

Some acrocarpous mosses new to central India

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ABSTRACT

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Four taxa, viz. *Campylopus fragilis* subsp. *goughii* (Mitt.) J.-P. Frahm, *Campylopus savannarum* (Müll. Hal.) Mitt., *Cynodontium gracilescens* (F. Weber & D. Mohr) Schimp. and *Dicranella leptoneura* Dixon are being reported from central India for the first time. These mosses have been encountered from Pachmarhi Biosphere Reserve (PBR), a central Indian hotspot of bryophyte vegetation. Among these taxa, *Campylopus fragilis* subsp. *goughii* and *Dicranella leptoneura* show restricted distribution in Asia while the other two are widely distributed. In India, the above taxa were earlier known from eastern Himalaya, western Himalaya and southern India. Considering the restricted distribution of these mosses in India, mentioned above, their extended distribution in central India is noteworthy as the central Indian belt is considered the connecting channel for East Himalayan and South Indian flora, mainly the western Ghats, both of which are the biodiversity hotspots.

Key-words: Acrocarpous mosses, Pachmarhi Biosphere Reserve, central India.

INTRODUCTION

Indian subcontinent is one of the 12 megadiversity centres of the world and is also considered as one of the world's 12 centres of origin of cultivated plants (Vavilov 1951). Further, although India occupies only 2% of the world's total land mass, yet it harbours nearly 11% of the known world flora. Among the major plant groups, bryophyte flora of the country again accounts for 11% of the total known bryophyte flora of the world (Sharma et al. 1997).

The central Indian bryo-geographical zone boasts of substantial bryophyte flora with some important centres being Amarkantak-Achanakmar Biosphere Reserve, Bhimbetka World Heritage site, Gujarat, Kanha National Park, Mt. Abu, Pachmarhi Biosphere Reserve (PBR) and parts of Chota Nagpur plateau. Among the bryophytes, the mosses of central India have attracted attention only recently, with researchers

venturing into unveiling of the central Indian moss flora (Chaudhary & Deora 2001, Singh & Kaul 2002, Chaudhary & Sharma 2002, 2007, Nath & Gupta 2007, 2008, 2009a, b, Nath & Bansal 2009, Nath et al. 2005, 2007, 2008, 2010, 2011a, b).

In the present state of our knowledge, PBR stands out to be the richest region of central India in terms of the bryophyte diversity. PBR encompasses three biodiversity conservation units, viz. Pachmarhi Sanctuary, Satpura National Park and Bori Sanctuary, covering an area of 4987.38 km². It is an important biodiversity hotspot of central India, as evident from its inclusion in the Man and Biosphere (MAB) Programme and the 'Project Tiger'. The fact which highlights PBR as a prominent biodiversity hub of central India is that the flora of this region also forms a connecting link between the flora of the eastern Himalaya and that of southern India, specially the western Ghats.

The present work describes four acrocarpous mosses, viz. *Campylopus fragilis* (Brid.) subsp. *goughii* (Mitt.) J.-P. Frahm, *Campylopus savannarum* (Müll. Hal.) Mitt. belonging to family Leucobryaceae, *Cynodontium gracilescens* (F. Weber & D. Mohr) Schimp. belonging to Rhabdoweisiaceae and *Dicranella leptoneura* Dixon under family Dicranaceae from central India for the first time, which have been encountered from PBR. A remarkable point is that among these mosses, *Dicranella leptoneura* was previously reported by Gangulee (1969-1972) as endemic to India and restricted to the eastern Himalaya, but was later reported from China (Readfearn & Wu 1986). *Cynodontium gracilescens* has been known in India from eastern Himalaya only (Gangulee 1969-1972, Lal 2005). Similarly, *Campylopus fragilis* ssp. *goughii* was previously known from western Himalaya, eastern Himalaya and southern India and *C. savannarum* from eastern Himalaya and South India (Lal 2005). It can thus be aptly stated that these four taxa are new additions to the bryoflora of central Indian region. *Campylopus laetus* (Mitt.) A. Jaeger has been described as *Campylopus savannarum* (Müll. Hal.) Mitt. and *C. goughii* as *Campylopus fragilis* (Brid.) subsp. *goughii* (Mitt.) J.-P. Frahm in accordance with the synonymy provided by Frahm (1985, 1991). In the present work, the authors have followed the moss classification by Goffinet et al. (2008).

MATERIAL AND METHOD

The specimens were collected during 1992, 1993 and 2006 successively from 11 localities of PBR covering an altitudinal range of 400 to 1000 metres. These were collected on epiphytic habitats and from rocks. The collections have been deposited in the Bryophyte Herbarium, National Botanical Research Institute, Lucknow (LWG), India. The plants were compared with other specimens of the same species from eastern India.

OBSERVATION AND DISCUSSION

Campylopus fragilis subsp. *goughii* (Mitt.) J.-P. Frahm

Text-figures 1A-J

In: Trop. Bryol. 4: 61 (1991). *Campylopus*

goughii (Mitt.) A. Jaeger in Ber. S. Gall. Naturw. Ges., 1870-71: 424 (1872). *Dicranum goughii* Mitt. in Musc. Ind. Or.: 17 (1859).

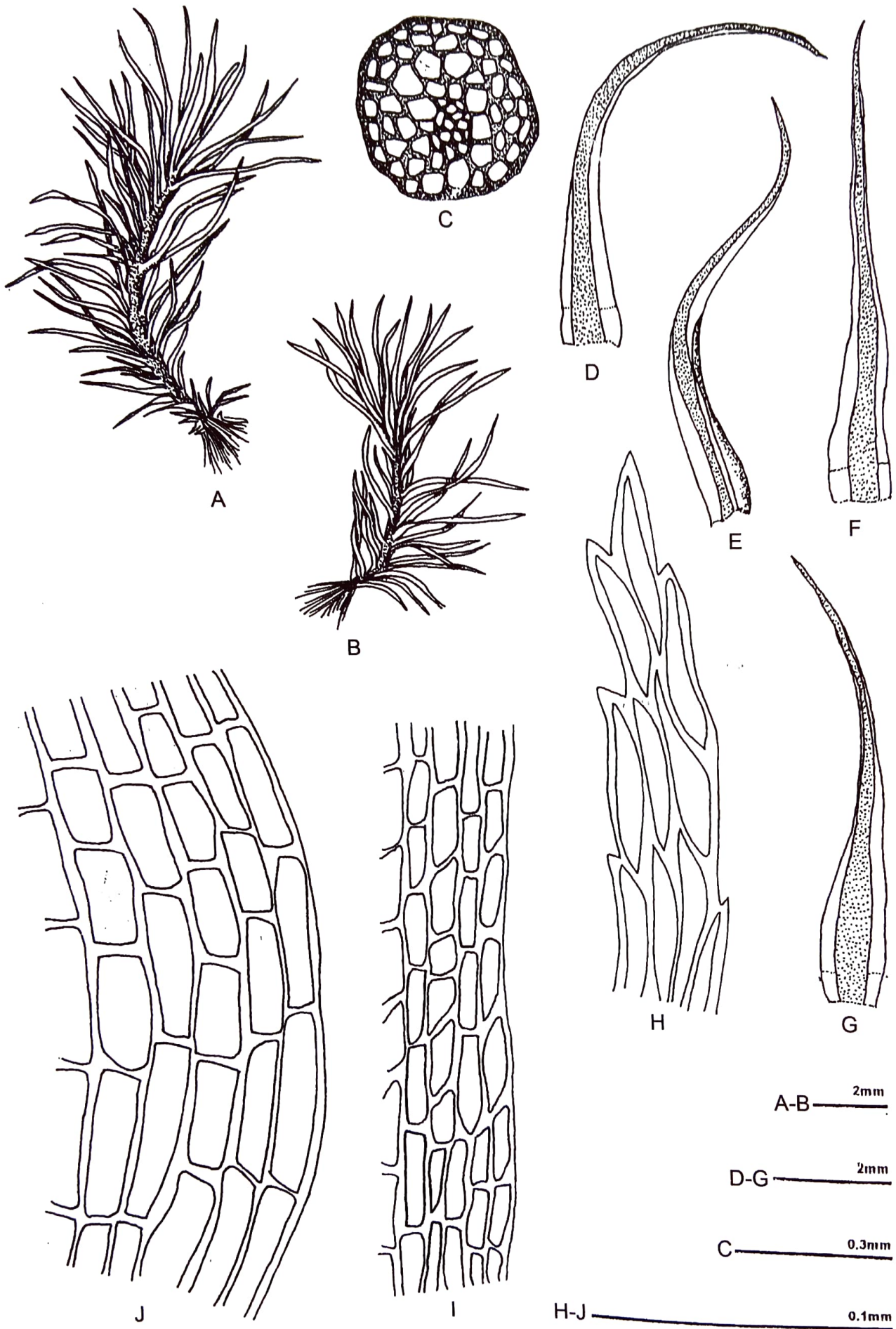
Description: Plants caespitose ± 15 mm, dull brown stem, unbranched. Stem circular in cross section, outer cortical cells smaller, medullary cells larger, innermost cells small, thick walled, forming distinct conducting region. Leaves erectopate, densely arranged throughout plant length, slightly smaller below larger upwards, $\pm 3.03 \times 0.43$ mm dense at apex; lanceolate, extending into canaliculated subula, costa light brown, occupying half width at leaf base ± 220 μ m wide; leaf margin smooth, dentate slightly at tip. Leaf cells smaller, rhomboidal, $\pm 21 \times 6.8$ μ m at apex, basal cells large, $\pm 41.7 \times 20.1$ μ m, becoming narrower towards the margin. Alar distinct, not bulging, inflated, hyaline, $\pm 42 \times 28$ μ m in size. Sporophyte not seen.

Ecology and distribution: On wet rocks, near Jambu Dweep, 793 m.

Range of distribution: China, Bhutan, Nepal, India: central India (PBR), eastern Himalaya (Darjeeling, Khasi Hills, Sikkim), western Himalaya, western Ghats (Palni, Tirunelveli - Travancore Hills), Sri Lanka.

Specimens examined: India, Madhya Pradesh, Pachmarhi: near Jambu Dweep, alt. ca. 793 m, 29.11.2006, on wet rock, leg. V. Sahu & V. Awasthi, 227652 B, 227655 B (LWG).

Remarks: *Campylopus fragilis* subsp. *goughii* is closely related to another sub species of *Campylopus fragilis*, viz. *Campylopus fragilis* subsp. *zollingerianus* (Müll. Hal.) J.-P. Frahm in having similar leaf size, inflexed margins, subulate apex and broad costa. However, both the sub-species can be distinguished only on the basis of shape of the upper laminal cells, which are oval in subsp. *goughii* while rectangular in subsp. *zollingerianus*. Both of these are found in South East Asia and have been discussed by Frahm (1992). Gangulee (1969-1972) had described a species *C. albescens* (Müll. Hal.) A. Jaeger occurring in eastern Himalaya and South India, some works have treated it as a synonym of *Campylopus fragilis* subsp. *zollingerianus* and this can be considered as the representation of subsp. *zollingerianus* from India.



Text-figure 1. *Campylopus fragilis* subsp. *goughii* (Mitt.) J-P. Frahm. A-J: LWG 227655B. A-B. Plants. C. Cross section of axis. D-G. Leaves, H. Apical leaf cells. I. Middle leaf cells. J. Basal leaf cells.

***Campylopus savannarum* (Müll. Hal.) Mitt.**

Text-figures 2A-J

In: J. Linn. Soc. Bot. 12: 85 (1869). *Campylopus laetus* (Mitt.) A. Jaeger in Ber. S. Gall. Naturw. Ges., 1870- 71: 417 (1872). *Dicranum laeteum* Mitt. in Musc. Ind. Or.: 19 (1859).

Description: Plants caespitose, up to 12 mm (can be much more due to proliferation), unbranched. Stem oval in cross section, outer cortical cells smaller followed by larger medullary cells, extreme central cells small and thick walled forming a distinct conducting zone. Leaves erectopatent, densely arranged throughout the stem, smaller below, larger above, long, lanceolate, $\pm 2 \times \pm 0.5$ mm in size, extending into a long subula; leaf margin incurved mostly at apex, sometimes at lower leaf as well, serrated at apex, costa strong, brownish yellow, ± 270 μ m wide. Leaf cells irregular at apex, rectangular to rhomboidal, $\pm 24 \times 16$ μ m in size, getting larger towards base, rectangular, up to 50.0×20.9 μ m. Alar not bulging, cells large, hyaline, $\pm 63.5 \times 33.4$ μ m in size. Sporophytes not seen.

Ecology and distribution: Epiphytic (on tree bark), Twynam Pool, 853 m.

Range of distribution: Angola, Australia, Belize, Bolivia, Brazil, Burundi, Cambodia, Cameroon, Colombia, Comoros, Congo, Costa Rica, Ecuador, El Salvador, French Guiana, Gabon, Guatemala, Guinea, Guyana, Honduras, India: central India (PBR), eastern Himalaya (Darjeeling, Khasi Hills, Sikkim), western Ghats (Palni, Tirunelveli - Travancore Hills), Indonesia, Madagascar, Malaysia, Mexico, Nicaragua, Niger, Panama, Philippines, Reunion, Rwanda, Sao Tome and Principe, South Africa, Surinam, Taiwan, Tanzania, Thailand, Trinidad and Tobago, United States, Venezuela, Zambia.

Specimens examined: India, Madhya Pradesh, Pachmarhi: Twynam Pool, alt. ca. 853 m, 29.11.2006, epiphytic, leg. V. Sahu & V. Awasthi, 227619 (LWG).

Remarks: *Campylopus savannarum* shows affinities to another species *Campylopus subluteus* (Mitt.) A. Jaeger in plant size, leaf shape and leaf tip characteristics. Both the plants can be differentiated on the basis of unbranched proliferating habit and slightly bulging colourless alar in the former against the branched

habit and less conspicuous colourless alar which is mostly tinted slightly near the costa in the latter. *Campylopus subluteus* occurs in India only from eastern Himalaya but not reported from central India (Gangulee 1969-1972).

***Cynodontium gracilescens* (F. Weber & D. Mohr) Schimp.**

Text-figures 3A-K

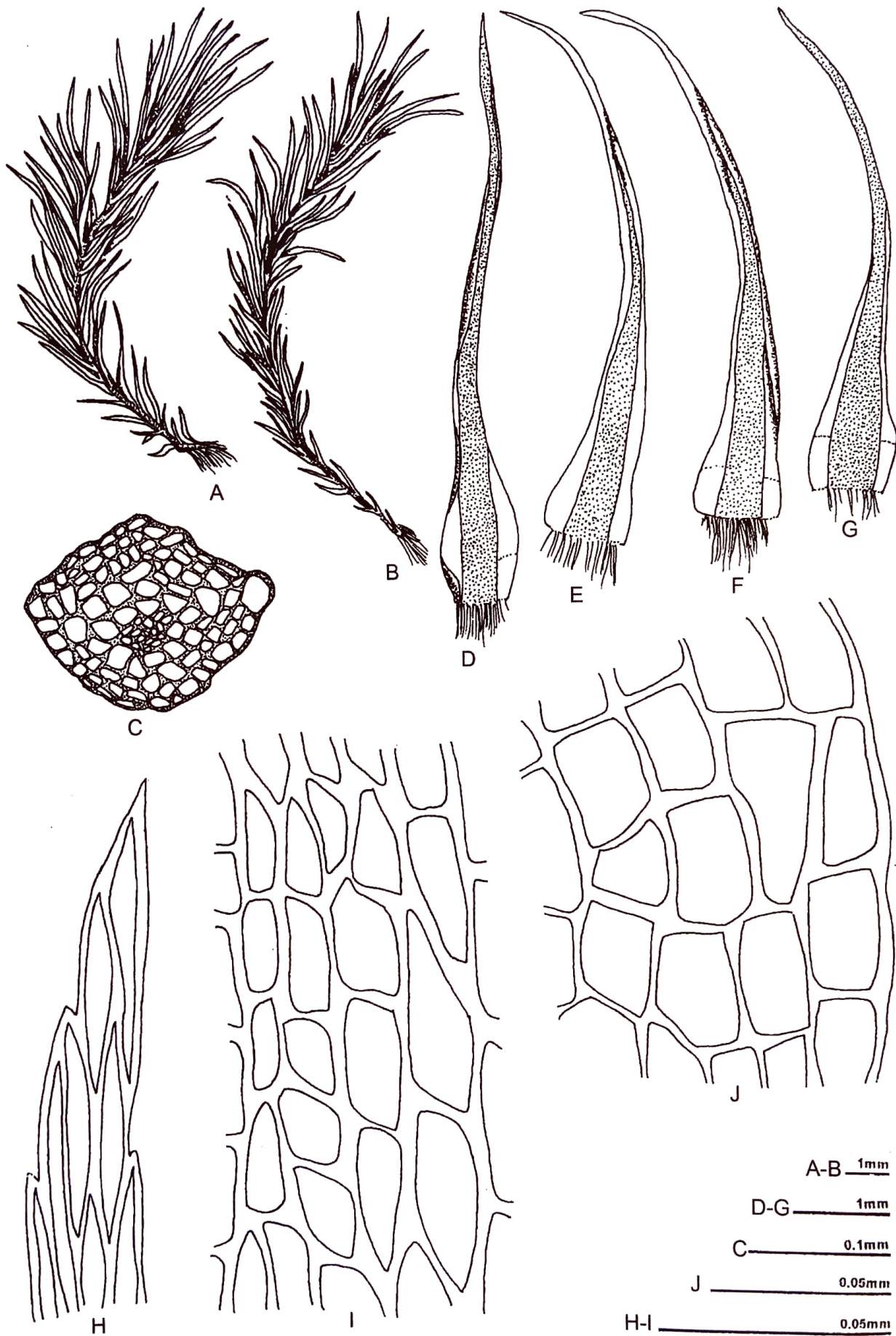
In: Coroll. Bryol. Eur. 12 (1856). *Dicranum gracilescens* F. Weber & D. Mohr. In Bot. Taschenb.: 184 (1807).

Description: Plants tufted, dull green, 8-20 mm in size, radiculose, rarely branched. Stem round to triangular in cross section, cortical cells smaller, inner medullary cells larger. Leaves densely arranged, erectopatent, lanceolate, sheathing and broader below, tapering at apex, crumpled when dry, $\pm 3.8 \times 0.62$ mm in size; margin wavy, involute, slightly dentate due to cell projections, costa strong, dull brown, prominent, wider at base, tapering above and vanishing just below the apex. Lamina cells highly incrassate and mamilliose, $\pm 14 \times 9.4$ μ m as wide as long, ovate - quadrate at apex, basal cells rectangular, hyaline, $\pm 18 \times 7.5$ μ m in size. Cross section of leaf shows larger thin walled cells in the middle surrounded by smaller thick walled cells starting from bistratose at the midrib becoming unistratose towards wings. Sporophyte not seen.

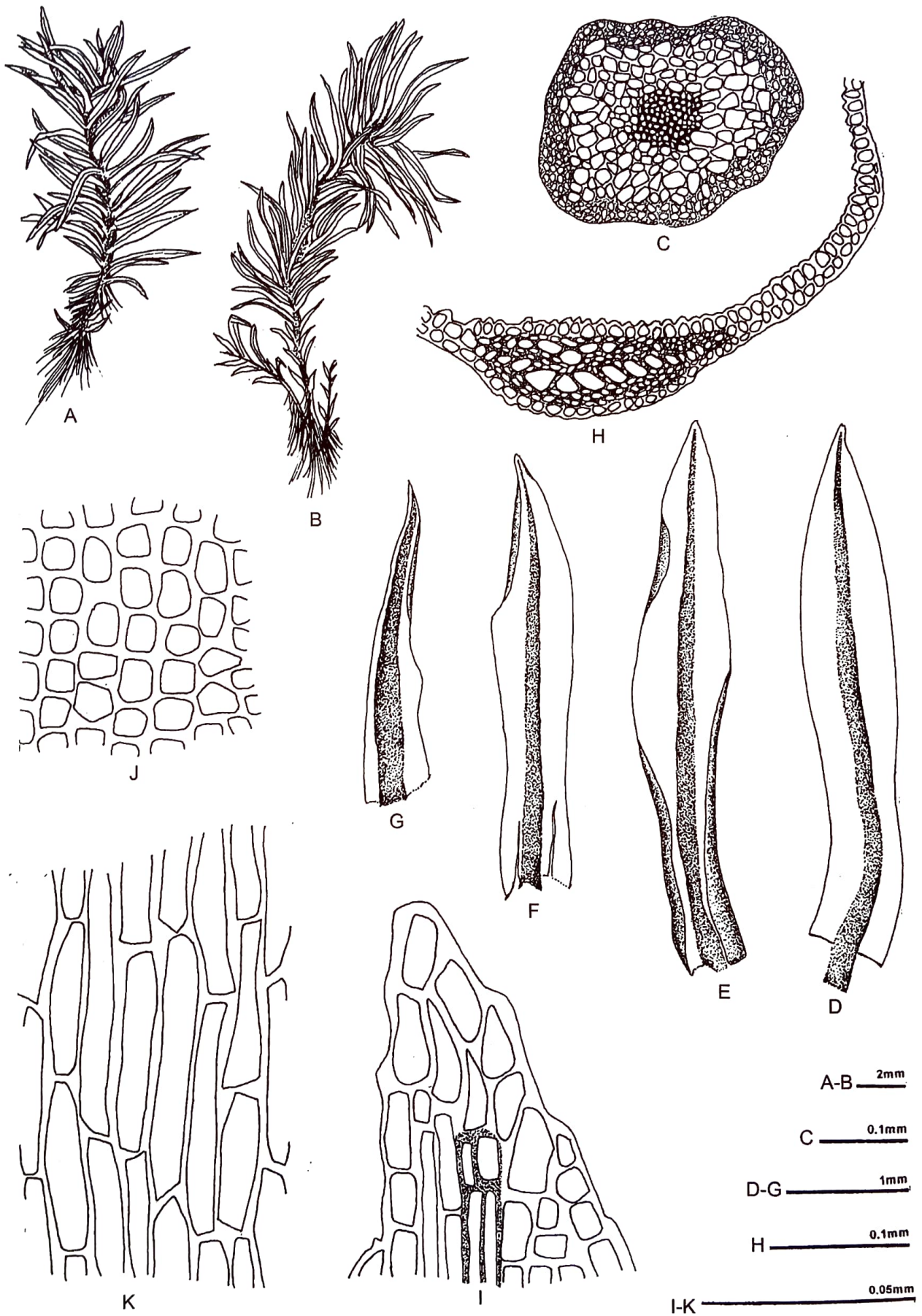
Ecology and distribution: On soil covered rock, Rajakhoh (Patalkot), 400 m; on fallen log, Sandakphu, 2622 m.

Range of distribution: Austria, Canada, China, Finland, France, Germany, Greenland, India: central India (PBR), eastern Himalaya (Darjeeling, Sikkim), Italy, Japan, Luxembourg, Nepal, Norway, Poland, Portugal, Sweden, Switzerland, Tanzania, United States.

Specimens examined: India, Madhya Pradesh, Pachmarhi: Rajakhoh (Patalkot), alt. ca. 400 m, 20.12.1993, on soil covered rock, leg. V. Nath & A. K. Asthana, 205724 (LWG); West Bengal, Darjeeling: on way to Sandakphu, alt. ca. 2622 m, 04.11.2003, on fallen log, leg. A. K. Asthana & V. Sahu, 225343A (LWG).



Text-figure 2. *Campylopus savannarum* (Müll. Hal.) Mitt. A-J: LWG 227619. A-B. Plants. C. Cross section of axis. D-G. Leaves. H. Apical leaf cells. I. Middle leaf cells. J. Basal leaf cells.



Text-figure 3. *Cynodontium gracilescens* (F. Weber & D. Mohr) Schimp. A-K: LWG 205724. A-B. Plants. C. T.S. of axis. D-G. Leaves. H. Cross section of leaf. I. Apical leaf cells. J. Middle leaf cells. K. Basal leaf cells.

Table 1. Distribution of mosses in bryo-geographical regions of India (Bryogeographical zones according to Singh (1997); Distribution according to Gangulee (1969-72), Lal (2005) and Chopra (1975). F: Recorded first time from central India; +: Present; -: Absent)

Bryo-geographical Zones → Plant names ↓	Western Himalaya	Eastern Himalaya	Punjab & West Rajasthan Plains	Gangetic Plains	Central India	Western Ghats	Eastern Ghats	Andaman & Nicobar Islands
<i>Campylopus fragilis</i> ssp. <i>goughii</i>	+	+	-	-	F	+	-	-
<i>Campylopus savannarum</i>	-	+	-	-	F	+	-	-
<i>Cynodontium gracilescens</i>	-	+	-	-	F	-	-	-
<i>Dicranella leptoneura</i>	-	+	-	-	F	-	-	-

Remarks: The genus *Cynodontium* is represented by only single species, viz. *Cynodontium gracilescens*, in India. The plant approaches another species, *C. polycarpum* (Hedw.) Schimp., of the genus, which has been known only from Nepal in the Indian subcontinent. Nevertheless, this species is distinct from the former in having acute leaf tip and less incrassate leaf cells.

Dicranella leptoneura Dixon

Text-figures 4A-L

In: J. Bomb. Nat. Hist. Soc., 39: 774 (1937).

Description: Plants caespitose, pale green to brown, ±10 mm in size, unbranched. Stem laxly covered with leaves below, densely at apex. Stem circular in cross section, outer cortical cells smaller compared to medullary cells which are irregular and large. Leaves erect, lanceolate, smaller below, ±1.4 × 0.23 mm, larger near the apex, ±2.1 × 0.32 mm, base wide, concave, tapering above, passing into canaliculated acute subula; leaf lamina incurved at places, usually at apex; costa very slightly darker than leaf colour, broader at base, narrowing upwards, smooth, may be slightly irregular at extreme apex. Leaf cells elongated, rectangular or slightly spindle shaped, ±24 × 19 µm, basal cells broader, up to 10.4 × 17 µm; leaf cell size increases from margin towards costa. Antheridial cluster present at apex, surrounded by large leaves. Antheridia broadly spindle shaped, sometimes slightly broader at upper region as compared to lower region. Female plants or sporophyte not seen.

Ecology and distribution: Epiphytic (on tree

bark), near Jambu Dweep, 853 m.; on soil, Darjeeling, 2800 m.

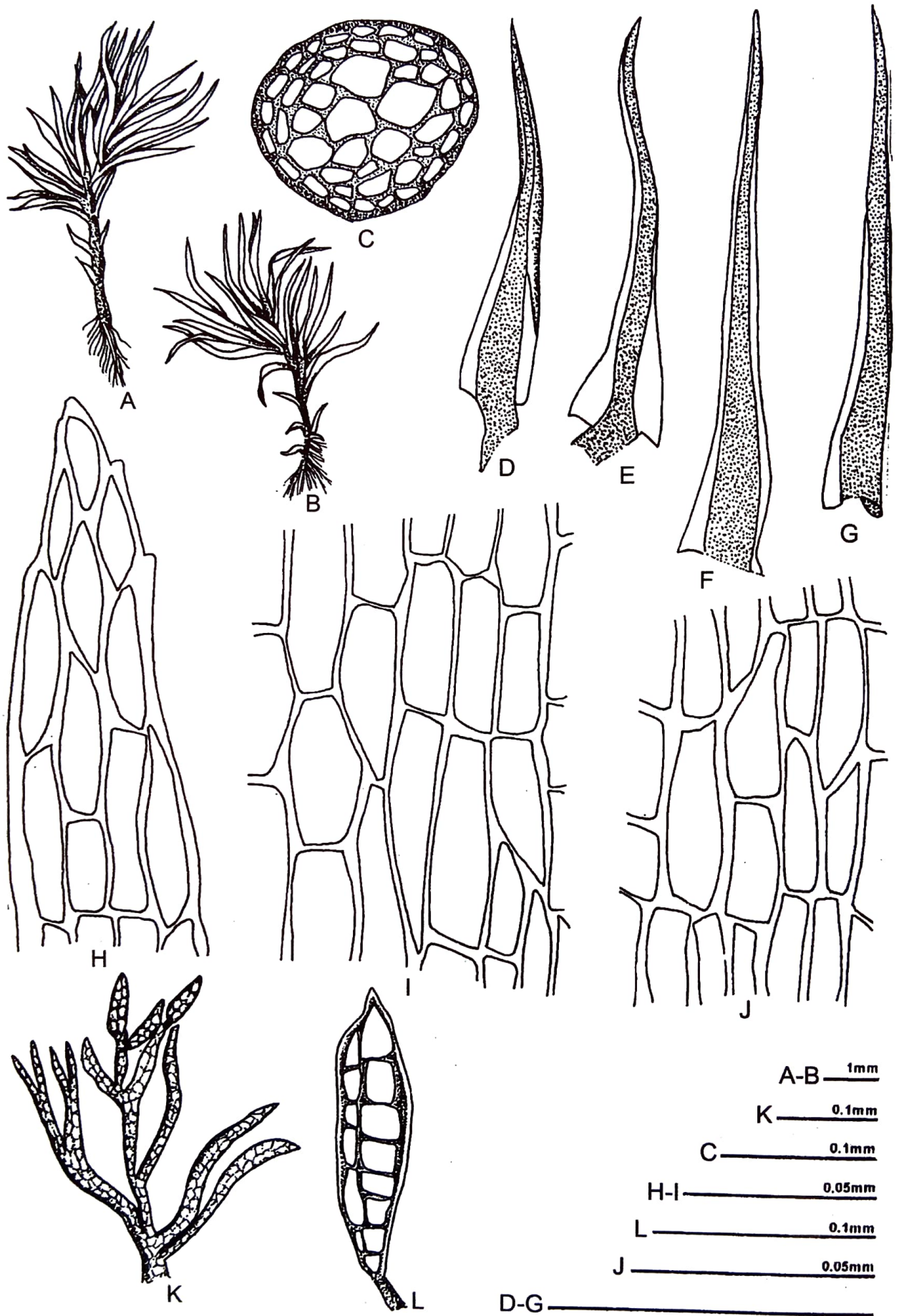
Range of distribution: China, India: central India (PBR), eastern Himalaya (Darjeeling, N.E.F.A.).

Specimens examined: India, Madhya Pradesh, Pachmarhi: near Jambu Dweep, alt. ca. 853 m, 29.11.2006, epiphytic, leg. V. Sahu & V. Awasthi, 227643 (LWG); West Bengal, Darjeeling, alt ca. 2800 m, 29.04.1965, on soil, leg. S. Chandra, 202517E (LWG).

Remarks: *Dicranella leptoneura* shows proximity to another Indian subcontinent species, *D. amplexans* (Mitt.) A. Jaeger reported from Bangladesh and Nepal (Gangulee 1969 – 1972, Banu-Fattah & Hadiuzzaman 1996) in similar habit and leaf shape. Though the two species differ in the leaf apex and colour of the costa. The leaf apex is nearly smooth and costa is light brown in the former, whereas leaf apex is dentate and costa dark dull brown in the latter.

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Text-figure 4. *Dicranella leptoneura* Dixon. A-L: LWG 227643. A-B. Plants. C. Cross section of axis. D-G. Leaves. H. Apical leaf cells. I. Middle leaf cells. J. Basal leaf cells. K. Antheridial cluster. L. Antheridium.

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