

## CONTRIBUTION TO THE LIVERWORTS OF GOBIND NATIONAL PARK, UTTARANCHAL, INDIA.

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### ABSTRACT

The paper presents the result of a morphotaxonomic study on the liverworts of Gobind National Park in North-west Himalaya. A total of nine species, viz. *Plagiochila asplenoides* (L.) Dum. (Plagiochilaceae), *Porella campylophylla* var. *ligulifera* (Tayl.) Hatt. (Porellaceae), *Porella hattorii* Udar & Shaheen (Porellaceae), *Pellia endivaefolia* (Dicks.) Dum. (Pelliaceae), *Metzgeria hamata* Lindenb. (Metzgeriaceae), *Targionia indica* Udar & Gupta (Targioniaceae), *Conocephalum conicum* (L.) Dum. (Conocephallaceae), *Reboulia hemisphaerica* (L.) Raddi (Rebouliaaceae), and *Dumortiera hirsuta* (Sw.) Reinw., Blume & Nees (Marchantiaceae) have been described in present communication. This constitutes first record of liverworts from this National Park, situated in Uttarkashi district of newly created state of Uttaranchal.

### INTRODUCTION

Beginning with the listing of 55 species of liverworts from Mussoorie by Royle (1839; see also Udar, 1976), the taxonomy and floristics of West Himalayan liverworts, as reviewed from time to time (Pande, 1936, 1958; Udar, 1976; Srivastava, 1994; Singh, 1997), have received considerable attention in Indian Bryology. In fact this is the only bryogeographical region of India for which a floristic account of liverworts is available (Kashyap, 1929, 1932). Still no baseline information is available on the liverwort flora of Protected Area Network in this region, comprising 12 National Parks and 53 Wildlife Sanctuaries, except some scattered reports (Udar & al, 1982; Udar & Kumar, 1984; Srivastava, 1986; Kumar, 1987; Sharma & Srivastava, 1993; Srivastava & Dixit, 1994; Narayan & al., 2001; Srivastava & Srivastava, 2002). Recently, during a People's Biodiversity Register awareness campaign in the Gobind National Park in Uttarkashi district of Uttaranchal state, one of us (DKS) collected some specimens from the area. After careful morphotaxonomic studies, these have been identified and reported here for the

first time from this protected area in the Western Himalaya, which spans over an area of about 953 km<sup>2</sup> between 1300-6230 m altitude.

The families in the text have been arranged as per the System of classification proposed by Schuster (1984), whereas the genera and species within a family are arranged alphabetically. All the specimens have been deposited in Cryptogamic Section of the herbarium of Botanical Survey of India, Northern Circle, Dehra Dun (BSD).

#### GENERALISED SYNOPSIS OF THE LIVERWORTS

- 1a. Plants body foliaceous, differentiated  
into stem and leaves ... 2
- 1b. Plants body thalloid, not differentiated  
into stem and leaves ... 4
- 2a. Leaf succubous, underleaves absent. Stem  
14-17 cells in cross section; cortical cells  
in 3-4 layers with thickened, pale brown  
walls, medullary cells thin walled; leaves,  
transversely inserted, quadrate-ovate or  
sub-orbicular with 17-29 small regular  
teeth along the margin; teeth 2-5 cells  
long and 2-4 cells wide at base ... 1. *Plagiochila asplenoides*
- 2b. Leaf incubous, underleaves present ... 3
- 3a. Leaf lobe triangular-ovate, margin with  
6-10 sharp teeth; teeth 3-7 cells long,  
2-4 cells wide at base, apex acute to  
acuminate, ventral margin recurved and  
prominently arched at the base near keel;  
lobules lanceolate, canaliculate, base long  
decurrent, apex obtuse or rounded; under  
leaves oblong-ovate, sometimes triangular,  
apex obtuse to truncate with 2-4 teeth,  
margin recurved longly  
decurrent ... 2. *Porella campylophylla* var. *ligulifera*

- 3b. Leaf lobe oblong-ovate, margin entire or with 2-3 teeth at apex, apex acute; lobules lanceolate, small, apex ligulate, entire, shortly decurrent; underleaves triangular, apex truncate or shallowly bilobed, base broad and short decurrent, entire  
... 3. *Porella hattorii*
- 4a. Thallus not differentiated into assimilatory and storage zones; dorsal pore and ventral scales absent  
... 5
- 4b. Thallus usually differentiated into assimilatory and storage zones; dorsal pore and ventral scales present  
... 6
- 5a. Thallus broad, obcordate, multistratose, up to 12 cells thick in middle, unistratose towards margin; margin undulate; fibrous band or thickenings absent in between cells  
... 4. *Pellia endiviaefolia*
- 5b. Thallus linear-oblong, winged, unistratose except costa; wings ending in unicellular long, hooked, paired hairs; hairs also present on ventral surface of costa; epidermal cells of costa 2/2, large, inner cells 16-21 in 3-5 layers  
... 5. *Metzgeria hamata*
- 6a. Air chambers and pores well developed; ventral scales conspicuous  
... 7
- 6b. Air chambers and pores usually absent; ventral scales vestigial. Thallus flat, dark green, semi-translucent, repeatedly dichotomously branched, margin undulate, apex notched  
... 9. *Dumortiera hirsuta*
- 7a. Air chambers single layered  
... 8

- 7b. Air chambers multilayered, obliquely septate. Thallus yellowish green, obcordate, deeply notched, margin purple, ascending, wavy; epidermal cells 5-6 angled; dorsal pores simple or semi barrel shaped, elevated over the surface, opening surrounded by 4 concentric ring of 7 cells each; ventral scales purple, imbricate, obliquely lunate, with 1-2 parallel linear appendages

... 8. *Reboulia hemisphaerica*

- 8a. Thallus small, up to 18 mm long and 5 mm broad, obovate, yellowish green; dorsal pores elliptical, with 4-5 concentric rings of 6-8 cells each (outer most sometimes up to 20 cells); assimilatory filaments 2-4 cells high; involucre naviculate, situated ventrally at apex; spores yellowish to deep brown, spherical  $43.2-56.6\ \mu\text{m}$ , sporoderm with double reticulations on distal surface, lamellate on proximal surface; elaters bispiral,  $186-206 \times 6.6-9.9\ \mu\text{m}$

... 6. *Targionia indica*

- 8b. Thallus large, up to 75 mm long and 12 mm broad; dorsal pores large, with 5-6 concentric rings of 6-8 cells each; assimilatory filaments 1-3 cells high; ventral scales purple, lunate, with rounded to sub-orbicular appendages

... 7. *Conocephalum conicum*

## ENUMERATION

### PLAGIOCHILACEAE

1. ***Plagiochila asplenioides*** (L.) Dum., Rec.D' dos., 14. 1635. *Jungermannia asplenioides* L., Sp. Pl. 1131. 1753.

Fig.I (1-9)

Plants yellowish green to dull green, 25-55 mm long, 3-6 mm broad; stem

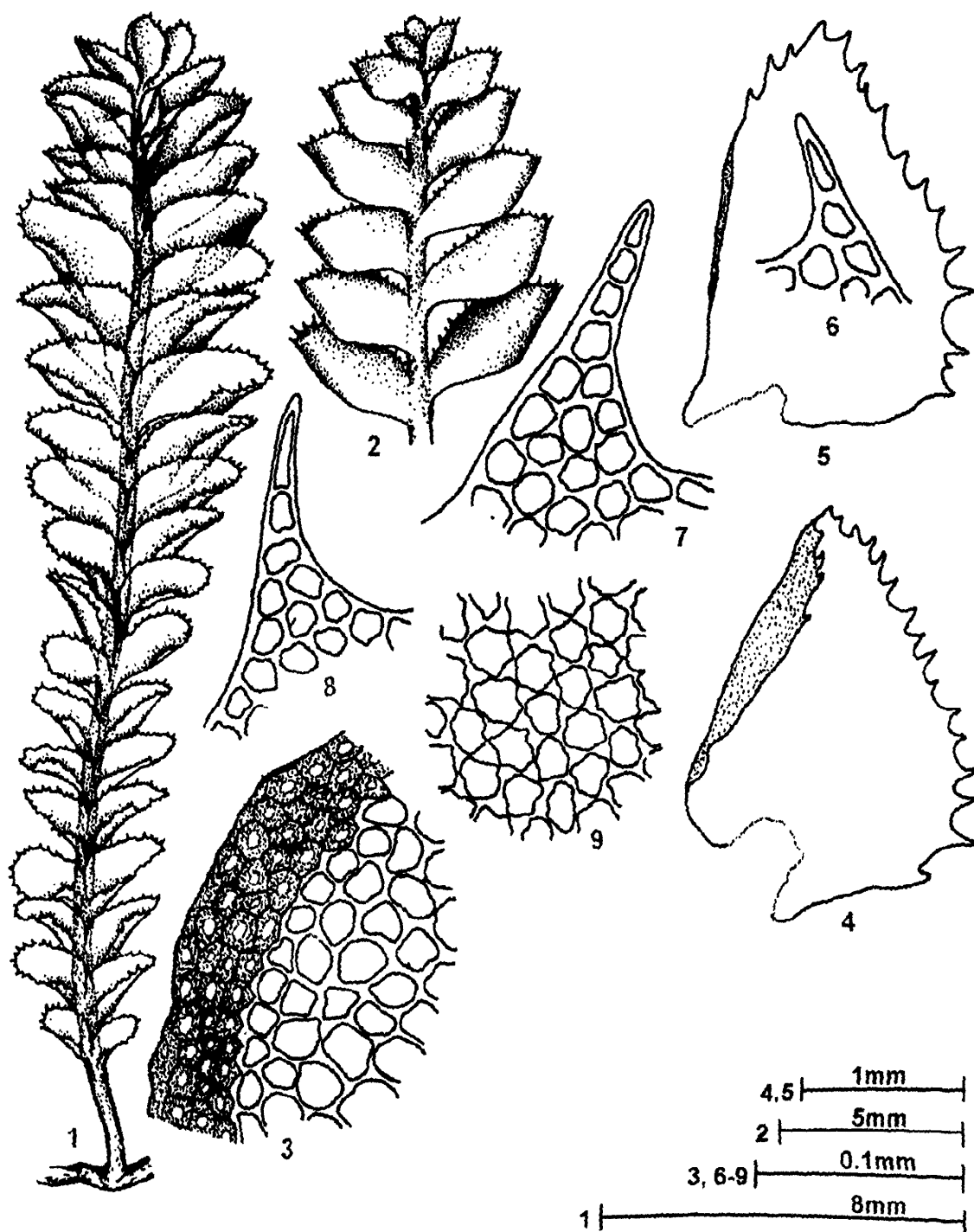


Fig 1.(1-9) : *Plagiochila asplenioides* (L.) Dum. 1. A portion of plant (ventral view); 2. The same (dorsal view); 3. T.S. stem (a portion); 4, 5. Leaves; 6-8. Marginal teeth of leaves; 9. Median cells of leaf.

brown, 14-17 cells in cross section, cortical cells in 3-4 layers with thickened walls, medullary cells thin walled, trigones absent. Leaves succubous, transversely inserted to the stem, quadrate-ovate to sub-orbicular, 2-2.7 mm long, 1.6-2.1 mm wide, loosely to closely imbricate, margin typically with 17-29 small regular teeth, terminal cells of teeth generally longer than width; teeth 2-5 cells long, 2-4 cells wide at base; marginal cells  $19.9-26.0 \times 13.3-16.6 \mu\text{m}$ ; median cells  $23.3-29.9 \times 16.6-23.3 \mu\text{m}$ ; basal cells slightly elongated,  $49.9-76.5 \times 9.9-19.9 \mu\text{m}$ , thin walled, trigones medium to large, acute or nodulose; leaf lobule absent. Underleaves absent.

*Specimens examined* : Epiphytic, grows on bark of trees in shaded places in association with *Claopodium prionophyllum* and *Metzgeria hamata*. Taluka, Uttarkashi (alt. 2200 m), 18th June 2001, D.K. Singh 98549-a (BSD).

*Distribution* : India : Jammu & Kashmir, Uttaranchal. North Asia, Japan, North America and Europe.

## PORELLACEAE

**2. *Porella campylophylla* var. *ligulifera* (Tayl.) Hatt.** in J. Hattori Bot. Lab. 32: 333. 1969. *Madotheca ligulifera* Tayl. in Lehm. Pugill. 8: 10. 1844.

Fig.II (1-11)

Plants brownish green (younger region light green), 35-75 mm long, 3-4 mm wide; stem bipinnately branched, dark brown, cylindrical, 0.26 mm in diameter in cross section; cortical cells smaller in 2-4 rows, cells thick walled,  $11.4-19.15 \times 7.6-26.8 \mu\text{m}$ ; medullary cells thin walled, hexagonal,  $15.0-34.4 \times 15.0-30.6 \mu\text{m}$ ; slightly trigonous. Leaves densely imbricate, incubous, lobes triangular-ovate, 1.64-1.98 mm long, 1.36-1.47 mm wide; apex acute to acuminate, margin with 6-10 sharp teeth; teeth 3-7 cells long, 2-4 cells wide at the base; ventral margin recurved, prominently arched at base near keel; marginal cells  $15.0-26.8 \times 11.0-19.0 \mu\text{m}$ ; median cells  $19.0-30.7 \times 11.4-23.0 \mu\text{m}$ ; basal cells  $34.4-53.6 \times 15.3-26.8 \mu\text{m}$ ; trigones well developed; lobules lanceolate, canaliculate, 0.68-0.75 mm long, 0.26-0.39 mm broad, base long decurrent, apex obtuse or rounded. Underleaves oblong-ovate, sometimes triangular, 0.66-0.90 mm wide, apex truncate or shallowly bilobed, longly decurrent, margin entire.

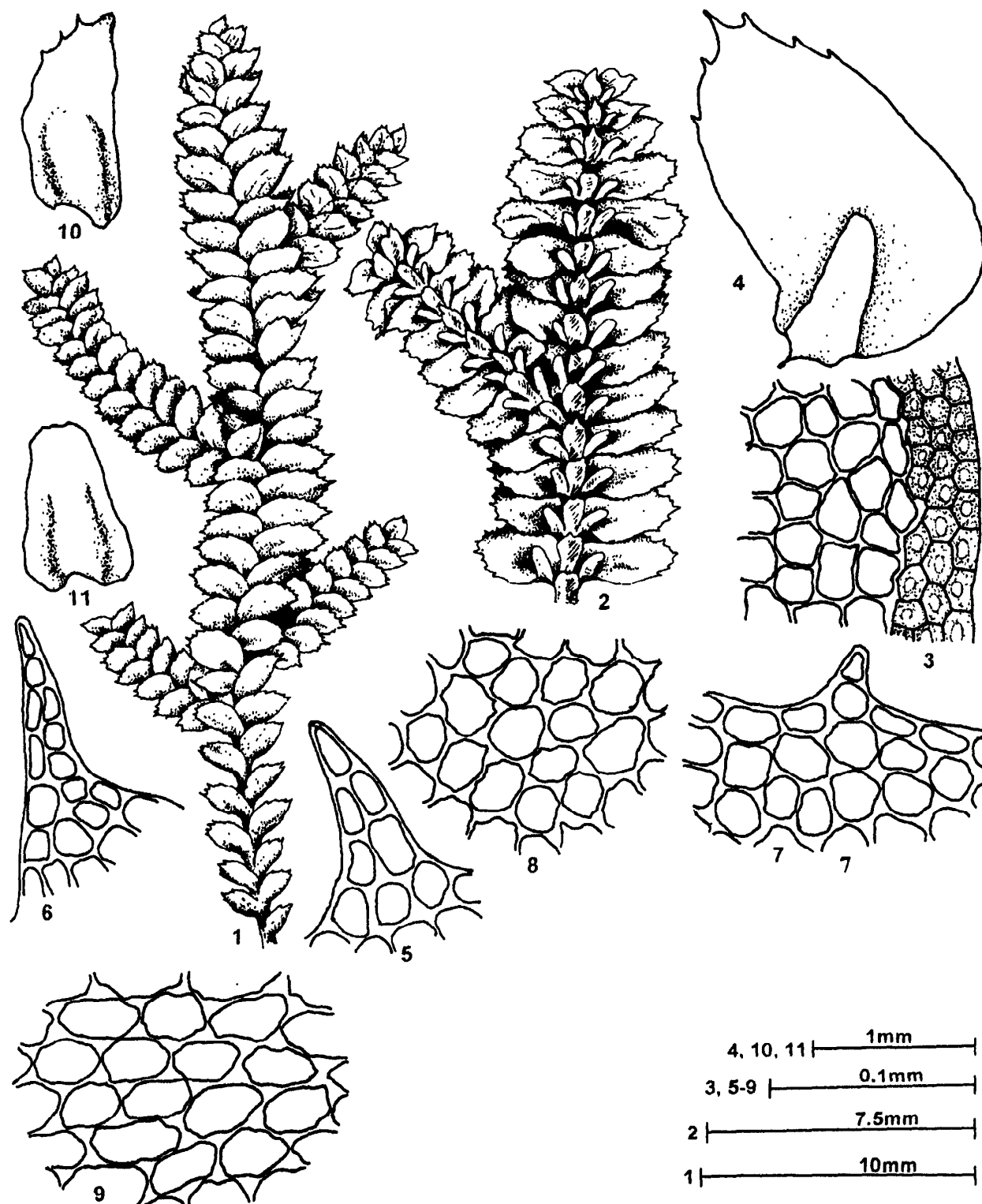


Fig.II (1-11) : *Porella campylophylla* var. *ligulifera* (Tayl.) Hatt. 1. A portion of plant (dorsal view); 2. The same (ventral view); 3. T.S. stem (a portion); 4. A leaf lobe with lobule; 5, 6. Marginal teeth of leaves; 7. Marginal cells of leaf lobe towards apex; 8. Median cells of leaf lobe; 9. Basal cells of leaf lobe. 10, 11. Underleaves.

*Specimens examined* : Epiphytic, grows on bark of the trees towards base in association with *Regmatodon orthostegius* and *Timmia megapolitana*. Taluka, Uttarkashi (alt. 2200 m), 18th June 2001, *D. K. Singh* 98550-a, 98555-a (BSD).

*Distribution*: India : Uttaranchal, Sikkim, Arunachal Pradesh, Meghalaya. Nepal, Thailand.

### 3. *Porella hattorii* Udar & Shaheen in Lindbergia 9: 70. 1983.

Fig.III (1-9)

Plants yellowish brown to light green, 30-49 mm long, 3.0-4.5 mm wide; stem bipinnately branched, dark brown, cylindrical, 0.3 mm in diameter, in cross section; cortical cells smaller, in 3-5 rows, cells thick walled,  $16.0-23.0 \times 9.0-19.0 \mu\text{m}$ ; medullary cells thin walled, penta - hexagonal, in 11-15 rows across the stem,  $26.0-36.0 \times 13.0-23.0 \mu\text{m}$ . Leaves incubous, imbricate, oblong, very rarely ovate, 1.06-1.6 mm long, 0.75-1.06 mm wide, margin entire or 2-toothed, apex acute; marginal cells  $19.0-30.6 \times 15.0-23.0 \mu\text{m}$ ; median cells  $30.0-42.0 \times 11.4-23.0 \mu\text{m}$ , trigonous; basal cells  $30.6-49.0 \times 15.3-30.6 \mu\text{m}$ , trigones well developed; lobules lanceolate, smaller than underleaves, 0.41-0.61 mm long, 0.17-0.27 mm broad; apex ligulate, entire, base broad and shortly decurrent. Underleaves triangular, 0.44-0.89 mm long, 0.30-0.55 mm wide, apex truncate to shallowly bilobed, shortly decurrent, margin entire.

*Specimens examined* : Epiphytic, grows on bark of trees. Osla, Uttarkashi (alt. 2700 m), 19th June 2001, *D.K. Singh* 98547-a, 98554-b (BSD).

*Distribution* : India : Uttaranchal, Meghalaya. Endemic.

## PELLIACEAE

### 4. *Pellia endiviaefolia* (Dicks.) Dum., Rec. d'Obs. Jungern. 27. 1835. *Jungermannia endiviaefolia* Dicks. in Fl. Crypt. 4 : 19. 1801.

Fig.IV (1-3)

Thallus deep green, 16-20 mm long, 4-9 mm broad, overlapping each other



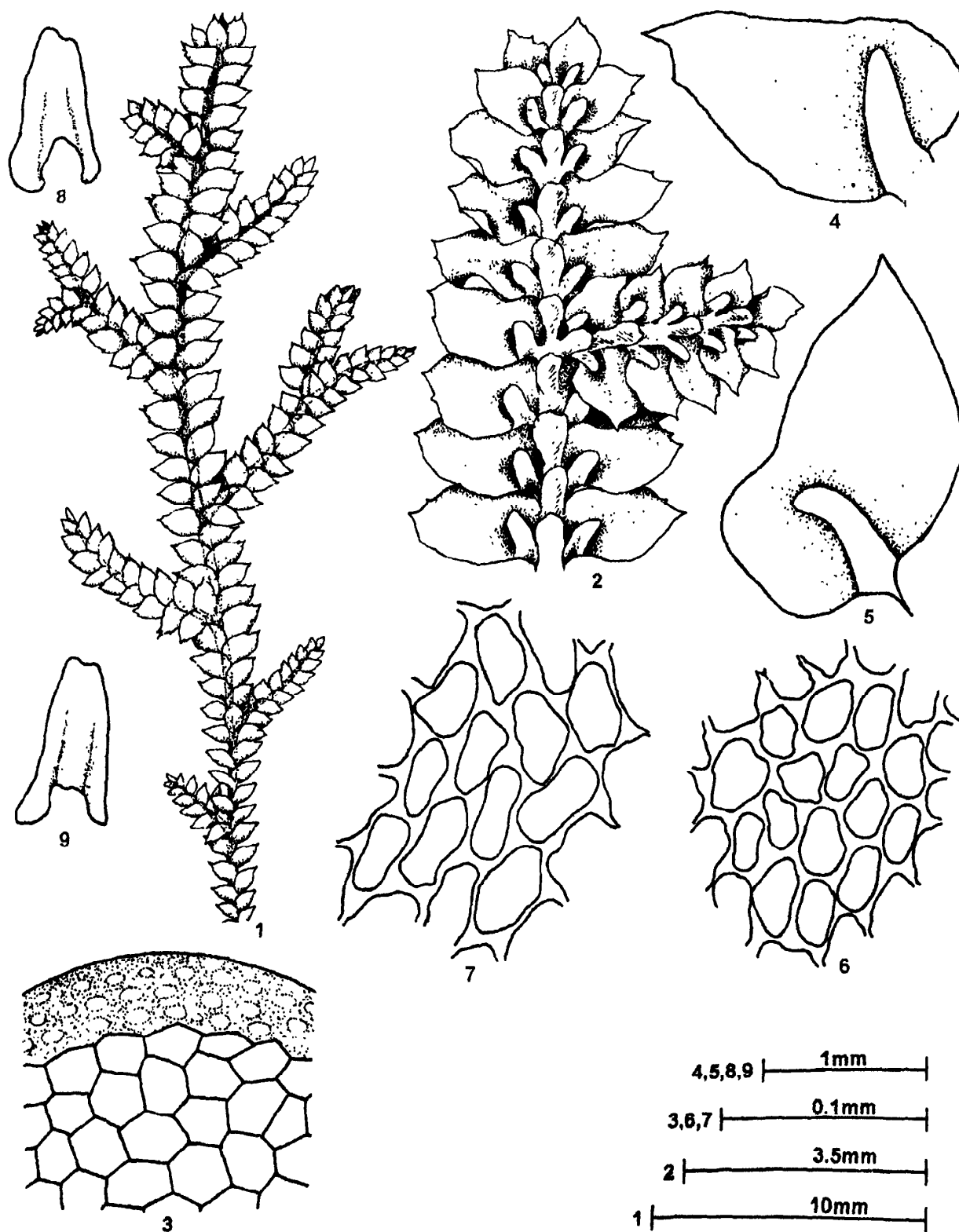


Fig.III (1-9) : *Porella hattorii* Udar & Shaheen. 1. A portion of plant (dorsal view); 2. The same (ventral view); 3. T.S. stem (a portion); 4, 5. Leaf lobes with lobules; 6. Median cells of leaf lobe; 7. Basal cells of leaf lobe; 8, 9. Underleaves.

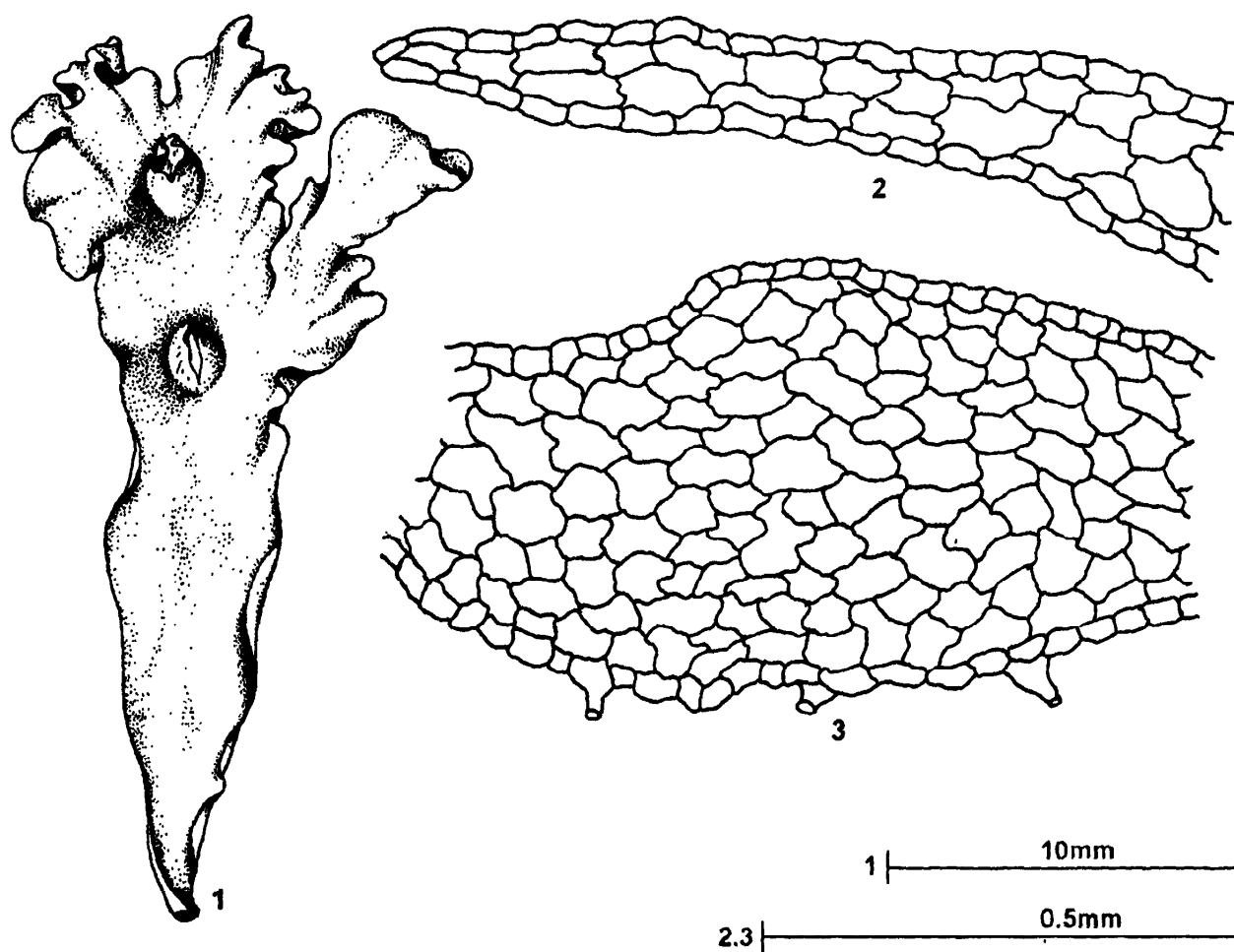


Fig.IV (1-3) : *Pellia endiviaefolia* (Dicks.) Dum. 1. A portion of thallus (dorsal view); 2, 3. T.S. of thallus.

in patches, thin, flat, dichotomously branched, obcordate to oblong linear, margin dissected, apex slightly notched; pores absent; midrib conspicuous, slightly projecting ventrally, gradually passing into many-celled lamina ending into one cell thick margin, 12 cells thick in middle, fibrous thickening absent in between the cells; cells parenchymatous, polyhedral, uniformly joined together in honey-comb like manner; cells of epidermis smaller than other cells of the thallus; ventral portion bears only smooth walled rhizoids; tuberculate rhizoids and scales absent.

*Specimens examined* : Terrestrial, grows in moist, shady places in association with *Hypnum cupressiforme*. Har-ki-dun, Uttarkashi (alt. 2700 m), 19th June 2001, D.K. Singh 98556 (BSD).

*Distribution* : India : Jammu & Kashmir, Himachal Pradesh, Uttaranchal, West Bengal, Sikkim. Pakistan, China, Africa, Europe and North America.

#### METZGERIACEAE

**5. Metzgeria hamata** Lindenb., Acta Soc. Fauna Fl. Fennica 1: 25. 1877.

Fig.V (1-4)

Thallus up to 50 mm long, 16 mm wide, ribbon shaped, dichotomously branched, apex obtuse, margin incurved, sometimes forming a tubular structure; wing dorsally convex, 18-21 cells wide on either side of the midrib; marginal cells  $20.0-56.6 \times 20.0-26.8 \mu\text{m}$ ; middle cells  $26.8-56.6 \times 26.8-40.2 \mu\text{m}$ , cells polygonal, thin walled, without distinct trigones; hairs long, single-celled, curved, scattered on ventral surface of the midrib, disposed in pairs at margin; midrib convex below, epidermal cells 2/2, inner cells small, 18-21 in 3-5 layers; scales absent.

*Specimens examined* : Epiphytic, grows on the bark of trees in shaded places, in association with *Plagiochila asplenioides* and *Claopodium prionophyllum*. Taluka, Uttarkashi (alt. 2200 m), 18th June 2001, D.K. Singh 98549-c (BSD).

*Distribution* : India : Himachal Pradesh, Uttaranchal, Sikkim, West Bengal. Indonesia, New Guinea.

#### TARGIONIACEAE

**6. Targionia indica** Udar & Gupta in Geophytology 13 (1) : 83. 1983.

Fig.VI (1-10)

Thallus yellowish green to dark green, small, up to 18 mm long, 5 mm wide, obovate, ventral and lateral innovation common, margin entire, apex notched with few whitish scales raised over the apical notch; ventral scales stiff in one row on either side of mid rib, appendaged, appendages round, sometimes ovate-subovate, margin irregular with mucilage papillae and extended scale cells; upper surface of thallus with distinct air chambers; air chamber single layered, assimilatory filaments 2-4 cells high; dorsal pores elevated, elliptical, rarely rounded, enclosed by 4-5 concentric rings of 6-8 cells each (outermost sometimes up to 20 cells).

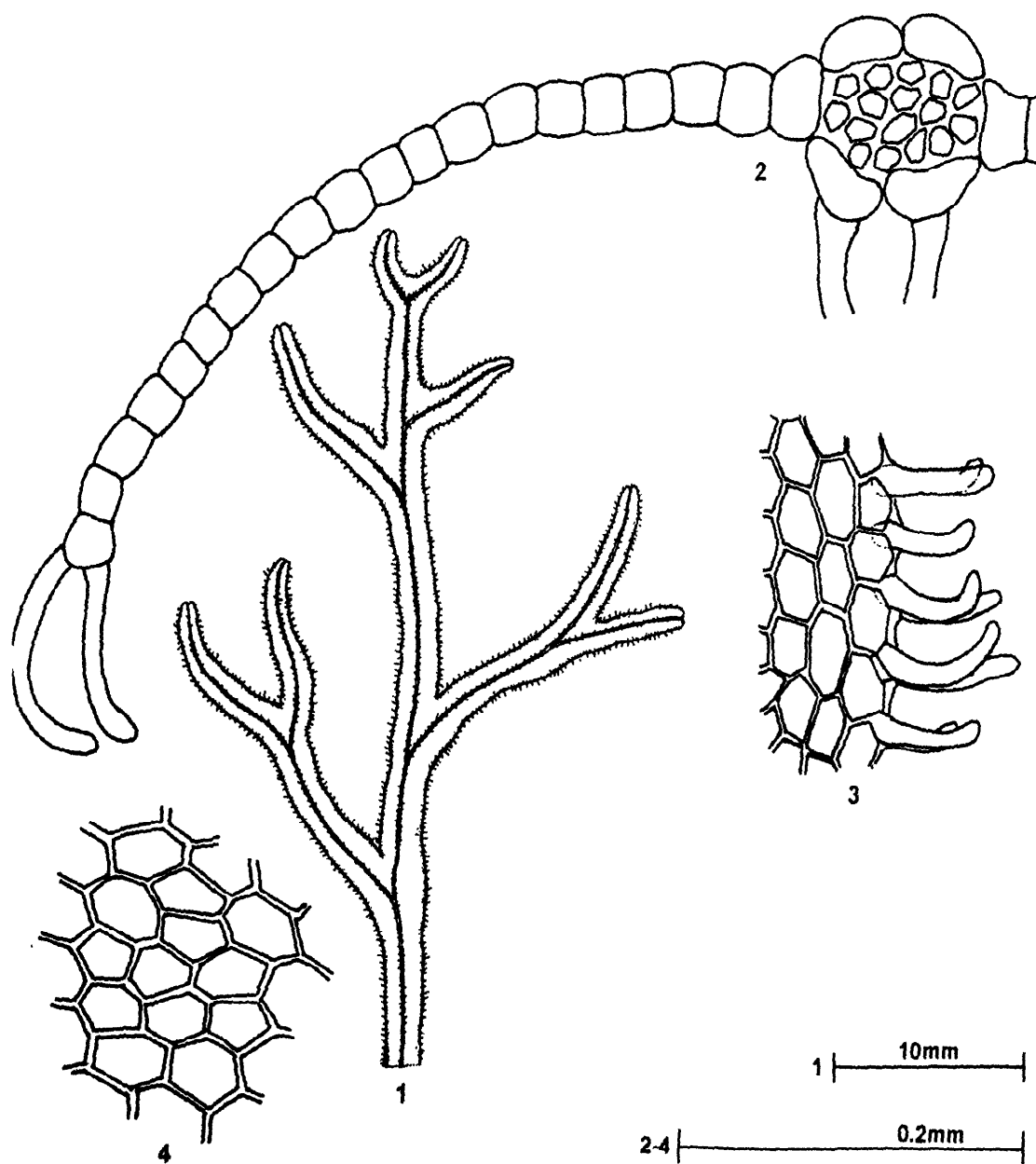


Fig. V (1-4) : *Metzgeria hamata* Lindenb. 1. A thallus (ventral view); 2. T.S. of thallus; 3. Marginal cells of wing; 4. Median cells of wing.

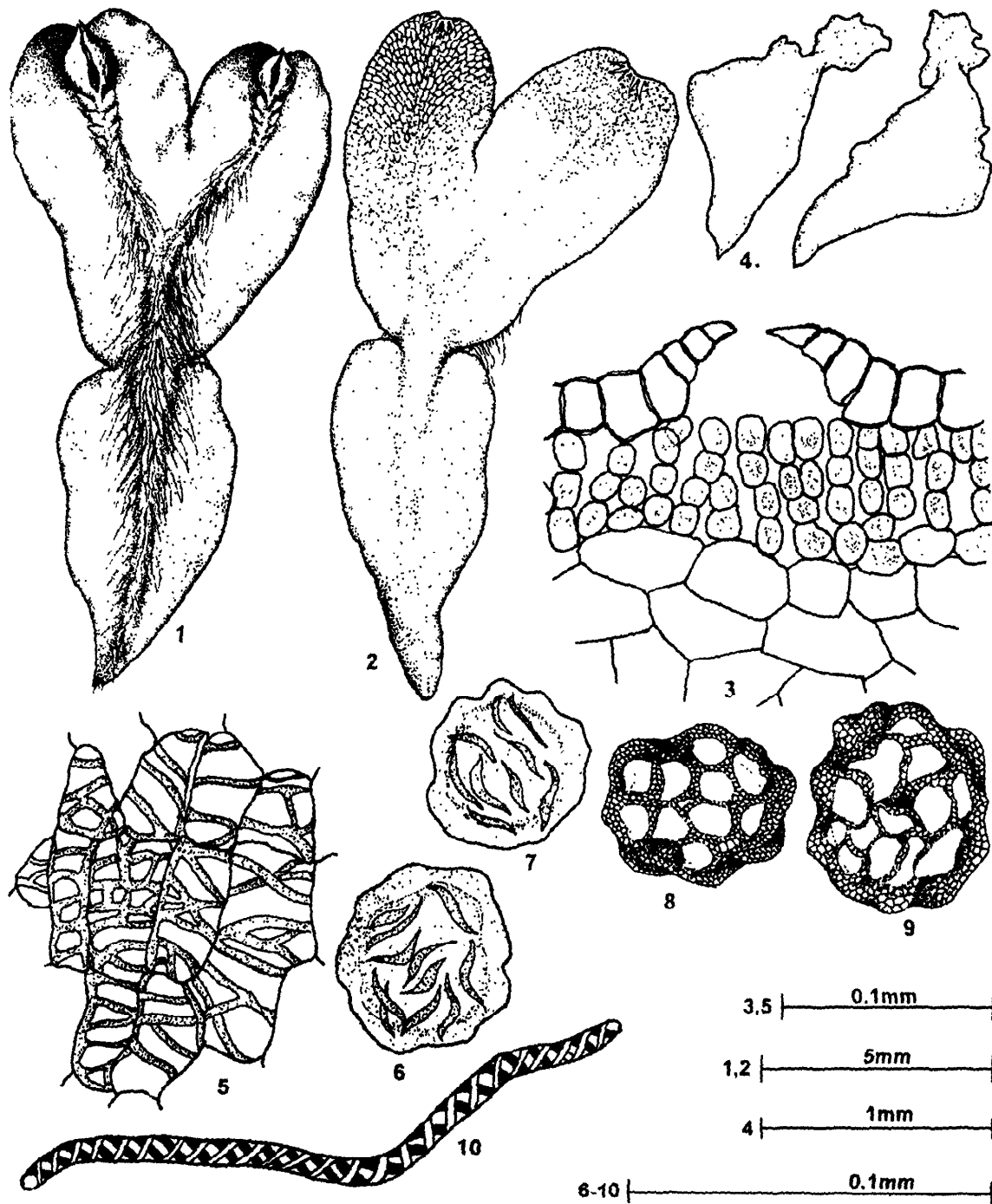


Fig. VI (1-10) : *Targionia indica* Udar & Gupta 1. Thallus in ventral view showing bivalved involucre; 2. The same (dorsal view); 3. T.S. of thallus (a portion); 4. Ventral scales; 5. Capsule wall (a portion); 6, 7. Spores in proximal view; 8, 9. The same in distal view; 10. Elaters.

Mature sporophytes situated ventrally; involucre naviculate, bi-valved, lid not clearly demarcated; cells of capsule walls show thickening band throughout; spores deep brown, spherical, 43.2-56.6  $\mu\text{m}$  in diameter, reticulate on distal face, lamellate on proximal face; elaters with bispiral thickening bands, 186-206  $\mu\text{m}$  long 9.9-13.3  $\mu\text{m}$  broad.

*Specimens examined* : Terrestrial, grows on thick moist soil in considerably exposed places in association with *Plagiothecium neckeroideum*, *Atrichum undulatum* var. *hausknechtii*, *Pohlia gedeanae*, *Timmia megapolitana*. Taluka, Uttarkashi (alt. 2200 m), 18th June 2001, D. K. Singh 98551, 98553-a (BSD).

*Distribution* : India : Uttaranchal, Madhya Pradesh, Maharashtra. Endemic.

#### CONOCEPHALACEAE

7. **Conocephalum conicum** (L.) Dum., Comm. Bot. : 115. 1822. *Marchantia conica* L., Sp. Pl. 1138. 1753.

Fig.VII (1-5)

Thallus large, light green, up to 75 mm long, 12 mm wide, oblong to linear, apical innovation common, lobe apex emarginate, margin wavy; long pointed beak of terminal cells of filament forming the floor of the air chamber below simple pores; air chamber single-layered, filaments 1-3 cells high; pores large, show star shaped appearance in surface view, simple, elevated over the epidermal surface, with 5-6 concentric rings of 6-8 cells each; midrib conspicuous ventral scale in one row on each side of the midrib, purple, lunate with rounded to suborbicular appendages.

*Specimens examined* : Terrestrial, grows on thin soil layer over rocks in association with *Hypnum cupressiforme*. Taluka, Uttarkashi (alt. 2200 m), 18th June 2001, D.K. Singh 98548 (BSD).

*Distribution* : India : Jammu & Kashmir, Himachal Pradesh, Uttaranchal, West Bengal. Bhutan, Nepal, Pakistan, Africa, Europe, U.S.A., C.I.S., Japan, China and Korea.

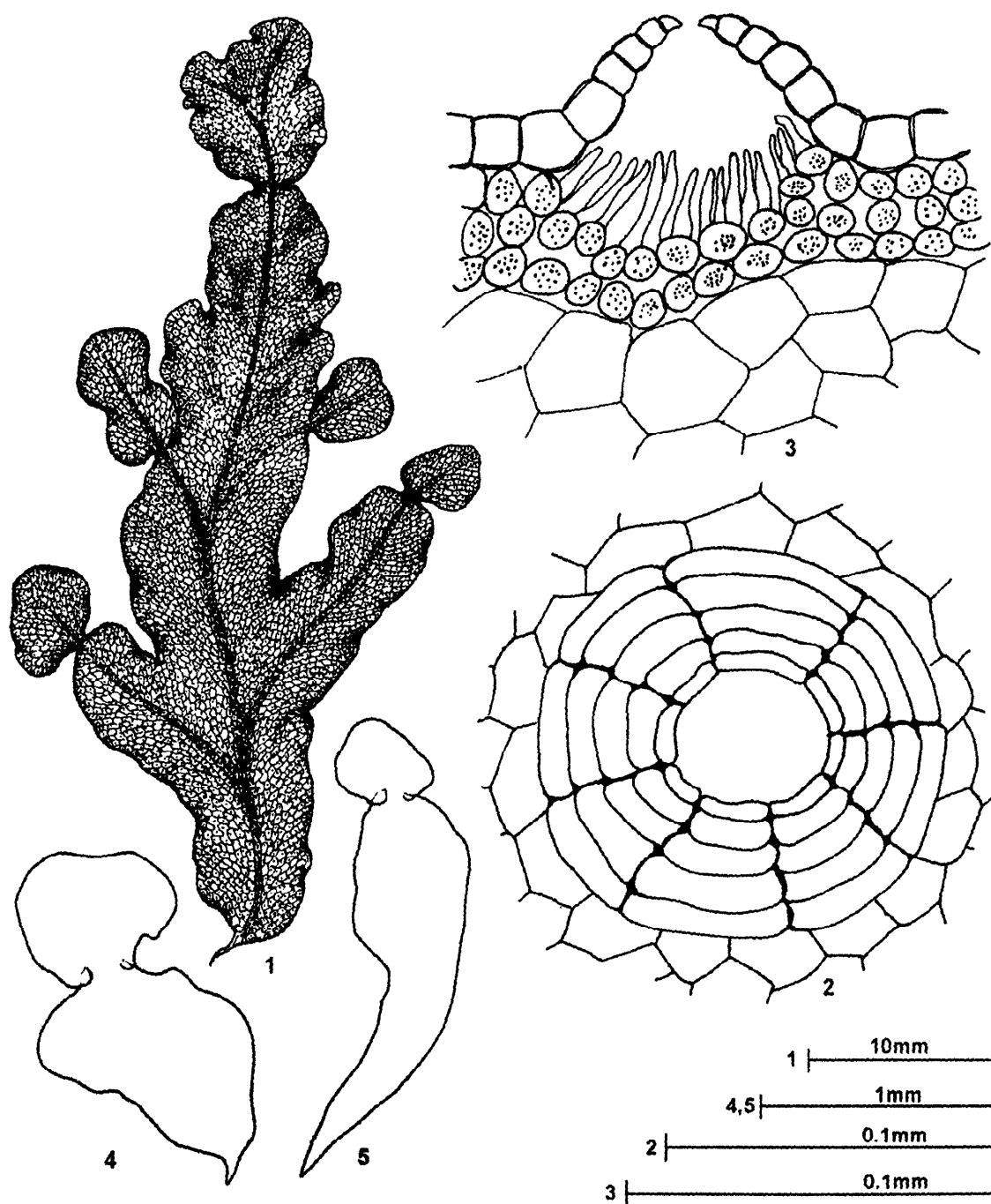


Fig. VII (1-5) : *Conocephalum conicum* (L.) Dum. 1. Thallus (dorsal view); 2. Pores (surface view); 3. T.S. of thallus (a portion); 4, 5. Ventral scales.

## REBOULIACEAE

8. **Reboulia hemisphaerica** (L.) Raddi, Opusc. Scient. di Bologna II : 357. 1818.  
*Marchantia hemisphaerica* L., Sp. Pl., 1138. 1753.

Fig.VIII (1-6)

Thallus yellowish green to dark green, 6-20 mm long, 4-8 mm wide; obcordate, margin violet, ascending, crenulate; apex deeply notched; upper epidermal cells 5-6 angled, thin walled or slightly thickened; epidermal pore simple or semi-barrel shaped, elevated over the surface, opening surrounded by 4 concentric rings of 7 cells each, walls radiate, radial wall thickened; air chambers obliquely septate, 4-5 layered in median part of the thallus, tissues in lower portion of thallus narrow and absent below the wings; ventral surface purple; scales purple, large, imbricate, obliquely lunate, appendiculate, appendage 1-2, parallel, linear, acute. Dioecious; male receptacle not seen. Female receptacle hemispherical, situated near the apical notch, 4-5 lobed; stalk 5-7 mm long, apex and base scaly; scales red or pink, pointed at apex.

*Specimens examined* : Terrestrial, grows on rocks in partially exposed places, in association with *Targionia indica*. Har-ki-dun, Uttarkashi (alt. 2700 m), 19th June 2001, D.K. Singh 98554 (BSD).

*Distribution* : India : Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Uttar Pradesh, West Bengal, Rajasthan, Madhya Pradesh, Tamil Nadu. Bhutan, Nepal, Afganistan, Pakistan, China, Japan, Australia, U.S.A., Europe and Africa.

## MARCHANTIACEAE

9. **Dumortiera hirsuta** (Sw.) Reinw., Blume. & Nees, Nova Act. Leop. Carol. VII: 410.1824. *Marchantia hirsuta* Sw., Prodr. Fl. Ind. Occid. 145. 1788.

Fig.IX (1-4)

Thallus flat, yellowish to dark green, semi-translucent, repeatedly dichotomously branched, large, 30-60 mm long, 7-12 mm wide, apex notched, margin undulate; midrib prominent; epidermal cells 4-6 angled, thin walled; air



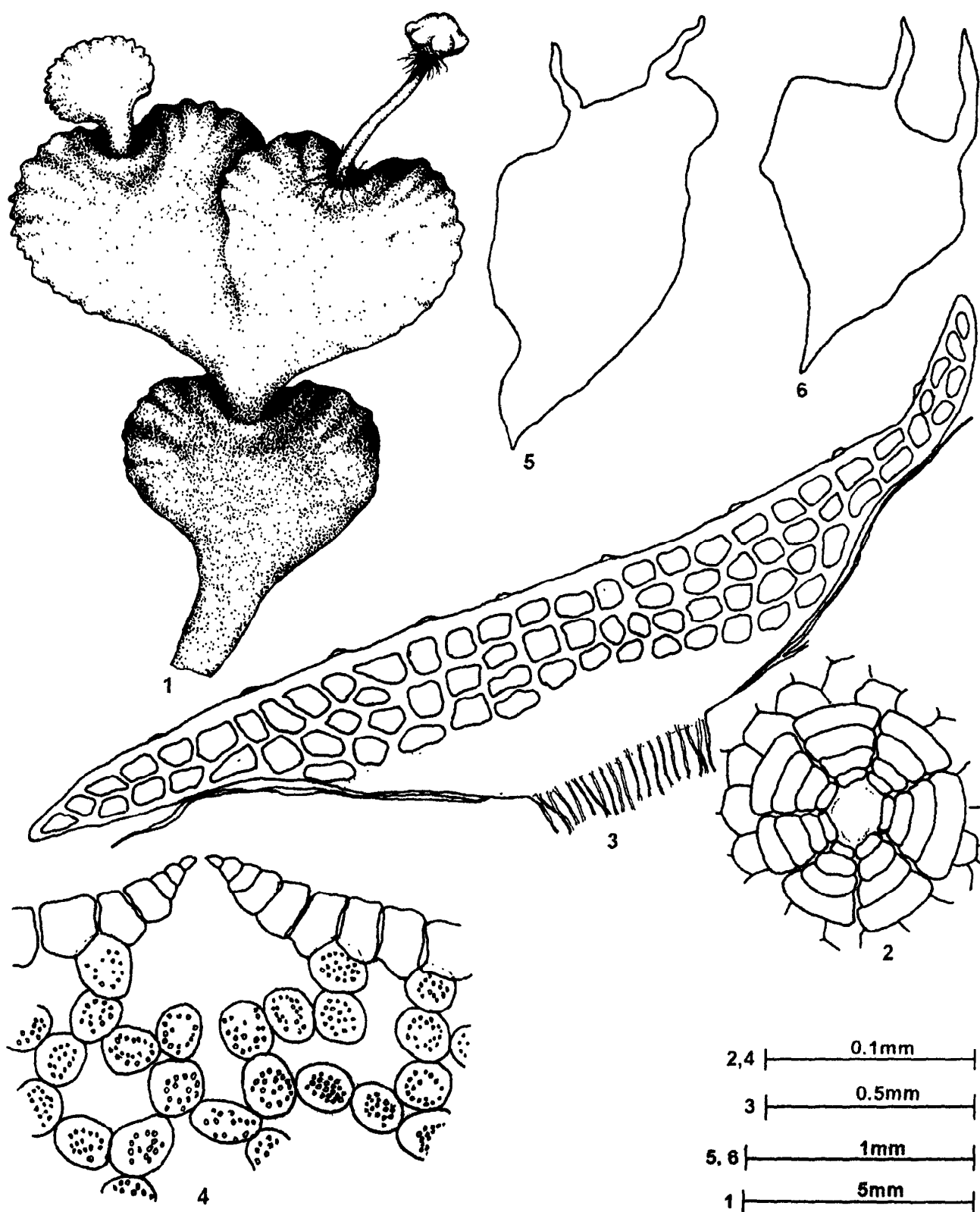


Fig.VIII (1-6) : *Reboulia hemisphaerica* (L.) Raddi 1. Thallus showing archegoniophore (dorsal view); 2. Pore in surface view; 3. T.S. of thallus (semidiagrammatic); 4. A part of the same enlarged; 5, 6. Ventral scales.

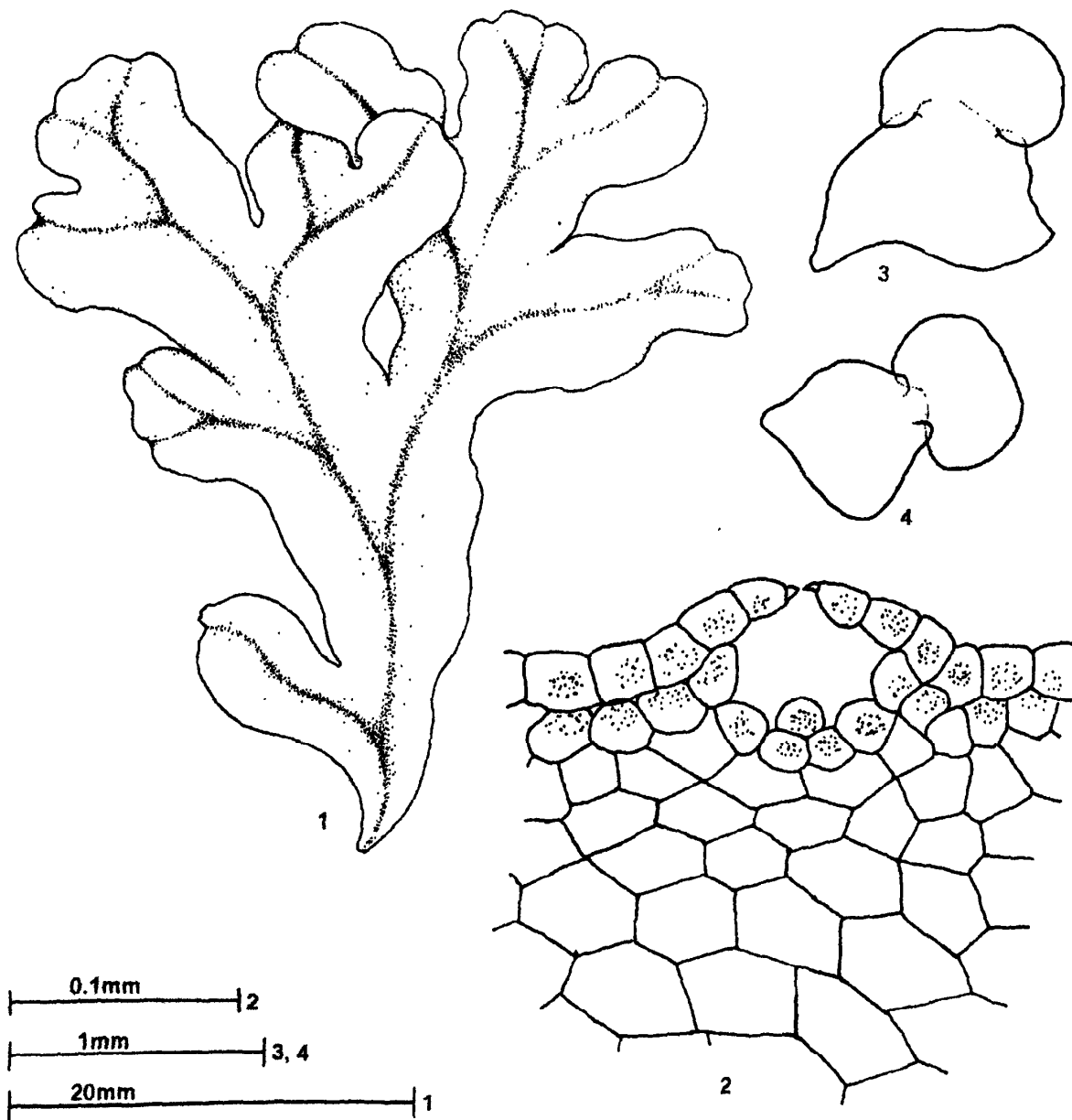


Fig.IX (1-4) : *Dumortiera hirsuta* Reinw., Blume & Nees 1. Thallus (dorsal view); 2. T.S. of thallus (a portion); 3, 4. Ventral scales.

chambers absent, cells of outermost layer chlorophyllous; pores usually absent, in some cases confined to apical portion only; ventral scales highly reduced, simple, hyaline with rounded appendage, attached to the thallus along the entire length on each side of midrib.

*Specimens examined* : Terrestrial, grows in sufficiently moist, shady places on soil over rocks in association with *Bartramidula bartramioides*. Himri, Uttarkashi

(alt. 1500 m), 17th June 2001, *D. K. Singh* 98546 (BSD).

*Distribution* : India : Himachal Pradesh, Uttaranchal, Assam, Meghalaya, Madhya Pradesh, Tamil Nadu. Nepal, Japan, N. America, Europe, New Zealand, Hawaii, Africa.

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