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REVIEW OF THE GENUS *STICHONEURON* (*STEMONACEAE*)

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The genus *Stichoneuron* (*Stemonaceae*) with five species is revised. Three new species are described: *Stichoneuron calcicola* Inthachub, *S. halabalensis* Inthachub, and *S. bognerianum* Duyfjes. A key to the species, distribution map and descriptions are provided.

Keywords. Croomia, *Stemonaceae*, *Stichoneuron*.

INTRODUCTION

Stemonaceae is a small (three genera, c.23 spp.) monocotyledonous family of perennial herbs; without or with a rhizome; with 4-merous flowers; superior or half-inferior, unilocular, unicarpellate ovary; 2-valved fruit; funicular seeds with a conspicuous aril composed of finger-like appendages; and leaves with thin but conspicuous transverse veinlets between the main veins (Rudall *et al.*, 2005; Rudall & Bateman, 2006). The three genera are (Rogers, 1982): (i) *Stemona* Lour. (c.15 spp.), widespread in tropical SE Asia, distinct from the other two genera in having an essentially twining habit, rhizome lacking, but with swollen roots and basally inserted ovules; (ii) *Stichoneuron* Hook.f. (5 spp.), in SE Asia; and (iii) *Croomia* Torr. (3 spp.), with two species in Japan (Ohwi, 1965) and one in North America (Tomlinson & Ayensu, 1968). *Stichoneuron* and *Croomia* are closely related and share an erect, non-twining leafy stem, a rhizome with non-tuberous roots, and apically inserted ovules. A fourth genus, *Pentastemona* Steenis (2 spp.), from Sumatra, is sometimes placed in *Stemonaceae* but we maintain it in a segregate monotypic family *Pentastemonaceae* (Duyfjes, 1992). *Pentastemona* has been included in *Stemonaceae* based on both morphology (van Steenis, 1982) and DNA sequence data (Caddick *et al.*, 2002). However, in Caddick *et al.* (2002) *Pentastemona* was placed as sister to the other genera so a two family solution would have been equally as valid a conclusion. Rudall *et al.* (2005) and Rudall & Bateman (2006) also suggest

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the situation is not clear cut. Van der Ham (1991) argued that pollen morphology supports family rank for *Pentastemona*. Bouman & Devente (1992) and Bouman (1995) also placed *Stemona* and *Pentastemona* in separate families, based on ovule and seed characters. *Pentastemona* are juicy herbs; a rhizome is absent; the leaf bases are sheathing; the flowers are 5-merous (and altogether very different from those of *Stemonaceae*); the ovary is 3-carpellate and inferior, with 3 parietal placentas; and the seeds have a very short funicle or not. Nakai (1937) found the genera *Croomia* and *Stichoneuron* sufficiently different from *Stemona* to establish a separate family *Croomiaceae* but we have not followed this position. Morphological differences between the four genera are summarised in Table 1.

Recent fieldwork and cultivation in the greenhouse have revealed three new species of *Stichoneuron* from Peninsular Thailand and Peninsular Malaysia. These are described here.

Croomia versus *Stichoneuron*

Croomia and *Stichoneuron* have historically been maintained as separate genera. They have also been maintained, sister to one another, in three recent phylogenetic papers (Caddick *et al.*, 2002; Rudall *et al.*, 2005; Rudall & Bateman, 2006). However, they are hardly separable based on morphology. It seems that the only difference is in the growth habit. *Croomia* has a long rhizome, at the apex of which an erect, herbaceous, unbranched shoot is produced each year which then dies off at the end of the season (Rogers, 1982). *Stichoneuron* has a short rhizome, similarly producing erect somewhat branched shoots, lasting two or three years at most. In *Stichoneuron calcicola* the shoots of the plants may grow older and branches are rather prostrate, possibly an adaptation to its specialised habitat, crevices in (vertical) limestone rock. Both *Croomia* and *Stichoneuron* have few ovules attached to the apex of the ovary. According to van Heel (1992) *Stichoneuron* and *Croomia* have a similar floral morphology and could be merged. In *Croomia* the funicled seeds dangle outside the open mature fruit below the valves on a conspicuous long 'pseudo-funicle' formed by the detached vessel-bundle. This was noted by Gray (1859) and Takhtajan (1982) in *Croomia pauciflora* Torr., from North America, and also clearly depicted by Makino (1961) for *C. heterosepala* (Baker) Okuyama from Japan. However, the 'pseudo-funicle' is present in *Stichoneuron* as well, at least in *S. calcicola*.

Stichoneuron was described in 1883 by J. D. Hooker, who cited a single specimen but did not name it. This was done, however, in 1888 and 1892 with one species, *Stichoneuron membranaceum*. The material, lacking fruit, was from India. Although it was noted that the fruit was lacking it was considered as distinct from *Croomia* by its few-branched habit, many-flowered inflorescences, and three minute stigmas. Ridley (1911) described a second species, *Stichoneuron caudatum*, also lacking fruit, from Malaya. Since then only a few collections of the Indian species have been made, all without fruit. The Malaysian *Stichoneuron* species are somewhat better collected (about 15 specimens), seldom with fruit, and not clearly showing the mode of

TABLE 1. Comparison of *Croomia*, *Stichoneuron* and *Stemona* (*Stemonaceae*) and *Pentastemona* (*Pentastemonaceae*)

	Croomia	*Stichoneuron*	*Stemona*	*Pentastemona*
Stem	Erect, unbranched, dying off each season	Erect or procumbent, branched, perennial	(Erect or) twining, branched, mostly perennial	Short, juicy, unbranched, perennial
Roots	Rhizome	Rhizome	Root tubers	Thin roots, no rhizome
Petiole	Non-sheathing	Non-sheathing	Non-sheathing	Sheathing
Tepals and stamens	4	4	4	5
Tepals	Free	Free	Free	Almost free or halfway connate
Filaments	Short	Short	Short	Lacking
Anthers	Short	Short	Elongate	Short
Connective appendage	Lacking	Lacking	Tepal-like, long	Lacking, connective broad, inward curved, fused with the style
Ovary (1-celled)	Superior or semi-inferior	Superior or semi-inferior	Superior	Inferior
Stigma	Minute	Minute	Minute	Broad, 3–4-lobed
Carpels	1	1	1	3
Placentas	1, apical	1, apical	1, basal	3, parietal
Fruit	2-valved capsule	2-valved capsule	2-valved capsule	10-ridged berry
Seeds*	Few, large	Few, large	3–20, large	Many, up to 60, small (1 mm long)
Funicle	Short	Short	Long (longer than seed)	Inconspicuous
Pseudo-funicle	Present	Present	Lacking	Not applicable

*Large = 5 mm long or more.

attachment of the mature seed. Only in recent times, with more material available and the description of three new species, has it become known that the Thai–Malaysian species all have few-flowered inflorescences (i.e. when the inflorescences are young and start flowering), and also a minute single stigma. Therefore, the branched subperennial habit of the stem remains the only character to distinguish *Stichoneuron* and *Croomia*.

Other characters used to separate *Stichoneuron* and *Croomia* (van Steenis, 1982; Kubitzki, 1998) also appear invalid. For example, curvinerved leaves in *Croomia* are also found in *Stichoneuron calcicola*; the distichous leaves of *Croomia* can also be seen in *Stichoneuron*; the disposition of the anther cells and the condition of the connectivum are essentially the same in both genera; the character of the tepals – valvate in *Stichoneuron* versus imbricate in *Croomia* – appears to be arbitrary.

In the present study we refrain from uniting these genera as, despite their clear similarity, there is no current evidence to suggest either genus is not monophyletic. The extra-tropical genus *Croomia* is the older name. Pending further research we maintain the SE Asian genus *Stichoneuron* and herewith propose new species names necessary for the forthcoming family treatment for the Flora of Thailand and the Flora of Peninsular Malaysia.

Flower Dimorphism in *Stichoneuron*

Stemonaceae usually have perfect flowers. Dahlgren *et al.* (1985) mentioned the rare occurrence of unisexual flowers in the family. The flowers of *Stichoneuron* are (probably) rarely functionally unisexual with some dimorphism (Duyfjes, 1991; Kubitzki, 1998). In *Stichoneuron* the fruit are scarce on specimens, and in *S. membranaceum* still unknown. This species, from the Khasia Hills in India and northern Burma, is only known from a few collections although Hooker (1888) provided a good description and a drawing of the small flowers taken from the collection *Hooker f. & Thomson* s.n. from the Khasia Mountains. However, recently we discovered a single fully open flower on the L duplicate of the collection *Native Collector for Koelz* 5835 (6 vi 1952), which differs from the flowers depicted by Hooker (1888). Photographs in Tanaka *et al.* (2007) are apparently of male flowering plants from northern Burma collected by *Murata et al.* (MBK and TI, not investigated by us). Our supposition is that Hooker described and figured a (largely) functionally female flower with a large ovary and spreading reduced stamens and that the flower in *Koelz* 5835 (in L) is a male flower, with a reduced ovary. The male flower of *Stichoneuron membranaceum* is much smaller than those of the other *Stichoneuron* species. Even with the small number of flowers seen of the other species it would appear that these have less pronounced functionally male and female dimorphism. It may also be that the flowers are protandrous, in which they initially have conspicuously forward-directed and protruding stamens presenting orange-yellow pollen, and a minute ovary; the ovary possibly then develops later when the stamens (with empty anthers) are pushed away laterally. Duyfjes (1993) postulated

that the hermaphroditic-looking flowers of *Stichoneuron caudatum* (at the time including material of *S. halabalensis* and *S. bognerianum*) might be either functionally female or male, partly explaining the observed variation. However, available herbarium material is too scanty to affirm this.

Small insects may be involved in cross-pollination. The flowers of *Stichoneuron membranaceum* and *S. caudatum* are subglabrous, but the adaxial side of the tepals of *S. calcicola*, *S. halabalensis* and *S. bognerianum* is conspicuously hairy and purplish green or reddish tinged, reminiscent of carrion fly pollinated flowers. The odour of the flowers is unknown.

Systematic Treatment

Stichoneuron Hook.f. in Benth. & Hook.f., Gen. Pl. 3: 747 (1883); Hooker, Hooker's Icon. Pl. 8: t.1776 (1888); Hooker, Fl. Brit. India 6: 299 (1892); Ridley, Fl. Malay. Penin. 4: 320 (1924); Duyfjes, Fl. Males., Ser. 1, Spermat. 11(2): 408 (1993). – Type species: *Stichoneuron membranaceum* Hook.f.

Erect or decumbent branched herbs with short crowded rootstock, leafy shoots several years of age; roots lacking tubers; lower part of stem with sheathing cataphylls often with fimbriate margins; prophyllum present at point of ramification; in erect plants the upper branches often leaning over. *Leaves* alternate, subdistichous; petiole slightly sheathing at base or not; blade simple, ovate-oblong or elliptic, margin entire, apex acute-acuminate, lateral veins 2–4 pairs, curved, one pair basal, venation finely trabeculate. *Inflorescences* axillary, pedunculate, with flowers arranged in clusters or raceme-like with only 1 or 2 flowers at apex in anthesis; buds (depressed) globose. *Flowers* small, perfect or functionally unisexual with some reduction of one sex and some dimorphism; pedicel filiform, stiff, articulate, persistent below articulation; bracts narrow, margins fringed, acute, persistent; perianth of 4 tepals, imbricate, almost free, often recurved; *stamens* 4, free, filaments at base shortly adnate to tepals; anther comprising 2 dorsifixed thecae, horizontal or curved over the apex of the filament, connective broad or narrow, without appendages; *ovary* superior or half-inferior, green, ovoid, minute, c.0.5 mm diam., 1-celled, ovules 2–4, placentation apical, style lacking, stigma minute, sessile, 1 (but see the note under *Stichoneuron membranaceum*). *Fruit* elongate, apex acute or beaked, green, capsular with 1–4 seeds; pericarp thin; perianth persistent. *Seeds* large, brown or reddish-brown, broad-ellipsoid, (irregularly) longitudinally ridged, aril (elaiosome) of 5–8 finger-like hyaline appendages or irregularly shaped, surrounding seed to about halfway; funicle shorter than the seed, pseudo-funicle (always present?) as long as the fruit.

Distribution. *Stichoneuron membranaceum* in NE India and northern Burma, *S. bognerianum*, *S. calcicola*, *S. caudatum* and *S. halabalensis* in Peninsular Thailand and Peninsular Malaysia (Fig. 1).

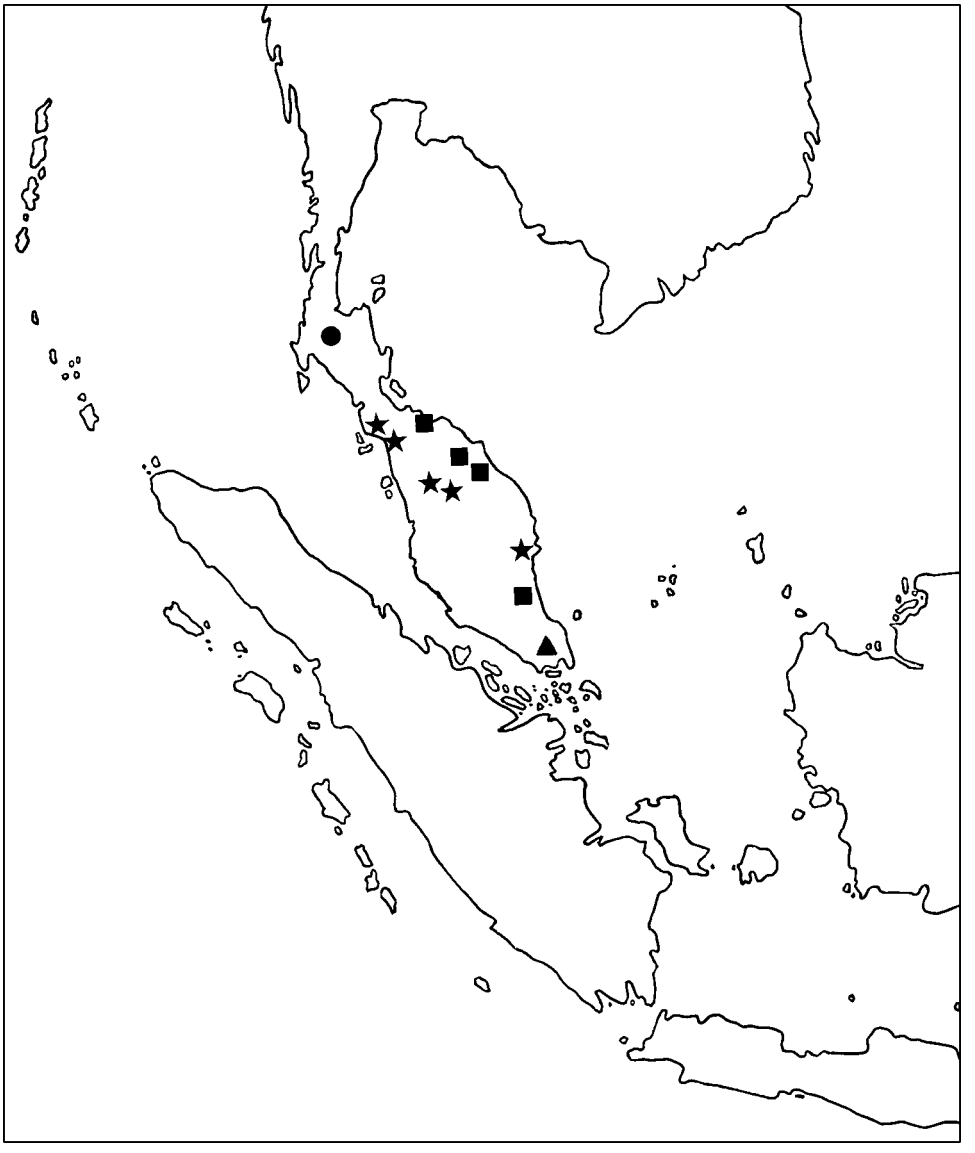

FIG. 1. Distribution of *Stichoneuron* in Peninsular Thailand and Peninsular Malaysia: *S. bognerianum* (▲); *S. calcicola* (●); *S. caudatum* (★); *S. halabalensis* (■).

Key to the species

1a. Plant decumbent; leaves suborbicular or heart-shaped, all veins basal; flowers red; on limestone rocks; Peninsular Thailand _____ **2. S. calcicola**

1b. Plant erect; leaves ovate, elliptic or narrowly elliptic, pinnately veined, one pair basal; flowers pink-purplish, green, whitish or pale yellowish; terrestrial; India, Burma, Thailand, Malaysia _____ 2

2a. Corolla c.3 mm diam., pale yellowish; petiole 1–4 mm long; NE India, northern Burma _____ **5. S. membranaceum**

2b. Corolla 5–10 mm diam., reddish, whitish-purplish, purple or green; petiole (4–)5–10 mm long; Peninsular Thailand, Peninsular Malaysia _____ 3

3a. Tepals reflexed, acute and with c.7 mm long apical appendage, adaxial surface pink-purplish, with papillose hairs to 0.5 mm long; peduncle somewhat curved, 3–7(–10) cm long _____ **3. S. caudatum**

3b. Tepals somewhat reflexed or laterally patent, acute or acute-acuminate, with apical appendage to 1 mm long, adaxial surface green or whitish, densely or sparsely hairy; peduncle stiff, up to 2 cm long _____ 4

4a. Peduncle 1–2 cm long; flower c.5 mm diam. (c.4 mm when dry); tepals adaxially green, with sparse purplish hairs c.1 mm long _____ **4. S. halabalensis**

4b. Peduncle c.0.5 cm long; flower c.10 mm diam. (c.7 mm when dry); tepals whitish, with dense white or reddish hairs c.0.5 mm long _____ **1. S. bognerianum**

1. Stichoneuron bognerianum Duyfjes, **sp. nov. Fig. 2.**

A *Stichoneuro caudato* pedunculo brevi c.0.5 cm longo, floribus magnis c.10 mm diam., tepalis adaxialiter albescentibus dense breviter albo-pilosis, pilis c.0.5 mm

FIG. 2. *Stichoneuron bognerianum* Duyfjes. A, flower, side view; B, flower, top view. Photos: J. Bogner, from *Bogner* 1789 (K, L, M).

longis differt. – Type: Cultivated at Münich Botanic Garden 1993, originating from Peninsular Malaysia, Johor, *Bogner* 1789 (holo M; iso K, L).

Stichoneuron caudatum auct. non Ridl.: Duyfjes, Fl. Males., Ser. 1, Spermat. 11(2): 408, p.p., f. 3, 4 (1993); Bouman, Blumea 36: f. 36 (1995); Rudall et al., Taxon 54(3): f. 4 (2005); Rudall & Bateman, Syst. Bot. 31(2): f. 1A (2006).

Erect herb, 20–40 cm tall, short-hairy. *Leaves*: petiole c.5 mm long, non-sheathing to barely sheathing; blade narrowly elliptic, 5–7 × 2.5–4 cm, base short-cuneate, lateral veins 3(or 4) pairs; prophyll 3–4 mm long. *Inflorescences* glabrous; peduncle c.5 mm long, straight, 1–5-flowered, bracts 1–2 mm long, ± fringed. *Flowers*: corolla pale greenish, 10–12 mm diam.; pedicel 10–15 mm long, persistent part 5(–10) mm long; tepals spreading or faintly recurved, elliptic, 6–7 × c.3 mm, margin ± recurved, apex acute, lacking appendix, abaxially greenish and glabrous, adaxially pale green and densely somewhat papillose white-hairy, hairs c.0.5 mm long; stamens c.1.5 mm long, filaments purple-red, white-hairy; anthers curved over apex of filaments, 1(–1.5) mm long, yellow; ovules 3 or 4. *Fruit* 15–20 mm long, 6–8 mm diam., shortly beaked. *Seeds* 1 or 2, ellipsoid, 5–6 mm long, ridges sinuate, aril irregularly lobed; funicle short (see Bouman, 1995); pseudo-funicle not seen.

Distribution. Southern Peninsular Malaysia (Johor); known from few collections and from flowering plants cultivated in the Münich Botanic Garden (see note).

Ecology. In or near swamp forest; sea level to 30 m.

Additional specimens examined. Peninsular Malaysia. **Johor**: Kota Tinggi-Mawai Road, 4 ii 1935, *Corner* SF 28716 (K); Sungai Kaya, 11 iii 1937, *Corner* SF 3271 (K); 5 viii 1939, *Corner* SF 37056 (K).

The species is named after Josef Bogner (M) who received living material from the greenhouses of the biology department at Amherst (USA) in 1993 and successfully cultivated it to the present day in the botanic gardens at Münich. The material was collected by Dr Conover near a sawmill near Sg. Kayu, a tributary of the Sidili River, near Mawai, beside the Kota Tinggi Road (see Corner, 1978: f. 1 for map).

2. Stichoneuron calcicola Inthachub, **sp. nov. Fig. 3.**

Stichoneuro caudato in habitu decumbenti, foliis cordiformibus, 3-, 5- vel 7-plinervibus differt. – Type: Peninsular Thailand, Surat Thani, Khlong Phanom National Park, 21 ii 2001, *Middleton* 544 (holo BKF; iso A, E, L).

Several-branched low herb with the branches ± woody at base, 20–50(–100) cm long, decumbent or trailing or hanging, growing on vertical limestone rock; most parts (except upper leaf surface, pedicels and flowers) finely hairy, hairs 0.5–1 mm long. *Leaves*: petiole 2–5(–10) mm long, not sheathing at base; blade ovate or subcircular in outline, 1.5–6 × 1.5–5 cm, base cordate, veins 4(–7) broadly arching from (near) the base to near the apex; prophyll 1–2 mm long. *Inflorescences*: peduncle glabrescent, 1.5–3.5 cm long, flowers up to 40, in short, dense raceme, to 15 mm

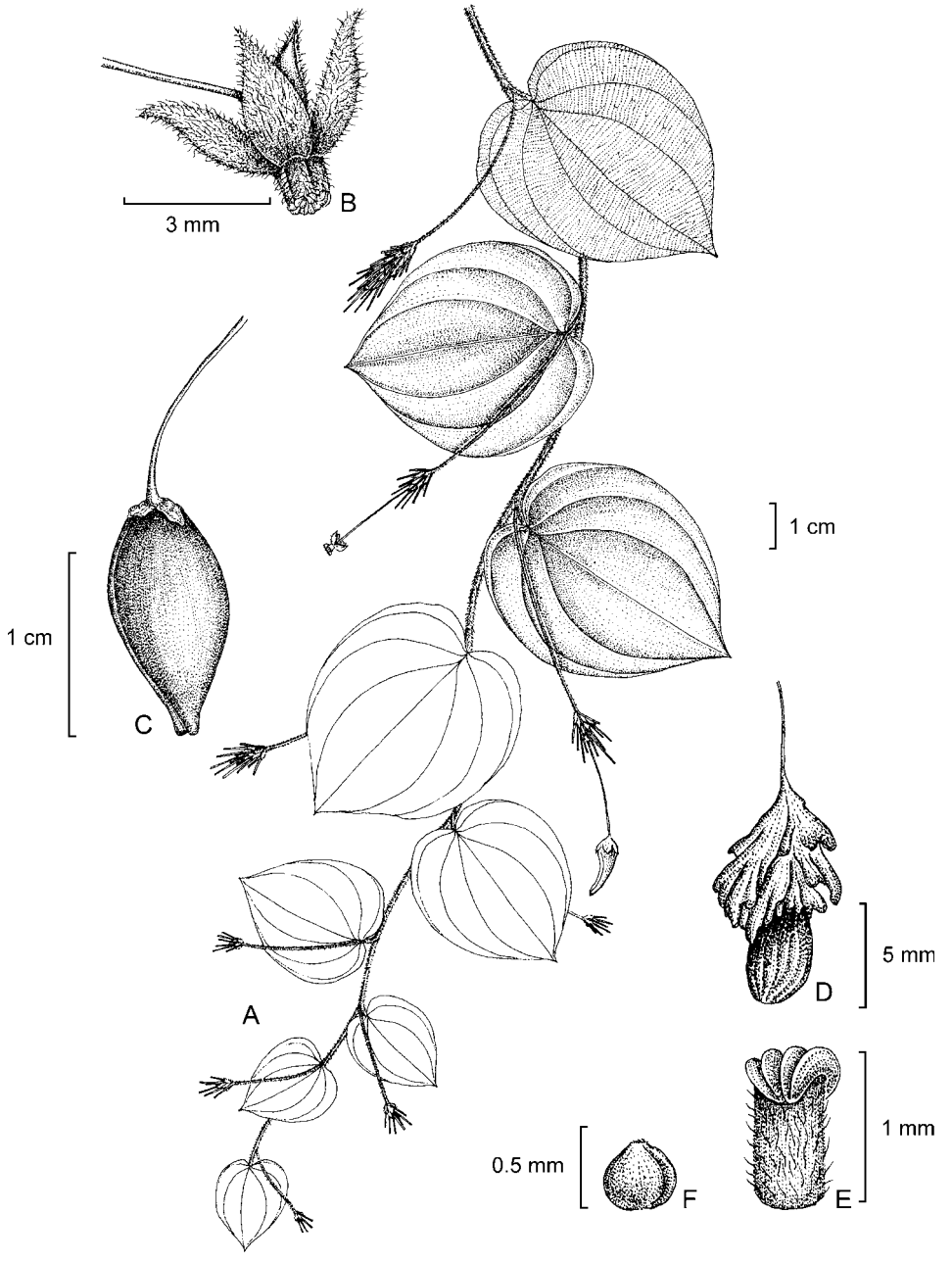

FIG. 3. *Stichoneuron calcicola* Inthachub. A, flowering and fruiting stem; B, flower; C, stamen; D, ovary; E, fruit; F, seed with irregularly lobed aril. Drawn from *Inthachub* 155 (BKF, L).

long, sometimes ramified and producing secondary peduncles to 2 cm long; bracts ovate-oblong, acute-acuminate, 1.5–2 × 1–1.5 mm. *Flowers*: corolla red, 4–5 mm diam.; pedicel 10–15(–20) mm long, persistent part 5–10 mm long, glabrous; tepals ovate-elliptic, 2–3 × 1.5–2 mm, acute(-acuminate), abaxially glabrous, adaxially sparsely or densely set with red hairs < 0.5 mm long; filaments reddish or purplish, closely adhering, forward directed, stout, 1–1.5 × c.0.5 mm, hairy; anthers yellow or orange, c.0.5 mm diam. *Fruit* narrowly ovoid, (5–)10–12 mm long, 5(–7) mm diam., glabrous, apex narrowed and ± 2-lobed; fruiting pedicel c.15 mm long. *Seeds* 1 or 2, reddish or purple-brown, c.5 × 3 mm, ridges straight, aril wide, irregularly lobed, reaching over halfway up the seed; funicle short; pseudo-funicle distinct, nearly as long as fruit.

Field notes. Flowers red; fruit green.

Distribution. Peninsular Thailand; known only from a restricted area in Surat Thani (Khlong Phanom National Park and Khlong Saeng Wildlife Sanctuary).

Ecology. Secondary forest on limestone; hanging from fissures in rock; 50–300 m.

Additional specimens examined. THAILAND. **Surat Thani**: Khlong Phanom National Park: 16 vii 2000, *Chamchumroon* 865 (BKF); 21 ii 2006, *Greger & Vajrodaya* HG 1026 (WU); 24 iii 2006, *Inthachub* 155 (BKF, L); 11 iv 2003, *Middleton et al.* 2142 (BKF, K, L); 24 iv 2005, *Pooma et al.* 5198 (BKF, L); 16 ii 2005, *Williams & Pooma* 1545 (BKF, L); Khlong Saeng Wildlife Sanctuary: *Middleton et al.* 4304 (BK, BKF, E).

Stichoneuron calcicola is distinct by its procumbent habit and ecology (growing on limestone). The leaves are subplinerved, somewhat similar to those of *Croomia* and *Stemona*. All collections are from limestone rock.

3. Stichoneuron caudatum Ridl., J. Straits Branch Roy. Asiat. Soc. 57: 107 (1911); Ridley, Fl. Malay. Penin. 4: 321 (1924); Grey-Wilson, Kew Bull. 26: 150 (1971); Steenis, Blumea 28: 151 (1982); Duyfjes, Fl. Males., Ser. 1, Spermat. 11(2): 408 (1993). – Type: Peninsular Malaysia, Perak, Temango, vii 1909, *Ridley* 14582 (holo SING; iso K). **Fig. 4.**

Stichoneuron membranaceum auct. non Hook.f.: Prain, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 73: 43 (1904).

Slender erect herb (20–)30–80 cm tall, with few branches; stem, petiole and leaves thinly hairy or glabrous. *Leaves*: petiole 5–10 mm long, sparsely hairy, slightly sheathing at base; blade (ob)ovate or narrowly elliptic, 9–10(–12) × 3–4(–5) cm, base obtuse or shortly cuneate, lateral veins 3(or 4) pairs; prophyll c.5 mm long. *Inflorescences*: subglabrous, peduncle slender, somewhat curved downward, 3–7(–10) cm long, few to densely (c.40) flowered, raceme to 3 cm long; bracts with ± fimbriate margin, c.2 mm long. *Flowers*: corolla pinkish brown or reddish purple, 6–8 mm diam.; pedicel 10–15 mm long, persistent part 5–8 mm long; tepals lanceolate, strongly reflexed, 3–4 × c.2 mm, at apex with a slender appendage

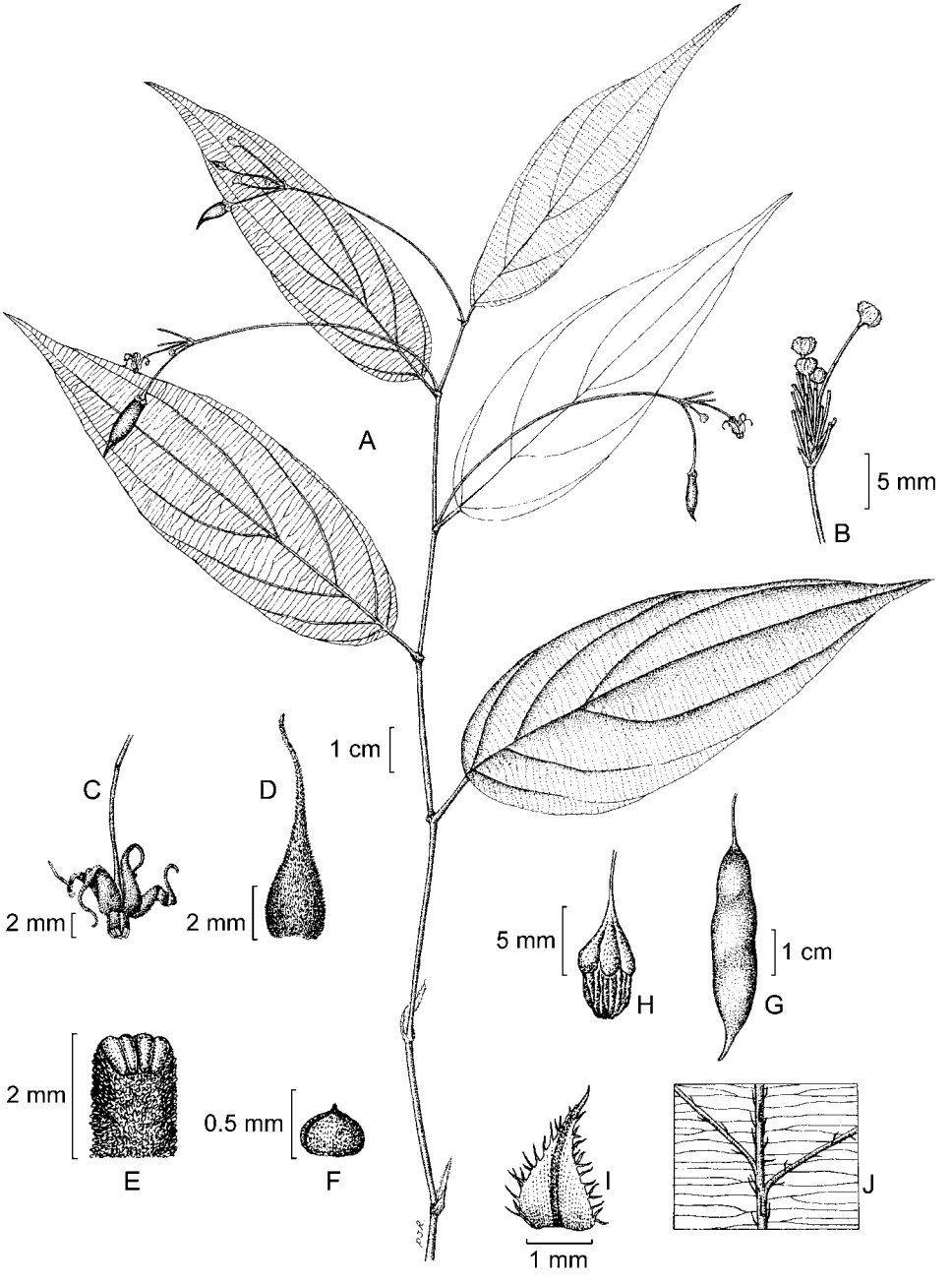

FIG. 4. *Stichoneuron caudatum* Ridl. A, flowering and fruiting stem; B, inflorescence with buds; C, flower; D, tepal, seen from inside; E, stamen; F, ovary; G, fruit; H, seed with finger-like aril lobes; I, bract; J, detail of lower leaf surface. Drawn from *Inthachub* 103 (BKF, L).

4–7 mm long, abaxially glabrous, adaxially papillose, papillae up to 0.5 mm high; stamens 1.5–2 mm long, filaments forward directed, stout, 1–1.5 mm long, reddish purple, glabrous or papillose; anthers yellow (or purple?). *Fruit* 20–45 mm long, 7–10 mm wide, 5(–10) mm beaked; fruiting pedicel c.15 mm long. *Seeds* 2–4, brown, c.7 × 4 mm, ridges straight, aril lobes straight, finger-like; funicle and pseudo-funicle not seen.

Distribution. Peninsular Thailand (Pattani, Yala, Narathiwat), Peninsular Malaysia (Perak, Terengganu, Kelantan).

Ecology. Wet habitats in lowland dipterocarp forests and rain forests, mostly near streams; granite bedrock, and sandy places; 30–600 m.

Additional specimens examined. THAILAND. **Pattani**: Bachaw [Bacho], 13 vii 1923, *Kerr* 7172 (BK, K, L); Betong, 11 iii 1925, *Kerr* 10082 (BK, K, L); Toh Muh, Ban Kaluki, 23 iv 1931, *Lakshnakara* 775 (BK, K). **Yala**: Than To Waterfall, 27 ii 2003, *Greger & Vajrodaya* HG 898 (WU); Bang Lang National Park, 19 vii 2004, *Pooma et al.* 4440 (BKF, L); Ban Chulabhorn, 21 iv 2005, *Pooma et al.* 5075 (BKF, L); Betong, 2 iii 2001, *Suksathan* 2930 (QBG). **Narathiwat**: Hala-Bala Wildlife Sanctuary, 20 iv 2004, *Chongko* 305 (BKF, L); ibid., 10 ix 2004, *Inthachub* 103 (BKF, L).

PENINSULAR MALAYSIA. **Kelantan**: Gua Musang-Kuala Betis track, 14 vii 1935, *Henderson* SF 29662 (K, L); Gua Musang, Gua Cha, 9 x 1985, *Latiff et al.* ALM 1035 (K); Sungai Lebir, 28 iv 1976, *Stone & Sidek* 12514 (L); Kuala Aring, x 1899, *Yap* 108 (K). **Perak**: Temenggor Forest Reserve, 31 viii 1993, *Latiff et al.* 3970 (L); Chior Forest Reserve, 5 x 1967, *Ng* FRI 5740 (L). **Terengganu**: Ulu Telemong Forest Reserve, 25 vii 2006, *Imin et al.* FRI 50586 (L); ibid., 26 vii 2006, *Lee SL* 142 (L).

4. Stichoneuron halabalensis Inthachub, **sp. nov. Fig. 5.**

A *Stichoneuro caudato* pedunculo multo breviore c.1 cm longo, tepalis acuminatis differt. – Type: Thailand, Narathiwat, Hala-Bala Wildlife Sanctuary, 10 ix 2004, *Inthachub* 117 (holo BKF; iso L).

Erect herb 30–60 cm tall, with few branches; stem, petiole and leaves sparsely hairy. *Leaves*: petiole 5(–7) mm long, inconspicuously sheathing at base, blade narrowly ovate-oblong or elliptic-oblong, glabrous, except veins on lower surface sparsely hairy, 6–12 × 1.5–5.5 cm, base broadly rounded or short cuneate, lateral veins 3(or 4) pairs; prophyll c.0.5 cm long. *Inflorescences*: subglabrous, peduncle straight, 0.5–1.5 cm long, with few hairs at base, flowers 5–25, in condensed raceme up to 1 cm long; bracts 1–2 mm long. *Flowers*: corolla greenish, c.6 mm diam.; pedicel (2–)5–7 mm long, persistent part 2–4 mm long; tepals oblong, patent and slightly reflexed, 3–4 × 1–1.5 mm, apex acuminate for c.1 mm, abaxially green, glabrous, adaxially yellowish green, sparsely or densely hairy with pale purplish hairs 0.5(–1) mm long; stamens c.1.5 mm long, filaments patent, erect, greenish or purple, 1(–1.2) mm long, glabrous or fine-papillose; anthers c.0.5 mm long, yellow or orange. *Fruit* c.30 mm long, 10 mm wide, with a 5 mm long beak; fruiting pedicel c.7 mm long. *Seeds* (1 or)2, (dark) brown, c.9 × 5–6 mm, ridges straight, aril lobes straight, finger-like; funicle short, pseudo-funicle present.

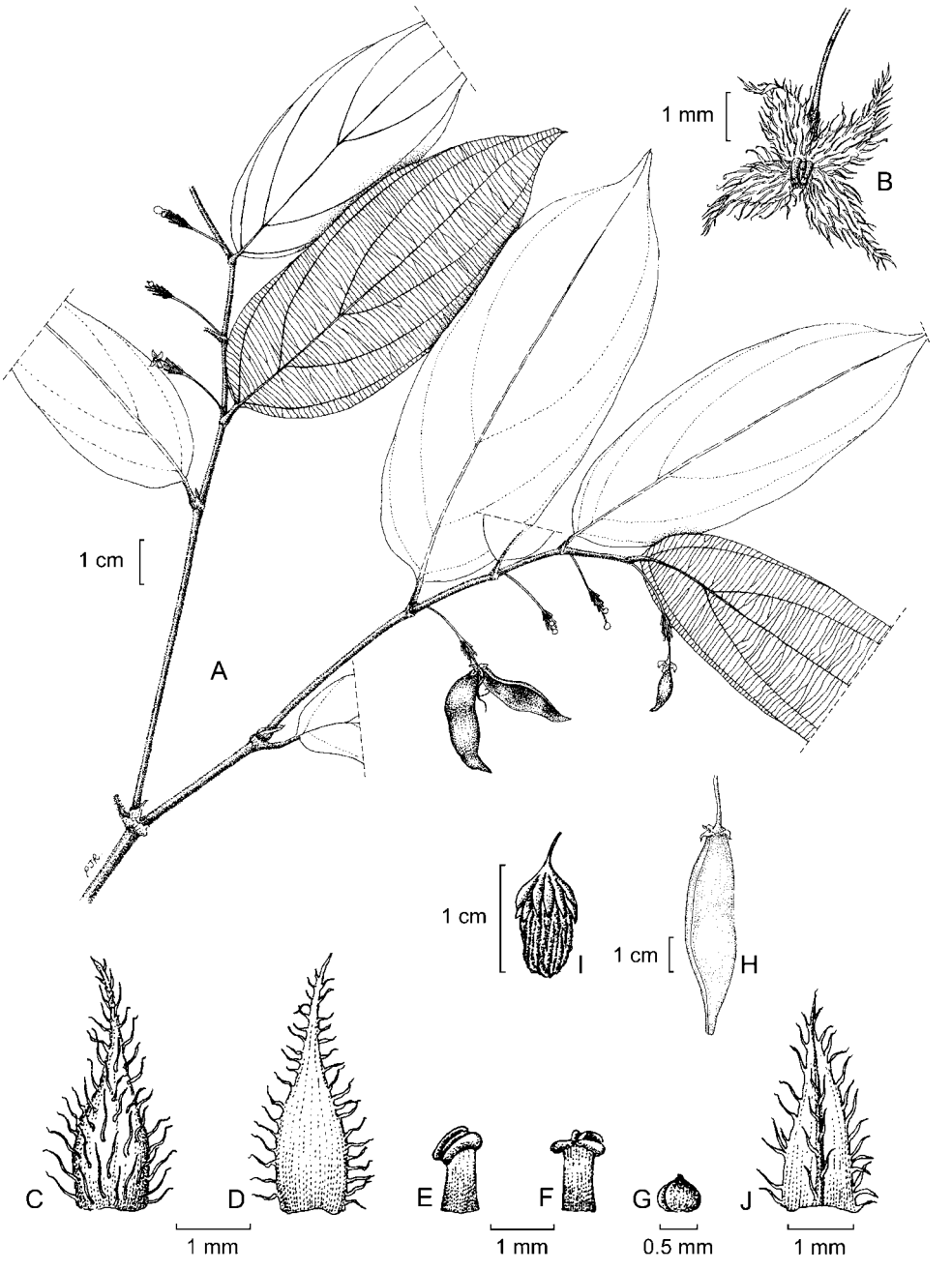

FIG. 5. *Stichoneuron halabalensis* Inthachub. A, flowering and fruiting stem; B, flower; C–D, tepal, seen from inside and outside respectively; E–F, stamens; G, ovary; H, fruit; I, seed with finger-like aril lobes; J, bract. Drawn from *Inthachub* 117 (BKF, L).

Distribution. Peninsular Thailand (Narathiwat), Peninsular Malaysia (Terengganu, Pahang).

Ecology. In rain forest along streams; 30–160 m.

Additional specimens examined. THAILAND. **Narathiwat**: Hala-Bala Wildlife Sanctuary, 10 iii 2005, *Poopath* 213 (BKF); Waeng, 26 viii 2006, *Poopath* s.n. (BKF).

PENINSULAR MALAYSIA. **Terengganu**: Ulu Kajang, Bukit Haliya, Kemaman, 17 xi 1935, *Corner* SF 30503 (K); Ulu Ayam, Bukit Kajang, Kemaman, 5 xi 1935, *Corner* SF 30242 (K, L); near 36th mile Jerangau Road, 22 ix 1955, *Sinclair & Kiah* 40942 (K, L). **Pahang**: Lesong Forest Reserve, 7 iii 1980, *Maxwell* 80-85 (L).

The habit of *Stichoneuron halabalensis* is similar to *S. caudatum*, the latter differing chiefly in its longer peduncles, longer pedicels (5–15 mm long), red or purplish flowers, and in its strongly reflexed long-caudate tepals which are adaxially glabrous or papillose rather than long-hairy. Both species grow in the same area in Narathiwat.

5. Stichoneuron membranaceum Hook.f., Hooker's Icon. Pl. 8: t.1776 (1888); Hooker, Fl. Brit. India 6: 299 (1892); Tanaka et al., J. Jap. Bot. 82(5): 272, f. 4: A–B, 5 (2007). – Type: India, Silhet [but probably Khasia Hills above Silhet], *De Silva* in *Wallich* 9110 (holo K-W).

Stem erect, 50–80 cm tall; all parts subglabrous. *Leaves*: petiole 1–5 mm long, slightly sheathing at base, blade narrowly ovate-elliptic or narrowly elliptic, 5–12 × 2–5 cm, base (broadly) rounded or short cuneate, lateral veins (2 or)3 pairs; prophyll 1(–1.5) cm long. *Inflorescences*: subglabrous, peduncle 1.5–2 cm long, flowers 5–10, crowded; bracts 2–4 mm long. *Flowers*: pale, subglabrous. *Hermaphroditic flowers*: pedicel c.10 mm long, hypanthium enlarged, corolla c.4 mm diam.; tepals subtriangular, c.1.5 mm long, adaxially glabrous, abaxially sparsely hairy; filaments c.1 mm long, thecae c.0.5 mm long. *Male flowers*: pedicel 3–6 mm long, corolla c.3 mm diam. *Fruit* and *seeds* unknown.

Distribution. India (Meghalaya: Khasia Hills), Burma.

Ecology. Forests; 200–1000 m; flowering in June (Khasia) and February (Burma).

Additional specimens examined. INDIA. **Assam**: Khasia, 1850?, *Hooker f. & Thomson* s.n. (K, L); Cherrapunjee, Khasia Hills, 6 vi 1952, *Koelz* 5835 (L); photo and distribution map in Tanaka *et al.* (2007).

The inflorescences are situated above the leaf blade, with the peduncle closely appressed to the basal part of the midvein (see Tanaka *et al.*, 2007).

The ovary in Hooker's plate is c.1.5 mm across which is larger than is known in the other species which are c.0.5 mm across. Possibly the drawing is of a functionally female flower, with possibly two stigmas on top of conical styles. See also the discussion in the section on flower dimorphism above.

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