BIGNONIACEAE (C. G. G. J. van Steenis, Leyden)

Trees, shrubs, lianas, very rarely herbaceous (*extra*-Mal.); twigs often lenticellate and nodes with gland fields; spines very rare (*extra*-Mal.). Stipules absent. *Leaves* simple or mostly compound (digitate or impari-1–4-pinnate), (in Mal.) decussate, rarely in whorls of 3–4, often provided with glands underneath, in the New World often provided with terminal tendrils, rarely scattered or in pseudo-whorls (*extra*-Mal.); domatia sometimes present (fig. 8b, 23h). *Inflorescences* bracteate, cymose, but not rarely thyrses contracted to racemiform or racemose inflorescences, or even reduced to solitary flowers (*extra*-Mal.), terminal, axillary or from the old wood. Pedicels mostly with 1–2 bracteoles. *Flowers* usually very showy, rather large, bisexual, articulate with the pedicel or not. *Calyx* connate, closed in bud and later (not rarely irregularly) splitting into lobes, or cupular, or spathaceous, or lobed from the beginning and with equal or unequal, valvate lobes, developing earlier than the corolla, often glandular outside and inside with water and slime producing glands and hydathodes, persistent or circumscissile caducous along an abscission line. *Corolla* sympetalous, campanulate, tubular, funnel- or salver-shaped, mostly zygomorphic, lobes equal or unequal, valvate or imbricate in bud, tube often with a narrow cylindrical (constricted) lower part (basal tube) and a widened upper part (upper tube). *Stamens* 5 almost equal, or mostly 4 didynamous, the 5th sterile, rudimentary, adnate to the corolla tube, mostly inserted at the rim of the basal tube and not rarely (glandular) hairy at the insertion, more rarely inserted higher up. *Anthers* basifixed, 2-celled, rarely one cell barren or 1-celled, introrse, dehiscing lengthwise, usually the anthers connivent in pairs; anther cells often free and divergent, connective not rarely produced. *Disk* intrastaminal, mostly annular, rarely absent. *Ovary* superior, 2-celled, rarely 1- or 4-celled (*extra*-Mal.); style filiform, stigma usually 2-lipped, sensitive. *Ovules* (in Mal.) in each cell on the septum in two or more rows of 3–∞, mostly on 2 placentas. *Capsule* 2-valved, either loculicid with the septum perpendicular to the valves — sometimes provided with an additional transverse false septum — or septicid with the septum parallel with the valves, or (*extra*-Mal.) an indehiscent, 1-celled, soft or hard-shelled, pulpy berry. *Seeds* in each cell attached to the dissepiment in one or more rows, inserted transverse to axis of fruit, anatropous, mostly on both sides with hyaline wings; *embryo* exalbuminous, the cotyledons mostly notched, sometimes on both sides. Germination always epigeal.

Distribution. About 120 genera and some 650 *spp.*, mainly in the tropics and subtropics, roughly between 40° N and 30–35° S, very few in the warm-temperate zone; in *Malesia:* 14 native genera of which 2 are endemic, *viz Hieris* in Penang and *Lamiodendron* in Papuasia. Among the remaining 12 one occurs through the Old World (*Dolichandrone*), 7 are shared with continental SE. Asia (two of which extend also to Africa and Madagascar: *Fernandoa, Stereospermum*) and 4 with Australia and Melanesia; the latter occur in Malesia only in the east except *Deplanchea* which ranges westward to Sumatra.

In the family tropical Asia and Africa share a few genera (*Markhamia, Fernandoa, Stereospermum*, and *Dolichandrone*), but Africa and America share only one, *viz Tecoma*. This latter affinity goes further, though very disjunct via *Campsidium* (Chile) and *Campsis* (N. America and E. Asia) to *Tecomanthe-Pandorea-Neosepicaea* (Moluccas to Three Kings Is. and E. Australia). Otherwise there appear to be only two other transoceanic ties, *viz* tribe *Crescentieae* which is shared by Africa and the Americas, and the genus *Catalpa* which occurs in E. Asia and the Caribbean area.

As GENTRY (Brittonia 25, 1973, 227–230) has shown, the average number of species per genus

is only 5, which is very small in comparison with many other families, but can only partly be explained by a possibly small generic concept. There are quite a number of monotypic genera (in Malesia 5), but they are well defined in many characters and stand very apart.

This, and the worldwide distribution of the family, and the disjunctions in ranges, definitely point to relict survival and ancient origin, onwards of which period the three tribes have undergone a separate, independent development on the continents, mainly leading to differentiation in Indo-Australia and in the New World, with the greatest abundance in the latter. Unfortunately, the fossil evidence (only Tertiary) is meagre and untrustworthy (SCHUMANN in E. & P. Nat. Pfl. Fam. 4, 3b, 1894, 208), both to macrofossils and to pollen.

Ecology. Within the family there is a fairly wide coverage of habitats and there are quite a few which are confined to arid conditions (*Rhigozum* and *Catophractes* in S. Africa, *Tecomella* in Arabia, *Phyllarthron bernierianum* in Madagascar, *Dolichandrone filiformis*, *D. heterophylla* and the linear-leaved drought form of *Pandorea pandorana* in Australia). A few are rheophytic (*Astianthus* and *Chilopsis* in the Americas). A few are warm-temperate (*Catalpa*) or subtropical-alpine (*Incarvillea* incl. *Amphicome* in the Sino-Himalayas and *Argylia* and *Campsidium* in the Andes). One species is bound to the mangrove (*Dolichandrone spathacea* in Indo-Melanesia).

The majority, however, belongs to the tropical forest, mostly the everwet type, but a fair number in the seasonal type, below *c.* 2000 m; only *Tecomanthe* ascending to *c.* 3100 m in New Guinea.

In Malesia most are evergreen, but *Oroxylum indicum* (fig. 5) and *Dolichandrone spathacea* can stand leafless in the dry season for many months. *Fernandoa macroloba* is also deciduous, as are the species of *Stereospermum*.

Habit. The majority of the Malesian genera are small or large trees, the only climbing genera being *Nyctocalos*, *Hieris*, *Tecomanthe*, *Pandorea*, and *Neosepicaea*; in subalpine heathland *Tecomanthe* may be forced to creep on other vegetation.

Most trees are of medium size, but species of *Stereospermum*, *Fernandoa*, *Pajanelia*, and also *Radermachera gigantea* may attain quite good dimensions. *Oroxylum* is a short-lived nomad tree.

Dominance. Almost all species occur scattered in the forest and several are very rare indeed. An exception is *Dolichandrone spathacea*, bound to the swampy, brackish inner mangrove, which according to CORNER (Wayside Trees, 1940, 164) is in the North of the Malay Peninsula, in Perlis, a feature of the country, flanking roads and standing as an upright poplar in the rice-fields. Fig. 16. In Great Natuna I. (NW. off Sarawak) I found *Pajanelia longifolia* locally very common in coastal forest, but this was probably encouraged by devastation. In secondary forests, on earth slides, abandoned fields, and on fresh volcanic ash *Radermachera glandulosa* and *R. gigantea* may be frequent in the pioneer upgrowth in Java (also on Krakatao), but this high frequency is local; KOORDERS mentioned it for G. Telemojo and Pringombo in Central Java. Even *Oroxylum indicum* which is a nomad plant bound to secondary growths is always found in only a few specimens. *Lamiodendron magnificum* was once mentioned by BRASS as forming a community on a gravel bank behind the beach, in Normanby I., but this tree is extremely rare otherwise.

Flower biology. In many species (like in several *Gesneriaceae*, *Verbenaceae*, *Solanaceae*) the calyx develops much earlier than the corolla and is closed in bud. Inside of the calyx with water and slime producing glands and hydathodes in which the corolla develops. These so-called waterbuds are very characteristic, especially in such large-flowered species as *Spathodea campanulata*, the tulip tree, which derives a Dutch and Malay name from this feature (*spuitjesboom*, *panchot*) which is enjoyed by children to play with. It is one of the few biological phenomena which are entirely confined to the tropics, as far as I am aware.

TREUB (Ann. Jard. Bot. Btzg 8, 1889, 38–46, t. 13–15) made an anatomical study of the glands inside the calyx of *Spathodea campanulata* and on his instigation GRESHOFF examined the exudate, dissolved organic and inorganic substances, which appeared similar to those of leaf-hydathodes. KOORDERS (*ibid.* 14, 1897, 354–469, t. 21–27) extended this subject with research on some other genera of *Bignoniaceae* (*Parmentiera*, *Kigelia*, *Crescentia*, *Fernandoa adenophylla*, *Radermachera gigantea*) and some other plants, confirming TREUB's results.

Pollination. Flower-shape, -colour, -position, and -scent are very different in the mostly showy flowers of *Bignoniaceae*, and the syndromes attract different visitors.

Bats are frequently visiting species of certain genera, another phenomenon restricted to tropical plants. According to FAEGRI & VAN DER PIJL (Principles Pollination Ecology, ed. 2, 1971, 154) the attraction syndrome is: nocturnal anthesis, whitish, creamish or drab greenish or dark purple colour, stale or sour, unpleasant smell reminiscent of fermentation at night, large quantity of nectar and pollen in large anthers, large-mouthed and coarse flowers on strong stalks sticking out of the foliage or cauliflorous to flagelliflorous flowers, thus coming into easy reach for landing. This is found in Malesia in several cultivated genera (*Kigelia, Crescentia, Parmentiera, Markhamia, etc.*) but occurs also in the native *Fernandoa adenophylla, Pajanelia,* and *Oroxylum.* Fig. 7. Notwithstanding the many papers and records of observation — corollas show claw marks after these visits — it is not proved to my satisfaction that visits of bats are compulsory for pollination *cq.* fertilisation, experimenting being in this field deplorably meagre. My doubt is strengthened by observations by HARRIS & BAKER in Ghana where *Kigelia* is native (J. West Afr. Sc. Assoc. 4, 1958, 28) and can set fruit in absence of bats; they observed also frequent visits by sphingids but they doubt effective pollination by these.

Birds, humming birds and sun-birds, frequently visit certain species, the attraction syndrome being: tubed, vividly coloured (orange, scarlet), diurnal, mostly odorless, nectar-producing tubular flowers. Here also many observations are made, *e.g.* in *Tecoma* (*Tecomaria*). To this class belong in Malesia some species of *Radermachera* (*R. ramiflora*), *Neosepicaea, Tecomanthe,* and it can be expected for *Deplanchea.* Also the cultivated *Spathodea campanulata* is frequented by birds (*cf.* BEUMÉE, Trop. Natuur 14, 1925, 28–30), notably kutilans and ?djalaks, at Bogor; they severely damage the corolla. Here again the question whether bird-visits are compulsory for pollination *cq.* fertilisation is inadequately supported by experiments. Caution is necessary to conclude to the necessity of cross-pollination, as *e.g.* HUNTER (Rec. Auckl. Inst. Mus. 6, 1967, 169–170, t. 24) recorded that in *Tecomanthe speciosa,* of which cuttings of a single plant led to its cultivation, fertilisation — that is selfing — could be effected by hand-pollination, but later also naturally by bees, although far from its native habitat.

Moths. A few species have the moth-attraction syndrome for flower visitors, which implies: nocturnal, very fragrant flowers with abundant honey, in mostly pale or white, long-tubed or salver-shaped corollas. Fig. 1, 8, 15. This is found in species of *Nyctocalos, Dolichandrone, Hieris, Millingtonia,* and some species of *Radermachera* (*e.g.* the Chinese *R. sinica, R. pentandra,* and *R. peninsularis*). Probably long-tongued sphingids (hawk-moths) visit these flowers.

Bees and butterflies. Possibly bees visit flowers of species not belonging to the three categories mentioned above.

The ecological role of the many sorts of extra-floral nectaries in unexplained.

It is a fact that in general fruit setting is scarce in *Bignoniaceae*; in several the fruit was only occasionally found long after the plant had been described in flower. In Malesia the fruit is still unknown of *Hieris* and *Lamiodendron.* Even after abundant flowering fruit production is often very low with 1 or 2 fruits in each inflorescence, except in *Radermachera glandulosa* and *Tecoma stans.* With all these flower visit devices one would expect otherwise.

Dispersal. Bignoniaceae occur throughout the tropics and several are still found in the subtropics of the whole world. One might ascribe this to their having winged seed (except *Crescentieae* and a few other exceptions), but against expectations they are almost absent from oceanic islands. *Bignoniaceae* occur all along the coasts of the West Pacific, notably in New Guinea and in Australia species of *Tecomanthe* and *Pandorea* are not rare, but the only occurrence in the West Pacific islands is a common Australian *Pandorea* in New Caledonia and Lord Howe I., and a peculiar *Tecomanthe* in a single locality of the Three Kings Is., the northernmost territory of New Zealand.

Obviously wind dispersal has not been as effective as one would expect.

Dispersal by seawater is common in *Dolichandrone spathacea,* a back-mangrove species, ranging from the western Deccan Peninsula to North Luzon, south to Timor and southeastwards to New Caledonia; the range is almost continuous without gaps. Fig. 14. It is most peculiar, however, that so far it has never been found in the mangroves of northern Australia. Its seeds have thickish corky wings instead of flimsy wings as usual in most members of the family (except the fleshy indehiscent fruits of the *Crescentieae* and a few other exceptions as *e.g. Pauldopia*) and are most excellently adapted to be dispersed by seawater.

Seedlings. These are very uniform in all tribes of the family; in the embryo the foliaceous cotyledons are flat in one plane, mostly emarginate at both ends, hypocotyle and rootlet are small. Germination is epigeal by stretching of the hypocotyle. The first leaves are mostly simple, as in most compound-leaved families; they are often dentate. In a very few genera with thick seeds there may develop — possibly by intrusion of the testa — a false septum in the seed, in Malesia notably in *Stereospermum* and here also the cotyledons are folded. The only exception is mentioned by LUBBOCK (Contr. Knowl. Seedlings 2, 1892, 334, fig. 569) for '*Bignonia insignis*' with fleshy connate cotyledons and hypogeal germination; the name is evasive and at Kew the identity could not be traced; presumably the record rests on an error.

Literature: E. BUREAU, Monogr. Bign. (1864); J. LUBBOCK, Contr. Knowl. Seedlings 2 (1892) 332–345, fig. 569–575; R. S. TROUP, Silvic. Indian Trees 2 (1921) 684–693; J. A. DUKE, Ann. Mo. Bot. Gard. 52 (1965) 349, pl. 20; G. DE LA MENSBRUGE, La germination et les plantules essences arbres Côte d'Ivoire; Techn. For. Trop. Nogent-sur-Marne, Paris (1966) 332–333; D. BURGER, Seedlings (1972) 52–54; C. S. SCHOPMEIJER, Seeds Woody Pl. U.S., Agric. Handb. 450 (1974) 260, 281, 321.

Juvenile plants of *Pandorea pandorana* show leaves very different from the mature foliage, in having many jugae and being coarsely dentate. *Tecoma filicifolia* NICHOLS. was based on such material. This led also to a serious misinterpretation of *Tecoma leptophylla* BL., from New Guinea, of which the juvenile leaves (fig. 37b) are *Pandorea pandorana* but the flowers belong to *Neosepicaea.*

Taxonomy. Since the basic work on the systematy by E. BUREAU (Monographie, 1864), the treatment of the family in Flora Brasiliensis by BUREAU & SCHUMANN (1896–97), and the treatment of SCHUMANN in the Pflanzenfamilien (1895) the traditional subdivision of the family in 5 tribes has proved satisfactory. *Crescentieae* with 1-celled berries occur in Africa and the Americas, two other monogeneric tribes are South American, while the bulk of the family belongs to *Bignonieae* and *Tecomeae*, of which the latter are about balanced as to number of genera in the Old and New World, but *Bignonieae* are predominantly American. These two tribes are largely distinguished on the dehiscence of the fruit, loculicid in *Bignonieae* and septicid in *Tecomeae.*

In passing it may be remarked that GENTRY (Pl. Syst. Evol. p. 126, 255) recently advocated that *Crescentieae* of the neo-tropics and of Africa-Madagascar are of separate descent and would represent two parallel evolutionary lineages; this suggestion is more based on geographic argument and evolutionary hypotheses than on morphological arguments.

The delimitation against other families of *Sympetalae* is well-defined, but there are a few genera, notably *Wightia* and *Paulownia*, which are sometimes referred to *Bignoniaceae*, though FENZL (Denkschr. K. Bay. Bot. Ges. Regensburg 3, 1841, 227–230), BUREAU, SCHUMANN, VON WETTSTEIN, and other specialists referred them to *Scrophulariaceae.* A survey of opinions I gave in my paper on *Wightia* (Bull. Bot. Gard. Btzg III, 18, 1949, 214–216), in which I excluded it from *Bignoniaceae.* Even recently *Paulownia* is sometimes casually treated as Bignoniaceous (*e.g.* SCHOPMEIJER, Agric. Handb. U.S.A. 450, 1974, 527), although the embryo is embedded in endosperm; furthermore the stigma is different from that in *Bignoniaceae*, the anthers have no prolonged connective, there is no rudimentary stamen and the seeds are provided with several wings and seem to be laterally attached, not transverse as in *Bignoniaceae.* For *Wightia* I tabulated (*l.c.*) the relation to both families. Its seeds have no endosperm, but the absence of a staminode, the structure of the stigma, the central placenta and the absence of a produced connective on the anthers point distinctly to *Scrophulariaceae.* The seed is quite differently attached as compared with *Bignoniaceae*, *viz* laterally and the wing surrounds the entire seed. Its wood has two kinds of medullary rays, narrow and broad ones, a character which, at least in Malesian *Bignoniaceae*, is absent.

Though the capsule in *Wightia* is septicid and in *Paulownia* loculicid, both genera have the same kind of axile placentation, in which the thickened placenta becomes detached from the valves as a subquadrangular seed-cake, showing their close affinity, completely differing from the situation in *Bignoniaceae.*

According to SURYAKANTA (J. Palyn. 9, 1973, 73) the pollen of both genera differs from that in *Bignoniaceae* and resembles that of *Scrophulariaceae.*

NAKAI (J. Jap. Bot. 24, 1949, 13) accommodated *Paulownia* in *Paulowniaceae*, probably in-

duced mostly by its arboreous habit and fruit; they certainly merit to be placed in a separate tribe or subtribe of *Scrophulariaceae*. We regard nowadays the arboreous habit as primitive in herbaceous families and we might conclude that they are ancient relicts from a period when *Bignoniaceae* and *Scrophulariaceae* had a common matrix.

Also in South America there are two woody genera of the *Scrophulariaceae* which were at times referred to *Bignoniaceae, viz Schlegelia* (syn. *Dermatocalyx*) and *Gibsoniothamnus*, according to GENTRY (Fieldiana, Bot. 34, 1971, 55; Ann. Mo. Bot. Gard. 61, 1974, 533–537); see also LEINFELLNER (Oest. Bot. Z. 121, 1973, 13–22). They are (hemi-?) epiphytic shrubs or lianas, a similar habit as in *Wightia*.

Genetics. *Chromosomes.* DARLINGTON & WYLIE (Chrom. Atlas, 1955) and MOORE (ed.) (Regn. Veg. 90, 1973) gave for 26 genera x = 20 (2n = 40) and they belong to *Tecomeae, Bignonieae* and *Crescentieae*, both from the palaeo- or neotropics. There is one higher number x = 22 (*Amphilophium*, South America, *Niedzwedzkia* = *Incarvillea*) and several lower ones: *Pandorea*, and some doubtful countings in *Tecoma* x = 19, *Tecomanthe dendrophila* 2n = 36 (Christine BRIGHTON in litt.), *Jacaranda* x = 18, *Tecoma capensis* x = 17, *Oroxylum, Millingtonia, Argylia* (from South America) x = 15, *Spathodea* x = 13, and *Incarvillea* x = 11. In supplement indices *Campsis* is also given as 16 and *Oroxylum* as 14.

I have scanned the numbers of *Scrophulariaceae, Gesneriaceae* and *Verbenaceae*, but can find no reliable ties, *Bignoniaceae* being obviously more homogeneous than those.

The number given for *Paulownia*, 2n = 40, x = 10, might as well fit *Bignoniaceae* as *Scrophulariaceae*.

Hybridisation. Not many species hybrids are known to me, but those known are interesting, as there are at least two between species of East Asia and SE. North America which are now very disjunct after the Pleistocene Ice Age; it is not impossible that they formed part of more continuous populations in the warmer Pliocene via Beringia. This idea is supported by the fact that in both cases the hybrids are fertile.

E. C. SMITH (J. Arn. Arb. 22, 1941, 219) reported on *Catalpa ovata* DON × *C. bignonioides* WALT. (= × *C. syringifolia* SIMS). Haploid all have 20 chromosomes (SAX, J. Arn. Arb. 14, 1933, 274).

Then there is × *Campsis tagliabuana* (VIVIANI) REHDER, a hybrid between the Chinese *C. grandiflora* (THUNB.) K. SCH. (*C. chinensis* (LAMK) VOSS.) and *C. radicans* (L.) SEEM. which produces fertile progeny (*cf.* STEARN, Bot. Mag. 169, 1953, t. 198).

The third one is also bi-continental, *Tecoma smithii* W. WATSON (Gard. Chron. 14, 1893, 649, fig. 104; E. SMITH, *ibid.* 16, 1894, 64; *cf.* also Gartenflora 44, 1895, 51, fig. 14). This is a reputed hybrid, which E. SMITH made at Adelaide, in 1882, between *T. velutina* (a hairy variety of *T. stans*) and *T. capensis*. It was propagated by cuttings, but it produced seed and its offspring of seedlings diverged in size and flower colour. Curiously SPRAGUE, in a succinct note (Fl. Cap. 4, 2, 1904, 448) reduced it to *T. alata* DC., without referring to its hybrid nature.

Anatomy. *Wood.* Of the Malesian *Bignoniaceae* only a small proportion of tree species is known wood-anatomically; the climbing and scandent species are fully unexplored in this respect. Anomalous structure has, however, been described for several genera outside Malesia. As far as known, the Malesian tree genera are wood-anatomically rather homogeneous: with simple, rarely also reticulate, perforations to the vessels, homogeneous rays, mainly paratracheal, aliform or confluent parenchyma, and fibres with simple to minutely bordered pits. Except for its unusually narrow rays, *Dolichandrone spathacea* from the mangrove swamps does not differ appreciably from the inland genera in its wood structure.

Leaves. Very poorly known for the Malesian representatives. Diversity of stomatal type and indumentum (non-glandular and glandular hairs in a variety of forms) certainly deserves detailed comprehensive studies, which will probably yield important additional taxonomic characters.

References: *General surveys:* SOLEREDER, Syst. Anat. Dicot. Stuttgart (1899, 1908); METCALFE & CHALK, Anat. Dicot. Oxford (1950). — *Wood:* JANSSONIUS, Mikrographie des Holzes 4 (1926) 721–753 (*Dolichandrone, Oroxylum, Stereospermum*); PANSHIN, Philip. J. Sc. 48 (1932) 143–205 (*Dolichandrone*); DESCH, Mal. For. Rec. 15 (1941) 50 (*Deplanchea, Dolichandrone, Pajanelia, Stereospermum*); JANSSONIUS, Blumea 6 (1950) 450–452 (affinities); SEBASTINE, J. Ind. Bot. Soc. 34 (1955) 299–306 (*Pajanelia*); JUTTE, Nova Guinea 10 (1959) 242 (*Deplanchea*). —

Leaves: SIEBERT, Ann. Mo. Bot. Gard. 35 (1948) 123–136 (glands); PALIWAL, Flora 159 (1970) 124–132 (stomata). — P. BAAS.

Pollen morphology. *Bignoniaceae* have a long history of pollenmorphological study, starting with the pioneer studies of H. MOHL (1835). The first author to present a detailed pollenmorphological survey of the family, drawing attention to the taxonomical significance of the pollen characters, was URBAN (1916). He concluded that (1) any attempt to base the main subdivision of the family on pollen characters would group together taxonomically unrelated genera, (2) for generic delimitation pollen had limited value. Later studies by several authors have confirmed this (*cf.* BUURMAN, in the press).

Inaperturate, tricolpate, stephanocolpate and pericolpate apertural types occur in the family. In a few genera tetrads are found.

Size ranges between 25 μm in *Astianthus antisyphilitica* and 100 μm in *Nyctocalos cuspidata*, shape varies between suboblate and subprolate.

Remarkable is the amount of variation which may occur within genera or even intraspecifically. In *Stereospermum* inaperturate, tricolpate and perisyncolpate pollen is found, while in *Anemopaegma longepetiolatum* inaperturate, stephanocolpate, pericolpate grains as well as tetrads occur. In such cases sculpture affords more constant characters.

The tricolpate type is dominant in the family and is found in all four tribes. It rarely shows well developed equatorial endoapertures. Instead, characteristically ruptured aperture membranes are present, especially in *Tecomeae*. Operculate colpi occur in *Argylia*. A subdivision of the tricolpate type is possible on sculpture, which mostly varies between perforate and reticulate.

In some genera very complex pollen grains are present, such as those of *Nyctocalos* (fig. 2).

The tricolpate pollen grains in *Bignoniaceae* resemble those in *Scrophulariaceae* and *Myoporaceae*. The similarities with *Pedaliaceae*, stressed by ERDTMAN (1952) refer to a rather specialized pollen type and may not reflect close affinity.

References: MOHL, Ann. Sc. Nat. II, 3 (1835) 304–346; URBAN, Ber. Deut. Bot. Ges. 34 (1916) 728–758; ERDTMAN, Pollen morphology and plant taxonomy. Angiosperms. Almqvist & Wiksell, Stockholm (1952) 73–74; BUURMAN, Contribution to the pollenmorphology of the *Bignoniaceae*, with special reference to the tricolpate type (in the press). — J. MULLER.

Chemotaxonomy. *Bignoniaceae* share a number of biochemical tendencies with *Verbenaceae*, *Labiatae*, *Scrophulariaceae* and with several other families of WETTSTEIN's *Tubiflorae*. Most of their outstanding chemical characters were already mentioned and discussed in my 'Chemotaxonomie der Pflanzen' vol. 3 (1964) 268–281, 645–646, to which the reader is referred. Much phytochemical information, however, became available only in more recent time. Recent results confirm the trends already apparent in 1963; they are summarized in the following pages. Chemical characters of *Bignoniaceae* may ultimately prove to be very useful in tracing inter- and intrafamiliar relationships.

(1) Most members seem to produce and accumulate iridoid glucosides (formerly often called pseudoindicans). Since a long time *Bignoniaceae* are known to contain labile glycosidic bitter principles. Such a compound was isolated in 1888 from the bark and fruits of *Catalpa bignonioides* WALTER and called catalpin (name changed later to catalposide). The structure of catalposide was definitely established in 1962; it is an aucubin-type (C_9-aglucone) ester glucoside and one of the first pseudoindicans for which clearcut structural and biogenetic relationships with iridodial and nepentalactone were demonstrated (hence the name iridoid glucosides for a presently very large group of constituents of dicotyledonous plants). Catalposide (tastes bitter) is an ester of *p*-hydroxybenzoic acid with catalpol (= 7,8-epoxy-aucubin). Catalpol and catalposide occur in all species of *Catalpa* (leaves, stems, fruits) and catalpol (= catalpinoside) was also isolated from barks of *Paulownia tomentosa* STEUD. and *P. fargesii* FRANCH. where it occurs together with syringin (V. PLOUVIER, C. R. Ac. Sc. Paris 272D, 1971, 1443). Probably catalpol and catalposide occur in many more members of the family. In most recent times some related glucosides were isolated from *Bignoniaceae*. Vanilloyl-catalpol (= amphicoside) is a constituent of *Amphicome emodi* LINDL. and veratroyl-catalpol occurs in *Tecomella undulata* SEEM. 5-Hydroxycatalpol (= macfadyenoside) was isolated from *Macfadyena cynanchoides* MORONG. All iridoid glucosides mentioned hitherto have structures based on the aucubin-derivative catalpol. The first non-aucubin-type glucoside described from *Bignoniaceae* is tecomoside with a C_{10}-aglucone; it was

isolated from *Tecoma capensis* LINDL. (A. BIANCO *et al.* Gazz. Chim. Ital. 105, 1975, 195). It is to be expected that much more iridoid glucosides will be detected in the family in future.

(2) Some *Bignoniaceae* produce alkaloids. So far only pyridine-type and piperidine-type alkaloids with an iridoid C_{10}- or rarely C_9-skeleton were identified definitely in species belonging to this family. This fact strengthens the belief that the tendency to produce iridoid compounds is a very important character of *Bignoniaceae*. Thusfar simple iridoid alkaloids were described for species of *Campsis* (boschniakine), *Incarvillea* (plantagonine, indicain), *Tecoma* (tecomanine, tecostidine, tecostanine, boschniakine, 4-noractinidine and several derivatives of skytanthine). The basic constituents of *Amphicome* (now reduced to *Incarvillea*), *Newbouldia* and other genera may belong to the same group of alkaloids.

A recent review of the chemistry, distribution and systematic meaning of all presently known main groups of iridoid plant constitutents was published by S. ROSENDAL JENSEN *et al.* (Bot. Notis. 128, 1975, 148–180).

(3) Many *Bignoniaceae* synthesize naphthaquinones and corresponding anthraquinones by prenylation of *o*-succinylbenzoic acid. This pathway to quinonoid naphthalene- and anthracene-type secondary metabolites is presently known from taxa belonging to *Rubiaceae*, *Verbenaceae*, *Scrophulariaceae*, *Bignoniaceae* and possibly *Acanthaceae* and *Gesneriaceae*. In roots, woods and barks of *Bignoniaceae* lapachol, lapachonone, α- and β-lapachone and dehydro-α-lapachone occur frequently. These monomeric naphthaquinonoid compounds are often accompanied and sometimes replaced by more complex dimeric constituents like tectol, guayacanine and guayine and by corresponding anthraquinones such as tectoquinone and 2-methyl-3-hydroxyanthraquinone. Woods which contain appreciable amounts of these quinonoid compounds are more or less resistant to marine borers, white ants and *Fungi*. At the same time such woods may be the causes of skin irritations and of allergic skin diseases in man. Lapachol- and tectoquine-type substances are presently known from species of the genera *Catalpa*, *Heterophragma*, *Kigelia*, *Paratecoma*, *Phyllarthron*, *Stereospermum*, *Tabebuia*, *Tecoma*, *Tecomella*, and *Zeyhera*. R. H. THOMSON has reviewed the chemistry and distribution of quinones and related compounds in his book 'Naturally occurring quinones' (2nd ed. 1971). The phthalide catalpalactone from the wood of *Catalpa bignonioides* WALTER and *C. ovata* G. DON arises from the same pathway as lapachol and its congeners (H. INOUYE *et al.* Chem. Pharm. Bull. Tokyo 23, 1975, 384, 392, 2523). On the other hand it should be stressed that the red-coloured naphthaquinones of *Boraginaceae* (*e.g.* alkannin) which are structurally very similar to lapachol are produced along a totally different biosynthetic pathway (cf. E. LEISTNER, Chinoide Farbstoffe, Ber. Deut. Bot. Ges. 88, 1975, 163–178).

(4) The "tannins" mentioned for many *Bignoniaceae* in the older phytochemical literature (*e.g.* DEKKER, 1913) seem to be glycosides and esters of *o*-diphenolic compounds. Orobanchin (= verbascoside)-type ester glycosides were definitely demonstrated to occur in species of *Campsis*, *Catalpa*, *Eccremocarpus* and *Pandorea*. A review of this type of polyphenolic plant constituents which simulate true tannins in some respects is to be found in my 'Chemotaxonomie der Pflanzen' vol. 5 (1969) 250–252. Orobanchin yields a molecule of caffeic acid, 3,4-dihydroxyphenylethanol, glucose and rhamnose each. Just as in most other families of *Sympetalae* true tannins are replaced in *Bignoniaceae* by more or less complex esters and glycosides of *o*-diphenolic cinnamic acid derivatives. Moreover, simple esters of caffeic acid and biosynthetically related derivatives of cinnamic and benzoic acids are present in large amounts in many *Bignoniaceae*. The recent investigations of V. B. PANDEY and B. DASGUPTA with the bark of *Tecomella undulata* SEEM. (veratroylglucose = tecomin: Experientia 26, 1970, 1187) and of M. SUGUMARAN *et al.* with leaves of *Tecoma stans* H.B.K. (16 aromatic acids: Ind. J. Exper. Biol. 13, 1975, 93) exemplify this trend. *p*-Hydroxybenzoic acid is present as an ester in all species producing catalposide; probably this phenolic acid is rather ubiquitous in the family. The presence of appreciable amounts of hydroquinone (in living cells as the glucoside arbutin?) in leaves of *Jacaranda mimosaefolia* D. DON (S. SANKARA SUBRAMANIAN *et al.* Phytochemistry 12, 1973, 220) might be connected with a strong tendency to produce and accumulate *p*-hydroxybenzoic acid; if this is actually the case hydroquinone (and arbutin?) may be detected in much more *Bignoniaceae* in future. Jacaranone, a quinonoid compound which exhibits antitumor and cytotoxic activity was recently isolated from leaves and twigs of *Jacaranda caucana* PITTIER (M. OGURA *et al.* Lloydia

39, 1976, 255); it seems to be derived from tyrosine and is chemically very similar to the *Cornus* quinol glucoside (= cornoside) which is also present in leaves of *Digitalis purpurea* (Bot. Notis. 128, 1975, 174).

(5) According to J. B. HARBORNE (Phytochemistry 6, 1967, 1643) leaf flavonoid patterns of *Bignoniaceae* are close to those of *Acanthaceae*, *Gesneriaceae*, *Labiatae* and *Scrophulariaceae*. Features which support such a statement are the replacement of flavonols by flavones in many species, the relatively frequent occurrence of flavones with an unsubstituted B-ring (*e.g.* chryson, baicalein), of 6-hydroxylation of chrysin (baicalein), apigenin (scutellarein) and luteolin (6-hydroxyluteolin) and of 0-methylation of flavones. The latter trend is illustrated by *Zeyhera tuberculosa* BUR. *ex* VERLOT which contains 5,6,7-trimethoxyflavone and 5,6,7,8-tetramethoxy-flavone in leaves (J. P. KUTNEY & H. W. HANSSEN, Phytochemistry 10, 1971, 3298). The bitter principle of the fruits of *Sparattosperma vernicosum* BUR. & K. SCH. was shown by J. P. KUTNEY *et al.* (Phytochemistry 9, 1970, 1877) to be the 7-neohesperidoside of pinocembrin (= 2,3-dihydrochryson).

(6) Free triterpenic acids occur in appreciable amounts in leaf waxes of many families of *Tubiflorae* (especially *Verbenaceae*, *Labiatae* and *Plantaginaceae*) and related orders. It is of interest in this respect that ursolic acid was isolated in recent time from leaves of *Bignonia diversifolia* H.B.K., *Campsis radicans* SEEM., *Catalpa bignonioides* WALTER, *Heterophragma quadriloculare* K. SCH., *Jacaranda mimosaefolia* D. DON (not definitely identified) and *Paulownia tomentosa* STEUD. The bark of *Jacaranda mimosaefolia* yielded lupenon.

(7) Many members of *Verbenaceae*, *Labiatae*, *Scrophulariaceae* and *Plantaginaceae* replaced starch by stachyose-type oligosaccharides as storage carbohydrates. The same trend seems to exist in *Bignoniaceae*. Large amounts of stachyose occur in species of *Catalpa* (roots, wood, bark), *Newbouldia laevis* SEEM. (roots) and *Paulownia tomentosa* (stem).

(8) Most representatives of *Tubiflorae* produce starch-free seeds which are rich in proteins and oils. The seed oils are often characterized by a high degree of unsaturation. In this respect *Bignoniaceae* conform to the rule. Their seeds generally contain 20–35% of oil. In some taxa oleic and (or) linolic and (or) linolenic acid are the only major fatty acids of the seed oils (*e.g.* species of *Crescentia*, *Niedzwedzkia* = *Incarvillea*, *Paulownia* and *Stereospermum*). In other taxa the 'normal' fatty acids are accompanied or replaced by large amounts of unusual fatty acids such as conjugated trienoic acids (species of *Catalpa*, *Chilopsis*, *Jacaranda*), C_{26}-keto-acids (*Cuspidaria pterocarpa* DC.), octadeca-*trans*-3,*cis*-9,*cis*-12,*cis*-15-tetraenoic acid (*Tecoma stans* H.B.K.) or hexadec-9-enoic and octadec-11-enoic acid (*Doxantha unguis-cati* MIERS). M. J. CHISHOLM and C. Y. HOPKINS discussed the chemistry of seed oils of 11 species representing 4 tribes (Canad. J. Chem. 43, 1965, 2566).

The preceding phytochemical picture places *Bignoniaceae* phytochemically very close to a number of families of *Tubiflorae*, especially *Verbenaceae*, *Labiatae* and *Scrophulariaceae*. Still other constituents are known from *Bignoniaceae*. Lack of acquaintance with their structures and (or) with their distribution, however, does not yet allow a systematic evaluation. Saponins, which seem to be rather widespread in the family but were never investigated in detail, belong to these chemical characters. The same holds for a number of phenolic compounds isolated in recent time, such as the lignans sesamin and paulownin from *Paulownia tomentosa* STEUD. and *Phyllarthron comorense* DC., the dilignol (a lignan-type compound) zeyherol from *Zeyhera digitalis* HOEHNE and the dihydroisocoumarins 6-methoxymellein, kigelin and 6-demethylkigelin from *Kigelia pinnata* DC.

Concluding it may be stated that the intimate relationships between *Bignoniaceae* and *Scrophulariaceae* which are indicated by genera like *Catalpa* and *Paulownia* (often placed in *Scrophulariaceae*) are confirmed by phytochemistry. At the same time phytochemistry stresses a very close coherence of a core of families of *Tubiflorae*; this core comprises *Scrophulariales sensu* CRONQUIST (1968) and *Lamiales sensu* TAKHTAJAN (1969). — R. HEGNAUER.

Uses. There are no outstanding qualities marking *Bignoniaceae* as useful plants, otherwise than ornamentals and these concern mostly the introduced species for which I refer to the special key and account at the end. There are magnificent native species notably of *Tecomanthe* but they have as yet not become in general use.

Good roadside trees are *Millingtonia hortensis* and *Spathodea campanulata*. A highly esteemed

vegetable (*lalab*) with the Sundanese is *Oroxylum indicum* (flowers, buds, and very young pods).

For re-afforestation and holding terraces on slopes the pioneer qualities of species of *Radermachera* and *Deplanchea* might be useful.

The timber is in general not valuable and in nature not available in sufficient quantity. The soft wood of *Millingtonia hortensis* was advertized as useful for tea-boxes. The only species yielding sizeable timber of good quality are: *Fernandoa macroloba*, *Pajanelia longifolia*, *Radermachera gigantea*, and the three species of *Stereospermum*, which all may be valuable for silviculture.

Terminology. The shape of the corolla has been defined as tubular (fig. 4b, 10e) in which case there can be a distinction in a basal tube (on apex of which inside the stamens are inserted) as in fig. 4b; funnel-shaped (fig. 23d, 26c), hypocrateriform or salver-shaped (fig. 1a, 8c, 15) or infundibuliform (fig. 32a).

Notes. Since my thesis (Rec. Trav. Bot. Néerl. 24, 1927, 787–1049), here always cited as 'Thesis (1927)', and subsequent revision in Bull. Jard. Bot. Btzg III, 10 (1928), I have remained always much interested in this family and have published some revisions and many notes precursory to the present treatment. I have to thank the late Mr. N. Y. SANDWITH (Kew) for namings of cultivated species, and Dr. A. L. GENTRY (St. Louis) for recent information on them, Dr. H. HEINE (Paris) for assistance in various matters, Mr. Michael GALORE (Lae) and Prof. E. J. H. CORNER (Cambridge) for photographs, Miss Christine BRIGHTON (Jodrell Lab., Kew) for the first chromosome count in *Tecomanthe*, while I gratefully acknowledge precursory work performed by Mr. J. C. DEN HARTOG on *Tecomanthe* and *Pandorea* in 1969/70 at the Rijksherbarium where he worked as a graduate student.

KEY TO THE GENERA[1]

1. Erect trees or shrubs.
2. Leaves simple, mostly in whorls . . . . . **6. Deplanchea**
2. Leaves compound, almost always decussate.
3. Leaves 1-pinnate.
4. Leaf rachis with a sharp, keel-like ridge above. Leaflets 8–12 pairs. Capsules winged **12. Pajanelia**
4. Leaf rachis not keeled above. Leaflets less than 6 pairs. Capsules not winged.
5. Corolla salver-shaped, white, nocturnal, the tube 12–18 cm long, narrow-cylindric. Calyx spathaceous to the base, 3–6 cm. Leaves nigrescent, with domatia. A flat pseudoseptum developed parallel to the valves. Seeds rectangular, with corky wings as thick as the seed . **7. Dolichandrone**
5. Corolla much shorter. No pseudoseptum. Seeds with hyaline wings. Leaves not nigrescent.
6. Mature leaflets serrate, crenate, or pinnatifid . . . . . **5. Tecoma**
6. Mature leaflets entire.
7. Calyx regularly 5-lobed, rather thin, reticulately veined, short-hairy, 2–3 cm **11. Lamiodendron[1]**
7. Calyx lobes unequal, often less than 5; calyx not thin and reticulate-veined.
8. Capsule rather flattened, with a flat septum, if terete with 10 ribs . . . **10. Fernandoa**
8. Capsule terete, with a terete septum, never with many ribs, sometimes one ridge on each valve. No domatia in Mal. *spp.*
9. Seeds thick, in one row in each cell, each fitting in deep notch in the septum. Valves rather hard. Ovules in 2 rows in each cell . . . . . **8. Stereospermum**
9. Seeds thick, in many rows, the septum without notches. Valves thin. Ovules in many rows in each cell . . . . . **9. Radermachera**
3. Leaves 2–3(–4)-pinnate.
10. Flowers fleshy, very coarse: calyx 2–4 cm, corolla wide, dirty violet or reddish purple to liver brown, 7–10 cm. Capsule flat, sword-shaped, 60–120 cm. . . . . **3. Oroxylum**
10. Flowers not fleshy, much smaller or thinner, white or pink. Capsule smaller and of different shape.
11. Leaflets with domatia. Corolla white, salver-shaped, the tube 6–8 cm long, cylindric, 2 mm wide. Capsule compressed parallel to the septum, the latter parallel to the valves; dehiscence septicidal. **4. Millingtonia**
11. Leaflets without domatia. Corolla tube otherwise, wider. Capsule cylindric, with a terete corky septum attached perpendicular to the valves; dehiscence loculicidal. . . . . **9. Radermachera**
1. Lianas.
12. Corolla salver-shaped, with a narrow cylindric tube, 5–19 cm long. Capsule flat, large, with a median lengthwise ridge. Septum parallel to the valves, dehiscence loculicid . . . . **1. Nyctocalos**
12. Corolla not salver-shaped, tubular, infundibuliform or funnel-shaped.

(1) Of *Lamiodendron* and *Hieris* the fruit is still unknown.
The key given here is only to native and thoroughly naturalized species (only *Tecoma stans*).
A tentative key to the cultivated species is added in an appendix on page 180.

13. Corolla tube ± geniculate above the basal tube, upper tube slightly curved and flattened with a prominent fold. Calyx *c.* 1/2 cm, below the very short lobes with a short spur-like tooth. Ovules 6–8 per cell, in ± two rows. Leaflets 5, those of the lower pair sessile . . . . . **2. Hieris**[1]
13. Corolla tube not geniculate, without a fold. Ovules ∞ per cell in several rows. Capsule loculicid, with boat-shaped valves.
14. Leaves digitate, with 3(–5) leaflets. Corolla lobes valvate . . . . . **13. Neosepicaea**
14. Leaves pinnate, with 1 or more pairs of leaflets. Corolla lobes imbricate.
15. Flowers in racemes, axillary, mostly on the old wood, rarely terminal (in a high-mountain *sp.*), the rachis at the base usually with several crowded pairs of minute sterile bracts. Calyx large, 15–40 mm, distinctly lobed. Corolla large, mostly red, 5–12 cm long incl. the lobes, not bearded in the mouth and upper part of the tube, but stuppose hairy at the insertion of the stamens (rim of the basal tube). Corolla lobes usually deltoid, very narrowly overlapping. Anther-cells 4–5(–10) mm long. . . . . **14. Tecomanthe**
15. Flowers in thyrses, only occasionally depauperate into racemes, usually terminal, sometimes axillary or on old wood. No sterile bracts at base of peduncle. Calyx small, mostly stunted or very shortly lobed, 2–7 mm. Corolla incl. lobes up to *c.* 3 1/2 cm (in a single Australian species with large lobes *c.* 5 cm), usually white or yellowish with red dots or streaks inside lobes and mouth, often bearded in the mouth and upper part of the tube, sometimes with a hair-ring at the insertion of the anthers. Corolla lobes widely overlapping, often roundish. Anther-cells 1 1/2–2 mm long . . . . . **15. Pandorea**

Tribe 1. Bignonieae

B. & H. Gen. Pl. 2 (1876) 1027; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 209; BUREAU, Fl. Bras. 8, 2 (1896) 16. — *Eubignonieae* ENDL. Gen. Pl. (1839) 712. — *Subtribe Eubignonieae* DC. Rév. Bign., Bibl. Univ. Genève (1838) 122; FENZL, Denkschr. K. Bay. Bot. Ges. Regensburg 3 (1841) 262; DC. Prod. 9 (1845) 143.

Capsule septicid, the septum parallel to the valves. Frequently lianas, with tendrils, mostly in the neotropics.

Note. BOJER (Hort. Maur. 218) and DC. (*l.c.*) included the two present tribes in *tribe Bignonieae.*

1. NYCTOCALOS

T. & B. in Miq. J. Bot. Néerl. 1 (1862) 366; BUREAU, Mon. (1864) 52; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 201; *ibid.* 3 (1867) 249; SEEM. J. Bot. 8 (1870) 147; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 219 ('*Nycticalos*'); STEEN. Thesis (1927) 805; Bull. Jard. Bot. Btzg III, 10 (1928) 178; Acta Bot. Neerl. 2 (1953) 306; SANTISUK, Kew Bull. 28 (1973) 182. — **Fig. 1–2.**

Lianas, without tendrils. *Leaves* pinnately 3-foliolate (in one *extra*-Mal. *sp.* 1-pinnate with 5 leaflets). Leaflets herbaceous to chartaceous, entire, ± elliptic, acuminate, with a few scattered crateriform glands along and spaced from the midrib underneath, above very fine punctate-pitted glandular. *Inflorescence* a short lateral or terminal 8–12-flowered raceme. Pedicels bracteolate. *Flowers* nocturnal, erect, fragrant; lobes widely imbricate. *Calyx* cup-shaped, truncate, with 5 horn-like teeth, the latter with glands on both sides. *Corolla* almost actinomorphic, salver-shaped, the long narrow basal tube dilated in the upper part, with 5 rounded unequal or subequal lobes. *Stamens* inserted in the throat 4 with or without a rudiment or 5, equal or 2 anterior ones sometimes longer, not exserted; anther-cells divergent, versatile; filaments glabrous and no hairs near their insertion. Disk annular, fleshy. *Ovary* with ∞ rows of ∞ ovules along the margins of the dissepiment; style long, filiform. *Capsule* large, flat, stalked and acuminate but with

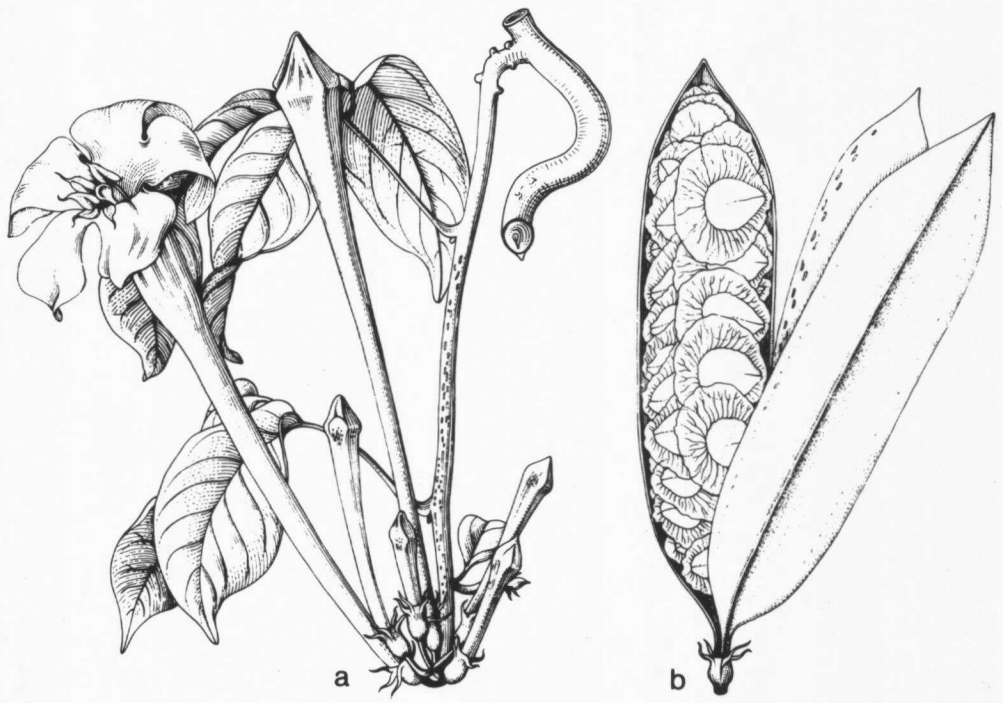


Fig. 1. *Nyctocalos cuspidata* (BL.) MIQ. a. Habit, in flower, b. fruit, opened, showing seeds and dissepiment, × ½ (after MIQUEL, 1867)

parallel edges, valves with a central prominent rib; dissepiment thinnish, flat. *Seeds* flimsy winged, roundish.

Distr. Three *spp.* in SE. Asia (Assam, Burma, Thailand, Yunnan) and *West Malesia* (Java, Borneo, Celebes, and the Philippines). Fig. 3.

Ecol. Rare rain-forest lianas at low altitude.

Taxon. The genus stands isolated in the Old World flora. In many aspects the small New World genus *Tanaecium* SW. is very similar, but in this genus at least part of the leaflets carries a terminal tendril; besides its fruit is not flat, but said to be cylindric or quadrangular with convex woody valves. Still I believe it to be an ally in the New World. There is also a similar resemblance with the monotypic South American genus *Macranthisiphon* BUREAU but that has 2-ranked ovules and a more elongate, funnel-shaped corolla tube.

For a moment I thought that *Nyctocalos pinnata* STEEN. (from Yunnan, only known in fruit, *l.c.* 1953, 306) might belong to *Hieris*, but the very numerous seeds defeat this, as far as *H. curtisii* is concerned. *Hieris* is, of course, the most intimate related genus, with the same punctate glands on the leaves and a deceptively similar calyx; its pollen is quite different.

Too much importance has been ascribed to the structure of the androecium: 5 equal stamens to 4 didynamous; this varies as is explained under *N. cuspidata*. It led SEEMANN (*l.c.*) even to the inclusion of the Australian *Hausmannia jucunda* into the genus, which belongs in fact to the *Tecomeae* with quite different fruit and valvate corolla lobes.

Nomencl. The generic name is female, being derived from the Greek *nux*.

KEY TO THE SPECIES

1. Corolla tube *c.* 15–16 cm long, white. Calyx teeth horn-like, with a linear apex. Lateral petiolules 5–12 mm. . . . . **1. N. cuspidata**
1. Corolla tube *c.* 5–6 cm long, tinged palish yellow suffused with pinkish shade. Calyx teeth triangular, acute. Lateral petiolules 2–3 mm . . . . . **2. N. brunfelsiiflora**

1. Nyctocalos cuspidata (BL.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 249, t. 8B (*'cuspidatum'*); MERR. Philip. J. Sc. 1 (1906) Suppl. 237; C. B. ROB. *ibid.* 6 (1911) Bot. 211; MERR. En. Philip. 3 (1923) 443; STEEN. Thesis (1927) 813, *incl. var. oblongum* STEEN.; Bull. Jard. Bot. Btzg III, 10 (1928) 180; SANTISUK, Kew Bull. 28 (1973) 183. — *Tecoma cuspidata* BL. Rumphia 4 (1849) 35. — *N. macrosiphon* T. & B. Cat. Hort. Bog. (1856) 155, *nomen.* — *N. brunfelsiaeflorus* (*non* T. & B.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 201, *pro specim. celeb.* — *N. thomsonii* HOOK. *f.* Bot. Mag. 93 (1867) t. 5678; CLARKE, Fl. Br. Ind. 4 (1884) 377; STEEN. Thesis (1927) 809; Bull. Jard. Bot. Btzg III, 10 (1928) 180; SANTISUK, Kew Bull. 28 (1973) 183. — *Gelseminum cuspidatum* O. K. Rev. Gen. Pl. 2 (1891) 479. — *N. assamica* HOOK. *f. ex.* K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 221, *nomen, lapsus.* — **Fig. 1–2.**

Leaflets elliptic, ovate, obovate, or narrow oblong, rounded at base, acuminate to cuspidate at apex, 6–11(–18) by $3^1/_2$–7(–10) cm; petiole 3–5 cm; rachis $2^1/_2$–$3^1/_2$ cm; petiolules $^1/_2$–1 cm. Pedicels *c.* $^1/_2$–1 cm. *Calyx c.* 6 mm. *Corolla* in bud pale green, later creamy, the tube *c.* 15–19 cm; dilated part *c.* 3–6 cm; lobes rounded, *c.* $1^1/_2$–2 cm. *Stamens* 4, didynamous, with or without a filiform rudimentary 5th one; anther-cells 6–10 mm; connective with a filiform appendage 2–3 mm. *Capsule* 16–24 by $3^3/_4$–$4^3/_4$ cm. *Seeds* (including the flimsy wings) rounded to obovate, 3–4 by 2!–3 cm.

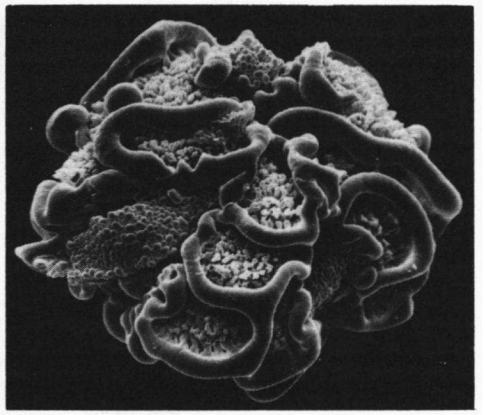


Fig. 2. *Nyctocalos cuspidata* (BL.) MIQ. Pollen grain, SEM × 500 (BS 10396).

Distr. SE. Asia (Assam: Mikir & Gowhatty Hills) and *Central Malesia:* Philippines (Luzon, Polillo, Palawan, Biliran, Mindanao, Basilan) and Celebes (Manado, Kema, Bantaeng). The type was said to have been collected in the Moluccas by ZIPPEL but this must be doubted. Fig. 3.

Ecol. Lowland rain-forests.

Notes. Hitherto importance was laid in keys on the difference between *N. cuspidata* and *N. thomsonii* in that the former was described with 5 fertile stamens and the latter with 4 didynamous stamens and a filiform rudiment. This was suspicious as there were hardly any other differences. In material on spirit of Celebes specimens cultivated in Hort. Bog. I have now found flowers with didynamous stamens whether or not accompanied by a staminode. Furthermore, in RIEDEL *s.n.* from Manado and in BS 10396 from Polillo there are 5 perfect stamens; but even here in one flower the two anterior stamens were somewhat longer than the others. There is thus variation in the degree of tendency to zygomorphism. This is also visible in the difference in size of the corolla lobes of which one is mostly larger than the others. The taxonomical implication is the reduction of *N. thomsonii.*

In the Malesian specimens the calyx teeth appear to be somewhat longer and more horn-like than in the Assam specimens depicted by HOOKER *f.*

2. Nyctocalos brunfelsiiflora T. & B. in Miq. J. Bot. Néerl. 1 (1862) 367 (*'brunfelsiaeflorus'*); MIQ. Choix (1863) t. VII; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 201, *excl. syn. et specim. celeb.*; *ibid.* 3 (1867) 248, t. 8A; STEEN. Thesis (1927) 811; Bull. Jard. Bot. Btzg III, 10 (1928) 179 (*'brunfelsiiflorus'*); Acta Bot. Neerl. 2 (1953) 306; BACK. & BAKH. *f.* Fl. Java 2 (1965) 536; SANTISUK, Kew Bull. 28 (1973) 183. — *N. shanica* MACGREGOR & W. W. SMITH, Rec. Bot. Surv. India 4 (1911) 280; STEEN. Thesis (1927) 811; SANTISUK, Kew Bull. 28 (1973) 182, 183; Thai For. Bull. Bot. 8 (1974) 88.

Leaflets elliptic, oblong, or obovate, acuminate to cuspidate, 7–13 by 3–6 cm; petiole 4–7 cm; rachis $1^1/_2$–3 cm; petiolules 1–2 mm. *Racemes* 5–10-flowered. Pedicels 1–$1^1/_2$ cm. *Calyx* 5–6 mm, suffused with reddish tinge in anthesis (*ex coll.*). *Corolla* whitish afterwards yellowish, later apically suffused with pink; tube 5–7 cm, the dilated part some 2–$2^1/_2$ cm; lobes rounded to obovate or truncate, *c.* 2 cm. *Stamens* (so far as known) 5. fertile, equal or subequal. *Capsule* 10–13 by 3–4 cm,

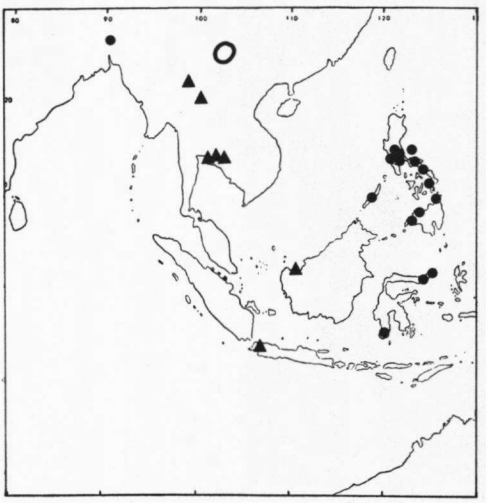


Fig. 3. Range of the genus *Nyctocalos* T. & B.: *N. brunfelsiiflora* T. & B. (triangles), *N. cuspidata* (BL.) MIQ. (dots), and *N. pinnata* STEEN. (circle).

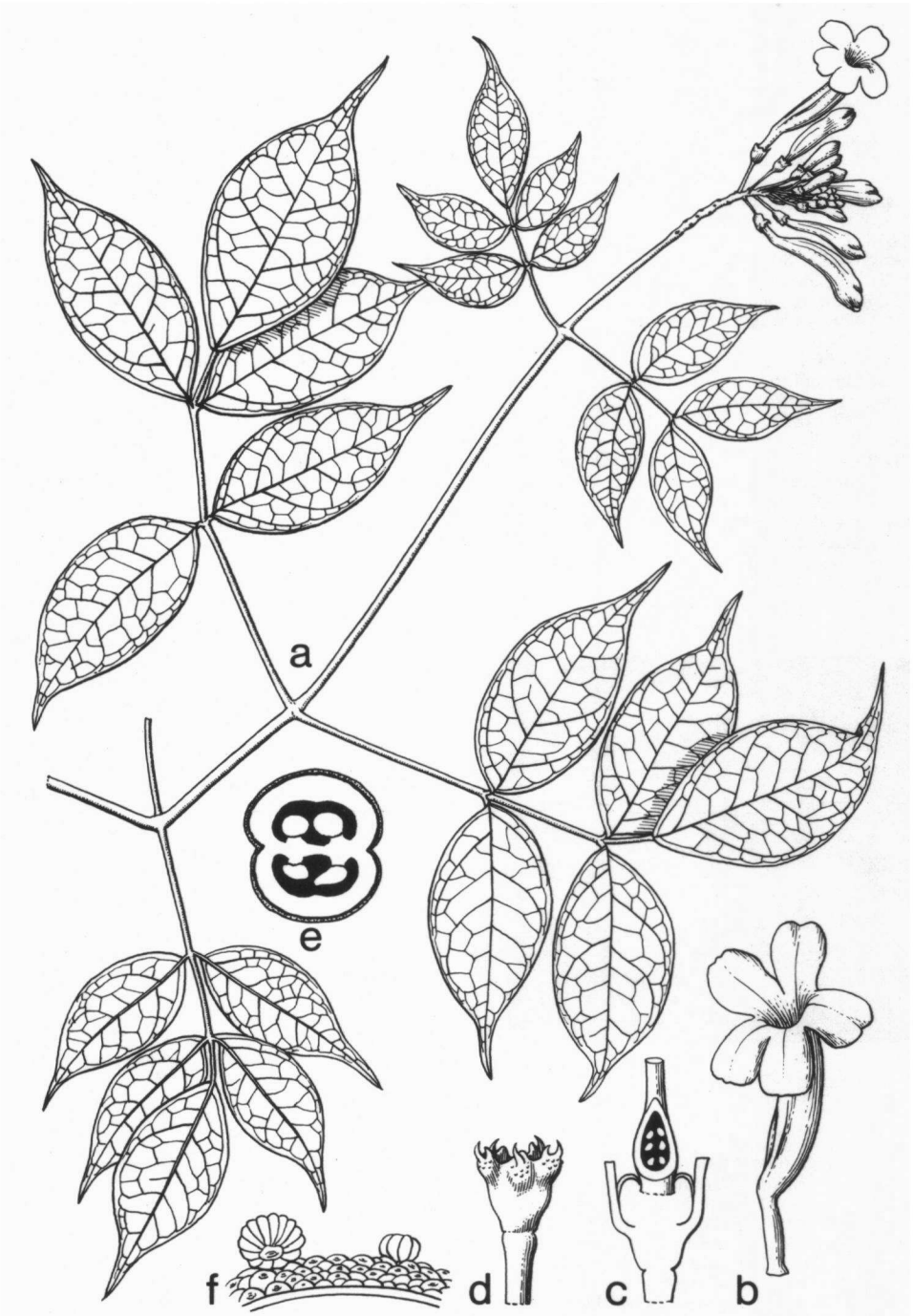


Fig. 4. *Hieris curtisii* (RIDL.) STEEN. a. Habit, × 1/2, b. corolla, nat. size, c. LS of ovary, disk and receptacle, × 2 1/2, d. calyx, × 2 1/2, e. CS of ovary, × 7 1/2, f. glands on ovary (HENDERSON *s.n.*).

Distr. SE. Asia (Upper Burma: S. Shan States; Thailand: N. & SE.), in *Malesia:* Borneo (Sabah, near Kudat; Sarawak, near Niah), SW. Java (Wijnkoops Bay). Fig. 3.

Ecol. Lowland rain-forests, even in Burma below 300 m.

Uses. TEYSMANN found it a beautiful ornamental; as far as nocturnally flowering plants can be. He could easily propagate it by marcottes. VAN HASSELT (*in sched.*) noted that in SW. Java crushed leaves are rubbed against head and stomach aches.

Vern. *Kakatjangan*, S, SW. Java.

Notes. *N. shanica* was distinguished by having glabrous anthers; these had in *N. brunfelsiiflora* been described and depicted as hairy to the base. This is, however, a lapsus: the base of the filaments and tube in the vicinity of the insertion is only dotted with small sessile granular glands. SANTISUK (*l.c.*) said that the pollen would be different from that of *N. shanica*, but I cannot accept this for specific distinction. The colour of *N. shanica* was described as white, but field data enumerated by SANTISUK mention also creamy white, buds purplish, and pale yellow flowers. Of *N. brunfelsiiflora* MIQUEL mentioned them to be pale pinkish 'tirant légèrement vers le jaune', more purplish to anthesis. BACKER said: corolla at first white, afterwards yellowish; tube apically suffused with red. I do not ascribe much importance to these faint colour variances, especially nocturnal flowers often discolour with age.

In comparing the scanty flowering material of both species it seems that in *N. shanica* the widening of the corolla tube starts lower than in *N. brunfelsiiflora*, but I can not accept this for specific distinction.

2. HIERIS

STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 279, f. 13. — **Fig. 4.**

Slender woody twiner. *Leaves* 1-pinnate, with (1–)2(–3) pairs of entire leaflets. *Racemes* (?axillary or) terminal. Pedicels bracteolate. *Flowers* scattered. *Calyx* cupular, articulated with the pedicel, short- or indistinctly 5-lobed, just below the margin with 5 spur-like, upcurved teeth at the base of each lobe, each tooth with a few glands on each side of its base. *Corolla* zygomorphic, the basal narrowed tube *c.* $^1/_3$ of its length, ± geniculate with the upper $^2/_3$ which is widened, flattened, and gently curved; lobes subequal, suborbicular, finely capitate-glandular, papillose-hairy outside at base. *Stamens* 4, didynamous, inserted at the end of the basal tube, included, 5th rudimentary; anthers connivent in pairs, divaricate, connective apiculate. Disk entire, pulvinate-annular, fleshy. *Ovary* ovate, subterete, with 2 grooves, microscopically glandular; ovules in ± two rows of 3–4 in each cell.

Distr. Monotypic. *Malesia:* Malaysia: Penang I. (near village on north coast).

Taxon. Outstanding by the few ovules and the geniculate tube of the corolla. The structure of the inflorescence seems to be racemose though flowers are articulated.

Notes. Unfortunately the fruit and seed of this most interesting plant is unknown; from the cross-section of the ovary one might assume it to belong to *tribe Bignonieae* as the grooves of the ovary correspond with the edges of the septum, while furthermore the calyx structure is a replica of that of *Nyctocalos*, with which genus it seems closest related. In *Nyctocalos*, however, there is a very large number of ovules in each cell, which are very few in the Penang plant, like in the South American genus *Memora*. By the pinnate leaves *Hieris* shows resemblance with *Nyctocalos pinnata* STEEN. from Yunnan, which is unfortunately only known in fruit, but has abundant seeds in each cell.

Mr J. MULLER told me (Febr. 1975) that the pollen of *Hieris* is not in the least resembling the showy pattern of *Nyctocalos*.

1. Hieris curtisii (RIDL.) STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 280, f. 13. — *Tecoma curtisii* RIDL. J. As. Soc. Str. Br. 49 (1908) 26. — *Pandorea curtisii* RIDL. Fl. Mal. Pen. 2 (1923) 553, f. 125; STEEN. Nova Guinea 14 (1927) 301; Thesis (1927) 846, f. 4(2). — **Fig. 4.**

Glabrous. Twigs terete, with very many small lenticels; nodes with glands and a dark transversal line. *Leaves* (10–)15–20 cm long; petiole $2^1/_2$–8 cm; rachis *c.* 4–5 cm; petiolules of lower pair of leaflets 4–12 mm, of upper pair (0–)1–2 mm. Leaflets herbaceous, slightly unequal-sided, ovate-oblong, long-acuminate, 5–8 by 2–3 cm; nerves 4–5 pairs; undersurface with scattered, small, rimmed-crateriform glands, upper surface with microscopical pitted-punctate glands. Rachis rather densely flowered, microscopically puberulous, 2–7 cm; peduncle 2 cm, with barren bracts. Bracts linear, 2 mm. Pedicels thin, 5–8 mm, with 1–2 minute bracteoles in the lower half. *Calyx* 6 mm, purplish, bluntly 5-ribbed, inside with dark red microscopical capitate-glandular hairs. *Corolla* $4^1/_2$–5 cm, tube yellow, lobes whitish turning pale lilac, *c.* 1 cm ∅, 2 upper recurved, 3 lower erect; outside on transition of tube and lobes scattered, rather large, brown red glands; basal tube $1^1/_2$ cm by 2 mm,

near the insertion of the stamens scattered microscopical red-tipped, capitate-glandular hairs as in the calyx tube. *Filaments* glabrous, 12 and 14 mm; rudiment 5 mm, with reflexed apex; anther-cells $2^1/_2$ mm, connective appendage linear, 1 mm. *Ovary* elliptic $1^1/_2$ by 1 mm; style 2 cm; stigmatic lobes elliptic, $1^1/_2$ mm.

Distr. *Malesia:* Penang I., see above.

Ecol. Not well noted, 3 collections, all from 1898–1902; *fl.* June, July, Nov., and a cultivated specimen in Hort. Sing., Lawn 0, in Febr.

3. OROXYLUM

VENT. Dec. Gen. Nov. (1808) 8; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 225 ('*Oroxylon*'), *l.c.* 212 *in clavi*; STEEN. Thesis (1927) 816; Bull. Jard. Bot. Btzg III, 10 (1928) 181. — *Calosanthes* BL. Bijdr. (1826) 760; DC. Prod. 9 (1845) 177; BUREAU, Mon. (1864) 45, t. 9. — *Hippoxylon* RAFIN. Sylv. Tellur. (1838) 78, *nom. illeg.* — **Fig. 5, 7.**

Glabrous tree, robust in all its parts. *Leaves* 2–3(–4)-pinnate, all nodes with in sicco shrinking articulations; leaflets entire. *Flowers* very large, fetid, nocturnal, in large terminal racemes (by exception in a thyrse). *Calyx* persistent, not articulated, coriaceous, closed in bud, with a fine apical pore, later opening campanulate, ± entire. *Corolla* funnel-shaped, lobes 5, subequal, imbricate in bud. *Stamens* 5, subequal, all fertile; anthers 2-celled, cells free, ± parallel. *Ovary* with ∞ rows of ovules in both cells. *Capsule* flat, very large, sword-shaped, linear; dissepiment flat, coriaceous. *Seeds* large in ∞ rows; insertion linear, 1 cm wide.

Distr. Probably monotypic. From Ceylon, the Deccan and Himalayas through SE. Asia (also in S. China: Yunnan, Kwangsi, Setchuan, Kweichou) and *Malesia* eastwards to the Philippines, Celebes, and Timor. Fig. 6.

Ecol. A characteristic, short-lived nomad tree, nowhere gregarious, not in mature rain-forest but always in openings, secondary growths and thickets, rather indifferent to climate (also in teak forest under seasonal conditions) and soils, mostly below 1000 m, but in S. China up to 1375 m (HANDEL-MAZZETTI).

Taxon. A second species has been described, raised from seed, collected by A. HENRY in Yunnan, in 1889, in the Arnold Arboretum, and named *O. flavum* REHDER (in Sargent, Trees & Shrubs 1, 1904, 193, t. 92). REHDER discriminated this from *O. indicum* chiefly by the sulphur yellow colour of the nearly symmetrical flowers, the plain not toothed or crisped corolla lobes, the splitting calyx, and the oblong leaflets.

Several of these characters are not valid, especially if we take into consideration that REHDER's plant was an unbranched sapling of 3 m high. In such saplings the leaves are always somewhat longer and thinner. The sulphur-yellow corolla is also rarely found in *O. indicum* from where I described it (1928) as *var. citrinum* STEEN. on a cultivated specimen at Bogor so annotated by J. J. SMITH (C.H.B. XV.K.B.IX–11). The calyx is indeed different from that in *O. indicum*, in being thinner and having 5 faint ribs, but it is lobed by tearing, and this is also sometimes found in fruiting specimens of *O. indicum*. The corolla in *O. flavum* is also regular and somewhat smaller than usual but an examination of the type showed an exactly similar occurrence of hairs at the anther bases, the patelliform glands outside and the granular-glandular hairs inside. Remains the plain, entire corolla lobes, and an other character figured by REHDER but not mentioned by him, *viz* that the inflorescence is not a raceme, but a thyrse, with the lower stalks 5-flowered in double triads and the upper ones in simple triads, a situation never recorded or seen by me in *O. indicum*. I cannot well account for these two differences, but they could be due to cultivation; in our experience tropical plants in hothouses often deviate from those in the wild, certainly in first-flowering saplings.

1. Oroxylum indicum (L.) KURZ, Fl. Burma 2 (1877) 237; CLARKE, Fl. Br. Ind. 4 (1884) 378; K. & V. Bijdr. Booms. 1 (1894) 66, Atlas 2 (1914) t. 358; RIDL. Fl. Mal. Pen. 2 (1923) 548; MERR. En. Philip. 3 (1923) 444; STEEN. Thesis (1927) 816; Bull. Jard. Bot. Btzg III, 10 (1928) 181, *incl. var. citrinum* STEEN. *l.c.* 184; OCHSE & BAKH. Ind. Groent. (1931) 77, f. 46; HAND.-MAZZ. Symb. Sin. 7 (1936) 888; CORNER, Ways. Trees (1940) 166, Atlas t. 29. — *Palega-pajaneli* RHEEDE, Hort. Mal. 1 (1686) 77, t. 43. — *Bignonia indica var.* α LINNÉ, Sp. Pl. (1753) 625; ROXB. Fl. Ind. ed. Carey 3 (1832) 110. — *Bignonia pentandra* LOUR. Fl. Coch. 2 (1790) 379. —*Bignonia tripinnata* NORONHA, Verh. Bat. Gen. 5 (1790) art. 4, p. 8, *nomen.* — *Spathodea indica* PERS. Syn. 2 (1807) 273. — *Calosanthes indica* BL. Bijdr. (1826) 760; WIGHT, Ic. Pl. 4 (1850) t. 1337–1338; MIQ. Fl. Ind. Bat. 2 (1858) 752; BUREAU, Mon. (1864) 45, t. 9. — *Bignonia quadripinnata* BLANCO, Fl. Filip. (1837) 499, ed. 3, t. 219. —

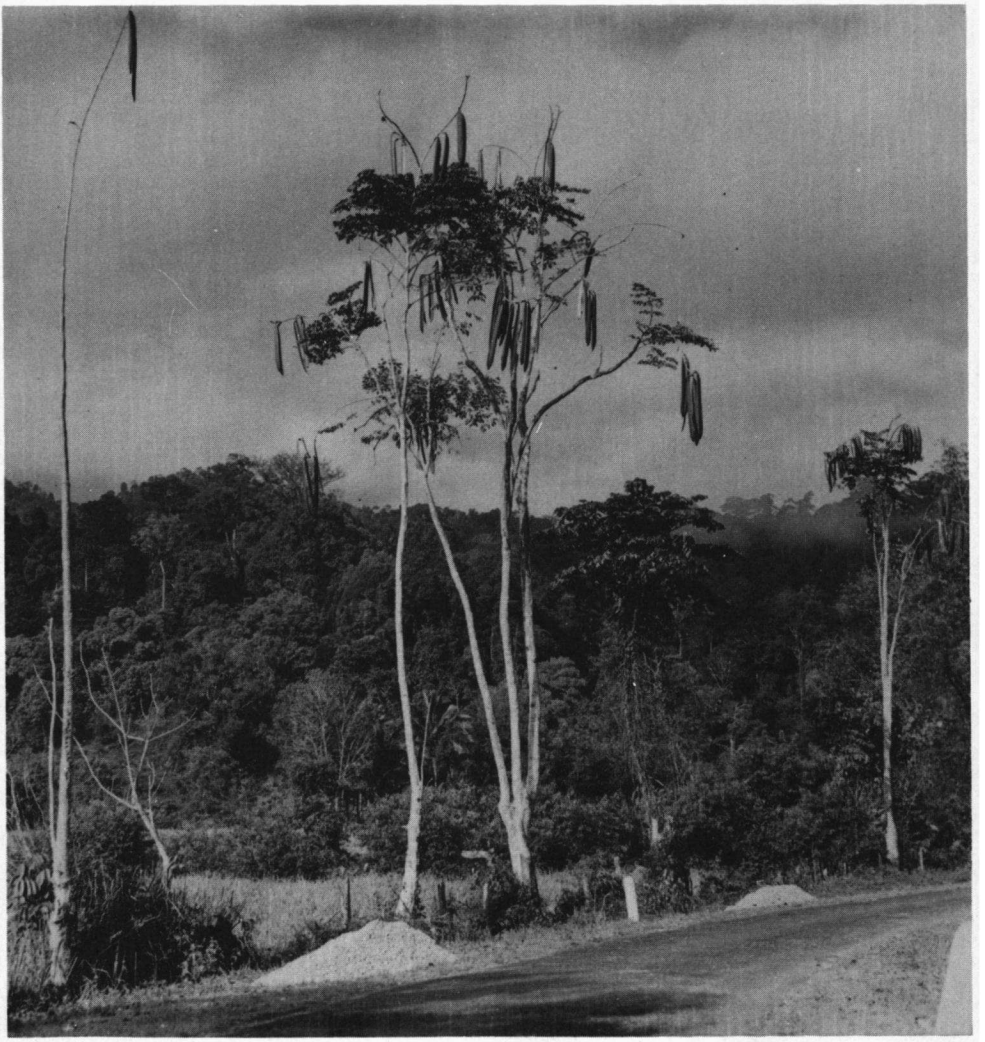


Fig. 5. *Oroxylum indicum* (L.) KURZ, the 'midnight horror'. Pole on left is a sapling that has flowered and fruited and is temporarily leafless. Different branches of the same tree may be in leaf, flower or fruit at the same time (Tg. Bukit, Sg. Sedili Ketchil, photogr. CORNER, June 1934).

Hippoxylon indicum RAFIN. Sylv. Tellur. (1838) 78, *nom. illeg.* — *Arthrophyllum ceylanicum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 27. — *Arthrophyllum reticulatum* BL. *ex* MIQ. *l.c.*, *et corr.* 318. — Fig. 5, 7.

Smallish, glabrous, sparingly branched, semi-deciduous tree, 6–20(–27) m; trunk 10–40 cm ∅, with grey bark and large leaf-scars; twigs thick, (as the trunk at least at apex) pithy, later hollow, lenticellate, as the leaf-rachis. *Leaves* tufted at twig-ends, with a long petiole, $^1/_2$–2 m; leaflets long petioled, ovate to oblong, acuminate, 4–11(–15) by 3–9 cm, cuneate, rounded or reniform at the triplinerved mostly oblique base, underneath distinctly reticulate-veined, with some scattered gland fields near the axils of the nerves and scattered, microscopical scales. Innovations of leaves and racemes viscid. *Racemes* terminal, erect, $^1/_4$–$1^1/_2$ m long, pith of twig-apex, peduncle and rachis partitioned. Pedicels long, with a few bracteoles in lower part, 2–4 cm. *Calyx* coriaceous, becoming almost woody in fruit, containing water in bud, truncate or irregularly shallow lobed by tearing, campanulate, brown or dirty-violet, 2–4 by $1^1/_2$–2 cm. *Corolla* reddish purple to liver-brown to dirty violet outside, dirty yellowish to pinkish inside, with a foxy stench, 7–10 cm long, the lobes subequal, in young buds strongly folded into a massive apex, ±

crisped or undulate-crenate, in flower patent to ± reflexed, outside with scattered patelliform glands, the lobes inside with dense, almost sessile capitate gland-hairs; basal tube wide, widened to base, *c.* $1^1/_2$ cm. *Stamens* inserted in throat, their base long hairy. *Style* 4–6 cm, dark violet as the subentire, large disk. *Capsule* pendent, 45–120 by 6–10 cm, valves flat, almost woody, finally black. *Seeds* incl. wings 5–9 by $2^1/_2$–4 cm.

Distr. As the genus. Fig. 6.

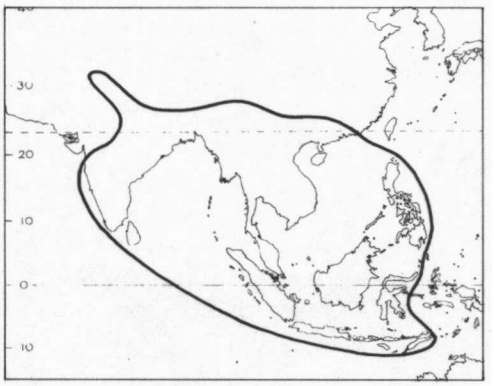


Fig. 6. Range of the genus *Oroxylum* VENT.

Ecol. As the genus. As a consequence of its short-lived, short-sized nomad habit relatively rare in tracts with largely high primary forest, *e.g.* Borneo. In Malaya chiefly by villages and by ricefields (CORNER). Also not particularly common in open but seasonally very dry tracts, such as the Lesser Sunda Is. and in teak forest largely confined to mixed forest stands. *Fl.* Jan.–Dec., according to KOORDERS in Java at the start of the dry season; *fr.* July–May, the fruit remaining during the dry season on often leafless stems.

CORNER (*l.c.*) gave a lively account of his observations on this grotesque treelet. He remarked: "that each leaf develops as a unit and when it withers it breaks up gradually in regular order from the tip to the base: the leaflets fall off singly and the main stalk and its side-stalks break up at the joints: the bits accumulate round the base of the trunk like a collection of limb-bones, so that we may call it the 'Broken Bones Plant'. The leaves are crowded near the end of the stem or its branches, and saplings, which remain unbranched until after their first flowering at a height of some 15 ft., look like gigantic umbrellas. When the saplings flower, the inflorescence develops from the apical bud and therefore further upward growth of the main stem is prevented. When the inflorescence has finished flowering, the leaves below it fall off and the leafless stem is left as a pole with a few sabre-like pods dangling from its extremity: wherefore, we may call it the 'Tree of Damocles'. Then, after 3–4 weeks in a leafless state, one or more lateral buds on the stem break out and grow into side-branches which, in due course, flower, fruit, shed their leaves and branch in their turn: and, thus, the big trees are constructed sympodially with open irregular crown and a few lanky ascending limbs. Each branch seems to flower independently of the others so that flowers, fruits and growing twigs may be found on the same tree."

Flower biology. The flowers are nocturnal; on each raceme 1–2 flowers open on one night. According to CORNER (*l.c.*): "The corolla begins to open about 10 p.m., when the tumid, wrinkled lips part and the harsh odour escapes from them. By midnight, the lurid mouth gapes widely and is filled with stink. Before sunrise the corolla is detached and slips off over the long style. The flowers are pollinated by bats which are attracted by the smell and, holding to the fleshy corolla with the claws on their wings, thrust their noses into its throat: scratches, as of bats, can be seen on the fallen flowers of the 'Midnight Horror' next morning." Fig. 7.

Dispersal. The gauzy seeds slip out of the opened pods and flit away on the breeze with the jerky motion of a butterfly: so in noon-tide, we may call the tree the 'Midday Marvel' (CORNER, *l.c.*).

Uses. Popular with the Sundanese as a vegetable (*lalab*), fresh young leaves and flowers; even unripe capsule valves are eaten after being cooked (HASSKARL).

In Bawean I. flowers are used against inflammation of the eyes. The bitter bark is chewed in Java for depurative purpose, especially after delivery.

In Sarawak used for dyeing rattan of black shiny baskets.

In West Java (Priangan) local people are convinced that the tree is a protection of the house against thieves, a superstition probably derived from the sword-like shape of the capsules.

Vern. *Midnight horror*, E; Malaya: (*beka*) *kampong*, *blalai*, *blonglai* (*kaya*), *bulai kaju*, *kain*, *merlai*, *poko bulai*, Malacca; Sumatra: *bolai*, Minangkabau, *habreng*, Atjeh, (*ka*)*kapung*, M, S. Sum., *měnglèo*, Simalur I., *abang-abang*, Asahan; Borneo: *gimurai*, Sarawak, Bidayan name; Java: *ki tongtorang*, *pongpor*(*r*)*ang*, S, (*kayu*) *lanang*, *mungli*, *wongli*, *wungli*, J, *pedangan*, Japara, *dělěg*, *kadjěn djalěr*, *kěok*, *padangan*, *raon*, J (all once noted), *bunglo*, *punglo*, Md; *h. lema kaba*, *kowa*, Flores; Celebes: *buli*, Bantaeng, *pohon padang*, Manado; *karu kadang*, *kayu*, Kutai; Philippines: *balilang-uak*, *pingka-pingka*, *p.-pinkáhan*, *taghilau*, Tag., *abang-abang*, P.Bis., *abong-abong*, Bis., *sakayan-bakus*, Tagb., *balay-uak*, *bunglui*, Sul., *baliuag*, *bungoi*, C.Bis., *banloi*, Sub., *barañgau*, *kamkampilan*, Ilk., *kampilan*, Neg., *maidbaid*, Bik.

Fig. 7. *Oroxylum indicum* (L.) KURZ. a. Top of raceme with two open flowers, × 1/2, b. bat arriving on a flower, c. landed bat on a flower sucking honey (Old Bot. Garden, Univ. Malaya, Kuala Lumpur, photogr. SOEPADMO, Sept. 1973, 9.30 p.m.).

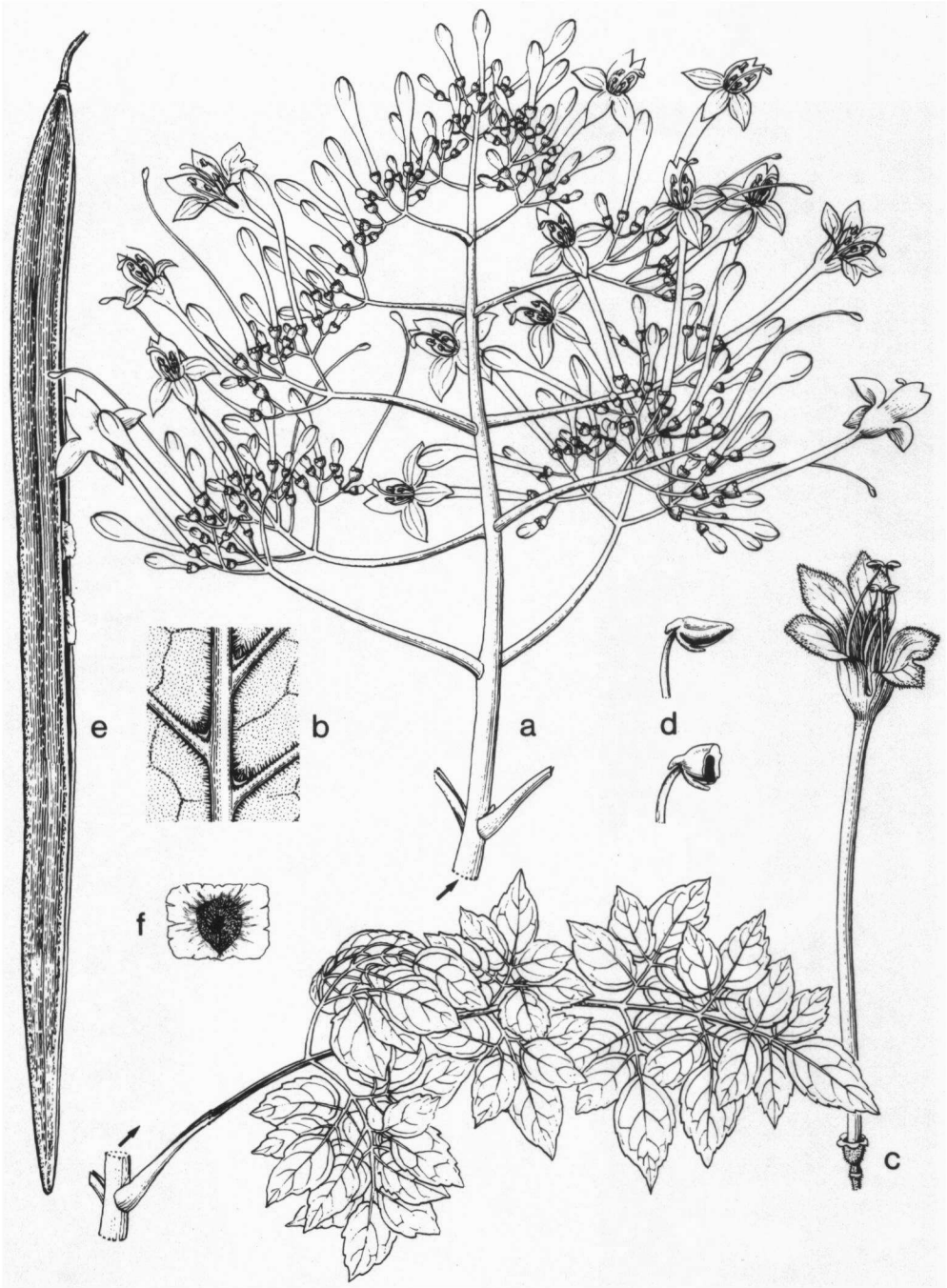


Fig. 8. *Millingtonia hortensis* L. *f.* a. Habit, × 1/2, b. detail of underside of leaflet, showing domatia, × 5, c. flower, nat. size, d. anthers, one in CS, e. capsule, × 1/2, f. seed, nat. size (*a* after WALLICH, *c–d* after BUREAU, b, *e–f* SPANOGHE *s.n.* TIMOR).

4. MILLINGTONIA

LINNÉ *f.* Suppl. (1781) 45, 291, *non* DONN, 1807, *nec* ROXB. 1820; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 226, f. 89 j–k; STEEN. Thesis (1927) 825; Bull. Jard. Bot. Btzg III, 10 (1928) 186. — *Nevrilis* RAFIN. Sylv. Tellur. (1838) 138, *nom. illeg.* — **Fig. 8.**

Medium-sized evergreen or deciduous tree with corky bark. *Leaves* 2–3-pinnate, with domatia. Thyrses lax, ∞-flowered, terminal. *Flowers* white, fragrant, nocturnal. *Calyx* small, truncate-campanulate, ± 5-lobed, persistent. *Corolla* salver-shaped, glabrous, with a very long, slender, basal tube at apex widening towards the limb, limb at base short funnel-shaped, zygomorphic (± 2-lipped), 5-lobed, imbricate in bud. *Stamens* 4, didynamous, glabrous, inserted at the base of the widened part of the tube (throat), shortly exserted, no staminode; anthers with 1 fertile cell, the other spur-like, barren; connective dorsal, swollen. *Disk* cup-shaped, crenate. *Capsule* linear, compressed parallel to the septum, septicid-dehiscent, valves flat. *Seeds* ∞, thinly discoid, winged.

Distr. Monotypic. SE. Asia (India, Burma, Thailand, Indo-China, Yunnan) and *Malesia:* probably native, in E. Java, Madura and Kangean Is., Lesser Sunda Is. (Bali, Sumbawa, Sumba, Flores, Timor), and S. Celebes (SW. Peninsula; Muna I.), in many places also cultivated (Penang, Sumatra, Java, *etc.*) and in dry areas running wild, may be wild also in N. Malaya (Perlis and Kedah, CORNER, *l.c.*). Fig. 9.

Ecol. Lowland monsoon forest.

1. Millingtonia hortensis LINNÉ *f.* Suppl. (1781) 291; DECNE, Herb. Timor. (1835) 32; SPAN. Linnaea 15 (1841) 326; MIQ. Fl. Ind. Bat. 2 (1858) 753; BUREAU, Mon. (1864) 45, t. 8; F.-VILL. Nov. App. (1880) 150, cult. Manila; CLARKE, Fl. Br. Ind. 4 (1884) 377; K. & V. Booms. Java 1 (1894) 65; STEEN. Thesis (1927) 826; Bull. Jard. Bot. Btzg III, 10 (1928) 187; CORNER, Ways. Trees (1940) 165; MERR. J. Arn. Arb. 25 (1944) 316; BACK. & BAKH. *f.* Fl. Java 2 (1965) 234. — *Bignonia suberosa* ROXB. Cor. Pl. 3 (1811) 11, t. 214, *nom. illeg.* — *Bignonia cicutaria* MART. Denkschr. K. Ak. Wiss. München 6, Kl. Math. Phys. (1820) 153, t. D. — *M. dubiosa* SPAN. in Hook. Comp. Bot. Mag. 1 (1835) 348, *nomen.* — *Nevrilis suberosa* RAFIN. Sylv. Tellur. (1838) 138, *nom. illeg.* — **Fig. 8.**

Evergreen (or deciduous?) tree, 5–25 m, to 30 cm ⌀; bark corky, very rough, cracking; twigs lenticellate. Mature *leaves* herbaceous, nearly glabrous, 3–5-jugate, lower pairs pinnate, up to 1 m; leaflets ovate-lanceolate, acuminate, sinuate or crenate, or entire, $2^1/_2$–6 by $1^1/_2$–3 cm; domatia haired. *Thyrse* erect, 10–40 cm, puberulous, flowers fragrant, only few open at a time. *Calyx* 2–4 mm, teeth short, broad, obtuse, margin revolute. *Corolla* tube 6–8 cm by 2 mm, widened to mouth, limb 4–5 cm ⌀, lobes ovate, acute, outside with crateriform glands, *c.* $1^1/_2$ cm. *Filaments* *c.* 10 and 14 mm long; anthers 2 mm, with a small appendage at the base. Style to 8 cm long. Stigmatic lobes ovate-acute, $1^1/_2$ mm. *Capsule* 30–35 by $1^1/_2$–$1^3/_4$ cm. *Seeds* thin-discoid, $1^1/_2$–$3^1/_2$ by 1–$1^1/_2$ cm including the wings.

Distr. As the genus. Fig. 9.

Ecol. A characteristic tree of regions subject to annual drought ('monsoon flora'), companion of teak, fire-resistant by its thick corky bark and profuse capacity of suckering from roots, below 750 m alt. In Timor common in *Ziziphus* stands (MEIJER DREES). *Fl.* Jan.–Sept., mostly June.

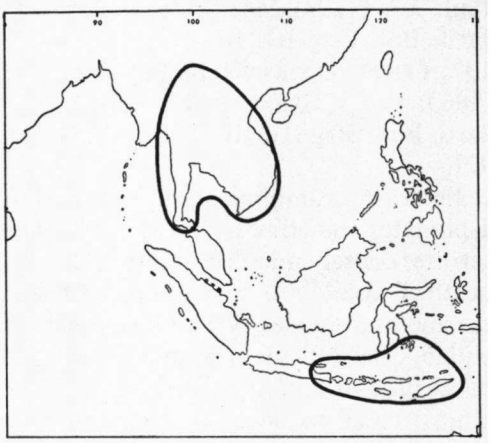


Fig. 9. Range of *Millingtonia* L. *f.*; delimitation in Asia is slightly arbitrary.

Father SCHMUTZ reported that it is in Flores not deciduous; flowers appear at the end of the dry season, before the first rains set in.

Uses. The soft, even-grained timber was sometimes advertized for tea-boxes but is not of high quality. Tree sometimes used for parks or roadsides, leaves as a poor substitute of opium in cigarettes, sometimes received from the opium factory in Java under the vernacular name *gendjè*.

Vern. *Indian cork tree*, E, *kurkboom*, D, *kahombu*, M (Sum.), *amfiunan*, *sĕkar pĕtak*, *sĕkar putih*, J, *karpoti*, Kangean, *kanongoh*, Bali, *kĕtangar*, Sumba, *takah*, Dawang lang., Timor, *ai katong inggar*, *takah*, *toka hau*, Timor, *ai kakassa*, Tetun lang., Port. Timor, *katangka*, Bug., Makassar, *kaulolo*, Muna I.

Notes. From Sumba the flowers have once been noted to be red (IBOET 264), never confirmed.

MEIJER DREES (Comm. For. Res. Inst. Bogor 33, 1951, 39) recorded that *Millingtonia* is deciduous in the driest regions of Timor, but the scant field notes do not confirm this.

Tribe 2. Tecomeae

ENDL. Gen. Pl. (1839) 711; FENZL, Denkschr. K. Bay. Bot. Ges. Regensburg 3 (1841) 261; B. & H. Gen. Pl. 2 (1876) 1029; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 209; BUREAU, Fl. Bras. 8, 2 (1897) 300. — *Subtribe Catalpeae* DC. Rév. Bign., Bibl. Univ. Genève (1838) 123; Prod. 9 (1845) 203.

Capsule loculicid, the septum attached transverse to the valves. Mostly trees or shrubs, rarely lianas, by exception with tendrils.

5. TECOMA

JUSS. Gen. (1789) 139; REHDER, Mitt. Deut. Dendr. Ges. 22 (1913) 262; BRITTON, Bull. Torr. Bot. Club 42 (1915) 372; URBAN in Fedde, Rep. 14 (1916) 313; MELCHIOR, Ber. Deut. Bot. Ges. 59 (1941) 18–31. — *Stenolobium* D.DON, Edinb. Phil. J. 9 (1823) 264; SEEM. J. Bot. 1 (1863) 87; STEEN. Thesis (1927) 964; Bull. Jard. Bot. Btzg III, 10 (1928) 217. — *Tecomaria* SPACH, Hist. Nat. Vég. 9 (1840) 137; FENZL, Denkschr. K. Bay. Bot. Ges. Regensburg 3 (1841) 266; SEEM. J. Bot. 1 (1863) 19–23; SPRAGUE, Fl. Cap. 4, 2 (1904) 448; STEEN. Thesis (1927) 831; Bull. Jard. Bot. Btzg III, 10 (1928) 193; BRUMMITT, Bull. Jard. Bot. Nat. Belg. 44 (1974) 421.

Erect or scrambling shrubs or small trees. No gland fields at the nodes. *Leaves* 1-pinnate, sometimes 1-jugate, or more rarely simple; leaf or leaflets incised or serrate, densely microscopically glandular-punctate and with hairy domatia underneath. Pedicel with minute bracteoles. *Flowers* in terminal racemes or more often raceme-like thyrses, yellow, orangish or scarlet. *Calyx* cupular or campanulate, with 5, often apiculate deltoid lobes, glands scattered. *Corolla* tubular, with a short basal tube, funnel-shaped, ± straight or ± curved, widened to the mouth, lobes almost equal to unequal, imbricate in bud, minutely ciliate. *Stamens* 4, didynamous, exserted or included; anther-cells divergent, often finally standing out transversally, free or partly connate, sometimes hairy; 5th rudimentary. *Disk* cupular-pulvinate to shallowly cup-shaped. *Ovary* narrow cylindric or oblong, compressed, lepidote; ovules 2–4-seriate in each cell. *Capsule* linear, ± compressed parallel to septum; valves smooth. *Seeds* hyaline-winged all round, insertion punctiform.

Distr. Some dozen species in the New World, from extreme S. Arizona and S. Florida to northern Argentina, especially in the Andes, and one species in southern Africa. Some species widely cultivated in the tropics and subtropics and one of these locally naturalized in *Malesia*.

Taxon. I can see not sufficient reason to keep *Tecomaria* generically apart from *Tecoma*. It often is said to differ by the exserted stamens and orange-red to scarlet flowers, but it has appeared that among the many taxa of South American *Tecoma* (*Stenolobium*) there are taxa with exserted stamens and in some the flowers are orangish. Inadvertently SEEMANN (J. Bot. 1, 1863, 19–23) also united them, but curiously later distinguished *Stenolobium* (*l.c.* 87).

According to SPRAGUE (Fl. Cap. 4, 2, 1904, 448) there are only two valid characters, *viz* the number of the rows of ovules in each cell (2 in *Tecoma*, 4 in *Tecomaria*) and the anthers. As to the first character, in a dozen American genera this number varies, from 2–4, 2–6 and in *Tabebuia* even from 2-many; its value seems therefore to be rather low. The second character holds: in American *Tecoma* the anther-cells are completely free causing them in full anthesis to stand often perpendicular to the filament; in *Tecomaria* they are connate in the upper 3rd or 4th part, so that they can not diverge so widely.

The intimate relationship between *Tecoma* and *Tecomaria* is emphasized by a reputed fertile hybrid, × *Tecoma smithii* W. WATSON (see p. 118), between *Tecoma velutina* and *Tecomaria capensis*.

As the differences between the genera coincide with the geographical disjunction I am prepared to distinguish them at sectional level and refer *Tecomaria* to *Tecoma sect. Tecomaria* (SPACH) ENDL. Gen. Pl. (1839) 71.

From southern Africa 3 spp. were described but F. WHITE (For. Fl. N. Rhod. 1962, 380) and BRUMMITT (Bull. Jard. Bot. Nat. Belg. 44, 1974, 419) distinguish only one.

In South America a thorough revision probably will also show reduction to fewer variable and raciated species.

1. Tecoma stans (L.) H.B.K. Nov. Gen. Sp. 3 (1819) 144; DC. Prod. 9 (1845) 224; F.-VILL. Nov. App. (1880) 151; MERR. Fl. Manila (1912) 428; JOHNSTON, Proc. Cal. Ac. Sc. IV, 12, 2 (1924) 1166; SANDWITH in Pulle, Fl. Surinam 4, 2 (1938) 79; CORNER, Ways. Trees (1940) 170, f. 44, pl. 159; BACK. & BAKH. *f.* Fl. Java 2 (1965) 539; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 958, f. 38, with full synonymy. — *Bignonia stans* LINNÉ, Sp. Pl. ed. 2 (1763) 871; JUSS. Gen. (1789) 139; RECHINGER, Denkschr. K. Ak. Wiss. Wien 85 (1911) 356. — *Stenolobium stans* SEEM. Ann. Mag. Nat. Hist. 10 (1862) 30; J. Bot. 1 (1863) 88, *incl. var. pinnata* SEEM. *type var.*; BUREAU, Mon. (1864) t. 13; MERR. En. Philip. 3 (1923) 444; STEEN. Thesis (1927) 905; Bull. Jard. Bot. Btzg III, 10 (1928) 218.

Shrub, up to *c.* 1–4 m. *Leaflets* 1–3 pairs (cult. sometimes 1-foliolate) lanceolate, acuminate, serrate, glabrous, but often along midrib laxly hairy, 3–10 by 1–4 cm, cuneate at the base, no proper petiolules; petiole 2–5 cm. *Racemes* glabrous, *c.* 5–15 cm. Pedicels 5–10 mm. *Calyx* campanulate, 5–7 mm, usually with some impressed plate-shaped glands in middle part or upper half, lobes short-ciliate. *Corolla* yellow, $3^1/_2$–5 cm, limb up to $3^1/_2$ cm ∅. *Stamens* included, anther-cells ± pilose. *Capsule* acute, often lenticellate, 10–22 by $^1/_2$–$^3/_4$ cm. *Seeds* (incl. wings) 2 by $^1/_2$ cm, inserted in two rows on the margins of the septum.

Distr. From Florida through Central and South America to N. Argentina, widely cultivated in the tropics, also in *Malesia*, and sometimes run wild, naturalized e.g. in Tahiti, the Society Is. (Raiatea), and the Marquesas (Nunuhiva), often together with tree ferns and *Gleichenia*.

Notes. Vegetatively a rather variable species. The normal form is with pinnate leaves, but sometimes there are 3-foliolate and even simple leaves intermixed in one sheet. In Tahiti the specimens have 5–6 pairs of leaflets. (This may be *var. multijugum* R. E. FRIES, Ark. Bot. 1, 1903, 401). In Mexico a sheet had almost entire leaflets (SUMICHRAST 1885). There is in America a form with underneath woolly-hairy leaflets: *T. stans var. velutina* DC. (*T. mollis* H.B.K.), but the density of the tomentum varies considerably in degree and I am not very much in favour to recognize this; this is also the opinion of STANDLEY (Trees, Shrubs Mexico, 1926, 1319).

JOHNSTON (J. Arn. Arb. 21, 1940, 264) said that in Mexico the normal-leaved form occurs in coastal regions, the incised-leaved form in inland places and the tomentose form south of these two, all three replacing, suggesting subspecific segregation.

It is rather peculiar that, though the normal-leaved form is widely cultivated throughout Malesia, the only naturalized one is a fairly constant form with deeply incised leaflets, which seems to be rather rare in the Americas.

var. **incisa** G. DON, Gen. Syst. 4 (1838) 224; J. K. MAHESWARI, Bull. Bot. Surv. India 3 (1961) 357. — *T. incisa* SWEET, Hort. Brit. ed. 1 (1827) 284, *nomen.* — *T. stans var. apiifolium* DC. Prod. 9 (1845) 224; BACK. & BAKH. *f.* Fl. Java 2 (1965) 539. — *Stenolobium stans var. apiifolium* SEEM. J. Bot. 1 (1863) 89; STEEN. Thesis (1927) 906; Bull. Jard. Bot. Btzg III, 10 (1928) 218. — ? *Stenolobium incisum* ROSE & STANDLEY, Contr. U.S. Nat. Herb. 16 (1913) 174. — ? *T. stans var. angustatum* REHDER, Mitt. Deut. Dendr. Ges. 24 (1915) 227. — *T. incisa* (ROSE & STANDLEY) JOHNSTON, J. Arn. Arb. 21 (1940) 264.

Leaflets (2–3–)4(–5) pairs, very coarsely toothed to deeply pinnately incised, not rarely to the midrib, making acute-triangular lobing, 5–10 by 1–$2^1/_2$ cm (incl. teeth).

Distr. Central America, widely cultivated in the tropics, also in *Malesia:* naturalized in Timor, Ternate, and SW. New Guinea (near Uta); also naturalized in the Concan and N. Kanara (TALBOT).

Ecol. In Timor (Kupang and Baucau Plateau) characteristic for red calcareous soils and limestone, in the latter place gregarious in shrubberies, flowering already at an early age; 5–500 m. *Fl.* mostly Aug.–Sept. (Oct.), *fr.* Oct.–Dec.

Vern. *Yellow bells*, E, Malaya; *ai funan*, Tètu lang., E. Timor; *dufa dufa*, Ternate.

6. DEPLANCHEA

VIEILLARD, Bull. Soc. Bot. Normandie 7 (1862) 96; BUREAU, Bull. Soc. Bot. Fr. 9 (1862) 164; BEAUVIS. Gen. Montrouz. (1901) 90; STEEN. Thesis (1927) 906, f. 8–9;

Bull. Jard. Bot. Btzg III, 10 (1928) 218, f. 2–3; HEINE, Fl. Nouv.-Caléd. 7 (1976) 71, f. 16–17. — *Diplanthera* BANKS & SOL. *ex* R.BR. Prod. (1810) 448, *non* THOUARS, 1806, *nec* SCHRANK, 1819; SCHEFFER, Nat. Tijd. N. I. 31 (1870) 332; B. & H. Gen. Pl. 2 (1876) 1048; STEEN. Nova Guinea 14 (1927) 293. — *Bulweria* F.v.M. Fragm. 4 (1864) 147. — **Fig. 10, 12–13.**

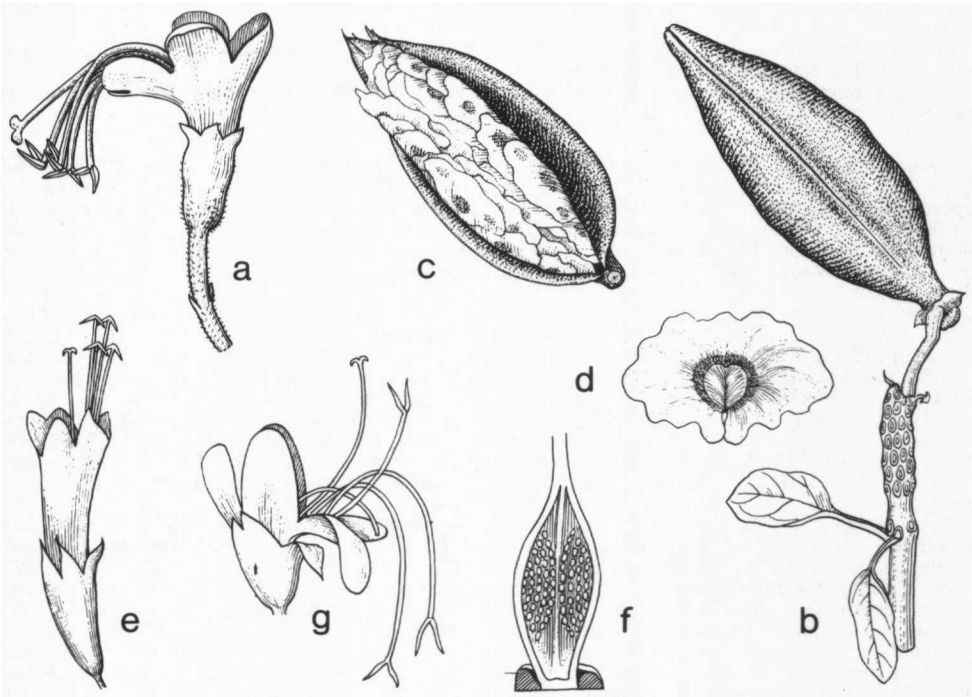


Fig. 10. *Deplanchea bancana* (SCHEFFER) STEEN. a. Flower, b. fruit on thickened rachis, c. opened capsule, seeds covering the septum, d. seed, all nat. size. — *D. glabra* (STEEN.) STEEN. e. Flower, nat. size, f. LS of ovary, enlarged. — *D. tetraphylla* (R.BR.) F.v.M. g. FLOWER, nat. size (*a–d* C.H.B. XIII-J–65, *e-f* GJELLERUP 583, *g* after VAN STEENIS, 1927).

Trees, with thick, pithy branches, robust in all parts. *Leaves* simple, in whorls of 3–4, ± tufted to end of branches, entire, at base above with a few large crateriform or saucer-shaped glands, underneath often fine-punctiform dotted and sometimes with scattered larger crateriform glands; glabrous or with a yellow indument of simple hairs. *Thyrses* terminal, erect, a thick short rachis with crowded, horizontal, long-stalked triads or twice-forked triads. *Flowers* erect, showy, yellow, stalked. *Calyx* on a 2–3 mm high, obconical, solid hypanthium, articulate with the pedicel, closed in bud, with short lobes hairy at tip, in anthesis with 5 rather regular, acute lobes or tearing into 2–5 unequal, irregular lobes, inside fine-glandular, outside not rarely with few large crateriform glands, tip penicellate. *Corolla* imbricate in bud, lobes ciliate, zygomorphous to degree, hardly with a distinct basal tube, tube just or far exceeding the calyx. *Stamens* 4, didynamous, exserted, rarely a 5th rudiment, ± erect or recurved to one side, together with a style inserted shortly

above the base of tube, base capitate-glandular hairy; filaments ribbon-shaped; anther-cells free, wide-divergent. *Disk* annular, crenate. *Ovary* subsessile, glabrous, 2-celled, each cell with 2 closely placed placentas; style very long; stigma with 2 narrow lobes. Ovules ∞, in many rows. *Capsule* short-stalked, ellipsoid, with hard, boat-shaped valves, erect; septum flattened, lens-shaped, thick. *Seeds* very many, roundish, very thin hyaline-winged all around, punctate-inserted.

Distr. Probably 5 *spp.*, 1 in West Malesia, 2 in New Guinea (of which 1 *sp.* also in N. Australia and the other also in E. Borneo and Central Celebes), and 2 in New Caledonia. Fig. 11.

Ecol. Rain-forests with preference for light and secondary forest, kerangas forest, others in woodland savannahs and invading grasslands, from sea-level to 1000 m.

Notes. The much increased collections gave a better understanding in specific delimitation and variability of characters, leading to reduction in the number of species. Especially the hairiness occurs to degree and is occasionally deviating; in occasional specimens of *D. bancana* the calyx may possess dense long hairs inside the calyx. For this reason I have reduced *D. tubulosa* STEEN. and *D. coriacea* STEEN. The Australian *D. hirsuta* BAILEY I have reduced tentatively to *D. tetraphylla*; I believe it to be a juvenile form which accounts for its sinuate leaf margin and occurrence of deviating phyllotaxis, decussate or whorls of 3.

For brevity's sake the characters mentioned in the key are not repeated in the descriptions.

Specimens in fruit or in bud, or without corolla are difficult to identify.

Affinity. *Deplanchea* has no affinity to other Old World genera. BUREAU (Mon. 1864, 51) compared it with the genus *Delostoma* from Andine South America with which it shares several characteristic features: thick twigs, terminal inflorescences, simple leaves, and boat-shaped fruit valves. *Delostoma* differs in having the valves said to be unequal, one flat, one boat-shaped, and further by triplinerved leaves, a regular, dentate (sometimes 'double') stunted calyx, and pink or violet flowers.

KEY TO THE SPECIES

1. Corolla tubular, the tube ± twice as long as the calyx, straight or slightly curved. Stamens and style erect, ± straight in anthesis. Leaves in whorls of 3, underneath almost always very laxly hairy on midrib and nerves as is the petiole. Calyx lobes ± equal, corolla lobes *ditto* . . . . **3. D. glabra**
1. Corolla tube only for 2–5 mm exceeding the calyx, the limb distinctly zygomorphous, 2 lobes higher connate, patent and longer than the others. Stamens and style patent-curved over this lobe or recurved. Leaves in whorls of 3–4.
   2. Branches of the thyrse triads, or flowers solitary. Pedicels $1^1/_4$–$2^1/_2$ cm long. Bud ± cylindric in shape, rarely pear-shaped, often with 5 faint ribs below the lobes. Calyx with a few to several large crateriform glands, the lobes ± equal, in anthesis *c.* $^1/_3$–$^1/_4$ as long as the tube. Corolla tube almost cylindric, *c.* 10 by 5 mm. Stamens *c.* 3–$3^1/_2$ cm. Leaves in whorls of 3 (by exception 4), hairy underneath or glabrous . . . . . **1. D. bancana**
   2. Branches of the inflorescence often 2(–3) times forked. Pedicels $^1/_2$–2 cm. Buds pear- or spindle-shaped, or obovoid, smooth. Calyx without crateriform glands, distinctly widened ± campanulate in anthesis, the lobes mostly unequally tearing, sometimes only 2 or 3, $^1/_2$–$^2/_3$ as long as the tube in anthesis. Corolla tube widened almost from the base, *c.* 1–$1^1/_4$ cm high, $1^1/_2$ cm wide at the mouth in anthesis. Stamens 4–$4^1/_2$ cm. Leaves in whorls of (3–)4, always hairy underneath . . . . **2. D. tetraphylla**

1. Deplanchea bancana (SCHEFFER) STEEN. Thesis (1927) 921, *incl. var. glabra* STEEN. *l.c.* 923; Bull. Jard. Bot. Btzg III, 10 (1928) 221, f. 2b, 3. — *Diplanthera bancana* SCHEFFER, Nat. Tijd. N. I. 31 (1870) 334; HASSK. Flora 53 (1870) 219; CLARKE, Fl. Br. Ind. 4 (1884) 385; RIDL. Fl. Mal. Pen. 2 (1923) 552. — *D. coriacea* STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 224, f. 2c–e. — **Fig. 10a–d.**

Small to large tree, 4–36 m; bole to 20 m; d.b.h. 15–150 cm, with small or larger buttresses; bark finely fissured, flaky, wood soft, white. *Leaves* chartaceous to coriaceous, obovate to elliptic, 9–34 by $5^1/_2$–20 cm, apex rounded, rarely short-wide-acuminate; base cuneate to cordate; glabrous to yellow hairy in various degree, as is the thyrse; petiole 3–6 cm. Peduncle 5–20 cm; rachis 2–5 cm; primary lateral stalks of triads 2–4 cm. *Calyx* 12–18 mm. *Corolla* tube inside at base densely capitate-glandular hairy on insertion of stamens. *Anthers* orange, darker than corolla. *Fruit* 10–14 by $3^1/_2$ cm. *Seeds c.* $^3/_4$ cm ∅, incl. wings 3 by 2 cm.

Distr. *West Malesia:* Sumatra (Palembang, Asahan, Bencoolen, Indragiri, Tapanuli), Riouw Is. (Karimon I., P. Temiang, P. Kedondong), Malaya (also Penang I.), Banka (common), Billiton, and Borneo. Fig. 11.

Ecol. In primary and secondary forests, in Borneo not rare in heath forest, mostly on sandy soils, podsols and wet kerangas, slopes of podsol terraces, from sea-level up to 1000 m. *Fl.* Jan.–Oct.

Vern. *Mĕndjanbing, mĕngkubèng, mĕngkubung*, M (Banka), *kayu chĕndĕru*, Malacca, *labu*, Palembang, *mĕngkubong, mĕrtapa*, P. Temiang, *kayu si martim, baha*, Batak, *tui*, M (P. Karimon, in error with *Dolichandrone?*), *ĕndjabiengien*, Billiton.

Notes. A fairly variable plant. In addition to the yellow-tomentose or velutinous haired typical form as described by SCHEFFER there occur glab-

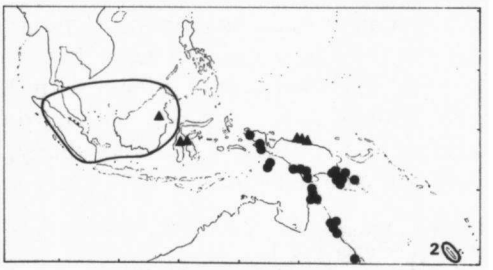


Fig. 11. Range of the genus *Deplanchea* VIEILLARD: *D. tetraphylla* (R.BR.) F.v.M. (dots), *D. glabra* (STEEN.) STEEN. (triangles), *D. bancana* (SCHEFFER) STEEN. (line). In New Caledonia 2 endemic species.

rous forms, but in degree, with few hairs, or the hairs still more reduced and confined to the lower part of the petiolar groove, or only to the axillary bud. There are also specimens of which the calyx is inside long pubescent with 1-seriate hairs, notably S 11989, 16427, 17591, 25411, SAN 32195, ANDERSON 8398, HALLIER B 2507, VAN NIEL 4019, but they are hairy as the type or glabrous, or with small glabrous leaves, rounded leaves or with short acuminate tip. This is also the reason that I cannot maintain *D. coriacea*, as the leaf-base varies from cordate to rounded to cuneate, without correlation with other sets of characters. Also the number of crateriform glands varies and these are also found in other specimens. I will not exclude the possibility that in the field certain biotypes may be bound to certain soil types, but I see no possibility to definitions and formal recognition from the herbarium.

In ANDERSON 8398 from Sarawak the leaves are in a whorl of 4.

Fruits are extremely scarce in the herbarium.

2. Deplanchea tetraphylla (R.BR.) F.v.M. Second Syst. Cens. Austr. Pl. 1 (1889) 167; STEEN. Thesis (1927) 916, *incl. var. novoguineensis* STEEN. *l.c.* 917; Bull. Jard. Bot. Btzg III, 10 (1928) 220; Proc. R. Soc. Queensl. 41 (1929) 55; Webbia 8 (1952) 435. — *Diplanthera tetraphylla* R.BR. Prod. (1810) 449; BTH. Fl. Austr. 4 (1869) 540; SCHEFFER, Nat. Tijd. N. I. 31 (1870) 335; BANKS & SOL. Ill. Cook's Voy. 2 (1901) 72, t. 229; BAILEY, Queensl. Fl. (1901) 1137; Compr. Cat. Q. Pl. (1909) 368; WHITE, Proc. R. Soc. Queensl. 34 (1922) 52; *ibid.* 38 (1927) 259; LANE-POOLE, For. Res. (1925) 137; STEEN. Nova Guinea 14 (1927) 293. — *Bulweria nobilissima* F.v.M. Fragm. 4 (1864) 147. — *D. bulwerii* F.v.M. *ibid.* 5 (1865) 72, (1866) 214. — ? *Diplanthera hirsuta* F. M. BAILEY, Bot. Bull. Dep. Agric. Queensl. 14 (1896) 11; Queensl. Fl. (1901) 1137; Compr. Cat. Q. Pl. (1909) 368. — *Faradaya chrysoclada* K.SCH. & LAUT. Nachtr. Fl. Schutzgeb. (1905) 370; BEER & H. J. LAM, Blumea 2 (1936) 225, *cf.* LAM & MEEUSE, Blumea 3 (1938) 201. — *D. hirsuta* (F. M. BAILEY) STEEN. Proc. R. Soc. Queensl. 41 (1929) 56. — **Fig. 10g, 12–13.**

Tree, without buttresses, 4–25 m; d.b.h. 10 to over 100 cm; bole 1–17 m; bark grey or grey-brown, corky, furrowed and rectangular-flaking; wood pale straw-coloured. *Leaves* chartaceous to coriaceous, usually obovate or oblong-obovate, underneath yellow-velutinous, base somewhat cuneate to stunted, exceptionally cordate, on the base above with 1–7 cup-shaped large glands, 11–23(–60) by 7–14(–30) cm; petiole $2^1/_2$–5 cm. Peduncle 4–12 cm; rachis 3–9 cm; branches 2–$7^1/_2$ cm; pedicels 1–2 cm. *Calyx* 12–14 mm. *Fruit* 5–11 by *c.* $2^1/_2$ cm. *Seeds* incl. the wings 2 by $1^1/_2$ cm.

Distr. NE. Queensland (incl. Thursday I., Fitzroy I.) and *East Malesia:* New Guinea and the Aru Is. (Trangan and Wokam Is.). Fig. 11.

Ecol. Predominantly in the periodically dry belts of New Guinea, also in gallery forest, very rarely in rain-forest, almost confined to grassland and wooded savannahs and associated with *Eucalyptus tereticornis* (Central Distr.) or *Melaleuca*, but also in mixed savannahs (*Antidesma*, *Schefflera*, palms, *etc.*, at Merauke), not rarely common, also a pioneer in fired areas, from sea-level to *c.* 600 m, rarely at 1200 m (Mafulu). *Fl.* May–Oct., *fr.* July–Oct., often flowers and fruits together, but fruiting specimens very rare in the herbarium. Dwarf specimens may in places flower and fruit.

C. J. STEFELS (Verkenningsrapport Berari Komebwaller. Mimeo, Fak Fak, 1956, p. 6, 7, 10, phot. 2) reported *D. tetraphylla* from sandy soils, often inundated through an impervious subsoil in a heathy forest of *Melaleuca*.

Field notes: style greenish yellow, filaments yellow, anthers brown. According to VAN ROYEN the flowers have a sourish-sweet scent and are eaten by 'luries', lorikeets (at Merauke).

Uses. At Fak Fak the timber is used for prahus by the Papuans.

Vern. *Laargola*, Trangan, Aru Is., *kapul*, M, Merauke, *bas*, Sorong, Mooi lang., *tembako d'ora*, Fak Fak, Ersania lang., *pwan*, Mumuni, Orokaiva lang., *pakawa*, Maipa, Mekeo lang.

Notes. The phyllotaxis is not constant, several specimens have whorls of 3, reminding of *D. bancana* with which this species is closest related. In 3 m high saplings (DOCTERS VAN LEEUWEN *n.* 38, cultivated in Hort. Bog. *sub* XVI.I.F.8) all leaves were opposite.

Similarly saplings in Queensland may have opposite leaves and, moreover, narrow oblong to lanceolate leaves with wavy, even toothed margin (L. S. SMITH 12382). Such plants were described as *D. hirsuta* and may precociously flower; also very small normal-leaved specimens may flower, obviously at an early age, in New Guinea, possibly stimulated by open, pyrogenous habitat. Such specimens may also sucker.

3. Deplanchea glabra (STEEN.) STEEN. Thesis (1927) 919, f. 8f, l; Bull. Jard. Bot. Btzg III, 10 (1928) 225. — *Diplanthera glabra* STEEN. Nova Guinea 14 (1927) 293. — *D. tubulosa* STEEN. Thesis (1927) 926, f. 8g, k, m; Bull. Jard. Bot. Btzg III, 10 (1928) 226. — **Fig. 10e–f.**

Tree, $1^1/_2$–22 m; d.b.h. 12–60 cm; bole 3–12 m; bark grey, scaly; mostly ± glabrous in all its parts. *Leaves* obovate-oblong to elliptic-oblong, coriaceous, usually very laxly haired on the midrib (and nerves) below, very rarely yellow short-velutinous on inflorescence, midrib, nerves and petiole, fine dark-dotted beneath, 9–40 by $4^1/_2$–25 cm, rarely with some scattered larger glands; base rounded to

Fig. 12. *Deplanchea tetraphylla* (R.BR.) F.v.M. Inflorescence from above, capsules, partly opened, showing dissepiment (fl. photogr. HOOGLAND 4249; fr. photogr. WOMERSLEY, 1956, Sogeri).

Fig. 13. Rather young tree of *Deplanchea tetraphylla* (R.BR.) F.v.M. in Bot. Garden Lae (photogr. M. GALORE).

cuneate or subcordate, apex rounded; petiole $2^1/_2$–7 cm. Peduncle 3–7 cm; rachis 1–11 cm; triads $^1/_2$–2 cm stalked; pedicels 4–15 mm. Bud spindle-shaped to obovoid. *Calyx* glabrous, very rarely haired on the mid-sepaline ribs, pustular towards apex but the pustules hardly ever opening as crateriform glands, 15–17 mm long, lobes 5 subequal, 3–6 by $2^1/_2$–5 mm, *c.* $2^1/_2$–$3^1/_2$ times as short as the tube. *Corolla* tube inside near the stamens capitate-glandular hairy. Placentas in each cell 2, nearly confluent. *Capsule* 6–9 by *c.* 2–$2^1/_2$ cm. *Seeds* incl. wings $1^1/_2$ by 1 cm.

Distr. *Malesia* rather common in North New Guinea in the vicinity of Hollandia and Mt Cyclops, also found twice in Central Celebes (Malili, Tobela, Palopo) and once in E. Borneo (Mt Njapa, Kelai R., Berau). Fig. 11.

It is remarkable that the species is obviously never found in other parts of New Guinea.

Ecol. Both in high forest and in savannah, but more commonly in pyrogenous grassland (*Gleichenia-Ischaemum*), as a pioneer, often flowering and fruiting already when small, 10–700 (–1000) m.

Field notes: pedicels red, filaments and style yellowish green, anthers orange, glands on leaf-base orange. No buttresses. *Fl. fr.* March–Oct.

Vern. Celebes: *momo*, Malili, *kalambutoh*, Toradja.

Notes. Although this species is usually almost glabrous, except for some lax hairs on the midrib beneath, KOSTERMANS & SOEGENG 444, from Hollandia, has very hairy inflorescences, midrib and petioles, so that obviously the indumentum may vary as it does in *D. bancana*.

Also the single Bornean specimen known so far (KOSTERMANS 21491) is similarly hairy; it was found on a mountain ridge at 1000 m alt.

The two specimens from Central Celebes I refer to this species, although one is in fruit and the other in bud, because: the calyx is ± regularly lobed, with a few pustules but without crateriform glands and the small pod and seed do not match *D. bancana*; both *spp.* have leaves in whorls of 3.

7. DOLICHANDRONE

(FENZL) SEEM. [Ann. Mag. Nat. Hist. III, 10 (1862) 31, *nomen*; J. Bot. 1 (1863) 226, *nomen*] J. Bot. 8 (1870) 379, *nom. cons.*; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 240, f. 92B–D; SPRAGUE, Kew Bull. (1919) 303; STEEN. Thesis (1927) 928; Bull. Jard. Bot. Btzg III, 10 (1928) 227. — *Pongelia* RAFIN. Sylv. Tellur. (1838) 78, *nom. rejic.* — *Dolichandra sect. Dolichandrone* FENZL, Denkschr. Bay. Bot. Ges. Regensb. 3 (1841) 265. — **Fig. 15–16.**

Trees with 1-pinnate leaves (or scattered simple leaves, extra-Mal.), leaflets entire (or serrulate, extra-Mal.). *Flowers* in few-flowered terminal racemes, salver-shaped, white, fragrant, nocturnal. *Calyx* not articulate, closed in bud, later spathaceous, caducous. Basal tube of *corolla* long, narrow-cylindric, upper part inflated, lobes mostly crisped. *Stamens* 4, didynamous, 5th rudimentary, inserted at the throat; anther-cells divergent. *Disk* annular. *Ovules* ∞ in 4–6 rows, inserted on 2 placentas in each cell, on the septum. *Capsule* elongate subcylindric to ± compressed, septum very narrow, false septum very broad and parallel with the valves. *Seeds* hyaline-winged, in the Mal. *sp.* rectangular with thick corky wings.

Distr. *Spp.* 9, one in tropical E. Africa, 4 in tropical SE. Asia, 3 in tropical N. Australia, and one ranging widely from Malabar through Indo-Malesia to New Caledonia. Fig. 14.

Ecol. All inland species, except the wide-ranging *D. spathacea* which is a back-mangrove tree.

Typif. In the Code and in Ind. Gen. *D. spathacea* (L.*f.*) K.SCH. has been accepted as the type, following SEEMANN (J. Bot. 1, 1863, 226). However, the lectotype must be chosen from the original materials incorporated by FENZL in *Dolichandra sect. Dolichandrone*, elevated by SEEMANN to generic rank. He referred to *Spathodea b* of ENDLICHER and *Spathodea* R.BR. Under the first reference *D. spathacea* is not represented, at most a *Dolichandrone* represented by *Bignonia spathacea* (*non* L.) *sens.* ROXB. Corom. t. 144, a wrong identification for *D. falcata* (WALL. *ex* DC.) SEEM. (*cf.* SPRAGUE, Kew Bull. 1919, 308). This then must be the type of the genus.

Taxon. The Australian species are in habit very different from the African and Indo-Malesian ones: characteristic shrubs or small trees of xerophytic habit and xeromorphous structure, the leaves sometimes obviously not decussate, coriaceous, sometimes entire, with fine parallel ascending veins, or leaflets even needle-like. In addition I find the pods terete and the pseudoseptum not flat, but irregularly, corky swollen with deep impressions of the seeds. According to URBAN (Ber. Deut. Bot. Ges. 34, 1916, 755) these species would also be different in pollen from the other species. I have arranged them in *subg. Coriaceae* STEEN. (Thesis, 1927, 931, f. 10). They should probably be better arranged in a separate section, rather than in a subgenus.

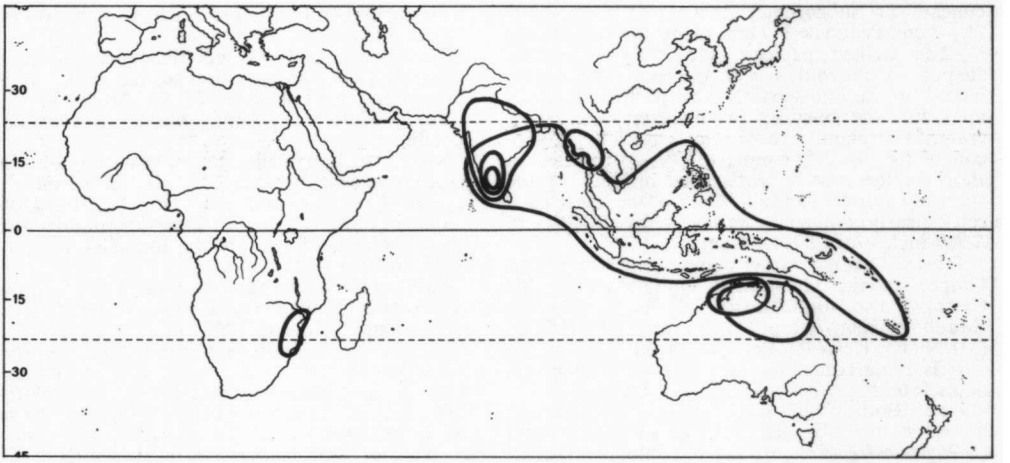


Fig. 14. Range of the genus *Dolichandrone* (FENZL) SEEM. and its species, the largest range being that of *D. spathacea* (L. *f.*) K.SCH., a mangrove tree with buoyant seeds.

Three *spp.* are distinguished; *D. filiformis* (DC.) F.v.M. is a fairly constant one, with 3–5 filiform leaflets, but *D. heterophylla* (R.BR.) F.v.M. is very variable, with simple to pinnate leaves (3–7 leaflets) also varying in width, whereas *D. alternifolia* (R.BR.) SEEM. with ovate, simple leaflets shows a tendency to split the leaf. Already SEEMANN (J. Bot. 8, 1870, 382) remarked that the latter two probably belong to one variable species, which opinion I now tend to share; he accepted the epithet *heterophylla*.

1. Dolichandrone spathacea (L. *f.*) K.SCH. Fl. Kais. Wilh. Land (1889) 123; MERR. Fl. Manila (1912) 429; Int. Herb. Amb. (1917) 469; Sp. Blanc. (1918) 349; SPRAGUE, Kew Bull. (1919) 304; STEEN. Thesis (1927) 937; Bull. Jard. Bot. Btzg III, 10 (1928) 227; C. T. WHITE, J. Arn. Arb. 10 (1929) 265; MERR. Comm. Lour. (1935) 355; CORNER, Ways. Trees (1940) 163, Atlas pl. 26–27; HEINE, Fl. Nouv.-Caléd. 7 (1976) 81, pl. 18. — *Niir Pongelion* RHEEDE, Hort. Mal. 6 (1686) 53, t. 29. — *Lignum equinum* RUMPH. Herb. Amb. 3 (1750) 73, t. 46. — *Bignonia spathacea* L. *f.* Suppl. (1781) 283; RETZ. Obs. Bot. 5 (1788) 5; BLANCO, Fl. Filip. (1837) 499. — *Bignonia longissima* LOUR. Fl. Coch. (1790) 380, *nom. illeg., non* JACQ. 1760. — *Bignonia javanica* THUNB. Mus. Nat. Ac. Upps. 17 (1794) 150, *nomen*; Fl. Ceil. (1825) 7, *nomen, cf.* STEEN. Blumea 6 (1950) 359. — *Spathodea longiflora* VENT. Choix (1803) 40; SPAN. Linnaea 15 (1841) 326. — *Spathodea rheedii* SPRENG. Syst. 2 (1825) 835, *quoad syn.*; WALL. Cat. (1832) *n.* 6516; DC. Prod. 9 (1845) 206; MIQ. Fl. Ind. Bat. 2 (1858) 754. — *Pongelia longiflora* RAFIN. Sylv. Tellur. (1838) 79. — *Bignonia longiflora* WILLD. *ex* DC. Prod. 9 (1845) 206. — *Spathodea loureiriana* DC. *l.c.* 209. — *Spathodea luzonica* BLANCO, Fl. Filip. ed. 2 (1845) 350; ed. 3, 2 (1878) 284, t. 242. — *Spathodea diepenhorstii* MIQ. Fl. Ind. Bat. 2 (1858) 754. — *D. rheedii* SEEM. J. Bot. 8 (1870) 380; KURZ, Fl. Burma 2 (1877) 234; CLARKE, Fl. Br. Ind. 4 (1884) 379; K. & V. Bijdr. (1894) 69; GAMBLE, J. As. Soc. Beng. 74, ii (1905) 377; RIDL. Fl. Mal. Pen. 2 (1923) 549. — *D. longissima* K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 240. — **Fig. 15–16.**

For fuller references see STEEN. (1928).

Evergreen, glabrous tree, 5–20 m; 10–40 cm ⌀; wood soft, white. *Leaves* usually 3–4-jugate, 15–35 cm, stalked, in the herbarium nigrescent as all other parts; young parts ± viscid, young leaves slightly pinkish in the field (CORNER); leaflets thin, ovate-oblong to lanceolate, unequal-sided, entire, long-tipped (in seedlings sometimes toothed), 6–16 by 3–7 cm, underneath with hairy domatia. *Racemes* 2–8-flowered. Rachis 2–3 cm. Bracts caducous. Bracteoles 0. Pedicels 2–4 cm. *Flowers* not articulated. *Calyx* conical, coriaceous, usually arcuate, beaked, circumscissile caducous, with many microscopical glands and a field with large crateriform glands at apex, 3–6(–8½) cm. *Corolla* tube 12–18 cm long, the mouth 7–12 cm ⌀; basal tube 9–12 cm, gradually funnel-shaped expanded above the throat for 4 cm; lobes 5, broad, subequal, frilled round the edge, with large glands, 2½–3 cm. *Stamens* not exserted. Style exserted. *Capsule* flattened-cylindrical, ± ribbed, straight or ± arcuate, or twisted, tipped, 25–70 by 2–3 cm; valves hard leathery, pseudoseptum flattish, hard corky, *c.* 1½–1¾ cm wide. *Seeds* dark grey, rectangular, in many rows, 12–18 by 6–8 mm including the thick corky wings; attachment a fine line, 8–10 mm long.

Distr. From the coast of Malabar throughout tropical SE. Asia and the whole of *Malesia* to New Guinea, Micronesia (W. Carolines: Korror; Yap: Tomil I.), the Solomons, the New Hebrides and New Caledonia, not found in Australia and Polynesia. Fig. 14.

Ecol. Confined to the back-mangrove and banks of tidal rivers and estuaries. RIDLEY (Kew Bull. 1910, 203; J. As. Soc. Str. Br. 59, 1911, 40, 146)

Fig. 15. *Dolichandrone spathacea* (L. *f.*) K.SCH. Flowers and twigs in bud and fruit, magnification $^1/_5$; upper capsules opened (photogr. CORNER).

recorded it common in low-lying rice-fields near Kanga village, Lower Siam, as the predominant tree, which he ascribed as "relics of the time when this whole country was a tidal swamp, gradually filled up after the disappearance of the sea". Other seashore plants were also found in these paddy fields, such as *Euphorbia atoto*. This inland occurrence is also stressed by CORNER (*l.c.* 164) who found it "frequently in coastal rice-fields; in Perlis it is indeed a feature of the country; also in North Kedah, as soon as one reaches Kodiang it attracts attention, standing in the paddies as an upright poplar and flanks the roads which lead to Kangar and Singgora. Old tree trunks are massive and fluted at the base, the crown tapering upward. The old, opened twisted pods remain for a long time on the tree."

BRASS found it very abundant in Daru I. (S. New Guinea), while K. J. WHITE found almost pure stands in Umboi I. (Morobe Distr.) in swamps behind the mangrove. He recorded it also from freshwater swamps in the Markham Valley. At the Bogor Botanic Gardens it is successfully cultivated in freshwater.

The calyx is filled with water in bud. The very young inflorescence and developed ovary is often slightly glossy varnished in the herbarium, similarly as is found in *Radermachera*, certainly by the exudate of glands which are found at the apex of the calyx. *Fl. fr.* Jan.–Dec., flowers and fruits not rarely found together. KOORDERS (1894 *l.c.*) and HEYNE (Nutt. Pl. 1371) say that in the dry season it may be at times nearly leafless fruiting in Central and East Java.

Fig. 16. Trees of *Dolichandrone spathacea* (L. *f.*) K.SCH. in the coastal rice-fields of Perlis where it is a feature of the country (photogr. CORNER).

Pollination. Flowers open at dusk and drop before sunrise; they must be pollinated by hawk-moths with very long tongues to attain the honey. In each inflorescence one flower is open at a time (CORNER).

Dispersal. The corky seeds float readily and must be dispersed by seawater. In this respect it is strange that the species is not found in northern Australia and Polynesia.

Uses. Of little use other than fire-wood; in N. Borneo a collector deemed the wood useful for making clogs and matches; in the Carolines (Koror I.) leaves and fruit are said to be used as a substitute for betel leaves in chewing. HEYNE (Nutt. Pl. 1371) said that the wood is not durable, but light and easy to work for small things in the house; pieces of branches are sometimes used for floats of fishing nets in East Java and the Karimon Djawa Is.; in the Minahassa it is used for scabbards, in Madura I. for masks for the *topèng*. In Madura a cold concoction of the leaves is also used against mouth sprew. RUMPHIUS said that in Ambon twigs of *lignum equinum* (translation of *kaju kuda*) were used for making hedges.

Vern. Malaya: *poko kulo*, *tuj*, M; Sumatra: *tuwĕ-ĕj*, Atjeh, *kudo-kudo uwi*, Simalur, *kuda kuda*, Pariaman, *ki arak*, Palembang; Java: *kaju* or *ki djaran*, M, *djarang*, S, *djaram*, *djaran pĕlok*, *djaranan*, *kadjèng kapal*, *kaju pélok*, *kapal*, J, *kadju djharan*, *kaju djaran binèk*, Md; Borneo: *kĕlaju*, *tuwi*, Kutai, *toi*, *tui*, Brunei, Bajau lang., *towi*, Kedayan; Celebes: *fojet*, *kaju pĕlumping*, *sangi*, *tomana*, Minahassa; Talaud Is.: *sansarangi*; Alor: *bombila*; Ternate: *djodjamé*; Tidore: *djamé*; Ambon: *kaju kuda*, *kati kati*; Philip.: *tua*, *tui*, Tag., *pata*, Ilk., *tañgas*, Tagb., *tanhas*, C. Bis., *tanghas*, P.Bis., *tewi*, Mbo., *tiwi*, Tag., Bik., C.Bis.; New Guinea: *tie*, Holtekang, Wembie lang., *pide*, *pier*, S. New Guinea, Asmat lang., *aisumbu*, Manikiang lang., *asember tiy*, Oransbari, Hatam lang., *daud*, Cape Vogel, Wanigela; New Britain: *latiu*, W. Nakanai, *tavituviti*, Gazelle Pen., Boava lang.; Solomons: *kwae kwaele*, Guadalcanal, *kwe kweale*, Malaita, *kwe'ekwe'eali*, Kolombangara, *ririge*, Small Nggela, Kwara'ae lang.

Note. Especially leaflets of saplings may, at times, show some serrulations on the margin and may also be slightly hairy.

8. STEREOSPERMUM

CHAM. Linnaea 7 (1832) 720; A.DC. Prod. 9 (1845) 210; B. & H. Gen. Pl. 2 (1875) 104, *pro sect. Eustereospermum*; STEEN. Thesis (1927) 946; Bull. Jard. Bot. Btzg III, 10 (1928) 233; CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 68. — *Hieranthes* RAFIN. Sylv. Tellur. (1838) 79. — *Dipterosperma* HASSK. Flora 25, 2 (1842) Beibl. 1, p. 28; Cat. Hort. Bog. (1844) 152; Pl. Jav. Rar. (1848) 507. — **Fig. 17, 19.**

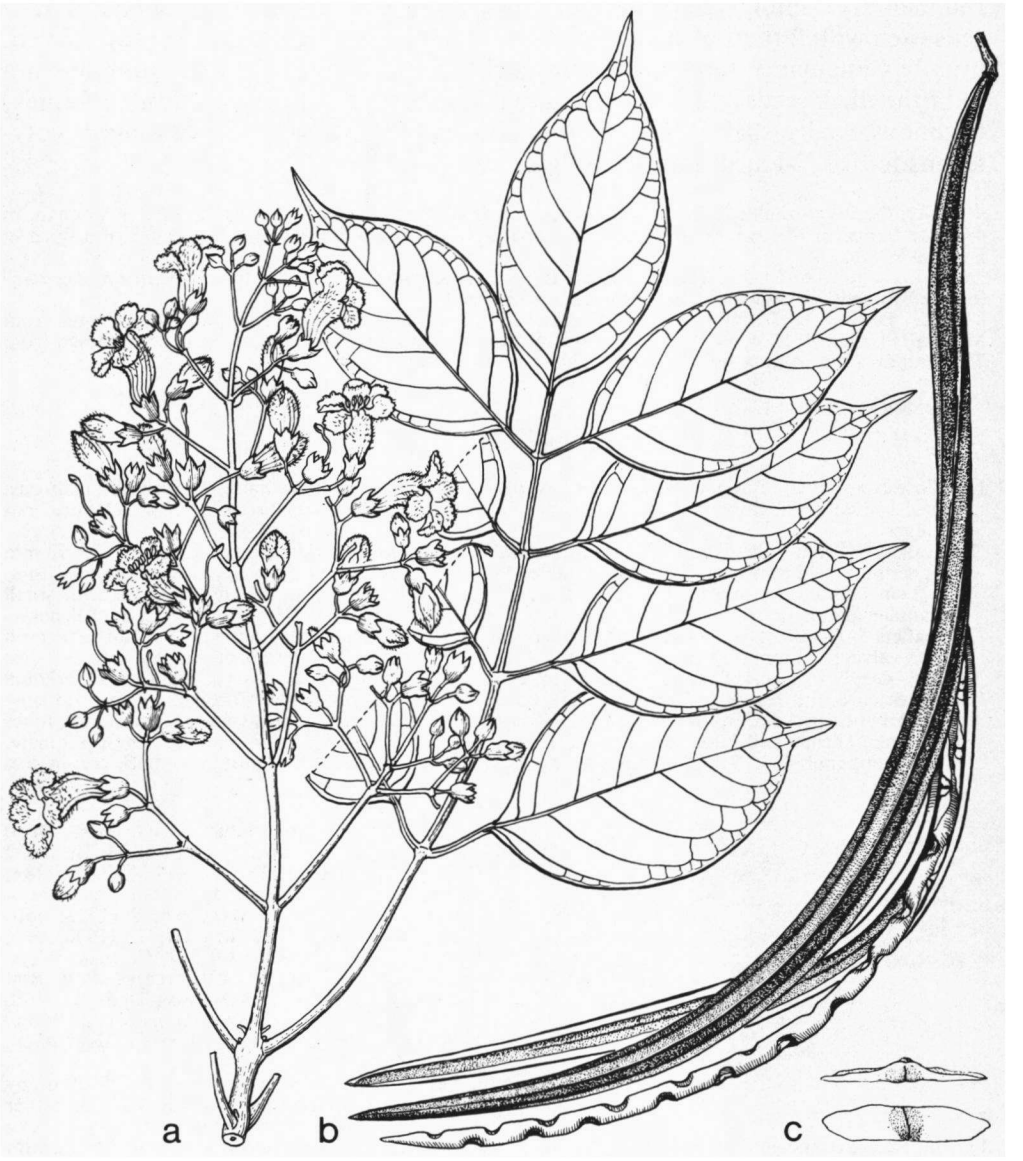


Fig. 17. *Stereospermum personatum* (HASSK.) CHATTERJEE. a. Habit, b. capsule, both × $^1/_2$, c. seed, nat. size (*a* after WIGHT, Ic. 4, t. 1341, *b–c* BEUSEKOM & GEESINK 3662).

Rather tall, deciduous trees. *Leaves* 1-pinnate; leaflets a few pairs, diminishing in size downwards, underneath usually with flat, dish- or cup-shaped glands or glandular spots; no domatia (in Mal.). *Thyrses* well-branched, paniculiform, mostly terminal, or on old wood. *Flowers* fragrant (in Mal.). *Calyx* usually short-lobed. *Corolla* infundibuliform; basal tube mostly concealed in the calyx, upper part usually funnel-shaped; mouth bilabiate, upper lip 2-, lower 3-cleft, lobes subequal, rounded, crisped, toothed or laciniate. *Stamens* 4, didynamous, included, 5th rudimentary; anthers glabrous, cells divergent. *Disk* cupular to annular. *Ovary* cells each with 2 rows of many ovules. *Capsule* long linear, terete, mostly twisted, usually 4-angular in section; septum thick, corky, terete, with alternating notches to fit the thick seeds which appear in two rows; valves coriaceous. *Seeds* ∾, thick, trigonous, wedge-shaped, with a cross-groove, on both sides thinly winged; cotyledons folded, 2-lobed, radicle straight.

Distr. Over a dozen *spp.*, in tropical Africa and Madagascar, in SE. Asia as far east as Yunnan, in *Malesia:* 2 *spp.* in Malaya, possibly also in Sumatra, and a doubtfully indigenous record of a third in East Java. Fig. 18.

Ecol. Largely confined to regions subject to a seasonal climate, all in the lowlands, in everwet rainforest obviously deciduous and flowering after a dry spell.

Note. Besides the 3 Malesian *spp.* distinguished here, P. DOP mentioned *S. cylindricum* PIERRE from Malaya (Fl. Gén. I.-C. 4, 1930, 582), but this must rest on an error as that species is only known from Thailand and Indo-China (*cf.* SANTISUK, Thai For. Bull. Bot. 8, 1974, 22).

KEY TO THE SPECIES

1. Inflorescence (incl. flowers) viscid-hairy by patent capitate-glandular hairs. Leaves not glabrous. Corolla tube gradually funnel-shaped widened, straight, Stamens glabrous at base. Capsule not 4-ridged.
   2. Leaflets 0–5 mm stalked, base cuneate-attenuate. Capsule faintly 3-ridged on each valve, *c.* 15–18 mm ∅, septum 8–13 mm ∅. Calyx campanulate, 5–7 mm. Corolla dull purple, yellow-streaked within, *c.* 3 cm (stretched); lobes crenulate; tube *c.* 1¾ cm. Filaments towards the insertion with small granular glands . . . . . **2. S. chelonoides**
2. Leaflets 5–11 mm stalked, rounded to subcordate at the base. Capsule only with 1 median ridge on each valve, 8–12 mm ∅, septum 6–9 mm ∅. Calyx ± cylindric, 8–12 mm. Corolla pale lilac, 6–7 cm; lobes deeply fringed-laciniate; tube *c.* 4 cm. Filaments glabrous . . . . . **1. S. fimbriatum**
1. Inflorescence and leaves glabrous (or very rarely minutely puberulous). Corolla *c.* 3 cm, suddenly widened and curved above the basal tube, yellowish, the limb with reddish veins and markings, lobes crenulate. Throat and base of filaments densely hairy. Leaflets 5–15 mm stalked, long-acuminate. Calyx campanulate, 4–5 mm. Capsule 4-ridged, 8–10 mm ∅; septum 4–5 mm ∅ . **3. S. personatum**

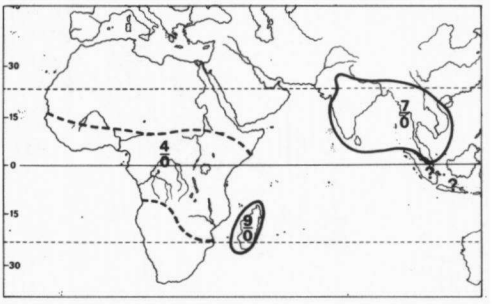


Fig. 18. Range of the genus *Stereospermum* CHAM. In Asia and Africa generalized, and numbers of species an approximation. Occurrence in Sumatra and Java doubtful.

1. Stereospermum fimbriatum (WALL. *ex* G. DON) A.DC. Prod. 9 (1845) 211; KURZ, Fl. Burma 2 (1877) 231; CLARKE, Fl. Br. Ind. 4 (1884) 383; GAMBLE, Man. (1902) 516; J. As. Soc. Beng. 74, ii (1905) 378; RIDL. Fl. Mal. Pen. 2 (1923) 550; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 234; DOP, Fl. Gén. I.-C. 4 (1930) 578; CORNER, Ways. Trees (1940) 172, pl. 33; CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 69; SANTISUK, Thai For. Bull. Bot. 8 (1974) 23. — *Bignonia fimbriata* WALL. [Cat. (1832) *n.* 6500, *nomen*] *ex* G. DON, Gen. Syst. 4 (1838) 221. — Fig. 19.

Very upright, deciduous tree, to 27–30 m by 30–160 cm ∅; crown narrow, cylindrical, rather open; bark light grey, rough and flaky; young leaves purple or violaceous. *Leaves* 30–75 cm, with rather sticky hairs, stalks yellowish; leaflets (2–)3(–4) pairs, rounded at the asymmetric base, ovate-oblong, long-tipped, 8–16 by 3–7 cm;

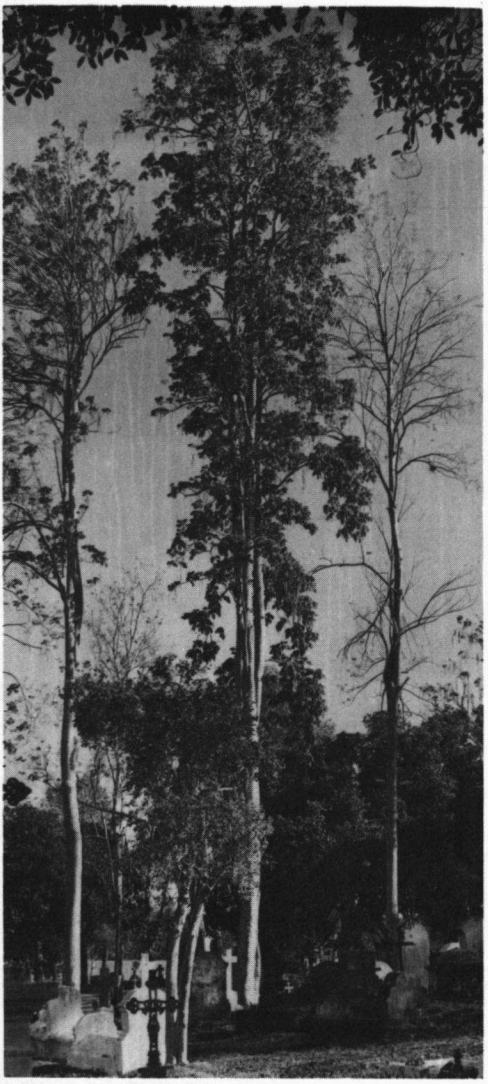


Fig. 19. *Stereospermum fimbriatum* (G.DON) A.DC. Its slender habit; some trees deciduous; on the churchyard in Malacca (photogr. CORNER).

petiolules 5–10 mm. *Flowers* in large spreading viscid-pilose clusters, 8–30 cm ⌀, on the bare twigs or with the new leaves. *Calyx* tubular, with 5 very short pointed lobes, *c.* 8–12 mm. *Corolla* dull white to pale pink or pale pinkish lilac, narrow funnel-shaped, without a distinct basal tube, the tube 4–5 cm long, the lobes beautifully long-fringed (as a dainty night cap), *c.* 2 cm. Filaments glabrous, inserted at *c.* 11–13 mm from the base. *Capsule* more or less quadrangular, snake-like twisted, 35–60 cm by 8–12 mm; septum *c.* 5 mm ⌀. *Seeds* *c.* 2½ cm long, 7 mm wide, with rather thick wings.

Distr. Continental SE. Asia (Burma; Thailand: Chiengmai to Peninsular Thailand); in *Malesia:* Malay Peninsula (incl. Langkawi, Penang, and Tioman Is.), possibly also in Sumatra.

The record from Sumatra rests on an unpublished, beautiful plate in a collection of RAFFLES in the India Office Library & Records (NHD 49/20), which might have been made in Bencoolen, but according to Mr R. DESMOND the provenance is uncertain. It might be rare in Sumatra, similarly as *S. personatum.*

Ecol. In the lowland and hill forests, in Burma up to 1000 m, in Malaya in high forest and open country: frequent in villages and belukar from Malacca to Perlis and Kelantan, often on rocky coasts and headlands. *Fl.* Febr.–June, *fr.* March–Nov. "After the first spell of dry weather the leaves are shed and the flowers appear on the bare boughs in delicate clusters until the new foliage is mature; in the early morning the corollas spin down like snow-flakes and carpet the ground with pale lilac blossom. There are many trees in the Christian Cemetery at Malacca, and a fairer one for a graveyard would be hard to come by" (CORNER, *l.c.*).

Uses. A hard and durable fairly large timber rather dark coloured, used for beams and posts and said to be durable in the soil.

Roots and leaves are used medicinally for some minor ailments: juice of leaves is dropped into the ear for ear-ache; leaves pounded with lime are applied to the skin for itch; a decoction of roots is given as a protective medicine after childbirth (BURKILL, Dict. 1935, 2082).

Vern. Malaya: *chac(h)a(h), chachar, chechar, chicha(r),* M, *lempoyan, beka(k)* (BURKILL), *snake tree,* E (CORNER).

2. Stereospermum chelonoides (L. *f.*) A.P.DC. Bibl. Univ. Genève II, 17 (1838) 125, *pro comb., excl. ref.* RHEEDE t. 26; A.DC. Prod. 9 (1845) 210, *pro basion.*; HAINES, Kew Bull. (1922) 121, *in text*; SANTISUK, Kew Bull. 28 (1973) 176; *non auct. al.* — *Bignonia chelonoides* L. *f.* Suppl. (1781) 282, *pro typ., excl. ref.* RHEEDE; *non auct. al.* — *Bignonia suaveolens* ROXB. Fl. Ind. ed. Carey 3 (1832) 104. — *Tecoma suaveolens* G. DON, Gen. Syst. 4 (1838) 224. — *Hieranthes fragrans* RAFIN. Sylv. Tellur. (1838) 79, *nom. illeg.* — *S. suaveolens* A.DC. Prod. 9 (1845) 211; WIGHT, Ic. 4 (1848) 9, t. 1342; KURZ, Fl. Burma 2 (1877) 231; CLARKE, Fl. Br. Ind. 4 (1884) 382; TRIMEN, Fl. Ceyl. 3 (1895) 284; GAMBLE, Man. (1902) 515; BRANDIS, Ind. Trees (1906) 495; HAINES, Fl. Bihar Orissa (1922) 656; BEUMÉE, Fl. Anal. Onderz. (1922) 33; GAMBLE, Fl. Madras 2 (1924) 998; STEEN. Thesis (1927) 948, *incl. f. verticillatum* STEEN. *l.c.* 950; Bull. Jard. Bot. Btzg III, 10 (1928) 236; DOP, Fl. Gén. I.-C. 4 (1930) 588; CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 70; BACK. & BAKH. *f.* Fl. Java 2 (1965) 540.

Deciduous tree, up to 30 m, 80 cm ⌀; timber dark, hard. Innovations viscid hairy. *Leaves* opposite (rarely in whorls of 3), 30–50 by 15–25 cm; leaflets 3–4 pairs, viscid-hirsute, glabrescent, rough above and brittle when mature, ovate to obovate to broadly oblong, acute to short-acuminate, entire or fine-dentate, 5–23 by 3–10 cm; glandless or with a few scattered spots; midrib finally puberulous

above, venation sparsely hirsute beneath; petiolules thick, 2–3(–5) cm. *Thyrse* up to 25 cm ∅, viscid-pubescent with capitate-glandular hairs. *Flowers* dull crimson to dull purple, yellow streaked within, very fragrant. *Calyx* campanulate, viscid pubescent, 6–8 mm, shortly acutely 5-lobed. *Corolla* viscid-hairy, $2^1/_4$–3 cm long, the tube rather gradually funnel-shaped, mouth long pubescent; lobes subentire, ± as long as the tube. *Filaments* inserted at 4–5 mm from the base, towards the insertion with small sessile granular glands. *Ovary* 4-ribbed, sometimes sparsely glandular. *Capsule* smooth or valves obscurely 3-ribbed, to 45 by $1^1/_2$–$1^3/_4$ cm; valves woody; septum 8–13 mm ∅. *Seeds* $3^1/_2$ by $^3/_4$ cm.

Distr. Widely distributed in continental tropical SE. Asia, from Ceylon and the Deccan to Assam and Burma, not yet reported for Thailand and erroneously so for Indo-China (SANTISUK, *l.c.*); in *Malesia:* very locally found in East Java, but somewhat doubtful whether native.

BEUMÉE *l.c.* recorded this tree for the first time for East Java, where it was found locally in some places in the (teak) forest districts S. Surabaya and E. Tuban. He suggested that this occurrence would fit the theory of a number of forest officers of early import by Hindus of teak and some associated trees (*Butea monosperma, Schleichera oleosa, etc.*) and several other plants. I certainly agree that in the Hindu period (roughly 800–1400 A.D.) plants have come from India, especially those favoured for sacred purposes; for example *Cochlospermum religiosum* (L.) ALSTON, and others went to India *vice versa*, as for example *Santalum album* L. (see C. E. C. FISCHER, J. Bomb. Nat. Hist. Soc. 40, 1938, 458–467). The first is still only found near Hindu temples in Bali and the latter is still spreading in India. The disjunction between the localities in East Java and India-Burma is in these cases certainly caused by intentional dispersal by man in historic time.

There are, however, a large number of other plants showing this same disjunction, and all bound to a seasonal climate, that is, subject to a distinct annual period of drought. In a succinct analysis I found these to belong to 4 classes (Hand. 8th Ned. Ind. Natuurwet. Congr. Surabaya 1938, 1939, 408–409). Later I have further elaborated this problem and tried to solve it (Reinwardtia 5, 1961, 420–429, maps 1–6). From this it appeared that the ecological disjunction of the seasonal climate between the colossal area it covers in SE. Asia (south as far as Tenasserim) and a similar ecology in Central & East Java and the Lesser Sunda Is. is shared by a homologous plant-geographical disjunction of many hundreds of plants which do not occur in everwet West Malesia, or only in very local seasonal spots in Celebes and the Philippine Islands. A fair number extend their range southeastwards to Australia. This proves that such patterns are quite natural; I have assumed they originated during the Pleistocene Glacial Period, which created a temporary pathway for drought plants between SE. Asia and Australia, to vanish in the Late Holocene.

It could thus well be that also *S. chelonoides* does occur in the native state in the East Javanese teak forest. As a matter of fact no fruit has yet been collected, although flowering was abundant. I cannot subscribe to the opinion of BEUMÉE that its dispersal is here by vegetative means, because I cannot well see by what vegetative means and furthermore because it is difficult to see how it would have maintained itself vegetatively in this way for many centuries. On the other hand the existence of a Javanese vernacular name is no argument that it is native; experience tells us that such names are often invented quickly. If it is native, it remains curious that, though it is obviously of rare occurrence, it was only recently discovered. It cannot be disproved, however, that its seed was inadvertently introduced by the Forest Service with teak seed from India or Burma.

Ecol. Seasonal forest and savannahs. *Fl.* Sept.–Oct. (India: April–June), *fr.* (Asia) Nov.–Dec.

Uses. GAMBLE, *l.c.* 516, said it is in SE. Asia rather an important large tree by its durable timber which is easy to work and good for building, though the amount of heartwood is small. It also is an excellent fire-wood and makes good charcoal. The root and bark are used as a favourite tonic native medicine. It also is important in sylviculture for its very free seed reproduction; the fruit remains long unopened on the tree and seed gets dispersed at the very end of the hot season after the danger of fire is nearly over, and can germinate with the first rains. Even on exposed slopes and among grass its good natural reproduction is noticeable.

BURKILL (Dict. 1935, 2082) mentions that it yields a gum of the tragacanth class. He also mentioned that it is referred to as a plant of magic in Sanskritic India, *patala*, being the Sanskrit name, of which modern vernaculars have been derived. In this respect it is noteworthy that the Javanese name '*bedali*' is a name for *Radermachera spp.* TRIMEN reported it in Ceylon planted near Buddhist temples.

Vern. *Djati tĕkĕn, kaju tĕkĕn*, J.

Notes. In East Java one specimen had leaves in whorls of three. Leaves of saplings and suckers may show a serrate-dentate leaf margin. Such leaves are sometimes also rather narrow and acuminate; those of mature trees are broader and more wide at apex.

Under *S. personatum* I referred to the lamentable name change caused by erroneous interpretation of the type of *Bignonia chelonoides* L. *f.* The first to observe this was G. DON, *l.c.*, who put '*B. chelonoides Kon.*' under the synonyms of *Tecoma suaveolens.* Then HAINES remarked that the type of *Bignonia chelonoides* L. *f.* was currently named *S. chelonoides* (Kew Bull. 1922, 121). I myself (Thesis, 1927, 951) was of the same opinion. But these observations were not evaluated nomenclaturally until recently by CHATTERJEE and SANTISUK.

3. Stereospermum personatum (HASSK.) CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 70; SANTISUK, Kew Bull. 28 (1973) 178; Thai For. Bull. Bot. 8 (1974) 26. — *Padri* RHEEDE, Hort. Mal. 6 (1736) 47, t. 26. — *Bignonia chelonoides* (*non* L. *f.*) ROXB. Fl. Ind. ed. Carey 3 (1832) 106, *p.p.* — *S. chelonoides* [*non* (L.*f.*) A.P.DC.] A.P.DC. Bibl. Univ. Genève II, 17 (1838) 125, *quoad ref.* RHEEDE, t. 26; A.DC. Prod. 9 (1845) 210, *p.p.*; KURZ, Fl. Burma 2 (1877) 230; CLARKE, Fl. Br. Ind. 4 (1884) 382; TRIMEN, Fl. Ceyl. 3 (1895) 283; RIDL. Fl. Mal. Pen. 2 (1923)

550; STEEN. Thesis (1927) 951; Bull. Jard. Bot. Btzg III, 10 (1928) 237; DOP. Fl. Gén. I.-C. 4 (1930) 579; CORNER, Ways. Trees (1940) 172, f. 43. — *Dipterosperma personatum* HASSK. Flora 25, 2 (1842) Beibl. 1, p. 28; Cat. Hort. Bog. (1844) 152; Pl. Jav. Rar. (1848) 507. — *S. tetragonum* A.DC. Prod. 9 (1845) 210; HAINES, Fl. Bihar Orissa (1922) 655; Kew Bull. (1922) 121; GAMBLE, Fl. Madras 2 (1924) 998; HAND.-MAZZ. Symb. Sin. 7 (1936) 889. — *Bignonia caudata* A.DC. Prod. 9 (1845) 166. — *S. hasskarlii* Z. & M. *ex* ZOLL. Syst. Verz. 3 (1855) 54, *nom. illeg.*, based on *Dipterosperma personatum* HASSK.; MIQ. Fl. Ind. Bat. 2 (1858) 756; Ann. Mus. Lugd. Bat. 1 (1864) 200. — *S. caudatum* MIQ. *l.c.* 200. — Fig. 17.

Deciduous, glabrous tree, up to 30 m, 75 cm ⌀; bark pale pinkish grey becoming rather coarsely fissured and flaky but not ridged. Young leaves purplish or pinkish (CORNER). *Leaves* glabrous, 20–50 cm; leaflets 3–6 pairs, elliptic-oblong, gradually tapering to the base, tip acuminate to caudate; 5–15 by $2^1/_2$–6 cm; underneath minutely glandular-punctate, often with a few large flat spot-glands (black in dry state); petiolules slender, 5–15 mm. *Thyrses* widely branched, paniculiform, to 40 cm long. *Flowers* dingy yellow, cream within with dark red stripes, in slender, erect, lengthening thyrses 15–40 cm long, on the bare twigs with the new leaves, *c.* 3 cm long, $1^3/_4$ cm wide at the limb. *Calyx* campanulate, 6–8 mm, with 3–4 short acute lobes, purple. *Corolla* with a narrow basal tube 4–5 mm long, then campanulately widened and curved, the bell-shaped part compressed with the mouth closed and the underside grooved; tube *c.* $1^3/_4$ cm long; lobes crisped, the upper two recurved, the lower bearded at the mouth, ochre-buff with brownish or purplish lines, pinkish purple on the outside (CORNER). *Filaments* with a dense hair tuft at the base. *Capsule* linear, ± terete, 4-ribbed, curved or twisted, 8–45 cm by 8–10 mm; septum 4–5 mm ⌀. *Seeds* 2 by $^1/_2$ cm, incl. wings $^3/_4$ cm.

Distr. Widely distributed from Ceylon through entire continental tropical SE. Asia to Yunnan and Indo-China; in *Malesia:* Malaya (very rare, only in Penang, *e.g.* on Glugor Road, and Singapore), possibly also in Sumatra.

Unfortunately there is no certainty about the records in Indonesia: HASSKARL described his type from trees cultivated in the Botanic Gardens at Bogor; ZOLLINGER described *S. hasskarlii* also from a cultivated tree in these gardens (ZOLLINGER 3069) but noted that it would have originated from Bantam, West Java, adding the Sundanese vernacular '*ki langir*'; a duplicate of this number in Paris is said by SANTISUK to have been annotated to come from the Lampong Distr. in S. Sumatra, which then probably is an error.

Then there is a collection said to have been collected by KORTHALS with 'Borneo' printed labels. This provenance is very unlikely, as the use of these old labels has been proved to be often erratic. These specimens may have come from West Central Sumatra but may also have been collected by KORTHALS in the Bogor Botanic Gardens. Plant-geographically the species might occur (or have occurred) in Sumatra and West Java, but probably as rare as in Malaya because of its preference for seasonal forest conditions.

Ecol. Preferring lowland forests, up to 1000 m. *Fl.* March–July (at Bogor Aug., Nov.–Febr.), *fr.* Febr. (Asia), June (Malaya).

Uses. According to BURKILL in India an important timber tree, especially in the northeast where it is common; the hard grey wood is moderately durable and easy to work, good for furniture, used but less good for building; in Assam and E. Bengal *padri*-wood is used for canoes and teaboxes. In S. India a cooling drink, from roots and flowers, is given in fevers. The fragrant flowers are offered in temples.

Nomencl. There has been a most unfortunate confusion about the identity of *Bignonia chelonoides* L. *f.* (1781). This emanated from LINNÉ *f.* who described it as a hairy plant (type herb. König, in LINN), but added the reference to *Padri* of RHEEDE, an other glabrous species with long petiolules. This probably misled ROXBURGH who applied LINNÉ's epithet to the latter. This interpretation was followed by almost all subsequent authors. In 1922 HAINES concluded that two species were involved and he adopted for the present one the name *S. tetragonum* DC. In 1948 CHATTERJEE replaced this by an older epithet of HASSKARL.

Notes. As in several other members of this family leaves from suckers and saplings may be toothed or serrate at the margin; leaves of mature trees are entire.

In a few continental Asiatic specimens a very minute puberulous indument occurs on nerves underneath in the inflorescence (KERR 1167, KOSTERMANS 1056, LESCHENAULT 157).

9. RADERMACHERA

ZOLL. & MOR. in Zoll. Syst. Verz. 3 (1855) 53; BUREAU, Adansonia 2 (1861) 192, t. 2; Mon. (1864) 50, t. 28; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 250; SEEM. J. Bot. 8 (1870) 145; JACKSON, Ind. Kew. 2 (1895) 679 ('*Radermachia*'); STEEN. Thesis (1927) 953; Bull. Jard. Bot. Btzg III, 10 (1928) 238; DOP, Fl. Gén. I.-C. 4 (1930) 583; CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 71; SANTISUK, Thai For. Bull. Bot. 8 (1974) 27; STEEN. Blumea 23 (1976) 121. — *Lagaropyxis* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 198. — *Mayodendron* KURZ, Prel. Rep. For. Veget. Pegu, App. D (1875) pl. 1 & 2; Fl. Burma 2 (1877) 232. — *Stereospermum sect.*

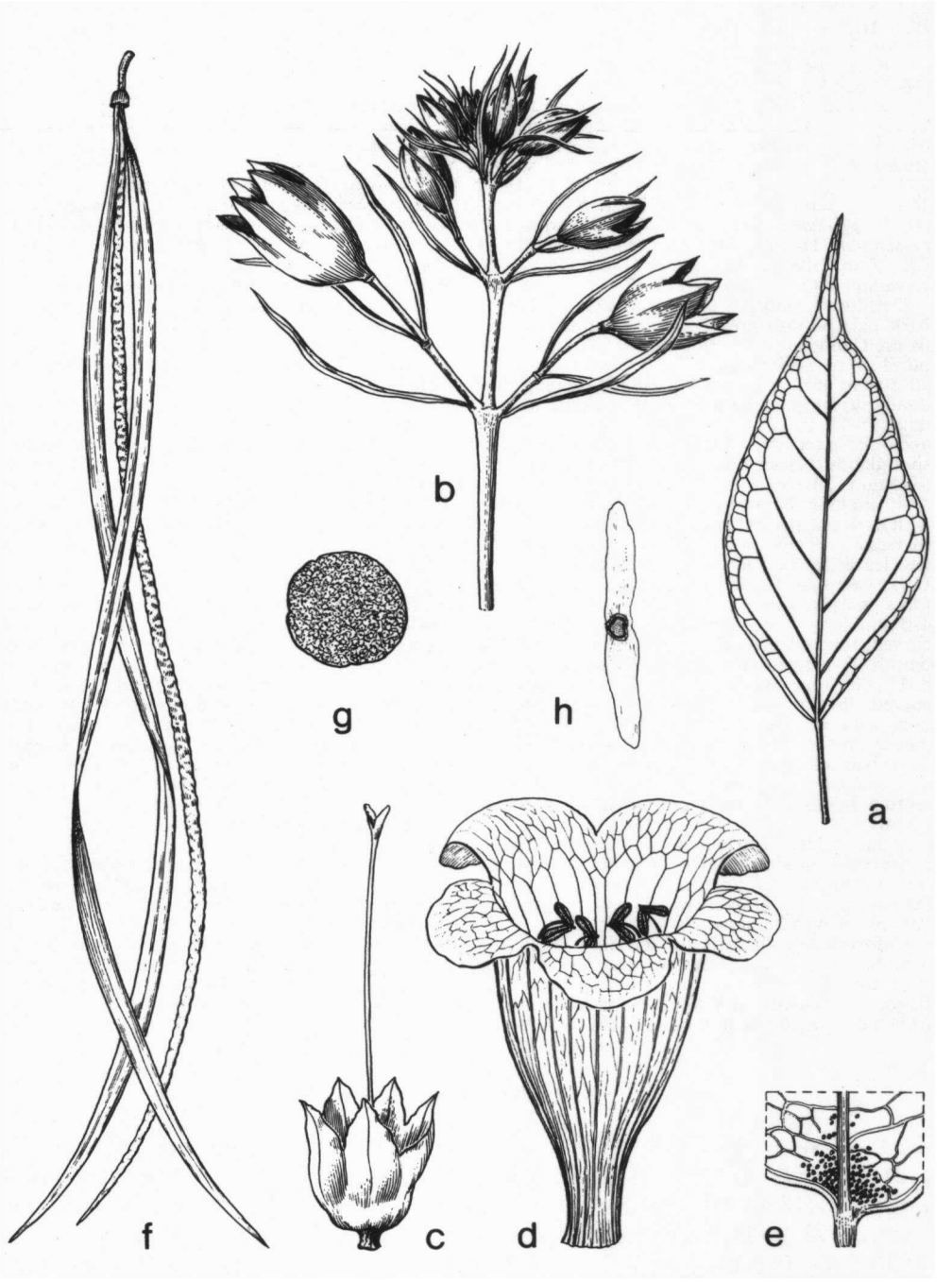


Fig. 20. *Radermachera peninsularis* STEEN. a. Leaflet, b. apex of thyrse, c. calyx and style, d. corolla, all nat. size. — *R. glandulosa* (BL.) MIQ. e. Leaf base, underneath with dense glandfield, × 2, f. empty capsule, with 2 valves and septum, × ½, g. section of septum, × 5, h. seed, × 2 (*a–d* LARSEN *c.s.* 31239. *e–h* KOSTERMANS 6360A).

Radermachera et Xylocarpaea B. & H. Gen. Pl. 2 (1876) 1047; CLARKE, Fl. Br. Ind. 4 (1884) 383; K. & V. Bijdr. Booms. 1 (1894) 71. — *Radermachera sect. Alatae* STEEN. Acta Bot. Neerl. 2 (1953) 307. — **Fig. 20, 22.**

Trees, rarely shrubs, evergreen (except 2 Indian and 2 Chinese *spp.*). Twigs and floral rachis mostly distinctly lenticellate. Innovations sticky-lacquered. *Leaves* 2–3-pinnate; stalks and leaflets articulated; rachis sulcate; leaflets underneath minutely but densely dotted, furthermore with gland-fields or scattered glands underneath, mostly acuminate, very rarely laxly puberulous. *Thyrses* terminal, very rarely ramiflorous, in one *sp.* a raceme; bracts and bracteoles inconspicuous, very rarely leafy; thyrses (and calyx) very rarely short-hairy. *Flowers* white, pink with yellow streaks in mouth, more rarely greenish yellow, or golden yellow to orange-red. *Calyx* closed in bud, rarely lobed from the beginning, splitting spathaceously (not to the base) or mostly irregularly lobed, rarely stunted, often with microscopical scale-like glands, moreover mostly with larger crateriform glands; after anthesis almost always circumscissile-dehiscing at the base, along an abscission line, in one *sp.* persistent. *Corolla* either salver- or narrow funnel-shaped or more commonly with a mostly short basal tube and often rather suddenly widened into an upper tube; lobes mostly rounded unequal, not rarely ciliate. *Stamens* didynamous with a 5th rudiment, but in one Chinese *sp.* 5 equal stamens, not exserted; another-cells V-shaped divergent; filaments inserted at the apex of the basal tube, except in two *spp.* capitate-glandular hairy at the insertion and in the basal part, for the rest glabrous; connective produced. *Ovary* elongate often minutely lepidote, glabrous, or tuberculate, never hairy; in both cells with several rows of ovules; style filiform, mostly exceeding the anthers; stigma 2-lipped. *Capsule* linear, terete, up to 75 cm; valves smooth, pergamentaceous, rarely ± woody, in one *sp.* tuberculate; septum terete, brittle, corky, but with shallow impressions of the flat seeds, a narrow line on both sides testimony of attachment to the middle of the valves. *Seeds* very ∞, flat, small, narrow, on both ends with a hyaline wing.

Distr. About 15 *spp.* in Indo-Malesia, from the Deccan to S. China, Hainan, Formosa, and the southern Ryu Kyus, most abundant in tropical SE. Asia; throughout *Malesia*, but not in the Moluccas proper and New Guinea. Fig. 21.

Ecol. Lowland primary and secondary rain-forests, up to *c.* 1500 m, not rarely pioneering in disturbed forest and on slopes.

Flower colour and corolla shape vary from pure white to orange-red and from hypocrateriform (*R. sinica* (HANCE) HEMSL. and *R. frondosa* CHUN & HOW) to tubular or campanulate. For the narrow-tubular orange-flowered species pollination by birds can be expected (*R. ramiflora*) and for the pure white, possibly nocturnal *R. peninsularis* hawk-moths may be the pollinating insects.

Ramiflory is found in Malesia in *R. ramiflora*; it occurs also occasionally in poor forms of *R. pinnata* after leader-shoots have been damaged. In continental Asia it is also found in *R. ignea* (KURZ) STEEN. and in *R. hainanensis* MERR.

Uses. Minor uses, see under the species.

Syst. Related to *Stereospermum*, which differs radically in having only two rows of ovules in each cell, and thick trigonous seeds with folded cotyledons fitting in cavities of the septum; moreover, its leaves are always 1-pinnate and most species are deciduous and prefer a seasonal climate.

Two small genera have recently been split off, both from SE. Asia, *viz* the monotypic *Pauldopia* STEEN. (Acta Bot. Neerl. 18, 1969, 425) which has winged rachises, a curved corolla tube, wingless thickish seed, a very thin septum, and a truncate calyx open in bud; and *Barnettia* SANTISUK (Kew Bull. 28, 1973, 172) with 2 *spp.* in Thailand, with 1-pinnate leaves in pseudowhorls, a short-ellipsoid, ± compressed capsule, and tuberculate or immersed-glandular calyx and capsule and a cruciform septum; the latter genus shows relationship with *Heterophragma*.

The closest ally of *Radermachera* is obviously the Afro-Asian genus *Fernandoa* (*cf.* STEEN. Blumea 23, 1976, 133) from which it differs by the terete septum, the usually not ribbed or striate and thinner,

narrower fruit valves, mostly 2–4-pinnate leaves, absence of domatia underneath the leaflets, and mostly crateriform glands.

Notes. Specific delimitation, especially in Malesian material, proved difficult, as several species appear to be variable and many were only known from the type, notably in the Philippine Islands. Degree of pinnation is variable, often in one collection. Also the number and place of the larger glands on undersurface of leaflets and on the calyx is liable to variation, as well as the flower colour and the way in which the calyx splits. A critical scrutiny showed only few tangible characters and resulted into a severe reduction of species in Malesia.

KEY TO THE SPECIES

1. Calyx strongly lengthwise 5–6-ridged, $1^3/_4$ cm, narrow, one side cleft down ± halfway, 3-toothed at apex. Leaves 1-pinnate, with 5 leaflets, coriaceous, very glossy above, with recurved edge, 7–14 by 3–4 cm. Corolla 4 cm, with narrow tube, slightly enlarged above; lobes *c.* 1 cm, obtuse. **6. R. coriacea**

1. Calyx not lengthwise 5–6-ridged.
2. Corolla narrowly funnel-shaped, without distinction of basal and upper tube. Flowers in cauliflorous racemes, with yellow tube and red limb. Leaves 2-pinnate . . . . . **1. R. ramiflora**
2. Corolla with a cylindric basal tube, widened rather abruptly into an upper tube. Flowers in terminal thyrses which are rarely raceme-like depauperated.
3. Calyx very short (3–5 mm), with a stunted rim, persistent. Leaves always 1-pinnate **2. R. glandulosa**
3. Calyx longer, irregularly lobed, after anthesis circumscissile-caducous.
4. Corolla $2–3^1/_2(–4^1/_4)$ cm long (incl. lobes). Calyx 5–10(–13) mm long . . . . . **3. R. pinnata**
4. Corolla 5–6 cm long. Calyx 10–25 mm.
5. Filaments and inside of basal tube glabrous. Corolla tube outside towards apex and on lobes with minute sessile glands. Leaves above puberulous on midrib and nerves, beneath with some scattered glands. Corolla white or cream-coloured . . . . . **4. R. peninsularis**
5. Filaments and inside of basal tube near insertions capitate-glandular hairy. Corolla tube outside towards apex mostly laxly and very short-hairy. Leaves glabrous above, beneath mostly with at least a gland-field at base. Corolla mostly pinkish, sometimes white, with yellow streaks in the mouth . . . . . **5. R. gigantea**

1. Radermachera ramiflora STEEN. J. Bot. 72 (1934) 5; Blumea 23 (1976) 129.

Large tree, 24–30 m, stem 30–60 cm ⌀; fluted at base; bark grey, fissured. Innovations and racemes lacquered, resinous sticky. *Leaves* (2–)3-pinnate, up to 1 m, more or less crowded at the twig-ends; pinnae 4–6 pairs; leaflets elliptic-lanceolate, acuminate at both ends, stalked, $3^1/_2–8^1/_2$ by $1^1/_2–3^1/_2$ cm, underneath fine glandular-punctate and with scattered small, shallow glands especially near the base, and a few scattered flat glandular spots. *Flowers* thickly set in closely placed ramiflorous pendent racemes to 20 cm long, erect on curved pedicels 1–2 cm long and with 3 bracteoles ± halfway on an articulation. *Calyx* in bud pear-shaped, closed, reddish green, tubular, 2–3-lobed, eglandular outside, microscopically glandular-papillose inside, *c.* $2^1/_4–2^1/_2$ cm long, 1 cm ⌀ at mouth, lobes 4–6 mm, 1–2 split ± halfway. *Corolla* with yellow tube and red limb; tube slightly curved, narrow salver-shaped, without narrowed basal tube, 5–7 cm, the basal $1^1/_2$ cm densely pubescent with thick hairs, mouth $1^1/_2–2$ cm ⌀; lobes rounded, subequal, ± 1 cm ⌀, ± papillose inside. *Stamens* (and style) reaching the mouth, inserted halfway the tube, glabrous but their adnate base lax glandular-papillose, thecae ± divergent, 4–5 mm; no produced connective. *Disk* thick, annular-cup-shaped, faintly crenate. *Ovary* ribbed, pistil *c.* 4 cm, stigmatic lobes 2 mm, very narrow. *Capsule* straight or twisted, 35–70 cm, *c.* 5 mm ⌀; septum $2^1/_4–3$ mm ⌀. *Seeds* 4–5 by $2^1/_2$ mm, the wings 6–7 mm.

Distr. *Malesia:* Sabah, Mt Kinabalu (Penibukan, Dallas, Mesilau, Tenompok, Kota Belud, Kp. Kiau I resthouse), not rare.

Ecol. Rain-forest, also in disturbed forest on hill side, 950–1500 m. *Fl.* Aug., Jan.–March, *fr.* April, Dec.

Notes. A characteristic, isolated species: ramiflorous, flowers in racemes, shape of corolla.

Leaflets of suckers and saplings dentate. NOOTEBOOM & ABAN 1603 has only 2-pinnate leaves, CLEMENS 30364 has them 2–3-pinnate.

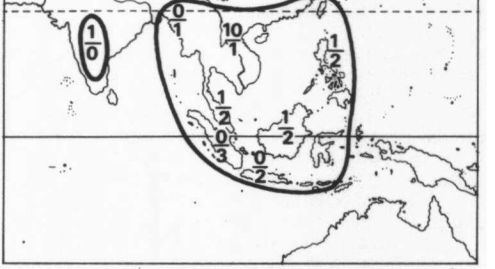


Fig. 21. Range of the genus *Radermachera* Z. & M.

2. Radermachera glandulosa (BL.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 250; K. & G. J. As. Soc. Beng. 74, ii (1905) 380; KOORD. Atlas Baum. 2 (1914) t. 356; STEEN. Thesis (1927) 965; Bull. Jard. Bot. Btzg III, 10 (1928) 241; CORNER, Ways. Trees (1940) 168, f. 43; CHATTERJEE, Bull. Bot. Soc. Beng.

2 (1948) 74; STEEN. Acta Bot. Neerl. 2 (1953) 307; BACK. & BAKH. *f.* Fl. Java 2 (1965) 541; SANTISUK, Thai For. Bull. Bot. 8 (1974) 27, f. 15; STEEN. Blumea 23 (1976) 126. — *Spathodea glandulosa* BL. Bijdr. (1826) 762. — *Bignonia porteriana* WALL. *ex* DC. Prod. 9 (1845) 165. — *R. stricta* Z. & M. *ex* ZOLL. Syst. Verz. 3 (1855) 53; RIDL. Fl. Mal. Pen. 2 (1923) 550. — *Stereospermum glandulosum* MIQ. Suppl. (1860) 240, 565; CLARKE, Fl. Br. Ind. 4 (1884) 383; K. & V. Bijdr. Booms. 1 (1894) 74; KANJILAL & DAS, Fl. Assam 3 (1939) 404. — *Lagaropyxis glandulosa* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 199. — **Fig. 20e–h.**

Small, glabrous, evergreen, crooked tree, up to 12 m, 40 cm ∅; bark slightly pimply and peeling, but not flaky or fissured, bitter; young leaves deep purple, acrid. *Leaves* 1-pinnate; leaflets 2–5 pairs, large, chartaceous, elliptic (mostly broad-), rarely oblong-lanceolate, short-tipped, with a conspicuous dark, dense gland-field at the oblique base underneath (often bulging on upper surface), 10–30 by 5–17 cm. *Thyrse* narrow, 6–50 cm, gradually elongating, sometimes the upper part still flowering while lower are in fruit. *Calyx* 3–5 mm, cup-shaped, without abscission line, persistent, truncate, purple, spotted with 5–7 purple glands in a crescent. *Corolla* narrow, slender, tube narrow, slightly curved, halfway rather gradually widening, 3(–4) cm, pinkish purple outside, white inside, with a gland-field at outside of the ciliate lobes, basal part of lower tube short capitate-glandular hairy inside. *Stamens* hairy at insertion. *Pods* hanging in bunches, straight, 15–30 cm; valves 5–7 mm wide; septum 3–4 mm ∅. *Seeds* 10–16 by $1^1/_2$–2 mm.

Distr. Continental SE. Asia (Assam, Burma, Thailand, Laos, China: Kwangsi, Kwantung) and *West Malesia:* Malay Peninsula (also Penang), Sumatra, Krakatao, West to East Java.

The two records from Borneo are erroneous: the KORTHALS specimens are mislocalized and BECCARI 811 (mentioned by MERRILL, En. Born. 1921, 525) is a PS number. Both are from Sumatra.

Ecol. Primary and secondary forests and thickets, frequently by streamsides, even rocky *Saraca*-streams (CORNER), both under everwet and under seasonal conditions (in Central and East Java), from sea-level to 900 m, once reported from 5000 ft (Cameroon Highlands). *Fl.* April, July–Nov., *fr.* Jan.–Dec.

The fine seed would indicate easy dispersal, but though the species is found in Penang and Krakatao Is., it has never been collected in the Riau Is., not in the islands west of Sumatra and also not in those close to East Java (Madura I., Bali, and Kangean) though it is found in Java as far east as Bali Straits and *R. gigantea* extends east as far as Alor. The glands at the leaflet basis are often black from sooty moulds indicating actual glandular excretion.

Uses. The timber is small and of negligeable value.

Vern. *Tuwi gadang*, M, Minangkabau; *kia bako, ki hapit, ki langhit, kipahit, ki sakat, ki sikap*, S; *ambal, bangking, bangkongan, djelibru, godong ambol, hambal, kawuk = gabret, klaju, lambal, padali, pedali, pudang*, J; *sekar potè*, Md.

3. Radermachera pinnata (BLANCO) SEEM. J. Bot. 8 (1870) 147; MERR. Philip. J. Sc. 3 (1908) Bot. 336, *incl. var. glabra* MERR. *l.c.*; Sp. Blanc. (1918) 350; En. Philip. 3 (1923) 446; STEEN. Thesis (1927) 973; Bull. Jard. Bot. Btzg III, 10 (1928) 248; Blumea 23 (1976) 129. — *Millingtonia pinnata* BLANCO, Fl. Filip. (1837) 501. — *Millingtonia quadripinnata* BLANCO, *l.c.*; ed. 3, 2 (1878) 286, t. 252. — *R. banaibana* BUREAU, Adansonia 2 (1861) 194. — *R. quadripinna* SEEM. J. Bot. 8 (1870) 147. — *Stereospermum pinnatum* F.-VILL. Nov. App. (1880) 151; ROLFE, J. Linn. Soc. 23 (1884) 314; VIDAL, Phan. Cuming. Philip. (1885) 132; Rev. Pl. Vasc. Filip. (1886) 203. — *Stereospermum quadripinnatum* F.-VILL. Nov. App. (1880) 151; VIDAL, Syn. Atlas (1883) 35, t. 73. — *Stereospermum banaibanai* ROLFE, J. Linn. Soc. 23 (1884) 314. — *Stereospermum seemannii* ROLFE, *l.c.* — *R. acuminata* MERR. Philip. J. Sc. 3 (1908) Bot. 335; En. Philip. 3 (1923) 445; STEEN. Thesis (1927) 980. — *R. mindorensis* MERR. Philip. J. Sc. 3 (1908) Bot. 338; En. Philip. 3 (1923) 446; STEEN. Thesis (1927) 971. — *R. fenicis* MERR. Philip. J. Sc. 3 (1908) Bot. 335, 434; En. Philip. 3 (1923) 446; STEEN. Thesis (1927) 979, *incl. var. acuminata* STEEN.; Jard. Bot. Btzg III, 10 (1928) 261. — *R. whitfordii* MERR. Philip. J. Sc. 7 (1912) 352; En. Philip. 3 (1923) 447; STEEN. Thesis (1927) 963. — *R. brachybotrys* MERR. Philip. J. Sc. 26 (1923) 489; ELMER, Leafl. Philip. Bot. 10 (1939) 3809. — *R. sorsogonensis* ELMER *ex* STEEN. Thesis (1927) 973; ELMER, Leafl. Philip. Bot. 10 (1939) 3809. — *R. elegans* STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 252, f. 8. — *R. fenicis* (*non* MERR.) STEEN. *l.c.* 261, f. 11.

See for other synonyms under ssp. acuminata.

Distr. *Malesia:* Sumatra (also Simalur, Banka, and Siberut Is.), Malaya, Borneo, Philippines, Celebes (also Muna I.), and W. Moluccas (Sula Is.: Taliabu).

Notes. It has appeared impossible to separate the material into smaller species, as there is gradual transition of the many populations, especially in the Philippine islands, notably in vegatative characters. *R. brachybotrys* is merely a depauperate ridge facies. In one specimen 1- and 2-pinnate or biternate leaves are not seldom found together. For brevity I have omitted from the synonymy the many pro parte citations under *R. amoena, hypostictum* and *gigantea.* Some specimens from Borneo and Celebes show a tendency in leaf-shape towards *ssp. acuminata.*

KEY TO THE SUBSPECIES

1. Leaflets usually chartaceous, elliptic, acuminate to caudate; basal gland field mostly distinct, at apex eglandular or with a few scattered glands *ssp.* **pinnata**
1. Leaflets firmly chartaceous to coriaceous with consequently less marked prominent venation beneath, usually obovate to elliptic-obovate, at apex mostly short- and blunt-tipped or blunt or rounded; basal gland field dense, often one also at apex . . . . . *ssp.* **acuminata**

ssp. **pinnata.**

Tree to 20 m, 15–40 cm ∅. Leaves (1–)2–3-pinnate, 25–50(–70) cm; leaflets elliptic-oblong, acuminate, mostly at both ends, to caudate, (3–)5–16 by $(1^1/_2$–)2–5(–8) cm, usually chartaceous,

Fig. 22. *Radermachera pinnata* (BLANCO) SEEM. *ssp. acuminata* (STEEN.) STEEN. Habit, in flower, Aug. 1970 (photogr. B. C. STONE).

with a basal gland field, apical gland field absent or of scattered glands. Thyrses glabrous, sometimes puberulous, (3–6–)15–60 cm, in odd specimens sometimes on the old wood. Calyx $^1/_2$–1(–$1^1/_2$?) cm, lobes unequal, (1–)2–4, glabrous, usually glandless. Corolla pink to pale purplish, with yellow markings in the throat, 2–$3^1/_2$(–$4^1/_2$) cm, rarely slightly lax short-hairy. Stamens glandular-hairy at their insertion. Ovary and style glabrous, 12–17(–22) mm. Capsule (6–)30–50 cm; valves 4–6(–7) mm wide; septum 2–$2^1/_2$ mm ∅. Seeds (7–)13–15 by 2–3 mm.

Distr. *Malesia:* Philippines (the most common species), Celebes (also in Muna I.), Moluccas (Sula Is.: Taliabu).

Ecol. Lowland and montane primary and secondary forests, on streamsides, up to 600 m. *Fl.* Aug.–May, *fr.* Febr.–Nov.

Uses. Minor uses only, for carving and fuel.

Vern. Philippines: *banai-bánai*, Tag., the common name, *kalapuing*, *salai*, *tuing-huló*, *ulimbabon*, *yabang-yábang*, Tag., *banoi-bánoi*, Bag., *ansohan*, *badlan*, Bis., *labayanan*, C.Bis., *paling-uák*, Bik., *pagalayan*, Bon., *bunglai*, Buk., *atiatip*, Ig., *lanunisi*, *lasilak*, Ibn., *barangauan*, Ilk., *bunlai*, Mbo,. *banaibayan*, *paitan*, *pata*, Pang., *bani-báni*, Sbl., *kutokong*, Sub., *hali-háli*, Sulu; Celebes: *ririh*, Muna.

Note. In a few specimens some inflorescences are ramiflorous, obviously due to damage of the leader shoot.

ssp. **acuminata** (STEEN.) STEEN. Blumea 23 (1976) 129. — *Spathodea lobbii* T. & B. Nat. Tijd. N. I. 25 (1863) 413. — *R. lobbii* MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 250; SEEM. J. Bot. 8 (1870) 147; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 243, f. 5, *incl. ssp. acuminata* STEEN. *l.c.* 247, f. 6; CORNER, Ways. Trees (1940) 168, f. 43 ('*lobbiana*'); SANTISUK, Thai For. Bull. Bot. 8 (1974) 29. — *R. amoena* [*non* (WALL.) SEEM.] GAMBLE, J. As. Soc. Beng. 74, ii (1905) 381; RIDL. Fl. Mal. Pen. 2 (1920) 551. — *R. corymbosa* STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 249, f. 7. — *R. gigantea* [*non* (BL.) MIQ.] BURK. Dict. (1935). — Fig. 22.

Tree, 7–40 m, 60 cm ∅. Leaves biternate or 2-pinnate; leaflets rather coriaceous, obovate to obovate-elliptic, not or short- and blunt-tipped, exceptionally acuminate, basal gland field well-developed, apical one usually distinct, 8–15 by $3^1/_2$–$7^1/_2$ cm. Thyrse apical, fairly narrow, 15–25 cm. Calyx 1 cm, rarely to $1^1/_2$ cm. Basal tube of corolla rather suddenly widened.

Distr. S. Peninsular Thailand (Krabi, Pattani); in *Malesia:* Sumatra (also in Banka; Mentawai Is.: Siberut; Simalur I.), Malaya, Borneo, SW. Philippines (Palawan, Culion).

Ecol. Primary and secondary forests, also in open grasslands. In Malaya especially by streams (CORNER), on granite as well as on limestone; at 0–400(–800) m. *Fl.* May, July–March, *fr.* May–Nov.

Taxon. Formerly often accepted as conspecific (also by myself, 1927) with *R. gigantea cq. amoena*, but certainly distinct.

Vern. Sumatra: *kaju singamba*, *sindur langit*, *sundur langit*, Batak, *kudo kudo pajo*, Simalur, *mentu*, *tuih*, *tuwi(k)*, Banka; *kapung suwi*, *kěka-*

pung, Lampong; *bunga pawang, setèngah burong, tangkani*, Malaya; Borneo: *binutan, kudjuk langit*, Dajak-Kapuas; Culion: *totancola*, Tagb.

Note. I must admit that I have somewhat hesitantly kept this apart as a subspecies from true *R. pinnata*, from which it differs only in shape and texture of leaflets and geographical range. There are some specimens in Borneo which seem transitional.

In the Philippines (Palawan and Culion) aberrant specimens are found with biternate leaves and coriaceous leaflets with recurved margin and rather prominent veins underneath. They were collected in grasslands which may account for their habit. However, in the same islands there are also larger-flowered specimens which I have referred to *R. gigantea* with similar habit. More field work in these islands is needed to check my tentative conclusions.

4. Radermachera peninsularis STEEN. Blumea 23 (1976) 128, f. 1a-d. — *R. borii* (*non* FISCHER) SANTISUK, Thai For. Bull. Bot. 8 (1974) 30. — **Fig. 20a–d.**

Tree, 4–15 m. *Leaves* 3-pinnate, 60–80 cm; leaflets lanceolate-oblong, falcate-caudate, 5–8 by 2–3 cm, on both surfaces microscopically punctate but only with a few scattered, very small 'larger' glands; midrib and main nerves (*c.* 4–5 pairs) puberulous above (as in *R. sinica*). *Inflorescences* terminal, similar to those in *R. sinica*; peduncle firm, 15–35 cm long, rachis 4–7 cm; full-grown pedicels $2^1/_2$–7 cm, halfway with 2 decussate linear bracteoles *c.* $1^1/_2$–3 cm long. Bracts long, linear, exceeding the buds, the lowest up to 5 cm long, upper ones $2^1/_2$–3 cm. *Calyx* campanulate, rather wide and thickish, densely microscopically lepidote, 2–$2^1/_2$ by $1^1/_2$ cm, rather irregularly lobed for $^1/_3$–$^2/_5$ of its length, with 5 ± distinct gland fields. *Corolla* white or creamy, *c.* 6–7 cm long (incl. the ?entire lobes), with a rather wide ($^3/_4$ cm) basal tube *c.* $1^1/_2$ cm long concealed in the calyx on top of which the filaments are inserted; upper tube funnel-shaped widened. *Filaments c.* 3 cm, glabrous; anthers $4^1/_2$ mm; connective appendage small. *Ovary* glabrous. *Capsule* terete, tortuous, 60–70 cm by 3–5 mm.

Distr. Peninsular Thailand (between Phangnga and Krabi); in *Malesia*: Malay Peninsula (Cameron Highlands), 2 collections.

Ecol. In Peninsular Thailand at 8°25′ N, 99°15′ E, in evergreen forest along a stream, on limestone, at 50 m altitude, in the Cameron Highlands at 1200 m in mixed rain-forest.

Notes. In habit deceptively like *R. sinica*, but at once different by the shorter (6–7 cm), not salver-shaped corolla and the much wider smooth calyx. The corolla in *R. sinica* measures *c.* 8–12 cm including the lobes, with a narrow, very gradually widening tube. *R. sinica* also has the minute lax pubescent nerves and veins above and long narrow bracts.

SANTISUK *l.c.* referred the specimens to *R. borii*, which I refer to *R. sinica*, a species ranging more northerly in SE. Asia, *viz* from N. Assam, N. Burma, and Tonkin to S. China, Hainan, Formosa, and the southern Ryu Kyu Is.

5. Radermachera gigantea (BL.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 250; SEEM. J. Bot. 8 (1870) 146; KOORD. Atlas Baum. 2 (1914) t. 356 A-K; HEYNE, Nutt. Pl. (1927) 1371; STEEN. Thesis (1927) 983, *p.p., excl. syn. lobbii*; Bull. Jard. Bot. Btzg III, 10 (1928) 253, f. 9; Blumea 23 (1976) 126. — *Bignonia gigantea* NOROÑA, Verh. Bat. Gen. 5 (1790) 70, *nomen.* — *Spathodea gigantea* BL. Bijdr. (1826) 761; MIQ. Fl. Ind. Bat. 2 (1858) 751. — *Bignonia amoena* WALL. [Cat. (1832) *n.* 6512, *nomen*] Pl. As. Rar. 2 (1831) 78, t. 183; LOUDON, Hort. Brit. (1830) 483, *err. amara*; G. DON, Gen. Hist. 4 (1838) 222. — *Bignonia oxyphylla* DC. Prod. 9 (1845) 169. — *Stereospermum hypostictum* MIQ. Sum. (1861) 565; CLARKE, Fl. Br. Ind. 4 (1884) 384, *excl. syn. S. lobbii*; K. & V. Bijdr. Booms. 1 (1894) 72, *excl. syn. lobbii*; KANJILAL & DAS, Fl. Assam 3 (1939) 405. — *Lagaropyxis gigantea* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 198, *incl. f. sumatrana et f. borneensis* MIQ. — *R. amoena* SEEM. J. Bot. 8 (1870) 146; *non* GAMBLE, J. As. Soc. Beng. 74, ii (1905) 381, *quae est R. lobbii.* — *R. elmeri* MERR. Bull. Gov. Lab. Philip. 29 (1905) 48; Philip. J. Sc. 3 (1908) Bot. 334; En. Philip. 3 (1923) 445; STEEN. Thesis (1927) 994. — *R. biternata* MERR. Philip. J. Sc. 1 (1906) Suppl. 238; *ibid.* 3 (1908) Bot. 333; En. Philip. 3 (1923) 445; STEEN. Thesis (1927) 970. — *R. palawanensis* MERR. Philip. J. Sc. 3 (1908) Bot. 336; STEEN. Thesis (1927) 977. — *R. elliptica* MERR. Philip. J. Sc. 3 (1908) Bot. 334; En. Philip. 3 (1923) 445; STEEN. Thesis (1927) 964. — *R. sibuyanensis* ELMER, Leafl. Philip. Bot. 4 (1912) 1485; MERR. En. Philip. 3 (1923) 447; STEEN. Thesis (1927) 992. — *R. elmeri var. fragrans* ELMER, Leafl. Philip. Bot. 7 (1915) 2561; MERR. En. Philip. 3 (1923) 446. — *R. fragrans* STEEN. Thesis (1927) 996. — *R. punctata* ELMER *ex* STEEN. Thesis (1927) 982; ELMER, Leafl. 10 (1939) 3709. — *R. borneensis* STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 258, f. 10.

Shrub or tree, (6–)20–40 m, up to 80 cm ⌀; bark and young leaves bitter. *Leaves* (1–)2(–3)-pinnate, 12–35(–80) cm, leaflets usually elliptic to oblong, rarely somewhat obovate or lanceolate, shorter or longer acuminate, 4–12(–15) by 2–6(–9) cm, at base underneath mostly with a gland-field, at apex with some scattered glands. *Thyrses* 8–40 cm, rather open, terminal, ∞-flowered, glabrous. *Flowers* not rarely fragrant. *Calyx* (1–)$1^1/_4$–$2^1/_2$ cm long, mostly 2-lobed, sometimes 1- or more-lobed; glands few or distinct. *Corolla* 5–6 cm long (incl. lobes), pink or white, usually with yellow streaks in the mouth, above the basal tube rather suddenly widened, campanulate upper tube towards apex almost always short-capitate glandular hairy, and lobes ciliate. *Filaments* densely capitate-glandular hairy at insertion. Style $2^1/_2$–3 cm. *Capsule* 15–60 cm long, 5–8 mm ⌀; septum 4 mm ⌀. *Seeds* 8–13 by 2–4 mm.

Distr. SE. Asia (Assam: Khasi & Jaintia Hills; Burma: Manipur, Tavoy, WALLICH, CLARKE, *l.c.*, not seen), and *Malesia:* Sumatra (incl. Billiton and Banka), West to East Java (common in Central and East Java), Lesser Sunda Is. (Bali, Sumbawa, Flores, Alor), Bawean I., SE. Borneo, and Philippines.

Ecol. Primary and secondary forests, also in areas subject to a dry monsoon, and in East Java in teak forest, very common on Mt Telemojo and near Pringombo (Banjumas) (KOORDERS, *l.c.*),

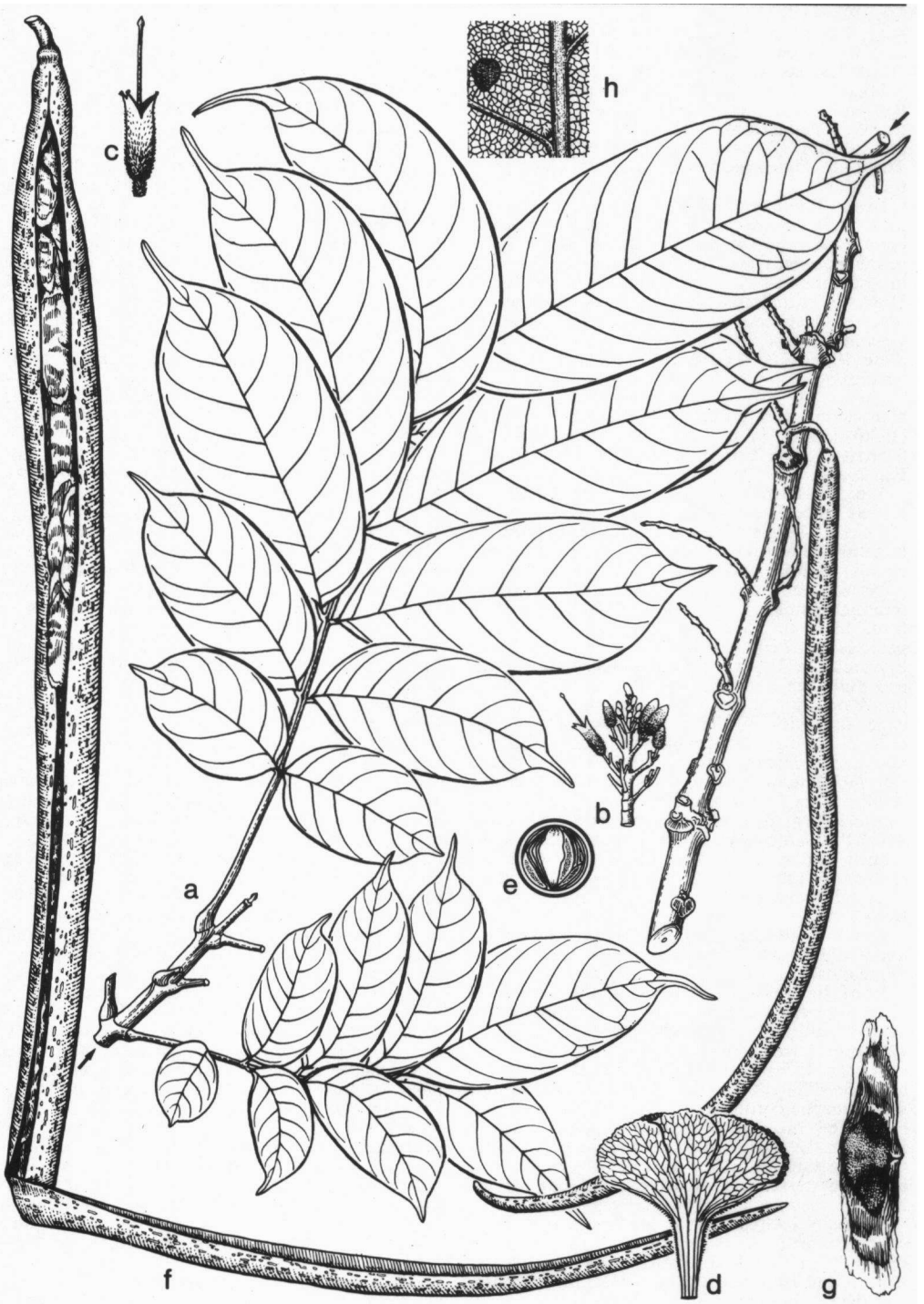


Fig. 23. *Fernandoa macroloba* (MIQ.) STEEN. a. Habit of branchlet with young fruit, × ½, b. inflorescence in bud, × ½, c. calyx, nat. size, d. corolla, × ¾, e. CS of young capsule, nat. size, f. mature capsule, × ½, g. seed, nat. size, h. detail of underside of leaflet, showing small domatia and flat gland, × 4, (*a–e*, *h* C.H.B. XI-C-106a, *f–g* DIEPENHORST 2353 HB, *type*).

from the lowland up to *c.* 1600 m. *Fl.* Jan.–Dec., *fr.* Jan.–Dec. Not rarely a pioneer in secondary forest, cuttings sometimes used for strengthening terracing on unstable slopes. Early flowering and fruiting as a shrub.

Uses. Sometimes cultivated; also suitable for re-afforestation. Timber is said to be strong and durable, locally used for bridges and houses, but not resistent against termites, and therefore of less value for outdoor constructions; used for making matches and matchboxes (HEYNE, *l.c.*).

Vern. Sumatra: *tui* (*batu*), M, Billiton, Minangk., *djamatan, djamaton, kaju angin, kaju dĕling, radja matan, simaisaludang, sundĕr langit*, M, Karo-Batak, *tangkè*, M, Atjeh, *kulit bĕrilang*, M, Kroei, (*kĕ*)*kapung tui, talas*, M, Lampong; West Java: *ki padali*, S; East Java: *bĕdali* (common name), *kĕdah*, (*kĕ*)*dali, kokok-kèjok*, J, *kaju raras, karpotèh, potian, putian, sĕkar pĕtak, sĕkar potè*, Md; *pĕdantĕn*, Bali; *atodjang*, Alor; Borneo: *binutan*, Dajak, Martapura, *bunglai batu, b. gunung*; Philippines: Palawan: *agtap, tantañgan*, Tagb., *sayo*, Ig., *barangau-a-nalabága, pamaya-bayen*, Ilk.

Notes. I have come to the conclusion that the large-flowered species of the Philippines, *R. borneensis* and *R. gigantea*, should be referred to one variable taxon. Though there may be local races they can not be properly distinguished, not even on subspecific level, as their 'characters' fade away; *R. elliptica* with 1-pinnate leaves goes via biternate leaves to 2-pinnate leaves. *R. sibuyanensis* has an almost glabrous corolla; *R. fragrans* has fragrant flowers, but fragrancy is mentioned frequently on labels, but also sometimes flowers are said to be scentless. Flower colour is said to be white or pink in the Philippines, to which mostly is added the occurrence of yellow streaks in the mouth. White flowers are only reported from Borneo and the Philippines.

Especially a few Philippine specimens from Palawan and Culion are aberrant; earlier collections were described by MERRILL as *R. palawanensis* and *R. biternata*. They were collected in grasslands and differ by thicker, often biternate leaves, leaflets with recurved margin and often distinctly arching prominent veins on the undersurface. One number (PNH 12319) has singularly slender tubular flowers 5 cm long. Other specimens with the same vegetative difference from normal *R. gigantea* have, however, smaller flowers (3–3$^1/_2$ cm) and these I have identified as *R. pinnata ssp. acuminata*. I must admit that closer field work is needed to check my tentative conclusions.

R. amoena (WALL.) SEEM. was described from a flowering shrub in Hort. Calc. which WALLICH found worthy of an ornamental. WALLICH was somewhat doubtful about its provenance, but assumed that it was introduced by Mr C. TELFAIR from Mauritius, where it must then also have been cultivated. Though it is not known from Malaya and Thailand, it does occur in Assam (Khasia & Jaintia Hills, *cf.* KANJILAL & DAS) and N. Burma (Manipur: MEEBOLD 5169). These specimens I cannot distinguish from *R. gigantea*. What KANJILAL & DAS mean in their key by 'rusty-coloured capsules' is not clear to me; they mention the flowers to be white.

Insufficiently known

6. Radermachera coriacea MERR. Philip. J. Sc. 3 (1908) Bot. 333; En. Philip. 3 (1923) 445; STEEN. Thesis (1927) 961; Blumea 23 (1976) 131.

Leaves 1-pinnate, 20–30 cm; leaflets 5, coriaceous, oblong to elliptic-oblong, base acute, apex blunt or obscurely blunt-tipped, margin recurved, 7–14 by 3–4 cm, very glossy above; nerves 13 pairs. Panicles 15 cm. Calyx 1$^3/_4$ cm, narrow, strongly lengthwise 5–6-ridged, cleft on one side halfway, 3-toothed at apex. Corolla 4 cm, the tube rather narrow, slightly enlarged above, the lobes obtuse *c.* 1 cm. Capsule 16 cm, valves 5–7 mm wide (*ex descr.*).

Distr. *Malesia:* Philippines: Central E. Luzon (Tayabas Prov.: Baler), only known from the type (MERRILL 1099); vern. name *bibit parang*.

Note. This is the only specific name in the genus of which I could not trace the type, which may be lost. A lengthwise ridged calyx I have not observed in any species of the genus; the 1-pinnate leaves and narrow leaflets seem rather characteristic. It might possibly be an extreme form of *R. pinnata ssp. acuminata*.

10. FERNANDOA

WELW. *ex* SEEM. J. Bot. 3 (1865) 330, t. 37–38, *sphalma Ferdinandia*; *ibid.* 4 (1866) 123; *ibid.* 8 (1870) 280, *sphalma Ferdinandoa*; *ibid.* 9 (1871) 81; MILNE-REDHEAD, Kew Bull. 3 (1948) 171; HEINE, Adansonia 4 (1964) 467–470; GENTRY, Ann. Mo. Bot. Gard. 62 (1975) 480; STEEN. Blumea 23 (1976) 133. — *Kigelianthe* BAILL. Hist. Pl. 10 (1891) 50. — *Haplophragma* P.DOP, Bull. Soc. Bot. Fr. 72 (1925) 889; STEEN. Thesis (1927) 998; Bull. Jard. Bot. Btzg III, 10 (1928) 262. — *Spathodeopsis* P.DOP, C. R. Ac. Sc. Paris 189 (1929) 1097. — *Hexaneurocarpon* P.DOP, *l.c.* — *Tisseranthodendron* SILLANS, Bull. Soc. Bot. Fr. 98 (1951) 270–272, pl. — **Fig. 23, 25.**

Trees. *Leaves* 1-pinnate; leaflets 2–5 pairs, diminishing in size downwards, terminal one largest, beneath glabrous or tomentose with stellate hairs, with few

scattered, larger, flat, spot-like glands and small hairy domatia in the nerve-axils. *Thyrses* axillary or terminal, densely or laxly tomentose, or at least almost always with (sometimes) small and appressed stellate hairs. *Calyx* tubular or campanulate, unequally 2–5-lobed, with few to many warty or prominent glands in the upper half. *Corolla* with a fairly large basal tube, rather suddenly campanulate-funnel-shaped widened to the mouth; lobes undulate to crenate. *Stamens* 4, didynamous; 5th rudimentary; anthers divaricate. *Disk* annular. *Ovary* elongate, with 2 marginal placentas in each cell; ovules ∞. *Capsule* long, linear, terete, twisted or straight, pendent, smooth or ribbed; septum flat, smooth, not rarely glossy, thickish. *Seeds* numerous, rather rectangular, the wings rather narrow; insertion punctiform.

Distr. About 4 *spp.* in tropical West Africa (Angola to Gabon) and East Africa (Tanganyika), 3 in Madagascar, and 6 in Indo-Malesia (India to Indo-China); in *Malesia* 2 *spp.*, in the Malay Peninsula and N. Sumatra. Fig. 24.

Ecol. Tropical lowland forest.

Taxon. In Blumea *l.c.* I have given the reasons for uniting all these genera, by which the range of *Fernandoa* is considerably extended and becomes similar to that of *Stereospermum*, *Dolichandrone* and *Markhamia*. It differs from *Markhamia* and *Dolichandrone* in not having a false septum and a spathaceous calyx; it differs from the continental Asian genus *Barnettia* in not having a cruciate septum, shortly ellipsoid-oblong capsules and pseudo-whorled leaves. Its closest ally is *Radermachera* which has thinner, linear-terete capsules which are not striate or ribbed and with thinner valves (except in *R. sinica*), and a terete septum; moreover, the leaves in *Radermachera* are mostly 2–4-pinnate and the leaflets have no domatia and another type of glands and never stellate hairs.

It is noteworthy that *Fernandoa adenophylla* shows in the aspect of flower size and shape, thick indument and especially in the leaves (leaflet texture and size diminishing downwards, often auricles) a striking similarity in habit with *Markhamia* (*e.g. M. cauda-felina*), a genus which may have also ridged pods in Africa: but *Markhamia* has a 4-angled septum and a spathaceous calyx! One gets the impression that there are signs of reticulate affinity among the Afro-Asian genera, and possibly parallel evolution, but it must be observed that several genera are obviously not unnatural in having distinct pollen types.

From its wide distribution *Fernandoa* might be supposed to be an ancient genus, from which *Radermachera*, *Barnettia* SANTISUK (*cf.* Kew Bull. 28, 1973, 172) and *Stereospermum* are derived specialisations.

Uses. All Indo-Malesian species seem to be good timber trees and of the Indo-Chinese species it is said that the timber is good for all purposes and not attacked by termites. They may already flower and fruit at an early age.

KEY TO THE SPECIES

1. Leaves hairy beneath. Inflorescence terminal, rusty tomentose, with stellate and branched hairs. Calyx thick, campanulate, $2^1/_2$–$3^1/_2$ cm, woolly-tomentose outside. Corolla thick, 6–7 cm, whitish to yellowish. Capsule twisted, rusty-tomentose, 10-ribbed . . . . . **1. F. adenophylla**
1. Leaves glabrous except a few short hairs of the domatia. Inflorescences lateral, with appressed, fine, partly stellate hairs. Calyx tubular, thin, *c.* 1–$1^1/_4$ cm by 3 mm, fine appressed stellate-hairy. Corolla thin, pink, short-hairy outside, *c.* 4–5 cm. Capsule straight or ± twisted, glabrous, smooth. **2. F. macroloba**

1. Fernandoa adenophylla (G. DON) STEEN. Blumea 23 (1976) 135. — *Bignonia adenophylla* [WALL. Cat. 6502] *ex* G.DON, Gen. Syst. 4 (1838) 221. — *Spathodea adenophylla* DC. Prod. 9 (1845) 206; WIGHT, Ill. 1 (1839) t. 160. — *Heterophragma adenophyllum* SEEM. *ex* B. & H. Gen. Pl. 2 (1875) 1047; KURZ, Fl. Burma 2 (1877) 236; CLARKE, Fl. Br. Ind. 4 (1884) 381; PRAIN, J. As. Soc. Beng. 60, ii (1891) 322; KOORD. Ann. Jard. Bot. Btzg 14 (1897) 417; GAMBLE, Man. (1902) 514; RIDL. Fl. Mal. Pen. 2 (1923) 551. — *Haplophragma adenophyllum* (DC.) P. DOP, Bull. Soc. Bot. Fr. 72 (1925) 890; STEEN. Thesis (1927) 1006, f. 13a, 14e–f; Bull. Jard. Bot. Btzg III, 10 (1928) 265; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 856, f. 14.

Tree, 4–20 m, not rarely poorly developed and with irregular crown, 10–35 cm ∅; innovations, thyrse and calyx with dark rusty, multicellular compactly branched hairs. *Leaves* 20–50 cm long; leaflets 2–3(–4) pairs, subsessile, the lowest often close to the base of the petiole and smallish and orbicular auricle-like, the terminal leaflet largest, mostly obovate to oblong to elliptic, obtuse to acuminate, underneath with scattered crateriform plate glands and glandular spots and with yellowish-pubescent, stellate hairs (sometimes on short, multicellular stalks), 7–24 by 4–19 cm; petiole 0–8 cm, sulcate as is the rachis. *Thyrse* terminal, stout, erect, lax-flowered, *c.* 20 cm. *Calyx* campanulate, *c.* $2^1/_2$–$3^1/_2$ by $1^1/_2$–2 cm, inside sordid white, thick, persistent; lobes $^1/_2$–1 cm, subequal, entire. *Corolla* yellow-brown, white, yellowish

green (brown *in sicco*), outside woolly tomentose, inside glabrous, basal tube *c.* $1^1/_2$–2 cm, upper tube *c.* 3–4 cm; the mouth *c.* 5 cm ∅; lobes ± entire, 1–$1^1/_2$ by $1^1/_2$–$2^1/_2$ cm ∅. *Anthers* ± included, cells ± free. *Ovary* elongate, brown stellate hairy, 1 cm, style 4 cm, ± exceeding longer stamens. *Capsule* subterete, pendulous, twisted, rusty by stellate hairs, 30–60 by $1^1/_2$–$2^1/_2$ cm ∅, the valves with 5 strong prominent ribs; septum flat, shining, corky, over 1 cm wide. *Seeds* variable in size in one capsule, *c.* $2^1/_2$–$3^3/_4$ by $^3/_4$–$1^1/_4$ cm incl. the smallish wings.

Distr. Continental SE. Asia (Assam to Tenasserim and Chittagong, Burma, Thailand, Indo-China; also in the Andaman and Coco Is.: PRAIN, 1891); in *Malesia:* only in the extreme northern part of Malaya (Langkawi, Perlis: Chupeng; Kedah: Alor Star; in 1882 also found on Bt. Timah in Singapore I.).

Ecol. Mixed deciduous or evergreen monsoon forest, also in bamboo forest often on limestone and calcareous soils, but in Burma preferring pervious siliceous soils (KURZ); 0–750 m. *Fl.* May–Sept., *fr.* March–Sept.

KOSTERMANS (*n.* 1436) noted that in Thailand the 'white' flowers open at night and drop the next morning. KURZ *l.c.* stated it leaf-shedding in Burma and flowering at the close of the cold season. VAN DER PIJL (Act. Bot. Neerl. 5, 1956, 138) stated that the nocturnal flowers are visited by bats.

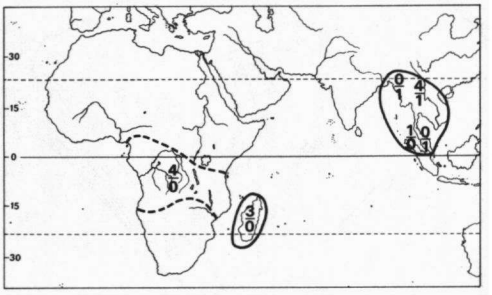


Fig. 24. Range of the genus *Fernandoa* SEEM. Figures above the hyphen indicate endemic species, those below the hyphen non-endemic species for each area or subarea. In Africa and SE. Asia the delimitation is generalized.

2. Fernandoa macroloba (MIQ.) STEEN. Blumea 23 (1976) 136. — *Spathodea sp.* TEYSM. Nat. Tijd. N. I. 14 (1857) 345. — *Spathodea macroloba* MIQ. Sum. (1861) 565; HEYNE, Nutt. Pl. ed. 1, 4 (1917) 167. — *Heterophragma macrolobum* BACK. *ex* HEYNE, Nutt. Pl. ed. 2 (1927) 1371. — *Haplophragma macrolobum* (MIQ.) STEEN. Thesis (1927) 1002, f. 13b, 14a–d; Bull. Jard. Bot. Btzg III, 10 (1928) 263, f. 12. — **Fig. 23, 25.**

Tall, deciduous tree, 15–40 m (bole 15–20 m), 20–70 cm ∅; no buttresses; larger twigs terete. *Leaves* 25–40 cm; leaflets 3–5 pairs, a few mm stalked to sessile, obovate- to elliptic-oblong, glabrous, beneath with a few large spot-glands, entire, abruptly acute-acuminate, cuneate at base, the lowest pair often (2–4 cm) small and roundish, 14–18 by 4–7 cm; underneath some scattered dark glandular spots and minute hairy domatia. *Thyrses* rather short (2–8 cm), lateral, narrow and dense, densely appressed pubescent; peduncle short; pedicels *c.* $^1/_2$ cm. *Calyx* tubular, less than halfway with 2–3 incised, short, acute lobes, 1–$1^1/_4$ cm by 3 mm, appressed-pubescent by appressed partly stellate hairs and a few warty elevated glands in upper half, faintly 5-ribbed. *Corolla* white or pale pinkish, of thin texture, outside minutely puberulous, 4–5 cm (incl. lobes); basal tube *c.* $1^3/_4$ cm long, upper one wide-funnel-shaped, *c.* $1^1/_4$ cm long; lobes unequal obovate-roundish, with crenulate margin, $1^1/_2$–$1^3/_4$ by $1^3/_4$–$2^1/_4$ cm. *Stamens* 4, didynamous, inserted halfway the basal tube. *Disk* annular, ± puberulous. *Ovary* lanceolate, densely yellow-tomentose, 4-angular, faintly 6-ribbed; ovules in 6 rows in each cell; style delicate, $1^1/_2$–2 cm, at base appressed-hairy. *Capsule* linear, terete, straight or ± twisted, glabrous, 40–65 by 1–$1^1/_2$ cm ∅; valves thin-coriaceous, lenticellate; septum flat, $^3/_4$–1 cm wide, shining, of corky texture. *Seeds* 2–$2^1/_2$ cm (incl. the very short hyaline wing) by $^3/_4$ cm.

Distr. *Malesia:* northern half of Sumatra: from the Res. Minangkabau and Pariaman northward to Atjeh and even on P. Breuëh.

Fig. 25. *Fernandoa macroloba* (MIQ.) STEEN. Twig with flowers, nat. size (photogr. HUYSMANS, Nov. 1956).

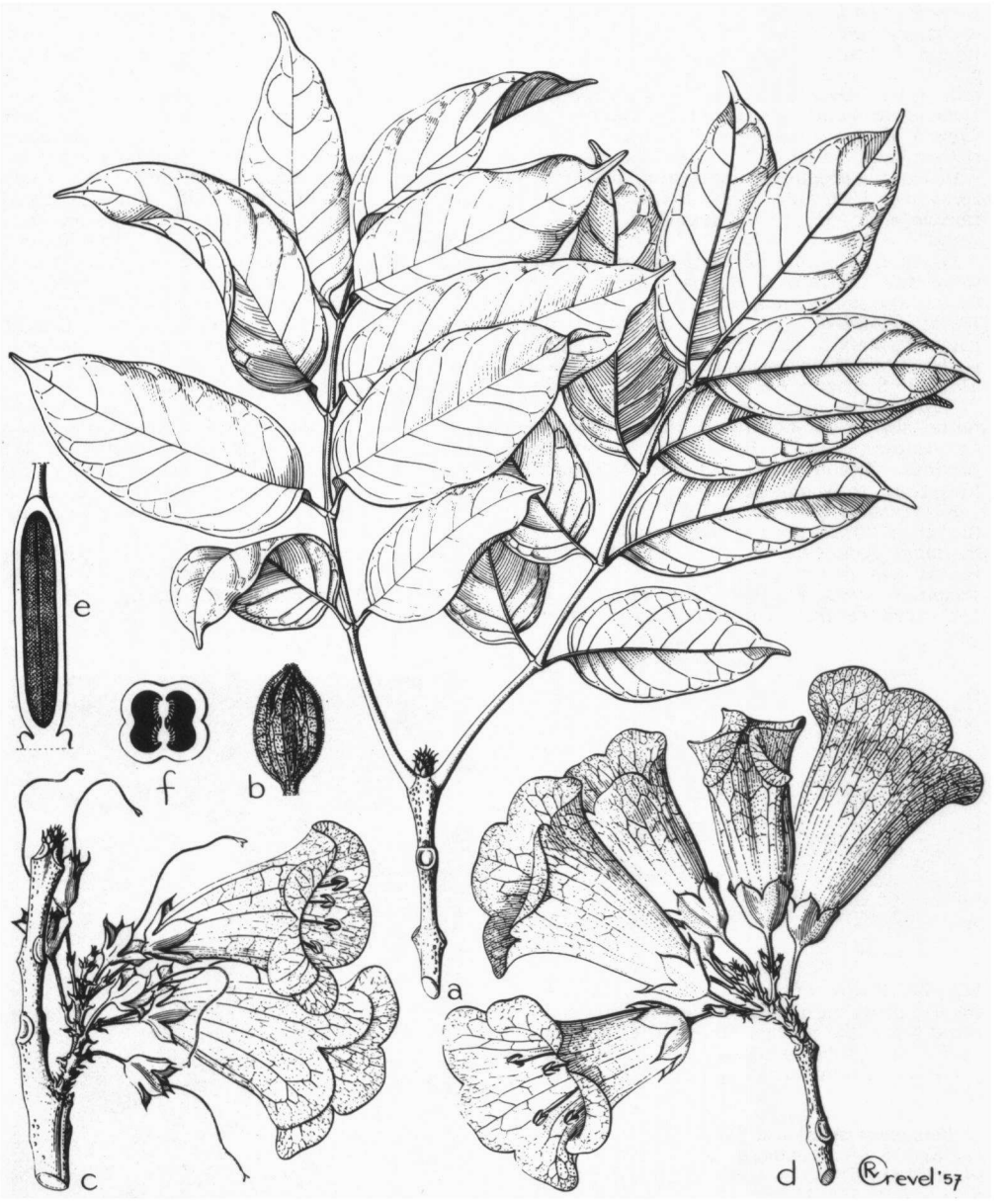


Fig. 26. *Lamiodendron magnificum* STEEN. a. End of twig, × 1/3, b. bud, nat. size, c. ramiflorous raceme, d. terminal raceme, both × 1/3, e. LS section of ovary, × 3, f. CS of *ditto*, × 5 (BRASS 25543).

12. PAJANELIA

A.P.DC. Bibl. Univ. Genève II, 17 (1838) 130, repr. p. 14; A.DC. Prod. 9 (1845) 227; BUREAU, Mon. (1864) 35, 50, t. 20; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1895) 244. — **Fig. 27, 29.**

Ecol. Rain-forest, up to 350 m, according to field labels in most localities rather common; see *e.g.* TEYSMANN, *l.c. Fl.* Oct.–Dec., *fr.* Dec.–May.

Uses. An estimated timber tree, used for boats *etc.* (HEYNE, *l.c.*).

Vern. *Tuwé*, Atjeh, *tuhi*, Karo-Batak, *radja*, Batak, *sungkè* (*tjirit*)), M, Padang Uplands, *sungkai rimbo*, Minangkabau. The name *sungkai* is also used in Palembang for another timber tree with opposite pinnate leaves: *Peronema canescens* (*Verben.*).

Note. DEN BERGER & BIANCHI (Tectona 24, 1931, 894–903) noted that the vessels contain a sulphur-yellow substance colouring red with alcohol: lapachol; a rare feature.

This tree is cultivated in Hort. Bog. *sub n.* XI-C-106A and XI-H-27; unfortunately duplicates of several other numbers (XI-I-10, 20 & 50) have been distributed under this name also; they, however, all belong to *Dolichandrone serrulata* (WALL. *ex* DC.) SEEM.

11. LAMIODENDRON

STEEN. Nova Guinea n.s. 8 (2) (1957) 381, f. 1. — **Fig. 26.**

Evergreen tree. Twigs thick, hard, lenticellate, nodes with pitted glands, internodes flattened. *Leaves* 1-pinnate; leaflets without domatia. *Racemes* or *panicles* terminal or from the twigs, hairy and with numerous capitate-glandular hairs. *Thyrses* terminal, sometimes reduced to short-racemiform. *Flowers* large, not articulated with the pedicels. Pedicels bracteolate, often with abortive flowers in the axil. *Calyx* halfway split, valvately 5-lobed already in bud, thin, veined. *Corolla* campanulate, hardly zygomorphic, without basal tube, glabrous, glandular-punctate; lobes 5, imbricate in bud, rounded, entire. *Stamens* 4 and a staminode, inserted in the hairy throat. *Ovary* 4-sulcate, each cell with 2 placentas on the septum, ovules very many, in many rows; stigma with 2 oblong-spathulate lips. *Capsule* (immature, $4^1/_2$ cm long) linear, shortly beaked, oval in CS with a flat septum on which developed winged ovules; pericarp with 2 fine grooves in the middle of the valves and obviously the capsule loculicid.

Distr. Monotypic. *Malesia:* E. New Guinea: Milne Bay Distr., d'Entrecasteaux Is. (Normanby I.) and Louisiades (Rossel I.).

Ecol. Coastal lowland forest, rain-forest and sago swamps.

Taxon. Possibly related to *Fernandoa*, but lacking domatia and with small crateriform glands on the leaflets beneath; the fruit structure may yield further criteria.

1. Lamiodendron magnificum STEEN. Nova Guinea n.s. 8 (2) (1957) 381, f. 1; Blumea 18 (1970) 563. — **Fig. 26.**

Tree, 12–20 m; flush purplish green. *Leaves* 4–5-jugate, glabrous, 30–50 cm; petiole ($2^1/_2$–)6–10 cm; petiolules 1–2 cm; leaflets firmly chartaceous, ovate-oblong, acuminate, oblique with unequal base, 7–19 by $3^1/_2$–9 cm; nerves 7–11 pairs; beneath with scattered, small, pitted crateriform glands. *Thyrses* glandular-hairy, 2–3 times cymosely branched, up to 18 cm, sometimes seemingly from old wood reduced to racemiform and rachis 1–3 cm. Bracts ovate-acute, 3–4 mm. Pedicels $1^1/_2$–$2^1/_2$ cm, with 1–2 pairs of bracteoles 3–5 mm long. *Calyx* 2–3 cm, with a few glands, rather densely short capitate-glandular hairy; lobes wide-ovate, mucronate, 1–$1^1/_2$ by $^3/_4$–1 cm. *Corolla* showy, brilliant orange to apricot, dark purple-red veined, with many small glands and the lobes (and tube) laxly capitate-glandular hairy, 8–10 by $4^1/_2$–6 cm; lobes $^1/_2$–2 cm long, 3–$3^1/_2$ cm wide. *Stamens* 5–7 cm long, inserted near the base of the corolla, at the base densely hairy; staminode 2 cm; anthers with free, divaricate cells, not versatile, reflexed, 6 mm long. *Ovary* quadrangular-fusiform, 1 cm long, with large impressed glands, moreover covered by dense, microscopical 1-celled hairs and short-stalked peltate to capitate-glandular hairs; style 4–6 cm; stigmatic lobes oblong-acuminate, 4 mm.

Distr. *Malesia:* E. New Guinea (Milne Bay Distr., Raba Raba Subdistr., Biniguni, May I track, 9°38′ S, 149°18′ E; Northern Distr., Popondetta Subdistr., road to Gona-Arunda; near Wanigela; near Alotau), Normanby and Rossel Is.

Ecol. In Normanby I. forming a community on a gravel bank behind the beach fronting swamp forest, near Wanigela in sago swamps, in Rossel I. at 10 m in a rain-forest on a stream bank, near Biniguni in poor lowland rain-forest at 90 m, in Popondetta in disturbed forest, near Alotau CRUTTWELL saw a single tree.

Note. Worthy of introduction into cultivation for the large showy flowers.

Glabrous tree without buttresses, robust in all its parts. *Leaves* 1-pinnate; rachis and petiole sharp-keeled above. *Thyrses* coarse, erect, terminal; branches scattered, 1–3 times dichotomous. *Calyx* closed in bud, campanulate, coriaceous, with 5 irregular lobes, articulated with the pedicel. *Corolla* large, ventricose-campanulate,

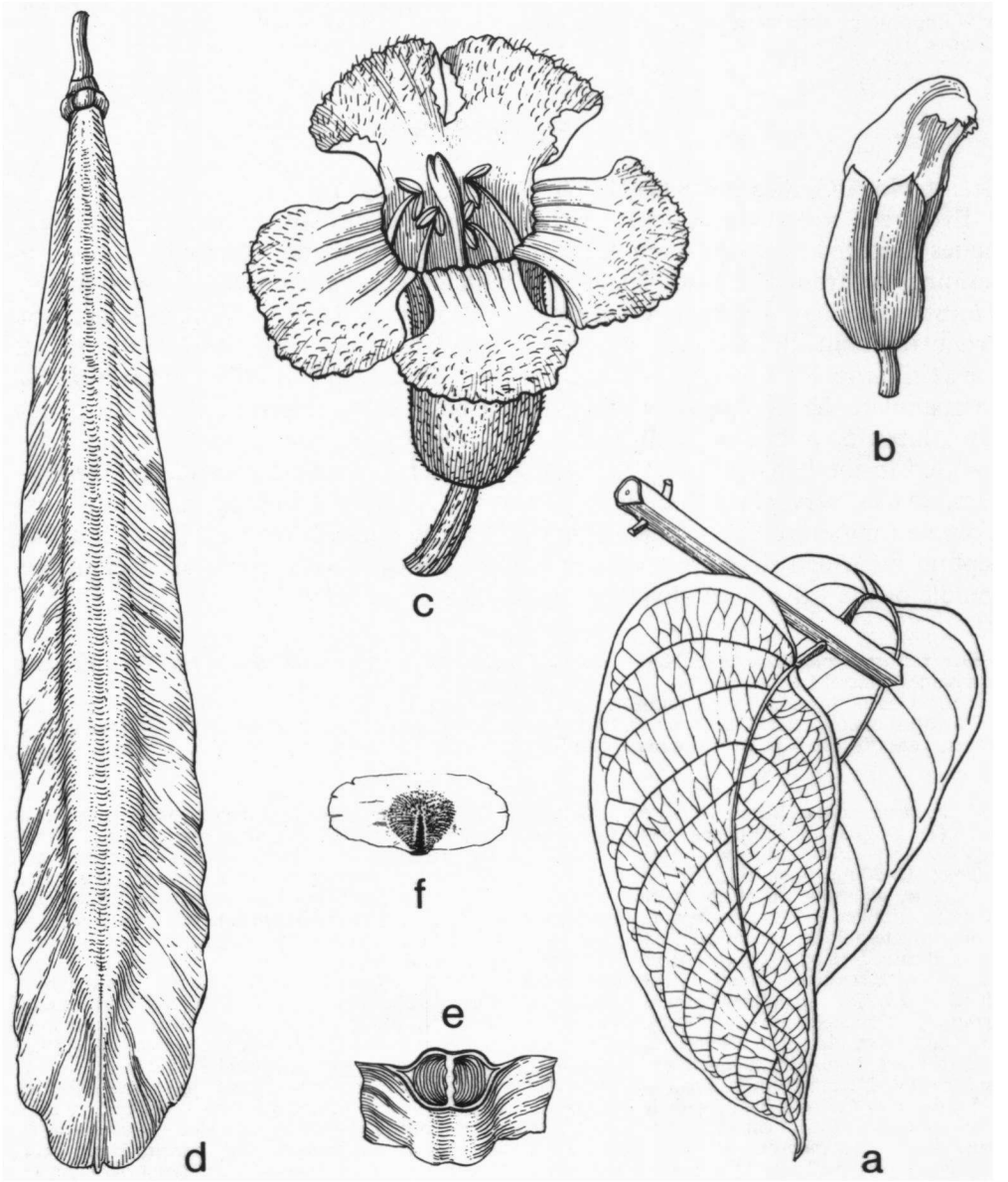


Fig. 27. *Pajanelia longifolia* (WILLD.) K.SCH. a. Fragment of leaf, × ½, b. bud, c. flower, both nat. size, d. capsule, e. *ditto* in CS, both × ½, f. seed, nat. size (*a–c* after WALLICH, Pl. As. Rar. 1, t. 95/96, *e–f* KERR 18547).

± constricted above basal tube, zygomorphous; lobes 5, spreading to recurved, nearly equal, 2 lobes connate halfway up, imbricate in bud. *Stamens* 4, inserted at apex of lower tube, didynamous, subexserted, 5th rudimentary; filaments thick, anther-cells divergent. *Disk* large, annular, fleshy. *Ovary* oblong-cylindric; ovules in each cell ∞, on 2 placentas, ∞-seriate. *Capsule* flat, obovate-lanceolate, tipped, valves broadly winged along the margin. *Seeds* in several rows on the edges of the septum, compressed, hyaline-winged.

Distr. Monotypic, from Malabar eastwards through SE. Asia (E. Bengal: Khasia, Sylhet; Burma: Pegu, Travancore, Chittagong, Tenasserim; Thailand, Andaman Is.) to *West Malesia:* N. Sumatra (E. Atjeh), Malaya (Perak, N. Kedah, ?Singapore, ?Penang), and the Natuna Is. (Sedanau, Bunguran, Duperré) in the S. China Sea, NW. of Sarawak. Fig. 28.

F.-VILLAR (Nov. App. 1880, 150) recorded it erroneously from the Philippines.

Ecol. Lowland evergreen mixed forests, in the Andaman Is. also in deciduous forest.

I assume bats visit the probably nocturnal flowers, but there are no direct records.

1. Pajanelia longifolia (WILLD.) K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1895) 244; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 267; *ibid.* 12 (1932) 164, f. 2 (map). — *Pajaneli* RHEEDE, Hort. Mal. 1 (1678) 79, t. 44, *sphalma in textu* t. "45". — *Bignonia indica var.* β LINNÉ, Sp. Pl. (1753) 625. — *Bignonia longifolia* WILLD. Sp. Pl. 3 (1800) 306. — *Bignonia pajanelia* BUCH. HAM. Trans. Linn. Soc. 13 (1821) 516, *nom illeg.*, quoting WILLD. — *Bignonia multijuga* WALL. [Cat. 6503] Pl. As. Rar. 1 (1830) 81, t. 95–96; G. DON, Gen. Syst. 4 (1838) 221. — *P. multijuga* A.P.DC. Bibl. Univ. Genève II, 17 (1838) 130; A.DC. Prod. 9 (1845) 227, *excl. syn.* LOUR. *et* PERS.; MIQ. Fl. Ind. Bat. 2 (1858) 758; BUREAU, Mon. (1864) 50, t. 20; KURZ, Prel. Rep. For. Veget. Pegu (1875) App. A: xciii, App. B: 69; Fl. Burma 2 (1877) 237 ('*Payanelia*'); GAMBLE, J. As. Soc. Beng. 74, ii (1905) 382; RIDL. Fl. Mal. Pen. 2 (1923) 549. — *P. rheedii* WIGHT, Ic. 4 (1848) t. 1343–4; Ill. 2 (1850) t. 161bis; BEDD. Fl. Sylv. 3 (1872) clxix, t. 21–5; CLARKE, Fl. Br. Ind. 4 (1884) 384; BRANDIS, Ind. Trees (1906) 494; PARKINSON, For. Fl. Andam. (1923) 215. — *P. bijuga, lapsus mihi, in syn.* Bull. Jard. Bot. Btzg III, 10 (1928) 267. — **Fig. 27, 29.**

Evergreen, small to large tree up to 30 m, 1 m ⌀, changing leaves before flowering. Innovations resinous. Twigs terete, thick, lenticellate. *Leaves* 1-pinnate, 8–12-jugate, 40–120 cm; petiole thick, to 15 cm, rachis sharply keeled above, rounded beneath; leaflets entire, oblique, ovate-oblong, tipped, chartaceous, 10–20 by 5–8 cm, 3–5 mm stalked; nerves anterior side 9–12, posterior 6–9 pairs; beneath with scattered or heaped crateriform glands along the midrib. *Thyrses* up to 1 m, coarse, rachis hollow, 1 cm ⌀; pedicels $2^1/_2$ cm; bracteoles minute. *Flowers* with a soapy smell, pale yellowish, inside dull-purple shaded. *Calyx* 3–5 cm, densely covered with microscopical glands and besides with scattered, rimmed, dish-shaped, large glands; splitting into 5 irregular, crispately-crenulate, acute lobes, tube at base with keel-like folds, persistent. *Corolla* 5–$7^1/_2$ cm, thick, ± constricted above base, pubescent except at base; lobes imbricate in bud, in anthesis reflexed, broad-obovate, crenulate and crispate; anthers brown to nigrescent, cells divergent. *Style* long, with a 2-lobed, clavate stigma. *Capsule* stiped, 30–45 by 5–9 cm (incl. the 2–3 cm wide, often splitting wings), with a dorsal ridge, and a corky margin on which the wings; septum quadrangular in CS, contracted in the middle, corky. *Seeds* in ∞ rows on each margin of the septum, curved, $2^1/_4$–3 by $^3/_4$–$1^1/_4$ cm (incl. the hyaline wings).

Distr. As the genus. Erroneously recorded for the Philippines by F.-VILLAR, Nov. App. (1880) 150. Rarely planted (Atjeh). Fig. 28.

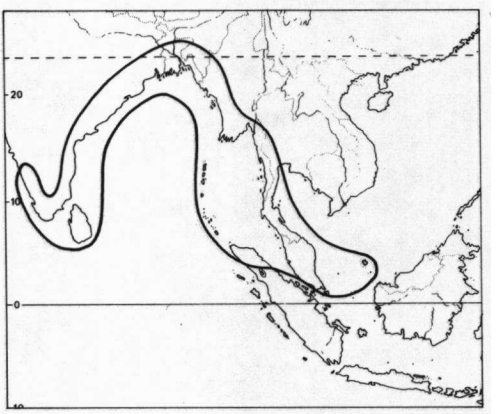


Fig. 28. Range of the genus *Pajanelia* A.P.DC.

Ecol. Lowland primary and secondary rain-forest, in the Natuna Is. common, with plenty of seedlings, spared in coconut stands, elsewhere scattered, riverbanks, etc., mostly coastal, from sea-level to 100 m; in the Ghats recorded to 700 m altitude. *Fl.* Jan.–April, Aug., *fr.* March–April, Aug.

Indian authors cite it as being evergreen, but in the Natuna Is. I found it shortly deciduous. KURZ found it in Burma an evergreen tree. He recorded it from the Andaman Is. as 'very abundant in the leafless jungles', that is: monsoon forest (Rep. Veg. Andam. Is. 1870, 12, 43, 71). PARKINSON gave no definite clue on the leaf change.

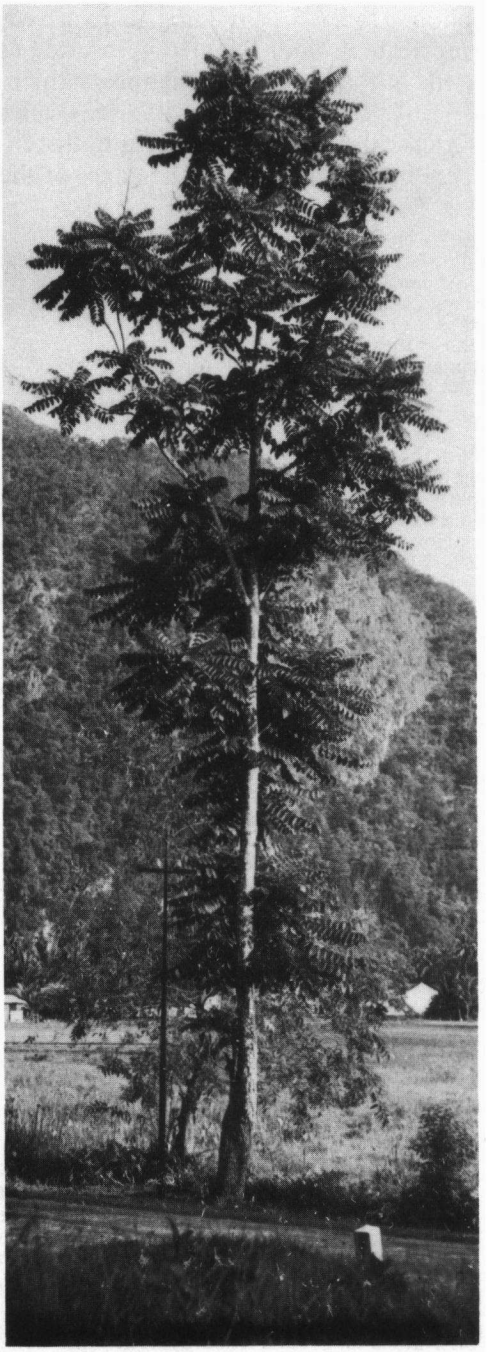


Fig. 29. Tree of *Pajanelia longifolia* (WILLD.) K.SCH. showing the sparingly branched, ± pachycaul habit; behind is a limestone hill with dry evergreen forest (photogr. CORNER, 1935, Sg. Sedili).

The calyx contains water in bud, like other coarse-flowered members (*Spathodea*, *Oroxylum*, *etc.*).

Uses. GAMBLE (Manual Ind. Timb. ed. 1922, 517) said it is a good timber with close-grained wood. PARKINSON *l.c.* found it common in the Andaman Is. where it is used for canoes, planking, and boat-building; timber smells like teak and seems to withstand attacks of white ants. KURZ (1870) recorded the largest tree with a trunk of 2 m ∅. In the Natuna Is. it is estimated for building boats.

In the latter islands a decoction of leaves is used against fever; in Malaya a hot fermentation is applied on the body for stomach disorders (BURKILL, Dict. 1935, 1623).

Vern. *Bĕkak gunong*, *bongli*, *kaju bonglai*, M, Malaya, *kaju sĕmua*, Natuna Is., *abeuèng laut*, Meulaboh, Atjeh.

Note. For obscure reasons BEDDOME (*l.c.*) found this anomalous in the family, its flower reminded of *Jasmineae*; but he also included *Schrebera* (*Oleaceae*)!

13. NEOSEPICAEA

DIELS, Bot. Jahrb. 57 (1922) 500, f. 1; STEEN. Thesis (1927) 899; Bull. Jard. Bot. Btzg III, 10 (1928) 216; Nova Guinea n.s. 8 (1957) 173; *ibid.* Bot. *n.* 3 (1960) 15. — *Haussmannia* F.v.M. Fragm. 4 (1864) 148, *non Hausmannia* DUNKER, 1846; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 223; STEEN. Thesis (1927) 901. — *Nyctocalos subg. Haussmannia* SEEM. J. Bot. 8 (1870) 149. — *Pandorea sect. Leptophyllae* STEEN. Thesis (1927), 841, *in clav.*; Bull. Jard. Bot. Btzg III, 10 (1928) 200. — *Pandorea sect. Grandiflores* STEEN. Nova Guinea 14 (1927) 301, *in clav., pro parte.* — *Tecomanthe sect. Aurantiacae* STEEN. Thesis (1927) 872, *in clav.*; Bull. Jard. Bot. Btzg III, 10 (1928) 203. — *Haussmannianthes* STEEN. Proc. R. Soc. Queensl. 41 (1929) 50. — **Fig. 30, 37c.**

Large lianas. Twigs with a distinct gland-field on the nodes. *Leaves* digitately compound; leaflets 3–5, sessile or short-stalked, only articulated at the base of the petiolule, mostly unequal, terminal one largest, often with a metallic hue above (*s.s.*), both faces with numerous microscopical glandlets, underneath besides with

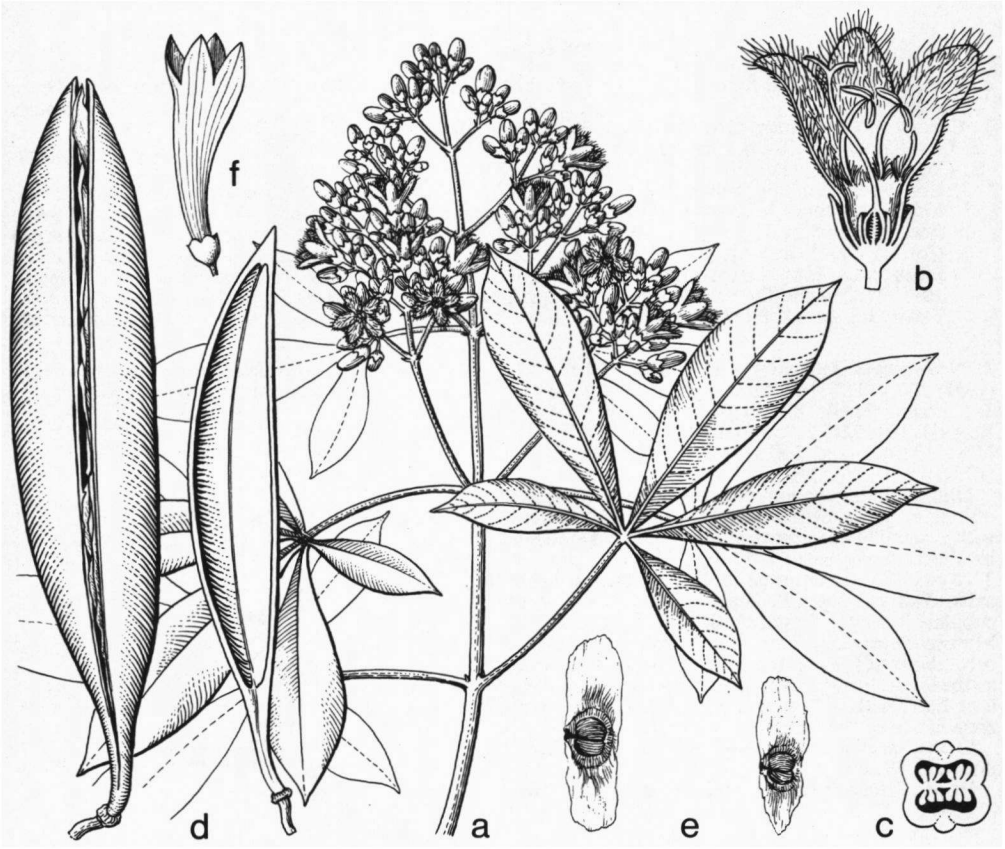


Fig. 30. *Neosepicaea viticoides* DIELS. a. Habit, × 1/2, b. LS of flower, showing also disk and staminode, × 2, c. CS of ovary, × 12. — *N. leptophylla* (BL.) STEEN. d. Just opened capsule and one valve from inside, × 1/2, e. two seeds, × 1/2, f. flower, × 1/2 (*a–c* LEDERMANN 9809, after DIELS, *d–e* BECCARI PP 687, *f* D. BERGMANN 261).

few, flat, scattered, larger, round glands $^1/_4$–$^1/_2$ mm ⌀. *Thyrses* ∞-flowered, terminal, axillary to ramiflorous. *Calyx* proportionally small, cupular to campanulate, truncate and minutely toothed, or shallowly 5-lobed by tearing. *Corolla* short-campanulate or more often ± curved, narrow trumpet-shaped, glabrous, or outside at least the lobes puberulous-papillose; lobes deltoid, valvate, tomentose on the inner margin, lobes or tube inside sometimes with larger hairs; tube with a dense ring of long hairs at the insertion of the stamens. *Stamens* 4, didynamous, exserted, 5th rudimentary; anther-cells divaricate. *Disk* cupular, enveloping the ovary base. *Ovary* glabrous; style exserted; stigma 2-lamellate, 2-celled, with 2 placentas in each cell and ∞ ovules. *Capsules* stipitate, *c.* 10–20 cm long, narrow oblong, terete to broad-ellipsoid in section, beaked; valves boat-shaped. *Seeds* ∞, thin-winged, rectangular.

Distr. Queensland (1 *sp.*) and *Malesia:* New Guinea (3 *spp.*). Fig. 31.
Ecol. Rain-forests, from the lowland up to *c.* 2000 m.
Note. In the *Campsis*-alliance possibly closest related to *Pandorea*, different by the almost regular flowers, the valvate corolla lobes, the exserted stamens and style, digitate leaves, and cupular disk clasping the base of the ovary.

KEY TO THE SPECIES

1. Corolla brown, basal tube, upper tube and lobes all about $^1/_2$ cm long; lobes inside bearded, tube on one side so . . . . . **1. N. viticoides**
1. Corolla red or orange, at least 3 cm long, the tube many times as long as the lobes.
2. Corolla orange, 10 cm long incl. the lobes . . . . . **3. N. aurantiaca**
2. Corolla red or pink, $2^1/_2$–7 cm long incl. the lobes.
3. Corolla 5–7 cm long, puberulous to glabrous, lobes 1–2 cm long, outside sometimes with dark glands, inside sometimes long-hairy. Thyrses axillary. Capsule 13–20 by 3 cm, with woody valves. Seeds (incl. wings) 5 by $1^1/_2$ cm . . . . . **2. N. leptophylla**
3. Corolla $2^1/_2$–3 cm long, glabrous outside except occasionally the puberulous apex of the glandless lobes $^1/_2$ cm long, inside glabrous. Thyrses terminal and from the uppermost leaf-axils. Capsule 10–15 by $2^1/_2$ cm, the valves thin-coriaceous. Seeds (incl. wings) 3 by 1 cm. Queensland. *Cf.* STEEN. Nova Guinea n.s. 8 (1957) 174 . . . . . **N. jucunda** (F.v.M.) STEEN.

1. Neosepicaea viticoides DIELS, Bot. Jahrb. 57 (1922) 500, f. 1; S. MOORE, J. Bot. 61 (1923) Suppl. 38; STEEN. Thesis (1927) 900; Bull. Jard. Bot. Btzg III, 10 (1928) 217; J. Arn. Arb. 28 (1947) 423; Nova Guinea n.s. 8 (1957) 174; *ibid.* Bot. *n.* 3 (1960) 15. — **Fig. 30a–c.**

High-climbing canopy liana. *Leaflets* (3–)4–5, oblong-elliptic, acuminate, chartaceous, often with a metallic hue above, sessile to $1^1/_2$ cm stalked by the tapering base; 8–17 by 3–$7^1/_2$ cm; petiole 3–10 cm. *Thyrses* terminal and in uppermost leaf-axils, 5–20 cm long. Pedicels *c.* $^1/_4$–$^1/_2$ cm. *Calyx* cupular, 3–5 by 3–5 mm, shallow-lobed, glandless. Mature *corolla* $2^1/_2$–3 cm, outside papillose, basal tube about as long as the widened upper tube and as the lobes, brown, with dark streaks inside; lobes long-hairy within, 3–4 mm; tube with a long-hairy zone inside to the insertion of the stamens.

Distr. *Malesia:* East New Guinea (18 collections), in W. one.

Ecol. Rain-forest, not rare, from sea-level to *c.* 1500 m. *Fl.* Jan.–Oct.

Notes. A homogeneous species, but the flower colour is variously defined probably in part due to the age of the flowers: dull ochre, dull yellow with maroon markings, brownish olive, dull red or brick-purple, brown and purple within; petals velvet red. Young leaves are purple.

No fruit has as yet been collected, and it has only once been found in West New Guinea.

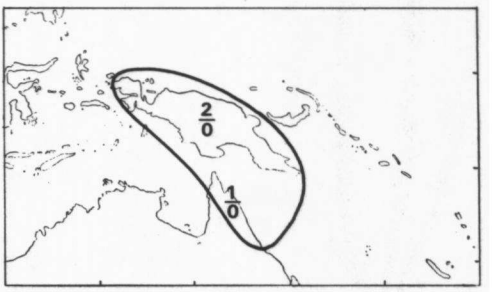


Fig. 31. Range of the genus *Neosepicaea* DIELS; in New Guinea 2 (?3) and in Queensland 1 endemic species.

2. Neosepicaea leptophylla (BL.) STEEN. Nova Guinea, Bot. *n.* 3 (1960) 15. — *Tecoma leptophylla* BL. Rumphia 4 (1849) 35, *quoad flor.*; Mus. Bot. 1 (1849) 27; MIQ. Fl. Ind. Bat. 2 (1858) 758; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 197; K.SCH. in

K.Sch. & Laut. Fl. Schutzgeb. (1900) 540. — *Gelseminum leptophyllum* O.K. Rev. Gen. Pl. 2 (1891) 480. — *Pandorea leptophylla* BOERL. Handl. 2 (1899) 600; DIELS, Bot. Jahrb. 57 (1922) 449; STEEN. Nova Guinea 14 (1927) 301, t. 33; Thesis (1927) 843; Bull. Jard. Bot. Btzg III, 10 (1928) 200; Proc. R. Soc. Queensl. 41 (1929) 46, 56. — *N. superba* STEEN. Nova Guinea n.s. 8 (1957) 173; *ibid.* Bot. *n.* 3 (1960) 15. — **Fig. 30d–f.**

Large liana, up to 20 m, 3 cm ∅. *Leaflets* 3–5, oblong elliptic, acuminate, chartaceous to coriaceous, often with a metallic hue above, base cuneate in degree, from sessile to not rarely narrowed to a pseudo-petiolule to 3 cm long; 6–18 by 3–11 cm; petiole 5–12 cm. *Thyrses* obviously axillary, or on old wood, 5–30 cm long. Pedicels $^1/_2$–$1^1/_4$ cm. *Calyx* cupular, not appressed to corolla, 4–7 by 6–7 mm, margin ± entire to shallowly lobed, glabrous, often with a few glands. Mature corolla 5–7 cm (incl. the lobes *c.* 1–2 by $^1/_2$–$^3/_4$ cm), tube $2^1/_2$ cm wide at mouth, slightly curved, outside glabrous or papillose (except at base), purplish (see notes), lobes outside papillose or glabrous, with few to several dark glands or glandless, inside sometimes with long hairs; tube inside glabrous or with a few or a line of long hairs. *Capsule* 13–20 by $2^1/_2$ cm, terete or oval in section, the valves woody. *Seeds* (incl. the wings) 4–5 by $1^1/_2$ cm.

Distr. *Malesia:* New Guinea.

Ecol. Rain-forest from the lowland to *c.* 2000 m. *Fl.* March–May, July–Nov.

Vern. *Ie-up*, Kebar (once noted).

Notes. Fruits have only once been collected by BECCARI (Arfak Mts).

All inflorescences hitherto observed are axillary, a single one is from old wood.

The flower colour seems to vary, and to change. VINK (BW 11404) noted buds: calyx green, tube pale green, lobes purple; submature flower base of tube yellow, further orange-red, inside yellow, orange-red veined. PULLEN (7729) noted on mature flowers: pale purple, lobes recurved, inside white with purple streaks. Others say merely flowers pale violet; PLEYTE (887) noted yellow. As in *N. jucunda* the lobes obviously are reflexed in mature flowers.

I have reduced here *N. superba* which was distinguished by the papillose-puberulous corolla, dark glands on the outside of the lobes, and long hairs within extending in a narrow line into the tube. Three collections have this well expressed (BRASS 23829, PAYMANS 53 and PULLEN 7729). However, there are other specimens defeating these characters: SATAKE 834 and PLEYTE 887 have no hairs in the tube and hardly any glands on the lobes; BECCARI *s.n.* has a puberulous corolla, but no long hairs; BERGMANN 226 has an occasional hair in the tube and an occasional gland on the lobes, but a glabrous corolla; BERGMANN 261 has the long hairs inside, but a glabrous corolla without glands and thus comes nearest to BLUME's type.

The Papuan species is close to *N. jucunda* from Queensland. This has a much smaller, glabrous corolla except occasionally the puberulous tip of the lobes, the latter constantly much smaller; also the thyrses are generally terminal whereas they always seem lateral in *N. leptophylla*; its fruit is smaller and the valves much thinner.

3. Neosepicaea aurantiaca (DIELS) STEEN. Blumea 15 (1967) 298. — *Tecomanthe aurantiaca* DIELS, Bot. Jahrb. 57 (1922) 497; STEEN. Nova Guinea 14 (1927) 296; Thesis (1927) 874, 834, f. 3d; Bull. Jard. Bot. Btzg III, 10 (1928) 204. — **Fig. 37c.**

Leaflets 3, coriaceous; petiole 6–7 cm; blade oblong, acuminate, cuneate at base, 10–15 by $4^1/_2$–6 cm; nerves 8–10 pairs. Thyrses axillary; peduncle 8 cm. Calyx 5–8 by 8–9 mm. Corolla orange, c. 10 cm long, $2^1/_4$–$2^3/_4$ cm wide at apex; lobes inside puberulous, $1^1/_2$–$2^1/_2$ cm.

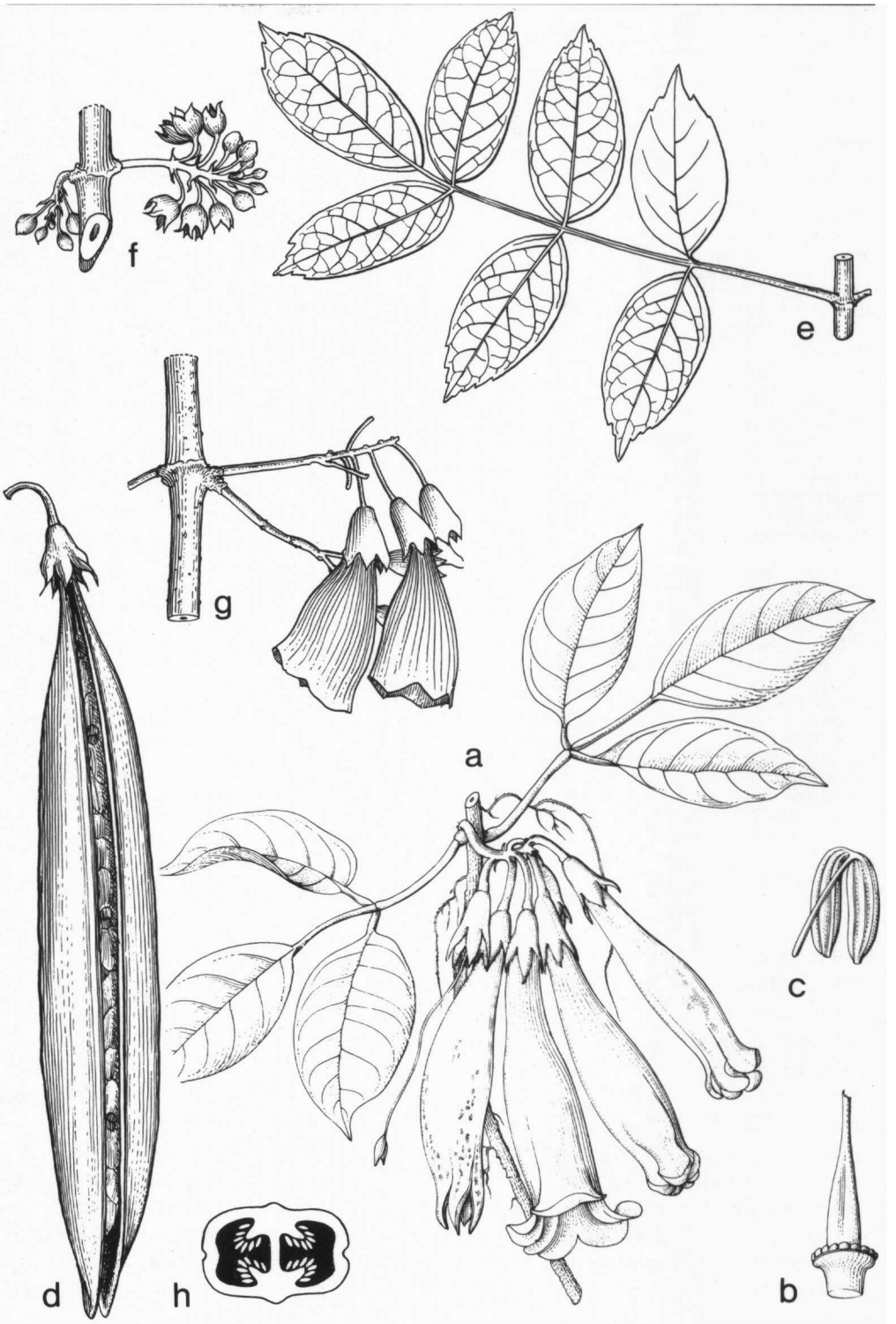
Distr. *Malesia:* East New Guinea (Etappenberg, Sepik Distr.: LEDERMANN 9561, B†), once found at 850 m.

Note. The cupular calyx and thyrsoid inflorescence stamp this as a *Neosepicaea*. It might turn out to be an exceptionally large-flowered form of *N. leptophylla*.

14. TECOMANTHE

BAILL. Hist. Pl. 10 (1891) 41; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; BOERL. Handl. 2 (1899) 590; DIELS, Bot. Jahrb. 57 (1922) 496; STEEN. Nova Guinea 14 (1927) 294; Thesis (1927) 864; Bull. Jard. Bot. Btzg III, 10 (1928) 201, *incl. sect. Dendrophilae, Volubiles et Saxosae* STEEN. *l.c.* 205, 208, 210; Pac. Pl. Areas 1 (1963) 288, map. — *Campana* RUMPH. *ex* POST & O.K. Lexicon (1904) 95, *nom. inval.* — *Pandorea sect. Grandiflores* STEEN. Nova Guinea 14 (1927) 301, *pro parte.* — **Fig. 32–36.**

Small to large lianas, climbing or creeping (in mountain heaths). Glands on twig-nodes small. *Leaves* 1-pinnate, 1–7-jugate; leaflets entire or toothed, underneath very finely punctate-glandular. *Racemes* short, pendent, from efoliate nodes on old wood, very rarely axillary or terminal; peduncle short, with some crowded, small, sterile bracts at base, in fruit thickening like a brachyblast; rachis short (up to *c.* 7(–13) cm); flowers opposite, in the axil of a small, narrow fugacious bract.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Pedicels with 2 small, narrow bracteoles. *Calyx* closed in bud, persistent, *c.* $1^1/_2$–4 cm, with 5 fairly large, deltoid ± equal lobes short-hairy along the margin, rarely split on one side. *Corolla* infundibuliform, the basal tube gradually widening upwards, ± straight, mostly pink, *c.* 5–12 cm long, inside near the insertion of the stamens stuppose or lax-hairy and sometimes with capitate-glandular papillae; limb mostly slightly zygomorphous, very rarely distinctly zygomorphous; lobes in bud narrowly imbricate, mostly deltoid. *Stamens* didynamous, mostly included, 5th rudimentary; anther-cells almost free, (in Mal.) *c.* 4 mm and almost always divaricate. *Disk* thick, annular. *Ovary* glabrous, in each of the 2 cells with ∞ rows of ovules attached on 2 placentas on the dissepiment; stigma long, filiform, with 2 spathulate stigmas. *Capsule* linear-terete or flattened, stipitate and beaked, with 2 coriaceous or almost woody, smooth, wide or very narrow boat-shaped valves. *Seeds* ∞, orbicular, with fairly large, thin-membranous wings.

Distr. Species 5, 1 in the Three Kings Is. at the N. tip of New Zealand, 1 in East Queensland, the others in *Malesia:* Moluccas (Ternate, Halmaheira, Ambon, Ceram, Aru Is.), throughout New Guinea (incl. Misool, Biak, Jappen, New Britain and Woodlark I., Trobriands), and ?Solomons (Bougainville). Fig. 34.

Ecol. Primary and secondary rain-forest, mossy forest and mountain heaths, from sea-level up to 3100 m.

One collector noted honey in the flowers. It is likely that the diurnal flowers are bird-pollinated, but there are no records.

Tecomanthe speciosa was derived from cuttings of the single plant found in nature. It has in cultivation produced flowers and can obviously propagate by self-pollination. The corolla is sometimes (in the herbarium) already ± open before full maturity. In one case rather long, unbranched, pendent, aerial roots were observed emitted from a node. In juvenile specimens leaves tend to be more toothed than in mature foliage.

Taxon. As I stated before *Tecomanthe* belongs with *Pandorea* to a distinct circum-Pacific affinity of lianas, including *Campsis* in East Asia and North America and *Campsidium* in Chile, all sharing a similar shape of flower and fruit. The South African genus *Podranea* is more remote and with its inflated calyx and linear capsules possibly more allied to *Tecoma*. The four genera can be keyed out as follows:

1. Flowers in racemes, opposite. Evergreen, not climbing with roots. Calyx with well-developed lobes, 1–4 cm long. Corolla with a hair-ring (lax or stuppose, sometimes replaced in part by capitate-glandular papillae) near the insertion of the stamens.
2. Racemes almost always on the old wood, rarely axillary or terminal. Peduncle at the base with crowded sterile bracts, rachis up to 7 cm, pendent, flowers close together. Calyx large, $1^1/_2$–4 cm. Corolla 6–12 cm, tube not contracted below the slightly or distinctly zygomorphous limb; lobes deltoid, in bud narrowly imbricate. Anthers mostly included, cells almost always divaricate. Valves of the capsule widely or narrowly boat-shaped; endocarp not removable . . . . . **Tecomanthe**
2. Racemes terminal on leafy twigs. Peduncle at base without bracts; flower pairs spaced. Calyx *c.* 1 cm. Corolla *c.* $3^1/_2$ cm long, tube contracted below the limb; lobes rounded. Stamens ± exserted; anther-cells free but parallel. Capsule narrowly elliptic-oblong, with removable papery endocarp. Chile . . . . . **Campsidium**
1. Flowers paniculate in terminal thyrses, very rarely depauperate in racemes but then the calyx much smaller than 1 cm. Corolla lobes widely imbricating. Anther-cells divaricate.
3. Deciduous, climbing with roots. Leaflets 5 pairs, distinctly sharply serrate. Calyx large, *c.* $1^1/_2$–3 cm, with large lobes. Corolla inside glabrous, large, *c.* $5^1/_2$–8 cm . . . . . **Campsis**
3. Evergreen, not climbing with roots, rarely erect (in arid country). Leaflets 1–7 pairs, not distinctly sharply serrate in mature specimens. Calyx small, stunted or short-lobed, $2^1/_2$–8 mm. Corolla smaller, $1^1/_2$–$3^1/_2$(–5) cm, almost always with a hair-ring near the insertion of the stamens and long hairs one-sided in throat and upper part of tube . . . . . **Pandorea**

Uses. Almost all species are ornamental and can be cultivated in tropical and subtropical countries; they are not hardy. Propagation by cuttings or seed.

KEY TO THE SPECIES AND SUBSPECIES

1. Corolla cream-coloured, woolly tomentose in the upper half, 6–8 cm long, the limb very zygomorphic. Stamens exserted, anthers *c.* 10 mm, with parallel cells. Calyx often split on one side to the base, the

Fig. 32. *Tecomanthe dendrophila* (BL.) K.SCH. a. Habit, × $^1/_2$, b. pistil, c. anther, both enlarged, d. capsule, × $^1/_2$. — *T. ternatensis* STEEN. e. Leaf, f–g. inflorescence in bud and flower, all × $^1/_2$ h. CS of ovary (*a–c* after BLUME, *d* LAE 58656, *e–h* BEGUIN 1201).

Fig. 33. *Tecomanthe dendrophila* (BL.) K.SCH. in the mossy forest on Mt Cycloop, N. New Guinea, at 1200 m (photogr. VAN ROYEN).

lobes very unequal. Leaflets 5, orbicular-elliptic, apex broadly rounded to slightly notched, 8–18 by 5–11 cm, fleshy, coriaceous when dry. Capsule terete, pointed at both ends, *c.* 16 by $2^1/_2$ cm; valves thick, almost woody. Seeds 3–4 by $1^1/_2$ cm (incl. wings). *Cf.* HUNTER, Rec. Auckl. Inst. Mus. 5 (1958) 41, pl. 6–7; HUNT, Bot. Mag. 179 (1972) t. 618. Three Kings Is. (New Zealand) . **T. speciosa** OLIV.

1. Corolla at most puberulous in the upper half of the lobes, not very zygomorphic. Anther-cells 3–4 mm long, divaricate. Calyx never split on one side to the base, lobes equal or unequal. Leaflets acute to acuminate.
2. Uniseriate hairs near the insertion of the stamens very lax, few or almost absent. Rachis of raceme glabrous. Corolla $4^1/_2$–7 cm long.
3. Leaflets in 3–4 pairs, *c.* $3^1/_2$–6 by $1^1/_2$–3 cm, about twice as long as wide, herbaceous, veins between the main nerves usually distinct; lower lateral petiolules 0–3 mm. Calyx *c.* $1^1/_2$ cm long (incl. lobes). Corolla whitish, later pink tinged, $4^1/_2$–6 cm, the lobes 2–5 by 10–15 mm, with dark dots in transparent view. Stamens as long as the style, ± exserted. No capitate-glandular papillae near the insertions of the stamens . . . . . **2. T. ternatensis**
3. Leaflets in 2 pairs (4 or 5), *c.* 3–$8^1/_2$ by $1^1/_4$–4 cm, at least twice as long as wide, often narrower, obviously rather fleshy, at base rounded to truncate, often oblique, veins between the 4–5 main nerves hardly visible; lower lateral petiolules 4–9 mm, longer than upper ones. Calyx $2^1/_2$–3 cm long (incl. lobes). Corolla tube pale, limb pink to rosy-purplish, tube marked with purplish lines inside, $4^1/_2$–7 cm, lobes ovate-triangular, ($^3/_4$–)1–$1^3/_4$ by ($^3/_4$–)$1^1/_2$–$1^3/_4$ cm, without dark dots. Stamens ± shorter than the style, not exserted. Near the insertions of the stamens mainly capitate-glandular papillae and no or few uniseriate hairs. Capsule $5^1/_2$ by 2 cm. *Cf.* C. T. WHITE, Queensl. Nat. 4 (1920) 100, f.; STEEN. Proc. R. Soc. Queensl. 41 (1929) 49. Queensland . . . . . **T. hillii** (F.v.M.) STEEN.

2. Hairs near the insertion of the stamens in a stuppose ring. Corolla 6–13 cm. Rachis of inflorescence often puberulous.
4. Leaves 1–2-jugate; leaflets fairly large, averagely 5–10 by $2^1/_2$–5 cm, mostly herbaceous, usually entire, occasionally with a few coarse teeth to apex; rachis not winged. Lateral pedicels 2–8 mm. Racemes finally rich-flowered (6–20), on the old wood of coarse lianas. Capsule broad-elliptic in section, *c.* 17–22(–30) cm long, *c.* 3(–$3^3/_4$) cm wide and thick, the valves wide-boat-shaped, hard, almost woody. Seeds including wing $2^1/_2$–$3^1/_2$ by $1^1/_4$–$1^1/_2$ cm . . . . . **1. T. dendrophila**
4. Leaves 2–7-jugate; leaflets small, averagely $1^1/_2$–4(–8) by $^1/_2$–$1^3/_4$(–$3^1/_2$) cm, herbaceous to coriaceous, the margin almost always toothed; the sulcate rachis (very) narrow-winged; lateral pedicels 0–2 mm. Racemes pauciflorous (2–6), lateral or terminal, on small, slender lianas. Capsule flat and compressed, 8–14 cm long, the valves very much compressed-boat-shaped, coriaceous. Seeds including wings *c.* $1^1/_2$–2 by 1–$1^1/_2$ cm.
5. Leaves 3–6(–7)-jugate, 4-jugate leaves always present. Leaflets thick-coriaceous to chartaceous (or even herbaceous), elliptic with usually short, acute apex, brittle in the herbarium, the nerves and midrib usually impressed above, never strongly prominent. Calyx $1^1/_2$–3 cm. Corolla 6–10 cm. Staminode usually less than 1 cm long . . . . . **3. T. volubilis**
5. Leaves 2(–3)-jugate, 4- and more-jugate leaves absent. Leaf-apex acute to cuspidate. Staminode $1^1/_2$–3 cm.
6. Leaflets coriaceous, tough when mature, not easily breakable, sharply toothed, with nerves and veins conspicuously prominent on *both* sides. Calyx ($1^3/_4$–)2–$3^1/_2$ cm. Corolla 7–12 cm. **3b. T. volubilis** *ssp.* **tenax**
6. Leaves coriaceous to herbaceous, brittle in the herbarium, toothed but not sharply so; midrib and veins flat or slightly sulcate above, somewhat prominent beneath. Calyx $1^1/_2$–$2^1/_2$ cm. Corolla 6–8 cm . . . . . **3a. T. volubilis** *ssp.* **silvicola**

1. Tecomanthe dendrophila (BL.) K.SCH. in K.Sch. & Laut. Fl. Schutzgeb. (1900) 539; RECH. Denkschr. K. Ak. Wiss. M.-N. Kl. Wien 89 (1913) 603; DIELS, Bot. Jahrb. 57 (1922) 496; STEEN. Nova Guinea 14 (1927) 297; Thesis (1927) 880; Bull. Jard. Bot. Btzg III, 10 (1928) 206; LAUT. Bot. Jahrb. 62 (1928) 292; LOTHIAN, J. R. Hort. Soc. 83 (1958) 295; SYKES, Stud. Cult. Pl. N.Z. 1 (1966) 43, f. 18; HERKLOTS, Fl. Trop. Climb. (1976) 73, f. 97. — *Campana rubra* RUMPH. Herb. Amb. (1755) Auct. 42; *an Pandorea*?, MERR. Int. Rumph. Herb. Amb. (1917) 469. — *Tecoma dendrophila* BL. RUMPHIA 4 (1849) 35, *et Dendrophila trifoliata* BL. *sub.* t. 190; Mus. Bot. 1 (1849) 25; MIQ. Fl. Ind. Bat. 2 (1858) 757; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 197; K.SCH. Bot. Jahrb. 9 (1887) 218; Fl. Kais. Wilh. Land (1889) 123; WARB. Bot. Jahrb. 13 (1891) 418; F.v.M. Descr. Not. 9 (1890) 64. — *Tecoma amboinensis* BL. Rumphia 4 (1849) 35; Mus. Bot. 1 (1849) 26; MIQ. Fl. Ind. Bat. 2 (1858) 757. — *Campsis dendrophila* SEEM. J. Bot. 5 (1867) 373. — *Campsis amboinensis* SEEM. *l.c.* 374. — *T. bureavii* BAILL. Hist. Pl. 10 (1891) 41; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230. — *Gelseminum amboinense et dendrophilum* O.K. Rev. Gen. Pl. 2 (1891) 479. — *Pandorea dendrophila* BOERL. Handl. 2 (1899) 600. — *Pandorea amboinensis* BOERL. *l.c.* — *T. gloriosa* S. MOORE, J. Bot. 61 (1923) Suppl. 38; STEEN. Nova Guinea 14 (1927) 299; Thesis (1927) 888; Bull. Jard. Bot. Btzg III, 10 (1928) 210. — *T. venusta* S. MOORE, J. Bot. 61 (1923) Suppl. 38; STEEN. Nova Guinea 14 (1927) 298; Thesis (1927) 897, f. 5b, *incl. var. parviflora* STEEN.; Bull. Jard. Bot. Btzg III, 10 (1928) 216; HUNT, Bot. Mag. 180 (1975) t. 693; HERKLOTS, Fl. Trop. Climb. (1976) 71, f. 96, col. pl. 7. — *T. elliptica* STEEN. Nova Guinea 14 (1927) 296, t. 34D; Thesis (1927) 876, f. 5a; Bull. Jard. Bot. Btzg III, 10 (1928) 205. — *T. acutifolia* STEEN. Nova Guinea 14 (1927) 297; Thesis (1927) 879; Bull. Jard. Bot. Btzg III, 10 (1928) 206. — *T. amboinensis* STEEN. Nova Guinea 14 (1927) 298; Thesis (1927) 890;

Bull. Jard. Bot. Btzg III, 10 (1928) 211. — *T. gjellerupii* STEEN. Nova Guinea 14 (1927) 298; Thesis (1927) 896; Bull. Jard. Bot. Btzg III, 10 (1928) 215. — **Fig. 32a–d, 33.**

A tall liana, up to 20(–30) m. *Leaves* 1–2-jugate; leaflets ovate to elliptic or oblong-lanceolate, herbaceous to chartaceous, entire or with a few coarse teeth to the top, apex rather blunt to acuminate, (3–)5–13 by (1½–)2½–7 cm; nerves flat above or slightly impressed, prominent beneath; rachis not winged; lateral petiolules 2–8 mm. *Racemes* on the old wood, the rachis *c.* ½–7(–13) cm, with usually 6–20 densely set flowers; pedicels 1–2 cm. *Calyx* herbaceous to ± coriaceous, (1¼–)1½–4 cm long, for ¼–½ incised, greenish tinged red to purple-brown, the lobes triangular, blunt to cuspidate, 8–15 by 5–10 mm, midrib prominent or not. *Corolla* 7–11 cm long including the broad triangular acutish to blunt lobes ¾–1½ by 1–2 cm, the tube pink, rosa or pale carmine, the lobes creamy to yellowish, sometimes streaked with purple lines, or pink all over, inside near the insertion of the stamens stuppose-hairy. *Anthers c.* 4 mm long, divaricate. *Capsule* almost cylindric, stiped and beaked, 17–22(–30) by 3–3¾ by 3 cm, with hard, almost woody, boat-shaped valves. *Seeds* including the thin wing 2½–3½ by 1¼–1½ cm.

Distr. *Malesia:* Moluccas (Ambon, Ceram, Aru Is.), New Guinea (throughout, and incl. Misool, Jappen, Biak, Woodlark I. & New Britain), and ?Solomons (Bougainville), 120 collections.

MILLAR & VANDENBERG collected this species (NGF 48505) at Arawa Plantation, Kieta Subdistr., Bougainville, cultivated in a garden 'from a native vine'. I feel not certain that it is native in Bougainville; it might have been introduced from Papua.

Ecol. In swampy or dry rain-forests, sometimes riverine forest, once on limestone, from sea-level up to *c.* 1500 m. *Fl.* April–Dec., *fr.* June–Nov.

Vern. *Asee*, Maibrat lang., *fiyo*, Wapi lang., Marok; Sepik: *gwimbipuk*, *gwoimbipok*, Waskuk, *sanie*, Ambuti, *ilei*, Wagu, *yakomenga*, Narak & Ganja, Mt Hagen.

Notes. Through the great increase in collections it has appeared impossible to maintain several formerly described species. The characters of the leaves, calyx and corolla show transient, not correlated variation. Though the number of herbarium collections in which 1- and 2-jugate leaves occur together is restricted, they do occur on one plant in cultivation and in the forest according to collectors. The calyx shows a great variation in size and degree of incision. Puberulous hairiness may occur on the rachis, pedicels, the calyx, the midrib and nerves beneath, the apical part of the corolla-lobes, and on the leaf-rachis. Aberrations are sometimes found in individual specimens: a multi-lobed, wide calyx in BW 11242; a very thin, tortuous, 20 cm long rachis of a lax raceme in NGF 11866 and BW 13352; once a leaf with 6 and 7 leaflets; once long unbranched roots produced from a node of the old wood (JANOWSKI 427); an axillary raceme (BRASS 28745).

Seemingly open flowers measure sometimes only 5 cm, but I assume this to be caused in drying of immature flowers and tardy growth.

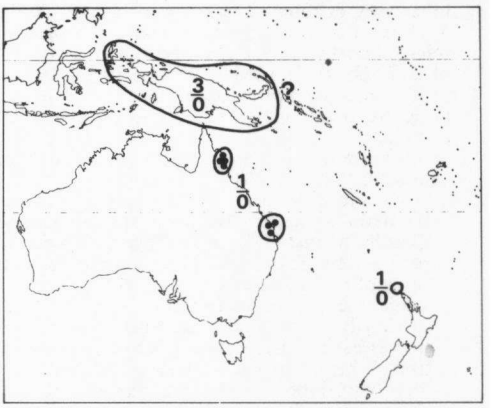

Fig. 34. Range of the genus *Tecomanthe* BAILL. Figures above the hyphen indicate endemic species, those below the hyphen non-endemic species. The Australian *T. hillii* (F.v.M.) STEEN. occupies two areas.

2. Tecomanthe ternatensis STEEN. Thesis (1927) 893; Bull. Jard. Bot. Btzg III, 10 (1928) 214, f. 1. — **Fig. 32e–h.**

Large liana, up to 30 m or more; stem to arm-thick. *Leaves* 3–4-jugate; leaflets elliptic, herbaceous, base ± rounded, apex short-acute, with some teeth towards the apex, *c.* 3½–7 by 1½–3 cm; veins between the nerves usually distinct; lower lateral petiolules 0–3 mm. *Racemes* on the old wood, 2–6 cm long, densely rich-flowered. Pedicels *c.* 1 cm. *Calyx* pale green, 1½–2 cm long, the lobes deltoid, 7 by 5 mm. *Corolla* whitish, later tinged pink, 5–6 cm long including lobes, lobes wide and short, *c.* 2–5 by 10–15 mm, with dark spots in transparent view; tube near the insertions of the stamens with very few hairs and no capitate-glandular papillae. *Stamens* as long as the style, ± exserted.

Distr. *Malesia:* Moluccas (Ternate, Halmaheira) and NW. New Guinea (Biak I.), 5 collections.

Ecol. Primary and secondary forest, in Biak on coralline limestone, in the Moluccas at 500–600 m. *Fl.* Sept.–Nov., April.

Note. The Biak specimens are rather poor but clearly belong to this species.

3. Tecomanthe volubilis GIBBS, Arfak (1917) 179; DIELS, Bot. Jahrb. 57 (1922) 498; STEEN. Nova Guinea 14 (1927) 299; Thesis (1927) 885; Bull. Jard. Bot. Btzg III, 10 (1928) 209. — *T. nitida* STEEN. Nova Guinea 14 (1927) 299, t. 33; Thesis (1927) 887; Bull. Jard. Bot. Btzg III, 10 (1928) 209. — *T. arfaki* STEEN. Nova Guinea 14 (1927) 300, t. 34B; Thesis (1927) 884, f. 5d, j; Bull. Jard. Bot. Btzg III, 10 (1928) 208. — **Fig. 35a–c.**

Small, slender climber, 2–5 m. *Leaves* 3–6(–7)-jugate, with 4-jugate leaves always present; leaflets mostly glossy on both sides, dark green above, pale beneath, mostly coriaceous, brittle in the herbarium, ovate, obovate to elliptic, rarely lanceolate, base usually cuneate, apex acute, rarely blunt, margin in exposed places recurved, usually

with 1–5 pairs of bluntish teeth, $^3/_4$–$2^1/_2$ by $^1/_2$–$1^1/_2$ cm, usually sessile but lateral pedicels up to 2 mm, nerves above usually impressed, beneath usually prominent, often nigrescent in sicco. *Racemes* axillary or terminal, rachis $^1/_2$–$2^1/_2$ cm; flowers 1–3 pairs, pedicels $^3/_4$–$1^1/_4$ cm, both often lax-puberulous. *Calyx* green suffused with red, coriaceous to herbaceous, $1^1/_2$–3 cm, tube as long as or up to 2 times as long as the acute triangular lobes. *Corolla* pink to carmine, inside creamy, sometimes streaked red inside, 6–8(–10) cm including the triangular, acute lobes $1^1/_2$–$2^1/_2$ by $1^1/_2$–3 cm. *Staminode* usually less than 1 cm. *Capsule* 11–14 by 3–4 cm, compressed; valves coriaceous. *Seeds c.* $1^1/_2$ cm ∅.

Distr. *Malesia:* New Guinea (Mts Arfak, incl. Nettoti, Tamrau; Wissel Lakes, Wichmann, Carstensz, Lake Habbema, Star Mts, Telefomin, Bosavi), 20 collections.

Ecol. Mossy thickets and heaths, often burned, ridges in high forest, open scrub and secondary forest, sometimes on peaty soil or on limestone, 1250–3100 m. *Fl.* Sept.–Febr. (once April), *fr.* Aug., Nov., Jan., April.

Vern. *Basengga,* Hattam lang., Arfak, *daibuda, děběbuda,* Kapauku lang., Wissel Lakes.

Note. At lower altitude and more shaded localities leaflets tend to be larger and less rigid and coriaceous, with less impressed nerves above and flat leaf margin.

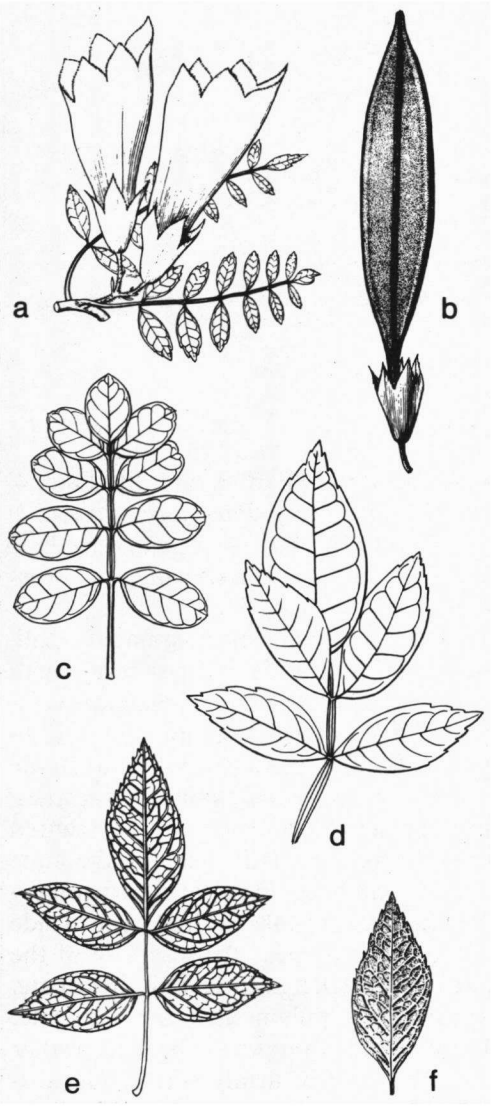

Fig. 35. *Tecomanthe volubilis* GIBBS. a. Habit, b. unripe capsule, c. leaf. — *T. volubilis ssp. silvicola* STEEN. d. Leaf. — *T. volubilis ssp. tenax* STEEN. e. Leaf, underside, f. leaflet, upper surface. All × $^1/_2$ (*a* VAN ROYEN & SLEUMER 7417, *b* BRASS 9052, *c* BW 3050, *d* LEDERMANN 12904, *e–f* KALKMAN 5178).

3a. *ssp.* silvicola STEEN. *nov. ssp.* — *T. saxosa* DIELS, Bot. Jahrb. 57 (1922) 498; STEEN. Nova Guinea 14 (1927) 889, f. 5c; Thesis (1927) 297; Bull. Jard. Bot. Btzg III, 10 (1928) 211. — *T. cyclopensis* STEEN. Nova Guinea 14 (1927) 298, t. 34A; Thesis (1927) 895; Bull. Jard. Bot. Btzg III, 10 (1928) 214. — *T. nitida* (*non* STEEN.) HERKLOTS, Fl. Trop. Climb. (1976) 73, f. 98. — **Fig. 35d.**

Differt a T. volubili foliolis 2(–3)*-jugatis, apice acutis vel cuspidatis; staminodiis plerumque* $1^1/_2$–3 *cm longis.* — *Typus:* VAN ROYEN & SLEUMER 7117 (L), NW. New Guinea, Vogelkop Peninsula, Tamrau Mts, 1350 m.

Slender liana. *Leaflets* 2(–3) pairs, mostly herbaceous to chartaceous, usually elliptic to ovate-oblong, or lanceolate-oblong, entire but mostly with several pairs of teeth, base cuneate to rounded, apex acute, lateral leaflets $1^3/_4$–5(–8) by $^3/_4$–$2^1/_2$(–3) cm, terminal one longest; pedicels $^1/_2$–6 mm. *Racemes* axillary or on old wood. *Calyx* usually herbaceous, $1^1/_2$–3(–$3^1/_2$) cm, halfway incised or ± less. *Corolla* 5–7(–9–11) cm, including the lobes. *Capsule* flat, 8–12 by 2–3 cm. *Seeds* $1^1/_2$–2 by 1–$1^1/_2$ cm.

Distr. *Malesia:* New Guinea (throughout, but far more common in East New Guinea, common in Morobe Distr.), 30 collections.

Ecol. In the understorey of *Nothofagus-Araucaria* and *Castanopsis* forest, more rarely in moss forest and on ridges, mostly in fairly tall forest, (1000–)1500–2400(–3000) m (once found at 80 m between Hollandia and Sentani). *Fl.* Jan.–Dec., *fr.* March, June, Oct.

Note. I regard this montane forest plant to represent a race of *T. volubilis*; it is rather variable in foliage, some specimens looking transitional to low altitude specimens of *ssp. volubilis.*

3b. *ssp.* tenax STEEN. *nov. ssp.* — **Fig. 35e–f.**

Differt a foliolis 2(–3)*-jugatis, coriaceis, venis nervisque utrinque perspicue prominentibus.* — *Typus:* LAE 60706, leg. CROFT *et al.*, E. Papua, S. slopes of Mt. Giluwe, 6°7′ S, 143°55′ E, fl. fr. 25-XII-1973 (L, iso in LAE).

Smallish liana, 2–10 m; branchlets puberulous to subglabrous. *Leaflets* 2-jugate (very rarely 1- or 3-jugate), dark green above, pale green beneath, glossy on both sides, ovate to lanceolate, coriaceous, not nigrescent, 2–5½(–8) by 1–2(–4) cm, terminal one largest, very tough, margin especially towards apex with sharp teeth. *Racemes* axillary, rarely terminal, lax, with (1–)2–3 pairs of flowers; rachis and pedicels ± lax-puberulous; rachis 1–5 cm; pedicels 1¼–2½ cm. *Calyx* mostly thin, 2¼–3½ cm, tube 1½–2(–3) times as long as the lobes; reddish white to green with pink tinge; lobes triangular, mucronate. *Corolla* pink to crimson (once noted white), the lobes yellowish to white, streaked red within, 7–12 cm long including the triangular lobes *c.* 1½ by 1½ cm. *Capsule* 8–14 by 2–3 cm (septum 2½ cm stalked). *Seeds c.* 1½ by 1 cm including wing.

Distr. *Malesia:* New Guinea: Papua (E., S. & W. Highlands, largely *c.* 6° S and 143–144° E), but also in West New Guinea (Bernard Camp, Idenburg R.). Fig. 36.

Ecol. Mountain forest, often mossy, often with *Nothofagus* dominating, sometimes in shrubs bordering glades, 1800–3000 m. *Fl.* June, Sept.–Jan. (once in May), *fr.* (twice) July, Dec.

Vern. *Tserki*, Enga lang., *taugurapu*, Tari, *igidumbroki*, Mendi lang.

Note. The material is very homogeneous in 25 collections seen and though fertile characters with *ssp. silvicola* are overlapping it can easily be recognized vegetatively without any transitions.

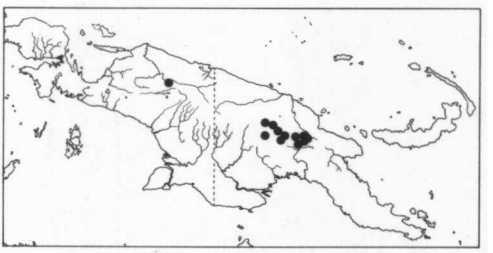

Fig. 36. Localities of *Tecomanthe volubilis* GIBBS *ssp. tenax* STEEN.

15. PANDOREA

SPACH, Hist. Vég. 9 (1840) 136; Mon. (1864) 49; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; STEEN. Nova Guinea 14 (1927) 301, *incl. sect. Parviflores* STEEN., *in clav.*; Thesis (1927) 294; Proc. R. Soc. Queensl. 41 (1929) 43. — *Tecoma sect. Pandorea* ENDL. Gen. Pl. (1839) 711; DC. Prod. 9 (1845) 225. — *Tecomanthe sect. Montanae* STEEN. Bull Jard. Bot. Btzg III, 10 (1928) 204. — **Fig. 37, 39.**

Lianas, only exceptionally (in arid countries) erect. Glands on twig-nodes small. *Leaves* (1–)2–4(–7)-jugate; leaflets with microscopical glands and not rarely with few to many larger crateriform scattered glands underneath; petiole in some species with some ventral large glands near the base. *Thyrses* terminal, sometimes additional partial axillary thyrses in the upper leaf-axils; peduncle without sterile bracts at the base; depauperate thyrses may appear occasionally as racemes. *Calyx* closed in bud, small (less than 7 mm), cup-shaped to campanulate, stunted or very shallowly lobed, sometimes tearing. *Corolla* generally small, the tube cylindric or infundibuliform, incl. lobes at most 5 cm long, limb usually zygomorphous, the lobes small or large, in bud widely imbricating; throat and ventral side of the tube mostly long-hairy and often with a hair-ring near the insertion of the anthers. *Stamens* didynamous, almost always inserted; anther-cells divaricate, *c.* 1½–2 mm long; 5th rudimentary. *Disk* annular or ± pulvinous. *Ovary* elongate, each cell with 2 placentas and many ovules. *Capsule* stipitate, ± beaked, rather thick, terete or ± flattened; valves widely boat-shaped, firmly coriaceous; dissepiment flat, oblong, thickish, with marginal seed-scars. *Seeds* many, roundish, thin-winged.

Distr. Six *spp.*, Central, N. & E. Australia, Tasmania, Lord Howe I., New Caledonia, Solomons (Bougainville), and *East Malesia:* New Guinea (New Britain included), Moluccas, and the Lesser Sunda Islands (Lombok, Flores, Timor). Fig. 38.

Ecol. In Malesia in rain-forest, from sea-level to 2450 m.

KEY TO THE SPECIES

1. Corolla tube glabrous outside, usually rather wide, without hair-ring inside near the insertion of the stamens. Base of filaments glandular and also the ovary with similar sessile glands. Calyx cupular, *c.* 2–3 mm. Venation not prominent above. Filaments inserted close to the base of the tube, which is not narrowed . . . . . **1. P. pandorana**
1. Corolla tube (except at the very base) outside puberulous. Base of filaments without sessile glands. Venation above mostly prominent.
2. Flowers large, 4–5 cm long (incl. lobes), white with crimson throat, the tube *c.* twice as long as the rounded lobes. Leaves 2-jugate, the entire leaflets blunt at apex, nerves and veins not distinctly prominent above. Queensland and New South Wales . . . . . **P. jasminoides** (LINDL.) K.SCH.
2. Flowers much smaller, at most $3^1/_2$ cm, the tube 4–6 times as long as the lobes; lobes less than *c.* 1 cm diameter. Leaflets acute, nerves and veins usually distinctly prominent above, mostly toothed towards the apex.
3. Corolla 12–15 mm long, narrow-cylindric, the tube *c.* 6 times as long as the lobes. No hair-ring at the staminal base. Calyx 3–5 mm. Petiole above at base with one or a few large glands; leaf-rachis narrowly winged.
4. Leaflets entire, 3–4-jugate, 5–12 by 2–5 cm. Corolla *c.* 12–13 mm, tube ± curved, *c.* 2–3 mm wide, no beard in the mouth and tube, lobes *c.* 2 mm. Ovary orbicular, with sessile glands. Venation on upper surface of leaflets raised, but not fine-tessellate. Flowers cream-coloured, lobes and throat pink-shaded. Queensland. *Cf.* STEEN. Proc. R. Soc. Queensl. 41 (1929) 46, f. 1. **P. baileyana** (MAID. & R. T. BAKER) STEEN.
4. Leaflets apically toothed, (1–)2–3-jugate, 6–$8^1/_2$ by $3^1/_2$–4 cm. Corolla tube straight, *c.* 20 mm long, *c.* 5 mm wide, mouth and upper part of tube inside bearded, lobes *c.* 3–4 mm. Ovary obconical-oblong, eglandular. Venation on upper surface of leaflets raised, fine-tessellate. (Corolla tube yellow, the lobes white) . . . . . **2. P. stenantha**
3. Corolla 20–35 mm long, the tube *c.* 4 times as long as the lobes, the mouth and upper part of the tube inside bearded. Calyx *c.* 6–$7^1/_2$ mm. Petiole without glands; rachis narrowly winged; leaflets dentate in upper part, venation not fine-tessellate raised above.
5. Corolla straight, tubular, 20–25 mm long, with yellow tube, the lobes white to pale red or streaked red, inside with a distinct hair-ring near the insertion of the stamens. Ovary ± conical, eglandular. Pedicels slender, 1–2 cm . . . . . **3. P. montana**
5. Corolla *c.* 30–35 mm long, white with pale yellow mouth, infundibuliform, with a fairly narrow lower part of the tube, widened apically, inside at the insertion of the stamens with a few hairs. Ovary ellipsoid, with sessile glands. Pedicels *c.* 5 mm. Queensland. *Cf.* STEEN. J. Arn. Arb. 12 (1931) 149, pl. 35 . . . . . **P. nervosa** STEEN.

1. Pandorea pandorana (ANDR.) STEEN. Bull. Jard. Bull. Btzg III, 10 (1928) 198; Proc. R. Soc. Queensl. 41 (1929) 43; J. H. WILLIS, Handb. Pl. Vict. 2 (1972) 578; BEADLE, EVANS & CAROLIN, Fl. Sydney Reg. ed. 2 (1972) 502; HERKLOTS, Fl. Trop. Climb. (1976) 69, f. 91. — *Bignonia pandorana* ANDR. Bot. Rep. 2 (1800) t. 86. — *Bignonia pandorea* VENT. Jard. Malm. (1803) t. 43. — *Bignonia pandorae* SIMS, Bot. Mag. 22 (1805) t. 865. — *Tecoma australis* R.BR. Prod. (1810) 471; DC. Prod. 9 (1845) 225, *incl. var. meonantha* (LINK) DC.; BTH. Fl. Austr. 4 (1869) 537; BAILEY, Queensl. Fl. 4 (1901) 1134, *incl. var. pandorea* (VENT.) BAILEY (= var. typ.), *var. meonantha et var. linearis* BAILEY, *l.c.* pl. 45. — *Bignonia australis* AIT. Hort. Kew. ed. 2, 4 (1814) 34. — *Bignonia meonantha* LINK, En. Berol. 2 (1822) 130. — *Tecoma meonantha* SWEET, Hort. Brit. (1827) 284; G. DON, Syst. 4 (1838) 224; HARRIS, Wild Fl. Austr. (1938) 151, pl. 6 (as *T. australis*). — *Tecoma diversifolia* G. DON, Syst. 4 (1838) 225; DC. Prod. 9 (1845) 225. — *P. australis* SPACH, Hist. Nat. Vég. 9 (1840) 136; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; DIELS, Bot. Jahrb. 57 (1922) 498; STEEN. Nova Guinea 14 (1927) 302; Thesis (1927) 859, *incl. ssp. pandorea* STEEN. *l.c.* 861, *ssp. meonantha* STEEN. *l.c.* 862, *et ssp. linearis* STEEN. *l.c.* 863; DOMIN Bibl. Bot. 22 (1929) 1153, *incl. var. oxleyi, nom. illeg., et var. meonantha, l.c.* 1154. — *Tecoma floribunda* CUNN. *ex* DC. Prod. 9 (1845) 225. — *Tecoma oxleyi* CUNN. *ex* DC. l.c.; J. M. BLACK, Trans. R. Soc. S. Austr. 39 (1915) 836; WHITE & FRANCIS, Proc. R. Soc. Queensl. 37 (1926) 166; HARRIS, Wild Fl. Austr. (1938) 151, pl. 39. — *Tecoma ochroxantha* KTH & BOUCHÉ, Ind. Sem. Hort. Berol. (1847) 12, *sec.* BTH. 1869. — *Tecoma leptophylla* BL. Rumphia 4 (1849) 35; STEEN. Nova Guinea 14 (1927) 301, t. 33, *pro parte, pro fol. sol.* — *Tecoma austro-caledonica* BUREAU, Bull. Soc. Bot. Fr. 9 (1862) 163; MAID. Proc. Linn. Soc. N.S.W. 39 (1914) 382; COMPTON, J. Linn. Soc. Bot. 45 (1921) 373. — *Tecoma ceramensis* T. & B. Nat. Tijd. N. I. 25 (1863) 412; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 197, t. 5, *incl. var. elliptica* MIQ. — *P. austro-caledonica* SEEM. Gard. Chron. (1870) 1085; BAILL. Hist. Pl. 10 (1891) 40; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; GUILLAUMIN, Fl. Nouv. Cal. (1948) 317 ('*austro-caledonicum*'); HEINE, Fl. Nouv.-Caléd. 7 (1976) 87, pl. 20. — *Campsidium filicifolium* BULL, Wholesale List New, Beaut. & Rare Pl. (1874) fig.; Cat., *ex* JOHNSON & HOGG, J. Hort. 51 (1874) 366; A. VAN GEERT, Cat. *n.* 74 (1874); T. MOORE, Fl. & Pom. (1874) 280. — *Tecoma filicifolium* NICHOLSON, Dict. Gard. 4 (1887) 13; *cf.* STEEN. Blumea 15 (1967) 146. — *Gelseminum pandorea et ochroxanthum* O.K. Rev. Gen. Pl. 2 (1891) 480. — *P. ceramensis* BAILL. Hist. Pl. 10 (1891) 40; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230 ('*ceramica*'); STEEN. Nova Guinea 14 (1927) 302; Thesis (1927) 852. — *Tecoma pandorana* SKEELS, U.S. Dep. Agric. Bur. Pl. Ind. Bull. 282 (1913) 62. — *P. acutifolia* STEEN. Nova Guinea 14 (1927) 303, t. 34C; Thesis (1927) 855; Bull. Jard. Bot. Btzg III,

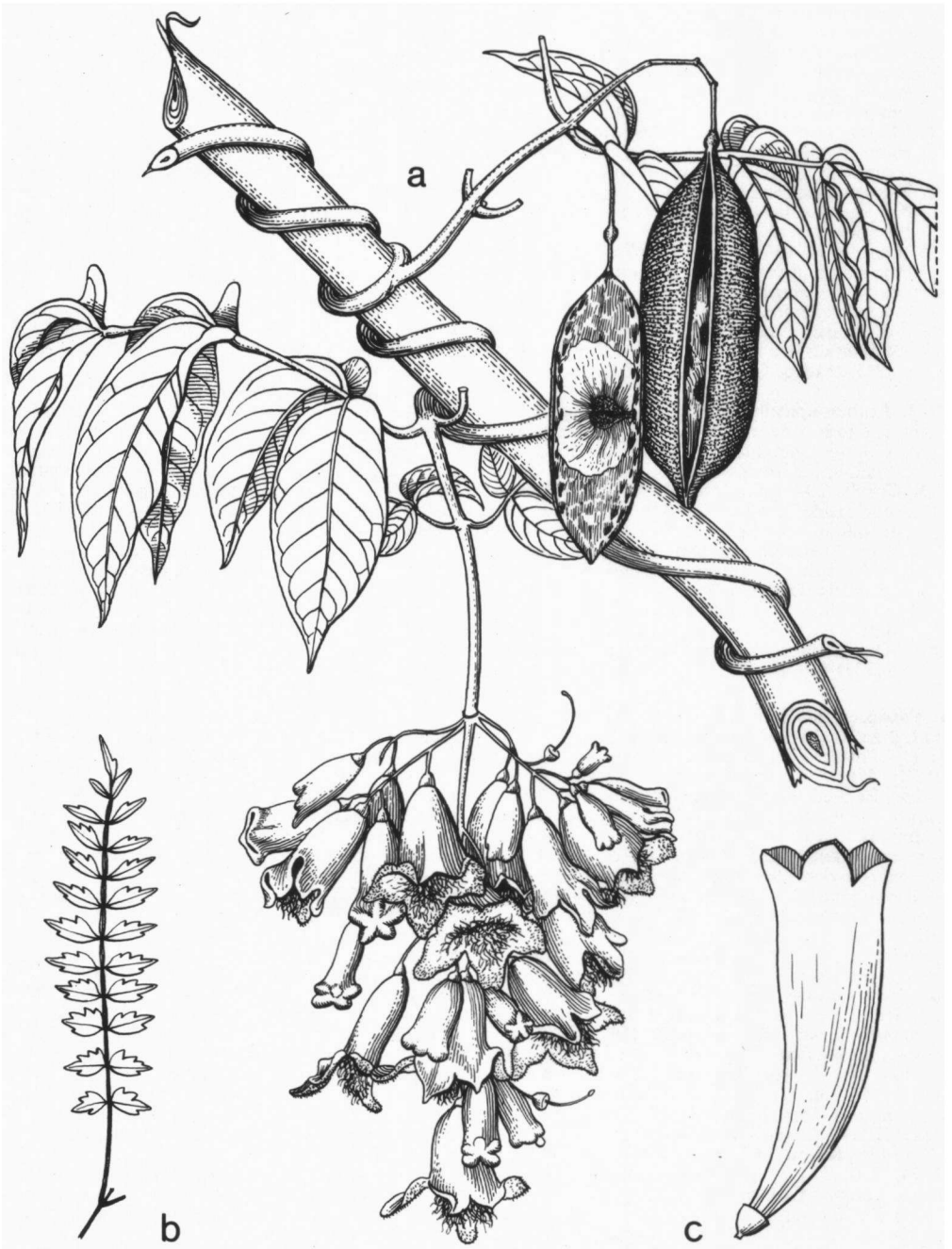

Fig. 37. *Pandorea pandorana* (ANDR.) STEEN. a. Habit, flowers and fruit, b. foliage of juvenile plants, both × ½. — *Neosepicaea aurantiaca* (DIELS) STEEN. c. Flower, × ½ (*a* after BLUME, *b* ZIPPEL *s.n.* New Guinea, *c* LEDERMANN 9561).

10 (1928) 196. — *P. poincillantha* STEEN. Nova Guinea 14 (1927) 302; Thesis (1927) 857, *incl. var. fragrans* STEEN. — *Tecoma doratoxylon* J. M. BLACK, Trans. Proc. R. Soc. S. Austr. 51 (1927) 383; GARDNER, En. Pl. Austr. Occ. (1930) 118. — *P. doratoxylon* J. M. BLACK, Trans. Proc. R. Soc. S. Austr. 61 (1937) 248; Fl. S. Austr. pt 4 (1957) 773, f. 1106. — *Campsis pandorana* STEEN. Fl. Males. I, 4 (1948) xxi. — Fig. 37a–b.

Malesian specimens: Often large liana, 20–30 m. *Leaves* 2–4(–6)-jugate; leaflets usually ovate-elliptic to oblong, mostly entire and acuminate, 3–10 by $1^1/_2$–6 cm, glabrous, underneath with few or many scattered large crateriform glands, nerves not prominent above; midrib sulcate; lateral petiolules 0–10 mm; petiole without glands at the base above. *Thyrses* terminal, lateral or from old wood, *c.* (1–)5–20 cm, glabrous, rarely puberulous. Pedicels *c.* $^1/_2$–$1^1/_4$ cm, rarely longer. *Calyx* cupular, stunted or short-lobed, thin, *c.* 2–3 mm. *Corolla* 1–2(–3) cm long including the lobes, mostly rather inflated-tubular, the tube mostly ± twice as long as the lobes, glabrous outside, lobes mostly densely papillose-puberulous, mouth and tube inside bearded on the ventral side, light yellow, the zygomorphous limb and tube inside streaked or mottled red or purple dotted, without a hair-ring near the base of the stamens and no proper basal tube. *Stamens* included, at their base glandular-papillose, inserted very near the base of the tube. *Ovary* glandular-papillose. *Capsule* acute, *c.* (5–)9–12 by ($1^3/_4$–)$2^1/_2$–3 by 2–$2^1/_2$ cm; valves coriaceous; dissepiment rather thick, $6^1/_2$–8 by $1^3/_4$–2 cm, the seed scars marginal. *Seeds c.* $2^1/_2$–3 by $1^1/_2$–2 cm including the hyaline wings.

Distr. Central, N. & E. Australia, Tasmania, Lord Howe I., New Caledonia, N. Solomons (Bougainville), and *East Malesia:* New Guinea (incl. New Britain), Moluccas (Morotai, Halmaheira, Ambon, Ceram, Key Is.), and Lesser Sunda Is. (Lombok, Flores, Timor); 65 collections.

Though *Tecoma filicifolium*, a juvenile form, was said to have come from Fiji, I have shown (1967, *l.c.*) that this hailed from New Caledonia.

SIMS claimed that LODDIGES nurseries had received *Bignonia pandorae* from Norfolk I., but this seems to rest either on an erroneous localisation or on a cultivated source.

Ecol. In Malesia in primary and secondary rain-forest, from sea-level up to *c.* 2000(–2400) m, getting distinctly scarcer upwards of 1350 m. *Fl.* Jan.–Dec., *fr.* Oct.–Dec.

Taxon. A quite well recognizable species in spite of a fair degree of variability. This is in part ontogenetic, the juvenile form having narrow, many-jugate, crenate, small leaflets; these are sometimes still found on odd twigs of mature-foliaged plants.

The main variation is in Australia in the leaves, the rain-forest (type variety) form having ovate to elliptic 2-jugate leaflets, whereas in drier places 2–4-jugate leaves occur with lanceolate leaflets (described as *T. meonantha*), while in still more arid places the 2–6-jugate leaves have almost linear leaflets (described as *T. oxleyi* and *T. doratoxylon*). The latter form may at times be scrambling, bushy or even erect (spearwood bush) and carry racemose inflorescences. Though the typical representatives of these three forms are distinct, they are connected by a clear series of specimens with intermediary characters, which already induced BAILEY to say that he named the three forms as varieties merely for convenience. Whether these forms are genetically different taxa (races) or merely phenotypic forms can only be established by experiments. BAILEY added that flowers of the type variety would emit a strongly disagreeable odour while *T. meonantha* would have fragrant flowers. This matter must be solved by field botanists.

In Malesia the 3–4-jugate leaves are often narrower, sessile, and also more toothed than the 2-jugate ones; it looks like a matter of lingering neoteny.

At higher altitudes, 1300–2000 m, leaflets tend to be more coriaceous. In SCHMUTZ 3178 the veins are by exception prominent above.

The New Caledonian form seems to be a local race with small flowers and small roundish, dentate leaves.

In rain-forest the leaflets are usually entire, or with a few coarse teeth towards the apex, and usually they have underneath a fair number of crater-like larger glands, in Australian specimens these are scarce or absent.

Lateral petiolules are usually short (2–5 mm), but in HYLAND 5092 they measure $1^1/_2$ cm.

1a. *ssp.* timorensis STEEN. *nov. ssp.*

Differt a speciminibus malayanis floribus comparate magnis (2–3 cm longis, lobis incl.), staminibus atque stylo exsertis, ceterum ore atque tubo floris barbis longis destitutis. — Typus: C. W. KOOY 363 (L), pr. Temef, S. Central Timor, fl. 18–VII–1966, *c.* 800 m.

Leaflets 2–4-jugate, without crateriform glands beneath. Calyx 2–4 mm, stunted, minutely 5-mucronulate. Corolla 2–3 cm long incl. lobes. Mouth and tube not bearded inside, the puberulous papillae from the lobes extending in the tube in a lax way. Stamens and style exserted.

Distr. *Malesia:* Lesser Sunda Is. (Timor); 4 collections.

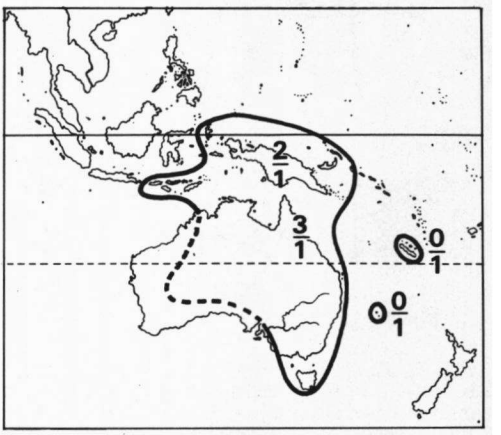

Fig. 38. Range of the genus *Pandorea* SPACH. Figures above the hyphen indicate endemic species, those below the hyphen non-endemic species.

Ecol. On limestone (once) and along ravine in mountain Eucalypt forest, *c.* 700–1000 m. *Fl.* March, May, July.

Vern. *Tufe*, Dawan lang., *non amisu*, Niki-Niki, *non fulèh*, Mt Mutis.

Notes. Though undoubtedly *P. pandorana*, the Timor race deviates within the species by lacking the usual beard in the mouth and tube of the corolla and in the genus by exserted stamens and style. It is remarkable that the specimens from Lombok and Flores do not belong to this subspecies but agree with the Moluccan specimens.

2. Pandorea stenantha DIELS, Bot. Jahrb. 57 (1922) 498; STEEN. Nova Guinea 14 (1927) 302; Thesis (1927) 850; Bull. Jard. Bot. Btzg III, 10 (1928) 197. — **Fig. 39e–f.**

Large liana (stem to $2^1/_2$ cm ⌀). *Leaves* (1–)2–3-jugate, the leaflets coriaceous, ovate-oblong, acute, towards apex toothed, venation raised on both sides, above fine-tessellate, 6–$8^1/_2$ by $3^1/_2$–4 cm; rachis narrowly winged; petiolules 0–8 mm; petiole near the base above with one or few large, sometimes raised glands, sometimes also one at the articulation of the rachis. *Thyrses* axillary and terminal or on old wood, 10–15 cm, fine-puberulous. Pedicels 4–10 mm. *Calyx* 3–5 mm, campanulate, with 5 short, broad-deltoid lobes. *Corolla* tube yellow, the lobes white (*ex typ.*), tube *c.* 20 mm long and *c.* 5 mm wide, outside puberulous-papillose, the mouth and upper part of the tube bearded, lobes *c.* 3–4 mm; no hair-ring at the insertion of the stamens. *Stamens* included. *Disk* cupular. *Ovary* flattened, obconical-oblong, glandless.

Distr. *Malesia:* New Guinea (Sepik Distr.: April R.; Mt Cyclops; SE. Irian: Ingembit); 3 collections.

Ecol. Rain-forest, 125–800 m. *Fl.* June, Nov. Flowers once noted to be fragrant.

Notes. Apparently a rare species; available flower material unfortunately rather inadequate. VAN ROYEN noted: flowers white at base of tube pale purple; SOEGENG: tube dirty yellow, lobes lilac. The petiolar glands were not mentioned by DIELS in his brief description, but I noted them on the type (1927).

3. Pandorea montana (DIELS) STEEN. *nov. comb.* — *Tecomanthe montana* DIELS, Bot. Jahrb. 57 (1922) 497; STEEN. Nova Guinea 14 (1927) 296; Thesis (1927) 875, f. 3c; Bull. Jard. Bot. Btzg III, 10 (1928) 204. — **Fig. 39a–d.**

Slender liana, to finger-thick. *Leaves* 3–4(–5)-jugate, leaflets chartaceous to coriaceous, elliptic-oblong, acute, towards apex toothed or shallowly crenate, venation raised on both sides, but not fine-tessellate above, *c.* 2–$5^1/_2$ by 1–$2^1/_2$ cm, rachis narrowly winged; petiole without basal glands; petiolules almost absent. *Thyrses* axillary and terminal, lax, almost glabrous. Pedicels filiform, 1–2 cm. *Calyx c.* 7 mm, with 5 short, broad-triangular teeth. *Corolla* ± infundibuliform, 20–25 mm long, the tube narrowed to the base, straight, limb zygomorphous, *c.* 8–10 mm wide at the mouth, the lobes 2–4 mm, bearded in the mouth and upper part of the tube, the lobes white to pale red or streaked red, the tube light brown or yellow flushed red outside, yellow inside, with a distinct stuppose hair-ring near the insertion of the filaments. *Stamens* included. *Disk* cupular. *Ovary* ± conical, eglandular. *Capsule* flattened, 4–$8^1/_2$ by $1^1/_2$–3 by $^1/_2$–1 cm, sessile to stiped and short-beaked; valves hard, almost coriaceous to woody, narrow boat-shaped; dissepiment thick-coriaceous, 3–10 by $1^1/_4$–$2^1/_2$ cm. *Seeds* $1^1/_4$–$2^3/_4$ by 1–2 cm.

Distr. *Malesia:* East New Guinea (Sepik: Hunstein Mts: Lordberg, Hunsteinspitze, 1000–1350 m, 4 coll.), *loc. class.*; Morobe Distr.: Mt Kaindi, 7°25′, 146°45′ E, 12 coll.; Mt Giluwe, 6°10′, 144° E.

Ecol. Mountain rain-forest, often mossy, forest edges and regrowths, 1000–1350, 2100–2450 m. *Fl.* Febr., May–June, Aug.–Nov., *fr.* Aug.–Sept., Dec.

Notes. The thyrsoid inflorescence and flower-size point to congenerity with *Pandorea*; luckily I had made in 1927 a small drawing of the type and observed several flower details on the original material not mentioned by DIELS in his brief description. Unfortunately almost all duplicates at L lack flowers, by careless distribution. The flower colour noted on labels varies rather considerably: tube cream, yellow, golden brown or red outside, lobes white, cream, pale purple, streaked red.

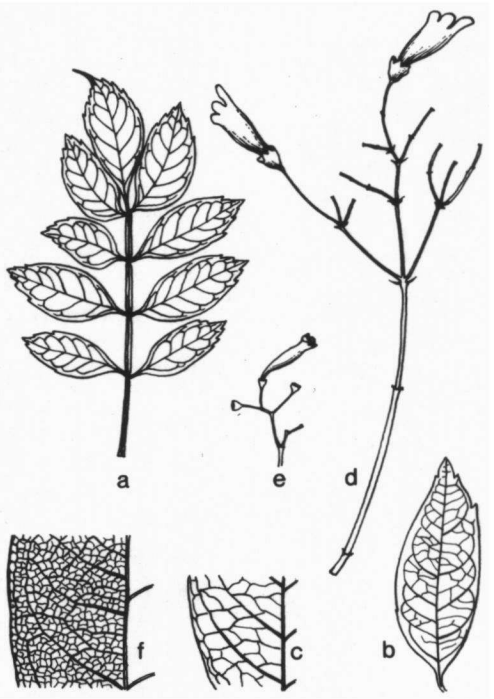

Fig. 39. *Pandorea montana* (DIELS) STEEN. a. Leaf, b. leaflet, × $^1/_2$, c. reticulate venation above, d. inflorescence, × $^1/_2$. — *P. stenantha* DIELS. e. Inflorescence, × $^1/_2$, f. tessellate venation of leaflet above (*a*, *c* NGF 13905, *b* LEDERMANN 9916, *d* NGF 21251, *e* SOEGENG 360, *f* VAN ROYEN & SLEUMER 5816).

Doubtful & Excluded

In this list are combined all names of Malesian and SE. Asian plant names which are excluded or of which the identity is uncertain or of which I have not seen the types.

Bignonia albida BL. Verh. Bat. Gen. 9 (1823) 195; STEUD. Nomencl. 2 (1841) 204 = *Aeschynanthus albidus* (BL.) STEUD. (*Gesneriaceae*).

Bignonia angustifolia BL. Verh. Bat. Gen. 9 (1823) 194; Cat. Hort. Bog. (1823) 82 = *Aeschynanthus angustifolius* (BL.) STEUD. (*Gesneriaceae*).

Bignonia comosa ROXB. [Hort. Beng. (1814) 95, *nom. semi-nudum*] Fl. Ind. ed. Carey 3 (1832) 103; DC. Prod. 9 (1845) 144; MIQ. Fl. Ind. Bat. 2 (1858) 751. — *Spathodea comosa* G. DON, Gen. Syst. 4 (1838) 222, said to come from the Moluccas, is according to the type (Herb. Martius, in BR) *Clerodendron lanuginosum* BL. 1825 (*Verbenaceae*). The detached fruit on the sheet was not described and belongs to some SE. Asian *Bignoniaceae*.

Bignonia compressa LAMK, Encycl. 1 (1785) 424; G. DON, Gen. Syst. 4 (1838) 220, said to come from the East Indies, is according to PERRIER DE LA BÂTHIE from Madagascar (Fl. Madag. 178, 1938, 59) (*Colea decora* DC. Prod. 9, 1845, 241) = *Rhodocolea racemosa* H. PERRIER.

Bignonia fraxinoides PERROTTET, Mém. Soc. Linn. Paris 3 (1824) 102, *nom. semi-nudum*, said to grow in East Java, is *cf.* STEEN. Blumea 15 (1967) 146 probably not from Java,; the name ought to be discarded entirely.

Bignonia glauca WALL. Cat. 6506, *nomen, non* DECNE 1844. The type at Kew, a sterile specimen, was annotated "perhaps not *Bignoniaceae*" by C. B. CLARKE. It has recently further been annotated "prob. *Meliaceae*" by ALAN RADCLIFFE-SMITH.

Bignonia hirsuta LAMK, Encycl. 1 (1785) 422; WILLD. Sp. Pl. 3 (1802) 299; G. DON, Gen. Syst. 4 (1838) 225. — *Tecoma hirsuta* DC. Prod. 9 (1845) 173, 222.

Said to have come from "l'Indes"; leaves opposite, digitate, with 5 leaflets, stalked and with petiolules; leaflets oblong, cuneate at base, emarginate at apex, downy, slightly pubescent beneath. Flowers small, curved, short reddish-yellow hairy. Calyx truncate, with 4 minute teeth. Stamens 4, exserted.

Vitex (*Verb.*) might be involved, but all its Indo-Malesian species have acuminate leaves and in *Vitex* the corolla is not curved and if hairy the corolla is greyish. It might possibly be an American plant, *Tabebuia*, or allied to that.

LAMARCK described the specimen from herb. Jussieu. Dr. H. HEINE made elaborate but unfortunately unsuccessful attempts in herb. Jussieu and Lamarck to locate the specimen in the Paris Herbarium; there is also no trace of it at Geneva; DE CANDOLLE did not see any material.

Bignonia laeta WALL. Cat. 6505A, *cf.* CLARKE, Fl. Br. Ind. 4 (1884) 376, is according to SPRAGUE, Kew Bull. (1919) 306 = *Dolichandrone serrulata* SEEM.

Bignonia longiflora REINW. msc. *ex* DE VRIESE, Pl. Ind. Bat. Or. (1856) 9, *nomen* = *Aeschynanthus longiflorus* (BL.) DC. (*Gesneriaceae*).

Bignonia macrostachya WALL. [Cat. 6504, *nomen*] *ex* G. DON, Gen. Syst. 4 (1838) 221; DC. Prod. 9 (1845) 166. Mr. R. K. BRUMMITT, Kew, kindly remarked on this (*in litt.* 15-VIII-1975) that "WALLICH 8504 consists of two rather long inflorescences in bud only (one corolla almost open) and a fairly stout piece of stem, and bears no leaves, open flowers or fruits. It has been annotated '*Bignonia macrostachya* WALL. (and of G. DON & DC.)' by C. B. CLARKE, but has no more recent identification. It seems to me to be fairly clearly referable to *Pajanelia longifolia* (WILLD.) K.SCH. My opinion seems to be supported by a specimen laid away in the main herbarium under this species in a red folder (though it is not obvious what it is supposed to be a type of), collected in Khasiya by GRIFFITH and labelled '*Bignonia macrostachya* WALL. Cat. 6504 & – *rostrata* WALL. Herb. 6503A'. The specimen WALLICH 6503A does indeed also seem to be this species. The citation of WALLICH 6505 by G. DON in validating the name *B. macrostachya* is presumably an error for 6504.

Bignonia moluccana DC. Prod. 9 (1845) 144; MIQ. Fl. Ind. Bat. 2 (1858) 751. — *B. discolor* A. RICH. Sert. Astrol. (1834) xxix, *non* R.BR. 1814, said to come from the Moluccas. The description would tally with *Gmelina asiatica* LOUR. (*Verbenaceae*), but a sheet with an original label (in P) was identified by E. BUREAU as *Bignonia capreolata* L. which does not agree with the description. Confusion with labels and specimens must have taken place and the name should be discarded. *Cf.* STEEN. Blumea 15 (1967) 146.

Bignonia purpurea THUNB. Fl. Jav. (1825) 15, *nomen*. Of unknown identity, not mentioned by JUEL.

Bignonia ramiflora DECNE, Nouv. Ann. Mus. Paris 3 (1834) 381, repr. Herb. Timor. Descr. (1835) 53. — ? *Bignonia colei* G. DON, Gen. Syst. 4 (1838) 221. — *Colea ramiflora* DC. Prod. 9 (1845) 241; MIQ. Fl. Ind. Bat. 2 (1858) 759. — *Colea colei* M. L. Green, Stand. Sp. Nom. Cons. (1926) 55–63; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 277, *excl. syn. alter.* — *Colea timorensis in sched., in syn., ex* PERRIER.

This rests on a mislocalized specimen of POIVRE in herb. Jussieu from Madagascar, and is according to PERRIER DE LA BÂTHIE, Ann. Mus. Col. Marseille 46 (1938) 43 = *Rhodocolea racemosa* H. PERRIER.

Bignonia ternatea REINW. *ex* DE VRIESE, Reinwardt's Reize (1858) 495, 644, *nomen* = *Dichrotrichum ternateum* REINW. *ex* DE VRIESE.

Bignoniacea incerta: ZOLL. Syst. Verz. Heft 3 (1855) 53–54, based on ZOLLINGER 2214 = *Wightia borneensis* HOOK. *f. ssp. ottolanderi* (KOORD.) STEEN. (*Scrophulariaceae*).

Colea aberrans BAILL. Bull. Soc. Linn. Paris 1 (1889) 687 rests on a specimen said to have been collected by POIVRE in Timor, but came from Madagascar according to PERRIER DE LA BÂTHIE, Ann. Mus. Col. Marseille 46 (1938) 28, and = *Rhodocolea racemosa* PERRIER *var. humblotiana* H. PERRIER.

Dolichandrone falcata (WALL. *ex* DC.) SEEM.: F.-VILL. Nov. App. (1880) 151. According to MERRILL, En. Philip. 3 (1923) 445, obviously an erroneous record from the Philippines of this Asian species.

Dolichandrone tulipifera BTH. in B. & H. Gen. Pl. 2 (1876) 1046; F.-VILL. Nov. App. (1880) 151; MERR. En. Philip. 3 (1923) 445. This is an erroneous, non-existing combination for *Spathodea tulipifera* G. DON which was used by F.-VILLAR for the tulip tree, *Spathodea campanulata*, which he saw cultivated at Manila.

Hadongia eberhardtii GAGN. Not. Syst. 14 (1950) 30, from Indo-China, is according to VIDAL, Bull. Soc. Bot. Fr. 106 (1959) 352 a cultivated specimen of *Citharexylum spinosum* L. (*Verbenaceae*).

Hausmannia mollis K.SCH. *ex* STEEN. *in sched.*; Thesis (1927) 902; *Hausemannia mollis* F.v.M. *sphalm.* Ind. Kew. Suppl. 1 (1906) 16 (*Hausemannia mollis* K.SCH.) = *Archidendron molle* (K.SCH.) DE WIT (*Leguminosae*).

Markhamia cauda-felina (HANCE) CRAIB: SPRAGUE, Kew Bull. (1919) 310. — *Dolichandrone sp.* CERON, Cat. Pl. Herb. Fl. For. Filip. (1892) 127. Now considered to be *Markhamia stipulata* (WALL.) SEEM. *var. cauda-felina* (HANCE) SANTISUK, *cf.* Thai For. Bull. Bot. 8 (1974) 15.

The collection on which this was based is VIDAL 3398 (K), from Montufar, Albay Prov., Luzon. MERRILL noted (J. Arn. Arb. 35, 1954, 154) that it was possibly occasionally introduced for forestry purposes by VIDAL from S. China. As no later collections were ever made its cultivation seems to have been ephemeral.

Stereospermum cylindricum PIERRE *ex* P. DOP, Fl. Gén. I.-C. 4 (1930) 581, a species from Indo-China and Thailand, was mentioned by DOP, *l.c.* 582 to occur in Malaya, but on what evidence is unclear. I found no sheets in Paris to corroborate this.

Tripinna tripinnata LOUR. Fl. Coch. (1790) 391. — *Tripinnaria cochinchinensis* PERS. Syn. 2 (1807) 173. — *Tripinnaria asiatica* SPRENG. Syst. 2 (1825) 842, taken for a *Bignoniacea* by several authors. According to MERRILL, Comm. Lour. (1935) = *Vitex tripinnata* (LOUR.) MERR. (*Verbenaceae*).

CULTIVATED BIGNONIACEAE

There are quite a number of *Bignoniaceae* cultivated in Malesia; they stem from all parts of the tropics. Frequently they hardly set any seed. *Tecoma stans* does so profusely and this has led to its naturalization. *Jacarandas* also set seed but did not naturalize.

As *Bignoniaceae* are often very showy plants and are largely tropical there is no end to their introduction. Therefore the survey given below may be or at least become incomplete.

It should also be remembered that cultivated plants are often neglected by botanical explorers and are mostly scantily represent in herbaria.

These introduced species have mostly not been critically studied by me, but it is assumed that their names are correct. I acknowledge with great thanks the loyal collaboration of the late Mr. N. J. SANDWITH (Kew) who formerly named at my request certain introduced species, and of Dr. A. H. GENTRY (Missouri Botanical Garden, St. Louis) who was so kind as to check this appendix.

Some papers or appendices are dedicated solely to cultivated *Bignoniaceae* or have taken them up and often give keys and illustrations:

BACKER, C. A. & BAKHUIZEN VAN DEN BRINK Jr, R. C. 1965. Flora of Java 2: 534–542.

CHATTERJEE, D. 1948. A review of Bignoniaceae of India and Burma. Bull. Bot. Soc. Beng. 2: 75–79.

FABRIS, H. A. 1959. Las plantas cultivadas de la Republica Argentina. Bignoniacas. Inst. Bot. Agr. 10, fasc. 173: 57 pp., 25 fig.

GENTRY, A. H. 1973. Ann. Mo. Bot. Gard. 60: Flora of Panama, part IX, fam. 172: 781–977, 41 fig.

HEINE, H. 1976. Flore de Nouvelle-Calédonie 7: 91–93.

HERKLOTS, G. 1976. Flowering tropical climbers: 63–74, fig. 80–101, col. pl. 5–7.

HOLTTUM, R. E. 1941. The Bignonia family in Malayan gardens. M.A.H.A. Mag. 11: 3–11.

SANTISUK, T. 1974. Bignoniaceae. Thai For. Bull. Bot. 8: 1–46.

SYKES, W. R. 1966. Studies of cultivated plants in New Zealand. 1. Bignoniaceae. New Zeal. D.S.I.R. Inf. ser. 54: 63 pp., 25 fig.

ARTIFICIAL KEY TO CULTIVATED BIGNONIACEAE IN MALESIA

1. Climbing plants.
 2. Leaves at least 2-jugate. Tendrils absent.
  3. Stamens exserted. Corolla narrow-tubular, scarlet or sulphur-yellow . . . . . **Tecoma capensis**
  3. Stamens included. Corolla not narrow-tubular, lavendar or white streaked with carmine.
   4. Calyx truncate, at most 6 mm, including minute teeth, not inflated.
    5. Corolla *c.* 4–5 cm long, white with crimson throat, the tube puberulous outside. Calyx *c.* 6 mm. **Pandorea jasminoides**

5. Corolla (1–)2–3 cm long, pale yellow, lobes purple dotted or streaked, the tube glabrous outside. Calyx 2–3 mm . . . . . **Pandorea pandorana**
4. Calyx campanulate, inflated, white, distinctly 5-lobed, $1^1/_2$ cm long . . . **Podranea ricasoliana**

2. Leaves 1-jugate. Tendrils in a number of leaves present.
6. Corolla lobes valvate; tube narrow, without a distinct basal tube. Stamens exserted. Flowers bright orange . . . . . **Pyrostegia venusta**
6. Corolla lobes imbricate.
7. Calyx spathaceous, thin, 3 cm long. Corolla very large, rose-purple, (5–)7–9 cm. Disk absent. **Phryganocydia corymbosa**
7. Calyx regular, not spathaceous. Disk present.
8. Inflorescence, calyx and outside of corolla tube densely hairy.
9. Calyx 5-6 mm long, 6–8 mm wide at the mouth. Inflorescence pauciflorous, almost a raceme, with 2–4 pairs of opposite flowers. Tendrils branched . . . . . **Pithecoctenium cynanchoides**
9. Calyx 3–4 mm long, $2^1/_2$–4 mm wide at the mouth. Thyrse rich-flowered, the flowers in triad cymes. Tendrils unbranched . . . . . **Arrabidaea mollissima**
8. Inflorescence, calyx and outside of corolla tube glabrous.
10. Tendrils undivided. Leaves obovate with long-cuneate base, the two basal nerves straight, running up over halfway the blade, in the narrow angle with the midrib a large dark coloured gland field. Pseudostipules present . . . . . **Saritaea magnifica**
10. Tendrils 3-parted. Leaves not obovate, and no such gland field in the narrow angle at the base.
11. Corolla yellow, outside of lobes glabrous or lepidote. Plant without garlic odor.
12. Tendril with 3 claws. Pseudostipules scale-like. Calyx thin, broadly campanulate **Macfadyena unguis-cati**
12. Tendril 3-fid. Pseudostipules foliaceous, 5–7(–15) mm in diameter. Calyx coriaceous, cupular. **Anemopaegma chamberlaynii**
11. Corolla pale mauve to pale purple, outside of lobes puberulous. Plant smelling of garlic. **Pachyptera hymenaea**

1. Erect shrubs or trees.
13. Leaves in scattered fascicles. Fruit indehiscent, hard-shelled with fleshy pulp.
14. Leaves simple . . . . . **Crescentia cujete**
14. Leaves 3-foliate, petiole winged . . . . . **Crescentia alata**
13. Leaves decussate or in whorls. Fruit dehiscent or fleshy and without a hard shell.
15. Leaves simple.
16. Leaves elliptic on a long, slender petiole. Thyrses terminal. Capsule linear with long-hairy, linear seeds. Unarmed tree . . . . . **Catalpa longissima**
16. Leaves small, obovate, tapering into the base; no proper petiole. Flowers ramiflorous. Fruit an oblong berry. Twig nodes with a pair of thorns . . . . . **Parmentiera aculeata**
15. Leaves compound.
17. Leaflets 3, sessile, articulated on top of a winged petiole. Fruit fleshy.
18. Branchlets usually with 2 short, ascending thorns at most nodes. Fruit costate and curved, less than 17 cm long . . . . . **Parmentiera aculeata**
18. Branchlets unarmed. Fruit neither curved nor costate, usually more than 30 cm long, candle-like. **Parmentiera cereifera**
17. Leaflets 5 or more.
19. Leaves digitately compound. Leaflets 5.
20. Leaflets stellate-hairy beneath. Flowers yellow. Calyx rusty stellate-tomentose **Tabebuia chrysantha**
20. Leaflets lepidote, otherwise glabrous. Flowers pink. Calyx lepidote.
21. Leaflets acuminate or sharply acute. Inflorescence usually many-flowered. Mature capsule more than 22 cm long . . . . . **Tabebuia rosea**
21. Leaflets obtuse. Inflorescence few-flowered. Mature capsule usually less than 15 cm long **Tabebuia pallida**
19. Leaves pinnate.
22. Leaves 2-pinnate.
23. Corolla infundibuliform, lilac. Capsule broad-ellipsoid, with woody valves. Staminode longer than the stamens, glandular-pubescent, especially at apex.
24. Corolla glabrous, distinctly sigmoid. Leaflets acute, with oblique base. **Jacaranda obtusifolia *ssp.* rhombifolia**
24. Corolla densely short-hairy, not sigmoid. Leaflets cuspidate, base hardly oblique **Jacaranda mimosifolia**
23. Corolla salver-shaped, white, the tube 6–8 cm long, 2 mm wide. Capsule linear. Staminode absent . . . . . **Millingtonia hortensis**
22. Leaves 1-pinnate.
25. Calyx coarse, 2–7 cm long. Corolla wide-campanulate, coarse and large.
26. Calyx irregularly lobed, 2–3 cm. Flowers inside dark red, nocturnal, in long, pendent racemes. Berry massive, sausage-shaped . . . . . **Kigelia africana**
26. Calyx spathaceous, 4–7 cm. Flowers orange-red, in erect terminal thyrses, diurnal. Capsule dehiscent, with winged seeds . . . . . **Spathodea campanulata**
25. Calyx short 5-lobed, 5–6 mm. Flowers not coarse.

27. Corolla infundibuliform, yellow, with included stamens. Leaflets lanceolate, serrate, sometimes deeply incised . . . . . **Tecoma stans**
27. Corolla narrow-tubular, usually orange red, sometimes sulphur-yellow, with exserted stamens. Leaflets ovate, dentate . . . . . **Tecoma capensis**

Anemopaegma chamberlaynii (SIMS) BUR. & K.SCH. Fl. Bras. 8, 2 (1896) 128; HERKLOTS, Fl. Trop. Climb. (1976) 65, f. 82. — *Bignonia chamberlaynii* SIMS, Bot. Mag. (1820) t. 2148. — *Bignonia scandens* VELL. Fl. Flum. 6 (1825) 232, t. 22. —*A. scandens* MELLO *ex* K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 215; BACK. & BAKH. *f.* Fl. Java 2 (1965) 536.

Glabrous. Pseudostipules foliaceous, ovate to ± orbicular, 5–7(–15) mm. Leaflets ovate-oblong, to lanceolate-oblong, acute, 5–14 by $2^1/_2$–$5^1/_2$ cm. Tendrils 3-fid. Flowers in 2–8-flowered axillary racemes. Calyx campanulate, truncate, 7–8 mm. Corolla 4–5 cm, pale yellow.

Distr. Brazil, introduced in East Java as an ornamental, at Malang and Kali Baru (Besuki), 250–600 m; also seen from Rangoon, Burma (DICKASON 6660). All Asian material has smallish ovate leaflets, 5–6 by $2^1/_2$–$3^1/_2$ cm and smallish acute pseudostipules 5–7 mm long; in America both can obtain much larger size.

Arrabidaea mollissima (H.B.K.) BUR. & K.SCH. Fl. Bras. 8, 2 (1896) 46; SEIBERT, Carnegie Ins., Wash. 522 (1940) 406; DUGAND, Caldasia 3 (1945) 255.

Leaves patent, lax hairy, the longer hairs mostly gland-tipped; leaflets ovate, acuminate, 4–$12^1/_2$ by $2^1/_2$–$7^1/_2$ cm. Flowers pink to rose, $3^1/_2$–5 cm, mouth whitish with yellow spot.

Distr. Mexico and Central America to Columbia and Venezuela; cultivated in the vicinity of Manila.

Catalpa longissima (JACQ.) DUM. Cours. Bot. Cult. 2 (1802) 190; SIMS, Bot. Mag. (1808) t. 1094; SANDWITH, Rec. Trav. Bot. Néerl. 34 (1937) 228; ADAMS, Fl. Pl. Jamaica (1972) 669; LITTLE Jr., Trees Puerto Rico & Virgin Is. 2 (1974) 890, f. 700. — *Bignonia longissima* JACQ. En. Pl. Carib. (1760) 25. — *Macrocatalpa longissima* BRITTON, J. N.Y. Bot. Gard. 19 (1918) 8.

Tree up to 30 m, occasionally deciduous. Petioles slender; blades ovate-lanceolate, acute, (3–)5–11 by ($1^1/_2$–)2–4 cm. Flowers in small panicles, white, pinkish on the lobes, yellow in mouth with purple markings, $2^1/_2$–3 cm long. Calyx 2-cleft. Capsule 35–75 cm by 4 mm.

Distr. Jamaica, Hispaniola, Martinique, introduced for ornamental or forestry purposes in other tropics, *e.g.* in the Marianas (Guam, Saipan) and the Philippines (Luzon: Lamao For. Res.).

Vern. *French oak*, *Haitian oak*, *Mast-wood*, *Yoke-wood*, E.

Crescentia alata H.B.K. Nov. Gen. Sp. 3 (1819) 158; F.-VILL. Nov. App. (1880) 151; VIDAL, Sinopsis Atlas (1883) 35, t. 73, f. C; MERR. Fl. Manila (1912) 430; Sp. Blanc. (1918) 350; En. Philip. 3 (1923) 447; STANDLEY, Trees Shrubs Mex. (1926) 1324; BACK. & BAKH. *f.* Fl. Java 2 (1965) 542; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 829. — *C. trifolia* BLANCO, Fl. Filip. (1837) 489; DC. Prod. 9 (1845) 247; BLANCO, Fl. Filip. ed. 3. 2 (1878) 271, t. 327. — *Otophora paradoxa* BL. Rumphia 3 (1847) 146; MIQ. Fl. Ind. Bat. 1, 2 (1859) 560 (L). — *Parmentiera alata* MIERS, Trans. Linn. Soc. Bot. 26 (1870) 166.

A crooked tree, 5–14 m, to 25 cm ø. Leaves in scattered fascicles on the twigs, with a winged petiole, $2^1/_2$–11 cm; leaflets brittle, lanceolate-obspathulate, sessile, 1–$4^1/_2$ cm. Flowers 1–2 rami- and cauliflorous; calyx 2-lobed to the base; corolla brownish with brown-purple venation, rank-scented, with a transversal fold, 4–6 cm. Fruit with a hard shell, ± globular, 5–10 cm ø.

Distr. Mexico to Costa Rica, from Mexico early introduced by the Spaniards via Guam in the Philippines, also in Java (rare) and Rabaul (New Britain).

Vern. Philippines: *cruz-cruzan*, Tag., *hoja cruz*, Spanish.

The pulp is in Mexico sometimes used as a medicine; the shells are less in demand than those of *Crescentia cujete*, but used for the same purposes. No fruits seen from Malesia.

Crescentia cujete LINNÉ, Sp. Pl. (1753) 626; STANDLEY, Trees Shrubs Mex. (1926) 1324; STEEN. Thesis (1927) 1010; Bull. Jard. Bot. Btzg III, 10 (1928) 274; SEIBERT, Carnegie Inst. Wash. 522 (1940) 383; BACK. & BAKH. *f.* Fl. Java 2 (1965) 542; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 831. — *C. ovata* BURM. *f.* Fl. Ind. (1768) 132, *nom. semi-nudum* (G).

Crooked tree to 10 m, 30 cm ø. Leaves in scattered bundles on the rough twigs, obspathulate, sometimes short-acuminate, without petiole, up to 26 by $7^1/_2$ cm. Flowers solitary or in pairs on the twigs, of a musty odor; calyx 2-lobed to the base; corolla 4–7 cm, dirty white or pale greenish, purplish veined, finally turning dull purplish, the wide tube with a transversal fold. Fruit broad-ellipsoid to globular, 13–20 by up to 30 cm, indehiscent, with a hard shell.

Distr. Central America, very widely and early distributed in the American and other tropics, throughout Malesia, in the lowland, grown in lawns, parks and used for hedges.

Vern. *Tabu kaju*, S. Sum., *bila*, Djakarta, *sĕkopal*, *sikadel*, J, *bila radja*, Kangean, *bila bilanda*, Makas., *calabassa*, Moluccas, *bĕr(e)nuk*, S, *bua no*, Ternate, *buwano*, Halmaheira, *Calabash tree*, E.

The pulp is sometimes used for medicinal purpose and the hard shells are commonly in use for drinking cups, vessels, and carving.

The flowers are bat-pollinated. *Cf.* PORSCH, Oest. Bot. Z. 80 (1931) 31–44, t. 9–10.

I saw the type of *C. ovata* BURM. *f.* which was described from Java and which was in Index Kewensis reduced to *C. cucurbitina* L. (now *Amphitecna latifolia* (MILL.) GENTRY); the type consists of 3 leaves and a single damaged flower; the sheet carries no name, but the note 'Kalbas, 4 stam., 1 pistile'.

Jacaranda mimosifolia D. DON, Bot. Reg. 8 (1822) t. 631. — *J. ovalifolia* R.BR. Bot. Mag. 49 (1822) t. 2337. — *J. acutifolia* (*non* H. & B.) *auct.*; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 270; BACK. & BAKH. *f.* Fl. Java 2 (1965) 239.

Distr. Tropical America, Bolivia to NW. Argentina. Seen from W. Java, Hawaii, S. Africa, Madagascar, Congo. Perhaps not distinct from the Peruvian *J. acutifolia* H.B.K.

Suitable as a roadside tree and in parks. Flowers often when leaves are shed.

The names of DON and BROWN were published on the same day on material from the same source; a unique nomenclatural case!

Jacaranda obtusifolia H.B.K. *ssp.* **rhombifolia** (G. F. W. MEIJER) GENTRY, Mem. N.Y. Bot. Gard., in the press. — *J. rhombifolia* G. F. W. MEIJER, Fl. Esseq. (1818) 213. — *J. filicifolia* D. DON, Edinb. Phil. J. 9 (1823) 266; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 269; HOLTTUM, M.A.H.A. Mag. 3 (1933) 188, fig.; BACK. & BAKH. *f.* Fl. Java 2 (1965) 239.

Distr. Northern South America, Venezuela to Guiana. Seen from Malaya, Java (W. Java, also Semarang and Malang), and Borneo (Sandakan, Kuching).

Good roadside tree, and for large gardens and parks.

Kigelia africana (LAMK) BTH. in Hook. Niger Fl. (1849) 463; SPRAGUE, Fl. Trop. Afr. 4, 2 (1906) 536; MERR. Fl. Manila (1912) 430; En. Philip. 3 (1923) 444; H. HEINE in Hutch. & Dalz. Fl. W. Trop. Afr. ed. 2, 2 (1963) 385; MERXM. & SCHREIB. Prod. Fl. SW. Afr. fam. 128 (1967) 3. — *Bignonia africana* LAMK, Encycl. 1 (1785) 424. — *Crescentia pinnata* JACQ. Coll. 3 (1789) 203, t. 18. — *Tecoma africana* G. DON, Gen. Syst. 4 (1838) 224. — *K. pinnata* DC. Prod. 9 (1845) 247; KOENS, Trop. Natuur 1 (1912) 167, 6 f. — *K. aethiopica* (FENZL) DECNE in Deless. Ic. Sel. Pl. 5 (1845) 39, t. 93; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 275; BACK. & BAKH. *f.* Fl. Java 2 (1965) 542. — See for further synonyms HEINE, *vide supra*.

Widely branched tree, to 20 m. Leaves decussate or in whorls of 3–4, up to 50 cm; leaflets oblong, entire or serrate distally, glabrous or hairy on nerves, to 20 by 6 cm. Flowers nocturnal, coarse, in terminal, pendent, narrow panicles up to 2 m long; calyx greenish, 2–3 cm, 2-lipped; corolla outside yellowish, veined, inside dark wine-red, 5–10 cm; basal tube as long as the calyx or longer. Berry sausage-like, 25–50 by $7^1/_2$–15 cm, often on still flowering panicles.

Distr. Africa, widely cultivated in other tropics as an ornamental tree in parks and along roads, in Malesia not rare.

HEINE *l.c.* concluded that the genus consists of one species only as the species distinguished by STAPF are racial and grading.

The calyx contains much watery slime in bud (*cf.* KOORD. Ann. Jard. Bot. Btzg 14, 1897, 407–411). The flowers are in Malesia invariably visited by bats. *Cf.* FAIRCHILD, Trop. Gard. Bull. July 1968, 5; HARRIS & BAKER, The Nigerian Field 40: 151–158; J. West Afr. Sc. Assoc. 4 (1958) 25–30; KOENS, Trop. Natuur 1 (1912) 167, f. 1–6; MCCANN, J. Bomb. Nat. Hist. Soc. (1931) 467–471, 3 f. They are, however, also frequented by hawk-moths and HARRIS & BAKER *ll.cc.* concluded that bats are not essential pollinating visitors.

Macfadyena unguis-cati (L.) A. GENTRY, Brittonia 25 (1973) 236; Ann. Mo. Bot. Gard. 60 (1973) 874. — *Bignonia unguis-cati* LINNÉ, Sp. Pl. (1753) 623. — *Doxantha unguis-cati* MIERS *em.* REHDER, Mitt. Deut. Dendr. Ges. (1913) 262; HERKLOTS, Fl. Trop. Climb. (1976) 66, f. 87. — *Bignonia tweediana* LINDL. Bot. Reg. 26 (1840) t. 45, non GRISEB.; BUYSMAN, Flora 107 (1915) 361, cult. in Java. — ? *M. dentata* BUR. & K.SCH. Fl. Bras. 8, 2 (1897) 291; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 186; BACK. & BAKH. *f.* Fl. Java 2 (1965) 538.

Leaves very variable, those of juvenile plant appressed to substratum, very small; later to 5 by $3^1/_2$ cm, ovate, dentate, but in other forms elliptic-oblong and hardly dentate. Calyx irregularly lobed to spathaceous or subspathaceous. Corolla $4^1/_2$–8 cm.

Distr. Mexico to Brazil and N. Argentina, sometimes cultivated in Malesia.

Specific characters in this genus seem to be vague; those used to distinguish *M. uncata* (ANDR.) SPRAGUE & SANDW. from *M. unguis-cati* by GENTRY (Ann. *l.c.* 871) he declared himself (Brittonia *l.c.* 236) as inconstant. The one specimen I have seen from Java agrees with the plate of *M. dentata* but for the non-spathaceous calyx. Shape of calyx, margin of leaves and length of corolla seem to be very variable in this species which has alrea dy a very large synonymy (GENTRY, Ann. *l.c.* 871). Does not fruit in Java; propagated by suckers and cuttings.

Millingtonia hortensis L. *f.* Suppl. (1781) 291. See for a full treatment p. 133.

Distr. SE. Asia, probably also native in the Lesser Sunda Islands.

Suitable as a tree for roadsides and parks.

Pachyptera hymenaea (DC.) GENTRY, Brittonia 25 (1973) 236; Ann. Mo. Bot. Gard. 60 (1973) 888, with full synonymy.

Glabrous liana. Vegetative parts smelling of garlic. Pseudostipules bract-like, $1^1/_2$ mm. Leaflets triplinerved, ovate-oblong, short-acuminate, $3^1/_2$–7 by $1^1/_2$–3 cm; venation prominent on both sides. Flowers in short axillary racemes. Calyx tube 4–5 mm, with minute prominent pustular glands. Basal tube of corolla twice as long as calyx, in all 3–4 cm. Anthers glabrous. Fruit flattened, 16–22 by $1^1/_4$–$1^1/_2$ cm; valves with a central rib. Seeds 1–$1^1/_2$ by 3–$3^1/_2$ cm, incl. the membranous wing.

Distr. A common liana ranging from Mexico to Brazil of tropical dry forest, sporadically also in moist forest, introduced in the Philippines (Manila, Mindanao) and E. Java (Surabaya).

Another species may also be cultivated which is in flower not easy to distinguish from *P. hymenaea*, *viz P. alliacea* (LAMK) GENTRY; this latter species has a short oblong fruit with thick, corky wingless seeds.

The genus *Pseudocalymna* SAMP. & KUHLM. has been reduced to *Pachyptera* A.DC. by GENTRY (*l.c.*).

Pandorea jasminoides (LINDL.) K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; STEEN. Thesis

(1927) 847; Bull. Jard. Bot. Btzg III, 10 (1928) 195; Proc. R. Soc. Queensl. 41 (1929) 48; BACK. & BAKH. *f.* Fl. Java 2 (1965) 538; HERKLOTS, Fl. Trop. Climb. (1976) 69, f. 90. — *Tecoma jasminoides* LINDL. Bot. Reg. (1939) t. 2002.

Fairly tall climber; leaflets 4–7(–9), lanceolate, blunt, $2^1/_2$–5 by 1–2 cm. Corolla white streaked with carmine in the mouth, 4–5 cm long, short hairy.

Distr. NE. Australia, not rarely cultivated in the tropics and also subtropics (Mediterranean, N. New Zealand), in Malesia rarely cultivated (*e.g.* West Java), in the temperate zone in greenhouses.

Propagated by cuttings; seeds very rare.

Pandorea pandorana (ANDR.) STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 198; BACK. & BAKH. *f.* Fl. Java 2 (1965) 538. For full references see p. 176.

Distr. East Australia, New Caledonia, Lord Howe I., Solomons (Bougainville), New Guinea, Moluccas, and Lesser Sunda Islands.

In Malesia an unfrequent ornamental, but cultivated here and there through the tropics and subtropics (also in the Mediterranean and N. New Zealand).

Propagated by tjankoks (marcotting) and cuttings.

Parmentiera aculeata (H.B.K.) SEEM. Bot. Voy. Herald (1854) 183; SEIBERT, Carnegie Inst. Wash. 522 (1940) 385; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 899. — *Crescentia edulis* DESV. J. Bot. 4 (1814) 112. — *Crescentia aculeata* H.B.K. Nov. Gen. Sp. 3 (1819) 158. — *P. edulis* DC. Prod. 9 (1845) 244 (heterotypic with *Crescentia edulis* DESV.).

Tree 7–8 m. Leaves articulated with very hard, thorny extension of the nodal bark, the latter remaining a permanent, ascending, sharp thorn; leaflets elliptic, narrowed at both ends, 2–5 by 1–3 cm; axillary fascicled leaves mostly simple. Flowers 1-several together, terminal, axillary or on branches or stem. Calyx spathaceous, 3–5 cm; corolla white, 6–7 cm. Berry pendent, cylindric, curved, costate with thick ribs, 8–17 cm by over 3 cm ∅.

Distr. S. Mexico to northern Central America, cultivated elsewhere in the tropics; in Malesia rare: W. Java, Luzon, also seen from Cairns (N. Queensland).

Young sterile offshoots have no thorns and possess coarsely dentate leaflets.

Parmentiera cereifera SEEM. in Hook. J. Bot. & Kew Gard. Misc. 3 (1851) 302; Bot. Voy. Herald (1854) 182, t. 32; STEEN. Thesis (1927) 1008; Bull. Jard. Bot. Btzg III, 10 (1928) 272; BACK. & BAKH. *f.* Fl. Java 2 (1965) 542.

Tree to 7 m, 20 cm ∅. Leaflets oblong, acuminate, 4–8 by $1^1/_2$–$3^1/_2$ cm. Flowers cauliflorous, nocturnal, white, slightly fragrant. Calyx spathaceous, 3 cm; corolla 5–6 cm. Berry pale yellow, pendent, candle-like, smooth, 30–100 by $1^1/_2$–$2^1/_2$ cm.

Distr. Panama, cultivated in many tropical countries, and in many parts of Malesia in parks and gardens. With its waxy-fleshy, candle-like fruits a showy plant.

Vern. *Candle tree*, E, *kaarsenboom*, D.

The flowers are bat-pollinated, as in *Crescentia*. In Panama fruits are utilized as cattle food (SEEMANN).

Phryganocydia corymbosa (VENT.) BUR. *ex* K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 224, f. 89H; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 905; HERKLOTS, Fl. Trop. Climb. (1976) 69, col. pl. 6. — *Spathodea corymbosa* VENT. Choix (1807) t. 40.

Sometimes pseudostipules. Leaflets (4–)12–15 by (2–)7–9 cm, triplinerved. Calyx spathaceous. Corolla lavender to blue purple, with a white mouth.

Distr. Panama to Brazil, cultivated at Seria (Brunei).

A Brunei specimen (VAN NIEL 3826) identified by A. A. ATCHLEY (1973).

Pithecoctenium cynanchoides DC. Prod. 9 (1845) 193; FABRIS, Rev. Mus. La Plata 9, Bot. n. 49 (1965) 353, f. 19.

Leaves reniform-triangular acuminate, ciliate at the margin, $2^1/_2$–4 by 2–4 cm. Corolla 3–6 cm, white with yellow markings in the mouth.

Distr. Southern Brazil to Argentina, in E. Java once cultivated (Mt Tengger: BUYSMAN).

Podranea ricasoliana (TANF.) SPRAGUE, Fl. Cap. 4, 2 (1904) 450; SYKES, New Zeal. D.S.I.R. Inf. ser. 54 (1966) 39, f. 16; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 916, f. 29; HERKLOTS, Fl. Trop. Climb. (1976) 70, f. 92. — *Tecoma ricasoliana* TANF. Bull. Soc. Tos. Ort. (1887) 17, t. 1–2. — *Pandorea ricasoliana* BAILL. Hist. Pl. 10 (1891) 40.

Leaflets 7–9, crenate, $2^1/_2$–4 by 1–2 cm. Corolla pale lavender or pinkish, with magenta patches and lines in the mouth and tube, 6–8 cm long, in terminal thyrses.

Distr. South Africa, cultivated elsewhere in the tropics (*e.g.* in the Philippines, New Caledonia) and subtropics (Mediterranean, New Zealand).

Pyrostegia venusta (KER) MIERS, Proc. R. Hort. Soc. Lond. 3 (1863) 188; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 189; BRUGGEMAN, Ind. Tuinb. (1939) 64, f. 21; BACK. & BAKH. *f.* Fl. Java 2 (1965) 536; SYKES, New Zeal. D.S.I.R. Inf. ser. 54 (1966) 22, f. 6; HERKLOTS, Fl. Trop. Climb. (1976) 71, f. 94. — *Bignonia venusta* KER, Bot. Reg. (1818) t. 249; Bot. Mag. (1819) t. 2050. — *Tecoma venusta* LEM. Hort. Univ. (1834) 1, *icon.* — *P. ignea* (VELL.) PRESL, Bot. Bemerk. (1845) 93.

Leaflets ovate-lanceolate, 4–6 by 3–4 cm. Thyrses dense, rachis 10 cm. Calyx 6–7 mm. Corolla tube *c.* 7 cm.

Distr. Brazil, commonly cultivated throughout the tropics and also in subtropics (North I. of New Zealand), in the temperate zone in glass-houses since the early 19th century. Widely cultivated in Malesia.

A richly flowering ornamental, good for walls and trellis, excellent between 500–1700 m altitude, not flowering in Java below 250 m and never setting fruit. The *oranje stephanoot*, D, is easily propagated by tjankoks (marcotting) and cuttings.

Saritaea magnifica (STEEN.) DUGAND, Caldasia 3 (1945) 263, fig.; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 920, f. 31; SANTISUK, Kew Bull. 28 (1973)

184; Thai For. Bull. Bot. 8 (1974) 46; HERKLOTS, Fl. Trop. Climb. (1976) 71, f. 95. — *Arrabidaea magnifica* STEEN. Rec. Trav. Bot. Néerl. 24 (1927) 830, *excl. syn. Bignonia magnifica* BULL; Bull. Jard. Bot. Btzg III, 10 (1928) 191; GUTTENBERG, Ann. Jard. Bot. Btzg 44 (1934) 195; CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 78; BACK. & BAKH. *f.* Fl. Java 2 (1965) 536. — *Arrabidaea sp.*: DAUBANTON, Teysmannia 29 (1918) 51–53, phot.

Pseudostipules present. Tendrils simple. Leaflets obovate, bluntly short-acuminate, 5–11 by 3–6 cm. Calyx cupular-campanulate, truncate, 6–12 by 3–7 mm. Corolla purple to magenta, 8–9 cm, the mouth white with magenta markings.

Distr. Colombia and Ecuador, widely cultivated through the tropics and common in SE. Asia and Malesia, never setting fruit. Obviously first introduced in Singapore; the Bogor Botanic Gardens received it from Banka in 1911.

A robust climber, good for walls and trellis, profusely flowering all the year round, especially in the wet season (Oct.–May), easily propagated by cuttings, found up to *c.* 1000 m.

Spathodea campanulata P. BEAUV. Fl. Oware Benin 1 (1805) 47, t. 27; HOOK. Bot. Mag. 85 (1859) t. 5091; SPRAGUE, Fl. Trop. Afr. 4, 2 (1906) 529; MERR. Fl. Manila (1912) 429; En. Philip. 3 (1923) 447; STEEN. Rec. Trav. Bot. Néerl. 24 (1927) 945; Bull. Jard. Bot. Btzg III, 10 (1928) 232; HOLTTUM, M.A.H.A. Mag. 3 (1933) 186, fig.; IRVINE, Woody Pl. Ghana (1961) 739, t. 7; HEINE, Fl. Trop. W. Afr. ed. 2, 2 (1963) 386; BACK. & BAKH. *f.* Fl. Java 2 (1965) 540.

Large tree, 7–25 m, 10–50 cm ø. Pseudostipules leafy. Leaves decussate; leaflets in (4–)5–6(–9) pairs, oblong, entire, glabrous or puberulous beneath, 5–14 by $2^1/_2$–$5^1/_2$ cm. Flowers erect, in terminal thyrses; calyx navicular, ribbed, beaked, thinly velutinous, 4–7 cm; corolla scarlet to orange, wide, 8–14 cm. Capsules erect, lanceolate-oblong, 15–20 by $2^1/_2$–3 cm; valves keeled; seeds $2^1/_2$ by 2 cm, hyaline winged.

Distr. Tropical Africa; widely cultivated in the tropics in parks and as an avenue tree; throughout Malesia, up to *c.* 1000 m.

Vern. *African tulip*, *Tulip tree*, E, *spuitjesboom*, D, *panchot*, Malaya, *djati bĕlanda*, Kangean; Sabah: *anchit anchit*, *maundi*, Banggi.

The flowers are frequented by birds on which BEUMÉE (Trop. Natuur 14, 1925, 28–30, f. 1) did observations at Bogor. Flowers remain open for at least two days and each flower may be visited by more than one bird, obviously in search of honey. Possibly the birds play a role in pollination; corollas are frequently damaged.

AYENSU observed bats visiting the flowers at night (Ann. Mo. Bot. Gard. 61, 1974, 713).

The calyx, which is closed in bud, contains water and children play the 'waterspout' with it, hence the Dutch name. Children also use the boat-shaped valves for making small sailing boats.

Fruiting and flowering takes place throughout the year. At Bogor I found young seedlings in hedges and gardens, with a long taproot and dentate leaves, but there are no records of spontaneous naturalization. Timber is weak and worthless.

RIDLEY (Fl. Mal. Pen. 2, 1923, 547) mentioned it erroneously from Singapore under the name *S. nilotica* SEEM.; although this is a closely related African tree, it is a distinct taxon characterized by a longer-tomentose, hardly ribbed calyx, leaflets tomentose underneath, a longer lobed disk and a long-hairy ovary.

Tabebuia chrysantha (JACQ). NICHOLS. Dict. Gard. 4 (1887) 1; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 941. — *Bignonia chrysantha* JACQ. Hort. Schoenbr. 2 (1797) 45, t. 211.

Deciduous tree to 25 m, 50 cm ø. Leaflets elliptic-oblong, abruptly acuminate, 5–25 by 4–11 cm. Calyx shallowly lobed, 5–13 mm. Corolla glabrous, tubular-infundibuliform, 5–8 cm.

Distr. Mexico to northern Venezuela, in SE. Asia cultivated, rare in Malesia (Philippines: U.S. Cemetery, Fort McKinley, Rizal Prov.). No fruit seen.

A yellow-flowered species has been reported by BACK. & BAKH. *f.* (Fl. Java 2, 1965, 539) to be cultivated in Java under the name *T. capitata* (BUR. & K.SCH.) SANDW., but in absence of material I cannot check the identity.

Tabebuia pallida (LINDL.) MIERS, Proc. R. Hort. Soc. 3 (1863) 199; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 950. — *Bignonia pallida* LINDL. Bot. Reg. (1826) 12, t. 695.

Shrub or small tree. Leaves 1–5-foliolate, leaflets elliptic to elliptic oblong or obovate, obtuse. Inflorescence few-flowered, often reduced to 1 or 2 flowers. Corolla pinkish lavender to almost white, the throat opening yellow.

Distr. A common variable West Indian species, closely related to *T. rosea*, cultivated in various parts of the tropics, in Indonesia distributed from Botanic Gardens, Bogor.

Tabebuia rosea (BERTOL.) DC. Prod. 9 (1845) 215; SANDW. Kew Bull. (1953) 454; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 951, with synonymy. — *Tecoma rosea* BERTOL. Fl. Guat. (1840) 25.

Deciduous tree, up to 30 m, 1 m ø. Leaflets and petiolules often unequal, lepidote, 5–30 by 2–12 cm. Calyx cupular, bilabiate, densely lepidote, $^3/_4$–2 cm. Corolla outside glabrous, 6–10 cm.

Distr. S. Mexico to Venezuela, cultivated in the tropics in parks and along roadsides; a magnificent ornamental when abundantly flowering with blossoms in bunches on the bare twigs; not rare in SE. Asia, in Malesia only known to me from the vicinity of Manila, Luzon. No fruit seen.

Tecoma capensis (THUNB.) LINDL. Bot. Reg. 13 (1828) t. 1117. — *Bignonia capensis* THUNB. Prod. (1800) 105. — *Tecomaria capensis* (THUNB.) SPACH, Hist. Nat. Vég. 9 (1840) 137; SPRAGUE, Fl. Cap. 4, 2 (1904) 448; STEEN. Thesis (1927) 832; Bull. Jard. Bot. Btzg III, 10 (1928) 193; BRUGGEMAN, Ind. Tuinb. (1948) 39, 268 f. 273; BACK. & BAKH. *f.* Fl. Java 2 (1965) 538; BRUMMITT, Bull. Jard. Bot. Nat. Belg. 44 (1974) 421, f. 1 (map); HERKLOTS, Fl. Trop. Climb. (1976) 74, f. 101.

An erect and scrambling shrub, up to *c.* 3 m, never in my experience a true climber. Leaflets 2–4 pairs, crenate, with domatia, 1–3 by 1–2 cm. Corolla tubular, red, rarely pale yellow, 4–5 cm.

Distr. South Africa, cultivated and naturalized in many subtropical and tropical countries, *e.g.*

the Mediterranean; also in South America. Commonly cultivated in Java and elsewhere in Malesia, up to *c.* 1000 m. Flowering all the year round. No capsules seen; not run wild. Easily propagated by suckers or cuttings. A nice ornamental for gardens and often used for hedges.

BRUMMITT *l.c.* assumes that there is only one *Tecoma* (*Tecomaria*) in Africa and reduced 7 other names, distinguishing the tropical taxa as a separate race, *ssp. nyassae* (OLIV.) BRUMMITT.

In South African parks and gardens is also cultivated an even sulphur-yellow variety which was originally found in the wild, *cf.* A. JACOT-GUILLARMOD, Veld en Flora 4 (1974) 36; it hybridizes with the red-flowered variety and sets abundant fruit.

Tecoma capensis, the Cape Honey suckle, is bird-pollinated; *cf.* M. S. EVANS, Nature 18 (1878) 543; SCOTT-ELLIOT, Ann. Bot. 4 (1890) 270.

Tecoma stans (L.) H.B.K. Nov. Gen. Sp. 3 (1819) 144; CORNER, Wayside Trees (1940) 170, f. 44, pl. 159; BACK. & BAKH. *f.* Fl. Java 2 (1965) 539. — *Stenolobium stans* (L.) SEEM. Ann. Mag. Nat. Hist. 10 (1862) 30. — See for elaborate treatment p. 135.

Yellow Bells is a small, erect, ornamental shrub with showy yellow flowers.

Distr. Southern U.S.A. to southern Argentina, commonly cultivated through the tropics, in certain places naturalized. Easily propagated by seed or by suckers or cuttings. It flowers and fruits profusely in Malesia the year round, from the lowland up to *c.* 1000 m. Suitable for gardens and parks.

There is a form with hairy leaves (*var. velutina* DC. = *T. mollis* H.B.K.) and one with much incised leaves (*var. incisa* G. DON), the latter being naturalized in Malesia.