SIMAROUBACEAE (H. P. Nooteboom, Leyden)

Trees or shrubs, in Mal. evergreen or almost so, usually containing very bitter substances. Twigs pithy. Hairs mostly simple and 1-cellular, sometimes glandular-capitate. *Leaves* (in Mal.) spirally arranged, simple or 1-pinnate, often articulated, often provided beneath (rarely also above) with pitted, concave, or flattish glands (in Mal. in *Ailanthus*, *Brucea*, *Samadera*, and *Soulamea*). Stipules usually absent, (in Mal.) present in *Irvingia* and *Picrasma*. *Inflorescences* usually compound, axillary, rarely terminal; plants monoecious, rarely dioecious. *Flowers* usually small, actinomorphic, uni- or bisexual, or functionally unisexual. *Sepals* 3–5, almost always partly connate, valvate to slightly imbricate. *Petals* 3–5, free, imbricate or valvate, rarely absent (in extra-Mal.), or united into a tube (extra-Mal.). *Stamens* inserted at the base of the disk, isomerous or dimerous, rarely numerous (extra-Mal.), mostly obdiplostemonous, rarely the stamens of the outer whorl doubled, not rarely with a scale at the inner base; anthers 2-celled, opening lengthwise, introrse to latrorse, versatile. Disk intrastaminal, often gynophorous, sometimes rather inconspicuous, at least when dry. *Ovary* often 2–5-lobed, 1–5-celled, or with free carpels; styles 1–5. *Ovules* 1–2 (in Mal. 2 only in *Suriana*), axile, anatropous (in *Harrisonia* and *Suriana* amphitropous). *Fruit(s)* usually indehiscent, often drupaceous, sometimes a samara, some carpels sometimes aborted. *Seed:* endosperm 0 or scant; cotyledons planoconvex; embryo straight or curved; no aril.

Distribution. About 30 genera, with *c.* 200 *spp.* with the main centre in tropical America, and a second centre in tropical West Africa. With the exception of *Picrasma quassioides* (D. DON) BENN., ranging as far north as North Japan and Korea, and of *Ailanthus altissima* (MILL.) SWINGLE, which is endemic in subtropical to temperate China, the species of this family are native in the tropics. The monotypic genus *Suriana* has the widest range and is almost pantropical along sandy beach, being absent only on the west coast of Africa.

A remarkable distribution is exhibited by *Soulamea*, with 6 endemic species in New Caledonia, one in Fiji, one widely ranging sandy beach species from Polynesia westwards to Borneo and one endemic species in Mahé I. (Seychelles).

Another remarkable type of distribution is displayed by *Picrasma*, which is disjunct tropical transpacific.

Ecology. Most of the Malaysian *Simaroubaceae* are inhabitants of the lowland forest; only *Brucea mollis* WALL. *ex* KURZ is recorded as high as 1800 m (in the Philippines)

Climatically defined areas in Malaysia are occupied by both species of *Harrisonia* and to a less degree by *Ailanthus triphysa*, all of which distinctly avoid the everwet forest belt of West Malaysia (in Sumatra, Malaya, Borneo, and West Java), and prefer regions subject to a dry monsoon. Fig. 10, 11, and 20. *Brucea*, *Picrasma*, and *Ailanthus integrifolia* behave rather indifferent to climate. As to soil *Irvingia* and *Samadera* are indifferent but *Eurycoma* has a distinct preference for acid, leached sandy soils and is classified as silicicolous. *Quassia* § *Samadera* shows preference for temporarily inundated places.

Suriana and *Soulamea* both belong to the Barringtonia formation and obviously prefer calcareous or rocky beaches.

Pollination. Is probably performed by insects, as the flowers are often reported to be fragrant. They are either unisexual or functionally so, or bisexual.

Dispersal. Unfortunately little is known on this subject.The fruits of *Suriana maritima* and *Soulamea amara* are certainly dispersed by seawater and this seems to have been very effective. RIDLEY (Disp. 1930, 264) assumes dispersal by fresh-water for *Quassia* § *Samadera* which has large fruits and is frequent in alluvial forests and swamp forest. In all cases buoyancy is gained by the seed not entirely filling the fruit and leaving a cavity. The thin-winged samaras of *Ailanthus* will be wind-dispersed over small distances. See further under the genera.

Phytochemistry. All *Simaroubaceae* (with the exception of the *Irvingioideae* and *Surianioideae*) contain bitter principles which seem to be closely related to each other. Unfortunately their chemical structure has not yet been fully elucidated. The best known bitter principle of the family is quassin, which has been isolated from the woods and barks of *Quassia amara* AUBL. and *Aeschrion excelsa* (SW.) O. KUNTZE (*Picrasma*). According to recent investigations of ROBERTSON and collaborators (J. Chem. Soc.

1950, 3431; 1954, 3672, 4238) quassin is a mixture of two closely related compounds which were called quassin and neo-quassin. Both bitter principles contain a carbon skeleton built up from 20 C-atoms and belong probably to the diterpenoid compounds. Quassin, $C_{20}H_{22}O_4(OCH_3)_2$ has the following functional groups: 2 methoxyl, a lacton, a tertiary hydroxyl and a carbonyl group. Another bitter principle of the family was isolated from the seeds of *Simarouba glauca* (E. A. HAM *et al.*, J. Am. Chem. Soc. 76, 1954, 6066) and termed glaucarubin. Glaucarubin like quassin seems to be a derivative of a C_{20}-compound; it is, however, an ester of α-methyl-α-hydroxybutyric acid with the diterpenoid hexahydroxylacton, glaucarubol. A third bitter principle examinated recently is cedrin from the seeds of *Simarouba cedron* PLANCHON. According to KREBS and RÜBER (Arzneimittelforschung 10, 1960, 500) cedrin is a sesquiterpenelacton of the santonin-type. The common features of all bitter principles of *Simaroubaceae* seem to be the lactonic function and the isoprenoid structure (sesquiterpenes or diterpenes). In this respect these constituents are related to the bitter principles of *Rutaceae* (limonin nomilin, obacunon); the latter, however, contain a carbon skeleton, which is related to triterpenes rather than to sesquiterpenes or diterpenes.

Many *Simaroubaceae* are used locally as therapeutic agents, especially as tonics, antidysenterics and anthelmintics. The bitter principles are believed to be the therapeutically most important constituents of the members of the family.

Another feature rather characteristic for the family is the common occurrence of small amounts of essential oils and large amounts of resins. These excretions are located in perimedullar resin canals said to be of schizolysigenous origin and in idioblasts occurring in the pith, phloem and cortex and in the leaves of some species. Practically nothing is known about the precise chemical nature of these essential oils and resins.

Mucilages too are wide spread in the family. They are deposited in mucilage cells in the epidermis of the leaves and in the subfamily of *Irvingioideae* in lysigenous cavities in the pith.

In *Simarouboideae* and *Irvingioideae* the epidermal cells of the leaves are heavily silicified as demonstrated by EDMAN (Svensk Bot. Tidskr. 30, 1936, 493).

There are some indications that tannins, coumarines and alkaloids are not rare in the family, but no detailed informations are available, besides the statement of ALTMAN (Bol. tecn. inst. agron. do Norte, Belém, *no* 31, 1956, 27) that the twigs of *Picrolemma pseudocoffea* DUCKE contain quinine. It would be very interesting to investigate *Simaroubaceae* for alkaloids and coumarines because the closely related *Rutaceae* are so rich in highly characteristic alkaloids and coumarines.

A very interesting chemical feature of the family is to be found in the composition of the fatty oils of the seeds. As a rule the seed fats of the members of a family are rather uniform in composition. In the family of *Simaroubaceae*, however, four different types of seed fats have been found up to now. The fats of the genus *Irvingia* are similar to those of *Lauraceae* and *Myristicaceae* by the high amounts of lauric and myristic acid. The genus *Picramnia* seems to be characterized by fats with the acetylenic tariric acid related by the position of unsaturation to petroselinic acid. The latter one (characteristic for the families *Umbelliferae* and *Araliaceae*) has been demonstrated to be a major fatty acid in the seed fat of *Picrasma quassioides* (D. DON) BENN. The rest of the seed oils of the family investigated (of the genera *Ailanthus, Brucea, Perriera, Samadera, Simarouba*) belong to the common and very wide spread type characterized by palmitic, oleic and linoleic acids as major fatty acids. There exist many striking phytochemical resemblances between *Rutaceae* and *Umbelliferae*. Therefore the occurrence of petroselinic acid and tariric acid as major fatty acids in the seeds of *Simaroubaceae* which seem to be closely related to *Rutaceae*, may be more than purely chemical convergence.—R. HEGNAUER.

Wood anatomy. DEN BERGER, Determinatietabel van Malesië, Veenman, Wageningen (1949) several pp., due to the occurrence of gum ducts, storied structure, the distribution of the wood parenchyma or the structure of the rays in the various genera (hand lens). HEIMSCH, Lilloa 8 (1942) 117; METCALFE & CHALK, Anat. Dic. 1 (1950) 321; MOLL & JANSSONIUS, Mikr. Holzes 2 (1908) 72; SAYA, Ann. Accad. ital. Sci. for. 4 (1955) 315; WEBBER, Am. J. Bot, 23 (1936) 577; Lilloa 6 (1941) 441. According to HEIMSCH (*l.c.* 176) the *Burseraceae* and *Anacardiaceae* are highly similar in wood structure and together are distinct from the *Rutaceae, Simaroubaceae, Meliaceae*, and *Sapindaceae*, and in general the *Simaroubaceae* simulate the *Rutaceae* rather closely (*l.c.* 177); because of the large variation in wood structure the members of the family most probably do not represent a natural group (*l.c.* 189, *cf.* also METCALFE & CHALK, *l.c.* 325). Note that the term septate fibre tracheids (WEBBER, *l.c.*, HEIMSCH, *l.c.*) has to be replaced by septate (libriform wood) fibres (REINDERS, Trop. Woods 44, 1935, 30; Handl. Plantenanatomie ed. 4, 1951, 147; RECORD, Trop. Woods 78, 1944, 36). According to the definitions of SANIO-JANSSONIUS-REINDERS (REINDERS, *l.c.*) all species of this family possess libriform fibres and none of them fibre-tracheids. — C.A.R.-G.

Taxonomy. The *Simaroubaceae* are doubtless closest related with the *Rutaceae*, followed by the *Meliaceae* and *Burseraceae*, in that order. They lack homogeneity and there is no single character common to all genera and not present in the other families. The bitter substances are commonly assumed to be characteristic of the quassi family, but they are absent in the *Irvingioideae* (*Klaineodoxa* and *Irvingia*) and in the *Surianoideae* (*Cadellia* and *Suriana*), and, besides, occur also in some *Rutaceae* and *Meliaceae* (*Trichilia*) Another very common character is the occurrence of concave or flattish but sunken spot-glands on the underside of the leaves which are also found in the meliaceous genus *Trichilia*. Both vegetatively and in sexual organs *Simaroubaceae* are diverse in character: leaves are simple or compound, stipules are present or absent, carpels are free or connate, stamens are isomerous or dimerous, and the

fruit structure displays a great variaton. From this follows that delimitation against the allied families must remain arbitrary. In 1874 ENGLER (Abh. Naturf. Ges. Halle 13, 2, p. 140) considered the *Simaroubaceae* as a residue of the *Geraniales*: 'Wir sind genöthigt alle diejenigen Formen aus der Reihe der Geraniales, welche sich äusserlich an eine der verschiedenen Rutaceen-Gruppen anschliessen, in ihrem anatomischen Verhalten aber in der angegebenen Weise von denselben sich unterscheiden, zu den Simarubaceae zu rechnen.'

It must be remembered, however, that *Simaroubaceae* sometimes (*Irvingia*) possess lysigenous cavities containing mucilage, METCALFE & CHALK (Anat. Dic. 1950, 317–326) recently concluded from the anatomy: 'There are very few characters common to the whole of the *Simaroubaceae*. This lack of homogeneity, which also occurs in the external morphological characters, seems to indicate that the family is unnatural, but consists of a number of groups which are themselves relatively uniform.' This diversity is also expressed in the large number of subfamilies. WEBBER (Am. J. Bot. 23, 1936, 577–587) concluded from the wood anatomy that the subfamilies *Kirkioideae*, *Irvingioideae*, *Picramnioideae*, and *Alvaradoideae* might rank as distinct families or as components of other families if these were suggested on other morphological grounds.

In phytochemical aspect it is interesting that EDMAN (Svensk Bot. Tidskr. 30, 1936, 493–514) found lack of homogeneity in the amount of silica in the leaves, a character which is generally characteristic for taxa of higher rank. In the *Simaroubaceae* it appears that the *Irvingioideae* and the *subtr. Simaroubinae* are the only groups which are highly silicified. He assumes that this is a primitive character; it is also found in the primitive members of the *Rutaceae* and *Burseraceae*; the ability to store a large amount of silica has obviously been lost by some groups of all three families.

Palynologically the family also shows a certain lack of homogeneity, according to ERDTMAN (Pollen Morph. & Tax. 1, 1952, 406–409), although a relation of *Irvingia* and *Suriana* with the true *Simaroubaceae* is probable.

The genera without bitter substances, *viz Irvingia* and *Suriana*, have often been discussed.

Irvingia, together with *Klainedoxa*, was by ENGLER (Pfl. Fam.3, 4, 1896, 227) distinguished as a subtribe, and later by BOAS (Beih. Bot. Centr. 29 i, 1913, 348) and ENGLER (Pfl. Fam. ed. 2, 19a, 1931, 396) raised to subfamily rank. PIERRE (Fl. For. Coch. 4, 263) has already given it family rank in 1892, mainly because of presence of stipules and lysigenous mucilage cavities in the cortex and pith of branches and petioles. He placed the *Irvingiacées* next to *Anacardiaceae*. VAN TIEGHEM (Ann. Sc. Nat. IX, Bot. 1, 1905, 247–320) considered the *Irvingiaceae* close to but distinct from the *Simaroubaceae*. HALLIER *f.* (Beih. Bot. Centr. 39, ii, 1923, 62–68) classified *Irvingia* next to the *Linaceae-Erythroxyleae*, a disposition which has recently partly been accepted by HUTCHINSON (Fam. Fl. Pl. ed. 2, 1959, 261) in placing the *Irvingiaceae* in the order *Malpighiales* next to the *Linaceae*. As EDMAN's phytochemical results are in favour of affinity between *Irvingia* with *Simarouboideae* and as the leaves of *Irvingia* are extremely similar to those of *Quassia § Samadera* (though without glands), and stipules also occur in *Picrasma*, I think it is reasonable to maintain *Irvingia* within the *Simaroubaceae*. It is true that the stipules in *Irvingia* leave an annular scar, which is not the case in *Picrasma*, but in other families, *e.g. Hamamelidaceae* and *Rubiaceae* their insertion also varies in degree.

Suriana has also a chequered taxonomical history, and was successively classified in the *Crassulaceae* by LINNÉ, in the *Spiraeaceae* by ENDLICHER and PLANCHON, and in the *Geraniaceae* by LINDLEY. ARNOTT (W. & A. Prod. 1 (1834) 360) raised *Suriana* to family rank. J. G. AGARDH (Theor. Syst. Pl. 1858, 169) placed the family next to the *Geraniaceae* with the following argumentation: lack of bitter substances, thin and brightly coloured clawed petals, and an ovary with 2 amphitropous ovules per cell. Amphitropous ovules occur, however, also in *Harrisonia*. AGARDH's opinion was sustained by JADIN (Ann. Sc. Nat. VIII, Bot. 13, 1901, 303) on – somewhat inadequate – anatomical characters. According to WEBBER (1936, *l.c.*) the anatomical structure of *Suriana* supports SOLEREDER's opinion (Syst.Anat. Dic. 1899, 207–213) of suppressing a monotypic family *Surianaceae* and classifying it with the *Simaroubaceae* as proposed by BENTHAM & HOOKER (Gen. Pl. 1, 1862, 307) and accepted by ENGLER (Pfl. Fam. ed. 2, 19a, 1931, 365) and CRONQUIST (Brittonia 5, 1944, 129), which seems still the most acceptable disposition.

Uses. All the bitter tasting genera are highly in demand for medicinal purposes by the people, and are used against a wide variety of illnesses. It seems that they have sometimes some healing properties indeed, for example the nuts of *Brucea javanica*. These are known under the name of '*Makassaarse pitjes*' (Dutch) or '*Kho-Sam*' (Chin.). They were about 1900 imported into Europe and came highly in demand as a drug. According to MOUSSALLI (Contr. à l'étude des Simarubacées, 1939) an unidentified, much less bitter tasting drupe was often handled by crooked merchants to adulterate true '*Kho-Sam*'.

Some of the toxic constituents, after having been extracted, are occasionally used as an insecticide.

None of the genera furnishes timber of general commercial importance, though some, *e.g. Ailanthus*, produces a timber that is used locally, chiefly for packing-cases and also for house building. In none of the genera the wood is very durable.

KEY TO THE GENERA

1. Leaves simple.
 2. Stipules present, leaving annular scars. . . . . **9. Irvingia**
 2. Stipules absent.
  3. Leaves sessile or nearly so, linear-spathulate, up to 5 mm wide. Plant not bitter **1. Suriana**
  3. Leaves larger, distinctly petioled. Bitter substances present.
   4. Leaves obovate. Branchlets thick. Stamens without an adaxial scale. Carpels connate. Fruits obcordate. . . . . **8. Soulamea**
   4. Leaves subelliptic, with concave glands, usually on the undersurface. Branchlets not thick. Stamens without an adaxial scale. Carpels free. Fruit ± semicircular. . . . . **2. Quassia**
1. Leaves compound.
 5. Leaf-rachis winged or leaves ternate. Stamens with an adaxial scale.
  6. Branches with stipular thorns. Leaf-rachis narrowly winged or leaves ternate. Carpels united. **4. Harrisonia**
  6. Branches without thorns. Leaf-rachis broadly winged and articulated. Carpels free . . . **2. Quassia**
 5. Leaf-rachis not winged. Leaves pinnate. Stamens either with an adaxial scale or not.
  7. Stipules present, caducous. Stamens without an adaxial scale . . . . . **6. Picrasma**
  7. Stipules absent. Stamens either with an adaxial scale or not.
   8. Leaflets sessile or nearly so, attached to the rachis with a conspicuous (constricted) articulation. Stamens with an adaxial scale, the same number as the petals, alternating with staminodal scales **3. Eurycoma**
   8. Leaflets distinctly stalked, not conspicuously articulated. Androecium haplo- or obdiplostemonous. Stamens either with an adaxial scale or not.
    9. Stamens twice the number of petals, either with an adaxial scale or not. Inflorescence a panicle.
     10. Stamens without an adaxial scale. Large trees. Branches thick, with large, crowded leaf scars. Fruit a samara. . . . . **7. Ailanthus**
     10. Stamens with an adaxial scale. Branches not very thick, not with large, crowded leaf scars **2. Quassia**
    9. Stamens the same number as petals, without an adaxial scale. Thyrse narrow . . **5. Brucea**

1. SURIANA

LINNÉ, Gen. Pl. ed. 5 (1754) 137; Sp. Pl. (1753) 284—**Fig. 1.**

Shrubs or small trees; innovations hairy, partly glandular-capitate; without a bitter taste. *Leaves* sessile, simple. Stipules 0. *Flowers* 5-merous, bisexual, in pauciflorous, axillary cymes, rarely solitary; stalks articulated at the base. Bracts persistent, foliaceous. *Sepals* persistent, connate at the base, imbricate in bud, as large as the imbricate petals. *Stamens* 10, sometimes 5 barren in 2 distinct rows, with latrorse, versatile anthers. Disk not developed. *Carpels* 5, free, each with a free, filiform, basally attached erect style; stigmas free, small, inconspicuous; ovules 2 in each carpel, collateral, basal, amphitropous, micropyle directed to the base. *Fruits* drupaceous, 3–5 together, enclosed by the calyx. *Seed* 1 in each carpel; embryo curved, albumen 0.

Distr. Monotypic, pantropical. Fig. 2.

Notes. JADIN (Ann. Sc. Nat. VIII, Bot. 8, 1901, 224–226) considered *Suriana* as representative of a monotypic family, *Surianaceae*, on behalf of the occurrence of glandular hairs (a character which he overlooked in some other genera), the number and basal attachment of the ovules, the lack of bitter substances, and some other minor characters. SOLEREDER (Verh. Bot. Ver. Brandenb. 47, 1905, 35–62) referred the genus to the *Simaroubaceae*, which was agreed to by later authors.

1. Suriana maritima LINNÉ, Sp. Pl. (1753) 284; DC. Prod. 2 (1825) 91; SPRENG. Gen. Pl. ed. 9 (1830) 383; W. & A. Prod. (1834) 361; DECNE, Herb. Tim. Descr. (1835) 121; BENTH. Fl. Austr. 1 (1863) 375; BENN. in Fl. Br. Ind. 1 (1875) 522; HEMSL. Bot. Chall. 1 (1885) 131; TRIMEN, Fl. Ceyl. 1 (1893) 222; WARB. Bot. Jahrb. 18 (1893) 194; BAILEY, Queensl. Fl. 1 (1899) 220; GUPPY, Observ. Natur. Pac. 2 (1906) 105; BACK. Schoolfl. Java (1911) 193; MERR. Philip. J. Sc. 7 (1912) Bot. 274; GUPPY, Seeds & Curr. (1917) 239–242; LAUT. Bot. Jahrb. 56 (1920) 342; E. G. BAKER, J. Linn. Soc. Bot. 45 (1921) 285; MERR. En. Philip. 2 (1923) 345; C. T. WHITE, J. Arn. Arb. 10 (1929) 227; RIDL. Disp. (1930) 264; DÄNIKER, Viert. Jahrschr. Naturf. Ges. Zürich 77 (1932) 204; F. B. H. BROWN, Bull. Bern. P. Bish. Mus. 130 (1935) 131; GUILLAUMIN, Bull. Soc. Bot. Fr. 85

(1938) 20; Fl. Nouv. Cal. (1948) 170; PERR. DE LA BÂTHIE, Fl. Madag. fam. 105 (1950) 7; W. R. TAYLOR, Pl. Bikini (1950) 183; YUNCKER, Bull. Bern. P. Bish. Mus. 220 (1959) 154.—**Fig. 1.**

Shrub or small tree, up to 3(–8?) m, rather densely pubescent in all the younger parts; hairs partly glandular-capitate. Wood very hard. *Leaves* somewhat fleshy, linear-spathulate, up to 3½ by ½ cm, crowded at the end of the branchlets, leaving tuberculate scars; midrib, nerves, and veins inconspicuous. Inflorescences 2–4-flowered. *Bracts* lanceolate, 4–9 by 1–1½ mm. *Pedicels* up to *c.* 1 cm. *Sepals* ovate-lanceolate to ovate-oblong, 5–10 by 2–4 mm. *Petals* yellow, ± obovate-oblong to orbicular, shortly clawed, about as long as the sepals. *Filaments* sericeous at the base, up to 5 mm; anthers with emarginate top and base, 1 mm ø. *Carpels* hairy, obovoid, in anthesis up to *c.* 1 mm long; styles glabrous, except at the very base, up to 5 mm. *Fruits* hairy, subovoid, *c.* 3½ mm long.

Distr. Pantropical (but not in West Africa, not on the Asiatic and Australian[1] continents, and not in Hawaii), in the Pacific-Indian Oceans usually on small isolated islands or coral islets and atolls, in *Malaysia*: very scarce, only found in the Philippines (Lumbucan, Sulu Sea), Timor, and the Tanimbar Is (unlocalized), and East New Guinea (Kelana, Port Moresby, Misima I.). Fig. 2.

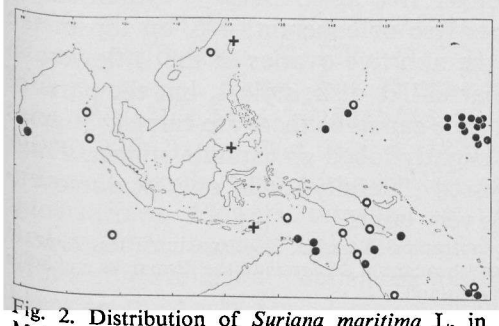

Fig. 2. Distribution of *Suriana maritima* L. in Malaysia and adjacent countries; material seen (•), from literature (o), unlocalized (+).

Ecol. A coastal shrub of the Barringtonia formation, usually rare, but locally often very common and forming thickets along the sandy beach and along coral coasts, often associated with *Messerschmidia*, *Scaevola*, *Guettarda*, *etc.*, from sea-level up to 10 m. *Fl. fr.* Jan.–Dec.

In SE. Polynesia F. B. H. BROWN found that the dense branching causes it to act occasionally as a sand binder initiating the formation of small dunes. In Bikini especially common on the windward side of the islet. In the Tuamotus one of the most common littoral woody plants.

It is remarkable that almost all localities are

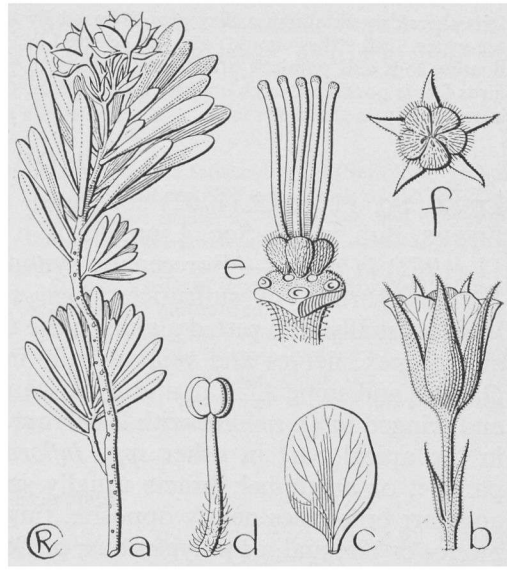

Fig. 1. *Suriana maritima* L. *a.* Flowering twig, × ⅔, *b.* flower, × 2, *c.* petal, × 3, *d.* stamen, × 6, *e.* gynoecium, scars of other flower parts visible, × 6, *f.* fruit, × ½ (*a* FOSBERG 26890, *b–e* MCKEE 4997, *f* after BRITTON).

situated in the small islands or islets in the Malaysian Pacific area, except some in East New Guinea. No specimen is known from the Australian and Asiatic continents proper, though BENNETT (*l.c.*) recorded it from the 'shores of the western Peninsula', *i.e.* the Deccan. Among shore plants it shares this peculiarity with *Pisonia grandis* for which it has been accepted that these localities coincide with bird colonies, and consequently guano accumulation leading to calcium phosphate coral rock; *Pisonia* would then also be dispersed by these sea birds. It is, however, unlikely that the fruits of *Suriana* are dispersed in this way.

Mr L. S. SMITH (*in litt.*) suggested that *Suriana* and other rare littoral plants avoiding continental shores (*Messerschmidia argentea*, *Soulamea amara*) might prefer highly calcareous beaches which, of course, are much more prevalent on islands than on the mainland where rivers silt the coral by outflow of freshwater and sediments.

RIDLEY (*l.c.*) dwelt at length on the peculiar distribution pattern and I agree that GUPPY's assumption (Plants, Seeds, *etc.* 1917, 240) that it would have been destroyed in spots as firewood by wandering islanders is unlikely.

SCHIMPER and GUPPY (Observ. 529) have established that the buoyancy power of the nuts is very great, up to at least 5 months; the floating power being due to an unfilled space in its cavity

(1) Except two localities, near Yirrkalla, at the NE. corner of Arnhem Land and Look-Out Point in Queensland.

It is therefore certain that they are dispersed by sea-water, but 'they could also be carried in floating logs and pumice'; attachment in mud to birds feet is possible though unlikely as its habitat is too sandy.

In the herbaria *Suriana* is sometimes confused with *Pemphis acidula* FORST. (*Lythraceae*) which can immediately be distinguished by a lengthwise sulcate, campanulate calyx tube and 6-merous flowers.

2. QUASSIA

LINNÉ, Sp. Pl. ed. 2 (1762) 553,, app. (1763) 1679; Gen. Pl. ed. 6 (1764) 212; PIERRE, Bull. mens. Soc. Linn. Paris *n.* 156 (1896) 1236; NOOTEBOOM, Blumea 11 (1962) *in press.* — For generic synonyms see under the sections. — **Fig. 3-5.**

Trees, shrubs, or suffrutices. *Leaves* pari- or imparipinnate, rarely simple; leaflets usually with pitted glands in the upper surface along the margin, especially at the apex; nerves and veins usually immersed or obscure, sometimes (in *sect. Quassia* and some African and American *spp.*) prominent; rachis distinctly jointed and winged in *Q. amara*, with 2 narrow ribs or terete and not jointed, or only so in the apical part in other *spp.*. *Inflorescence* a simple or branched raceme, a panicle, or an umbel; bracts usually spathulate, more or less succulent, or triangular; bracteoles nearly opposite, tiny, triangular, ciliate. *Flowers* 4–6-merous, mono- or bisexual, or polygamous; pedicels jointed about the middle in *Q. amara*, either jointed at the base or not in the other *spp.*. *Calyx* more or less lobed, rarely (*§ Simaba, p.p.*) closed in bud and irregularly rupturing. *Petals* imbricate or contorted in bud, longer than the calyx, sometimes very long. *Stamens* obdiplostemonous (in a single African *sp.* the outer whorl doubled), with a shorter or longer, hairy, adaxial scale with a shorter or longer free apex. *Disk* ± cylindrical or subglobose, highly varying in size. *Ovaries* free or coherent, 4–6, on top of the disk, often more or less immersed in it, the abortive ovaries of the ♂ flowers in some monoecious *spp.* surrounded by a barrel-like disk; style 1, but the parts of each carpel discernible, and with as many style canals as there are carpels; stigmas more or less stellately spreading, or one slightly lobed or capitate stigma. *Fruits* 1–6, drupaceous or woody, often compressed (laterally, or in one *sp.* dorsoventrally), either bicarinate or not, sometimes very large.

Distr. Pantropical, *c.* 25 species in tropical and subtropical America, 5–10 *spp.* in Africa, 2 *spp.* in lower Burma and Cambodia, one of which also almost throughout *Malaysia* to the Bismarcks and Solomons, 1 endemic in Borneo & Sumatra, and 2 in Queensland.

Ecol. In Malaysia in rain-forests at low altitude.

Notes. The new North Bornean species, which could be described thanks to the generous co-operation of Mr FORMAN, Kew, necessitated a reconsideration of the *trib. Simaroubeae.* Mr FORMAN assumed it to belong to the American genus *Simaba*, but though the similarity is striking indeed, *Simaba* is defined in having bisexual flowers, and the flowers of the new species are male, with clearly reduced ovaries. Unisexual flowers occur in the likewise American genus *Simarouba.* The new species showed, however, also similarity to some African genera for example *Hannoa* and *Odyendyea.* I have come to the conclusion that all these genera, including also *Samadera* and the African genus *Pierreodendron*, cannot be separated generically and should be arranged in an enlarged genus *Quassia*, a point of view already suggested by PIERRE in 1896. This emended genus *Quassia* comprises four sections, three of which occur in Malaysia.

KEY TO THE SPECIES

1. Leaves compound.
 2. Leaf-rachis winged, conspicuously articulated. Flowers in racemes . . . . . **1. Q. amara**
 2. Leaf-rachis not winged, not articulated. Flowers in panicles . . . . . **3. Q. borneensis**
1. Leaves simple. Flowers in pseudo-umbels. . . . . **2. Q. indica**

1. Section Quassia

Leaves pinnate, with a more or less winged and conspicuously articulated rachis. Racemes terminal, either branched or not. Pedicels articulated about the

middle, with 2 tiny bracteoles below the joint. Flowers bisexual. Petals 5, contorted, oblong, erect, much longer than the calyx. Disk large, nearly as high as broad. Styles long, with a small, slightly 5-lobed stigma.

Distr. One *sp.* native in Brazil and introduced in all tropical countries for medicinal and ornamental purposes.

1. **Quassia amara** LINNÉ, Sp. Pl. ed. 2 (1762) 553, app. (1763) 1679; BACK. Fl. Bat. 1 (1907) 256; Schoolfl. Java (1911) 190; LECOMTE, Fl. Gén. I.-C. (1911) 689; MERR. Fl. Manila (1912) 272; En. Philip. 2 (1923) 346; CRAIB, Fl. Siam. En. 1 (1926) 239; HEYNE, Nutt. Pl. (1927) 870; BACK. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 3.

Very bitter, erect shrub, 2–3 m high. *Leaves* with broadly winged rachis; rachis + petiole *c.* 5–16 cm; leaflets usually 5, apical ones reduced to 3–1; flush purple; almost sessile, obovate-oblong. *Racemes* 10–25 cm long, often branched. Pedicels 8–14 mm, accrescent. Bracts spathulate, the lowermost sometimes foliaceous, 3–14 mm long. *Calyx* patent, bright red, 7–8 mm. *Petals* bright red outside, whitish inside, 27–32 by 5–6 mm. *Stamens* longer than the petals, slightly unequal, 3½–4 cm. *Drupes* 1–5, purple-black, 12–13 mm long.

Distr. Native of Brazil, in *Malaysia* cultivated, occasionally naturalized.

Uses. The *Quassi*-wood is used as a tonic in case of stomach diseases and as an insecticide to destroy for instance plant lice. The active constituent of the wood consists of a number of bitter substances (HEYNE, *l.c.*).

2. Section Samadera

(GAERTN.) NOOTEBOOM, *nov. stat.*—*Locandi* ADANS. Fam. Pl. 2 (1763) 449, based on RHEEDE, Hort. Mal. 6 (1686) t. 18, *nom. gen. rejic.*; O.K. Rev. Gen. Pl. 1 (1891) 104.—*Samadera* GAERTN. Fruct. 2 (1791) 352, t. 156, 'f. 3', *nom. gen. cons.*; BOERL. Ned. Kruidk. Arch. II, 5 (1890) 520–524.—*Vitmannia* VAHL, Symb. Bot. 3 (1794) 51, t. 60.—*Niota* [POIR. in Lamk, Tabl. Enc. Méth. (1792) t. 299] LAMK, Enc. Méth. 4 (1797) 490.—*Biporeia* PETIT-THOUARS, Gen. Nov. Madag. (1806) 14, *nom. illeg.*—*Mauduita* COMM. *ex* DC. Prod. 1 (1824) 592, *nom. inval.*—*Manungala* BLANCO, Fl. Filip. (1837) 306.—*Samandura* LINNÉ [Fl. Zeyl. (1747) 202, *pro specim. Herm., excl.* RHEEDE t. 21] *ex* BAILLON, Hist. Pl. 4 (1873) 491, *nom. illeg.*; Bot. Méd. 2 (1884) 845, 874; PIERRE in De Laness. Pl. Utiles Col. Fr. (1886) 305; BAILL. Dict. Bot. 4 (1892) 11.

Leaves simple, with more or less scattered concave glands, usually on the undersurface. Flowers bisexual, in axillary or terminal, peduncled pseudo-umbels or in racemes. Calyx lobes 3–5, imbricate in bud, obtuse, in the centre with a concave gland. Petals 3–5, contorted, much longer than the calyx, usually hairy on the back. Disk large, as high as broad, gynophore-like. Style with a terminal inconspicuous stigma. Fruits rather large, (in Mal.) laterally compressed with a narrow unilateral sharp-edged thinner part in the apical half (in the Indo-Chinese *sp.* very large and dorsoventrally compressed).

Distr. Two *spp.*, Madagascar and from lower Burma and Cambodia throughout *Malaysia* (except Java and the Lesser Sunda Islands) to the Bismarcks and Solomons. *Q. indica* is cultivated in Java.

Ecol. Usually at low altitude under everwet climate conditions.

Note. BACKER (1907) defined the flowers as 3–5-merous. In *Q. indica* I have only seen 4-merous ones.

2. **Quassia indica** (GAERTN.) NOOTEBOOM, *comb. nov.*—*Samadera indica* GAERTN. Fruct. 2 (1791) 352, t. 156, f. 3; W. & A. Prod. (1834) 151; HOOK. Ic. Pl. 1 (1837) t. 7; GRAH. Cat. Bomb. Pl. (1839) 37; PLANCH. in Hook. Lond. J. Bot. 5 (1846) 562; THWAITES, En. (1858) 70; MIQ. Fl. Ind. Bat. 1, 2 (1859) 677; BENN. in Hook. f. Fl. Br. Ind. 1 (1875) 519; KURZ, For. Fl. Burma 1 (1877) 200; BLANCO, Fl. Filip. ed. 3, 4 (1880) 38; VIDAL, Sin. Atlas (1883) 19, t. 26, f. c.; Phan. Cuming. (1885) 101; Rev. Pl. Vasc. Filip. (1886) 78; TRIMEN, Fl. Ceyl. 1 (1893) 231; GRESHOFF, Schetsen (1894) 17–19, t.; MERR. Gov. Lab. Publ. Philip. *n.* 27 (1905) 29; BACK. Fl. Bat. (1907) 258, *incl. var. brevipetala* (SCHEFFER) BACK.; Schoolfl. Java (1911) 191; LAUT. Bot. Jahrb. 56 (1920) 342, *incl. var. papuana* LAUT.; MERR. Sp. Blanc. (1918) 206; En. Born. (1921) 315; RIDLEY, Fl. Mal. Pen. 1 (1922) 363; MERR. En. Philip. 2 (1923) 345; BACK. Bekn. Fl. Java (em. ed.) 4 (1948) fam. 146, p. 2; CAPURON, Adans. 1 (1961) 83.—*Karin-Njoti* RHEEDE, Hort. Mal. 6 (1686) t. 18.—*Vitmannia elliptica* VAHL, Symb. Bot. 3 (1794) 51, t. 60.—*Niota pentapetala* POIR. in Lamk,

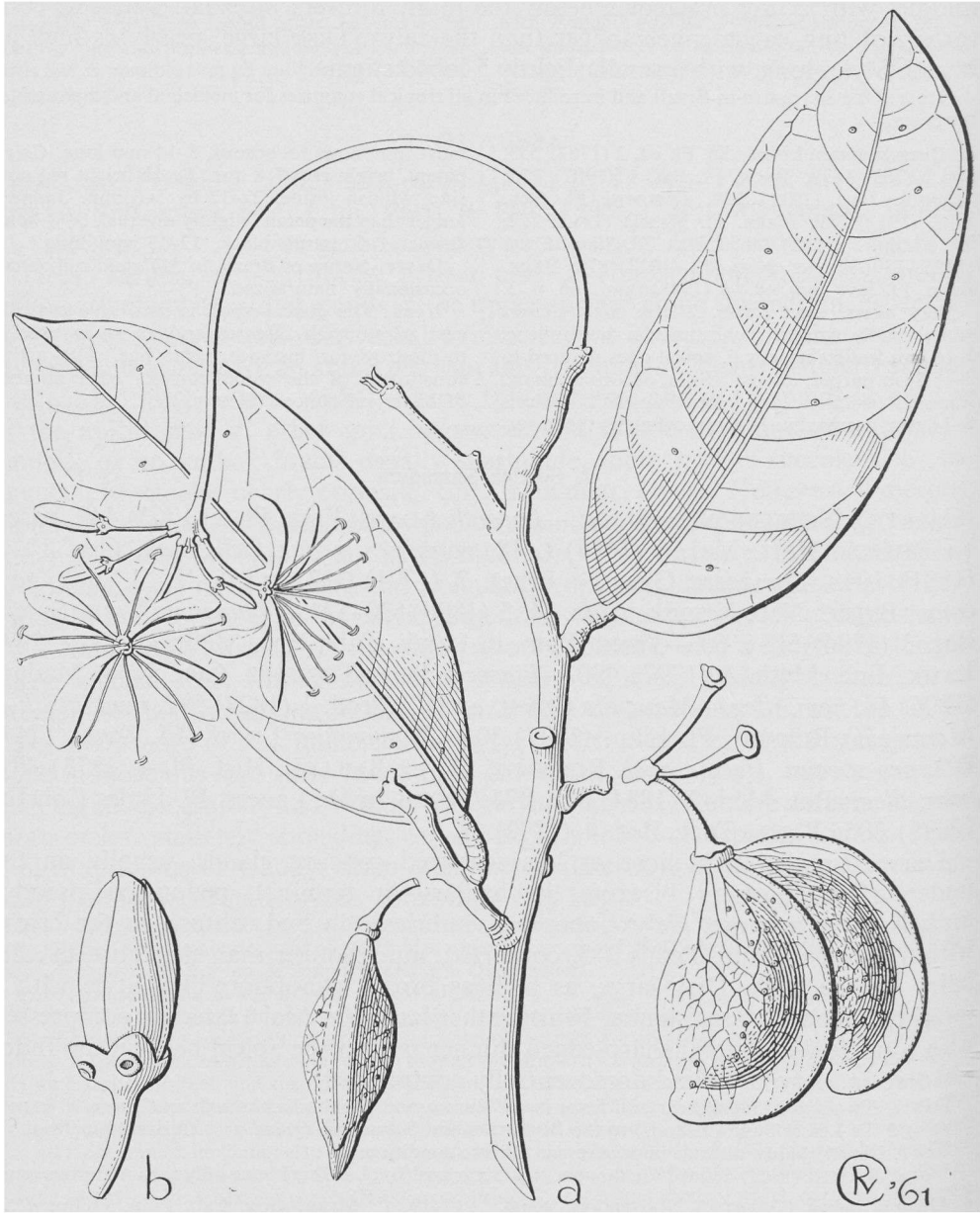

Fig. 3. *Quassia indica* (GAERTN.) NOOTEBOOM. *a*. Twig with flowers and fruit, × ⅔, *b*. bud, with glands on calyx, × 3 (*a* after GRESHOFF, *b* IBOET 48).

Encycl. 4 (1797) 490; DC. Prod. 1 (1824) 592; BLANCO, Fl. Filip. ed. 2 (1845) 213.—*Niota tetrapetala* POIR. in Lamk, Tabl. Encycl. Méth. (1792) t. 299; in Lamk, Encycl. 4 (1797) 490; DC. Prod. 1 (1824) 592; BLANCO, Fl. Filip. ed. 2 (1845) 213.—*Niota commersonii* PERS. Syn. 1 (1805) 416, *nom. inval.*—*Mauduita penduliflora* COMM. *ex* DC. Prod. 1 (1824) 592, *nom. inval.*—*Samadera madagascariensis* JUSS. Mém. Mus. Hist. Nat. Paris 12 (1825) 516, t. 27, *n.* 46, *nom. illeg.*—*Niota lamarckiana* BL. Bijdr. 5 (1825) 251, *nom. illeg.*—*Niota lucida* WALL. Pl. As. Rar. 2 (1831) 54, t. 168.—*Samadera tetrapetala* G. DON, Gard. Dict. 1 (1831) 811.—*Samadera*

pentapetala G. DON, *l.c.*—*Samadera glandulifera* PRESL, Symb. Bot. 2 (1833) 1, t. 51.—*Manungala pendula* BLANCO, Fl. Filip. (1837) 306.—*Vitmannia lucida* STEUD. Nomencl. ed. 2 (1841) 779.—*Samadera brevipetala* SCHEFF. Nat. Tijd. N.I. 32 (1871) 410.—*Samandura indica* BAILL. Bot. Méd. 2 (1884) 874; PIERRE in De Laness. Pl. Utiles Col. Fr. (1886) 305.—*Locandia indica* O.K. Rev. Gen. Pl. 1 (1891) 104.—*Locandia* O.K. *l.c.*—*Locandia madagascariensis* O.K. *l.c.*—*Samandura mekongensis* PIERRE, Fl. For. Coch. 4 (1892) t. 262, t.; LECOMTE, Fl. Gén. I.-C. 1 (1911) 694.—*Locandia glandulifera* PIERRE, Fl. For. Coch. 4 (1892) sub t. 262, *text.*—*Locandia mekongensis* PIERRE, *l.c.* t. 262, *text.*—*Locandia merguensis* PIERRE, *l.c.* sub t. 262, *text, nomen.*—*Locandia pendula* PIERRE, *l.c.* sub t. 262, *text.*—*Samadera mekongensis* ENGL. in E. & P. Pfl. Fam. 3, 4 (1896) 210.—*Samandura madagascariensis* PERRIER DE LA BATHIE, Fl. Madag. Fam. 105 (1950) 6, t. 2.—**Fig. 3.**

Glabrous evergreen shrub or tree, up to 20 m. *Branchlets* with a small pith, the base of each shoot provided with some stiff persistent scales. *Leaves* elliptic-oblong to lanceolate, rather acute or sometimes rounded or even subcordate at the base, blunt, more or less acuminate or sometimes rounded at the apex, 12–30 by 4–12 cm, midrib, nerves, and distinctly reticulated veins conspicuously prominent at either surface, always with internerval veins, usually with 2 pitted glands at the base beneath and similar ones scattered on the surface, less so above; petiole 1–2½ cm. *Flowers* up to 20 or more in an umbelliform, glabrous or puberulous inflorescence. Peduncle more or less flattened, thickened at apex, terminal or axillary, sometimes on old wood, 1–30 cm. *Pedicels* jointed in the lower half, ½–2½ cm, growing during anthesis, in fruit to more than 3 cm. Bracts minute. *Calyx* 4-lobed, 2–3 mm high, lobes about as long as the tube or longer, ± semiorbicular, puberulous outside. *Petals* 4, free, dorsally puberulous, obtuse, usually narrowed to the base, growing during anthesis, creamy-green to violet, purplish or brownish, up to 3 by 1 cm. *Filaments* puberulous, hairy except towards the apex, up to 2½ cm, inserted at the base of the disk; anthers lanceolate to oblong, *c.* 4 by 1–2 mm. *Disk* glabrous or nearly so, *c.* 2 by 1½ mm. *Carpels* 4, free, more or less puberulous, *c.* 2 by 2 mm; styles up to 2 cm. *Fruits* 1–4 together, flattened, with ± straight inner and ± semicircular outer margin, which is sharp and thinner in the upper half, the apex more or less overtopping the subapical stylar scar, 4–9 by 2½–5 cm; pericarp with similar glands as the leaf. *Seed* with an apical plumule and an adaxial conspicuous chalaza; testa thin; endosperm none; cotyledons planoconvex, up to 3½ by 2½ cm.

Distr. Madagascar, Ceylon, S. Concan, Malabar, Lower Burma (Martaban, Tenasserim), Andamans, and Cochinchina, throughout *Malaysia* (not in Sumatra, Java, and the Lesser Sunda Islands) to the Bismarcks and Solomons; cultivated in Java and elsewhere. Fig. 4.

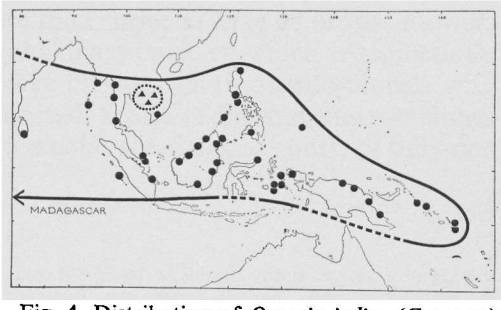

Fig. 4. Distribution of *Quassia indica* (GAERTN.) NOOTEBOOM (delineated and dots) and *Q. harmandiana* (PIERRE) NOOTEBOOM (dotted delineation with localities in triangles).

Ecol. Usually very rare, but locally rather common in the eastern part of its area, preferably in wet places in lowland, forests below 150 m, sometimes in localities which are periodically inundated by fresh or by salt water, for example on edge of the mangrove, in East North Borneo common in young swamp forests back of the mangrove. *Fl. fr.* Jan.–Dec.

Uses. In Sarawak the wood is used for making handles of knives, in the Solomons the macerated leaves, mixed with coconut oil, are applied to hair for cleansing purposes.

The seeds are given as an emetic and purgative, and sometimes in bilious fevers. In the Philippines chips of wood are put in coconut oil which is drunk as a purgative. The same oil is used as a liniment for rheumatism and bruises. The plant is also used against malignant fevers, as a tonic, and as insecticide, specially against ants.

The seeds contain oil to the extent of one third of their weight, but by difficulty of getting a sufficient supply it is not commercial (GRESHOFF, Schets. 1, 1894, 19; HEYNE, Nutt. Pl. 1927, 869; BURK. Dict. 2, 1935, 1945; QUIS. Medic. Pl. Philip. 1951, 475).

Vern. Philip.: *daraput, linatog-anat, lintongamai, mabingdato, palagarium, palagium, ponoan,* Bis., *maluñggál, móñgal,* Tag., *manuñggál,* Tag., Bik., Pamp., P. Bis., Lan., Ibn., *palo santo,* Spanish, *rapus* (tree), *kĕlĕpis, klipis* (fruit), Banka, *kaju pait,* Borneo, *gatĕp pait,* Java, *onne,* Ternate.

Notes. According to CAPURON *l.c.* the species is doubtless native in Madagascar and not rare in the substage of swampy forests along the east coast, rarely ascending on crests to 400–600 m.

The leaves show a resemblance to those of *Irvingia* and *Inocarpus* but are distinguished by the occurrence of scattered concave glands.

3. Section Simaba

PIERRE, Bull. mens. Soc. Linn. Paris *n.* 156 (1896) 1236.—*Quassia sect. Odyendyea*

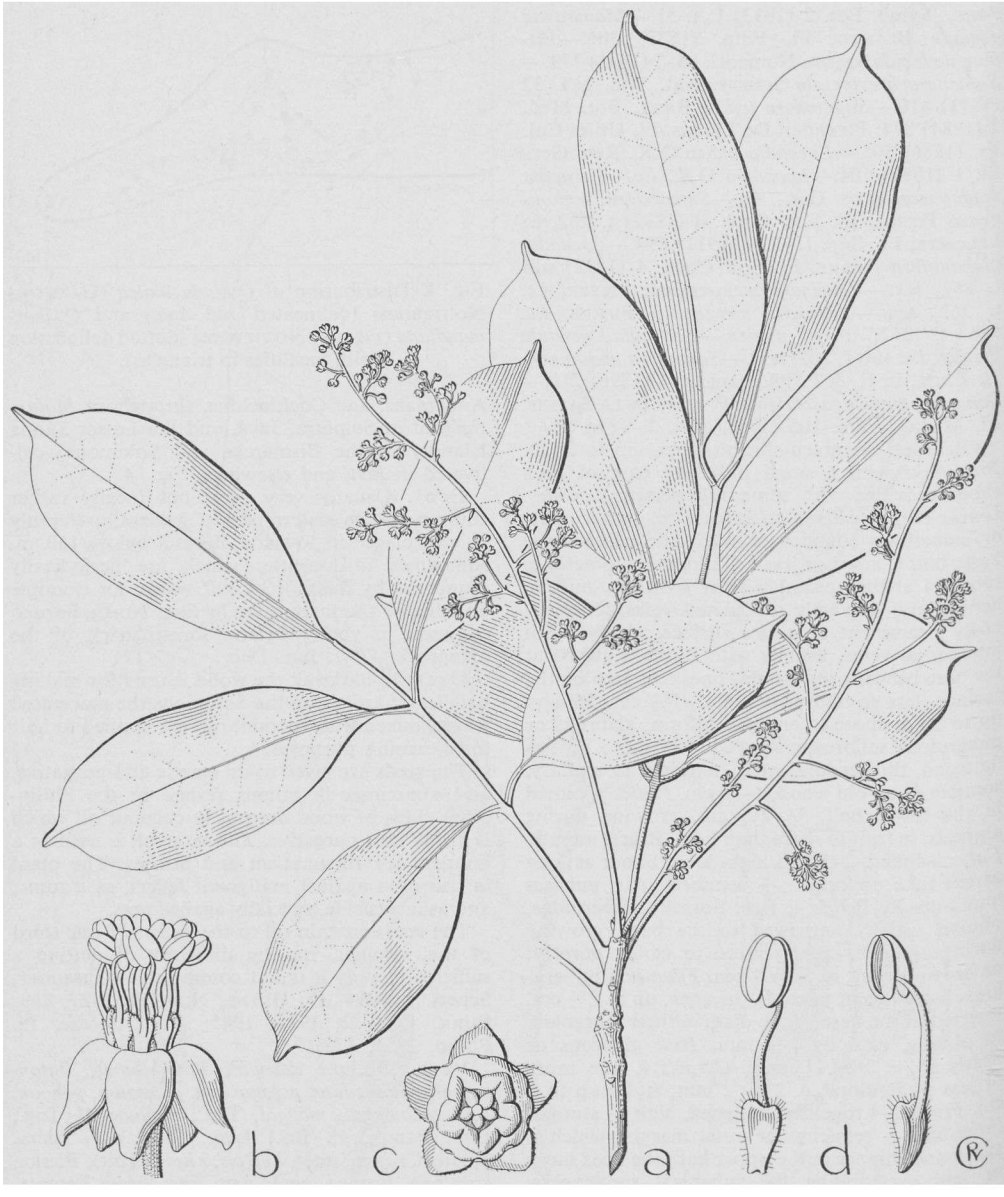

Fig. 5. *Quassia borneensis* NOOTEBOOM. *a.* Habit, × ½, *b.* ♂ flower, × 5, *c. ditto*, from above, stamen and petals removed, the disk seemingly consists of two rings, the star-shaped structure in the centr represents the 5 vestigial carpels, × 10, *d.* frontal and dorsal view of stamen (*a–d* MEYER San 20499).

PIERRE, *l.c.* 1238.—*Simaba* AUBL. Hist. Pl. Guian. (1775) 400, t. 153.—*Aruba* AUBL. *l.c.* 293, t. 115.—*Hannoa* PLANCH. in Hook. *f.* Lond. J. Bot. 5 (1846) 566.—*Mannia* HOOK. *f.* in B. & H. Gen. Pl. 1 (1862) 309.—*Hyptiandra* HOOK. *f. l.c.* 293, 990.—*Odyendyea* (PIERRE) ENGL. in E. & P. 3, 4 (1896) 215.—*Pierreodendron* ENGL. Bot. Jahrb. 39 (1906) 575.—*Simarubopsis* ENGL. Bot. Jahrb. 46 (1911) 276.

Leaves pinnate or simple, if simple more than thrice as long as broad. Flowers bisexual or trees polygamous, in terminal or axillary panicles, which are sometimes reduced to few-flowered, axillary, umbel-like clusters, or to pseudo-umbels with forked peduncles. Petals imbricate or contorted. Scales of the stamens sometimes nearly as long as the filament and somewhat coherent. Stigmas short, or only one 4–5-lobed or punctate stigma.

Distr. Pantropical, *c.* 20 *spp.* in tropical South and Central America, *c.* 5–10 *spp.* in Africa, 1 *sp.* in Malaysia, and 2 *spp.* in Australia.

3. Quassia borneensis NOOTEBOOM, *nov. spec.*—**Fig. 5.**

Arbor mediocris, foliis paripinnatis vel imparipinnatis, 2–3-jugatis. Foliola elliptico-oblonga vel obovato-oblonga, abrupte acuminata, glabra, margine superne glandulis parvis munita, 8–12 cm longa, 4–4½ cm lata. Flores ♂ sepalis puberulis basi coalitis 1 mm longis; petalis imbricatis vel contortis, elliptico-oblongis vel ovato-oblongis, glabris, 3 mm longis 2 mm latis, staminibus squama pilosa apice emarginata ½–1 mm longa semiadnata instructis; disco insigni, basi 2 mm lato, apice 1 mm lato, ½ mm alto; vestigiis carpellorum ¼ mm longis, stylo carpellis longitudine aequanti.—Typus MEIJER SAN 20499, in L, isotypes K, SAN.

Tree, 14 m by 25 cm ø; outer bark densely fissured, brittle and corky. *Leaves* spirally arranged, pari- or imparipinnate; leaflets 2–3 pairs, glabrous, elliptic to obovate-oblong, shortly rounded-acuminate, 8–12 by 4–4½ cm; upper surface shining, lower surface opaque; very small pitted glands along the margins and in the acumen on the upper surface; nerves sunken in both upper and lower surface, or obscure, ending in a marginal vein; veins obscure; petiole *c.* 5 cm, as the rachis ± terete; petiolules 1–1½ cm, articulated at the base. *Panicle* puberulous in all its parts, not quite as long as the leaves. Bracts spathulate, succulent in the apical part, up to 2½ mm long. ♂ *Flowers* 4–5-merous. Pedicels up to 7 mm. *Calyx c.* 1 mm high, outside puberulous, lobes ovate to triangular, longer than the tube. *Petals* contorted or imbricate in bud, glabrous, elliptic to ovate-oblong, *c.* 3–4 by 2 mm. *Stamens* slightly shorter than the petals; filaments sigmoid-folded in bud, with a hairy adaxial scale at the base; scale free for ⅓ of its length, more or less emarginate, *c.* ½–1 mm long; anthers oblong, latrorse, *c.* ½–1 mm long. *Disk c.* ½ mm high, at the basis *c.* 2 and at the apex *c.* 1 mm wide, the upper half distinct from the lower half and folded around the barren ovaries. *Carpels* free, *c.* ¼ mm high; style as long as the carpels, with a small 4–5-lobed stigma. ♀ *Flowers* unknown. *Fruits* drupaceous, 1–5 from each flower, if more than one diverging radially from a thickened torus, prune-shaped, dark purple-red when ripe *sec. coll.*; in dry state slightly flattened-ellipsoid, with a faint dorsal and ventral ridge, *c.* 2–3 by 1½ cm; pericarp thin but hard. *Seed* with a thin testa; plumule short; cotyledons large, green, plano-convex; no endosperm (BURGESS 2849).

Distr. *Malaysia*: Central Sumatra (Indragiri), Borneo.

Ecol. Primary rain-forest at low altitude, often in peat-swamp forest, also on mineral soil.

Notes. Obviously closely allied to the African species described by PIERRE in *Quassia sect. Odyendyea*. All these species have the filaments sinuously folded in bud, a condition not observed in other species of *Quassia*.

Excluded

Niota globosa BLANCO, Fl. Filip. ed. 2 (1845) 214 is, according to MERR. Sp. Blanc. (1918) 225 = *Cleidion spiciflorum* (BURM. *f.*) MERR. (*Euphorbiaceae*).

Niota polyandra BUCH. HAM. *ex* W. & A. Prod. (1834) 63, *nomen subnudum*; *Vitmannia polyandra* STEUD. Nomencl. ed. 2, 4 (1841) 779 = *Brownlowia tersa* (L.) KOSTERM. (*Tiliaceae*).

3. EURYCOMA

JACK, Mal. Misc. 2 (1822) 45; ROXB. Fl. Ind. 2 (1824) 307; PIERRE, Fl. For. Coch. 4 (1892) t. 292, t. 293; ENGL. in E. & P. Nat. Pfl. Fam. ed. 2, 19a (1931) 380.—*Picroxylon* WARB. in Fedde, Rep. 16 (1919) 256.—**Fig. 6, 7a–e.**

Treelets or rarely shrubs, up to *c.* 10 m high, monoecious or dioecious. *Leaves* imparipinnate, usually multijugate, long and numerous, crowded at the tips of the rather thick, pithy branches, leaving large scars. *Leaflets* opposite or subopposite, slightly oblique, ovate-lanceolate to obovate-lanceolate, rarely ovate-oblong (or linear extra-Mal.), sessile or nearly so, attached to the rachis with a *conspicuous articulation*; midrib slightly prominent on the upper surface, prominent beneath; nerves inconspicuous above and below, or slightly sulcate beneath, straight, ending

Fig. 6. Habit of *Eurycoma longifolia* JACK (Photogr. W. MEIJER, Sandakan, June 1960).

in an intramarginal, looped vein. Panicles axillary, mostly large and lax, puberulous, usually also with thickish, short, stiff, capitate-glandular hairs. *Flowers* bisexual, ♀ or ♂; ♀ flowers always with rather large but sterile stamens, ♂ flowers always with a sterile pistil. *Calyx* small, 5(–6) lobed, lobes ovate to triangular, acute or bluntish, longer than the tube. *Petals* 5(–6), induplicate-valvate in bud, lanceolate or ovate- to obovate-oblong. *Stamens* 5(–6), episepalous, filaments narrowing to the top, usually with a very small (*c.* $^1/_5$ mm long) adaxial ligule at the base, alternating with 5(–6) small entire, emarginate or cleft staminodes, which are usually connate with the abaxial and lateral sides of the base of the filaments; sometimes there is a second row of still smaller entire staminodes outside the stamens; stamens and staminodes sometimes connate with the base of the petals; filaments glabrous or sparsely hairy. Disk inconspicuous. *Carpels* 5(–6), free, the style attached adaxially near the top and mutually connate or coherent; stigma peltate, 5(–6)-lobed. Each ovary with 1 anatropous ovule with adaxial placenta. *Fruits* up to 5, *c.* 3 mm stalked, spreading, ellipsoid or ovoid, slightly bicarinate nuts with very thin exocarp and hard endocarp. *Seed* exalbuminous with 2 planoconvex cotyledons and a short plumule.

Distr. Three *spp.* in tropical SE. Asia (Lower Burma, Siam, Indo-China), Sumatra, the Malay Peninsula, Borneo, and the S. Philippines. Fig. 8, 14.

Ecol. Preferably on sandy soils below 1200 m, sometimes flowering at an early age.

Uses. The roots, and particularly the bark of the roots, are used as a febrifuge. The Malays give it also as a tonic, *e.g.* after childbirth. In Borneo a decoction of the bark is drunk to relieve pain in the bones and a decoction of the leaves is used for washing itches. The Malavan name *bĕdara laut* is also used for *Strychnos*, which has the same uses (*cf.* BURKILL, Dict. 1, p. 984).

Vern. (for both Mal. *spp.*). Malay Peninsula: *bĕdara mèrah, b. puteh, b. pahit, bumi, lĕmpĕdu pahit, muntah, payong ali, pĕnawar pahit, pĕtala bumi, tongkit ali, t. baginda*, M; *akar jangat sĕmang, duak, jĕlas*, Sakai; Sumatra: *bĕgu-gad-jan, bĕsan, bèsèng*, Karo; *bidara laut, b. putih*, M; *kaju pĕtimah, k. porhis potala*, Alas; *njatu suria*, Taram; *kaju pulae, mĕmpoleh*, Banka; *parie potala*, Padang; Borneo: *bina, kabal kabal bĕrang, sĕrirama, tongkat ali; babi kurus*, J for the drug.

Note. Though in current classifications *Eurycoma* is referred to the subtribe *Eurycominae* and the genus *Quassia* to the subtribe *Simaroubinae*, of the tribe *Simaroubeae*, I find it unsatisfactory to divorce *Eurycoma* from *Quassia* which show an astonishing similarity in both vegetative and generative aspects, save that whereas *Eurycoma* has 5 stamens and 5 staminodes, valvate petals and a less developed disk, there are in *Quassia* 10 stamens, contorted or imbricate petals, and a well-developed disk. In my opinion they represent a couple of closely related genera of one tribe.

KEY TO THE SPECIES

1. Leaflets ovate-lanceolate to obovate-lanceolate, rarely ovate-oblong, more than ½ cm wide.
2. Leaflets not or slightly acuminate, but the apex rather acutish as compared with next species. Petals about twice as long as wide. Anthers *c.* ¼mm long. Styles rather long, stigma *c.* 1 mm above the ovaries . . . . . **1. E. longifolia**
2. Leaflets usually rather abruptly very blunt-acuminate. Petals linear 4 or more times as long as wide. Anthers *c.* ¾ mm long. Styles very short, stigma sessile . . . . . **2. E. apiculata**
1. Leaflets linear, up to 7 by *c.* ½ cm, hard coriaceous, leaves 8–18 cm long. Dwarf tree or shrub, up to 1 m high. Petals pubescent on both sides. Anthers *c.* ¾ mm long. Panicles without glandular hairs. (Siam and Cambodia.) . . . . . **3. E. harmandiana**

1. **Eurycoma longifolia** JACK, Mal. Misc. 2 (1822) 45; ROXB. Fl. Ind. 2 (1824) 307; DC. Prod. 2 (1825) 86; MIQ. Fl. Ind. Bat. 1, 2 (1859) 681; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 521; F.-VILL. Nov. App. (1880) 39; VIDAL, Rev. Pl. Vasc. Filip. (1886) 78; PIERRE, Fl. For. Coch. 4 (1892) t. 292, t. 293, *incl. var. merguensis* and *var. cochinchinensis*; KING, J. As. Soc. Beng. 62, ii (1893) 229; RIDL. J. Str. Br. R. As. Soc. 30 (1897) 205, *err. latifolia*; J. Str. Br. Med. Assoc. *n.* 5 (1897) 127, *ditto*; LECOMTE, Fl. Gén. I.–C. 1 (1911) 695; BACK. Schoolfl. Java (1911) 193; MERR. Philip. J. Sc. 10 (1915) Bot. 190; En. Born. (1921) 316; RIDLEY, Fl. Mal. Pen. 1 (1922) 362; MERR. En. Philip. 2 (1923) 346; CRAIB, Fl. Siam. En. 1 (1926) 242; MERR. Pl. Elm. Born. (1929) 116.—*E. merguensis* PLANCH. in Hook. Lond. J. Bot. 5 (1846) 584,—*E. tavoyana* WALL. Cat. (1847) *n.* 8523, *nomen.*—*Picroxylon siamense* WARB. in Fedde, Rep. 16 (1919) 256.—*Manotes asiatica* GAGN. Bull. Soc. Bot. Fr. 98 (1951) 207 (VIDAL, *in litt.*).

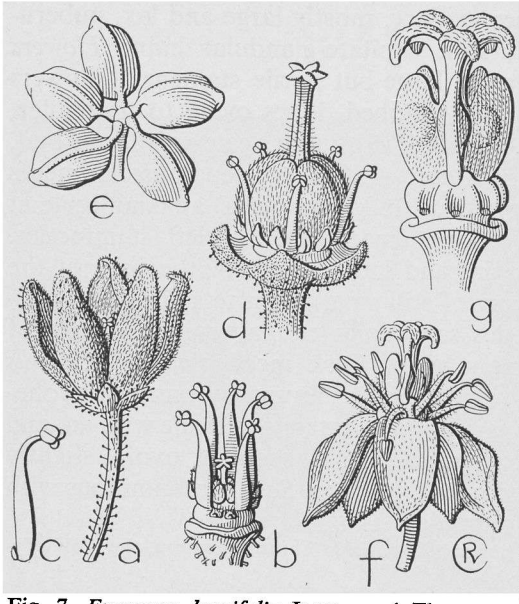

Fig. 7. *Eurycoma longifolia* JACK. *a.* ♂ Flower, × 4, *b. ditto*, petals and sepals removed, × 8, *c.* stamen, × 16, *d.* ♀ flower, petals removed, × 8, *e.* fruits, nat. size.—*Ailanthus integrifolia* LAMK. *f.* Flower, × 2, *g.* ovary, × 4 (*a–d* MEIJER 6712, *e* KOSTERMANS 6654, *f–g* C.H.B. III–E–2).

ssp. **longifolia.—Fig. 6, 7a–e.**

Leaves up to *c.* 1 m long. Leaflets lanceolate to obovate-lanceolate, rarely ovate-oblong, sometimes slightly acuminate with a bluntish or acute apex, *c.* 5–20 by 1½–6 cm. *Panicles*, pedicels, sepals, and calyx puberulous and with capitate-glandular hairs. Flowers reddish. Bracts triangular, very small, up to *c.* 1 mm, caducous. Pedicels rather thick, up to *c.* 7 mm. *Calyx* small, lobes *c.* 1 mm long. *Petals* puberulous on both surfaces, lanceolate to ovate- or obovate-oblong, *c.* 4½–5½ by 2–3 mm. *Stamens* usually longer than the calyx, *c.* 1½–2½ mm long, anthers *c.* ¼ mm long. Staminodes from ½ mm in ♀ flowers to *c.* 2 mm in ♂ flowers. *Styles* rather long, with a peltate 5(–6)-lobed stigma elevated *c.* 1 mm above the ovaries. *Fruits* 10–17(–20) by 5–12 mm.

Distr. Lower Burma, Siam, Laos, Cambodia, Indo-China; in *Malaysia*: Sumatra, Malay Peninsula, and Borneo. Fig. 8.

Ecol. Frequent at low altitude in beach forests on sandy soil, in primary and secondary forest as an understorey treelet, according to RICHARDS (J. Ecol. 24, 1936, 22) in mixed dipterocarp rain-forest, in heath forest and in low forest on ridge crests in Sarawak on Mt Dulit, on sandstone and dry kerangas, a characteristic silicicolous species, locally frequent, generally at low altitude, rarely up to 500 or even 1000 m. *Fl. fr.* Jan.–Dec.

Note. *Eurycoma longifolia* JACK *ssp. longifolia* has been recorded from the Philippines by F.-VILLAR and VIDAL, but this record rested on an erroneously localized specimen (LOBB 486) which according to MERRILL (1915) probably came from Borneo or Malaya.

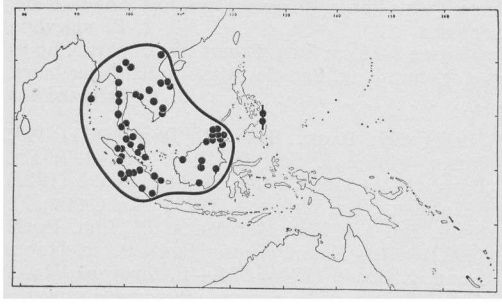

Fig. 8. Distribution of *Eurycoma longifolia* JACK (delineated, dots) and its *var. eglandulosa* (MERR) NOOTEBOOM (2 lined dots).

ssp. **eglandulosa** (MERR.) NOOTEBOOM, *nov. stat.*—*E. eglandulosa* MERR. Philip. J. Sc. 17 (1920) 266; En. Philip. 2 (1923) 346.

Panicles, pedicels, and flowers puberulous, without glandular hairs. Petals 5–6½ mm long.

Distr. *Malaysia*: Philippines (Mindanao: Surigao; Dinagat), twice collected. Fig. 8.

Ecol. In forests at low altitudes.

2. Eurycoma apiculata BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 522; KING, J. As. Soc. Beng. 62, ii (1893) 230; RIDL. Fl. Mal. Pen. 1 (1922) 363.

Leaves c. 40 cm long. *Leaflets* usually rather abruptly very blunt-acuminate, *c.* 8–14 by 2–4 cm. *Panicles*, pedicels, calyx, and petals with thick, stiff, capitate-glandular hairs. Bracts small, linear, up to *c.* 1 mm long. Pedicels rather slender, up to *c.* 7 mm long. *Calyx lobes c.* 1½–2 mm long. *Petals* puberulous, with glandular hairs outside, glabrous within, linear, rarely lanceolate, *c.* 4–9 by 1–1½ mm. *Stamens* usually as long as the calyx or shorter, *c.* 2 mm long, anthers *c.* ¾ mm long; ligule usually absent; staminodes in 1 or 2 rows, up to *c.* ¼ mm, small or absent. *Styles* very short, with a 5-lobed sessile stigma. Fruit as in former species.

Distr. *Malaysia*: Sumatra, Malay Peninsula. Fig. 14.

Ecol. Similar as in *E. longifolia*, but usually at higher altitude, up to *c.* 1200 m. *Fl. fr.* Jan.–Dec.

3. Eurycoma harmandiana PIERRE, Fl. For. Coch. 4 (1892) t. 292 B; LECOMTE, Fl. Gén. I.–C. 1 (1911) 696; CRAIB, Fl. Siam. En. 1 (1926) 242.

Excluded

Eurycoma dubia ELMER, Leafl. Philip. Bot. 2 (1908) 481 is according to HALLIER, Rec. Trav. Bot. Néerl. 15 (1918) 55 and MERRILL, En. Philip. 2 (1923) 329 = *Evodia meliaefolia* (HANCE) BENTH. (*Rutaceae*).

4. HARRISONIA

R. BROWN *ex* A. JUSS. Mém. Mus. Hist. Nat. Paris 12 (1825) 517, *nom. gen. cons. prop., non* ADANS. *ex* LEMAN, 1821; *cf.* Taxon 10 (1961) 243.—*Ebelingia* KCHB. Consp. (1828) 199.—*Lasiolepis* BENN. Pl. Jav. Rar. (1844) 202.—**Fig. 9.**

Thorny, erect or sprawling shrubs, rarely small trees, up to 12 m. Branches pithy, older ones glabrous, lenticellate; stipular thorns accrescent, conical, finally caducous, slightly recurved, up to 7 mm; annual shoots at the base with small persistent bud-scales and sometimes spines. *Leaves* imparipinnate or ternate; rachis narrowly winged; leaflets subentire to lobed, ± sessile, the apical one whether or not with a longer petiole than the lateral ones but without articulation, rhomboid to ovate-lanceolate, blunt. *Flowers* bisexual, 4–5-merous, in bracteate axillary cymes or terminal, rarely axillary thyrses. *Calyx* small, lobes acutish-triangular, about as long as the tube or longer. *Petals* much longer than the calyx, slightly imbricate in bud. *Stamens* attached at the base of the disk, twice as many as petals; filaments with an adnate 2-lobed or emarginate hairy ligule free at its top; anthers latrorse, cells diverging in lower half; filament attached between the cells. *Ovary* 4–5-celled, slightly lobed, seated on a rather thick disk; ovules 1 per cell, amphitropous, pendent from the adaxial side near the top; styles 4–5, connate or sometimes free at the very base; stigma knob-shaped, slightly 4–5-lobed. *Drupe* depressed-globose, sometimes ± lobed; exocarp fleshy or coriaceous; endocarp hard; fertile cells 2–5, each with a perforation of the hard endocarp at the base of the stylar canal. *Seed* with a thin testa, endosperm present; cotyledons horse-shoe-shaped, radicle pointing upwards.

Distr. About 3–4 *spp.* in tropical Africa and from SE. Asia through *Malaysia* (2 *spp.*) to North Australia.

Ecol. The Malaysian *spp.* usually on dry, open, hot places, often on limestone rocks, under distinctly seasonal conditions, usually at low altitude, up to 700 m, locally sometimes extremely common in thickets, less common in open monsoon forests.

Uses. In some parts of Malaysia the shoots are used as a drug against diarrhoea. In the Philippines a decoction of the bark and roots is used against diarrhoea and dysentery, and apparently also against cholera (HEYNE, Nutt. Pl. 1927, 871; BURK. Dict. 1935, 1128).

Note. The leaves resemble some species of *Zanthoxylum* (*Fagara*) but these are gland-dotted.

KEY TO THE SPECIES

1. Leaves ternate. Flowers usually 4-merous, *c.* 4 mm long. Fruits 4–5 by 7–9 mm . . . . **1. H. brownii**
1. Leaves imparipinnate, (1–) 3–8 (–13)-jugate. Flowers usually 5-merous, 6–10 mm long. Fruits 4–9 by 11–15 mm. . . . . **2. H. perforata**

1. **Harrisonia brownii** A. JUSS. Mém. Mus. Hist. Nat. Paris 12 (1825) 540, pl. 28, *n.* 47; GAUDICH. Bot. Freyc. Voy. (1826) t. 103, *non vidi*; DECNE, Herb. Tim. Descr. (1835) 120; MIQ. Fl. Ind. Bat. 1, 2 (1859) 677; BENTH. Fl. Austr. 1 (1863) 376; F.-VILL. Nov. App. (1880) 39; VIDAL, Phan. Cuming. Philip. (1885) 101; Rev. Pl. Vasc. Filip. (1886) 78; BAILEY, Queensl. Fl. 1 (1899) 221; BACK. Schoolfl. Java (1911) 194; MERR. En. Philip. 2 (1923) 346; BACK. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 4.—*Ebelingia brownii* STEUD. Nom. ed. 2 (1840) 535; O.K. Rev. Gen. Pl. 1 (1891) 103.—**Fig. 9f.**

Leaves ternate; apical leaflet gradually narrowing into a 0–1 cm long petiolule, 1½–8(–13) by ½–5(–8) cm; lateral leaflets usually oblique, cuneate towards the rachis, 1–5 by ½–2½ cm; petiole ½–3 cm. *Cymes* and *thyrses* up to 5(–7) cm long. *Bracts* persistent, triangular, pubescent, *c.* 1½ mm long, once found like a small leaflet. *Flowers* 4(–5)-merous. *Pedicels* up to 6 mm. *Calyx* glabrous or sparsely hairy, *c.* ½ mm high. *Petals* lanceolate to oblong, 3½–5 by 1½–2½ mm. *Anthers* 1½–2 by 1 mm; filaments *c.* 2 mm; ligule 1–1½ mm. Disk ± short-cylindrical, slightly 8- or 10-lobed below the margin, ¼–½ mm high. *Ovary c.* ½–1 mm high, rather deeply lobed; style ½–2½ mm. *Drupe c.* 4–5 by 7–9 mm; exocarp thin, fleshy; endocarp hard; each cell with an abaxial suture.

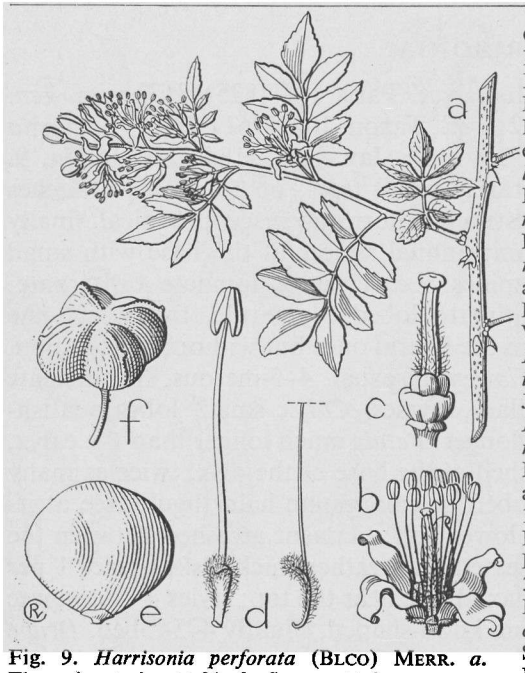

Fig. 9. *Harrisonia perforata* (BLCO) MERR. *a.* Flowering twig, × ⅔, *b.* flower, × 2, *c.* gynaecium and disk, × 4, *d.* stamens, × 8, *e.* fruit, nat. size.—*H. brownii* A. JUSS. *f.* Fruit, × 2 (*a* MERRILL 433, *b–d* TEYSMANN & DE VRIESE *s.n.*, *e* KOORDERS 30017, *f* BACKER 19469).

Distr. North Australia (islands in the Gulf of Carpentaria), S. Andaman, and *Malaysia*: S. Philippines (Palawan, Mindanao, Cebu, Bohol, Siquijor), E. Celebes (Banggai Pen., Muna I.), E. Java (also Madura and Kangean), Lesser Sunda Islands (Bali, Sumba, Sumbawa, Flores, Timor, Wetar), S. Moluccas (Babar and Tanimbar Is), and SE. New Guinea. Fig. 10.

Ecol. and Uses. See under the genus.

Vern. Philip.: *kankasira*, Tagb., *malomanhak*, C. Bis.; *kaju bilis*, Md, *tadaibana*, *tara kedauk*, Sumba, *kai tudu*, Timor.

Notes. In one sheet I found detached fruits of which the cells had dehisced along the suture.

The species has erroneously been recorded from Malaya by KING (J. As. Soc. Beng. 62, ii, 1893, 227) and RIDLEY (Fl. Mal. Pen. 1, 1922, 360) in confusion with *H. perforata*.

The leaves of the S. Andaman specimen (KING *s.n.* 7-3-1891, in SING) agree with those of *H. brownii*, but the buds are immature and fruit is lacking, defeating proper identification. KURZ also with doubt referred material from the Andamans to *H. brownii* (Rep. Veg. Andam. 1870, 33) but his material was lost. Plant-geographically the Andamans represent a marked and unexpected extension of the range towards the west.

2. Harrisonia perforata (BLANCO) MERR. Philip. J. Sc. 7 (1912) Bot. 236; Fl. Manila (1912) 272; Sp. Blanc. (1918) 206; En. Philip. 2 (1923) 346; CRAIB, Fl. Siam. En. 1 (1926) 243; GAGNEP. Fl. Gén. I.–C. Suppl. 1 (1946) 659; BACK. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 4; FORMAN, Kew Bull. 1957 (1958) 503.—*Paliurus perforatus* BLANCO, Fl. Filip. (1837) 174, ed. 2 (1845) 122, ed. 3, 1 (1877) 220.—*Paliurus dubius* BLANCO, *ll. cc.* 175, 123, and 221.—*Lasiolepis paucijuga* BENN. Pl. Jav. Rar. (1844) 202, t. 42.—*Lasiolepis multijuga* BENN. *l.c.* 204.—*Lasiolepis bennettii* PLANCH. in Hook. Lond. J. Bot. 5 (1846) 570, *nom. illeg., incl. var. α paucijuga* (BENN.) PLANCH. and *var. β multiijga* (BENN.) PLANCH.; MIQ. Fl. Ind. Bat. 1, 2 (1859) 678.—*Limonia pubescens* WALL. *ex* HOOK. *f.* Fl. Br. Ind. 1 (1875) 507.—*H. paucijuga* OLIV. Fl. Trop. Afr. 1 (1868) 312, *in obs.*; BACK. Fl. Bat. 1 (1907) 257; Schoolfl. Java (1911) 194; HEYNE, Nutt. Pl. (1927) 871.—*H. bennettii* BENN. in Fl. Br. Ind. 1 (1875) 519, *nom. illeg.*; KURZ, For. Fl. Burma 1 (1877) 203; F.-VILL. Nov. App. (1880) 39, *incl. var. paucijuga* and *var. multijuga*; VIDAL, Sinops. Atlas (1883) 19, t. 26 f. A; Phan. Cum. Philip. (1885) 101; Rev. Pl. Vasc. Filip. (1886) 78; LEC. Fl. Gén. I.–C. 1 (1911) 689; RIDL. Fl. Mal. Pen. 1 (1922) 360.—*Fagara piperita* (*non* L.) NAVES in Blanco, Fl. Filip. ed. 3, 1 (1877) t. 23, *excl. syn.* DC., *cf.* F.-VILL. Novis. App. (1880) 39 and MERR. Sp. Blanc. (1918) 206.—*Ebelingia paucijuga* O.K. Rev. Gen. Pl. 1 (1891) 103.—*H. citrinaecarpa* ELM. Leafl. Philip. Bot. 8 (1915) 2828.—*Feroniella pubescens* TANAKA, Bull. Mus. Hist. Nat. Paris II, 2 (1930) 161; ENGL. Pfl. Fam. ed. 2, 19a (1931) 354; SWINGLE in The Citrus Industry 1 (1943) 470; GAGNEP. Fl. Gén. I.–C. Suppl. 1 (1946) 651.—**Fig. 9a–e.**

Leaves 1–15-jugate, up to *c.* 20 cm; rachis narrowly winged, usually with a rib above, more or less pubescent, especially above; leaflets 10–20 by 5–15 mm; petiole ½–3 cm. Branches of cymes and thyrses usually for some length adnate to the peduncle. Pedicels up to 2 mm. *Calyx c.* 1½ mm high, lobes *c.* ¾ mm. *Petals* lanceolate, rarely oblong, 6–9 by 2–4 mm. *Anthers c.* 1½–4½ mm; filaments 7–10 mm; ligule densely woolly at the margin, *c.* 2 mm. Disk cup-shaped, 1–2 mm high. *Ovary* ½–1 mm high, slightly lobed; style pubescent, 5–8 mm. *Fruit* 4–9 by 11–15 mm; exocarp coriaceous, at least 1 mm thick; endocarp hard; no suture in the endocarp.

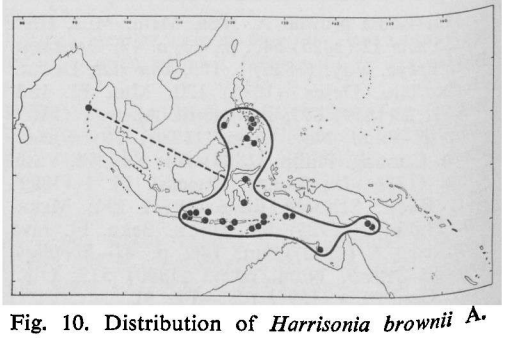

Fig. 10. Distribution of *Harrisonia brownii* A. JUSS.

Distr. SE. Asia (Hainan, Cochinchina, Cambodia, Siam, and Burma) and *Malaysia*: Malay Peninsula (Perlis, ?Kedah, ?Perak), Philippines, N. Borneo (Sandakan), Celebes (also Buton), Java (also Madura and Kangean), S. Sumatra (Lampongs), and Lesser Sunda Islands (Bali). Fig. 11.

Ecol. and Uses. See under the genus.

Vern. Philip.: *asimau, laiya, mamigil*, Tag., *bákit. sapsapáng*, Ilk., Pang., *dagiangas*, Mbo., *kamungi*, Sul., *muntani*, Bis., *saplèng*, Sbl.; *ri kèng-kèng*, J, Md., *garut, sësëpang*, Lamp.

Note. In the sterile state sometimes difficult to distinguish from certain *spp.* of *Fagara* (*Zanthoxylum*) which have pellucid glands in the leaf and large glands along the margin near the teeth. However, in *H. perforata* the latter may occasionally also be observed.

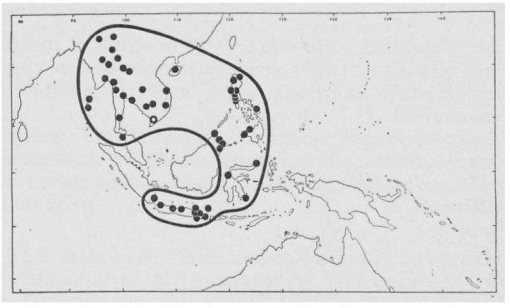

Fig. 11. Distribution of *Harrisonia perforata* (BLCO) MERR., from Asia following the drought corridor through Central Malaysia.

5. BRUCEA

J. F. MILL. Icon. (1779) t. 25, *nom. gen. cons.*; L' HÉRIT. Stirp. (1784) 19, t. 10; BRUCE, Travels 5, App. (1789) 69, tab.; Cartes & Fig. Voy. Nub. & Abess. (1792) t. 21; ENGLER, Nat. Pfl. Fam. ed. II, 19a (1931) 386.—*Lussa* RUMPH. [Herb. Amb. 7 (Auct.) (1755) 27, t. 15, *nom. inval.*] *ex* O.K. Rev. Gen. Pl. 1 (1891) 104.—*Gonus* LOUR. Fl. Coch. (1790) 158.—**Fig. 12.**

Very bitter, monoecious or dioecious shrubs or small trees; at least the younger parts pubescent or puberulous. *Leaves* exstipulate, imparipinnate, petiolar base and rachis-joints shrunken in the herb.; leaflets 3–15, more or less oblique, ovate to lanceolate, acuminate, entire or not, on the undersurface with scattered, flat, spot-like glands along the margin, situated under the teeth if these are present. *Flowers* uni- or bisexual, in axillary inflorescences (in Mal.) which consist of small cymes, united into bracteate, mostly unbranched raceme-like thyrses. *Sepals* 4, connate at the base, imbricate in bud, ovate-elongate or triangular, small. *Petals* 4, free, imbricate in bud, ovate-oblong, oblong or linear, small. *Disk* thick, with 4 lobes. *Stamens* 4, with short filaments, inserted between the lobes under the outer margin of the disk; filaments attached in the middle, basal, between the divergent latrorse cells of the cordate-ovate anthers. Stamens vestigial or absent in the ♀ flowers. *Ovaries* 4, free, ovate; ovule 1, anatropous, pendent, attached above the middle at the adaxial side. *Styles* free or coherent at the base, absent laterally, adaxially, short, subulate, widened in a thickened or club-shaped stigma, bent outward over the top of the ovary. Fruit ± drupaceous, hardly fleshy. Mature dried *nuts* ovoid, with 2 ribs; pericarp thin, endocarp wrinkled and hard. *Seeds* ovoid, with a thin testa and a thin to very thin endosperm; embryo with a short plumule and 2 planoconvex cotyledons.

Distr. Old World tropics, *c.* 4 *spp.* in tropical Africa and 2 in tropical Asia (to S. China & S. Formosa), Malaysia and North Australia; *B. javanica* introduced in Fiji and Ponape.

Notes. *Brucea* was on the list of *nomina generica conservanda* because of the name *Lussa* RUMPH., but as the RUMPHIUS names have no nomenclatural standing this conservation is unnecessary.

BACKER (Fl. Bat. 1907, 260) mentioned the rare occurrence of 5-merous flowers in *B. javanica*; I have not observed them.

MILLER'S *Icones* is in the B. M. Library; although cited generally as *Icones Animalium et Plantarum* the original title was *Various Subjects in Natural History* (STEARN *in litt.*).

Fig. 12. *Brucea javanica* (L.) MERR. *a*. Twig in flower and fruit, × ⅔, *b*. ♂ flower, × 8, *c*. ♀ flower, × 8, *d*. fruits, × 2.—*Brucea mollis* WALL. *ex* KURZ. *e*. Leaf, × ⅔, *f*. fruit, × 2 (*a* after GRESHOFF, *b* ELBERT 2807, *c* COLFS 174, *d* ENDERT 1971, *e–f* RAMOS 13612).

KEY TO THE SPECIES

1. Dried fruits 4–5 (–7) mm long, with pedicels of 2–6 mm. Endosperm 1/5–1/2 mm thick. Pedicels of the ♀ flowers up to 2½ mm long[1]. Leaflets always bluntly serrate or crenate with 6–15 pairs of nearly parallel nerves which without anastomosing directly end in a marginal gland; insertions of the lateral nerves 1–10 (–17) mm apart. . . . . **1. B. javanica**
1. Dried fruits 9–13 mm long, with pedicels of 4–10 mm. Endosperm membranous. Pedicels of the ♀ flowers up to 6 mm long. Leaflets entire or a little toothed, sometimes bluntly serrate, crenate or undulate, with 4–9 (–11) pairs of mostly not parallel nerves which usually anastomose before reaching the margin; insertions of the lateral nerves 3–30 mm apart . . . . . **2. B. mollis**

1. Brucea javanica (L.) MERR. J. Arn. Arb. 9 (1928) 3; BACKER, Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 5; A. C. SMITH, J. Arn. Arb. (1955) 279; NAIR & SUKAMARAN, Bot. Gaz. 121 (1960) 175–185 (floral morph. and embryol.).—*Rhus javanica* LINNÉ, Sp. Pl. (1753) 265; ed. 2 (1762) 380 (T. in LINN).—*Lussa radja* RUMPH. Herb. Amb. (Auct.) 7 (1755) 27, t. 15.—*Gonus amarissimus* LOUR. Fl. Coch. (1790) 658 (T. in P).—*Ailanthus gracilis* SALISB. Prod. (1796) 171.—*B. sumatrana* ROXB. Hort. Beng. (1814) 12, based on *Lussa radja* RUMPH.; SPRENG. Syst. veg. 1 (1825) 441; DC. Prod. 2 (1825) 88; BLUME, Bijdr. 17 (1826) 1167; ROXB. Fl. Ind. ed. Carey 1 (1832) 449; BENN. Pl. Jav. Rar. (1844) 200; MIQ. Fl. Ind. Bat. 1, 2 (1859) 680; BTH. Fl. Austr. 1 (1863) 373; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 521; BAILEY, Queensl. Fl. 1 (1899) 218; BACKER, Fl. Bat. (1907) 260; Schoolfl. Java (1911) 192; LECOMTE, Fl. Gén. I.-C. (1911) 698; RIDL. Fl. Mal. Pen. 1 (1922) 361.—*B. sumatrensis* SPRENG. Pl. Min. Cogn. 2 (1815) 90.—*B. gracilis* DC. Prod. 2 (1825) 88.—*B. glabrata* DECNE, Nouv. Ann. Mus. Par. 3 (1834) 447, t. 20; Herb. Timor. Descr. (1835) 119; MIQ. Fl. Ind. Bat. 1, 2 (1859) 680.—*B. amarissima* DESV. *ex* GOMES in Mem. Acad. Sc. Lisb. n.s. 4, pars 1 (1872) 30; MERR. Philip. J. Sc. 10 (1915) Bot. 18; Int. Rumph. (1917) 299; BACKER, Trop. Natuur 11 (1922) 134; MERR. En. Philip. 2 (1923) 347; CRAIB, Fl. Siam. En. 1 (1926) 241; N. C. NAIR, J. Bomb. Nat. Hist. Soc. 57 (1960) 237–238, t.—**Fig. 12a–d.**

Shrub or small tree, 0.3–10 m, up to 10 cm ø. *Leaves* 20–50 cm long; leaflets 3–15, ovate-oblong to ovate-lanceolate, sparsely hairy above, more or less pubescent beneath, sometimes completely glabrous, 3½–11 by 1½–5 cm, the younger ones usually densely pubescent; petiole 5–10 cm, lateral petiolules 2–9 mm, terminal one 3–40 mm. *Peduncle* almost absent, rachis 7–60 cm. Bracts deltoid, small. *Flowers* greenish-white to greenish-red or purple.—♂: Pedicels very slender, up to *c.* 3 mm long, sepals pubescent, sometimes toothed, *c.* ½–1 by 1/3–½ mm; petals sparsely pubescent to nearly glabrous, sometimes toothed, 1–2 by ½–1 mm; filaments subulate, *c.* 0.6 mm, anthers *c.* 0.4 mm long.—♀: Pedicels up to 2½ mm, sepals and petals as in ♂; stamens 0 or vestigial. Mature dried drupes 1–4 together, 4–5(–7) mm long, pedicels 2–6 mm.

Distr. From Ceylon and the Deccan through SE. Asia to S. China and S. Formosa, *throughout Malaysia* to N. Australia (N. Territory and N. Queensland); introduced in Fiji (A. C. SMITH, *l.c.*) and Micronesia: Ponape (KANEHIRA, En. Micr. Pl. 1935, 343). Fig. 13. It is most remarkable that the localities of this very tolerant plant are very scattered in East Malaysia; there is no material from the central Moluccas (Buru, Ceram, Ambon) and only one recent sheet from the Wassi Kussa area in New Guinea. RUMPHIUS knew it only from the Lesser Sunda Islands. From this distribution pattern it can be deduced that man has probably imported it in several places of its area, but this cannot be traced or proved in detail. Fig. 13.

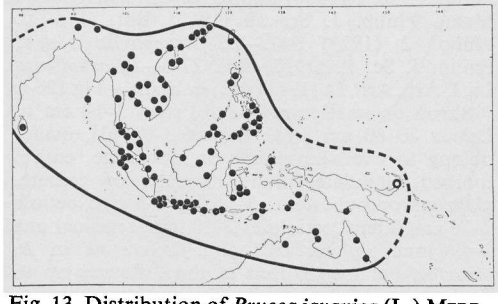

Fig. 13. Distribution of *Brucea javanica* (L.) MERR. (open dot after literature).

Ecol. A common, tolerant species, preferring open sites and light secondary forest and thickets, forest edges and ridges, even occurring in sunny places in sandy dunes and on limestone rocks, under both everwet and seasonal conditions (0–900 m).

In 1907 BACKER stated that all specimens he had seen had bisexual flowers; in 1911 he had received material from Semarang with ♂ and ♀ flowers. According to BACKER (1922) in Java specimens with bisexual flowers would be found only west of the line Semarang-Djokjakarta, plants with unisexual flowers east of it. In my opinion unisexual flowers prevail.—*Fl.* Jan.–Dec.

Uses. The very bitter roots and fruits are used as a medicine against dysentery and other fevers, and against diarrhoea. The leaves are applied against spleenomegaly and internal pains, scurf, ringworm, boils, and centipede-bites. The fruits are well known under the name of *Macassar kernels*, E, and *Makassaarse pitjes*, D (GRES-

(1) The length of the pedicels in flower and fruit has been measured above the last bract or bracteole.

HOFF, Nutt. Ind. Pl. 1894, 71; HEYNE, Nutt. Pl. Ned. Ind. 1927, 871; BURKILL, Dict. Econ. Prod. Mal. Penin. 1, 1935, 370).

Vern. Malaya: *abĕlor, chĕrĕk jantan, ĕmbalau, ĕ. bĕtina, ĕ. padang, hebĕlur, hĕmpĕdu bĕruang, kusum* (from the Chinese), *lada barau, (mĕ)lada pait, malau, sarai pusur, sĕrajat, sisek manek, suntang hutan*; Sumatra: *dadih-dadih*, Karo, *tambar-si-pogu*, Toba Mal., *malur, sikalur, tambar bui, tambar sipago*, Batak, *bĕrul*, Lamp.; Java: *kĕndung peutjang, ki padèsa, kuwalot, trawalot, walot*, S, *kwalot, tambara maritja*, J, *morindja*, M; Philippines: *balaniog*, Chab., *bogo-bogo*, P. Bis., C. Bis., *magka payos*, S. L. Bis., *manongao-bobi*, C. Bis., *selte*, Yakan.

2. Brucea mollis WALL. [Cat. (1848) 8483] *ex* KURZ, J. As. Soc. Beng. 42, ii (1873) 64; BENN. Fl. Br. Ind. 1 (1875) 521; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 104; LECOMTE, Fl. Gén. I.–C. 1 (1911) 698; MERR. En Philip. 2 (1923) 347; CRAIB, Fl. Siam. En. 1 (1926) 241; MERR. & CHUN, Sunyatsenia 5 (1940) 89.—*B. luzoniensis* VIDAL, Sinops. Atlas (1883) 19 t. 26, f. B; MERR. Publ. Gov. Lab. Philip. *no.* 35 (1906) 26; Philip. J. Sc. 1 (1906) Suppl. 70.—*B. membranacea* MERR. Philip. J. Sc. 1 (1906) Suppl. 70.—*B. macrobotrys* MERR. Philip. J. Sc. 10 (1915) Bot. 19; En. Philip. 2 (1923) 347.—*B. stenophylla* MERR. Philip. J. Sc. 12 (1917) Bot. 274.—*B. acuminata* LI, J. Arn. Arb. 24 (1943) 445, *ex descr.*—**Fig. 12e-f.**

Shrub or small tree, 1–8 m, stem 3–10 cm ø. *Leaves* 20–60 cm long; leaflets 3–9(–13), ovate-oblong to ovate-lanceolate or lanceolate, entire, toothed, undulate, bluntly serrate, or crenate, glabrous or pubescent, 5–16 by 1–8 cm; petiole 2–13 cm, lateral petiolules 2–10 mm, terminal one 3–40 mm. *Inflorescence* and *flowers* as in *B. javanica*, but the pedicels of the ♀ flowers up to 6 mm long. Flowers white, creamy, green or red. Mature dried drupes 1–2(–3) together, 9–13 mm long.

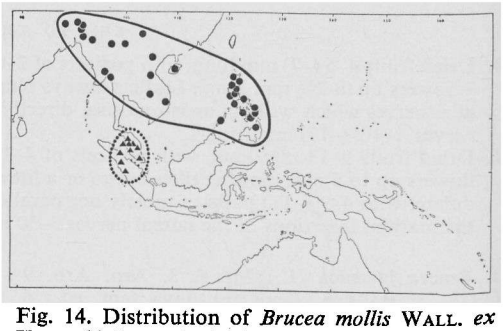

Fig. 14. Distribution of *Brucea mollis* WALL. *ex* KURZ (delineated, dots) and *Eurycoma apiculata* BENN. (dotted delineation, triangles).

Distr. From the East Himalayas, Burma, Siam, Laos, Cambodia, and Hainan, to *Malaysia*: throughout the Philippines. Fig. 14.

Ecol. Always in open forests, often in damp places, usually on slopes and ridges, 0–1800 m. *Fl.* Jan.–Aug.

Vern. Philippines: *makamara*, Mag., *suga*, Ig.

Notes. The form with narrow leaflets, distinguished by MERRILL as *B. stenophylla*, occurs only above 1500 m. The form with large leaflets, distinguished by him as *B. macrobotrys*, occurs only at a low altitude. In my opinion these variations are only due to the influence of the altitude. As I saw a complete series of transitional forms I reduced both to *B. mollis*. *B. mollis* is more variable than *B. javanica*.

Excluded

Brucea quercifolia SEEM. Fl. Vit. (1865) 33, based on SEEMANN 105, coll. *a.* 1860 (K), is according to A. C. SMITH & W. L. STERN, Brittonia 14 (1962) 237–241, 16 fig. = *Dysoxylum quercifolium* (SEEM.) A. C. SMITH (*Meliaceae*).

6. PICRASMA

BLUME, Bijdr. 5 (1825) 247.—*Nima* HAM. *ex* A. JUSS. Mém. Mus. Hist. Nat. Paris 12 (1825) 516.—*Aeschrion* VELLOSO, Fl. Flum. (1825) 58, Ic. (1835) t. 152.—*Picraena* LINDL. Fl. Med. (1838) 208.—*Muenteria* WALP. Rep. 5 (1846) 398.—*Triscaphis* GAGNEP. Not. Syst. 13 (1948) 190; cf. Fl. Mal. I, 6 (1960) 49.—**Fig. 15.**

Monoecious or dioecious trees or shrubs. Branches pithy, almost glabrous. *Leaves* imparipinnate; base of the petiole and usually the rachis nodes swollen, ± shrunken when dry; leaflets opposite or subopposite. Stipules early caducous, triangular, ovate or orbicular, sometimes seemingly absent, but present on innovations. *Inflorescences* axillary, longish peduncled, compound-cymose, unisexual. Bracts small, whether or not early caducous. Pedicels articulated in the lower half. *Flowers* 4–5-merous, unisexual or functionally ♀, the ♀ ones usually twice as large as the ♂. *Sepals* small, free to united halfway up, persistent. *Petals* valvate or subvalvate in bud, the mucronate tips incurved, persistent in ♀ flowers, much longer than the sepals and sometimes accrescent. *Stamens* 4–5; anthers latrorse, emargi-

Fig. 15 *Picrasma javanica* BL. *a*. Flowering twig, × ⅔, *b*. fullgrown stipules, × ⅔, *c*. ♂ flower, × 6 *d*. ♀ flower, petals and sepals removed, × 6, *e*. fruits, nat. size (*a*, *d* DE VRIESE & TEYSMANN *s. n.*, *b* NGF 10115, *c* JUNGHUHN *s.n.*, *e* KOSTERMANS 431).

nate at the top, split from the base to halfway up, basidorsifixed, versatile; filament inserted at the narrowed base of the disk (torus). *Disk* rather thick, sometimes accrescent in fruit. *Carpels* up to 7, free, vestigial or absent in ♂ flowers; styles connate except at the base, sometimes 1 or 2 free; stigmas free, rather long, filiform. *Ovule* 1, basal. *Fruits* 1–4, drupaceous; exocarp thin, fleshy, wrinkled when dry, endocarp hard. *Seed* with a broad hilum; placenta adaxial, basal; testa rather thick and hard; no endosperm.

Distr. About 6 *spp.* in America (Mexico, West Indies, Venezuela, Brazil, Argentina), 2 *spp.* in Asia (Korea, Japan, S. China, and SE. Asia), one of which through *Malaysia* to the Solomon Is.

Note. *Triscaphis* GAGN., described in *Staphyleaceae*, is reduced here at the instigation of Mr AIRY SHAW.

1. Picrasma javanica BLUME, Bijdr. 5 (1825) 248; BENN. Pl. Jav. Rar. (1844) 197, t. 41; MIQ. Fl. Ind. Bat. 1, 2 (1859) 679; BENN. in Fl. Br. Ind. 1 (1875) 520; KURZ, For. Fl. Burma 1 (1877) 201; KING, J. As. Soc. Beng. 62, ii (1893) 227; K. & V. Bijdr. 4 (1896) 8; MERR. Bull. Bur. For. Philip. 1 (1903) 27; BACK. Schoolfl. Java (1911) 192; LECOMTE, Fl. Gén. I.–C. 1 (1911) 699; KOORD. Atlas 2 (1914) t. 319; LAUT. Bot. Jahrb. 56 (1920) 344; RIDL. Fl. Mal. Pen. 1 (1922) 361; MERR. En. Philip. 2 (1923) 347; CRAIB, Fl. Siam. En. 1 (1926) 240; GAGNEP. Fl. Gén. I.–C. Suppl. 1 (1946) 667; BACK. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 6.—*Brucea dubia* STEUD. Nomencl. 1 (1841) 230, *nomen.*—*P. nepalensis* BENN. Pl. Jav. Rar. (1844) 201; in Fl. Br. Ind. 1 (1875) 520.—*P. andamanica* KURZ *ex* BENN. in Fl. Br. Ind. 1 (1875) 520.—*P. philippinensis* ELM. Leafl. Philip. Bot. 5 (1913) 1837.—*Triscaphis kerrii* GAGN. Not. Syst. 13 (1948) 190; Fl. Gén. I.–C. Suppl. 1 (1950) 999, f. 128 3–8.—**Fig. 15.**

Tree, up to 20 m, bole up to 15 m and 35 cm ø. Bark grey to brown, smooth, fissured. *Leaves* 2–3(–4)-jugate; petiole 2–6 cm, as the rachis terete, sparsely puberulous to glabrous; petiolules 0–7 mm; leaflets entire, sometimes with a waved or wrinkled margin, usually rather abruptly blunt-acuminate, cuneate at the base, 4–20 by 1–10 cm; nerves 3–8 pairs; on upper surface midrib crested, nerves narrowly sulcate, venation indistinct; underneath nerves and reticulate venation prominent. Stipules foliaceous, flabellately veined, nearly orbicular with rounded apex and acute base, 7–25 by 5–20 mm, usually early caducous, leaving a rather large scar. *Inflorescences* up to 20 cm long, planoconvex. Bracts obovate, rounded, very early caducous. *Flowers* 4-merous, white to yellow or green. Pedicels *c.* 10 mm in ♀ and up to 7 mm in ♂ flowers. *Sepals* glabrous to puberulous, triangular to ovate, acutish, *c.* 1 mm. *Petals* ovate-oblong or oblong, often acute-acuminate to mucronate, glabrous or sparsely hairy, with a conspicuous midrib, in ♂ flowers 2–5 by 1–2 mm; in ♀ flowers 3–7 by 3–5 mm, accrescent to 10–15(–20) by *c.* 7(–10) mm. *Disk* hairy, 4-lobed, ½–1 mm high. *Stamens* usually longer than petals in ♂ flowers, shorter than petals in ♀ flowers; filaments gradually thinner towards the top, hairy at the base, ½–2 mm in ♀ and 1–5 mm in ♂ flowers; anthers 1–2 by ¾–1½ mm in ♂ and up to 1 by ½ mm and barren in ♀ flowers. *Carpels* up to 4, glabrous or puberulous; styles 1–1½ mm, stigmas *c.* 2 mm. *Fruits* 1–4, green to red or blue, ovoid to depressed-globose, *c.* 9–10 by 7–12 mm.

Distr. Tropical SE. Asia (from Sikkim, Assam, Burma, and Tonkin southward), throughout *Malaysia* to the Solomon Is. Fig. 16.

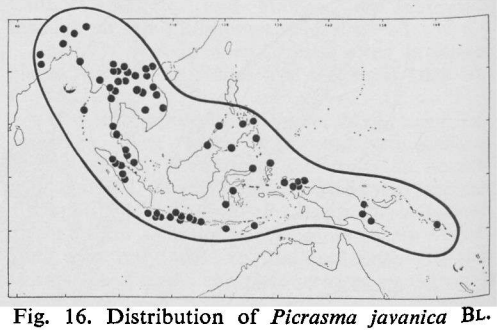

Fig. 16. Distribution of *Picrasma javanica* BL.

Ecol. Usually rather scarce, scattered in rain forests from sea-level up to 1500 m. *Fl. fr.* Jan.–Dec.

Uses. The bark contains quassiin, which gives it a bitterness and causes it to be used in Burma and Java in lieu of quinine, though there is no alkaloid in it. In Java the leaves may be applied to sores. The trunk is too small for timber and the wood is not durable (HEYNE, Nutt. Pl. 1927, 872; BURK. Dict. 1935, 1723).

Vern. Philip.: *nalis*, Sul., *palumpang*, Bag.; Celebes: *tambara tĕdong*, Bonthain; Sumatra: *tuba lalat*, Karo, *t. ulĕt*, Palemb., *ĕmpĕdu kaju*; Java: *ki bagara*, *k. brahma*, *k. pahit*, *k. tjaăn*, *k. tjanting*, *k. tjitan*, S, *pati laler*, J; *kaju chutu*, Minah.; New Guinea: *snippa*, Numfoor, *annamur*, Biak.

Note. The second Asiatic species, *P. quassioides* (D. DON) BENN., occurs from the Himalayas to Japan and Korea; it is medicinal and is sometimes cultivated in Europe for ornamental purpose. It is easily distinguished by its crenate or serrate leaflets, 5-merous flowers and smaller fruit (*c.* 5 mm).

Excluded

Picrasma denhamii SEEM. Fl. Vit. (1865) 33 from Aneityum, New Hebrides, is according to Mr J. E. DANDY (*in litt.*) = *Evodia triphylla* DC. Prod. 1 (1824) 724 (*Rutaceae*).

7. AILANTHUS

DESF. Mém. Phys. Math. Ac. R. Sc. Paris (1786) 270 t. 8, *nom. gen. cons.*; DC. Prod. 2 (1825) 88 (*Ailantus*); PIERRE, Fl. For. Coch. 4 (1892) t. 294–295; ENGLER in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 223; ed. 2, 19a (1931) 390; VAN TIEGHEM, Ann. Sc. Nat. IX, 4 (1906) 272.—*Pongelion* ADANS. Fam. Pl. 2 (1763) 319; VAN TIEGHEM, Ann. Sc. Nat. IX, 4 (1906) 272.—*Albonia* BUCHOZ, Herb. Color. Am. (1783) t. 57, *sine descr.*—*Hebonga* RADLK. Philip. J. Sc. 6 (1911) Bot. 365. **Fig. 7f–g, 17, 18.**

Tall, fast-growing, sometimes deciduous, dioecious trees. Branches thick, pithy; leaf-scars large. *Leaves* large, imparipinnate or paripinnate (with a prolonged rachis), sometimes on a single tree, more or less tufted at the ends of the twigs, multijugate, base of petiole often shrunken when dry; leaflets opposite or subopposite, oblique, usually acuminate, (in Mal.) entire, rachis and petiole terete, pithy, nearly always with some glands on the undersurface, usually near the base; midrib and lateral nerves prominent on the undersurface; petiole, rachis, petiolules, and branchlets of the panicles usually striate when drv. *Flowers* in axillary panicles, 5(–6)-merous. *Calyx* small, 5(–6)-lobed or closed in bud and later irregularly dehiscing (often 2-lobed) to the base, rarely cupular. *Petals* 5(–6), induplicate-valvate in bud, concave, oblong to narrowly oblong, still enlarging during anthesis. *Stamens* 10, in ♂ flowers inserted below the outer margin of the disk, in ♀ flowers either of subnormal size (but without pollen) or vestigial or absent; anthers oblong to broadly oblong, latrorse to extrorse, filaments dorsally attached halfway, the 2 cells free in their lower half. *Carpels* 2–5, free, flat, in the ♂ flowers vestigial or absent; styles 2–5, free or connate, inserted above the middle on the adaxial side; ovule 1, epitropous, anatropous, adaxially attached in the middle. *Fruit* a linear or oblong-lanceolate samara. *Seed* flat, orbicular or obovate or somewhat triangular, exalbuminous; testa thin; cotyledons 2, flat, planoconvex, radicle pointing upwards.

Distr. Five *spp.* in tropical and subtropical SE. Asia from Turkestan and India to China through Malaysia to the Solomon Islands, Queensland, and northern New South Wales; in *Malaysia* 2 species, not yet found in the Malay Peninsula. The seed of the Chinese *A. altissima* (MILL.) SWINGLE was received in England in 1751. The species was soon cultivated in Europe and N. America where it became widely naturalized and now occurs as a common weed on the outskirts of large cities; also naturalized in Australia.

According to the fossil record (fruits!) *Ailanthus* occurred during the Tertiary in Europe and North America.

Ecol. In Malaysia both in the rain-forest and in monsoon forest, below 1000 m, on the whole rather uncommon and never gregarious, in valleys, along streams, and in open places.

In literature it has often been suggested that the flowers might also be bisexual (*e.g.* by ENGLER, 1931) or the trees monoecious (ROXBURGH). I have, however, never observed bisexual flowers. The trees PRAIN observed (Ind. For. 28, 1902, 131–134, 210–211, t. 1–3; Contr. Ind. Bot. 1906, 1–6, t. 1–3) were all dioecious, as is the commonly cultivated *A. altissima* (MILL.) SWINGLE. The stamens which are often present in ♀ flowers do not contain pollen.

During anthesis the ♂ flowers emit a fetid, disgusting smell and for that reason ♂ trees are not desirable to cultivate as an ornamental.

The rarity of the species is remarkable as trees produce an immense number of membranous samaras fit for dispersal by wind. And if the species might be shade-intolerant one would expect them to settle as a nomad tree in glades, clearings, and open secondary forests.

Uses. See under the species.

Taxon. PIERRE, *l.c.*, subdivided the genus (*Pongelion*) into two sections, *Eupongelion* RUMPH. *ex* PIERRE and *Ailanthus* PIERRE, according to the occurrence of 1–3 or 5 styles respectively, but he placed *P. moluccanum* DC. erroneously in the first section. ENGLER, 1896, *l.c.*, accepted the sectional names of PIERRE, changing *Ailanthus* into *Euailanthus*, but distinguished them on another character, *viz Eupongelion* with free styles and *Euailanthus* with connate styles, thereby redistributing the species in a different way. No use was ever made of the structure of the calyx which seems to me a third character worthy of

consideration. Among the five species which I admit under the genus, one, *A. altissima*, has free styles, one, *A. triphysa*, has (2–) 3(–4) styles, and one, *A. integrifolia*, has a calyx closed in bud rupturing irregularly during anthesis. As these three characters are obviously not correlated, it appears that they are of specific value and cannot serve for subdividing the genus. This was also the opinion of VAN TIEGHEM, *l.c.* 272–280, who, in an elaborate anatomical study of the leaves proposed to distinguish two genera based on vegetative characters, *viz. Pongelion* with entire leaflets without glands and *Ailanthus* with dentate leaflets with under each tooth a gland. However, in the species with entire leaves also glands occur, either at the base or scattered, or in the forks of the lateral nerves near the margin. As the situation of the glands varies with the species, I can only conclude to the specific value of this character.

RICKETT & STAFLEU (Taxon 8, 1959, 302) erroneously assumed that *Pongelion* ADANS. is a *Leguminosa*.

Notes. The name of the genus is derived from RUMPHIUS's Amboinese vernacular name *aylanto*, meaning tree of heaven, alluding to the lofty size of the Moluccan species.

Due to inadequacy of the material and the rarity of the species, specific distinction has been in great confusion. I felt necessitated to extend my study to all species described and could examine the types of many specific names. I have come to the conclusion that only 5 species can be distinguished; it is remarkable that DE CANDOLLE had four of them. Although only two of them have as yet been found in Malaysia, it is of interest to give a key to and synonymy of all of them. Though variable they can easily be distinguished in flower, fruit, and vegetatively.

In the herbarium flowers and fruit are never present on one sheet; field collectors are therefore requested to mark flowering trees to collect fruit later.

KEY TO THE SPECIES

based on flowering material

1. Leaflets entire.
   2. Petals puberulous. ♀ Flowers with 5 carpels. Stigmas long, stellately spreading. Leaflets ovate to elliptic-oblong, rarely ovate-lanceolate, usually with a few glabrous, large, black glands on the undersurface mostly near the base . . . . . **1. A. integrifolia**
   2. Petals glabrous or nearly so. Leaflets without large glands near the base, but some small glands may occur over the surface, either scattered or in vein-forks.
      3. Calyx lobes as long as the tube or longer. ♀ Flowers with 3–4 glabrous carpels. Stigmas connate, peltate, slightly 3–4-lobed. Leaflets ovate to oblong-lanceolate, rarely ovate to elliptic-oblong. In the forks of the dichotomous-branching nerves usually a more or less hairy, often pitted gland, sometimes obscured by a hair tuft. . . . . **2. A. triphysa**
      3. Calyx lobes shorter than the tube. ♀ Flowers with 5 puberulous carpels. Stigmas free, stellately spreading. Leaflets as in *A. integrifolia* but not with large black basal glands; a few small flat glands scattered on the undersurface. (Hongkong.) . . . . . **5. A. fordii**

1. Leaflets toothed.
   4. Leaflets coarsely toothed or lobed. Petiolules long, *c.* 2–4 cm. Petals glabrous or nearly so. Filaments as long as the anthers or shorter. Carpels sparsely longish hairy or pubescent; styles attached near the top, very short, free or connate, with long, outwards curling stigmas. (India and Ceylon.) **3. A. excelsa**
   4. Leaflets with a few short, rarely rather large teeth near the base. Petiolules short, ½(–1) cm. Petals densely woolly hairy on the lower half of the margins and on the inner surface. Filaments twice as long as the anthers or longer. Carpels glabrous; styles attached nearly halfway, connate, *c.* 1½ mm long, with a peltate, 5-lobed stigma *c.* 1 mm above the carpels. (China.) . . . **4. A. altissima**

KEY TO THE SPECIES

based on fruit characters

1. Leaflets entire.
   2. Main vascular bundle towards seed in the margin of the samara . . . . . **1. A. integrifolia**
   2. Main vascular bundle towards seed intramarginal.
      3. Samaras 4½–7½ cm long. Scar of style at the same level as the middle of the seed. **2. A. triphysa**
      3. Samaras 3–5 cm. Scar of style at the same level as the apex of the seed . . . . . **5. A. fordii**
1. Leaflets toothed.
   4. Scar of style nearly at the same level as the apex of the seed. Main vascular bundle towards seed intramarginal . . . . . **3. A. excelsa**
   4. Scar of style nearly at the same level as the middle of the seed. Main vascular bundle towards seed in the margin of the samara . . . . . **4. A. altissima**

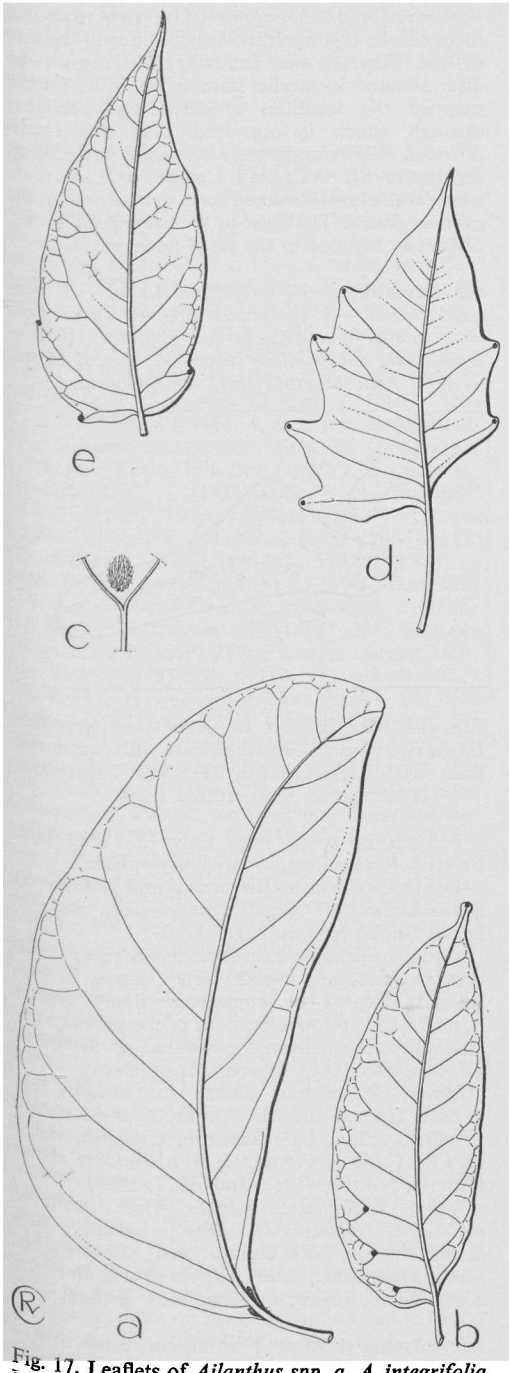

Fig. 17. Leaflets of *Ailanthus spp. a. A. integrifolia* LAMK, *b. A. triphysa* (DENNST.) ALSTON, *c. ditto*, glandular domatium, *d. A. excelsa* ROXB., *e. A. altissima* (MILL.) SWINGLE, all × ⅔ (*a* WATERHOUSE 664, *b–c* VILLAMIL 20972, *d* DRUMMOND 21597).

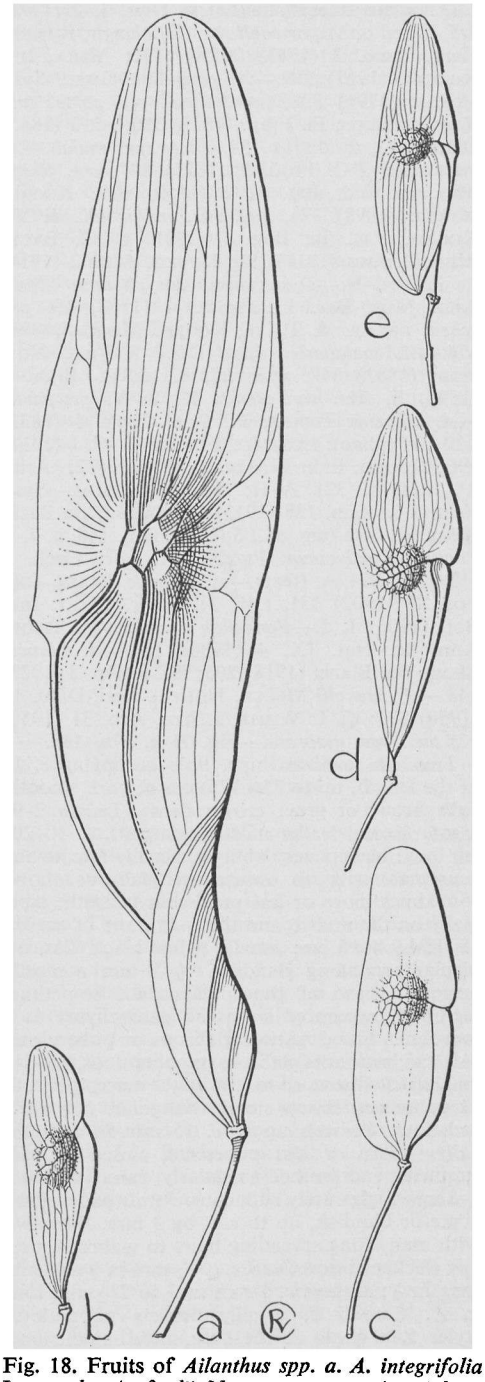

Fig. 18. Fruits of *Ailanthus spp. a. A. integrifolia* LAMK, *b. A. fordii* NOOTEBOOM, *c. A. triphysa* (DENNST.) ALSTON, *d. A. excelsa* ROXB., *e. A. altissima* (MILL.) SWINGLE, all × ⅔ (*a* WATERHOUSE 664, *b.* HANCE 1497, *c* CURRAN 3847, *d* DRUMMOND 21597).

1. Ailanthus integrifolia LAMK, Dict. 3, 2 (1792) 417, based on *Arbor coeli sive Caju langit*, RUMPH. Herb. Amb. 3 (1743) 205, t. 132; MERR. Int. Rumph. (1917) 299.—*A. pongelion* GMEL. Syst. Veg. 1 (1791) 726, *nom. illeg., pro parte, tab. Rumph.*; BLCO, Fl. Filip. (1837) 380; ed. 2 (1845) 268; ed. 3, 2 (1878) 134, *excl. syn. malab.*—*A. moluccana* DC. Prod. 2 (1825) 89, *nom. illeg.*; MIQ. Fl. Ind. Bat. 1, 2 (1859) 679; KOORD. Minah. (1898) 374, *incl. var. mollis* (K. & V.) KOORD.; VAL. Ic. Bog. 1 (1901) t. 82; BACK. Schoolfl. Java (1911) 191; KOORD. Atlas 2 (1914) t. 321, I–K.—*Dysoxylum dasyphyllum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 19, *pro sched.* DE VR. & T., *cf.* KOORD. Minah. (1898) 374.—*A. malabarica* (*non* DC.) F.-VILL. Nov. App. (1883) 349, *non vidi*; K. & V. Bijdr. 4 (1896) 3, *incl. var. mollis* K. & V. *pro parte.*—*A. calycina* PIERRE, Fl. For. Coch. 4 (1892) t. 294 A (plate); LECOMTE, Fl. Gén. I.–C. 1 (1911) 696; KOORD. Exk. Fl. Java 2 (1912) 432; Atlas 2 (1914) t. 321 A–H; KOORD.-SCHUM. Syst. Verz. 1 § 1 fam. 138 (1913) 18; BAKH. *f.* in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 7.—*Pongelion calycinum* PIERRE, Fl. For. Coch. 4 (1892) t. 294 A (text).—*A. grandis* PRAIN, Ind. For. 28 (1902) 131, t. 1, 210, repr. Contr. Ind. Bot. (1906) 1, 5.—*Pongelion grandis* VAN TIEGH. Ann. Sc. Nat. IX, 4 (1906) 278.—*A. blancoi* MERR. Sp. Blanc. (1918) 205; En. Philip. 2 (1923) 348.—*A. peekelii* MELCH. Notizbl. Berl.-Dahl. 10 (1930) 893; C. T. WHITE, J. Arn. Arb. 31 (1950) 91, *incl. var. glabrata.*—**Fig. 7f–g, 17a, 18a.**

Tree, up to 60 m high, bole occupying *c.* ¾ of the length, up to 75(–175) cm ø; bark smooth, light brown or grey; crown dense. *Leaves* 2–9-jugate (apical leaflet mostly vestigial), *c.* 30–200 cm long; leaflets very oblique, usually falcate and acuminate with an obtuse tip, glabrous above, sometimes more or less pubescent beneath, especially on the midrib and the 6–13 pairs of nerves, 10–40 by 4–15 cm; usually a few black, flat, orbicular or oblong glands *c.* ½–5 mm ø mostly near the base of the undersurface sometimes seemingly separated from the parenchyma as a loose membrane; petiole glabrous or puberulous, 5–20 cm; petiolules glabrous or puberulous, ½–1½ cm. *Panicles* loose, up to *c.* 40 cm or more, glabrous or pubescent. Bracts small, triangular, very early caducous. Pedicels up to *c.* 15 mm in anthesis. *Calyx* more or less pubescent, closed in bud, rupturing and toothed irregularly, rarely cupular, 1–4 mm high, rarely caducous. *Petals* puberulous, acute or bluntish, up to *c.* 9 by 3 mm. *Filaments* with many long spreading hairs to glabrous, usually thickened downwards, *c.* ½ mm in ♀ to 4 mm long in ♂; anthers *c.* 1 mm in ♀ to 2½ mm long in ♂. *Carpels* 5, usually densely puberulous; styles 5, connate at the base, including the long, stellately spreading stigmas, up to *c.* 6 mm long. *Samaras* (1–)3–5, with obtuse apex, more or less prominently reticulate or lengthwise striate, *c.* 11–22 by 2½–5 cm; main vascular bundle to the seed in the adaxial margin; scar of the style beneath the seed; pedicel 2½–5 cm.

Note. Of *A. integrifolia* LAMK two replacing races can be distinguished which differ in the size of the flowers, but unfortunately cannot be discriminated in sterile state or in fruit. I have mapped the localities of flowering specimens through which it appeared that the small-flowered race is apparently restricted to seasonal regions in SE. Asia and Central to East Java, whereas the large-flowered form occurs only in the everwet forest. The type of *A. integrifolia* LAMK, obviously belongs to the large-flowered race.

ssp. **integrifolia.**—*A. integrifolia* LAMK.—*A. pongelion* GMEL.—*A. moluccana* DC.—*A. moluccana var. mollis* (*non* K. & V.) KOORD. 1898.—*Dysoxylum dasyphyllum* MIQ.—*A. blancoi* MERR.—*A. peekelii* MELCH., *incl. var. glabrata.*

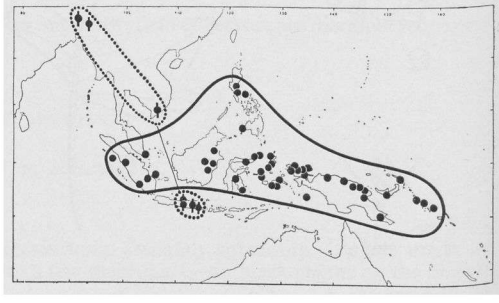

Fig. 19. Distribution of *Ailanthus integrifolia* LAMK *ssp. integrifolia* (delineation with continuous line) and *ssp. calycina* (PIERRE) NOOTEBOOM (delineation with dotted line).

Pedicels up to 15 mm. Calyx 2–3 mm high. Petals 6–10 mm long, evenly hairy outside.

Distr. Melanesia (Bismarcks and Solomons), in *Malaysia*: all islands, except Java and the Lesser Sunda Islands. Fig. 19.

Ecol. In primary rain-forest, very rare, locally rather common in North New Guinea, in New Ireland said to be commoner than *Pometia*, *Alstonia*, and *Octomeles*, both in the primary and secondary forest, from the lowland up to 900 m. *Fl.* Jan.–Dec., *fr.* March, April, Nov.

Uses. Made into planks for housing *etc.* in New Guinea and the Bismarcks; the sapwood is white, yellow, pale brown or creamish, and is very soft and not durable; heartwood is absent (HEYNE, Nutt. Pl. Ned. Ind. 1927, 1499).

Vern. Philippines: *balokas*, Tagb., *makaisa, malaaduás, malasapsáp*, Tag.; *aylanto, kaju langit*, Ambon; New Guinea: *won*, Karoon lang., *broes*, Mooi lang., *aisasa*, Upper Waria, *limoetiti*, Kebar lang., *kokop, kun-kun*, New Britain.

ssp. **calycina** (PIERRE) NOOTEBOOM, *comb. nov.*—*A. malabarica var. mollis* K. & V., *pro parte.*—*A. calycina* PIERRE.—*Pongelion calycinum* PIERRE.—*A. grandis* PRAIN.—*Pongelion grandis* VAN TIEGH.

Pedicels up to 5 mm. Calyx shorter than 2 mm. Petals *c.* 4 mm long, the margins densely, the outer surface laxly hairy.

Distr. SE. Asia (Assam, Sikkim, Cochinchina), in *Malaysia*: Central to East Java. Fig. 19.

Ecol. Mixed primary forest, obviously under seasonal conditions.

Vern. *Raden, tawa*, J.

2. Ailanthus triphysa (DENNST.) ALSTON, Handb. Fl. Ceyl. VI, Suppl. (1931) 41.—*A. integrifolia var. β* LAMK, Dict. 3, 2 (1792) 417, *typ. rheed.*—*Adenanthera triphysa* DENNST. Schlüss. Hort. Mal. (1818) 32, based on *Pongelion* RHEEDE, Hort. Mal. 6 (1686) 27 t. 15.—*A. malabarica* DC. Prod. 2 (1825) 89, *nom. illeg.*; W. & A. Prod. (1834) 150; WIGHT, Ic. (1850) t. 1604; DALZ. & GIBS. Bomb. Fl. (1861) 46; BRANDIS, For. Fl. (1874) 58; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 518; PIERRE, Fl. For. Coch. 4 (1892) t. 294 B; TRIMEN, Handb. Fl. Ceyl. 1 (1893) 230; K. & V. Bijdr. 4 (1896) 4, *incl. var. mollis* K. & V. *pro parte*; PRAIN, Ind. For. 28 (1902) 132, t. 3 A, repr. Contr. Ind. Bot. (1906) 132; LECOMTE, Fl. Gén. I.–C. 1 (1911) 692; BACK. Schoolfl. Java (1911) 191; FRANCIS, Austr. Rain-For. Trees (1929) 174, t. 110, 111; ed. 2 (1951) 196, t. 112, 113; KOORD. Atlas 2 (1914) t. 320; BAKH. *f.* in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 6.—*A. imberbiflora* F. v. M. Fragm. 3 (1862) 42; BENTH. Fl. Austr. 1 (1863) 373; BAILEY, Queensl. Fl. 1 (1899) 217; FRANCIS, Austr. Rain-For. Trees (1929) 174, t. 110, 111; ed. 2 (1951) 196, t. 112, 113.—*A. fauveliana* PIERRE, Fl. For. Coch. 4 (1892) t. 295 B (plate); LECOMTE, Fl. Gén. I.–C. 1 (1911) 692; CRAIB, Fl. Siam. En. 1 (1926) 240.—*Pongelion fauvelianum* PIERRE, Fl. For. Coch. 4 (1892) t. 295 B (text).—*Pongelion malabaricum* PIERRE, *l.c.* t. 294.—*Pongelion imberbiflora* PIERRE, *l.c.* t. 294.—*A. kurzii* PRAIN, Ind. For. 28 (1902) 133, t. 3 B, repr. Contr. Ind. Bot. (1906) 3.—*A. philippinensis* MERR. Publ. Gov. Lab. Philip. *no* 35 (1906) 25; Philip. J. Sc. 1 (1906) Suppl. 70; *ibid.* 2 (1907) Bot. 431.—*Hebonga obliqua* RADLK. Philip. J. Sc. 6 (1911) Bot. 366; BOAS, Beitr. Anat. Syst. Simar. (1912) 49; repr. in Fedde, Rep. 13 (1914) 290; MERR. En. 2 (1923) 348.—*Hebonga mollis* RADLK. *l.c.* 367; BOAS, *l.c.*; MERR. *l.c.*—*Hebonga siamensis* RADLK. *ex* CRAIB, Kew Bull. (1912) 264; Fl. Siam. En. 1 (1926) 243; GAGNEP. Fl. Gén. I.–C. Suppl. 1 (1946) 668.—**Fig. 17b–c, 18c.**

Tree, up to 45 m high and ¾(–1½) m ø. *Leaves* 6–17(–30)-jugate, 20–70 cm long; leaflets glabrous above, more or less pubescent beneath, obliquely ovate-lanceolate to oblong-lanceolate, rarely ovate or oblong, falcate, acuminate, (5–)9–15(–26) by 2½–5½ cm; nerves 8–20 pairs; usually at the end of the midrib beneath a hairy gland, making the apex obtuse or even emarginate, apex rarely acute; on the undersurface in the forks of the usually dichotomous-branching nerves usually a circumvallate, more or less hairy, often pitted gland, sometimes obscured by a hair tuft. *Panicles* dense and many-flowered, more or less pubescent, *c.* 20–60 cm long. Bracts small, ovate to triangular, caducous. Pedicels up to *c.* 4 mm. *Calyx* pubescent, less than 1 mm high, the triangular, acute lobes as long as the tube or a little longer. *Petals* glabrous or nearly so, *c.* 3–5 by 1–1½ mm. *Filaments* tortuous-folded in bud, filiform or sometimes attenuating from the base to the top, usually with spreading hairs beneath, *c.* 1–3 mm long in ♀ and *c.* 3–6 mm long in ♂ flowers; anthers *c.* 1,2 by 1 mm in ♂ flowers, smaller in ♀ flowers. *Carpels* (2–)3(–4), glabrous, *c.* 2–2½ by 1–1½ mm; styles free or coherent at the base, connate at the top, *c.* 1–1½ mm; stigma (2–)3(–4)-lobed, peltate, *c.* 2 mm ø. *Samaras* 1–3(–4), obtuse at the apex, main vascular bundle towards the seed intramarginal, scar of the style at the same level as the seed, *c.* 4½–8 by 1⅓–2½ cm; pedicels 8–20 mm.

Distr. SE. Asia: India (Concan, Malabar, Canara), Ceylon, Burma, Siam, Vietnam, through *Malaysia* (except the Malay Peninsula, Sumatra, the Lesser Sunda Is, and New Guinea) to Queensland and the north of New South Wales. Fig. 20.

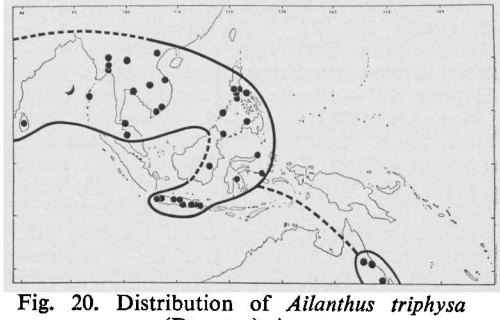

Fig. 20. Distribution of *Ailanthus triphysa* (DENNST.) ALSTON.

Ecol. In forests, usually very rare, under both everwet and seasonal conditions, according to BURKILL intolerant of shade, from the lowland up to ± 600 m. Fl. Jan.–Dec.

Uses. The resin, obtained by making incisions in the bark, is used as incense and medicinally in India. In Indo-China the bark is burned as incense. The bark and the leaves are in great repute as a tonic, especially in debility after childbirth. They also possess febrifuge properties and are useful in dyspeptic complaints. The wood is used for making wooden shoes in Luzon; in India for fishing floats, catamarans, sword-handles, and spear-sheaths, and in Ceylon for teaboxes (BURKILL, Dict. Ec. Prod, Mal. Pen. 1, 1935, 79).

Vern. *Ki pahit*, S, *sĕlangkĕ*, Central J; Philip.: *empau*, Tagb., *kalauag*, Bik., *hebong, makaisa, malaaduás*, Tag.

3. Ailanthus excelsa ROXB. Pl. Corom. 1 (1795) 24, t. 23; DC. Prod. 2 (1825) 89; ROXB. Fl. Ind. ed. Carey 2 (1832) 450; W. & A. Prod. (1834) 150; GRAH. Cat. Bomb. Pl. (1839) 37; WIGHT, Ill. Ind. Bot. 1 (1840) 170 t. 67; BENN. in Hook. *f.* Fl. Br. Ind. 1 (1875) 518; PIERRE, Fl. For. Coch. 4 (1892) t. 295 A; PRAIN, Ind. For. 28 (1902) t. 2 B; VAN TIEGH. Ann. Sc. Nat. IX, 4 (1906) 277.—*Pongelion excelsum* PIERRE, Fl. For. Coch. 4 (1892) t. 295 A.—*Pongelion wighti* VAN TIEGH.

Ann. Sc. Nat. IX, 4 (1906) 277.—**Fig. 17d, 18d.**

Distr. South, Central, and NW. India (in the last probably introduced) and Ceylon.

Note. VAN TIEGHEM, *l.c.*, rightly observed that there is a discrepancy between the figures given by ROXBURGH and by WIGHT, the latter being in entire accordance with the material, that of ROXBURGH deviating by very short petiolules and very long filaments. As there is only one species on the Coromandel Coast with dentate leaflets I assume that ROXBURGH's plate is inaccurate in detail. Therefore I have reduced *Pongelion wighti* TIEGH., based on WIGHT's plate, to the synonymy. Dr. SANTAPAU (*in litt.*), after having examined the specimens in the Blatter Herbarium, agreed with this interpretation.

4. Ailanthus altissima (MILL.) SWINGLE, J. Wash. Ac. Sc. 6 (1916) 495; REHDER & WILSON, J. Arn. Arb. 9 (1928) 86; CRONQUIST, Brittonia 5 (1944) 146; E. ANDERSON, Bull. Mo. Bot. Gard. 49 (1961) 105–107, 2 fig.—*Toxicodendron altissimum* MILL. Gard. Dict. ed. 8 (1768) *n.* 10.—*Rhus cacodendron* EHRH. Hann. Mag. (1783) 227, *non vidi.*—*Albonia peregrina* BUCHOZ, Herb. Color. Am. (1783) t. 57.—*A. glandulosa* DESF. Mém. Math. Phys. Ac. R. Sc. Paris (1786) 265, t. 8; AITON, Hort. Kew. 3 (1789) 443; DC. Prod. 2 (1825) 89; W. & A. Prod. (1834) 150; MIQ. Fl. Ind. Bat. 1, 2 (1859) 678; KOCH, Dendrol. 1 (1869) 569; BAILEY, Queensl. Fl. 1 (1899) 218; PRAIN, Ind. For. 28 (1902) t. 2 A.—*A. cacodendron* L'HÉRIT. Stirp. Nov. 6 (1790) 179; SCHINZ & THELL. Mém. Soc. Nat. Sc. Cherbourg IV, 38 (1911–12) 679.—*A. pongelion* GMEL. Syst. Veg. 1 (1791) 726, *nom. illeg., pro parte, cit. tab. Desfont.*—*A. procera* SALISB. Prod. (1796) 171, *ex* Ind. Kew.—*A. rhodoptera* F. v. M. Fragm. 3 (1862) 43, *ex descr.*—*A. erythrocarpa* CARR. Rev. Hortic. (1867) 419.—*Pongelium glandulosum* PIERRE, Fl. For. Coch. 4 (1892) t. 294.—*A. macrophylla ex* Handl. Trees Kew pt 1 (Polypet.) (1894) 53, *cult., ex* Ind. Kew.—*A. mascula l.c.*—*A. rubra l.c.*—*A. vilmoriniana* DODE, Rev. Hortic. (1904) 444.—*Pongelium vilmorinianum* VAN TIEGH. Ann. Sc. Nat. IX, 4 (1906) 278.—*A. giraldii* DODE, Bull. Soc. Dendr. Fr. (1907) 191.—*A. sutchuensis* DODE, *l.c.*—*Pongelion cacodendron* FARWELL, Am. Midl. Nat. (1930) 67.—*A. peregrina* F. A. BARKLEY, Ann. Mo. Bot. Gard. 24 (1937) 264.—**Fig. 17e, 18e.**

Distr. Native in China, cultivated in nearly all countries of the world with a temperate or subtropical climate, and often naturalized.

Note. The type specimen (from a cultivated tree) of *A. vilmoriniana* DODE agrees in all respects save that the branches and leaf rachis bear small spines which are further unknown in the genus.

5. Ailanthus fordii NOOTEBOOM, *nov. sp.*

Arbor parva, teste collectore palmae habitu conspicua. Foliola 6–13-juga, integra, subtus glandulis parvis applanatis sparse munita. Pedicelli 1–2 *mm. Flores paniculati, ultimi* 1–3 *aggregati. Calyx cupulatus c.* ½ *mm longus, breviter obtuse* 5*-lobatus. Petala* 5*, glabra, oblonga,* 2–3 *mm longa, c.* 1 *mm lata. Stamina glabra, in floribus* ♂ *in alabastro plicata c.* 3–5 *mm longa, in floribus* ♀ *c.* 1–3 *mm longa. Discus superne* 5*-lobatus,* ½–1 *mm altus. Carpella* 5*, dense puberula, stylis connatis* ½—1 *mm longis terminata. Stigmata* 5*, libera, basi excepta excurvata,* 1–1½ *mm longa. Samara* 3–5 *cm longa,* 1–1¾ *cm lata; fasciculus vasorum seminem versus intramarginalis; styli cicatrix seminis apici opposita.—Typus*: CH. FORD *s.n.* (K; isotype BM), Hongkong, Cape Aquilar.—**Fig. 18b.**

Small but conspicuous tree, *sec. coll.* 'the bare trunk surmounted with foliage like a palm'. *Leaves c.* 40 cm long; leaflets 6–13 pairs, opposite to subopposite, entire, glabrous or nearly so, with few, small, flat glands scattered on the undersurface; petiole 7–13 cm; rachis puberulous to glabrous. *Panicle* large, dense-flowered, pyramidal, 20–40 cm long and *c.* 20 cm wide at the base; branches of the first, and sometimes also of the 2nd and 3rd order with a conspicuous constricted articulation at the base. Pedicels 1–2 mm. Bracts small, triangular, not early caducous. *Flowers* 1–3 together, unisexual, the ♀ ones with reduced stamens. *Calyx* cupular, *c.* ½ mm high, with 5 short, obtuse lobes. *Petals* 5, glabrous, ± oblong, 2–3 by *c.* 1 mm. *Stamens* glabrous, in ♂ flowers sinuous in bud, 3–5 mm long, in ♀ flowers *c.* 1–3 mm long; anthers *c.* ¾ mm long, sterile in ♀ flowers. Disk 5-lobed on top, ½–1 mm high. *Carpels* 5, densely puberulous; styles connate, ½–1 mm high, more or less puberulous; stigmas 5, free, except at the very base, recurved-curled outwards, 1–1½ mm long. *Samara* 3–5 by 1–1¾ cm; main vessel to seed intramarginal; stylar scar at the same level as the apex of the seed.

Distr. Hongkong, near Cape Aquilar quite common (FORD; 1884–1886); emergent from shrubberies along ravines.

Note. This species differs from *A. triphysa* in having 5 pubescent carpels, long free stigmas, a very short lobed cupular calyx, the stylar scar being at the same level as the apex of the seed. It differs from *A. integrifolia* in the leaflets never having 2 large glands at the base, in the flowers being much smaller and the petals being glabrous, and in the main vascular bundle towards the seed in the samara which is intramarginal.

Excluded

Ailanthus mairei GAGNEP. Not. Syst. 11 (1944) 164 from Yunnan = *Toona sinensis* (JUSS.) ROEM. (*Meliaceae*).

Ailanthus punctata F. v. M. Fragm. 3 (1862) 42, *cf.* BENTH. Fl. Austr. 1 (1863) 373 = *Pentaceras australis* HOOK. *f.* (*Rutaceae*).

Ailanthus scripta GAGNEP. Not. Syst. 11 (1944) 165 from Yunnan = *Rhus vernicifera* DC. (*Anacardiaceae*).

8. SOULAMEA

LAMK, Dict. Enc. Méth. 1 (1783) 449; GUILLAUMIN, Bull. Soc. Bot. Fr. 85 (1938) 20.—*Cardiocarpus* REINW. Syll. Ratisb. 2 (1826) 14, 48, *nom. illeg.*—*Cardiophora* BENTH. in Hook. Lond. J. Bot. 2 (1843) 216.—*Amaroria* A. GRAY in Wilkes, U.S. Expl. Exp. 1 (1854) 356, t. 40.—**Fig. 21.**

Shrubs or small trees. *Leaves* simple (imparipinnate in some New Cal. *ssp.*), sometimes with a few glands underneath. *Flowers* in axillary racemes or narrow thyrses, 3(–4–5)-merous, bisexual or unisexual (in New Cal. and the Seychelles); floral parts persistent. Bracts minute. *Sepals* more or less connate at the base, slightly imbricate in bud. *Petals* not touching, longer than sepals. Stamens twice as many as petals, in 2 distinct rows, inserted under the lower outer margin of the disk; filaments attached adaxially, versatile; cells latrorse, diverging at both ends, connective very short. Disk 3(–4–5)-lobed, each lobe forked. *Carpels* (1–)2(–3), connate; ovules sessile, anatropous; style horizontally adnate to its carpel, except for a short free patent tip; stigma small, rarely reniform. *Fruit* dry, (1–)2(–3)-celled, indehiscent, flattened, distinctly winged, more or less emarginate, rarely flattened, ovoid, acute. *Seed* attached adaxially nearly halfway down, with more or less albumen; testa thin; cotyledons planoconvex.

Distr. One *sp.* endemic in the Seychelles (Mahé I.), one *sp.* widely distributed in *Malaysia* and Polynesia, 6 *spp.* in New Caledonia, and one in Fiji.

Notes. The monotypic Fijian genus *Amaroria* can in my opinion not be upheld against *Soulamea*. It differs merely by having one carpel, against 2–3 in *Soulamea*. The characteristic, emarginate fruit shape of the 2-celled *Soulameas* cannot be expected to occur in the 1-celled *Amaroria*, as this shape is precisely caused by the presence of 2 not entirely connate cells and absence of a terminal style; the difference in fruit shape is thus a compulsory structural consequence. Geographically it fits well with the distribution of the genus. Like the other inland species of the genus, **S. soulameoides** (A. GRAY) NOOTEBOOM, *comb. nov.* (*Amaroria soulameoides* A. GRAY, *l.c.*) has unisexual flowers.

The specimen I saw of *S. terminalioides* BAKER, from the Seychelles, is strongly suggestive of *S. amara* LAMK. It differs in the leaves (rounded apex), fruit (3-winged), and unisexual flowers.

All New Caledonian species have also unisexual flowers and besides less emarginate fruits. They differ *inter se* hardly in their generative parts, and are obviously very closely allied. The main differences are in their leaf structure, varying from 1–11 leaflets, and the indument. The first character is, however, not particularly important taxonomically as JADIN has demonstrated that simple and compound leaves may occur on a single plant (Ann. Sc. Nat. VIII, 13, 1901, 283–285, t. 1).

Although the littoral *S. amara* has not been found in New Caledonia it seems that whereas the largest (phenotypic and genetic) variability occurs in that island, and that inland, the origin of the genus and its distribution must have taken place in Melanesia. It is not impossible that in its primitive state it was unisexual – and in that case the Seychelles 'species' could be considered a marginal relic – and that it has later become bisexual by selection on the littoral.

The 'escape' of a littoral species from an inland aggregate finds a marked parallel in *Casuarina*, *Spinifex*, and some other genera.

Soulamea shows a striking resemblance in habit with *Lunasia* (*Rutac.*).

1. **Soulamea amara** LAMK, Dict. Enc. Méth. 1 (1783) 449; BL. Bijdr. 2 (1825) 60; ENDL. Ann. Mus. Wien 1 (1836) 188, t. 16; BENTH. Voy. Sulphur (1844) 181, t. 56, *textu*; MIQ. Fl. Ind. Bat. 1, 2 (1859) 129; HEMSLEY, Bot. Chall. 3 (1885) 235; WARB. Bot. Jahrb. 13 (1891) 341; BACK. Schoolfl. Java (1911) 193; MERR. Int. Rumph. (1917) 300; LAUT. Bot. Jahrb. 56 (1920) 344; HEYNE, Nutt. Pl. (1927) 872; STEEN. Bull. Jard. Bot. Btzg III, 12 (1932) 259, f. 13 map 3; KANEHIRA, J. Dep. Kyushu Imp. Un. 4, 6 (1935) 343; K. SCH. & LAUT. Fl. Schutzgeb. Südsee (1901) 378 ('*Sulamea*'); GUILLAUMIN, Ann. Mus. Col. Mars. 55/56 (1948) 28.—*Rex amaroris* RUMPH. Herb. Amb. 2 (1743) 129, t. 41.—*Cardiocarpus amarus* REINW. Syll. Ratisb. 2 (1826) 14.—*Cardiophora hindsii* BENTH. in Hook. Lond. J. Bot. 2 (1843) 216; Voy. Sulphur (1844) 181, t. 56, *ic.*—**Fig. 21.**

Shrub or small tree, up to 5(–15) m. Innovations rusty tomentose. Branchlets 5–15 mm ø, rather abruptly narrowed at the apex, with a thick pith. *Leaves* simple, crowded at the apex of the branchlets, leaving large scars, obovate-oblong and with a blunt but never rounded apex which is sometimes mucronate, cuneate at the base, hairy on midrib, nerves and veins below, 10–35 by 4–12 cm; midrib slightly immersed or inconspicuous above, strongly

Fig. 21. *Soulamea amara* LAMK. *a.* Fertile twig, × ⅔, *b.* flower, × 8, *c. ditto*, in section, pistil removed, × 8, *d.* fruit, nat. size (*a*, *d* FOSBERG 33912, *b*, *c* FOSBERG 26162).

prominent beneath; nerves straight, parallel, ending in an intramarginal looped vein, sulcate, slightly prominent or inconspicuous above, prominent beneath; veins inconspicuous above, finely dense-reticulate beneath; petiole pithy, shrunken at the base when dry, sometimes also at the apex, hairy, 3–8 cm. Racemes erect, shorter than the leaves, 3–12 cm. *Flowers* bisexual, 3(–4–5)-merous, *c.* 2 mm long. Pedicels up to 5 mm. *Sepals* puberulous, erect, appressed, *c.* ½–1 mm long. *Petals* concave, spreading, finally reflexed, sparsely hairy to glabrous, accrescent to 2½ by 1 mm. *Filaments* glabrous, up to 1 mm long; anther cells *c.* ¾ mm long. *Disk c.* ½ mm high. *Carpels* 2(–3), never more than 2 fertile, connate, except at the top, rather large, growing during

anthesis. *Fruit* obcordate, up to 2 by 2½ cm, strongly emarginate, wings often nearly touching by the inward curved style-bases; pericarp hard-corky.

Distr. From SW. Borneo eastwards to Micronesia (West and East Carolines and Marshalls) and Melanesia (New Britain, Solomons, New Hebrides), not in Australia and not in New Caledonia; in *Malaysia*: N. and SW. Borneo (only Sanguey, Sarawak, Karimata I.), Moluccas (Halmaheira, Sula, Batjan, Gebe, Buru, Ceram, Ambon, Banda), and New Guinea (also Admiralty Is). Fig. 22.

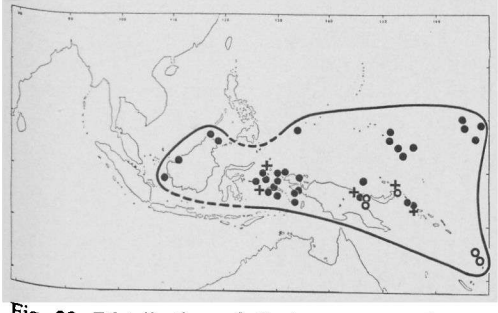

Fig. 22. Distribution of *Soulamea amara* LAMK, sheets seen (●), from literature (o), unlocalized (+).

It was recorded from Java by MIQUEL, but this rests on an error.

Ecol. A typical constituent of the Barringtonia formation, but much rarer than most of the species belonging to that formation, though locally common on the sandy beach and behind coral reefs, below 3 m, associated with *Messerschmidia argentea*, *Scaevola taccada*, and *Ochrosia*, sometimes (but not in Malaysia) dominant as a rather small shrub along the shore, and of more scattered occurrence as a treelet more inland. Under the parent plant seedlings may be found in great profusion. The majority of the localities are situated on small islands or islets, and atolls, a peculiarity which it shares with very many other beach plants, such as *Pisonia grandis*, *Suriana maritima*, *etc.* Though its distribution is less erratic as compared with *Suriana*, it is less common than could be expected; the reason of its preference will probably rather lie in a sort of exacting habitat than in the chances offered by dispersal. Though not expressly stated and justified by experiments I agree with RIDLEY (Disp. p. 264) that the fruits possess buoyancy power and seem adapted to dispersal by seawater; HEMSLEY recorded that seeds have been found in the crop of birds in the Admiralty Is.

The reason why it is absent in West Malaysia, the Philippines, Celebes, Java, and the Lesser Sunda Islands, save for four localities in Borneo, must remain a rather fascinating problem, similar to that found in the erratic distribution of the beach *Triumfettas*, *Scaevola plumierii*, *Launaea pinnatifida*, *Spilanthes urens*, *etc.*

Uses. The roots and fruits of this very bitter plant are often used against cholera, pleurisy, and other fevers. Powdered and mixed with water the beverage is taken against colic and cough. In poisoning, *e.g.* by snake bites, the fruits are wholesome by urging the patient to vomit (RUMPHIUS, *l.c.*, HEYNE, *l.c.*).

Vern. *Bona atti*, *buwa hati*, *kaju sulamu*, M, *pĕnawar pipis*, *sulamu pohon*, Ternate, *dschiri pangpang*, Tami.

9. IRVINGIA

HOOK. *f.* Trans. Linn. Soc. 23 (1860) 167; BENTH. & HOOK. *f.* Gen. Pl. 1 (1862) 314; PIERRE, Fl. For. Coch. 4 (1892) t. 263; VAN TIEGH. Ann. Sc. Nat. IX, 1 (1905) 247–320; ENGLER, in E. & P. Pfl. Fam. 19a (1931) 398.—*Irvingella* VAN TIEGH. Ann. Sc. Nat. IX, 1 (1905) 276.—**Fig. 23, 24.**

Large trees. Branchlets with conspicuous annular scars of the stem-clasping, very early caducous stipules forming a narrow-conical cap surrounding the terminal bud. *Leaves* simple, glabrous, entire; midrib sulcate; petiole with a groove above between the very narrow wings. Panicles terminal or axillary. Bracts small, early caducous. *Flowers* (4–)5-merous, bisexual. Sepals connate at the base, imbricate in bud. Petals exceeding the sepals, imbricate in bud. *Stamens* twice as many as petals, inserted beneath the disk; filaments slender, long, dorsally attached; anthers latrorse, emarginate at base and apex. Disk large, cushion-shaped, intrastaminal. *Ovary* 2-celled, conical or somewhat flattened, sessile on the torus-like disk; style 1, with an inconspicuous terminal stigma; ovules solitary, anatropous, attached adaxially and apically. *Drupe* large, 1–(2–)-seeded, resembling a mango. Albumen 0 or small (*e.g.* in *I. malayana*).

Fig. 23. *Irvingia malayana* OLIV. *ex* BENN. in cleared area with secondary forest behind, grassland and *Musa* in foreground, near Gemas, Malay Peninsula (Photogr. CORNER).

Distr. About 3 *spp.* in tropical Africa and 1 *sp.* in tropical SE. Asia and W. Malaysia.

Ecol. The African species are sometimes a conspicuous constituent of the tropical rain-forest. The Asiatic species is not seldom frequent in the lowland forest. Because of its hard wood and big buttresses it is often left in forest clearings and thus by its great size stands out on the landscape (CORNER).

Uses. The fruit of all species is edible, but usually only the seeds are eaten. The cotyledons (as the bark and pith of branchlets and petioles) contain large lysigenous arabin-containing mucilaginous cells, surrounded by cells containing fat. The seeds are used for the manufacturing of wax, cacao, and soap.

1. Irvingia malayana OLIV. *ex* BENN. in Fl. Br. Ind. 1 (1875) 522; OLIV. in Hook. Ic. Pl. (1877) t. 1247; PIERRE, Fl. For. Coch. 4 (1892) t. 263 A; KING, J. As. Soc. Beng. 62, ii (1893) 230; BACK. Schoolfl. Java (1911) 194; CRAIB, Fl. Siam. En. 1 (1926) 243; RIDLEY, Fl. Mal. Pen. 1 (1922) 364; HEYNE, Nutt. Pl. (1927) 872; BURK. Dict. 2 (1935) 1251; CORNER, Ways. Trees (1940) 604; GAGNEP. Fl. Gén. I.–C. Suppl. 1 (1946) 669.—*I. oliveri* PIERRE, Fl. For. Coch. 4 (1892) t. 263 B; LECOMTE, Fl. Gén. I.–C. 1 (1911) 701; CRAIB, Fl. Siam. En. 1 (1926) 243; GAGNEP. Fl. Gén. I.–C. Suppl. 1 (1946) 670.—*Irvingella malayana* VAN TIEGH. Ann. Sc. Nat. IX, 1 (1905) 276.—*Irvingella oliveri* VAN TIEGH. *l.c.*—*Irvingella harmandiana* VAN TIEGH. *l.c.* 279.—*I. harmandiana* PIERRE [in De Laness. Pl. Ut. Col. Fr. (1886) 306, *nomen*] *ex* LECOMTE, Fl. Gén. I.–C. 1 (1911) 701.—*I. longipedicellata* GAGNEP. *ibid.* Suppl. 1 (1946) 670.—**Fig. 23, 24.**

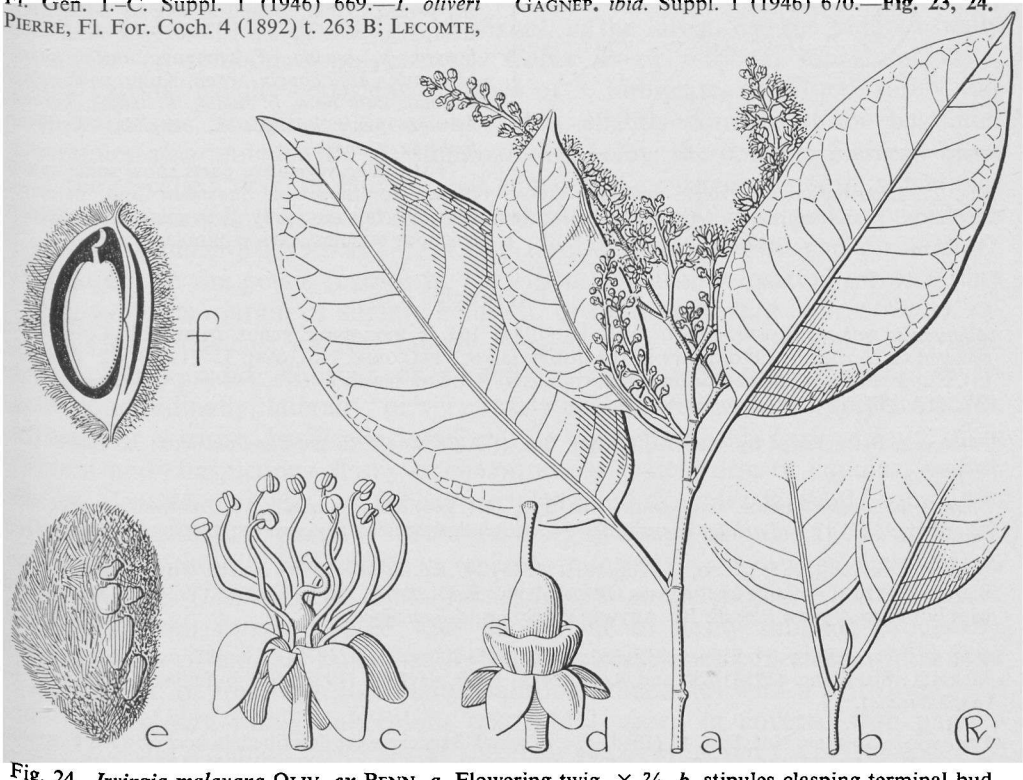

Fig. 24. *Irvingia malayana* OLIV. *ex* BENN. *a.* Flowering twig, × ⅔, *b.* stipules clasping terminal bud, × ⅔, *c.* flower, × 4, *d. ditto*, petals and stamens removed, × 4, *e.* withered fruit showing fibrous mesocarp and remains of exocarp, *f. ditto*, in section, × ⅔ (*a* THORENAAR 29-E-1P-362, *b* bb 8375, *c–d* 29-E-1P-424, *e–f* 29-E-1P-484).

More or less deciduous large tree, up to 60 m and 1½ m ø; bole straight with very prominent, thin, steep buttresses; bark grey, sometimes peeling off in large pieces. *Leaves* elliptic-oblong to lanceolate, slightly acuminate, broad-cuneate to roundish, or even subcordate at the base, distinctly prominent-reticulate-veined at either side, 8–20 by 2½–9 cm; petiole 1–2 cm. Stipules surrounding the buds as a sharp, narrow-conical cap up to 3(–4) cm long. Panicles 5–15 cm long. Bracts ovate, acute, *c.* 1½ mm. Pedicels up to 3(–5) mm, articulate at the base. *Flowers* glabrous, greenish-white or yellowish. *Calyx c.* 1½ mm long, the lobes rounded, with membranous margin, *c.* 1 by ¾–1 mm. *Petals* elliptic-oblong, rounded, finely reticulate, *c.* 3–4 by 2 mm, spreading finally or reflexed and with often involute margin in the upper half. *Disk* plicate outside and with sinuous margin, apex excavated in the middle. *Filaments* sinuous in bud, 3–6 mm, their base situated in the

concavities of the disk; anthers *c.* ½ by ½ mm. *Ovary c.* 1 mm high, style 1–2 mm, sinuous in bud. *Drupe* with thick, fleshy, very fibrous, orange exocarp and hard endocarp, somewhat flattened-ellipsoid, up to 6 by 4 cm when dry. *Seed* with small albumen, only at the back of the cotyledons.

Distr. Siam, Indo-China (Laos, Cambodia, Cochinchina); in *Malaysia*: Sumatra, Malay Peninsula, Borneo, and Bawean. Fig. 25.

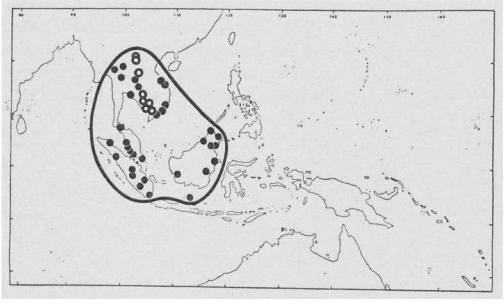

Fig. 25. Distribution of *Irvingia malayana* OLIV. *ex* BENN., examined sheets (●), from literature (o).

Ecol. Scarce or rather common, scattered in dryland primary rain-forest, below 250 m. Flowers before or with the new leaves. *Fl. fr.* Jan.–Dec.

Uses. The yellow-coloured wood is too hard to manufacture, and, besides, not very durable. MAINGAY recorded its use for making kris-handles and FOXWORTHY for handles of tapping knives (BURKILL).

The seeds contain a white or sometimes yellow fat with an agreeable smell and taste, which is known as 'dika' fat in Europe and is used for making soap, wax, and candles. The seeds are also eaten (HEYNE, *l.c.*; FOXWORTHY, Mal. For. Rec. 8, 1930, 26; BURKILL, *l.c.*).

Vern. Mal. Pen.: *bunga paukijang, kĕbayang, mĕrĕlang, mirlang, pauh kidjang, pauh kijang*, M, *perseh*, Sakai; Sumatra: *ĕmplas batu, kulut*, Lampong, *pauh bayan, p. kijang, p. rusu, sĕpah bongin, s. bungin*, Palembang, *kalĕk karsik*, Minangk.; *kaju bongin, sèpah*, Kubu, *pauh mĕnté*; Borneo: *kaju batu, k. tulang, k. tulung, kĕrangi, kĕranji, pauh kijang*, M, *tĕngilan*, Kedayan, *malenna gunung*.

Note. The vegetative parts show some resemblance to those of *Samadera* and *Inocarpus* (*Legum.*) but are easily distinguished by the conspicuous stipules leaving annular scars.

Excluded

Ailantopsis poilanei GAGNEP. Not. Syst. 11 (1944) 163, a monotypic genus from Indo-China, was reduced to *Heynea* by GAGNEPAIN at the instigation of PELLEGRIN, Not. Syst. 13 (1947) 63; Fl. Gén. I.-C.Suppl. 1 (1948) 727 is according to BENTVELZEN, Act. Bot. Neerl. 11 (1962) 14 = *Trichilia connaroides* (W. & A.) BENTVELZEN *f. connaroides (Meliaceae)*.

Philagonia BL. referred by MIQUEL, Fl. Ind. Bat. 1, 2 (1859) 679 to the *Simaroubaceae* = *Evodia* (*Rutaceae*).

Picroderma laotica THOREL *ex* GAGNEP. Not. Syst. 11 (1944) 165 is according to BENTVELZEN, Act. Bot. Neerl. 11 (1962) 17 = *Trichilia connaroides* (W. & A.) BENTVELZEN *f. glabra* BENTVELZEN (*Meliaceae*).

Quassia simaruba (*non* L.)BLCO, Fl.Filip. ed. 2 (1845) 247, ed. 3, 2 (1878) 94 is according to MERRILL, Sp. Blanc. (1918) 241 = *Guioa koelreuteria* (BLCO)MERR.; RADLKOFER, Pfl. R. Heft 98 (1933) 1273 reduced it with doubt to *Arytera litoralis* BL. Anyway it belongs to *Sapindaceae*.

Quassia tricarpa BLCO, Fl. Filip. (1837) 351; ed. 2 (1845) 206, ed. 3, 2 (1878) 94, t. 388, *p.p.* is according to MERRILL, Sp. Blanc. (1918) 238 and RADLKOFER, Pfl.R. Heft 98 (1932) 642 = *Sapindus saponaria* L. (*Sapindaceae*).

Tetramyxis GAGNEP. Not. Syst. 11 (1944) 166, of which 3 species were described, is, according to FORMAN, Kew Bull. 16 (1962) 158 and TARDIEU-BLOT, Fl. Cambodge *etc. n.* 2 (1962) 130—131 = *Allospondias lakonensis* (PIERRE) STAPF (*Anacardiaceae*).