

A TAXONOMIC REVISION OF THE GENUS IXONANTHES (LINACEAE)

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SUMMARY

In this revision 3 species are recognized for the Southeast Asian, mainly Malesian, genus *Ixonanthes* Jack (Linaceae). No new species are described, while 29 names have been placed into synonymy. It is proposed to unite the African genus *Phyllocosmus* Klotzsch with the American genus *Ochihocosmus* Benth.

INTRODUCTION

The genus *Ixonanthes* was described in 1822 by William Jack and was based on two species from Sumatra: *I. reticulata* Jack from Tappanuly on the West Coast and *I. icosandra* Jack from Bencoolen. The name refers clearly to the sticky (resin!) flowers (*ixos* — birdlime, *anthos* — flower). Often (especially in older literature) one sees the orthographic variant *Ixonanthes*. As far as I know this was first used by Endlicher (1840). Although more authors adopted this way of spelling, it has never become a persistent source of error and it has disappeared in the more recent literature.

Hooker and Arnott (1837) described *Emmenanthes* based on *E. chinensis* Hook. & Arn., which is a synonym of *I. reticulata*. M. J. Roemer (1846) separated *I. icosandra* from the genus and called it *Brewstera crenata* M. J. Roemer (which is a superfluous epithet), because of differences with *I. reticulata* in the leafmargin and length of the petiole ('*Folia brevi petiolata, dentato-crenata*'). Because of this *I. reticulata* may be considered to be the lecto-typespecies of *Ixonanthes*. Blume (1850) described *Pierotia*, which he put into the synonymy of *Ixonanthes* two years later. He described two new species, viz. *P. reticulata* and *P. lucida*, identical with *I. petiolaris* and *I. icosandra*, respectively.

The last comprehensive treatment of *Ixonanthes* (and other Linaceae) was given by Hallier f. (1923), who split *Ixonanthes* into two sections: *Brewstera* and *Emmenanthes* (correct name: sect. *Ixonanthes*, Art. 22.1). Section *Brewstera* is monotypic with *I. icosandra* and in section *Emmenanthes* he described six species, of which two were new. In the present treatment this opinion has been followed, but in sect. *Emmenanthes* only two species could be recognized, viz. *I. petiolaris* and *I. reticulata*.

MORPHOLOGY

The leaf blades of *I. reticulata* show a great variability in their shape and consistence, corresponding with the geographical distribution of the species.

Typical for N. Borneo are the thick, coriaceous, obovate, often emarginate leaves. However, plants with 'normal' elliptic blades occur in the same area, sometimes on the same specimen. In China and Indo-China we only find leaves which are thin and elliptic-oblong (often acute). In the rest of the Malesian area *I. reticulata* occurs with more or less elliptic blades, which hardly differ from those of *I. petiolaris*.

The leaf of *I. icosandra* shows sessile marginal glands; these are supplied by veins of the second order. They originate very early from epidermal cells and are functional before the beginning of the lamina development. The glands have been considered as nectaries (Belin-Depoux, 1978).

The primary axes in the inflorescence of *I. icosandra* are conspicuously \pm 4-whorled. It is evidently a condensation of the first dichotomous axes as present in the other species and does not provide fundamental difference with them.

A striking feature of the fruit of the subfamily *Ixonanthoideae* (see next chapter) is the incomplete false septum on the middle of each carpel. These septa reach almost to the placenta in the center of the fruit in *Ixonanthes*. It is less developed in *Ochthocosmus s.s.* and in some species of '*Phyllocosmus*' it is merely a thickened ridge. The ovules appear to be inserted on the central axis, actually they are solitary and marginal on the carpels. The fruit is a deeply septicidal and completely septifragal capsule; the false septa do not split and there is no central column.

The arillode on the seed of *I. icosandra* is attached between the micropyle and the hilum (terminology according to van der Pijl, 1969). In young stages this arillode



Fig. 1. Seeds. — a. *Ochthocosmus roraimae*, $\times 6$ (Ducke 23421). — b. *Ochthocosmus congolensis*, $\times 6$ (Compère 1292). — c. *Ixonanthes icosandra*, $\times 6$ (KEP FRI 97905). — d. *Ixonanthes petiolaris*, $\times 6$ (Smythies 13300).

consists of three long appendages, one pointing upwards, the other two downwards, and are much longer than the ovules. In mature seeds it is swollen, laterally and adaxillary attached to the seed without clasping it, and about as long as that. The tripartition is then much more difficult to recognize. The genera *Ochthocosmus* s.s. and '*Phyllocosmus*' are supposedly distinct by having a wing or an arillode, respectively. These structures are homologous with the arillode of *I. icosandra* as they emerge from the same area (but they are not lobed) and the tissue is more or less of the same consistency: thin, membranous to fleshy, and differing in colour from the testa. In *Ochthocosmus* s.s. the arillode points upwards in fruit ('wing') and in '*Phyllocosmus*' it is turned down, clasping the upper part of the seed (arillode). The wings of *I. reticulata* and *I. petiolaris*, however, are certainly not homologous with the arillodes of *I. icosandra* and *Ochthocosmus* s.l., for they develop from the chalazal part at the base of the ovule, below the hilum and not above it; they include the vascular bundle and do not have the difference in consistency as seen in the arillode of the other taxa: they are thicker and have the same colour as the rest of the testa. In these species there is no trace of any outgrowth above the hilum. The wing here is obviously of a quite different origin as the wing of *Ochthocosmus* s.s. (Fig. 1) For the taxonomic implications see the next chapter.

TAXONOMY

Ixonanthes has been considered by some recent authors (Forman, 1965; Airy Shaw, 1973; Hutchinson, ed. 3, 1973) to belong to a family distinct from the Linaceae, the *Ixonanthaceae*. Other genera included are: *Allantospermum* Forman, *Cyrillopsis* Kuhlm., *Ochthocosmus* Benth., and *Phyllocosmus* Klotzsch. It was beyond the scope of this revision to study the taxonomy on the level of family or subfamily, but some remarks may be made as far as the *Ixonanthoideae* are concerned, here regarded in the classical sense as a subfamily of the Linaceae.

Allantospermum appears out of place here, as has been demonstrated by Nooteboom (1967), because of the differences of the fruit (persistent columella and no false septa), a true aril which originates from the placenta, the intra-petiolar stipules, the wood-anatomy, and the phenolic constituents of the dry leaves. He included it together with *Irvingiaceae* in *Simaroubaceae*.

Cyrillopsis, a little known genus from the Amazonian area, must apparently be retained in *Ixonanthoideae* because of the microscopic, fugacious lateral stipules, the floral characters (persistent imbricate petals and filaments), and the phenolic constituents of the dry leaves (Nooteboom, 1967); and also because of the presence of an abaxial, flat, triangular arillode covering the upper part of the seed (no ripe fruit seen) and the anatomic characters of wood and leaves (Forman, 1965). *Cyrillopsis* is distinct from the other genera by the presence of small bracts both below and on the lower half of the articulated (!) pedicel and the 2-locular ovary.

Forman (1965) has enumerated a number of characters by which *Ochthocosmus* s.s. would differ from *Phyllocosmus*. The most important of these is the absence or presence of either a wing or an aril. The homology of these has been pointed out in the previous chapter. The other characters mentioned seem of little value or are erroneously interpreted. I have been unable to see the supposed difference in the nervature of the leaves. The number of stamens is stated to be 5 in *Phyllocosmus* and 5 or 10 in *Ochthocosmus* s.s., but as already pointed out by Hallier f. (1923)

Phyllocosmus has either 5 (*Ochthocosmus* sect. *Phyllocosmus*) or 10 (*Ochthocosmus* sect. *Decastemon*) stamens and *Ochthocosmus* s.s. (*Ochthocosmus* sect. *Euochthocosmus*) has 5 stamens. Forman seems to have inadvertently interchanged his figures. The capsules of *Phyllocosmus* are supposedly globose, actually they are somewhat elongate and only relatively somewhat broader than those found in *Ochthocosmus*. They do not differ in structural features, therefore such a shape can hardly be considered of any value on a generic level (at most it is a specific character, or one to show the affinity between species). I was not able to find either in the herbarium or in field-notes a difference in the capsule-wall, which Forman said is fleshy in *Phyllocosmus* and dry in *Ochthocosmus*.

Another reason why *Phyllocosmus* and *Ochthocosmus* have been regarded as distinct is no doubt the fact that the first is an African genus and the other an American one. Some characters unite the taxa of the respective areas, as could be expected, but as shown above none is of any value at the generic level. It must therefore be concluded that they should be merged into *Ochthocosmus* as was already proposed by Hallier f. (1923), who, as is seen above, distinguished three sections. The characters on which he based this are summarized in tab. I.

Tab. I: Main characters of the sections of *Ochthocosmus* s.l. (Hallier f., 1923)

	<i>Euochthocosmus</i>	<i>Decastemon</i>	<i>Phyllocosmus</i>
pedicel	present	absent	present
petals in fruit	not indurated, not appressed	indurated or not appressed	indurated and appressed
stamens	5, included	10, exserted	5, usually exserted
style	included	exserted	usually exserted
false septum distribution	present America	present Africa	absent Africa

Tab. II: Main characters of *Ixonanthes* and *Ochthocosmus* s.l.

	<i>Ochthocosmus</i> s.l.	<i>Ixonanthes</i>	
		§ <i>Brewsteria</i>	§ <i>Ixonanthes</i>
petiole	2–6 mm	2–3 mm	10–20 mm
leafmargin	serrate	serrate	entire
inflorescence	raceme of fascicles	compound cyme	compound cyme
petals	contort	imbricate	imbricate
stamens	5 or 10	(15–)20	10
seed	arillode	arillode	wing
distribution	America/Africa	S.E. Asia	S.E. Asia

Ixonanthes is closely related to *Ochthocosmus* s.l., but is distinct in some features, which I consider to be important enough: the imbricate petals and the structure of the inflorescence which is a compound cyme, versus contort petals and racemes of fascicles.

Ixonanthes may be divided into two sections (Hallier f., 1923), also based on the presence of either a true basal wing or a lateral arillode to the seed as explained in the previous chapter: sect. *Ixonanthes* and sect. *Brewstera* (M. J. Roemer) Hall. f. There are some additional correlating characters in the leafmargin, the number of stamens, and the length of the petiole (see tab. II).

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IXONANTHES

- Ixonanthes* Jack, Mal. Misc. 2, 7 (1822) 51; Hall. f., Beih. Bot. Centralbl. 39, 2 (1923) 6–11. — Lectotype: *Ixonanthes reticulata* Jack.
Emmenanthes Hook. & Arn., Bot. Beech. Voy. (1836) 217. — Type: *Emmenanthes chinensis* Hook. & Arn. (= *I. reticulata* Jack).
Brewstera M. J. Roemer, Syn. Monogr. (1846) 141. — Type: *Brewstera crenata* M. J. Roemer (= *I. icosandra* Jack).
Pierotia Bl., Mus. Bot. Lugd. Bat. 1 (1850) 179. — Lectotype: *Pierotia lucida* Bl. (= *I. icosandra* Jack).
Discogyne Schltr. in Lauterbach, Bot. Jahrb. 52 (1915) 123. — Type: *Discogyne papuana* Schltr. (= *I. reticulata* Jack).

Trees or treelets, growing monopodially with flushes, glabrous. Branches ascending, cylindrical. Bark brownish, finely fissured; younger parts smooth.

Lenticels punctiform or slit-like (inconspicuous in *I. icosandra*). Leaves spirally arranged, simple. *Stipules* caducous, free, scale-like, \pm obliquely triangular, entire, acutish, glabrous. *Petiole* sometimes pulvinate at base (*I. icosandra*). *Blade* elliptic or obovate or elliptic-oblong, parchmentaceous to coriaceous (i.s.), smooth; base acute, slightly decurrent; margin slightly incrassate, entire or glandular-serrate; apex obtuse or retuse, sometimes emarginate; pinnately nerved, midrib canaliculate on the upper surface, protruding on the lower, nervation obscure or distinctly protruding on both sides, venation finely and irregularly reticulate. *Inflorescences* axillary (sometimes supra-axillary) to the upper leaves, dichasially corymbose. Peduncle angular to flattened, sometimes distally grooved, smooth, glabrous; primary axes paired or sub-4-whorled, secondary axes paired, otherwise as the primary ones, but usually much shorter; bracts scale-like, triangular, persistent, acutish, entire, smooth; bracteoles absent. *Flowers* bisexual, 5-merous, actinomorphic, perigynous. Young buds sticky. Calyx and corolla indurated and persistent in fruit, increasing in size. *Sepals* 5, connate for up to 0.2 of their length, quincuncial, orbicular to elliptic, glabrous, margin entire, apex obtuse, fleshy to coriaceous in fruit. *Petals* 5, quincuncial, orbicular or orbicular-elliptic, glabrous, margin hyaline, entire, apex rounded or obtuse-rounded, nervation distinct. *Stamens* 10 or (15—)20, in one whorl; filaments inserted outside and against the disk, in bud irregularly coiled, filiform, elongating in anthesis, glabrous, subpersistent in fruit. Anthers (basi-)dorso-versatile with a large, peltate connective, introrse, with 2 longitudinal slits, finely verrucose. *Disk* well-developed, bowl-shaped, margin free, erect, entire or slightly lobed. *Ovary* superior, 5-locular, globose or top-shaped, glabrous. *Ovules* 2 per locule, axillary, 1 on each margin of the carpel, collateral, pendulous, epitropous. Style 1, in bud irregularly coiled, either elongating to 25 mm or remaining very short (up to 2.5 mm in *I. petiolaris*), glabrous, subpersistent in fruit. Stigma mushroom-shaped, margin slightly lobed, fleshy. *Capsule* septicidal and septifragal, 5-locular, 5-valvate without a central column, valves sometimes ultimately apically bifid, ovoid-conical or ellipsoid, acute or obtuse, glabrous, smooth. Carpels in transverse section W-shaped. Exocarp sometimes fibrous and subtended by a thin membrane (hypoderm) folding along the septa and apparently into the 5 epicarpal rimae. Mesocarp dark, spongy. Endocarp glossy. *Seeds* 1 or 2 per locule, either with a basal wing or with a supra-hilar arillode. Testa tenacious, brown. Endosperm spongy, white, containing oil. Embryo straight, c. half as long as the dorso-ventrally appressed, \pm asymmetrically elliptic cotyledons.

Distribution: 3 spp. in S. E. Asia and Malesia, absent in Java (Bogor, cultivated), the Lesser Sunda Isles, and the Moluccas.

KEY TO THE TAXA

- 1a. Petioles 2–3 mm long. Leaf-margins slightly glandular-serrate. Primary branches of the inflorescence sub-4-whorled. Stamens (15—)20. Ovules and seeds with a supra-hilar arillode, without a basal wing (sect. *Brewstera*)
 - 1. *I. icosandra*
- b. Petioles 10–25 mm long. Leaf-margins entire, eglandular. Primary branches of the inflorescence paired. Stamens 10. Seeds with a basal wing, supra-hilar arillode absent. (sect. *Ixonanthes*) 2

Section Brewstera (M. J. Roemer) Hall, f.

Ixonanthes sect. *Brewstera* (M. J. Roemer) Hall. f., Beih. Bot. Centralbl. 39, 2 (1923) 7. — *Brewstera* M. J. Roemer, Syn. Monogr. 1 (1846) 141.

Young axes, petioles, etc. not glaucous. Lenticels inconspicuous. Petiole pulvinate. Leaf-margin slightly glandular-serrate. Peduncle slightly flattened and distally faintly grooved with four ridges; primary branches sub-4-whorled around the usually developed terminal flower of the peduncle. Disk entire. Stamens (15-)20. Ovules 2 per locule, usually 1 fertile. Capsule ovoid-conical, acute. Seeds with a supra-hilar arillode, without a basal wing; arillode as long as the seed, fleshy, cream-coloured.

1. Ixonanthes icosandra Jack — Fig. 2.

Ixonanthes icosandra Jack, Mal. Misc. 2, 7 (1822) 53; Hall s., Beih. Bot. Centralbl. 39, 2 (1923) 7. — *Brewsteria crenata* M. J. Roemer, Syn. Monogr. 1 (1846) 141, nom. illeg. — *Macharisia icosandra* Planch. in Herb. Hook. ex Choisy, Mém Soc. Phys. & Hist. Nat. 14 (1855) 168, nom. inval. — T y p e : Jack s.n. ('Interior of Bencoolen'), apparently lost, n e o t y p e : KEP-FRI 7666 Cockburn (L; iso in K, KEP).

[*Gordonia peduncularis* Wall., Cat. (1831) 4409, *nomen*].

[*Hypericella peduncularis* Wall., Cat. (1831) 4832, nomen].

Pierotia lucida Bl., Mus. Bot. Lugd. Bat. 1 (1850) 180. — *I. lucida* Bl., Mus. Bot. Lugd. Bat. 1 (1852) 396.
— Type: Anon. s.n. (L. no. 908.126—1295, holo).

I. dodecandra Griff., J. As. Soc. Beng. 23, 7 (1854) 632, t. 1 ('*subdodecandra*'). — **T y p e**: *Cantor s.n.* (K). *I. cuneata* Miq., Fl. Ind. Bat. Suppl. (1869) 484.— *I. cicosandra* var. *cuneata* Miq., Ill. Fl. Arch. Ind. (1870) 68. — **T y p e**: *Tournefortia s.s.*, Palembang, prop. Muara Enim, (Linné), sp. n. in K.

326.—Type: Lobb 308 (K; iso in BM, CGE, E, G, OXF).

Trees or treelets up to 30 m, bole up to 1.30 m Ø. Leaf-scars ± round to triangular. *Stipules* up to c. 0.6 mm long. *Petiole* 2–3 mm long, pulvinate. *Blade* oblong to slightly obovate-oblong, 6–19 by 3–6.5 cm, parchmentaceous, base tapering; apex obtuse, often retuse, apiculate. *Peduncle* 6–14 cm; pedicels 3–15 mm long; bracts up to 5 mm long. *Flowers* at anthesis 2–3 by 1–2 mm Ø. *Sepals* elliptic, 1–1.5 by 0.8–1.0 mm (in fruit enlarging to 1.5–2.5 by 1.0–1.5 mm), c. 0.3 mm thick at the base, margin ± hyaline, subcoriaceous in fruit. *Petals* orbicular, 2.0–2.5 by 2.0–2.5 mm (in fruit enlarging to 3.0–4.0 by 3.0–4.0 mm), apex rounded, subcoriaceous in fruit. *Filaments* ultimately up to 15 mm long. *Anthers* basi-dorso-versatile, c. 0.75 by 1.0 mm. *Style* up to 10 mm long. *Ovary* top-shaped, ± 5-angular, c. 0.5 by 0.75 mm Ø. *Capsule* 15(–20) by 5–6 mm. *Seeds* ellipsoid, c. 10 by 2 mm; arillode adaxillary, tripartite.

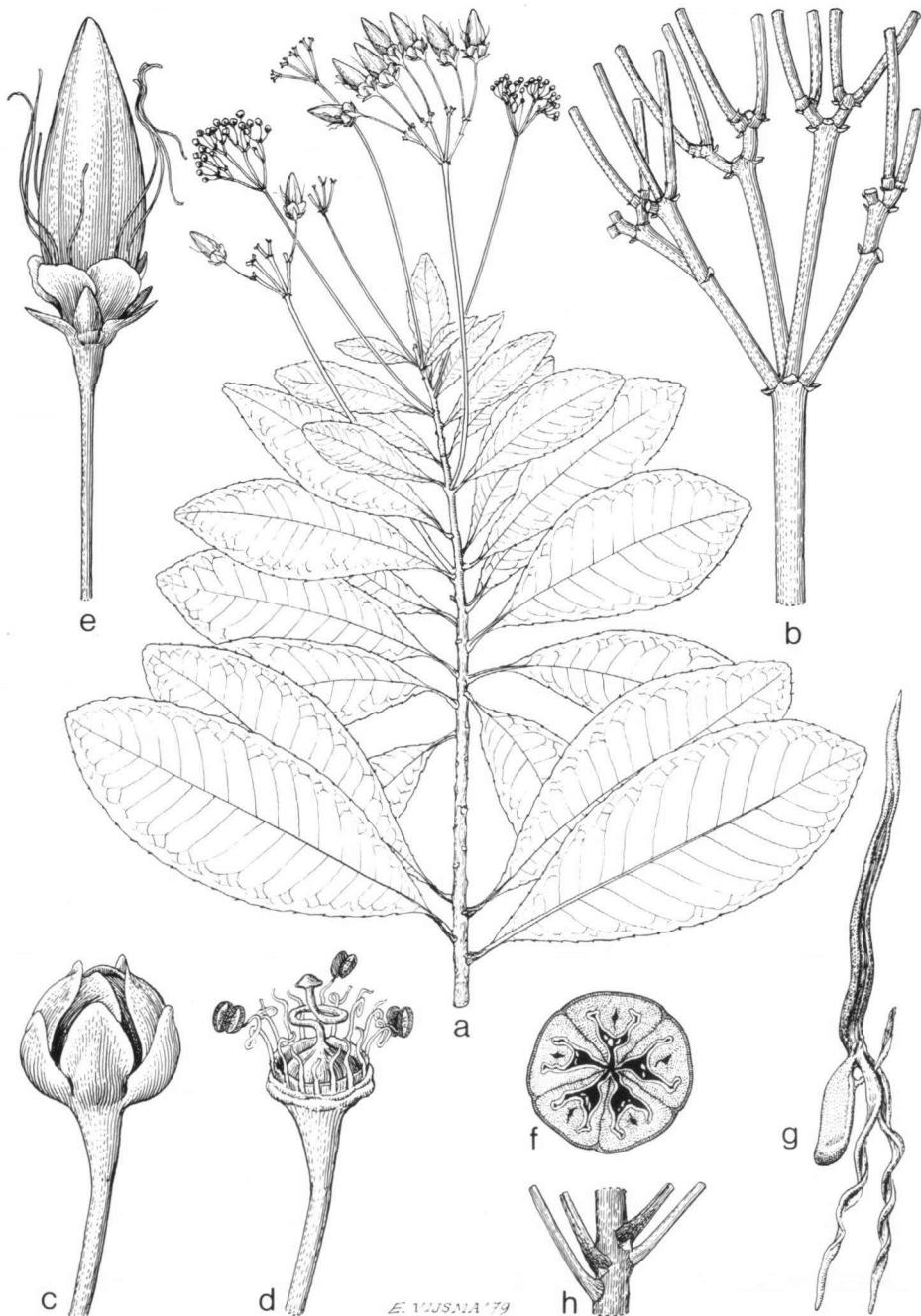


Fig. 2. *Ixonanthes icosandra*. — a. Habit, $\times \frac{1}{2}$; b. primary and secondary branches of inflorescence, $\times 3$; c. flower bud, $\times 10$; d. flower bud without perianth, $\times 10$; e. fruit, $\times 3$; f. transverse section through fruit, $\times 3$; g. ovule with three-lobed arillode, $\times 15$; h. stipules, $\times 2$. All from KEP FRI 3121.

Distribution. Thailand, Malay Peninsula, Sumatra; in Java cultivated.

THAILAND. Peninsular. Surath Thani: *RFD 18166 Saam, Phenkhai 989, SF 37463 Kingdon-Ward*; Songkla: *Kerr 15132*; Pattani: *Lakshnakara 612*.

MALAYA. Kedah; Perak; Kelantan; Trengganu; Pahang; Selangor; Negri-Sembilan; Malacca: *CF 2076 Bachee & Kondak, 4881 Hamid, Kunstler 7*; Johore; Panang: *Curtis 717, Wallich 4409, 4832*.

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SUMATRA. East Coast: *bb 16376, Toroes 3827*; Riouw; Palembang; Indragiri: *Meijer 5*; Banka: *Teijmann HB 3368*.

JAVA. Cult. in hort. bot. Bogor. IV. F. 27, *Kostermans 11194*.

E c o l o g y : Primary and secondary forests on slopes and ridges; 0 – 600(– 950) m alt.

C o l l e c t o r ' s n o t e s : Bole straight, sometimes with short stilt-roots. Bark smooth or slightly shallowly fissured, red, fawn, brown, or grey, soft. Inner bark red, purplish-red, reddish-brown, or brown; firmly fibrous, thick, soft. Wood white, orange, yellow, brown, cream-brown, or brownish-red; hard. Crown conical (not spreading), dense. Flowers whitish, yellow, green, sticky. Fruits green, brownish-green, or dark brown, sticky.

V e r n a c u l a r n a m e s : *ai sai* (Pattani), *pagar anak* (Malaya), *tinjau belukar* (Pahang), *jenjulang*, *punggong kijang*, *menjulong* (Kedah), *kajuh beluks* (Banka), *kassi branah*, *pempaaga*, *kajuh ratuh* (Palembang), *kaju leja-leja* (Sumatra East Coast).

U s e s : Sometimes for house-building.

Section *Ixonanthes*

Emmenanthes Hook. & Arn., Bot. Beech. Voy. (1836) 217. — *Ixonanthes* sect. *Emmenanthes* Hall. f., Beih. Bot. Centralbl. 39, 2 (1923) 8, *nom. inval.*

Young axes, petioles, etc. glaucous. Lenticels punctiform or slit-like. Petiole flattened, upper side more or less deeply longitudinally furrowed, sometimes very narrowly winged. Leaf-margin slightly incrassate, entire, eglandular. Peduncle angular to flattened, not grooved; primary branches paired, terminal flower of the peduncle usually developed. Disk entire or sometimes slightly 10-lobed. Stamens 10. Ovules 2 per locule, usually both fertile. Capsule short- or long-ellipsoid, obtuse. Seeds with a basal wing, without a supra-hilar arillode; wing oblong, fairly stiff, concolourous, with a distinct dark-coloured raphe.

2. *Ixonanthes petiolaris* Bl. — Fig. 3B.

Ixonanthes petiolaris Bl., Mus. Bot. Lugd. Bat. I (1852) 396. — *Pierotia reticulata* Bl., Mus. Bot. Lugd. Bat. I (1850), non *I. reticulata* Jack. — T y p e : *Praetorius s.n.* (L. no. 908. 126—1336).

I. multiflora Stapf ex Ridl., Kew Bull. (1930) 75. — T y p e : *Haviland & Hose 3385* (K; iso in CGE, L). *I. philippinensis* Elm., Leafl. Philip. Bot. 10 (1939) 3758, *nom. inval.* — T y p e : *Elmer 17234* (L; iso in A, BM, G, K, P).

Trees or treelets up to 30 m, bole up to 50 cm Ø. Young bark with punctiform lenticels, older parts striped with numerous lanceolate lenticels. Leaf-scars round with 3 or 5, sometimes distinct vascular scars. *Stipules* up to c. 0.5 mm long. Petiole 14–20 mm long. *Blade* elliptic-oblong, 6–15 by 3–7.5 cm, parchmentaceous to subcoriaceous; base acute; apex slightly obtuse. *Inflorescences* densely flowered.

Peduncle 3.5–7.0(–9.5) cm long; pedicels c. 5 mm long; bracts up to 1.0 mm long. Flowers at anthesis 1.5–3.0 by 1.0–2.5 mm Ø. Sepals elliptic to orbicular, 1.0–1.5 by 1.0–1.5 mm (in fruit enlarging to 1.5–2.0 by 1.5–2.0 mm), thickened at base, laterally with a c. 0.5 mm wide hyaline band; fleshy in fruit. Petals orbicular-elliptic, 2.0–2.5 by 1.0–1.5 mm (in fruit enlarging to 2.5–3.0 by 1.5–2.0 mm), thickened at base, margin narrowly hyalinous, apex rounded; chartaceous in fruit. Filaments ultimately up to 15 mm long. Anthers dorso-versatile, c. 1.5 by 1.1 mm. Style up to 2.5 mm long. Ovary flattened globose, c. 1.5 by 0.5 mm Ø. Capsule short-ellipsoid, 1.5(–2.0) by 0.8(–1.2) cm, valves ultimately apically bifid (1–2 mm deep), septa after dehiscence (long-)persistently adaxially connate with the adjacent ones. Seeds 1.0–1.3 by 0.3–0.4 cm.

Distribution. Thailand, Malay Peninsula, Sumatra, Borneo, Philippines, Celebes; in Java cultivated, perhaps New Guinea, see also sub *I. reticulata*.

THAILAND. Peninsular. Narathiwat: *Sangkachand & Nimanong* 1302.

MALAYA. Perak: *KEP-FRI* 13961 Everett; Kelantan: *KEP* 108866 Suppiah; Selangor: *CF* 988 Hamid, *KEP* 37561 Hamid, *KEP-FRI* 70405 Sow; Negri Sembilan: *KEP-FRI* 14244 Everett; Malacca: *Alvins* 1722, *Holmberg* 762, *KEP* 3750 Symington; Penang: *SF* 3019 Haniff.

SUMATRA. West Coast: *bb* 5489, 17699, *Teijsmann HB* 637; East Coast: *Boeea* 9370; Palembang: *Thorenaar* 913; Banka: *bb* 33992, 34119, *Kostermans & Anta* 994, *J. J. Smith C* 138; Riouw: *bb* 20377.

JAVA. Cult. in hort. bot. Bogor. II. I. 5.

BORNEO. N. W. & E. Kalimantan; S. Kalimantan: *Motley* 26; Sabah

PHILIPPINES. Luzon: *Elmer* 17234; Sulu Islands: *Olsen* 843.

CELEBES. Mahili Oesoe: *Cel/III*—5.

Ecology: In primary and secondary forests on granitic sand and on slopes and ridges; 0–800 m alt.

Collector's notes: Bole deeply fluted, buttresses merging into the bole. Outer bark smooth, green, red, pale brown, yellowish-brown, or black, flaking in small pieces, minutely ridged. Inner bark orange-whitish, yellow, pink, red, or reddish-brown, granular, sticky, soft. Wood white, or reddish-brown. Sapwood white, pinkish-white, honey-coloured, yellow, or brown, with distinct lamination. Crown large, spreading, medium dense. Flowers cream or green. Calyx green. Stamens white. Fruits green, older ones brown.

Vernacular names: *gerungang, jurung* (Malaya), *inyang burong* (N. Sembilan, Selangor), *mara jening, meribikang* (Sumatra), *tinjau laut* (Sumatra: West Coast), *kayurdori bunga* (Sumatra: East Coast), *ingga burong* (Borneo: Iban?), *pinang-pinang* (Borneo: Melanu?).

3. *Ixonanthes reticulata* Jack — Fig. 3A.

I. reticulata Jack, Mal. Misc. 2, 7 (1822) 51; Hall. f., Beih. Bot. Centralbl. 39, 2 (1923) 9. — **Type:** Jack s.n., Tappanuly (L).

[*Hypericina macrocarpa* Wall., Cat. (1831) 4833, *nomen*.]

Gordonia decandra Roxb., Fl. Ind. 2 (1832) 573. — **Type:** Native coll. s.n., Pulu Penang, n.v.

Emmenanthes chinensis Hook. & Arn., Bot. Beech. Voy. (1836) 217. — **Type:** Beechey s.n. (E).

I. chinensis Champ. in R. Brown, Proc. Linn. Soc. 2 (1850) 100. — **Type:** Champion s.n. (K).

I. khasiana Hook. f., Fl. Brit. Ind. 1 (1874) 416. — **Type:** Wallich 4826 (K; iso in BM, G).

I. hancei Pierre in Laness., Pl. Util. Colon. France (1886) 306. — **Type:** not indicated.

I. cochinchinensis Pierre, Fl. For. Cochin. 4 (1893) t. 284 A. — **Type:** Pierre 1414 (P; iso in BM, E, G, K).

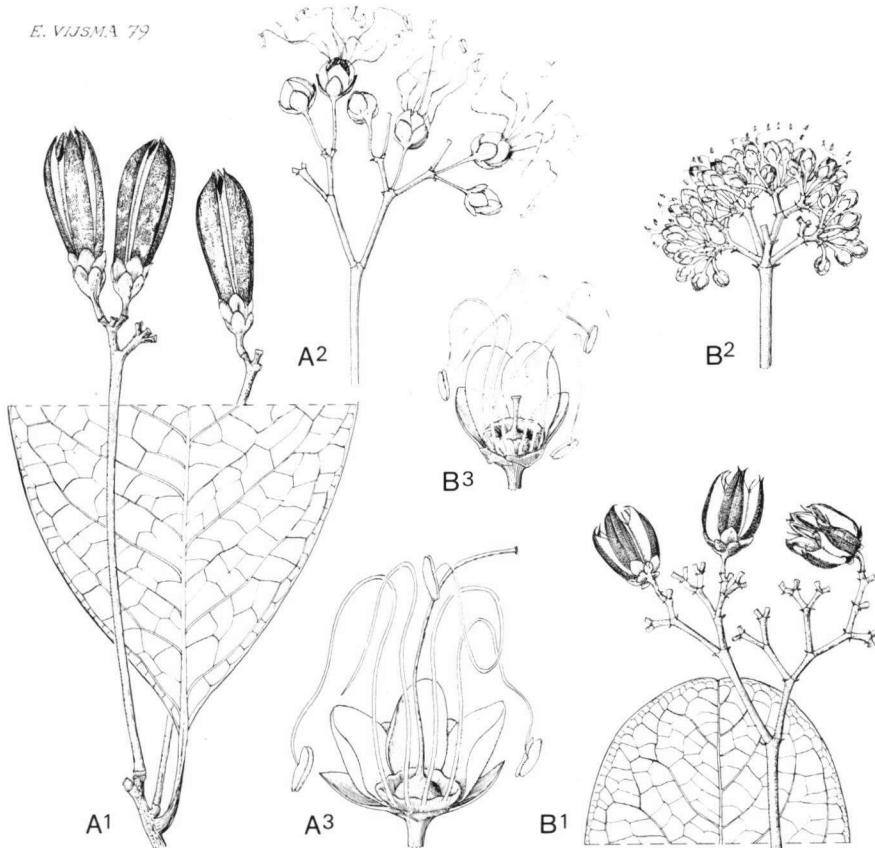


Fig. 3. A. *Ixonanthes reticulata*. 1. Fruits, $\times 2/3$ (SAN 37864); 2. inflorescence, $\times 2/3$ (Sinclair s.n., 3-5-1950); 3. flower, $\times 2$ (ditto). — B. *Ixonanthes petiolaris*. 1. Fruits, $\times 2/3$ (Ding Hou 587); 2. inflorescence, $\times 1$ (SAN 40370); 3. flower, $\times 3$ (SAN 40370).

I. grandiflora Hochr., Pl. Bog. Exsicc. (1904) 39. — T y p e : Hochreutiner 80 (BO, n.v.; iso in BR, CAL, G, K, L, NSW, NY, P, WU).

Discogyne papuana Schltr. in Lauterb., Bot. Jahrb. 52 (1915) 123. — *I. papuana* H. Winkler in E. & P., Nat. Pfl. Fam. ed. 2, 19a (1931) 126, t. 55, 56 A-E. — T y p e : Ledermann 9671 (B, f; iso in K, L).

I. longipedunculata Merr., Philip. J. Sc. 17, 3 (1921) 264, nom. inval. — T y p e : BS 34488 Ramos &

Pascasio (A; iso in K).

I. beccarii Hall. f., Beih. Bot. Centralbl. 39, 2 (1923) 10. — T y p e : Beccari 3674 (FI; iso in G, K).

I. crassifolia Hall. f., Beih. Bot. Centralbl. 39, 2 (1923) 10. — T y p e : Hallier f. B 2380 (L; iso in BO, n.v.)

I. grandifolia Ridl., Kew Bull. (1930) 74. — T y p e : Creagh s.n. (Presumably K, but not found, the paratype cited belongs here).

I. petiolaris auct. non Bl.: Hall. f., Beih. Bot. Centralbl. 39, 2 (1923) 8, pro syn. Griff., Hook. f., King, Roxb.

Trees or treelets up to 30 m, bole up to 1.0 m \varnothing . Lenticels slit-like or punctiform. Leaf-scars round to ovate. Stipules up to 1.0 mm long. Petiole 10–25 mm long. Blade elliptic, or elliptic-oblong, or slightly obovate, 5.5–14 by 3–10 cm, parchmentaceous to coriaceous; base acute; apex slightly obtuse to emarginate.

Inflorescences lax. Peduncle (3.5—)5—8(—14) cm long; pedicels c. 0.5 cm long; bracts up to 1.0 mm long. Flowers at anthesis 3—5.5 by 2—7 mm Ø. Sepals elliptic, 4—5 by 3—4 mm (in fruit enlarging to c. 8 by 4 mm), inside in the middle from top to bottom with a slightly thickened and paler band, fleshy to coriaceous in fruit. Petals orbicular-elliptic, 4—5.5 by 3—4 mm (in fruit enlarging to c. 10 by 6 mm), inside from the base upwards thickened by a bundle of nerves, margin broadly hyaline, apex rounded, subcoriaceous in fruit. Filaments ultimately up to 20 mm long. Anthers dorso-versatile, 1.5 by (0.5—)1.0 mm. Style up to 2.0 cm long. Ovary globose, c. 3 by 2 mm Ø. Capsule long-ellipsoid, (2.0—)3—4(—4.5) cm long, valves never apically bifid, septa after dehiscence (long-)persistently connate with the adjacent ones. Seeds 1.8—2.0 by 0.4—0.9 cm.

Distribution. India, Burma, S. Vietnam, N. Vietnam, S. China, Hong Kong, Malay Peninsula, Sumatra, Borneo, Philippines, Celebes, New Guinea.

INDIA. Assam: Koeltz 28156.

BURMA. Myitkyina: Mya 2256.

S. VIETNAM. Phu Quoc: Pierre 1414, 19109.

N. VIETNAM. Tonkin: Balansa 3560, Fleury 37939, 38027, Tsang 29882.

S. CHINA. Kwang-si: Ching 8287; Kwantung: Hainan.

HONG KONG. Champion s.n., Chan 1039, Ford 3/83, Wright 57.

MALAYA. Kedah: KEP-FRI 369 Whitmore, SF 17915 Moh, Stone 8529; Trengganu: KEP 104357 Chelliah; Pahang: Stone 9483; Negri Sembilan: KEP-FRI 7000 Shing, Shah 82; Johore; Penang.

SINGAPORE. Cantley 158, SF 39541 Sinclair.

SUMATRA. West Coast: Jack s.n.; East Coast: Boeza 790, 10030; Palembang: Grashoff 949, Thorenaar 150 TP 196; Banka: Kostermans & Anta 992; Riouw: Rachmat 57, Teijmann s.n.

JAVA. Cult. in hort. bot. Bogor. IV, A, 31, Hochreutiner 80.

BORNEO. N. W. Kalimantan: Hallier B 1283, B 2380, Teijmann 7893; S. Kalimantan: Kostermans 7932; N. E. Kalimantan: Kostermans 9312; Sabah.

PHILIPPINES. Mindanao: BS 34488 Ramos & Pascasio.

CELEBES. Malili Oesoe: Cel/II-357.

NEW GUINEA. Japen: Beccari s.n.; Sepik: Ledermann 9671, NGF 42639 Henty & Forman; W. District: LAE 51871 Streiman, Pullen 7364, 7415, see also note.

E cology: In primary and secondary forests on hillsides and ridges; in heath-forests, also frequent in swamp-forests; 0—700(—2400) m alt.

Collector's notes: Bole straight and fluted. Buttresses narrow, small. Bark smooth, slightly lengthwise fissured, scaly or cracked, pink, yellowish, brown, fawn, or grey to blackish. Inner bark red, light brown, or dark orange brown, granular, soft. Wood white, dirty white, or dirty yellowish, hard, heavy. Sapwood yellow or ochre, with white or yellow lamination, medium hard. Flowers white or greenish. Calyx cream. Petals green, yellowish-green towards apex. Stamens yellowish-brown. Anthers yellowish-brown. Ovary brown. Style green.

Vernacular names: chi-un, po-ting (Hainan), obah (Malaya), sansak china (Penang), ingeran burong (Selangor), angaran buron (Trengganu), langudai, perepat rimba (N. Borneo), kanju junong (Brunei), lura (Celebes), keseruok (N. Guinea: Tehid language).

Notes: From New Guinea I have seen the following sterile specimens: Vogelkop (BW 6027 Schram, 12302 id., 12325 id., 13058 Moll), Meos Num (BW 15051 Schram), Japen (bb 30647 Aët, 30357 id., BW 10008 Iwanggin), Southeast (BW 6434 Kalkman, 8526 id.), Western District (NGF 10406 Grey & White). Although the difference between *I. petiolaris* and the present species cannot be

ascertained by the leaves only, *I. reticulata* is so far the only one certain to occur in the island. I have therefore tentatively included them here with the following additional information summarized from their field-labels: Lowland mixed as well as lowland Agathis forest, and midmountain forests. Outer bark light brown, inner bark pink, with much red exudate. Wood orange brown, or brown. Sapwood orange- (or light-)brown, or cream. Heartwood red brown. Vernaculars: *soewok* (Mooi-language), *akoewa* (Pom-language), *ajampi* (Japen-dialect), *taag* (Moejoe-language), *solak* (Iwoer-language).

It is remarkable to note the disjunct distribution of the species in New Guinea, for which I can not give a satisfactory explanation.

excluded names

I. parvifolia Merr., Univ. Calif. Publ. Bot. 13 (1926) 135 = *Tirpitzia sinensis* (Hemsl.) Hall. f., Beih. Bot. Centralbl. 39, 2 (1923) 5.

IDENTIFICATION LIST

The numbers refer to the species in the preceding enumeration. Unnumbered or sterile collections have not been included.

- A* 1378 (*Cuadra*): 3; 4151 (*Wood*): 2; *Alvins* 1644: 1; 1722: 2; 2128: 1; *Anderson* 125: 1.
Balansa 3204: 3; 3560: 3; v. *Balgooij* 2551: 1; bb 5489: 2; 16376: 1; 17699: 2; 20377: 2; 26228: 1; 27463: 1; 27614: 1; 28576: 1; 30040: 1; 31719: 1; 32126: 1; 32133: 1; 32978: 3; 33992: 2; 34119: 2; 35354: 2; *Beccari* 1706: 3; 3674: 3; *Beguin* 567: 2; *Boeza* 790: 3; 9370: 2; 10030: 3; *BRUN* 400 (*Ashton & Whitmore*): 3; 966 (*Ashton*): 3; *BS* 34488 (*Ramos & Pascasio*): 3; *Bunnemeijer* 7687: 1; *Burkill & Shah* 1018: 1; 1077: 1; *BW* 3565 (*Kalkman*): 3; 6034 (*Schram*): 3.
Cantley 13: 1; 39: 1; 158: 3; *Cel II*-357: 3; III-5: 2; *CF* 478 (*Hashim*): 1; 583 (*Usope*): 1; 586 (*Hamid*): 1; 614 (*Tahir*): 1; 988 (*Hamid*): 2; 1373 (*Burkhill*): 1; 1878 (*Dusch*): 1; 1975 (*Gakim*): 1; 2059 (*Kasim*): 1; 2076 (*Bachee & Konjak*): 1; 2281 (*Aker*): 1; 2360 (*Foxworthy*): 1; 3716 (*Mahamud*): 1; 4029 (*Matnong*): 1; 4493 (*Yassin*): 1; 4881 (*Hamid*): 1; 5722 (*Hamid*): 1; 5981 (*Bain*): 1; 8378 (*Kiah*): 1; 19490 (*Jeop*): 1; 9605 (*Omar*): 1; 9719 (*Sallih*): 1; 9772 (*Mat Gani*): 1; 11646 (*Ngah*): 1; 12616 (*Strugnell*): 1; 12777 (*id.*): 1; 15740 (*Soh*): 1; 16448 (*Sow & Tachon*): 1; 17778 (*Meh*): 1; 17887 (*id.*): 1; 20293 (*Ismail*): 1; 20740 (*Dolman*): 1; 21263 (*Symington*): 1; 22090 (*Walton*): 1; 23362 (*Raub*): 1; *Chan* 1039: 3; *Chevalier* 38609: 3; *Ching* 8287: 3; *Clemens* 3392: 3; 22253: 2; 26865: 2; *Curtis* 717: 1; 978: 3; 3572: 3.
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Goklin 3038: 3; *Goodenough* 130: 1; 10568: 1; *Grashoff* 656: 1; 949: 3; 1079: 1; *Griffith KD* 784/I: 1.
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IBCS 6736 (*McClure*): 3; 18148 (*Tsang & Fung*): 3; 18272 (*McClure & Fung*): 3; 32912 (*Wang*): 3; 33703 (*Wang*): 3; 36644 (*Wang*): 3; 43877 (*Chun & Tso*): 3; 44135 (*Chun & Tso*): 3; 62171 (*Liang*): 3; 63361 (*Liang*): 3; 70738 (*How*): 3; 71002 (*How*): 3; 72502 (*How*): 3; 72880 (*How*): 3.
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KEP 3750 (*Symington*): 2; 37561 (*Hamed*): 2; 50823 (?): 3; 65158 (*Hussin*): 1; 71352 (*J. W. Smith*): 1; 76183 (*id.*): 1; 80009 (*Sow*): 2; 97905 (*Zainuddin*): 1; 99566 (*Mohzan*): 1; 100021 (*Ng*): 1; 104357 (*Chelliah*): 3; 104824 (*Suppiah*): 1; 104987 (*Suppiah*): 1; 108866 (*Suppiah*): 2; 109418 (*Ismail*): 1; *KEP-FRI* 0360 (*Whitmore*): 3; 1896 (*Ng*): 1; 3121 (*Whitmore*): 1; 3537 (*id.*): 1; 5130 (*Ng*): 1; 5651 (*id.*): 1; 6032 (*id.*): 1; 6434 (*Ng & Beltran*): 1; 6683 (*Chan*): 1; 6810 (*id.*): 1; 7000 (*Shing*): 3; 7666 (*Cockburn*): 1; 8274 (*id.*): 1; 8881 (*Whitmore*): 1; 11104 (*Cockburn*): 3; 13013 (*Selvaraj*): 1; 13119 (*Chan*): 1; 13394 (*Loh*): 1; 13694 (*Everett*): 1; 13748 (*id.*): 1; 13961 (*id.*): 2; 14224 (*id.*): 1; 14244 (*id.*): 2; 14309 (*id.*): 1; 14316 (*id.*): 1; 14340 (*id.*): 1; 14426 (*id.*): 1; 14732 (*Sohadi*): 1; 14836 (*Suppiah*): 1; 15194 (*Whitmore*): 1; 17095 (*Shing*): 1; 17516 (*Chan*): 3; 17662 (*id.*): 3; 20993 (*Ng*): 1; 22132 (*id.*): 1; 23391 (*Cheng*): 1; 70405 (*Sow*): 2; *Kerr* 15132: 1; *King* 1078: 1; 1638: 3; 4371: 1; 8861: 1; *Koeltz* 28156: 3; *Kostermans* 4962: 2; 6852: 2; 7932: 3; 9162: 2; 9227: 2; 9312: 3; 11194: 1; 12012: 1; *Kostermans & Anta* 410: 2; 992: 3; 994: 2; *Kunstler* 7: 1.

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Olsen 843: 2.
Phengklai 989: 1; *Pierre* 1414: 3; 5693: 1; 19108: 3; *Pullen* 7364: 3; 7415: 3; *Purseglove* 4885: 3.
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