Taiwania, **53**(3): 258-263, 2008

A New Species of *Cololejeunea* (Hepaticae: Lejeuneaceae) from Eastern Himalaya, India

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(Manuscript received 1 February 2008; accepted 14 May 2008)

ABSTRACT: A new species of *Cololejeunea* (Spruce) Schiffn., *C. tixieriana* M. Dey, D. Singh *et* D.K. Singh, sp. nov. belonging to subgenus *Leptocolea* (Spruce) Schiffn. is described from Eastern Himalaya, India. The species has been compared with *C. trichomanis* (Gottsche) Steph. and *C. serrulata* Steph.

KEY WORDS: ***Cololejeunea tixieriana*, Lejeuneaceae, New Species, Eastern Himalaya, India.**

INTRODUCTION

The genus *Cololejeunea* (Spruce) Schiffn. is represented in India by 31 species (Asthana and Srivastava, 2003; Singh et al., 2006). The major centers of diversity of the genus in India are the Western Ghats, which harbours 21 species, and the Eastern Himalaya with 17 species (Asthana and Srivastava, 2003). Ten species are common between the two regions. Besides, Andaman and Nicobar Islands have four species [*C. appressa* (A. Evans) Benedix, *C. desciscens* Steph., *C. jelinekii* Steph., and *C. lanciloba* Steph.], West Himalayan region has two species [*C. latilobula* (Herzog) Tixier and *C. producta* (Mitt.) S. Hatt.], whereas Central Indian region has *C. latilobula* (Asthana and Srivastava, 2003; Singh et al., 2006). During the course of studies on the epiphyllous liverworts of Eastern Himalaya, comprising Indian States of Arunachal Pradesh and Sikkim, and Darjeeling district of West Bengal, some interesting plants of the genus were collected from Darjeeling district of West Bengal and East district of Sikkim in Eastern Himalaya. Subsequent morpho-taxonomic studies, coupled with detailed review of literature, (Mizutani, 1961, 1965, 1966, 1970; Tixier, 1969, 1979; Pócs, 1980, 1993; Schuster, 1980; Grolle, 1988; Zhu, 1995; Zhu and So, 1999, 2001, 2002; Asthana and Srivastava, 2003; Zhu et al., 2004; Wigginton, 2006; Wigginton et al., 2007) revealed it to be hitherto an undescribed species of the genus. The same has been described and illustrated as *C. tixieriana*.

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TAXONOMIC TREATMENTS

Cololejeunea tixieriana M. Dey, D. Singh *et* D. K. Singh, *sp. nov.* Figs. 1 & 2

Cololejeuneae trichomanis (Gottsche) Steph. et *Cololejeuneae serrulatae* Steph. affinis, sed ab *C. trichomanis* (Gottsche) Steph. caulis validis, in sectionis cruciatim 110 – 130 x 80 – 100 μm; foliis multo magnioribus, 0.9 – 1.2 mm longis, 0.6 – 0.9 mm latis; secundario- dentibus lobulorum foliorum 2–3 cellulo-longis; bracteis femineorum magnioribus, 0.5 – 0.62 mm longis, 0.22 – 0.34 mm latis; paginis perianthiorum papillosis et ab *C. serrulatae* Steph. foliis obovatis, crenulatis et characteribus secundario-dentium foliorum, stylorum, bracteorum femineorum et paginorum perianthiorum differt. (Table 1)

Holotype: India: Eastern Himalaya, West Bengal, Darjeeling district, Rangi Rum, Bhutan road, ca 1750 m, 19 December 2004, *K. P. Singh*, 36397A (CAL).

Paratype: India: Eastern Himalaya, West Bengal, Darjeeling district, Mungpoo, ca 2000 m, 19 December 2004, *K. P. Singh*, 36391 (CAL), Lava, ca 2184 m, 15 January 2005, *D. Singh & M. Dey*, 36156 (CAL); Sikkim, East district, Pangthang, ca 1780 m, 25 October 2005, *D. Singh*, 36623 (CAL).

Plants yellowish green in herbarium; shoot 6 – 11 mm long, 2.0 – 2.7 mm wide. Stem orbicular – oval in outline in transverse section, 110 – 130 x 80 – 100 μm, 3 cells across the diameter; cortical cells in 5 – 6 vertical rows, rectangular – polygonal, 25.0 – 62.5 x 20.0 – 45.0 μm, thin-walled; medullary cell one, polygonal, 35.0 – 45.0 x 25.0 – 37.5 μm, thin-walled; ventral merophytes of stem 1 – 2 cells wide. Leaves loosely imbricate, obliquely spreading; leaf lobe obovate, 0.9 – 1.2 mm long, 0.6 – 0.9 mm wide, apex obtuse – slightly rounded, margin crenulate due to

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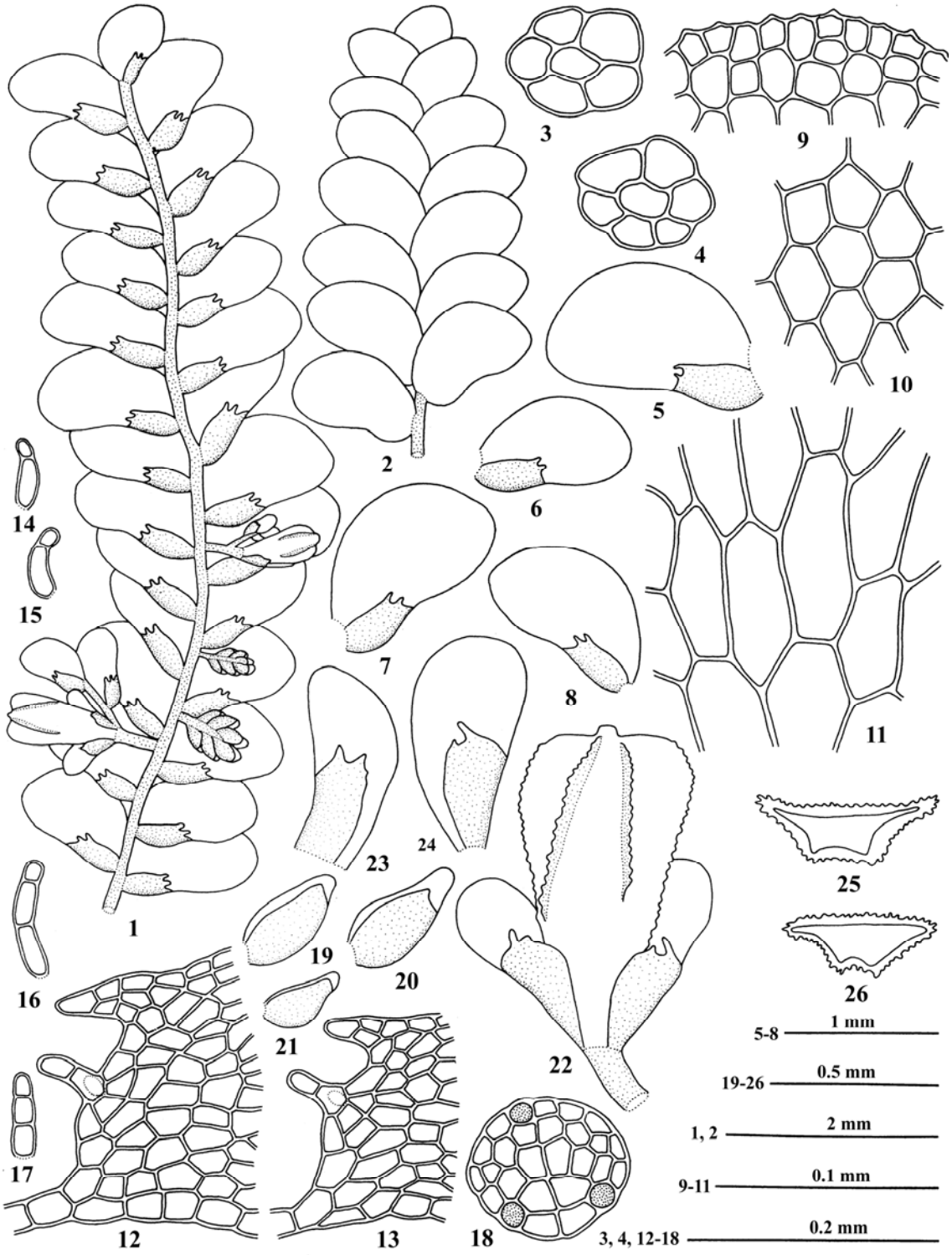


Fig. 1. *Cololejeunea tixieriana* M. Dey, D. Singh & D. K. Singh 1: A portion of plant in ventral view (rhizoids not drawn). 2: The same in dorsal view. 3-4: Transverse sections of stem. 5-8: Leaves. 9: Apical leaf cells. 10: Median leaf cells. 11: Basal leaf cells. 12-13: Apices of leaf lobules. 14-17: Styli. 18: A gemma. 19-21: Male bracts. 22: A gynoecial branch. 23-24: Female bracts. 25-26: Cross-sections of perianth (all figures drawn from holotype).

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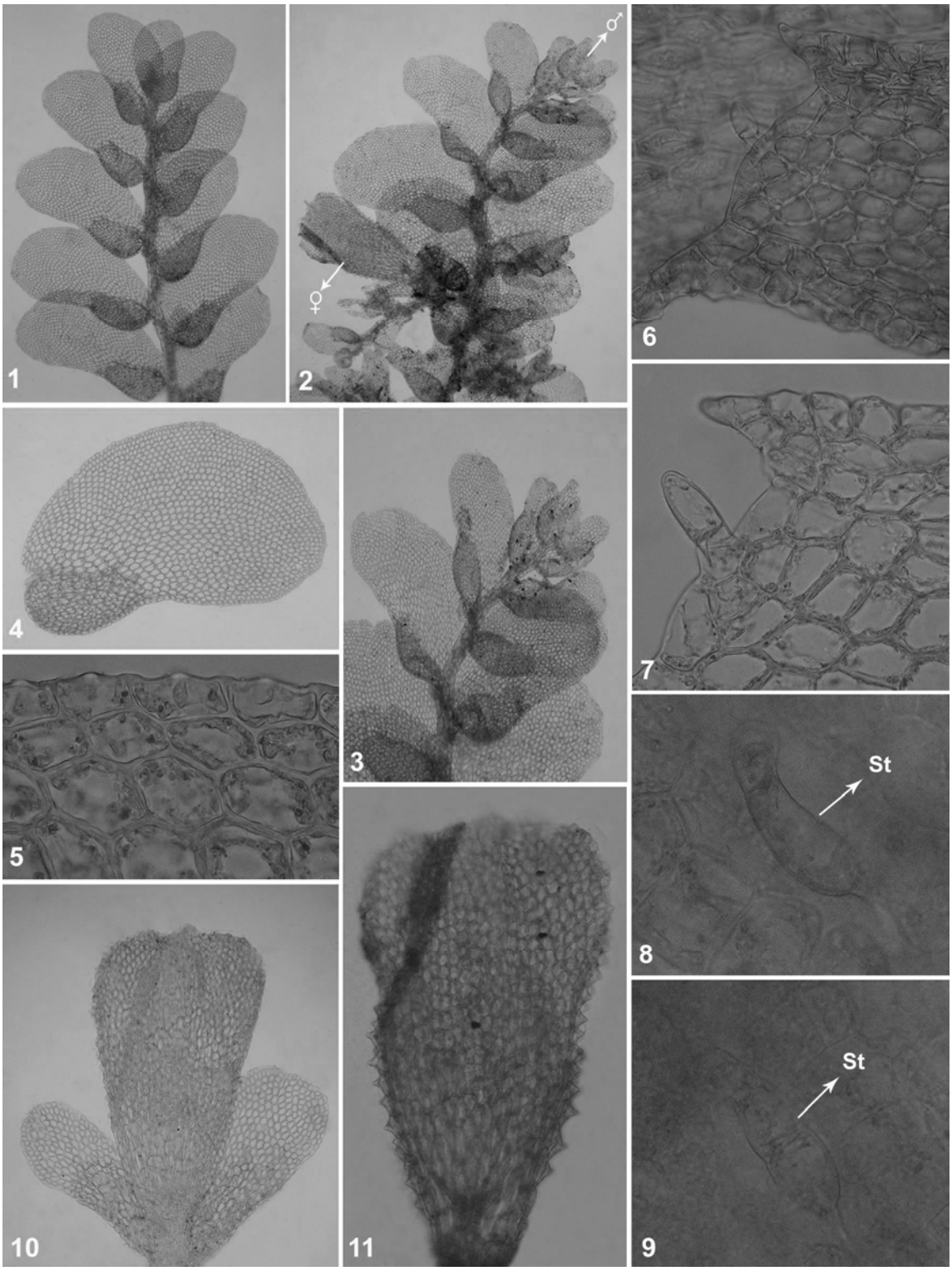


Fig. 2. *Cololejeunea tixieriana* M. Dey, D. Singh & D. K. Singh 1: A portion of plant (vegetative) ventral view. x 20. 2: A portion of plant showing male and female inflorescence. x 20 (♂ = male branch; ♀ = female branch). 3: A portion of plant showing terminal male inflorescence. x 30. 4: A leaf. x 38. 5: Marginal leaf cells. x 470. 6: Apical portion of leaf lobule. x 300. 7: The same enlarged. x 460. 8-9: Styli. x 600 (St = stylus). 10: A gynoecial branch. x 50. 11. A perianth. x 70 (all photographs from holotype).

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Table 1. A comparative analysis of *Cololejeunea tixieriana* and closely related species.

Taxonomic characters	*C. tixieriana*	*C. trichomanis*	*C. serrulata*
Plant size	6 – 11 mm long 2.0 – 2.7 mm wide	3 – 11 mm long 1.5 mm wide	4 – 12 mm long 1.0 – 1.5 mm wide
Stem diameter	110 – 130 x 80 – 100 µm	50 – 70 µm	64 – 72 (– 100) µm
Stem anatomy	Cortical cells - 5 – 6 Medullary cell - 1	Cortical cells - 6 Medullary cell - 1	Cortical cells - 6 Medullary cell - 1
Leaf shape	Obovate	Oblong	Ovate – sub-elliptical
Leaf size	0.9 – 1.2 mm long 0.6 – 0.9 mm wide	0.59 – 0.77 mm long 0.32 – 0.45 mm wide	0.50 – 0.88 mm long 0.44 – 0.60 mm wide
Leaf margin	Crenulate	Crenate	Irregularly serrulate
Lobule teeth	First tooth 2 cells long, 1 cell wide, second tooth 2 – 3 cells long, 2 – 3 cells wide at base	First tooth 2(– 3)-celled, second tooth 1-celled	First tooth 2 cells long, 1 –2 cells wide at base, second tooth 1 – 2-celled or obsolete
Stylus	2 – 3 cells long	4 – 6 cells long	Unicellular
Sexuality	Monoecious	Monoecious	Monoecious
No. of male bracts	2 – 3 pairs	Up to 5 pairs	3 – 6 pairs
Female bract size	0.5 – 0.62 mm long 0.22 – 0.34 mm wide	0.32 mm long 0.14 mm wide	0.28 – 0.36 mm long 0.10 – 0.13 mm wide
Perianth shape	Obovate	Obovate – Pyriform	Obovate
Perianth size	0.8 – 1.1 mm long 0.4 – 0.53 mm wide	0.81 mm long 0.54 mm wide	0.64 – 0.9 mm long 0.36 – 0.73 mm wide
Perianth surface	Papillate	Smooth	Smooth
Perianth keels	4 (2 lateral, 2 ventral), margin irregularly denticulate	4 (2 lateral, 2 ventral), margin crenulate	4 (2 lateral, 2 ventral), margin irregularly crenulate-denticulate

projecting cells, dorsal margin arched, ventral margin almost straight – slightly arched; marginal leaf cells rectangular – polygonal, 12.5 – 27.5 x 12.5 – 22.5 µm; median leaf cells pentagonal – hexagonal, 25.0 – 40.0 x 20.0 – 27.5 µm; basal leaf cells elongated, polygonal, 55.0 – 82.5 x 15.0 – 30.0 µm; walls thin with minute trigones, intermediate thickenings absent; cuticle smooth; oil bodies not seen; leaf lobule inflated, 1/3 as long as the leaf lobe, ovate, 0.35 – 0.5 mm long, 0.2 – 0.26 mm wide, bidentate , first tooth 2 cells long, 1 cell wide; second tooth 2 – 3 cells long, 2 – 3 cells wide at base; hyaline papilla oval, present at the inner surface of the base of first tooth; keel slightly arched, smooth; stylus filiform, uniseriate, 2 – 3 cells long. Gemmae discoid, on the ventral surface of leaf lobe, 18 – 27-celled, 62.5 – 112.5 x 57.5 – 100.0 µm, with 3 adhesive cells.

Monoecious. Androecia terminal on short lateral branches, 0.48 – 0.56 mm long, 0.27 – 0.43 mm wide; male bracts in 2 – 3 pairs, densely imbricate; bract lobe oblong-ovate, 0.24 – 0.37 mm long, 0.12 – 0.18 mm wide; bract lobule strongly inflated, almost as long as the bract lobe or slightly smaller. Gynoecia terminal on short branches with a single sub-floral innovation; female bract lobe oblong – ovate, 0.5 – 0.62 mm long, 0.22 – 0.34 mm wide, apex rounded – obtuse; bract lobule 1/2 – 2/3 as long as the bract lobe, apex with 2 tooth; perianth obovate, 0.8 – 1.1 mm long, 0.4 – 0.53 mm wide, slightly dorso-ventrally flattened, surface papillate; keels 4 (2 lateral, 2 ventral), margin of keels irregularly denticulate; beak short, 1 – 2 cells long. Mature sporophyte not seen.

Habitat and ecology: Epiphyllous on the leaves of *Eurya* sp. in association with *Lejeunea alata* Gottsche, as well as epiphytic, in moist and shady places along the periphery of moist temperate forests.

Etymology: The species has been named after Dr. P. Tixier, Laboratoire de Cryptogamie, Museum National d'Histoire Naturelle, Paris for his notable contributions towards Asian *Cololejeunea*.

DISCUSSION

Cololejeunea tixieriana, in the presence of crenulate leaf lobe margins and absence of dorsal papillosity on leaf cells, belongs to subgenus *Leptocolea* (Spruce) Schiffn. It is characterised by orbicular – oval outline of the stem in transverse section, having 5 – 6 cortical cells and one medullary cell (Fig. 1. 3 & 4); obovate leaves with crenulate margins; leaf cells with minute trigones, lacking intermediate thickenings (Fig. 1. 9-11; Fig. 2. 5); smooth cuticle; bidentate lobule with first tooth 2 cells long, 1 cell wide, second tooth 2 – 3 cells long, 2 – 3 cells wide at base (Fig. 1. 12 & 13; Fig. 2. 6 & 7); filiform, 2 – 3 cells long stylus (Fig. 1. 14-17; Fig. 2. 8 & 9); 18 – 27-celled, discoid gemmae with 3 adhesive cells (Fig. 1. 18); monoecious sexuality; terminal androecia with 2 – 3-paired, densely imbricate bracts; terminal gynoecia with a single sub-floral innovation (Fig. 1. 1; Fig. 2. 2); obovate,

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4-keeled perianth with papillate surface and irregularly denticulate margins of the keels (Fig. 1. 22, 25, 26; Fig. 2. 11).

C. tixieriana closely resembles *C. trichomanis* (Gottsche) Steph., a species distributed in India, Nepal, China, Indonesia, Taiwan, Japan, Korea, Laos, Malaysia, Philippines, Thailand, Vietnam, Cambodia, Australia (Stephani, 1916; Zhu and So, 2001; Asthana and Srivastava, 2003), in the presence of crenulate leaf margins, leaf cells with minute trigones, but devoid of intermediate thickenings; monoecism and 4-keeled perianth. But, it is distinct from the latter which has much delicate stem, 50 – 70 µm in diameter; much smaller, 0.59 – 0.77 x 0.32 – 0.45 mm leaves; 1-celled second tooth of leaf lobule; 4 – 6 cells long stylus; much smaller, 0.32 x 0.14 mm, female bracts and smooth perianth (Asthana and Srivastava, 2003). The present species also resembles *C. serrulata* Steph., distributed in China and Vietnam (Stephani, 1916; Zhu and So, 2001), in having leaf cells with small trigones, but devoid of intermediate thickenings; monoecious plants and 4-keeled, obovate perianth with crenulate – denticulate margins. But it differs from latter which exhibits ovate – sub-elliptical leaves with irregularly serrulate margins; 1 – 2-celled or obsolete second tooth of leaf lobule; unicellular stylus; much smaller, 0.28 – 0.36 x 0.10 – 0.13 mm female bracts and smooth perianth. (Zhu and So, 2001). A comparative morphological account of the three species is presented in Table 1.

ACKNOWLEDGEMENTS

The authors are thankful to the Director, Botanical Survey of India for facilities and encouragement, the Chief Wildlife Warden, Sikkim Forest Department for facilitating the exploration work in Sikkim, Dr. V. J. Nair, Emeritus Scientist, Southern Circle, BSI, Coimbatore for Latin rendering of diagnosis, and to the Ministry of Environment and Forests, New Delhi for financial assistance under the All India Coordinated Project on Taxonomy (AICOPTAX). One of us (MD) is also grateful to the Director, BSI for financial support under "Flora of India" project.

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印度東喜瑪拉雅山脈疣鱗苔屬（苔綱：細鱗苔科）一新種

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(收稿日期：2008 年 2 月 1 日；接受日期：2008 年 5 月 14 日)

摘　　要

本文描述苔綱植物疣鱗苔屬的一新種，提氏疣鱗苔 (*Cololejeunea tixieriana*)。此新種來自印度東喜瑪拉雅山脈。此新種與 *C. trichomanis* 及 *C. serrulata* 進行比較。

關鍵詞：提氏疣鱗苔、細鱗苔科、新種、東喜瑪拉雅山脈、印度。

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