A REVISION OF SARCOTHECA BL. AND DAPANIA KORTH. (OXALIDACEAE)

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SUMMARY

In this revision 11 spp. and a doubtful one are recognized for *Sarcotheca* Bl. One new species and one new variety are described and one species is transferred to *Rourea* Aubl. (*Connaraceae*). Five species have been reduced to synonymy and two to varietal rank. A new name is proposed for *Connaropsis macrophylla* King, *non Sarcotheca macrophylla* Bl.

In *Dapania* Korth. one new species is described and one is reduced to synonymy. There are 3 spp. in all.

TAXONOMIC HISTORY

Sarcotheca was first described by Blume (1850) who added it to the then monogeneric family *Hugoniaceae* (now *Linaceae*), remarking that it differed from *Hugonia* L. by the superposed ovules, smaller flowers, and different habit. He presumed there were small, caducous stipules. Miquel (1859) reduced it to *Roucheria* Planch. which he placed together with *Hugonia* in the *Hugoniaceae*, while Bentham & Hooker (1862) regarded it as a distinct genus in the *Linaceae-Ixonantheae*. Baillon (1873) merged it with *Hugonia* in the *Linaceae-Hugonieae*. Reiche (1894) included it also in the *Linaceae*. Hallier *f.* (1911) was the first to include it in the *Oxalidaceae*. This view was shared by Heimsch (1942) after a study of its wood-anatomy, which also showed affinities with *Geraniaceae*.

On the basis of the structure of the vascular traces and floral morphology Narayana (1966) also reckons *Sarcotheca* to belong to the *Oxalidaceae*, and not to the *Linaceae*.

Hallier *f.* (1911) included *Connaropsis* Planch. *ex* Hook. *f.*, described in 1860 and accommodated in the *Oxalidaceae*, in *Sarcotheca*. Baillon (1873) already pointed out its affinities with *Averrhoa* L., even suggesting that it might be included in that genus when more details would be known. I agree with the current opinion that *Sarcotheca* should be kept distinct from *Averrhoa*.

Dapania was described by Korthals (1854) who referred it to the *Chrysobalanaceae* (aff. *Rosaceae*), although he was not very sure about this, noting similarities with *Connaraceae*, *Oxalidaceae*, and *Simaroubaceae*. His main point against adding it to the *Oxalidaceae* was the presence of an aril. In the same year Planchon referred it to the *Oxalidaceae*, where it has remained ever since (or in the *Geraniaceae*, if these include the *Oxalidaceae*, as in Bentham & Hooker, 1862). Stapf (1891) suggested congenerity between *Dapania* and *Connaropsis*, a view shared only temporarily by Knuth (1914).

Hutchinson (1959) in his rigorous attempt to prevent natural families to have both ligneous and herbaceous genera, split up the *Oxalidaceae* into a herbaceous part, the *Oxalidaceae sens. str.* (in the *Geraniales*) and two arboreous parts, which he accommodated in the *Lepidobotryaceae* (*Malpighiales*) and in a newly created family *Averrhoaceae* (*Rutales*) respectively, the latter including only the genus *Averrhoa*.

With this I cannot agree, because *Averrhoa*, *Dapania*, and *Sarcotheca* are clearly naturally

affiliated and should be included in one family. This family must be accommodated in the *Malpighiales*, not in the *Rutales*, because of the absence of a disk and the presence of pendulous ovules.

Whether *Lepidobotrys* Engler also belongs here is not certain. Hallier *f.* (1923) thought it close to *Sarcotheca*. Knuth did not include it in his monograph for the '*Pflanzenreich*' (1930), but followed Hallier's opinion in the '*Pflanzenfamilien*' (1931). Léonard (1950) is of opinion that it represents a separate family. Of the differential characters he mentioned, the following seem significant:

Lepidobotrys: Leaves with stipules and stipels. Flowers strictly dioecious; disk present; gynoecium 3-merous; ovules collateral. Capsule septicidal.

Oxalidaceae: Leaves not with stipules and stipels. Flowers bisexual or androdioecious; disk absent; gynoecium 5-merous; ovules superposed. Fruit indehiscent or a loculicidal capsule.

On the other hand there are remarkable similarities in the articulate, unifoliate leaves and the stamens of two lengths. Erdtman (1952) gave rather similar descriptions of the pollen of *Sarcotheca diversifolia* and *Lepidobotrys staudtii* Engl., currently having *Lepidobotrys* in the *Oxalidaceae*.

GENERAL MORPHOLOGY OF DAPANIA AND SARCOTHECA

(1) *The young leaves* are often red, in *Sarcotheca* covered by a thin but dense, usually ferrugineous indument, which is generally caducous; in the seedling of *Dapania pentandra* the young parts have small, caducous, capitate-glandular hairs, later it is as well as the other species eglandular and glabrous, but for the pubescence of the inflorescence. The leaves soon harden, their upper surface is then shiny to dull, but never glaucous, as stated by Knuth (1930, p. 15); beneath they are paler and sometimes subglaucous, as can be ascertained by holding a burning match near it: a slight, temporary discoloration spreads out, betraying the melting wax. The lower surface may retain the pubescence to various degree.

The leaf is compound, either 1-foliolate in *Dapania* and most species of *Sarcotheca*, or exclusively 3-foliolate in 2 species of *Sarcotheca*. In *S. griffithii* the young seedling has 1-foliolate leaflets but the mature plant is 3-foliolate. The petiole is distinctly constricted-articulate with the petiolule, and the petiolule is mostly cross-wrinkled. In falling the petiolule remains attached to the leaflet. In 3-foliolate species the laterals fall first, sometimes at an early stage, and always leave a scar. Such leaves give the impression of a long-stalked, 1-foliolate leaf.

(2) *The venation* is usually rather prominent beneath and only slightly so on the upper surface. In *Sarcotheca* the nerves loop to the margin, where they are often distinctly archingly joined. The veins are fine and clearly distinct from the nerves. There are 2 more or less distinct basal nerves of various length, sometimes giving a triplinerved appearance.

In *Dapania* the nerves are not as distinct beneath, nor as straight as in *Sarcotheca*. Usually they are irregularly branched, transcending into the veinlets and often not much different from these, thus forming an irregular network, without being distinctly joined by arches.

(3) *The petiole* is smooth with an incrassate base which perhaps may function in sleeping movements as recorded for other *Oxalidaceae*. Hooker *f.* (1874) says that the leaves of the trifoliolate *Sarcotheca griffithii* (Hook. *f.*) Hall. *f.* are 'irritable to the touch', with which he presumably means these movements.

(4) *The pedicel* is jointed, the upper part falling off with the flower or the fruit.

(5) *The inflorescence* is made up of a rachis, only occasionally branched, bearing either more or less stalked cymes (*Sarcotheca*) or solitary flowers (*Dapania*).

(6) *The flowers* are said to be scentless and to taste sour. Their parts show only very little variation and have the usual pattern of the family. They are heterodistylous or androdioecious (Malesian *Dapania*).

a. *The sepals* are usually a little unequal, the outer generally being somewhat larger, more pubescent, more acute, and more ovate.

b. *The petals* are unguiculate and coherent above the claw, thus falling off jointly (in the Malesian *Dapania* not coherent and falling off separately). The inside has fine capitate papils (lens!) apically in *Sarcotheca*, pluricellular, strandlike papillae in *Dapania pentandra*, or is glabrous in *D. racemosa* and *D. grandifolia*. Sometimes there are minute cilia or stalked, capitate glands on the apical margin.

c. *The filaments* are of two lengths and united at base in an '*annulus*'. Three types of flowers can be discerned: the long-styled form (LF) in which the styles are longer than the filaments, the short-styled form (SF) in which the styles are shorter than all filaments but the ovary is still fertile. In Malesian *Dapania* the SF is further reduced to a ♂ flower with a minute, sterile ovary and very short styles. A type with the style intermediate in length between the long and short filaments (MF) as recorded for *Oxalis* and other genera, has not been observed. Only one floral type is found on one individual plant.

(7) There is no *disk*. The nature of the scales found in *Dapania* between the filament bases is uncertain. They may be of filamental origin, if one accepts the annulus to be merely the connate base of the filaments. Similar scales are recorded in *Oxalis*. Another interpretation could be to homologize them with disk-like emanations.

(8) *The fruit* is either an indehiscent berry or a loculicidal, 5-rayed, fleshy capsule. It is never septicidal as assumed by some authors, who probably have misinterpreted the septal folds (*rimae*) in *Sarcotheca* for an early state of dehiscence. These rimae are also found in Malesian *Dapania*. Moreover, the fruits of *Sarcotheca* are loculicidal after pressure, as the septs often become rather woody, fibrous, and tough. In some species the rimae are closed and inconspicuous, thus resembling *Averrhoa*, where only traces of rimae are found. In some species of *Sarcotheca* the inside surface of the rimae is lighter and covered by similar papils as found on the petals.

The mesocarp is juicy, edible, and reported to be rather sour.

(9) *The seed* in *Sarcotheca* has no trace of an aril; in *Dapania* the aril is bilabiate, envelops the seed and is larger than it, attached to the entire ventral raphe. It develops before the seed, but no trace of it can be found on the ovules. This probably has prompted Stapf (1891), who had a specimen with 2 ovules per locule, to assume that Korthals had mistaken the upper one for an aril. He did not see fruits, however, while the latter did.

In *Dapania* the testa splits longitudinally, in *Sarcotheca* irregularly, after pressure.

(10) The pendulous, straight *embryo* has the normal shape as encountered in the family, the radicle is straight in *Sarcotheca*, oblique in *Dapania*. It matures after the rest of the seed, this in turn after the fruit wall, so one often finds fruits with no seed at all. Also, not all ovules become seeds, so there are 0-few seeds per fruit.

(11) *Seedlings* were found on two sheets of *Sarcotheca* (*S. griffithii* and *S. laxa* var. *hirsuta*). The shape of their leaves is cordate, as recorded for the family. In *Dapania pentandra* they are elliptic as I observed from seedlings at the Leyden Botanical Garden.

ANATOMY

Little is known, cf. Chauvel (1903) [on *Sarcotheca griffithii* and *Dapania scandens* (= *racemosa*)], Metcalfe & Chalk (1950), and Heimsch (1942), who also points at the similarity with the *Geraniaceae*. In a study on the vascular traces and floral anatomy Narayana (1966) concluded that *Sarcotheca* should be arranged in *Oxalidaceae*.

INTERGENERIC RELATIONSHIPS

Sarcotheca and *Dapania* are no doubt closely allied mutually and to *Averrhoa*. The affinity with *Lepidobotrys* is uncertain.

The phylogenetical lineage argued for by Hallier *f.* (1917), based on the dehiscence of the fruit and its fleshiness (*Dapania*, *Sarcotheca*, *Averrhoa*) does not seem to be tenable when other characters are studied (number of leaflets, ovules, presence or absence of aril, etc.), which point at a more reticulate relationship.

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PRESENTATION

In the keys and descriptions measurements of floral and fruiting parts have been taken from boiled material; leaves and inflorescences have been measured in dry state. Petiole and petiolule were measured separately.

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KEY TO THE GENERA

1. Leaves uni- or trifoliolate; leaflets chartaceous to coriaceous. Ovules 0—2 per cell.
   2. Lianas. Inflorescence racemose. Petals inside glabrous or pilose. Fruit dehiscent into a 5-rayed star. Seed arillate . . . . . **1. Dapania**
   2. Shrubs or trees. Inflorescence paniculate. Petals minutely papillose inside. Fruit indehiscent, but 5-furrowed (episeptal rimae). Seed exarillate . . . . . **2. Sarcotheca**
1. Leaves at least 5-foliolate; leaflets herbaceous to papyraceous. Ovules 3—7 per cell . **3. Averrhoa**

1. DAPANIA

Korthals, Ned. Kruidk. Arch. 3 (1854) 381; Benth. & Hook. *f.*, Gen. Pl. 1 (1862) 277; Stapf in Hook. *f.*, Ic. Pl. 3, 10 (1891) 1997; Reiche, in Nat. Pfl. Fam. 3, 4 (1896) 23; Knuth, Bot. Jahrb. 50 (1914) 234, *pro parte*; Hallier *f.*, Beih. Bot. Centr. Bl. 34, ii (1917) 25; Ridl., Fl. Mal. Pen. 1 (1922) 332; Knuth, Pfl. R. Heft 95 (1930) 419; Knuth, Nat. Pfl. Fam. ed. 2, 19a (1931) 39; Hutchinson, Fam. Fl. Pl. 1 (1959) 266. — **Fig. 1.**

Lianas (rarely shrubbish), innovations glabrous. *Leaves* spirally arranged, estipulate, unifoliolate, pergamentaceous to coriaceous, penninerved; petioles articulate. *Inflorescences* racemose, ramiflorous and axillary, solitary to fascicled. Pedicels articulate. Flowers heterodistylous or androdioecious. *Sepals* 5, connate in lower half, margins ciliate, glabrous inside, persistent, hardening. *Petals* 5, apotact or paratact, rarely quincuncial, free (or in *D. pentandra* coherent above the claw and falling off jointly), glabrous (*D. pentandra* pilose inside), red to white. *Filaments* 5 + 5, all (in *D. pentandra* only the longer) antheriferous, connate at base in an annulus, between the filaments with scales, these sometimes reduced to dark lines. *Disk* none. *Ovary* 5-celled, 5-lobed, glabrous, reduced and sterile in ♂ plants; styles 5. Ovules in ♀ 1—2 per cell, in ♂ 0—1; adaxial, superposed, pendulous. *Fruit* fleshy, loculicid to the base, valves patent. Carpels outside with episeptal furrows (rimae) (none in *D. pentandra*, not to be confused with the dehiscing lines!). *Seeds* 0—2 per cell, oblong, terete, testa terminally thickened around the micropyle. Fruit by abortion 1—6 seeded. Aril present, enveloping the seed, attached to the entire length of the adaxial raphe, fleshy, bright to whitish yellow, margin irregularly crenate, with oily drops. Testa smooth, hard, yellowish red, splitting longitudinally under pressure. Endosperm copious, with oily drops. Embryo with the cotyledon 1½—2 times as long as the straight, oblique radicle.

Type species: *D. racemosa* Korth.

Distribution: Three species, of which two in W. Malesia (Malaya, Sumatra, Borneo) and one in Madagascar.

Ecology: Lianas in forests, swamps, near rivers on poor soil at low altitudes.

Notes: The Malesian species are very closely related, while the Malagasian *D. pentandra* shares some floral characters with *Sarcotheca* Bl., to wit cohering, unguiculate petals with internal appendages and heterodistylous flowers.

KEY TO THE SPECIES

1. Petals free, clawless, not pilose inside. All filaments with anthers.
   2. Leaves up to 15 cm, base cuneate to rounded. Sepals glabrous, except the ciliate margin. **1. D. racemosa**
   2. Leaves longer than 15 cm, base deeply emarginate. Sepals puberulous outside . **2. D. grandifolia**
1. Petals coherent above the claw, pilose inside. Shorter filaments without anthers. Madagascar. **3. D. pentandra**

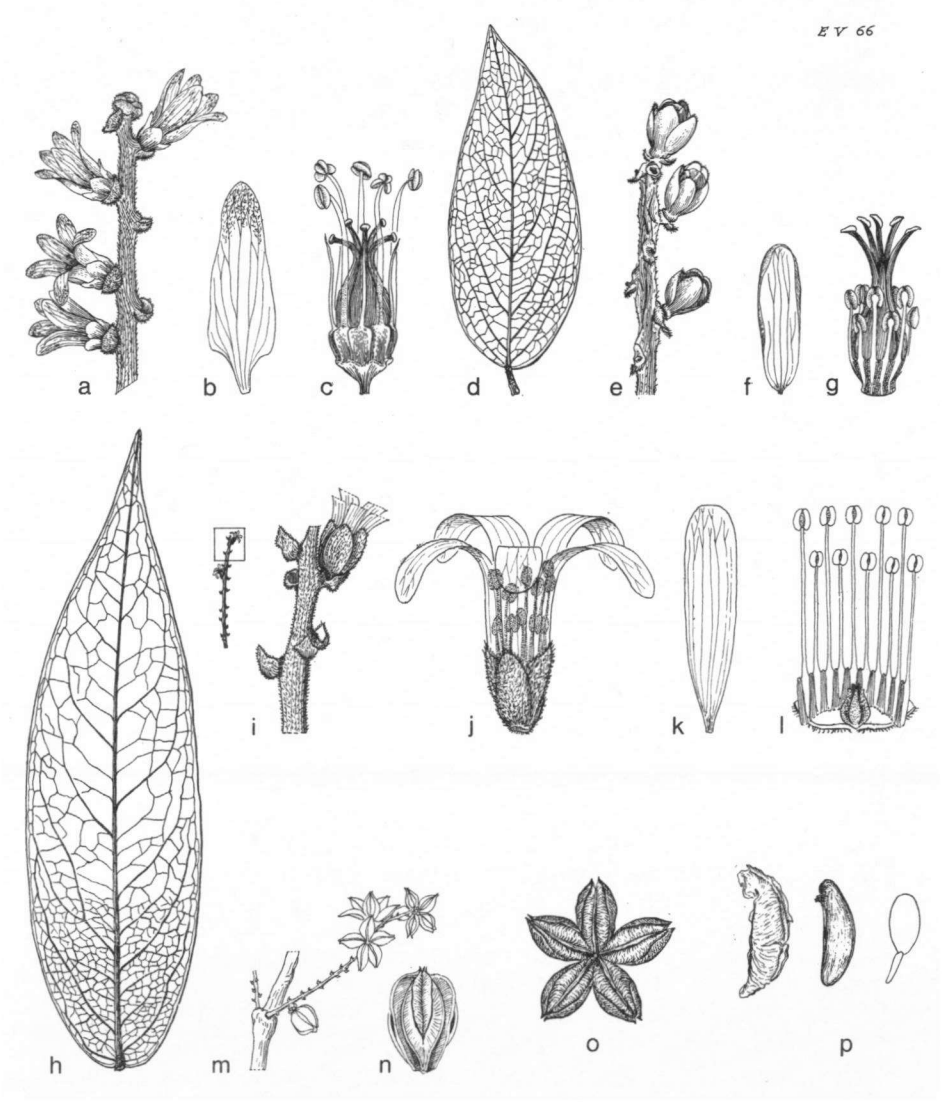

Fig. 1. *Dapania pentandra* Capuron. a. Apex of spike, × 3, b. petal, from inside, × 6, c. flower, × 11, (*Capuron 23730*). — *D. racemosa* Korth. d. Leaf, × ⅓, e. buds, × 3, f. petal from inside, × 7, g. androgynoecium × 10 (*Nur 7294*). — *D. grandifolia* Veldk. h. Leaf, × ⅛, i. spike, × 3, j. ♂ flower, × 7, k. petal from inside, × 7, l. sexual organs of ♂ flower, × 6, m. infructescence, × ⅛, n. fruit, ± nat. size, o. open fruit from outside, showing the widely opened rimae bordered by the recurved carpel margins, nat. size, p. seed enveloped by dry aril, the same, cleaned, × 3, right: embryo × 3 (h—l. *Ramos 1626*, m—p. *SAN 22805*).

1. Dapania racemosa Korth., Ned. Kruidk. Arch. 3 (1854) 381; Planchon, Ann. Sc. Nat. 4, ii (1854) 266; Miq., Fl. Ind. Bat. 1, 2 (1859) 134; Stapf, in Hook. *f.*, Ic. Pl. 3, 10 (1891) 1997; Hall. *f.*, Beih. Bot. Centr. Bl. 34, ii (1917) 25; Knuth, Pfl. R. Heft 95 (1930) 420, fig. — *D. scandens* Stapf, l.c.; King, Journ. As. Soc. Beng. 62, ii (1893) 201; Hall. *f.*, l.c.; Ridl., Fl. Mal. Pen. 1 (1922) 334; Knuth, l.c. — **Fig. 1d—g.**

Large liana, sometimes shrubbish, up to 30 m long, 20 cm ∅, rather profusely branched. *Leaves* 5¾—15(—25) by 2½—6¾ cm, oblong to lanceolate [index 2—4(—5)], pergamentaceous to subcoriaceous, apex acute to cuspidate, base cuneate to rounded, when fresh above dark to light green, dull, beneath bright yellowish-green, ± dark brown and dull when dry; petiole 3—10 by 1—2 mm, petiolule 2—6 by 1—2 mm, both glabrous. *Flowers* androdioecious. *Racemes* solitary to fascicled, in ♀ 1—3 together, 3—13½ cm long, in ♂ 1—15 together, 2—5½(—12½) cm long; rachis patent to ascending, puberulous, in fruit ± glabrous. *Pedicel* with lower joint 0—1 mm, upper ¼—½ mm long, not covered by the minute, broadly ovate, acute bract ¼—½ by ½ mm. *Calyx* 1½—2 mm high, membranaceous, reddish-brown when dry, glabrous to sparsely puberulous outside, margin ciliate, sepals ½—1½ by ¾—1¼ mm, broadly ovate to elliptic, rounded to emarginate. *Petals* free, 3—4 by 1—1¼ mm, obovate-oblong to -lanceolate, upper half often reflexed at anthesis, apex obtuse to rounded, darker, glabrous inside, base attenuate, clawless; whitish to crimson. *Filaments* in ♀ ¼—½ and ¾—1 mm, in ♂ 1—3 and 1½—4 mm long; all stamens fertile. *Pistil* in ♀ 1½—2½ mm, in ♂ ⅓—¾ mm; *styles* in ♀ 1—1¼ mm, in ♂ very short, acute. *Fruit* pale green (red when dry), before dehiscing obovate with cuneate base, 5—11 by 6—10 mm, afterwards 9—22 mm ∅; rimae open to base. *Seeds* 1—5 per fruit, 0—1 per cell, 4—5 by 1½ mm. *Radicle* 1¼—1¾ mm long, cotyledons 2—2½ by ¾—1 mm.

Type: *Korthals 1311* (L).

Distribution: Sumatra, Malaya, Borneo.

Ecology: Dense jungle, swamp forest on poor soil, at low altitudes.

Vernacular names: *Batieg-batieg* (Sumatra), *bĕlimbing bait* (M), *dapan* (Sumatra), *jaloai* (Brunei), *pau-kiang* (Malacca), *selambun akar* (Selangor).

Note: *D. scandens* is included in this species, as was already suggested by Hallier *f.* (1917). The differences given by Stapf (1891) are inconsistent. A large-leaved form occurs in North Sumatra.

2. Dapania grandifolia Veldkamp, *sp. nov.* — **Fig. 1h—p.**

A speciebus ceteris differt foliis coriaceis certe 16½ cm excedentibus, basi retusis vel profunde emarginatis, petiolis 2—3½ mm latis; rhachibus dense et persistenter puberulis, pedicellis bracteis conspicuis naviformibus obtectis; sepalis puberulis.

Liana, or treelet, up to 27 m, 7 cm ∅. *Leaves* coriaceous, (10½—)16½—31 by 5½—11 cm, oblong to lanceolate (index 2.7—4.8), widest at or below the middle, base retuse to deeply emarginate, apex acute to attenuate, glabrous and glossy on both sides, above yellowish brown when dry, venation ± distinct, beneath darker, midrib prominent, nerves (6—11 pairs) and veinlets less so, but conspicuous; petiole 2—6 by 2—3½ mm, stout, petiolule 1—3 by 2—3½ mm. *Flowers* androdioecious, only ♂ seen. *Racemes* ± densely and ± patently puberulous, not glabrescent in fruit, erect to ascending, in ♂ 1—5 fascicled, 3—5 cm long, in ♀ 1—2 together, 4—8 cm long. Bracts boat-shaped, sometimes recurved, ¾—1 by ½—1 mm, broadly ovate, acute, covering the minute (*c.* ½ mm long) pedicel, but not the base of the calyx. *Calyx* 1¾—2½ mm high, pale to brown puberulous, membranaceous, in fruit patent to recurved, yellowish-brown when dry. *Sepals* 1—1½ by ¾—1½ mm, suborbicular to ovate, apex acute to rounded. *Petals*

white, free, glabrous inside, 5 by ½—1 mm, obovate-lanceolate, apex rounded, base attenuate, clawless. *Filaments* in ♂ 2—3½ and 3—4 mm long, in ♀ ¾ and 1 mm. *Pistil* in ♂ reduced, sterile, 0—1 ovules per cell, ⅓—¾ by ¼—½ mm, ovate, *styles* minute, acute (those of ♀ were not seen, apparently with 2 ovules per cell). *Fruit* before dehiscing 9—11 by 6—8 mm, suborbicular to ovate, rimae open to base, afterwards 20—22 mm ∅, first pale yellowish-green, later more redbrown, glossy in life, red and dull when dry. *Seeds* 2—6 per fruit, 0—2 per cell, 4½—5 by 1½—1¾ mm. *Embryo* 4 mm long, radicle 1¼ by ⅓ mm, cotyledons 2½ by 1¼ mm.

Type: *Ramos 1626* (L, isotypes in BO, K).

Distribution: NE. to SE. Borneo.

Ecology: Primary forest, on flat to undulating land on clay near rivers. Low altitudes. Apparently flowering and fruiting all the year round.

Vernacular name: *Salung kapit* (Dusun).

3. Dapania pentandra Capuron, Adansonia 5 (1965) 217, fig. — **Fig. 1a—c.**

Large liana. *Leaves* pergamentaceous, 5—9 by 1—3 cm, oblong to lanceolate (index 2.2—4.5), widest at or below the middle, base cuneate, apex acute to long attenuate, glabrous, dull, yellowish-green above, darker beneath when dry; nerves inconspicuous on both sides, *c.* 4—5 pairs; petiole ½—2 by 1 mm, petiolule 2—4 by 1 mm. *Racemes* 1—3 together, ½—5 cm long, rather dense, ascending and patent, persistently ± patently puberulous; bracts ½—¾ by 1—1¼ mm, cup-shaped and clasping the minute pedicel and the base of the calyx. *Flowers* heterodistylous. *Calyx* puberulous, margins red to pale ciliate, 1½—2 mm high, herbaceous. *Sepals* 1—1½ by 1¼—1½ mm, suborbicular to broadly obovate, apex rounded to emarginate, appressed in fruit. *Petals* reddish-purplish in life, dark when dry, bluish when boiled, apex darker, 4½ by 1½ mm, elliptic-oblong, apex rounded, inside pilose; claw contracted, 1—1¼ mm, petals coherent above it and falling off jointly. *Filaments* in SF 1 and 1¾ mm, in LF 1 and 1¼ mm long, the shorter epipetalous, without anthers; annulus tumid; scales pronounced to ± absent; anthers red. *Pistil* in SF 1¾ mm high, in LF 2 mm; glabrous. *Styles* in SF ½—¾ mm, in LF 1 mm long. *Ovary* 1—1¼ by ½—1 mm, ovate. *Ovules* 1—2 per cell. *Fruit* before dehiscence 6—9 by 6—9 mm, subglobose, yellowish-green becoming translucent, red when dry; rimae absent. *Seeds* 1—2 per fruit, 0—1 per locule, 3—3½ by 1 mm. Aril bright yellow in life, greenish, later red in alcohol, 4—4½ by 2 mm, D-shaped. *Embryo* 2½ mm long, radicle 1 mm, cotyledons 1½ by 1 mm.

Type: *Capuron 23730 - SF* (isotype in L).

Distribution: E. Madagascar.

Ecology: Along rivers. *Fl.*: Oct., *fr.*: Febr.

Seedling. A few seeds were received in February 1966 from Dr. Capuron, together with material preserved in alcohol originating from a region *c.* 50 km south of Moramanga (along the road to Angosibe; 800—900 m alt.). Five were sown in the hothouse at Leyden Botanical Garden in black earth under glas. Six were send to Wageningen, where they did not germinate.

About a month after sowing two plantlets appeared. The elliptic cotyledons, *c.* 1 cm long and faintly triplinerved, were pushed up to *c.* 1 cm above the surface of the soil, capped by the testa which had split along the raphe. After a few days they spread horizontally, the testa persisting on one of them.

One seedling soon died, the other produced some small leaves, similar in shape to those of the dried material, but much smaller, herbaceous, and obtuse, while all herbaceous parts had an indument of dispersed, small, capitate-glandular hairs. During the first

year growth was slow, but in the summer of 1967, after placing the plant in apparently more favourable conditions, it increased rapidly in length. It branched freely, the branches being thin and slender, loop-like, giving a trailing appearance, consistent with the climbing habit of the full-grown plant. The leaflets changed also and became larger, pergamentaceous, and attenuate as in the dried material, while the glandular hairs disappeared entirely. The young leaves are sometimes purplish. The pedicels are swollen and there is an indication of sleeping movements. In the morning and on cloudy days the leaflets are somewhat drooping, while on a sunny midday they are all placed in one plane, giving a distichous aspect, although they are not inserted that way.

In May 1966, the second month after sowing, a third plantlet appeared which is still (Oct. 1967) very arrested in its growth, although it is standing next to the other plant; it is only a few cm high with the small, herbaceous, and glandular type of leaflets.

The slowness of the growth or the arresting of it is probably due to the suboptimal conditions of the hothouse. A few experiments have been tried (change in temperature, humidity, light, and food), to no avail or even detrimental to the plant as shown by yellowing or falling of the leaflets.

Note: This species resembles *Sarcotheca* Bl. in its floral aspects.

2. SARCOTHECA

Blume, Mus. Bot. Lugd. Bat. 1 (1850) 241; Benth. & Hook. *f.*, Gen. Pl. 1 (1862) 245; Reiche, Nat. Pfl. Fam. 3, 4 (1896) 34; Hallier *f.*, Med. Rijksherb. 1 (1911) 1; Knuth, Pfl. R. Heft 95 (1930) 420; Knuth, Nat. Pfl. Fam. ed. 2, 19a (1931) 39; Hutchinson, Fam. Fl. Pl. 1 (1959) 267. — *Roucheria* Miquel, Fl. Ind. Bat. 1, 2 (1859) 136. — *Connaropsis* Planchon *ex* Hook. *f.*, Trans. Linn. Soc. 23 (1860) 166; Benth. & Hook. *f.*, l.c. 277; Edgeworth & Hook. *f.*, Fl. Br. Ind. 1 (1874) 439; King, Journ. As. Soc. Beng. 62, ii (1893) 200; Reiche, l.c. 23; Ridl., Fl. Mal. Pen. 1 (1922) 332. — *Dapania* (*non* Korth.) Knuth, Bot. Jahrb. 50 (1914) 234, *pro parte, excl. typ.* — **Fig. 2—5.**

Shrubs or trees; innovations pubescent. *Leaves* spirally arranged, estipulate, uni- or trifoliolate (leaflets almost opposite), pergamentaceous to subcoriaceous, penninerved with subbasals; petioles articulate. *Panicles* axillary or pseudoterminal, solitary to a few together; flowers in more or less stalked cymes, scattered along a simple or sparsely branched rachis; cymes subtended by small caducous bracts, occasionally by a reduced petiole *(petioloid)*, or rarely a small leaf. Pedicels articulate, subtended by minute, often caducous bracts. *Flowers* heterodistylous. *Sepals* 5, unequal, shortly connate at base, inside appressed strigose, persistent (except in *S. diversifolia*). *Petals* 5, contorted, sometimes paratact, free at base, cohering above the claw and falling off jointly, inside with minute papils in the upper half, apex obtuse to retuse. *Filaments* 5 + 5, connate at base, annulus without scales. *Disk* none. *Ovary* 5-celled, styles 5. Ovules 2 per cell, adaxial, superposed, pendulous. *Fruit* fleshy, indehiscent, with more or less distinct episeptal furrows (*rimae*), which in some species are lighter and minutely papillose inside (at least when dry). *Seeds* 0—2 per cell, flattened, elliptic-ovate, fruit by abortion, 0-few seeded. No aril; testa smooth to transversely rugose, hard, reddish, splitting irregularly by pressure; after boiling the epidermis swells and easily comes loose from the seed, thus sometimes imitating an aril; no caruncle; endosperm in various amounts, with oily drops; embryo with a straight radicle in line with the cotyledons, these 3—5 times as long as the radicle.

Type species: *S. macrophylla* Bl.

Distribution: In W. Malesia 11 spp.: Sumatra, Malaya, Borneo, Celebes.

Ecology: Primary and secondary forest on poor soil at low altitudes. Apparently flowering and fruiting all the year round.

Uses: The fruit of *Sarcotheca*, although acid, is eaten in curry, sajur, and manisan and is said to be a remedy against coughing. The roots of *S. laxa* var. *sericea* are said to be used for poulticing wounds externally (collector's note, *Burkill & Haniff SFN 17611*). The wood is said to be light, neither very strong nor durable, sometimes used for roofs.

Notes: A subdivision of the genus has never been made. The trifoliolate species which also have comparatively large flowers and greenish-yellow fruits (the latter with obscure rimae), show features suggestive of *Averrhoa*. Among the unifoliolate species with red fruits *S. glauca* seems to have affinities with most others, especially with *S. monophylla* and *S. celebica*, while the Malayan *S. laxa* and *S. glomerula* seem rather close.

The closest affinity is with *Averrhoa* as already a century ago pointed out by Baillon. The latter genus is different by multijugate leaves, more than 2 ovules per cell, a larger fruit, occurrence of an aril in one species, larger cotyledons compared with the radicle, and various minor characters.

The genus has often been confused with *Rourea* Aubl. (*Connaraceae*). Miquel (1860) described *S. diversifolia* (Miq.) Hall. *f.* under *Rourea*. Reversely, several *Sarcotheca* (or *Connaropsis*) species proved to belong to *Rourea* as appears from the excluded names at the end of this paper.

Rourea differs from *Sarcotheca* in having free carpels, seeds with an aril, and a dry, indehiscent, 1-celled and 1-seeded fruit; cf. Leenhouts, Blumea 12 (1963) 20.

The species of the genus are closely related and most of them occupy small ranges; in several cases close allies show replacing areas. With a broader species concept several species could be reduced to subspecific rank, notably the triad *S. monophylla* from Malaya, *S. glauca* from Borneo, and *S. celebica* from Celebes.

KEY TO THE SPECIES

1. Leaves trifoliolate, laterals sometimes caducous, leaving a scar. Mature fruit greenish-yellow when fresh (red when dry!); more than 1½ cm long.
   2. Calyx 3—5 mm high, outside pale puberulous to glabrous, not persistent in fruit. **1. S. diversifolia**
   2. Calyx 2½—3 mm high, outside brown puberulous, persistent in fruit . . . . . **2. S. griffithii**
1. Leaves unifoliolate; no lateral scars. Mature fruit red when fresh; less than 1½ cm long.
   3. Mature leaf puberulous to pubescent beneath, also between the nerves.
      4. Panicles not or barely exceeding the leaves. Petals 4—7 mm long. Rimae obscure, glabrous inside.
         5. Leaves 5—23 by 2—8½ cm, margins never paler. Calyx 1¼—2 mm high . . . . **4. S. laxa**
         5. Leaves 3—11½ by 1—3½ cm, margins usually paler. Calyx 2—3¼ mm high **8. S. ferruginea**
      4. Panicles exceeding the leaves. Calyx 3—3½ mm high. Petals 6—8 mm long. Rimae conspicuous, lighter and minutely papillose inside . . . . . **10. S. ochracea**
   3. Mature leaf beneath at most sparsely puberulous on the nerves.
      6. Calyx (and often panicle also) glabrous to finely *pale* puberulous. Rimae obscure and glabrous inside.
         7. Panicle glabrous, stout. Cymes sessile, flowers in glomerules along the rachis. **3. S. glomerula**
         7. Panicle puberulous, slender. Cymes stalked . . . . . **4. S. laxa**
      6. Calyx at least at the base (and panicle) *rusty* puberulous. Rimae conspicuous, inside lighter and minutely papillose.
         8. Leaves 1—13½ cm long. Panicle up to 13 cm, erect, ± compact (lax in no. 7).
            9. Cymes not ± secund. Basal parts of pedicels all ± equal.
               10. Leaves when dry brown to reddish-brown. Basal parts of pedicels 0—2 mm long. Calyx 1¾—2¼ mm high, persistently puberulous outside, reddish-brown when dry.
                  11. Leaves 2½—10 cm long, acuminate to cuspidate. Panicle ± dense, pedicels with shorter and reduced upper joint (*c.* ½ mm) . . . . . **6. S. monophylla**

11. Leaves 6—13½ cm long, cuneate-acute to faintly acuminate; venation above more prominent than in the other two species. Panicle slender, lax, joints of pedicel ± equal (up to 1½ mm) . . . . . **7. S. celebica**

10. Leaves when dry palish to olive green, 1.3—11 cm long, acuminate. Basal part of pedicels 2—6 mm long. Calyx 2—3 mm high, outside glabrescent in fruit, except for base and margins, crimson when dry . . . . . **5. S. glauca**

9. Cymes ± secundly branched. Basal part of one pedicel per cyme usually elongated, up to 5 mm. Nerves of leaf beneath often reddish when dry . . . . . **9. S. rubrinervis**

8. Leaves 7½—23½ cm long. Panicle usually pendulous, slender, usually much longer than 13 cm.

12. Leaf widest at the middle, apex gradually acute to caudate, base obtuse to rounded. Nerves often reddish when dry. Petiolules 2—4 by 1—2 mm. Cymes ± secundly branched, basal part of one pedicel elongated, up to 5 mm. Claw of petals ⅝—1 mm long. **9. S. rubrinervis**

12. Leaf widest at or above the middle, margins ± parallel, apex abruptly acuminate to caudate, base truncate to emarginate. Nerves concolourous with intervenium when dry. Petiolules 3—9 by 1—3 mm. Cymes not ± secundly branched, basal part of pedicels ± equal. Claw of petal ¼—½ mm long . . . . . **11. S. macrophylla**

1. Sarcotheca diversifolia (Miq.) Hall. *f.*, Med. Rijksherb. Leiden 1 (1911) 2. — *Rourea diversifolia* Miquel, Fl. Ind. Bat. Suppl. 1 (1860) 528. — *Connaropsis diversifolia* Kurz, l.c. excl. syn. *C. griffithii*. — *Santalodes diversifolium* O. Kuntze, Rev. Gen. 1 (1891) 155. — *Connaropsis acuminata* Pearson, Kew Bull. (1906) 2. — *S. acuminata* Hallier *f.*, Beih. Bot., Centr. Bl. 34, ii (1917) 27. — *S. subtriplinervis* Hallier *f.*, l.c. (1917). — *Connaropsis grandiflora* Ridley, Kew Bull. (1930) 75. — **Fig. 2a—c.**

Shrub or tree, up to 27 m high, 90 cm ∅, base often deeply fluted. *Leaves* trifoliolate, papyraceous to subcoriaceous, ovate- to elliptic-oblong to -lanceolate (index 1.5—4), glabrous, apex acute to caudate, base acute to truncate, above bright green, dull to glossy, venation not very conspicuous, beneath pale to whitish-green, dull, sometimes subglaucous, venation paler than to ± concolorous with the intervenium, nerves 1—5 pairs, usually ± prominent, sometimes conspicuous and somewhat triplinerved, veinlets not as finely reticulate as in *S. griffithii*; lateral leaflets 3—9½ by 1—3¾ cm, terminal ones 5½—18 by 2—6¾ cm; petiole 6—25 by 1—2½ mm, rachis (5—)9—27 by ¾—2 mm; petiolules 4—7 by ¾—2 mm. *Panicle* shorter than subtending leaf, 1—4 together, loosely branched, 1—8½(—13½) cm long, ferrugineous puberulous, stout to elongated and glabrescent in fruit; branches ascending to perpendicular patent, lower longest, flattened, 2—30(—40) mm long, subtended by an ovate, acute bract, or a petioloid, up to 7 mm long, rarely a small leaf. *Flowers* rarely clustered, if so, the bracts relatively large and conspicuous. *Pedicels* with the lower joint 2½—5 mm long, upper 1—3 mm. *Calyx* 3—5 mm high, outside pale puberulous to glabrous, purplish, membranaceous, caducous in fruit, sometimes persistent, patent to recurved. *Sepals* 2¼—5 by 1¼—3 mm, broadly ovate to oblong, apex acute to emarginate, inner longer, more obovate and obtuse. *Petals* 7—11 by 2—5 mm, obovate-oblong to -lanceolate, apex rounded to emarginate, 1—2 mm clawed, lilac or pink to scarlet or red. *Filaments* in SF 2¾—3½ and 3¼—4½ mm, in LF 1½—2¼ and 2¼—3 mm long, the longer sometimes without anthers; pollen white. *Pistil* pale puberulous to glabrous, in SF 1¼—2½ mm, in LF 3½—5 mm long; styles in SF ¼—1 mm, in LF 2½—4 mm; ovary 1—2 by ¾—1¼ mm, ellipsoid. *Fruit* white to greenish when fresh, red when dry, 16—31 by 9—20 mm, ellipsoid, glabrous. *Rimae* inconspicuous, ± lighter inside. *Seeds* 0—7 per fruit, 0—2 per cell, 7½ by 5 mm, testa smooth; cotyledons 4⅔ by 4 mm, radicle 1⅓—1¾ by ⅘ mm.

Type: *Teysmann HB 707* (= ? *706*) (L, isotypes in BO, K, CAL).

Distribution: N. Sumatra (Sibolga, Morsala I.), Borneo.

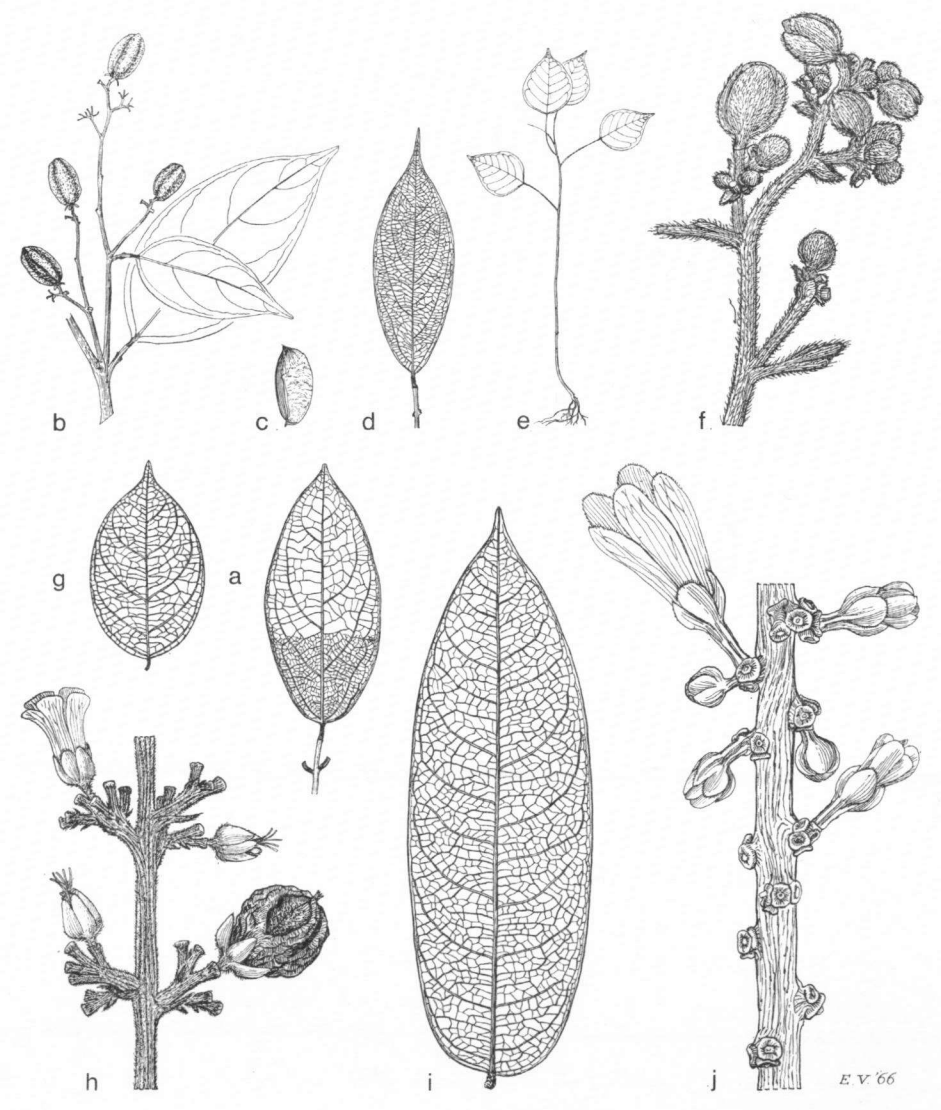

Fig. 2. *Sarcotheca diversifolia* (Miq.) Hall. *f.* a. Terminal leaflet, × ½, b. fruiting twig, × ⅛, c. seed with part of testa epidermis removed, × 3 (*SAN 29465*). — *S. griffithii* (Hook. *f.*) Hall. *f.* d. Terminal leaflet, × ½, e. young seedling, × ⅓, f. cymes in detail, × 3 (*Alvins 526*). — *S. monophylla* (Hook. *f.*) Hall. *f.* g. Leaf, × ½, h. fruit and flowers, × 3 (*Symington FMS 23066*). — *S. glomerula* Veldk. i. Leaf, × ½, j. flowers, × 3 (*Sinclair 9915*).

Ecology: First and second storey of primary and secondary forest on wet, well-drained, poor soil (e.g. podsolized sand) on undulating to flat land at low altitude.

Vernacular names: *Bělimbing bulat* (M), *buah piang* (Iban), *iba jantan* (Suluk), *kadazan* (Brunei), *kandis(-daham)* (Tidong), *kěrapa-kěrapa*, *pěrapan macas* (Tutong Dusun), *tabaus*, *těbarus* (Brunei).

Note: True unifolioly has not been observed. The laterals drop off, however, but leave ± distinct scars. This holds also for *S. griffithii*. With Kurz's statement, followed by Knuth, that *S. griffithii* is conspecific, I cannot agree, as it differs in many respects from the aggregation of forms that constitute *S. diversifolia*. I refrain from giving these any infraspecific status.

Pollen morphology: See Erdtman, Pollen morphology and plant taxonomy (1952) 303 on pollen of *Elmer 21351*.

Collector's notes: Clear bole if present up to 18 m, pockmarked; buttresses when present up to 90 cm high, 5 cm thick, 135 cm wide. Bark smooth, reddish-brown with grey, shallow, elongated flakes. Slash: outer bark up to 2½ mm thick, red-brown, soft; inner orange-brown to yellow, up to 4 mm thick, fibrous, hard; sapwood white to pale pink or yellow, up to 5 cm; cambium pinkish; hardwood pink to light brown.

2. Sarcotheca griffithii (Planch. *ex* Hook. *f.*) Hall. *f.* Meded. Rijksherb. Leiden 1 (1911) 2; Knuth, Pfl. R. Heft 95 (1930) 425. — *Connaropsis griffithii* Planchon *ex* Hook. *f.*, Trans. Linn. Soc. 23 (1860) 166; Edgeworth & Hook. *f.*, Fl. Br. Ind. 1 (1870) 440; Kurz, Journ. As. Soc. Beng. 39, ii (1870) 69; Kurz, ibid. 62, ii (1893) 200; Ridl., Fl. Mal. Pen. 1 (1922) 332, fig.; Kochummen, Res. Pamphl. (For. Res. Inst. For. Dep. Mal.) 43 (1963) 6, 38. — *Dapania griffithii* Knuth, Bot. Jahrb. 50 (1914) 234. — **Fig. 2e—f.**

Tree, up to 42 m, 1 m ∅, base fluted. *Leaves* trifoliolate, glabrous, pergamentaceous, often crisped when dry, subglaucous beneath, dull, darker above when dry, red when young; venation slightly prominent, rather inconspicuous, not white when dry, ± concolorous with intervenium; veinlets on upper surface flat to slightly immersed, finely reticulate. Leaflets elliptic-oblong to -lanceolate (index 2—4), occasionally somewhat obovate, apex tapering acuminate to caudate, base obtuse to acute, lateral leaflets 2—7 by ¾—2¾ cm, nerves 1—5 pairs; terminal leaflet 4—11½ by 1½—4 cm; nerves 4—6 pairs; petiole 5—12 by 1¼—2 mm, rachis 3—16 by ¾—1 mm; petiolules 3—7 by ¾—1¼ mm. *Panicles* shorter to a little longer than the subtending leaf, stout, densely branched, ferrugineous puberulous, 2—10 cm long, at flowering time dark red; branches subtended either by a caducous, linear petioloid up to 2½ mm long or by a small, ovate bract, patent to obliquely ascending, basals up to 2 cm, diminishing upwards (2 mm). *Flowers* pectinately clustered, subtended by minute bracts. Lower joint of *pedicel* 1—2½ mm, upper ½—1 mm. *Calyx* 2½—3 mm high, dark red, herbaceous, outside brown puberulous, in fruit persistent and recurved. *Sepals* unequal, inner wider, more obovate, apex blunter, 2—2¾ by 1½—2¼ mm, broadly ovate to -obovate, apex acute to emarginate. *Petals* ± glossy, when fresh blackish-red at anthesis, inside basally whitish, 4½—8¼ by 2—2½ mm, obovate-lanceolate to -oblong, apex rounded to obtuse; claw ⅜—1½ mm long. *Filaments* when fresh reddish to white, base pale, all pale when dry, in SF 4—4½ and 5—5½ mm long, in LF 1½ and 2 mm; the longer sometimes without anther and club-shaped, red. *Pistil* in SF 1¾ mm, in LF 3—4 mm; puberulous; *styles* in SF ¾ mm, in LF 2—3 mm. *Ovary* 1 by ¾—1 mm, subglobose. *Fruit* 18—32 by 10—23 mm, ellipsoid, glabrescent, greenish-yellow at maturity when fresh, inside yellow, mesocarp glazy; all red when dry; rimae inconspicuous. *Seeds* 0—2 per fruit, 0—1 per cell, 5—7½ by 2—4 mm; testa smooth neither grooved nor dotted; radicle 1¼ by ½ mm, cotyledons 5½ by 3½ mm.

Type: *Griffith 946* (K).

Distribution: Malaya, Sumatra.

Ecology: Lowest storey of primary forest on flat to undulating sandy clay on dry to temporarily flooded land at low altitudes.

Vernacular names: *As(s)am pupy* (or *pupoii*), *bělimbing* (*hutan*), *kaju manau* (Lampong), *kukui* (Oesoe), *Lain jenis* (sic), *jintek-jintek*, *kupoyi*, *pandija* (N. Sumatra), *pupoy*, *pupoi*, *pupui*, *pokô pupoě*.

Anatomy: Cf. Chauvel, l.c.

Notes: Seed of the tree numbered by the Neth. Indian Forest Service 50 E - 1P-558 from S. Sumatra was grown and seedlings are preserved; their leaves are *unifoliolate*! Their rootsystem is branched from top of the hypocotyl which is 6—8½ cm long; there are 4—6 leaves to a plant, 20—30 by 12—27 mm, broadly ovate to ovate, herbaceous, apex acute to contractedly acuminate, base cordate, light green above, whitish beneath; venation indistinct, a little prominent beneath; petiole 12—16 by ½ mm, very slender and thin; petiolule 1—1½ by ¼ mm. Flowers of this same number have the longer filaments without anthers, but apically club-shaped instead.

According to Edgeworth & Hooker *f.* the leaves are irritable to the touch.

Collector's notes: Bole straight, to the first branch up to 20 m, fluted, ridges up to 4 m high, at base 6—7½ cm thick, up to 1 m wide. Slash: Outer bark pockmarked to smooth, flaky, rosebrown, hard. Inner bark laminated, 2½ cm thick, light red. Sapwood pale yellow-white. Heartwood reddish. Crown highly placed, densely branched and leaved.

3. Sarcotheca glomerula Veldkamp, *nom. nov.* — *Connaropsis macrophylla* King, Journ. As. Soc. Beng. 62, ii (1893) 201, *non S. macrophylla* Bl. 1850; Ridl., Fl. Mal. Pen. 1 (1922) 334. — *Dapania macrophylla* (King) Knuth, Bot. Jahrb. 50 (1914) 234. — *S. macrophylla* (*non* Bl.) Knuth, Pfl. R. Heft 95 (1930) 424, *pro specim. malay., excl. specim. born. et syn. Miq.* — **Fig. 2i—j.**

Shrub or tree, up to 9 m, 8 cm ∅. *Leaves* unifoliolate, (6—)11½—28 by (2¼—)4—9 cm, pergamentaceous to subcoriaceous, glabrous, glossy on both sides, oblong to lanceolate (index 2.3—3.8), margins ± parallel, apex contractedly acute to cuspidate, base broadly truncate to emarginate, above light to dark green, darkening in drying, paler beneath, not glaucous; nerves 8—13 pairs, branching off with wide angle (lower ± 65—90°), basals usually recurved; petiole 4—11½ by 1½—3 mm, petiolule 3—8 by 2—3 mm, glabrous. *Panicles* subterminal or axillary, 1—few together, ± erect, glabrous, stout, 4—19 cm long; branches reduced, wart-like 0—2½ cm, cymes sessile, few-flowered, glomerulous, sometimes subtended by a small caducous bract. Lower joint of pedicel ± absent, upper 1—3 by ¾ mm. *Calyx* 1½—2 mm high, glabrous outside except the ciliate margin, ± herbaceous, red when dry, patent in fruit. *Sepals* ± unequal, 1¼—1½ by 1¼—1½ mm, broadly ovate, apex rounded to obtuse. *Petals* 6—8½ by 1¾—2⅓ mm, lanceolate-oblong to obovate-lanceolate, apex rounded, claw slender, ⅔—1 mm, red to crimson, tube lighter. *Filaments* in LF 1 and 1¾ mm, in SF 2½—3 and 3½—4 mm. *Pistil* sparsely puberulous, in SF 2 mm, in LF 4 mm. *Styles* in SF ¾—1 mm, in LF 2½—3 mm. *Ovary* 1 by ⅔—¾ mm, subglobose, pubescence mainly apically. *Fruit* 8—16 by 5—10 mm, ellipsoid to ovoid, apex acute to acuminate, glabrous, red, recurved; rimae inconspicuous, in the upper half, neither lighter nor papillose inside. *Seeds* 1—4 per fruit, 0—1 per cell, 10 by 4 mm; testa transversely rugose; cotyledons 7¼ by 3 mm, radicle ± 1 mm long, stout.

Lectotype: *Curtis 474* (K, SING).
Distribution: Malaya.
Ecology: Primary and secondary forest on flat to undulating land at low altitudes.
Vernacular names: *(Asam) (sĕ-) tundok, tĕtindok, sĕndok, bĕlimbing bĕsi, -hutan.*
Notes: This species had to be renamed. The epithet alludes to the sessile cymes leading to a spike-like inflorescence. This is why Hallier *f.* compared it with *Dapania*; having no fruit at his disposal he refrained from a definite decision.

4. Sarcotheca laxa (Ridl.) Knuth, Pfl. R. Heft 95 (1930) 422. — *Connaropsis laxa* Ridl., Journ. As. Soc. Str. Br. 75 (1917) 9; Fl. Mal. Pen. 1 (1922) 333. — *Connaropsis glabra* Ridl., l.c. (1917) & (1922) 332. — *S. glabra* Knuth, l.c. — *Connaropsis sericea* Ridl., Journ. Fed. Mal. St. Mus. 10 (1920) 121; Ridl., l.c. (1922) 334. — *S. sericea* Knuth, l.c. 424. — *Connaropsis simplicifolia* Ridl., l.c. (1922) 334. — *S. simplicifolia* Knuth, l.c. 424. — **Fig. 3a—g.**

Shrub or treelet, up to 18 m high, 30 cm ∅. Branches glabrous or densely ferrugineous-tomentose, glabrescent. *Leaves* unifoliolate, papyraceous to pergamentaceous, 5—23 by 2—8½ cm, oblong to lanceolate (index 2.2—3.8), elliptic to obovate, apex acuminate to caudate, base broadly cuneate to truncate, above dark green, glossy, glabrous to pale, sparsely, and silky pubescent, mainly at base and on the midrib, beneath lighter and paler, glossy to dull, sometimes subglaucous, glabrous or pale to ferrugineous pubescent; nerves 5—11 pairs, basals sometimes at 90°; petiole 5—25 by 1—3½ mm, petiolule 3—7 by 1—3 mm, glabrous or pubescent. *Panicles* 1—3 together, up to 30 cm long, erect, glabrous, or finely pale puberulous, or ferrugineous velvety; branches patent to recurved in fruit, up to 14 mm long, sometimes once forked near the top, subtended by a small caducous bract, or a subulate to club-shaped petioloid (up to 4 mm long), rarely by a small leaf. Lower and upper joint of pedicel subequal, ½—1 mm. *Calyx* 1¼—2 mm high, outside glabrous or very shortly pale puberulous or ferrugineous puberulous, yellowish brown to brown when dry, membranaceous to firm, patent to recurved in fruit. *Sepals* 1¼—2 by 1—2 mm, outer broadly ovate to elliptic, apex acute to rounded, inner elliptic to spathulate, apex obtuse to emarginate. *Petals* 4—7 by 1¼—2 mm, obovate-lanceolate, apex rounded to emarginate, claw minute to 1¼ mm long; in life pale white to dark red, dark blue when older, dark when dry. *Filaments* in SF 1—2½ and 2—3½ mm, in LF ½—1 and 1—1¾ mm; pollen white. *Pistil* glabrous to appressed strigose throughout, in SF 1—1½ mm, in LF 3—4 mm long; *styles* in SF ½ mm, in LF 2—3 mm long; *ovary* ¾—1 by ½—⅝ mm, ellipsoid. *Fruit* 6—13 by 4—9 mm, ovoid to ellipsoid with rounded to acuminate apex, recurved, glabrescent to glabrous. Rimae inconspicuous, closed, not lighter nor glandular inside. *Seeds* 1—3 per fruit, 0—1 per cell, 5—9 by 3—4 mm; testa smooth to transversely rugose; cotyledons 4—5 by 2—2½ mm, 3—4 times as long as the radicle which measures 1—1½ by ⅓ mm.

Type: *King's Coll. 2384* (K).
Distribution: Malaya.
Ecology: Forest edges, swamps at low altitudes.
Notes: A number of varieties have been distinguished. To this species probably also belongs a collection from Sumatra (Tenajan R., Upper Riouw, *Soepadmo 154*) of which the leaves and also the fruit somewhat resemble the Bornean *S. rubrinervis*, but of which the panicle is like the Malayan *S. laxa* var. *sericea*. It might be a new variety of *S. laxa*, but more material is needed to reach a definite conclusion.

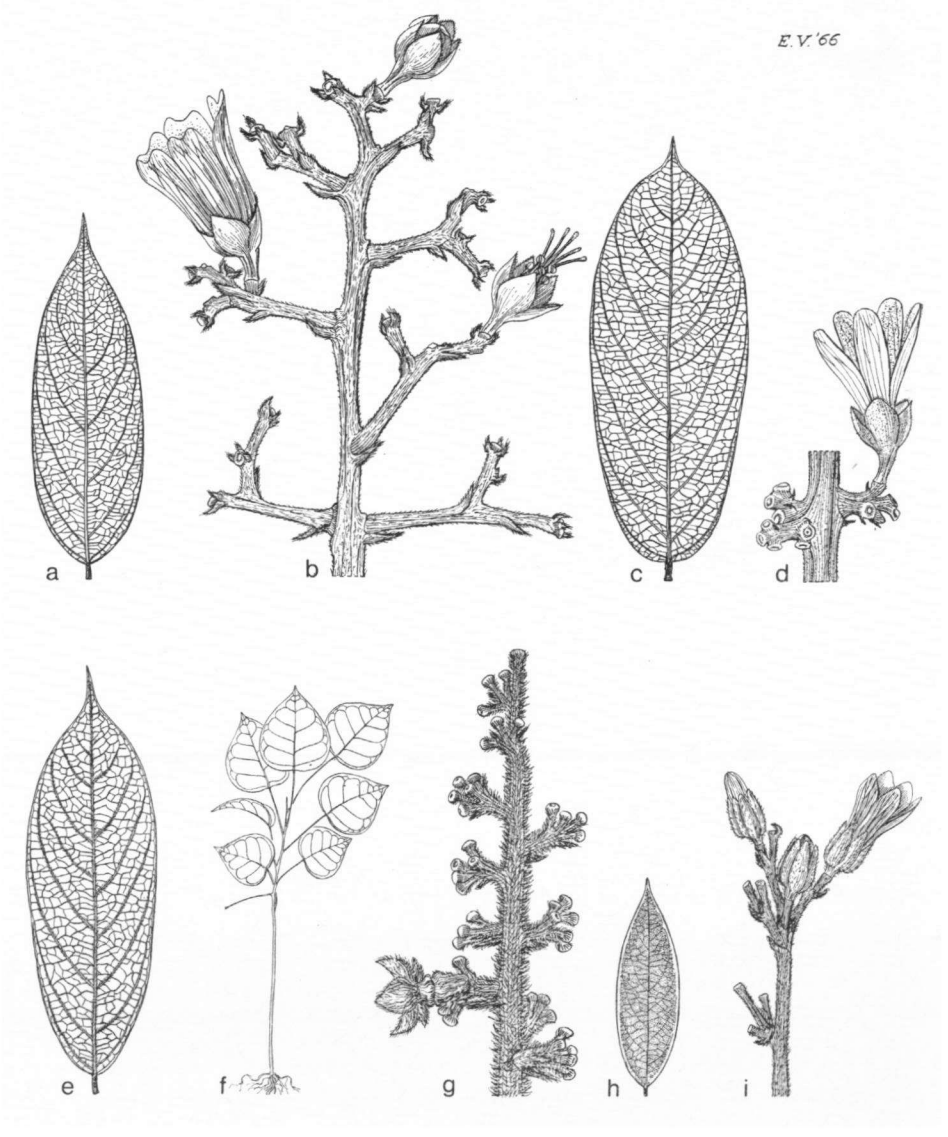

Fig. 3. *Sarcotheca laxa* (Ridl.) Knuth var. *laxa*. a. Leaf, × ⅓, b. cymes, × 3 (*Sinclair 9897*). — *S. laxa* var. *sericea* (Ridl.) Veldk. c. Leaf, × ⅓, d. cyme and flower, × 3 (*Sinclair 39894*). — *S. laxa* var. *hirsuta* Veldk. e. Leaf, × ⅓, f. young seedling, × ⅓, g. cymes in detail, × 3 (*Corner SF 29380*). — *S. ferruginea* Merr. h. Leaf, note pale margin, × ⅓, i. cymes in detail, × 3 (*Rahmat si Boeea 358*).

a. var. laxa. — *S. laxa* (Ridl.) Knuth. — *S. glabra* (Ridl.) Knuth. — **Fig. 3a—b.**

Nearly glabrous throughout. Petals retuse to truncate, $4\frac{1}{2}$—$4\frac{3}{4}$ by $1\frac{1}{4}$—$1\frac{1}{2}$ mm, claw 0—$\frac{1}{2}$ mm long, stout. Leaf with 6—9 pairs of nerves. Branches of panicle distinct, slender, 2—14 mm long, near top once forked. Fruit 6—7 mm long. Seed 5 by 3 mm.

Distribution: NW. Malaya.

Vernacular name: *Měsěkam.*

b. var. sericea (Ridl.) Veldkamp, *stat. nov.* — *S. sericea* (Ridl.) Knuth. — *S. simplicifolia* (Ridl.) Knuth, ll. cc. — **Fig. 3c—d.**

Leaf glabrous above, beneath sparsely puberulous to glabrous; 8—11 pairs of nerves. Panicle densely, shortly puberulous. Petals obtuse to truncate, 5—7 by $1\frac{2}{3}$—2 mm, claw slender, $\frac{2}{3}$—1 mm. Pistil mainly apically, sparsely strigose. Branches of inflorescence reduced, not forked, 1—6 mm. Fruit 8—10 mm long, seed $7\frac{1}{2}$—8 by 3—4 mm.

Type: *Evans FMS. 13265* (K).

Distribution: E. coast of Malaya.

Vernacular names: *Bělimbing hutan, -cherchek, gěriji, mědang, sětundok.*

Uses: Roots for poulticing wounds externally (*Burkill & Haniff SFN. 17611*).

c. var. hirsuta Veldkamp, *var. nov.* — **Fig. 3e—g.**

A varietatibus ceteris differt ramulis ferrugineo-tomentosis, passim glabrescentibus, foliis subtus pallido- usque ad ferrugineo-pubescentibus, supra ad basim et per costam sparse sericeis, nervis utrinque 5—8, paniculis ferrugineo-pubescentibus, ramulis reductis, crassis, 1—3 mm longis, petalis apice obtusis vel retusis, ungui $\frac{1}{2}$—1 mm longo, pistillis dense adpresse strigosis, fructibus 9—13 mm longis, 4 mm latis.

Twigs ferrugineous-tomentose, patchily glabrescent. Leaf beneath pale to ferrugineous-pubescent, above sparsely and silky so, mainly at base and along the midrib; nerves 5—8 pairs. Panicle ferrugineous-pubescent. Petals obtuse, sometimes notched. Claw $\frac{1}{2}$—1 mm long. Pistil densely appressed strigose. Branches of panicle reduced, stout, 1—3 mm. Fruit 9—13 mm long. Seed 9 by 4 mm.

Type: *Corner SFN. 29009* (L, isotypes in SING, BO, BM, A, K, E).

Distribution: Malaya: Johore.

Vernacular names: *Bělimbing běsi, -burong, -hutan, rèsak rambai daun.*

Note: To *Corner SFN. 29380* (SING) belong two cultivated seedlings with 7 and 8 leaves respectively: Main root unbranched, several rootlets. Hypocotyle 5—$7\frac{1}{2}$ cm. Stem reddish, minutely appressed-puberulous. Leaves $1\frac{3}{4}$—$3\frac{1}{2}$ by 2—3 cm, broadly ovate to ovate, apex acute to acuminate, base cordate, herbaceous, dull on both sides, upper darker, lower faintly glaucous; young leaves dull purplish, glabrous; venation prominent on both sides; petiole 6—25 by $\frac{1}{4}$ mm, slender, those of upper leaves longest, reddish, ± glabrous, petiolule 1 by $\frac{1}{4}$ mm, slightly darker.

5. Sarcotheca glauca (Hook *f.*) Hall. *f.*, Meded. Rijksherb. Leiden 1 (1911) 2; Knuth, Pfl. R. Heft 95 (1930) 421 + fig.; Anderson, Gard. Bull. Sing. 20 (1963) 162 (ecology). — *Connaropsis glauca* Hook *f.*, Trans. Linn. Soc. 23 (1860) 166. — **Fig. 4a—c.**

Shrub or tree, up to 21 m, 20 cm ∅; no buttresses. *Leaves* unifoliolate, $1\frac{1}{3}$—11 by $1\frac{1}{4}$—$4\frac{3}{4}$ cm (those of sterile twigs larger, up to $13\frac{1}{2}$ by $6\frac{1}{2}$ cm), elliptic to oblong (index 1.5—2.9), apex acuminate, base obtusely cuneate to emarginate, pergamentaceous to subcoriaceous, glabrous; above glossy dark green when dry, beneath whitish green, dull, subglaucous, sometimes with a reddish tinge to whitish; nerves 5—7 pairs; petiole 10—27 by $\frac{1}{2}$—1 mm, petiolule 3—6 by $\frac{3}{4}$—$1\frac{1}{2}$ mm. *Panicle* 1—2 together, erect, $1\frac{1}{2}$—13 cm long, ferrugineous-puberulous; branches reduced, up to 10 mm, usually many-

flowered, rather closely placed, ascending to patent, cymes dense, giving a dense appearance to the panicle, subtended by a narrowly triangular bract or a club-shaped petioloid, up to 3 mm. *Pedicels* pectinately clustered, lower joint elongated, 2—6 mm, upper ¼—½ mm. *Calyx* ferrugineous-puberulous outside, glabrescent in fruit except for margins and base, 2—3 mm high, crimson when dry, patent in fruit. *Sepals* 1¾—3 by ¾—1¼ mm, inner narrower and more oblong, ovate to rectangular-oblong, acute to truncate. *Petals* red, apex darker, 3¾—6 by 1—2 mm, oblong to lanceolate, sometimes obovate, margins sometimes with small stalked glands, claw ½—1¼ mm. *Filaments* red, in SF 2—2¾ and 2½—3⅔ mm, in LF 1¼—1½ and 1½—1¾ mm. *Pistil* in SF 1—1½ mm, in LF 3¼—3½ mm long, appressed ferrugineous-strigose; *styles* in SF ½—¾ mm, in LF 2½—3 mm; *ovary* ½—1 by ½—⅔ mm, ellipsoid. *Fruit* bright pink to dark red, black when old, 8—12 by 5—11 mm, subglobose to ellipsoid with obtuse to rounded apex, glabrescent; rimae open and conspicuous, inside lighter and papillose. *Seeds* 1—9 per fruit, 0—2 per cell, 6 by 3½ mm; testa shiny, smooth; embryo with the cotyledons 5 by 2½ mm, radicle 1 mm long.

Type: *Lobb 1857* (K).

Distribution: Sarawak and Brunei (Brünig MS).

Ecology: Rare to very rare in undisturbed forest, heath forest on well-drained humus podsols, ground-water podsols, peaty '*Hochmoors*' and sand covered clay on terraces and sand stone. Occasionally in secondary forest (Brünig MS).

Vernacular names: *Arémajuh* (Dajak), *asam daham* (Brunei), *bělimbing, -daham* (Brunei), *barus, gitan gizu, kandis daham* (Brunei), *mědang, piang* (Iban), *rangkas-rangkas* (Dusun Kinabatangan), *sěgot* (Baju), *tampusi, temposi(s)* (Kedayan).

Notes: This species is closely allied to *S. rubrinervis* Hall. *f.* and differs in having a less puberulous, when dry dark red to crimson calyx, a short compact panicle with very reduced primary branches, while the way of branching in the cyme is indistinct. The pistil in LF is 3¼—3½ mm long, the filaments in SF 2—2¾ and 2½—3⅔ mm. The cotyledons are lanceolate.

The vernacular epitheton '*daham*' might point at the use of this plant against coughing; in related genera (*Averrhoa, Oxalis*) this use also is found (cf. Heyne, Nutt. Pl. Ind. 1927, 850, 852).

Collector's notes: Clear bole up to 4½ m. Slash: Outer bark grey to (pink-)brown, smooth to fissured and warty, laminated, 4 mm thick, brittle; inner pale yellowish-brown to light red, soft, fibrous, 4 mm thick. Sapwood paler, white to pink, medium hard. Cambium pale yellow to brown. Heartwood brown to light yellow, soft. Crown monopodial, symmetrical.

6. Sarcotheca monophylla (Planch. *ex* Hook. *f.*) Hall. *f.*, Meded. Rijksherb. Leiden 1 (1911) 2; Knuth, Pfl. R. Heft 95 (1930) 422 + fig. — *Connaropsis monophylla* Planchon *ex* Hook. *f.*, Trans. Linn. Soc. 23 (1860) 166; Edgeworth & Hooker *f.*, Fl. Br. Ind. 1 (1874) 440; King, Journ. As. Soc. Beng. 62, ii (1893) 200; Ridl., Fl. Mal. Pen. 1 (1922) 332 + fig. — *Dapania monophylla* Knuth, Bot. Jahrb. 50 (1914) 648. — **Fig. 2g—h.**

Shrub or tree, up to 18 m, 38 cm ∅, bole occasionally fluted. *Leaf* unifoliolate, 2½—10 by 1½—3¼(—7) cm, elliptic to oblong (index 1.8—2.5), rarely suborbicular, apex acuminate to cuspidate, base rounded to cuneate, pergamentaceous, glabrous, above bright to dark green, shiny, dark when dry, beneath dull, grey to brown-grey with reddish tinge when dry, subglaucous; venation beneath ± concolorous with intervenium, slightly prominent; nerves 5—7 pairs; petiole 6—31 by ½—¾ mm, petiolule 3 by ⅔—1 mm. *Panicles* 1—2 together, erect, 1—9½ cm long, ferrugineous-puberulous; ± dense; branches

reduced, ascending, 0—4 mm long, subtended by a small bract or sometimes a small leaf. Pedicels pectinately clustered, subtended by a minute bract, upper joint reduced, up to ⅓ mm; lower 1—2 mm. *Calyx* 1¾—2 mm high, outside ferrugineous-puberulous, apically less so, herbaceous, red when dry, patent in fruit. *Sepals* ± unequal, 1½—2 by 1—1½ mm, ovate to rectangular, acute to emarginate, outer ones somewhat longer and more ovate. *Petals* deep red, 3—5 by ¾—1½ mm, lanceolate, apex emarginate, sometimes with minute glands, claw ⅔—1¼ mm. *Filaments* in LF 1—1¼ and 1¼—1½ mm, in SF 1½ and 2 mm; pollen white. *Pistil* densely appressed ferrugineous-strigose, in LF 3—3½, in SF 1 mm; *styles* in LF 2—2½ mm, in SF ½ mm long; *ovary* ½—1 by ½—⅔ mm, ellipsoid. *Fruit* up to 13 by 13 mm, pale to bright red, subglobose to ovoid, apex rounded to acute; conspicuous, open, lighter and papillose inside. *Seeds* 1—7 per fruit, 0—2 per cell, 7½ by 3 mm; testa smooth; cotyledons 4 by 2¼ mm, radicle 1¼ by ⅓ mm.

Type: *Cuming 2324* (K), from Malaya, not from the Philippines as Knuth (1930, p. 422) cited.

Distribution: W. and Central Malaya.

Ecology: Secondary forest, open jungle on flat to undulating land on rich soil at low altitude.

Vernacular names: *(Asam-)pupoy, bělimbing akar, -bĕsih, -bulat, -burong, -hutan, -kĕris, -k(ĕ)ra, -pĕnjuru, -pipit (pĕpit, pipĕt), bibit* (Sakai), *kûlat pipit, sĕtundok*.

Collector's notes: Slash: Outer bark red to red-brown, smooth to cracked, brittle; inner pink to brown, fibrous; sapwood pale yellow-white. Crown dense, spheric.

7. Sarcotheca celebica Veldkamp, *sp. nov.* — Fig. 4f—m.

A speciebus ceteris differt foliis unifoliolatis, 6—13½ cm longis, basi cuneatis, apice acutis vel subacuminatis, subtus sparse puberulis, haud albo-viridis, supra in sicco venatione prominente, paniculis ± laxis, erectis, folia non excedentibus, 1—7 cm longis, partibus inferioribus pedicellorum superioribus acquilongis, inter se ad 1½ mm longis, calycibus 2—2¼ mm altis, externe persistenter ferrugineo-puberulis, rimis fructuum conspicuis, intus pallidioribus papillosisque.

Shrub or tree, up to 35 m, 17 cm ∅. *Leaf* unifoliolate, (3½—)6—13½ bij 1¼—5 cm, elliptic to lanceolate (index 1.8—3.5), pergamentaceous to subcoriaceous, apex cuneate-acute, base cuneate to ± truncate, above dark, shiny, with prominent, rather carse venation, glabrous, beneath lighter to yellowish-red, dull, subglaucous, sparsely puberulous; nerves 5—6 pairs; petiole 6—21 by ½—1 mm, petiolule 2—5 by ½—1¼ mm, sparsely strigose. *Panicles* 1—2 together, 1—7 cm long, erect, slender, ferrugineous-puberulous; branches ascending, reduced, short, 0—2(—7) mm, distant, subtended by a narrowly triangular bract up to 1½ mm, or a club-shaped petioloid up to 3 mm, rarely by a small leaf. *Pedicels* close and few together with equal upper and lower joint, up to 1½ mm. *Calyx* 2—2¼ mm high, ferugineous-puberulous outside, dark when dry, herbaceous, patent in fruit. *Sepals* 1½—2 by 1—1⅓ mm, ovate to rectangular, apex acute to truncate, inner more elliptic, more obtuse. *Petals* red, 4—4¼ by 1—1½ mm, lanceolate, apex rounded to retuse, claw ½—¾ mm. *Filaments* in SF 1—2 and 2—2¼ mm, in LF ¾ and 1 mm long. *Pistil* appressed strigose, in SF 1 mm, in LF 2½ mm long; *styles* in SF ¼ mm, in LF 2 mm long; *ovary* ½—¾ by ½—¾ mm, subglobose to ellipsoid. *Fruit* 8—13 by 6—9 mm, ellipsoid with rounded to acutish apex, glabrescent, red; rimae open from the top to below the middle, ± conspicuous, lighter and papillose inside. *Seeds* 0—3 per fruit, 0—1 per cell, 4—5 by 3 mm; testa slightly transversely rugose to ± smooth; cotyledons 3 by 2¾ mm, radicle 1 mm long.

Type: *Neth. Ind. For. Inst., Cel II/439* (BO, isotypes SING, A, K, L).

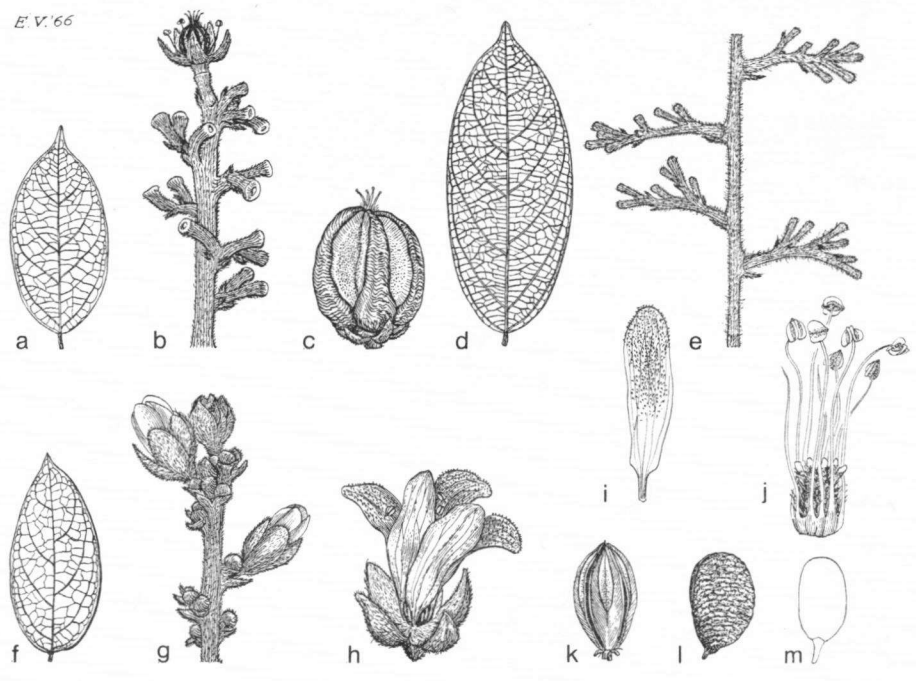

Fig. 4. *Sarcotheca glauca* (Hook. *f.*) Hall. *f.* a. Leaf, × ½, b. cymes in detail, × 3, c. fruit, showing papillae in rimae, × 2 (*Brunig S 17532*). — *S. rubrinervis* Hall. *f.* d. Leaf, × ⅛, e. cymes in detail, note secund branching, × 3 (*FMS 36342*). — *S. celebica* Veldk. f. Leaf, × ½, g. cymes in detail, × 3, h. flower, × 5, i. petal from inside, × 6, j. sexual organs of short-styled flower, × 10, k. fruit, showing open rimae, × ⅘, l. seed, × 3, m. embryo, × 8 (*Cel. II/439*).

Distribution: Central Celebes (Malili) and Kabaëna I. (S. of SE. Celebes).

Ecology: Rather open country, primary forest on stony to clayish, flat to undulating land at low altitude.

Vernacular names: *Ko(e)ngilu* [*(mo-)puté*] (To Bela, To Padoë, To Tambeë).

Collector's notes: Slash: Outer bark brown with few longitudinal grooves, 2 mm thick; inner redbrown, inside white, 6 mm thick; sapwood white, 2 cm thick, sharply distinct from the lightbrown heartwood. Crown dense, wide.

Notes: This new species is best distinguished by its slender panicles and the coarser and more prominent venation on the upper side of the leaf as compared with other species.

The species was already recognized *in sched.* by Hallier *f.* on the basis of an Elbert collection from Kabaëna I.

8. Sarcotheca ferruginea Merr., Pap. Mich. Ac. Sc. 19 (1933) 160. — **Fig. 3h—i.**

Tree. Twigs velvety ferrugineous pubescent, later patchily glabrescent and dark. *Leaves* pergamentaceous, shiny golden pubescent when young, upper surface soon glabrous or with a few appressed, pale hairs at the basis and along midribs, dark, beneath lighter, dull, not glaucous, densely ferrugineous-pubescent, 3½—11¼ by 1—3½ cm,

oblong to oblanceolate (index 2—3.8), widest in or above the middle, apex acute to caudate, base broadly cuneate to rounded, margins usually paler; nerves 5—7 pairs; petiole 4—6½ by ½—1 mm, petiolule 2—4 by ¾—1½ mm, ferrugineous velvety, glabrescent. *Panicles* 1—2 together, short, slender, up to 7½ cm, velvety; branches distant, reduced, ½—2 mm long, ascending, subtended by a small triangular bract or a petioloid up to 3 mm long, rarely by a small leaf. *Pedicels* with unequal lower joints, one per cyme elongated, 3—4 mm long, others *c.* 1 mm; upper joint ½—1 mm. *Calyx* 2—3¾ mm high, ferrugineous-puberulous outside, purplish to light brown when dry. *Sepals* 1¾—3½ by ½—1 mm, ovate-lanceolate, acute, inner narrower, acute to truncate. *Petals* red, dark crimson when dry, 4—6 by 1½—2 mm, obovate-elliptic to -lanceolate, apex rounded to obtuse, claw 1 mm long. *Filaments* in LF 1 and 1½ mm long. *Pistil* in LF 3—3½ mm long, appressed strigose; *styles* in LF 2—2½ mm; *ovary* 1 by 1 mm, subglobose. *Fruit* 7—14 by 6—12 mm, ovoid to subglobose with rounded apex, somewhat shiny, reddish; calyx persistent; rimae inconspicuous, not glandular or lighter inside. *Seeds* 1—4 per fruit, 0—1 per cell, 7 by 4½ mm; testa transversely rugose; cotyledons 5 by 3 mm, radicle 1 mm long.

Type: *Rahmat si Boeea* (= *si Toroes*) *358* (MICH, isotypes in SING, A).

Distribution: N. Sumatra (E. & W. Coast Res.); apparently local and rare.

Vernacular name: *kaju kandis.*

Note: I have not seen the short-styled form.

9. Sarcotheca rubrinervis Hall. *f.*, Beih. Bot. Centr. Bl. 34, 2 (1917) 29; Knuth, Pfl. R. Heft 95 (1930) 425. — *S. oblongifolia* Merr., Univ. Cal. Publ. Bot. 15 (1929) 111; Knuth, l.c. 421. — **Fig. 4d—e.**

Shrub to tree, up to 19 m, bole up to 10½ m, 30 cm ∅. *Leaf* unifoliolate, 5—18½ by 1¾—7 cm, oblong to lanceolate (index 2—4), papyraceous to subcoriaceous, glabrous, apex acute to caudate, base obtuse to rounded, above glossy, green, beneath dull, not or slightly glaucous, often reddish when dry, pale; nerves 4—11 pairs, often with reddish tinge; petiole 6—20 by 1—2 mm, petiolule 2—4 by 1—2 mm. *Panicles* 1—2 together, elongated, lax, pendulous, ferrugineous-puberulous, 7—38½ cm long; branches elongated, slender, patent, ± monochasially branched, up to 8(—21) mm, subtended by a narrowly triangular bract up to 2 mm, or a spathulate, densely-ferrugineous-puberulous petioloid up to 5 mm. *Pedicels* with unequal lower joints, usually one per cyme elongated to 5 mm, others up to 3 mm; upper ¼—1 mm long. *Calyx* 2—3 mm high, ferrugineous-puberulous, at least at base, light brown when dry, rarely purplish, herbaceous. *Sepals* 1⅔—2¾ by 1—1½ mm, ovate to lanceolate, acute to emarginate, inner ones longer and more obtuse, recurved in fruit. *Petals* 3¾—5½ by 1—1½ mm, lanceolate, apex rounded to emarginate, claw ⅔—1 mm; pale red to red, occasionally white, apex usually darker. *Filaments* in SF 1⅔—2 and 2½—3 mm, in LF ½—⅔ and 1—1¼ mm long. *Pistil* in SF 1—1¼ mm, in LF 2¼—2⅔ mm long; *styles* in SF ½ mm, in LF 1⅔—1⅘ mm long; appressed puberulous; *ovary* ½—⅘ by ½—⅔ mm, subglobose, densely appressed strigose. *Fruit* 6—10 by 5—10 mm, subglobose with rounded apex, glabrescent, glaucous to glossy, pink to bright red; rimae not always conspicuous, lighter and papillose inside. *Seeds* 1—4 per fruit, 0—1 per cell, up to 6¾ by 5 mm; testa smooth to ± transversely rugose; cotyledons 4¾ by 1½ mm, elliptic, radicle 1 by ⅔ mm.

Type: *Amdjah 1082* (L, isotypes in BO).

Distribution: E. Borneo (from Tawao to Balikpapan).

Ecology: Primary and secondary forest near rivers on loam, flat to undulating land at low altitude.

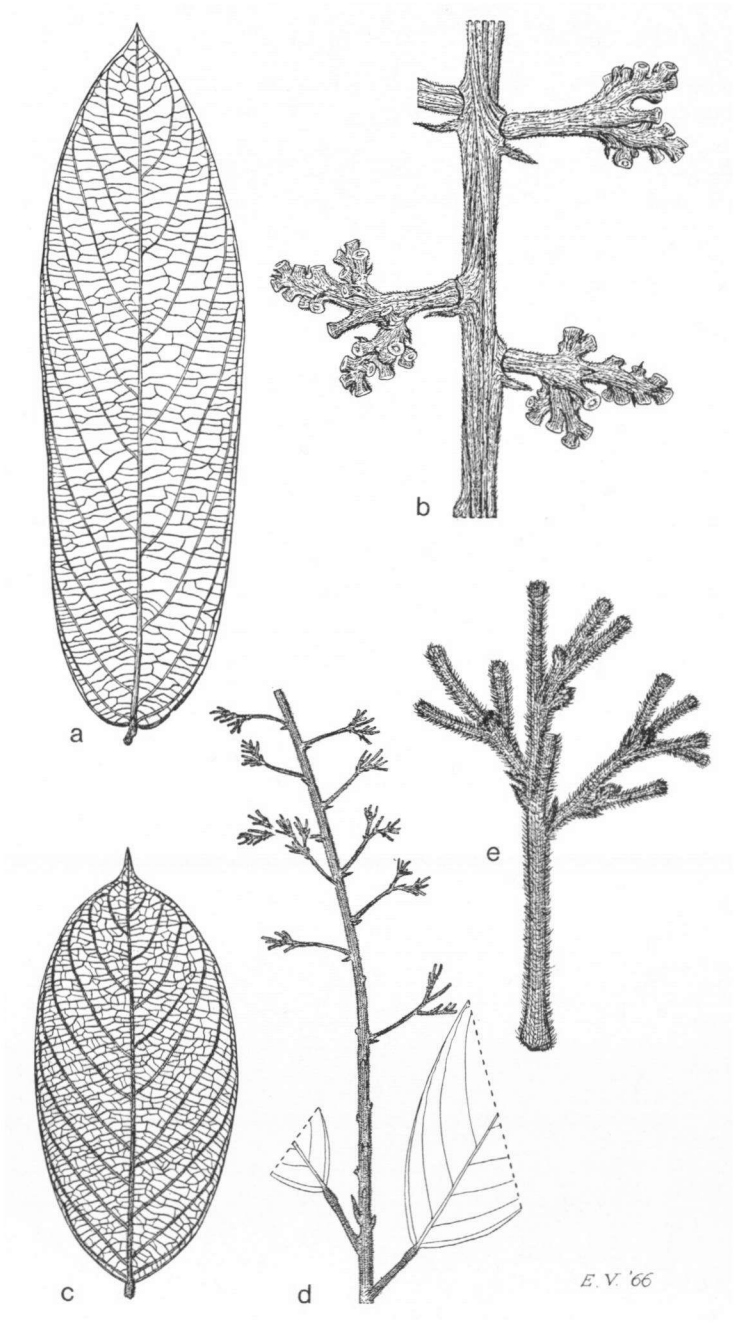

Fig. 5. *Sarcotheca macrophylla* Bl. a. Leaf, × $\frac{1}{3}$, b. cymes in detail, × 3 (*Hallier f. B 2269*). — *S. ochracea* Hall. *f.* c. Leaf, × $\frac{1}{3}$, d. habit, × $\frac{1}{3}$, e. cymes in detail, × 2 (*Ashton S. 18065*).

Vernacular names: *Asĕm-asĕm* (Dusun Kinabatangan), *iba talon* (Bajau), *ira prumpuan* (Suluk), *kajo badjuk* (Kajam-dajak), *kandis daham* (Brunei), *lampyos* (Dusun pĕnompang), *pinguh, pinggoh* (Klabakan), *pingo* (Tidong), *tĕnggoh* (Kutai).

Notes: Sometimes difficult to distinguish from *S. glauca* (see there).

Endert 1589 from Kutai is ferrugineous-pubescent throughout with a more cuneate base to the leaves. Until more material is available I prefer to postpone a decision on its status.

Collector's notes: Crown 9 m high. Slash: Outer bark red to brown, smooth, papery, 1 mm thick; inner hard, fibrous, yellow, whitish near cambium, this yellow; sapwood white to yellow, 1 cm; heartwood white to light yellow-red, moderately soft.

10. Sarcotheca ochracea Hall. *f.*, Beih. Bot. Centr. Bl. 34, ii (1917) 28; Knuth, Pfl. R. Heft 95 (1930) 424. — **Fig. 5c—e.**

Treelet up to 7½ m, 10 cm ∅. Twigs velvety, glabrescent. *Leaves* unifoliolate, 7½—23½ by 3½—10¼ cm, elliptic to oblong (index 1.8—2.8), apex abruptly acuminate to cuspidate, base obtuse to truncate, pergamentaceous to subcoriaceous, above glossy, glabrous, beneath lighter, dull, ferrugineous-pubescent to -velvety, sometimes subglaucous; nerves 6—11 pairs; petiole 5—24 by 1½—3 mm, petiolule 3—7 by 1½—3 mm; ferrugineous-velvety to glabrous. *Panicles* 1—2 together, 7—70 cm, erect to pendulous, ferrugineous-velvety, compact to elongated. Branches reduced to elongated, often distant, pectinately branched, many-flowered, patent to recurved, up to 30 mm long, ferrugineous-velvety, subtended by a narrowly triangular bract up to 2 mm, or a petioloid up to 7 mm. Lower joint of pedicel 4—8 mm, upper ½—1 mm. *Calyx* (2¼—)3—3½ mm high, ferrugineous-puberulous outside, herbaceous, reddish-brown, rather pale when dry, patent in fruit. *Sepals* suborbicular to obovate, rounded to retuse, 2¼—3 by 1⅔—3 mm, inner more obovate and retuse. *Petals* crimson, apically darker, (4¼—)6—8 by (1—)1½—1¾ mm, obovate-lanceolate to lanceolate, apex obtuse to rounded, claw 1—2 mm. *Filaments* in SF 2½ and 3—3¼ mm, in LF 1½—1¾ and 2—2¼ mm long. *Pistil* densely appressed ferrugineous-strigose, in SF 1¾—2, in LF 3—4 mm long; *styles* red, in SF ⅓—¾ mm, in LF 2—2½ mm long; *ovary* 1—1½ by 1 mm, subglobose. *Fruit* 8—15 by 6—15 mm, subglobose to oblong with rounded apex, glabrescent, bright red; rimae conspicuous, lighter and/or papillose inside. *Seed* 1 per fruit, 5¼—7 by 3¼—4½ mm; testa transversely rugose. Mature embryo not seen.

Type: *Haviland 2343* (L, isotypes in SING, K).

Distribution: Borneo: Sarawak (Bintulu).

Ecology: Along streams in forest on clay at low altitudes.

Vernacular names: *Ikor mata* (Iban), *pechi mata.*

Note: The type-specimen is somewhat smaller in flowers and fruits, while the inflorescence is dense as in *S. glauca*. The normal specimens have the panicle as in *S. macrophylla* Bl.

11. Sarcotheca macrophylla Blume, Mus. Lugd. Bat. 1 (1850) 242; Miq., Fl. Arch. Ind. Ill. (1870) 70, t. 30; Baillon, Adansonia 10 (1873) 364; Hist. Pl. 5 (1874) 26, 47; Hall. *f.*, Beih. Bot. Centr. Bl. 34, ii (1917) 29; Knuth, Pfl. R. Heft 95 (1930) 424, *pro spec. Born.* — *Roucheria macrophylla* Miquel, Fl. Ind. Bat. 1, 2 (1858) 136; Suppl. (1860) 162. — **Fig. 5a—b.**

Shrub or tree, up to 15 m, 10 cm ∅. *Leaf* unifoliolate, (5—)14—28½ by 4—10½ cm, oblong to oblanceolate (index 2—3.9), widest in or above the middle, margins ± parallel, apex abruptly acuminate to cuspidate, base truncate to emarginate, subcoriaceous, above

glabrous, dark green, glossy, beneath dull, puberulous on the veins, sometimes subglaucous; nerves 6—13 pairs; petiole 5—12(—25) by 1½—3 mm, petiolule 3—9 by 1—3 mm. *Panicles* 1—4 together, slender, lax, 12—85 cm, pendulous, brown-puberulous; branches elongated, patent to recurved, 6—25(—50) mm, often flattened, subtended by a narrowly triangular bract up to 3 mm. Pedicel with reduced lower joint, 0—2 mm, upper ¼—1 mm. *Calyx* 1½—3 mm high, ferrugineous-puberulous outside, recurved in fruit. *Sepals* 1¼—2½ by 1—1¾ mm (inner narrower), obovate to ovate, apex rounded to obtuse. *Petals* dark red, 3¼—5 by 1—1¾ mm, obovate-oblong to lanceolate, obtuse to emarginate, claw ¼—½ mm long. *Filaments* in SF 1—2 and 1¾—3 mm, in LF ¾—1¼ mm and 1½—1¾ mm long. *Pistil* appressed strigose, in LF 2—3 mm, in SF 1¼—1¾ mm long; *styles* in SF ¼—⅔ mm, in LF 1—2 mm long; *ovary* ⅔—1 by ½—¾ mm, subglobose to ellipsoid. *Fruit* 6—11 by 5—8 mm, subglobose, with rounded apex, glabrescent, shiny, dark red; rimae inside lighter, papillose, conspicuous. *Seeds* 1—4 per fruit, 0—1 per cell, up to 9 by 4 mm; testa transversely rugose; cotyledons 4 by 2½ mm, radicle 1 mm long.

Lectotype: *Müller s.n.* (L, no. 908/126/971).

Distribution: Indonesian Borneo, once from Marop, Sarawak (*Beccari 3p66*).

Ecology: Primary and secondary forest on sand at low altitudes.

Vernacular names: *Bělimbing manik* (Bakumpai-dajak), *Kaju kim, krumbai mèrah, mim, pengu* (Dusun), *ram(b)ajan.*

Notes: Blume cited Borneo and Sumatra as the native country, without indicating collectors. Already Miquel questioned the occurrence in Sumatra; only Bornean material has come to my attention. In the Leyden Herbarium there are 8 sheets, all from Borneo, which Blume must have seen. According to the labels they were collected by Korthals and Müller, who jointly made this tour (cf. Fl. Mal. I, 1: 297b) to the Téwe River.

Kostermans 10442 (Belajan R. near Tubang, Central Kutai) has pergamentaceous leaves.

This species has been confused with *Connaropsis macrophylla* King, see note under 3. *S. glomerula.*

Collector's notes: Clear bole up to 7 m. Slash: Outer bark smooth, pale brown, thin; inner reddish, 5 mm thick; sapwood white, 1 cm thick; heartwood light brown.

DUBIOUS SPECIES

Sarcotheca philippica (Villar) Hall. *f.*, Meded. Rijksherb. Leiden 1 (1911) 2. — *Connaropsis philippica* Villar in Blanco, Fl. Filip. ed. 3, 4 (1880) App. 33; Merr., Sp. Blanc. (1918) 19, 195; Knuth, Pfl. R. Heft 95 (1930) 417.

Subscandent. Innovations dark purple. *Leaves* imparipinnate, 1—4-jugate. *Leaflets* 6—10 by 2—3 cm, oblique-ovate, acute, subcoriaceous, pubescent when young, later glabrous. *Panicle* axillary and terminal, shorter than the subtending leaf. *Sepals* 2—4 mm long. *Petals* twice as long, connate at base when young, later free. *Filaments* alternatingly shorter ('*alterna breviora*'), often without anthers. *Ovary* ovoid, pilose, 5-locular, *ovules* 2 per cell. *Styles* 5, erect, adpressed. *Stigmata* oblong, apiculate. *Fruit* 2—3 by ½—1 cm, orange-red, pilose, 5-angular, 5-locular. *Seed* 1 per cell, ovate, with white aril (transl. from type description).

Distribution: Philippines: Bugney near Igbarás (Iloilo).

Vernacular names: *Malabangquilin, balabangquilin.*

Note: Merrill noted that he has seen no representative of this genus in the Philippines and none is known to me. Although he is very critical of Villar's work (cf. l.c. 14—18),

he thinks it to be '... apparently a true ... *Sarcotheca* ...'. Knuth referred it to *Averrhoa carambola* L., with which the description agrees for the greater part, differing, however, by the subscandent habit, the subcoriaceous leaflets, the 2 ovules per cell, and the rather small, orange-red, pilose fruit. Villar stated he has seen the plant alive, so presumably his remarks pertaining habit and fruit are correct; the more so as in his work this species follows the description of *Averrhoa carambola*. As long as no representative is found the status of this species will remain in doubt.

EXCLUDED NAMES

Connaropsis rubescens Ridl., Journ. Bot. 62 (1924) 295 = **Rourea minor** (Gaertn.) Leenhouts, Blumea 12 (1963) 20. — *Connaraceae.*

Sarcotheca paniculata Ridl., Trans. Linn. Soc. 3, 2 (1893) 282 = **Rourea minor** (Gaertn.) Leenhouts, Fl. Mal. I, 5 (1958) 515a. — *Connaraceae.*

Sarcotheca pinnata Merr., Journ. Str. Br. Roy. As. Soc. 86 (1922) 314 = **Rourea pinnata** (Merr.) Veldkamp, *comb. nov.* — *Connaraceae.*

Dr. Leenhouts has examined the only number known (*Ramos 1485*) collected in the vicinity of Sandakan, Sabah; in his opinion it represents an unknown species of *Rourea.*

Sarcotheca varians (Craib) Knuth, Pfl. R. Heft 95 (1930) 425. — *Connaropsis varians* Craib, Kew Bull. (1926) 158 = **Rourea minor** (Gaertn.) Leenhouts, Fl. Mal. I, 5 (1958) 515b.— *Connaraceae.*

INDEX

New names are in **bold type,** synonyms are in *italics.* Numbers refer to numbers of genera and species. 'Dub. Sp.' refers to the dubious species, 'excl.' refers to the excluded names, both listed at the end.