

## A revision of the genus *Greenea* (Rubiaceae)

CHRISTIAN TANGE<sup>1</sup>

**ABSTRACT.** The genus *Greenea* Wight & Arn. is revised using traditional herbarium taxonomic methods and field observations; nine species are recognised. Four new species are described: *G. adangensis*, *G. montana*, *G. rivularis* and *G. vietnamensis*. *Spathichlamys oblonga* Fisher is transferred to *Greenea* and named *G. schizocorolla*. The two species *G. oblonga* Craib and *G. siamensis* Craib are reduced to varieties of *G. corymbosa*. *Greenea wightiana* Wight & Arn. is reduced to a synonym of *G. corymbosa* var. *corymbosa*. *Greenea* is distributed from Sumatra through the Malay Peninsula to S Thailand and Burma, and occurs again in N and SE Thailand, Laos, and Vietnam.

**KEY WORDS:** *Greenea*, taxonomy, Thailand, Malesia, *Spathichlamys*, new species.

### INTRODUCTION

The genus *Greenea* Wight & Arn. was established by Wight & Arnott (1834) to accommodate *Rondeletia corymbosa* Jack and a new species, *G. wightiana* Wight & Arn. It was named after the American botanist Benjamin Daniel Greene. The nearly 20 species described so far form a heterogeneous assemblage and, therefore, *Greenea* is in need of revision.

*Greenea* is a genus of small trees often growing on slopes, along streams and in disturbed places. The leaves are large, often 30–50 cm long, and confined to the upper nodes. The inflorescences are terminal and contain up to several hundred flowers. The capsular fruits release many small seeds. Based on a chloroplast DNA phylogenetic study by Mouly et al. (2009), *Greenea* is placed in the monogeneric tribe Greeneae, sister to the Ixoreae-Aleisanthieae clade.

### MATERIALS AND METHODS

This revision is based on herbarium material (335 collections) from the following herbaria, with abbreviations in accordance with Index Herbariorum (Thiers [continuously updated]): A, ABD, AAU, B, BK, BKF, BM, BO, C, CAL, DD, E, HAM, HNU, K, KEP, L, P, PSU, SAR, SING, U and W. During

the study the following herbaria were visited: BK, BKF, BO, BSD, C, CAL, DD, HNU, K, KEP, L, PSU, SAR, and SING. Six of the following nine species were studied in the field: *G. corymbosa*, *G. commersonii*, *G. adangensis*, *G. montana*, *G. rivularis*, and *G. vietnamensis*. All measurements of floral parts are from material boiled in water in rehydrate. Stipule characters are measured from dry material. Material for microscope study was obtained from herbarium specimens or from alcohol preserved material.

***Greenea*** Wight & Arn. Prodr. Fl. Ind. Orient. 1: 403. 1834.— Type species: *Greenea corymbosa* (Jack) Voigt — *Rhombospora* Korth., Nederl. Kruidk. Arch. 2: 114. 1851. Type species: *Rhombospora commersonii* Korth.— *Spathichlamys* Parker, Bull. Misc. Inform. Kew 1931: 42. 1931. Type species: *Spathichlamys oblonga* Parker.

Small trees up to ca 10 m high. Young branches hairy, later becoming glabrous. Leaves opposite and decussate or in whorls of 3, blades up to 50 cm long, very gradually tapering to the petiole, hairy to almost glabrous; petioles swollen at the base. *Stipules* interpetiolar, shortly fused at the base, forming a short tube around the stem, with free entire limb, hairy to almost glabrous, inside with colleters. *Inflorescences* terminal, determinate

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thyrses; the partial inflorescences branching dichasially one to a few times and then continuing as monochasia. *Flowers* hermaphrodite, or in one species hermaphrodite and female, 4- to 5-merous; calyx tubes absent or short; calyx lobes triangular to narrowly triangular or oblong, often of unequal size; corolla tube cylindrical to campanulate, or splitting along one side; corolla lobe aestivation sinistorse, always shorter than tube, erect or folding inwards to close the throat, on the inner side villous; filaments inserted in the corolla tube, long or short, sometimes decurrent; anthers included or exerted from the corolla, opening introrsely by longitudinal slits; style filiform; stigma with two lobes, erect or recurved; ovary bilocular, crowned by a glandular disc, depressed around the style,

placentas peltate with numerous ovules. *Fruits* capsular with hard endocarp and persistent calyx lobes; opening septicidally by hygroscopic twisting of the endocarp, each carpel splitting slightly in the upper part. *Seeds* numerous in each locule; brown and angular, 0.4–0.5 mm in diam; exotesta cells flattened radially, without thickenings on the outer wall, inner wall thickened, with large pores, radial walls with low thickenings, thickenings smooth. *Raphides* absent, idioblasts with abundant tannin content. *Pollen* spherical, tricolporate, tectum reticulate to foveolate.

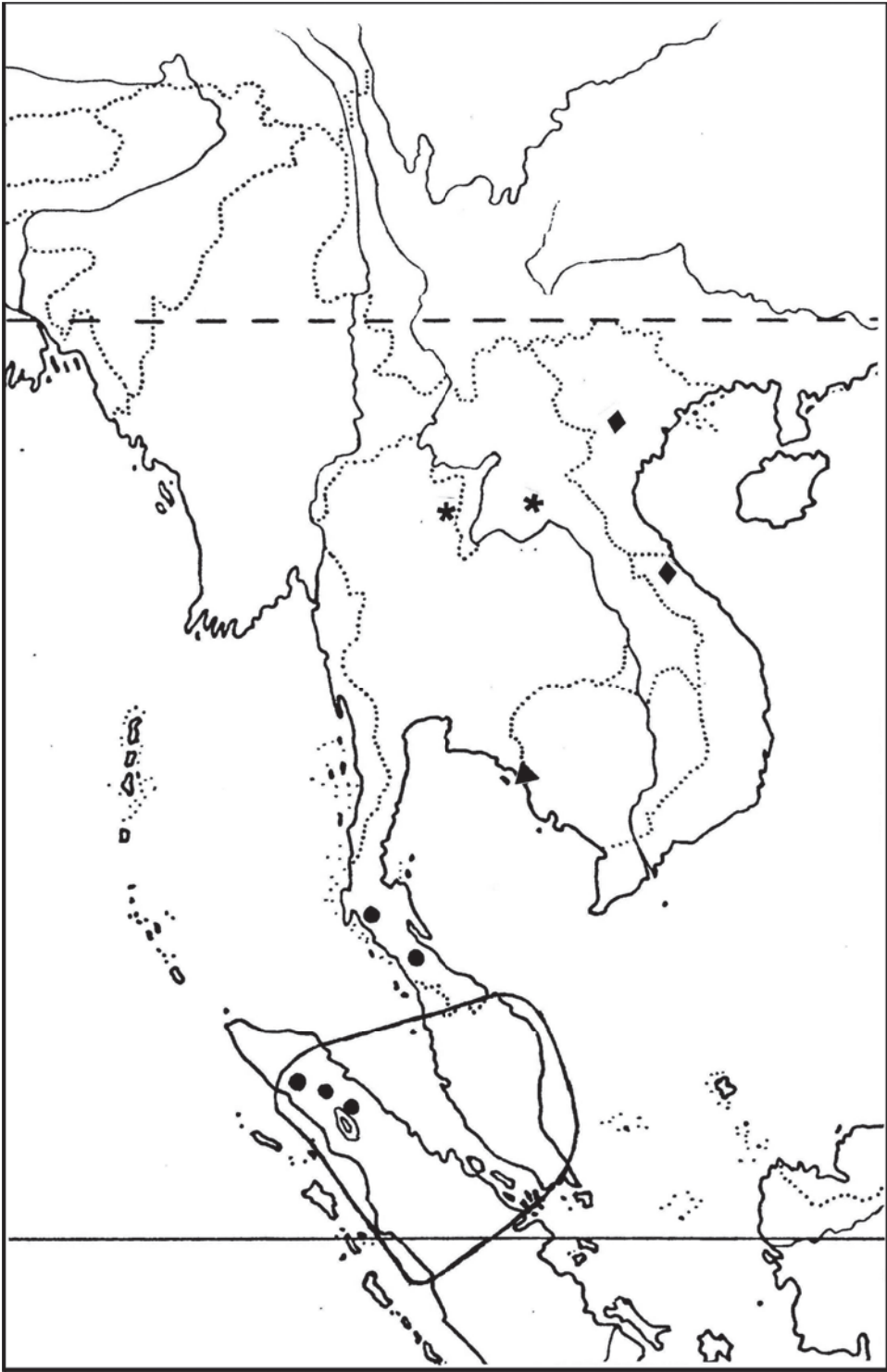
Distribution.—Sumatra, Peninsular Malaysia, Thailand, Burma, Laos and Vietnam (Maps 1, 2).

## KEY TO THE SPECIES

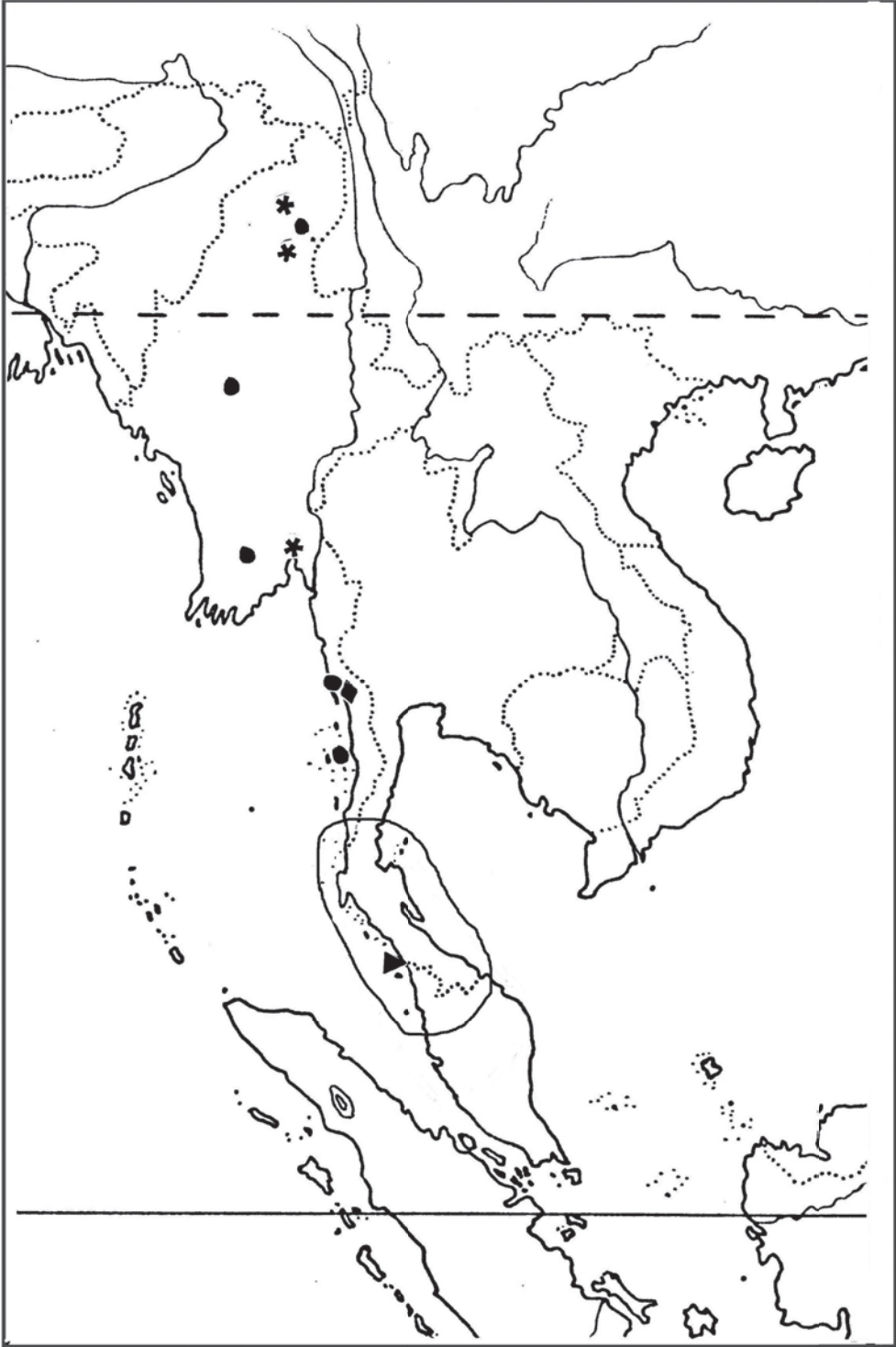
1. Stipules cuspidate
  2. Flowers 5-merous; anthers sagittate; leaves usually in whorls of three **6. *G. secunda***
  2. Flowers 4-merous; anthers not sagittate; leaves decussate **7. *G. adangensis***
1. Stipules not cuspidate, but rounded to acuminate
  3. Flowers with a 1–5 mm long pedicel
    4. Corolla tubes urceolate, not splitting **8. *G. parkinsonii***
    4. Corolla tubes cylindrical, splitting along one side **9. *G. schizocorolla***
  3. Flowers sessile
    5. Corolla tubes inside with a ring of straight, stiff hairs ca 1–2 mm from the base, often indicated by a constriction; corolla lobes usually oblong
      6. Filaments 0–1 mm; anthers glabrous; calyx lobes triangular, reflexed in fruit **3. *G. montana***
      6. Filaments more than 1 mm; anthers sparsely hairy; calyx lobes not triangular, not reflexed in fruit
        7. Apex of stipules rounded; apex of anthers pointed; calyx lobes narrowly triangular to lanceolate, pointing inwards in mature fruit; plant with appressed hairs **4. *G. rivularis***
        7. Apex of stipules acute; apex of anthers not pointed, calyx lobes oblong, erect in fruit; plant with patent hairs **5. *G. vietnamensis***
    5. Corolla tubes inside without a ring of straight, stiff hairs ca 1–2 mm from the base, often corolla lobes ovate; or flowers female with corolla tube short or absent, corolla lobes linear
      8. Ring of hairs present at the very base of the corolla tube, or if only few hairs, then these are also at the very base; filaments more than 1.4 mm long; calyx lobes less than 1 mm; (or flowers female with linear corolla lobes); flowers 5-merous **2. *G. commersonii***
      8. Ring of hairs in the corolla tube absent, if few hairs are present, then these are ca 1 mm above the base (in var. *siamensis* only); filaments less than 0.5 mm; calyx lobes often more than 1 mm; flowers always hermaphroditic, 4- to 5-merous **1. *G. corymbosa***

**1. *Greenea corymbosa*** (Jack) Voigt, Hort. Suburb. Calcutt. 385. 1845; K. Schum. in Engler & Prantl, Nat. Pflanzenfam. iv(4): 37. 1891.—*Rondeletia corymbosa* Jack, Malayan Misc. 1(2): 4. 1820.—*Wendlandia corymbosa* (Jack) Wall. ex DC., Prodr. 4: 413. 1830.—*Greenea jackii* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 404. 1834.— Type: Malaysia, Pulau Penang, 1819, *Jack s.n.* (lectotype **K**, selected here; isolectotypes **ABD**, **E**).—*Rondeletia spicata* Wall. ex. Roxb., Fl. Ind [Carey & Wallich ed.] 2: 139. 1824.—*Wendlandia spicata* (Wall. ex Roxb.)

DC., Prodr. 4: 412. 1830.— Type: Malaysia, Penang, 1822, *Wallich* 6276 (lectotype **K**, selected here; isolectotypes **BM**, **C**, **E**, **K**).—*Greenea wightiana* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 404. 1834 [10 Oct. 1834]. — *Wendlandia wightiana* (Wight & Arn.) Wall. ex G. Don, Gen. Hist. 3: 520. 1834 [8–15 Nov. 1834].— Type: Peninsulae Indiae Orientalis, *Wight* 1286 = *Wallich* 6277 (lectotype **K**, selected here; isolectotypes **E**, **K**).—*Greenea oblonga* Craib var. *venosa* Craib, Fl. Siam. 2: 25. 1932.— Type: Thailand, Narathiwat, Bacho, 11



Map 1. Collecting sites of *Greenia montana* (●); *G. rivularis* (\*); *G. vietnamensis* (◆), *G. commersonii* densely collected inside the surrounded area(—), single locality (▶).



Map 2. Collecting sites of *Greenea secunda* (●); *G. parkinsonii* (\*); *G. schizocorolla* (◆), *G. adangensis* (▲), *G. corymbosa* densely collected inside the surrounded area(—).

July 1923, *Kerr* 7153 (lectotype **K**, selected here; isolectotypes **ABD**, **BK**, **BM**).

Trees to ca 10 m high. Young branches strigose to hirsute. *Leaves* decussate; blades to ca 50 by 13 cm oblong, oblong-elliptic or oblong-oblongeolate, base attenuate, very gradually tapering to petiole, apex acute to caudate, almost glabrous to strigose to hirsute on both sides, more dense on the lower surface, especially on the nerves, lateral nerves 18–30; petioles indistinct, 0.5–2.0 cm. *Stipules* 1.5–2.5 cm, apex rounded to acute, from just in contact to connate 4 mm above the base, outer surface strigose to hirsute, inside sericeous from the base and ca 4 mm upwards in a triangular zone, with colleters at the base, glabrous elsewhere. *Inflorescence* 8–20 by 8–20 cm, with 5–15 sessile flowers on each branch. *Flowers* 4- to 5-merous; calyx tube short, calyx lobes triangular 0.8–1.2 mm long, or oblong to oblanceolate 2.5–4 mm long; corolla tube 8–12 mm long, diameter at base ca. 1.5 mm, increasing to ca 3 mm at the apex, outer surface puberulous to villose, inside glabrous (except for a few hairs in var. *siamensis*); corolla lobes ovate, 2.0–3.1 by 1.6–2.4 mm, apex rounded to acute, densely pilose inside; stamens inserted in the corolla tube 5–7 mm above the base, filaments 0.25–0.5 mm long, anthers 2–2.5 mm long, base bilobed, apex bifid to truncate; ovary densely strigose to hirsute; style 7.5–13 mm long, stigma bifurcate. *Fruits* spherical, ca 3 mm in diam., hirsute to strigose, with the calyx lobes erect or reflexed.

Notes.—Wight & Arnott (1834) described the genus *Greenea* to accommodate *Rondeletia spicata* and *Rondeletia corymbosa*, which they recognized as the same species, along with a new species *Greenea wightiana*. For *Rondeletia spicata* and *Rondeletia corymbosa*, they proposed the illegitimate name *Greenea jackii*. The correct name *Greenea corymbosa* was published by Voigt (1845). This was overlooked by Schumann (1891) who published an isonym that was widely used until Mabberley (1980) highlighted Voigt's prior name.

*Greenea corymbosa* is a very variable species in the size and shape of the leaves. Also the hairs are variable in density and can be strigose to hirsute. The flowers are most often 4-merous, but 5-merous plants can also be found; the 5-merous plants are common in Ranong and Chumphon provinces of Thailand. The type specimen of *G. wightiana* (Wight 1286) differs from the type of *G. corymbosa* var. *corymbosa* in having appressed and less dense hairs, but this falls within the range of *G. corymbosa* as recognised here. *Greenea oblonga* var. *venosa*, described by Craib (1932), lacks the defining character states of *G. oblonga* and is reduced to a synonym of *Greenea corymbosa* var. *corymbosa*. *Greenea siamensis* var. *longicalyx* differs from *G. corymbosa* only in the longer calyx lobes. Therefore *Greenea siamensis* var. *longicalyx* is recognised here as a variety of *G. corymbosa*.

#### KEY TO THE VARIETIES

1. Calyx lobes oblong to oblanceolate, 2.5–4 mm long

1.2 var. **longicalyx**

1. Calyx lobes triangular, 0.8–1.2 mm long

1.3 var. **oblonga**

2. Corolla lobes oblong, 2 by 1 mm

2. Corolla lobes ovate

1.1 var. **corymbosa**

3. Corolla tube inside glabrous

1.4 var. **siamensis**

3. Corolla tube inside with four groups of ca 10 hairs, ca 1 mm from the base

#### 1.1 var. **corymbosa** Fig. 1E.

Corolla tube glabrous inside; corolla lobes ovate; calyx lobes triangular 0.8–1.2 mm long.

Myanmar.—Tenasserim [Tenasserim and Andaman Islands, *Helper* 2843 (**A**, **CAL**, **K**, **L**); Pachman, *Collector unknown s.n.* (**BM**)].

Malaysia.—Kedah [Langkawi Islands, Along the coast, 11 Feb. 1940, *Batten-Pool s.n.* (**SING**);

Langkawi Islands, Gunung Raya, 13 Nov. 1921, *Haniff & Nur* 7105 (**CAL**, **SING**); Langkawi Islands, 24 Aug. 1925, *Holttum* 15150 (**SING**); Langkawi Islands, Gunung Raja, alt. 600 m, 19 June 1932, *Kerr* 21716 (**AAU**, **BK**, **BM**, **K**, **L**); Langkawi Islands, Gunung Raja, 3 Nov. 1968, *Kong et al.* **K**. 6173 (**AAU**); Langkawi Islands, Pulau Dayang Bunting, 16 May 1957, *Chew Wee-Lek* CWL 144 (**K**, **L**, **SING**); Langkawi Islands, Burau, 4 Nov.

1916, *Robinson 6306 (ABD)*; Langkawi Islands, Gunung Raya, E slope, alt. 600 m, 12 Dec. 1969, *Whitmore Fri 15031 (A, K, L, SING)*; Ulu Muda Forest Reserve, N Kedah, Hillside, alt. 350 m, 22 Jan. 1969, *Chan FRI 6789 (A, K, L)*; Penasah catchment area, 27 Nov. 1929, *Dahnann 21451 (KEP)*; Gunong Jerai near Sungei Patani Kedah, Roadside 1/4 mile up G. Jerai, alt. 100 m, *Everett FRI 13668 (A, K, L, SING)*; Lubok Pusing, Dec. 1925, *Guard 9038 (K, SING)*; Lubok Pusing, 25 April 1944, *Meh 9038 (K, KEP)*; Koh Mai Forest Reserve, 3 April 1938, *Kiah SFN 35147 (A, K, KEP, SING)*; Pantai Mulik, 23 March 1938, *Sow 34648 (KEP)*; Kedah peak, Sept. 1949, *Wolfe s.n. (SING)*; Malacca [Malacca, *Unknown collector 2778 (SING)*; Malacca, *Maingay 909 (BM, CAL, K, L)*]; Negri Sembilan [Pulau Jerak, 7 Oct. 1974, *Unknown collector s.n. (KEP, SING)*]; Penang [Penang Hill, 7 July 1936, *Corner 31571 (K, SING)*; Tanjung Bunga, Oct. 1884, *Curtis 106 (K, SING)*; Tanjung Bunga, Oct. 1884, *Curtis 1457 (SING)*; Between Teluk Bahang and the Waterfall to the south, alt. 150–300 m, 23 Jan. 1983, *Davis 69458 (E)*; Penang Mountains, 18 Dec. 1900, *Deschamps s.n. (CAL)*; Penang, alt. 750 m, *Didrichsen s.n. (A)*; Top of waterfall, alt. 730 m, 25 July 1890, *Fox 19 (SING)*; Ayer Hitam Dam Reserve. 3 March 1965, *Hardial & Samauri 208 (A, B, C, K, L, SING)*; Botanic Gardens Jungle, 9 Sept. 1968, *Hardial 649 (C, L)*; Teluk Bahang, alt. 50 m. 15 Sept. 1966, *Hou 855 (BO, K, L)*; Penang Hill, 4 Nov. 1879, *Kings s.n. (CAL)*; Malay Islands [Penang], April 1881, *King's Collector, Kunstler 1650 (A, K, CAL)*; Penang, *Kurz s.n. (CAL)*; Base of Penang Hill. 8 Aug. 1982, *Maxwell 82-217 (AAU, BK, L, SING)*; Muka Head, Rocky Coast, 23 June 1982, *Ng FRI 27330 (KEP)*; Penang, June 1893, *Nur s.n. (SING)*; Penang, Aug. 1823, *Porter s.n. (BM)*; Province Wellesley, Bukit Kierlgoon, June 1890, *Ridley s.n. (SING)*; Penang, July 1846, *Rink s.n. (C)*; En route from Penang hill to Waterfall Botanic Garden, 14 Oct. 1967, *Shimizu et al. 13066 (BK, L)*; Behind Waterfall Gardens in jungle, 9 Nov. 1950, *Sinclair 6624 (BM, E, K, SING)*; Galak Sangul, 2 May 1973, *Stein R3 (SING)*; Batu Ferringhi, above sandy beach, May 1966, *Stone 6314 (L)*; Perak [Sg Kenening, Upper Perak, 15 June 1930, *Henderson 23880 (SING)*; Sg Pelus, Chior FR, Sg Siput, alt. 600 m, 6 Oct. 1967, *Ng FRI 5760 (K, L, SING)*; Bukit Kemunting, Taiping, alt. 100

m. 9 Dec. 1965, *Shah & Sidek MS 1178 (A, C, K, L, SING)*; Ljok Forest Reserve, 10 Aug. 1934, *Symington 37397 (A, K, KEP, L)*; Upper Perak, May 1889, *Wray 3570 (CAL, SING)*; Perlis [Mata Ayer Forest Reserve, North Perlis, 11 March 1969, *Chan FRI 6818 (A, K, KEP, L, SING)*; Mata Ayer Forest Reserve, alt. 110 m, 18 Feb. 1981, *Wong et al. FRI 32119 (A, K, KEP, SING)*].

Thailand.—PENINSULAR: Chumphon [10 km E of Ban Racha Krude, alt. 50–100 m, 7 July 1992, *Larsen et al. 43209 (AAU)*; Ban Racha Krude, alt. 150–200 m, 6 July 1992, *Larsen et al. 43140 (AAU)*; 2 km south of Ban Racha Krude, alt. 150–200 m, 6 July 1992, *Larsen et al. 43168 (AAU)*; Ban Racha Krude, alt. 50–100 m, 7 July 1992, *Larsen et al. 43211 (AAU)*]; Ranong [Wild life preservation region, Nakha village, Kaper District, alt. 50–100 m, 24 Dec. 1983, *Fukoka T-35472 (AAU, A)*; Wildlife preservation region. Nakha village, Kaper District, alt. 50–100 m, 24 Dec. 1983, *Fukoka T-35487 (BKF)*; Around Research Center of Mangrove at Ranong, 10 Sept. 1984, *Fukuoka & Nakhon T-36066 (A)*; Ngao Waterfall Forest Reserve, Ngao Mountain, Ngao District, Roadside, 6 Sept. 1984, *Fukuoka & Nakhon T-35886 (BKF)*; Ngao Waterfall Forest Reserve, Ngao Mountain, Ngao District, 9 Sept. 1984, *Fukuoka & Nakhon T-36027 (BK)*; Khlong Naka, 25 April 1973, *Geesink & Santisuk 4852 (AAU, BKF, E, K, L)*; Khlong Kam Puang, 26 April 1973, *Geesink & Santisuk 4933 (AAU, BKF, C, E, K, L, P)*; Khlong Nakha, alt. 50 m, 22 June 1974, *Geesink et al. 7391 (AAU, BKF, K, L)*; Khlong Nakha, alt. 150–300 m, 24 Feb. 1974, *Geesink et al. 7520 (B, BKF, C, K, L)*; La-un, alt. 50 m, 31 Dec. 1928, *Kerr 16455 (AAU, BK, BM, E, K)*; Prapat Beach, Kaper District, 1 March 1983, *Koyama et al. 33932 (BKF)*; Ranong near hot springs, alt. 50–100 m, 5 July 1992, *Larsen et al. 43111 (AAU)*; Foothill of Khao Phra Mi, alt. 60 m, 8 July 1972, *Larsen & Larsen 30770 (AAU, BKF, K)*; 30–70 km south of Ranong, alt. 50–100 m, 27 April 1974, *Larsen & Larsen 33451 (AAU)*; Tambon Hat Som Paen, alt. 200–300 m, 2 May 1974, *Larsen & Larsen 33548 (AAU, B)*; Hat Hin Dam, near the sea, 25 April 1974, *Larsen & Larsen 33378 (AAU, B, E, L)*; Klong Bang Nan, Kaper, alt. 100–250 m, 15 July 1979, *Niyomdham et al. 309 (AAU, BK, C, K, L)*; Bang Hin, Kaper, 23 Aug. 1977, *Santisuk 1270 (A,*

**L, PSU**); Hot Spring Park, alt. 100 m, 6 Dec. 1979, *Shimizu et al.* 26215 (**BKF, L**); Khlong Nakha Wildlife Sanctuary, Kaper District, alt. 50 m, 8 Dec. 1979, *Shimizu et al.* 2640 (**BKF, L**); Khlong Nakha Wildlife Sanctuary, Kaper District, alt. 50 m, 8 Dec. 1979, *Shimizu et al.* 26410 (**BKF**); Khlong Nakha Wildlife Sanctuary, Kaper District, alt. 50 m, 8 Dec. 1979, *Shimizu et al.* 26464 (**BKF, L**); Khlong Nakha Wildlife Sanctuary, Kaper District, alt. 50 m, 8 Dec. 1979, *Shimizu et al.* 26465 (**BKF, L**); Ngao Waterfall, 20 km south of Ranong, Muang District, 8 Dec. 1979, *Shimizu et al.* 26558 (**BKF, L**); Khao Porta Luangkaeo, Kaper District, alt. 600 m, 11 Dec. 1979, *Shimizu et al.* 26927 (**L, BKF**); Khao Porta Luangkaeo, Kaper District, alt. 600 m, 11 Dec. 1979, *Shimizu* 26983 (**BKF, L**); Rak Sa Warin Botanical Garden, alt. 50 m, 6 Sept. 1984, *W. N.* 634 (**BKF**); Surat Thani [Khao Sok, alt. 100–200 m, 25 Oct. 1991, *Larsen et al.* 45533 (**AAU**); Khao Sok, 30 km E of Takuapa, alt. 100–200 m, 9 June 1992, *Larsen et al.* 42761 (**AAU**); Klong sok, 14 Dec. 1975, *Prapat* 163 (**BKF**); Khao Sok National Park, 4 July 1993, *Puff & Sridith* 930704-1/3 (**AAU**); Siepyan, Sept. 1924, *Put* 941 (**ABD, BK, BM, E, K**); Tako, Langsuan, 16 June 1928, *Put* 1690 (**BK, BM**); Tako, Langsuan, 19 June 1928, *Put* 1740 (**ABD, BK, BM**); Tako, Langsuan, 19 June 1928, *Put* 1940 (**ABD**); Phangnga [Ko Surin Nuea, 16 April 1976, *Chira & Smitinand* 2111 (**BK**); Ko Yao Yai, alt. 20 m, 21 Feb. 1966, *Hansen & Smitinand* 12416 (**C, K, L, SING**); Ko Kam Yai, Coast of Takuapa, 5 Nov. 1919, *Kloss* 6630 (**K**); Khao Nang Hong, between Thap Put and Phangnga, alt. 230 m, 24 Aug. 1967, *Shimizu et al.* 8006 (**BKF, L**); Khao Nang Hong, between Thap Put and Phangnga, alt. 230 m, 24 Aug. 1967, *Shimizu et al.* 8018 (**BKF, L**); Khao Nang Hong, 8 June 1967, *Sutheeson* 2555 (**BK**); Krabi [Khao Phanom Bencha, foothill of S range, alt. 100–350 m, 11 July 1992, *Larsen et al.* 43298 (**AAU**); Bang Kram Forest Reserve, 18 km E of Khlong Thom, alt. 75 m, 14 July 1992, *Larsen et al.* 43419 (**AAU**); Ko Kradan, 11 Feb. 1966, *Hansen & Smitinand* 12230 (**BKF, C, K, L, SING**); Nakhon Si Thammarat [Khiri Wong, trail from village up to Khao Luang area, alt. 400–500 m, 15 May 1968, *Beusekom & Pengkhlai* 752 (**K**); Waterfall, Khao Luang National Park, alt. 150–300 m, 5 March 1983, *Koyama et al.* 34075 (**A**); Yong Waterfall, Thungsong District, alt. 150–250 m, 4

March 1983, *Koyama et al.* T-34024 (**BKF**); Khao Luang, alt. 700 m, 23 Aug. 1995, *Larsen et al.* 45900 (**AAU**); Khao Luang, alt. 650 m, 24 March 1954, *Phengnaren* 48 (**BKF**); Khao Soon, Chawang District, alt. 650 m, *Phengnaren* 82 (**BKF**); Khao Soon, Chawang District, alt. 650 m, 26 July 1956, *Phengnaren* 750 (**BKF**); Khao Luang National Park, Phrom Lok Falls, 12 July 1993, *Puff & Sridith* 930712-1/5 (**AAU, PSU, WU**); Khiriwong, alt. 400 m, 17 Oct. 1957, *Sangkhachand* 726 (**BKF**); Thung Song, Nam Tok Yong, alt. 100–150 m, 28 Aug. 1967, *Shimizu & Nalampoon* 8208 (**BKF, L**); Khiriwong, 29 July 1951, *Smitinand* 801 (**A, BKF**); Prom Loke, 23 Aug. 1980, *Student-PSU* 26 (**PSU**); Garome Falls, Khao Luang National Park, alt. 250 m, 15 Sept. 1985, *Ramsri* 98 (**AAU, A, L, PSU**); Phatthalung [Tamot, NW of Hat Yai, alt. 150 m, 20 Aug. 1995, *Larsen et al.* 45808 (**AAU**); Tamot, S Thailand, 11 Aug. 1994, *Tange* 45193 (**AAU**); Trang [Khao Chong, 1 Oct. 1965, *Boonnab & Phuphattanapong* 16 (**BKF**); Khao Chong, 31 Oct. 1949, *Din* 378 (**BKF**); Khao Chong, 15 km E of Trang, alt. 100–150 m, 18 Nov. 1990, *Larsen et al.* 41538 (**AAU**); Khao Chong, alt. 150 m, 13 Aug. 1975, *Maxwell* 75-840 (**AAU, BK**); Amphoe Sikao, alt. 50 m, 28 July 1987, *Paisooksantivatana & Sangkhachand* Y2141-87 (**BK**); Amphoe Kao Kao Tree on roadside, 1 Aug. 1929, *Rabil* 290 (**ABD, BK, BM, K, SING**); Khao Chong, 17 Aug. 1964, *Suvarnakoses* 2184 (**BKF**); Khao Chong, alt. 200 m, 7 June 1933, *Collector Unknown* 267 (**BKF**); Satun [Khuan Kalong, 40 km NW of Satun, 15 Oct. 1970, *Charoenphol et al.* 3868 (**AAU, BKF**); Mo-Lae Bay, Tarutao Island, 6 June 1980, *Congdon* 579 (**A, PSU**); Thon Plieo, 25 km N of Satun, alt. 100 m, 28 Oct. 1993, *Larsen et al.* 44102 (**AAU**); Ban Ton, 35 km N of Satun, E of Ban Thung Nui, alt. 100 m, 29 Oct. 1993, *Larsen et al.* 44115 (**AAU**); Thale Ban, 20 km, NE of Satun, alt. 100–150 m, 4 Nov. 1990, *Larsen et al.* 41109 (**AAU**); Ton Plieo waterfall, alt. 100 m, 6 June 1992, *Larsen et al.* 42700 (**AAU**); Kwan Dohn, Thale Ban National Park, alt. 250 m, 6 Sept. 1985, *Maxwell* 85-835 (**AAU, A, BKF, L, PSU**); Khuan Kalong, alt. 100 m, May 1967, *Phengnaren & Hambananda* 497 (**BKF**); Khuan Kalong, alt. 100 m, 5 May 1967, *Phengnaren & Hambananda* 542 (**BKF, K**); Thale Ban National Park, alt. 100–250 m, 13 Sept. 1990, *Puff et al.* 900913-1/1 (**BKF, WU**); Songkhla [Ko Hong, Hat Yai, 24 Nov. 1978,

*Congdon & Hamilton 20 (PSU)*; Ko Hong Hill, Kuan Maut Daeng, alt. 50 m, 15 Nov. 1985, *Jingpitakgoon 18 (PSU)*; Hat Yai, alt. 50 m, 26 July 1927, *Kerr 13659 (ABD, BK, BM, K)*; Boripat waterfall, alt. 150 m, 1990, *Larsen et al. 41250 (AAU)*; Ton Nga Chang, 20 km W of Hat Yai, alt. 100–200 m, 4 Oct. 1991, *Larsen et al. 42129 (AAU)*; Khao Nam Khang, Na Thawee S of Chana, 13 June 1992, *Larsen et al. 42879 (AAU)*; Ko Hong at Hat Yai, alt. 100 m, 22 Oct. 1993, *Larsen et al. 43919 (AAU)*; 20 km NW of Hat Yai, behind the Literature Botanical Garden, alt. 50 m, 27 Oct. 1993, *Larsen et al. 44079 (AAU)*; Ton Nga Chang Wildlife Sanctuary, alt. 250 m, 13 Aug. 1995, *Larsen et al. 45533 (AAU)*; Ton Nga Chang Wildlife Sanctuary, alt. 250 m, 17 Aug. 1995, *Larsen et al. 45751 (AAU)*; Ton Sa Tor Waterfall, alt. 100 m, 26 Aug. 1995, *Larsen et al. 46047 (AAU)*; Hat Yai, 16 April 1963, *Pradit 170 (BK)*; Ton Nga Chang Wildlife Sanctuary, 14 Sept. 1990, *Puff et al. 900914-1/1 (BKF, WU)*; Kamphaengphet, 20 June 1930, *Kiah 24347 (ABD, BK, K, SING)*; Ko Hong Hill, alt. 275 m, 3 Nov. 1984, *Maxwell 84-398 (A, BKF)*; Pattani [Bukit, alt. 50 m, 6 June 1923, *Kerr s.n. (BM)*]; Yala [Betong, Ayer Kuwing, alt. 150 m, 25 April 1974, *Geesink 6442 (L)*]; Narathiwat [Waeng, 22 Nov. 1971, *C.S.S. 253 (BKF)*]; Bacho National Park, alt. 150–350 m, 18 June 1992, *Larsen et al. 42981 (AAU)*; Bacho Falls, alt. 150 m, 8 Oct. 1988, *Larsen & Larsen 40315 (AAU)*; Khao Sama, Ban Kabulae Kahiwtai, 14 July 1983, *Niyomdham 714 (C, BKF)*; Bacho, Budo Sungai Padi National Park, 12 July 1993, *Puff & Sridith 930718-1/1 (AAU, PSU, WU)*; Bacho, 28 Nov. 1961, *Sangkhachand 272 (AAU, BK, BKF, K, L, P)*; Bacho, 12 Dec. 1968, *Sangkhachand 1556 (BK)*].

Distribution.— Northern Peninsular Malaysia to Peninsular Thailand and Tenasserim (Map 2).

Ecology.— Common in lightly disturbed forests, on slopes along roads and streams.

Notes.— A plate with colour photographs of *G. corymbosa* is found in Puff et al. (2005).

**1.2 var. *longicalyx*** (Craib) Tange **comb. nov.**— *Greenea siamensis* Craib var. *longicalyx* Craib, Fl. Siam. 2(1): 26. 1932.— Type: Thailand, Phangnga, Kopah, Ban Knap. 11 Dec. 1917, *Haniff & Nur 2747* (lectotype **K**, selected here; isolectotypes **ABD, CAL, SING**).

Corolla tube glabrous inside; corolla lobes ovate; calyx lobes oblong to oblanceolate, 2.5–4 mm long.

Thailand.— PENINSULAR: Phangnga [15 km N of Takuapa, 13 July 1972, *Larsen & Larsen 30910 (AAU, BKF, K)*; Lampi Waterfall, alt. 40 m, 15 July 1989, *Rakanam. 8 (PSU)*].

Distribution.— Peninsular Thailand.

Ecology.— Unknown.

Note.— This variety differs from *G. corymbosa* var. *corymbosa* in having longer calyx lobes.

**1.3 var. *oblonga*** (Craib) Tange **comb. et stat. nov.**— *Greenea oblonga* Craib, Bull. Misc. Inform. Kew 211. 1931.— Type: Thailand, Ranong, Takuapa, Kapong, alt. 100 m, 18 Feb. 1929, *Kerr 17136* (holotype **K**; isotype **ABD**).

Corolla tube inside glabrous; corolla lobes oblong, 2 by 1 mm; calyx lobes triangular 0.8–1.2 mm long.

Distribution.— Peninsular Thailand.

Ecology.— Unknown.

Notes.— *Greenea oblonga* is here reduced to a variety of *G. corymbosa*, and differs from *G. corymbosa* var. *corymbosa* only in the shape and size of the corolla lobes. The variety is only known from the type collection.

**1.4 var. *siamensis*** (Craib) Tange **comb. et stat. nov.**— *Greenea siamensis* Craib, Bull. Misc. Inform. Kew 211. 1931.— Type: Thailand, Satun, Ban Ton, alt. 50 m, 10 March 1928, *Kerr 14424* (holotype **K**; isotypes **ABD, BK**).

Corolla tube inside with four groups of ca 10 hairs, ca 1 mm from the base, opposite the corolla lobes; corolla lobes ovate; calyx lobes triangular 0.8–1.2 mm long.

Distribution.— Peninsular Thailand.

Ecology.— Unknown.

Note.— The characteristic hairs inside the corolla tube have only been found on the type sheets of *Greenea siamensis*. A search for *Greenea* with this hairiness in the corolla tube at the type locality was unsuccessful. *Greenea corymbosa* var. *corymbosa* was common at the type locality. The hairs on these specimens is the same as on type

sheets of *G. siamensis* except for the lack of the characteristic hairs in the corolla. Therefore, *G. siamensis* is here considered a variety of *Greenea corymbosa*.

2. ***Greenea commersonii*** (Korth.) Tange ex Ruhsam, Bot. J. Linn. Soc. 157(1): 121. 2008.—*Rhombospora commersonii* Korth., Ned. Kruidk. Arch. 2: 115. 1850.—Type: Sumatra, *Korthals s.n.* (lectotype **L**, selected here; isoelectotype **K**). Fig. 1F.

Trees to ca 5 m high. Young branches strigose to hirsute. *Leaves* decussate, blade narrowly elliptic to oblanceolate, 15–40 by 5–12 cm, base attenuate, apex acute to acuminate, on upper side glabrous or with few hairs, lower surface puberulous, strigose to hirsute on the nerves otherwise almost glabrous, lateral nerves 15–30; petioles ca 1–3 cm. *Stipules* 1.0–1.5 cm triangular, apex rounded, connate 3–7 mm above the base, outer surface puberulous, strigose to hirsute, inner surface with few hairs and densely covered with colleters up to 3.5 mm from base. *Inflorescence* to 30 by 25 cm, with 20–35 sessile flowers on each branch, closely spaced. *Flowers* hermaphrodite or female, 5-merous; calyx tube short, hairy on both sides, calyx lobes acute 0.6–1.0 by 0.6–0.8 mm. In hermaphroditic flowers: corolla tube 8–11 mm, diameter at base 1.3 mm increasing to 2.5 mm at the apex, with pale hairs on the outside, inside with a ring of thin-walled, septate hairs inserted at the very base; corolla lobes ovate, 1.7–2.5 by 1.6–2.1 mm, apex rounded, densely pilose inside; stamens inserted on the corolla tube 5.0–5.5 mm above the base, filaments 1.4–2.1 mm long, anthers glabrous 1.9–2.0 mm, apex and base slightly bifid; ovary densely strigose to hirsute; style 10–12 mm, stigma bifurcate. *Female flowers*: corolla tube very short or absent; corolla lobes linear, 2.5–3.5 by 0.15–0.2 mm, very shallowly triangular in cross section, apex rounded, in bud erect, not contorted but later twisted, with pale hairs on the outside, inside with pilose hairs on the upper end; anthers absent. *Fruit* spherical to slightly obconic, ca 3 mm in diameter, strigose to hirsute with the calyx lobes reflexed.

Indonesia.— North Sumatra [Tapianoeli, Subdivision Toba, District Toetoepean, 1933, *Boeea* 6081 (**A, K, L**); Vicinity of Hoeta Bagasan, Asahan, 1935, *Boeea* 7338 (**A**); Vicinity of Lombaria, Asahan, 1934, *Boeea* 7636 (**A**); Vicinity of Lombaria, Asahan, 21 Nov. 1936, *Boeea* 7935

(**SING**); Adian Rindang, Asahan, vicinity of Hoeta Tomoean Dolok, 1935, *Boeea* 8631 (**A, L**); East coast Sumatra, *Yates* 1337 (**L**); West Sumatra [C. Sumatra, N of Pajakumbuh in Harau ravine, 15 Aug. 1956, *Jacobs* 4593 (**BO, K, L, SING**); W. K. Sumatra, 21 Aug. 1932, *Kleinhoonte* 451 (**BO**); Middle Sumatra, 28 Feb. 1891, *Koorders* 102778 (**BO**); Sumatra, *Korthals s.n.* (**K, U**); Harau-canyon near Pajakumbuh, alt. 500 m., 15 Aug. 1956, *Meijer* 5246 (**BM, L**); Taram, East of Pajakumbuh, W Sumatra, sandstone region of River Tjampo, along river (Sungai Batu basakit). alt. 500–1000 m, 20 Aug. 1957, *Meijer* 6743 (**L**); Taram, East of Pajakumbuh, W Sumatra, sandstone region of River Tjampo, along Sungai Batu babak, alt. 500–1000 m, 20 Aug. 1957, *Meijer* 6748 (**L, SING**); Harau vally, *Tange* 45169 (**AAU**); W. K. Sumatra, Simaram Kotta Nopan, *Teijsmann* 922hb (**BO, U**); West Coast Sumatra, Fort de Kock, 1927, *Yates*. 2482 (**A, BO**); Jambi [Merangin, M. Djankang, 27 July 1925, *Posthumus*. 628 (**BO**)].

Malaysia.— Johor [Hutan Simpan Labis, above the 3<sup>rd</sup> rapids on the Sungei Endau, upstream from Kuala Kemapan, 6 Sep. 1985, *Wong FRI* 30904 (**KEP**); Kelantan [Sg Lebir F. R., Kuala Krai, by the hillside near river Miak, alt. 400 m, 8 July 1987, *Damanhuri & Khairuddin FRI* 35985 (**KEP**); Kota Baru, Nov. 1880, *Kings' collector, Kunstler* 1089 (**BM, CAL**); Sg Brok, Ulu Kelantan, 9 June 1967, *Ng Fri* 5316 (**K, L, SING**); Sungei Keleh, 6 Feb. 1924, *Nur* 11966 (**SING**); Kota Baru, Feb. 1917, *Ridley s.n.* (**K**); Ulu Sungei Ketil, Ulu Kelantan, alt. 150 m, 15 March 1972, *Shah* 2542 (**A, B, C, SING**); Hill station Ulu Sat, Compt. 6. Hill forest, alt. 50 m, 12 June 1982, *Wong FRI* 32403 (**KEP**); Melaka [Bukit Kajang, Kemam, alt. 150 m, 4 Nov. 1935, *Corner* 30204 (**K, L**); Pakô Sukam Bular, 1885, *Unknown collector* 960 (**SING**); Negeri Sembilan [Sungei Ujong, *Ridley s.n.* (**BM, SING**); Jebebu, F. R., alt. 1000 m, 4 July 1969, *Suppiah FRI* 11308 (**K, L, SING**); Pahang [Sungai Tahan, 18 Sep. 1937, *Corner s.n.* (**SING**); Summit ridge of smallish Bukit due W of Kuala Yong. Taman Negara, 9 July 1970, *Everett FRI* 14368 (**A, KEP, L, K, SING**); 8 miles S of Kuala Lipis, 17 Nov. 1924, *Haniff* 17198 (**SING**); Sg Telom, alt. 150 m, 29 Aug. 1930, *Kiah & Strugnell* 23985 (**BM, K, KEP, SING**); Tanjung Antan, 6–9 July 1891, *Ridley* 2186 (**BM, CAL, SING**); Way to Mount Brinchang,

Cameron Highland, alt. 1700 m, 13 Aug. 1970, *Samat 00302* (**L**); Kuala Teku, alt. 150 m, Feb. 1921, *Seimund 942* (**SING**); Kuala Tahan, alt. 100 m, Feb. 1921, *Seimund 947* (**SING**); Kuala Tahan, alt. 100 m, Feb. 1921, *Seimund 954* (**SING**); Jeram Katak, Taman Negara, alt. 35 m, 13 Aug. 1972, *Shah 2653* (**KEP, C, SING**); Sungai Teku, 20 Feb. 1968, *Chin & Shah 1388* (**AAU, BK, C, K, L, SING**); Along river Sg. Sempang, alt. 500 m, 18 April 1970, *Soepadmo 719* (**A, BO, K**); G. Benom, alt. 240 m, 23 March 1967, *Whitmore FRI 3409* (**A, K, L, SING**); Ascent of Gunong Tahan, Feb. 1961, *Wong & Wyatt-Smith 31* (**KEP**); G. Benom Game Reserve, Ulu Krau, alt. 500 m, 23 April 1967, *Yusoff, Zahir for Hillard 99148* (**A, K, L, SING**); Perak [K. Temengor (Sungei), State land, alt. 360 m, 17 July 1966, *Chelliah 98636* (**A, K, KEP, L, SING**); Sg. Larik, Korbu F.R., alt. 650 m, 12 Feb. 1987, *Ibrahim AI21* (**SING**); Larut, alt. 100–250 m, June 1883, *Kings collector, Kunstler 4402* (**A, BM, CAL, K, L, P, U**); Ulu Bubong, June 1886, *King's collector 10247* (**CAL, K**); Perak s.l., 1884, *Scortechini 280* (**W**); Sungei Rias, Gunung Bujang Melaka, Chenderiang, alt. 600 m, 12 Feb. 1975, *Shah & Shukor 3388* (**C, SING**); Path to Ulu Piah, Tambon Forest Reserve, 18 Feb. 1976, *Sidek SK 491* (**SING**); Sungei Liang, 20 June 1938, *Sow 47204* (**KEP**); Gunung Laba, Sungei Perak, summit, also on lower slopes, alt. 200 m, 10 July 1966, *Whitmore FRI 0583* (**K, KEP, L**); Slim Hills F. R., SE Perak, Rocky banks of S. Mut, 8 Sep. 1966, *Whitmore FRI 0826* (**A, K, L, SING**); Gunung Laba, Sungei Perak, Upper Perak, summit, shallow soil over quartzite, alt. 210 m, 10 July 1966, *Whitmore FRI 0583* (**K, KEP, L**); Penang [Pantai Aeheh, 30 Aug. 1931, *Symington 27778* (**KEP**)]; Selangor [Compt. 52. Gading F. R., Ulu Selangor, 19 July 1969, *Chan 11238* (**K, L, SING**); Jarom Jarom Rimba, 30 Dec. 1920, *Gd. & Rahman 5800* (**KEP**); Gombak Forest Reserve, Compt. 2, Kuala Lumpur, Sungei Gombak, 15 March 1925, *Hamid & Jaamat 10201* (**KEP, SING**); Klang Gates, 19 May 1921, *Hume 7240* (**SING**); Batang Berjuntai Forest Reserve, alt. 600 m, 30 Aug. 1921, *Hume 4248* (**SING**); Ulu Sungei Gombak, 23 Sep. 1921, *Hume 8465* (**SING**); Genting Sempah, alt. 1800 m, 7 Oct. 1921, *Hume 8883* (**SING**); Genting Sempah, alt. 500 m, 12 Nov. 1921, *Hume 9694* (**SING**); Ulu Gombak, Kasim 293 (**KLU**); Genting Sempah, alt. 600 m, 9 Jan. 1963, *Sidek 4808* (**A, K**); Genting

Sempah, alt. 300 m, 30 March 1950, *Smith 71250* (**K**); Genting Sempah, 26 Feb. 1927, *Strugnell 12674* (**KEP, SING**); Batu 12 Jalan Batu Talam, Sungei Batu, 28 Jan. 1930, *Strugnell 20494* (**KEP**); Ulu Gombak, secondary forest, 2 Jan. 1969, *T. & P. 184* (**K, L, SING**); Klang Gates, *Tange 45172* (**AAU**); Ulu Langat, 10 Jan. 1959, *Umbei 1283* (**K, L, SING**); Bukit Kaya Kapen, 1894, *Ridley 10588* (**A, CAL**); Kuala Lumpur [Welds Hill Reserve, Kuala Lumpur, 1916, *Curtis 917* (**SING**); Welds hill res., Kuala Lumpur, 6 March 1918, *Foxworthy 2626* (**KEP**); Weld Hill Forest Reserve, Kuala Lumpur, 17 March 1917, *Hamid 210* (**KEP**); Welds Hill Reserve, Kuala Lumpur, 19 Aug. 1929, *Kalong 17464* (**KEP, SING**); Welds Hill Forest Reserve, Kuala Lumpur, 29 March 1923, *Kiri 8248* (**KEP**); Welds Hill Forest Reserve, Kuala Lumpur, 5 Nov. 1936, *Sow 42946* (**KEP**); Welds Hill, Kuala Lumpur, alt. 100 m, 9 Feb. 1969, *Stone 8333* (**KLU, L**); Welds Hill Forest Reserve, Kuala Lumpur, 10 Nov. 1936, *Symington 40982* (**KEP**); Welds Hill, Kuala Lumpur, *Tange 45170* (**AAU**); Genting Sempah, *Tange 46972* (**AAU**)]; Terengganu [Ulu Sg Trengganu, 1/2 mile upstream from Kuala Petang, Ulu Trengganu, 4 June 1968, *Cockburn FRI 8489* (**A, L, SING**); Kuala Berang, Kenyin Dam Area, alt. 160 m, 15 Feb. 1991, *Lesmy FRI 33965* (**KEP**); Ulu Brang Kuala Berang, alt. 750 m, July 1937, *Moysey & Kiah SFN 33304* (**A, SING**); Bukit yong, Jerteh, alt. 700 m, 1 March 1974, *Shah & Shukor 3254* (**HAM, KEP, SING**); Jungle path to Burkit Bongkok, via Kampong La, alt. 500 m, 3 March 1976, *Shah & Samsuri 3800* (**C, SING**); Ulu S. Loh below E face G. Mandi Angin, alt. 700 m, 13 July 1968, *Whitmore Fri 12141* (**K, L, SING**)].

Thailand.—SOUTH-EASTERN: Trat [Ban Saphan Hin, Waterfall 3 km NE of the village, alt. 100 m, 8 Nov. 1993, *Larsen et al. 44312* (**AAU**); Khlong Saphan Hin, Muang District, alt. 175 m, 4 May 1974, *Maxwell 74-351* (**AAU, BK**)]; PENINSULAR: Narathiwat [Sungei Kolok, Nikhom Waeng, alt. 400–500 m, 26 Feb. 1974, *Larsen & Larsen 32623* (**AAU, B, BKF, E, L**)].

Distribution.—From Sumatra throughout the Malay Peninsula to Peninsular Thailand, and also in Trat province of SE Thailand (Map 1).

Ecology.—On slopes along roads and streams.

Notes.—The specimens from Sumatra have

longer and nearly patent hairs. This is rare in the specimens from Peninsular Malaysia, except for specimens collected on Gunung Tahan.

Hooker (1873) regarded *Rhombospora* as a synonym of *Greenea*. The combination was made at species level by Ruhsam et al. (2008), not by Boerlage (1891) as suggested by Mouly et al. (2009). Gynodioecious populations occur in this species. In the Harau valley near Pajakumbuh on Sumatra, the female plants have flowers without or with a very short corolla tube, linear corolla lobes, and no anthers. These female plants have normally developed fruits and seeds. A few other collections from Sumatra are functionally female with sterile anthers, but otherwise appear to be normal.

### 3. *Greenea montana* Tange sp. nov.

*Greenea corymbosa* affinis a qua differt corolla tubo intra annulus pili rigidus praesentia et corollae lobi oblongus.— Type: Thailand, Phangnga, Khao Porta Luang Kao, alt. 900–1000 m, *Geesink et al.* 7685 (holotype **K**; isotypes **AAU**, **B**, **BKF**, **C**, **L**). Fig. 1J.

Shrub to 10 m high. Young branches puberulous to strigose. *Leaves* decussate, blade narrowly elliptic to oblanceolate, 15–40 by 5–12 cm, base attenuate, apex acute to acuminate, on upperside almost glabrous, lower surface strigose on the nerves otherwise almost glabrous, lateral nerves 15–25; petioles ca 1.5–6.0 cm. *Stipules* triangular 1.0–2.5 cm, apex rounded, connate for ca 1 mm from the base, outer surface sparsely strigose, inside sericeous and with colleters up to 3.5 mm from base, otherwise glabrous. *Inflorescence* ca 15 by 15 cm, with 10–15 sessile flowers on each branch. *Flowers* 5-merous; calyx tube short, calyx lobes triangular, 0.7–1.0 by 0.6–0.8 mm; corolla tube 7–10 mm long, diameter at base ca 1.3 mm increasing to ca 2.5 mm at the mouth, outer surface puberulous to strigose, inside with a narrow ring of upward pointing stiff hairs ca 1 mm long, inserted ca 1.5 mm above the base, otherwise glabrous; corolla lobes oblonge 1.5–2.6 by 0.8–1.1 mm (rarely ovate), apex rounded, densely pilose inside; stamens inserted on the corolla tube ca 5 mm above the base; filaments ca 0.4 mm long, not decurrent; anthers glabrous, 1.8–3.7 mm, apex and base bifid; ovary densely puberulous to strigose; style 7.5–10.0

mm, thickened towards the apex, stigma bifurcate. *Fruit* spherical, ca 3 mm in diameter, puberulous to strigose, with the calyx lobes reflexed or recurved.

Indonesia.— North Sumatra [Sibolangit, alt. 500 m, 27 Nov. 1915, *Lörzing* 4124 (**BO**); Sibolangit, alt. 400 m, 6 March 1918, *Lörzing* 5544 (**BO**); Sibolangit, alt. 450 m, 18 Nov. 1927, *Lörzing* 12289 (**BO**, **K**, **L**)]; Aceh [G. Gohalembu, from biv. Aer Poetih waterfall to biv. “halfweg”, alt. 1000 m, 18 Feb. 1937, *Van Steenis* 8911 (**A**, **K**, **L**); Gunung Leuser Bandaharh Nature reserve, alt. 700 m, 28 June 1972, *De Wilde & De Wilde-Duyfjes* 13429 (**BO**, **K**, **L**); ca 6 km NE of Kampung Seldok (Alas Valley), ca 25 km N of Kutacane, alt. 1000 m, 19 Feb. 1975, *De Wilde & De Wilde-Duyfjes* 14905 (**K**, **L**)].

Thailand.— PENINSULAR: Ranong [Kaper District, Khao Porta Luang Kao, alt. 1200 m, 28 Feb. 1983, *Koyama et al.* T-33823 (**A**); Khao Pawta Luang Kao, alt. 1000 m, 9 Dec. 1979, *Shimizu et al.* 26652, 26666, 26678, 26689 (**BKF**, **L**); Khao Porta Luang Kao, alt. 1000 m, 10 Dec. 1979, *Shimizu et al.* 26825 (**BKF**); Khao Porta Luang Kao, alt. 400–800 m, 29 Nov. 1973, *Santisuk* 714 (**A**, **BK**, **BKF**, **CAL**, **PSU**)]; Phatthalung [Tamot, 5 Oct. 1986, *Sirirugsa* 1033 (**PSU**); Tamot, 11 Aug. 1994, *Tange* 45192 (**AAU**)].

Distribution.— N Sumatra and Peninsular Thailand (Map 1).

Ecology.— The flowers are whitish-pink with a swollen basal part. The two collections from Tamot differ from all others in having ovate corolla lobes that close the tube, similar to those in *Greenea corymbosa*. In this area *G. corymbosa* is also present, so hybridization may occur.

Note.— Differs from *Greenea corymbosa* in having a ring of hairs in the corolla tube and oblong corolla lobes.

### 4. *Greenea rivularis* Tange, sp. nov.

*Greenea montana* affinis a qua differt corolla campanulata, anthera filamenta ca 1.6 mm longa, et apex anthera cuspidata.— Type: Thailand, Nan, Sappan waterfall, few km N of Ban Klueai, E of Road 1081, dense evergreen forest along watercourse and waterfall, alt. 600 m, 17 Nov. 1993, *Larsen et al.* 44419 (holotype **AAU**; isotypes, **BKF**, **K**, **L**). Fig. 1H.

Small tree to ca 4 m high. Young branches strigose. *Leaves* decussate, blade oblanceolate to obovate 24–38 by 8–15 cm, base attenuate, apex acuminate to caudate, on upper surface almost glabrous, lower surface glabrous except the sparsely strigose nerves, lateral nerves 18–25; petioles ca 3–6 cm. *Stipules* triangular, 2–3 cm long, apex rounded, connate for 1–5 mm from the base, outer surface sparsely strigose, inner surface densely sericeous and with colleters 3.5 mm up from the base, otherwise glabrous. *Inflorescences* ca 20 by 20 cm, with ca 5 sessile flowers on each branch. *Flowers* 5-merous, calyx tube absent, calyx lobes narrowly triangular to lanceolate, 1.5–3.0 by 0.6–0.8 mm; corolla tube ca 4.6 mm long, narrowly campanulate, diameter at base 1.3 mm, increasing to 2.5 mm at the apex, outer surface strigose, inside with a ring of upward pointing stiff hairs inserted ca 1 mm above the base, also hairy below the ring, otherwise glabrous; corolla lobes oblong, ca 2.6 by 1.0 mm, erect, apex rounded, densely pilose inside; stamens inserted on the corolla tube, ca 2.6 mm above the base, filaments ca 1.6 mm long, decurrent, anthers ca 2.7 mm, with few, adpressed hairs, apex cuspidate, base rounded and bifid; ovary densely strigose; style ca 6 mm, thickened towards the apex, stigma bifurcate. *Fruit* spherical, ca 3 mm in diameter, with the calyx lobes pointing inwards and touching.

Laos.— Xiangkhoang [Tatom (Tha Thom)], Cherig Kwang, 1 April 1932, *Kerr 20831* (**BM**, **K**).

Distribution.— N Thailand and Laos (Map 1).

Ecology.— On rocky slopes along river.

Note.— Differs from *Greenea montana* in having narrowly campanulate corollas, longer anther filaments (ca 1.6 mm), and cuspidate anther apices.

##### 5. *Greenea vietnamensis* Tange, *sp. nov.*

*Greenea montana* affinis a qua differt corolla campanulata et anthera filamenta 2–3 mm longa.— *Greenea jackii* auct. non Wight & Arn.: Pitard in Lecomte, Fl. Indo-Chine 3: 70–71. 1922.— Type: Vietnam, Thua-Thien, Cây Truong Son, 11 Feb. 1920, *Poilane 1004* (holotype **K**; isotype **P**). Fig. 1G.

Small tree to ca 4 m high. Young branches hirsute. *Leaves* decussate, blade elliptic to oblanceolate, 15–35 by 4.5–9 cm, base attenuate, apex

acuminate to caudate, on upper surface sparsely hirsute, lower surface hirsute, lateral nerves ca 20; petioles 0.5–2.0 cm. *Stipules* 1.0–2.0 cm triangular, apex acute, connate for ca 1 mm from the base, outer surface strigose to hirsute, inner surface sericeous and with colleters up to 2.5 mm from base, elsewhere glabrous. *Inflorescence* ca 12 by 15 cm, with 10–15 sessile flowers on each branch. *Flowers* 5-merous; calyx tube short, calyx lobes triangular to ovate 1.0–1.8 by 0.7–1.1 mm, apex acute; corolla tube campanulate, 10–11 mm long, diameter at base 1.3 mm, increasing to 4.5 mm at the mouth, outer surface strigose, inner surface with a ring of upward pointing stiff hairs inserted ca 2 mm above the base; corolla lobes oblong, erect, ca 3 by 1.5 mm, apex rounded, densely pilose inside; stamens inserted on the corolla tube ca 4.6 mm above the base, filaments 2–3 mm long, decurrent, anthers ca 3.0 mm, with few appressed hairs, apex rounded, base bifid; ovary densely hirsute; style ca 11 mm, thickened towards the apex, stigma bifurcate. *Fruit* spherical, ca 3 mm in diameter, with calyx lobes erect.

Vietnam.— Thua Thien-Hue [Thua Lu, 27 April 1916, *Eberhardt 2465* (**P**); 8. Nov. 1911, *Unknown Collector 13211* (**P**); Bai Ka, alt. 200 m, 13 April 1916, *Eberhardt 2465* (**P**); Bach Ma, 23 Jan. 1944, *Vidal 991A* (**P**); Mount Bani, about 25 km from Da Nang, May–Aug. 1927, *Clemens & Clemens 3502* (**A**, **BM**, **P**); Da Nang [Da Nang-BaNa, along road, 18 Aug. 1994, *Tange 45194* (**AAU**); Hoi-Mit, alt. 150 m, 13 April 1916, *Eberhardt 2986* (**P**); Da Nang and vicinity, May–Aug. 1928, *Clemens & Clemens 4418* (**P**); Hoa-Binh [Ha Son Binh, Tuly, Da Bac District, Hoa Binh, 19 Nov. 1981, *Nguyen NB1012* (**HNU**); Haute vallee du song, Chuy Cam, 28 June 1916, *Eberhardt 3078* (**P**)].

Distribution.— Central and northern Vietnam (Map 1).

Ecology.— In disturbed forest, on slopes, and along roads and streams.

Note.— Differs from *Greenea montana* in having a campanulate corolla and longer anther filaments (2–3 mm).

6. *Greenea secunda* (Griff.) Craib, Fl. Siam. 2: 25. 1932.— *Wendlandia secunda* Griff., Not. Pl. Asiat. 4: 266. 1854.— *Greenea wightiana* auct. non Wight & Arn.: Wight. Icon. Pl. Ind. Orient. 3: t. 1161.

1846.— Type: Burma, Mergui, *Griffith 212* (holotype **K**; isotype **A, E**). Fig. 1C.

Shrub to 5 m high. Young branches strigose. *Leaves* in whorls of (2–)3, blade narrowly elliptic to oblanceolate 10–27 by 2–7 cm, base attenuate, apex acute to acuminate, on upper surface glabrous, lower surface strigose on the nerves else glabrous, lateral nerves 15–25; petioles 0.5–2.0 cm. *Stipules* 0.5–1.5 cm triangular, cuspidate, connate for ca 1 mm from the base, sparsely strigose, inside densely covered with hairs except 0.5 mm from the margins, with colleters at the base. *Inflorescence* ca 15 by 15 cm, with 10–15 sessile flowers on each branch, 1.5–5.0 mm apart. *Flowers* 5-merous, calyx tube absent; calyx lobes triangular 0.6–1.0 by 0.3–0.5 mm, apex acute; corolla tube cylindrical below, gradually narrowly funnel-shaped above, 9–11 mm long, diameter at base ca 1 mm, increasing to ca 2.5 mm at the mouth, outer surface sparsely strigose, inside glabrous; corolla lobes oblong 3.2–4.2 by 1.5–1.7 mm, apex acute, densely pilose inside; stamens inserted on the corolla tube ca 8 mm above the base, filaments ca 2.5 mm long, anthers glabrous, sagittate, 2.9–3.3 mm; ovary densely strigose, style 12–14 mm, stigma bifurcate. *Fruit* spherical 2.5–3.0 mm in diameter, with the calyx lobes erect.

Myanmar.— Kachin State [Mandalei, July 1868, *Parish 1039* (**K**); Tenasserim [Pelai, Merguie Archipelago, 1 March 1882, *Anderson s.n.* (**CAL**); Merguie Archipelago, 8 Feb. 1882, *Anderson s.n.* (**CAL**); Tavoy, Kaleinaung Res, 4 Feb. 1925, *BaPE 860* (**CAL**); *Griffith 2844* (**P**); Tenasserim and Andamans, 1835–1838, *Helper 2845* (**A, C, BM, L, HAM**); South of Paungdaw Power Station, on east bank of Paungdaw river, alt. 330 m, Oct. 1961, *Keenan et al. 1736* (**A, E**); Tenasserim, *Manson 380* (**CAL**); Mergui, March 1911, *Meebold 14123* (**CAL**); Tenasserim, March 1911, *Meebold 14451* (**CAL**); Mergui, Nov. 1900, *Mokim 15* (**CAL**); Mergui, Nov. 1900, *Mokim 29* (**CAL**); Kaleinaung Reserve, 14 Nov. 1929, *Parker 2214* (**A**); Patav Island, 10 March 1927, *Parker 2769* (**A**); Patav Island, 12 Feb. 1892, *Proudlock 20* (**A, CAL, HAM**); Sandawut Reserve, alt. 60 m, 23 Jan. 1919, *Rogers 402* (**CAL**); Tavoy, *Russell 173* (**CAL**); Tavoy, W Gorneg, *Wall 8400* (**A, BM**)].

Distribution.— Myanmar (Map 2).

Ecology.— Unknown.

Notes.— An easily recognized species, because of the cuspidate stipules, whorled leaves and sagittate anthers. It is vegetatively very similar to *G. adangensis* except for the whorled leaves, but the flowers are different, being 5-merous with oblong corolla lobes. *G. secunda* has been confused with *G. wightiana*. As Craib (1932) noted, Wight (1846) published a drawing of *G. secunda* (t. 1161) based on the type collection of that species, but with the wrong name *G. wightiana*. Wight & Arnott (1834) described *G. wightiana* based on the specimen Wight Cat. 1286, which Craib (1932) noted was an unlocalised duplicate of *Wall. Cat. 6277*, a collection that belongs to *G. corymbosa*.

## 7. *Greenea adangensis* Tange, sp. nov.

*Greenea corymbosa* affinis a qua differt stipulae cuspidatas et folia anguste oblanceolatus.— Type: Thailand, Satun, Ko Adang, common on hills in evergreen forest, 17 Dec. 1994, *Tange 46957* (holotype **AAU**; isotypes **BK, BKF, C, K, KEP, L, PSU, SING**). Fig. 1D.

Tree to more than 10 m high. Young branches strigose. *Leaves* decussate, blade narrowly oblanceolate up to 35 by 5 cm, base attenuate, apex acute to caudate, on upper surface glabrous, lower surface strigose on the nerves elsewhere glabrous, lateral nerves 15–20, curving upwards near the leaf margin; petioles indistinct, 0.5–2.0 cm. *Stipules* cuspidate, 0.5–0.7 cm, connate for ca 1 mm from the base, outer surface sparsely strigose, inside densely covered with hairs except 0.5 mm from the margins, with colleters at the base. *Inflorescence* ca 10 by 12 cm, with ca 6 sessile flowers on each branch, ca 1 mm apart. *Flowers* 4-merous; calyx tube absent, calyx lobes triangular to oblong, 0.6–1.2 by 0.5–0.7 mm, apex rounded to acute; corolla tube ca 9 mm long, diameter at base ca 1.5 mm, increasing to 2.5–3.5 mm at the mouth, outer surface strigose, inner surface glabrous; corolla lobes ovate, ca 2.3 by 2.0 mm, densely pilose inside; stamens inserted on the corolla tube ca 7.0 mm above the base; filaments ca 0.3 mm long, anthers glabrous, ca 2.6 mm long; ovary densely strigose, style ca 10 mm, stigma bifurcate. *Fruit* spherical ca 2.5 mm in diameter, with the calyx lobes erect.

Thailand.— PENINSULAR: Satun [Tarutao National Park, Adang, hill behind H. Q., alt. 100 m,

7 Dec. 1979, *Congdon 231* (AAU, PSU); Ko Adang, 16 May 1928, *Kerr 14147* (ABD, BK, BM, K)].

Distribution.— A species so far only collected on the island of Ko Adang, ca 80 km west of the coast of Satun province (Map 2).

Ecology.— In forest on rocky slopes along the coast and streams.

Notes.— Differs from *G. corymbosa* in having cuspidate stipules and narrowly oblanceolate leaves. All collections were made in the dry period December to February and are in the fruiting stage. The flowers seen were from plants cultivated in the greenhouse at AAU. Craib (1932) identified *Kerr 14147* with some doubt to *G. secunda*, although he had not seen the flowers. The two species are similar in vegetative characters, but the inflorescences and flowers of *G. adangensis* are of the type found in *G. corymbosa*.

**8. *Greenea parkinsonii*** C.E.C.Fisch., Bull. Misc. Inform. Kew 1927: 90. 1927.— Type: Burma, Myitkyina, Nawraw Chaung, 11 Dec. 1925, *Parkinson 404* (holotype K; isotype CAL). Fig. 1A.

Small tree to 10 m high. Young branches strigose. *Leaves* decussate; blade elliptic to oblanceolate to 32 by 8 cm, apex acuminate to caudate, base attenuate, upper surface glabrous, midrib very sparsely strigose, lower surface strigose on the nerves and veins, elsewhere glabrous, lateral nerves 20–25, curving upwards near the leaf margin; petioles indistinct, 1.5–3 cm. *Stipules* triangular to lanceolate, 1–1.5 cm long, apex rounded to acute, connate for 1–1.5 mm from the base, outer surface strigose, denser on the nerves, inner surface glabrous except at the base. *Inflorescence* to ca 25 by 25 cm, with ca 10 flowers on each branch, the flowers 2–5 mm apart. *Flowers* 5-merous; pedicels 1–2 mm; calyx tube absent, calyx lobes triangular to oblong, 0.5–1.0 by 0.4–0.6 mm; corolla tube ca 3.7–4 mm long, diameter at base ca 2.0 mm, increasing to 4–5 mm at the apex, outside puberulous, inside pilose with decreasing density towards the base, corolla lobes transversely half-elliptic, 1.5–2.0 by 1.5–2.0 mm, apex rounded, densely pilose inside; stamens inserted on the corolla tube 3.1–3.6 mm above the base, filaments 0.5–1.0 mm long, anthers glabrous, 2.2–2.4 mm long, base bilobed, apex acute; ovary densely strigose; style and stigma

6.0–6.5 mm, thickened towards the apex, stigma not bifurcate. *Fruit* spherical, ca 3 mm in diameter, strigose, with the calyx lobes erect to reflexed.

Myanmar.— Kachin [Kant Bun, on eastern slopes, alt. 2300 m, 15 Jan. 1962, *Keenan et al. 3316* (A, E); Hills east of Kanang, alt. 1300 m, 15 Jan. 1962, *Keenan et al. 3412* (A, E); Surroundings of Hpuginhku village, alt. 1700 m, Feb. 1962, *Keenan et al. 3684* (A, E, K); alt. 1200 m, 2 March 1953, *Kingdon-Ward 20598* (A, BM, E)]; Tenasserim [W side of Dawne Raux, above Pauigkyn Thaton District, 21 Feb. 1909, *Lace 4603* (CAL, E)].

Distribution.— Myanmar (Map 2).

Ecology.— Unknown.

Notes.— As in *Greenea schizocorolla*, *G. parkinsonii* has stylar pollen presentation. There is a thickened region just below the stigma lobes, and here the pollen seems to be deposited. The shape of the corolla is similar to that of *Aleisanthia rupestris* Ridl. which also has stylar pollen presentation (Tange, 1997).

**9. *Greenea schizocorolla*** Tange **nom. nov.**— *Spathichlamys oblonga* Parker, Bull. Misc. Inform. Kew 42. 1931; Ridsdale, Blumea 28: 143–144. 1982.— Type: Burma, Mergui District, Myinmolekat, alt. 1200 m, large shrub with cream coloured flowers, 17 Jan. 1930, *Parker 3100* (holotype K; isotype CAL). Fig. 1B.

Shrub or tree. Young branches sparsely strigose to glabrous. *Leaves* decussate; blade elliptic to 8–20 by 2.5–5 cm, base attenuate, apex acute, on upper side glabrous, lower side with few appressed hairs on the nerves, elsewhere glabrous, lateral nerves 15–18, curving upwards near the leaf margin; petioles indistinct, 1–2 cm. *Stipules* ovate to lanceolate, 8–10 cm, apex rounded, connate for ca 1 mm from the base, outer surface strigose, denser on the nerves, inner surface glabrous except at the base. *Inflorescence* ca 4–8 by 4–12 cm, with ca 6 flowers on each branch, 2–5 mm apart. *Flowers* 5-merous; pedicels 1–5 mm; calyx tube absent; calyx lobes oblong 1–2 by 0.5–1.0 mm, apex rounded; corolla tube 18–20 mm long, diameter at base ca 1.2 mm, splitting along one side and rolling backwards exposing the style and stigma, strigose outside, inside velutinous; corolla lobes square, ca

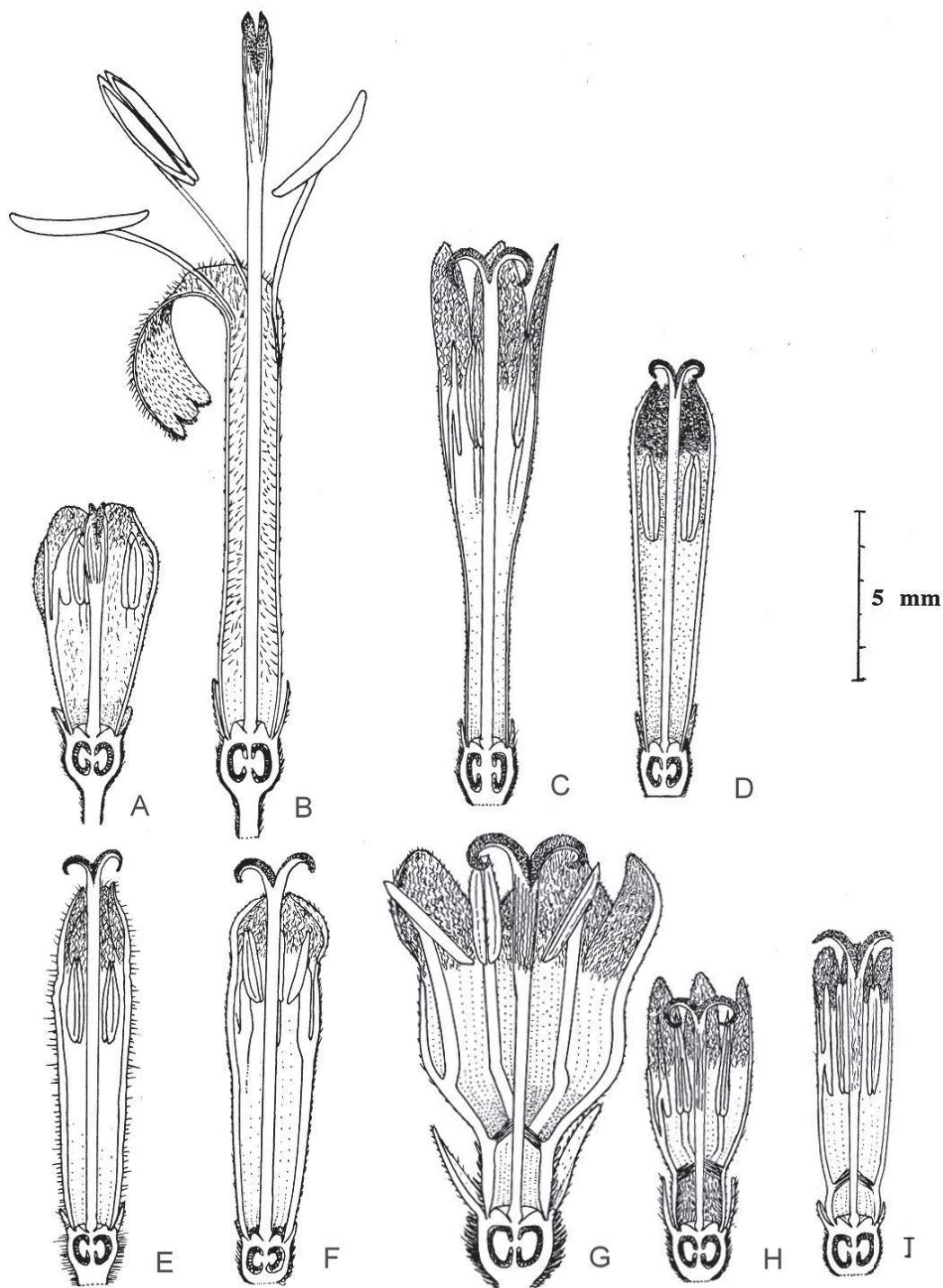


Figure 1. Longitudinal section of flowers: A: *Greenia parkinsonii* (Parkinson 404); B: *G. schizocorolla* (Parker 3100); C: *G. secunda* (Parish, C. 1039); D: *G. adangensis* (Tange 45194); E: *G. corymbosa* (Larsen, K. et al. 43919); F: *G. commersonii* (Tange 46194); G: *G. vietnamensis* (Tange 45194); H: *G. rivularis* (Kerr 20831); J: *G. montana* (Geesink et al. 7685).

1 by 1 mm, densely pilose inside; stamens inserted on the corolla tube ca 13 mm above the base, filaments 2–3 mm long, anthers glabrous, ca 4.0 mm long; ovary densely strigose; style and stigma ca 18 mm long, thickened towards the apex, stigma not bifurcate. *Fruit* spherical, ca 3.0 mm in diameter, strigose, with the calyx lobes erect.

Distribution.— Myanmar (Map 2).

Ecology.— Unknown.

Notes.— Known from the type collection only (Map 2). Parker differentiated the genus from *Greenea* by one single character, the splitting of the corolla. Because all character states, except the splitting of the corolla in *Spathichlamys oblonga*, are shared with *Greenea*, *Spathichlamys oblonga* is here included in *Greenea*. In order to avoid a homonym with *Greenea oblonga* Craib, the new name *Greenea schizocorolla* (Parker) Tange is proposed. The illustration in Ridsdale (1982) shows a corolla split along one side and rolling backwards exposing the style and stigma. The stigma-lobes are similar to those in *G. parkinsonii*. The style is thickened and grooved just below the stigma-lobes. On this part of the style, and on the outside of the stigma-lobes, are remnants of deposited pollen. This indicates that *Greenea schizocorolla* probably has stylar pollen presentation.

#### TAXA EXCLUDED FROM *GREENEA*

*Greenea bahadurii* Gaur & Dayal, Indian J. Forest. 8(4): 323–325. 1986. = ***Dunnia assamica*** (Hook.f.) Ridsdale, Blumea 24: 368. 1978 (see Deb, Phytotaxonomy 1: 53–56. 2001).

*Greenea distantiflora* Merr., Mitt. Allg. Bot. Hamburg 7: 276. 1937. = ***Aleisanthiopsis distantiflora*** (Merr.) Tange, Nord. J. Bot. 16: 573. 1997.

*Greenea hirsuta* Elmer, Leaf. Philipp. Bot. 5: 1857. 1913. = ***Timonius hirsutus*** (Merr.) Merr., J. Straits Branch Roy. Asiat. Soc. 77: 242. 1917.

*Greenea höaensis* Pierre ex Pitard, Fl. Indo-Chine 3: 174. 1924. = ***Schizomussaenda dehiscens*** (Craib) H.L.Li, J. Arnold Arbor. 24: 100. 1943.

*Greenea latifolia* Teijsm. & Binn., nomen nudum.

*Greenea longiflora* Merr., Philipp. J. Sci. C. 4: 323. 1909. = ***Timonius longiflorus*** (Merr.) Merr., Enum. Philipp. Fl. Pl. 3: 542. 1923.

*Greenea macrophylla* Teijsm. & Binn., Tijdschr. Nederl. Ind. 29: 248. 1867. = ***Timonius macrophyllus*** (Teijsm. & Binn.) Valeton, Bull. Dép. Agric. Indes Néerl. 26: 45. 1909.

*Greenea tetrandra* Miq., Fl. Ned. Ind. 2: 157. 1856. = ***Hedyotis tetrandra*** (Roxb.) Craib, Fl. Siam. 2: 49. 1932.

*Greenea xanthophytoides* Valeton, Icon. Bogor. t. 358. 1913. = ***Neomussaenda xanthophytoides*** (Val.) Tange, Nord. J. Bot. 14: 496. 1994.

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