



*Original Article*

## Genus *Schistochila* Dumort. (Schistochilaceae, Marchantiophyta) in Thailand

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### Abstract

A review of the genus *Schistochila* Dumort. in Thailand is presented, based on the study of fresh and herbarium specimens. Five species are recognized, namely *S. aligera* (Nees & Blume) J.B. Jack & Steph., *S. blumei* (Nees) Trevis., *S. nuda* Horik., *S. sciurea* (Nees) Schiffn., and *S. yakushimensis* Ohnishi & Deguchi. In addition, a key to species, descriptions and line drawings are provided, and notes on the ecology and geographical distribution of the species.

**Keywords:** bryophyte, liverworts, *Schistochila*, Schistochilaceae, Thailand

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### 1. Introduction

The genus *Schistochila*, the only genus in the family Schistochilaceae (He and Glenny, 2010), was first described by Dumortier in 1835. It contains about 80 species (including: *Gottschea* Nees ex Mont., *Pachyschistochila* R. M. Schust. & J. J. Engel, *Paraschistochila* R. M. Schust., *Perssoniella* Herzog, *Pleurocladopsis* R. M. Schust., *Schistochilaster* H. A. Mill., and *Tegulifolium* Hässel), distributed mainly in southern South America and temperate to subantarctic Australasia, and is usually growing on the forest floor (He and Glenny, 2010; He and Sun, 2013). Nine species are recognized in Asia (So, 2003a). The genus is easily separated from other liverwort genera by 1) plant flattened, medium-sized to robust, 2) leaves conduplicate, abaxial face normally with two wings, and 3) underleaf smaller than lateral leaves or lacking.

A comprehensive taxonomic revision of *Schistochila* in Asia and Oceania was published by So (2003a, b), but there are few reports of this genus from Thailand, probably due to the paucity of bryological studies in this country (Sukkharak and Chantanaorrapint, 2014). Moreover, no taxonomic revision of the genus is available in this country. The aim of the present study was to prepare a revision of *Schistochila* in the framework of the study and floristic treatment of the bryophyte flora of Thailand.

### 2. Materials and Methods

This study is based on fresh specimens from fieldwork as well as herbarium specimens in BCU, BKF, BM, HSNU, L, NICH, and PSU. Morphological and anatomical characters were studied using stereo and compound microscopes. The distinctive characters of the species were illustrated with the aid of an Olympus drawing tube. In addition, the distributions of each species were assessed by fieldwork throughout Thailand during 2010-2014, and using the available taxonomic literature. Distributional and ecological data were compiled, and detailed descriptions, illustrations and key to species were prepared.

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### 3. Results and Discussion

Five species of *Schistochila* are recorded for Thailand: *S. aligera* (Nees & Blume) J.B. Jack & Steph., *S. blumei* (Nees) Trevis., *S. nuda* Horik., *S. sciurea* (Nees) Schiffn., and *S. yakushimensis* Ohnishi & Deguchi. A key for distinguishing these five species is given below. They are mostly epiphytes, growing on tree trunks, usually from ground level to a 2 m height, but also on decaying wood and rocks, and they are found in humid montane forests from 900 to 2,550 m above sea level.

Based on geographical localities from field surveys, herbarium specimens, and data from published literature (Tixier, 1973; Kitagawa, 1978; Ohnishi and Deguchi, 2003; So, 2003a; Chantanaorrapint *et al.*, 2004; Sukkharak *et al.*, 2008), the peninsular region exhibits a great diversity of species (Figure 1). The most common species of *Schistochila* in Thailand is *S. aligera*, distributed in five floristic regions, including the Northern, North-Eastern, South-Western and Peninsular region (Figure 1), while *S. yakushimensis* and *S. nuda* have a restricted distribution and found only in the Northern and Peninsular region, respectively.

#### 3.1 Key to *Schistochila* species in Thailand

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|--|-----------------------------------|
| 1. Underleaves usually lacking on sterile shoots   | 2                                 |
| 2. Plant small with leaves 2.5–4.0 mm wide; leaf apex round, margins entire throughout             | 3. <b><i>S. nuda</i></b>          |
| 2. Plant larger with leaves 3.0–12.0 mm wide; leaf apex acute or obtuse with dentate margin        | 1. <b><i>S. aligera</i></b>       |
| 1. Underleaves always present on sterile shoots  | 3                                 |
| 3. Dorsal leaf lobe smaller than ventral leaf lobe, ventral leaf lobe with lamella                 | 2. <b><i>S. blumei</i></b>        |
| 3. Dorsal leaf lobe as large as or larger than ventral leaf lobe, ventral leaf lobe with lamella   | 4                                 |
| 4. Dorsal leaf lobe as large as ventral leaf lobe; margin of ventral lobe strongly dentate-ciliate | 4. <b><i>S. sciurea</i></b>       |
| 4. Dorsal leaf lobe clearly larger than ventral leaf lobe; margin of ventral lobe nearly entire    | 5. <b><i>S. yakushimensis</i></b> |

**3.1.1 *Schistochila aligera*** (Nee & Blume) Jack & Steph., *Hedwigia* 31: 12. 1892; E.A. Hodgs., *Trans. & Proc. Roy. Soc. New Zealand* 71: 181. 1942; Tixier., *Nat. Hist. Bull. Siam Soc.* 24: 449. 1973; N. Kitag., *Acta Phytotax. Geobot.* 29: 63. 1978; Piippo, *Ann. Bot. Fennici* 21: 40. 1984; M. L. So, *J. Hattori Bot. Lab.* 93: 80. Figures 1 & 6. 2003; *New Zealand J. Bot.* 41: 25. Figure 2. 2003; A. E. D. Daniels & P. Daniels., *Cryptog. Bryol.* 29(3): 308. Figures 1-15. 2008. — *Jungermannia aligera* Nees & Blume, *Nov. Actorum Acad. Caes. Leop.-Carol. Nat. Cur. Nat. Cur.* TYPE: Indonesia, Java, Tjieriman, *Junghuhn s.n.* (holotype: STR; isotypes: BM, L). — *Schistochila philippinensis* (Mont.) Steph. in Engler, *Bot. Jahrb. Syst.* 23: 308. 1896; N. Kitag., *Acta Phytotax. Geobot.* 29: 63. 1978. Chantanaorr., Boonkerd & Thaithong. *Nat. Hist. Bull. Siam*

*Soc.* 52(2): 179. 2004. For further synonyms, see So (2003a, b); see Figure 2.

*Plants* epiphytic or lithophytic, medium to large in size, flattened, yellowish green, 1.8-6.5 cm long, 0.5-1.2 cm wide with leaves, simple or sparingly branched, creeping and tightly adherent to substrate. *Rhizoids* reddish, purple to magenta, dense along ventral surface of stem, except apex. *Stems* dark brown, in cross section 15-20 cells across; cortical cells 1-2 layers, thick walled; medullary cells as large as cortical ones, with indistinct trigones. *Lateral leaves* imbricate, widely spreading, more or less contorted when dry, dorsal lobes narrowly ovate, 1.0-3.2 mm long, 0.4-0.7 mm wide, widest at base, apex truncate, margins entire to dentate, about 1/2 area of ventral lobe; ventral lobes narrowly ovate to lanceolate, 2.0-6.3 mm long, 0.5-1.5 mm wide, widest at base, dentate at upper part; basal and median cells hexagonal to octagonal, 65-69 x 29-36  $\mu\text{m}$ , with small trigones; margin cells pentagonal to hexagonal, 24-30 x 19-28  $\mu\text{m}$ , with larger nodulose trigones; apical cells isodymetric, 27-34 x 26-30  $\mu\text{m}$ ,

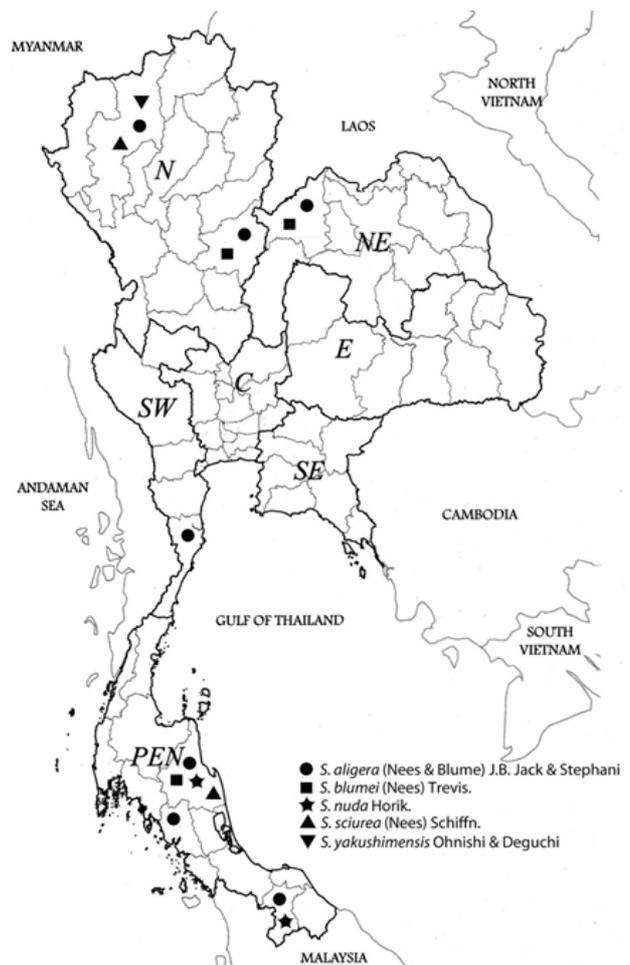


Figure 1. Distribution of *Schistochila* species in Thailand. Thai Floristic regions N = Northern, NE = North-Eastern, E = Eastern, SE = South-Eastern, C = Central, SW = South-Western, PEN = Peninsular.

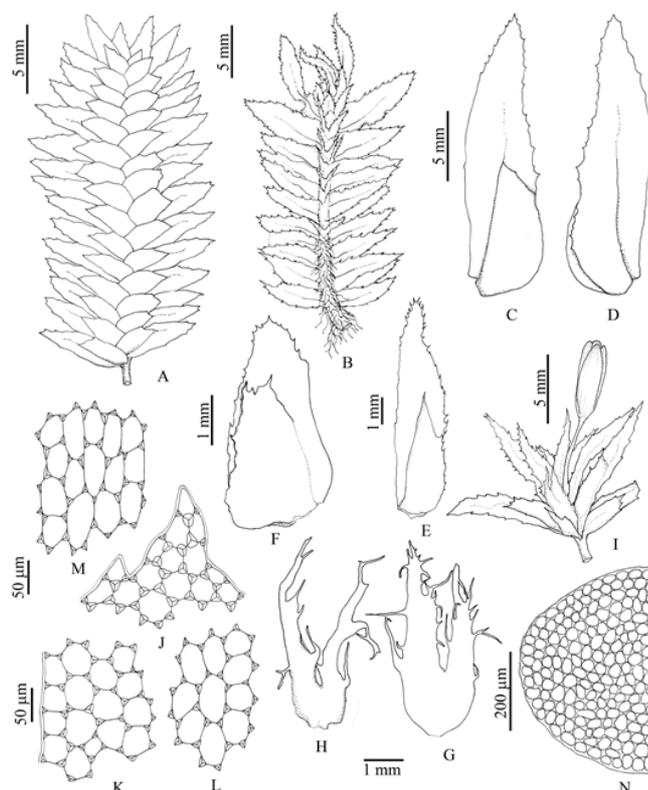


Figure 2. *Schistochila aligera* (Nees & Blume) J. B. Jack & Steph.: A. part of plant on sterile branch, dorsal view; B. plant on fertile branch, ventral view; C.-D. lateral leaves; E. female bract; F. male bract; G.-H. underleaves; I. gynoecium with sporophyte; J.-M. leaf cells, J. apical cells, K. marginal cells, L. median cells, M. basal cells; N. cross section of stem. Drawn by W. Juengprayoon from *Juengprayoon 41* (PSU).

thin walled with large nodulose trigones. *Underleaves* absent in sterile shoots, if present only in fertile shoot, bilobed to 2/3-4/5 the length, 0.9-1.0 mm long, 0.4-0.95 mm, margin irregularly dentate. *Paraphyllia* numerous at axil of leaves. *Gynoecia* usually on main branch, about 18-20 mm long; perianths narrowly ovate, 3.5-6.0 mm long, 1.0-1.5 mm wide, acute, dentate. *Androecium* on terminal shoot, ca 4.0 mm long; antheridium globose, ca 150-300 µm in diameter.

**Habitat and ecology:** On tree trunks, also on decaying wood, and rocks, but also found on tree fern and rotten lag, occurs in montane forests and evergreen forests, ca. 1,000-1,800 m above sea level (a.s.l.).

**Thailand:** NORTHERN: Chiang Mai (Doi Inthanon, Doi Suthep), Phitsanulok (Phu Hin Rong Kla); NORTH-EASTERN: Loei (Phu Luang); SOUTH-WESTERN: Prachaup Khiri Khan (Khao Luang summit); PENINSULAR: Nakhon Si Thammarat (Khao Luang, Khao Nan Yai, Prom Lok), Yala (Betong), Trang (Khao Chong, Khao Chedyod).

**Distribution:** This species is widely distributed in Asia and Melanesia: China, India, Indonesia, Malaysia, Micronesia, New Caledonia, Papua New Guinea, Philippines, Samoa,

Solomon Islands, Sri Lanka, Tahiti, Thailand, and Vanuatu (So, 2003a, b)

**Specimens examined:** Chiang Mai, Doi Inthanon National Park, 1,500 m a.s.l., 17 Dec. 1965, *Touw 9612* (BKF); Doi Suthep, 1,550-1,600 m a.s.l., nd, *Touw 8793* (BKF, L); Phitsanulok, Phu Hin Rong Kla National Park, 1,250-1,300 m a.s.l., 14 Apr. 2011, *Chantanaorrapint, Inuthai & Promma 206* (PSU); 8 Dec. 2013, *Chantanaorrapint, Inuthai & Promma 3353, 3366* (PSU); Loei, Phu Luang, 1,300-1,350 m a.s.l., 9 Jan. 1966, *Touw 10703* (BKF, L); Phu Hin Longkla National Park, Man Daeng Waterfall, 1,353 m a.s.l., 13 Apr. 2011 *Chantanaorrapint, Inuthai & Promma 111a, 111b* (PSU); Prachaup Khiri Khan, Hui Yang Waterfall National Park, Khao Luang summit, 1,200 m a.s.l., 11 Aug. 2000, *Chantanaorrapint 377* (BCU); Nakhon Si Thammarat, Khao Luang National Park, Khao Luang, 1,000-1,700 m a.s.l., 20 Apr. 1952, *Touw 8860* (BKF, L); 25 Jun. 1953, *Touw 10172, 10187* (BKF, L); 5 Dec. 1965, *Tagawa & Kitagawa T1678, T1697* (BKF); 21 Jan. 1966, *Tagawa & Kitagawa T5223, T5227, T5234* (BKF); 5 Feb. 1966, *Touw 11650, 11704b, 11721, 11749, 11767* (BKF, L); 1500-1700 m, 16 Mar. 2013, *Juengprayoon 27* (PSU); 17 Mar. 2013, *Juengprayoon 28, 29, 31* (PSU); 18 Mar. 2013, *Juengprayoon 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53,*

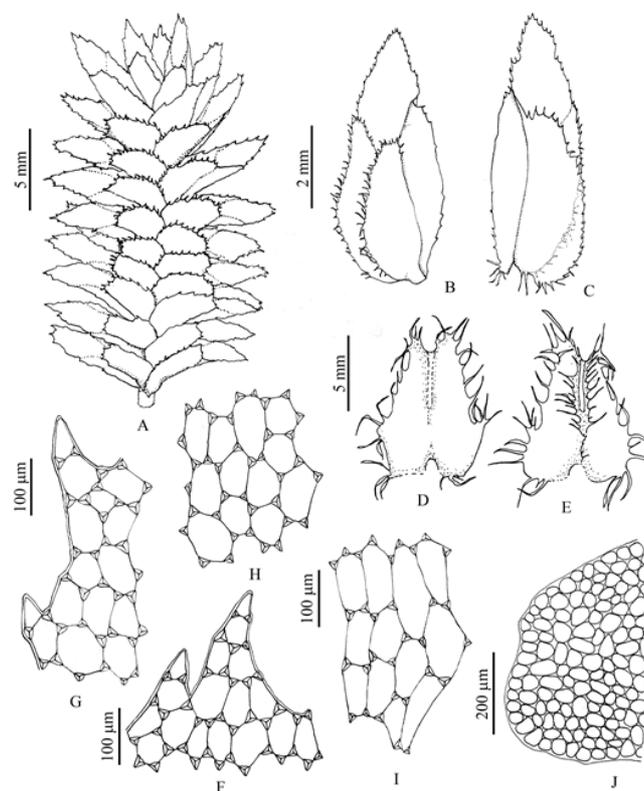


Figure 3. *Schistochila blumei* (Nees) Trevis.: A. part of plant, dorsal view; B-C. lateral leaves; D-E. underleaves; F-I. leaf cells, F. apical cells, G. marginal cells, H. median cells, I. basal cells; J. cross section of stem. Drawn by W. Juengprayoon from *Chantanaorrapint, Inuthai & Promma 3434* (PSU).

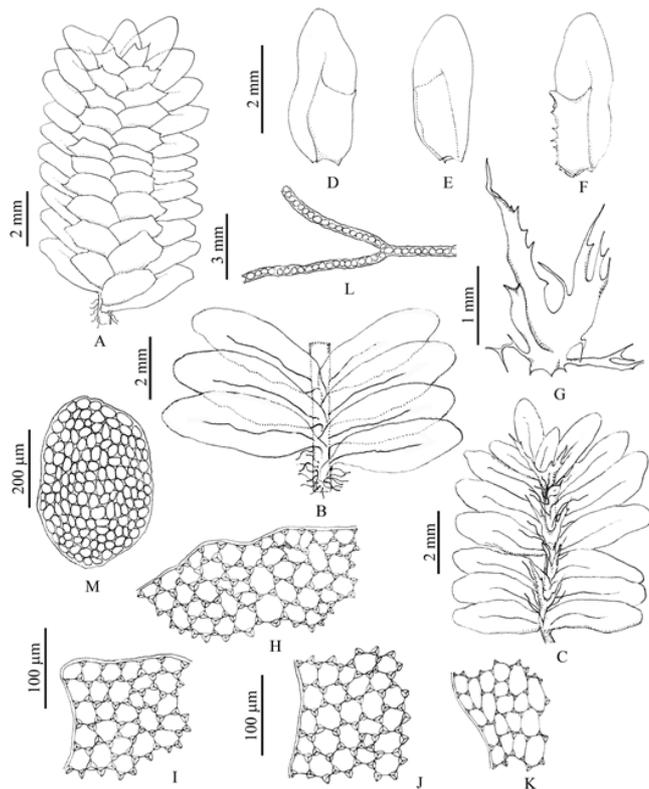


Figure 4. *Schistochila nuda* Horik. A.-B. part of plant on sterile branches, A. on dorsal view, B. on ventral view; C. part of plant on fertile branch; D.-E. lateral leaves; F. female bract; G. underleaf; H.-K. leaf cells, H. apical cells on ventral lobe, I. apical cells on dorsal lobe, J. marginal cells, K. basal cells; L. cross section of leaf, M. cross section of stem. Drawn by W. Juengprayoon from *Chantanaorrapint & Promma 2516* (HSNU, PSU).

54, 55, 56, 57, 61, 63, 64b, 69b, 70, 71, 72, 74, 76 (PSU); 19 Mar. 2013, *Juengprayoon 77* (PSU); 21 Apr. 2014, *Juengprayoon 98, 99, 100, 101, 102, 103, 104, 108b, 110* (PSU); 22 Apr. 2014, *Juengprayoon 118, 121a, 123b, 130b* (PSU); 22 Apr. 2014, *Juengprayoon 134* (PSU); Khao Luang National Park, Prom Lok, 1,400-1,800 m a.s.l., 27 Mar. 2004, *Pollawatn & Chantanaorrapint 044, 045, 046, 047, 048, 049* (PSU); Khao Nan National Park, Khao Nan Yai, 1,359 m a.s.l., 26 Jan 2006, *Sukkharak 499* (BCU) 14 March 2006, *Sukkharak & Seelanan 151* (BCU); 11 May 2006, *Sukkharak 541c* (BCU); 13 Aug. 2006, *Sukkharak 456* (BCU); 14 Aug. 2006, *Sukkharak 257b* (BCU); 27 Jan. 2007, *Sukkharak 541b* (BCU); Khao Nan National Park, San Yen, 1,000-1,200 m a.s.l., 21 Apr. 2007, *Sukkharak 472* (BCU); 26 Apr. 2007, *Sukkharak 143* (BCU), 17 Aug. 2007, *Sukkharak & Seelanan 31* (BCU), 28 Aug. 2007, *Sukkharak 532* (BCU); Khao Nan, 1,359 m, 27 Jan. 2007, *Sukkharak 541a* (BCU); Ron Phibun, Khao Ramrome, 600-990 m, 12 Mar. 2013, *Juengprayoon 26* (PSU); 28 July 2014, *Juengprayoon 183* (PSU); Trang, Khao Chong, 800-1,100 m a.s.l., 27 Jan. 1966, *Tagawa & Kitagawa T6915* (BKF); Khao chedyod, 1,097 m a.s.l., 22 May 2012, *Chan-*

*tanaorrapint, Inuthai & Promma 1339b* (PSU); 1 May 2014, *Juengprayoon 148* (PSU); 2 May 2014, *Juengprayoon 158b* (PSU); Yala, Betong, Ban Piyamit 2, 1,000-1,050 m a.s.l., 17 Apr. 2013, *Juengprayoon 78, 79* (PSU).

Taxonomic notes: *Schistochila aligera* is one of the most widespread species in Asia and Oceania, which is also extremely variable in shape and size of the lateral leaf. Diagnostic features of *S. aligera* are 1) underleaves usually lacking on sterile shoots, 2) the apex of the dorsal leaf lobe usually almost truncate, and 3) the leaf margin more or less dentate on the upper part.

**3.1.2 *Schistochila blumei* (Nees) Trevis., Mem. Reale Ist. Lomb. (Ser. 3) CI. Sci. 4: 392. 1877.** [Schema Classific. Epat: 10]; N. Kitag., *Acta Phytotax. Geobot.* 29: 63. 1978; Piippo *Ann. Bot. Fennici* 21: 34. 1984; M. L. So, *J. Hattori Bot. Lab.* 93: 89. Figure 6. 2003; *New Zealand J. Bot.* 41: 262. Figures 2, 4, 8. 2003.— *Jungermania blumei* Nees in *Blume, Nova Acta Acad. Leop.-Carol* 11(1): 136. 1832. TYPE: Indonesia, Java, *collector unknown* (holotype: STR; isotypes: BM!, STR). For further synonyms, see So (2003a, b); see Figure 3.

*Plant* epiphytic or lithophytic, medium to large in size, flattened, yellowish green, light green to brownish, 3.5-5.5 cm long, 0.9-1.0 cm wide with leaves, creeping on substrate. *Rhizoids* reddish to purple, dense along ventral surface of

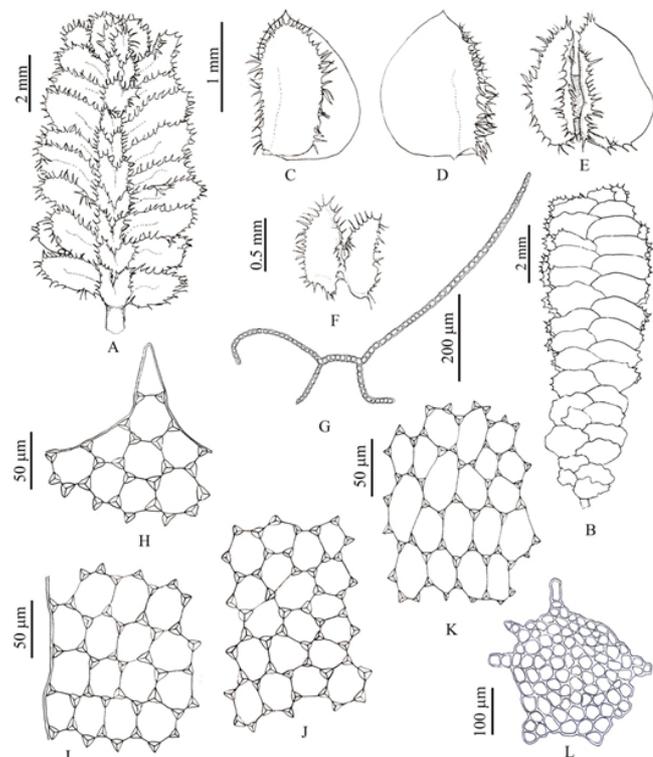


Figure 5. *Schistochila sciurea* (Nees) Schiffn.: A.-B. parts of plant; C.-E. lateral leaves; F. underleaf; G. cross section of leaf; H.-K. leaf cells, H. apical cells, I. marginal cells, J. median cells, K. basal cells; L. cross section of stem. Drawn by W. Juengprayoon from *Juengprayoon 68* (PSU).

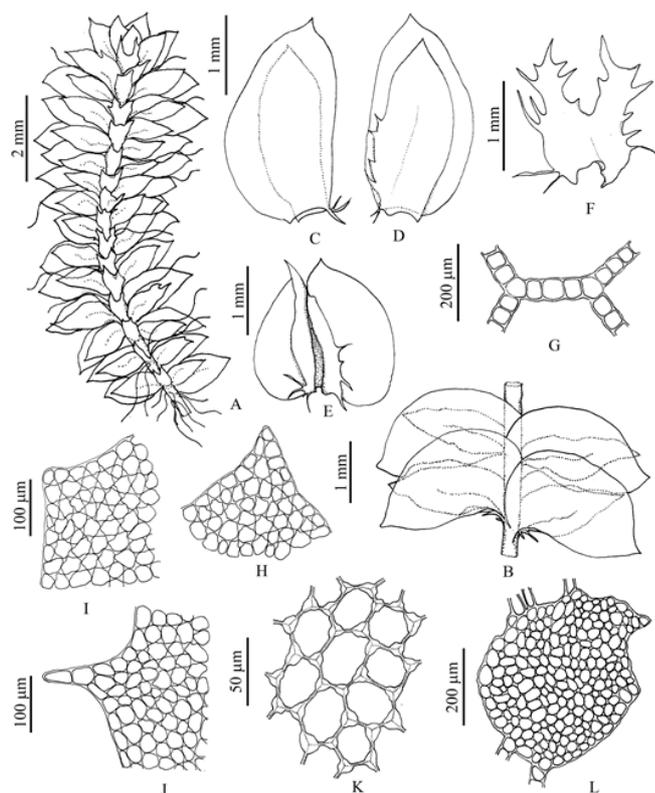


Figure 6. *Schistochila yakushimensis* Ohnishi & Deguchi: A-B. part of plant, A. ventral view, B. dorsal view; C-E. lateral leaves; F. underleaf; G. cross section of leaf; H-K. leaf cells, H. apical cells of ventral lobe, I. apical cells of dorsal lobe, J. marginal cells, K. median cells; L. cross section of stem. Drawn by W. Juengprayoon from *Chantanaorrapint & Promma 1734* (PSU).

stem, except apex. *Stems* dark-green, in cross section 14-16 cells across; cortical cells 2-3 layers, thick walled; medullary cells as large as cortical ones, with indistinct trigones. *Lateral leaves* moderately imbricate, widely spreading, more or less contorted when dry, dorsal lobe, dorsal lobes ovate, 2.8-3 mm long, 0.8-1.0 mm wide, widest at middle, apex truncate, margins ciliate, about 1/2 area of ventral lobe; ventral lobes narrowly ovate to elliptic, 3.0-5.0 mm long, 0.6-0.7 mm wide, widest at middle, apex acute, margins dentate to ciliate; lamina cells thin walled with small trigones, basal and median cells octagonal,  $55-62 \times 24-27 \mu\text{m}$  marginal cells hexagonal,  $45-50 \times 19-25 \mu\text{m}$ , apical cells hexagonal,  $37-40 \times 15-22 \mu\text{m}$ ; lamellae 3 rows on dorsal surface of ventral leaf lobe. *Underleaves* bilobed, to 1/2 the length, 1.0-1.1 mm long, 0.6-0.7 mm wide, margin ciliate. *Paraphyllia* numerous at axil of leaves. *Reproductive organs* not seen.

**Habitat and ecology:** On tree trunks and rocks, occurring in montane and evergreen forests at 1,200-1,700 m a.s.l.

**Thailand:** NORTHERN: Phitsanulok (Phu Hin Rong Kla); NORTH-EASTERN: Loei (Phu Luang, *Man Daeng water fall*); PENINSULAR: Nakhon Si Thammarat (Khao Luang National Park, Khao Nan National Park).

**Distribution:** This species is widely distributed in Asia and Melanesia: China, Indonesia, Malaysia, Papua New Guinea and Vanuatu (So, 2003a, b).

**Specimens examined:** Loei, Phu Luang, 1,300-1,350 m a.s.l., 9 Jan. 1966, *Touw 10653* (BKF); 1,250 m a.s.l., 8 Jan. 1966, *Touw 10490* (BKF, L); Man Dang Waterfall, 1,332 m a.s.l., 9 Dec. 2013, *Chantanaorrapint, Inuthai & Promma 3434* (PSU); Nakhon Si Thammarat, Khao Luang National Park, Khao Luang, 1,650 m a.s.l., 5 Feb. 1966, *Touw 11704a* (BKF, L); Prom Lok, 1,400 m a.s.l., 27 Mar. 2004, *Pollawatn & Chantanaorrapint 050* (PSU); Khao Nan National Park, Khao Nan Yai, 1,269 m, 26 Jan. 2007, *Sukkharak 506* (BCU); 1340 m, 11 May 2006, *Sukkharak 377* (BCU).

**Taxonomic notes:** *Schistochila blumei* is easily separated from other species by 1) the large size of plant, 2) underleaves presence on sterile shoot, 3) the margins of leaf lobes and underleaves strongly dentate, and 4) the presence of lamellae on leaf lobes.

**3.1.3 *Schistochila nuda*** Horik., J. Sci. Hiroshima Univ., Ser. B, Div. 2, Bot. 2: 215. 1934; M.L. So, J. Hattori Bot. Lab. 93: 94. Figure 7. 2003. TYPE: Taiwan, Formosa, Prov. Taito, between Schinsuieie & Shucho-kykai, 3 Jan. 1933, *Y. Horikawa 10626* (holotype: HIRO); see Figure 4.

*Plants* epiphytic, small in size, flattened, yellowish green, light green, 0.7-2.0 cm long, 0.25-0.40 cm with leaves, creeping and tightly adherent to substrate. *Rhizoids* reddish, purple, dense along ventral surface of stem to apex. *Stems* green, in cross-section 9-11 cells across; cortical cells 2-3 layers, thick walled; medullary cells as large as cortical ones, with indistinct trigones. *Lateral leaves* imbricate widely spreading, less contorted when dry, dorsal lobes oblong, 0.4-0.7 mm long, 0.2-0.3 mm wide, about 1/2 area of ventral leaf lobe, apex round, margins entire; ventral lobes oblong, 0.8-1.3 mm long, 0.4-0.6 mm wide, apex round, margins entire throughout; basal and median cells hexagonal to octagonal,  $36-40 \times 25-30 \mu\text{m}$ , thin walled with nodulose trigones; marginal cells hexagonal to octagonal  $30-35 \times 18-22 \mu\text{m}$  with large nodulose trigones; apical cells hexagonal to octagonal,  $31-35 \times 34-36 \mu\text{m}$ , slightly thick walled with large nodulose trigones, *Underleaves* absent in sterile shoots, if present only in fertile shoots, bilobed to 2/3 the length, 0.9-1.0 mm long, 0.3-0.5 mm, margin irregularly dentate. *Gynoeceia* usually on main branches, about 8.5 mm long, perianths narrowly ovate, 3.0-3.3 mm long, 0.7-1.0 mm wide, acute, dentate.

**Habitat and ecology:** On tree trunks, occur in montane forests at 900-1,800 m a.s.l.

**Thailand:** PENINSULAR: Nakhon Si Thammarat (Khao Luang, Khao Nan National Park), Yala (Betong).

**Distribution:** China (Taiwan), Japan, Philippines (So, 2003a) and Thailand.

**Specimens examined:** Nakhon Si Thammarat, Khao Luang National Park, Khao Luang, 1,800 m a.s.l., 18 Mar. 2013, *Juengprayoon 58* (PSU); Khao Nan National Park, Khao Nan, 1,074 m a.s.l., 26 May 2007, *Sukkharak 488* (BCU); 1,305 m a.s.l., 20 May 2007, *Sukkharak & Seelanan 109* (BCU);

Yala, Betong, Ban Piyamit 2, 830-977 m, 14 Jun. 2013, *Chantanaorrapint & Promma 2514, 2516* (HSNU, PSU).

Taxonomic notes: *Schistochila nuda* is closely related to *S. integerrima* Steph., which also has a small size, and the entire leaf margin and underleaves lack on sterile shoot. So (2003b) also noted that the two species may be conspecific. However, more samples of these two *Schistochila* need to be examined for understanding their status.

**3.1.4 *Schistochila sciurea*** (Nees) Schiffn., Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 60: 251 [Exot. Hep.: 35]. 1893; Piippo Ann. Bot. Fennici 21: 34. 1984; M.L. So, J. Hattori Bot. Lab. 93: 272. 2003; New Zealand J. Bot. 41: 98. Figure 7. 2003:—*Jungermannia sciurea* Nees, Hep. Javan.: 34. 1830. Type: Indonesia, Java, *Collector unknown s.n.* (holotype: STR; isotypes: BM!, L). For further synonyms, see So (2003a); see Figure 5

*Plants* epiphytic, small to medium in size, flattened, yellowish green, reddish brown, 1.20-2.50 cm long, 0.20-0.35 cm wide with leaves, simple or sparingly branched, creeping and tightly adherent to substrate. *Rhizoids* reddish, purple to magenta, dense along ventral surface of stem. *Stems* yellow brown, in cross section 9-12 cells across; cortical cells 1-2 layers, thick walled; medullary cells as large as cortical ones, with indistinct trigones. *Lateral leaves* densely imbricate, widely spreading, dorsal lobes broadly ovate to round, 0.8-1.5 mm long, 0.5-0.9 mm wide, acute to acuminate, entire; ventral lobes broadly ovate, 1.0-1.7 mm long, 0.4-0.72 mm wide, widest at base, about 5/6 area of dorsal lobe, acute to acuminate, ciliate, basal and median cells hexagonal, 30-35 × 17-20 μm; marginal cells hexagonal, 12-18 × 10-15 μm; apical cells hexagonal, 21-27 × 17-23 μm; trigones large, nodulose. *Underleaves* always present, bilobes to 1/2 the length, 0.6-0.7 mm long, 0.4-0.55 mm wide, margin ciliate. *Paraphyllia* numerous at axil of leaves. *Reproductive organs* not seen.

Habitat and ecology: On tree trunks, occur in montane forests at 1,500-2,500 m a.s.l.

Thailand: NORTHERN: Chiang Mai (Doi Inthanon National Park, Angka), PENINSULAR: Nakhon Si Thammarat (Khao Luang and Khao Nan National Park).

Distribution: South East Asia and Melanesia (So, 2003a)

Specimens examined: Chiang Mai, Doi Inthanon National Park, Angka, 2,500-2,543 m a.s.l., 20 Dec. 2011, *Chantanaorrapint 2363* (PSU); 4 Apr. 2014, *Juengprayoon 80b* (PSU); Nakhon Si Thammarat, Khao Luang National Park, Khao Luang, 1,740 m a.s.l., 5 Feb. 1966, *Touw 11784* (BKF, L); 1,800 m a.s.l., 18 Mar. 2013, *Juengprayoon 59, 60, 61a, 62, 63a, 64a, 65, 66, 67, 68, 69a, 73, 74d, 75* (PSU); Khao Nan National Park, Khao Nan, 1,327 m a.s.l., 13 Aug. 2006, *Sukkharak 457* (BCU).

Taxonomic notes: This species is well characterized and easily recognized from other species of *Schistochila* in Thailand by its leaf lobes and underleaves with ciliate margins. *Schistochila sciurea* resembles *S. yakushimensis* in having two distinct leaf-wings. The former, however, differs

from the latter by broadly ovate, lobed ventral lobes of the lateral leaves with numerous teeth and cilia along their margins and distinct lamellae of the lateral leaves and underleaves (Ohnishi and Deguchi, 2003).

**3.1.5 *Schistochila yakushimensis*** Ohnishi & Deguchi, Bryologist 106(3): 451. Figure 1. 2003. TYPE: Japan. Kyushu, Kagoshima, Yaku, Yakushima Isl., Onaida, Mt. Mochomu, 920 m a.s.l., *N. Ohnishi 4344* (holotype: HIRO; isotype: H, NICH!); see Figure 6

*Plants* epiphytic, small to medium in size, flattened, yellowish green, brownish green, 1.3-2.0 cm long, 0.3-0.45 cm wide with leaves, creeping and tightly adherent to substrate, *Rhizoids* reddish, purple, scattered over ventral portions of the axis and arising from stem. *Stems* dark brown, in cross-section 11-15 cells across; cortical cells 1-2 layers, thick walled; medullary cells as large as cortical ones, with indistinct trigones. *Lateral leaves* densely imbricate, widely spreading, more or less contorted when dry, dorsal lobes broadly ovate, 1.2-1.5 mm long, 0.4-0.5 mm wide, widest at base, acute, entire; ventral lobes broadly ovate to round, 0.9-1.2 mm long, 0.3-0.4 mm wide, about 5/6 area of dorsal leaf lobe or as large as dorsal lobe, acute, entire, both dorsal and ventral lobes connate with each other by one-cell layered, basal and median cells hexagonal, 30-36 × 24-26 μm with large nodulose trigones; marginal cells hexagonal, 20-27 × 12.5-18 μm with large nodulose trigones; apical cells pentagonal to hexagonal, 25-29 × 17-25 μm with large nodulose trigones, wall slightly thickened and distinct trigone. *Underleaves* present, bilobed to 2/3 the length, 0.6-0.8 mm long, 0.5-0.55 mm wide, margin irregularly dentate. *Paraphyllia* at axil of leaves. *Reproductive organs* not seen.

Habitat and ecology: On tree trunks and base, also on decaying wood, and rocks, occur in evergreen forests at 2,000-2,500 m a.s.l.

Thailand: NORTHERN: Chiang Mai (Doi Inthanon)

Distribution: Japan and Thailand (Ohnishi and Deguchi, 2003)

Specimens examined: Chiang Mai, Doi Inthanon National Park, Angka, 2000-2,535 m a.s.l., 19 Dec. 1965, *Tagawa & Kitagawa 3005* (paratype, BKF); 20 Dec. 1965, *Tagawa & Kitagawa 3096* (paratype, BKF); 9 Oct. 2012, *Chantanaorrapint & Promma 1734* (HSNU, PSU); 4 Apr. 2014, *Juengprayoon 80a* (PSU).

Taxonomic notes: The diagnostic features of *S. yakushimensis* are the presence of two distinct leaf-wings with few cilia along margins of lateral leaves, the absence of lamellae on surface of lateral leaves, and trigones nodulose.

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