 m (Kalabit Highlands, Sarawak). *Fl. fr.* Jan.–Dec.

Fig. 62. *Campnosperma coriaceum* (JACK) HALL. *f. ex* STEEN. with loop roots at Pontian, Pengkalan Raya, Johore (Photogr. CORNER, 1939).

Uses. ROBBINS & PULLEN *l.c.* recorded *tigaso*-oil for this species (see also *sub C. brevipetiolatum*) which is "traded extensively throughout the Southern Highlands (of Papua New Guinea) to the north as a body oil for 'sing-sing' decoration". It is possible, however, that this record relates to either *C. brevipetiolatum* or *C. montanum*.

Vern. Sumatra: *ambatjang rawang*, W. Coast, *mĕnggajuran, tĕrĕntang*, M, *mĕranti ajĕr*, Tapanuli, *mĕranti lèbar daun*, E. Coast, *tĕrĕntang-malung*, Banka; Malay Peninsula: *pĕlok kĕlinting, tĕrĕntang simpoh, t. kĕlinting*, M; Borneo: *tĕrĕntang*, Brunei & M; New Guinea: *eem*, Asmat, *kilius*, Amele.

Note. Specimens of the present species can be easily recognized even in sterile condition by the leaves having a distinct (long) petiole, many pairs of patent and straight nerves, and being densely hairy beneath even at old age, only rarely becoming finally glabrescent.

4. Campnosperma squamatum RIDL. Kew Bull. (1933) 197; SMYTHIES, Common Sarawak Trees (1965) 3; MEIJER, Bot. News Bull. F. D. Sandakan 8 (1967) 21. — *C. auriculata* (*non* HOOK. *f.*) KING, J. As. Soc. Beng. 65, ii (1896) 495; RIDL. Fl. Mal. Pen. 1 (1922) 534. — *C. minor* CORNER, Gard. Bull. S. S. 10 (1939) 255; Ways. Trees (1940) 104, f. 20. — *C. montana* (*non* LAUT.) ANDERSON, Gard. Bull. Sing. 20 (1963) 141 & 170; KOCHUM. Mal. For. Rec. 17 (1964) 222. — Fig. 59i.

Tree(let) up to 30 m high and 60 cm ∅. Buttresses occasionally present, narrow, up to 1 m high, rarely stilt roots present. Bark white to grey-brown, smooth or shallowly fissured and/or papery flaky. *Leaves* oblanceolate to spathulate, or elliptic, 6–30(–61) by 2–8(–11) cm, up to by 14 cm on sapling; glabrous, exceptionally pubescent on the lower surface; base decurrent towards near the insertion and ending abruptly (forming amplexicaul auricles on sapling leaves); apex obtuse, sometimes emarginate, very rarely acute or shortly acuminate; nerves 8–21 pairs, veins reticulate or reticulate-scalariform, distinct on both surfaces; petiole very short ($^1/_5$–$^3/_4$ cm). *Panicles* 4–29 cm long, scantly branched, bracnches up to 5 cm, sometimes with rather simple, short branches and seemingly racemose; bracts triangular, *c.* $^2/_3$ mm long; pedicels *c.* $^1/_3$ mm. *Flowers* light yellow or yellowish green. *Calyx* lobes triangular, $^1/_3$–$^3/_4$ mm long. *Petals* ovate, $1^1/_3$–2 by 1–$1^1/_2$ mm. *Stamens* $^2/_3$–2 mm; staminodes in ♀ shorter and smaller. *Disk* 1–$1^2/_3$ mm ∅. *Ovary* subglobose, *c.* 1 mm ∅. *Drupe* subglobose, 12–17 by 10–15 mm, green speckled white (? never red) (CORNER, 1940) or dark green (BURKILL 2154); septum hollow.

Distr. *Malesia:* Malay Peninsula (Trengganu, Kelantan, Pahang, Selangor, Johore, Singapore) and Borneo (Sarawak: Kuching, Loba Kabang, Sg. Mas, Baram, Sibu, Bintulu; Sabah: Mt Tavai; Kalimantan: Bulongan, Sampit).

Ecol. Common to rare in lowland (peat-)swamps to mixed primary forest on well-drained soils, also in heath forest, 3–1200 m. *Fl. fr.* Jan.–Dec.

Vern. Malay Peninsula: *tĕrĕntang, t. bukit, t. daun kĕchil*, M; Borneo: *kayu mansan, tĕrĕntang*, Sarawak.

5. Campnosperma montanum LAUT. Bot. Jahrb. 56 (1920) 359; MERR. & PERRY, J. Arn. Arb. 22 (1941) 533; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 167; KRAEMER, Trees W. Pac. Reg. (1951) 190, f. 66; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 18; DING HOU, Blumea 24 (1978) 5. — Fig. 59h.

Shrub $2^1/_2$–4 m high to tree up to 30 m and 60 cm ∅; sometimes slightly buttressed. Bark grey (to light brown), smooth and pustularly lenticellate but also shallowly fissured and/or somewhat scaly. Young foliage pink to red, mature foliage dark green, old leaves withering red. *Leaves* lanceolate, elliptic-lanceolate, or obovate-oblong, $4^1/_2$–23 by 2–9 cm (up to 64 by $14^1/_2$ cm on vegetative twigs), pubescent on both surfaces at the basal part when young, glabrescent, sometimes almost glabrous; base gradually decurrent towards the insertion, sometimes (obscurely) auriculate on vegetative leaves; nerves 5–12 pairs (up to 24 pairs on vegetative leaves); veins usually reticulate, sometimes reticulate-scalariform, distinct on both surfaces; petiole 0–$1^1/_2$ cm. *Panicles* up to 10 cm long, scantly branched, with rather simple, short branches (up to $3^1/_2$ cm long) and seemingly racemose; bracts triangular, $^1/_2$–$^3/_4$ mm long; pedicels $^2/_3$–1 mm. *Flowers* light yellow or yellow. *Calyx* lobes triangular, $^2/_3$–1 mm long. *Petals* ovate, *c.* 2 by $1^1/_4$ mm. *Stamens c.* $1^1/_2$ mm; staminodes in ♀ shorter and smaller. *Disk* 1–$1^1/_2$ mm ∅. *Ovary* subglobose, *c.* $^3/_4$ mm ∅. *Drupe* ovoid or subglobose, 11–15 by 7–11 mm, red to dark red or black when ripe; septum solid.

Distr. *Malesia:* Moluccas (Ternate, Halmaheira, Morotai, Ambon) and New Guinea (West: West-, Hollandia-, and South Division; East: Sepik, Western and Southern Highlands), New Britain (Omoi), and New Ireland.

Ecol. Common to rare in freshwater (*Melaleuca*-, sago-)swamps, seasonally inundated to well drained mixed lowland and submontane forest, *Lithocarpus*-, *Nothofagus*-, and *Agathis*-forest, even in mossy forest; sometimes in secondary forest, on limestone, or shrubby on marshy limestone silt; 0–1500 m. *Fl.* Febr.–Dec.; *fr.* Febr.–Sept.

Uses. DORNSTREICH (*in sched.*) reported that sap from the tree is tapped, used and traded as body and hair oil (see also *sub C. coriaceum*) while leaves are used to pack sago, meat, or fish for cooking on hot stones in earthen ovens.

Vern. Moluccas: *hotong otan*, Ambon; New Guinea: *alep*, Muju, *kaauwe*, Tanah Merah, *ketukar*, Tehid, *kutur*, Mandobo, *sabek*, Mooi, *siemchat, siemegat*, Maibrat, *sobrowanye, tsobala*, Sepik, *su*, Kiunga, *tiesentur*, Asmat, *tsesegene*, Kutubu.

Notes. Fruit-like insect galls were observed (BRASS & VERSTEEGH 12541 & BW 6498), which have the floral parts crowned at the top instead of at the base as in a normal fruit.

Young branchlets bear very small leaves and axillary inflorescences resembling much-branched panicles (VAN ROYEN & SLEUMER 5814).

Excluded

Campnosperma acutiauris BOERL. & KOORD. in Koord.-Schum. Syst. Verz. 2 (1910) 32 (type: Sumatra, KOORDERS 20929, BO, L), according to VAN STEENIS (Tectona 22, 1929, 1340) = *Tristania* (*Myrtaceae*). The isotype in Leiden was annotated by him (March 1959) as *Tristania cf. whiteana* GRIFF.

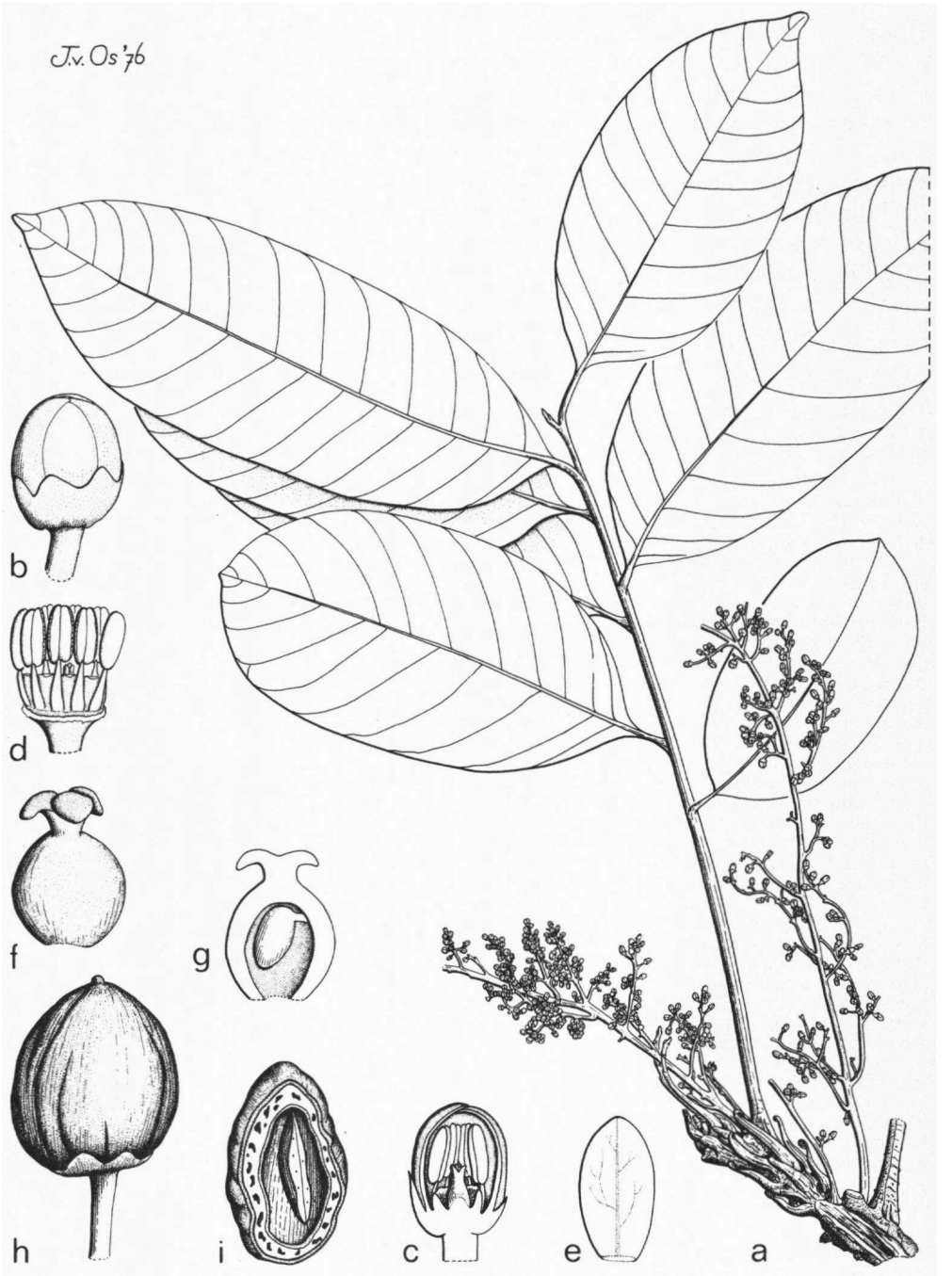

Fig. 63. *Euroschinus papuanus* MERR. & PERRY. *a.* Habit, × 1/2, *b.* bud, *c.* LS of ♂ bud, *d.* ♂ flower, calyx lobes and petals removed, *e.* petal, inner surface, all × 7, *f.* pistil, × 15, *g. ditto* in LS, × 15, *h.* fruit, × 3 1/2, *i. ditto* in LS, × 3 1/2 (*a–e* BRASS 25476, *f–g* HOOGLAND 3375, *h–i* LAE 51313).

19. EUROSCHINUS

HOOK. *f.* in B. & H. Gen. Pl. 1 (1862) 422; MARCH. Rév. Anacard. (1869) 59; ENGL. in DC. Mon. Phan. 4 (1883) 321. — **Fig. 63.**

Trees, very rarely shrubs. *Leaves* spiral, paripinnate, petioled. *Leaflets* alternate or subopposite, entire. *Inflorescences* axillary, rarely cauliflorous, sometimes terminal (*extra*-Mal. *spp.*), paniculate. *Flowers* unisexual or bisexual (plants polygamous). *Calyx* 5-(or 4-)lobed. *Petals* 5 (or 4), imbricate, glabrous. *Stamens* twice the number of petals; filaments subulate, glabrous; anthers basifixed, oblong, reduced or abortive in ♀. *Disk* intrastaminal, shortly cupular in ♂, round and flat in ♀. *Ovary* ovoid, 1-celled and 1-ovuled; style short; stigmas 3; ovary abortive and small in ♂. *Drupe* 1-celled; endocarp crustaceous. *Seed* with testa free from the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. Species 6, four of them in New Caledonia, one in Australia, and one in *Malesia* (New Guinea) and New Britain.

Ecol. In forests from lowland to *c.* 500 m, sometimes up to *c.* 1000 m.

Note. The leaves in this genus are invariably paripinnate, the rachis showing a distinct extension above the insertion of the highest leaflet. Fig. 63a. This structure is unique among Malesian *Anacardiaceae.*

1. Euroschinus papuanus MERR. & PERRY, J. Arn. Arb. 29 (1948) 158; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 23, f. 8. — **Fig. 63.**

Tree up to 30 m high and 67 cm ∅, very rarely shrubby *c.* 2 m high (*cf.* CARR 14726, at 1050 m). Buttresses occasionally present up to *c.* $1^1/_2$ m high. Bark brownish grey, finely fissured. Twigs sometimes inhabited by ants and hollow. *Leaves* with (3–)5–6(–8) pairs of leaflets; rachis 12–46 cm, petiole 7–26 cm, both tomentose, glabrescent, or glabrous. *Leaflets* coriaceous, elliptic to elliptic-lanceolate or ovate to lanceolate, $4^1/_2$–23(–32) by 3–9(–15) cm; upper surface glabrous except sometimes tomentose on the midrib; lower surface pubescent (sometimes only on the midrib), glabrescent, or glabrous; base cuneate; apex obtuse or slightly emarginate, rarely abruptly acuminate; nerves 7–19 pairs, veins reticulate-scalariform; petiolules $^1/_2$–$1^1/_2$ cm. *Panicles* up to 28 cm long, pubescent, glabrescent, branches up to 10 cm long; bracts linear, 1–$1^3/_4$ mm; pedicels *c.* $^3/_4$ mm. *Flowers* white. *Calyx* lobes triangular, *c.* $^2/_3$ mm long. *Petals* elliptic, or obovate-oblong, $1^1/_2$–$3^1/_4$ by $^2/_3$–$1^1/_4$ mm. *Stamens* *c.* 2 mm; anthers $^2/_3$–1 mm, abortive and smaller in ♀. *Disk* *c.* 1 mm ∅. *Ovary* subglobose, *c.* $^3/_4$ mm ∅, glabrous; style *c.* $^1/_2$ mm; stigmas subglobose; ovary abortive and small in ♂. *Drupe* obliquely broad-ellipsoid, $^2/_3$–1 by $^1/_2$–$^2/_3$ cm, blackish purple when ripe, with an excentric scar of the style.

Distr. *Malesia:* New Guinea and neighbouring islands (Hollandia; Sepik, Madang, Morobe, Northern, Central, and Milne Bay Districts; New Britain, Normanby and Misima Is.). Fig. 64.

Ecol. Forests of inundated areas and dryland, up to 540 m, sometimes up to *c.* 1000 m. *Fl.* March–Sept.; *fr.* March–Oct.

Vern. *A'uru, ongoi,* Orokaiva, *enal, timol,* Amele, *garuve,* Faita, *manai,* Dumpu, *sugun,* Bilia, *talak,* Sko.

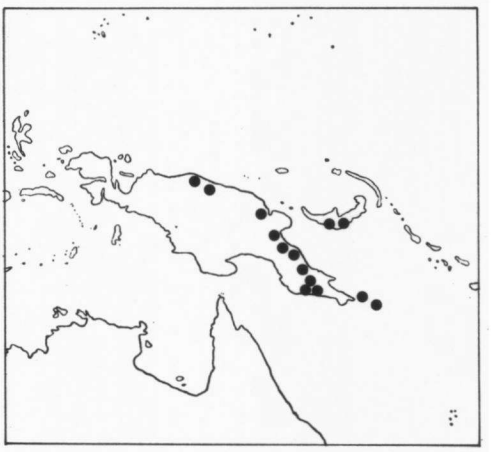

Fig. 64. Localities of *Euroschinus papuanus* MERR. & PERRY.

20. RHUS

(TOURNEFORT, Inst. Rei Herb. 1700, 611) LINNÉ, Gen. Pl. ed. 5 (1754) 129; Sp. Pl. 1 (1753) 265; MARCH. Rév. Anacard. (1869) 84 & 179; ENGL. Bot. Jahrb. 1 (1881) 378; in DC. Mon. Phan. 4 (1883) 376; BARKLEY, Ann. Mo. Bot. Gard. 24 (1937)

312; BRIZICKY, J. Arn. Arb. 44 (1963) 62; DING HOU, Blumea 24 (1978) 34. — *Toxicodendron* (TOURNEFORT, Inst. Rei Herb. 1700, 610) MILLER, Gard. Dict. abridged ed. 4 (1754), ed. 8 (1768); BARKLEY, Ann. Mo. Bot. Gard. 24 (1937) 417; GILLIS, Rhodora 73 (1971) 161. — *Melanococca* BL. Mus. Bot. 1 (1850) 236. — *Duckera* BARKLEY, Am. Midl. Nat. 28 (1942) 472, *nom. superfl.* — **Fig. 65–67.**

Erect or scandent shrubs, trees, or lianas, sometimes hemi-epiphytic, mostly deciduous. *Leaves* spiral, imparipinnate, trifoliolate, unifoliolate, rarely simple (*R. borneensis*), petioled; venation (in Mal. *spp.*) not reticulate, no areolae. *Leaflets* usually opposite or subopposite, entire, rarely crenate-dentate; without or with (glabrous pit-like) domatia (fig. 65b–c), or sometimes with a spot-like group of reddish brown papillae or glands (fig. 65h–i) in the axils of the nerves beneath. *Inflorescences* paniculate, rarely racemose and few-flowered, terminal, axillary, sometimes pseudoterminal (then terminal bud of the twig present). *Flowers* unisexual or bisexual (plants dioecious, sometimes polygamous, or polygamo-dioecious). *Calyx* 5-lobed. *Petals* 5, imbricate, glabrous, rarely hairy on the inner surface. *Stamens* 5; filaments subulate, glabrous; anthers dorsifixed, imperfect or sterile in ♀. *Disk* intrastaminal, discoid, shortly cupular, or round and flat. *Ovary* 1-celled, abortive in ♂; style short, distinct or obscure; stigmas 3, free or united, capitate or obscure. Pistillode in ♂ very small. *Drupe* 1-celled; endocarp coriaceous, crustaceous or bony. *Seed* with the testa adhering to the endocarp or free from it; embryo straight, cotyledons free, flat.

Distr. Widely distributed in the temperate zones of both hemispheres extending in the subtropics and tropics, abundant in seasonal and dry areas, but surprisingly poorly occurring in Australia where it is only represented in Queensland by 2 *spp.*, of which 1 endemic (and a closely related monotypic genus *Rhodosphaera*); throughout *Malesia*, also in West Pacific Is.

Since ENGLER (1883) revised the genus it has not been monographed in its entirety. The number of species is difficult to estimate, but will probably run to *c.* 200.

Ecol. In Malesia usually in primary or montane forest, sometimes in savannahs, in mossy and inundated forest, or in secondary forest, from sea-level up to 2400 m.

Several species may occur obviously as hemi-epiphytes, *e.g. R. caudata*, *R. lenticellosa*, *R. linguata*, and *R. nodosa*, similarly as in *Spondias*.

Taxon. Recently two American authors proposed to split the genus. GILLIS *l.c.* recognized again *Toxicodendron* on generic rank with 3 American and 2 Asian *spp.*, but also 1 American–Asian *sp.* BARKLEY *l.c.* (1942) distinguished a genus *Duckera* BARKLEY, which he based on *Rhus sect. Melanocarpeae* ENGL.; but ENGLER had already based this on the genus *Melanococca* BL. 1850, so that *Duckera* is superfluous and illegitimate. It has already been reduced to *Rhus* by BRIZICKY (1963) who is in favour of keeping the genus *Rhus* in the large sense, with which I agree.

The genus has been subdivided into a few subgenera and sections, but I refrain from an opinion as this can only be considered in the scope of an entire revision of the genus.

Phylog. From an elaborate study of the African species DIELS (Bot. Jahrb. 24, 1898, 568–646, 8 fig., t. 14) concluded that *Rhus* has already in the Old Tertiary migrated from India towards Africa, during which extension form development was mostly in the vegetative parts with manyfold adaptation to various extra-tropical climatic conditions.

Uses. No uses known of native species. Growing the Sino-japanese lacquer yielding *R. vernicifera* DC. has been unsuccessful (BURKILL) and suggestions to attempt this quite unrealistic (HEYNE).

Note. Among the species are unifoliolate ones. Their leaflet is articulated. *R. borneensis* has, however, really simple leaves lacking any articulation.

KEY TO THE SPECIES

1. Leaves simple (not unifoliolate) . . . . . **9. R. borneensis**
1. Leaves compound; imparipinnate, trifoliolate, or unifoliolate.
2. Leaflets with glabrous pit-like domatia in the axils between nerves and midrib on the lower surface; apex caudate to lingulate.
3. Leaflets 13–24 by 5–7½ cm. Branchlets conspicuously lenticellate . . . . . **6. R. lenticellosa**
3. Leaflets smaller, 4–10 by 1¼–3¾ cm. Branchlets rather smooth.

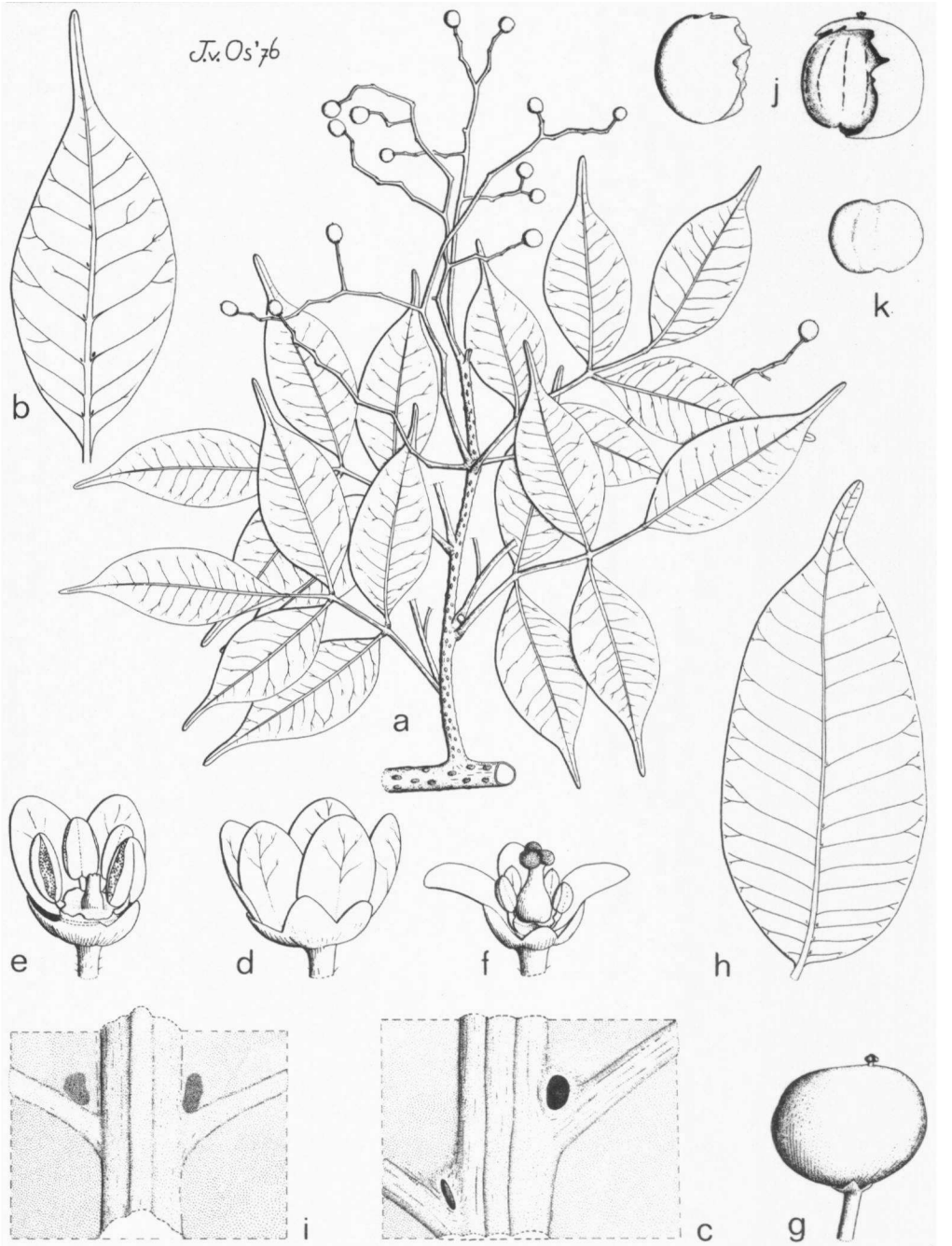

Fig. 65. *Rhus caudata* LAUT. *a*. Habit, × 1/2, *b*. lower surface of leaflet with domatia, nat. size, *c*. *ditto*, enlarged, × 15, *d*. ♂ flower, *e*. *ditto*, one calyx lobe, 3 petals and 1 stamen removed, *f*. ♀ flower, 2 petals and 1 stamen removed, all × 7, *g*. fruit, × 3 1/2. — *R. nodosa* BL. *h*. Lower leaf surface showing (pseudo-) domatia, groups of glands, nat. size, *i*. *ditto*, enlarged, × 15. — *R. lamprocarpa* MERR. & PERRY. *j*. Fruit, with almost half of exocarp broken off showing the seed still enveloped by the mesocarp, *k*. endocarp, side view, both × 3 1/2 (*a–c*, *g* NGF 41529, *d–e* NGF 39947, *h–i* S 16547, *j–k* CLEMENS 8256).

4. Leaves (1–)5(–7)-foliolate, terminal petiolule ($^1/_2$–)$1^3/_4$–$2^1/_2$ cm. Anthers *c.* 1 mm long. (Pollen grains rather smooth) . . . . . **7. R. caudata**
4. Leaves unifoliolate and/or trifoliolate, terminal petiolule very short, *c.* $^1/_5$ cm. Anthers *c.* $^1/_2$ mm long. (Pollen grains conspicuously reticulate) . . . . . **8. R. linguata**
2. Leaflets without glabrous pit-like domatia in the axils between nerves and midrib on the lower surface; apex acute, acuminate, or obtuse.
5. Leaflets crenate-dentate. Petals sparsely pilose on the inner surface. Fruits densely puberulous **1. R. chinensis**
5. Leaflets entire (very rarely some of them irregularly dentate in *R. lamprocarpa*). Petals glabrous (except in *R. taitensis*). Fruits glabrous.
6. Inflorescences terminal, sometimes also with some axillary ones in the leaf axils at the end of twigs, very rarely axillary only. Petals sparsely pilose on the inner surface. Fruits black when ripe **2. R. taitensis**
6. Inflorescences axillary and/or pseudoterminal (then terminal bud of the twig present). Petals glabrous. Fruits not black when ripe.
7. Old leaflets pubescent on both surfaces (without a group of reddish brown papillae or glands in the axils between nerves and midrib on the lower surface). Ovary sparsely hairy **5. R. lamprocarpa**
7. Old leaflets almost glabrous on both surfaces. Ovary glabrous.
8. Petals 1–$1^1/_2$ by $^2/_3$ mm. Leaflets usually with a spot consisting of a group of reddish brown papillae or glands in the axils of the nerves beneath. Small tree or shrub . . . **3. R. succedanea**
8. Petals 2–3 by $1^1/_4$–$1^1/_2$ mm. Leaflets rarely with papillae or glands as above. Scandent shrub or liana, sometimes small shrub or tree. . . . . **4. R. nodosa**

1. Rhus chinensis MILLER, Gard. Dict. ed. 8 (1768) *sub n.* 7; MERR. Contr. Arn. Arb. 8 (1934) 91; Comm. Lour. (1935) 244; TARD. Fl. C. L. & V. 2 (1962) 182. — *R. semialata* MURRAY, Comm. Soc. Goett. 5 (1784) 27, t. 3; DC. Prod. 2 (1825) 67; ENGL. in DC. Mon. Phan. 4 (1883) 380; BACK. Schoolfl. (1911) 283; HEYNE, Nutt. Pl. (1927) 979; MERR. J. Arn. Arb. 9 (1928) 3, t. 11. — *R. javanica* (*non* L.) THUNB. Fl. Jap. (1785) 121; LOUR. Fl. Coch. (1790) 183; CRAIB, Fl. Siam. En. 1 (1926) 342; WALKER, Fl. Okin. & S. Ryu Kyu Is. (1976) 661, f. 103.

Small tree or shrub, 4–12 m high and 6–18 cm ∅. *Leaves* imparipinnate, with 4–6 pairs of leaflets; rachis 10–30 cm, sometimes winged, petiole 8–11 cm, both tomentose. *Leaflets* subcoriaceous, ovate-oblong, rarely ovate or lanceolate, 5–15 by $2^1/_2$–8 cm; margin crenate-dentate; lower surface tomentose and also distinctly papillose, without domatia; upper surface tomentose on the midrib, the rest sparsely hairy; base unequal, cuneate, in terminal leaflets sometimes attenuate or decurrent; apex acute or acuminate; nerves 14–20 pairs, veins reticulate-scalariform, distinct below, rather faint above; lateral petiolules 0 or very short, terminal one $2^1/_2$–$3^1/_2$ cm. *Inflorescences* paniculate, terminal, very rarely also in one or more leaf axils at the end of a twig, up to 40 cm long, tomentose, branches up to 25 cm; bracts triangular to lanceolate, $^1/_3$–1 mm long; pedicels $^1/_3$–$^2/_3$ mm. *Flowers* white or pale yellow-green. *Calyx* lobes triangular, *c.* $^2/_3$ mm long. *Petals* broad-elliptic or oblong, 2–$2^1/_4$ by $1^1/_4$–$1^1/_2$ mm, sparsely pilose on the inner surface. *Stamens* 2 mm; anthers broad-ellipsoid, $^2/_3$–$^3/_4$ mm long; staminodes in ♀ 1–$1^1/_2$ mm. *Disk* discoid or short-cupular, *c.* $^3/_4$ mm ∅. *Ovary* globose, *c.* $^1/_2$ mm ∅, densely puberulous; pistillode in ♂ *c.* $^3/_4$ mm long. *Drupe* subglobose, *c.* 5 mm ∅, densely puberulous; exocarp separating from mesocarp in ripe fruits.

Distr. Widely distributed in temperate and subtropical Asia: India, Burma, Thailand, Laos, Cambodia, Vietnam, China, Taiwan, Ryu Kyu, Japan, and *Malesia:* Sumatra (Toba Lands, Sibolangit).

Cultivated in Java.

Ecol. In primary and secondary forest and thickets, 900–1200 m; in China (Yunnan) up to 3200 m. *Fl.* July–Oct.; *fr.* March, Sept.–Nov.

Uses. Imported galls are in use as medicine (*cf.* HEYNE, *l.c.* 979).

Vern. Sumatra: *batu babru*, E. Coast, *kaju bane pora*, *k. pora-pora*, *k. si hurpak*, Lumban Lobu, *martipos*, Toba-Batak.

2. Rhus taitensis GUILLEMIN, Ann. Sc. Nat. II ,7 (1837) 361; MERR. En. Philip. 2 (1923) 473; KANEH. Bot. Mag. Tokyo 45 (1931) 292; Fl. Micron. (1933) 185, f. 76; CHRISTOPHERSEN, Bull. Bish. Mus. 128 (1935) 127; MERR. & PERRY, J. Arn. Arb. 22 (1941) 536; ROYEN, Man. For. Trees Papua & N. G. 4 (1964) 36, f. 13; BACK. & BAKH. *f.* Fl. Java 2 (1965) 153. — *Melanococca tomentosa* BL. Mus. Bot. 1 (1850) 236; MIQ. Fl. Ind. Bat. 1, 2 (1859) 674. — *R. simarubaefolia* A. GRAY, U.S. Expl. Exp. (1856) 367, t. 44; ENGL. in DC. Mon. Phan. 4 (1883) 450, *incl. var. taitensis* (GUILLEMIN) ENGL.; VIDAL, Phan. Cuming. (1885) 105; Rev. Pl. Vasc. Filip. (1886) 99; LANE-POOLE, For. Res. (1925) 107. — *Otonychium retusum* MIQ. Fl. Ind. Bat. 1, 2 (1859) 572, *sub Sapindaceae*; *cf.* DING HOU, Blumea 24 (1978) 34. — *R. rufa* T. & B. Nat. Tijd. N. I. 27 (1863) 52; ADELB. Blumea 6 (1948) 326. — *R. panaciformis* F.v.M. Fragm. 7 (1869) 22. — *R. retusa* ZOLL. *ex* (T. & B. Cat. Hort. Bog. 1866, 230, *nomen*) ENGL. in DC. Mon. Phan. 4 (1883) 450, *nom. illeg.*, *incl. var. blumei* ENGL.; K. & V. Bijdr. 4 (1896) 119; KOORD. Minah. (1898) 412, *incl. var. rufa* (T. & B.) K. & V.; BACK. Schoolfl. (1911) 282; LAUT. Bot. Jahrb. 56 (1920) 362; C. T. WHITE, J. Arn. Arb. 10 (1929) 235; GUILLAUMIN, *ibid.* 12 (1931) 242; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 169. — *R. engleriana* WARB. Bot. Jahrb. 13 (1891) 363. — *Duckera taitensis* (GUILLEMIN) BARKLEY, Lilloa 23 (1950) 253.

Tree up to 30 m high and 70 cm ∅. Buttresses sometimes present, $^1/_2$–$1^1/_2$ m high, 1–3 m wide, 5–10 cm thick. Bark grey-brown or brown, smooth to rough, finely superficially fissured. *Leaves*

imparipinnate, (7–)13–15(–21)-foliolate; rachis 20–50 cm, petiole 8–15 cm, both puberulous or tomentose. *Leaflets* chartaceous to subcoriaceous, elliptic to elliptic-lanceolate or ovate to lanceolate, 4–20 by $1^1/_2$–$6^1/_2$(–$8^1/_2$) cm, entire; without domatia; puberulous especially on the midrib, nerves and veins below, sometimes also on the upper surface especially on midrib and nerves; base slightly unequal, obtuse or slightly cuneate; apex acute, acuminate, or obtuse; nerves 9–16 pairs; veins reticulate, some ± perpendicular to the nerves, faint on both surfaces, sometimes distinct below; lateral petiolules *c.* $^1/_2$ cm, terminal one up to 3 cm. *Inflorescences* paniculate, terminal, sometimes also with some axillary ones in the leaf axils at the end of twigs, very rarely axillary only, up to 30 cm long, puberulous to tomentose, branches up to 26 cm; bracts triangular to linear, $^1/_3$–1 mm long; pedicels very short, *c.* $^1/_3$ mm. *Flowers* cream white, rarely pink. *Calyx* lobes slightly triangular, 1–$1^1/_2$ mm long. *Petals* ovate to ovate-oblong, sometimes broad-elliptic, $1^3/_4$–2 by 1–$1^1/_4$ mm, sparsely pilose on the inner surface. *Stamens* 1–$2^3/_4$ mm; anthers broad-ovoid, *c.* $^3/_4$ mm long; staminodes in ♀ *c.* $^1/_2$ mm. *Disk* discoid, $^2/_3$–$1^1/_4$ mm ∅. *Ovary* subglobose, *c.* 1 mm ∅, papillose; pistillode in ♂ *c.* $^2/_3$ mm long. *Drupe* subglobose, 4–8 mm ∅, black when ripe, exocarp not separating from the mesocarp in ripe fruits.

Distr. Polynesia (Tahiti, Niue Is., Fiji), Micronesia (Palau, Yap, Ponape), Solomon Is., Australia (Queensland: Rockingham Bay), New Britain to Malesia. In *Malesia* widely distributed in East Java (Besuki), Lesser Sunda Is. (Flores, Sumba, Alor, Wetar, Timor, Tanimbar), Philippines (Bohol I., Mindanao), Celebes (Minahassa), Moluccas (Talaud, Ternate, Ceram, Key Is.), and New Guinea. Fig. 66.

Cultivated in Hort. Bog. *sub* III–E–50, VI–B–19, VI–B–76. In West Java near Bogor escaped from the Botanic Garden.

Ecol. Primary, dryland rain-forest, also in inundated forest along rivers, sometimes in clearings, secondary forest, or savannahs, rarely in forest on ultra-basic rock or on limestone; from sea-level up to 1950 m. *Fl. fr.* Febr.–Dec.

Vern. Fiji: *manawi*; Solomon Is.: *akwasi*, Kwara'ae, *panasihu*, Bougainville. Java: *ki mĕnjan*, Bogor, *tjĕmbawak*, *tombawa*, J; Lesser Sunda Is.: *dwa puè*, *kaingait*, Tanimbar, *enggo*, Sumbawa, *goré*, *kare*, Flores, *wala*, Sumba; Moluccas: *nanitu*, Talaud, *njego*, Ternate; New Guinea: *ba*, Amele, *baib*, Karkar I., *bas*, Utu, *jiem*, *djiem*, Kebar lang., *elna*, Melpa, *eluwa*, Hagen, *eruget*, Rai Coast, *fore*, Onjob, *gerum*, Maibrat lang., *gjèwo*, *upit utsju*, Papuan, *ibaamkatgat*, *juarambruum*, Kemtuk, *kie-em*, Mooi lang., *kwaia*, Minufia, *mo*, Karoon lang., *ono*, Waria, *orena*, Laruni, *pajungbulung*, Doromena lang., *priejij*, Hattam lang., *sika*, Rawa, *samuwin*, Biak lang., *sietseka*, *siska*, Manikiong lang., *tabilemabo*, Kutubu lang.

Notes. For unknown reasons the name *R. retusa* ZOLL. remained for a long time a *nom. in sched.* ENGLER's acception of it was illegitimate by mentioning the earlier *R. rufa* in the synonymy.

Otonychium retusum MIQ. was based on an anonymous ♂ flowering specimen from Java, which MIQUEL referred to a Sapindaceous genus. RADLKOFER correctly referred this to *Rhus* (Sapind. Holl.-Ind. 1877, 14; Pfl. R. Heft. 98, 1934, 1462). A specimen named by MIQUEL could not be traced in BO, L, and U. At Leiden there is one specimen named *R. retusa* ZOLL. in BLUME's handwriting to which MIQUEL noted that it did not belong to that order (*i.c. Anacardiaceae*) with reference to his Fl. Ind. Bat.

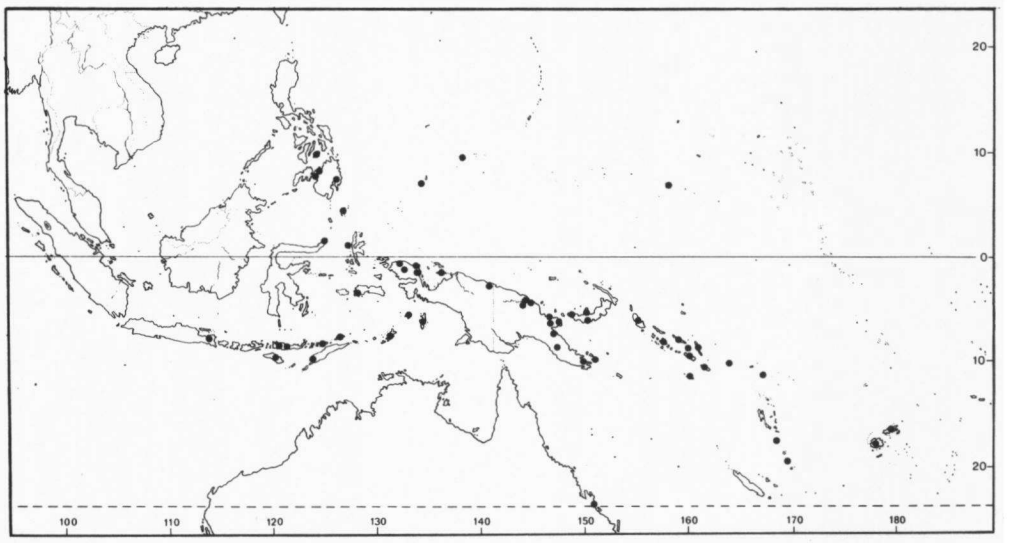

Fig. 66. Localities of *Rhus taitensis* GUILLEMIN (locality in Tahiti not drawn).

3. Rhus succedanea LINNÉ, Mant. 2 (1771) 221; WIGHT, Ic. 2 (1842) t. 560; HASSK. Flora 25 (1842) Beibl. ii: 45, *incl. var. discolor* HASSK.; *ibid.* 27 (1844) 618; HOOK. *f.* Fl. Br. Ind. 2 (1876) 12; ENGL. in DC. Mon. Phan. 4 (1883) 399; BACK. Schoolfl. (1911) 283; CRAIB, Fl. Siam. En. 1 (1926) 342; BURK. Dict. (1935) 1905; LIU, Ill. Pl. Taiwan 2 (1962) 940, f. 775; LI, Woody Fl. Taiwan (1963) 449, f. 174; BACK. & BAKH. *f.* Fl. Java 2 (1965) 154; WALKER, Fl. Okin. & S. Ryu Kyu Is. (1976) 660, f. 102. — *R. pubigera* BL. Bijdr. (1826) 1165. — *Toxicodendron succedanea* MOLDENKE, Phytologia 2 (1946) 142; TARD. Fl. C. L. & V. 2 (1962) 185, t. 16, f. 1–4.

Small tree or shrub up to 7 m high, rarely up to 15 m high and 50 cm ∅. *Leaves* imparipinnate, with (2–)3–4(–6) pairs of leaflets; rachis (1½–) 8–27 cm, petiole 4–6 cm, both slightly puberulous, or glabrous. *Leaflets* membranous to chartaceous, lanceolate, elliptic-lanceolate, rarely linear, 3¼–8 by 1¼–2½ cm, entire, glabrous above, on the lower surface sparsely pubescent especially on the midrib and nerves, glabrescent, almost glabrous when old, usually with a group of reddish brown papillae or glands in the axils of the nerves; base obliquely cuneate, sometimes obtuse, in terminal leaflet rarely decurrent; apex acuminate; nerves 10–30 pairs, veins reticulate, rather faint on both surfaces; lateral petiolules 1/10–1/5(–½) cm, terminal one ½–1½ cm. *Inflorescences* paniculate, axillary, up to 24 cm long, sparsely puberulous, glabrescent, branches up to 10 cm; bracts triangular, *c.* ⅓ mm long; pedicels (1½–)2–3 mm. *Flowers* cream white. *Calyx* lobes triangular, ½–⅔ mm long. *Petals* ovate or slightly oblong, 1–1½ by ⅔ mm (recorded 2–5 mm long by BACKER & BAKH. *f. l.c.*), glabrous. *Stamens* 1½–2½ mm; anthers broad-ovoid, ⅔–1 mm long, rarely abortive. *Disk* slightly discoid, *c.* ¾ mm ∅. *Ovary* subglobose, *c.* ⅔ mm ∅, glabrous, rarely abortive. *Drupe* subglobose, 5–8 mm ∅, dull yellowish when ripe; exocarp separating from mesocarp in ripe fruits.

Distr. India, Burma, Thailand, Laos, Cambodia, Vietnam, China (also Hongkong & Hainan), Japan, Ryu Kyu Is., Taiwan, and *Malesia:* N. Sumatra (Atjeh: Gajo Lands, Mt Losir; West Coast: Mt Sago), 2 collections.

In Java formerly rarely cultivated; Cult. Hort. Bog. *sub. n.* XV-J-B-XXX-9, 9a, from Japan.

Ecol. Open slopes or by streams in montane forest, 900–2200 m. *Fl.* April; *fr.* Aug.

Note. In collecting this species in the Gajo Lands Dr & Mrs DE WILDE and their companions suffered from a badly swollen face, ears, and hands, accompanied by bad itching; they did not get blisters!

4. Rhus nodosa BL. Bijdr. (1826) 1164; BACK. Schoolfl. (1911) 283; BACK. & BAKH. *f.* Fl. Java 2 (1965) 153. — *R. perakensis* SCORT. *ex* King, J. As. Soc. Beng. 65, ii (1896) 500; RIDL. Kew Bull. (1933) 193. — *Toxicodendron nodosum* GILLIS, Rhodora 73 (1971) 168, f. 26 & 28. — **Fig. 65h–i, 67.**

Scandent shrub, or liana, up to 15 m high, sometimes small shrub or tree, 1½–9 m high.

Fig. 67. *Rhus nodosa* BL. at Kuching (Photogr. DING HOU).

Leaves copper-red when young, imparipinnate, with (1–)2–3(–5) pairs of leaflets; rachis 4–10 cm, petiole 4½–6 cm, both glabrous. *Leaflets* subcoriaceous, ovate, elliptic, or elliptic-lanceolate, 4–15 by 1¾–6 cm, entire; lower surface sparsely puberulous when young, glabrescent, almost glabrous when old, rarely with a group of reddish brown papillae or glands in the axils of the nerves; upper surface glabrous; base cuneate or attenuate, sometimes obtuse, terminal one decurrent; apex acuminate; nerves 12–23 pairs, veins reticulate, rather faint on both surfaces, sometimes distinct beneath; lateral petiolules 0–¾ cm, of terminal leaflet 0–2¼ cm. *Inflorescences* paniculate, axillary or pseudoterminal, up to 40 cm long, sparsely puberulous, glabrescent, or glabrous, branches up to 7½ cm; bracts triangular, ⅓–½ mm long; pedicels ½–2 mm. *Flowers* cream, light or yellowish green. *Calyx* lobes triangular, ⅔–¾ mm long. *Petals* ovate or elliptic, 2–3 by 1¼–1½ mm, glabrous. *Stamens* 1½–2 mm; anthers ovoid, *c.* 1 mm long; staminodes in ♀ *c.* 1 mm. *Disk* discoid, 1–1¼ mm ∅. *Ovary* subglobose, *c.* 1 mm ∅, glabrous; pistillode in ♂ *c.* ¾ mm long. *Drupe* subglobose, subreniform, 5–7 by 5–8 mm, colour variable, in shades of red to buff; exocarp separating from mesocarp in ripe fruits.

Distr. *Malesia:* Malay Peninsula, Sumatra (Bencoolen: Batang Baru; West Coast: G. Talang), Java (Nirmala, Bogor, Bangas, G. Batu, G. Tjikoraj, G. Sembung, Tjidadap, Pekalongan), Borneo (Sarawak: Mt Hose, Long Kapa, Kalabit Highlands, Kuching, Baram, Bau; Kalimantan: E. Kutai), and SW. Celebes (Makale, Makassar).

Ecol. Primary forest, open rocky jungle, on river-banks, in ravines, in disturbed vegetation at margins of peat-swamp forest, sometimes on limestone ridges, from the lowland up to 1400 m. *Fl.* July–Nov.; *fr.* March, June–Nov.

From the variation in habit one might conclude that this species is sometimes a hemi-epiphyte.

Vern. Sumatra: *kalodan*, G. Talang, *sitakan nan djantěn*, M; Java: *těběl katjě*, S.

5. Rhus lamprocarpa MERR. & PERRY, J. Arn. Arb. 29 (1948) 159. — Fig. 65j–k.

Tree up to 15 m high and 27 cm ∅, once recorded 45–50 cm ∅. Bark light grey, grey-brown, deeply fissured and ridged. *Leaves* imparipinnate, with 3–4(–5) pairs of leaflets; rachis 5–11½ cm, petiole 3–6 cm, both pubescent. *Leaflets* chartaceous to subcoriaceous, elliptic- or ovate-oblong, 4½–13 by 2½–5½ cm, entire, very rarely some of them irregularly dentate; lower surface rather more densely pubescent than the upper surface, especially on the midrib, nerves, and veins, without a group of reddish brown papillae or glands in the axils between nerves and midrib; nerves 10–16 pairs; veins reticulate, distinct below, obscure above; base obliquely rounded or slightly cuneate; apex acute or acuminate; lateral petiolules ⅓–¾ cm, terminal one ½–1½ cm. *Inflorescences* paniculate, axillary, sometimes pseudo-terminal, up to 15 cm long, puberulous, glabrescent, branches up to 5 cm; bracts lanceolate, ⅓–1 mm long; pedicels *c.* 1 mm. *Flowers* cream white. *Calyx* lobes triangular, *c.* 1 mm long. *Petals* oblong or oblong-elliptic, 2–2¼ by 1–1¼ mm, glabrous. *Stamens* 1½ mm; anthers ovoid, 1–1¼ mm long; staminodes in ♀ *c.* 1 mm. *Disk* round and flat or discoid, *c.* 1¼ mm ∅. *Ovary* subglobose, *c.* ⅔ mm, sparsely hairy; pistillode in ♂ *c.* ½ mm long. *Drupe* subglobose, *c.* 5 mm ∅, glabrous, pale brown to bronze when ripe, exocarp separating from mesocarp in ripe fruits.

Distr. *Malesia:* New Guinea (Morobe and E. Highlands Distr.).

Ecol. Open grassy hills, hill scrub-forest, and forest along river-banks, 240–1800 m. *Fl.* Aug.–Jan.; *fr.* June.

Vern. *Vaka-ono*, *valoi-patep*, *wolo*, Morobe Distr.

6. Rhus lenticellosa LAUT. Nova Guinea 8 (1910) 297; Bot. Jahrb. 56 (1920) 361, *incl. var. pentaphylla* LAUT. *et var. monophylla* LAUT.

Shrub 5 m high, or liana up to 30 m high. *Leaves* unifoliolate or with 1–2 pairs of leaflets, glabrous; rachis, if present, up to 5 cm; petiole 4–7 cm. *Leaflets* chartaceous to subcoriaceous, ovate- or elliptic-oblong, or lanceolate, 13–24 by 5–7½ cm, entire, with glabrous pit-like domatia; base cuneate; apex caudate to lingulate, acumen up to 1½(–2) cm; nerves 15–21 pairs, veins reticulate, faint or distinct on both surfaces; lateral petiolules *c.* ½ cm, terminal one up to 4 cm. *Inflorescences* paniculate, axillary or pseudo-terminal, up to 38 cm long, glabrous, branches up to 8 cm; bracts triangular, *c.* ½ mm long; pedicels 1½–2 mm. *Flowers* yellowish green or yellowish. *Calyx* lobes triangular, *c.* ½ mm long. *Petals* elliptic, 2–2½ by 1–1½ mm, glabrous. *Stamens* *c.* 1½ mm; anthers ovoid, *c.* ¾ mm long; staminodes in ♀ *c.* 1 mm. *Disk* discoid, 1–1¼ mm ∅. *Ovary* globose, *c.* ⅔ mm ∅, glabrous; pistillode in ♂ *c.* ⅔ mm long. *Drupe* subglobose, *c.* 5 by 7 mm, brownish, red-brown or red-black when ripe; exocarp separating from mesocarp in ripe fruits.

Distr. *Malesia:* New Guinea (Siriwo R., Lorentz R., Sepik Distr., and Southern Highlands Distr.).

Ecol. Primary forest, sometimes in sago swamps or on river-banks, 200–800 m. *Fl.* May, July–Nov.; *fr.* June, Sept., Oct.

The variation in habit leads to the assumption that this species may occur as a hemi-epiphyte.

Vern. *Pfenegabe*, Kutubu.

Note. The leaves of JACOBS 9263 from the Southern Highlands Distr., Papua New Guinea, are all 1-foliolate, while in other collections of this species such leaves were always found together with the 3- and/or 5-foliolate ones.

7. Rhus caudata LAUT. Bot. Jahrb. 56 (1920) 362. — Fig. 65a–g.

Epiphytic shrub or small tree, 4–8 m high, or a liana. *Leaves* with 2(–3) pairs of leaflets, rarely 1-foliolate, glabrous; rachis 2½–6 cm, petiole 2–3½ cm. *Leaflets* chartaceous, elliptic, or elliptic-lanceolate, 5–9 by 2–3¾ cm, entire, with glabrous pit-like domatia; base acute or cuneate; apex caudate to lingulate, acumen 1–1¾ cm long; nerves 8–15 pairs, veins reticulate, distinct below, obscure above; lateral petiolules ⅕–¾ cm, terminal one (½–)1¾–2½ cm. *Inflorescences* paniculate, axillary, sometimes pseudo-terminal, up to 17 cm long, sparsely puberulous, glabrescent, branches up to 9 cm; bracts ovate, ⅓–⅔ mm long; pedicels

$1^1/_2$–$4^1/_2$ mm. *Flowers* yellowish. *Calyx* lobes triangular, $^2/_3$–1 mm long. *Petals* elliptic, rarely obovate or ovate, 2–$2^3/_4$ by 1–$1^3/_4$ mm, glabrous. *Stamens* $1^1/_2$–2 mm; anthers ovoid, *c.* 1 mm long; staminodes in ♀ $^1/_3$–$^3/_4$ mm. *Disk* discoid, $^2/_3$–$1^1/_4$ mm ∅. *Ovary* subglobose, *c.* $^2/_3$ mm ∅, glabrous; pistillode in ♂ *c.* $^1/_2$ mm long. *Drupe* subglobose, *c.* 7 mm ∅, deep red; exocarp separating from mesocarp in ripe fruits.

Distr. *Malesia:* New Guinea (West: Biak I., Apalapsilli; East: Sepik, Western and Southern Highlands Districts).

Ecol. Mossy montane forest with many epiphytes, in forest dominated by *Podocarpus* or *Nothofagus*, or in mixed forest, 900–2400 m, once found on wet coastal coral limestone ridge at 10 m (Biak I.). *Fl.* March, Aug.–Dec.; *fr.* Aug., Oct., Dec.

This species may obviously occur as a hemi-epiphyte.

Vern. *Pukhabou*, Southern Highlands Distr.

8. Rhus linguata SLIS, Nova Guinea 14 (1924) 97; FORMAN, Kew Bull. 19 (1965) 419. — *Perrottetia caudata* RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 31, *non Rhus caudata* LAUT.

Shrub $2^1/_2$ m, sometimes epiphytic. *Leaves* 1-foliolate and/or 3-foliolate; petiole $1^1/_2$–3 cm, sparsely puberulous, glabrescent. *Leaflets* subcoriaceous, elliptic to narrowly elliptic, 4–10 by $1^1/_4$–$3^1/_2$ cm, entire, glabrous, rarely sparsely puberulous on the midrib beneath, with glabrous pit-like domatia; base cuneate to attenuate; apex caudate to lingulate, acumen $1^1/_4$–2 cm long; nerves 10–17 pairs, veins reticulate, faint or obscure on both surfaces; petiolules very short, *c.* $^1/_5$ cm. *Inflorescences* axillary, paniculate, rarely racemose and few-flowered, $2^1/_2$–11 cm long, glabrous, branches up to 3(–6) cm; bracts ovate, *c.* $^2/_3$ mm long; pedicels 4–5 mm. *Flowers* cream coloured. *Calyx* lobes triangular, $^1/_2$–$^3/_4$ mm long. *Petals* elliptic, $1^1/_2$–2 by 1 mm, glabrous. *Stamens c.* 1 mm; anthers ovoid, *c.* $^1/_2$ mm long; staminodes in ♀ *c.* $^1/_2$ mm. *Disk* shortly cupular, *c.* 1 mm ∅. *Ovary* subglobose, *c.* $^1/_2$ mm ∅, glabrous; pistillode in ♂ *c.* $^1/_2$ mm long. *Drupe* (young) subglobose, 3 by 4 mm, purple-red.

Distr. *Malesia:* West New Guinea (Wissel Lakes, Mt Helwig, Perameles Bivouac and Utakwa R. region).

Ecol. Forest, 1100–1770 m. *Fl.* May, Nov.–Dec.; *fr.* May.

Vern. *Iejawor*, Kapauku lang.

9. Rhus borneensis STAPF, Trans. Linn. Soc. Bot. II, 4 (1894) 142; MERR. En. Born. (1921) 351. — *Toxicodendron borneense* GILLIS, Rhodora 73 (1971) 164, f. 25 & 26.

Shrub or small tree up to 3 m high. *Leaves* simple (not unifoliolate), subcoriaceous, obovate to oblanceolate, or elliptic, $3^3/_4$–16 by 2–$6^1/_2$ cm, entire, glabrous, rarely sparsely puberulous on both surfaces; sometimes with a group of reddish brown papillae or glands in the axils between nerves and midrib beneath; base cuneate or attenuate; apex acuminate, slightly acute, sometimes mucronate, or rarely obtuse; nerves 10–22 pairs, veins ± perpendicular to the nerves, rather faint on both surfaces; petiole 0–$^1/_2$ cm. *Inflorescences* axillary, paniculate, up to 14 cm long, puberulous, glabrescent, branches up to 4 cm; bracts triangular to lanceolate, $1^1/_4$–2 mm long; pedicels $1^1/_2$–3 mm. *Calyx* lobes triangular, $^2/_3$ mm long. *Petals* elliptic, 2–$2^3/_4$ by 1–$1^1/_2$ mm, glabrous. *Stamens c.* $1^1/_2$ mm; anthers ovoid, *c.* 1 mm long; staminodes in ♀ $^3/_4$–1 mm. *Disk* flat and round, *c.* 1 mm ∅. Pistil *c.* $1^1/_2$ mm long. *Ovary* ovoid, *c.* 1 mm ∅, glabrous; pistillode in ♂ *c.* $^2/_3$ mm long. *Drupe* (young) subglobose, 5–7 mm ∅.

Distr. *Malesia:* Borneo (Sabah: Mt Kinabalu; Sarawak: Kalabit Highlands, Bario; Kalimantan: Peak of Balikpapan).

Ecol. Primary and mossy forest, sometimes on sandstone, 1200–2000 m. *Fl.* April–June; *fr.* June–Aug.

Cultivated

Rhus verniciflua STOKES, Bot. Mat. Med. 2 (1812) 164. — *R. vernicifera* DC. Prod. 2 (1825) 68; K. & V. Bijdr. 4 (1896) 121; BACK. Schoolfl. (1911) 283; HEYNE, Nutt. Pl. (1927) 979, was formerly introduced from Japan in the Botanic Gardens at Bogor and Tjibodas and may occur cultivated.

Excluded

Rhus densiflora BL., *nom. in sched. ex Java* (L), served as the type of *Schmidelia mutabilis* BL. Rumphia 3 (1843) 140; *Allophylus mutabilis* (BL.) BOERL. is according to LEENHOUTS, Blumea 15 (1967) 341 = *Allophylus cobbe* (L.) RAEUSCHL. (*Sapindaceae*).

Rhus javanica LINNÉ, Sp. Pl. (1753) 265, is according to MERRILL, J. Arn. Arb. 9 (1928) 3, pl. 10 = *Brucea javanica* (L.) MERR. (*Simaroubaceae*).

21. PARISHIA

HOOK. *f.* Trans. Linn. Soc. 23 (1860) 169; Fl. Br. Ind. 2 (1876) 29; ENGL. in DC. Mon. Phan. 4 (1863) 308; CORNER, Ways. Trees (1940) 112. — *Astronium* JACQ. *sect. Parishia* (HOOK. *f.*) MARCH. Rév. Anacard. (1869) 177. — **Fig. 68.**

(Deciduous) Trees. *Leaves* spiral, imparipinnate, petioled. *Leaflets* subopposite or opposite, entire, mostly with internerval veins. *Inflorescences* paniculate, axillary and/or terminal. *Flowers* unisexual (plants dioecious). *Calyx* 4-lobed, greatly enlarged in fruit. *Petals* 4, imbricate, glabrous or sparsely hairy on the outer sur-

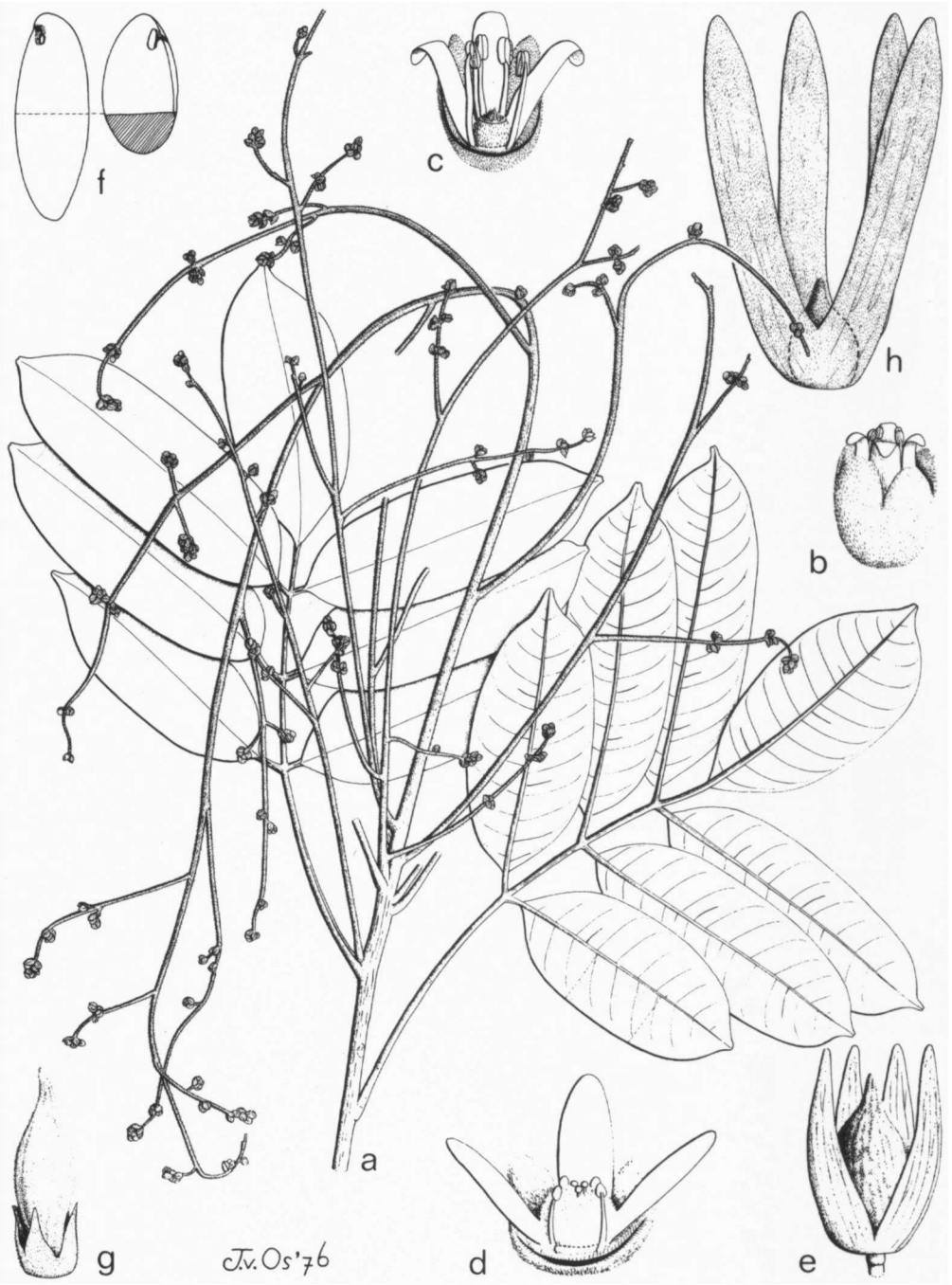

Fig. 68. *Parishia paucijuga* ENGL. *a*. Habit, × 1/2, *b*. ♂ flower, *c*. *ditto*, 2 calyx lobes and 1 petal removed, *d*. ♀ flower, 2 calyx lobes and 1 petal removed, all × 3 1/2, *e*. fruit with enlarged calyx lobes, × 1/2, *f*. embryo, opened, 1 cotyledon cut halfway to show its CS, nat. size. — *P. sericea* RIDL. *g*. Fruit with enlarged calyx lobes, × 1/2. — *P. maingayi* HOOK. *f*. *h*. Fruit with enlarged calyx lobes, × 1/2 (*a* KEP 105198, *b–c* KEP 7914, *d* KEP 105018, *e–f* RIDLEY 6720, *g* S 15817, *h* CF 1137).

face. *Stamens* 4, filaments long, often thin, glabrous; anthers usually ovoid, rarely oblong, dorsifixed or dorso-basifixed, abortive in ♀. *Disk* intrastaminal, hairy, round or slightly 4-angular, flat or discoid, 4-notched or -lobed; or pulvinate and 4-grooved. *Ovary* 1-celled, densely hairy; style 3-(rarely 4-)lobed; stigmas 3 (rarely 4). Sterile pistil in ♂ very small. *Drupe* 1-celled, densely brown hairy; subtended by the enlarged calyx, the 4 lobes wing-like; endocarp cartilaginous. *Seed* with testa adhering to the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. Species 5, in the Andaman Is., Burma, Thailand, and *Malesia:* Sumatra, Malay Peninsula, Borneo, and the Philippines.

Ecol. Usually in dryland forest, also on inundated river-banks and in freshwater swamps, in the lowland, rarely higher from 600–1450 m.

Vern. Malaysian standard timber name: *lelayang*.

Notes. CORNER (*l.c.*) stated under *Parishia:* "It seems that all Malayan species are deciduous and flower before or with the new leaves. *P. insignis*, however, (like *Firmiana*) matures even its fruits while the crown is bare of leaves".

Among Malesian *Anacardiaceae*, *Parishia* is the only genus in which the fruit is subtended by the much enlarged, wing-like calyx. From the material examined, it appears that after fertilization the increase in size of the calyx takes place much more rapidly than the development of fruit.

The shape, texture, size, indumentum, *etc.* of the leaflets are very variable in this genus. Specimens consisting of sterile material, young bare infructescences or ♀ inflorescences, or detached young fruits are very difficult to name with certainty.

KEY TO THE SPECIES

Based on flowering material

1. Leaflets with symmetric base; petiolules grooved or the margins incurved above. Petals obovate to oblanceolate, oblong, or narrowly oblong, 3–8 by 1–2 mm. Anthers dorsifixed.
 2. Leaflets 4–12 pairs, coriaceous, nerves 14–20 pairs.
  3. Stamens inserted in the grooves at the lower half of the disk . . . . . **1. P. maingayi**
  3. Stamens inserted at the base of the disk . . . . . **2. P. sericea**
 2. Leaflets usually 2–3 pairs, thin-coriaceous, nerves 9–11 pairs . . . . . **3. P. paucijuga**
1. Leaflets usually with asymmetric or oblique base; petiolules, if present, flat or convex above. Petals broadly ovate, ovate-oblong, or elliptic to elliptic-oblong, 3–5 by $1^1/_2$–3 mm. Anthers dorso-basifixed.
 4. Flowers distinctly pedicelled, pedicels 2–5(–7) mm. Calyx lobes $^2/_3$ or more the length of the calyx **4. P. insignis**
 4. Flowers subsessile. Calyx lobes *c.* $^1/_3$ the length of the calyx . . . . . **5. P. malabog**

KEY TO THE SPECIES

Based on fruiting material

1. Mature fruits ellipsoid, 4–6 cm long, longer or as long as the enlarged calyx; wing-like calyx lobes 2–5 cm long.
 2. Enlarged calyx slightly shorter than or as long as the fruit, tube *c.* $^1/_2$ cm long, lobes narrowly oblong, $3^1/_2$–5 by $^1/_2$–$1^1/_4$ cm. Leaflets 5–7; nerves 9–11 pairs . . . . . **3. P. paucijuga**
 2. Enlarged calyx much shorter than the fruit, tube *c.* $^3/_4$ cm long, lobes oblong or lanceolate, 2–3 by $^1/_2$–1 cm. Leaflets 9–11(–15); nerves 14–20 pairs . . . . . **2. P. sericea**
1. Mature fruits ovoid or subglobose, $1^1/_2$–$2^1/_2$ cm long, several times shorter than the enlarged calyx; wing-like calyx lobes $5^1/_2$–$10^1/_2$(–16) cm long.
 3. Leaflets with symmetric base; petiolules grooved or the margins incurved above. Enlarged calyx tube on fruit $1^1/_2$–$2^3/_4$ cm long . . . . . **1. P. maingayi**
 3. Leaflets with usually asymmetric or oblique base; petiolules, if present, flat or convex above.
  4. Fruits distinctly $^1/_2$–$1^1/_2$ cm pedicelled; enlarged calyx tube *c.* $^1/_2$ cm long. Leaflets sparsely puberulous to rusty-pubescent beneath . . . . . **4. P. insignis**
  4. Fruits subsessile; enlarged calyx tube *c.* $1^1/_2$ cm long. Leaflets glabrous . . . . . **5. P. malabog**

1. Parishia maingayi HOOK. *f.* Fl. Br. Ind. 2 (1876) 30; ENGL. in DC. Mon. Phan. 4 (1883) 310; KING, J. As. Soc. Beng. 65, ii (1896) 493; RIDL. Fl. Mal. Pen. 1 (1922) 535; CORNER, Ways. Trees (1940) 112; MERR. J. Arn. Arb. 35 (1954) 140; KOCHUM. Mal. For. Rec. 17 (1964) 323. — *P. oblongifolia* MERR. Philip. J. Sc. 14 (1919) 413; En. Philip. 2 (1923) 473. — *P. elmeri* MERR. Pl. Elm. Born. (1929) 168. — *P. polycarpa* RIDL. Kew Bull. (1933) 200. — *P. minor* RIDL. *l.c.* 201 — Fig. 68h.

Tree up to 40(–55) m high and 84(–93) cm ∅. Bark cracked or fissured. Buttresses up to $1^1/_2$ m

high, 1¼ m extending outward from the trunk, and 15 cm thick. *Leaves* with (4–)7–12 pairs of leaflets; petiole, rachis and petiolules puberulous, sometimes glabrescent. *Leaflets* coriaceous, shining and glabrous above, sometimes puberulous or pubescent beneath, lanceolate, elliptic, or ovate-oblong, 3–17 (–28½) by 1¾–7½(–8) cm; base symmetric, cuneate or rounded; apex acuminate; nerves 15–20 pairs, slightly elevated or distinct below, visible above; veins reticulate, distinct or visible below, obscure above; petiolules grooved or the margins incurved above, lateral ones ⅓–¾ cm, terminal one up to 2¼ cm. *Panicles* up to 50 cm long, rusty-pubescent; branches up to 20 cm; bracts ovate, 2–3½ mm long, puberulous outside, sometimes also towards the base inside; pedicels (½–)1½–3 mm. *Flowers* white. *Calyx* 2¼–6 mm long, densely appressed-hairy on both surfaces; lobes triangular, unequal, ⅓–2 mm long. *Petals* oblanceolate, or narrowly oblong, 5–8 by 1–2 mm, sometimes sparsely hairy on the outer surface. *Stamens* 3½–4 mm, inserted in the grooves at the lower half of the disk; anthers ovoid, *c.* 1 mm long; sterile stamens in ♀ *c.* 2 mm. *Disk* pulvinate and 4-grooved, *c.* 1¼ mm ∅ in ♂; fleshy and discoid, *c.* 2½ mm ∅ in ♀. *Ovary* conical, *c.* 1½ mm ∅; style *c.* 1 mm; stigmas capitate. *Drupe* ovoid or broad-ellipsoid, 1½–2½ by 1–1½ cm, apical part gradually narrowed into a beak; enlarged calyx pubescent on both surfaces, tube 1½–2¾ cm long, lobes (or wings, red when fresh) narrowly oblong, 6–10½(–16) by 1–1½ (–2¼) cm. *Seed* subglobose, ¾–1¼ cm ∅.

Distr. *Malesia:* Sumatra (Atjeh, Tapanuli, East Coast, Indragiri, Palembang), Malay Peninsula (Perak, Pahang, Singapore), Borneo (Sarawak: Kuching, Mt Santubong, Bau, Miri, Bintulu, Bergark, Lundu, Laba Kabang; Brunei; Sabah: Sepilok, Sandakan, Lahad Datu, Mt Silan, Sipitang, Beaufort, Tawao, Tenom, Mt Kinabalu; Kalimantan: Melawi, Mempawah, E. Kutai, Tarakan I., Nunukan I.), and Philippines (Panay, Sibuyan).

Ecol. Dryland, also mixed dipterocarp forest, on inundated river-banks and in freshwater swamp sometimes on limestone or ultrabasic soil, in the lowland, rarely higher, from 600–1450 m (Mt Kinabalu). *Fl. fr.* Jan.–Nov.

Vern. Sumatra: *bulu, parak, tapah*, Palembang, *surèn*, East Coast, *sèpol*, M; Borneo: *layang-layang, mimpas onggip*, Sabah, *keramu*, M, *lampong*, Brunei, *nyatoh pipit, pokuok, rèngas susu, upie, upi kèranges, upi payi*, Sarawak; Philippines: *buldbog*, P.Bis.

2. Parishia sericea RIDL. Kew Bull. (1933) 201. — **Fig. 68g.**

Tree up to 25 m high and 40 cm ∅. Bark scaly. Buttresses occasionally present, up to 1½ m high, 1½ m extending outward and 10 cm thick. *Leaves* with 4–5(–7) pairs of leaflets; petiole, rachis and petiolules puberulous, sometimes glabrescent. *Leaflets* coriaceous, shining and glabrous above except sometimes sparsely puberulous on the midrib towards the base, pubescent and glabrescent beneath; ovate-oblong, ovate, lanceolate, sometimes elliptic-oblong or obovate-oblong, 6½–17 by 3¼–6½ cm; base symmetric, obtuse or rounded; apex acute to acuminate; nerves 14–20 pairs, elevated and prominent below, visible or obscure above; veins loosely reticulate, faint or obscure on both surfaces; petiolules grooved or the margins incurved above, lateral ones ¾–1 cm, terminal one 1¼–4 cm. *Panicles* up to 44 cm long, densely pubescent, loosely branched, branches up to 14 cm long; bracts ovate to lanceolate, *c.* 2 mm long, densely puberulous outside, glabrous inside; pedicels 0–¾ mm. *Calyx* 3 mm long, hairy on both surfaces; lobes triangular, *c.* 1½ mm long. *Petals* oblanceolate, glabrous, 5 by 1¼–1½ mm. *Stamens c.* 3 mm, inserted at the base of the disk; anthers ovoid, *c.* ⅔ mm long. *Disk* pulvinate and 4-grooved, 1½–1¾ mm ∅. ♀ Flowers not seen. *Drupe* ± ellipsoid, 5–5¾ by 1¾ cm; apex acuminate; enlarged calyx brown or dark brown hairy on both surfaces, tube *c.* ¾ cm long, lobes oblong or lanceolate, 2–3 by ½–1 cm. *Seed* ellipsoid, *c.* 3 by 1½ cm.

Distr. *Malesia:* Borneo (Sarawak: Kuching, Bintulu; Sabah: Lahad Datu, Ranau).

Ecol. Lowland forest, sometimes in ultrabasic areas, and once at 750 m. *Fl.* Febr.; *fr.* Dec.

Vern. *Layang layang*, Lahad Datu.

3. Parishia paucijuga ENGL. in DC. Mon. Phan. 4 (1883) 309, t. 10, f. 25–27; RIDL. Fl. Mal. Pen. 1 (1922) 536; CORNER, Ways. Trees (1940) 113, f. 23 (right); KOCHUM. Mal. For. Rec. 17 (1964) 324. — **Fig. 68a–f.**

Tree up to 30 m high and 60 cm ∅. Bark fissured, sometimes flaky. Buttresses occasionally present. Young parts puberulous or pubescent, sometimes glabrescent. *Leaves* usually with 2–3 pairs of leaflets; petiole, rachis and petiolules puberulous, sometimes glabrescent. *Leaflets* thin-coriaceous, shining and glabrous above, glabrous or sparsely puberulous beneath; elliptic, lanceolate, rarely obovate-oblong, 5–13½ by 1½–6½ cm; base symmetric, cuneate; apex short-acuminate; nerves 9–11 pairs, distinct or faint on both surfaces; veins finely reticulate, distinct below, visible or obscure above; petiolules grooved or the margins incurved above, lateral ones ½–1 cm, terminal one 1½–2½ cm. *Panicles* up to 55 cm long, pubescent, loosely branched, branches up to 25 cm; bracts triangular, 2–5 mm long, usually densely hairy outside and slightly hairy inside; pedicels 0–⅔ mm. *Flowers* white. *Calyx* 3–4½ mm long, densely hairy on both surfaces; lobes triangular, 2–3 mm long. *Petals* obovate-oblong or oblong, 3–6 by 1½–2 mm, sometimes sparsely hairy outside. *Stamens* inserted at the base of the disk, 3–3½ mm; anthers oblong, ¾–1 mm long; sterile stamens in ♀ *c.* 2 mm. *Disk* pulvinate and 4-grooved in ♂, 1⅔–2 mm ∅; discoid in ♀, 2½–3 mm ∅. *Ovary* conical, *c.* 2 mm ∅; style *c.* 1¾ mm; stigmas capitate. *Drupe* ellipsoid, 4–6 by 2 cm; apex attenuate, sometimes beak-like; enlarged calyx pubescent on both surfaces, tube *c.* ½ cm long, lobes (or wings) narrowly oblong, 3½–5 by ½–1¼ cm. *Seed* ellipsoid, 1¾–3 by 1–1½ cm.

Distr. *Malesia:* Sumatra (Tapanuli), Malay Peninsula (Dindings, Malacca, Johore, Penang, Singapore), and Borneo (Sarawak: Lundu; Brunei).

Ecol. Lowland forest, sometimes in swamp forest, up to 200 m. *Fl.* March–April; *fr.* Febr.–March, July–Nov.

Vern. *Sèpul*, M; Sumatra: *barat daja*, Batak; Borneo: *semèmdoh*, Brunei.

4. Parishia insignis HOOK. *f.* Trans. Linn. Soc. 23 (1860) 170, t. 26; Fl. Br. Ind. 2 (1876) 30; ENGL. in DC. Mon. Phan. 4 (1883) 309, t. 10, f. 21–24, *incl. var. andamensis* ENGL.; King, J. As. Soc. Beng. 65, ii (1896) 492, *incl. var. pubescens* KING *et var. tomentosa* KING; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 91; Fl. Mal. Pen. 1 (1922) 536; PARKINSON, For. Fl. Andaman Is. (1923) 142; BURK. Dict. (1935) 1668; CORNER, Ways. Trees (1940) 112, f. 23 (left); KOCHUM. Mal. For. Rec. 17 (1964) 324. — *Astronium insigne* MARCH. Rév. Anacard. (1869) 177. — *P. pubescens* HOOK. *f.* Fl. Br. Ind. 2 (1876) 30; ENGL. in DC. Mon. Phan. 4 (1883) 310; KING, J. As. Soc. Beng. 65, ii (1896) 493; RIDL. Fl. Mal. Pen. 1 (1922) 535; CORNER, Ways. Trees (1940) 113; KOCHUM. Mal. For. Rec. 17 (1964) 323. — *P. rosea* RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 90; Fl. Mal. Pen. 1 (1922) 536. — *P. borneensis* RIDL. Kew Bull. (1933) 200. — *P. lowei* RIDL. *l.c.* 201.

Tall tree, up to 50 m high and 70 cm ∅. Bark shallowly fissured, finely cracked. Buttresses up to 4 m high, *c.* 2 m extending outward from the trunk. Young parts rusty-pubescent. *Leaves* with 4–6 pairs of leaflets; petiole, rachis, and petiolules sparsely puberulous to rusty-pubescent or tomentose, sometimes glabrescent. *Leaflets* thinly coriaceous, sparsely puberulous to rusty-pubescent or tomentose, sometimes glabrescent except on the midrib and nerves on both surfaces; ovate-oblong to lanceolate, elliptic, rarely ovate, $4^1/_2$–15 by 3–7 cm; base asymmetric or oblique, rounded, obtuse, cuneate, or subcordate; apex acute to acuminate; nerves 4–9 pairs, elevated beneath, visible above; veins reticulate-scalariform or reticulate, distinct or visible on both surfaces; petiolules, if present, flat or convex above, lateral ones up to $^1/_2$ cm, the terminal one 1–$3^3/_4$ cm. *Panicles* up to 54 cm long, rusty-pubescent or tomentose, much branched, branches up to 19 cm; bracts triangular, lancolate or narrowly elliptic, $2^3/_4$–$3^1/_2$ mm long, puberulous outside, glabrous inside; pedicels 2–5(–7) mm. *Calyx* $2^1/_2$–$4^1/_2$ mm long, puberulous on both surfaces; lobes triangular, unequal, 2–3 mm long. *Petals* broad-ovate to ovate-oblong, or elliptic, 3–5 by $1^3/_4$–3 mm, sometimes slightly hairy outside. *Stamens* $2^1/_2$–4 mm; anthers ovoid, *c.* $^3/_4$ mm long; sterile stamens in ♀ *c.* $1^1/_2$ mm. *Disk* fleshy, flat, round or slightly 4-angular, or discoid, hairy, 2–$2^3/_4$ mm ∅. *Ovary* conical, *c.* $1^1/_2$ mm ∅; style $1^1/_2$ mm; stigmas capitate. *Drupe* subglobose, 1–$1^1/_2$ by $^3/_4$–$1^1/_4$ cm, apiculate or beaked; enlarged calyx sparsely puberulous, tube *c.* $^1/_2$ cm long, lobes (or wings) narrowly oblong, 7–$8^1/_2$ (–$12^1/_2$) by $^3/_4$–$1^1/_2$ cm. *Seed* broad ellipsoid or subglobose, *c.* $^3/_4$ by $^1/_2$ cm.

Distr. Andaman Is., Burma (Mergui), Thailand (Kaw Pipi, Bachaw, Satul, Kao Taknam, Telo Udang, Panji I.), and *Malesia:* Sumatra (East Coast, Djambi, Indragiri, Palembang), Malay Peninsula (Kedah, Kelantan, Perak, Pahang, Johore, Langkawi, Penang, Malacca, Singapore), and Borneo (Sarawak: Kuching, Betong, Simanggan, Bintulu, Triso Peninsula; Brunei; Sabah: Sandakan, Sipitang, Lahad Datu; Kalimantan: Palo, Gontranah, Tg. Kimarun, Berouw, Kutai, Balikpapan).

Ecol. Dryland forest in the lowland, occasionally in inundated places or in peat-swamps, rarely on limestone (Langkawi), up to 280 m. *Fl.* Jan.–May, Sept. –Nov.; *fr.* Jan., March–July, Nov.

Its leaves turn red, then fall, and after this it flowers (BURKILL).

Uses. BURKILL *l.c.* gave some remarks on the timber, which is very light.

Vern. Sumatra: *balàm tembaga, kaju sepa, spah bengkarung, surian rimbo,* Palembang, *bochalang, ipah bengkarung, peonggai, sombé,* M; Malay Peninsula: *kayu poutianak,* Johore, *sapoi, sepui, sepul,* Perak, *sepul, suryan,* M; Borneo: *babigurus,* M, *gansiung buhis,* Dajak, *huram, kembajau,* Palo, *lomu kujang,* SE. Borneo, *medang sorukan,* Tengara, *upi paya,* Sarawak.

5. Parishia malabog MERR. Philip. J. Sc. 7 (1912) Bot. 281; En. Philip. 2 (1923) 472; J. Arn. Arb. 35 (1954) 140; AIRY SHAW & FORMAN, Kew Bull. 21 (1967) 19. — *Spondias romblonensis* ELMER, Leafl. Philip. Bot. 10 (1939) 3683, *descr. angl.*

Tree up to 25 m high and 60 cm ∅. *Leaves* with 4–7 pairs of leaflets, glabrous. *Leaflets* coriaceous, ovate-oblong to lanceolate, sometimes broadly ovate, 5–16 by $1^1/_2$–8 cm; base asymmetric or oblique, obtuse, subcordate, or cuneate; apex acuminate; nerves 5–14 pairs, slightly elevated below, distinct above; veins reticulate, distinct on both surfaces; petiolules flat or convex above, lateral ones $^1/_3$–$1^3/_4$ cm, terminal one up to $2^1/_2$ cm. *Panicles* up to 35 cm long, slightly puberulous, glabrescent; branches up to 8 cm; bracts suborbicular, *c.* $^1/_3$ mm long, puberulous outside, glabrous inside. *Flowers* subsessile, pinkish. *Calyx* *c.* $1^1/_2$ mm long, sparsely puberulous, sometimes almost glabrous, on both surfaces; lobes rounded, *c.* $^1/_3$ mm long. *Petals* elliptic to elliptic-oblong, 3–4 by $1^1/_2$ mm, glabrous. *Stamens* inserted at the outer margin of the disk, $2^1/_2$–3 mm; anthers ovoid, *c.* 1 mm long; sterile stamens in ♀ *c.* 2 mm. *Disk* flat and slightly 4-angular, 1–$1^3/_4$ mm wide. *Ovary* ovoid, *c.* $1^1/_2$ mm ∅; style *c.* 1 mm; stigmas capitate. *Drupe* (MERRILL) ovoid, *c.* 2 cm long, enlarged calyx sparsely puberulous or almost glabrous on both surfaces, reddish when young and brownish when ripe; tube *c.* $1^1/_2$ cm long; lobes (or wings) narrowly oblong, $5^1/_2$–10 by $^3/_4$–$1^1/_2$ cm. *Seed* not seen.

Distr. *Malesia:* Philippines (Luzon: Dingalan Bay, Bosoboso, Zambales, Tayabas; Ticao, Masbate, Cebu, Negros, Mindoro, Sibuyan, Romblon, Tablas, Sibutu).

Ecol. Forested slopes or rocky hills at low altitude, and on rocky cliffs near the seashore; common on Ticao I. (MERRILL). *Fl.* Febr.–March; *fr.* March.

Uses. The timber is not in general use; in Masbate, Philippines, it is recorded for making canoes (MERRILL).

Vern. *Bulkan,* Tag., *bulábog,* Sul., P.Bis., *kupang-kupang, malábog, malábol, malibog, mulábu,* P.Bis., *mulábug,* C.Bis.

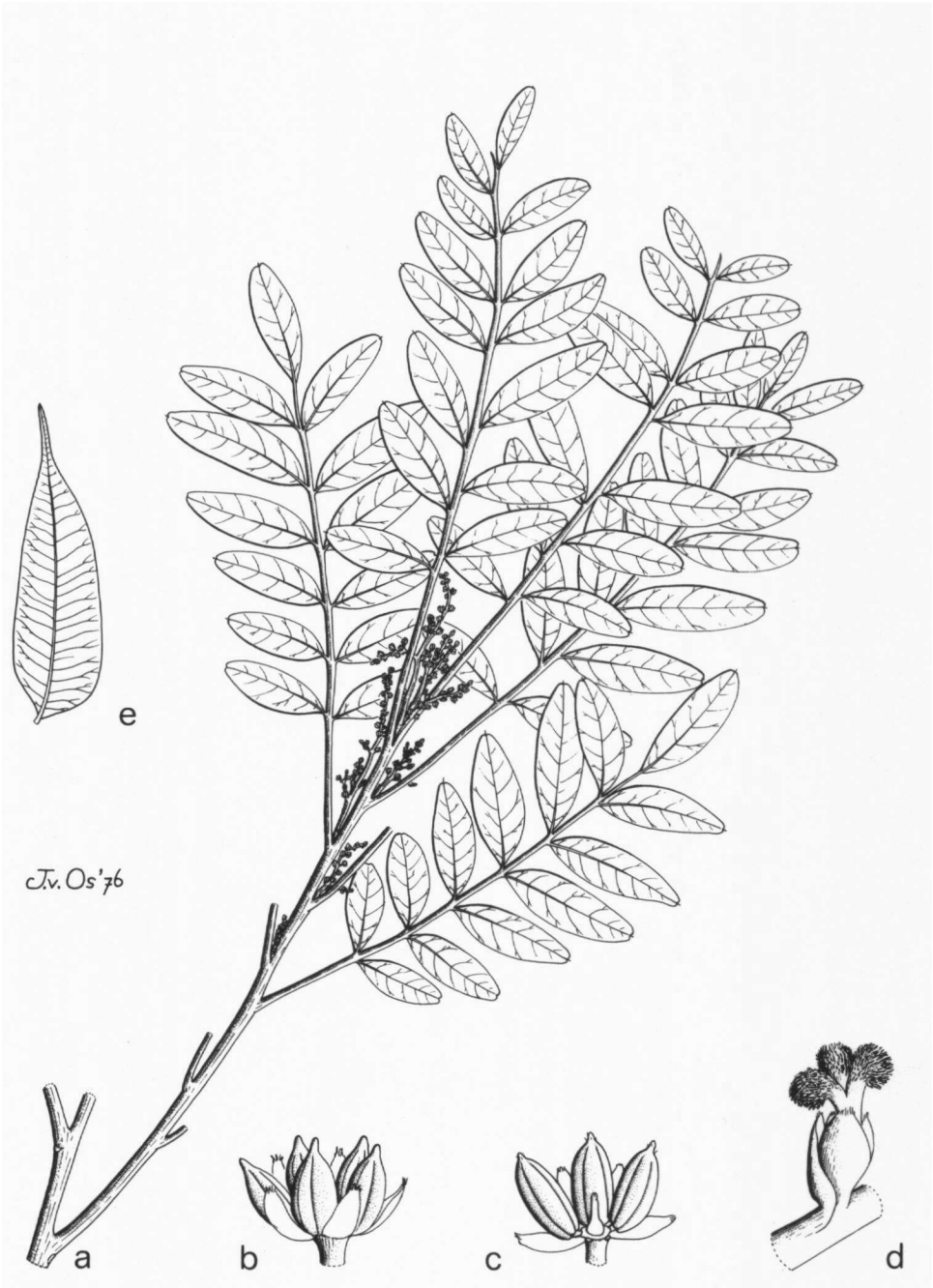

Fig. 69. *Pistacia malayana* HENDERSON. *a*. Habit, nat. size, *b*. ♂ flower, *c*. *ditto*, 1 perianth lobe and 2 stamens removed, *d*. ♀ flower, all × 15. — *P. chinensis* BUNGE. *e*. Leaflet, × ½ (*a–c* SF 34398, *d* SF 23831, *e* STEWARD & CHEO 443).

22. PISTACIA

LINNÉ, Gen. Pl. ed. 5 (1754) 452; Sp. Pl. (1753) 1025; HOOK. *f.* in B. & H. Gen. Pl. 1 (1862) 419; MARCH. Rév. Anacard. (1869) 96 & 184; ENGL. in DC. Mon. Phan. 4 (1883) 284. — **Fig. 69.**

Trees or shrubs. *Leaves* spiral, imparipinnate, pseudo-paripinnate, or paripinnate, (rarely 3- or uni-foliolate in *extra*-Mal. *spp.*), petioled. *Leaflets* opposite, subopposite, or alternate, entire. *Inflorescences* axillary and/or terminal, racemose and/or paniculate. *Flowers* unisexual (plants dioecious). *Tepals* free, 2–5. *Stamens* 3–5 in ♂, 0 in ♀; filaments short, glabrous; anthers basifixed, ellipsoid or ovoid. *Disk* minute or 0. *Ovary* subglobose, 1-celled; style short; stigmas 3, capitate or spathulate, spreading. Sterile pistil in ♂ 0 or minute. *Drupe* 1-celled; stone bony, smooth. *Seed* with testa free from the endocarp; embryo straight, cotyledons free, plano-convex.

Distr. Species *c.* 9, disjunctly distributed in the Mediterranean region, Canary Is., W., S. & E. Asia, North America (Texas, U.S.A.), and Central America (Mexico); 2 *spp.* in *Malesia:* Malay Peninsula and Philippines.

Notes. The perianth in this genus is unique in the family, consisting only of free, thin and narrow segments which could either be named tepals or calyx lobes. Some botanists suggested that they are of bracteal nature and that the flowers would properly be naked, *e.g.* H. F. COPELAND (Phytomorph. 5, 1955, 440). In the ♂ flowers they alternate with the stamens which rather defeats this idea.

Recently GRUNDWAG (Bot. J. Linn. Soc. 73, 1976, 355–370) published observations on embryology and fruit development in 4 *spp.*

KEY TO THE SPECIES

1. Apex of leaflets retuse or slightly emarginate. Leaflets obovate, elliptic, or rarely ovate-oblong, $2^3/_4$–$3^1/_2$ by 1–$1^1/_2$ cm . . . . . **1. P. malayana**
1. Apex of leaflets acuminate. Leaflets lanceolate, 4–8 by 1–$2^1/_2$ cm . . . . . **2. P. chinensis**

1. Pistacia malayana HENDERSON, Gard. Bull. S. S. 7 (1933) 97, t. 19; J. Mal. Br. R. As. Soc. 17 (1939) 23, 42. — **Fig. 69a–d.**

Tree up to 6 m tall and 19 cm ∅. Bark white, scaly. *Leaves* with 7–8 pairs of leaflets (terminal leaflet very small or obscure), 9–11 cm long; rachis and petiole sparsely puberulous, glabrescent; petiole 1–2 cm. *Leaflets* sessile or subsessile, rarely alternate, chartaceous, obovate, elliptic, or rarely ovate-oblong, $2^3/_4$–$3^1/_2$ by 1–$1^1/_2$ cm, glabrous; base cuneate; apex retuse or slightly emarginate, with a minute mucro in the notch; nerves 7–9 pairs, faint, veins obscure. *Inflorescences* paniculate, up to 7 cm long, sparsely puberulous, glabrescent; bracts ovate, $^2/_3$–1 mm long; pedicels $^1/_2$–$1^1/_2$ mm. *Flowers* red. *Tepals* 4–5, ovate, $^1/_2$–1 mm long, short-fringed at the acute apex. *Stamens* 3–5; filaments very short; anthers ellipsoid, 1–$1^1/_4$ mm, slightly apiculate. *Disk* minute, flat in ♂, 0 in ♀. *Ovary* ellipsoid, *c.* $^2/_3$ mm ∅; style $^1/_2$ mm long; stigmas $^1/_2$ mm long. Sterile pistil in ♂ $^2/_3$ mm long. *Drupe* obliquely subglobose, *c.* $^1/_2$ cm ∅, slightly compressed.

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

Ecol. On limestone, 150–350 m. *Fl.* June, Nov.; *fr.* June.

2. Pistacia chinensis BUNGE, En. Pl. China Bor. (1833) 15; Mém. Ac. Imp. Sc. St. Pétersb. 2 (1835) 89; TURCZ. Bull. Soc. Nat. Mosc. 10 (1837) 150; HANCE, J. Linn. Soc. 13 (1873) 77; ENGL. in DC. Mon. Phan. 4 (1883) 291; REHD. & WILS. in Sargent, Pl. Wils. 2 (1914) 173; MERR. En. Philip. 2 (1923) 472; REHD. J. Arn. Arb. 7 (1926) 194; KANEH. Form. Trees rev. ed. (1936) 362, f. 319; REHD. Man. Cult. Trees & Shrubs, ed. 2 (1947) 540; COPEL. Phytomorph. 5 (1955) 440; LIU, Ill. Pl. Taiwan 2 (1962) 936, f. 771; LI, Woody Fl. Taiwan (1963) 445, f. 173. — *P. formosana* MATSUM. Bot. Mag. Tokyo 15 (1901) 40; MATSUM. & HAYATA, J. Coll. Sc. Imp. Un. Tokyo 22 (1906) 99, t. 9. — *P. philippinensis* MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 107; MERR. & MERRITT, *ibid.* 5 (1910) Bot. 357. — **Fig. 69e.**

Tree up to 26 m tall and 1 m ∅, sometimes with buttresses. Bark light brownish, scaly. *Leaves* with (3–)5–6(–10) pairs of leaflets (terminal leaflet sometimes absent), up to 20 cm long; rachis and petiole puberulous, glabrescent; petiole up to 7 cm. *Leaflets* subsessile or sessile, chartaceous, lanceolate, 4–8 by 1–$2^1/_2$ cm, puberulous beneath, glabrescent; base cuneate; apex acuminate; nerves 10–14 pairs, distinct; veins reticulate. *Inflorescences* racemose in ♂, paniculate in ♀, up to 8 cm long, puberulous, glabrescent; bracts lanceolate, *c.* 1 mm long; pedicels 1–2 mm. *Tepals* 2–5, elliptic, 1–$1^1/_2$ mm long. *Stamens* 3–5, $^3/_4$ mm; filaments very short; anthers ellipsoid or oblong, *c.* 1 mm, slightly apiculate. *Disk* 0. *Ovary* globose, $^2/_3$ mm ∅; style $^1/_2$ mm long; stigmas *c.* $^1/_2$ mm long; sterile

pistil in ♂ minute. *Drupe* globose, $^1/_3$–$^1/_2$ cm ∅, slightly compressed, red changing to greenish blue when ripe.

Distr. China, Formosa, and *Malesia:* Philippines (Luzon).

Ecol. Open slopes, from the lowland up to 1350 m. *Fl.* March, July; *fr.* May, July, Sept.

Uses. The wood is used locally in the Philippines for making tobacco pipes (MERRILL & MERRITT, *l.c.*).

Vern. *Aglao*, Ilk., *sanguido*, *sanguilo*, *sanido*, Ig.

Note. The fruits are often empty with only an undeveloped ovule. This is apparently due to the failure of pollination (COPELAND, *l.c.*).

Excluded

Sorindeia glaberrima HASSK. Flora 25 (1842) Beibl. ii: 45; *ibid.* 27 (1844) 617; Cat. Hort. Bog. (1844) 245 was described from a tree grown in Hort. Bog., which according to HASSKARL was certainly introduced; *cf.* also STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 462. BLUME, Mus. Bot. 1 (1850) 205, reduced it to *Sorindeia madagascariensis* THOU. and said that it was introduced from Madagascar. BACKER, Schoolfl. (1911) 282 and BACKER & BAKH. *f.* Fl. Java 2 (1965) 152 referred it to its *var. paucijuga* ENGL. in DC. Mon. Phan. 4 (1883) 301, a variety not mentioned in the recent Flore de Madagascar.

Cultivated in Hort. Bog. *sub n.* VI–B–1 & 3.