

The genus *Diobelonella* Ochyra (Aongstroemiaceae)
in India, including *Diobelonella mollicula*
(Mitt.) Manchi, Darshan & Sushil K. Singh,
comb. nov.

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ISSN (électronique / electronic): 1776-0992

The genus *Diobelonella* Ochyra (Aongstroemiaceae) in India, including *Diobelonella mollicula* (Mitt.) Manchi, Darshan & Sushil K.Singh, comb. nov.

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Submitted on 8 November 2025 | Accepted on 6 February 2026 | Published on 5 October 2026

Jandial M., Shukla D. & Singh S. K. 2026. — The genus *Diobelonella* Ochyra (Aongstroemiaceae) in India, including *Diobelonella mollicula* (Mitt.) Manchi, Darshan & Sushil K.Singh, comb. nov. *Cryptogamie, Bryologie* 47 (10): 147-155. <https://doi.org/10.5252/cryptogamie-bryologie2026v47a10>. <http://cryptogamie.com/bryologie/47/10>

ABSTRACT

The taxonomic status of the genus *Diobelonella* Ochyra (Aongstroemiaceae) is reviewed here. This genus was not previously known to occur in India, hence this is a new contribution. An Indo-Pacific species *Diobelonella rotundata* (Broth.) Schäf.-Verw., Gerh. Winter & K.Y. Yao is reported here for the first time from India. The taxonomic status of *Dicranella mollicula* (Mitt.) A. Jaeger [synonym of *Anisothecium molliculum* (Mitt.) Broth.] is evaluated, revealing a close affinity with *Diobelonella*. Consequently, a new combination is proposed. Detailed taxonomic descriptions, illustrations and color plates of both the species are provided for their easier identification.

KEY WORDS

Anisothecium,
generic record,
new combination.

RÉSUMÉ

Le genre *Diobelonella* Ochyra (Aongstroemiaceae) en Inde, incluant *Diobelonella mollicula* (Mitt.) Manchi, Darshan & Sushil K.Singh, comb. nov.

Le statut taxonomique du genre *Diobelonella* Ochyra (Aongstroemiaceae) est examiné ici. La présence de ce genre en Inde n'était pas connue jusqu'à présent; il s'agit donc d'une nouvelle contribution. Une espèce indo-pacifique, *Diobelonella rotundata* (Broth.) Schäf.-Verw., Gerh. Winter & K.Y. Yao, est signalée ici pour la première fois en Inde. Le statut taxonomique de *Dicranella mollicula* (Mitt.) A. Jaeger [synonym of *Anisothecium molliculum* (Mitt.) Broth.] est évalué, révélant une affinité étroite avec *Diobelonella*. Par conséquent, une nouvelle combinaison est proposée. Des descriptions taxonomiques détaillées, des illustrations et des planches en couleurs des deux espèces sont fournies afin de faciliter leur identification.

MOTS CLÉS

Anisothecium,
fiche générique,
nouvelle combinaison.

INTRODUCTION

The genus *Anisothecium* Mitt. (Dicranaceae) was first described in 1869 with six species (Mitten 1869). Allen (1994) distinguished the genus *Anisothecium* on the basis of three characteristics, i.e., presence of stomata, absence of annulus and presence of low basal membrane. However, the last two characters are also found in *Dicranella* (Müll.Hal.) Schimp., so the separation of *Anisothecium* from *Dicranella* is unwarranted. Later, it was found that the generic name *Anisothecium* Mitt. is illegitimate as it included one of the species previously designated as the lectotype of *Dicranella* (Müll.Hal.) Schimp. (Margadant & Geissler 1995; see also Shenzhen Code: Art. 52.2(b)). Accordingly, the generic name *Dicranella* is conserved with the type species *D. heteromalla* and *Anisothecium* is placed as a section of *Dicranella* after Ochyra *et al.* (2003).

The genus *Diobelonella* Ochyra (Aongstroemiaceae) was described by Ochyra *et al.* (2003) with the type species *Diobelonella palustris* (Dicks.) Ochyra. The genus was separated from *Dicranella* by having characters such as robust plants, decurrent squarrose leaves, ending in a broad, often rounded and cucullate apex, and from *Dichodontium* by having characters such as prosenchymatous distal laminal cells which are thin-walled and entirely smooth, entire to bluntly crenulate leaf margins, and costa very weak and narrow, lacking the ventral stereid band (Ochyra *et al.* 2003).

To date, only two species are accepted under the genus *Diobelonella*, i.e., *D. palustris* and *D. rotundata* (Ochyra *et al.* 2003; Schäfer-Verwimp *et al.* 2021). As part of the “Bryofloristic studies of Garhwal region of Uttarakhand”, the authors encountered two specimens identified as *Diobelonella rotundata* (UKB920) and *Dicranella mollicula* (Mitt.) A. Jaeger (synonym of *Anisothecium molliculum*) (UKB867). The former species is a new addition to the Indian bryoflora, while, the latter species is closely related to *Diobelonella* species, not only in its overall appearance but also in characters such as greenish-yellow plants with decurrent squarrose, lanceolate to ovate-lanceolate leaves (never linear), spreading from a wider, sheathing erect base, costa ending below the leaf apex, smooth short-rectangular to rectangular leaf cells, upper leaf margins with obtuse teeth, cross-section of leaf with single central stereid band, weak and narrow costa, sporophyte terminal or appearing lateral by innovations and inclined to erect, oval capsule. Therefore, we propose to combine it under *Diobelonella*.

MATERIAL AND METHODS

Fresh specimens were collected by the authors from Uttarkashi district in April, 2024. The specimens are deposited in the Cryptogamic section of Herbarium of Botanical Survey of India Northern Regional Centre, Dehradun (BSD). The specimens were dissected and studied under Stereo-zoom microscope (Olympus SZ51) and morphological and anatomical characters were illustrated using Trinocular compound microscope (Nikon eclipse 50i). The specimens were identified with the help of relevant literature (Takaki 1968; Schäfer-Verwimp *et al.* 2021).

TAXONOMY

Family AONGSTROEMIACEAE De Not.

Gender *Diobelonella* Ochyra

Diobelonella rotundata (Broth.) Schäfer-Verw.
(Figs 1; 2)

Gerh. Winter & K.Y.Yao, *Frahmia* 25: 6 (Schäfer-Verwimp *et al.* 2021).

Anisothecium rotundatum Broth., *Symbolae Sinicae* 4: 15 (Brotherus 1929). — *Dicranella rotundata* (Broth.) Takaki, *The Journal of Japanese Botany* 43: 467 (Takaki 1968). — *Dicranella papua-palustris* D.H.Norris & T.J.Kop., *Acta Botanica Fennica* 139: 17 (Norris & Koponen 1990).

SPECIMEN EXAMINED. — India • Uttarakhand, Uttarkashi, Yamnoutri, Kharsali; 05.IV.2024; Jandial & Shukla UKB920 (BSD).

HABITAT AND ECOLOGY. — Terrestrial, growing on moist sandy soil, in association with *Apopellia endiviifolia* (Dicks.) Nebel & D.Quandt and some liverworts at 2500–2600 m alt.

DISTRIBUTION. — India [Uttarakhand (present study)], China (Brotherus 1929 as *A. rotundatum*), New Guinea (Norris & Koponen 1990 as *D. papua-palustris*), Pakistan (Ellis *et al.* 2025), Taiwan (Schäfer-Verwimp *et al.* 2021).

TAXONOMIC NOTES. — *Diobelonella rotundata* is reported here for the first time from India; it was previously reported from China, New Guinea, Pakistan, and Taiwan. The species was first described by Brotherus (1929) as *Anisothecium rotundatum* and was later placed in the genus *Dicranella* by Takaki (1968) as *D. rotundata* (Broth.) Takaki. However, it has recently been placed in genus *Diobelonella* by Schäfer-Verwimp *et al.* (2021).

DESCRIPTION

Plants yellowish-green, erect, robust, in loose tufts, up to 2–3.5 cm long and 2.4–3.5 mm wide, scarcely branched, filiform stem, leaves distant, very fragile, easily get broken. Stem erect, orbicular to faintly angular in cross section, 205–208 × 168–175 µm; cortical cells in one-two layers, smaller; medullary cells in four-five layers, larger; central strand present. Leaves squarrose, with decurrent sheathing base, distantly placed, lingulate to oblong-ovate with a broader base, 1.14–1.8 × 0.66–0.92 mm; margins bluntly toothed up to mid leaf; apex blunt, broadly acute to subacute, leaf cells smooth, arranged in rows, apical cells rectangular to sub-rectangular, 22.9–35.6 × 6–11.4 µm, apical marginal cells distinctly shorter than inner cells, 13.7–20.6 × 5.7–12.6 µm; basal cells elongated rectangular, 30–70 × 8–14 µm. Costa ending near the apex, sometimes forked at the apex, with a single central stereid band present in cross section. Sporophytes not found.

Diobelonella mollicula

(Mitt.) Manchi, Darshan & Sushil K.Singh, comb. nov.
(Figs 3; 4)

Leptotrichum molliculum Mitt., *Journal of the Proceedings of the Linnean Society, Botany, Supplement* 1: 11 (Mitten 1859).

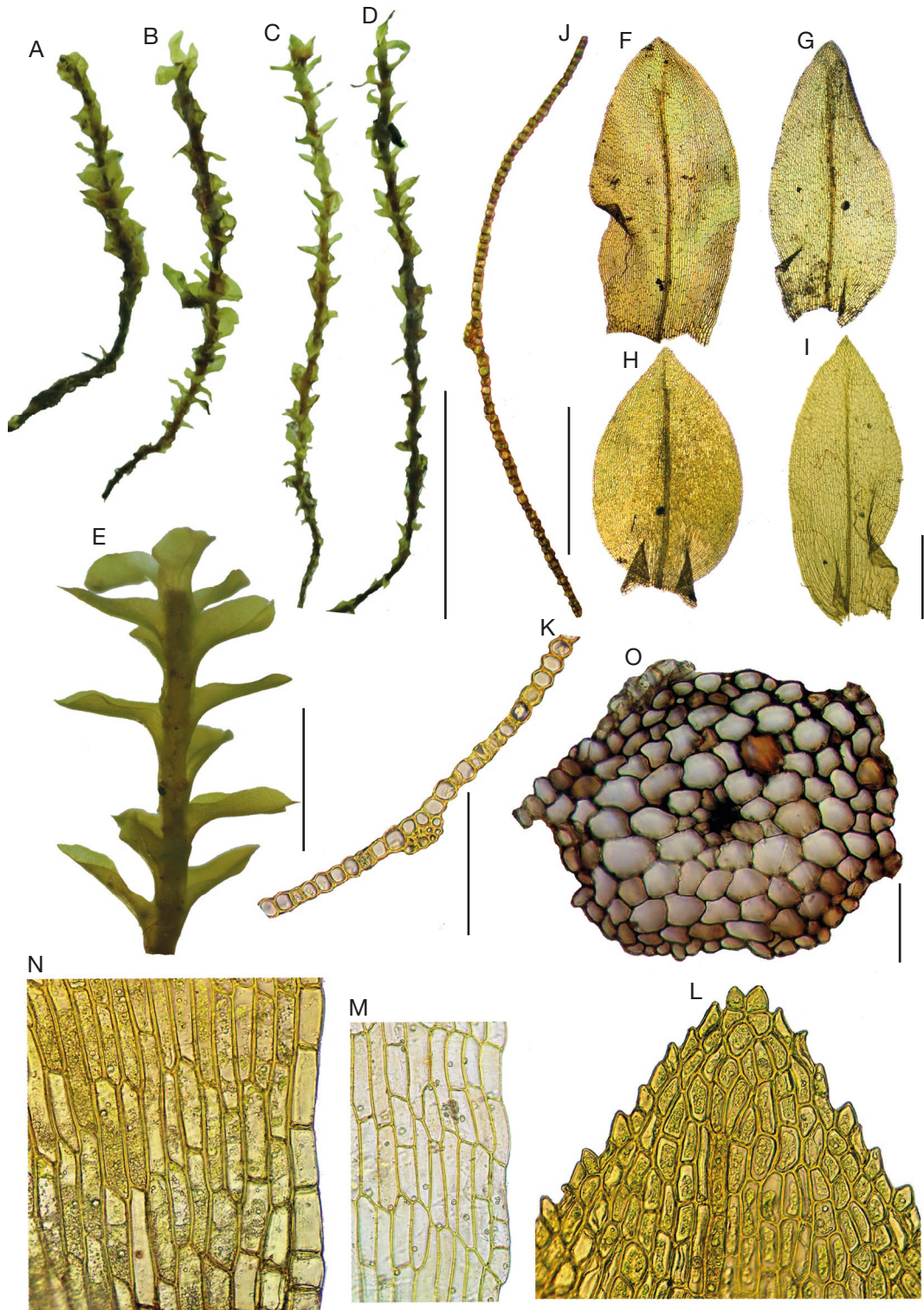


FIG. 1. — *Diobelonella rotundata* (Broth.) Schäf.-Verw., Gerh. Winter & K.-Y.Yao: **A-D**, vegetative plants; **E**, a part of the same plant enlarged; **F-I**, leaves; **J**, cross-section of leaf; **K**, a portion of the same magnified; **L**, apical leaf cells; **M**, median leaf cells; **N**, basal leaf cells; **O**, cross section of stem. Scale bars: A-D, 1 cm; E, 1.5 mm; F-I, 0.5 cm; J, 0.2 mm; K, O, 50 µm; L-N, 50 µm. All photographed from Jandial & Shukla UKB920 (BSD).

Dicranella mollicula (Mitt.) A.Jaeger, *Bericht über die Thätigkeit der St. Gallischen Naturwissenschaftlichen Gesellschaft* 1870-71: 381 (Jaeger 1872). — *Anisothecium molliculum* (Mitt.) Broth., *Die natürlichen Pflanzenfamilien, Zweite Auflage* 10: 177. (Brotherus

1924). — *Leptotrichum patulum* Mitt., *Journal of the Proceedings of the Linnean Society, Botany, Supplement* 1: 11. 1859. — *Anisothecium patulum* (Mitt.) Broth., *Die natürlichen Pflanzenfamilien, Zweite Auflage* 10: 525 (Brotherus 1929).

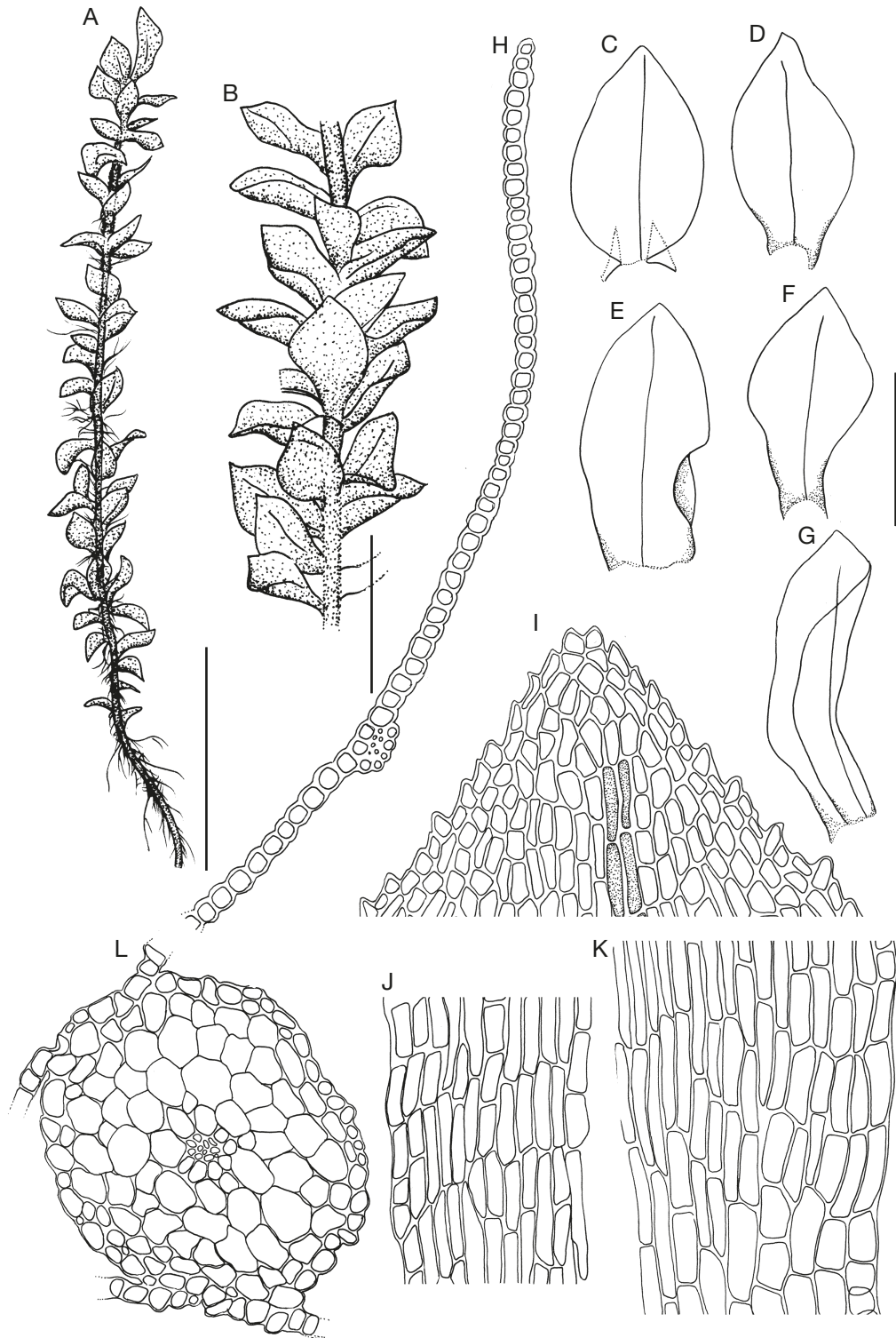


FIG. 2. — Illustration of *Diobelonella rotundata* (Broth.) Schäf.-Verw., Gerh. Winter & K.-Y.Yao: **A**, vegetative plant; **B**, a part of the same plant enlarged; **C-G**, leaves; **H**, cross section of a leaf; **I**, apical leaf cells; **J**, median leaf cells; **K**, basal leaf cells; **L**, cross section of stem. Scale bars: A, 6 mm; B, 2 mm; C-G, 1 mm; H-L, 50 μ m; All figures are taken from Jandial & Shukla UKB920 (BSD).

SPECIMEN EXAMINED. — **India** • Uttarakhand, Uttarkashi, Yamnouri, Rana Chatti; 03.IV.2024; Jandial & Shukla UKB867 (BSD).

HABITAT AND ECOLOGY. — Terrestrial, growing on sandy soil, in pure population at elev. 2000-2500 m alt.

DISTRIBUTION. — India [Sikkim, Himachal Pradesh (Gangulee 1971), Uttarakhand (Sahu & Asthana 2022)]; endemic (Fig. 5).

TAXONOMIC NOTES. — Mitten (1859) described *Leptotrichum molliculum* based on a collection made by T. Thomson in October 1849



FIG. 3. — *Diobelonella mollicula* (Mitt.) Manchi, Darshan & Sushil K.Singh, comb. nov.: **A**, plants in habit; **B**, fertile plant; **C**, a part of the same magnified; **D-H**, leaves; **I**, cross section of stem; **J-K**, cross section of leaf; **L**, apical leaf cells; **M**, median leaf cells; **N**, basal leaf cells; **O-P**, capsules; **Q**, cross section of seta; **R**, spores; **S**, peristome teeth. Scale bars: A, in field; B, 5 mm; C, 1 mm; D-H, O, P, 0.5 mm; I, J, L-M, Q, 50 μ m; K, S, 100 μ m. All photographed from *Jan-dial & Shukla UKB867* (BSD).

from the Western Himalayas, India “Boreali-occident”. Later, Jaeger (1872) placed it in the genus *Dicranella* as *D. mollicula* (Mitt.) A. Jaeger, Brotherus (1924) combined it with the genus *Anisothecium* as *A. molliculum* (Mitt.) Broth. Takaki (1968) followed the nomenclature of Jaeger (1872) and studied the holotype of *Leptotrichum*

molliculum (no. 98: NY) which was collected in Shimla and provided a detailed taxonomic description and illustration (Fig. 1A-L). According to Takaki (1968), the plant is about 4.8 mm long; leaves are squarrose, 1.6×0.4 mm, broadly lanceolate with an obtuse apex, the midrib disappears at apex; the upper leaf margin is

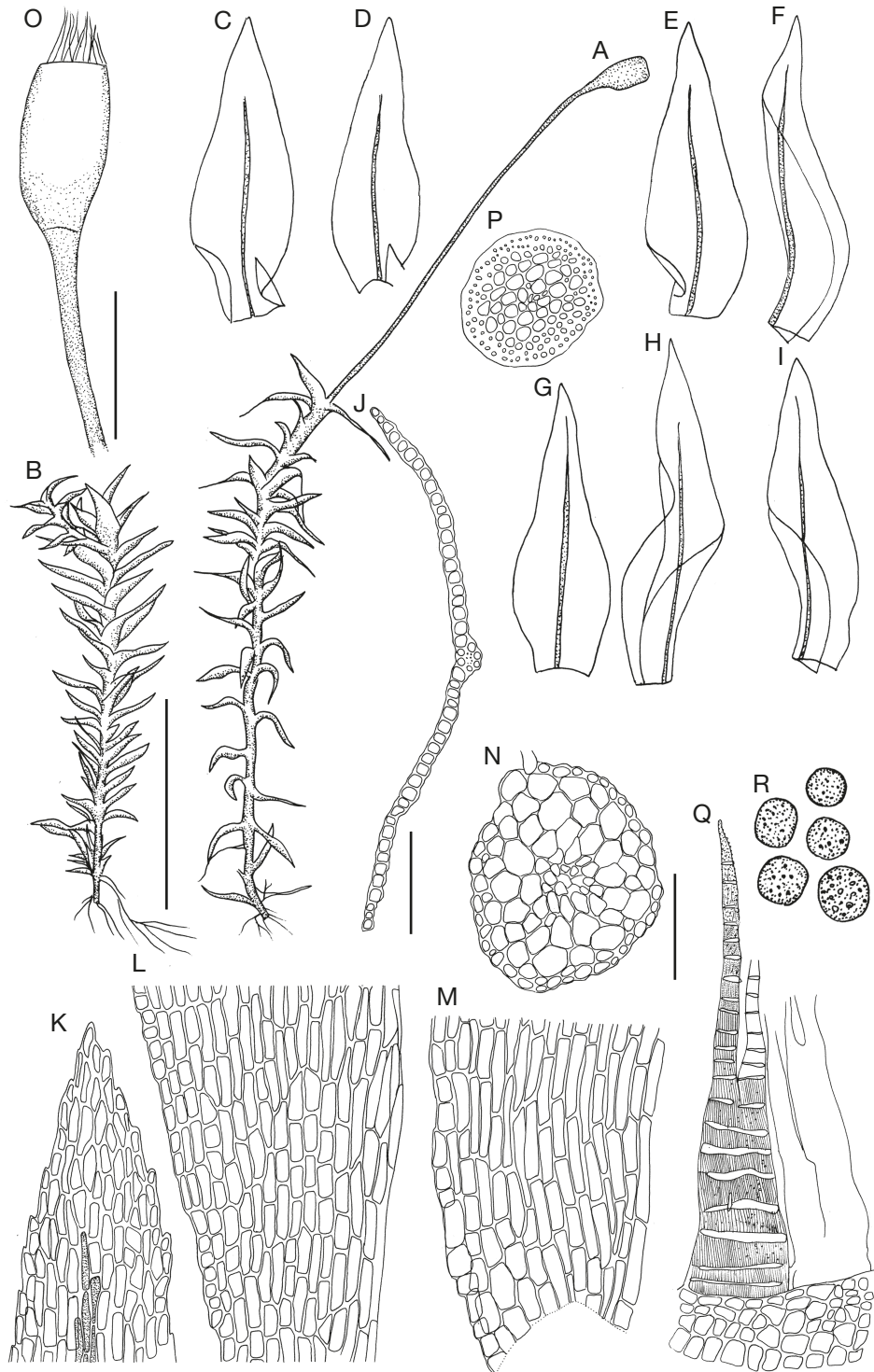


FIG. 4. — Illustration of *Diabelonella mollicula* (Mitt.) Manchi, Darshan & Sushil K. Singh, comb. nov.: A, fertile plant; B, a sterile plant; C–I, leaves; J, cross-section of leaf; K, apical leaf cells; L, median leaf cells; M, basal leaf cells; N, cross section of stem; O, capsules; P, cross section of seta; Q, peristome teeth; R, spores. Scale bars: A, B, 5 mm; C–I, 1 mm; J–Q, 100 µm; R, 50 µm; All are illustrated from Jandial & Shukla UKB867 (BSD).

serrated; leaf cells rectangular to oblong distally, longer toward the base; spores globose, faintly papillose, 15 µm in diameter. Gangulee (1971) once again studied the same type and according to him the plant is about 3.6 mm long and wide; leaves squarrose to patent,

apex acute and broader sheathing concave base, margins dentate distally, costa vanishing below tip; leaf cells rectangular, apical cells $25 \times 8 \mu\text{m}$, basal cells $56 \times 22 \mu\text{m}$; seta terminal, 6 mm long, capsule oval, $1.1 \times 0.47 \text{ mm}$, peristome teeth dicranate. He followed the

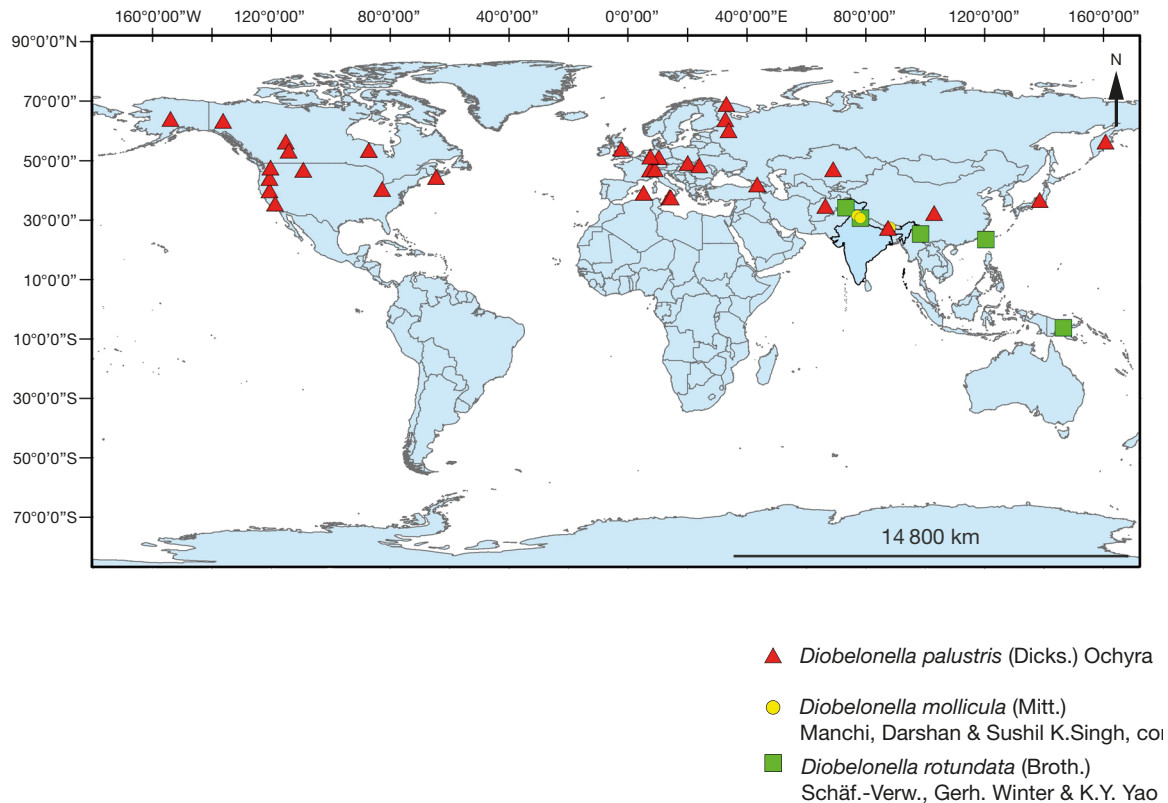


FIG. 5. — Map showing distribution of genus *Diobelonella* Ochyra in the world.

KEY TO THE SPECIES OF *DIOBELONELLA* OCHYRA

1. Leaf apex acute *D. mollicula* Manchi, Darshan & Sushil K.Singh, comb. nov.
— Leaf apex broadly acute to obtuse 2
2. Leaves ovate-lanceolate, leaf margins crenulate *D. palustris* (Dicks.) Ochyra
— Leaves lingulate to oblong-ovate, leaf margins serrate
..... *D. rotundata* (Broth.) Schäf.-Verw., Gerh. Winter & K.Y.Yao.

nomenclature of Brotherus (1924). Subsequent researchers in India (Lal 2005; Sahu & Asthana 2022) adopted the same approach as Gangulee, treating it as *Anisothecium molliculum*.

DESCRIPTION

Plants light green, erect, in loose tufts, 1-1.5 cm long, 2.2-3 mm wide, sometimes branched. Stem erect, cortical cells in one-two layers, ovate, thick-walled; medullary cells in two-three layers polygonal, thin-walled; central strand present. Leaves squarrose to erect-spreading, carinate, ovate-lanceolate, broadest in the middle, dentate up to mid leaf with sheathing base, 1.5-1.9 × 0.4-0.57 mm; apex acute, apical cells sub-rectangular to rectangular, 28.5-42.8 × 7.14-10 µm, apical margins serrate with obtuse teeth and with relatively shorter cells, 15.7-21.4 × 10-11.4 µm; median cells rectangular, 39.4-71.8 × 8.45-12.6 µm; basal cells short rectangular, 28.1-64.7 × 14-26.7 µm. Costa sub-percurrent with a cen-

tral stereid band. Sporophyte terminal, seta 0.8-1.2 cm long, erect, isodiametric in cross-section, 125-140 µm; capsule erect, 1-1.04 × 0.51-0.63 mm (excl. operculum); operculum long rostrate; peristome 16 in number, split into two or three filaments, lower part pigmented vertically striped, upper part transparent papillose, 422 × 70 µm. Spores globose, 13.7-15.8 µm in diameter, slightly papillose.

REMARKS

The diagnostic characters of this Himalayan endemic species such as plant morphology, leaf shape and its arrangement, dentation, leaf cell areolation, stereid band, capsule shape and position are similar to the genus *Diobelonella* (see also Table 1). Therefore, the names *Dicranella mollicula* (Mitt.) A.Jaeger, and *Anisothecium molliculum* (including its basionym *Leptotrichum molliculum* Mitt.) are combined here with *Diobelonella* as *D. mollicula* (Mitt.) Manchi, Darshan & Sushil K.Singh, comb. nov.

TABLE 1. — Comparison between *Diobelonella rotundata* (Broth.) Schäf.-Verw., *D. mollicula* (Mitt.) Manchi, Darshan & Sushil K. Singh, comb. nov., and *D. palustris* (Dicks.) Ochyra.

Character	<i>Diobelonella rotundata</i> (Broth.) Schäf.-Verw. (Brotherus (1929); Takaki (1968) and our observations)	<i>Diobelonella mollicula</i> (Mitt.) Manchi, Darshan & Sushil K. Singh, comb. nov. (Gangulee (1971) and our observations)	<i>Diobelonella palustris</i> (Dicks.) Ochyra (Crum (2007) and Müller & Roloff (2021))
Plant length	2-3.5 cm	1-1.5 cm	1-11 cm
Plant width	2.4-3.5 mm	2.2-3 mm	—
Leaf arrangement	Squarrose	Squarrose to erect-spreading	Squarrose
Leaf shape	Lingulate to oblong-ovate	Ovate-lanceolate	Oblong-lanceolate
Leaf size	1.1-1.8 × 0.7-0.9 mm	1.5-1.9 × 0.4-0.6 mm	2.5-3 mm long
Leaf apex shape	Broadly acute to subacute.	Acute	Rounded and cucullate
Leaf margins	Serrate	Serrate	Crenulate
Leaf apical cell size	6-30 × 6-10 µm	15.7-42.8 × 7.1-10 µm	17.1-40 × 7.14-10 µm
Leaf basal cell size	30-70 × 8-14 µm	28.1-64.7 × 14-26.7 µm	30-45.4 × 8.1-9.1 µm
Seta	1 cm long	0.8-1.2 cm long	1-3 cm long
Capsule	Inclined, oblong, 1.3 mm long, 0.6 mm wide	Erect, oval, 1-1.1 × 0.47-0.63 mm	Curved-inclined, 1-1.5 mm long

DISCUSSION

In our understanding, the genus *Diobelonella* is characterized by robust greenish-yellow plants, broadly wavy leaves which are lanceolate to ovate-lanceolate to ligulate, decurrent squarrose, broader sheathing leaf base and upper part of the leaf curving away from the stem, costa ending below apex, distal laminal cells smooth, broadly rectangular to short-rectangular, leaf margins not recurved, crenulate to bluntly dentate, shorter cells serrate, single central stereid band in leaf cross-section. Therefore, we conclude that *Dicranella mollicula* (Mitt.) A. Jaeger agrees very well with genus *Diobelonella* and a combination name is proposed.

Acknowledgements

The authors are thankful to the Director, Botanical Survey of India, Kolkata and Head of Office, Botanical Survey of India, Northern Regional Centre, Dehradun for facilities and encouragement. Two of us (Manchi & Darshan) are also thankful to the Director, BSI Kolkata for financial assistance under the Flora of India project. The authors also thank the reviewers and the editor-in-chief for their valuable work during the revision of the manuscript.

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*Submitted on 8 November 2025;
accepted on February 2026;
published on 5 October 2026.*