

NYCTAGINACEAE (J. F. Stemmerik, Leyden)

Trees, shrubs, herbs, or armed climbers; roots not rarely tuberous. Indument consisting of simple hairs. *Leaves* simple, exstipulate, opposite or rarely in whorls or pseudowhorls, sometimes unequal in one pair. *Inflorescence* cymose, often thyrsoid, corymbose or umbellate terminal or axillary, sometimes cauliflorous. Bracts and bracteoles present, sometimes very small, not rarely early caducous. *Flowers* actinomorphic, bisexual or unisexual by reduction; pedicelled, with 1–3 bracteoles sometimes coloured, or sustained by an involucre. *Perianth* tubular, campanulate, funnel-shaped, or urceolate, sometimes articulated with the pedicel; the basal part persistent, enclosing the receptacle, tubular, club- or funnel-shaped, often accrescent; the apical, mostly circumscissile caducous part plicate or valvate in bud, with (4–)5–10 lobes, green or coloured. *Stamens* 1–40, rarely more, in 1–2 whorls, connate at the base, free from the perianth; anthers 2-locular, latrorse, basifixed. *Ovary* (sub)sessile, superior, 1-celled, with one erect, anatropous ovule. Style terminal, stigma capitate or fimbriate- to shortly lobed. Basal persistent part of the perianth accrescent in fruit and enveloping the fruit, the whole being known as *anthocarp*; anthocarp indehiscent, smooth, or with viscid ribs and glands, sometimes the glands accrescent into prickles; pericarp thin. *Seed* 1; embryo straight or folded; endosperm mealy or reduced to a gelatinous rest.

Distribution. About 26 genera with 300 *spp.* in the New World, particularly in South America, with poor representations of mostly widespread (native or introduced) species in the warm parts of the Old World. Although the family is predominantly tropical, its area reaches to 38° SL in New Zealand and to 45° SL in Argentina. In Malesia there are 19 *spp.* in 4 genera, of which only *Pisonia* is undoubtedly native.

Ecology. A lowland family, occurring up to *c.* 2000 m, in not too dry climates, rather indifferent to soil. *Boerhavia* is a genus of weeds; *B. chinensis* is in Malesia distinctly preferring regions with a strong dry season; *Mirabilis* sometimes runs wild; *Pisonia* is a genus of various forest types; *P. aculeata* avoids more or less the high forest in everwet regions and prefers in Malesia localities with a feeble to strong dry season.

Pollination. Though of some species the flowers are distinctly showy, little is known about pollinators. See under *Bougainvillea*.

Dispersal. The mostly sticky anthocarps of *Pisonia* are obviously spread epizooically by birds. The equally sticky anthocarps of *Boerhavia* by birds, other animals, and man.

Phytochemistry. Chemically *Nyctaginaceae* are good members of the order *Centrospermae* of VON WETTSTEIN. Red pigmentations are not caused by anthocyanins but by the characteristic chromoalkaloids, known as betacyanins (compare for instance A. S. DREIDING in W. D. OLLIS, *Recent developments in the chemistry of natural phenolic compounds*, Pergamon Press, 1961). Other compounds known to be present in the family are saponins (*Bougainvillea*), alkaloids (*Boerhavia*), protoalkaloids (trigonellin in *Mirabilis jalapa* L.; 3, 4-dihydroxyphenylethylamine in *Hermicium alipes* S. WATS.), great amounts of KNO₃ (*Boerhavia*), pinitol (found in all four species investigated for this character) and large amounts of oxalate of lime (frequently deposited in the form of raphides). On the other hand true tannins seem to be rare or lacking; small amounts of leucoanthocyanins are, however, present in the leaves (and probably in the stems too) of some species. Quercetin, kaempferol, ferulic acid and sinapic acid are probably very common constituents of *Nyctaginaceae*. The seeds are starchy and contain very little fatty oil (4.3 % was found for those of *Mirabilis jalapa*).

This set of chemical characters is found in various combinations in all other families of *Centrospermae* (compare *Aizoaceae*, *Amaranthaceae*, *Basellaceae*, *Cactaceae*, *Caryophyllaceae*, and *Chenopodiaceae* in HEGNAUER, *Chemotaxonomie der Pflanzen* 3, 1964).—R. HEGNAUER.

Wood anatomy. METCALFE and CHALK 2 (1950) 1063–1067 with literature references until 1950; E. REINDERS, *Handl. Pflanzenanatomie, Centraal Magazijn Landbouwhogeschool Wageningen* 1961 p. 254.—*Nyctaginaceae* are chiefly remarkable for the occurrence of anomalous secondary tissue in all woody and many herbaceous species. In *Pisonia*, the only genus with woody species, an extrafascicular cambium is formed already during the development of the initial vascular bundles. Although secondary growth begins from a vascular cambium in the normal position, this cambium soon ceases activity. The extrafascicular cambium is persistent throughout the life of the stem and, in *Pisonia*,

forms groups of radial multiples or irregular clusters of vessels, each group with a cap of included phloem; the secondary tissue between the groups consists mainly of fibres with scarce parenchyma cells and wood rays. C.A.R.-G.—Another anatomical character is the abundance of raphids of Ca-oxalate which can sometimes even be observed in dried material as fine prominent dots or lines and in some cases appear pellucid as minute short lines under obliquely transparent light.

Taxonomy. Though generally *Nyctaginaceae* have been arranged among *Centrospermae* alongside *Phytolaccaceae*, HUTCHINSON, in both editions of his *Fam. Fl. Pl.*, considered *Nyctaginaceae* to belong to his *Herbaceae* and inserted the family in *Thymelaeales* of which it is an aberrant member by its 1-celled ovary with 1 basal ovule. I believe this position is unnatural and untenable.

I want to draw attention to the noteworthy parallel between *Boerhavia* and *Pisonia* with *Plumbago* in which the glandular calyx of the latter shows such a marked resemblance with the lower part of the anthocarp of the first two, whereas the corolline upper part of the anthocarp finds a parallel in the often scarious, unduplicate-plicate upper funnel-shaped part of the calyx of some *Plumbaginaceae*. Besides, circumscissile behaviour of flower parts is shown in both groups. This seems all parallel development, superficial, not intrinsic. But in this respect I must point to the remarkable fact that both groups have also in common a 1-celled ovary with 1 basal ovule, and anatomical resemblances. VON WETTSTEIN (*Handb. Syst. Bot.* ed. 2, 1911, 865) and PULLE (*Compendium*, 1938, in the plate representing his ideas about affinities of orders), indeed, attached *Plumbaginales* to *Centrospermae*. HUTCHINSON regards *Nyctaginaceae* as having lost the corolla; on the other hand *Nyctaginaceae* are characterized by having frequently “bracts below the flowers, occasionally simulating a calyx”. The homology seems not to be clear, but if we dare to apply CORNER’s hypothetical viewpoint of ‘transference of function’ one could assume that the anthocarp is a true calyx and has taken over at its apex the function of a corolla.

Chromosomes. DARLINGTON & WYLIE (1955) cite for *Mirabilis* and *Oxybaphus* $x = 29$, but for *Bougainvillea* $x = 17$ (except *B. glabra*, $x = 10$).

Note. Thanks are due to Mr M. JACOBS for help and criticism and to Dr R. E. HOLTUM for data on *Bougainvillea*.

KEY TO THE GENERA

1. Herbs, unarmed.
2. Leaves equal. Inflorescence involucrate. Perianth not articulated with the pedicel, 4½–6¼ cm long. Anthocarp with faint ribs, not viscid 1. *Mirabilis*
2. Leaves subequal. Inflorescences without an involucre. Perianth articulated with the pedicel, 1½–12 mm long. Anthocarp with 5 or 10 ribs and mostly with viscid glands. 2. *Boerhavia*
1. Ligneous plants, sometimes thorny.
3. Each pedicel adnate to a sessile coloured bract 3–6 cm long 3. *Bougainvillea*
3. Each pedicel bearing 1–3 small, not coloured bracteoles. 4. *Pisonia*

1. MIRABILIS

LINNÉ, *Gen. Pl.* ed. 5 (1754) 82; *Sp. Pl.* (1753) 177; HEIMERL in E. & P. *Pfl. Fam.* 3, 1b (1889) 23; *ibid.* ed. 2, 16c (1934) 108.

Erect herbs, often branched, glandular-pubescent or glabrous; nodes thickened; roots with tubers. *Leaves* of each pair equal. *Inflorescences* terminal, corymbose, 1–∞-flowered, each flower sustained by a persistent, accrescent involucre which is divided halfway into 5 oblong, acute lobes. *Flowers* bisexual, ephemeral, trumpet-shaped, coloured, large, the tube with a constriction above the basal green part; lower portion of tube roundish oblong, ribbed or with knobs; upper portion of tube and limb coloured and circumscissile caducous after anthesis. *Stamens* 3–6, unequal, distinctly exerted. *Ovary* (sub)sessile; style distinctly exerted; stigma capitate with short lobes or fimbriate. *Anthocarp* ribbed or with knobs, not viscid. *Seed* with bended embryo; cotyledons with recurved margin and surrounding the mealy endosperm.

Distr. About 60 *spp.*, mostly American, from California to The Argentine; 1 *sp.* in the Himalayas and SW. China. Several *spp.* cultivated.

1. *Mirabilis jalapa* LINNÉ, *Sp. Pl.* (1753) 177; CHOISY in DC. *Prod.* 13, 2 (1849) 427; FILET, *Pl. Bot. Tuin Weltevr.* (1855) 48; MART. *Fl. Bras.* 14, 2 (1872) t. 81; KOORD. *Med. Lands Pl. Tuin* 19 (1898) 563; STANDL. *Contr. U.S. Nat. Herb.* 12 (1909) 366; BAKER & WRIGHT, *Fl. Trop. Afr.* 6, 1 (1913) 2; MERR. *Int. Rumph.* (1917) 215; BACK.

Onkr. *Suiker.* 7 (1930) 233; GAGNEP. *Fl. Gén. I.-C.* 4 (1936) 1048; HOLT. *M.A.H.A. Mag.* 8, 2 (1938) 73, fig.; BACK. & BAKH. *f. Fl. Java* 1 (1963) 270.—*Mirabilis* RUMPH. *Herb. Amb.* 5 (1747) 253, t. 89.—*M. longiflora* (non L.) BLANCO, *Fl. Filip.* (1837) 77.

Herb, 50–80 cm. *Leaves* 2¼–15 by 1¼–9 cm,

oblong to triangular; petiole 1–4 cm. Peduncle 1½–6 mm. *Flowers* 3–7 together; involucre 8–10 mm long, stretching after anthesis to c. 15 mm; pedicel 0.2 mm. *Perianth* white, crimson, yellow or variegated; lower portion of tube ½ cm, upper portion c. 4–5 cm, limb 2½–3½ cm ø. *Stamens* 5–6, exerted for 8–15 mm. Style equalling the stamens; stigma capitate, with short lobes to fimbriate. *Anthocarp* subglobular, 7–8 mm long, ribbed or with knobs, black when mature.

Distr. Native in Peru, now cultivated as an ornamental or medicinal plant and occasionally escaped, in all tropical regions.

Ecol. Cultivated up to c. 1200 m. The flowers are ephemeral, open at c. 4–4.30 o'clock in the afternoon and close at 9 in the morning (see VAN DER PILL, *Trop. Natuur* 19, 1930, 95).

Uses. The large tubers were formerly mistaken in Europe for the source of *jalap*, and are mildly purgative. Bruised leaves are used for poulticing boils and abscesses; pounded seeds are used for making a cosmetic powder. BURKILL (*Dict.* 1935, 1478–1479) and HEYNE (*Nutt. Pl.* 1927, 609) mention some other minor uses. For a discussion of the medicinal value see QUISUMBING (*Medic. Pl. Philip.* 1951, 276).

Vern. *Four o'clock*, *Marvel of Peru*, E; *bonte wonderbloem*, *nachtschone*, *vieruursbloem*, D; *bunga* or *kembang pukul empat*, *kembang pagi soré*, *séraja*, M, *kédérat*, *ségérat*, *tégérat*, J; *nodja*, Bali, *bunga lédonosok*, *Roti*, *loro laka*, Timor (Tëtum lang.); *turaga*, Cel. (tonsaw.); *bunga waktu ketjil*, Moluccas, *kupa oras*, Ambon, *tjako raha*, Ternate.

2. BOERHAVIA

LINNÉ, *Gen. Pl.* ed. 5 (1754) 4; *Sp. Pl.* (1753) 3; CHOISY in DC. *Prod.* 13, 2 (1849) 449; HEIMERL in E. & P. *Pfl. Fam.* 3, 1b (1889) 26; *Bot. Jahrb.* 21 (1896) 617; STANDL. *Contr. U.S. Nat. Herb.* 12 (1909) 375 ('*Boerhaavia*'); *ibid.* 13 (1911) 418; N. Am. *Fl.* 21, 3 (1918) 204; *Field Mus. Nat. Hist. Bot.* 11, 3 (1931) 105; HEIMERL in E. & P. *Pfl. Fam.* ed. 2, 16c (1934) 117.—*Commicarpus* STANDL. *Contr. U.S. Nat. Herb.* 12 (1909) 373; *ibid.* 13 (1911) 428; N. Am. *Fl.* 21, 3 (1918) 215; HEIMERL in E. & P. *Pfl. Fam.* ed. 2, 16c (1934) 115.—Fig. 1.

Annual herbs, erect, ascending or creeping, puberulous-glabrescent, with sessile or stalked, club-shaped glands or hairs; stem base and root often woody. Stems often red tinged and swollen (when dry constricted) at the nodes. *Leaves* opposite, subequal in each pair, beneath paler, the epidermis with minute irregular cystolith-like sculpture, and sometimes with embedded reddish glands. *Inflorescences* axillary, in the axil of the smallest leaf of each pair, or (*B. erecta*) by reduction of leaves into bracts each stem forming one large thyrsoid inflorescence appearing terminal at the extremities, subumbels of 2–10 small flowers. Bracts (basal) and bracteoles (apical) small, acute, fimbriate, caducous. Pedicels jointed with the flower, mostly very short. *Flowers* bisexual. *Perianth* tubular-campanulate, with a distinct constriction mostly halfway; lower part (later becoming the coriaceous anthocarp) obconical, 5- or 10-ribbed, upper caducous part 5-lobed, plicate in bud, white or pink. *Stamens* 1–4, exerted. *Ovary* (sub)sessile, smooth; style as long as the perianth; stigma capitate. *Anthocarp* closed at apex, 5–10-ribbed, glabrous or set with glands, swelling and slimy in water. *Seed* with longitudinally folded embryo; cotyledons with recurved margin and surrounding the mealy endosperm.

Distr. Pantropical, generally between 35° N and 40° S, with in my opinion only 3 *ssp.* in all, largely introduced, all in *Malesia*.

Ecol. Distinctly heliophilous weeds of beaches and ruderal places preferring a slightly seasonal climate, indifferent to soil, up to c. 1000 m.

Notes. Specific delimitation has been different; HEIMERL had in 1889 c. 20 *ssp.* and in 1934 c. 36, of which he reckoned 16 *ssp.* to a separate genus *Commicarpus* STANDL. (*Boerhavia* § *Adenophorae* HEIMERL of 1889) following STANDLEY, who, however, sunk this again in *Boerhavia* in 1931. Surely, the generic difference of the concept *Commicarpus* (10-ribbed larger perianth), in this Flora represented only by *B. chinensis*, is of no more than specific value.

In addition to the Malesian sheets, I have examined a very large material, under many names, from

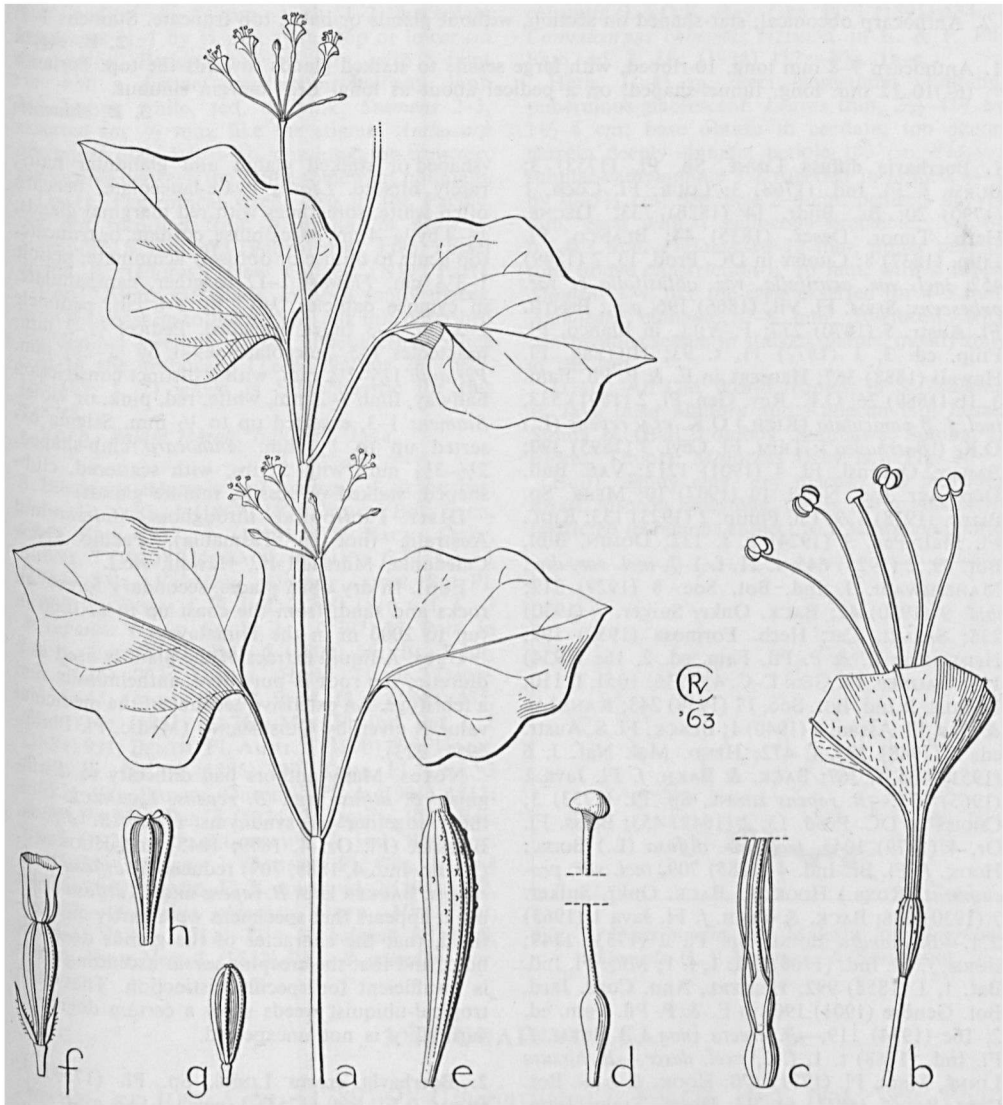


Fig. 1. *Boerhavia chinensis* (L.) ASCHERS. & SCHWEINF. a. Habit, $\times \frac{2}{3}$, b. flower, bracteoles omitted, $\times 4$, c. ovary surrounded by filaments united in basal tube, $\times 8$, d. ovary and stigma, $\times 8$, e. anthocarp, $\times 4$.—*B. diffusa* L. f. Flower, $\times 8$, g. anthocarp, $\times 4$.—*B. erecta* L. h. Anthocarp, $\times 4$ (a WIGHT 2468, b-d ELBERT 1495, e ELBERT 2046, f-g JUNGHUHN 67, h POPTA 541).

Africa and America, and I have come to the conclusion that there are only three variable species in all. Further it is my contention that the variability is in no mean degree due to the very different habitats occupied by these weeds, poor and rich soils, hot and dry beaches but also damp everwet places, etc. It is noteworthy that BALLE in the Fl. Congo Belg. also accepts 3 spp., save that he calls *Commicarpus plumbaginea* what I keep under *Boerhavia chinensis*.

As the number of extra-Malesian synonyms is very large it falls outside the scope of this Flora to enter them into the synonymy.

KEY TO THE SPECIES

1. Anthocarp to 4 mm long, 5-ribbed. Perianth to $3\frac{1}{2}$ mm long, tubular-campanulate.
2. Anthocarp club-shaped, roundish on section, with short hairs and small sessile to stalked glands, top rounded. Stamens 2-3 1. *B. diffusa*

2. Anthocarp obconical, star-shaped on section, without glands or hairs, top truncate. Stamens 1-2.
 2. *B. erecta*
 1. Anthocarp 7-8 mm long, 10-ribbed, with large sessile to stalked glands towards the top. Perianth (6-)-10-12 mm long, funnel-shaped, on a pedicel about as long. Leaf margin sinuous.
 3. *B. chinensis*

1. *Boerhavia diffusa* LINNÉ, Sp. Pl. (1753) 3; BURM. f. Fl. Ind. (1768) 3; LOUR. Fl. Coch. 1 (1790) 20; BL. Bijdr. 14 (1826) 733; DECNE, Herb. Timor. Descr. (1835) 44; BLANCO, Fl. Filip. (1837) 8; CHOISY in DC. Prod. 13, 2 (1849) 452, incl. var. *acutifolia*, var. *obtusifolia* et var. *pubescens*; SEEM. Fl. Vit. (1866) 196, p.p.; BENTH. Fl. Austr. 5 (1870) 277; F.-VILL. in Blanco, Fl. Filip. ed. 3, 1 (1877) 11, t. 93; HILLEBR. Fl. Hawaii (1888) 367; HEIMERL in E. & P. Pfl. Fam. 3, 1b (1889) 26; O.K. Rev. Gen. Pl. 2 (1891) 533, incl. f. β *paniculata* (RICH.) O.K. et γ *repens* (L.) O.K. ('*Boerhavia*'); TRIM. Fl. Ceyl. 3 (1895) 390; BAILEY, Queensl. Fl. 4 (1901) 1212; VAL. Bull. Dép. Agr. Ind. Néerl. 10 (1907) 10; MERR. Sp. Blanc. (1918) 139; En. Philip. 2 (1923) 133; RIDL. Fl. Mal. Pen. 3 (1924) 1, f. 132; DOMIN, Bibl. Bot. 89, 2 (1925) 645, t. 21, f. 1-7, incl. var. *div.*; MAHESHWARI, J. Ind. Bot. Soc. 8 (1929) 219; *ibid.* 9 (1930) 42; BACK. Onkr. Suiker. 7 (1930) 236; SASAKI, Cat. Herb. Formosa (1930) 199; HEIMERL in E. & P. Pfl. Fam. ed. 2, 16c (1934) 119; GAGNEP. Fl. Gén. I.-C. 4 (1936) 1051, f. 110; KAJALE, J. Ind. Bot. Soc. 17 (1938) 243; KANJILAL & DAS, Fl. Assam 4 (1940) 1; BLACK, Fl. S. Austr. ed. 2 (1948) 333, f. 472; HEND. Mal. Nat. J. 6 (1951) 406, f. 367; BACK. & BAKH. f. Fl. Java 1 (1963) 271.—*B. repens* LINNÉ, Sp. Pl. (1753) 3; CHOISY in DC. Prod. 13, 2 (1849) 453; BOISS. Fl. Or. 4 (1879) 1045, incl. var. *diffusa* (L.) BOISS.; HOOK. f. Fl. Br. Ind. 4 (1885) 709, incl. var. *procumbens* (ROXB.) HOOK. f.; BACK. Onkr. Suiker. 7 (1930) 236; BACK. & BAKH. f. Fl. Java 1 (1963) 271.—*B. diandra* LINNÉ, Sp. Pl. 2 (1753) 1149; BURM. f. Fl. Ind. (1768) 3, t. 1, f. 1; MIQ. Fl. Ind. Bot. 1, 1 (1858) 992; HEIMERL, Ann. Cons. Jard. Bot. Genève (1901) 190; in E. & P. Pfl. Fam. ed. 2, 16c (1934) 119.—*B. erecta* (non L.) BURM. f. Fl. Ind. (1768) t. 1, f. 2, excl. descr.—*B. hirsuta* LINNÉ, Mant. Pl. (1771) 170; HOOK. & ARN. Bot. Capt. Beech. (1841) 68, 93; HOOK. Trans. Linn. Soc. 20 (1851) 193; HEIMERL in Rechinger, Bot. Zool. Wiss. Samoa Is. (1913) 109.—*B. tetrandra* FORST. Prod. (1786) 2; VAHL, En. Pl. 1 (1804) 284; HOOK. & ARN. Bot. Capt. Beech. (1841) 93; CHOISY in DC. Prod. 13, 2 (1849) 456; HILLEBR. Fl. Hawaii (1888) 367; HEIMERL, Ann. Cons. Jard. Bot. Genève (1901) 188.—*B. glutinosa* VAHL, En. Pl. 1 (1804) 287; MIQ. Fl. Ind. Bot. 1, 1 (1858) 992.—*B. pubescens* R. BR. Prod. (1810) 422.—*B. mutabilis* R. BR. l.c. 422; CHOISY in DC. Prod. 13, 2 (1849) 456, incl. var. *pubescens* (R. BR.) CHOISY.—*B. procumbens* BANKS ex ROXB. Fl. Ind. 1 (1820) 148, nom. illeg.; HASSK. Pl. Javan. Rar. (1848) 225.—*B. glabrata* BL. Bijdr. 14 (1826) 733.—*B. acutifolia* S. MOORE, Occ. Pap. Bish. Mus. 10, n. 19 (1934) 6.—Fig. 1f-g.

Herb, 0.4-1(-2) m, erect, ascending, creeping, climbing, puberulous glabrescent with club-

-shaped or stalked glands and glandular hairs, rarely hirsute. Leaves ovate-lanceolate, beneath often white, sometimes with red marginal glands, $\frac{1}{2}$ -4 by $\frac{1}{4}$ -4 cm; base obtuse, cordate, or truncate; top acute to obtuse or obtusely acuminate; petiole 1-3 $\frac{1}{2}$ cm. Flowers 1-12 together, campanulate, in cymose panicles, $\frac{1}{2}$ -7 by 1-6 cm; peduncle 2-5 cm, 1-3 times branched. Pedicel $\frac{1}{4}$ -2 mm; bracteoles 1-3, lanceolate, 0.9-1 by $\frac{1}{4}$ -2 $\frac{1}{2}$ mm. Perianth 1 $\frac{1}{2}$ -2 $\frac{1}{4}$ mm, with a distinct constriction halfway, limb 1-2 mm, white, red, pink, or violet. Stamens 1-3, exerted up to $\frac{1}{2}$ mm. Stigma exerted up to $\frac{1}{2}$ mm. Anthocarp club-shaped, 2 $\frac{1}{2}$ -3 $\frac{1}{4}$ mm, with 5 ribs, with scattered, club-shaped, stalked or sessile, minute glands.

Distr. Pantropical, throughout Malesia and Australia (not in Tasmania), Pacific (New Caledonia, Marshall Is., Hawaii, etc.).

Ecol. In dry open places, secondary forest, on rocks and sand, from the coast up to c. 1000 m (up to 2000 m in the Himalayas).

Uses. A liquid extract of the plant is used as a diuretic; the root is purgative, anthelmintic, and a febrifuge. An extensive account of the medicinal value is given by QUISUMBING (Medic. Pl. Philip. 1951, 273).

Notes. Many authors had difficulty to distinguish *B. diffusa* and *B. repens*. LAMARCK took them together as synonyms under *B. diffusa*. BOISSIER (Fl. Or. 4, 1879, 1045) and HOOKER f. (Fl. Br. Ind. 4, 1885, 709) reduced *B. diffusa* to *B. repens*. BACKER kept *B. repens* and *B. diffusa* apart but it appears that specimens were partly misidentified, that the character of the glands does not hold, and that the creeping versus ascending habit is insufficient for specific distinction. That such tropical-ubiquitous weeds show a certain degree of variability is not unexpected.

2. *Boerhavia erecta* LINNÉ, Sp. Pl. (1753) 3; BURM. f. Fl. Ind. (1768) 3, non t. 1 f. 2, excl. syn.; JACQ. Hort. Bot. Vindob. 1 (1770) 2, t. 5, 6; GUILL. Zephyr. Taitensis (1837) 38; CHOISY in DC. Prod. 13, 2 (1849) 450; MART. Fl. Bras. 14, 2 (1872) 370; HEIMERL in E. & P. Pfl. Fam. 3, 1b (1889) 26; Bot. Jahrb. 21 (1896) 617, p.p.; Ann. Cons. Jard. Bot. Genève (1901) 187; BACK. Onkr. Suiker. 7 (1930) 235; HEIMERL in E. & P. Pfl. Fam. ed. 2, 16c (1934) 118; BACK. & BAKH. f. Fl. Java 1 (1963) 271.—Fig. 1h.

Herb, 20-80 cm, erect or decumbent at the very base, puberulous, especially in the upper part at the nodes, glabrescent. Leaves 1 $\frac{3}{4}$ -3 $\frac{1}{2}$ by 1-2 $\frac{1}{4}$ cm, ovate, oblong, or lanceolate; base rounded to truncate; lower surface mostly white and with sunken red glands; top acute, rarely obtuse; petiole 1 $\frac{1}{2}$ -4 cm. Flowers 2-3 together in cymose panicles, 1-2 $\frac{1}{2}$ by 1 $\frac{1}{2}$ -3 $\frac{1}{2}$ cm, 1-3 times branched; peduncle 1 $\frac{1}{2}$ -2 cm. Flowers tubular-campanu-

late; pedicel $\frac{1}{2}$ –5 mm, with 1–2 lanceolate bracteoles $\frac{3}{4}$ –1 by $\frac{1}{4}$ mm at the top or lower on the pedicel. *Perianth* $1\frac{3}{4}$ – $2\frac{1}{2}$ mm, with 5 faint ribs and a distinct constriction halfway; limb $1\frac{1}{2}$ –2 mm, white, red, or pink. *Stamens* 2–3, exerted for $\frac{1}{2}$ mm, like the stigma. *Anthocarp* obconical, glabrous, 3– $3\frac{3}{4}$ mm long, top truncate, the groove between the 5 ribs somewhat undulate.

Distr. Pantropical weed, also in the Pacific, but not recorded from Australia, in *Malesia*: Singapore, S. Sumatra (Palembang), Java, Lesser Sunda Is. (Flores), New Guinea (NW. part).

Ecol. Along rail-roads, in open sandy places, from the coast up to 700 m. VAN DER PIJL described the distinct swelling of the subepidermal slime coat of the anthocarp (Trop. Natuur 26, 1927, 186–187, f. 2) which is characteristic for this species.

Vern. *Bajam merah*, *tjakaran*, Java.

3. *Boerhavia chinensis* (L.) ASCHERS. & SCHWEINF. Beitr. Fl. Aeth. 1 (1867) 167; DRUCE, Bot. Exch. Club Rep. 1913, 3 (1914) 415; BACK, Onkr. Suiker. 7 (1930) 234; BACK. & BAKH. f. Fl. Java 1 (1963) 271.—*Valeriana chinensis* LINNÉ, Sp. Pl. (1753) 33; BURM. f. Fl. Ind. (1768) 15, t. 6, f. 3. — *B. repanda* WILLD. Sp. Pl. 1, 1 (1797) 22; POIR. in Lamk, Enc. Méth. Bot. 5 (1804) 56; BL. Bijdr. 14 (1826) 733; DECNE, Herb. Timor. Descr. (1835) 45; CHOISY in DC. Prod. 13, 2 (1849) 455; WIGHT, Ic. (1851) t. 1766; MIQ. Fl. Ind. Bat. 1, 1 (1858) 991; BENTH. Fl. Austr. 5 (1870) 278; HOOK. f. Fl. Br. Ind. 4 (1885) 709; TRIM. Fl. Ceyl. 3 (1895) 390; BAILEY, Queensl. Fl. 4 (1901) 1213; RIDL. Fl. Mal. Pen. 3 (1924) 2; DOMIN, Bibl. Bot. 89, 2 (1925) 645; BHARGAWA, J. Ind. Bot. Soc. 11 (1932) 303 (*anat.*); GAGNEP. Fl. Gén. I.–C. 4 (1936) 1049; BLACK, Fl. S. Austr. ed. 2 (1948) 333, f. 473.—*Astrephia chinensis* DUFR. Hist. Nat. Médic. Valér. (1811) 51.—*B. helenae* R. & S. Mant. Syst. Veg. 1 (1822) 73.—*B. scandens* var.

chinensis (L.) O.K. Rev. Gen. Pl. 1 (1891) 534.—*Commicarpus chinensis* HEIMERL in E. & P. Pfl. Fam. ed. 2, 16c (1934) 117.—Fig. 1a–e.

Herb, 1(–4) m, erect, sometimes climbing, puberulous-glabrescent. *Leaves* thin, $2\frac{1}{2}$ – $4\frac{1}{2}$ by $1\frac{1}{2}$ –4 cm; base obtuse to cordate; top acute; margin deeply sinuate; petiole 1–3 cm. *Flowers* tubular-campanulate 3–8 together in umbels $\frac{1}{2}$ –2 by $\frac{1}{4}$ – $3\frac{1}{4}$ cm; peduncle 2–6 cm; pedicels $2\frac{1}{2}$ –14 mm, each with 1 caducous bracteole, 2–3 by 0.2–0.3 mm. *Perianth* 10–12 mm, upper part of tube above constriction c. 10 mm, with 5 lobes. *Stamens* 3–4, like the style exerted for 4–5 mm. *Anthocarp* elongate, 7–8 mm, 10-ribbed, with conspicuous sessile to stalked glands, mostly only at the top.

Distr. All Old World tropics, in *S. Malesia*: E. Java (also Madura and Kangean Is.), Lesser Sunda Is. (Bali, Lombok, Sumbawa, Sumba, E. Flores, Timor), Moluccas (Key Is.). Fig. 2.

Ecol. Sandy clay, dry places, and monsoon forest, also on limestone, up to 700 m, distinctly restricted to regions subject to a seasonal climate.

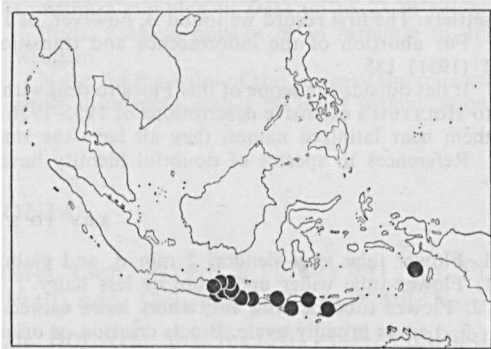


Fig. 2. Distribution in Malesia of *Boerhavia chinensis* (L.) ASCHERS. & SCHWEINF.

3. BOUGAINVILLEA

COMM. ex JUSS. Gen. (1789) 91 (*'Buginvillea'*); SPACH. Hist. Nat. Vég. Phan. 10 (1841) 516 (*'Bougainvillea'*, *etymol. cons.*); CHOISY in DC. Prod. 13, 2 (1841) 437; HEIMERL, Denkschr. K. Ak. Wiss. M.–N. Kl. Wien 70 (1900) 98; STANDL. Field Mus. Nat. Hist. Bot. 8 (1931) 308; *ibid.* 11 (1931) 96; HEIMERL, Notizbl. Berl.–Dahl. 11 (1932) 463; in E. & P. Pfl. Fam. ed. 2, 16c (1934) 122; BOR & RAIZ. J. Bomb. Nat. Hist. Soc. 47 (1948) 402; HOLTT. M.A.H.A. Mag. 8, 2 (1938) 69; *ibid.* 12, 2 (1955) 2; *ibid.* 12, 3 (1955) 2; *ibid.* 12, 4 (1955) 25; *ibid.* 13 (1956) 13, 66; *ibid.* 14 (1957) 13, 58; PANCHO & BARD. Bailey 7 (1959) 91.

Coarse climbers to 25 m, with supra-axillary spines (abortive inflorescences), more or less puberulous. *Leaves* (sub)opposite, ovate to elliptic-oblong. *Inflorescences* supra-axillary above a bud, the peduncle bearing a single apical triad of flowers (sometimes a second one lower), or the triads in dichasia 1–2(–3) times branched, each triad consisting of 3 subsessile, cordate, persistent, coloured bracts each with a single adnate pedicel. *Perianth* tubular, limb 5(–4)-lobed;

tube with 5(-4) ribs, after anthesis its top twisted, its base persistent. *Stamens* (4-)5-8(-10), unequal, not exerted. *Gynaecium* shorter than the tube; stigma fimbriate. *Anthocarp* spindle-shaped, coriaceous, 5-ribbed, not viscid; embryo longitudinally convolute.

Distr. About 14 *spp.*, Central and tropical South America. Three are cultivated everywhere in tropical and subtropical countries, a fourth, also recorded from *Malesia*, is actually a hybrid. Of the many other hybrids and cultivars, several occur in *Malesia*.

Ecol. Full sunlight is required for cultivation; in some cases growing in a pot will promote flowering. All plants of one clone are self-sterile. Pollination is performed by small birds and butterflies, and may lead, under dry conditions, to a limited amount of fruiting. At maturity of the fruit, which is after c. 30 days, the bracts dry up and may help dispersal by wind. Vegetative propagation is easy by cutting. In the tropics cultivation is possible up to c. 1500 m.

Uses. Ornamental, and sometimes for hedges.

Notes. All the present species belong to the type section (see HEIMERL, 1934); a second section, *Tricycla*, has only one species in S. America.

HOLTUM extensively studied the genus at Singapore, where a great number of forms were in cultivation. His work, published in Gard. Chron. 103 (1938) 164-165, in M.A.H.A. Magazine (cited above), and in Suppl. Dict. Gard. (1956) 163, covers cultivated *Bougainvilleas* of the whole world. It has been the basis of other papers, of our concern being BOR & RAIZADA (1948) on the Indian species, and PANCHO & BARDENAS (1959) on the Philippine ones. Also the present revision has mainly been compiled from HOLTUM's.

PANCHO & BARDENAS assumed that *Bougainvillea* was introduced into the Philippines by early Spanish settlers. The first record we found is, however, of 1880, by FERNANDEZ-VILLAR; see under *B. spectabilis*.

For abortion of the inflorescence and transitions to spines, see VAN DER PUL, Phytomorphology 1 (1951) 185.

It lies outside the scope of this Flora to deal with the numerous infraspecific forms, for which we refer to HOLTUM's extensive descriptions of 1955-1956 and his summary of 1956. Notwithstanding some of them bear latinized names, they all have the status of cultivar.

References to species of doubtful identity have been omitted.

KEY TO THE SPECIES

1. Flower tube very slender, 2 mm \varnothing , and glabrous 1. *B. peruviana*
1. Flower tube wider and more or less hairy.
 2. Flower tube bearing very short hairs curved towards the top.
 3. Leaves broadly ovate. Bracts crimson or orange fading to purple or mauve; edges of bracts much crisped 2. *B. buttiana*
 3. Leaves almost evenly elliptical. Bracts purple, changing little in colour on fading; edges of bracts little crisped 3. *B. glabra*
 2. Flower tube bearing copious spreading hairs up to 1 mm long. Leaves velvety hairy.
 4. *B. spectabilis*

1. *Bougainvillea peruviana* HUMB. & BONPL. Pl. Aequin. 1 (1808) 147, t. 49; HEIMERL, Denkschr. K. Ak. Wiss. M.-N. Kl. Wien 70 (1900) 114; Notizbl. Berl.-Dahl. 11 (1932) 465; BOR & RAIZ. J. Bomb. Nat. Hist. Soc. 47 (1948) 407; HOLTUM. M.A.H.A. Mag. 12, 2 (1955) 8; PANCHO & BARD. Bailey 7 (1959) 97, f. 27.

Leaves broadly ovate, on sucker shoots up to 10 by 7 cm, sparsely puberulent or glabrous. Spines 1-2½ cm. Bracts thin, 2½-3 by 1¾-2 cm, slightly crinkled, light magenta-pink all over, glabrous. *Perianth* 1½-2 cm long, the tube nearly 2 mm wide, slightly constricted in the middle, glabrous, only the limb outside hairy, 5-6 mm wide. *Stamens* 6. *Anthocarp* c. 10 mm long, glabrous.

Distr. NW. South America, introduced in Singapore in 1938; three garden varieties.

Ecol. Flowers a little after dry weather. Grows probably best on light soils.

2. *Bougainvillea* × *buttiana* HOLTUM & STANDL.

Bot. Ser. Field Mus. 23 (1944) 44; BOR & RAIZ. J. Bomb. Nat. Hist. Soc. 47 (1948) 405; HOLTUM. M.A.H.A. Mag. 12, 3 (1955) 2; PANCHO & BARD. Bailey 7 (1959) 99, f. 28.

Leaves on main stems very broadly ovate, to 18 by 14 cm, base often truncate to subcordate, top acuminate, densely puberulous on both sides, nerves c. 4 pairs; petiole to 5 cm. Bracts c. 3 by 2¼ cm at anthesis, later to 4½ by 2¾ cm, hairy like the leaves, edges crisped, crimson all over. *Perianth* c. 1¾ cm long, the tube 2½ mm wide, constricted about the middle, strongly angular, rather sparsely puberulous with appressed acroscopic hairs.

Distr. Only known in cultivation; discovered by Mrs. R. V. BUTT in 1910 in Colombia, and taken into cultivation by many European firms. Introduced in Singapore in 1923.

Ecol. Flowering, only after dry weather, can be timed by growing in pots. Easy in cultivation, propagation by cuttings; grafting is difficult.

Note. Several garden varieties, hybrids, and variegated forms were dealt with by HOLTUM in 1955, who by then also had discovered that this 'species' is a hybrid between *B. peruviana* HUMB. & BONPL. and *B. glabra* CHOISY.

3. *Bougainvillea glabra* CHOISY in DC. Prod. 13, 2 (1949) 437; HEIMERL, Denkschr. K. Ak. Wiss. M.-N. Kl. Wien 70 (1900) 110; STANDL. Field Mus. Nat. Hist. Bot. 11 (1931) 97; KANJ. & DAS Fl. Assam 4 (1940) 2; BOR & RAIZ. J. Bomb. Nat. Hist. Soc. 47 (1948) 405; HOLTT. M.A.H.A. Mag. 12, 4 (1955) 25; PANCHO & BARD. Baileya 7 (1959) 99, f. 29.—*B. spectabilis* var. *glabra* (CHOISY) HOOK. Curt. Bot. Mag. (1854) t. 4811.

Leaves almost evenly elliptic, sparsely puberulous on both sides, somewhat denser on the nerves underneath; nerves above paler and slightly depressed. Bracts 3–4¼ by 1¾–3 cm, minutely hairy, persistently purple, with green nerves. Perianth 1½–2½ cm long, distinctly swollen and 5-angular below the constriction, with very short, to 0.2 mm, white hairs with curved top. Anthocarp 7–13 mm long, glabrous.

Distr. Brazil, where doubtfully wild. Flowered in Europe in 1860, mentioned from Bogor in 1866, from India in 1869, from Singapore in 1879. Very commonly planted.

Ecol. Flowers under everwet conditions.

Note. In the hairs of the perianth the cells are

difficult to discern with a 30 times magnification.

4. *Bougainvillea spectabilis* WILLD. Sp. Pl. 2 (1799) 348; HOOK. Curt. Bot. Mag. (1854) t. 4810 (fig.), t. 4811 (text); HEIMERL, Denkschr. K. Ak. Wiss. M.-N. Kl. Wien 70 (1900) 108; MERR. Publ. Gov. Lab. Philip. 6 (1904) 32; En. Philip. 2 (1923) 133; STANDL. Field Mus. Nat. Hist. Bot. 11 (1931) 97; KANJ. & DAS, Fl. Assam 4 (1940) 2; BOR & RAIZ. J. Bomb. Nat. Hist. Soc. 47 (1948) 404; HOLTT. M.A.H.A. Mag. 13 (1956) 13; PANCHO & BARD. Baileya 7 (1959) 100, f. 98; BACK. & BAKH. f. Fl. Java 1 (1963) 271.

Leaves more or less ovate, proportionately wider than in *B. glabra*, velvety beneath and often above. Bracts 2½–5 by 1½–3¾ cm, sparsely puberulent or short villous, purplish red. Perianth 1½–3 cm long, with ½–1 mm long and more or less straight hairs; tube more slender and less distinctly angular than in *B. glabra*. Anthocarp 11–14 mm, densely hairy.

Distr. Peru. Introduced in Europe in 1829, recorded from Bogor in 1866, from Singapore in 1879. Very commonly planted, if not pruned sometimes climbing in trees up to 25 m height.

Ecol. Flowers only in or in response to dry weather.

Note. In the hairs of the perianth the cells are easily discernible with a 30 times magnification.

4. PISONIA

PLUM. [Nov. Gen. (1703) 7, t. 11] ex LINNÉ, Gen. Pl. ed. 5 (1754) 451; Sp. Pl. (1753) 1026; CHOISY in DC. Prod. 13, 2 (1849) 440; HEIMERL in E. & P. Pfl. Fam. 3, 1b (1889) 29; BARG.-PETR. Nuov. Giorn. Bot. Ital. n.s. 8 (1901) 604; HEIMERL in E. & P. Pfl. Fam. ed. 2, 16c (1934) 126; STEMMERIK, Blumea 12 (1964) 275.—*Ceodes* J. & G. FORST. Char. Gen. Pl. (1776) 71, t. 71; SKOTTSB. Svensk Bot. Tidskr. 30 (1936) 722; HEIMERL, Occ. Pap. Bish. Mus. 23 (1937) 27.—*Calpidia* HOUARS, Hist. Vég. Isle Fr. (1804) 37, t. 10; HEIMERL, Oest. Bot. Z. 63 (1913) 19, 280; in E. & P. Pfl. Fam. ed. 2, 16c (1934) 125.—*Timeroyea* MONTROUZ. Mém. Ac. R. Lyon Sc. 10 (1860) 247.—*Vieillardia* BRONGN. & GRIS, Bull. Soc. Bot. Fr. 8 (1861) 375.—*Rockia* HEIMERL, Oest. Bot. Z. 63 (1913) 289.—*Heimerlia* SKOTTSB. Svensk Bot. Tidskr. 30 (1936) 738, non VON HÖHNEL, 1903.—*Heimerliodendron* SKOTTSB. Svensk Bot. Tidskr. 35 (1941) 364.—Fig. 3—14.

Erect shrubs or trees up to 30 m tall, unarmed except one *sp.*, sympodially branched, mostly glabrescent; wood and bark soft and spongy, brittle, pith hardly distinct from the wood. Leaves (sub)opposite, alternate or conferted towards the twig ends, entire, dull, midrib flat above. Inflorescence axillary or terminal, small or large thyse exceptionally cauliflorous or ramiflorous, 2–8 times (sub)umbellately branched, each ultimate branch bearing diads or triads or single flowers. Pedicels with 1–3 small, caducous bracts, ½–10 mm, later stretching, in one species to c. 7½ cm. Dioecious or bisexual; ♂ and ♀ flowers sometimes of different shape, save in *P. aculeata* in unisexual flowers with rudiments of the other sex. Perianth somewhat fleshy, valvate in bud, campanulate, tubular,

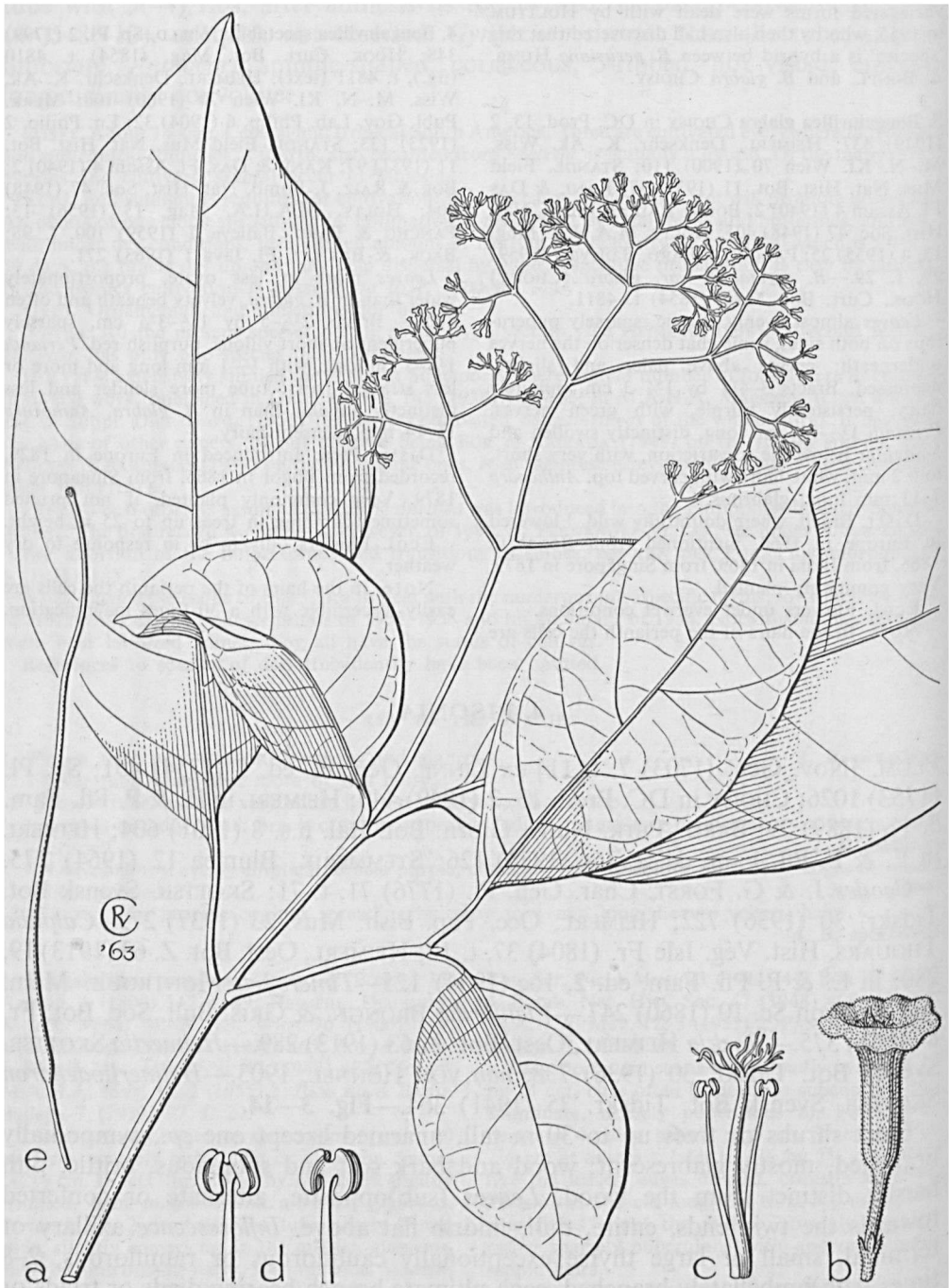


Fig. 3. *Pisonia diandra* PULLE. a. Habit, $\times \frac{2}{3}$, b. ♀ flower, $\times 6$, c. gynoecium with two staminodial stamens, $\times 12$, d. anther, frontal and dorsal view, $\times 24$, e. immature anthocarp, $\times \frac{2}{3}$ (a GJELLERUP 342, b-c GJELLERUP 347, d GJELLERUP 342, e SCHRAM BW 7831).

urceolate, or funnel-shaped, 5-, rarely 10-lobed, the basal part tubular, coriaceous, persistent and accrescent-elongating after anthesis (sometimes produced into a rostrum), the apical part coloured and often circumscissile caducous. *Stamens* 2-40, in 1-2 whorls, mostly exerted, sterile in the ♀ flowers. *Ovary* (sub)sessile on a small disk, elongate, narrowed towards the top, smooth; style longer than the ovary, stigma capitate with short lobes or fimbriate, radiating or unilateral. *Anthocarp* coriaceous, often crowned by a limb-rest, smooth or initially with 5(-6) ribs which are not seldom viscid through lengthwise rows of glands which sometimes grow into viscid prickles; sometimes a rostrum is produced; if this is long (up to *c.* 45 cm), it is twisted to the left and has also 5(-6) ribs. *Seed* oblong, with a deep longitudinal furrow and straight embryo; cotyledons recurved and surrounding the perisperm, the latter sometimes reduced to a gelatinous substance.

Distr. About 35 *spp.*, mostly in the Americas (*c.* 20), only 1 pantropical *sp.* in E. Africa, and 2 others in the Malagasian area, few in continental SE. Asia, 8 native in *Malesia*, 2 of which in North and East Australia southwards to New South Wales, Tasmania, and North Island of New Zealand, 5 endemic in Melanesia and Polynesia. Fig. 6.

Taxon. In the latest overall treatment, by HEIMERL (1934) *Pisonia* is still kept apart from *Calpidia*, which was reinstated by HEIMERL (1913), after CHOISY (1849) had reduced it to *Pisonia*. When SKOTTSBERG (1936) replaced the name *Calpidia* THOUARS 1804 by *Ceodes* J. & G. FORST. 1776, HEIMERL followed this (1937); by this *Pisonia* was, in the Old World, restricted to *P. grandis* and *P. aculeata*. The separation of *Ceodes* from *Pisonia* (Oest. Bot. Z. 63, 1913, 20) was mainly based on 3 points: (i) bracteoles at the base of the pedicel in *Calpidia*, apically in *Pisonia*; (ii) perisperm abortive, starch within the embryo, in *Calpidia*, mealy in *Pisonia*; (iii) pollen with 3 pores in *Pisonia*, 4 or more in *Calpidia*.

These characters are not very significant and would better serve for infrageneric rank. However, they are not even constant as HEIMERL himself admitted (*l.c.* 281-282) in stating that the bracteoles in *Pisonia* occur "manchmal auch etwas tiefer", that he found in two *Pisonias* pollen grains with 3 and 4 pores in a single anther, and that in *Calpidia pancheriana* the perisperm is mealy. Curiously HEIMERL failed to recognize that through these observations the distinction of two taxa thus becomes futile. As a matter of fact I could verify that in both *P. aculeata* and *P. grandis* the bracteoles can occur lower on the pedicel, sometimes at different height, and reversely that in some *Calpidias* they may occur up to halfway the pedicel. Furthermore, I found 3- and 4-pored pollen grains in one anther in *P. aculeata*, *P. excelsa*, *P. fragrans*, *P. grandis*, *P. longirostris*, etc.

For HEIMERL's supposed differences in habit and distribution, it is sufficient to note that the only species of which the habit is atypical for the genus, *P. aculeata*, is pantropical.

The genera *Rockia* and *Heimerlia* = *Heimerliodendron* were based on insufficient arguments and have been reduced to *Pisonia*. This I have more amply discussed in *Blumea* 12 (1964) 275 - 284, where also a more complete synonymy is cited.

KEY TO THE SPECIES
(mainly for flowering material)

1. Plants unarmed, erect.
2. Leaves distinctly petioled.
3. Inflorescence terminal, at least not cauliflorous or ramiflorous. Perianth lobes not keeled on the inside.
 4. Leaves with distinct dark veins contrasting with lighter coloured intervenium. Nerves and veins hairy beneath. Perianth glandular. Anthocarp with 5 rows of mono-serial prickles.
 7. *P. grandis*
 4. Leaves without distinctly contrasting dark veins, glabrous on lower surface. Perianth never glandular. Anthocarp without prickles.
 5. Perianth lobes truncate. Stamens 3-6. Anthocarp *c.* 5 cm, rostrum *c.* 3 cm.
 3. *P. mülleriana*
 5. Perianth lobes not truncate.
 6. Perianth densely light-brown hairy. Stamens 25-40. Anthocarp with sulcate ribs. New Caledonia.
 - P. artensis* (MONTR.) BARG.-PETR.
 6. Perianth dark-brown hairy, glabrescent. Stamens less than 15. Anthocarp without sulcate ribs.
 7. Perianth 5- or 10-lobed, the lobes short and wide separated by shallow sinuses, the margin as a whole nearly sinuate rather than lobed. Stamens 2 or 4; in ♂ flower longer than the vestigial gynaeceum; staminodes in ♀ flower shorter than the gynaeceum. Anthocarp with a long rostrum.
 5. *P. diandra*

7. Perianth distinctly 5-lobed. Stamens 5-14.

8. Stamens 6-14. Anthocarp 2-4 cm, with 5 viscid ribs, without rostrum.

1. *P. umbellifera*
 2. *P. corniculata*
 3. Inflorescence cauliflorous, sometimes ramiflorous. Perianth lobes keeled on the inside. Stamens 13-15. Anthocarp 7 cm long, not viscid 2. *P. cauliflora*
 2. Leaves (sub)sessile, elliptic to obovate, tapering towards the base. Flowers densely hairy, with truncate lobes. Stamens 5. Anthocarp smooth when mature, rostrum 10-40 cm 4. *P. longirostris*
 1. Plants spinose, climbing. Perianth limb with 5 large lobes, alternating with 5 smaller ones. Anthocarp with 5 rows of biserial prickles 8. *P. aculeata*

KEY TO THE SPECIES

(mainly for fruiting specimens)

1. Unarmed shrubs or trees. In dioecious *spp.* ♂ and ♀ flowers of similar shape. Perianth lobes 5 (but see *P. diandra*).
2. Perianth with 5 rows of black glands slightly concealed by a rather dense indument. Anthocarp c. 1¼ cm long, with 5 ribs, each soon provided with a row of viscid stiff prickles. Leaves 10-20 by 6-10 cm, with dark or dark-red veins contrasting with a paler intervenium, hairy on the nerves beneath 7. *P. grandis*
2. Perianth without 5 rows of black glands, sometimes with 5 faint ribs. Anthocarp without prickles. Leaves glabrous beneath.
3. Anthocarp not produced into a rostrum.
4. Inflorescence terminal. Perianth lobes not keeled inside. Anthocarp with viscid ribs. Leaves shorter than 23 cm.
5. Stamens 25-40. Ribs on anthocarp sulcate. Perianth light brown short-tomentose. New Caledonia *P. artensis* (MONTR.) BARG.-PETR.
5. Stamens 6-14. Ribs of anthocarp not sulcate. Perianth sparsely short brown hairy or puberulous. 1. *P. umbellifera*
4. Inflorescence cauliflorous or ramiflorous. Perianth lobes keeled inside. Ribs of the anthocarp not viscid. Leaves 24-60 cm long 2. *P. cauliflora*
3. Rostrum of the anthocarp 3-40 cm long.
6. Perianth densely hairy.
7. Buds almost cylindrical or at least hardly constricted, not club-shaped. Inflorescences very thin. Perianth campanulate, c. 5 mm long, lobes not truncate. Stamens 2 or 4. Rostrum (immature) at least 40 cm long, thin 5. *P. diandra*
7. Buds club-shaped. Inflorescences not particularly thin. Perianth lobes truncate.
8. Leaves c. 15-24 cm long, rather elliptic; petiole (1-)2-8 cm. Flowers c. 4½ mm long. Stamens 3-6. Rostrum c. 3-4 cm long, thick (in the only fruiting specimen known). 3. *P. mülleriana*
8. Leaves large, c. 25-50 cm long, rather obovate-oblong, sessile to subsessile; petiole 0-2 cm, coarse. Flowers c. 6 mm long. Stamens 5. Rostrum thin, 10-40 cm long. 4. *P. longirostris*
6. Perianth sparsely hairy to puberulous, in bud constricted halfway, in the only specimen known the lower portion thicker than the upper. Stamens 5-6. Rostrum (immature) thin, at least 7 cm long. 6. *P. corniculata*
1. Overhanging woody climber with mostly recurved axillary spines. ♂ and ♀ flowers of different shape. Perianth lobes 10, unequal. Anthocarp provided with 5 biserial rows of viscid prickles. 8. *P. aculeata*

1. *Pisonia umbellifera* (FORST.) SEEM. Bonplandia 10 (1862) 154; J. Bot. 1 (1863) 244; KURZ, For. Fl. Burma 2 (1877) 279; F.-VILL. Nov. App. 4 (1880) 167; HEMSLEY, Ann. Bot. 10 (1896) 248; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 307; VAL. Bot. Jahrb. 52 (1915) 102; KANEH. Bot. Mag. Tokyo 45 (1931) 278; MERR. En. Philip. 2 (1923) 134; BOOBERG, Bot. Jahrb. 66 (1933) 6; KANEH. J. Dep. Agr. Kyushu Imp. Un. 4, 6 (1935) 316; HOSOKAWA, J. Jap. Bot. 13 (1937) 202.—*Ceodes umbellifera* J. & G. FORST. Char. Gen. Pl. (1776) 71, t. 71; Prod. (1786) 93 ('*umbellata*'); MERR. & CHUN, Sunyatsenia 5 (1940) 52.—*P. excelsa* BL. Bijdr. 14 (1826) 735; CHOISY in DC. Prod. 13, 2 (1849) 441; MIQ. Fl. Ind. Bat. 1, 1 (1858) 990; Sum. (1860) 14; HOOK. f. Fl. Br. Ind. 4 (1885)

711; HEIMERL in E. & P. Pfl. Fam. 3, 1b (1889) 29; RENDLE in Andrews, Monogr. Christm. I. (1900) 158; HEIMERL, Ann. Cons. Jard. Bot. Genève 9 (1901) 197; Denkschr. K. Ak. Wiss. M.-N. Kl. Wien 85 (1910) 280; KOORD. Exk. Fl. Java 2 (1912) 204; MERR. Sp. Blanc. (1918) 139; RIDL. Fl. Mal. Pen. 3 (1924) 3; non CORNER, Wayside Trees (1940) 511; CAVACO, Fl. Madagasc. (1954) fam. 68, 10, 12; BACK. & BAKH. f. Fl. Java 1 (1963) 272.—*P. brunoniana* ENDL. Prod. Fl. Norf. (1833) 43; CHOISY in DC. Prod. 13, 2 (1849) 441; HOOK. f. Handb. New Zeal. Fl. 1 (1864) 229; BENTH. Fl. Austr. (1870) 280; KIRK, For. Fl. New Zeal. (1889) 292, t. 140; BAILEY, Queensl. Fl. (1901) 1215.—*Buginvillia racemosa* BLANCO, Fl. Filip. (1837) 307; MERR. Sp. Blanc. (1918) 139. —



Fig. 4. *Pisonia umbellifera* tree in old leaf-shedding teak forest. E. Tegal (Central Java), 1914.

-oblong, (6½)-9-23(-31) by (3-)-4-11(-13) cm; base acute to rounded; top acute to rounded; petiole ½-4 cm. *Inflorescence* terminal, branched, consisting of many-flowered umbels 3-9 cm through, puberulous or glabrous; peduncle 3½-4 cm. *Flowers* bisexual or unisexual; pedicel 1½-6 mm with 1-3 small bracteoles at the base or higher. *Perianth* 2½-7 mm long, campanulate. *Stamens* 6-14, exserted to 4 mm. *Stigma* fimbriate; in the ♀ flowers exserted for c. 1 mm and in the bisexual flowers c. 1½ mm. *Anthocarp* elongate, 2-4 by 0.3-0.35 cm, with 5 viscid ribs; pedicel 0.7-1½ cm. *Seed* 17-20 by 2 mm.

Distr. Cape of Good Hope (*sec.* HEIMERL!), Madagascar, Mauritius, Réunion, Mascarenes, Comores, Andaman Is., Central Cochinchina, Hainan, Formosa, Riu-Kiu Is., throughout *Malesia*, particularly in the eastern part, also in Christmas I. (S of Java), to North Australia, Queensland, New South Wales, Tasmania, and the Pacific: Bonin Is., Micronesia (Palau, Yap, and Truk), Melanesia (Bismarck Arch., Solomon Is., Fiji, Samoa, Tanna, Rapa, Mangareva, Pitcairn, Marquesas, Tubuai Is., Lord Howe I., Norfolk I., and North Island of New Zealand). Fig. 5.

Ecol. Often in coastal places, exposed to wind, both everwet and in monsoon forest, along river-banks, creeks, on sandy clay, sand, and rocks.

Birds are known to have fallen victim when they got too many fruits on their feathers. See KOORD. Med. Lands Pl. Tuin 19 (1898) 563; RIDL. *Disp.* (1930) 170.

Uses. The natives use the fruits to catch birds, see RIDL. *l.c.* VAN DER PIJL found on the limestone hills at Padalarang sticky clusters of fruits under the tree (*Trop. Natuur* 22, 1933, 95). BURKILL (*Dict.* 1935, 1755) mentions that the soft-wooded branches are eaten by elephants.

Vern. Sumatra: *angkola, gajam, kaju-pisang, loening, loning, luning*; Java: *gendala* or *pédaja, kitjar, kitjau, pulutan* (the latter for the fruit); Philip.: *anilin, balagasaha, malasa-a, padjang-*

Cedrota guianensis BLANCO, *Fl. Filip.* ed. 2 (1845) 213; MERR. *Sp. Blanc.* (1918) 139.—*P. mooriana* F. v. M. *Fragm. Phyt. Austr.* 1 (1858) 20.—*P. aruensis* BARG.—PETR. *Nuov. Giorn. Bot. Ital.* n.s. 8 (1901) 618.—*P. gammillii* MERR. *Philipp. J. Sc.* 5 (1910) Bot. 175.—*Calpidia excelsa* HEIMERL, *Oest. Bot. Z.* 63 (1913) 284.—*Calpidia brunoniana* (ENDL.) HEIMERL, *l.c.* 283.—*P. nishimura* KOIDZ. *Bot. Mag. Tokyo* 33 (1919) 120; HEIMERL in E. & P. *Pfl. Fam.* ed. 2. 16c (1934) 125.—*Ceodes excelsa* SKOTTSB. *Act. Hort. Gothob.* 2 (1926) 231; CHRISTOPH. *Bull. Bish. Mus.* 128 (1935) 84.—*Ceodes umbellifera* SKOTTSB. *Svensk Bot. Tidskr.* 30 (1936) 723.—*Ceodes brunoniana* SKOTTSB. *l.c.* 728.—*Heimerlia brunoniana* SKOTTSB. *l.c.* 738.—*Heimerliodendron brunonianum* SKOTTSB. *ibid.* 35 (1941) 364; ALLAN, *Fl. New Zeal.* 1 (1961) 286.

Shrub or tree to 28 m high, unarmed. *Leaves* opposite, sometimes conferted towards the end of the twigs or in pseudowhorls, ovate- to elliptic-

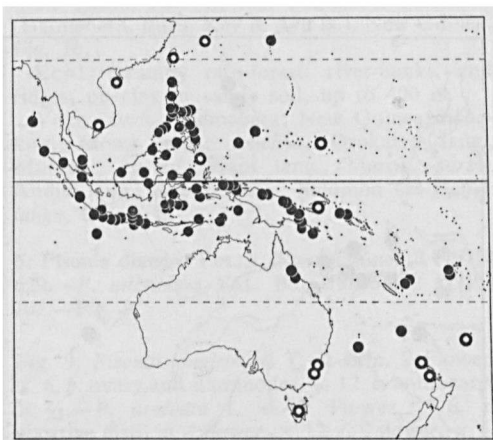


Fig. 5. *Pisonia umbellifera* FORST. Localities in and around Malesia; circled from literature data.

-labuyo, Tag., budubud, malasaging, tagkuling, tampa, tkan, C. Bis., anuring, P. Bis., anuling, Ting., Tag., Bik., P. Bis., malagasaha, Bik., maklas, Ilk., bubog, Maranao dial.; Celebes: andruling, palindu, saungkapaja; Moluccas: hares, Ambon, dane, Tanimbar; New Guinea: kwopen, rising, Nemo dial., paribui, parbu, Kebar dial., paperu, Andjai dial., fafoni-mo, Onjob dial., Koreaf, mugur, Madang, map, Usino, mal, Jal., sigi, Bembi, besup, bubul, Momi dial., doibies, Berik dial., bubukwa, Mamikiong dial., besobba or kesuba.

Note. For galls on the leaves see DOCTERS VAN LEEUWEN, Zoocecidia (1926) 178.

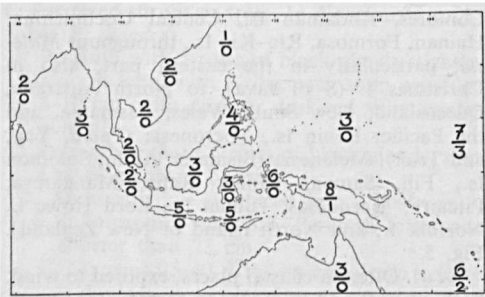


Fig. 6. Distribution density of *Pisonia* in Malesia; above the hyphen the total number of spp., below it the number of endemic spp.

2. *Pisonia cauliflora* SCHEFF. Nat. Tijd. N.I. 32 (1873) 417; Ann. Jard. Bot. Btzg 1 (1876) 44; VAL. Ic. Bog. 1 (1897) t. 22; HEIMERL, Oest. Bot. Z. 63 (1913) 20; VAL. Bot. Jahrb. 52 (1915) 102; HOSOKAWA, Trans. Nat. Hist. Soc. Form. 32, n. 221 (1942) 104.—*P. major* BAILL. Adansonia 10 (1872) 185.—*Calpidia cauliflora* HEIMERL, Oest. Bot. Z. 63 (1913) 283.

Small tree, 2 m, unarmed. *Leaves* opposite or in pseudowhorls, elliptic-oblong, (4½-)24-40(-55, BAILLON) by (3½-)6-10½ cm, base acute, top

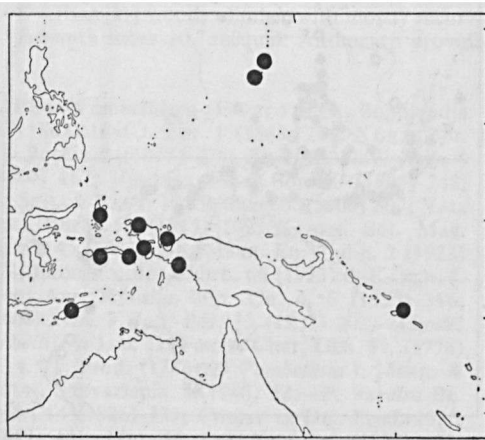


Fig. 7. Localities of *Pisonia cauliflora* SCHEFF.

acute to obtuse; petiole 1-5 cm. *Inflorescence* cauliflorous, rarely ramiflorous, corymbose-umbellate, laxly branched, 2-5½ by 3-7 cm; peduncle 5-12 cm, rarely puberulous. *Flowers* bisexual, tubular-campanulate; pedicels 6-8 mm with at the base, or higher up, one lanceolate bracteole. *Perianth* 5½ mm long with 5 faint ribs, sparsely hairy; lobes 5, keeled inside. *Stamens* 13-15, exerted for 1½-2 mm; stigma fimbriate, exerted for 2½ mm. *Anthocarp* elongate, 7 cm long, with 5 ribs, not viscid, between the ribs somewhat plicate; peduncle to 16 cm and pedicel to 6½ cm. *Seed* 28 by 2½ mm.

Distr. Micronesia (Marianas), Melanesia (Solomon Is.), in Malesia: Lesser Sunda Is. (Timor), Moluccas (Halmahera, Ceram, Ambon), West New Guinea. Fig. 7.

Ecol. Rain-forests, up to 150 m.

3. *Pisonia mülleriana* WARB. Bot. Jahrb. 13 (1891) 304, ex descr.; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 307; BARG.-PETR. Nuov. Giorn. Bot. Ital. n.s. 8 (1901) 614; VAL. Bot. Jahrb. 52 (1915) 102; RIDL. Trans. Linn. Soc. Lond. II, Bot. 9 (1916) 138.—*Calpidia mülleriana* (WARB.) HEIMERL, Oest. Bot. Z. 63 (1913) 287.—*Calpidia cuspidata* HEIMERL, l.c. 284.—*Ceodes corniculata* (non BARG.-PETR.) MERR. & PERRY, J. Arn. Arb. 20 (1939) 327, quoad specim.

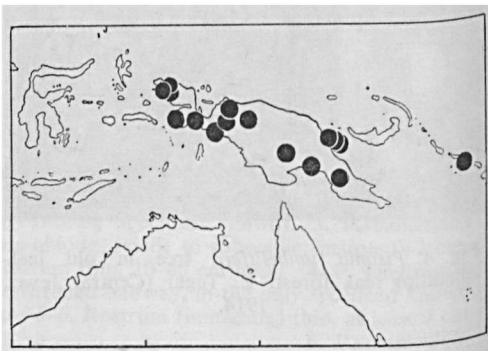
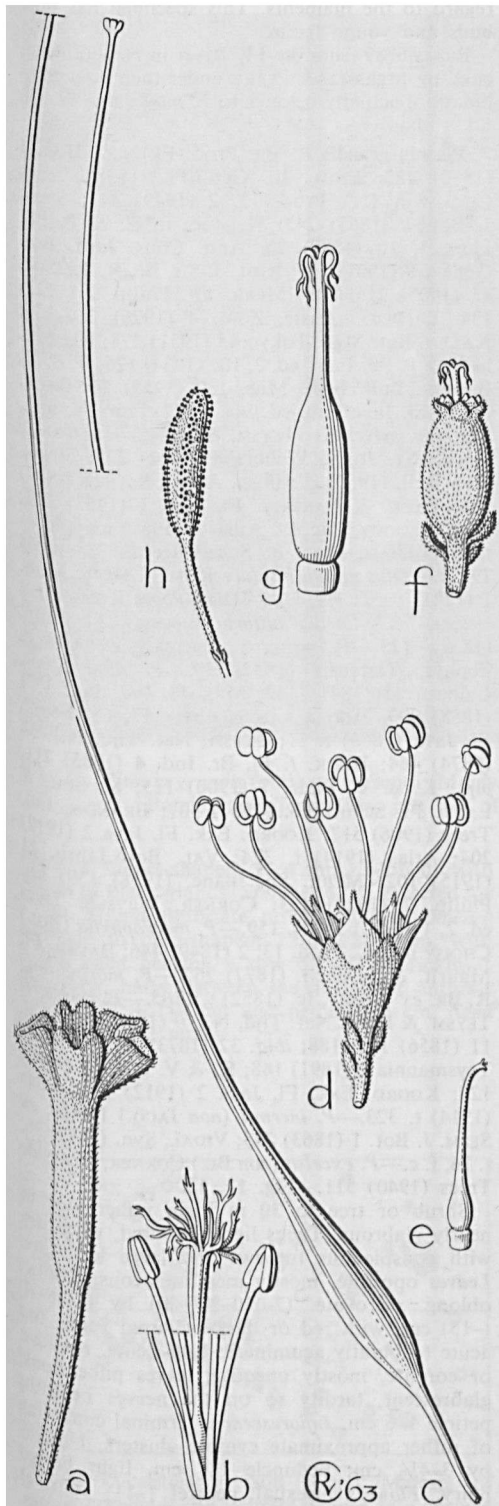


Fig. 8. Localities of *Pisonia mülleriana* WARB.

Shrub or small tree 4-10 m, unarmed, puberulous to glabrous. *Leaves* opposite, elliptic-oblong, 13-30 by 4-14 cm, base acute, top acute to obtuse; petiole 2-8 cm. *Inflorescences* terminal corymbose-umbellate, 3-10 by 5-15 cm, red-brown hairy, peduncle c. 7 cm. *Flowers* bisexual, pedicel 2 mm, at its base or higher 2 small acute bracteoles. *Perianth* tubular, c. 4½ mm high, lobes 5, truncate. *Stamens* 3-6, not exerted; stigma little fimbriate. *Anthocarp* spindle-shaped, rarely short hairy, with 5 faint ribs, 5 by 0.6-0.8 cm and a rostrum of 3 by 0.3 cm; pedicel 9 mm.

Distr. Melanesia (Solomon Is.) and Malesia: New Guinea. Fig. 8.

Ecol. Rain-forests, along rivers on muddy banks. Most records below 100 m; a few from 1000-1500 m.



4. *Pisonia longirostris* TEYSM. & BINN. Nat. Tijd. N.I. 25 (1863) 401; VAL. Ic. Bog. 1 (1897) t. 21; HEIMERL, Oest. Bot. Z. 63 (1913) 20; VAL. Bot. Jahrb. 52 (1915) 102; MERR. En. Philip. 2 (1923) 134.—*P. grandifolia* WARB. Bot. Jahrb. 13 (1891) 303, *ex descr.*; VAL. Bot. Jahrb. 52 (1915) 102.—*P. rostrata* WARB. Bot. Jahrb. 13 (1891) 304, *ex descr.*; VAL. *ibid.* 52 (1915) 102.—*P. spathiphylla* K. SCH. & LAUT. Fl. Schutzgeb. (1900) 308, *ex descr.*; VAL. Bot. Jahrb. 52 (1915) 102.—*P. beccariana* BARG.—PETR. Nuov. Giorn. Bot. Ital. n.s. 8 (1901) 612; HEIMERL, Oest. Bot. Z. 63 (1913) 287.—*P. triandra* BARG.—PETR. Nuov. Giorn. Bot. Ital. n.s. 8 (1901) 610.—*Calpidia grandifolia* HEIMERL, Oest. Bot. Z. 63 (1913) 286.—*Calpidia longirostris* HEIMERL, *l.c.* 287.—*Calpidia lauterbachii* WARB. *ex* HEIMERL, *l.c.* 286.—*Calpidia spathiphylla* HEIMERL, *l.c.* 288.—*Calpidia rostrata* HEIMERL, *l.c.* 288.—*Ceodes longirostris* MERR. & PERRY, J. Arn. Arb. 20 (1939) 328.—*Ceodes urocarpa* MERR. & PERRY, *l.c.* 328.—Fig. 9a-c.

Tree up to 30 m, unarmed. *Leaves* opposite or in pseudo-whorls or conferted towards the end of the twigs, (sub)sessile, glabrous, elliptic to oblong or obovate, (16-)25-50(-78) by (8-)10-15(-25) cm, base acute, top acute, obtuse, or obtusely-acuminate. *Inflorescences* many-flowered, dichasial umbels, 5-25 cm ϕ , red-brown hairy; peduncle axillary, 7½-22 cm. *Flowers* unisexual; pedicels 2-5 mm with 1-3 bracteoles, oblong-acute. *Perianth* tubular, c. 6 mm long, narrowed towards the throat, limb cup-shaped, c. 2½-3 mm long, about halfway incised with 5 truncate lobes. *Stamens* never exerted; in δ flowers mostly 5 and in ♀ sterile. Stigma fimbriate, filling the bottom of the limb. *Anthocarp* spindle-shaped, when young with faint ribs, later on smooth, c. 5 by 0.9 cm, passing into a slender rostrum 10-40 cm long at maturity twisted to the left; peduncle not elongated; pedicel c. 5 mm long. *Seed* c. 32-35 by 6-7 mm.

Distr. Melanesia (New Britain, Solomon Is.), in Malesia: Lesser Sunda Is. (Timor), Philippines (Sulu Arch., Jolo I., *sec.* MERRILL), Moluccas (Halmahera, Buru, Key & Aru Is.), New Guinea. Fig. 10.

Ecol. Swampy rain-forest, river-banks, and ridges, on clay or sandy soil, up to 400 m.

Vern. *Dudu*, Halmahera; New Guinea: *bubukwa*, Momi lang., *tohehna*, Orokaiva lang., Mumuni, *epanol*, Wapi lang., Marok, *parbu*, Andjai lang., Kebar Valley; Solomon Is.: *pupisilango*, Ulawa I.

5. *Pisonia diandra* PULLE, Nova Guinea 8 (1912) 629.—*P. micrantha* VAL. Bot. Jahrb. 52 (1915) 102.—Fig. 3.

Fig. 9. *Pisonia longirostris* T. & B. a. ♀ Flower, $\times 6$, b. ovary and staminodes, $\times 12$, c. anthocarp, $\times \frac{2}{3}$.—*P. aculeata* L. d. δ Flower, $\times 6$, e. abortive pistil in δ flower, $\times 12$, f. ♀ flower, $\times 6$, g. ovary in ♀ flower, on receptacle, $\times 12$, h. anthocarp, $\times 2$ (a-c TEYSMANN, type, d-e JACOBS 4724, f-g JACOBS 4894, h BEUMÉE 1082).

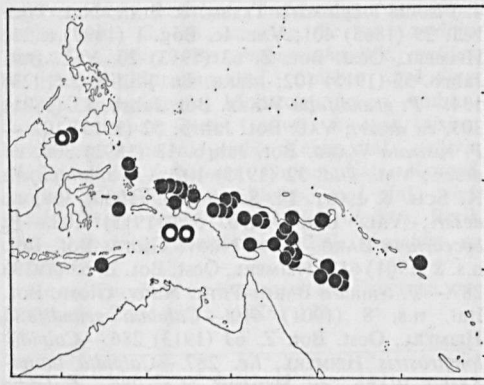


Fig. 10. Localities of *Pisonia longirostris* T. & B.

Tree, 2½–3 m, unarmed. *Leaves* opposite, brown-puberulous when young, glabrescent, elliptic-oblong, (7–)13–16(–20) by 4–7(–10) cm; base acute to rounded, top acute to obtuse; petiole c. 2 cm. *Inflorescences* terminal or axillary, 2–10 cm ø, dichasial, few-flowered, fairly lax, brown-hairy; peduncle 2–7 cm; pedicel c. 2 mm with two basal minute bracteoles. *Flowers* unisexual. *Perianth* campanulate, 5 mm long, lobes 5 or 10, obtuse, separated by shallow sinuses. *Stamens* 2 or 4, in the ♀ flower sterile and shorter than the gynaecium; in the ♂ flower exerted for 1 mm; thecae ear-shaped. *Stigma* fimbriate, just exerted. *Anthocarp* (immature) sparsely hairy, c. 8 cm long with 5 faint ribs and a rostrum of c. 40 cm; peduncle up to c. 11 cm; pedicel to c. 1½ cm.

Distr. *Malesia*: New Guinea.

Ecol. Rain-forests, on river-banks, on sandy clay, 45–630 m.

6. *Pisonia corniculata* BARG.–PETR. Nuov. Giorn. Bot. Ital. n.s. 8 (1901) 615, t. 11.—*Calpidia corniculata* HEIMERL, Oest. Bot. Z. 63 (1913) 283.—*Ceodes corniculata* MERR. & PERRY, J. Arn. Arb. 20 (1939) 327, *pro nomen*.

Shrub to 3 m, unarmed. *Leaves* opposite, elliptic-oblong, 14–19(–24) by 5–8(–10) cm, base and top acute; petiole 1–3 cm. *Inflorescence* axillary, cymose-dichasial, brown-hairy to glabrous; peduncle 1–1½ cm. *Flower* buds tubular, constricted in the middle, unisexual; pedicel 1–2 mm; bracteole 1, lanceolate, basal. *Perianth* 5-lobed. *Stamens* 5–6; in the ♀ flower sterile and shorter than the gynaecium. *Stigma* fimbriate. *Anthocarp* (immature) elongate, c. 4 cm long, sparsely hairy to glabrous; rostrum c. 7 cm; pedicel 2 cm long.

Distr. *Malesia*: Moluccas (Batjan I., *sec.* HEIMERL), West New Guinea (Vogelkop).

Ecol. Primary forests, along creeks, on limestone and sandy clay, up to 100 m.

Notes. In the holotype of BECCARI 650 (FI) I cannot find 8 stamens as BARGAGLI–PETRUCCI has described. His fig. 11 is also not correct with

regard to the filaments. This specimen has only buds and young fruits.

BRASS 6789 from the Fly River in New Guinea, cited by MERRILL & PERRY under their new combination, actually belongs to *P. mülleriana* WARB.

7. *Pisonia grandis* R. BR. Prod. Fl. Nov. Holl. 1 (1810) 422; ENDL. Ic. Gen. Pl. (1838) t. 30; CHOISY in DC. Prod. 13, 2 (1849) 441; SEEM. J. Bot. 1 (1863) 245; HEIMERL in E. & P. Pfl. Fam. 3, 1b (1889) 20; Ann. Cons. Jard. Bot. Genève 9 (1901) 197; RIDL. J. Str. Br. R. As. Soc. 45 (1905) 215, 268; MERR. En. Philip. 2 (1923) 134; GILBERT, Austr. Zool. 4 (1926) 210–226; KANEH. Bot. Mag. Tokyo 45 (1931) 278; HEIMERL in E. & P. Pfl. Fam. ed. 2, 16c (1934) 126; F. B. H. BROWN, Bull. Bish. Mus. 130 (1935) 74; BACK. Bekn. Fl. Java (em. ed.) 4a (1942) fam. 78, p. 5, *incl. var. sylvestris* (TEYSM. & BINN.) HEIMERL *in sched.*; ST. JOHN, Webbia 8 (1952) 225; SHAW, Kew Bull. (1952) 87; FOSS. Am. J. Sc. 225 (1957) 584; BACK. & BAKH. f. Fl. Java 1 (1963) 272; VAN BALGOOY, Pac. Pl. Areas 2 (196.) map 66 + text; GILHAM, Proc. R. Soc. Queensl. 73 (1963) 79–92.—*Olus album insulare* RUMPH. Herb. Amb. 1 (1741) 193, t. 79, f. 1.—*Olus album* RUMPH. l.c. 191, t. 78.—*Cordia olitoria* BLANCO, Fl. Filip. (1837) 123.—*P. procera* BERTERO ex GUILL. Zephyr. Taitensis (1837) 39.—*P. alba* SPAN. Linnaea 15 (1841) 342; MIQ. Fl. Ind. Bat. 1, 1 (1858) 990; HOOLA VAN NOOTEN, Fl. Fr. Feuill. Fl. Java (1863) t. 31; TEYSM. Nat. Tijds. N.I. 34 (1874) 464; HOOK. f. Fl. Br. Ind. 4 (1885) 711, *p.p.*; K. & V. Bijdr. 7 (1900) 123; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 307; BRANDIS, Ind. Trees (1906) 517; KOORD. Exk. Fl. Java 2 (1912) 204; Atlas (1914) t. 324; VAL. Bot. Jahrb. 21 (1915) 102; MERR. Sp. Blanc. (1918) 139; En. Philip. 2 (1923) 133; CORNER, Wayside Trees ed. 2, 1 (1952) 510, t. 159.—*P. macrophylla* (BOJ.) CHOISY in DC. Prod. 13, 2 (1849) 446; BAKER, Fl. Maurit. & Seychell. (1877) 262.—*P. morindifolia* R. BR. *ex* WIGHT, Ic. (1852) t. 1765.—*P. sylvestris* TEYSM. & BINN. Nat. Tijds. N.I. 9 (1855) 355; *ibid.* 11 (1856) 118, 188; *ibid.* 32 (1873) 73; WIGMAN, Teysmannia 2 (1891) 148; K. & V. Bijdr. 7 (1900) 123; KOORD. Exk. Fl. Java 2 (1912) 204; Atlas (1914) t. 323.—*P. inermis* (*non* JACQ.) FORST. *ex* SEEM. J. Bot. 1 (1863) 245; VIDAL, Syn. (1883) 36, t. 76, f. c.—*P. excelsa* (*non* BL.) CORNER, Wayside Trees (1940) 511.—Fig. 11, 13.

Shrub or tree to 30 m high, puberulous to nearly glabrous. Twigs light coloured, when dry with conspicuous furrows and large leaf-scars. *Leaves* opposite, mostly membranaceous, elliptic, oblong, or ovate, (7–)10–20(–30) by (4–)6–10(–15) cm, with red or dark coloured veins; top acute to bluntly acuminate; base acute, rounded or cordate, mostly unequal; leaves puberulous, glabrescent, tardily so on the nerves beneath; petiole 1–6 cm. *Inflorescences* terminal consisting of rather approximate cymose clusters, 1¼–3½ by 3–4½ cm; peduncle 1½ cm, light brown hairy. *Flowers* bisexual; pedicel 1–1½ mm, at the top or lower with 2–4 oblong bracteoles.



Fig. 11. *Pisonia grandis* forest on P. Sepoi (Malaya), grey trunks on granite rocks forming a belt of the Barringtonia formation, just out of reach of the waves (CORNER, 1935).

Perianth funnel-shaped, c. 4 mm, 5-lobed, with 5 rows of black glands. *Stamens* 6–10, exerted for 2 mm. Stigma fimbriate, not exerted. *Anthocarp* elongate to club-shaped, 12 by 2½ mm, with 5 ribs each bearing a row of viscid prickles 1 mm long, hairy between the ribs; after anthesis the pedicel 1–1½ cm and peduncle 3 cm. *Seed* 9–10 by 1½–2 mm.

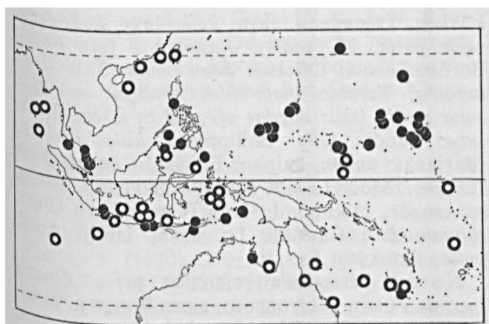


Fig. 12. Localities in and round Malesia of *Pisonia grandis* R. BR.; circles denote data derived from literature.

Distr. Madagascar, Mascarenes (Frigate I., Rodriguez I.), Seychelles, Laccadive and Maldive Is., Ceylon, India, Andaman Is., Nicobar Is., Parcel & Pratas Is. in the S. China Sea, E. Formosa, throughout *Malesia* (not in Sumatra) to Australia: islands in Carpentaria Gulf, NE. Queensland, Turtle Islet, Chesterfield Is., Capricorn Is., and the Pacific: Micronesia (Marianas, Carolines), Marcus I., Wake I., Marshall Is., Gilbert Is., New Caledonia, Loyalty Is., Polynesia (throughout, but not in Hawaii).

Ecol. On dry to semi-dry places, along coasts, sandy or rocky, up to 1200 m, on oceanic islets and atolls often dominant.

CORNER noted (under the erroneous name *P. excelsa*) that it is a medium-sized, deciduous tree shedding its leaves between April and August and flowering with the new foliage on the East coast of the Malay Peninsula where it grows best on the small granite islands in the neighbourhood of P. Tioman, being also abundant in the town of Kuala Trengganu. See fig. 11. Flowers are fragrant.

Dispersal is effected through the sticky anthocarps which attach themselves to birds, and birds are known to have fallen victim when they got too many fruits on their feathers. See also P. A. GILBERT, Austr. Zool. 4 (1926) 210–226. For the explanation of the peculiar distribution which is

largely confined to small islands, a feature which has intrigued many botanists since RUMPHIUS, AIRY SHAW recently advanced in an interesting solution, following observations by CHRISTOPHERSEN on Palmyra I. (Bull. Bish. Mus. 44, 1927). He suggested that, besides for dispersal, *P. grandis* can only grow well and maintain itself in quantity on the peculiar highly phosphatic limestone with acid reaction formed by accumulating guano of the birds. Such edaphic condition is only formed on coral and coral debris under bird colonies. The bird colonies, again, find on small islets a refuge from predating animals and man and prefer such places above nesting on large islands. If storms or other circumstances force the bird colonies to abandon the site, and the supply of guano is interrupted, *P. grandis* will gradually disappear or become rare as it seems unable to regenerate without phosphate-enriched soil. On the small rocks south of Nusa Kambangan (S. Java) KOORDERS (1918) could only locate 2 poor specimens, although 50 years earlier c. 20 specimens were reported from the same rock. See also FOSBERG, Pacif. Sc. 3¹ (1949); Atoll Research Bull. 2 (1951); Am. J. Sc. 255 (1957) 584.

Vegetation. *P. grandis* is a characteristic constituent of the *Barringtonia* formation; associates are frequently *Calophyllum*, *Cocos*, *Cordia*, *Erythrina*, *Guettarda*, *Messerschmidia*, *Pandanus*, *Pemphis*, *Scaevola*, and *Thespesia*. It gains especial importance on small low coral islands which are entirely covered by this type. Old trees may attain a considerable dimension, with a trunk to 2 m ø. The root system is shallow, the wood very brittle, and the massive crown with huge straggling branches so vulnerable to wind that such groves or fringes may easily fall a victim to heavy storms. However, it is observed that hollow rotted trees may produce shoots, and overleaning branches produce suckers. *Pisonia* is consequently preferring leeward faces of islets. See GIBSON-HILL, Bull. Raffl. Mus. 22 (1950) 11-28 on Cocos & Keeling Is., from where DARWIN already reported *Pisonia* groves. If on such islets the other species are lower than *Pisonia* it will take complete dominance. As it is shade intolerant, it will gradually be replaced by higher trees where such are present, and then represent a seral type. See M. E. GILHAM, Proc. R. Soc. Queensl. 73 (1963) 79-92.

In Malasia groves are reported from Zuidwachter I. (Djakarta Bay) by J. J. SMITH (Teysmannia 18, 1907, 452), Karimondjawa Is. (Nat. Tijds. N.I. 11, 1856, 118), Bali and Alor (*ibid.* 34, 1874, 464), Tjélagen islet in the Lèpar group (*ibid.* 32, 1873, 73) and Pombo islet in Ambon Bay (*ibid.* 37, 1876, 138-139); H. G. KEITH reported it from Sibuan islet near Tawao in North Borneo (*cf.* SHAW), and MERRILL stated that on Bancoran I., due East of S. Palawan, *Pisonia* covered the islet to the exclusion of all other trees (En. Philip. 2, 1923, 134). HOOGERWERF found pioneer dominance on the bird-inhabited low volcano G. Api (Banda Sea) (Trop. Natuur 28, 1939, 30, 83, f. 2, 85, 109, f. 2, 133, 134, 137).

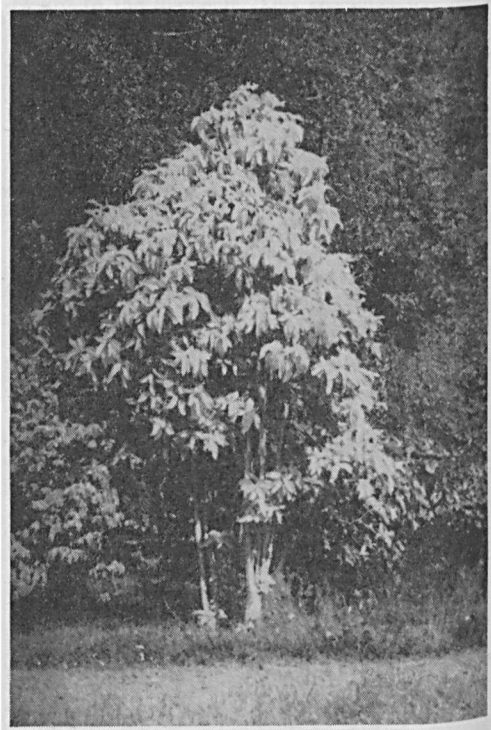


Fig. 13. The "Moluccan cabbage" tree, an almost echlorophyllose cultigen of *P. grandis*, described as *Pisonia alba* SPAN. Cult. Hort. Bog.

Uses. Native people sometimes use the sticky fruits to catch birds. In Bali the tree is used for hedges and on several other islands the leaves are eaten as a vegetable, specially of the cultivated race with creamy or yellowish chlorotic leaves described as *P. alba*, the so-called *Moluccan cabbage*. Fig. 13. This cultigen is propagated by cuttings; it is very rarely producing flowers. See RUMPHIUS (1741), KOORDERS (1912), HEYNE, Nutt. Pl. (1927), and BURKILL, Dict. (1935).

Vern. Malay Peninsula: *saudi kivaï*, Tamil, *mungkudu java*, m, *kémudu* or *měngkudu*, k, *sělat*, k, *siam*, Trengganu; Java: *kellor tree*, *kol-banda*, *sajur putih*, M, *widjojo kusumo*, J (see note); Borneo: *buluh*; Celebes: *daon bulan*; Talaud I.: *buran'a*; Ternate: *hate-bula*; Ambon: *ay-putih*, *sajur putih*; Bali: *dagdag sěe*, *sel* or *sirea*; Bima: *sabe*; Banda: *talla*; Philippines: *koles maluko*; Marianas: *umum*, Saipan; Enirik I.: *kanal*; Back I.: *kangl*; Moch I.: *mök* or *muök*; Aoman I.: *kanæ* or *kangæ*; Lukunor I.: *mük*; Vanua Levu (Fiji): *talatalambia*; Caroline I.: *mokh*, Ulithi Atoll, *puka*, Sinukutai I.

Notes. SEEMANN's reference to a *Pisonia inermis* FORST. is erroneous, since FORSTER, in his Prodomus (1786) 75, referred to MURRAY, Syst. Veg. ed. 14 (1784) 920, who cited *P. inermis* JACQ. Sel. Stirp. Amer. Hist. (1763) 275, a species which has nothing to do with *P. grandis*.

FORSTER'S MS notes on his "*P. inermis*" were published by GUILLEMIN (1837) as *P. procera*, which belongs to *P. grandis*.

Ethnobotany. In Javanese mythology this species is well known by its vernacular name *widjojo kusomo* and is still used in the wayang shows. TEYSMANN clarified the haze of mystery round this sacred plant which nobody was to gather or possess on the penalty of death. Only for the coronation of the Sultan of Solo (Surakarta) flowers were collected from the only place known in Java, viz specimens on top of two very small coral rocks before the south coast of the large island Nusa Kambangan in South Central Java. The proceedings of this ceremony were described from 1893: a legation of sixty persons, directed by a priest, climbed the rock on a ladder erected in a boat, and placed the flowers (their number would be proportional with the number of prosperous years in the reign of the new prince) in a golden box, enveloped in Bengal silk. This was placed in a decorated box on two bars and held in shade with a golden payong (umbrella) on the voyage back. On arrival, the flowers were placed on the flat opened hands of the sultan, who took them to the room of sacred objects. It is also said that the wife of the sultan has to eat the flower during pregnancy, in order that the child shall be a son, and victorious, as is the meaning of the name *widjojo kusomo* as derived from Sanskrit.

In 1854 TEYSMANN received cuttings from this same locality which he grew in the Bogor Botanic Gardens on which he based his *P. sylvestris*. Later the same form was also found in the island of Bali, and in a few small islets of the Karimondjawa group (North Central Java) and in the Bay of Djakarta.

How the esteem for this plant - which does not possess any special fragrancancy or showy characters - originated is not clear. It may be its extreme rarity in Java and its isolation on top of an otherwise naked rock.

Literature about this subject: TEYSM. Nat. Tijd. N.I. 9 (1855) 349; *ibid.* 11 (1856) 118, 188; MIQ. Fl. Ind. Bat. 1, 1 (1858) 990; TEYSM. Nat. Tijd. N.I. 32 (1873) 73; VETH, Java ed. 1, 1 (1875) 45; DE WOLFF VAN WESTERRODE, Tijd. Kon. Ned. Aardr. Gen. (1894) 915; HOEVENAARS, Ann. Jard. Bot. Btzg Suppl. 2 (1898) 153; K. & V. Bijdr. 7 (1900) 12; BLAAUW, De Tropische Natuur ed. 2 (1917) 76, f. 11; KOORD. Album Natuurmon. (1918) t. 2; KOOPER, Ned. Ind. Oud & Nieuw 18 (1933) 477.

8. *Pisonia aculeata* LINNÉ, Sp. Pl. (1753) 1026; LAMK, Ill. (1800) t. 861; ROXB. Fl. Ind. 2 (1832) 217; CHOISY in DC. Prod. 13, 2 (1849) 440; WIGHT, Ic. (1852) t. 1763-1764; BENTH. Fl. Austr. 5 (1870) 279; BAKER, Fl. Mauriti. & Seychell. (1877) 263; HOOK. f. Fl. Br. Ind. 4 (1885) 711; HEIMERL in E. & P. Pfl. Fam. 3, 1b (1889) 20; FORB. & HEMS. J. Linn. Soc. Bot. 26 (1891) 317; HEIMERL, Bot. Jahrb. 21 (1896) 631; BAILEY, Queensl. Fl. 4 (1901) 1214; BAKER & WRIGHT, Fl. Trop. Afr. 6, 1 (1913) 8; MERR. Sp.

Blanc. (1918) 139; MERR. En. Philip. 2 (1923) 133; RIDL. Fl. Mal. Pen. 3 (1924) 3; BOOBERG, Bot. Jahrb. 66 (1933) 6; HEIMERL in E. & P. Pfl. Fam. ed. 2, 16c (1934) 127; GAGNEP. Fl. Gén. I.-C. 4 (1936) 1052; BACK. Bekn. Fl. Java (em. ed.) 4a (1942) fam. 78, p. 5; MEYER DREES, Comm. For. Res. Inst. n. 33 (1951) 91; CAVACO, Fl. Madagasc. (1954) fam. 68, 10, f. 2; BACK. & BAKH. f. Fl. Java 1. (1963) 272.—*P. mitis* LINNÉ, Sp. Pl. 2 (1753) 1026.—*P. limonella* BL. Bijdr. 14 (1826) 735.—*P. villosa* POIR. in Lamk, Enc. Méth. Bot. 5 (1804) 347; MIQ. Fl. Ind. Bat. 1, 1 (1858) 989.—*P. anisophylla* HASSK. Hort. Bog. Descr. 1 (1858) 85.—Fig. 9d-h.

Overhanging climber to 20 m high, with mostly recurved, axillary thorns $\frac{1}{2}$ -1 cm long (abortive shoots). *Leaves* (sub)opposite, elliptic, 4-10 by $1\frac{1}{4}$ -5 cm, base acute, top obtuse, puberulous or glabrous; petiole $\frac{1}{2}$ -2 $\frac{1}{2}$ cm. *Flowers* unisexual in dense, cymose, axillary inflorescences, brown short-hairy, 1-2 $\frac{1}{2}$ cm ϕ . Peduncle $1\frac{1}{2}$ -3 cm. Bracteoles 1-3, oblong at the base of the receptacle to halfway on the pedicel; pedicel 1-1 $\frac{1}{2}$ mm. ♀ *Flower* campanulate, urceolate, 2 by $1\frac{1}{4}$ mm, androecium completely abortive. ♂ *Flower* funnel-shaped, 3 mm ϕ ; stamens 8, exserted for $\frac{1}{2}$ -1 mm. Limb with 5 larger lobes (only in the ♂ flower recurved) which alternate with 5 smaller ones; opposite the latter 5 rows of black stalked glands on the outside of the perianth. Stigma fimbriate, 1-1 $\frac{1}{2}$ mm exserted. *Anthocarp* club-shaped, 15 by 2-2 $\frac{1}{2}$ mm, puberulous, with 5 ribs each bearing a biserial row of glandular appendages which grow out to soft viscid prickles c. $1\frac{1}{2}$ mm long; pedicel 2-2 $\frac{1}{2}$ cm. *Seed* 9-11 by 2-2 $\frac{1}{2}$ mm.

Distr. (Sub)tropical America, Africa (west and east coasts), Madagascar, Mauritius, Seychelles, Ceylon, India (Deccan, Coromandel, S. Concan), Andaman Is., Burma (Tenasserim), Indo-China (Tonkin, Annam, Laos, S. Cochinchina), Hainan, Formosa, throughout *Malesia*: Central Sumatra, Malaya, Java, Lesser Sunda Is. (Bali, Sumbawa, Sumba, Flores, Timor, Alor, Wetar), North Borneo, Philippines (Luzon to Mindanao), Celebes (SW. and SE.), SW. New Guinea to Australia (N. Arnhem Land, Queensland, New South Wales), and New Caledonia.

Ecol. Along coasts, in hedges, rain-forest and

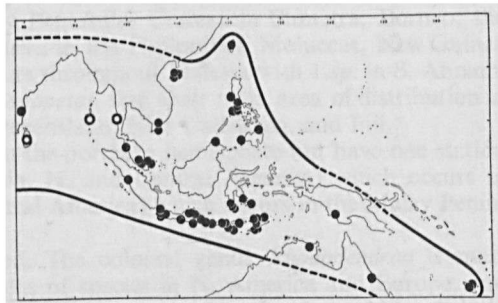


Fig. 14. Localities in Indo-Malesia of *Pisonia aculeata* L. showing clear preference for the climatically drier areas.

semi-dry places, forming impenetrable masses on forest edges reduced to a low straggling bush in open places, from the lowland up to 500 m.

Vern. *Alar*, M; *tjuhun-lamarang*, S. Bantam; *rampari*, Sumba; *matai-alât*, Alor.

Notes. If one or two peduncles and a spine occur in the same leaf-axil, their position is collateral, either near the spine or upon the base of a spine. Occasionally there is only one peduncle in a leaf-axil.

In the Linnean Herb. Cat. no. 1236 there is added on no. 4 "JACQ. amer. 275". This specimen, however, has nothing to do with *P. inermis* JACQ. Sel. Stirp. Amer. Hist. (1763) 275 and belongs to *P. aculeata* L.

For leaf-galls see DOCTERS VAN LEEUWEN, Zoocecidia (1926) 178.

In America, probably its fatherland, *P. aculeata*

seems to be a variable species and my impression is that several extremes have been described as species which do not deserve that status.

Excluded

Pisonia membranacea K. SCH. & HOLLR. Fl. Kais. Wilh. Land (1889) 43; from New Guinea. – According to WARBURG, Bot. Jahrb. 13 (1891) 303, this is a mixtum with flowers of *Pisonia* but leaves and twig of another plant, that is discordant elements. The name is for this reason illegitimate and should be omitted.

Pisonia lineatipilum C.DC. in Lorentz, Nova Guinea 8, 6 (1914) 1009, was in the Index Kewensis recorded under *Pisonia* instead of under *Piper*, where it belongs.