

## THYMELAEACEAE—GONYSTYLOIDEAE (H. K. Airy Shaw, Kew)

DOMKE, *Bibl. Bot.* 27, Heft 111 (1934) 30, 33, 103.

Trees, rarely shrubs. *Leaves* simple, mostly glandular-punctate, exstipulate. *Flowers* ♂, actinomorphic, 5-merous. *Calyx*-tube short, tube (and usually segments) densely setulose-hairy within. *Corolla* represented by 7–40 deltoid to linear-subulate processes, rarely by a low entire annulus. *Stamens* 8–80; filaments free, short, slender; anthers hippocrepiform. Disk 0. *Ovary* (2–)3–5(–8)-locular; cells with one anatropous ovule pendulous from the apex. Style elongate, filiform, sometimes accompanied by 'parastyles' at the base; stigma small, capitate. *Fruit* a thick-walled, woody, dehiscent, 1–5-seeded capsule, or a thin-walled, (?) indehiscent, 1–2-seeded capsule. *Seeds* large, without chalazal fold, usually with aril. Endosperm 0.

*Distr.* Almost confined to *Malaysia*, occurring in all parts of the archipelago except E. Java and the Lesser Sunda Isl.; found also in the Nicobar, Solomon and Fiji Islands. Genera 3. The greatest number of species is concentrated in Borneo, with apparently a marked inner centre of differentiation in the western part of the island. Fig. 1.

*Ecol.* Primary rain-forest at low and medium altitudes; one important species in freshwater swamp or peat forest.

*Uses.* Timber for planks, etc.; heartwood (*kayu garu*) for incense.

*Notes.* *Subfam. Gonystyloideae* differs from *subfam. Aquilarioideae* in: leaves usually pellucid-punctate; petals subulate to deltoid, often numerous, rarely represented by a low entire annulus; anthers hippocrepiform; disc absent; seeds without chalazal fold, usually with aril.

It differs from *subfam. Thymelaeoideae* in: leaves usually pellucid-punctate; calyx-tube very short or wanting; petals subulate to deltoid, often numerous, rarely represented by a low entire annulus; anthers hippocrepiform; disc absent; carpels 2–8; seeds usually without aril.

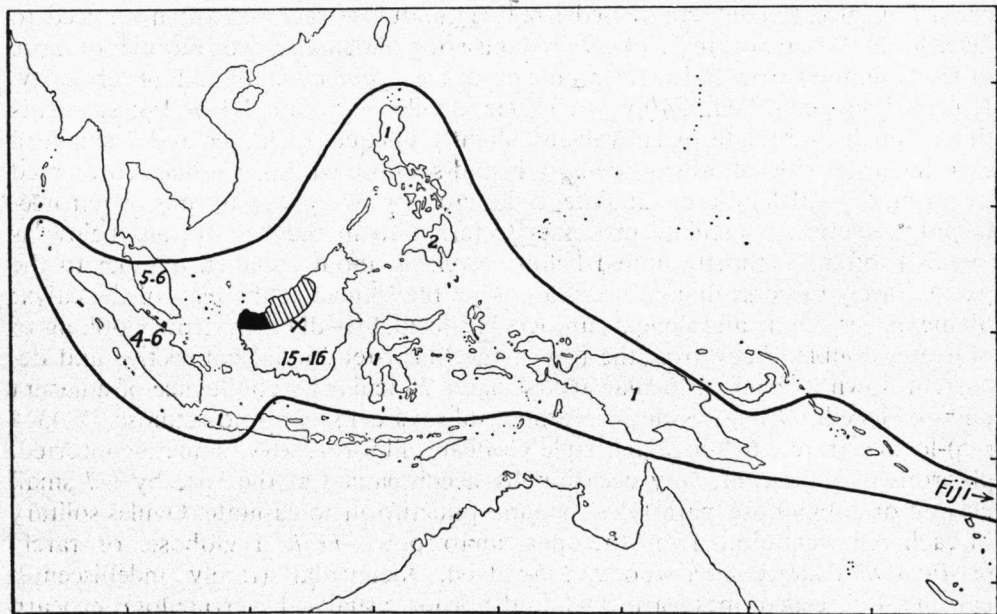


Fig. 1. Distribution of the *subfam. Gonystyloideae*. Continuous line: *Gonystylus* [and *G. macrophyllus* (Miq.) A.S.]. Black and hatched area: *Amyxa*. Black area: *Aëtoxyloñ* (and *Gonystylus* & *Auxanthus*). X: *Gonystylus areolatus* DOMKE ex A.S. Numerals indicate the number of species of *Gonystylus* known from the principal islands.

## KEY TO THE GENERA

1. Leaves (and branches) opposite or subopposite, coriaceous, smooth, with very lax, open, rather obscure venation. Inflorescence umbellate or almost so. Calyx-segments truly valvate. Corolla represented by a low, entire annulus. 'Parastyles' absent. Fruit irregularly subglobose or subpyriform, verruculose, apparently indehiscent . . . . . 3. *Aëtoxylon*
1. Leaves (and branches) perfectly alternate, chartaceous to coriaceous, nervation lax or more often close, very distinct, rarely obscure. Inflorescence variously thyrsoid, or rarely racemose, never umbellate. Calyx-segments imbricate, or only subvalvate. Corolla represented by 7-40 deltoid to filiform-subulate processes. 'Parastyles' sometimes present. Fruit various.
2. Leaves rather thinly chartaceous, with very few main lateral nerves, the ultimate nervules almost invisible. Inflorescence a very slender, much-branched, many-flowered thyrs. Flowers small, sericeous outside. Petals 10, approximate in pairs. 'Parastyles' subulate-corniform. Fruit thin-walled, with a long cylindrical beak, apparently indehiscent . . . . . 2. *Amyxa*
2. Leaves chartaceous to coriaceous, with numerous lateral nerves, these together with the ultimate nervules usually very conspicuous. Inflorescence irregular, not very slender, sometimes very robust, the flowers arranged in a nodose-fasciculate manner. Flowers usually much larger, usually tomentelous but rarely sericeous outside. Petals 7-40, not approximate in pairs. 'Parastyles', when present, very small and clavate. Fruit a thick-walled, woody, beakless, dehiscent capsule . . . . . 1. *Gonystylus*

## 1. GONYSTYLUS

TEYSMANN & BINNENDIJK, Bot. Zeit. 20 (1862) 265; DOMKE, Bibl. Bot. 27, Heft 111 (1934) 35, 103, 116, map 1; ERDTMAN, Svensk Bot. Tidskr. 40 (1946) 81; AIRY SHAW in HOOK. Ic. Pl. 35 (1947) t. 3474-3475; Kew Bull. 1950, 138-147. —*Asclerum* TIEGH. Ann. Sc. Nat. VII, 17 (1893) 245.—Fig. 2-4.

Mostly tall trees, occasionally shrubs. *Leaves* alternate, chartaceous to very coriaceous, commonly with sparse persistent hairs below, especially on midrib; young parts sericeous, tomentose, or velutinous. *Inflorescence* paniculate (*i.e.* basically racemose), the main branches few,  $\pm$  elongate, the lateral branches short, consisting of extremely condensed irregular nodulose racemes, often reduced to fascicles of flowers; or, in  $\S$  *Auxanthus*, consisting of dense regular racemes of more or less unlimited growth. Bracts minute or, in  $\S$  *Auxanthus*, small, falling very early. *Flowers* long-pedicelled. *Calyx*  $\pm$  cupular, divided to about 1/3 or 1/4; segments thick, tough, imbricate or subvalvate, slightly unequal (3 larger and 2 smaller),  $\pm$  tomentose without, always densely hispid-setulose within. *Corolla* represented by a ring of 7-40 deltoid or subulate, rigid, erect or incurved, glabrous or retrorse-hispid, sometimes pustulate processes (referred to in the descriptions below as 'petals'), often  $\pm$  shortly united below. *Stamens* about equal in number to the petals, rarely twice as many, inserted among the setulae at the base of the calyx; filaments very short and slender; anthers basifixed, broadly or narrowly oblong to obovate, doubled back over the top of the linear-tetragonal connective and decurrent down its back, 4-locular at first, later 2-locular by confluence of adjacent pairs of locelli. *Ovary* sessile,  $\pm$  globose, always densely hispid-setulose, (2-)3-4 (-5)-locular (rarely 6-8-locular); style elongate, filiform, wiry, sinuate-contorted, glabrous or pubescent, very occasionally accompanied at the base by 3-7 small clavate or subglobose 'parastyles'; stigma punctiform to capitate. Ovules solitary in each cell, pendulous from the apex, anatropous. *Fruit* a globose, or rarely ( $\S$  *Auxanthus*) lanceolate, woody, 2-5-valved, loculicidal (rarely indehiscent?) capsule, 1-5-seeded; mesocarp thick and fibrous, usually  $\pm$  verruculose; exocarp thinly fleshy. *Seeds* large, with smooth softly coriaceous testa, and thin dorsal aril arising from the fleshy funicle; cotyledons large, horny.

*Distr.* A genus of about 20  *spp.*, its area almost coinciding with that of the Malaysian region, outside this known only from the Nicobar, Solomon and Fiji Islands.

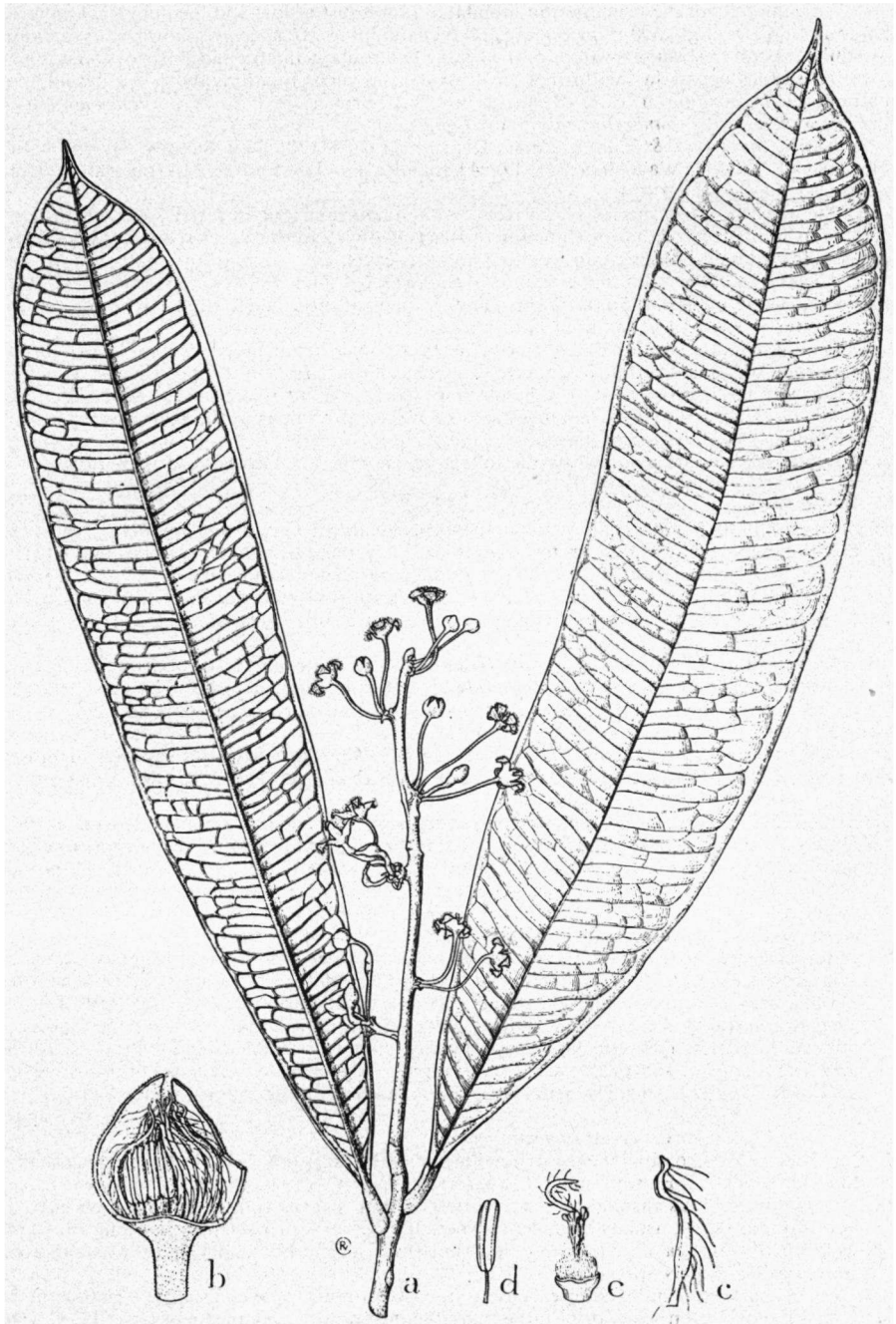


Fig. 2. *Gonystylus areolatus* DOMKE ex AIRY SHAW. *a.* Habit of flowering twig end,  $\times 1/3$ , *b.* bud with part of calyx and some petals removed,  $\times 3$ , *c.* petal,  $\times 3$ , *d.* stamen,  $\times 3$ , *e.* ovary with style and 'parastyles',  $\times 2$  (all details from a mature bud). The buds and flowers in *a.* with thickened short pedicels or with swellings in the pedicels are galled and abnormal (after the type, JAHERI 773, from Dingai River,  $0^{\circ} 40' N$ ,  $114^{\circ} 25' E$ ).

Ecol. Typically trees of the primary non-inundated rain-forest at low and medium elevations, reaching 1200 m in Sumatra and 1500 m in Borneo and the Philippines. *G. bancanus*, however, is a component of the (mainly coastal) freshwater swamps of the Malay Peninsula, Sumatra and Borneo, and it is possible that a second species occurs in this formation in Brunei; in such situations there is a development of pneumatophores. According to C. L. DURANT (For. Rep. Brunei 1933, p. 7) *G. bancanus* (*ramin*) is invariably associated with *Combretocarpus* and *Crypteronia*.

Wood anat. METCALFE & CHALK, Anat. Dicot. 2 (1950) 1178. DEN BERGER, Determinatietabel Houtsoorten van Malesië, Wageningen (1949), 47 (hand lens). JANSSONIUS, Mikrograph. d. Holzes 5 (1934), 434, Blumea 6 (1950) 454.

Uses. The wood of most species seems relatively unimportant, but in recent years there has been considerable exploitation of that of *G. bancanus*—largely owing to this species sometimes occurring in pure stands—for internal building construction, planks, cases, etc.. Export of *ramin* is estimated to constitute one third of the total timber export of Sarawak (cf. Mal. For. 14, 1951, 167, 231, 233). The use as incense, by the natives of Sumatra, Java and Borneo, of the (?due to fungal action) resin-impregnated heartwood, or *kayu garu*, has been known since the time of RUMPHIUS.

Notes. The systematic position of *Gonystylus* has been somewhat disputed, BAILLON, GILG and others having proposed to constitute it a separate family near the *Tiliaceae*. Its position as a member of the *Thymelaeaceae* has, however, been well substantiated by DOMKE's work (1934, *l.c.* 1-3 *et passim*), and confirmed by ERDTMAN's (1946, *l.c.*) investigation of the morphology of the pollen and JANSSONIUS's (1934 and 1950, *l.c.*) examination of the wood.

The characteristic colours assumed by the foliage of the different species on drying are noteworthy.

#### KEY TO THE SPECIES

1. Leaves very long, 40-50 cm, venation bullately impressed above, very prominent below. Inflorescence robust, with a very thick rhachis, up to 5 mm thick. Flowers large, with c. 40 petals and 80 stamens. Style robust, with large stigma, and 4-7 small clavate 'parastyles' near the base . . . . . 2. *G. areolatus*
1. Leaves shorter, 3-40 cm, venation not bullately impressed. Inflorescence much less robust. Flowers smaller, petals and stamens 10-40. Style slender; stigma small; 'parastyles' absent, but sometimes represented by 3-4 small rounded humps.
2. Inflorescence-branches elongating almost indefinitely, forming long crowded cicatricose racemes with a few flowers at the apex at the time of flowering. Leaves large, up to 29 × 14 cm. Petals 15-16, densely retrorse-setulose. Capsule lanceolate, 3- or 6-ribbed, apex as it were shortly and stoutly 3-winged (SECT. *Auxanthus* AIRY SHAW) . . . . . 1. *G. augescens*
2. Inflorescence-branches not elongating, bearing fascicles or short irregular racemes of flowers on short nodulose side-branches. Petals glabrous or occasionally setulose. Capsule ± globose, not or scarcely ribbed.
3. Leaves gradually narrowed at the apex into a relatively long slender acumen, cuneate at the base, up to 20 × 5 1/2 cm, almost glabrous, drying chestnut-brown. Inflorescence ferruginous-tomentellous, branches shortly racemiform. Flowers truncate at the base . . . . . 11. *G. acuminatus*
3. Leaves not gradually narrowed into a long acumen, usually rather suddenly narrowed into a relatively short acumen or cusp, sometimes rounded or even retuse.
4. Pedicels 2-3 cm. Leaves usually large (up to 40 × 15 cm).
5. Inflorescence elongate, up to 20 cm long, branches relatively slender, often simple. Leaves drying ochraceous-brown; petiole relatively long and slender, up to 2 1/2 cm long . . . . . 5. *G. macrophyllus*<sup>1</sup>
5. Inflorescence short and stout, 7-12 cm long. Petiole short and stout, 9-13 × 2-4 mm.
6. Leaves cuneate at the base, drying light green with a narrow dark brown edge; nerves rather robust, dense, strongly reticulate. Calyx densely tomentellous. Petals about 40 . . . . . 4. *G. reticulatus*
6. Leaves rounded or subcordate at the base, drying a dark purplish-leaden colour; nerves slender, relatively lax, less strongly reticulate. Calyx adpressed-puberulous. Petals 20-30. . . . . 3. *G. calophyllus*
4. Pedicels 1/2-2 cm; leaves small or medium.
7. Calyx-segments strongly reflexed or revolute at anthesis; petals 7-12. Inflorescence usually considerably branched. Flowers small. Leaves small, up to 13 × 5 cm, distinctly shagreened.
8. Petals tomentellous throughout and setulose within. Leaves elliptic or almost rhomboid, glabrous or almost so, usually ochraceous when dry; nerves rather steeply ascending . . . . . 14. *G. forbesii*
8. Petals glabrous. Leaves elliptic to oblong but never subrhomboid, drying brownish or greenish; nerves rather widely spreading.
9. Young parts and inflorescence densely fulvo-velutinous. Leaves usually ± pubescent below, glossy above (even when dry), rather variable in shape, often cuneate at base . . . . . 15. *G. velutinus*
9. Young parts and inflorescence tomentellous. Leaves glabrous or almost so below, dull above when dry, regularly elliptic-oblong, mostly rounded at base . . . . . 16. *G. maingayi*

(1) Probably related to *G. macrophyllus*, but imperfectly known, is 6. *G. xylocarpus*. Leaves more rigidly coriaceous, rounded or very shortly subapiculate at apex. Fruits exceptionally massive and woody; pericarp almost stony.

7. Calyx-segments not or scarcely reflexed at anthesis.
10. Petals  $\pm$  10. Flowers very small (4–5 mm). Leaves drying a dull purplish-leadен colour, up to 15  $\times$  6 cm . . . . . 18. *G. micranthus*
10. Petals 13–30. Flowers larger.
11. Leaves drying a dull purplish-leadен colour; midrib flat or slightly raised above 12. *G. confusus*
11. Leaves not drying purplish-leadен.
12. Petals retrorse-setulose within.
13. Petals 20–22. Leaves chartaceous, drying greyish-green above with a narrow brown border, pinkish-brown below; nervation lax, the primary nerves being distinctly differentiated from the secondaries . . . . . 9. *G. keithii*
13. Petals 25–30. Leaves coriaceous, drying chestnut-brown throughout; nervation rather dense. . . . . 10. *G. brunnescens*
12. Petals glabrous.
14. Midrib distinctly prominent above. Sepals narrowly triangular-lanceolate. Leaves yellow-ochraceous when dry . . . . . 7. *G. stenosepalus*
14. Midrib flat or channelled above. Sepals ovate-deltoid.
15. Leaves small, 4–15 by 2–7 cm, coriaceous, often  $\pm$  conduplicate, drying dull purplish-red below and chestnut above; nervation relatively inconspicuous . . . . . 19. *G. bancanus*
15. Leaves various, but not conduplicate, nor drying as above; nervation more conspicuous.
16. Inflorescence densely fulvous-tomentellous. Leaves strongly shagreened, often persistently tomentellous below . . . . . 13. *G. affinis*
16. Inflorescence thinly adpressed-pubescent or subsericeous. Leaves not strongly shagreened, glabrous or shortly adpressed-pubescent below.
17. Leaves 12–24 by 4 $\frac{1}{2}$ –7 $\frac{1}{2}$  cm . . . . . 8. *G. borneensis*
17. Leaves 9–11 by 3–4 cm . . . . . 17. *G. pendulus*

The colour of the leaves on drying being for many of the species very characteristic, the following synopsis may be found useful for herbarium specimens:

Dull purplish-leadен: *calophyllus*, *confusus*, *micranthus*.

Green: *reticulatus* (both surfaces), *keithii* (grey-green, upper surface only, lower surface purplish-brown).

Dull purplish-red or purplish-brown below, chestnut above: *bancanus*.

Chestnut-brown throughout: *brunnescens*, *acuminatus*.

Ochraceous-yellow or ochraceous-brown: *forbesii*, *macrophyllus* (variable), *stenosepalus*, *areolatus*.

Remainder indeterminate shades of brown, or colours not easily expressed in words.

1. *Gonystylus augescens* RIDL. Kew Bull. 1946, 43 (1946); AIRY SHAW, Kew Bull. 1947, 10 (1947); in HOOK. Ic. Pl. 35 (1947) t. 3474; Kew Bull. 1950, 143–4, fig. 1 (1950).

Small tree; branchlets dark brown, glabrous. Leaves broadly elliptic or elliptic-oblong, 16–29 by 8–14 cm; base rounded to somewhat cordate, more rarely very broadly cuneate; apex rounded and shortly cuspidate-acuminate; margin often strongly reflexed, almost revolute at the base, firmly coriaceous,  $\pm$  chestnut-brown when dry, darker below, glabrous except for the sparsely puberulous midrib below, minutely shagreened on both surfaces; nerves very conspicuous, rather crowded, widely spreading; petiole robust, 10–15 by 3–4 mm, minutely puberulous. Inflorescences up to 18 cm long, 2–2 $\frac{1}{2}$  mm thick, with 2–3 branches, densely ochraceous-tomentellous at first, later glabrescent; scars of the fallen flowers and bracts forming a dense, regular, nodulose spiral [somewhat resembling that seen in the *Icacinaea* *Stemonurus corniculatus* BECC. (*Cantleya johorica* RIDL.)], in 4 vertical rows, the successive members of each row being about 3–4(–8) mm apart. Bracts ovate-oblong, up to 7 by 2 $\frac{1}{2}$  mm, cucullate, subsericeous, caducous. Pedicels 8–13 mm long, sericeous. Buds subglobose. Flowers (expanded) 7–9 mm diam.. Sepals deltoid-ovate, 4–5 by 2–2 $\frac{1}{2}$  mm, subobtuse, densely fulvo-sericeous. Petals c. 16, subulate, 3 mm, densely retrorse-setulose within, sparingly setulose or sub-

glabrous without. Style pubescent. Fruit (immature) broadly lanceolate, 5 $\frac{1}{2}$  by 2 $\frac{1}{4}$  cm, 3-valved,  $\pm$  6-ribbed, the locular ribs broad, rounded or slightly angled, the sutural ones narrow, traversed by a fine groove, and forming a shortly 3-winged apex to the fruit, minutely rugulose, glabrous but covered with a fine brownish meal; calyx persistent, scarcely enlarged. Seed (very immature) compressed, narrowly elliptic, 2 $\frac{1}{4}$  by  $\frac{3}{4}$  cm, solitary in the fruit examined.

Distr. Malaysia: Borneo (SW. Sarawak, NW. part of W. Indonesian Borneo).

Ecol. Unknown; probably rain-forest at low altitudes; fl. Oct.–Jan.

Notes. This interesting species is known only from the neighbourhood of Kuching, in Sarawak, and from the Singkawang-Benkayang-Mampawah area in the extreme NW. of Western Indonesian Borneo (leg. DE VRIESE, 1857–61). The curious inflorescences seem to have the power of almost unlimited growth; besides *Stemonurus corniculatus* quoted above, compare also *Knema tridactyla* AIRY SHAW [Kew Bull. 1939, 543–5 (1940)].

2. *Gonystylus areolatus* DOMKE ex AIRY SHAW, Kew Bull. 1952, 73 (1952).—Fig. 2.

Shrub? (or small tree?), branchlets robust, 5–10 mm thick, bark fuscous, apparently lax. Leaves very large for the genus, 40–50 by 7 $\frac{1}{2}$ –10 $\frac{3}{4}$  cm, oblong (more rarely oblanceolate-oblong), base rather long-attenuate,  $\pm$  rounded at the apex,

shortly deflexed-acuminate or cuspidate, chartaceous, shortly and sparsely pilose below, glabrous above, ochraceous-chestnut when dry (or greenish above); midrib robust, terete below, 3 mm thick, narrowly impressed above; nerves very conspicuous, bullately impressed above, sharply prominent below, widely spreading, in narrower leaves almost straight, in wider leaves arching forwards, conspicuously anastomosing 1–3 mm from the margin, laxly disposed (about 30 pairs of primary nerves in a leaf 40 cm long), 1–5 secondary or minor nerves between the primaries, all conspicuously connected by short transverse veinlets forming a beautifully areolate reticulation; petiole short, thick, 15(–30) by 5(–10) mm, rugose, almost glabrous. *Inflorescence* terminal, narrowly pyramidal-thyrsoïd, 10–21 cm long, fulvo-tomentellous; rhachis 3–5 mm thick; branches 1–2½ cm long, spreading or reflexed, many-flowered; pedicels up to 4 cm, straight, spreading, 1–2 mm thick at anthesis. *Calyx* (expanded) 1½–1¾ cm diam., very shortly adpressed-tomentellous outside; segments deltoid-lanceolate, subobtusate, 9–10 mm long, reflexed at anthesis, very densely setulose within. *Petals* ± 40, subulate, 6–7 mm, glabrous or retrorsely sparsely setulose, pustulate (pustules evident in bud, scarcely visible at anthesis). Stamens up to 80; filaments 1 mm; anthers 2 mm, narrowly oblong, caducous-setose. Ovary (always) 6-locular; style robust, glabrous or setose, with, slightly above the base, 4–7 small, clavate, glabrous 'parastyles' 1–1½ mm; stigma rather large, cylindrical-capitate. Fruit unknown.

Distr. *Malaysia*: Borneo (S. & E. Division).

Ecol. Unknown, but doubtless primary rain-forest.

Notes. A most distinct, 'primitive-looking' species, unlike any other. Not the least interesting feature is the development of the 'parastyles', which here give the impression of being actual abortive styles.

3. *Gonystylus calophyllus* GILG in ENGL. & PR. Nat. Pfl. Fam. Nachtr. 1 (1897) 232; BOERL. Handl. 3 (1900) 112; MERR. En. Born. (1921) 372.

Shrub or small tree; branchlets dark brown. *Leaves* elliptic to oblong, 16–30 by 6–10 cm, rounded to cordate at the base, shortly caudate-acuminate at the apex, chartaceous, glabrous, somewhat glossy, drying a purplish-lead colour; nervation conspicuous, rather close, widely spreading; midrib not deeply channelled above; petiole robust, 9–12 by 2–4 mm, finely ochraceous-puberulous. *Inflorescences* subsimple or 2–4-branched, with short, straight, thick, stiff, subsuscicled branches, 4–12 cm long, rather thinly ochraceo-tomentellous. Pedicels elongate, 2½–2¾ cm, slender, adpressed-ochraceo-puberulous, rather gradually expanded into the calyx. *Calyx* 8–10 mm long, adpressed-puberulous; sepals lanceolate, 2½–3 mm wide, acute and subacuminate, erect or slightly spreading, the tips slightly recurved. *Petals* 20–30, subulate, 3–4 mm long, glabrous, epustulate. Ovary 3-locular, with three small pubescent subglobose

'parastyles'; style pubescent below. Fruit unknown ('green' according to HAVILAND's collector).

Distr. *Malaysia*: Borneo (SW. Sarawak).

Ecol. Unknown; probably lowland rain-forest; fl. Jan.-Feb..

Notes. Distinguished by the large leaves, drying a purplish-lead colour, and by the rather narrow, subacuminate sepals.

4. *Gonystylus reticulatus* (ELM.) MERR. Philip. J.Sc. 12 (1917) Bot. 284; En. Philip. 3 (1923) 21.—*Thea reticulata* ELM. Leaf. Philip. Bot. 8 (1915) 2838.

Small, slender tree, 12 m by 20 cm. Wood soft, light. Branchlets dark brown. *Leaves* oblong-oblancoate, base broadly cuneate, apex rounded and shortly cuspidate, 12–24 by 5–9½ cm, chartaceous-coriaceous, glabrous and somewhat glossy above; with sparse scattered ochraceous hairs below, midrib thinly adpressed pubescent, drying a relatively bright green on both surfaces, or sometimes ochraceous below, with a distinct narrow dark brown border; nervation very prominent, strongly reticulate, rather dense, midrib rather broadly and shallowly channelled above; petiole robust, 10–13 by 3–4 mm, pubescent below. *Inflorescences* relatively small, stout, 7–8 cm long, with 2–3 very short branches, densely ochraceous-pubescent when young, thinly so when mature. Pedicels c. 2½ cm, tomentellous. *Calyx* 12 mm long; sepals lanceolate, c. 10 by 4–5 mm, acute and subacuminate, densely tomentellous outside. *Petals* c. 40, filiform-subulate, c. 5 mm, glabrous, probably epustulate. Stamens c. 40. Style pubescent. Fruit (not seen in mature state) 'irregularly globose' (teste ELMER), up to 6 cm diam., 5-valved.

Distr. *Malaysia*: Philippines (Mindanao).

Ecol. Evergreen rain-forest at 900 m; fl. fr. Aug.

Notes. The important features of this species are the large flowers and the green colour of the leaves on drying, with a narrow brown margin.

5. *Gonystylus macrophyllus* (MIQ.) AIRY SHAW, Kew Bull. 1947, 9 (1947); HILDEBRAND, Rep. For. Res. Inst. Indon. no 50 (1951) 90.—*Aquilaria? macrophylla* MIQ. Fl. Ind. Bat. Suppl. (1861) 356.—*Gonystylus miquelianus* TEYSM. & BINNEND. Bot. Zeit. 20 (1862) 265, *nom. illegit.*; MIQ. Ann. Mus. Bot. Lugd. Bat. 1 (1863–4) 133, t. 4; KURZ, Jour. As. Soc. Beng. 45, II (1876) 146; GRESHOFF, Nutt. Ind. Pl. (1897) 171–5, t. 40; BOERL. Handl. 3 (1900) 112; KOORD. & VAL. Bijdr. Booms. Java 9 (1903) 48; BOORSMA, Bull. Dép. Agric. Ind. Néerl. no 7 (1907) 6.—? *G. philippinensis* ELM. Leaf. Philip. Bot. 7 (1915) 2674.—*G. obovatus* MERR. Philip. J.Sc. 12 (1917) Bot. 283.—*G. bancanus* [non (MIQ.) KURZ] PERK., Fragm. Fl. Philip. (1904) 79; KOORD. Exk. Fl. Java 2 (1912) 572; Atl. Baumart. Java 2 (1914) t. 300; MERR. En. Philip. 3 (1923) 21; METCALFE in Kew Bull. 1933, 10, t. II (anat.) (1933); *et auct. al., quoad pl. Jav., Sum. et Philip.*

Tree, up to 45 by 1 m. *Leaves* exceedingly variable in size and shape, oblong, elliptic, obovate or sublancoate, 3–40 by 2–15 cm, base cuneate to rounded, apex acuminate to rounded or even

retuse, chartaceous to coriaceous, drying various shades of ochraceous-brown, slightly (rarely strongly) shagreened above, scarcely so beneath, glabrous; nervation (especially on lower surface) characteristic, consisting of a rather open network of prominent relatively steeply ascending nerves, of uniform thickness, connected by rather frequent short cross-veins of similar thickness, producing a system of irregularly elongate areolae; midrib deeply channelled above; petiole relatively long, up to 2½ cm. *Inflorescence* often almost simple, consisting of an elongate axis up to 20 cm with sessile nodulose fascicles of flowers 1–2 cm apart, but sometimes branched, ochraceous-tomentelous when young, cinereous later. Pedicels elongate, slender, up to 2½ cm. *Calyx* shortly cupular, 6–8 mm long, 10–15 mm diam., sericeous; sepals ovate-deltoid, acute or obtuse, margin often reflexed. *Petals* 20–40, narrowly subulate, glabrous, epustulate (? sometimes minutely pustulate), 2–3 mm. Style glabrous. *Fruit* large, globose, up to 7 cm diam., 3–5-valved. Seeds semi-ellipsoid, 4 by 2½ cm.

Distr. Nicobar Isl. (Kamorta), *teste* KURZ, .c.; in *Malaysia*: widespread, but not recorded from Central & E. Java and the Lesser Sunda Islands.

Ecol. Primary forests at low and medium altitudes, ascending to 1200 m in Sumatra and to 1500 m in the Philippines; *fl.* Sept., Dec.–April; *fr.* May–June.

Uses. Wood for small boxes; heartwood for incense.

Vern. *Kələmbak*, Johore, *garu*, *pinang bai* (*baít*, *baik*), *médang ramuän*, *sirantih kunji*, *batu radja*, Sumatra, *puchatutup*, Mentawai, *garu kapas*, *garu hidung*, *səndarən*, *bəngang*, *ki laba*, W. Java, *garu tjampaka*, *garu bətul*, *médang karan*, W. Borneo, *anauan*, *asuaa*, *busilak*, *lanutan-bagio*, *pama-luan*, *panakuraring*, *pandit*, *sambulawan*, Philippines, *nio*, Talaud, *udim abiri* (? *akiri*), Morotai, *hunta*, Ceram, *ruwula*, *mangərai*, Aru.

Notes. A very variable and widespread species, characterized principally by the venation and long pedicels. *G. philippinensis* ELM. was based upon an exceptionally small-leaved form, superficially resembling *G. bancanus*, but there is little doubt that it belongs here. The Babuyan Islands, type locality of *G. obovatus* MERR., represent the northernmost limit of the genus. The imperfectly known *G. megacarpus* C. T. WHITE (Solomon Isl.) and *G. punctatus* A. C. SMITH (Fiji) may well prove ultimately to be referable to *G. macrophyllus*.

6. *Gonystylus xylocarpus* AIRY SHAW, Kew Bull. 1952, 73 (1952).

Tree, 12 by 1.2 m. *Leaves* broadly elliptic, 10–17 by 4½–9 cm, rounded at base and apex, or apex sometimes very shortly subapiculate, margin reflexed, rigidly coriaceous, brownish when dry, somewhat shining above, glabrous except for the midrib sparsely puberulous below; midrib narrowly incised above, robust below; nerves rather closely reticulate above, laxer below, anastomosing into a distinct intra-marginal nerve. *Inflorescence*

robust, up to 12 cm long; rhachis somewhat flattened, 3–4 mm thick; branches thick, very short, up to 8 mm long, apparently many-flowered at the apex, very minutely ferrugineo-puberulous. *Flowers* unknown. *Fruit* globose, indehiscent (?), up to 7½ cm diam., pericarp 1½–2 cm thick, very woody or almost stony, externally verruculose, pedicel 20 by 7 mm. *Seeds* complanate-ovoid, up to 3½ by 2 cm; testa smooth, somewhat shining, deep brown, scarcely 1 mm thick.

Distr. *Malaysia*: W. Borneo (SW. Sarawak and adjacent Indonesian Borneo).

Ecol. Probably rain-forest at low altitudes; *fr.* Feb.–Apr.

Uses. Timber for cheap furniture (Sarawak).

Vern. *Ramin*, Sarawak, *médang bələt*, Indonesian Borneo.

Note. The status of this species is uncertain; it may prove to be an extreme form of *G. macrophyllus* (MIQ.) A.S. when the flower becomes known. The exceptionally coriaceous leaves and massive fruits appear, however, to be distinctive.

7. *Gonystylus stenosepalus* AIRY SHAW, Kew Bull. 1947, 9 (1947), *in adnot.*

Small tree. Branchlets ochraceous brown. *Leaves* elliptic, 12–20 by 5–9 cm, rounded at base, shortly acuminate at apex, chartaceo-coriaceous, glabrous, yellowish-ochraceous when dry, smooth but not shining on both surfaces, not shagreened; venation distinct on both surfaces, moderately close; midrib narrowly prominent above; petiole 12 by 1–2 mm, conspicuously channelled above, glabrous. *Inflorescences* simple, terminal, 12–14 cm long, with very shortly peduncled fascicles of flowers, thinly adpressed-puberulous. Pedicels elongate, slender, 1½–2 cm, shortly sericeous. *Flowers* 6–7 mm long. *Sepals* narrowly triangular, c. 5 mm long, 2–2½ mm wide at the base, acute, shortly sericeous. *Petals* about 20, subulate, 4 mm, pustulate, glabrous. Style glabrous. *Fruit* unknown.

Distr. *Malaysia*: Borneo (Sarawak).

Ecol. Unknown, but doubtless primary rain-forest.

Notes. Distinguished from all other species by the midrib being prominent above, and by the narrow sepals. The yellowish colour of the leaves on drying, and the pustulate but glabrous petals, are characters shared with *G. macrophyllus*.

8. *Gonystylus borneensis* (TIEGH.) GILG in ENGL. & PR. Nat. Pfl. Fam. Nachtr. 1 (1897) 232; BOERL. Handl. 3 (1900) 112; MERR. En. Born. (1921) 372; DOMKE, Bibl. Bot. 27, Heft 111 (1934) t. I, fig. 2a–b.—*Asclerum borneense* TIEGH. Ann. Sc. Nat. VII, Bot., 17 (1893) 247.—*G. bancanus* [non (MIQ.) KURZ] MERR. Pl. Elm. Born. (1929) 184, *quoad* ELMER 21768 *tantum*.

Shrub or tree, trunk up to 60 cm diam.. Twigs blackish. *Leaves* elliptic to oblong, sometimes slightly oblanceolate or panduriform, 12–24 by 4½–7½ cm, base ± cuneate, rarely almost rounded, apex shortly cuspidate-acuminate, rather thinly chartaceous, dull pale brownish when dry, glabrous except for the sometimes thinly puberulous

midrib below; nervation very fine, dense and parallel; midrib shallowly channelled above or almost flat; petiole 8–12 by 2 mm, puberulous. *Inflorescences* 10–20 cm long (only 1–5 cm in the type, but doubtless not properly developed), subsimple, thinly adpressed-pubescent. Pedicels 1–1½ cm, densely fulvo-velutinous. *Calyx* 7–8 mm long, velutinous; sepals 5–6 mm long, ovate-lanceolate, subacute. *Petals* 25–30, subulate, glabrous, epustulate. Style glabrous. *Fruit* up to 7 cm diam..

Distr. *Malaysia*: Borneo.

Ecol. Rain-forest, prob. at low altitudes; *fl.* May, *fr.* Oct.–March. According to a MS. note by BECCARI (*in herb. Becc.*), the flowers open for a very short time only and are difficult to find in this state.

Notes. A species of doubtful status, known at present only from two flowering collections from Mt Matang in SW. Sarawak, and a fruiting collection from near Sandakan in Br. N. Borneo. The fine, close, parallel venation of the rather thin leaves is the most obvious feature; in this and in its glabrous petals it differs from *G. keithii*, which it otherwise somewhat resembles.

9. *Gonystylus keithii* AIRY SHAW, Kew Bull. 1947, 13 (1947).—*G. bancanus* [non (MIQ.) KURZ] MERR. Pl. Elm. Born. (1929) 184, *quoad* ELMER 21480.

Shrub or tree, 4½–26 m by 15–90 cm. Bark of twigs blackish-grey. *Leaves* elliptic-oblong to oblanceolate, 13–24 by 4–9 cm, base broadly cuneate or almost rounded, apex abruptly and shortly cuspidate-acuminate, chartaceous, usually drying conspicuously discolourous, greyish-green above (with a very narrow purplish-brown margin) and pinkish-brown below, practically glabrous throughout; nervation comparatively lax, primary nerves 12–15 pairs, widely patulous, distinctly differentiated from the secondary nerves; petiole 1–1½ cm, rather slender, minutely puberulous or glabrescent. *Inflorescences* mostly terminal, rather simple, 9–12½ cm long, sparsely puberulous, the short branchlets densely grey-subsericeous. Pedicels slender, up to 2 cm, densely ochraceous-tomentellous. *Sepals* ovate or oblong-ovate, c. 8 by 3–5 mm, densely subsericeous within and without. *Petals* 20–22, filiform-subulate, c. 5 mm, often uncinately recurved at the apex, conspicuously white-pustulate within towards the apex, each pustule bearing a short retrorse seta. Style glabrous. *Fruit* (when mature) at least 6½ cm long, rugose. Seed 4 by 2¾ cm, smooth, chestnut coloured; calyx persistent, scarcely enlarged.

Distr. *Malaysia*: Borneo.

Ecol. Evergreen non-inundated rain-forest, up to 410 m, mostly on sandy soil; *fl. fr.* March–June and Oct.

Uses. As fish poison (pounded fruit mixed with ash) and as medicine (unspecified), in Br. North Borneo.

Vern. *Mangriau* (? *mangsián*), *saukau*, *malindah*, *karai*, *kayu arang*, Br. N. Borneo, *sampah songkop*, *bépisang*, W. Borneo, *létung*, E. Borneo.

Notes. The colour of the leaves on drying is

very characteristic of this species, as also is the relatively lax venation. The material seen from Indonesian Borneo is all sterile, and is referred here on the basis of these characters alone.

10. *Gonystylus brunnescens* AIRY SHAW, Kew Bull. 1950, 138 (1950).—*G. bancanus* [non (MIQ.) KURZ] HEINE, in FEDDE, Rep. 54 (1951) 239.

Tree 18–23 m high, with habit of *Polyalthia* or *Garcinia*, branchlets dark brown. *Leaves* elliptic to oblong, 12–26 by 4–10 cm, cuneate to rounded at the base, ± rounded or subacute at apex, shortly deflexed-cuspidate, margin conspicuously reflexed, rather firmly coriaceous, glabrous, mostly chestnut-brown on both sides when dry, somewhat shagreened above, but not below; lateral nerves rather numerous, close and conspicuous; petiole 12–15 by 1–3 mm, minutely puberulous when young. *Inflorescences* terminal, sub-simple, 4–11 cm long, finely adpressed-pubescent or ferruginous-tomentellous. Pedicels 5–12 mm, densely pubescent. *Flowers* c. 7 mm in diameter, ochraceo-sericeous. *Calyx* truncate and gibbous at base; sepals ovate-deltoid, 4–5 by 3 mm, subobtuse. *Petals* 25–30, subulate-filiform, c. 3 mm, glabrous outside, rather densely retrorse-hispid within. epustulate, variously connate below. Style glabrous. *Fruit* (probably immature) ovoid, 3½–4 cm diam., trilocular; pedicel 3–3½ cm; persistent calyx-segments up to 7 mm long.

Distr. *Malaysia*: Malay Peninsula (E. Coast), Borneo.

Ecol. Evergreen non-inundated rain-forest at 175–345 m [but reaching 1500 m on Kemul (Kongkemul) in E. Borneo and on Mt Kinabalu], mostly on clay or sandy clay soil; *fl.* Oct.–Nov.; *young fr.* Oct..

Vern. *Mahabai binjak*, *lemiar*, *gërima*, *garu tjampaka* (and perhaps *seriangun*, *médang kèlik*), W. Borneo, *kelat*, Brunei, *paliu*, *nasi-nasi*, N. Borneo.

Notes. The leaves usually drying chestnut-brown on both sides and the setulose petals are characteristic of this species. Sometimes the leaves dry a dull greenish-brown above, but the channelled midrib remains yellowish, producing a characteristic effect.

11. *Gonystylus acuminatus* AIRY SHAW, Kew Bull. 1952, 74 (1952).

Tree, 25 by ½ m. *Leaves* oblong or lanceolate-oblong, 12–20 by 3–5½ cm, cuneate at the base, gradually narrowed at the apex into a 1–1½ cm long acumen, thinly chartaceous, chestnut-brown when dry, glabrous (except occasionally here and there along the midrib below); midrib narrowly impressed above, nerves slender, widely patulous, rather dense, not very conspicuous; petiole 9–12 by 1–2 mm, sparsely puberulous. *Inflorescences* 8–13 cm long, slender, subferruginous-tomentellous, with several branchlets, these racemiform, relatively elongate, ½–3 cm long; flowers scattered, not nodose-fasciculate; pedicels 1¼–1½ cm, densely tomentellous. *Calyx* shortly cupuliform, distinctly gibbous-truncate at the base, c. 4 mm long, 6–7 mm



wide, tomentellous; segments ovate-deltoid, obtuse, strongly revolute at anthesis. *Petals* 20–25, subulate, 2 mm, glabrous, epustulate. Style glabrous. Fruit unknown.

Distr. *Malaysia*: Borneo (S. & E. Division), ?Malay Peninsula, ?Sumatra.

Ecol. Primary rain-forest at 150 m; *fl.* Nov.

Notes. Probably referable here is a sterile specimen from Kokmoi Forest Reserve, Kedah (Malay Peninsula), and less probably one from Lampong Distr. (S. Sumatra).

12. *Gonystylus confusus* AIRY SHAW, Kew Bull. 1947, 10 (1947).—*G. maingayi* auctt., *p.p.*, non HOOK. *f.*

Tree, 15–30 m by 60 cm, sometimes with pendulous branches, bark of branchlets dark brown. *Leaves* oblanceolate-oblong or rarely oblong, 9–27 by 3½–9 cm, cuneate to rounded at the base, cuspidate to shortly acuminate at apex, chartaceo-coriaceous, glabrous except for a few adpressed hairs near the midrib below, glossy in the fresh state, drying a dull purplish-brown or leaden colour (the lower side more brownish); venation slender, parallel, prominent; midrib flat or very slightly raised above, not channelled; petiole 8–17 by 1–3 mm, glabrous. *Inflorescences* terminal, occasionally apparently axillary, 6–20 cm long, simple or with up to 4 branches, these up to 13 cm, adpressed-pubescent. Pedicels up to 18 mm, densely fulvo-tomentellous. Buds globose, 5 mm diam. before anthesis. *Sepals* ovate-deltoid, 6–7 by 2½–3½ mm, ochraceo-tomentellous, subacute to subobtuse. *Petals* c. 30, subulate-filiform, 3–4 mm, glabrous, epustulate. Ovary c. 3 mm long, with 3 small subglobose pubescent ‘parastyles’ round the base of the style; style glabrous. *Fruit* subglobose, 4–10 cm diam.; pericarp 7–8 mm thick. Seeds up to 3½ cm diam.

Distr. *Malaysia*: Malay Peninsula, ?N. Sumatra (E. Atjeh).

Ecol. Evergreen non-inundated rain-forest, 90–360 m; *fl.* March–Apr. and Sept.–Nov., *fr.* May–Aug. and Dec.–Febr..

Uses. Decoction of roots given after childbirth (Pahang); *cf.* BURKILL & HANIFF, Gard. Bull. S.S. 6 (1930) 179.

Vern. *Karu-karu*, Selangor. *pinang muda*, Perak, *gēlugor tawar*, Pahang, *banitan*, *sitabai*, Sumatra.

Notes. The colour of the leaves on drying, combined with the flat or slightly raised midrib on the upper surface, distinguishes this species from all others.

13. *Gonystylus affinis* RADLK. Sitzb. Math.-Phys. Kl. Bayer. Akad. Wiss. 1886, 16 (1887) 329; BOERL. Handl. 3 (1900) 112; MERR. En. Born. (1921) 371.—*G. beccarianus* TIEGH. Ann. Sc. Nat. VII, Bot. 17 (1893) 245, *descr. anat. tantum*.

Tree, 9–24 m. Branchlets blackish. *Leaves* elliptic to almost oblong, 10–17 by 3½–8½ cm, broadly cuneate to rounded at base, shortly caudate-acuminate at apex, margin markedly revolute, chartaceous, drying various shades of dull brown

or greenish-brown, strongly shagreened especially above, glabrous above, often rather persistently tomentellous below, especially on midrib; nervation relatively lax and not very conspicuous, patulous to widely spreading; petiole 1–1½(–2) cm by 2–2½ mm. *Inflorescences* terminal, 8–12 cm long, of 1–3 main branches, each with several short side-branches, densely fulvous-tomentellous. Pedicels 8–14 mm, tomentellous. *Calyx* 5 mm long; sepals 3 mm long, deltoid-ovate, obtuse or subobtuse. *Petals* ± 20, filiform-subulate, 4–5 mm. Style glabrous. *Fruit* (?immature) up to 4½ cm long, 3–4-valved.

Distr. *Malaysia*: Malay Peninsula, Borneo (SW. Sarawak, ?W. Indonesian Borneo).

Ecol. Open rain-forest, 40–240 m; *fl.* April and Oct., *fr.* July, Oct., Dec..

Uses. Wood (reddish, floats in water) used for house-construction in Negri Sembilan (Mal. Pen.).

Vern. *Pokō batu pasir*, Negri Sembilan, *banit*, W. Indonesian Borneo.

Notes. Characterized by the brownish colour of the leaves on drying, their strongly shagreened surface, the tomentellous midrib below, the strongly tomentellous inflorescence, and the small flowers resembling those of *G. forbesii* and *G. maingayi* but with less reflexed sepals and twice as many petals.

14. *Gonystylus forbesii* GILG in ENGL. & PR. Nat. Pfl. Fam. Nachtr. 1 (1897) 232; BOERL. Handl. 3 (1900) 112; MERR. En. Born. (1921) 372; S. MOORE, J. Bot. 62, Suppl. (1924) 14; *ibid.* 63, Suppl. (1925) 90.—*G. warburgianus* GILG ex DOMKE, Bibl. Bot. 27, Heft 111 (1932) 5, 8, 33, 146, t. 4, f. 32.—*G. bancanus* [non (MIQ.) KURZ] S. MOORE, *ll.cc.*

Tree 20–40 m by 35–85 cm. Branchlets blackish. *Leaves* elliptic, often almost rhomboid, 4–10(–11½) by 2½–5 cm, base usually markedly cuneate, occasionally slightly rounded, apex mostly cuneate-acuminate or sometimes ± rounded and caudate, rather thinly chartaceous, shagreened on both surfaces, drying usually light ochraceous-brown, glabrous throughout or thinly puberulous below, especially on midrib; nerves slender, crowded, conspicuous below, much less so above, rather more steeply ascending than most *spp.* (*cf.* also *G. pendulus*), midrib narrowly channelled above, or rarely almost flat; petiole slender, 9–11 mm long. *Inflorescence* 5–15 cm long, considerably branched, shortly cinereo-ochraceo-tomentellous. Pedicels slender, 10–11 mm, tomentellous. *Calyx* shortly cupular, 4–6 mm long, 6–7 mm diam., tomentellous; sepals ovate-deltoid, 3–5 by 2–3 mm, subobtuse. *Petals* ± 10, ovate-deltoid, acuminate, 1–2 mm long, tomentellous throughout and densely retrorse-setulose within. Style glabrous. *Fruit* oblong-ellipsoid, 4 cm long, 3-valved.

Distr. *Malaysia*: Sumatra (incl. Mentawai Isl.), S. Borneo.

Ecol. Frequent in evergreen non-inundated rain-forest, on sand or clay, as scattered individuals or small groups, from sea level to 1210 m; *fl.* Sept.–Nov., *fr.* Nov. & June.

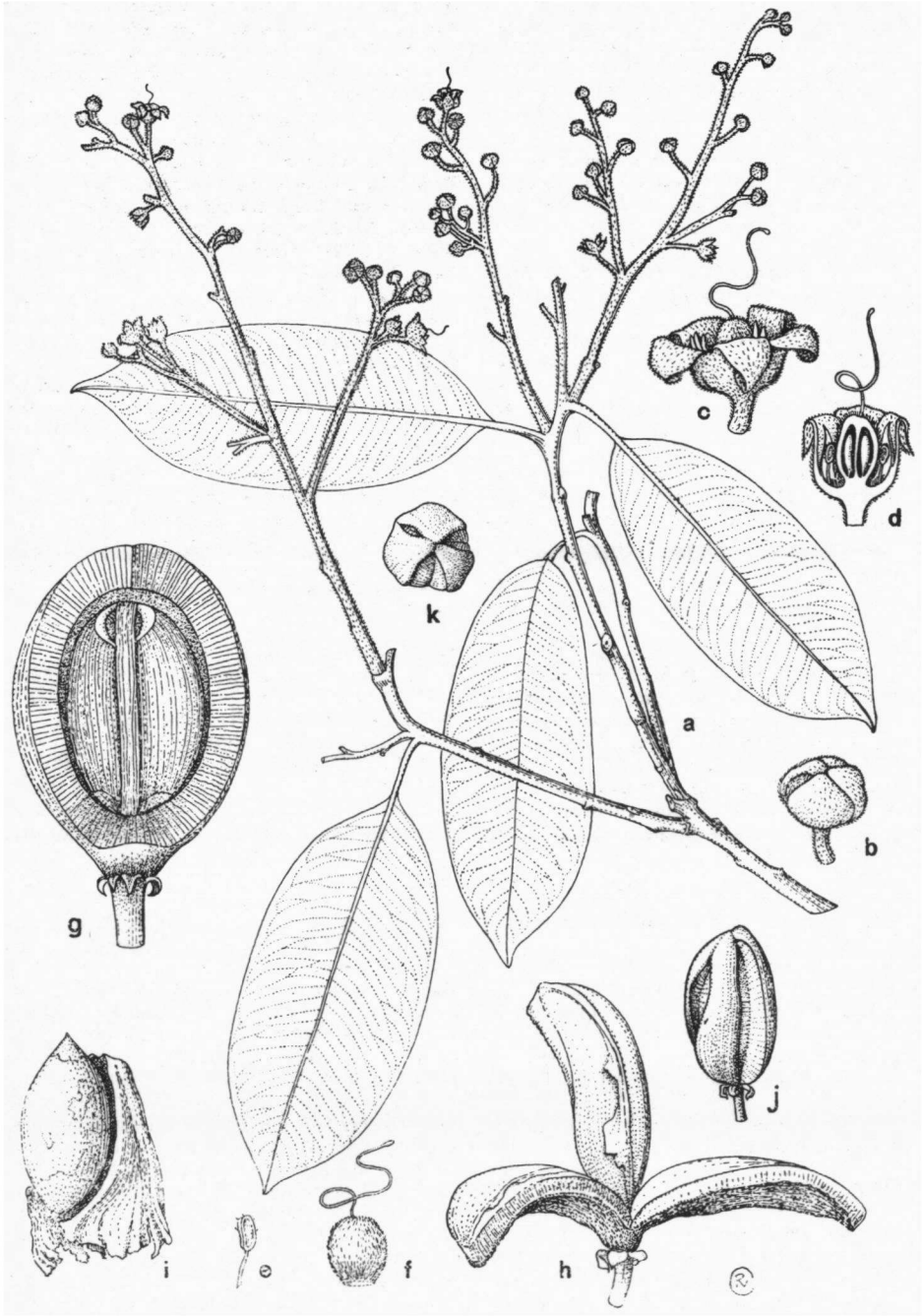


Fig. 3. *Gonystylus velutinus* AIRY SHAW. *a.* Flowering twig,  $\times 3/4$ , *b.* bud,  $\times 4$ , *c.* flower,  $\times 4$ , *d.* ditto, in section,  $\times 4$ , *e.* stamen,  $\times 7$ , *f.* gynoecium,  $\times 4$ , *g.* fruit, pericarp partly removed,  $\times 3/4$ , *h.* dry, dehiscent fruit,  $\times 3/4$ , *i.* placental tissue with seed, testa with remains of membranous aril  $\times 3/4$ , *j.* abnormal juvenile 2-valved, 1 seeded fruit,  $\times 3/4$ , *k.* juvenile 3-valved, 1-seeded fruit from top,  $\times 3/4$  (*g.* from 15 T I P 17, *h-i* from 15 T 3 P 812, others from 15 T I P 21).

Vern. *Maranti tanduk, banitan nirang, mēdang, djao-djao, kayu pisang, mēranti kambing, ? kēlat, tapih*, Sumatra, *sibutoh bulug, salio bulug, puchatutup*, Siberut, *paoh balang, bakubal, bērmiang, sērkaja, koop, mērang, dēdarah putih*, Borneo.

Notes. A rather well-marked species, owing to its small, elliptic, often almost rhomboid leaves, strongly cuneate at base and acuminate at apex, with relatively steeply ascending parallel veins and shagreened surface; and the small flowers with c. 10 petals, which are both tomentellous and setulose.

15. *Gonystylus velutinus* AIRY SHAW, Kew Bull. 1950, 140 (1950).—*G. bancanus* [non (MIQ.) KURZ] HALLIER f. Med. Rijksherb. no 44 (1922) 14–15, *quoad specim. Expos. Paris no 17 et VAN ROSSUM no 33 tantum*.—Fig. 3.

Tree, 23–35 m by 40–70 cm. Branchlets dark brown, densely fulvo-velutinous when young, ultimately ± glabrescent. *Leaves* elliptic, oblong-elliptic or lanceolate-elliptic, 8–11(–13) by 3½–5 cm, base cuneate to subrotundate, apex shortly and narrowly cuspidate-acuminate, glabrous, evidently shagreened and distinctly glossy above, usually more or less pubescent below, but sometimes only minutely so, densely fulvo-velutinous in the young state, chartaceo-coriaceous, obscurely brown or ochraceous when dry; nerves very slender, crowded, parallel, ± prominent on both surfaces; petiole 7–11 by 1–2 mm, densely velutinous. *Inflorescences* terminal and axillary, 7–12 cm long, densely velvotomentellous, sparsely branched. *Flowers* small, c. ½ cm diam. when expanded; pedicels 8–10 mm, tomentellous. *Calyx*-tube depressed-globose, 3 mm diam., rugulose; segments deltoid, c. 3 mm long, acute, strongly revolute at anthesis. *Petals* 7–8, deltoid, acute, 2 mm long, incurved. *Style* glabrous. *Capsule* lanceolate-oblong, 3½–5½ cm long, very woody; valves 3 (rarely 2), 1¼–2½ cm wide, ½ cm thick. *Seeds* 2½–3 cm long.

Distr. *Malaysia*: Sumatra, Banka, Billiton; probably also Borneo.

Ecol. Locally rather common, as isolated trees, in primary rain-forest at very low altitudes, mostly on non-inundated sandy soil, but also noted on clayey swampy ground by creeks, etc., subject to annual inundation; fl. Aug.–Oct. fr. Dec.–Jan.

Uses. Timber for planks and house construction in Sarawak, if this species. Sap said to be irritant.

Vern. *Kayu minyak, ulu tupai, bitis*, Sumatra, *durin bēlan, mēnamang*, Banka, *malam*, Billiton; also *lēmpong, tēbakau puteh, bēsuluh, babingkal, ramin*, Borneo, if this species.

Notes. Distinguished from *G. maingayi*, of which it might be regarded as a race, by the strongly velutinous indumentum of the young parts, and especially of the inflorescence.

16. *Gonystylus maingayi* Hook. f. Fl. Br. Ind. 5 (1886) 200; GRESHOFF, Nutt. Ind. Pl. (1897) 171, *in obs.*; RIDL. J. R. As. Soc. Str. Br. no 35 (1901) 85, p.p.; J. As. Soc. Beng. 75 (1912) 266, p.p.; Fl.

Mal. Pen. 1 (1923) 322, p.p.; AIRY SHAW, Kew Bull. 1947, 12 (1947), p.p., *quoad specim. e Malacca, Negri Sembilan et Singapore tantum*.

Tree, up to 27 m. Branchlets blackish, thinly ochraceo-puberulous when young, soon glabrescent. *Leaves* small, very regular in shape and size, elliptic-oblong, 7–12 by 2½–4¼ cm (up to 17 by 6 cm in Sumatra), cuneate to rounded at base, narrowed and acuminate at apex (rarely more abruptly cuspidate), chartaceous, strongly shagreened especially above (Sumatran form much less so), glabrous (finely puberulous below when young), midrib thinly puberulous below; nervation close and reticulate, rather widely spreading, conspicuous below, midrib rather deeply channelled above; petiole relatively long and slender, 8–15 by 1–2 mm, ochraceo-tomentellous when young, puberulous later. *Inflorescences* terminal, up to 14 cm long, rather copiously produced, with numerous short branches, densely tomentellous. *Pedicels* slender, 8–10 mm. *Calyx* 4–5 mm long, 5–7 mm diam., densely tomentellous; sepals deltoid, 2–3 mm long, apex subacute to subobtusate, revolute at anthesis. *Petals* 10–12, triangular-subulate to ovate-acuminate, 2–2½ by up to 1 mm, glabrous, epustulate. *Style* glabrous. *Fruit* 3–4 cm long.

Distr. *Malaysia*: Malay Peninsula, Sumatra (Palembang).

Ecol. Primary rain-forest up to 150 m; fl. Oct.–Nov., fr. Apr.

Vern. *Mērawan pēnak*, Negri Sembilan, *sēpa petri*, Malacca, *bēmban-itam*, Sumatra.

Notes. Differs from *G. forbesii* in the shape, and from *G. velutinus* in the scanty or absent pubescence, of the leaves. Leaves very similar to *G. pendulus* in size and shape, but lateral nerves of *maingayi* more widely spreading and flowers quite different. The Sumatran form differs somewhat from that of the Malay Peninsula, the leaves being much less strongly shagreened.

17. *Gonystylus pendulus* AIRY SHAW, Kew Bull. 1950, 141 (1950).

Small tree, 10½ m by 12½ cm, with elongate pendulous branches, bark of twigs dark brown. *Leaves* small, oblong-elliptic or almost oblong, 9–11 by 3–4 cm, rounded-cuneate at the base, shortly caudate at apex, chartaceo-coriaceous, glabrous above, very shortly adpressed-pubescent below (subsericeous when young), yellowish-grey and narrowly ochraceous-margined above, and ochraceous-brown below, when dry, almost epunctate, nervation rather distinct, close, reticulate and steeply ascending; petiole rather stout, 8–10 by 2–3 mm, pubescent. *Inflorescences* small and few-flowered, 2–3 cm long, almost simple, finely adpressed-pubescent or subsericeous. *Pedicels* elongate, 1–2 cm, sericeous. *Flowers* rather large, cream-coloured, slightly rose-tinged when dry. *Calyx* campanulate, 8 by 10 mm, shortly adpressed-sericeous externally, divided beyond the middle; segments narrowly or broadly ovate, 6 by 2½–4¼ mm, obtuse. *Petals* c. 30, narrowly subulate, subterete below, somewhat flattened and sulcate



Fig. 4. *Gonystylus bancanus* (MIQ.) KURZ. a. Twig,  $\times \frac{2}{3}$ , b. flower,  $\times 4$ , c. flower in section,  $\times 4$ , d. gynoecium,  $\times 6$ , e. stamens,  $\times 6$ , f. young fruit,  $\times \frac{2}{3}$ , g. ripe fruit with 3 seeds,  $\times \frac{2}{3}$ , h. seed,  $\times \frac{2}{3}$ . (a GRASHOFF 766, b-c ENDERT 281, f-h bb 5317).

above, c. 5 mm long, glabrous, epustulate. Style more or less setose below. Fruit unknown.

Distr. *Malaysia*: Borneo (SW. Sarawak).

Ecol. Evergreen rain-forest at 360 m; fl. Sept.

Notes. Distinguished from the other small-leaved species by the relatively large flowers with numerous petals.

**18. *Gonystylus micranthus* AIRY SHAW, Kew Bull. 1950, 142 (1950).**

Tree 18 by 0.6 m. Branches fuscous, glabrous; innovations shortly softly ochraceo-tomentellous. *Leaves* elliptic-oblong, 6½–15 by 3–6 cm, base mostly rounded, apex abruptly caudate (*cauda* 6–12 mm long), chartaceo-coriaceous, with a conspicuous narrow thickened margin below, drying a purplish-lead colour, especially beneath, dull but not shagreened above, sparsely puberulous especially on the midrib below; lateral nerves numerous, conspicuous and rather crowded; petiole 8–10 by 2–3 mm. *Inflorescences* little branched, up to 10 cm long, softly shortly ochraceo-pubescent. Pedicels up to 6 mm, densely tomentellous. *Flowers* the smallest known in the genus, 4–5 mm diam. (possibly not quite mature), globose. *Sepals* ovate-deltoid, 3 by 1½–2¼ mm, subacute, finely puberulous outside, densely silky within. *Petals* about 10, subulate, 2–3 mm, apparently with a few pustules towards the apex. Style 3–4 mm. Fruit unknown.

Distr. *Malaysia*: Borneo (Sarawak).

Ecol. Unknown; fl. Feb.

Uses. Timber for planks.

Vern. *Ramin hitam*.

Notes. Distinguished from all other species by its very small flowers, and from all except *G. calophyllus* and *G. confusus* by the purplish-lead colour of the leaves on drying. Further collections are very desirable.

**19. *Gonystylus bancanus* (MIQ.) KURZ, Nat. Tijds. N.I. 27 (1864) 171, 240; BAILL. Hist. Pl. 6 (1877) 123, in *adnot.*; GILG in ENGL. & PR. Nat. Pfl. Fam. Nachtr. 1 (1897) 232; HEYNE, Nutt. Pl. Ned. Ind. 3 (1917) 183, *pro majore parte*; AIRY SHAW, Kew Bull. 1947, 9 (1947), in *adnot.*; *auctt. cet. plerisque exclusis.*—*Aquilaria? bancana* MIQ. Fl. Ind. Bat. Suppl. (1861) 355.—*Gonystylus miquelianus* TEYSM. & BINNEND. Bot. Zeit. 20 (1862) 265, *pro minore parte, quoad pl. Banc. tantum.*—? *G. hackenbergii* DIELS, Bot. Jahrb. 60 (1926) 310, *e descr.*—Fig. 4.**

Tree, 18–42 m by 30–120 cm, with many knee-roots (pneumatophores). Branchlets blackish-grey, much branched and 'twiggy'. *Leaves* elliptic, short-

ly oblong-oblancoate or obovate, 4–14½ by 2–7 cm, base broadly cuneate to rounded, apex rounded and shortly acuminate-cuspidate, firmly coriaceous, often conduplicate, margins somewhat undulate and markedly reflexed, quite glabrous, mostly drying a characteristic dull purplish ('plum') colour below and ± chestnut or ochraceous above, appearing rather smooth, but under a lens minutely shagreened; midrib narrowly and deeply channelled above; nervation less conspicuous than in most species, moderately close above, rather lax and not sharply prominent below; petiole 8–18 by 1–2 mm, glabrous. *Inflorescences* (apparently rarely produced) subsimple, up to 9 cm long, minutely adpressedly ochraceo-puberulous. Pedicels up to 1½ cm, puberulous. *Calyx* shortly cupular, 5 mm long, 5–6 mm wide; sepals deltoid, 2–3 mm long, subacute. *Petals* 13–20, narrow-lanceolate, acuminate, 3 mm long, glabrous, epustulate. Style rather robust, much contorted, glabrous; stigma rather large, capitate. *Fruit* subglobose, 3-valved, valves orbicular-ovate, up to 4 cm long by 3½ cm wide, 3 mm thick, minutely roughened but not rugose. Seeds flattened-ovoid, 28 by 22 by 6 mm.

Distr. *Malaysia*: SW. Malay Peninsula, SE. Sumatra, Banka, Borneo.

Ecol. Lowland freshwater coastal swamps ('peat forests') (? on sandy soil), mostly subject to periodic inundation, but also in non-inundated areas, up to 100 m, sometimes forming pure stands (e.g. Rejang delta, Sarawak); occasionally in inland swamps (Selangor); fl. Feb.–March (buds also noted in May and Oct.), fr. May–June.

Uses. Timber, for planks, barrels, boxes, etc.; cf. THOMAS, Mal. For. 12 (1949) 206. Heartwood used for incense; cf. HEYNE, l.c. Inner bark contains numerous fine, brittle fibres, which break off and irritate the skin.

Vern. *Mélawis, mampis, nyoreh, sēpah petri, suasam* (Chinese), *langging*, Mal. Pen., *gérong-gang, kaju minjak, pulau mijang, sētalam, lapis kulit, matakeli, géharu buaja*, Sumatra, *balun* or *balang kulit*, Riouw, *kaju bulu, garu anteru, mēnameng, nameng*, Banka, *mēntailang, tutong, ramin*, Brunei, *ramin*, Sarawak, *garu buaja, djung-kang adung, mēdang kēran, s(i)riangun, mēnjan*, W. Borneo, *mērang*, S. & E. Borneo.

Notes. A well-marked species, both morphologically and ecologically. The small, rigidly coriaceous leaves, often folded together along the midrib, with much less conspicuous nerves than most species, and usually drying purplish-brown below, are very characteristic. The freshwater swamp habitat appears to be almost unique in the genus.

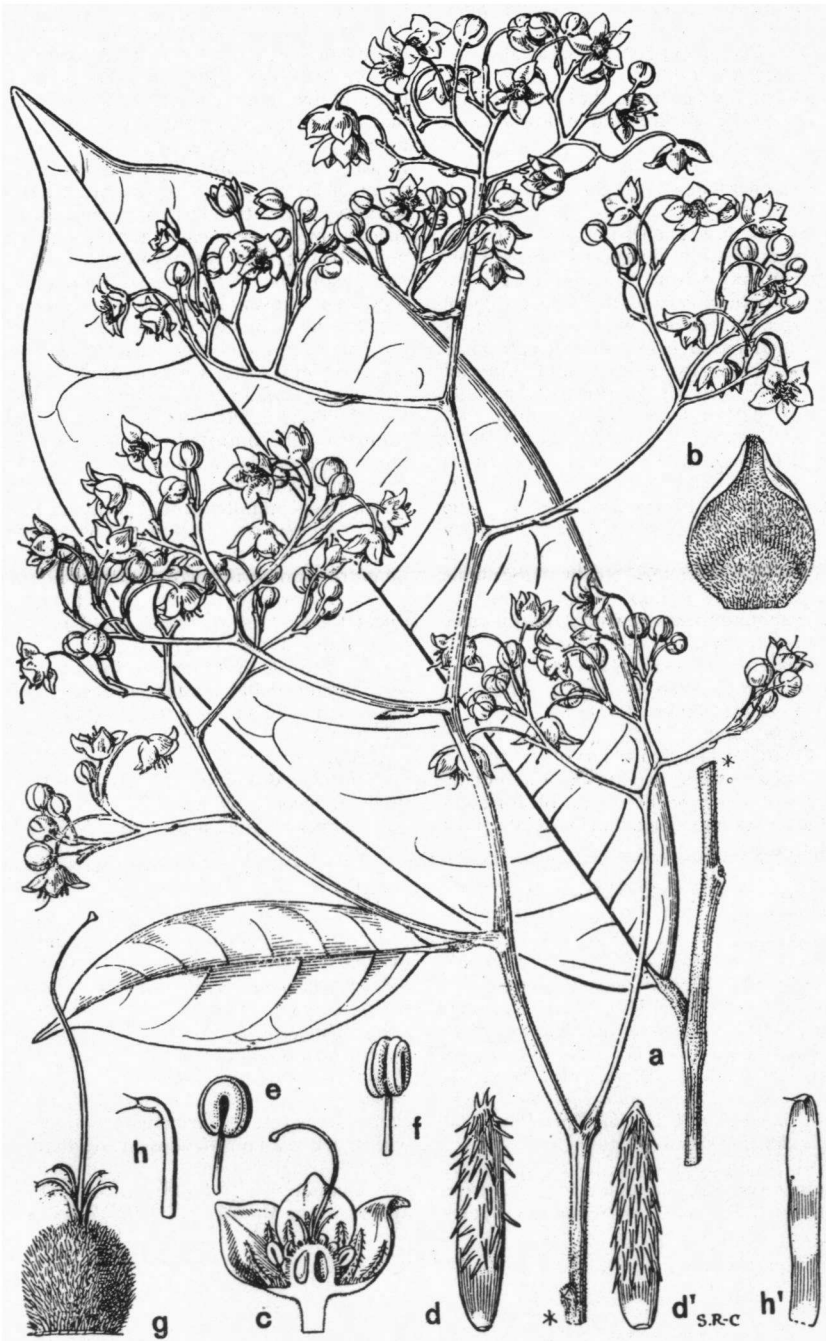


Fig. 5. *Amyxa pluricornis* (RADLK.) DOMKE. a. Flowering branch, with leaf, nat. size, b. sepal, outer surface,  $\times 6$ , c. flower, longitudinal section,  $\times 4$ , d, d'. petals,  $\times 18$ , e, f. stamens from bud, in two views,  $\times 8$ , g. gynoecium, showing parastyles,  $\times 8$ , h, h'. parastyles,  $\times 18$  (a-h, from HAVILAND 494, d' and h' from RICHARDS 1604). By courtesy of the Bentham-Moxon Trustees.

## 2. AMYXA

TIEGH. (Ann. Sc. Nat. VII, Bot., 17, 1893, 248, *descr. anat. tantum*) ex DOMKE, *Bibl. Bot.* 27, Heft 111 (1934) 116 *et passim*, map 1; AIRY SHAW, *Kew Bull.* 1940, 261 (1940); *ibid.* 1950, 146 (1950).—Fig. 5.

Medium-sized trees. *Leaves* alternate, petiolate, elliptic, acuminate, entire. *Flowers* small, in axillary and terminal, slender, copiously and widely branched thyrses. Bracts subtending main branches of inflorescence often carried up the branch for a short distance. Bracteoles 0. Pedicels articulate at base. *Calyx* widely cupular, segments 5, ovate-deltoid, imbricate. *Petals* 10, in pairs alternating with the calyx-segments, narrowly oblong, setulose. Stamens 10, alternating with the petals; filaments very short; anthers hippocrepiform. Ovary 3–4-locular, cells with 1 ovule. Style elongate, filiform, contorted; stigma capitate; 'parastyles' 3–6, short, corniform, erect-divaricate. *Fruit* a 2-seeded, thin-walled, velutinous, indehiscent (?), shortly stipitate, long-beaked capsule. Seed large, testa thinly coriaceous, smooth, funicle thickened but not expanded into an aril.

Distr. Monotypic, *Malaysia*: W. Borneo.

Notes. The genus is quite distinct from *Gonystylus* in its lax venation, diffuse inflorescence, paired petals, 'parastyles' and curious fruit.

1. *Amyxa pluricornis* (RADLK.) DOMKE, *l.c.* 117 *et passim*, t. 1, f. 4, t. 4, f. 35, t. 5, f. 38g; AIRY SHAW, *l.c.*; in *Hook. Ic. Pl.* 35 (1947) t. 3475; *Kew Bull.* 1950, 146, 144, f. 2 (1950).—*Gonystylus pluricornis* RADLK. in *Sitzber. Math.-Phys. Kl. Bayer. Akad. Wiss.* 1886, 16 (1887) 329; HALLIER *f. Med. Rijks-herb.* 44 (1922) 15; ERDTMAN, *Svensk Bot. Tidskr.* 40 (1946) 81.—*Amyxa kutcinensis* TIEGH. *Ann. Sc. Nat. VII, Bot.* 17 (1893) 248, *descr. anat. tantum*.—*A. taeniocera* AIRY SHAW, *Kew Bull.* 1950, 146 (1950).—Fig. 5.

Tree, 6–18 by 0.3 m; branchlets slender, dark brown, densely fulvo-tomentellous when very young, later minutely tomentellous or glabrescent. *Leaves* elliptic to elliptic-oblong, rarely slightly oblanceolate, 6–16½ by 2–6 cm, cuneate to almost rounded at the base, shortly caudate-acuminate at apex, thinly chartaceous, minutely shagreened and densely and minutely impressed-punctate above, almost smooth below, drying various shades of light brown, from reddish to olivaceous, glabrous above and below, or very sparsely puberulous below when young, midrib slender, narrowly impressed above, prominent and shortly puberulous below; primary lateral nerves 5–11 pairs, very slender, lax, patulous; petiole slender, 8–15 mm, densely fulvo-puberulous or tomentellous. Inflorescence up to 27 cm long, often unbranched in lower portion, much branched above, densely ochraceo-tomentellous or shortly adpressed-sericeous, branches spreading almost at right angles, up to 8 cm long, each subtended by an almost linear tomentellous bract (up to 7 mm long) which is sometimes carried as much as 1½ cm up the branch, ultimate branchlets loosely subfasciculate. Pedicels slender, 5–10 mm, shortly subsericeous. *Calyx* shortly and openly cupular, 5–7 mm diam., externally sericeous, glabrous within but setulose at the base; segments ovate, rounded to subacute, ± reflexed at apex. *Petals* 2–3 mm long, strongly re-

trorse-setulose, *setae* adpressed, sometimes spreading at apex. Stamens 2 mm long. Ovary 2 mm diam., densely setulose. Style 5–6 mm, glabrous or very sparingly pilose below. 'Parastyles' 1–2 mm long, glabrous or very sparingly pilose above. *Fruit* prismatic-trigonous or tetragonous when young, ellipsoid-oblong when mature (?), with a long cylindrical beak, 5¾–6¾ cm long (including 2–2½ cm long beak), 1–2 cm thick, shortly stipitate, densely shortly brown-velvety, traversed by the 3–4 elevate sutures; calyx persistent. *Seeds* large, oblong-ellipsoid, 3 by 1½ by 1 cm, ± planoconvex, testa thin, but firm and tough, very smooth and glossy, dark brown; funicle thickened, 36 by 3 mm, trigonous, enlarged into a conical appendage 6 mm long at base of seed; embryo about 23 by 11 by 9 mm; cotyledons thick and fleshy, with numerous oil-dots; radicle conical, blunt; plumule not detected.

Distr. *Malaysia*: Borneo (W. Indonesian Borneo, SW. & Central Sarawak).

Ecol. Primary non-inundated rain-forest at low or medium altitudes; *fl.* April, May, July, Sept.; *fr.* July.

Uses. Wood used for planks (SW. Sarawak).

Vern. *Sengabei*, W. Indonesian Borneo, *ramin batu*, *ramin bukit*, *soma merah*, Sarawak.

Notes. The above record from W. Indonesian Borneo rests on a sterile specimen (bb. 17136) from G. Belungei; the generic attribution is beyond doubt, but the species should be checked in due course from more complete material.

*A. taeniocera* A.S. must be reduced to synonymy; the supposed differences from *A. pluricornis* break down upon examination of further material, though the range of indumentum is striking.

The foliage of *Amyxa* is somewhat reminiscent of *Erycibe* spp. (*Convolvulaceae*), in the dried state. The sericeous indumentum of the inflorescence also suggests that of certain *Convolvulaceae*.



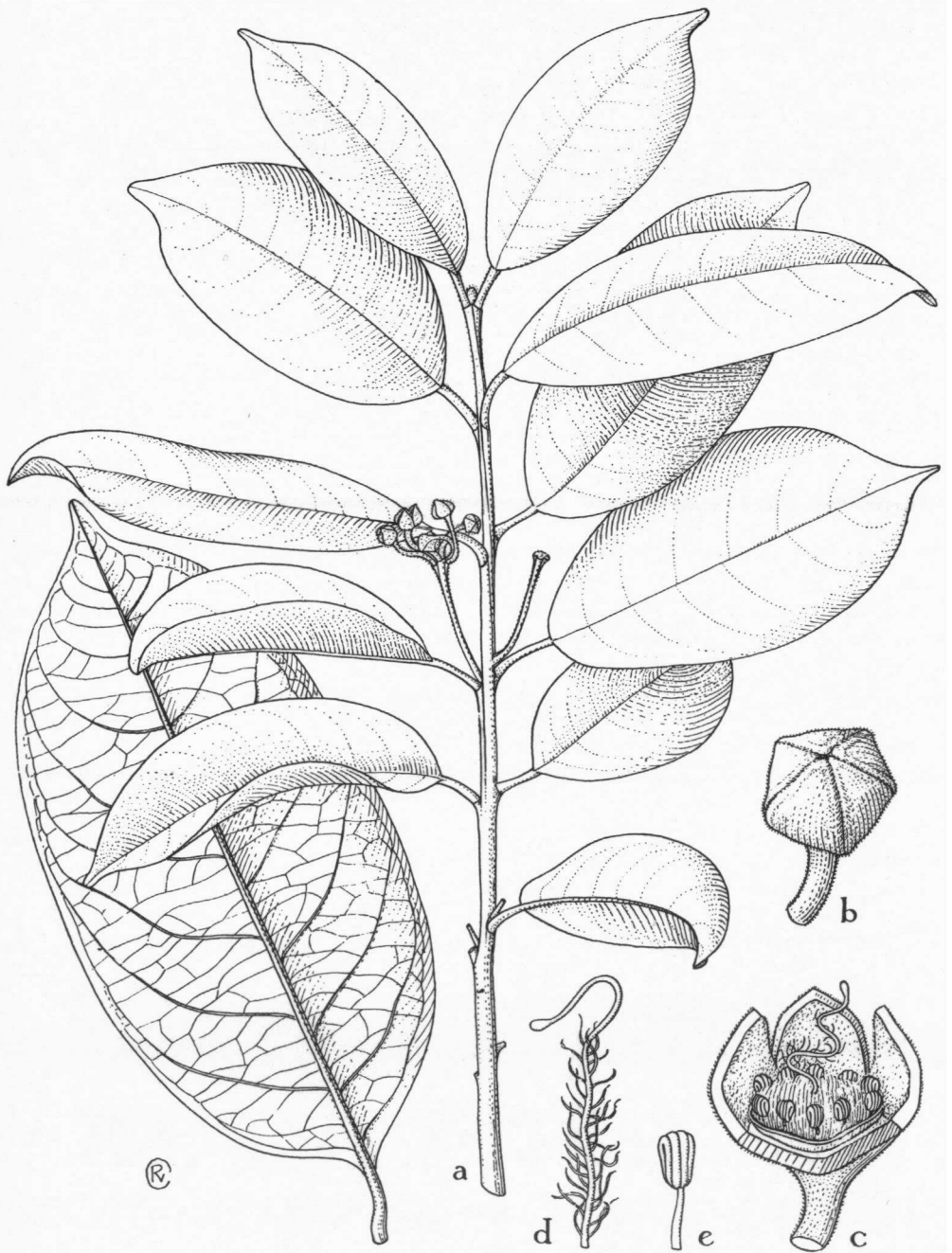


Fig. 6. *Aëtoxylon sympetalum* (STEEN. & DOMKE) AIRY SHAW. a. flowering twig,  $\times 4/5$ , b. bud,  $\times 7$ , c. young flower, two sepals removed,  $\times 7$ , d. style,  $\times 16$ , e. stamen,  $\times 16$  (after bb. 17222, loose leaf after bb. 16646).



## 3. AËTOXYLON

AIRY SHAW, Kew Bull. 1950, 145 (1950).—*Gonystylus sect. Aëtoxyton* AIRY SHAW, Kew Bull. 1947, 10 (1947).—Fig. 6.

Medium-sized tree. *Leaves* opposite or subopposite, coriaceous, glabrous. *Inflorescence* an axillary, peduncled, false-umbel. Bracts 0? *Flowers* long-pedicelled. *Calyx* cupular, divided to about half-way; segments valvate, slightly reduplicate, equal, setulose within. *Corolla* represented by a low, entire, slightly fleshy annulus. *Stamens* 10–15; filaments very short and slender; anthers hippocrepiform. *Ovary* sessile, ovoid, 3–5-locular, densely setulose. *Style* elongate, filiform, wiry, contorted, pilose; stigma capitate. *Fruit* a 1-seeded, rather thin-walled, velutinous, indehiscent, subglobose capsule. Seed large; testa coriaceous, roughened; funicle and aril not seen.

Distr. Monotypic, *Malaysia*: Borneo.

Notes. The opposite or subopposite leaves (and branching), curious venation, pseudo-umbellate inflorescence, reduplicate-valvate calyx-segments, and annuliform corolla, separate this genus sharply from *Gonystylus*. The fruit also appears to be of a basically different type.

1. *Aëtoxyton sympetalum* (STEEN. & DOMKE) AIRY SHAW, Kew Bull. 1950, 145, tt. 5 & 6 (1950).—*Gonystylus sympetala* STEEN. & DOMKE, Notizbl. Bot. Gart. Berlin 12 (1934) 233; DOMKE, Bibl. Bot. 27, Heft 111 (1934) 7, 33, 145, t. 1, f. 3; AIRY SHAW, Kew Bull. 1947, 10 (1947).—Fig. 6.

Tree, 18–35 by  $1\frac{1}{4}$ – $3\frac{1}{4}$  m. Bark containing scanty white sap. Branchlets robust, dark brown or blackish, innovations very shortly ochraceo-tomentellous. *Leaves* obovate, less frequently elliptic-oblong, base rounded to very broadly cuneate, apex rounded and shortly obtusely cuspidate, 5–10(–12) by  $2\frac{1}{2}$ – $5\frac{1}{2}$  cm, firmly coriaceous, very glossy when living, rather dull when dry, but smooth, and punctulate-shagreened above, glabrous, drying ochraceous-brown, margin flat or almost so; midrib rather slender, narrowly impressed above; nervation inconspicuous or quite obscure above, lax and often rather indistinct below, not sharply raised from the mesophyll but sloping gradually into it, as though smoothed off, spreading widely from the midrib but curving strongly forwards and freely anastomosing; the general effect suggesting species of *Ficus* § *Sycidium*, or of *Stemonurus* (*Icacinaeae*), e.g. *S. scorpioides* BECC.; petiole 6–10 by 1– $2\frac{1}{2}$  mm, shortly tomentellous when young. *Peduncles* patulous, patent or even deflexed, straight, 8–30 mm, grooved, tomentellous, gradually expanded upwards, suddenly enlarged at the apex into a nodose-discoid structure 2–3 mm in diam. (rarely itself very shortly branched) bearing the flowers. False umbel 5–6-flowered. *Pedicels* 8–10 mm long, tomentellous. *Flowers* cupular, globose-pentagonal in bud, 4–5 mm in diam., tomentellous.

*Calyx* divided about half-way, densely setulose within; segments deltoid, acute, margins slightly reduplicate. Corolline annulus barely 1 mm high, glabrous. Filaments 1 mm long; anthers about 0.8 mm long. *Ovary* ovoid,  $1\frac{1}{2}$  mm long, narrowed upwards, densely setulose; style about 3 mm long, long-pilose in lower part; stigma clavate-capitate. *Fruit* (immature) irregularly subglobose, substipitate, up to 3 by 2 by 1 cm, shallowly tricostate, verruculose, very shortly brown-velutinous; pericarp 2 mm thick, with copious resin-canals; pedicel  $1\frac{1}{2}$  cm long; calyx persistent, not enlarged. Seed ellipsoid, 23 by 15 by 13 mm; embryo unknown.

Distr. *Malaysia*: Borneo (W. Indonesian Borneo, SW. Sarawak).

Ecol. Low, level, sandy ground, in primary non-inundated rain-forest, up to 100 m, locally rather common; fl. Dec., fr. March.

Uses. Oil (*minjak garu-laka*) obtained from heartwood for incense; cf. VAN STEENIS & DOMKE, l.c..

Vern. *Kayu bidaroh, kayu laka, garu laka, garu buaja, mēlabajan*, Indon. Borneo, *ramin batu*, Sarawak.

Notes. The general resemblance of the vegetative parts to *Stemonurus* is striking; this genus is also characterized by umbellately arranged inflorescence branches. The inflorescence of *Aëtoxyton* appears to represent an extreme simplification and condensation from the *Gonystylus* type. The corolline annulus is somewhat fleshy, rather than membranous as stated by DOMKE. Ripe fruiting material of this tree is very desirable, as the interior of the only fruit examined was damaged and it was not possible to interpret the contents of the seed.