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FURTHER SUPPLEMENTARY DATA ON MALESIAN KNEMA (MYRISTICACEAE)

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SUMMARY

New material of *Knema*, mainly from Borneo, necessitated the description of 5 new species, 1 new subspecies, and 2 varieties, viz. *Knema latericia* subsp. *latericia* var. *subtilis*, *K. stylosa* (stat. nov.), *K. viridis*, *K. glauca* var. *riparia*, *K. stenophylla* subsp. *longipedicellata* (comb. et stat. nov.), *K. subhirtella*, *K. mogeana*, and *K. riangensis*. Altogether 14 species are commented upon. The new taxa have been inserted in the general key and regional keys to the species as presented in Blumea 25 (1979) and 27 (1981). At present 90 species in total are recognized in *Knema*. An index to names of taxa supplementary to that given in 1979 has been added.

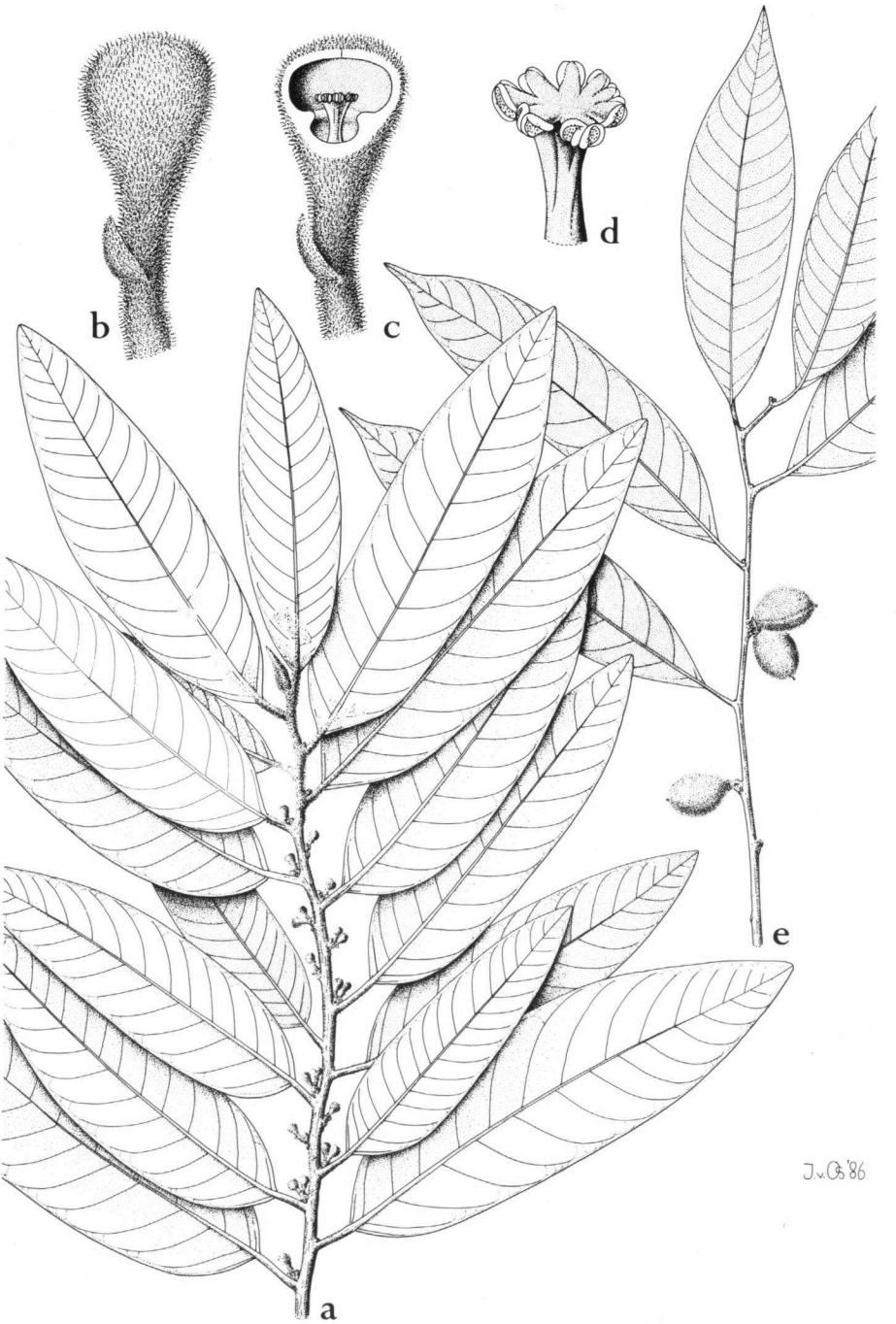
INTRODUCTION

Study of specimens of Myristicaceae made accessible in the Rijksherbarium since 1981 revealed some news, here published in addition to my revision of *Knema* (Blumea 25, 1979) and the supplementary data to this genus (Blumea 27, 1981). The numbers of the species refer to the numbers as used in these papers. New species have been inserted with the number of the foregoing species as numbered in the key and enumeration of species, with '-bis-1' or '-bis-2' etc. added. The total number of species accepted in *Knema* has herewith augmented to 90.

The diagnoses of the new taxa have been kindly translated into Latin by Dr. R.C. Bakhuizen van den Brink Jr. The drawings have been prepared by Mr. J. van Os (L). Essential plant material for the present paper was collected during botanical expeditions subventioned by the Netherlands Foundation for the Advancement of Tropical Research (WOTRO).

24a. Knema latericia Elmer subsp. **latericia** var. **latericia** de Wilde, Blumea 25 (1979) 396. – **Fig. 1a–d.**

The complex species *Knema latericia* was treated as containing three subspecies, viz. subsp. *latericia* confined to Palawan I., subsp. *ridleyi*, widely distributed from S. Thailand through Malaya, Singapore, Bangka, to Borneo, and subsp. *albifolia* from Borneo. Apart from the characters given in the key to the subspecies (l.c.: 395) it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was remarked in the notes that the male perianths of subsp. *ridleyi* are generally depressed-globose with a more or less convex staminal disk, whereas the perianths of subsp. *albifolia* are rather obovoid or pear-shaped, hence more distinctly tapered towards the base and with the staminal disk flat or but slightly convex; the male flowers of the type-subspecies were unknown. Subsp. *albifolia* was kept separate mainly because of the not or only inconspicuously flaking bark of the twigs, a feature contrasting with the markedly flaking twigs of the two other subspecies.

In my general key to the male flowering specimens of *Knema* I erroneously presumed that the then unknown male flowers of subsp. *latericia* would generally agree with those of subsp. *ridleyi* (hence, with perianth depressed-globose, pedicel 3–6 mm long, anthers 9–12). Consequently, subsp. *latericia* keys out besides *55. K. tomentella*, a superficially much similar species from the Moluccas, with male perianths subglobose, pedicel 2–5 mm long, anthers 8–9(–11), as contrasted in my key lead 61 (l.c.: 347).

Through beautiful specimens of *Knema latericia* subsp. *latericia* collected recently by the Palawan Botanical Expedition 1984, *Podzorski SMHI 531, 693*, male flowers of the type-subspecies can now be described as follows: Male flowers densely coarsely pubescent by dark rusty hairs c. 0.7 mm long, pedicel 1–2 mm long with bracteole subapical to halfway, persistent, perianth in bud depressed-obovoid to pear-shaped, c. 3.5 by 3.5 mm, valves 3, inside red, glabrous, c. 0.5 mm thick, splitting the bud c. 2/3; staminal disk flat, incl. anthers 1.5–2 mm diam., faintly 3-angular; column 1–1.5 mm long; anthers 7–9, shortly stiped, horizontal, c. 0.5 mm long, mutually not touching (fig. 1).

It appears that subsp. *latericia* in the male flowers closely agrees with subsp. *albifolia*, also with obovoid male perianth, rather than with subsp. *ridleyi* which has the male perianth ± depressed-globose.

Lead 61 of the general key to the species should now be rewritten as follows:

Amendment of the general key to male flowering specimens (l.c.: 347):

61 a. Pedicels 2–5 mm long. Perianth in bud subglobose, 2.5–3 mm diam., with hairs c. 0.3–0.5 mm long; anthers 8–11, each c. 0.3(–0.5) mm long. *Celebes, Moluccas, New Guinea* . . . . . **55. K. tomentella**

b. Pedicels 1–2 mm long. Perianth ± pear-shaped, c. 3.5 mm diam., with tomentum of coarse hairs c. 0.7 mm long; anthers 7–9, each c. 0.5 mm long. *Palawan* . . . . . **24a. K. latericia subsp. latericia**

Fig. 1. *Knema latericia* Elmer subsp. *latericia* var. *latericia*. a. Habit of male flowering branchlet, note finely striated bark, not flaking, × ½; b. mature male flower bud; c. ditto, longitudinally opened, showing position of androecium, both × 6½; d. androecium, × 12½. – *K. latericia* Elmer subsp. *latericia* var. *subtilis* de Wilde. e. Fruiting branchlet, × ½ (a–d. *SMHI 693 Podzorski*; e. *SMHI 1642 Ridsdale*, type).

24a-bis. Knema latericia Elmer subsp. **latericia** var. **subtilis** de Wilde, *var. nov.* – **Fig. 1e.**

Ramuli graciles, apice 1–1.5 mm diam., cortice ramulorum veterum striato, haud lamellari. Folia membranacea, parva, elliptica ad lanceolata, 5–13.5 × 1–4.5 cm. Fructus ellipsoidei, c. 1.5–2 × 1.2 cm, tomento e pilis scabriusculis 0.5(–1) mm longis composito. – Typus: *SMHI 1642 Ridsdale c.s.* (L), Philippines, Palawan.

Twigs slender, at apex 1–1.5 mm diam.; bark of older twigs striate, not flaking. Leaves membranous, small, elliptic to lanceolate, 5–13.5 by 1–4.5 cm. Fruits ellipsoid, 1.5–2 by 1.2 cm, with tomentum of rather rough hairs 0.5(–1) mm long.

Distribution. Philippines: Palawan.

PHILIPPINES. Palawan: Pagdanan Range, SMHI 488 Ridsdale (fr.), 1642 (fr., type); SMHI 882 Podzorski (female fl., fr.).

Ecology. On primary and logged ridges in broad-leaved dipterocarp forest; 0–100 m alt.; flowers and fruits in April. Once recorded from limestone.

Notes. 1. Fieldnotes: Small tree, the leaves pallid blue-green below, the fruit brown.

2. This variety differs markedly from the type variety of subsp. *latericia* by the more delicate twigs and leaves, and generally by fewer and thinner lateral nerves, 8–12 pairs. In the type variety the twigs are 2–4 mm thick at apex, the leaves 7–25 by 2.5–6 cm, with 11–18 pairs of lateral nerves. All three collections are in fruit, but I suppose that its male flowers are a somewhat smaller edition of those of the type variety.

3. It is possible that the occurrence of the new variety is related with the nature of the bedrock, possibly limestone.

4. *Knema latericia* subsp. *latericia* var. *subtilis* much resembles the delicate species *K. stenocarpa* from the Sulu I. and Mindanao, and keys out in the regional key besides this species as follows:

Amendment of the regional key to female specimens (6. Philippines etc.) (l.c.: 365):

4 a. Twigs in apical portion 1–2 mm diam. Female flower perianth c. 4 mm long. Fruits 10–20 mm long ..... 4^1

b. Twigs in apical portion (1.5–)2–3(–4) mm diam. Female flower perianth 4.5–6 mm long. Fruits (10–)15–25(–30) mm long 5

4^1a. Leaves on lower surface late-glabrescent or with subpersistent tomentum of minute rather scattered hairs. Fruits c. 13–15 mm long, the tomentum composed of hairs c. 0.1 mm long. *S. Philippines: Sulu I., Mindanao*

52. K. stenocarpa

b. Leaves on lower surface early glabrescent, the hairs early shed in the form of pieces of a matted tomentum. Fruits 15–20 mm long, with hairs c. 0.5(–1) mm long. *S. Philippines: Palawan*

24a-bis. K. latericia subsp. **latericia** var. **subtilis**

27-bis-2. Knema stylosa (de Wilde) de Wilde, *spec. et stat. nov.*

K. hirtella de Wilde var. *stylosa* de Wilde, Blumea 25 (1979) 460. – Type: *SAN 30179 Mikil* (L), Sarawak and Sabah.

Tree 8–20(–25) m. Twigs in apical portion (sub)terete, 2–3 mm diam., glabrescent from pale brown or grey-brown tomentum of hairs c. 0.1 mm long or less, bark lower down (dark-)brown, striate, not tending to crack or flake. *Leaves* thinly chartaceous, above drying olivaceous to brown, beneath glabrescent or with subpersistent tomentum composed of scattered, very minute stellate hairs less than 0.1 mm long, sparsely mixed with scars of coarser caducous hairs c. 0.2 mm; blade elliptic-oblong to oblong, widest below to above the middle, 12–24 by 3.5–7 cm, base (subcordate or) rounded to short-attenuate, top acute-acuminate, midrib above slender, convex, but as a whole generally partly sunken under surface-level; nerves 15–20 pairs, flattish or sunken above; tertiary venation forming a fine network, usually distinct above; petiole 10–20 by 2–3 mm, late-glabrescent; leaf bud slender, c. 12–15 by 1.5–3 mm, densely grey-brown pubescent by hairs 0.1 mm long or less. *Inflorescences* sessile, wart-like, simple or forked, up to 4 mm long, 3–6(–10)-flowered in male and female; flowers densely (pale) brown pubescent by hairs c. 0.1 mm long. *Male flower* pedicel 4–5 mm long, the bracteole ovate, c. 1 mm long, apical, persistent; perianth in bud obovoid, c. 3.5–4 by 3–3.5 mm; valves 3, at suture c. 0.7 mm thick, splitting the bud to c. 2/3; staminal disc flattish, blunt-triangular, incl. anthers c. 1.4 mm diam.; column rather tapering, c. 1.2 mm long, glabrous; anthers 11, half-sessile, suberect, c. 0.5 mm long. *Female flower* pedicels 3–5 mm long, the bracteole caducous, situated halfway to apical; perianth in bud ± obovoid-ellipsoid, c. 4.5 by 3.5 mm, valves at sutures 0.7(–1) mm thick, splitting the bud to ± halfway; pistil c. 2.5 mm long; ovary ovoid, c. 1.5 by 1 mm, densely minutely pubescent; style (0.5–)1 mm long; stigma broadly 2-lobed and each lobe again 6–12-lobulate. *Fruits* solitary or 2 or 3 together, ovoid, 2.5–3.5 by 1.8–2.5 cm, densely to sparsely pale brown tomentose by hairs c. 0.1 mm or less, sometimes glabrescent, style persisting or leaving a scar; pericarp 1.5–2.5 mm thick at suture; stalk 3–6 mm long.

Distribution. Borneo: NE. Sarawak (5th Div.), Sabah.

BORNEO. Sarawak: 5th Div., S 15865, 31137. – Sabah: SAN 28082, 30179, 30394, 31288, 31403, 36467, 41947, 78197, 84385, 84611.

Ecology. Primary forest, hillsides, often on blackish soil, sandstone or sandstone-derived soils; 0–800 m alt.; flowers in June, fruits found throughout the year.

Notes. 1. Fieldnotes: Bark rather smooth, slash pinkish with (dark) red exudate, sapwood whitish. Flowers recorded as chocolate-brown, or pale (perianth greenish inside?), fruits green or orange.

2. The specimens *SAN 30394 & 31288* slightly deviate from the rest of the material by having the reticulation on the upper leaf surface less distinct.

3. As mentioned under *72. K. stenophylla*, with the reconsideration of this complex species as conceived by me in 1979 (Blumea 25: 457) as well as under the variable *K. hirtella* (l.c.: 459) it appeared that *K. hirtella* var. *stylosa* could best be

treated as a species of its own. A re-examination of the male perianth (*SAN 78197*) induced me to consider it in series Obovoideae, in the vicinity of species like *K. pulchra, K. piriformis*, etc., hence going with the species with male perianths rather narrowly pear-shaped, the valves splitting the bud in anthesis to about 2/3 deep only. For convenience's sake I have presented a full description. The species is keyed out as in the amended keys presented under *73-bis. K. subhirtella* (see pages 133–136). A good additional character might be the midrib largely sunken into a groove above.

4. It should be kept in mind that with the removal of *K. hirtella* var. *stylosa*, the original species description of *K. hirtella* should be adapted. Two specimens, viz. *SAN 22768 & 72014*, as enumerated under var. *stylosa* (l.c.: 461) have been excluded; they are at present conveyed to dubious species enumerated under *K. hirtella.*

5. *Knema stylosa* may be confused with *K. glauca*, a species also with a very weak tomentum on the lower leaf surface. *Knema glauca*, however, has globose male perianths, stiped anthers, and early glabrescent fruits.

6. *Knema stylosa* is closely related with *K. pulchra* and *K. piriformis*; the former being much stouter, always having cordate or broadly rounded leaf bases, larger male perianths, usually more anthers, and larger fruits; the latter species, *K. piriformis*, is a mountain species, its male perianths are more narrowly pear-shaped, its anthers stiped, while the tomentum on the lower leaf surface is better developed.

34. Knema globularia (Lamk.) Warb.; de Wilde, Blumea 25 (1979) 411. – **Fig. 2.**

This species is well-defined and was recorded as distributed from NE. India (Assam, doubtful), S. China (Yunnan), through Lower Burma, Indochina and Thailand to Malaya, Singapore and northern Sumatra (Aceh, Pulau Beras, *Koorders 10532*, BO, SING, n.v., Riouw Arch., Pulau Keras, *Teijsmann s.n.*, BO, n.v.). See Sinclair, Gard. Bull. Sing. 16 (1958) 325; ibid. 18 (1961) 214; de Wilde, Blumea 25 (1979) 411. A distribution map was given by Sinclair (1961: 298, map 8).

The species may be found in China and Indochina in a variety of habitats, up to 850 m alt., but in southern Thailand, Malaya, Singapore, and northern Sumatra it distinctly prefers coastal areas. Sinclair (1958: 328) writes: 'usually occurs on the rocky seashores of small islands' and 'a tree of rocky sea-coasts and not of an inland habitat.' Herbarium labels from Malaya include localities as 'close to sandy beach', 'rocky headland', etc.

A recent collection of the present species is *de Vogel 1577*, in fruit, from Pulau Peucang, Ujong Kulon Nature Reserve, W. Java, collected on alluvial flatland with shallow sandy clay over coral sand, close to the sea. This means a large and significant range extension towards the south, that is, the direction or trend already apparent from the distribution as mapped by Sinclair cited above.

Knema globularia is the only species of the genus with a distinct coastal preference, although it certainly is not a beach species. Possibly its fruits or seeds are distributed by a coastal forest animal, presumably a bird, especially as its fruits or seeds are described as 'exposing seed with glossy red fleshy aril', or as 'orange flushed pink, aril succulent, red', etc. It also is the only species of *Knema* with a wider dis-

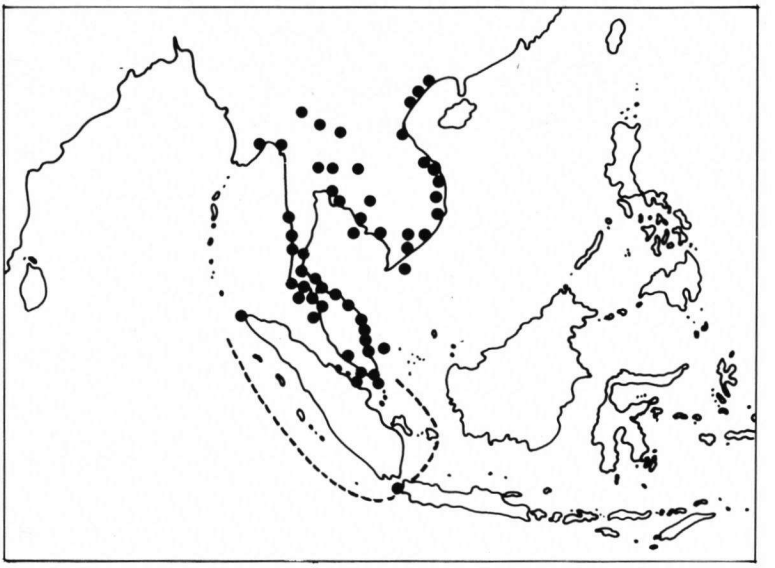


Fig. 2. Distribution of *Knema globularia* (Lamk.) Warb.

tribution ranging from continental Southeast Asia right south over the Malaya–Sumatra–Java archipelago, and not occurring in Borneo.

The Peucang collection furthermore means a record of a species new for Java, the fourth *Knema* besides *K. glauca, K. laurina* and *K. intermedia.*

It is interesting to note that the locality of the type specimens of the basionym *Myristica globularia, Sonnerat s.n.* (G, P), is given as Java, but this locality was regarded as a mistake by Sinclair and myself.

37. Knema linguiformis (Sinclair) de Wilde, Blumea 25 (1979) 416; ibid. 27 (1981) 227.

In my 1981 publication I added to this species a stout specimen, *S 34734 Chai.* This should be excluded from *K. linguiformis*, as I have seen that it belongs to a here newly described species, *37-bis. K. viridis.*

37-bis. Knema viridis de Wilde, *spec. nov.* – **Fig. 3.**

K. linguiformis auct. non (Sinclair) de Wilde: de Wilde, Blumea 27 (1981) 227.

Affine *Knematis linguiformis* de Wilde, differt habitu omnino robustiore. Folia 17–30 × 5–10.5 cm, sicca viridiscentia, distincte reticulata in utroque parte. Perianthium masculum depresso-globosum, 4.5–5 × 6–7 mm, valvis 1.5–2 mm crassis, antheris 25–30. Perianthium femineum 3.5 × 5 mm, stigmate multilobulato. Fructus ellipsoideus, c. 5 × 4 cm, glabrescens, pericarpio c. 1 cm crassum. – Typus: *S 37882 Yii Puan Ching* (L), Sarawak.

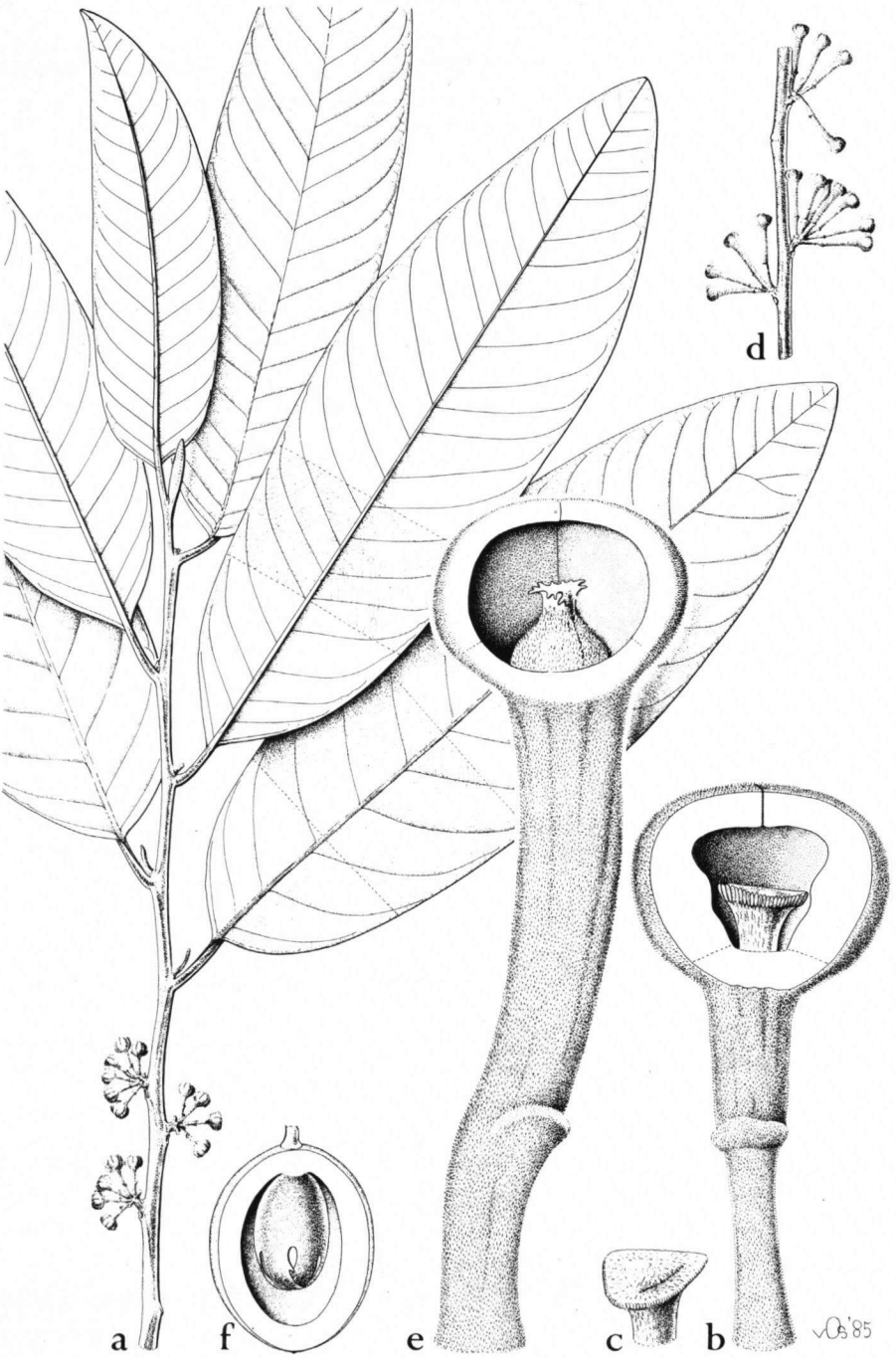
Tree 15–30 m. Twigs moderately stout, towards apex 2.5–4.5 mm diam., somewhat flattened or blunt 3-angular by ridges from the bases of the petioles, early glabrescent from dense pale brown tomentum of hairs c. 0.2–0.3 mm, older bark not or but little striate, yellowish turning purple-brown, neither cracking nor flaking. *Leaves* chartaceous to thinly coriaceous, above early glabrescent, drying greenish, beneath early glabrescent, without brown dots, greyish green; blade oblong to oblong-lanceolate, broadest at or slightly below the middle, 17–30 by 5–10.5 cm, base attenuate to rounded, top blunt to acute; midrib slender, raised at both surfaces; nerves 14–23 pairs, raised at both surfaces; venation forming a fine network, very distinct at both surfaces; leaf bud slender, 10–20 by 2–4 mm, densely pale brown pubescent by hairs (0.1–)0.2–0.3 mm; petiole glabrescent, drying dark brown, 12–18 by 1.5–3 mm. *Inflorescences* wart-like, simple or bifurcate, 2–5 mm diam., sessile or up to 2 mm stalked, in male 8–12-, in female 4–7-flowered. *Male flowers* rusty to pale brown tomentose by hairs c. 0.1(–0.2) mm; pedicel stout, 7–10 mm long, the bracteole blunt-triangular, 1–1.5 mm long, caducous, leaving a distinct scar at about halfway, i.e., at 4–5 mm below the perianth, the pedicel above the scar distinctly thicker than the lower portion; perianth in bud depressed-globose, 4.5–5 by 6–7 mm, faintly trigonous in transverse section, valves 3, splitting the bud to c. 3/4–4/5 deep, (1–)1.5–2 mm thick; staminal disk flattish to rather convex in the centre, blunt-trigonous in outline, 2.5–3 mm diam., anthers sessile, 0.5–0.7 mm long, 25–30 (thecae 50–60), closely set, ± hidden under the staminal disc at the margin; staminal column tapering, 1–1.5 mm long, at base c. 1 mm diam. *Female flower* (slightly immature): pedicel stout, 15–17 mm long, the bracteole situated slightly below the middle, perianth in bud depressed-globose, c. 3.5 by 5 mm, valves 0.5–1 mm thick, splitting the bud to 3/4–4/5; pistil c. 2.5 mm high, ovary broadly ovoid, c. 1.5 mm diam., densely pubescent by brown hairs 0.2–0.3 mm, narrowed into a style-like part c. 0.5 mm pubescent at base, stigma c. 1.5 mm diam., broadly subpeltately 2- (or 3-)lobed and each lobe again shallowly 4–6-lobulate. *Fruits* 1–3 per infructescence, ellipsoid, broadly rounded at both ends, early glabrescent, bright brown, not ridged, 5–6 by 4–4.5 cm, dry pericarp c. 10 mm thick; stalk c. 15 mm long. *Seed* 25–30 by 15–17 mm, aril laciniate at apex for 1/5–1/4.

Distribution. Borneo: Sarawak.

BORNEO. Sarawak: 4th and 5th Divisions, S 34734 Chai (immat. male); S 37882 Yii Puan Ching (mature male fl.); S 42885 George c.s. (female fl., fr.); S 38068 Lee (fr.).

Ecology. Lowland and hill mixed dipterocarp forest; on gentle slope; on wet slope near ridge; 50–600 m alt.; flowers Aug.–Nov., fruits Sept.

Fig. 3. *Knema viridis* de Wilde. a. Habit of male flowering twig, × ½; b. opened mature male flower, showing thick perianth and androecium with many appressed anthers, × 6; c. mature androecium, seen somewhat from above, staminal disk subtriangular in outline, × 6; d. portion of twig with female inflorescences, × ½; e. opened mature female flower, showing pistil with pubescent ovary, short style and many-lobed stigma, × 6; f. opened fruit, pericarp glabrous, thick-valved, aril of seed laciniate at apex, × ½ (a–c. *S 37882*, type; d, e. *S 42885*; f. *S 38068*).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Notes. 1. Fieldnotes: Slender tree to c. 30 m, c. 95 cm girth, without or with buttresses to one side, to c. 3 feet wide. Bark surface smooth, or slightly scaly, or with lenticels, brown or blackish; red exudate present; inner bark soft. Twigs green with dark patches, or dirty green, or black when young with brown tomentum. Leaves glaucous below. Flowers light brown or brown-green. Fruits elliptic or oblong, yellowish green, covered with slight brown tomentum. Aril yellow to red, netted at the lower part of the fruit, sweet.

2. The present species is known from four collections, two of which (*S 37882, 38068*) had been tentatively treated formerly under *K. woodii*, and one (*S 34734*) as a stout form of *K. linguiformis*. The fourth specimen, *S 42885*, with fine female flowers and fruits, came to my attention in 1984, together with the newly discovered mature fruits of *K. woodii*, and this made me realize that a good new species was concerned.

3. The present new species clearly is closely related to *K. linguiformis*, and hence belongs in series Curtisianae. It is markedly larger in all parts and especially differs by larger leaves, stouter flowers with male perianths with shorter tomentum, and by larger fruits with very thick, rather spongy drying pericarp of c. 10 mm thickness. The fruits of *K. linguiformis* are about 3.5–4 cm long with the stalk up to c. 8 mm long and with the dry pericarp only 1–2 mm thick, but with the seeds of about the same size as in *K. viridis*. Male perianths of *K. linguiformis* may reach as large as c. 6 mm diam., but the whole flower is more delicately built, and the tomentum of a more woolly nature with the hairs up to c. 0.4 mm long.

Apparently the present new species also has affinities with *K. woodii* (enumerated in series Glomeratae), which has resembling twigs, similarly thick perianth valves, a similar obconical androecium (but with the anthers mutually spaced, not tightly appressed), and a rather resembling pistil with the ovary narrowed into a slender style-like part.

4. *Knema viridis* fits into the general key to male flowering specimens and into the regional key to female flowering and fruiting specimens for Borneo as follows:

Amendment of the general key to male flowering specimens (l.c.: 344):

40 a. Leaves chartaceous to thinly coriaceous, drying greenish; the reticulation distinct at both surfaces; base cuneate to rounded, top obtuse to (sub)acute, rarely subacuminate. Mature male perianth in bud subtrigonous with rounded angles ..... 40[1]

b. Leaves membranous to chartaceous, etc. ..... **38. K. curtisii**

40[1]a. Leaves up to 15 by 5 cm, lateral nerves 8–20 pairs. Mature male perianth 3.5–6 mm diam., short-woolly pubescent by hairs 0.3–0.4 mm, valves 0.5–1 mm thick; pedicels slender ..... **37. K. linguiformis**

b. Leaves 17–30 by 5–10.5 cm, nerves 14–23 pairs. Mature male perianth c. 6 mm diam., hairs c. 0.1 mm long, valves 1–2 mm thick; pedicels stout **37-bis. K. viridis**

Amendment of the regional key to female specimens (5. Borneo) (l.c.: 361):

17 a. Fruits glabrescent. Perianth glabrescent, except in *K. linguiformis, K. viridis*, and *K. curtisii* p.p., the latter with bark of twigs smooth, glabrous, usually yellowish or purplish (but compare *46. K. woodii*) . . . . . 18 → 21

b. Fruits pubescent or glabrescent. Perianth with persistent tomentum, bark of twigs brown to blackish 22

(leads 18–20 unchanged)

21 a. Leaves 17–30 cm long. Female flower pedicels stout, c. 15 mm long. Fruits 5–6 cm long, pericarp c. 10 mm thick . . . . . **37-bis. K. viridis**

b. Leaves up to 20(–25) cm long. Female pedicels (2–)5–10 mm long. Fruits 2–5 cm long, pericarp 1–2.5 mm thick . . . . . 21[1]
(*37. K. linguiformis* and *38. K. curtisii*)

46. Knema woodii Sinclair; de Wilde, Blumea 25 (1979) 429.

The fruits, recently collected for the first time: *M. Leighton 849* (BO, DAV, L), from E. Kutai, E. Kalimantan, can now be described as follows: 1 or 2 per infructescence, ellipsoid, 30–40 by 20–25 mm, thinly mealy short-pubescent by greyish or yellowish brown scaly-stellate hairs c. 0.1 mm long or less, subglabrescent; dry pericarp c. 4 mm thick at suture; stalk c. 10 mm, with the bracteole scar about halfway; seed obliquely ellipsoid, 23–25 by 16–18 mm.

Notes. 1. Fieldnotes: Fruits with pericarp yellow, aril divided, cauliflorous, more or less solitary (also in spirit coll.).

2. Under note 3 in my treatment of this species (l.c.: 430), two deviating specimens (one in fruit) were discussed. These specimens (*S 37882*, male fl., *S 38068*, fr.) are presently referred to a newly described species, *37-bis. K. viridis* de Wilde (see page 121).

54. Knema glomerata (Blanco) Merr.; de Wilde, Blumea 25 (1979) 437.

This species is common all over the Philippines, and is further known from one male flowering collection from Sarawak (see the notes in my revision, l.c. 438). It was hitherto conspicuously absent from Palawan, but now known from this island by the collection *SMHI 484 Ridsdale*, collected during the Palawan Botanical Expedition 1984, as a small subcanopy tree in dipterocarp forest at 40 m alt. in the Pagdanan Range, Palawan.

A further range extension forms, most probably, *Nooteboom 5344* (fieldnumber *283*) from NW. Ceram, a small tree in rainforest. It is a single collection with immature male flowers, and deviates from the Philippine material by having 8 anthers instead of 9–13.

66. Knema glauca (Bl.) Warb.; de Wilde, Blumea 25 (1979) 452.

As mentioned in the notes under *K. glauca* in my account of *Knema* (l.c.: 453), this species displays much variability, especially in Borneo. The deviating specimens mentioned in the last paragraph (l.c.: 454), viz. *S 18949*, etc., supplemented by some taken out of the specimens cited for the species, appear to represent a separate taxon. It is apparently restricted to riverine forest in Sarawak, and is presently regarded as a variety of *K. glauca*. For convenience's sake a full description is given.

KEY TO THE VARIETIES

1a. Leaves membranous or chartaceous, elliptic to lanceolate. Fruit stalks 3–7 mm long; fruits greyish brown ..... **a. var. glauca**
b. Leaves membranous, oblong to lanceolate. Fruit stalks 8–12 mm long; fruits drying ± bright brown ..... **b. var. riparia**

a. var. glauca

Widespread, occurring in S. Thailand, Malaya, Sumatra, Java, Bali, and Borneo. Specimens cited in Blumea, l.c.: 452; for Borneo some specimens, presently cited here under var. *riparia*, should be excluded.

b. var. riparia de Wilde, *var. nov.*

Tomentum gemmae compositum e pilis minus quam 0.1 mm longis. Folia subtus glabrescentia, pilis debilibus atque minutissimis. Perianthium masculum in alabastro subglobosum, c. 3 mm diam., in anthesi profunde partitum; antheris 9–13, stipitatis. Fructuum stipes 8–12 mm longus, fructibus glabrescentibus, c. 2.5 cm longis, sicca vivide fusca. – Typus: *S 18949 Chai* (L), Sarawak.

Tree 5–12 m. Twigs terete, towards the apex 1.2–2 mm diam., glabrous or early glabrescent from minute greyish scale-like hairs less than 0.1 mm, finely striate, bark of twigs lower down not flaking. *Leaves* membranous, above drying olivaceous, on lower surface early glabrescent from very weak tomentum composed of scattered hairs less than 0.1 mm; blade (elliptic-)oblong to lanceolate, broadest below to above the middle, 11–22 by 2–5.5 cm, top acute to long-acuminate, base short to long attenuate; midrib above flattish to raised; nerves 12–25 pairs, flattish or raised above; tertiary venation distinct, forming a rather coarse network of areoles c. 0.5 mm diam. or more; petiole 10–15 by 1.5 mm, early glabrescent; leaf bud slender, c. 10 by 1.5 mm, densely short pubescent by hairs less than 0.1 mm. *Inflorescences* simple or forked, up to 4 mm long, sessile or less than 1 mm stalked, in male 2–6(–10)-flowered, in female 1–2(–4)-flowered; flowers tomentulose or subglabrescent from scaly hairs less than 0.1 mm; bracteole persistent, (0.5–)1 mm, elliptic, situated c. halfway below the perianth; perianth inside red. *Male flower* pedicels 8–10 mm long, perianth in bud subglobose, 3(–3.5) mm diam.; valves 3, splitting the bud to c. 5/6, at sutures 0.5–0.8 mm thick; staminal disk flattish, subcircular, c. 2 mm diam., column

± cylindrical, (1–)1.5 mm long, slender; anthers 9–13, distinctly stiped, well-spaced, horizontal (opening to beneath), 0.4–0.5 mm long. *Female flower* pedicel c. 6 mm long, perianth in bud c. 4 by 2 mm, valves 3, splitting the bud to ± halfway; ovary ± ovoid, c. 2 mm long, densely short-pubescent, style and stigmas c. 1 mm long, 2-lobed and each lobe again few-lobulate. *Fruits* solitary or 2 together, ellipsoid, top sometimes acutish, 2–2.5 by 1.5–1.8(–2) cm, glabrous (early glabrescent), usually ± granulate, bright brown, pericarp c. 1 mm thick; stalk 8–12 mm long.

Distribution. Borneo: Sarawak.

BORNEO. Sarawak: 3rd, 4th and 7th Divisions: Clemens 21600; S 10111, 18947, 18949, 22023, 27597, 33247, 37625, 40101, 40223, 41358.

Ecology. Mainly in primary riverine forest, on steep slopes; alluvial soil, rich clay soil, clay yellow soil, loamy soil; 0–500 m alt. Flowers and fruits throughout the year.

Vernacular name. Kumpang ensluai (Iban).

Notes. 1. Fieldnotes: Bark sometimes recorded as flaky. Flowers inside reddish, anthers yellow, disk red. Fruits yellow to red, aril bright red, seed whitish.

2. Besides by the characters as given in the key, this variety is also distinct by a strikingly different general habit, the twigs often with a yellowish tinge, relatively narrow leaves drying greenish, and the bright brown (long-stalked) fruits. It has some superficial resemblance to *K. luteola* but that species has the reticulation on the upper leaf surface much finer, has larger fruits (4–5.5 cm), and the perianth yellowish inside.

68. **Knema kostermansiana** de Wilde, Blumea 25 (1979) 455.

This species was described on the basis of four specimens, two of which with male flowers (*SAN 19047*, type, from Sabah, and *Amdjah 309* from the Kalimantan/Sabah border), one with fruits (*S 20000*, from Central Sarawak), and a sterile specimen, obviously identical with the fruiting one and from the same region (*Richards 1107*). Female flowers were not known.

Since then four good additional specimens from Sabah have come to my attention, viz. the male flowering specimens *SAN 79209 & 88834*, and two fruiting specimens, very clearly identical with the male ones, *SAN 80087* (also containing female flowers; seen from K only) and *89163*, both with fruits quite distinct from the fruits of *S 20000* from Sarawak as mentioned above.

At closer examination it appeared that *S 20000* and *Richards 1107* should be excluded from the present species; they differ by a more brownish drying colour of the leaves, by a different tomentum on the lower leaf surface, by less distinct reticulation of the tertiary venation on the upper leaf surface, by the small ellipsoid fruits c. 27 by 17 mm with rusty pubescence of hairs c. 0.1 mm long, and the fruit stalk 4–5 mm long, and obviously they belong to an unknown new taxon presumably in the vicinity of *73. K. hirtella*. Male flowers are needed for a decision on this.

The description and notes of *K. kostermansiana* can now be extended and altered as follows:

Leaves at base shallowly cordate to rounded, not attenuate. Female flower pedicels 3–4 mm long, the bracteole minute, caducous, situated (sub)apically; perianth in bud ellipsoid-oblong, ± narrowed in the middle, (4–)5–6 by (2–)2.5–3 mm, valves at sutures c. 1 mm thick, splitting the bud to ± halfway; pistil rather slender, c. (3.5–)4 mm long; ovary long-ovoid, 2–2.5 by 1.5 mm, densely very minutely pubescent; style slender, 1–1.5 mm long, glabrous, with 2-lobed fleshy stigma, each lobe again shallowly 3-lobulate. Fruits solitary or 2 or 3 together, oblong to oblong-lanceolate, ± fusiform, c. 70 by 20 mm, base tapering, top long-tapering or beaked, very minutely grey-brown scaly-pubescent by hairs less than 0.1 mm, appearing as if the fruits are subglabrous; pericarp c. 2 mm thick at suture; stalk stoutish, 8–10 mm long, with the bracteole scar slightly above halfway.

Distribution. Borneo: Sabah (including border area with NE. Kalimantan).

Ecology. Logged-over forest, riverbank forest; on sandstone; 0–500 m alt. Flowers June–Oct., fruit July–Oct.

Notes. 1. Fieldnotes: Medium-sized tree to 20 m. Bark chocolate- to dark-brown, fissured dark greyish, inner bark whitish brown, sapwood white-yellowish or brownish; exudate red. Flowers greenish or grey-brown, turning yellowish, inside pink. Fruits greenish.

2. As remarked in the notes in Blumea (l.c.: 455), this species seems related to and sometimes is vegetatively much resembling *66. K. glauca* and *26. K. pulchra*. From the former it now appears quite different by the long and narrow fruits; the latter species is distinct by pear-shaped, not globose, male perianths and by much broader ellipsoid fruits with rounded top. The slender, ± fusiform fruits of c. 7 cm length of the present species resemble much those of *68. K. luteola* and somewhat those of *15a. K. ashtonii* var. *ashtonii*; both taxa differ by a much finer reticulation of the tertiary venation on the upper leaf surface, the first-named by narrow-rounded or attenuate leaf base and somewhat smaller fruits (up to 60 mm long), the second one by a much stouter habit and the fruits with bluntish apex, not pointed.

3. The species seems confined to Sabah, as it appears that the two Sarawak records as cited by me in 1979 (l.c.: 455) should be excluded.

Because of the amendment of the description of the fruits of *K. kostermansiana*, the leads 32 and 36 in the regional key to female flowering and fruiting specimens for Borneo should now be altered as follows:

Amendment of the regional key to female specimens (5. Borneo) (l.c.: 363):

32 a. Twigs stout, at apex 4–6 mm diam. Fruits 60–80 mm long with blunt or rounded apex. Upper leaf surface very finely reticulate, areoles c. 0.5 mm diam. or less (compare also *65. K. luteola*) . . . . . **15a. K. ashtonii** var. **ashtonii**

b. Twigs various, towards apex 1–6(–8) mm diam. Fruits up to 70 mm long; if over 60 mm, then apex acute, not rounded. Reticulation of upper leaf surface various 33

(*the alteration of lead 36 is given with the keys under 73-bis. K. subhirtella*) (see page 135).

71. Knema cinerea (Poir.) Warb.; de Wilde, Blumea 25 (1979) 457.

The male flowering collection from northern Celebes, *de Vogel (& Vermeulen) 6506*, accompanied by a fine colour-slide photograph by Vermeulen (in L), clearly showed that in living specimens the inner side of the perianth (including the androecium) is bright pink-red (anthers pale yellow). The colour of the inside of the perianth in the 'difficult' *glauca*-group (series *Glaucae* de Wilde, l.c. 445) is regarded by me as important for the species distinction. For *K. cinerea* it never was recorded in the field, but was for this species erroneously supposed by me in the keys (general key: l.c. 350, lead 80b; regional key: l.c. 365, lead 8b) as probably being greenish creamy.

72. Knema stenophylla (Warb.) Sinclair; de Wilde, Blumea 25 (1979) 457.

As further explained under *K. subhirtella* and *K. mogeana*, the availability of new specimens from the Bukit Raya area (Central Kalimantan) – which appeared difficult to match with the two species especially to be considered, viz. *K. stenophylla* (in the broad sense) and *K. hirtella* (with 3 varieties) – forced me to reconsider these last-named very variable taxa. This resulted in the description of three new species: *K. subhirtella*, *K. mogeana*, and *K. riangensis*, the former largely containing specimens formerly included in *K. stenophylla*. Furthermore, *K. hirtella* var. *stylosa* was raised to specific rank, the species appearing close to *K. pulchra* etc. with pear-shaped male perianths.

This re-arrangement of specimens led to a much narrower circumscription of *K. stenophylla*, about the same as conceived by Sinclair (but including his *K. cinerea* var. *patentinervia* forma *longipedicellata*), and as compared to my treatment of 1979 (l.c. 458) now with the exclusion of a number of specimens generally of a stouter habit and then partly enumerated separately under 'a larger fruited form.' The specimens now to be excluded from *K. stenophylla* are: *S 3757, 12984, 15656, 16484, 21826, 21860, 21894, 21924, 24307, 24836, 28165, 28173; SAN 17401, 36300, 72219.*

The thus re-defined *K. stenophylla* is characterized as follows: tomentum on lower leaf surface consisting of scattered very minute ± equal-sized stellate-scaly hairs c. 0.1 mm or less, male perianth broadly obovoid to subglobose, cleft in anthesis nearly to the base, pedicel 5–9(–10) mm long, fruit c. 1.5 cm long. Two subspecies can be distinguished.

KEY TO THE SUBSPECIES

1a. Male pedicel 5–6 mm long. Stalk of fruit 4–8 mm long. *Malaya, Sumatra*
a. subsp. **stenophylla**

b. Male pedicel 7–10 mm long. Fruit stalk 10–20 mm long. *Borneo*
b. subsp. **longipedicellata**

a. subsp. **stenophylla**

The specimens as enumerated for Malaya and Sumatra belong here; see de Wilde, l.c. 458.

b. subsp. **longipedicellata** (Sinclair) de Wilde, *comb. and stat. nov.*

K. cinerea (Poir.) Warb. var. *patentinervia* Sinclair forma *longipedicellata* Sinclair, Gard. Bull. Sing. 18 (1961) 182, f. 5 A–E. – Type: *Clemens 20345* (K; iso L; A, BO, G, NY, SAR, n.v.).

The specimens enumerated for Borneo (l.c. 458) belong here, excluding the specimens mentioned above.

The new subspecies is keyed out in the regional key to female specimens as presented here under *73-bis. K. subhirtella* (see page 135).

73. Knema hirtella de Wilde, Blumea 25 (1979) 459.

When publishing this species, I recognized 3 varieties: var. *hirtella*, var. *stylosa*, and var. *pilocarpa*. As explained under *K. subhirtella*, and elsewhere in this article, at present I have removed the var. *stylosa* and reinstated it as a separate species: *27-bis-2. K. stylosa.* This necessitates the adjustment of the original description of *K. hirtella* as to exclude the characters typical for *K. stylosa*, e.g., the distinctly weaker tomentum of the lower leaf surface, the obovoid male perianth in anthesis cleft to ± 2/3 deep only, the half-sessile, suberect anthers (11), the glabrous androphore, the ovary wholly short-haired, style distinct, c. 1 mm long, the fruits measuring 2.5–3.5 cm long. *Knema hirtella* is distinct by a generally more conspicuous tomentum on the lower leaf surface, consisting of (sub)persistent scattered stellate hairs of variable size, 0.1–0.2(–0.3) mm, the larger ones caducous, the male perianth broadly obovoid cleft in anthesis to c. 4/5–5/6, the anthers (11 or 12) ± horizontal, just-stiped, the androphore (or: staminal column) somewhat narrower and usually with hairs towards the base, the pistil at base with coarser tomentum as compared with the rest of the ovary, the style short or absent, up to c. 0.5 mm long, the fruits generally seeming slightly smaller, c. 2.5–3 cm long, but possibly reaching 3.5 cm.

In *K. hirtella* the varieties *hirtella* and *pilocarpa* can be maintained, but some specimens, enumerated separately under var. *hirtella*, remained difficult to place.

Some specimens formerly enumerated under one of the two varieties have been removed to other species.

Amended key to the varieties (l.c.: 460):

1a. Twigs at apex and leaf bud with tomentum of minute hairs c. 0.1 mm long. Fruits with stellate(-dendroid) hairs c. 0.1 mm long or less. Staminal column minutely pubescent at base . . . . . **a.** var. **hirtella**

b. Twigs at apex and leaf bud with hairs 0.1–0.2(–0.3) mm long. Fruits with tomentum composed of rather rough dendroid hairs c. 0.5 mm long, especially towards the base of the fruit. (Male flowers not known with certainty.) **b.** var. **pilocarpa**

a. var. **hirtella**; de Wilde, Blumea 25 (1979) 460.

BORNEO. E. Sarawak: Anderson 4100. – Sabah: SAN A 4578, 30235, 30502, 35164, 37775. – Central Kalimantan: Nooteboom 4684, 4836.

Note. The following specimens are difficult to place in either variety, and some of them may represent new taxa:

- *S 16376*, from Sarawak, in fruit. This was formerly identified by me as *K. glauca*, but presently I see that it belongs in the vicinity of *K. hirtella*, mainly because of the nature of its tomentum on the lower leaf surface. It deviates from both varieties of *K. hirtella* by its general habit, especially the rather coriaceous leaves. The fruit is large, 3.5 cm long, ± glabrescent, the stalk only 4 mm long.
- *S 21106* (in fruit) and *S 21852* (with immature fruit) were both formerly identified by me as *K. glauca*. Both are from Sarawak. They apparently are identical with *Kostermans 12577* (mature fruits) from W. Kutei (E. Kalimantan). These three specimens have a rather well-developed (sub)persistent tomentum on the lower leaf surface, composed of hairs c. 0.2 mm, but paler and less compact as in 'true' var. *hirtella*. Fruits measure 2.5–3 cm, with short rusty tomentum; fruit stalk 5–6 mm.
- *SAN 22768*, from Sabah, was formerly placed by me in *K. glauca*. Its fruits are broad-ellipsoid, 2.3 cm long, very short-pubescent, glabrescent. The tomentum on the leaf surface is very inconspicuous. Possibly it belongs to *K. stylosa* (formerly *K. hirtella* var. *stylosa*), but deviating by leaves distinctly cuneate at base.
- *SAN 72014*, also from Sabah, comes close to the latter, but the fruits are larger, c. 4 cm long, the leaves at base are broadly rounded or short-attenuate.

b. var. **pilocarpa**; de Wilde, Blumea 25 (1979) 461.

BORNEO. Sarawak: S 33742. – Sabah: Kokawa & Hotta 2450; SAN 31303, 37043, 85084. E. Kalimantan: Kostermans 21547; Leighton 767, 810; Soegeng 738.

Note. The specimen *SAN 99720* (E. Sabah) with rather immature male flowers probably belongs here according to its type of tomentum and large leaves up to 23 by 7.5 cm. However, the androecium has 9 anthers and the column is glabrous, features reminiscent of *K. subhirtella*.

73-bis. Knema subhirtella de Wilde, *spec. nov.*

Affine *Knematis mogeani* de Wilde atque *K. hirtelli* de Wilde, differt perianthio masculo in alabastro obovoideo, c. 2.5–3.5 mm diam., antheris (7–)8–15, breviter stipitatis, patentibus, androphoro glabro vel pilis paucis, perianthio intus viridio-cremeo, fructibus late obovoideis, 2–2.7 cm longis, breviter pubescentibus. – Typus: *S 43132 Yii et al.* (L), Sarawak.

Tree 5–25 m. Twigs terete or blunt-triangular, towards the apex 1.5–2(–2.5) mm diam., pubescent by grey-brown to pale rusty stellate-dendroid hairs 0.1–0.3 mm long, lower down with the bark faintly or finely striate, not flaking. *Leaves* membranous, above early glabrescent, drying olivaceous to brown, beneath with persistent tomentum of scattered stellate(-dendroid) hairs of mixed sizes c. 0.1–

0.2(–0.3) mm diam., blade elliptic-oblong to lanceolate, broadest below to above the middle, or ± parallel-sided, 9–20 by (1.5–)2–5.5 cm, base short- to long-cuneate, top acute-acuminate, midrib little to much raised above; nerves 15–25 pairs, flattish to raised above, venation forming a rather coarse network usually distinct above; leaf bud slender, 8–12 by 1.5–2 mm, densely pubescent by hairs 0.1–0.3 mm, petiole ± late glabrescent, 8–12 by 1–2 mm. *Inflorescences* simple or rarely forked, to 4 mm long, up to 1 mm stalked, in male 4–7-, in female 1–4-flowered. *Male flowers* densely tomentose by hairs 0.1–0.2(–0.3) mm long; pedicel slender, 2–5 mm long, the bracteole late-caducous, ovate, 0.5–1 mm long, situated 0.5–1(–1.5) mm below the perianth; perianth in bud broadly obovoid, 2.5–3.5(–4) by 2.5–3.5 mm, valves 3, at suture c. 0.5 mm thick, in anthesis splitting the bud to about (1/2–)2/3(–3/4); staminal disk circular, flat or somewhat convex, including anthers 1.2–1.5(–2) mm diam., anthers (7–)9–13(–15), short-stiped, horizontal (opening downwards), 0.3–0.4 mm long, not touching; staminal column subcylindrical, only a little tapering, 1–1.5 mm long, glabrous or towards the base with some minute stellate hairs. *Female flowers:* pedicel 4–7(–10) mm, the bracteole ± halfway, perianth in bud ± obovoid, c. 5 by 3 mm, valves c. 0.5 mm thick, splitting the bud to about halfway; pistil c. 4 mm high, ovary c. 2.5 by 1.5 mm, densely pubescent by hairs 0.1 mm long or less, stigma c. 1.5 mm high, 2-lobed, subsessile, each lobe coarsely 2–3-lobulate. *Fruits* solitary or 2 per infructescence, broadly ellipsoid, top and base rounded, tomentum persistent, of dense hairs c. 0.1 mm long, 2–2.7 by 1.5–2 cm, dry pericarp c. 1.5 mm thick; stalk 4–10 mm long.

Distribution. Borneo: Sarawak, W. Sabah.

BORNEO. Sarawak: 1st–4th Div.: S 3624, 3738, 3757, 12984, 15656, 16382, 16484, 19213, 21826, 21852, 21860, 21894, 21924, 21966, 22484, 24307, 24836, 28165, 28173, 35119, 35183, 35994, 36579, 39476, 41910, 43132, 43428. – W. Sabah: SAN 16733, 17401, 36300, 66033, 72219.

Ecology. Mixed dipterocarp forest; hill slopes, ridges; sandy clay and loam, basalt rock, shales; 0–800(–1200) m. Flowers March–May(–Aug.), fruits mainly Sept., Oct.

Notes. 1. Fieldnotes: Understorey tree. Bark usually recorded as dark brown or chocolate-brown, ± smooth or dippled, not furrowed. Outer bark brittle, inner bark pink-cream, fibrous; sapwood cream. Exudate pink to blood red. Perianth outside yellow-brown, inside creamy-greenish. Fruit yellow-green to apricot or orange; aril red. The wood is used as firewood.

2. The material of the present new species mainly consists of specimens formerly included in the widely conceived *K. stenophylla*, and discussed in note 3 to that species (de Wilde, Blumea 25, 1979, 458), viz. specimens with a somewhat stouter habit and larger fruits, including those specimens enumerated separately under 'Borneo, a larger fruited form' (l.c.: 458). See further explanation under *K. stenophylla* in the present paper (page 129). A few specimens now assigned to *K. subhirtella* are taken out of the related *K. hirtella.*

3. *Knema subhirtella* is closely related to *K. mogeana* and *K. hirtella*, all three with a similar tomentum on the lower leaf surface. Furthermore, *K. subhirtella* may be confused with *K. stenophylla* (see also note 2 above), *K. glaucescens*, and *K. piriformis.*

Knema mogeana differs by somewhat smaller male perianth, and distinctly smaller fruit.

Knema hirtella has stouter twigs, somewhat larger male perianths, and the androphore is always provided with hairs towards the base, and it has somewhat larger fruit. In *K. subhirtella* the androphore is either glabrous or has only a few hairs towards the base.

Knema stenophylla (in Borneo the subsp. *longipedicellata*) differs by subglobose (not obovoid) male perianth, in anthesis cleft almost to the base, and it has an inconspicuous tomentum on the lower leaf surface, consisting of scattered stellate hairs of c. 0.1 mm diam. or less only.

Knema glaucescens, also with a globose male perianth, has much denser tomentum on the lower leaf surface.

Knema piriformis (of the group with distinctly pear-shaped male perianths, and keyed-out previously) may be resembling in cases where *K. subhirtella* has the perianth rather pear-shaped and cleft to c. 2/3 at anthesis. *Knema piriformis* is known only from a limited number of specimens: it generally has more elongate male perianths with the staminal column longer than the diameter of the disk, and is known from mountainous localities.

Finally, it should be noted that through its tendency of having a pear-shaped male perianth, *K. subhirtella* somewhat blurs the demarcation of series *Glaucae*, in which it obviously has a marginal position. Therefore, it keys out twice in the general key to male flowering specimens, as shown in the amended portions of this key as given below. Also, its position in the regional key to female flowering and fruiting specimens for Borneo is given. In these amendments of the keys also most of the resembling new or amended species as treated elsewhere in this article are incorporated.

Amendment of the general key to male flowering specimens:

Substitution of leads 30a–b (as published in Blumea 25, 1979, 343) and lead 30[1]a–b (as published in Blumea 27, 1981, 226)

30 a. Twigs usually stout, at apex 3–6(–8) mm diam. Leaf base cordate to broadly rounded. Male perianth in bud (3–)4–5.5 mm long; pedicel 4–8 mm long; anthers 12–25 . . . . . **26. K. pulchra**

b. Twigs more slender, towards the apex 1–3 mm diam. Leaf base rounded to attenuate. Male pedicel 2–5 mm long . . . . . 30[1]

30[1]a. Male perianth cleft by the valves to c. 5/6; pedicel 2–3 mm long; anthers 4 or 5. *Lesser Sunda Islands: Flores* . . . . . **27-bis. K. steenisii**

b. Male perianth cleft to c. 1/2–3/4; pedicel 2–5 mm long; anthers 8 or more. *Borneo* . . . . . 30[2]

30[2]a. Male perianth 2.5–4 mm long. Anthers 8–15, just stiped. Lower leaf surface with persistent tomentum composed of scattered minute hairs 0.1–0.2(–0.3) mm. Mainly lowland forest . . . . . **73-bis. K. subhirtella**

b. Male perianth 4–5 mm long. Anthers 11 or 12 . . . . . 30[3]

30[3]a. Anthers 11 or 12, just stiped, ± horizontal. Lower leaf surface with subpersistent tomentum of minute scattered hairs. Montane forest at (400?–)1000–2000 m . . . . . **27. K. piriformis**

b. Anthers 11, half-sessile, suberect. Lower leaf surface early glabrescent from very weak tomentum. Lowland forest up to 500 m . . . . . **27-bis-2. K. stylosa**

Amendment of the general key to male flowering specimens:

Substitution of lead 83a–b, and deletion of lead 76b: *K. hirtella* var. *stylosa* (as published in Blumea 25, 1979, 350 & 351)

83a. Twigs slender, towards the apex c. 1 mm diam. Leaves small, to 15 cm long, on lower surface with tomentum consisting of scattered very minute scaly hairs less than 0.1 mm high. Male perianth globose or broadly obovoid, 2.5–3 mm diam.; anthers 6–11; androphore glabrous . . . . . **72. K. stenophylla**

b. Twigs slender or stoutish, towards the apex 1–3 mm diam. Leaves up to 30 cm long, the tomentum on lower surface consisting of hairs more densely set or larger, 0.1–0.3 mm long. Androphore glabrous or finely pubescent at base 83[1]

83[1]a. Male perianth broadly obovate, c. 2 mm diam., in anthesis cleft to the base. Anthers 9, subsessile, half-erect; androphore rather tapering, glabrous or with a few minute hairs at base. Leaves to 25 cm long, base short-attenuate or rounded, lower surface with inconspicuous tomentum of rather densely set greyish equal-sized hairs c. 0.2 mm long . . . . . **73-bis-3. K. riangensis**

b. Male perianth in anthesis cleft to c. 3/4–4/5. Anthers 6–15, stiped, horizontal; androphore little tapering, glabrous or finely pubescent towards the base. Leaves various, at base attenuate; hairs scattered, of mixed sizes . . . . . 83[2]

83[2]a. Twigs stoutish, towards the apex 2–3 mm diam. Leaves to 25 cm long. Male perianth subglobose or broadly obovoid, c. 3–3.5 mm diam., anthers 11 or 12; androphore pubescent towards the base (male flowers not seen in var. *pilocarpa*). [Fruit 2.5–3.5 cm long] . . . . . **73. K. hirtella**

b. Twigs more slender, towards the apex 1–2 mm diam. Leaves generally smaller. Male perianth obovoid, c. 2.5 mm long . . . . . 83[3]

83[3]a. Male perianth 2.5–3 mm long, anthers 8–15, androphore glabrous or with a few minute hairs at base. Leaves distinctly reticulate above. [Fruit c. 2 cm long] . . . . . **73-bis. K. subhirtella**

b. Male perianth c. 2.5 mm long, anthers 6–8, androphore glabrous. Leaves rather faintly reticulate above. [Fruit 1.5–2 cm long] . . . . . **73-bis-2. K. mogeana**

Amendment of the regional key to female specimens (5. Borneo) (l.c.: 363):

Mainly of species in series *Glaucae* as defined in Blumea 25, 1979, 337.

35a. Leaf base generally broadly rounded to cordate. Twigs stoutish. Leaves up to 50 cm long 36

b. Leaf base attenuate to rounded (casually subcordate of broadly rounded in *K. glauca, K. stylosa, K. hirtella*, and *K. riangensis*). Twigs usually more slender, at apex 1–3.5 mm diam. Leaves up to 25 cm long 37

36 a. Twigs at apex 3–6(–8) mm diam. Leaves (20–)30–50 by (6–)10–17 cm, nerves flat or little raised above. Fruits subellipsoid, (3–)4–6 cm long, top rounded. Male perianth in bud pear-shaped ..... **26. K. pulchra**
b. Twigs at apex 2–4 mm diam. Leaves 12–30 by 5.5–12 cm; nerves sunken to flattish above. Fruits ± slender, c. 7 by 2 cm, top long-acute. Male perianth in bud globose ..... **68. K. kostermansiana**
37 a. Leaves coriaceous to rigidly coriaceous, the tertiary venation on the upper surface forming a raised and very distinct network. *Sabah, Mt Kinabalu and vicinity* (1000–2300 m alt.) ..... **64. K. kinabaluensis**
b. Leaves membranous to thinly coriaceous; tertiary venation on upper surface distinct or not. At 0–2000 m alt.; some specimens also on *Mt Kinabalu* ... 38
a. Twigs in apical portion usually somewhat flattened, light brown. Tertiary venation on upper leaf surface forming a distinct very fine network, the areoles less than 0.5 mm diam. ..... **65. K. luteola**
b. Twigs not flattened, towards apex terete or somewhat angular, drying brown to blackish. Tertiary venation on upper leaf surface generally coarser, distinct or not distinct 39
39 a. Fruits glabrescent. Bracteole (also in female flowers) usually persistent. Lower leaf surface early glabrescent (from indistinct tomentum of very weak greyish hairs) ..... **66. K. glauca** (2 vars.)
b. Fruits with persistent tomentum (although hairs may be very short). Bracteoles persistent or caducous. Tomentum of lower leaf surface persistent or glabrescent (hairs may be minute; lens!) 40
40 a. [Male perianth in bud pear-shaped, much tapered in the lower half.] A (sub)-montane species at (400?–)1000–2000 m alt. ..... **27. K. piriformis**
b. [Male perianth obovoid or globose.] Mainly in lowland forest, 0–1000(–1200) m alt. 41
41 a. Lower leaf surface early glabrescent from very weak tomentum. Style distinct, 0.5–1 mm long. [Male perianth obovoid] ..... **27-bis-2. K. stylosa**
b. Lower leaf surface with persistent tomentum or late-glabrescent. Style up to 0.5 mm (stigma lobes ± sessile or subsessile). [Male perianth obovoid or globose] 42
42 a. Hairs of tomentum of lower surface of just mature leaves densely set and touching or interwoven 43
b. Hairs scattered, not touching each other 44
43 a. Hairs pale brown. Lateral nerves usually raised above. Fruit 1.8–2.2 cm long **75. K. glaucescens**
b. Hairs yellowish or greyish white, inconspicuous, weak. Lateral nerves flat or partially raised above. Fruit c. (3–)4 cm long ..... **74-bis-3. K. riangensis**
44 a. Twigs slender, towards the apex c. 1 mm diam. Leaves small, up to 15 cm long, membranous, on lower surface with very inconspicuous tomentum of scattered scale-like stellate hairs less than 0.1 mm. Fruits 1–1.5 cm long, stalk 10–20 mm long ..... **72b. K. stenophylla** subsp. **longipedicellata**
b. Twigs towards apex generally stouter, 1–3.5 mm diam. Leaves up to 25 cm long, on lower surface with tomentum of hairs of mixed sizes, 0.1–0.3 mm long .. 45

45 a. Twigs slender, towards the apex 1–1.5(–2) mm diam. Reticulation on upper leaf surface rather raint. Fruit 1.5–2 cm long, stalk 4–10 mm long. [Anthers 6–8] ..... **73-bis-2. K. mogeana**

b. Twigs towards apex generally stouter. Reticulation on upper leaf surface distinct. [Anthers 8–13(–15)] 46

46 a. Twigs towards apex c. 1.5 mm diam. Leaves 9–20 cm long. Fruit 2–2.7 cm long ..... **73-bis. K. subhirtella**

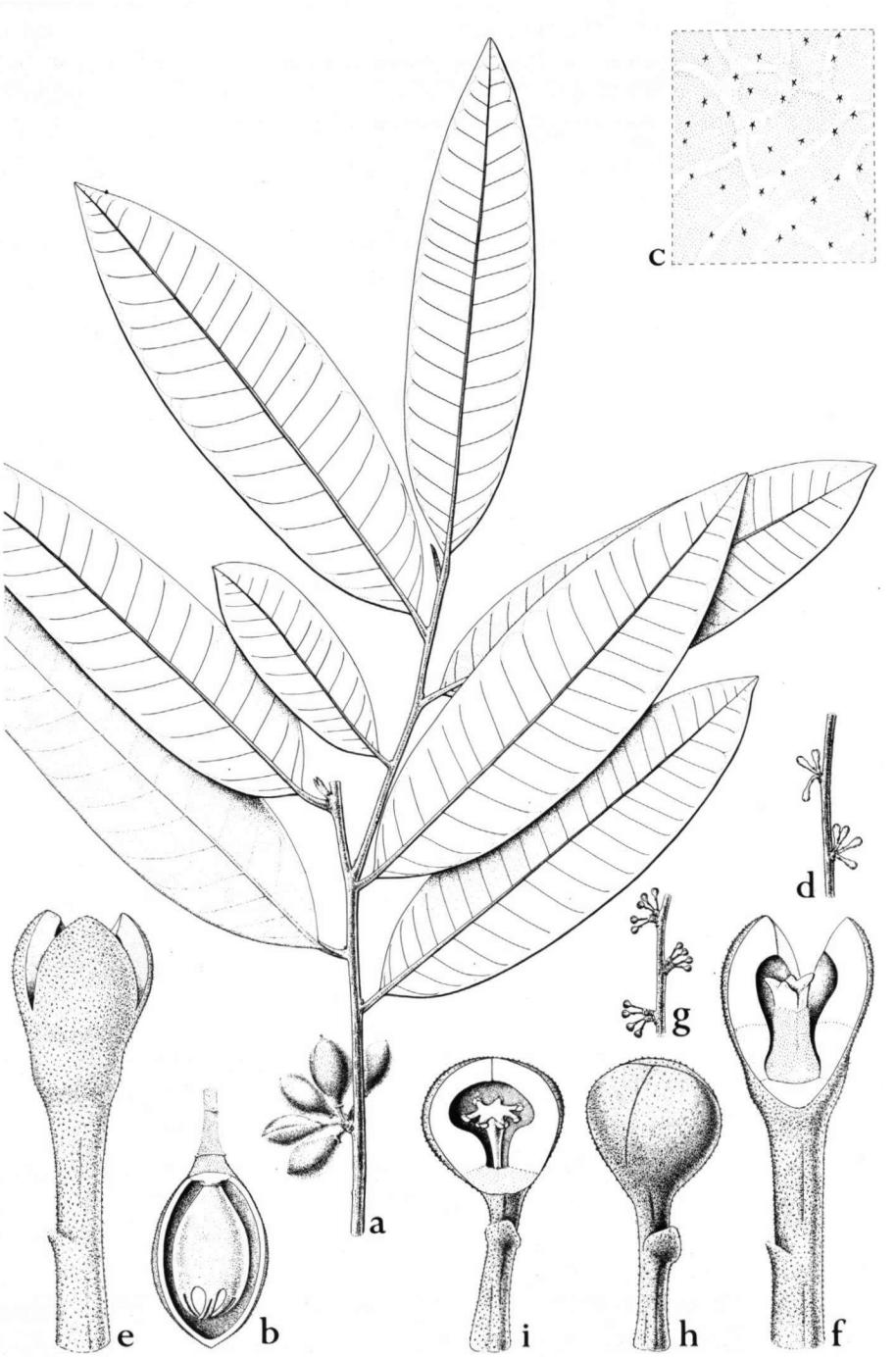
b. Twigs towards apex c. 3 mm diam. Leaves 16–25(–27) cm long. Fruit 2.5–3.5 cm long ..... **73. K. hirtella**

73-bis-2. Knema mogeana de Wilde, *spec. nov.* – **Fig. 4.**

Knema species e series *Glaucae* de Wilde, affine *K. stenophyllae* atque *K. subhirtelli*, differt foliis subtus tomento composito pilis stellatis sparsis 0.1–0.2 mm longis, perianthio masculo in alabastro obovoideo, c. 2.5 mm diam., antheris 6–8, breviter stipitatis, fructibus 1.5–2 cm longis, breviter pubescentibus. – Typus: *Mogea 4446* (L, iso BO), Central Kalimantan.

Tree 4–15 m. Twigs terete, towards the apex 1–1.5(–2) mm diam., minutely pubescent or glabrescent with dull brown hairs 0.1–0.2 mm long, bark of twigs lower down blackish brown, finely striate, not flaking. *Leaves* membranous, above early glabrescent, drying olivaceous or most frequently dark brown, beneath with persistent tomentum composed of widely scattered, not touching, pale yellowish stellate-scaly hairs of mixed sizes 0.1–0.2 mm diam.; blade oblong to lanceolate, broadest at about the middle or ± parallel-sided, 8–17(–24) by 1.5–4(–7) cm, base narrowly rounded to attenuate, top acute-acuminate; midrib raised above; nerves 13–20 pairs, sunken or flattish, sometimes ± raised above, venation forming a moderately fine network usually not very distinct above; leaf bud slender, 8–12 by 1–2 mm, densely dull rusty pubescent by hairs 0.1–0.2 mm; petiole glabrescent, 8–12(–15) by 1–2 (–3) mm. *Inflorescences* simple or 2- or 3-forked, up to 4 mm long, not stalked, in male 4–8-flowered, in female 2–6-flowered. *Male flowers* densely rusty tomentose by hairs c. 0.1–0.2 mm long; pedicel slender, 2–4 mm long, the bracteole persistent, broadly ovate, 0.5–1 mm long, situated c. 0.5 mm below the perianth; perianth in bud broadly obovoid, c. (2–)2.5 mm diam., valves 3, at suture c. 0.5(–0.8) mm thick, in anthesis splitting the bud to 4/5–5/6; staminal disk circular, flat above, including anthers 1–1.5 mm diam., anthers 6–8, short-stiped, horizontal (opening downwards), c. 0.3 mm long, not touching; staminal column subcylindrical, only little tapering, c. 1(–1.4) mm long, glabrous. *Female flower* pedicel 3–6(–8) mm long, the bracteole minute, persistent, inserted at about halfway or up to c. 2 mm

Fig. 4. *Knema mogeana* de Wilde. a. Fruiting twig, × ½; b. opened fruit, showing seed with aril laciniate at apex, × ½; c. lower leaf surface with scattered small hairs, × 25; d. portion of twig with female inflorescences, × ½; e. mature female flower, × 6; f. ditto, opened, showing pistil, × 6; g. portion of twig with male inflorescences, × ½; h. mature male flower, × 6; i. ditto, longitudinally opened, showing androecium with 7 stalked anthers, × 6 (a–c. *SAN 31172*; d–f. *Veldkamp 8135*; g–i. *S 21495 Ashton*).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below the perianth, the latter in bud long-obovoid, c. 4 by 2.5 mm, valves c. 0.5 mm thick, splitting the bud to ± halfway; pistil c. 2.5 mm high, ovary ovoid, c. 1.5 by 1(–1.3) mm, pubescent by hairs c. 0.1 mm long or less, style ± absent, stigma c. 1 mm long, 2-lobed and each lobe 4- or 5-lobulate. *Fruits* solitary or up to 6 per infructescence, ellipsoid to ellipsoid-oblong, top rounded to short-acute, tomentum persistent, consisting of hairs c. 0.1 mm long, 1.5–2 by 1–1.2 cm, dry pericarp c. 1 mm thick; stalk 4–10 mm long.

Distribution. Borneo: Sarawak, Sabah, Central Kalimantan, E. Kalimantan (E. Kutei).

BORNEO. Sarawak: 1st & 2nd Div., S 21495, 23602, 23633, 23678, 23722, 34321, 36730; Sinclair & Kadim 10289; SF 35627. – Sabah: SAN 31172. – Central Kalimantan: Mogea (& de Wilde) 4171, 4229, 4244, 4437, 4446; Nooteboom 4793; Veldkamp 8135. – E. Kalimantan, E. Kutei: Kostermans 5351.

Ecology. Primary forest on sandy loam soils, hill slope forest, mixed dipterocarp forest, on sandy soil, diorite, sandstone, limestone; 0–300 m alt. Flowers in Dec., Jan., May and June; fruits Jan. and June–Sept.

Notes. 1. Fieldnotes: Small tree, bark recorded as smooth, dark brown, or rough when old, with some pustules, not furrowed or striate. Sap copious, red. Perianth outside yellow-brown, inside greenish creamy, androecium (androphore) whitish, anthers pale yellow; fruits yellowish green. Leaves glaucous beneath, with yellowish green midrib.

2. This species is described as new after critical study of some recent collections made in the Bukit Raya area (Central Kalimantan), in conjunction with a re-assessment of the material belonging to the very variable *K. stenophylla* s.l. as conceived in my 1979-publication on *Knema*. Most of the specimens assigned to the present new species (as well as many of the here also as new described *K. subhirtella*) were formerly included by me in *K. stenophylla* s.l., which, consequently, now has a much narrower circumscription and is redefined, as pointed out elsewhere in this publication.

Knema mogeana differs from *K. stenophylla* by the tomentum on the lower leaf surface, with hairs of various sizes, and by smaller, broadly obovoid male perianths. It is particularly closely related to *K. subhirtella* (described as a new species on page 131) and to *K. hirtella*, both differing by generally a stouter habit, the leaves in general more prominently reticulate above, the androphore often minutely pubescent at base, generally more anthers, 8–13(–15), and larger fruits. In *K. subhirtella* apparently the bracteoles are late-caducous and the perianth in anthesis cleft less deeply.

3. The specimens *Mogea 4229 & 4437* deviate from the rest of the material by a relatively stout habit, the leaves measuring up to c. 24 by 7 cm.

4. For its position in the keys, see the keys presented under *73-bis. K. subhirtella.*

73-bis-3. Knema riangensis de Wilde, *spec. nov.*

Pertinens ad *Knema* series *Glaucae* de Wilde, differt foliis subtus tomento dense subpersistente, composito e pilis 0.1(–0.2) mm longis. Perianthium masculum in alabastro obovoideum, c. 2 × 1.7 mm, in anthesi fere ad basim fissum; antheris 9, subsessilibus, suberectis, androphoro valde

attenuato; stylo sat robusto, c. 0.5 mm longo; fructibus ellipsoideis, c. (2.5–)3.5–4 × 2 cm, tomento brevi persistente. – Typus: *Veldkamp 7941* (L), Central Kalimantan.

Tree 3–12 m. Twigs moderately stout, towards the apex 1.5–3(–4) mm diam., subterete or ± angular, very minutely pubescent by dull brown hairs c. 0.1 mm long, older bark coarsely striate, not flaking. *Leaves* membranous, above early glabrescent, drying olivaceous, beneath with (sub)persistent tomentum composed of pale yellowish to greyish almost uniform stellate(-dendroid) hairs 0.1(–0.2) mm long, rather densely set, ± touching, not widely scattered; blade elliptic-oblong to oblong-lanceolate, broadest at or above the middle, 14–30 by 5–10.5 cm, base short-attenuate to rounded, top acute-acuminate; midrib raised above; nerves 15–23 pairs, flattish to raised above, venation forming a rather fine network, distinct above; leaf bud slender, 10–20 by 1.5–3 mm, densely dull brown pubescent by hairs c. 0.1 mm; petiole dull brown pubescent or late glabrescent, 10–20 by 2–4 mm. *Inflorescences* wart-like protuberances, or simple or forked brachyblasts up to 5 mm long, up to 1 mm stalked, in male 2–6-flowered, in female 2–4-flowered. *Male flowers* densely dull brown tomentose by hairs c. 0.1(–0.2) mm long; pedicel slender, 3–4 mm long, the bracteole persistent, c. 0.5 mm long, situated 0.5–1 mm below the perianth; the latter in bud broadly obovoid, c. 2 by 1.7 mm, valves 3, at suture c. 0.5 mm thick, in anthesis splitting the bud to 5/6; staminal disk subcircular to faintly triangular, flat above, 0.8–1 mm diam., anthers 9, sessile, suberect, c. 0.3 mm long, closely set; staminal column conspicuously tapering (obconical), c. 0.8 mm long, glabrous or with a few very minute hairs at base. *Female flowers* stoutish, pedicel 5–12 mm long, the bracteole minute, inserted slightly above the middle, perianth in bud ± obovoid, c. 4–5 by 3 mm (or c. 7 by 4 mm, see the notes), valves 0.5–1 mm thick, splitting the bud to ± halfway; pistil 2.5–4.5 mm long (see notes); ovary ovoid, c. 2–4 mm long, densely pubescent by hairs 0.1(–0.2) mm long; style rather broad, c. 0.5 mm long, with 2 stigma lobes, each coarsely 2–4-lobulate. *Fruits* 1 or 2 per infructescence, ellipsoid, top bluntish, with persistent rust-brown tomentum of hairs c. 0.1 mm long, 2.4–4 by 1.7–2.5 cm, dry pericarp 1–2 mm thick; stalk 8–12 mm; seed ellipsoid, 2–2.5 cm long.

Distribution. Borneo: Central Kalimantan, possibly Sarawak (see notes).

BORNEO. Sarawak: 7th Div., S 43723 Othman et al. – Central Kalimantan: Upper Samba R., Bukit Raya area, near the mouth of the Riang River, Veldkamp 7941, 7970, 8209.

Ecology. Primary forest, riverine forest; yellow sandy clay; 100–300 m alt. Flowers and fruits Jan., Feb., fruits in May.

Notes. 1. Fieldnotes: Young shoots cinnamon. Leaves glossy above, whitish underneath. Tepals red or pinkish, column yellowish. Fruit orange, aril edible, sourish, bright red; pericarp edible, sweetish; outer testa white, inner black.

2. This species has become known mainly through collections made in and near the base camp of the joint Indonesian-Dutch botanical expedition to the Bukit Raya, near the mouth of the Riang River, a tributary of the upper Samba River.

Specimens were initially pre-identified by me as *K.* aff. *glauca* or *K. hirtella* var. *hirtella*, but a reconsideration of all the unsatisfactory named heterogeneous speci-

mens of the complex species *K. stenophylla* and *K. hirtella*, as conceived by me in my earlier treatment of *Knema* (Blumea 25, 1979), resulted in the recognition of the present species.

It is, among the species of its series *Glaucae*, mainly characterized by 1) lower leaf surface with persistent or late-glabrescent tomentum composed or rather densely set, touching or ± interwoven, hairs of almost uniform size, 0.1–0.2 mm long, 2) relatively small male perianths, c. 2 by 1.7 mm, in anthesis cleft nearly to the base, 3) androphore distinctly tapering, sometimes with a few minute hairs at base (which points to relationship with *K. hirtella*), 4) anthers 9, sessile, suberect, rather tightly set, 5) style rather distinct, c. 0.5 mm long (almost as in *K. stylosa*), and 6) fruits of medium size, with short persistent tomentum.

3. The specimen *Veldkamp 8209*, with fruits and female flowers, has the latter considerably stout, the perianth c. 7 by 4 mm, pedicel c. 12 mm long, ovary c. 4 by 3 mm, as is noted in the description, much larger than those in *Veldkamp 7970* (mixed male and female specimens), and I do not know whether these sizes just represent extremes of normal flower sizes.

4. The specimen *S 43723*, from Sarawak, deviates from the Bukit Raya (Kalimantan) collections by a somewhat less stout habit and smaller fruit, c. 2.5 cm long.

5. For the position of this new species in the keys, see the amendments in the keys as presented under *73-bis. K. subhirtella.*

ANNOTATED LIST OF UNNAMED SPECIMENS

When reconsidering the specimens and species-delimitation within the difficult group of species in series *Glaucae* (like *K. stenophylla, K. glauca, K. glaucescens, K. hirtella, K. subhirtella*, etc., as redefined in the preceding part of this article), some specimens formerly identified in a species now appeared difficult to place and remain unidentified as '*Knema spec.*'. They are the following:

– *SF 30339 Corner*, from Johore, Malaya, immature male flowers. This was formerly included by me in *K. stenophylla* s.l., but now I have seen that it comes close to *69. K. patentinervia*, where it was already placed by Sinclair (1958, 1961). It differs from the latter by having 8 or 9 anthers, instead of 11–17.

– *Hallier 323*, from P. Lemoekoetan, W. Kalimantan, sterile, was formerly identified by me in *75. K. glaucescens.* It has the same dense and subpersistent tomentum on the lower leaf surface but the sterile twigs differ so much in general aspect that I prefer to keep the specimen out of that species.

– *Kostermans 4327 & 9948*, from E. Kalimantan, both with male flowers (11 anthers), are obviously identical. Both were formerly included by me in *K. stenophylla* s.l., but cannot be maintained in that species because of the nature of the tomentum of the lower leaf surface: subpersistent, reminiscent of that of *73-bis. K. subhirtella* or to a lesser degree of *75. K. glaucescens*, but the present specimens are much more delicate of habit, with small leaves, very distinctly more reticulate above, etc., and possibly represent an undescribed new species.

– *S 37529 Othman et al.*, from Sarawak (1st Div.), with male flowers (7 anthers), was formerly determined by me as *K. stenophylla* s.l., but it differs by its tomentum of the lower leaf surface which is similar to that of *73-bis. K. subhirtella* or *73-bis-2. K. mogeana*. From these latter species, however, it differs by its perianth being pink or light red inside (not creamy green), deeply cleft in anthesis, and by differences in general aspect of the leaves.

– *S 37748 Ilias Pai'e*, from Sarawak (1st Div.), in fruit. This was originally identified by me as *66. K. glauca*. However, it somewhat deviates in general aspect and is reminiscent of *K. latifolia*, although the reticulation and nerves on the upper leaf surface are not raised enough for that species; its fruits (3 cm long) are glabrescent, as in *K. glauca*, but the fruit stalk measures c. 12 mm. This latter agrees with *K. glauca* var. *riparia*, a taxon from riverine forest distinct by usually narrower leaves and smaller fruit.

INDEX

This index contains additional references to species treated since my general account of *Knema* in Blumea 25 (1979). Numbers refer to species number as given in the general account and as those inserted herein for new species in (I) the supplementary data published in Blumea 27 (1981), and in (II) the present article. New names are in **bold-faced** type, synonyms in *italics*.