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RESEARCH ARTICLE

Taxonomic studies on Indian Pseudolepicoleaceae (Marchantiophyta: Jungermanniales)

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ABSTRACT: The Indian taxa of family Pseudolepicoleaceae Fulford & J.Taylor are morpho-taxonomically investigated and four species, viz. *Blepharostoma trichophyllum* (L.) Dumort., *Pseudolepicolea fryei* (Perss.) Grolle & Ando, *Pseudolepicolea trollii* (Herzog) Grolle & Ando and *Temnoma setigerum* (Lindenb.) R.M.Schust. have been recognized in the bryoflora of the country. *Pseudolepicolea fryei*, a species so far known from Russia and North America, is reported here for the first time from India. Whereas, *P. trollii* subsp. *andoi* (R.M.Schust.) S.Hatt. & Mizut. and *P. trolli* var. *darjeelingensis* S.Hatt. & Mizut., earlier recorded from the country, have not been found morphologically distinct from the typical taxon.

KEY WORDS: India, Pseudolepicoleaceae, taxonomy.

INTRODUCTION

The family Pseudolepicoleaceae Fulford & J.Taylor is characterized by terminal and ventral endogenous branching; transversely inserted succubous leaves, shallowly to deeply divided into 3 or 4 (rarely more) lobes, sometimes bisbifid. Leaf lobes are filiform with striolate or smooth surface; oil-bodies are small, ovoid–spherical, segmented, 2–8 or more per cell. Underleaves are similar to leaves (except *Temnoma*). Asexual reproduction takes place only through gemmae. Sporophytes are enclosed by a shoot calyptra and perianth, with the foot and seta deeply embedded in stem tissue; perianth is cylindrical, broadly 3-plicate with the third keel ventral. Capsules are ovoid to ellipsoidal, with 2–4-stratose wall and minutely papillose–vermiculate spores. The family is represented by 7 genera in the world (Crandall-Stotler et al., 2009) of which *Blepharostoma* Mitt., *Pseudolepicolea* Fulford & J.Taylor and *Temnoma* Mitt. occur in India (Mitten, 1861; Singh, 2001).

The genus *Blepharostoma* is globally represented by six species and one subspecies. Except for *B. trichophyllum* (L.) Dumort. subsp. *trichophyllum* widely distributed in Asia, Oceania, Africa, Europe, North and South America, the others, such as *B. arachnoideum* M.Howe, *B. corrugatum* Steph., *B. minus* Horik., *B. quadrilaciniata* (Sull.) Schiffn., *B. quadripartita* (Hook.) Trevis. and *B. trichophyllum* subsp. *brevirete* (Bryhn & Kaal.) R.M.Schust. are very limited in distribution (Mitten, 1861; Stephani, 1909; Kashyap, 1932; Chopra, 1943; Fulford and Taylor, 1960; Hattori, 1966, 1971, 1975; Schuster, 1966a; Grolle and Piippo, 1984; Tan and Engel, 1986; Long and Grolle, 1990; Piippo, 1990; Piippo et al., 1997; Staples and Imada, 2006; Yamada and Iwatsuki, 2006; Söderström et al., 2007, 2010; Konstantinova et al., 2009; Pradhan and Joshi, 2009; Singh and Singh, 2009; Wigginton, 2009; Chuah-Petiot, 2011; Wang et al., 2011).

Instituted by Dumortier (1835), the genus *Blepharostoma* Dumort. was first reported in India by Mitten (1861) as *Ptilidium trichophyllum* Mitt. based on the specimens collected by Sir J.D. Hooker from Sikkim. The species was later reported from Kumaon region of Uttrakhand in the Western Himalaya, Sikkim and West Bengal (Darjeeling) in the Eastern Himalaya (Kashyap, 1932; Chopra, 1938, 1943; Hattori, 1966). More recently, Singh and Singh (2009) and Nath et al. (2010) reported it from Great Himalayan National Park in Himachal Pradesh and the Valley of Flowers National Park in Garhwal region of Uttarakhand respectively.

The genus *Pseudolepicolea* Fulford & J.Taylor is represented by about six species in the world. Of these, *P. fryei* (Perss.) Grolle & Ando, *P. kuehnemannii* (R.M.Schust.) Hässel de Menéndez, *P. temnomoides* R.M.Schust., *P. quadrilaciniata* (Sull.) Fulford & J.Taylor and *P. grolleana* (R.M.Schust.) Grolle show a highly restricted distribution, whereas *P. trollii* is distributed in Bhutan, China, India, Malaysia and Nepal (Herzog, 1939; Schuster, 1966b; Long and Grolle, 1990; Piippo, 1990; Konstantinova et al., 2009; Pradhan and Joshi, 2009; Chuah-Petiot, 2011; Wang et al., 2011). In addition, *P. andoi* (R.M.Schust.) Inoue, so far known from China, Japan, India, Indonesia and

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Taiwan (Hattori and Mizutani, 1968; Kumar, 1986; Piippo, 1990; Yamada and Iwatsuki, 2006; Wang et al., 2011) has been treated differently by various authors. Schuster (1966b, as *Lophochaete andoi* R.M.Schust.) and Inoue (1978) considered it as a distinct species, Ando (1963) and Grolle (1966) as conspecific with *P. trollii*, whereas Hattori and Mizutani (1968) and Kumar (1986) treated it as a subspecies of *P. trollii*, i.e. *P. trollii* subsp. *andoi* (R.M.Schust.) S.Hatt. & Mizut.

Established by Fulford and Taylor (1960), *Pseudolepicolea* was first reported from India by Herzog (1939) as *Blepharostoma trollii* Herzog [= *Pseudolepicolea trollii* (Herzog) Ando] based on the specimens collected by C. Troll from Tsomgo Lake, Sikkim in 1937. Hattori (1966) and Hattori and Mizutani (1968) later also reported it from Darjeeling in West Bengal and Nepal. Hattori and Mizutani (l.c.) also described *P. trollii* var. *darjeelingensis* S.Hatt. & Mizut. from Darjeeling. Kumar (1986) reported *P. trollii* subsp. *andoi* from Darjeeling in West Bengal. More recently, Nath et al. (2010) reported *P. trollii* from Valley of Flowers National Park in Uttarakhand, Western Himalaya.

In the present state of our knowledge the genus *Temnoma* Mitt. is represented globally by 10 species. Of these, *T. townrowii* R.M.Schust., *T. pulchellum* (Hook.) Mitt., *T. palmatum* (Lindb. ex Pearson) R.M.Schust., *T. quadrifidum* (Mitt.) Mitt. ex E.A.Hodgs. & Allison, *T. angustifolium* R.M.Schust., *T. paucisetigerum* R.M. Schust., *T. quadripartitum* (Hook.) Mitt., *T. chaetophylla* R.M.Schust. and *T. pilosum* (A.Evans) R.M.Schust. show a rather restricted distribution, whereas *T. setigerum* is widely distributed in East Asia and Oceania (Mitten, 1861; Grolle, 1964; Tan and Engel, 1986; Long and Grolle, 1990; Piippo, 1990; Schuster, 1966c, 2000; Long, 2005; McCarthy, 2006).

Temnoma was established by Mitten in 1867, who had earlier reported this genus from India as *Jungermannia setigera* Lindenb. based on the collection made by Sir J.D. Hooker and T. Thomson from Khasi hills in Meghalaya (Mitten, 1861). Later, Long and Grolle (1990) and Long (2005) recorded this species from Bhutan and Nepal respectively, but the genus failed to find any mention in subsequent literature on Indian liverworts (Chopra, 1938, 1943; Parihar, 1961–62; Hattori, 1966, 1971, 1975; Kachroo et al., 1977; Parihar et al., 1994) and its occurrence in Indian bryoflora was totally overlooked till, Bapna and Kachroo (2000) described it from Khasi Hills, Meghalaya as *T. setigerum*, perhaps on the basis of Mitten's (1861) report. In fact the genus could not be collected again from anywhere in India for almost 160 years since its original collection from Meghalaya.

Based on the examination of specimens of Pseudolepicoleaceae available in various Indian herbaria in the present study it is concluded that the family is represented in India by *Blepharostoma trichophyllum* subsp. *trichophyllum*, *Pseudolepicolea fryei*, *P. trollii* and *Temnoma setigerum*.

Key to the Indian genera and species of the family Pseudolepicoleaceae

1a. Leaves and underleaves divided into (3–) 4 uniseriate lobes; basal lamina highly reduced; antheridial stalk uniseriate; seta 4 + 8-seriate; perianth 3-plicate ….. **(*Blepharostoma*) *B. trichophyllum***

1b. Leaves and underleaves not divided into uniseriate lobes; basal lamina distinct; antheridial stalk biseriate; seta massive (many-layered); perianth pluriplicate ……..….. 2

2a. Leaves anisophyllous, slightly or indistinctly lobed; margins toothed or ciliate/laciniate; leaf cuticle papillose–striolate-papillose; perianth wide at mouth; capsule wall cells hyaline (except along margin of valve); capsule wall 3–5-layered, outer epidermal cells elongated ……..... **(*Temnoma*) *T. setigerum***

2b. Leaves isophyllous, deeply lobed; margins entire–crenulate or wavy; leaf cuticle always striolate; perianth contracted at mouth; capsule wall cells with brownish thickenings; capsule wall 2-layered, outer epidermal cells quadrate–subquadrate ……... …… 3 **(*Pseudolepicolea*)**

3a. Leaves always 4-lobed; leaf lobes 4–10 cells wide at base; lamina 16–36 cells wide at middle; median cells of leaf lobe 15–55 × 5–15 µm; margins smooth–slightly wavy; cells below the sinus smaller, 10.0–20.0 × 7.0–17.5 µm ……..…… ***P. fryei***

3b. Leaves (3–) 4-lobed; leaf lobes 3–6 (–7) cells wide at base; lamina 12–18 cells wide at middle; median cells of leaf lobe 25.0–92.5 × 5.0–12.5 µm; margins more or less crenulate; cells below the sinus larger, 15.0–30.0 × 10.0–22.5 µm …..…….... ***P. trollii***

Blepharostoma trichophyllum (L.) Dumort., Recueil Observ. Jungerm. 18. 1835. *Jungermannia trichophyllum* L., Sp. Pl. 2: 1135. 1753. *Ptilidium trichophyllum* Mitt., J. Proc. Linn. Soc., Bot. 5: 102. 1861 subsp. ***trichophyllum***

Figs. 1, 2 & 7A–C

Plants light–bright green when fresh, pale green in herbarium; shoots 10–22 mm long, 0.6–1.3 mm wide, sparsely branched; branches lateral-intercalary, or sometimes ventral-intercalary. Stem not differentiated, more or less orbicular in outline in transverse section, 100–130 µm in diameter, 5–7 cells across; cortical cells in one layer, slightly larger, subquadrate–rectangulate, 20.0–40.0 × 12.5–32.5 µm, thin-walled, hyaline; medullary cells rectangulate–polygonal, 15.0–27.5 × 12.5–25.0 µm, thin-walled, hyaline, trigones indistinct. Leaves contiguous–distant or imbricate, transversely inserted, widely spreading or sometimes suberect, subquadrate–more or less obtriangulate, 0.4–1.1 mm long, 0.2–0.8 mm wide, (2–) 3–4-lobed; lobes filiform, 0.4–0.9 mm long, divided almost to the base, uniseriate, 7–15 cells long; apical leaf-lobe cells narrower, 40–80 × 10–15 µm; median leaf-lobe cells 75.0–100.0 × 17.5–22.5 µm; basal leaf-lobe cells 62.5–87.5 × 25.0–30.0 µm; lamina 1 cell long, 2–4 cells wide,

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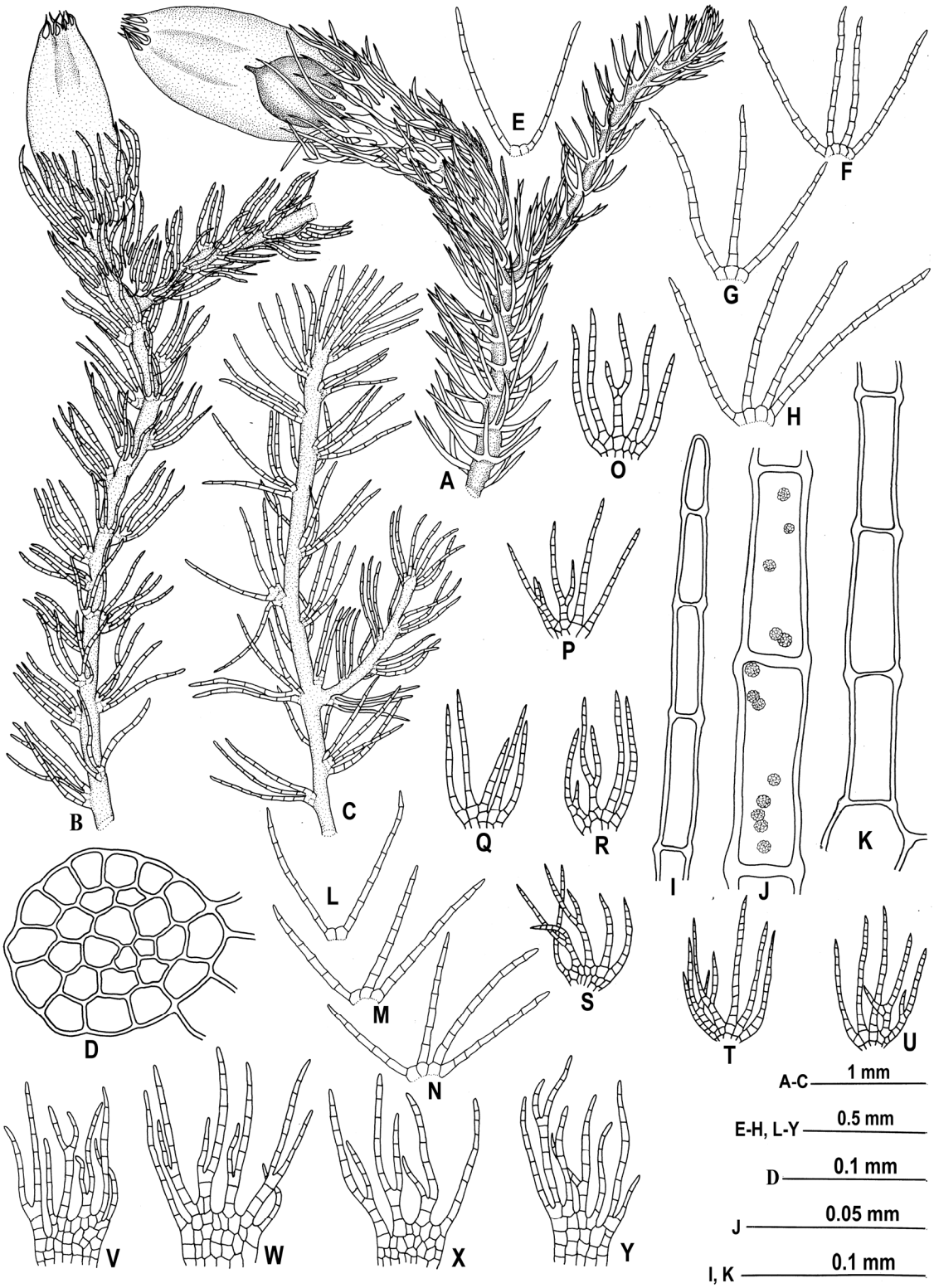


Fig. 1. ***Blepharostoma trichophyllum*** **(L.) Dumort. A: A portion of plant showing androecial branches in ventral view (rhizoids not drawn), note the androecial branch just below the perianth B: A portion of female plant in ventral view (rhizoids not drawn). C: A portion of vegetative plant in dorsal view. D: Transverse section of stem. E–H: Leaves. I: Apical leaf-lobe cells. J: Median leaf cells showing oil-bodies. K: Basal leaf-lobe cells. L–N: Underleaves. O–R: Male bracts: S–U: Male bracteoles. V, W: Female bracts. X, Y: Female bracteoles (Figures A, O–U drawn from** ***D. K. Singh 202A***; **J from** ***D. Singh 41036A***; **others from** ***D. Singh 39898A***; **figures A, O–U drawn by S. Majumdar; others by D. Singh).**

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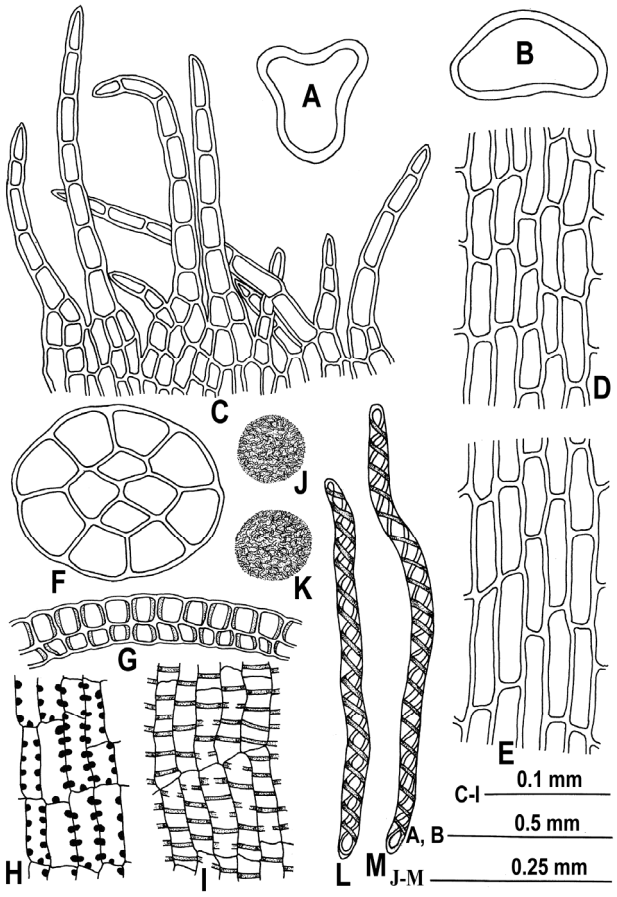


Fig. 2. ***Blepharostoma trichophyllum*** **(L.) Dumort. A, B: Transverse section of perianth. C: Apical cells of perianth. D: Median cells of perianth. E: Basal cells of perianth. F: Transverse section of seta. G: Transverse section of capsule wall. H: Outer layer of capsule wall. I: Inner layer of capsule wall. J, K: Spores. L, M: Elaters (All figures drawn from** ***D. Singh 46599*****; all figures drawn by D. Singh).**

laminal cells quadrate–subquadrate, 55.0–75.0 × 40.0–62.5 µm, uniformly thickened, except the transverse septa, which is slightly bulging; cuticle very finely striolate; oil-bodies grayish, 5–8 per cell, spherical, 2.5–3.75 µm in diameter, coarsely segmented with irregular outline. Underleaves similar to leaves, distant, more or less obtriangulate, 0.5–1.0 mm long, 0.2–0.7 mm wide, (2–) 3–4-lobed, lobes divided up to base, 6–11 cells long, uniseriate, cells and lamina similar to leaves. Rhizoids few on ventral surface of stem, hyaline.

Paroicous or dioicous. Androecial branches intercalary on the main shoot; bracts in 4–6 (–8) pairs, similar to leaves, 0.55–0.67 mm long, 0.23–0.30 mm wide 4–5-lobed; lobes uniseriate, branched, 6–14 cells long; lamina 1–3 cells long, 4–6 cells wide in middle; bracteoles similar to, but slightly smaller than underleaves, 0.50–0.65 mm long, 0.28–0.35 mm wide, erect–suberect, 5–6-lobed; lobes branched, uniseriate, 8–16 cells long, lamina 1–3 cells long, 5–8 cells wide in middle; antheridia not seen. Gynoecia terminal on main shoot; bracts similar to leaves, 0.95–1.4 mm long, 0.25–0.9 mm wide, 4–6-lobed; lobes branched, uniseriate; lamina 3–4 cells long, 6–8 cells wide at middle; bracteoles similar to underleaves, 1.0–1.2 mm long, 0.35–0.85 mm wide, 4–6-lobed; lobes branched, uniseriate; lamina 3–4 cells long, 5–8 cells wide in middle. Perianth cylindrical–cylindrical-clavate, 1.5–2.5 mm long, 0.5–0.6 mm wide, 3-plicate above; mouth contracted, strongly armed; cilia bristle-like, 5–8 cells long, 1–3 cells wide at base, occasionally with 1–2 short branches near base; apical cells of perianth 27.5–55.0 × 7.5–12.5 µm; median cells 20.0–67.5 × 10.0–15.0 µm; basal cells 25.0–72.5 × 10.0–25.0 µm, thin-walled with minute–indistinct trigones; seta orbicular in outline in transverse section, 125–160 µm in diameter, 4 cells across with 8 outer epidermal and 4 inner cells; capsule clavate, 1.1–1.3 × 0.8–0.9 mm, dehiscing into 4 valves; valves 1.5–1.6 mm long, 0.3–0.5 mm wide; outer capsule wall cells rectangular, 35.0–50.0 × 12.5–15.0 µm with nodulose thickening; inner capsule wall cells rectangular, 37.5–55.5 × 10.5–12.5 µm with usually complete or sometimes incomplete, semiannular thickening bands. Spores brownish, globose, 8–20 µm in diameter, vermiculate. Elaters light brown–dark brown, 125–175 µm long, 7.5–8.7 µm wide, bispiral.

Habitat: Terrestrial or lithophytic, growing in moist and shady or sometimes in exposed places in association with *Acrobolbus ciliatus* (Mitt.) Schiffn., *Anastrepta orcadensis* (Hook.) Schiffn., *Bazzania sikkimensis* (Steph.) Herzog, *B. tricrenata* (Wahlenb.) Lindb., *Delavayella serrata* Steph., *Herbertus dicranus* (Taylor) Trevis., *Jungermannia fauriana* P.Beauv., *Plagiochila corticola* Steph., *P. semidecurrens* (Lehm. & Lindenb.) Lindenb., *Plagiochilion braunianum* (Nees) S.Hatt., *Lepidozia kashyapii* D.Singh & D.K.Singh, *Lophozia* sp., *Metacalypogeia alternifolia* (Nees) Grolle, *Scapania contorta* Mitt., *S. ferruginea* (Lehm. & Lindenb.) Gottsche et al., *S. ligulata* Steph., *Solenostoma faurianum* (Beauverd.) Bakalin, *Syzygiella elongella* (Taylor) K. Feldberg and mosses.

Distribution: India, Bhutan, China, Hawaii, Indonesia, Japan, Korea, Malaysia, Nepal, Papua New Guinea, Philippines, Russia, Taiwan, Africa, Europe, North & South America (Figs. 8, 9; table 1).

Specimens examined: **INDIA**: Eastern Himalaya, Arunachal Pradesh–present study, West Siang district, on the way towards Yapik from Shikar, ca. 3000 m, 06.12.1984, *D.K. Singh 515C* (ASSAM); Menchukha (between Zupuk and Damingla forests), ca. 3500 m, 08.05.2011, *S. Singh Deo, 50788B* (CAL), Menchukha (Yarlaung, between Shastri camp and Trek Junction), ca. 2900 m, 05.09.2012, *S. Singh Deo, 57698A* (CAL); Anjaw district, on the way towards Chaglagam from Mailiang, 1800 m, 11.10.1985, *D.K. Singh 69/4* (ASSAM), on the way towards Seti from Yasong, ca. 1900 m, 27.10.1985, *D.K. Singh 124/1B* (ASSAM), on the way towards Jachhup from Hotspring, ca. 3400 m, 02.11.1985, *D.K. Singh 202A*,

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203A, *212J* (ASSAM); Sikkim, East district, 15th mile from Gangtok towards Tsomgo lake, ca. 3100 m, 29.04.2004, *D.K. Singh & D. Singh 35163C* (CAL); Kyangnoshla, ca. 3300 m, 29.04.2004, *D.K. Singh & D. Singh 35188C* (CAL), 19.09.2007, *D. Singh 41036A*, *41038B* (CAL); Upper Padamchen, ca. 2100 m, 01.03.2006, *D. Singh 39655B* (CAL); 1 km from Zaluk towards Kupup, ca. 2844 m, 08.06.2006, *D.K. Singh & D. Singh 39898A* (CAL); 5 km from Zaluk towards Lungthung, ca. 2986 m, 09.06.2006, *D.K. Singh & D. Singh 35188A* (CAL); Tuku-la, ca. 4082 m, 09.06.2006, *D.K. Singh & D. Singh 40901B* (CAL); North district, Chatten, ca. 2725 m, 03.05.2004, *D.K. Singh & D. Singh 3538C* (CAL); Yumthang, ca. 3700 m, 04.05.2004, *D.K. Singh & D. Singh 35469B* (CAL); 1 km from Shingba *Rhododendron* Sanctuary towards Yumthang, ca. 3400 m, 22.11.2009, *D. Singh 46599* (CAL); Western Himalaya, Himachal Pradesh, Kullu, near Jalori Pass, 03.06.2002, *S.K. Singh 99766* (BSD).

B. trichophyllum subsp. *trichophyllum* is characterized by (2–) 3–4-lobed leaves (Figs. 1E–H); 5–8 oil-bodies per leaf cell (Fig. 1J); paroicous or dioicous sexuality (Fig. 1A); 3-plicate perianth with longer cilia at mouth (Figs. 2A–C) and vermiculate spores (Figs. 2J, K). The typical subspecies closely resembles *B. trichophyllum* subsp. *brevirete* having similar plant size, leaf lobes, underleaves and spore size. But, the latter differs from the former in the size of cortical cells (18–23 µm), leaf size (0.2–0.3 mm long and 0.20–0.24 mm wide) and oil-bodies (2–5 per leaf cell) (see also Schuster, 1966a).

Pseudolepicolea fryei (Perss.) Grolle & Ando, Hikobia 3: 180. 1963. *Lepicolea fryei* Perss., Bryologist 49: 47. 1947. *Lophochaete fryei* (Perss.) R.M.Schust., Rev. Bryol. Lichènol 26: 126. 1957.

Figs. 3, 7D & E

Plants yellowish brown–brownish in herbarium, 6–13 mm long, 1.0–1.5 mm wide; branching terminal, lateral intercalary. Stem ovoid–elliptical in outline in transverse section, 170–190 × 120–140 µm, 9–13 cells across, differentiated; cortical cells 1–2-layered, rectangulate-subquadrate or polygonal, 10.0–17.5 × 7.5–12.5 µm, brownish, both thick- and thin-walled; ventral epidermal cells usually comparatively thin-walled; medullary cells quadrate–subquadrate or polygonal, 7.5–25.0 × 7.5–17.5 µm, light brown, thin-walled. Leaves contiguous–imbricate, distant towards older portion of the plant, obliquely inserted, encircling the stem, widely spreading, more or less obtriangulate–cuneiform, 0.5–1.0 mm long, 0.3–0.6 mm wide at middle, 4-lobed; lobes erect, linear, median lobes parallel–subparallel, lateral ones spreading, lobes 15–19 cells long, 4–10 cells wide at base, 2–3 cells uniseriate towards apex, sinus narrow–slightly wide, not reflexed; lamina constricted towards base, 6–14 cells long, 16–36 cells wide at middle; margin smooth to very minutely wavy, apex acute–subacute; apical cells, triangulate–rectangulate, 20.0–62.5 × 5.0–15.0 µm, subapical cells rectangulate–subquadrate, 20.0–55.0 × 10.0–15.0 µm, thick-walled; median cells of leaf lobe rectangulate–subquadrate, 15.0–55.0 × 5.0–15 µm, thick-walled; cells near the sinus smaller, subquadrate–polygonal, 10.0–20.0 × 7.0–17.5 µm, thick-walled; median cells of leaf lamina rectangulate–subquadrate or polygonal, 20.0–42.5 × 5.0–15.0 µm; basal cells of leaf lamina subquadrate–polygonal, 15.0–45.0 × 7.5–17.5 µm; cuticle striolate; oil-bodies not seen. Underleaves distant, contiguous towards apical portion of the plant, more or less obtriangulate–cuneiform, base encircling the stem, 4-lobed, similar to leaves, 0.6–0.9 mm long, 0.6–0.7 mm wide at middle, sinus wider than leaf; lobes 14–17 cells long, 5–11 cells wide at base, 2–4 cells uniseriate towards apex; lamina 6–11 cells long, 18–40 cells wide at middle, margin smooth–slightly wavy. Rhizoids present at underleaf base, hyaline. Androecial and gynoecial branches not seen.

Habitat: Terrestrial, growing in moist shady places on soil in association with *Pseudolepicolea trollii* (Herzog) Grolle & Ando.

Distribution: India, Russia, North America (Figs. 8, 9; table 1).

Specimen examined: **INDIA**: Western Himalaya (Uttarakhand, Chamoli district, on way to Hemkund, ca. 3343 m, 20.10.1964, *S. Chandra 200912E p.p.* (LWG), *200894C p.p.* (LWG), *200904G p.p.* (LWG).

P. fryei is characterized by 4-lobed leaves with smooth–slightly wavy margins (Figs. 3E–K); leaf lobes 4–10 cells wide at base (Figs. 3J–L); 16–36 cells wide leaf lamina at middle (Fig. 3L); median cells of leaf lobe 15–55 × 5–15 µm (Figs. 3J, K); margin of leaf lobe smooth–very minutely wavy (Figs. 3J, K).

P. fryei closely resembles *P. trollii* in stem anatomy, leaf shape and cuticle pattern but, differs distinctly in the size of leaf, both lobes as well as the lamina with the latter having (3–) 4-lobed leaves with more or less crenulate margin; leaf lobes 3–6 (–7) cells wide at base with the median cells 25.0–92.5 × 5.0–12.5 µm in size; smaller lamina, 12–18 cells wide with the cells below the sinus 15.0–30.0 × 10.0–22.5 µm. The present observations fully conform to those of Schuster (1966b) and the differences, fall within the variation of the species.

So far, *P. fryei* exhibited an interesting trans-oceanic disjunct distribution between North America and Russia. Its present discovery in Indian bryoflora extends its range southwards across the Asian continent.

Pseudolepicolea trollii (Herzog) Grolle & Ando, Hikobia 3: 177. 1963. *Blepharostoma trollii* Herzog, Ann. Bryol. 12: 80. 1939. *Lophochaete trollii* (Herzog) R.M.Schust., J. Hattori Bot. Lab. 23: 199. 1960. Figs. 4, 5 & 7F–H

Plants green–pale green when fresh, yellowish brownish in herbarium, (9–) 17–30 mm long, 1–2 mm

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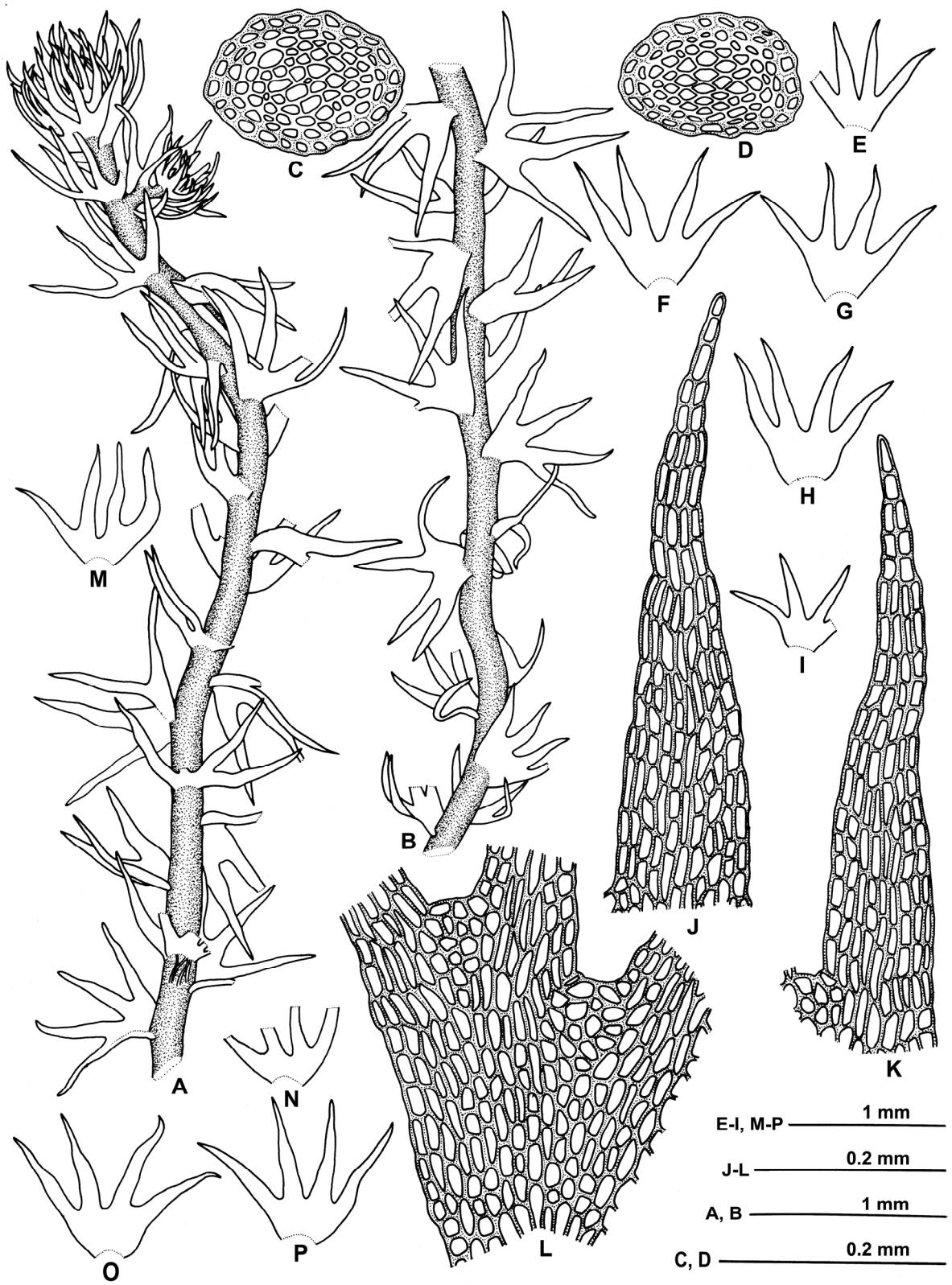


Fig. 3. ***Pseudolepicolea fryei*** **(Perss.) Grolle & Ando A: A portion of plant in ventral view. B: The same in dorsal view. C, D: Transverse section of stem. E–I: Leaves. J, K: Leaf lobes. L: A portion of leaf lamina showing median and basal cells. M–P: Underleaves (Figures A and B drawn from** ***S. Chandra 200912E p.p.***; **D–I, J, K, O, P from S.** ***Chandra 200904G p.p.***; **others from** ***S. Chandra 200894C p.p.*** **and drawn by S. Majumdar).**

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wide; branching terminal, *Frullania*-type. Stem orbicular–ovoid in outline in transverse section, 80–100 × 100 µm, 8–13 cells across, differentiated; cortical cells 1–2 (–3)-layered, subquadrate–polygonal, (5.0–) 10.0–40.0 × (5.0–) 10.0–22.5 µm, dark brown, both thick and thin-walled; outer epidermal cells thin-walled–slightly thick-walled or conspicuously thick-walled, dorsal epidermal cells usually more thickened than ventral epidermal cells or sometimes equally or less thickened; medullary cells quadrate–subquadrate or polygonal, 5.0–37.5 (–52.5) × 5.0–27.5 (–40.0) µm, light brown, thin-walled. Leaves imbricate, obliquely inserted, encircling the stem, widely spreading, more or less obtriangulate–cuneiform, 0.5–1.0 (–1.4) mm long, 0.3–0.7 (–1.0) mm wide at middle, (3–) 4-lobed; lobes erect, linear, median lobes subparallel, lateral ones widely spreading, lobes 9–18 cells long, 3–6 (–7) cells wide at base, 2–4 (–5) cells uniseriate towards apex, sinus narrow–slightly wide, not reflexed; lamina constricted towards base, 6–11 cells long, 12–18 cells wide at middle; margin more or less crenulate, apex acute–subacute; apical cells of leaf lobe elongate, triangulate–rectangulate, 20.0–80.0 × 7.5–12.5 µm, thick-walled, longer, equal or smaller than lower cells; subapical cells rectangulate–subquadrate, 22.0–95.0 × 7.5–12.5 µm, thick-walled; median cells rectangulate–subquadrate, 25.0–92.5 × 5.0–12.5 µm, thick-walled; lamina 12–18 cells wide; cells below the sinus larger, 15.0–30.0 × 10.0–22.5 µm, thick-walled; median cells of leaf lamina quadrate–subquadrate or polygonal, 15.0–30.0 × 7.5–20.0 µm; basal cells of leaf lamina quadrate–subquadrate or polygonal, 15.0–57.5 × 7.5–12.5 µm; cuticle striolate; oil-bodies not seen. Underleaves usually imbricate, rarely contiguous, more or less obtriangulate–cuneiform, 0.5–1.0 (–1.3) mm long, 0.3–0.7 (–0.9) mm wide at middle, base encircling the stem, 4-lobed, similar to leaves, 7–16 cells long, 2–5 (–6) cells wide at base, 2–4 (–5) cells uniseriate towards apex; lamina 3–9 cells long, 10–21 cells wide at middle, margin crenulate–slightly wavy, sinus slightly wider than leaf. Rhizoids not seen.

Monoicous. Androecial branches always lateral on the main shoot; bracts in 3–8 pairs, similar to leaves, 0.20–0.60 × 0.20–0.5 mm (with lobe), 4–6-lobed, 1–4 cells uniseriate towards apex; bracteoles similar to underleaves, smaller, 0.30–0.40 × 0.20–0.25 mm (with lobe), erect, linear, parallel, lobe 5–8 cells long, 2–4 cells wide, 2–3 cells uniseriate towards apex; antheridia 1–2 per bract; body globose, 0.07–0.15 × 0.06–0.12 mm; stalk slender, biseriate, 8–10 cells long. Gynoecia terminal on main shoot, rarely intercalary; bracts similar to leaves, 1.5–1.7 × 0.5–0.8 mm, 4-lobed; lobes similar to leaves, margin wavy, free or connate; bracteole obovate, 4-lobed to 1/2–2/3 (–3/4) of their length, lobes similar to underleaves. Perianth long, cylindrical, 2–3 mm long, 0.6–0.7 mm wide, 5–6-plicate; mouth contracted, deeply ciliated; cilia 8–12, acuminate, 2–4 cells uniseriate towards apex; apical cells of perianth rectangular–polygonal, 22.5–52.5 × 5.0–10.0 µm; median cells rectangular–polygonal, 17.5–52.5 × 7.5–17.5 µm; basal cells rectangular–polygonal, 25.0–60.0 × 10.0–22.5 µm, thin-walled with minute–indistinct trigones; capsule clavate, 2.0–2.3 × 1.4–1.6 mm, dehiscing into 4-valves; outer capsule wall cells subquadrate–polygonal, 20.0–37.5 × 27.5–42.5 µm with nodulose thickenings; inner capsule wall cells elongated, rectangular, 32.5–75.0 × 10.0–25.0 µm with complete or often incomplete, semiannular thickening bands. Spores light brown, globose, 15.0–17.5 µm in diameter, granulose. Elaters light brown, 81.1–121.6 µm long, 10.0–12.5 µm wide, bispiral.

Habitat: On decaying wood in moist shady places near dripping water in association with *Heteroscyphus argutus* (Reinw. et al.) Schiffn., *H. bescherellei* (Steph.) S.Hatt., *Pseudolepicolea fryei*, *Geocalyx graveolens* (Schrad.) Nees and the species of *Herbertus, Jungermannia*, *Riccardia* and *Scapania*.

Distribution: India, Bhutan, China, Indonesia, Japan, Malaysia, Nepal, Taiwan (Figs. 8, 9; Table 1).

Specimen examined: **INDIA**: Eastern Himalaya (Arunachal Pradesh, Anjaw district, on way from Mailiang to Chaglagam, 11.10.1985, *D.K. Singh 66/3A* (CAL); Lower Dibang Valley district, 2 km from Mayudia Pass towards Hunli, ca. 2580 m, 06.05.2010, *S. Majumdar 48101A*, *48107A*, *48108A* (CAL); 4 km from Mayudia Pass towards Hunli, ca. 2580 m, 06.05.2010, *S. Majumdar 48113B* (CAL); 8 km from Mayudia Pass towards Hunli, ca. 2550 m, 06.05.2010, *S. Majumdar 48151B*, *48152A* (CAL); 12 km from Mayudia Guest House towards Tewarigaon, ca. 2378 m, 05.05.2010, *S. Majumdar 48027A* (CAL); Sikkim, South district, Maenam Wildlife Sanctuary, ca. 3200 m, 31.05.2011, *D. Singh 51720* (CAL); North district, Thulung, ca. 2449 m, 03.04.2013, *D. Singh 60625*, *60626* (CAL).

Other specimens examined: *Pseudolepicolea trollii* subsp. *andoi* (R.M.Schust.) S.Hatt. & Mizut., Darjeeling district, on way to Senchal lake, ca. 2286 m, *A. K. Asthana & Vinay Sahu 224199F* (LWG); *Pseudolepicolea trollii*, Chamoli district, on way to Hemkund, ca. 3343 m, 20.10.1964, *S. Chandra 200899F* (LWG), *200916F* (LWG), *200917G* (LWG), *200912E p.p.* (LWG), *200894C p.p.* (LWG), *200904G p.p.* (LWG).

P. trollii is characterized by (3–) 4-lobed leaves (Figs. $4D_1$–D_{25}); leaf lobes 3–6 (–7) cells wide at base, 2–4 (–5) cells uniseriate towards apex (Figs. $4E_1$–E_3, F, G); apical leaf cells 27.5–70.0 × 7.5–12.5 µm (Figs. $4E_1$–E_3, F); always 4-lobed underleaves (Figs. $5A_1$–A_{13}) and 1/2–2/3 (–3/4)-lobed female bracts and bracteoles (Figs. $5E_1$– E_2).

The Indian plants of *Pseudolepicolea trollii* are considerably variable in their stem anatomy and the features of leaves, underleaves, bracts and bracteoles. The stem is 8–13 cells thick and is usually differentiated into 1–2-layered, thick-walled cortical cells and comparatively thin-walled medullary cells with little distinction in their size. Sometimes 3-layered cortical

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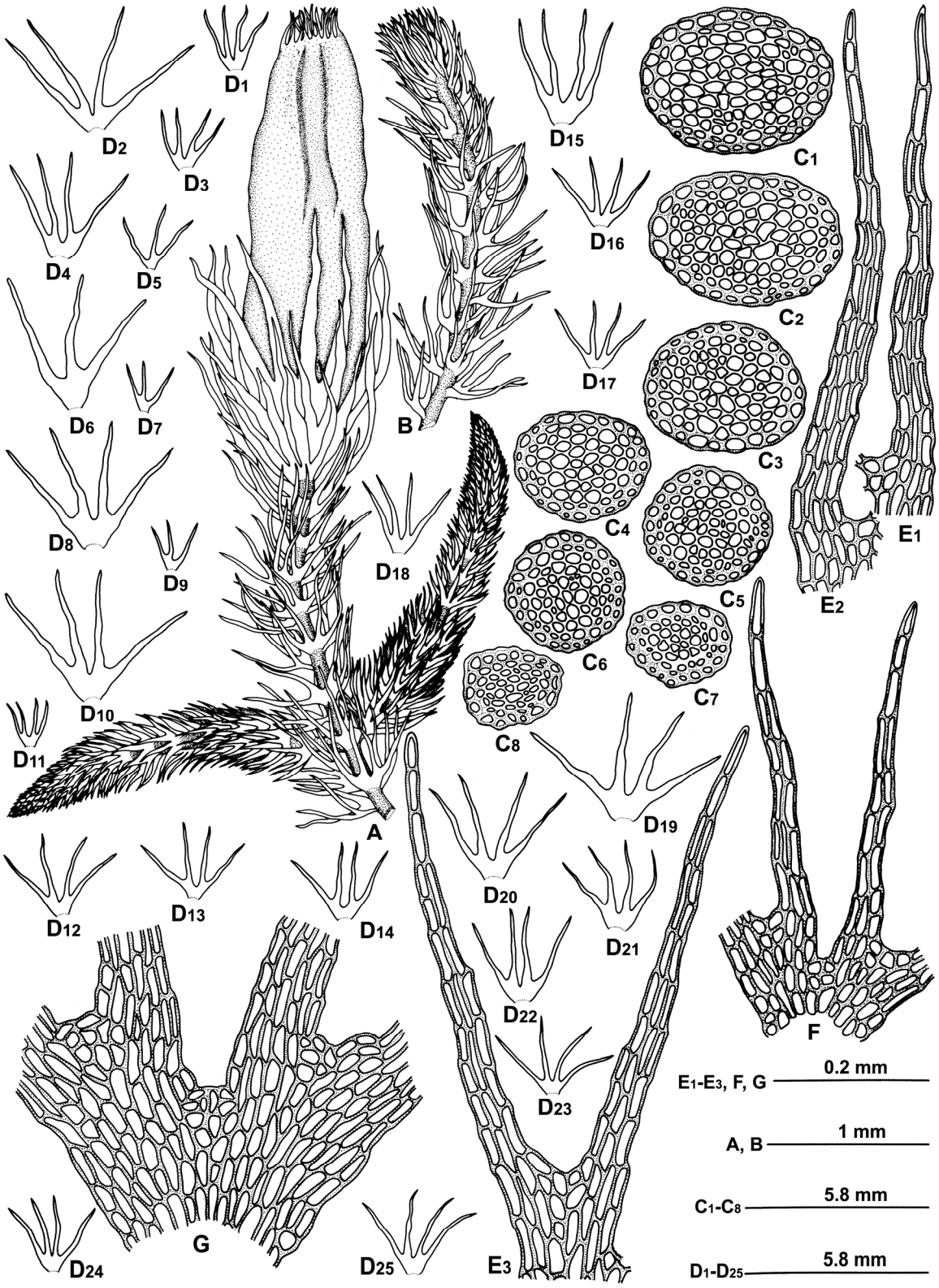


Fig. 4. ***Pseudolepicolea trollii*** **(Herzog) Grolle & Ando A: A portion of plant bearing androecial and gynoecial branches in ventral view (rhizoids not drawn). B: A portion of vegetative plant in dorsal view. C1–C8: Transverse section of stem. D1–D25: Leaves. E1–E3, F: Apex of leaf lobes. F, G: Leaf lamina showing apical, median and basal cells (Figures C8 drawn from** ***S. Chandra 200916F***; **others from** ***S. Majumdar 48101A*** **and drawn by S. Majumdar).**

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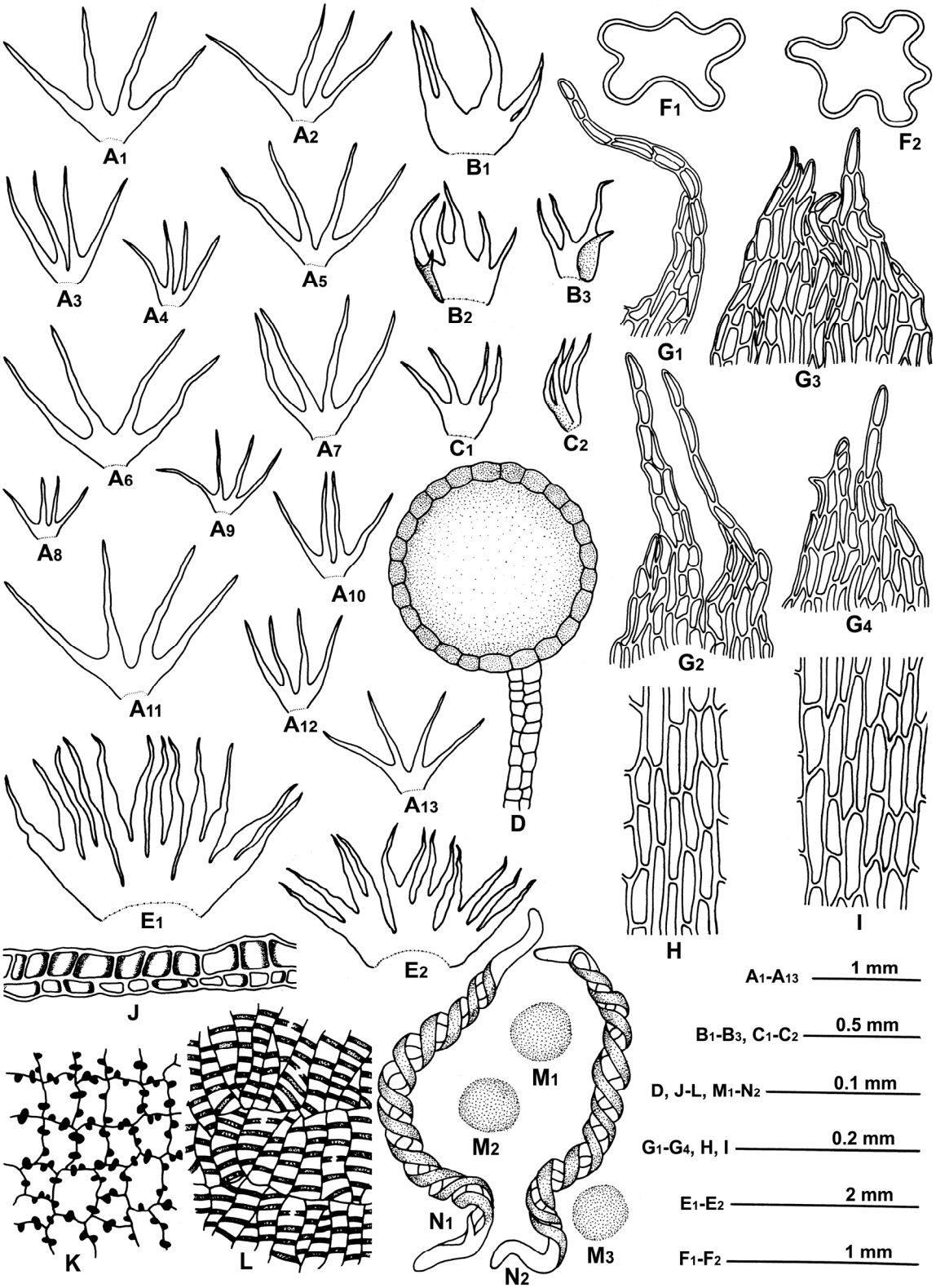


Fig. 5. ***Pseudolepicolea trollii*** **(Herzog) Grolle & Ando A1–A13: Underleaves. B1–B3: Male bracts. C1, C2: Male bracteoles. D: An antheridium. E1, E2: Female bracts and bracteoles. F1, F2: Transverse section of perianth. G1, G2: Apical cilia of young perianth. G3, G4: Apical cilia of mature sporophyte bearing perianth. H: Median cells of perianth. I: Basal cells of perianth. J: Transverse section of capsule wall. K: Outer layer of capsule wall. L: Inner layer of capsule wall. M1–M3: Spores. N1, N2: Elaters (All figures drawn from** ***S. Majumdar 48101A*** **and drawn by S. Majumdar).**

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cells were also seen in almost all populations. The cortical layer, however, shows considerable variability in the thickenings on their cell walls, especially in epidermal cells. The cells may be oblong or tangentially flattened and vary from fairly thin-walled through moderately thick-walled to thin-walled (Figs. $4C_1$–C_4). All the three conditions have been observed in plants of the same population or even in the single individual.

The leaves in *P. trollii* are usually 4-lobed and consistently bisbifid (Figs. $4D_1$–D_4, D_8, D_{10}–D_{25}). Sometimes, 3-lobed leaves are present on the same plants with one of the sinuses much deeper than the other, much like the median sinus in bisbifid leaves (Figs. $4D_5$–D_7, D_9), thereby indicating that the 3-lobed condition of the leaves is secondarily acquired. The leaf lobes are usually divergent, 9–18 cells long, 3–6 (–7) cells wide at base, with 2–4 (–5) cells uniseriate towards apex and weak to somewhat well pronounced crenulate margin. The underleaves in *P. trollii* are uniformly bisbifid with widely to not so divergent lobes (Figs. $5A_1$–A_{13}). The apical cells of leaf and underleaf lobes in majority of specimens are shorter than subapical cells. The female bracts and bracteoles are usually lobed to 1/2–2/3 of their length, but sometimes even up to 3/4 (Figs. $5E_1$–E_2).

The range of variation given above covers the differences of the two infraspecific taxa, viz. *P. trollii* var. *darjeelingensis* and *P. trollii* subsp. *andoi*, described from India (Hattori and Mizutani, 1968; Kumar, 1986), and hence makes their status taxonomically untenable.

Hattori and Mizutani (1968) segregated var. *darjeelingensis* from the typical variety on the basis of cortical cells less thickened; apical cells of leaf and underleaf lobes not shorter than lower cells, 2–3 cells uniseriate towards apex and the bracts and bracteoles 1/2–2/3-lobed and stated that the taxon was 'rather variable'.

Kumar (1986) differentiated *P. trollii* subsp. *andoi* from the typical subspecies by 1–2 (–3) layered, thick-walled cortical cells and thin-walled medullary cells in the stem; uniformly bisbifid leaves and underleaves, female bracts and bracteoles divided up to 2/3–3/4 of their length and constricted perianth mouth. Schuster (1966b), while differentiating *Lophochaete trollii* (= *Pseudolepicolea trollii*) from *L. andoi* (= *P. andoi*), emphasized on the features such as high incidence of 3-lobed leaves and underleaves, less deeply lobed female bracts and bracteoles and usually oblong cortical cells nearly equal to medullary cells with their free walls thin or comparatively less thickened in the former, compared with always 4-lobed, uniformly bisbifid leaves and underleaves; bracts and bracteoles divided up to 3/4 of their length and usually tangentially flattened, 'somewhat' thickened cortical cells which are comparatively smaller than medullary cells in the latter. Hattori and Mizutani (1968) found out that *P. trollii* subsp. *andoi* and *P. trollii* var. *darjeelingensis* had similar stem character. Based on their study on Japanese, Chinese and Indonesian plants of *P. trollii* subsp. *andoi*, Hattori and Mizutani (1968) observed that the plants of subsp. *andoi* were rather similar to sterile or environmentally induced modifications of var. *darjeelingensis*. The present study thus not only confirms that the two infraspecific taxa of *P. trollii* are morphologically inseparable from the typical taxon, but also supports the views of Ando (1963) and Grolle (1966) who regarded *P. andoi* (= *Lophochaete andoi*) as synonymous with *P. trollii.*

Temnoma setigerum (Lindenb.) R.M.Schust., Nova Hedwigia 5: 35. 1963. *Jungermannia setigera* Lindenb., Gottsche, Lindenb. & Nees, Syn. Hepat. 131. 1844; Mitten, J. Proc. Linn. Soc., Bot. 5: 93. 1861 var. ***setigerum*** Figs. 6, 7I & J

Plants light green–pale green, translucent, brownish in herbarium, 8–56 mm long, (1.3–) 1.7–2.6 mm wide; branching ventral intercalary. Stem reddish brown, orbicular in outline in transverse section, 140–200 µm in diameter, 8–11 cells across, undifferentiated, surface papillose-striolate-papillose; epidermal cells quadrate-subquadrate, 7.5–27.5 × 7.5–17.5 µm, thin-walled, light brownish in colour; medullary cells quadrate-subquadrate or polygonal, 8.5–30.0 × 7.5–27.5 µm, thin-walled, hyaline–light yellowish in colour. Leaves succubous, distant–contiguous or imbricate towards apex, symmetrical, both leaf base shortly deccurent (3–6 cells), obtrapezoidal, (0.20–) 0.50–0.70mm long, (0.23–) 0.55–0.90 mm wide (without lobes), (0.80–) 1.0–1.6 mm long, 0.75–1.4 mm wide (with lobes); lamina 14–23 cells long, 22–34 cells wide at middle; conspiquously or inconspiquously 4-lobed; lobes erect, usually parallel or sometimes subparallel, ciliate, usually two basal tooth present on each side of lobe; tooth sharp, acute, reddish brown, 5–8 cells long, 2–4 cells wide at base, 4–7 cells uniseriate towards apex; sinus base of the leaf lobe not reflexed, margins ciliate; cilia 27–43 per leaf, (0–) 1–2 per leaf lobe, erect, sometimes superimposed and reflexed, smaller, 2–5 cells long, 1–2 cells wide at base, (1–) 2–4 cells uniseriate towards apex; terminal cells of cilia 50–75 × 15–20 µm, thin-walled, septa dark brown; apical leaf lobe cells quadrate–subquadrate, 20.0–37.5 × 12.5–20.0 µm; median cells pentagonal–polygonal, 15.0–25.0 × 10.5–20.0 µm; basal cells pentagonal–hexagonal, 30.0–55.0 × 12.5–25.0 µm, thin-walled, trigones very minute or indistinct, intermediate thickenings absent; cuticle papillose–

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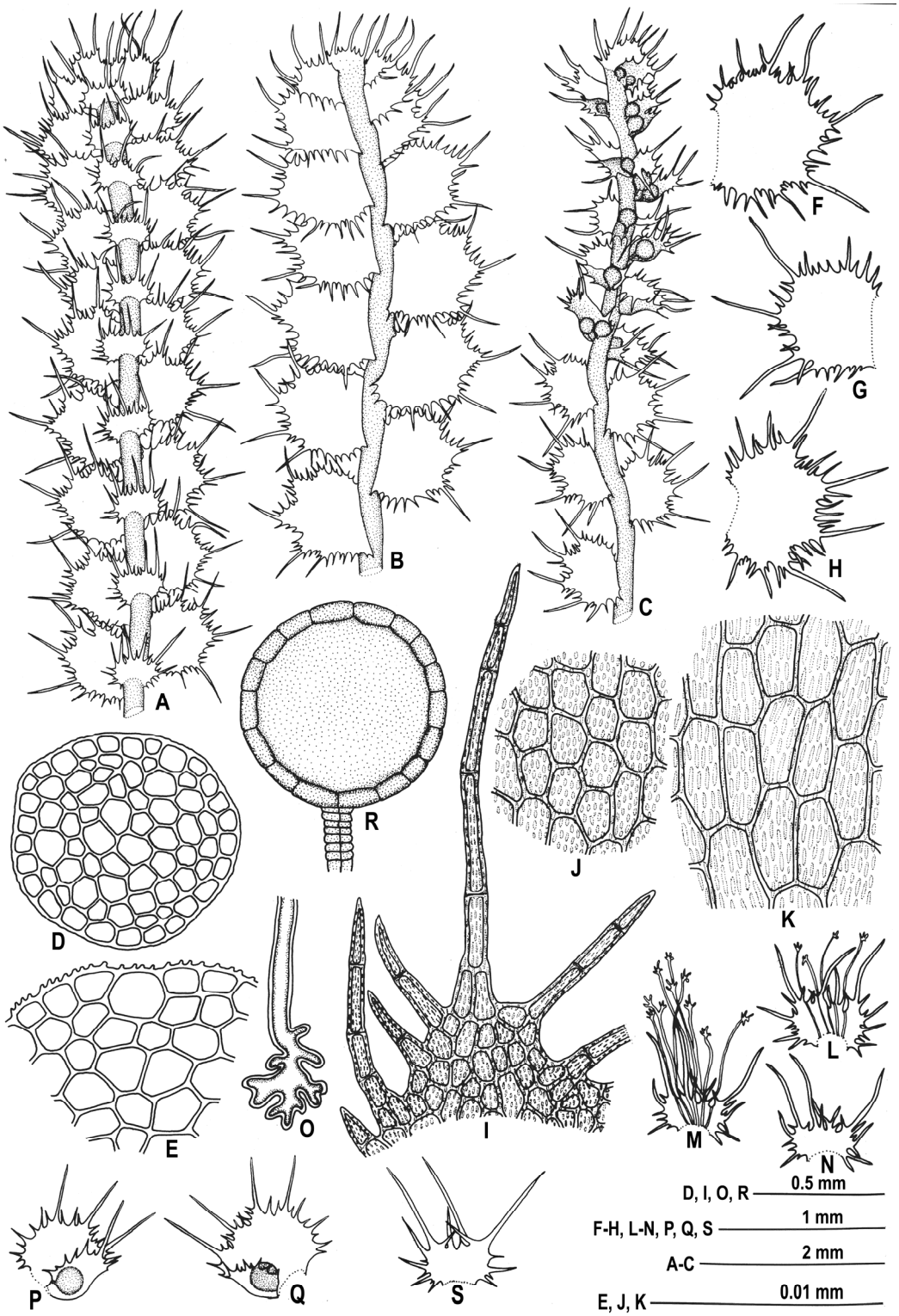


Fig. 6. ***Temnoma setigerum*** **(Lindenb.) R.M.Schust. A: A portion of plant in ventral view (rhizoids not drawn). B: The same in dorsal view. C: A portion of male plant in dorsal view. D: Transverse section of stem. E: A portion of the same enlarged showing striolate-papillose stem surface. F–H: Leaves. I: Apical leaf cells showing striolate-papillose cuticle. J: Median leaf cells showing striolate-papillose cuticle. K: Basal leaf cells showing striolate-papillose cuticle. L–N: Underleaves. O: A portion of rhizoid showing branched apices. P, Q: Male bracts. R: An antheridium. S: A male bracteole (Figures C, H, I, N, P–S drawn from** ***S. Majumdar, 48222A*****; others from** ***D. Singh 46695A*****; figures C, H, I, N, P–S drawn by S. Majumdar; others by D. Singh).**

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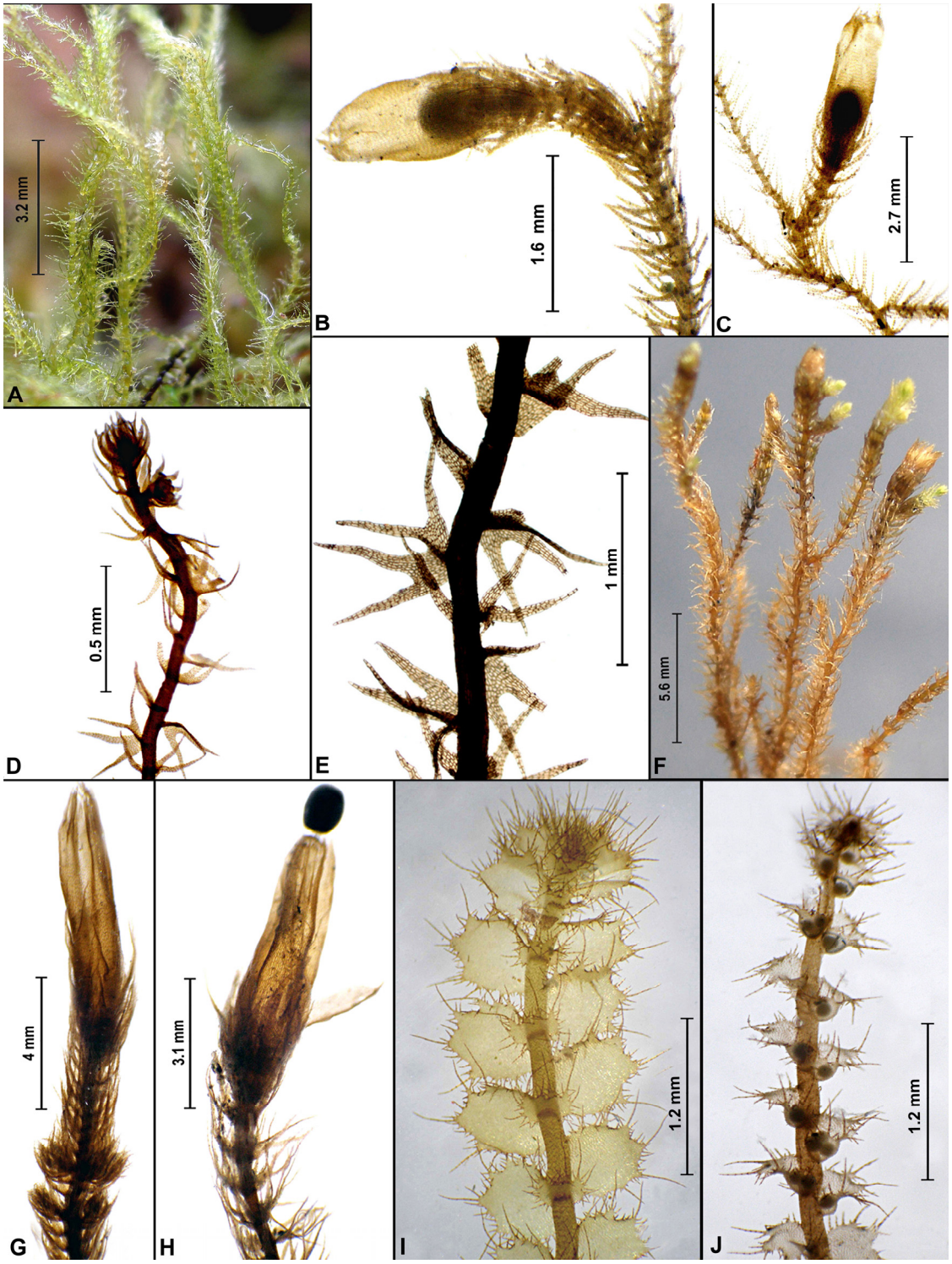


Fig. 7. (A–C) ***Blepharostoma trichophyllum*** **(L.) Dumort. A: Habit. B: A portion of plant bearing androecial and gynoecial branches. C: A portion of female plant in ventral view. (D, E)** ***Pseudolepicolea fryei*** **(Perss.) Grolle & Ando D: A portion of plant in ventral view. E: A portion of plant in dorsal view. (F–H)** ***Pseudolepicolea trollii*** **(Herzog) Grolle & Ando F: Habit. G: A portion of plant bearing androecial and gynoecial branches in ventral view. H: A portion of plant bearing mature sporophyte. (I, J)** ***Temnoma setigerum*** **(Lindenb.) R.M.Schust. I: A portion of plant in ventral view. J: A portion of male plant in dorsal view (Photographs A from** ***D. Singh 46599***, **B from** ***D. K. Singh 202A***, **C from** ***D. K. Singh & D. Singh 35469B***; **D, E from** ***S. Chandra 200912E p.p.***; **F from** ***D. Singh 51720***; **G, H from** ***S. Majumdar 48101A***, **I from** ***D. Singh 46695A***, **J from** ***S. Majumdar 48222A***).

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Table 1. Distribution of the members of family Pseudolepicoleaceae

Sl. No.	Name of the species of	Distribution	References
1.	***Blepharostoma arachnoideum***	Russia, North America	Stephani, 1909; Schuster, 1966a; Stotler and Crandall-Stotler, 1977; Konstantinova et al., 2009
2.	***B. corrugatum***	New Zealand	Stephani, 1909
3.	***B. minus***	China, Russia, Taiwan	Piippo, 1990; Konstantinova et al., 2009; Wang et al., 2011
4.	***B. quadrilaciniata***	South America	Fulford and Taylor, 1960
5.	***B. quadripartita***	South America	Stephani, 1909
6.	***B. trichophyllum* subsp. *trichophyllum***	Bhutan, China, Hawaii, India (Arunachal Pradesh – present study, Himachal Pradesh, Jammu & Kashmir, Uttarakhand, Sikkim, West Bengal), Indonesia, Japan, Korea, Malaysia, Nepal, Papua New Guinea, Philippines, Russia, Taiwan, Africa, Europe, North and South America	Mitten, 1861; Kashyap, 1932; Chopra, 1943; Hattori, 1966, 1971, 1975; Schuster, 1966a; Stotler and Crandall-Stotler, 1977; Grolle and Piippo, 1984; Tan and Engel, 1986; Long and Grolle, 1990; Piippo, 1990; Piippo et al., 1997; Dar et al., 2002; Song and Yamada, 2006; Staples and Imada, 2006; Yamada and Iwatsuki, 2006; Söderström et al., 2007, 2010; Singh et al., 2008; Konstantinova et al., 2009; Pradhan and Joshi, 2009; Singh and Singh, 2009; Wigginton, 2009; Nath et al., 2010; Chuah-Petiot, 2011; Wang et al., 2011
7.	***B. trichophyllum* subsp. *brevirete***	Russia, North America	Schuster, 1966a; Konstantinova et al., 2009
8.	***Pseudolepicolea fryei***	India (Uttarakhand) – present study, Russia, North America	Schuster, 1966b; Stotler and Crandall-Stotler, 1977; Konstantinova et al., 2009
9.	***P. grolleana***	Papua New Guinea	Grolle and Piippo, 1984
10.	***P. kuehnemannii***	South America	Schuster, 1966b
11.	***P. quadrilaciniata***	South America	Schuster, 1966b
12.	***P. temnomoides***	South America	Schuster, 1966b
13.	***P. trollii***	Bhutan, China, India (Arunachal Pradesh – present study, Sikkim, Uttarakhand, West Bengal), Indonesia, Japan, Malaysia, Nepal, Taiwan	Herzog, 1939 as *Blepharostoma trollii*; Hattori and Mizutani, 1968 as *P. trollii* var. *darjeelingensis*; Kumar, 1986 as *P. trollii* subsp. *andoi*; Long and Grolle, 1990; Piippo, 1990; Yamada and Iwatsuki, 2006 as *P. andoi*; Pradhan and Joshi, 2009; Nath et al., 2010; Chuah-Petiot, 2011; Wang et al., 2011 as *P. andoi*
14.	***Temnoma angustifolium***	New Zealand	Schuster, 1966c
15.	***T. chaetophylla***	South America	Schuster, 2000
16.	***T. palmatum***	Australia, New Zealand	Schuster, 1966c; McCarthy, 2006
17.	***T. paucisetigerum***	New Zealand	Schuster, 1966c
18.	***T. pilosum***	South America	Schuster, 1966c
19.	***T. pulchellum***	Australia, New Zealand	Schuster, 1966c; McCarthy, 2006
20.	***T. quadrifidum***	Australia, New Zealand	Schuster, 1966c; McCarthy, 2006
21.	***T. quadripartitum***	New Zealand, South America	Grolle, 1964; Schuster, 1966c
22.	***T. setigerum***	Bhutan, Fiji, India (Arunachal Pradesh and Sikkim – present study, Meghalaya), Indonesia, Nepal, Papua New Guinea, Philippines, Solomon Island, Taiwan	Mitten, 1861 as *Jungermannia setigera*; Grolle, 1964; Grolle and Piippo, 1984; Tan and Engel, 1986; Long and Grolle, 1990; Bapna and Kachroo, 2000; Long, 2005; Söderström et al., 2010, 2011; Wang et al., 2011
23.	***T. townrowii***	Australia	McCarthy, 2006

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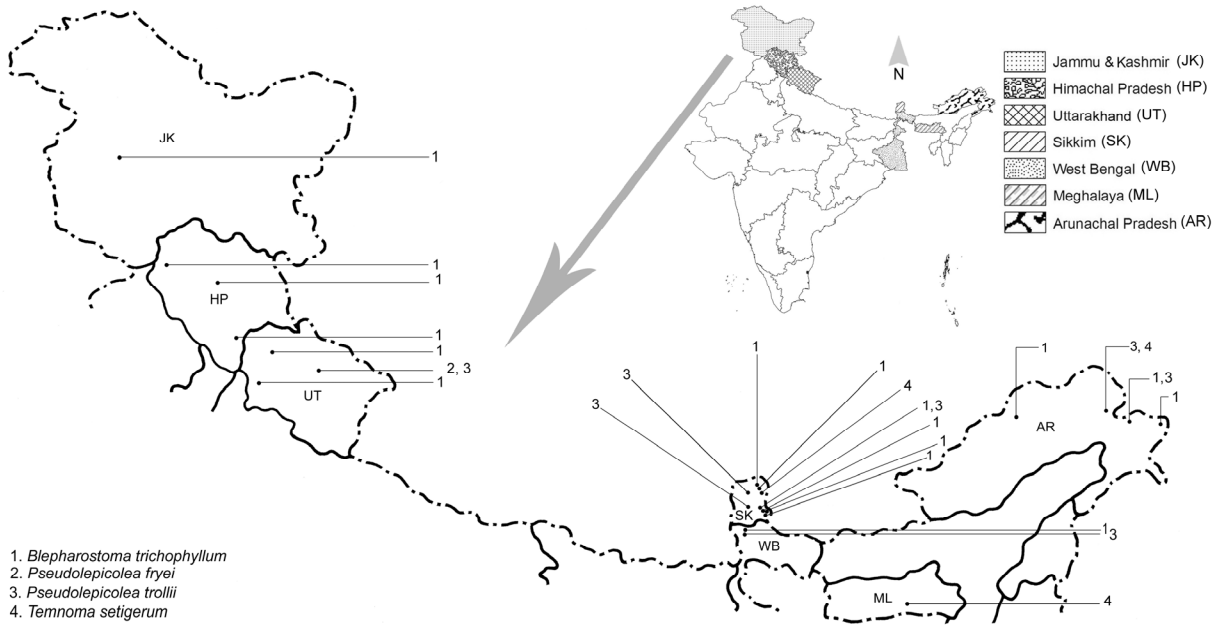


Fig. 8. Map showing distribution of taxa of Pseudolepicoleaceae in India.

striolate-papillose, usually more strongly striolate-papillose on leaf lobes and basal leaf cells; oil-bodies not seen. Underleaves distant, free, broadly encircling the stem, reniform, 0.18–0.27 mm long, 0.30–0.52 mm wide (without lobes), 0.55–0.75 mm long, 0.64–0.80 mm wide (with lobes), 3–4-lobed, lobes shallowly divided, usually with two basal tooth at each side of lobe; tooth sharp, erect, usually parallel or sometimes subparallel, acute, reddish-brown, 7–12 cells long, 2–4 cells wide at base, 5–9 cells uniseriate towards apex; margin toothed/ciliate; tooth erect, sometimes superimposed and reflexed, 2–6 cells long, 1–2 cells wide at base, 2–5 cells uniseriate towards apex, cuticle striolate-papillose. Rhizoids in tufts, present on ventral surface at the base of underleaves, hyaline.

Dioicous (?). Androecia terminal or intercalary on main shoots; bracts in 4–7 pairs, similar to leaves but smaller, reniform, 0.40–0.50 mm long, 0.45–0.60 mm wide (without lobes), 0.75–0.95 mm long, 0.65–0.90 mm wide (with lobes), 4-lobed; lobes, erect, parallel, acute; antheridia 1–2 per bract; body globose, 180–220 × 160–200 μm in diameter; stalk biseriate, 7–9 cells long; bracteoles similar to underleaves but smaller, 0.15–0.20 mm long, 0.25–0.30 mm wide (without lobes), 0.55–0.65 mm long, 0.50–0.60 mm wide (with lobes), 3–4-lobed, lobes erect, parallel–subparallel. Gynoecial branches not seen.

Habitat: Terrestrial and lignicolous, growing in loose patches on slightly rocky soil or on fallen leaves in association with *Heteroscyphus bescherellei*, *Lophocolea bidentata* (L.) Dumort., *Ptychanthus striatus* (Lehm. & Lindenb.) Nees and mosses.

Distribution: India, Bhutan, Fiji, Indonesia, Nepal, Papua New Guinea, Philippines, Solomon Island, Taiwan (Figs. 8, 9; Table 1).

Specimens examined: **INDIA**: Eastern Himalaya, Sikkim, North district, near Sachen basti along the Lachung chhu, ca. 1920 m, 24.11.2009, *D. Singh 46695A* (CAL); Arunachal Pradesh, Lower Dibang Valley district, 12 km from Mayudia forest guest house towards Tewarigaon, ca. 1375 m, 05.05.2010, *S. Majumdar, 48032A* (CAL); 10 km from Mayudia forest guest house towards Tewarigaon, ca. 1390 m, 07.05.2010, *S. Majumdar 48198A*, *48210A*, *48222A* (CAL); 8 km from Mayudia forest guest house towards Tewarigaon, ca. 1400 m, 07.05.2010, *S. Majumdar 48220A* (CAL).

T. setigerum is characterized by striolate-papillose stem surface (Fig. 6E); shallowly divided 4-lobed leaves and underleaves, distinct basal lamina, toothed/ciliate leaf and underleaf margins (Figs. 6F–H, L–N); 27–43 cilia per leaf (Figs. 6F–H); papillose–striolate-papillose leaf cuticle (Figs. 6I–K); 4–7 pairs of male bracts (Fig. 6C).

T. setigerum closely resembles *T. paucisetigerum* in the features of stem diameter, leaf shape, sinus of leaf lobe and male bracts. But, the latter differs in having 1.1–1.3 (–1.5) mm wide shoot, cortical cells 17–20 × 52–78 μm, 1.5–2.0 mm wide leaves and having 7–24 cilia per leaf lobe (Schuster, 1966c). *T. setigerum* also somewhat resembles *T. pulchellum* in plant size, size of cortical cells and cilia per leaf lobe, but is easily distinguished since the latter has stem 0.25–0.36 mm in diameter, 2.5–3.0 mm wide asymmetrical leaves (including cilia) with 2–5 pairs of cilia per leaf lobe and sinus of leaf strongly reflexed and male bracts in 6–10 or more pairs (Schuster, 1966c). The present discovery of this species from the Indian States of Arunachal

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Fig. 9. Map showing world distribution of taxa of Pseudolepicoleaceae recorded from India.

Pradesh and Sikkim, east and west of its presently known Indian locality in Meghalaya respectively, bridges the apparent gap in its range of distribution between Polynesia in the east to Nepal in the West.

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ADDENDUM

Blepharostoma indica G. Asthana, Saxena & Maurya, J. Bryol. 35: 267. 2013.

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Description: Asthana et al. (2013); illustration: Asthana et al. (2013, f. 2: A-I).

Distribution: India (Uttarakhand - Mukteshwar, Chakrata), probably endemic.

Asthana et al. (2013) have recently described *Blepha- rostoma indica* based on collections from Mukteshwar in Kumaon Hills and Chakrata in Garhwal Hills of Uttarakhand State in India. The authors have compared the new species with *B. trichophyllum* subsp. *trichophyllum,* from which it differs in having very delicate stem with 7–8 (–9) cortical and 2–4 medullary cells and 2–4 oil-bodies per leaf cell as compared to 12 cortical and up to 15 medullary cells and 4–8 oil-bodies in each leaf cell in the latter. With this new discovery, the representation of family Pseudolepicoleaceae in India has now gone up to five.

印度擬複叉蘚科的分類研究（地前門：葉蘚目）

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摘要：本文針對印度擬複叉蘚科內的分類群做形態上的分類調查，並辨認出四個物種：*Blepharostoma trichophyllum*、*Pseudolepicolea fryei*、*Pseudolepicolea trollii* 及 *Temnoma setigerum*。*Pseudolepicolea fryei*原本只發現生長在俄羅斯及北美洲，也藉由本文的報導了首次發現在印度的新紀錄分布；對其餘三個物種的型態研究，並無發現與模式分類群的差異。

關鍵詞：印度、擬複叉蘚科、分類學。

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