Note

Jubula pennsylvanica (Hepaticae: Jubulaceae) new to Asia

Monalisa Dey[(1)], Devendra Singh[(1)] and D. K. Singh[(2*)]

1. Botanical Survey of India, Central National Herbarium, Howrah – 711103, India.
2. Botanical Survey of India, CGO Complex, 3rd MSO Building, Block F (5th floor), Salt Lake Sector I, Kolkata – 700 064, India. Tel. +91 33 23214050, Fax +91 33 23215631
** Corresponding author. Email: singh_drdk@rediffmail.com*

(Manuscript received 14 March 2010; accepted 15 September 2010)

ABSTRACT: *Jubula pennsylvanica* (Steph.) A.Evans, a species so far known only from North America, is recorded for the first time in Asia from Eastern Himalaya, India.

KEY WORDS: *Jubula pennsylvanica*, Jubulaceae, new record, Asia.

INTRODUCTION

The genus *Jubula* Dumort. is represented by seven species, two subspecies and two varieties in the world (Guerke, 1978; Udar and Nath, 1978; Chang and Gao, 1984; Srivastava and Sharma, 1990; Sim-Sim et al., 2002) of which six taxa, viz. *J. hattorii* Udar & V.Nath, *J. himalayensis* S.C.Srivast. & D.Sharma, *J. hutchinsiae* (Hook.) Dumort. subsp. *hutchinsiae*, *J. hutchinsiae* subsp. *javanica* (Steph.) Verdoorn, *J. japonica* Steph. and *J. kwangsiensis* C.Gao & K.C.Chang are known from Asia (Kamimura, 1961; Udar and Nath, 1978; Chang and Gao, 1984; Srivastava and Sharma, 1990; Piippo, 1990). Of these *J. hattorii*, *J. himalayensis* and *J. hutchinsiae* subsp. *javanica* are known from India (Singh, 2001). Among the Indian species, *J. hattorii* is known from West Bengal and Meghalaya in Eastern Himalaya, *J. himalayensis* from Uttarakhand in Western Himalaya, while *J. hutchinsiae* subsp. *javanica* is known from Assam, Sikkim and West Bengal in Eastern Himalaya and the Western Ghats in India (Chopra, 1938; Hattori, 1966; Udar and Nath, 1978; Srivastava and Sharma, 1990; Long and Grolle, 1990; Singh et al., 2008).

During the course of studies on the epiphyllous liverworts of Eastern Himalaya, the authors came across some interesting specimens of the genus *Jubula* from East district of Sikkim which differed from the hitherto known species from Asia. A subsequent morpho-taxonomic investigation on the specimens followed by literature review (Guerke, 1978; Schuster, 1992) revealed that the plants belong to typical *J. pennsylvanica*, so far known from North America only. The same has been described and illustrated in the present communication.

TAXONOMIC TREATMENTS

Jubula pennsylvanica (Steph.) A.Evans in Rhodora 7: 55. 1905; W.R.Guerke in Bryophyt. Biblioth. 17: 79. 1978; R.M.Schust., Hepat. & Anthocerot. of North America 5: 275. 1992. *Frullania pennsylvanica* Steph. in Hedwigia 22: 147. 1883. subsp. *pennsylvanica* Figs. 1 & 2

Plants blackish green in herbarium; shoot 8.0-28.0 mm long, 1.2-1.6 mm wide, irregularly branched throughout. Stem elliptical in outline in transverse section, 0.18-0.23 × 0.11-0.13 mm, 7-9 cells across the diameter; cortical cells in one layer, rectangular, 8.14-16.3 × 8.14-28.5 µm, slightly thick-walled; medullary cells in 22-31 vertical rows, polygonal, 16.3-44.7 × 12.2-28.5 µm, thin-walled. Leaves imbricate, widely spreading, leaf lobe ovate - oblong ovate, 0.55-0.89 mm long, 0.41-0.65 mm wide, apex sub acute - acute, often apiculate, margin entire, dorsal margin strongly arched, ventral margin almost straight - slightly arched; apical leaf cells rectangular - polygonal, 10.2-20.3 × 10.2-24.4 µm; median leaf cells polygonal, 20.3-32.5 × 14.2-24.4 µm; basal leaf cells polygonal, 24.4-44.7 × 16.3-30.5 µm; walls thin with minute trigones, intermediate thickenings absent; cuticle smooth; oil-bodies not seen; leaf lobule dimorphic, galeate or explanate, when galeate ovoid, 0.12-0.27 × 0.09-0.19 mm, with rounded apex and truncate mouth; explanate lobule lanceolate, 0.16-0.24 × 0.06-0.10 mm, apex apiculate; stylus not seen; first branch leaf reduced, lanceolate, 0.23-0.36 mm long, 0.09-0.16 mm wide, apex apiculate, margin entire, lobule absent. Underleaves distant - slightly contiguous, 2-3 times as wide as the stem,

臺灣大學學術期刊資料庫

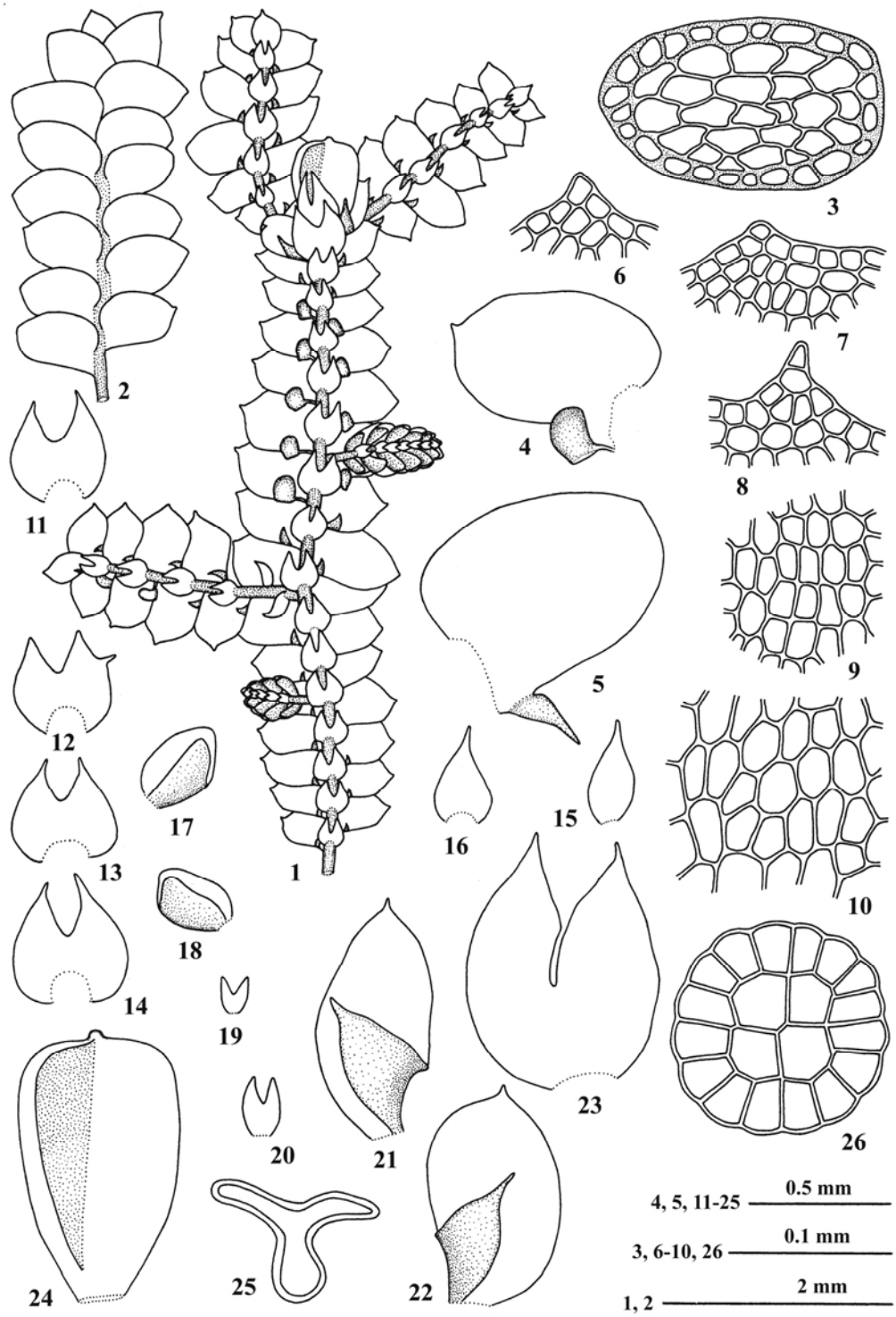


Fig. 1. *Jubula pennsylvanica* (Steph.) A.Evans subsp. *pennsylvanica.* 1: A portion of plant bearing androecial and gynoecial branches in ventral view (rhizoids not drawn). 2: A vegetative branch in dorsal view. 3: Transverse section of stem. 4, 5: Leaves. 6 – 8: Apical leaf cells. 9: Median leaf cells. 10: Basal leaf cells. 11–14: Underleaves. 15: First branch leaf. 16: First branch underleaf. 17, 18: Male bracts. 19, 20: Male bracteoles. 21, 22: Female bracts. 23: A female bracteole. 24: A perianth in ventral view. 25: Transverse section of perianth. 26: Transverse section of seta. (2–12, 14–16 drawn from *D. Singh* 36992B; others from *D. Singh* 39624A).

臺灣大學學術期刊資料庫

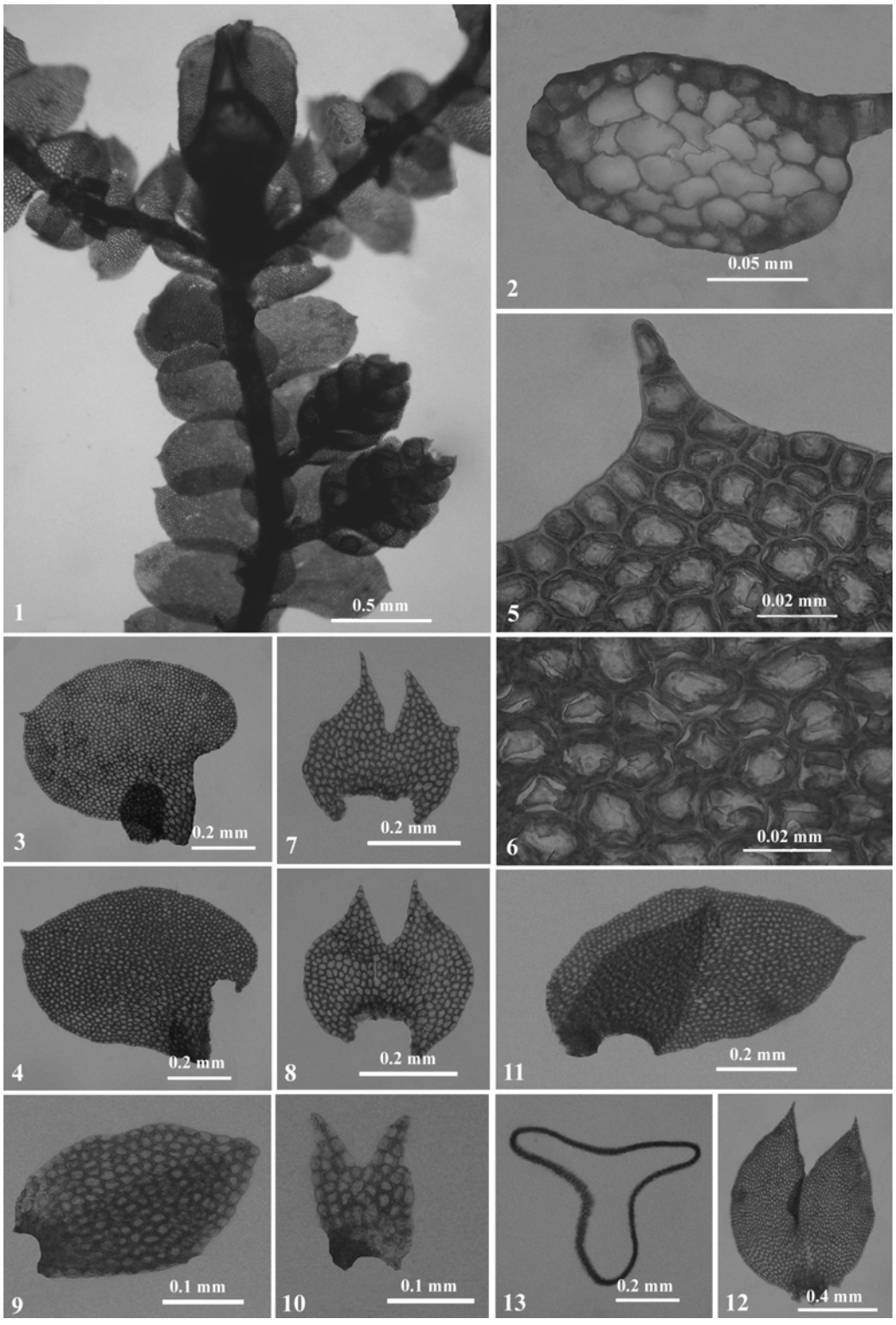


Fig. 2. *Jubula pennsylvanica* (Steph.) A.Evans subsp. *pennsylvanica*. 1: A portion of plant bearing androecial and gynoecial branches. 2: Transverse section of stem. 3, 4: Leaves. 5: Apical leaf cells. 6: Median leaf cells. 7, 8: Underleaves. 9: A male bract. 10: A male bracteole. 11: A female bract. 12: A female bracteole. 13: Transverse section of perianth. (2–6, 8 from *D. Singh* 36992B; others from *D. Singh* 39624A).

臺灣大學學術期刊資料庫

sub orbicular - ovate in outline, 0.22-0.42 mm long, 0.21-0.39 mm wide, bilobed to 1/2 of underleaf length, lobe apices long acute - acuminate, margin entire, very rarely with a single lateral cilium, sinus narrow - wide; first branch underleaf reduced, ovate, 0.25-0.35 mm long, 0.11-0.20 mm wide, apex apiculate, margin entire. Rhizoids few, fasciculated near base of underleaves. Gemmae absent.

Monoecious. Androecia terminal on short lateral branches; bracts in 3-9 pairs, closely imbricate, oblong ovate, 0.22-0.32 mm long, 0.15-0.23 mm wide, apex obtuse - sub acute, bract lobule strongly inflated, slightly smaller than bract lobe; bracteoles present throughout the androecium, oblong ovate, 0.12-0.21 mm long, 0.10-0.13 mm wide, bilobed to 1/2 their length. Gynoecia terminal on main shoot or long lateral branches with 1-2 subfloral innovations; bract lobe oblong ovate - lanceolate, 0.70-0.84 mm long, 0.34-0.46 mm wide, apex apiculate, margin entire, bract lobule ovate - lanceolate, 2/3 - 3/4 as long as the bract lobe, apex apiculate, margin entire, keel arched; bracteoles broadly obovate, 0.75-0.96 mm long, 0.50-0.76 mm wide, bilobed to 2/3 of their length, lobe apices apiculate, margin entire. Perianth obovate, 0.80-1.20 mm long, 0.45-0.63 mm wide; keels 3 (2 lateral, 1 ventral), lateral keels sharp, compressed, ventral keel broad, inflated; beak short. Seta orbicular in outline in transverse section, 115.0-132.5 µm in diameter, with 16 outer cells surrounding 4 inner cells; capsule spherical, 0.48-0.52 mm in diameter. Mature sporophyte not seen.

Habitat: Epiphyllous, growing on the leaves of *Microsorium* sp. and dicotyledonous angiosperms in moist and shady places, in association with *Heteroscyphus bescherellei*, *Lejeunea obscura*, *L. tuberculosa* and *Metzgeria lindbergii*.

Distribution: India [Eastern Himalaya (Sikkim) – present study], North America (Guerke, 1978; Schuster, 1992).

Specimens examined: India – Eastern Himalaya, Sikkim, East district, Dalapchand, *ca* 1650 m, 27. 02. 2006, *D. Singh* 36992B (CAL); Phendung khola, *ca* 1850 m, 28. 02. 2006, *D. Singh* 39623A, 39624A (CAL).

DISCUSSION

J. pennsylvanica subsp. *pennsylvanica* is characterized by monoecism of the plants (Figs. 1: 1; 2: 1); ovate - oblong ovate leaf lobes with sub acute - acute, often apiculate apices and entire margins (Figs. 1: 1, 2, 4-8; 2: 1, 3-5); leaf lobule dimorphic, both galeate as well as explanate (Figs. 1: 1, 4, 5; 2: 3, 4); bilobed underleaves with entire margins, very rarely with a single lateral cilium (Figs. 1: 1, 11-14; 2: 1, 7, 8) and female bracts and bracteoles with entire margins (Figs. 1: 21-23; 2: 11, 12). It can be readily distinguished from other species of the genus in having leaf lobes with entire margins. The present discovery of *J. pennsylvanica* from India also constitutes its first record in Asian bryoflora. The species shows an interesting bicentric, trans-oceanic disjunct distribution of considerable phytogeographical significance.

Key to the Asiatic taxa of *Jubula*

1a. Leaf lobe 0.25-0.3 mm long, 0.11-0.16 mm wide; lobule 47-75 µm long, 34-60 µm wide ……..…..……..…..… *J. kwangsiensis*
1b. Leaf lobe more than 0.5 mm long, more than 0.4 mm wide; lobule more than 120 µm long, more than 60 µm wide ……..... 2
2a. Plants dioecious; male bracteoles present only at the base of androecium …….. *J. hattorii*
2b. Plants monoecious; male bracteoles present throughout the androecium …..…… 3
3a. Female bracts and bracteoles with irregularly toothed or spinose margins ……...…. 4
3b. Female bracts and bracteoles with entire margins ……..…. 6
4a. Leaf lobes with densely spinose - ciliate margins, spines 4-12; lobules without a spinose appendage; underleaves 3-4 times as wide as stem, margins densely spinose - ciliate …..... *J. japonica*
4b. Leaf lobes with dentate margins, teeth (0-) 1-7; lobules usually with a spinose appendage; underleaves about 2 times as wide as stem, margins dentate, teeth (0-) 1-3 ……...…...……..…… 5
5a. Plants 1.3-3.0 mm wide with leaves; stem 250-275 µm in diameter; leaf lobe margins with 5-7 teeth ……...……... ……..…….…….. *J. hutchinsiae* subsp. *hutchinsiae*
5b. Plants 1.0-2.0 mm wide with leaves; stem 150-200 µm in diameter; leaf lobe margins with (0-)1-3 teeth..... ……..…...…… *J. hutchinsiae* subsp. *javanica*
6a. Stem 11-12 cells across diameter; leaf lobes as long as wide, ovate- sub triangulate, 1.14-1.20 mm long, 1.03-1.20 mm wide, with 1(-2) teeth at apex; explanate lobules absent ……... ……..... *J. himalayensis*
6b. Stem 7-9 cells across diameter; leaf lobes longer than wide, ovate-oblong ovate, 0.55-0.89 mm long, 0.41-0.65 mm wide, without apical teeth; explanate lobules present ……..……... …… *J. pennsylvanica* subsp. *pennsylvanica*

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, Prof. (Dr.) R.L. Zhu, Department of Biology, East China Normal University, Shanghai for providing relevant literature 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 during the tenure of which the present work was completed.

LITERATURE CITED

Chang, K. -C. and C. Gao. 1984. Plantae novae Hepaticarum Sinarum. Bull. Bot. Res., Harbin **4**: 83 - 99.

Chopra, R. S. 1938. Notes on Indian Hepatics. I. South India. Proc. Indian Acad. Sci. **B7**: 239-251.

臺灣大學學術期刊資料庫

Guerke, W. R. 1978. A monograph of the genus *Jubula* Dumortier. Bryophyt. Biblioth. **17**: 1-118.
Hattori, S. 1966. Anthocerotae and Hepaticae. In: Hara, H. (ed.), The Flora of Eastern Himalaya, 501-536. University of Tokyo Press, Tokyo, Japan.
Kamimura, M. 1961. A monograph of Japanese Frullaniaceae. J. Hattori Bot. Lab. **24**: 1-108.
Long, D. G. and R. Grolle. 1990. Hepaticae of Bhutan II. J. Hattori Bot. Lab. **68**: 381-440.
Piippo, S. 1990. Annotated catalogue of Chinese Hepaticae and Anthocerotae. J. Hattori Bot. Lab. **68**: 1-192.
Schuster, R. M. 1992. The Hepaticae and Anthocerotae of North America. V. Field Museum of Natural History, Chicago, USA. pp. 1-854.
Sim-Sim, M., S. Fontinha, A. C. Figueiredo, C. Sérgio and S. Carvalho. 2002. New data on *Jubula hutchinsiae* in Macaronesia, with special reference to Madeira Island. Nova Hedwigia **75**: 469-476.
Singh, A. P., D. Kumar and V. Nath. 2008. Studies on the Genera *Frullania* Raddi and *Jubula* Dum. from Meghalaya (India): Eastern Himalayas. Taiwania **53**: 51-84.
Singh, D.K. 2001. Diversity in Indian liverworts: their status, vulnerability and conservation. In: Nath, V. and A.K. Asthana (eds.), Perspectives in Indian Bryology, 325-354. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
Srivastava, S. C. and D. Sharma. 1990. A new species of *Jubula* Dumort. from Milam in Kumaon (western Himalaya). Proc. Indian Acad. Sci. Pl. Sci. **100**: 85 - 89.
Udar, R. and V. Nath. 1978. A new species of *Jubula* Dum. from India. Misc. Bryol. et Lichénol. **8**: 49-52.

亞洲新紀錄種－賓州毛耳葉蘚

Monalisa Dey[(1)], Devendra Singh[(1)] and D.K. Singh[(2*)]

1. *Botanical Survey of India, Central National Herbarium, Howrah – 711103, India.*
2. *Botanical Survey of India, CGO Complex, 3rd MSO Building, Block F (5th floor), Salt Lake Sector I, Kolkata – 700 064, India. Tel. +91 33 23214050, Fax +91 33 23215631*

* 通信作者。*Email: singh_drdk@rediffmail.com*

(收稿日期：2010 年 3 月 14 日；接受日期：2010 年 9 月 15 日)

摘要: 本文首次報導描述分布於東喜瑪拉雅山印度境內的賓州毛耳葉蘚(*Jubula pennsylvanica* (Steph.) A.Evans)，本種紀錄僅分布於北美洲，故亦為亞洲新紀錄種。

關鍵詞: 賓州毛耳葉蘚、毛耳葉蘚科、新紀錄種、亞洲。

臺灣大學學術期刊資料庫