

A REVISION OF THE GENUS *KUNSTLERIA* (LEGUMINOSAE–PAPILIONOIDEAE)

J.W.A. RIDDER-NUMAN & D.J. KORNET

Rijksherbarium / Hortus Botanicus, Leiden, The Netherlands

SUMMARY

A revision of the genus *Kunstleria* Prain is presented here. Seven species occur in the Malesian region, while one is found in Kerala (India). Two new species are described, *K. geesinkii* and *K. sara-wakensis*, while four others are put into synonymy: *K. borneensis* and *K. atroviolacea* are regarded as synonymous with *K. forbesii*, and *K. elmeri* and *K. derryi* are conspecific with *K. ridleyi*. A key, distribution maps and descriptions are given.

INTRODUCTION

At the Rijksherbarium a research programme is presently being carried out concerning the historical biogeography of the Malesian Archipelago. The genus *Kunstleria* Prain and its sistergroup comprising *Spatholobus* Hassk., *Butea* Roxb. and *Meizotropis* Voigt are among the genera that are analysed for this purpose. The revision of *Spatholobus* was published in 1985 (Ridder-Numan & Wiriadinata), and updated recently (Ridder-Numan, 1992), while the revision of *Butea* and *Meizotropis* was published in 1987 (Sanjappa). A preliminary revision of *Kunstleria* has been available (Kornet, 1984), and is here up-dated. A complete phylogenetic treatment of the four genera mentioned is presently in preparation and will soon be published.

The genus *Kunstleria* was first described by Prain (1897) containing five Malesian species: *K. curtisii*, *K. forbesii*, *K. kingii*, *K. ridleyi*, and *K. derryi*. Prain dedicated the genus to the memory of "Herr H.H. Kunstler, one of the most enthusiastic, as he was one of the most painstaking and faithful of the collectors who have laid down their lives in the cause of science in the tropics." All epitheta refer to the collectors of the types of the species; *K. kingii* combining the names of Dr. King and Kunstler, the latter being King's collector.

In 1914 Merrill added *K. philippinensis*, and in 1915 he transferred *Derris atroviolacea* to *Kunstleria*. In 1929 he described two more species, *K. borneensis* and *K. elmeri*.

Polhill (1971) transferred two species of *Lonchocarpus*, *L. blackii* and *L. stipularis*, to *Kunstleria*. His reasons were that the anomalous flower and fruit characters fitted quite well within a widened concept of *Kunstleria*, and that *Lonchocarpus* is represented by no other species in Australia. Geesink (1984), however, described a

new genus, *Austroteenisia*, to include these two species, and made the new combination for *A. blackii*. Jessup (1986) made the remaining new combination, *A. stipularis*, and described a new species in the genus.

More recently Mohanan & Nair (1981) added the species *K. keralensis*, found on the west coast of India (Kerala), to the genus till then represented only by Malesian species.

GENERAL MORPHOLOGY

The genus *Kunstleria* consists of woody lianas, which differ in only a few characters from each other. The macromorphological characters are described here; the pollen morphology and the leaf anatomy will be published separately.

The stem probably produces exudate, as is mentioned in the fieldnotes of one collection, and the branchlets in the dried material often show a hollow stem filled with a dark substance.

The leaves are pinnate with up to 11 subopposite leaflets. The stipules are early caducous, and not always seen in the dried material; the leaflets are exstipellate. There is one trifoliolate species, *K. kingii*, and one species, *K. curtisii*, in which we have seen unifoliolate leaves only; but according to the fieldnotes there should be variation in the number of leaflets. The other species have either up to five, five, or more leaflets. The leaflets are more or less symmetrical, but vary in shape: those at the top are usually elliptic to obovate, the lower ones are ovate to elliptic.

The nerves are prominent at the lower surface only; at the upper surface they are often more pubescent than the surface. The number of secondary nerves usually is about 4–8 pairs; two species, *K. geesinkii* and *K. sarawakensis*, have 8–12 pairs of lateral nerves placed close together. The nerves end diffusely towards the margin, but do not reach it. The venation is reticulate, and sometimes slightly scalariform.

The inflorescences are similar in all species: terminal or axillary panicles. Axillary and terminal panicles differ in the number of side branches. Axillary panicles consist of a main axis with side branches, which bear the flowers. The terminal panicle has side branches, which are similar to axillary panicles, and each side branch has two bracts. This suggests that the terminal panicle consists of an axis with axillary panicles placed in the axils of leaves, which are reduced to only their two stipules. The side branches of the panicles as well as the flowers have one bract.

The papilionate flowers are small, c. 0.5 cm long. The standard is slightly curved backwards. The wing and keel petals are about the same length, but differ in shape. The keel petals are broad and curved, the wing petals are rather narrow and straight; both have lateral pockets. The upper stamen is connate to the claw of the standard. This stamen is free from the others, which are connate. The connate stamens have alternately longer and shorter filaments with anthers which are respectively larger and smaller, the latter in some species reduced. The nectary glands at the base of the filaments (= intrastaminal disc) are absent in some species, in others they are present and glabrous, whereas in one species, *K. kingii*, they bear some pubescence in the mature flower. The ovary is densely pubescent. The small style, however, is glabrous and curved upwards, and bears a tiny stigma. There are two ovules placed in the lower half of the ovary.

The pod is almost always flat, strap-like, non-dehiscent, with a yellowish pubescence and contains usually one (or two) very flat seeds. Only *K. kingii* is slightly different, with a pod not as flat as in the other species and more narrow (up to 1.5 cm).

DISTRIBUTION

The genus *Kunstleria* consists of a number of rare lianas. Most occur in the West Malesian Archipelago: one species, *K. forbesii*, is rather widespread from the Malay Peninsula (Perak) to South Sumatra, North Borneo and the Philippines (Palawan); three species are restricted to Borneo, three others to the Malay Peninsula, and one is endemic in the Philippines. Recently a species, *K. keralensis*, has been described from Kerala, India.

SYSTEMATIC POSITION

Prain (1897) placed *Kunstleria* in the Dalbergieae beside *Lonchocarpus*, which it resembles in having indehiscent fruits with a centrally placed seed, and *Derris* sect. *Aganope*, which has also paniculate inflorescences. He mentioned also a close resemblance to the flowers of *Spatholobus*, especially in the distinct calyx teeth and the diadelphous stamens.

Hutchinson (1964) assigned subtribal status to the Lonchocarpeae, and kept this subtribe in the Dalbergieae. Polhill (1981), however, transferred the Dalbergieae–Lonchocarpaceae to the ‘Tephrosieae’ (= Millettieae), in accordance with their chemistry and wood structure, and ignored the classical character of non-dehiscence of the pod. *Kunstleria* belongs to this group, because of e.g. the interlocking of keel and wing petals, the ventrally adnate (but overlapping) keel and the seed without a specialized seed chamber, and was therefore placed in the Millettieae (Geesink, 1981, 1984). On the other hand, *Kunstleria* still has some less specialized structures as found in the Dalbergieae, e.g. the overlapping keel petals and the flattened pod with a central seed. Geesink (1984) mentioned also the lack of free amino-acids and amines in the seeds, which it shares with the Dalbergieae s.s. Because there are at this moment no other arguments, we do not hesitate to follow Geesink’s suggestion to place *Kunstleria* in the Millettieae.

KUNSTLERIA

Kunstleria Prain, J. As. Soc. Beng. 66, 2 (1897) 109, 464; King et al., Ann. Roy. Bot. Gard. Calc. 9, 1 (1901) 27; Ridley, Fl. Mal. Pen. 1 (1922) 599; Hutch., Gen. Flow. Pl. 1 (1964) 382; Geesink in Polhill & Raven, Adv. Legume Syst. (1981) 257; Scala Millettiearum, Leiden Bot. Ser. 8 (1964) 96. — Type species: *Kunstleria curtisii* Prain.

Woody climber. *Leaves*: stipulae caducous, rachis pulvinate, stipellae absent. *Leaflets* 1–11, (sub)opposite, sometimes subpeltate (*Kunstleria curtisii*); elliptic to ovate or obovate, apex acuminate, base rounded to obtuse or cordate; lateral leaflets more or less symmetrical; midrib sunken or slightly raised above, sometimes pubescent, midrib and secondary nerves raised below, venation usually a little less raised; secondary nerves 4–8(–12) pairs, angle between midrib and secondary nerves 25–55°; venation reticulate or sometimes reticulate-scalariform. *Inflorescence* a terminal or

axillary panicle; flowers and flower-bearing side branches with one bract, in terminal panicles one branching more, with two bracts. *Flowers*: pedicel up to 1 mm or rarely 1.5 mm; bracteoles 2, caducous, inserted immediately below the calyx. Calyx campanulate, up to 2.5 mm long, with 4 lobes, vexillary one slightly two-topped, others triangular or rounded (*K. geesinkii*) or orbicular (*K. sarawakensis*). Standard broadly ovate, lobed at the base, apex acute, without callosities or appendages, usually glabrous (*K. kingii* with some hairs on the outside), slightly reflexed halfway along the lamina. Wing petals with a curved dorsal auricle, sometimes a small ventral auricle, a lateral pocket or fold, and usually pubescence on at least the auricles. Wing and keel petals about equally long, joined by the lateral pockets or folds. Keel petals more boat-shaped, with only a dorsal auricle, which forms a sharp angle with the claw, usually pubescence in the axil between claw and auricle, at the ventral apical part overlapping and connate. *Filaments* diadelphous, the vexillary one free from the others, but connate to the claw of the standard; filaments alternately longer and shorter, with either all anthers equal or anthers alternately larger and smaller (reduced). *Disc* intrastaminal, with usually 10 nectary lobes at the base of the filaments. *Ovary* densely pubescent, ovules 2, style glabrous, stigma small capitate. *Pod* indehiscent, flat, thin, strap-like, usually without stipe, pubescent or puberulous, seed 1(–2) in the middle, flat.

KEY TO THE SPECIES

- 1a. Leaflet 1, subpeltate. Leaflets obovate, midrib and venation at the undersurface equally prominent. Perak, Pangkor Island **1. *K. curtisii***
- b. Leaflets (1–)3–11 (never only unifoliate leaves present), not subpeltate. Leaflets (narrowly) elliptic, ovate, obovate, venation prominent or not at the under surface **2**
- 2a. Leaflets 3, petiolule wrinkled, pubescent, on lower side often glabrous; standard blade with some hairs on the outside of the lower part, nectary lobes with some pubescence, pod up to 1.5 cm wide, not very flat. Perak **5. *K. kingii***
- b. Leaflets 3–11, never uniquely trifoliate, petiolule not much wrinkled, glabrous or pubescent; standard glabrous, nectary lobes, if present, glabrous, pod at least 1.5 cm wide, very flat **3**
- 3a. Indument on leaves and branches very densely rust-brown woolly-tomentose ('frizzled'). Leaflets elliptic to obovate, base never cordate ... **2. *K. forbesii***
- b. Indument absent or with straight hairs. Leaflets elliptic to ovate, sometimes slightly obovate, lower lateral leaflets often with a (sub)cordate base **4**
- 4a. Pairs of nerves 7 or more, leaflets up to 5, top of calyx lobes more or less rounded, or calyx lobes somewhat rhomboid, part of wing below lateral pocket pubescent **5**
- b. Pairs of nerves up to 7, leaflets 5–11, calyx lobes acute, lower part of wing only pubescent on margin **6**
- 5a. Lower surface of leaflets sericeous, ovules more or less in the middle of the ovary **8. *K. sarawakensis***
- b. Lower surface of leaflets sparsely adpressed pubescent or glabrous, ovules in the basal half of the ovary. Rachis light green, leaves and pod give a glabrous impression **3. *K. geesinkii***

- 6a. Pubescence dark brown, venation reticulate-scalariform, ovary without stipe, anthers all equal. Buds roundish. Philippines **6. *K. philippinensis***
 b. Pubescence yellowish brown, venation reticulate, stipe of ovary 0.5 mm, anthers alternately larger and smaller 7
 7a. Petiolule densely pubescent, glabrescent, main and secondary nerves prominent or not at the undersurface, venation finely reticulate **7. *K. ridleyi***
 b. Petiolule puberulous or papillous, main and secondary nerves strikingly prominent at the undersurface of the leaflets, venation coarsely reticulate. India, Kerala
4. *K. keralensis*

1. *Kunstleria curtisii* Prain — Fig. 1

Kunstleria curtisii Prain, J. As. Soc. Beng. 66, 2 (1897) 110, 464; Ridley, Fl. Mal. Pen. 1 (1922) 599. — Type: *Curtis 3019* (K), Penang, Tulloh Bahang.

Kunstleria curtisii var. *laxiflora* Prain, J. As. Soc. Beng. 66, 2 (1897) 110, 464, 465; Ridley, Fl. Mal. Pen. 1 (1922) 599. — Type: *Curtis 1632* (K), Pangkore, Tulloh Sera.

Stem not hollow, glabrescent from adpressed pubescent, with small round, wart-like lenticels. *Bark* smooth. *Leaves*: rachis 1.5–5.5 cm, no ultrajugal part; stipulae caducous, not seen; pulvinus 5–7 by 2 mm, pubescent; petiolule 4–7 by 1.5–2 mm, pubescent. *Leaflet 1* (but fieldnotes give up to 3 pairs of opposite leaflets); terminal leaflet 8–14 by 4–7 cm, (narrowly) obovate to oblong obovate, top acute, base subcordate, subpeltate; upper surface glaucish, glabrous, midrib pubescent, lower surface brown or green, glabrous or tomentose; main nerve flat above; main nerve, secondary nerves, and venation raised below; secondary nerves 5 or 6 pairs, terminating diffusely towards the apex; angle of the secondary nerves with the main nerve 40–55°; venation reticulate. *Inflorescence* yellowish brown pubescent; main axis with side branches, these with two bracts, 1.5–2 by 1 mm; secondary side branches with

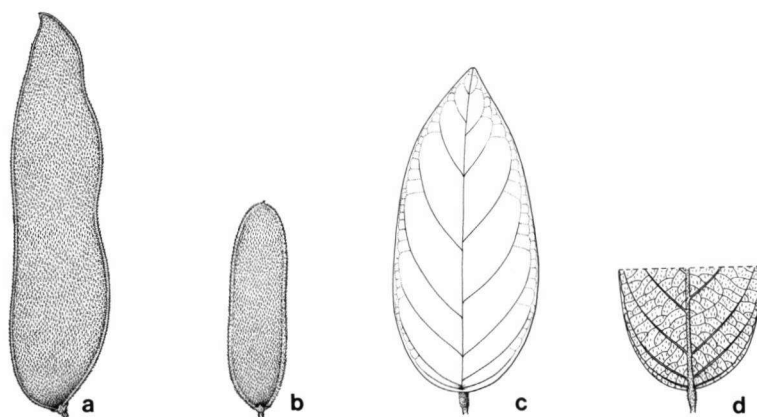


Fig. 1. *Kunstleria curtisii* Prain. a. Pod; b. young pod; c. leaflet, upper surface; d. part of lower surface of leaflet; all $\times 0.5$ (a: *Curtis 3019*; b–d: *Curtis 1632*).

one bract, 1.5 by 0.25 mm; flowers with one bract, not seen. *Flower*: not all parts seen, because only old flowers were available. Calyx cup adpressed pubescent; vexillary lobe with emarginate top, other lobes triangular, with an acute top. Wing with a dorsal auricle, a small ventral auricle, and a lateral pocket, hairs on the auricle and the ventral margin. Keel with a dorsal auricle and a lateral pocket, hairs on the axil of the auricle and the claw. *Filaments* c. 4 mm, 3/4 part connate; anthers all equal, 0.3 mm long. *Pod* 9–13.5 by 2–2.5 cm, golden brown sericeous, glabrescent when older, no stipe, suture slightly curved inwards once or twice at the place of the seed.

Fieldnotes – Big climber, main stems 8–10 cm diameter, bark dark grey, inner bark reddish. Leaves spirally, pinnate with 1–3 pairs of opposite leaflets and a terminal one; leaflets thick leathery, ovate, blunt, base cordate, dark green above, paler green below.

Distribution – Malay Peninsula (Perak: Pangkor Island). Fig. 2.

Note – This species differs from all others in having a subpeltate leaflet. Prain described two varieties of this species, but as he states (Prain, 1897): "... their leaves, but for the pubescence, are quite similar and it may prove unnecessary to separate them even as varieties." We prefer to follow this and do not separate the varieties.

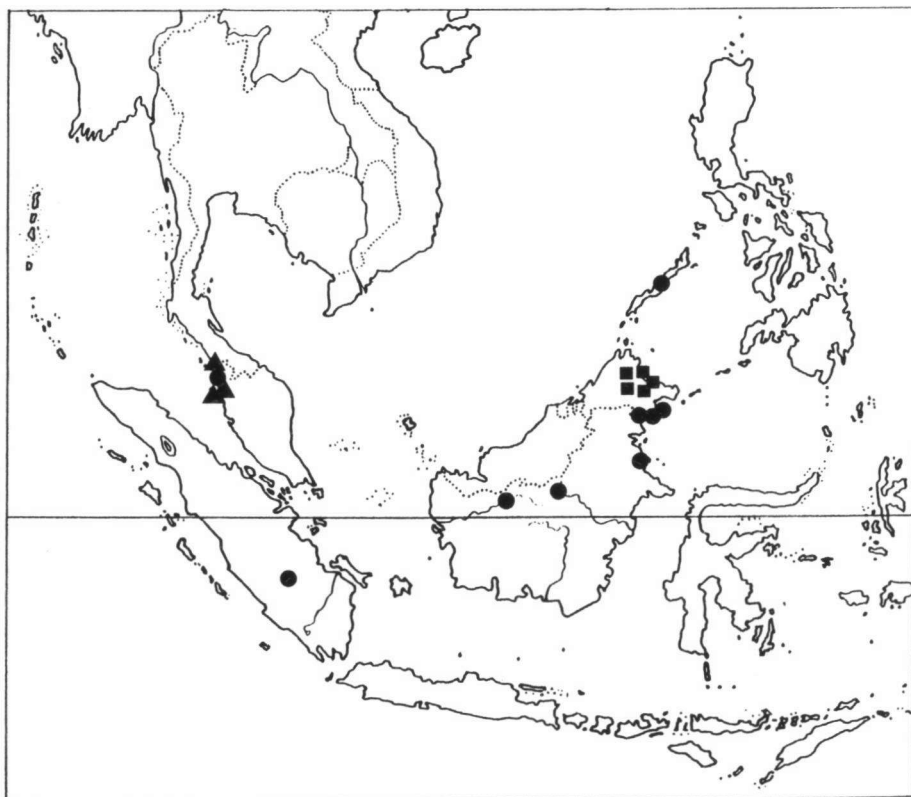


Fig. 2. Distribution of *Kunstleria curtisii* Prain (▲), *K. forbesii* Prain (●), and *K. gesinkii* Ridder-Numan & Kornet (■).

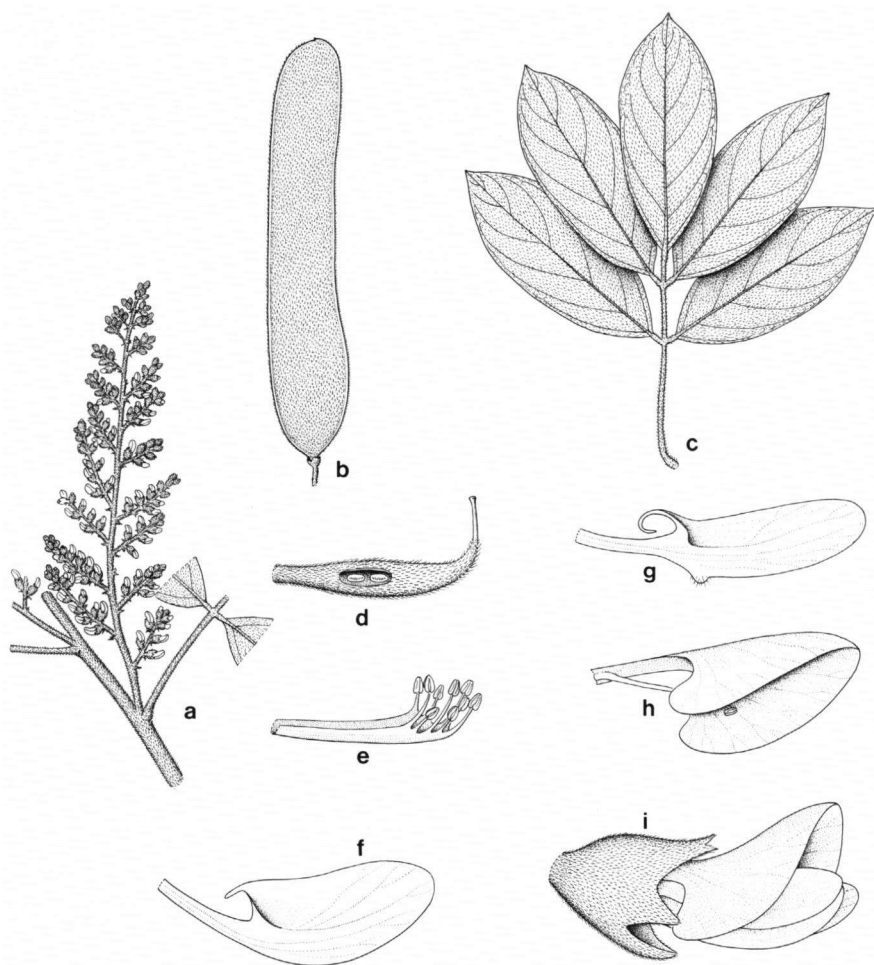


Fig. 3. *Kunstleria forbesii* Prain. a. Inflorescence; b. pod; c. part of leaf; d. pistil; e. stamens; f. keel petals; g. wing petals; h. standard; i. flower; a–c $\times 0.5$, d–i $\times 6$ (a, c–i: *Forbes 3241*; b: *Elmer 21605*).

2. *Kunstleria forbesii* Prain — Fig. 3

Kunstleria forbesii Prain, J. As. Soc. Beng. 66, 2 (1897) 111, 465; Ridley, Fl. Mal. Pen. 1 (1922) 600. — Lectotype (chosen here): *Forbes 3241* (A, BM, GH, L), Sumatra. Syntype: *Kunstler 3094* (K), Perak, Salama.

Kunstleria borneensis Merr., Univ. Cal. Publ. Bot. 15 (1929) 106. — Type: *Elmer 21605* (A, BM, BO, C, K, L, P, U, US), Tawao.

Kunstleria atrovioleacea (Elmer) Merr., Philipp. J. Sc., Bot. 10 (1915) 14; Enum. Philipp. Flow. Pl. 2 (1923) 298. — *Derris atrovioleacea* Elmer, Leaflet Philipp. Bot. 5 (1913) 1798, 1799. — Type: *Elmer 13105* (A, BO, GH, K, L, U), Palawan, Puerto Princessa.



Fig. 4. *Kunstleria geesinkii* Ridder-Numan & Kornet. a. Leaflet; b. pod; c. habit; d. wing petal; e. standard; f. flower; g. pistil; h. stamens; i. keel petal; a–c $\times 0.5$, d–i $\times 6$ (a, b: SAN 39751; c–i: SAN 52944).

Stem hollow, with a dark filling, woolly-tomentose, often in tufts, glabrescent when older, with small round or elongated lenticels. Bark, when glabrous, with small ridges. *Leaves*: rachis 6.5–17.5 cm, the ultrajugal part (0–)0.5–1 cm; stipulae 6 by 2–5 mm, pubescent, caducous; pulvinus 5–10 by 2–3 mm, tomentose, glabrescent; petiolule 3–8 by 1–2 mm, tomentose, upperside glabrous. *Leaflets* 5–11; terminal leaflet 5–12.5 by 2–8 cm, elliptic to obovate, top acuminate to abruptly acuminate, base rounded to acute; lateral leaflets more or less symmetric, elliptic; upper surface glaucish, glabrous, tomentose when young, midrib glabrescent, lower surface brown, tomentose; main nerve sunken, sometimes slightly raised above; main nerve, secondary nerves, and sometimes the venation raised below; secondary nerves 4–8 pairs, terminating diffusely towards the apex; angle of the secondary nerves with the main nerve 25–55°; venation reticulate. *Inflorescence* tomentose; main axis with side branches, these with two bracts, 2–5 by 1–3 mm; secondary side branches with one bract, 2–3 by 1–1.5 mm; flowers with one bract, 1.5–2.5 by 0.2–1 mm. *Flower*: pedicel up to 1 mm, bracteoles 1–2 mm. Calyx cup 1–2.5 by 1.5–2 mm, pubescent; vexillary lobe 1–1.5 by 1.5–2.5 mm, top emarginate, other lobes 1–1.5 by 1–1.5 mm, triangular. Standard blade 3–4 by 3–5 mm, sometimes with a light spot, claw 1.5–2 mm long. Wing blade 2–4 by 1–1.5 mm, claw 1.5–2 mm, with a dorsal auricle, often a small ventral auricle, and a lateral pocket, glabrous or with a few hairs on the ventral margin or auricle. Keel blade 3–4 by 1.5–2.5 mm, claw 1.5–2.5 mm, with a dorsal auricle and a lateral pocket, glabrous or with some pubescence in the axil between claw and dorsal auricle. *Filaments*: vexillary filament 2.5–3.5 mm, more than 1/3 connate to the claw of the standard; other filaments 3–5 and 4–6 mm, up to 3/4 connate; anthers not equal, alternately 0.5 mm and 0.2 mm long. *Ovary* 2 by 0.5 mm, densely pubescent up to half the style, ovules 2, basal, stipe 0.5 mm, style 1–2.5 mm, stigma small, capitate; nectary glands 10, glabrous, sometimes with a few hairs. *Pod* not seen.

Fieldnotes – Creeper or woody climber up to 10 m, with thick snake-like stems; bark brownish; leaves yellowish at the back. Fruit brownish, yellowish brown or greenish brown.

Distribution – Borneo (Tawao, Tarakan); Malay Peninsula (Perak); South Sumatra (Bigni Telok); Philippines (Palawan). Fig. 2.

Habitat & Ecology – Primary forest, Dipterocarp forest, hill side, inner forests or the flatland. Black or brown and reddish soil. Altitude up to 90 m.

3. *Kunstleria geesinkii* Ridder-Numan & Kornet, *spec. nov.* — Fig. 4

Folia leguminae matura glabra ut videtur, folii rhachis pallide viridis, foliola supra glaucescentia infra sparse pubescentia, terminalia elliptica ad ovata, lateralia ad numero 4 nervi secundarii 7–10 paribus, calycis lobi apice rotundato, alae infra marsupium lateralem utrinque pubescentes. — Typus: SAN 52944 (K, holotype), Borneo, Sandakan, Lahad Datu.

Stem hollow, with a loose filling, puberulous, with small elongated lenticels, round on older branchlets. Bark smooth, with tiny ridges. *Leaves*: rachis 4–13 cm, the ultrajugal part (0–)0.3–1.3 cm; stipulae caducous, not seen; pulvinus 3–8 by 1.5–2 mm, puberulous, glabrescent; petiolule 4–8 by 1 mm, pubescent. *Leaflets* (1–)3–5; terminal leaflet 7–12.5 by 2–5.5 cm, elliptic to obovate, top acuminate or sometimes

acute, base rounded to acute; lateral leaflets more or less symmetric, elliptic to ovate; upper surface glabrescent, midrib pubescent, lower surface brown or light green, adpressed pubescent, glabrescent; main nerve sunken above, main nerve, secondary nerves, and venation raised below; secondary nerves 7–10 pairs, terminating diffusely towards the apex; angle of the secondary nerves with the main nerve 30–45° (–50°); venation reticulate. *Inflorescence* dark brown pubescent; main axis with side branches, these with two bracts, 2 by 1 mm; secondary side branches with one bract, 2 by 1 mm; flowers with one bract, 1–2 by 0.2 mm. *Flower*: pedicel up to 1 mm, bracteoles 0.75 mm. Calyx cup 1.5–2 by 1.5–2 mm, adpressed pubescent; vexillary lobe 1 by 2 mm, top very slightly emarginate, other lobes 1 by 1 mm, top rounded. Standard 3 by 4 mm, claw 1 mm long. Wing 3 by 1.25 mm, claw 1 mm, with a dorsal auricle and a lateral pocket, hairs on the auricle and the ventral margin at the inside and outside. Keel 3.5 by 1.5 mm, claw 1 mm, with a dorsal auricle and a lateral pocket, hairs on the axil of the auricle and the claw. *Filaments*: vexillary filament 2.5–3.5 mm, only basally connate to the claw of the standard, other filaments 4–4.5 and 4.5–5.5 mm, 1/2 part connate; anthers not equal, alternately 0.5 mm and 0.2 mm long. *Ovary* 2 by 0.5 mm, densely pubescent, style glabrous, ovules 2, in the basal half, stipe 0.5 mm, style 1.5 mm, stigma small capitate; nectary glands 10, glabrous. *Pod* c. 8–11.5 by 2.5–3 cm, brown puberulous, no stipe, at the place of the seed suture slightly curved inwards.

Fieldnotes – Woody climber, stem produces red latex, outer bark greyish, corky, inner bark greenish or reddish, girth 7.5–10 cm. Flower: petals red, chocolate or blackish.

Distribution – North Borneo. Fig. 2.

Habitat & Ecology – Low undulating land, hills, logged area, near a stream. Primary or secondary forest. Soil blackish or yellowish, sandy, stony. Altitude 9–180 m.

Notes – 1. This species was first recognized by Kornet (1984). It is named after Dr. Rob Geesink, who supervised the Leguminosae revisions at the Rijksherbarium, Leiden. His untimely death in September 1992 deprived us of an inspiring colleague and friend.

2. *Kunstleria geesinkii* resembles *K. ridleyi*, but apart from the number of lateral nerves, and the number of leaflets, *K. geesinkii* has rounded calyx lobes, which are acute in *K. ridleyi*.

4. *Kunstleria keralensis* Mohanan & Nair — Fig. 5

Kunstleria keralensis Mohanan & Nair, Proc. Indian Acad. Sc. (Plant Sc.) 90, 3 (1981) 207–209.

— Type: Mohanan 68351 (holo CAL; iso MH). Paratype: Mohanan 68348 (MH). All from Kerala, South India, Quilon District, Kodumon, Adoor.

Stem hollow, with a dark filling, glabrous, with small round, wart-like or elongated lenticels. Exudate not known. Bark smooth. *Leaves*: rachis 11.5–14 cm, the ultrajugal part 0.7–1 cm; stipulae caducous, not seen; pulvinus 8 by 2.5–3 mm, papillose; petiolule 5–7 by 1.5 mm, puberulous, papillous. *Leaflets* 5–7; terminal leaflet 9–11 by 4–5.5 cm, elliptic to obovate, top acuminate, base rounded acute; lateral leaflets more or less symmetric, elliptic to ovate; upper surface green-brown, sparsely pubescent especially on the nerves, lower surface brown or green, sparsely pu-

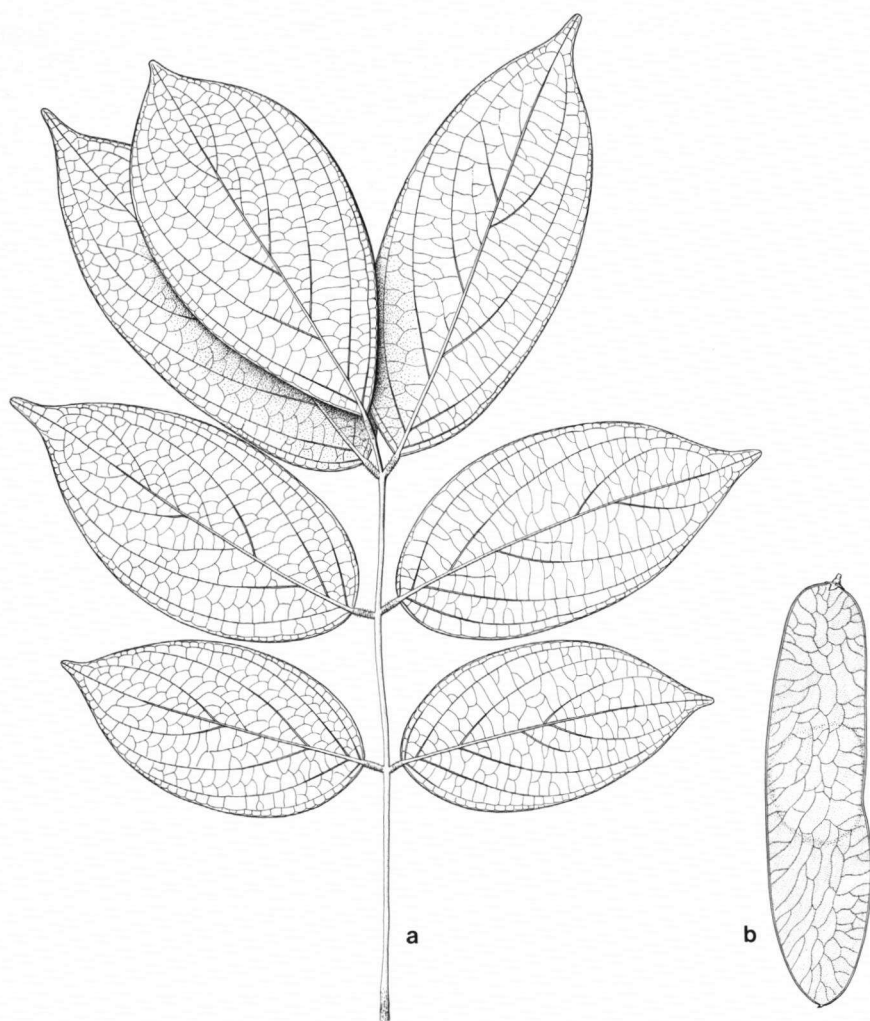


Fig. 5. *Kunstleria keralensis* Mohanan & Nair. a. Leaf; b. pod; both $\times 0.5$ (a, b: Ellis 38517).

bescent especially on the nerves; main nerve sunken above; main nerve, secondary nerves, and venation raised below; secondary nerves 4–5 pairs, terminating diffusely towards the apex; angle of the secondary nerves with the main nerve $25\text{--}35^\circ$; venation reticulate. *Inflorescence* brown pubescent; main axis with flower-bearing side branches, bracts not seen. [Information on flowers taken from Mohanan & Nair (1981)]. *Flowers*: subsessile. Calyx 3 by 2–2.5 mm, finely brownish tomentose, lobes 1.5 mm long, vexillary lobe emarginate, other lobes triangular. Standard 4–5 by 4–4.5 mm, claw c. 3 mm long. Wing 4–4.5 by 1.5–2.5 mm, claw c. 2 mm long, with hairs at the margins towards the base, with a the dorsal auricle and lateral pocket.

Keel 4–4.5 by 2–3 mm, claw c. 2 mm long, with a small dorsal auricle and lateral pocket, hairs at the dorsal margin. *Filaments*: vexillary filament 4 mm, connate to the base of the claw of the standard, other filaments 4–5 and 5–6 mm long, 3/4 part connate; anthers alternately larger and reduced, fertile anthers 0.5 mm. Ovary c. 4 by 1.5 mm, silky pubescent, style glabrous, 2 mm long, ovules 2, stipe 1 mm, stigma small capitate. *Pod* 10–14 by 2.5–3.5 cm, brown sericeous, no stipe, sometimes tapering towards tip.

Fieldnotes – Liana, shrubby climber, flowers deep purple, fruits brown or brownish green.

Distribution – India (Kerala).

Habitat & Ecology – Altitude 125–500 m.

5. *Kunstleria kingii* Prain — Fig. 6

Kunstleria kingii Prain, J. As. Soc. Beng. 66, 2 (1897) 110, 111, 465; Ridley, Fl. Mal. Pen. 1 (1922) 599; Polhill, Kew Bull. 25 (1971) 263, 264. — Type: *Kunstler* 6935 (BM, K, L, P, US). Syntypes: *Kunstler* 3830 (BM, K), 6870 (K). All from Perak.

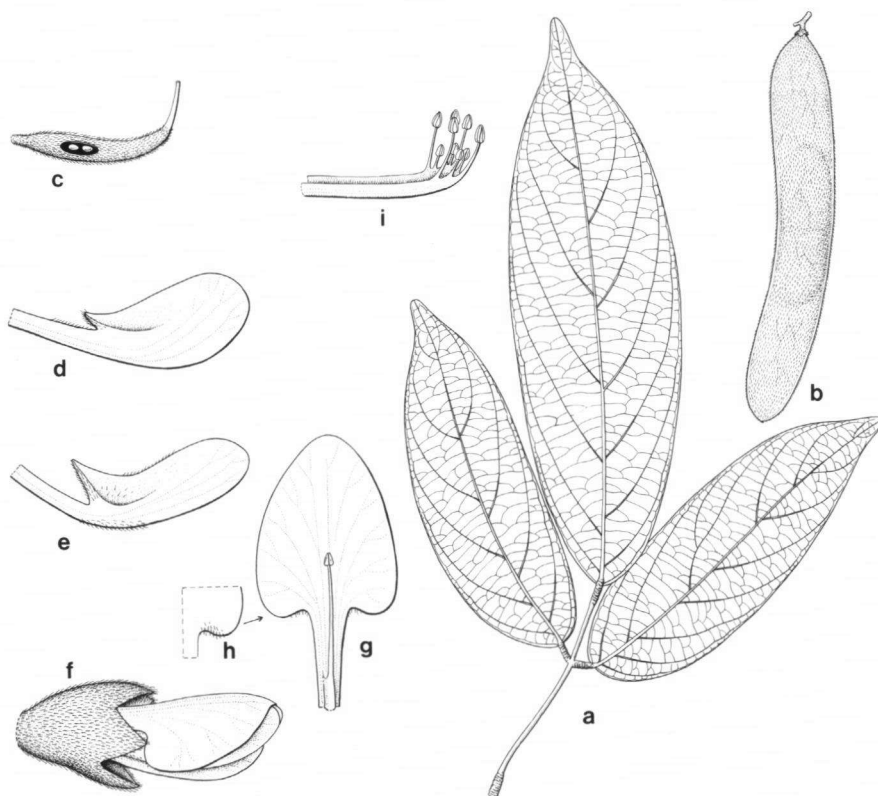


Fig. 6. *Kunstleria kingii* Prain. a. Leaf; b. pod; c. pistil; d. keel petal; e. wing petal; f. flower; g. standard; h. part of standard outside; i. stamens; a, b $\times 0.5$; c–i $\times 6$ (a, b: *Kunstler* 3830; c–i: *Kunstler* 6935).

Stem not hollow, sparsely adpressed puberulous, with small round lenticels. Bark smooth. *Leaves*: rachis 2.5–6.5 cm, the ultrajugal part 0.5–1.5 cm; stipulae caducous, not seen; pulvinus 4–8 by 1–2 mm, glabrous or puberulous, wrinkled; petiole 4–6 by 1–1.5 mm, glabrous or puberulous, wrinkled. *Leaflets* 3; terminal leaflet 8–16.5 by 2.5–5.5 cm, (narrowly) elliptic to elliptic-ovate, top acute to acuminate, base rounded to acute; lateral leaflets more or less symmetric, (narrowly) elliptic to ovate; upper surface glaucous, glabrous, nerves also, lower surface light brown, glabrous or sparsely pubescent; main nerve raised above; main nerve, secondary nerves, and sometimes venation raised below; secondary nerves 4–6 pairs, terminating diffusely towards the apex; angle of the secondary nerves with the main nerve 25–45°; venation reticulate. *Inflorescence* puberulous; main axis with side branches, these with two bracts, 3 by 1 mm; secondary side branches with one bract, 1–2 by 0.25–1 mm; flowers with one bract, 1–1.5 by 0.25 mm. *Flower*: pedicel up to 1 mm, bracteoles 1 mm. Calyx cup 2 by 2 mm, puberulous; vexillary lobe 1 by 2 mm, top emarginate, other lobes 1 by 1 mm, triangular. Standard blade 2.5 by 3 mm,

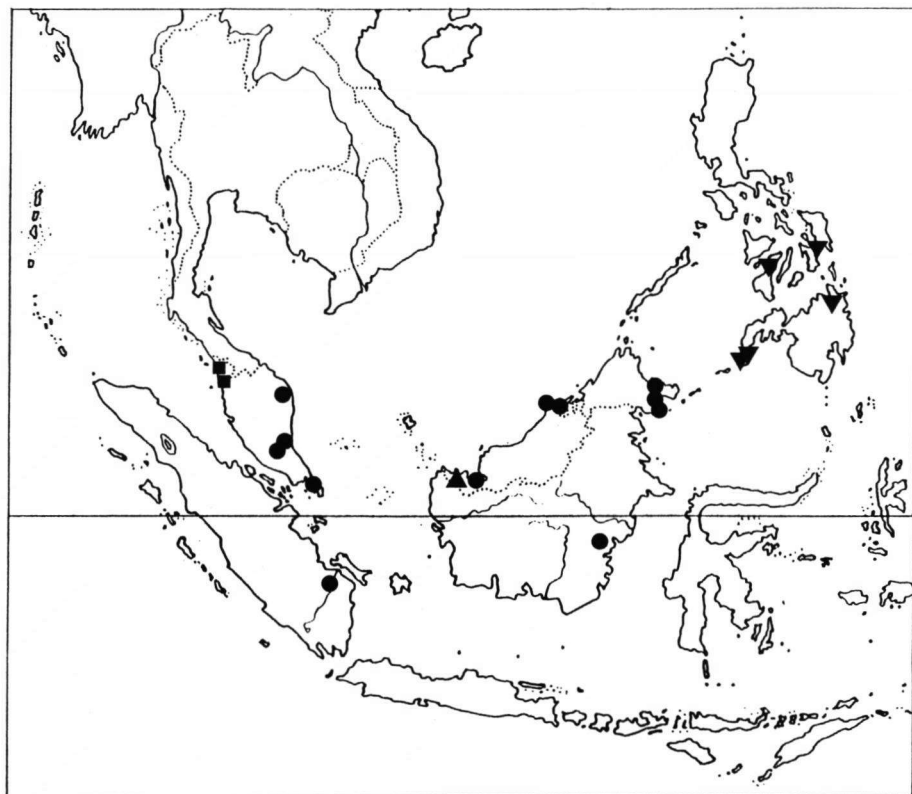


Fig. 7. Distribution of *Kunstleria kingii* Prain (■), *K. philippinensis* Merr. (▼), *K. ridleyi* Prain (●), and *K. sarawakensis* Ridder-Numan & Kornet (▲).

claw 1 mm long, a few hairs at the outside of the blade just above the auricles. Wing 3.5 by 1.25 mm, claw 1 mm, with a dorsal auricle and a lateral pocket, hairs on the auricle, the ventral margin, and the axil of the auricle and claw. Keel 3 by 1 mm, claw 1 mm, with a dorsal auricle and a lateral pocket, hairs on the axil of the auricle and the claw; keel petals with a small overlap. *Filaments*: vexillary filament 2–4 mm, up to 1/3 part connate to the claw of the standard, other filaments 2.5–4 and 3–5 mm, 2/3 part connate; anthers (not) equal, 0.5 mm (and 0.2 mm) long. *Ovary* 1.5–2 by 0.5 mm, densely pubescent up to the half of the style, ovules 2, medio-basal, stipe 0.5 mm, style 1–1.5 mm, stigma small; nectary glands 10, pubescent (not in small buds). *Pod* 6.5–10.5 by 1.5 cm, brown puberulous, no stipe or sometimes 0.5 cm. *Seed* large, 6 by 1.25 cm.

Fieldnotes – A rare, slender, long climber up to over 30 m long. Stem 75–100 cm in diameter. Leaves light green. Flower: petals velvety black, dark red inside, deep red towards calyx, calyx velvety dark brown. Fruit of a glossy dark golden colour.

Distribution – Perak. Fig. 7.

Habitat & Ecology – Cling to large trees in dense jungle, open old jungle, hillside. Altitude 150–450 m.

Note – The pods are narrow and not as flat as in the other species.

6. *Kunstleria philippinensis* Merr. — Fig. 8

Kunstleria philippinensis Merr., Philipp. J. Sc., Bot. 9 (1914) 359; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 298. — Type: Wenzel 836 (US, n.v.), Leyte, Buena Vista. Paratypes: BS (Reillo) 16114, Basilan, Wenzel 818 (BM, Harvard), Leyte, Buena Vista.

Stem not hollow, puberulous, with small round, wart-like lenticels. Bark smooth, with tiny wrinkles. *Leaves*: rachis 8–12 cm, the ultrajugal part 1–2 cm; stipulae caducous, not seen; pulvinus 5–10 by 2–3 mm, sparsely pubescent, glabrescent; petiolule 5–8 by 1–1.5 mm, sparsely pubescent. *Leaflets* 5–7; terminal leaflet 6.5–11 by 4–4.5 cm, elliptic, top acuminate, base rounded; lateral leaflets more or less symmetric, elliptic to ovate, base subcordate; upper surface glaucous or brown, glabrous or very sparsely pubescent, glabrescent; lower surface brown, sparsely pubescent, glabrescent; nerves pubescent; main nerve sunken above; main nerve, secondary nerves, and venation raised below; secondary nerves 4–5 pairs, terminating diffusely towards the apex; angle of the secondary nerves with the main nerve 30–40°; venation reticulate-scalariform. *Inflorescence* dark-brown pubescent; main axis with side branches, these with two bracts, not seen; secondary side branches with one bract, 2–3 by 1–1.5 mm; flowers with one bract, 1–1.5 by 0.5 mm. *Flower*: pedicel up to 1 mm, bracteoles 1 mm long. Calyx cup 2 by 2.5 mm, adpressed pubescent; vexillary lobe 1.5 by 2.5 mm, top slightly emarginate, other lobes 1.5 by 1 mm, triangular. Standard 3–4 by 3.5–5 mm, with a light spot, claw 1 mm long. Wing 3 by 1.5 mm, claw 1–2 mm, with a dorsal auricle and a lateral pocket, hairs on the auricle and the ventral margin. Keel 4 by 1.5 mm, claw 1 mm, with a dorsal auricle and a lateral pocket, hairs on the axil of the auricle. *Filaments*: vexillary filament 2.5–3 mm, only connate to the basal part of the claw of the standard, other fila-

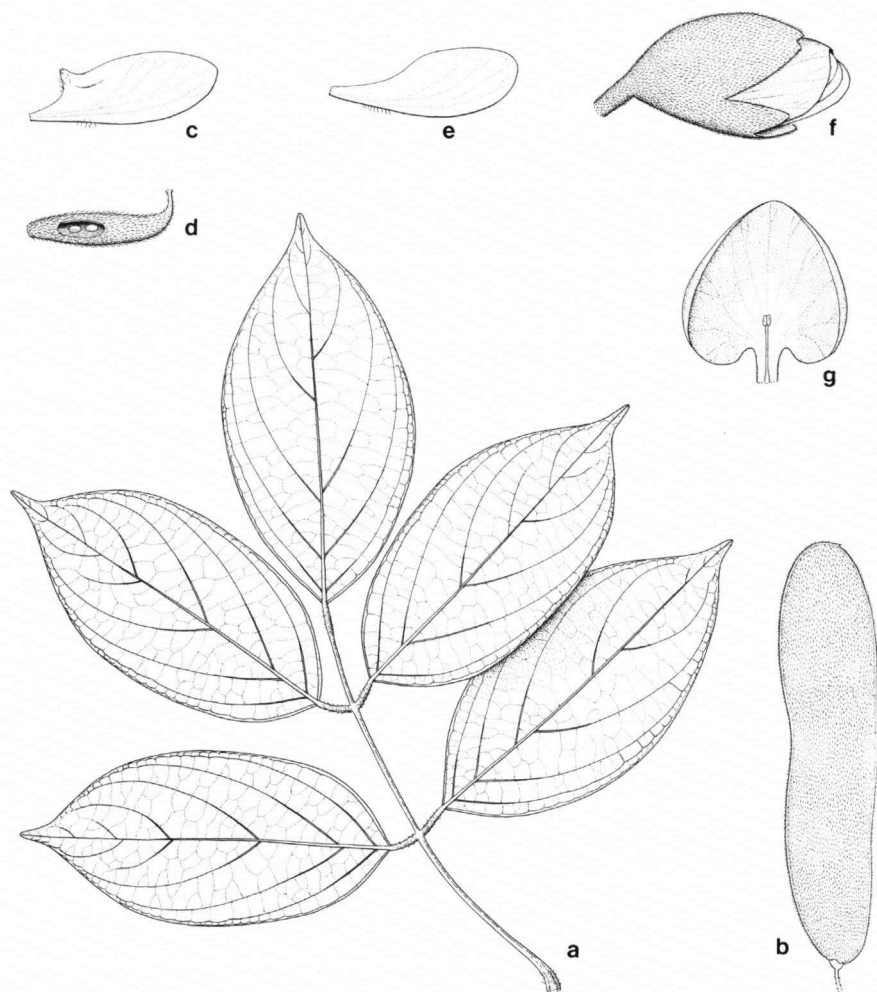


Fig. 8. *Kunstleria philippinensis* Merr. a. Leaf; b. pod; c. wing petal; d. pistil; e. (part of) keel petal; f. flowerbud; g. standard; a, b $\times 0.5$, c–g $\times 6$ (a, c–g: Wenzel 818; b: BS 16114).

ments 2–2.5. and 2.5–3 mm, 2/3 part connate; anthers equal, 0.5 mm long. *Ovary* 2 by 0.5 mm, densely pubescent up to half of the style, ovules 2, medio-basal, no stipe, style 1 mm, stigma small; nectary glands 10, only slightly thickened filament base, glabrous. *Pod* 7–16 by 1.5–2.5 cm, dark brown pubescent, no stipe, sometimes 2 seeds.

Fieldnotes – Vine, flowers dark red-purple, fruits green.

Distribution – Philippines: Leyte, Basilan, Mindanao. Fig. 7.

Ecology – Secondary growth forest.

Note – Herbarium specimens coloured dark chocolate brown.

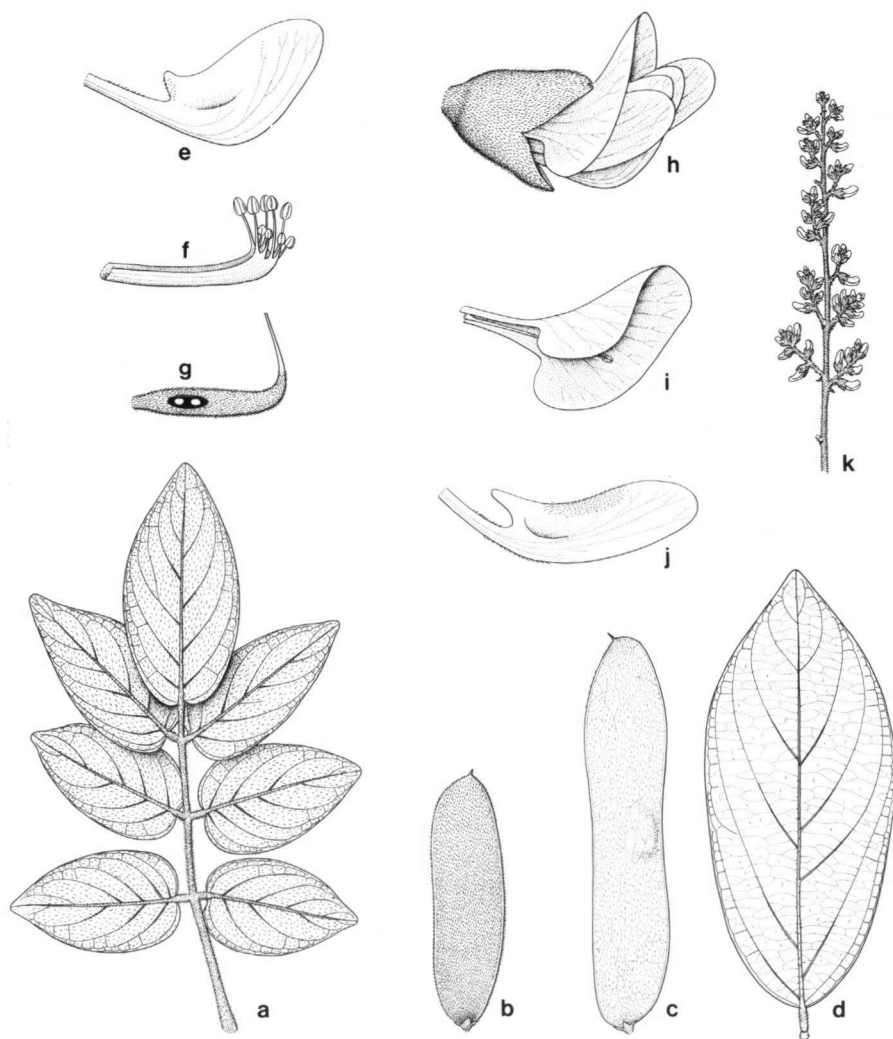


Fig. 9. *Kunstleria ridleyi* Prain. a. Leaf; b. young pod; c. pod; d. leaflet; e. keel petal; f. connate stamens; g. pistil; h. flower; i. standard; j. wing petal; k. part of inflorescence; a–d $\times 0.5$, e–k $\times 6$ (a, b: *FRI* 16919; c–k: *Hort. Bog. XVIII. F. 13*).

7. *Kunstleria ridleyi* Prain — Fig. 9

Kunstleria ridleyi Prain, J. As. Soc. Beng. 66, 2 (1897) 111, 112, 465; Ridley, Fl. Mal. Pen. 1 (1922) 600. — Type: *Ridley* 6395 (BM, K), Bot. Gard. Singapore.

Kunstleria derryi Prain, J. As. Soc. Beng. 66, 2 (1897) 112, 465, 466; Ridley, Fl. Mal. Pen. 1 (1922) 600. — Type: *Derry* 1006 (K), Malakka, Machap Tebung Road.

Kunstleria elmeri Merr., Univ. Cal. Publ. Bot. 15 (1929) 107. — Type: *Elmer* 21494 (A, BM, C, K, L, P, U, US), Tawao.

Stem hollow, with a dark filling, pubescent, later glabrous, with small round, wart-like or elongated lenticels. Bark smooth, with tiny ridges. *Leaves*: rachis 5–11 cm, the ultrajugal part 0.5–1.5 cm; stipulae 4–5 by 1–1.5 mm, caducous, pubescent; pulvinus 3–9 by 1–3.5 mm, (densely) pubescent; petiolule 1–6 by 1–2 mm, (densely) pubescent. *Leaflets* 5–9; terminal leaflet 3.5–11 by 1.5–5 cm, elliptic to ovate, top acute or acuminate, base rounded to subcordate; lateral leaflets more or less symmetric, elliptic to ovate; upper surface glaucous or brown, sparsely to densely pubescent, glabrescent, nerves pubescent, lower surface brown or green, sparsely to densely pubescent; main nerve slightly prominent or raised in a furrow above; main nerves, secondary nerves, and sometimes venation raised below; secondary nerves 3–7 pairs, terminating diffusely towards the apex; angle of the secondary nerves with the main nerve 25–45°; venation reticulate. *Inflorescence* rust-brown pubescent; main axis with side branches, these with two bracts, 3–6 by 1–3 mm; secondary side branches with one bract, 2–4 by 1–2 mm; flowers with one bract, 1.5–2 by 0.25 mm. *Flower*: pedicel up to 1.5 mm, sometimes almost sessile, bracteoles 0.5–2 mm. Calyx cup 1.5–2 by 2–2.5 mm, adpressed pubescent; vexillary lobe 1–1.5 by 2–2.5 mm, top slightly emarginate or not, other lobes 1–1.5 by 1–1.5 mm, triangular. Standard 3–4 by 3–5 mm, claw 1–2 mm long. Wing 3–4.5 by 1–2.5 mm, claw 1–2 mm, with a dorsal and a small ventral auricle and a lateral pocket, hairs on the auricles, the ventral margin, and sometimes on the part above the lateral pocket. Keel 3–4 by 2–3.5 mm, claw 1.5–2 mm, with a dorsal auricle and a lateral pocket, hairs on the axil of the auricle and the claw. *Filaments*: vexillary filament 2–4 mm, up to 3/4 part connate to the claw of the standard, other filaments 2.5–5 and 3–6.5 mm, 2/3 part connate; anthers not equal, alternately 0.3–0.5 mm and 0.2 mm long. *Ovary* 2.5–3.5 by 0.5–0.75 mm, densely pubescent up to the base of the style, ovules 2, medio-basal, stipe 0.25–0.5 mm, style 1–2.5 mm, stigma small, capitate; nectary glands 5 or 10, rather flat, and glabrous, or absent. *Pod* 8–10 by 2 cm, yellow brown pubescent or sericeous, no stipe, sometimes the sutures are curved inwards at the place of the seed.

Fieldnotes – Climber, 3–12 m high, stem up to 12.5 cm girth, outer bark smooth, whitish, inner bark whitish, red latex. Flower colour indicated as follows: like *Geranium phaeum*, brownish, deep black purple, or blue black with lip inside with a green spot. Pod covered with silky brownish hairs.

Distribution – Sumatra, Malay Peninsula, Borneo. Fig. 7.

Habitat & Ecology – Primary forest on hill, blackish soil, stony. Level land, or low undulating country. Altitude 6–45 m.

Notes – Prain described two species, *K. ridleyi* and *K. derryi*, which seemed to be quite different: the latter densely soft pubescent, the first one nearly glabrous. The material is scarce, but we found there is no reason other than the pubescence for separation into two species. The two kinds are changing gradually into each other: the soft and densely hairy specimens are mostly from Malacca, while the more glabrous ones occur on Borneo and Singapore. A rather hairy specimen was recently collected in Brunei, the first record outside the Malay Peninsula.

See also note under *K. geesinkii*.

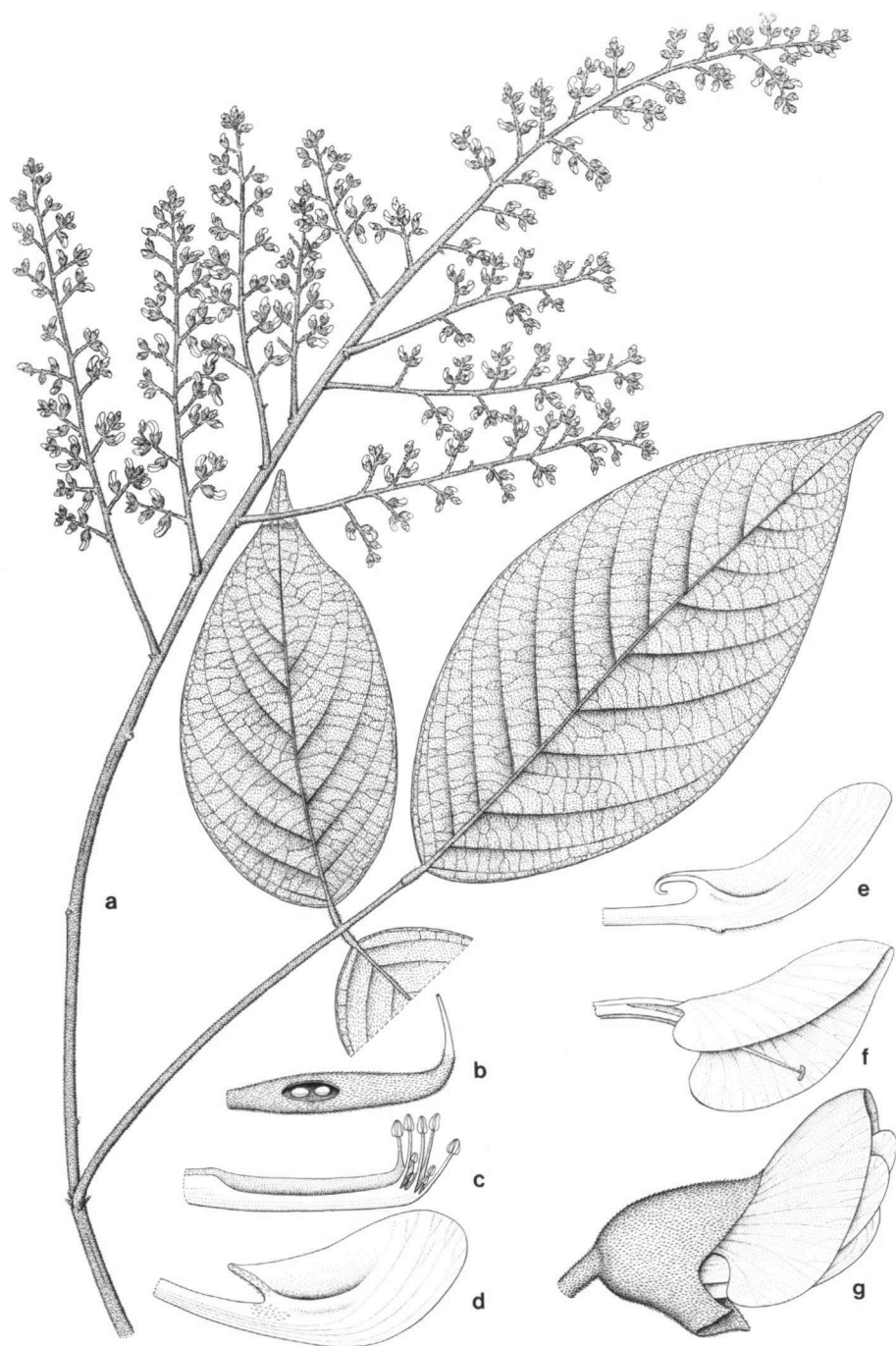


Fig. 10. *Kunstleria sarawakensis* Ridder-Numan & Kornet. a. Leaf and inflorescence; b. pistil; c. stamens; d. keel petal; e. wing petal; f. standard; g. flower; a $\times 0.5$, b–g $\times 6$ (all *S* 18036).

8. *Kunstleria sarawakensis* Ridder-Numan & Kornet, *spec. nov.* — Fig. 10

Foliola 3–5 elliptica infra sericea, nervi secundarii 8–12 paribus sub angulo 40–50° abeuntes, calycis lobi rhomboidei. — Typus: *S 18036* (holo K; iso P) Sarawak, Lundu.

Stem hollow, filled with black, brown pubescent, with small lenticels. Bark smooth, with very tiny ridges. *Leaves*: rachis 12–16.5 cm, the ultrajugal part 1.2–2.5 cm; stipulae caducous, not seen; pulvinus 10–15 by 2–4 mm, pubescent; petiolule 5–8 by 1–2 mm, pubescent. *Leaflets* 3–5; terminal leaflet 9.5–17.5 by 5.8 cm, elliptic, top acuminate, base rounded-obtuse; lateral leaflets more or less symmetric, elliptic to elliptic-ovate; upper surface sparsely adpressed pubescent, glabrescent, nerves pubescent, lower surface light brown, sericeous; main nerve sunken above, main nerve, secondary nerves, and sometimes the venation raised below; secondary nerves 8–12 pairs, terminating diffusely towards the apex; angle of the secondary nerves with the main nerve 40–50°; venation reticulate. *Inflorescence* dark brown pubescent; main axis with side branches, these with two bracts, not seen; secondary side branches with one bract, 2–3 by 1 mm; flowers with one bract, not seen. *Flower*: pedicel 1–1.5 mm, bracteoles 1.5 mm long. Calyx cup 2–2.5 by 2–2.5 mm, dark puberulous; vexillary lobe 1–1.5 by 2 mm, top slightly emarginate, other lobes 1–1.5 by 1 mm, orbicular. Standard 4 by 4 mm, claw 1.5 mm long. Wing 3.5 by 1.25 mm, claw 1–2 mm, with a dorsal auricle, a small ventral auricle, and a lateral pocket, hairs on the auricles and the ventral margin. Keel 3.5–4 by 1.5–2 mm, claw 1–1.5 mm, with a dorsal auricle and a lateral pocket, hairs on the axil between claw and the auricle. *Filaments*: vexillary filament 2–3 mm, at least halfway connate to the claw of the standard, other filaments 2.5–3.5 and 3.5–4 mm, 3/4 part connate; anthers not equal, 0.5 and 0.3 mm long. Ovary 2.5–3 by 0.5–0.75 mm, densely pubescent up to the base of the style, ovules 2, medial, stipe 0.5 mm, style 1.5–2 mm, stigma capitate; nectary glands 10, glabrous. *Pod* not seen.

Fieldnotes – Woody climber, 18 m tall. Ovary, androecium, and style cream, calyx black, corolla pale green at base changing through pink to black elsewhere. Pale rust tomentum.

Distribution – Sarawak (Lundu). Fig. 7.

Habitat & Ecology – Undulating land, mixed Dipterocarp forest, granodiorite, derived soils. Altitude 15 m.

Notes – The leaves are silky on the lower surface.

The species was first recognized by Dr. Harry Wiriadinata, in his manuscript on *Spatholobus*.

EXCLUDED SPECIES

Kunstleria blackii (F. Muell.) Polhill, Kew Bull. 25 (1971) 263 = *Austrosteenisia blackii* (F. Muell.) Geesink, Leiden Bot. Ser. 8 (1984) 78.

Kunstleria stipularis (C. T. White) Polhill, Kew Bull. 25 (1971) 265 = *Austrosteenisia stipularis* (C. T. White) Jessup, Austrobaileya 2 (1986) 243.

ACKNOWLEDGEMENTS

We would like to thank the directors of the herbaria of A, BM, BO, C, GH, K, L, MH, P, U, US for their kind hospitality during the first author's visits and the material loaned.

We also thank Mr. J.H. van Os for preparing the drawings and Dr. J.F. Veldkamp for his assistance with the Latin diagnoses.

Finally we are grateful to Dr. F.A.C.B. Adema, Professors P. Baas and C. Kalkman, Dr. P.W. Leenhouts, and Dr. M.C. Roos for critically reading the manuscript and testing the key. Special thanks are due to the latter for taking over the task of supervisor after the death of Dr. Rob Geesink.

This project is financially supported by the Foundation for Fundamental Biological Research (BION) (Project nr 440.041).

REFERENCES

- Geesink, R. 1981. Tephrosieae. In: R.M. Polhill & P.H. Raven (eds.), *Advances in Legume Systematics* 1: 245–260. Kew.
- Geesink, R. 1984. *Scala Millettiarum*: Leiden Bot. Series 8. Leiden.
- Hutchinson, J. 1964. Papilionaceae. In: *The Genera of Flowering Plants* 1: 297–489.
- Jessup, L.W. 1986. New combination and species in *Austrosteenisia* Geesink (Fabaceae-Millettieae). *Austrobaileya* 2 (3): 243–245.
- Kornet, D.J. 1984. Revision of *Kunstleria*. Internal report. Rijksherbarium, Leiden.
- Merrill, E.D. 1914. *Plantae Wenzeliana*, II. Philipp. J. Sc., Bot. 9: 359.
- Merrill, E.D. 1915. New or noteworthy Philippine plants, XI. Philipp. J. Sc., Bot. 10: 14.
- Merrill, E.D. 1929. *Plantae Elmerianae Borneensis*. Univ. Cal. Publ. Bot. 15: 106–107.
- Mohanan, C.N., & N.C. Nair. 1981. A new genus record for India and a new species in the genus. *Proc. Indian Acad. Sci. (Plant Sci.)* 90 (3): 207–209.
- Polhill, R.M. 1971. Some observations on generic limits in Dalbergieae-Lonchocarpaceae Benth. (Leguminosae). *Kew Bull.* 25: 263–265.
- Polhill, R.M. 1981. Papilionoideae. In: R.M. Polhill & P.H. Raven (eds.), *Advances in Legume Systematics* 1: 191–208. Kew.
- Prain, D. 1897a. Leguminosae. In: G. King & J.S. Gamble (eds.), *Materials for a Flora of the Malay Peninsula*. J. As. Soc. Beng. 66, 2: 109–112.
- Prain, D. 1897b. Noviciae Indicae XV. Some additional Leguminosae. J. As. Soc. Beng. 66, 2: 464–467.
- Ridder-Numan, J.W.A. 1992. *Spatholobus* (Leguminosae-Papilionoideae): a new species and some notes. *Blumea* 37: 63–71.
- Ridder-Numan, J.W.A., & H. Wiriadinata. 1985. A revision of the genus *Spatholobus* (Leguminosae-Papilionoideae). *Reinwardtia* 10: 139–205.
- Sanjappa, M. 1987. Revision of the genera *Butea* Roxb. ex Willd. and *Meizotropis* Voigt (Fabaceae). *Bull. Bot. Surv. India* 29: 199–225.

IDENTIFICATION LIST

The list includes the specimens studied for this revision of the genus *Kunstleria*.

- | | | | |
|--------------------|----------------------|--------------------------|------------------------|
| 1. <i>curtisii</i> | 3. <i>geesinki</i> | 5. <i>kingii</i> | 7. <i>ridleyi</i> |
| 2. <i>forbesii</i> | 4. <i>keralensis</i> | 6. <i>philippinensis</i> | 8. <i>sarawakensis</i> |

Ahmed (Bot. Gard. Sing.) 1226: 7.

BNB series 1043 (Austin Cuadra): 3; 1429 (Puasa): 3 — BS series 390: 7; 16114 (Reillo): 6 —

Buurman van Vreeden 53: 7.

Curtis 1632: 1; 3019: 1.

Derry 1006: 7.

Ellis 38517: 4 — Elmer 13105: 2; 21322: 2; 21494: 7; 21605: 2.

Forbes 3241: 2 — FRI series 8360 (Cockburn): 7; 10518 (Cockburn): 7; 13056 (Y.C. Chan): 5; 16919 (Y.C. Chan): 7.

Hallier 2181: 2 — Hort. Bog. XVII. F. 36: 7; XVIII. F. 13: 7; XVIII. D. 60: 7; XI. A. 106: 7.

Jaheri (exp. Nieuwenhuis) 1282: 2.

KL 3428 (T. & P. 828): 1 — Kostermans 6569: 7 — Kunstler 3094: 2; 3830: 5; 6870: 5; 6935: 5.

Maidin NBFD 4905: 7 — Maingay 1168 (K.D. 609): 7 — Meijer 2256: 2 — Mohanan 65080: 4.

Niga Nangkat NN 193: 7.

PNH series 41944 (Mendoza): 6.

Ridley 1903: 7; 6395: 7.

S series 15769 (Rosli): 7; 18036 (Ashton): 8 — SAN series 31574 (Mikil): 3; 36594 (Ampuria): 7; 37083 (Gibot): 2; 38871 (Sayu Elleh): 3; 39227 (Mujin): 2; 39751 (Nicholson): 3; 52944 (Talip): 3; 54866 (Talip): 3; 54997 (Talip): 7; 89034 (Fedilis & Sumbing): 2; 89128 (Fedilis & Sumbing): 2; 93752 (Dewol Sundaling): 3; 96189 (Fedilis & Sualis): 2; 99453 (Dewol Sundaling): 3 — Santos 4355: 6 — SF series 25866 (Holtum): 7; 37735 (Corner): 7.

Wenzel 818: 6.