

Species of *Scapania* from Lilam in Kumaon (Western Himalayas), Uttar Pradesh, India*

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Taxonomic account of four species of genus *Scapania* (Dum.) Dum., *S. ciliatospinosa* Horik., *S. parva* St., *S. orientalis* St. and *S. verrucosa* Heeg., from Lilam in Kumaon region of Western Himalayas has been provided. *Scapania ciliatospinosa* is being reported for the first time from the Western Himalayas (from Lilam to Bogdiyar, Pithoragarh, Kumaon Hills) showing a considerable extension of range from its only previously known locality in Sikkim (Eastern Himalayas).

Key-words- Bryophyta, Hepaticae, Scapaniaceae, *Scapania ciliatospinosa* Horik., *S. parva* St., *S. orientalis* St. and *S. verrucosa* Heeg.

INTRODUCTION

THE bryological flora of Western Himalayas, a territory luxuriant in liverworts both in frequency and variety (see Udari 1976) received attention by Kashyap (1929, 1932) and others, yet some of the high altitude areas still remain to be explored thoroughly. The high altitude areas like Lilam in Kumaon Himalayas and the Bhyundar valley fondly named as the "Valley of flowers" by the famous English mountaineer F.S. Smythe in Garhwal Himalayas did not receive adequate attention of Indian bryologists. Stray references to some species of *Scapania* (Dum.) Dum. from these areas occur in few publications (Chopra 1938, 1943; Kachroo 1969, 1973; Kashyap 1932 and Parihar 1961-1962). Recently two species of *Scapania*, *S. undulata* (L.) Dum. and *Scapania* sp. have been reported from Pindari and neighbouring areas (3100-4000 m) in the Western Himalayas (Tewari *et al.* 1993-94). Fortunately the authors have the opportunity to examine the specimens of the unnamed *Scapania* sp. (H.N.-H.L. 51) which turned out to be *S. verrucosa* Heeg.

The genus *Scapania* (Scapaniaceae) is largely holarctic in distribution (Schuster 1974). In India it is represented by 21 species. The West Himalayan region has only 10 species viz., *S. ciliatospinosa* Horik., *S. ferruginea* (Lehm. *et* Lindenb.) Gott., Lindenb. *et* Nees., *S. ornithopodioides* (With.) Pears., *S. angusta* Mitt. ex K.

Müll., *S. parva* St., *S. udarii* Srivast. *et* Srivast., *S. acqueloba* (Schwaegr.) Dum., *S. undulata* (L.) Dumort., *S. orientalis* St. and *S. verrucosa* Heeg.

Scapania generally grows on rock or soil forming flat patches to deep mats, characterized by few branches with lateral intercalary branching, usually long and scattered rhizoids, complicate bilobed with conduplicate leaves (dorsal lobe smaller than the ventral lobe), denticulate to dentate leaf margin with sharp keel and usually 1-2 celled ovoid to ellipsoidal gemmae. Few species are Xylicolous in nature.

Although several workers like Amakawa (1964), Hattori (1966, 1971, 1975), Kashyap (1932) and Stephani (1910) have investigated the species of *Scapania*, but it is largely the East Himalayan species only which have attracted the attention of most of the workers. The West Himalayan species have received scant attention.

Recently during an investigation of the collection of liverworts from (Lilam to Bogdiyar : alt. ca. 1850-2450 m) in the Western Himalayas, four species of *Scapania* have been discovered which on critical investigation revealed to be *S. ciliatospinosa* Horik., *S. parva* St., *S. orientalis* St. and *S. verrucosa* Heeg. Out of these Kashyap (1932) described only two species, *S. parva* and *S. verrucosa*, the former not seen by him. The present report of *S. ciliatospinosa* Horik. from Western Himalayas earlier known from India in East Himalayan territory only, has revealed a range of extension within the country.

Key to the species of *Scapania* from Western Himalayas

1. Leaf-dorsal lobe obtuse, cordate-reniform 2.
2. Leaf margin distantly ciliate-dentate..... *S. orientalis*.
2. Leaf margin coarsely ciliate-dentate 3.
3. Leaf-dorsal lobe shortly decurrent *S. ciliatospinosa*.
3. Leaf-dorsal lobe longly decurrent *S. ferruginea*.
1. Leaf-dorsal lobe oblong, rectangulate-ovate 4.
4. Leaf cuticle smooth *S. angusta*.
4. Leaf cuticle papillose-verrucose 5
5. Leaf cell lumina hexagonal 6.
6. Leaf margin strongly dentate and keel absent *S. ornithopodioides*.
6. Leaf margin denticulate to weakly dentate and keel present 7.
7. Gemmae ovoidal *S. verrucosa*.
7. Gemmae stellate (triangular to polyangular) *S. udarii*.
5. Leaf cell lumina subquadrate-rounded 8.
8. Ventral lobe subovate to ovate *S. aequaloba*.
8. Ventral lobe obovate 9.
9. Leaf margin entire or less denticulate having rounded apex.....*S. undulata*.
9. Leaf margin regularly denticulate having acute to obtuse apex.....*S. parva*.

DESCRIPTION

1. *Scapania ciliatospinosa* Horik. *Journ. Sci. Hiroshima Univ. B*, 2, 2: 222(1934).

Text-figs 1-9

Scapania nepalensis sensu K. Müller, 1905, non Nees in Gottsche *et al.* (1844); *Scapania ferruginea* (Lehm. & Lindenb.) Lehm. & Lindenb. var. *minor* Amakawa in *Journ. Hattori Bot. Lab.* 27: 9 (1964).

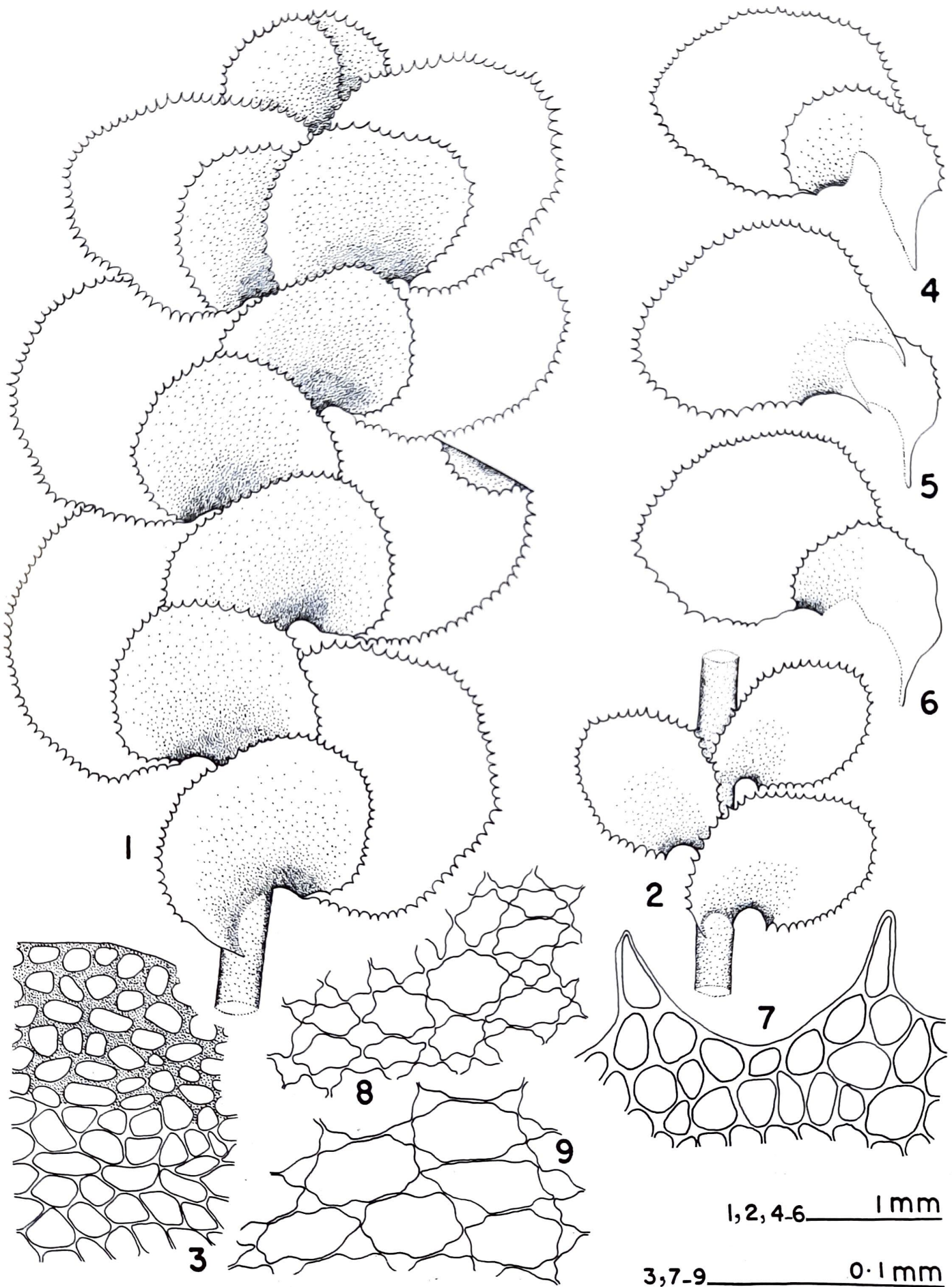
Plants small, light olive brown, robust, in caespitose patches, prostrate, 10-25 mm long and 1.8 - 2.0 mm wide (with leaves); branching frequent, lateral intercalary, branches short. Rhizoids pale, long, rather scarce, scattered distantly along the ventral surface of the stem. Stem brown, nearly flexuous, broadly elliptical in cross-section, 22-25 cells across diameter, cortex 4-5 cell layers thick, dark-brown, cells distinctly different from cortical cells, large, subquadrate to isodiametric, thin-walled, 15-19 x 19-34 μm . Leaves distantly arranged, upper 2-3 leaves imbricate, shortly decurrent, complicate bilobed into unequal lobes, widely spreading; dorsal lobe very small, cordate to reniform, obliquely inserted, arching beyond the farther edge of the stem, 0.5 - 0.8 mm long and 0.7 - 1.0 mm wide, apex obtuse, margin ciliate - dentate; ventral lobe large, broadly ovate, 1.8 - 2.2 mm long and 1.3 - 1.8 mm wide, shortly decurrent, nearly transversely inserted with the line of insertion, slightly curved upward and then down ending shortly below

the level of the base of the keel, apex obtuse with a point, margin completely ciliate-dentate, keel very short, 1/10th of the ventral lobe length, sinuate, teeth large, usually 1-celled, rarely 2-celled, 11-23 x 15 - 19 μm , cells at margin and apex usually quadrate to subquadrate, thick-walled 11-23 x 15-19 μm , median cells thin-walled with nodulose or acute angle trigones, 15-30 x 15-19 μm , basal cells large, thin-walled with acute angle trigones, 45-56 x 19-30 μm . Cuticle smooth. Fertile plants not found.

Locality: Lilam to Bogdiyar, district Pithoragarh, Western Himalayas, India.

Range: India-Eastern Himalayas-Sikkim, Western Himalayas-Lilam to Bogdiyar; Nepal.

Specimens examined: NICH 358741/1977, *S. ciliatospinosa* Horik., Himalayan Expedition of Chiba University, alt. 3300m, on rock, Loc.: E. Nepal, Coll.: S. Takiguchi. Universite Louis Pasteur, Institute Botanique de Strasbourg, conservation des Herbiers, STR. Fiche d' expedition, *Scapania nepalensis* (H.B. nees^o 17). *Plagiochila* (*Scapania*) *nepalensis* Nees, Loc.: Nepal, LWU 9766/88, 9767/88, 9796/88, 9797/88, *S. ciliatospinosa* Horik., Loc.: Lilam to Bogdiyar, alt. ca 1850m - 2450 m (W.H.). India, Date: 18.6.99, Habitat: on soil in association with *Metacalypogeia* sp., *Jungermannia* sp. and *Plagiochila* sp., Leg.: D. Sharma, Det.: S.C. Srivastava and Anshu Srivastava.



Text-figs 1-9: *Scapania ciliatospinosa* Horik. 1. Plant in dorsal view, 2. Portion of plant in ventral view, 3. Cross section of stem, 4-6. Leaves, 7. Marginal cells of leaf, 8. Middle cells of leaf, 9. Basal cells of leaf.

Discussion - *Scapania ciliatospinosa* was reported by Horikawa (1934) from Nepal. Grolle (1966) recorded *S. schiffneri* and Amakawa (1964) reported *S. ferruginea* var. *minor* from Sikkim which were synonymized under *S. ciliatospinosa* (Hattori, 1975).

Scapania ciliatospinosa approaches *S. parva* St. in robustness of plant and closely denticulate to dentate leaf margin but the latter is distinct from the former in rectangular to ovate dorsal lobe, longly inserted leaf lobes and concave sided trigones. *S. parva* further differs from *S. ciliatospinosa* in having papillose cuticle (smooth in the latter).

Scapania ciliatospinosa is also conspecific to *S. ferruginea* var. *ferruginea* (Lehm. et Lindenb.) Gott., Lindenb. et Nees. but the latter differs in large size of plant, contiguous leaves having longly and obliquely inserted ventral lobe.

2. *Scapania parva* St. Mem. Soc. Nat. Cherbourg. Vol. 29, P. 226 (1844).

Text-figs 10-22

Scapania parva Sp. Hep., Vol. 6, p. 142(1910); Kashyap, *Liverworts of the Western Himalayas and the Panjab Plain*. 2: 50 (1932); Amakawa in *Journ. Hattori Bot. Lab.* 27:13(1964); Kachroo in *Journ. of Sciences*, University of Kashmir, Vol. 6 Nos. (1- 2): 154 (1973).

Plants large, reddish-brown, robust, in loose caespitose patches, prostrate, 25-35 mm long and 2.5 - 3.0 mm wide (with leaves); branching lateral intercalary, branches short. Rhizoids pale, short and scattered along the ventral surface of the stem. Stem thick, rigid, often reddish-brown, broadly elliptical in cross-section, 23-26 cells across diameter, cortex 3-4 cell layers thick, dark brown, cells quadrate to subquadrate, 8-15 x 8-11 µm; medullary cells distinctly different from cortical cells, subquadrate, elliptical and rhomboidal, 19-26 x 15-19 µm. Leaves distant, strongly decurrent, complicate bilobed, widely spreading, dorsal lobe small somewhat rectangular to ovate, nearly transversely inserted with the line of insertion, slightly curved downward on the stem, 0.8-1.0 mm long and 0.7-0.8 mm wide, apex obtuse generally with a point, margin denticulate; ventral lobe large, convex, obovate, 1.8-2.5 mm long and 0.9-1.3 mm wide, having a very long insertion, slightly curved upwards on the stem and ending down below the level of the base of the keel, keel arching outward, 1/4th of the ventral lobe length, apex obtuse with a point, margin regularly denticulate, teeth 1-celled; cells at margin and apex usually quadrate to subquadrate, isodiametric, thick-walled, 11-15 x 8-15 µm, median cells thin-walled with rounded lumina, concave sided trigones, 15-19 x 19-23 µm, basal cells thin-walled, rounded lumina, concave sided trigones, 26-45 x 15-19 µm. Cuticle finely papillose. Gemmae in clusters at apex, single celled, subquadrangular, ellipsoidal, oval and flexuous, 15-23 x 8-15 µm. Fertile plants not found.

Locality: Lilam to Bogdiyar, district Pithoragarh (U.P.), Western Himalayas, India.

Range: India-Eastern Himalayas-Sikkim, Western Himalayas-Lilam to Bogdiyar, Kashmir Valley; China; Europe; Japan; Hawaii.

Specimens examined: Herbarium E. Levier 008177, *Scapania parva* St., Loc.: China, Yunnan, Coll.: Delavay. LWU 9787/88, 9788/88, 9790/88, *S. parva* St. Loc.: Lilam to Bogdiyar (alt. ca 1850m 2450 m), W.H., India, Date: 18.6.88, Habitat: on soil, in association with *Plagiochila* sp., Leg.: D. Sharma, Det.: S.C. Srivastava and Anshu Srivastava.

Discussion-*Scapania parva* was also recorded from Himalayas by Stephani (1910), however, it was earlier treated under the synonymy of *S. verrucosa* Heeg. by Muller (1905). Stephani (1910) transferred *S. verrucifera* Mass. under the synonymy of *S. parva* St. Kashyap (1932) described *S. parva* only on the basis of Stephani's description. Amakawa (1964) recorded it from the Eastern Himalayas.

Scapania parva approaches *S. ciliatospinosa* Horik. in robust plant and closely denticulate to dentate leaf margin but the latter differs in cordate to reniform dorsal lobe, shortly inserted leaf lobes, acute angle trigones and smooth cuticle.

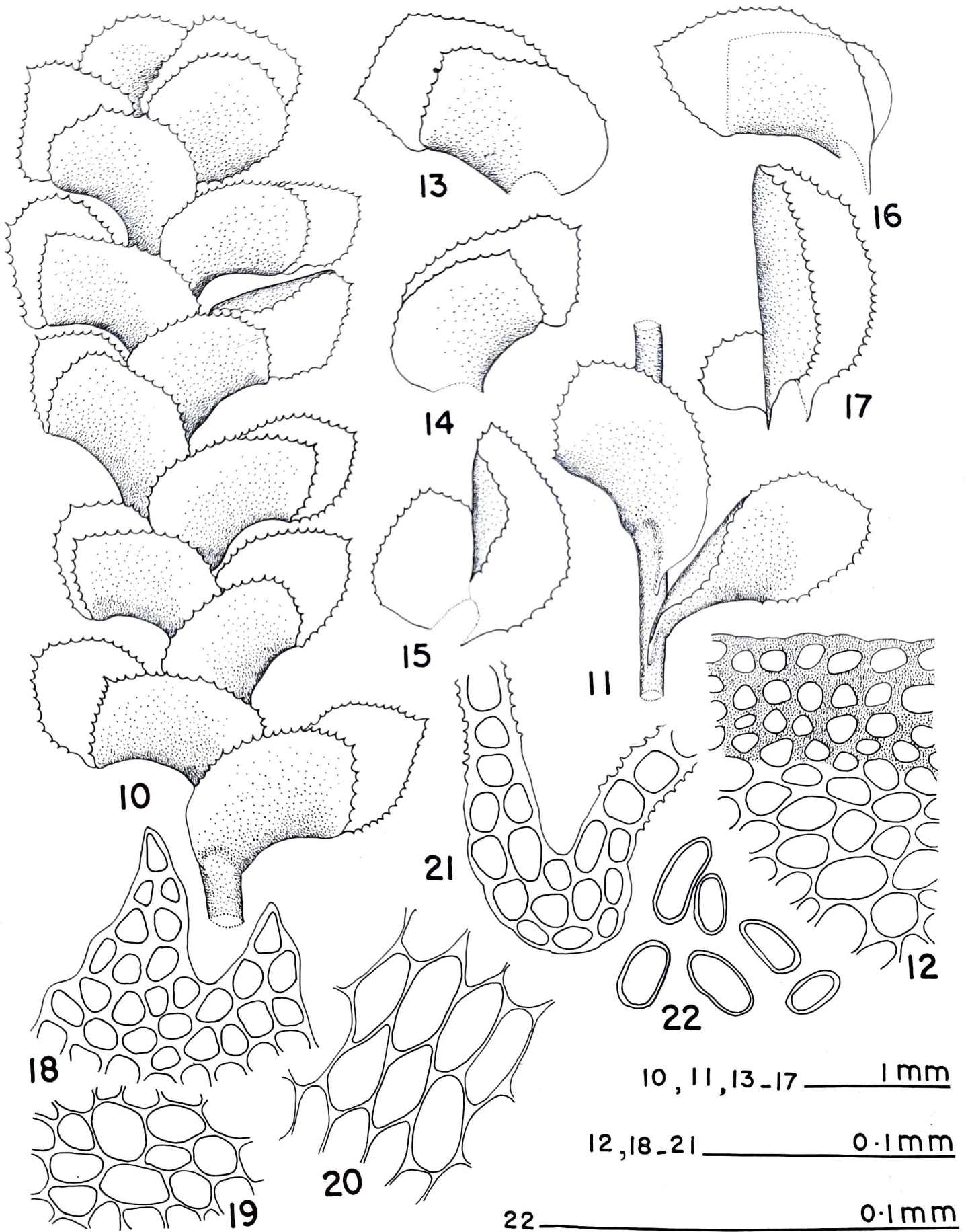
Scapania parva also approaches *S. verrucosa* Heeg., which was earlier treated as synonym of the latter. However, the species under discussion differs from *S. verrucosa* in having numerous unicellular teeth at the leaf margin, rounded lumina of the leaf cell, concave sided trigones and papillose cuticle as opposed to irregularly arranged unicellular teeth at the leaf margin, stellate lumina of the leaf cell, nodulose trigones and verrucose cuticle in the latter (*S. verrucosa*).

3. *Scapania orientalis* St. Mull. *Nova Acta Acad. Caes Leop Carol.* 83: 298, Pl. 46 (1901).

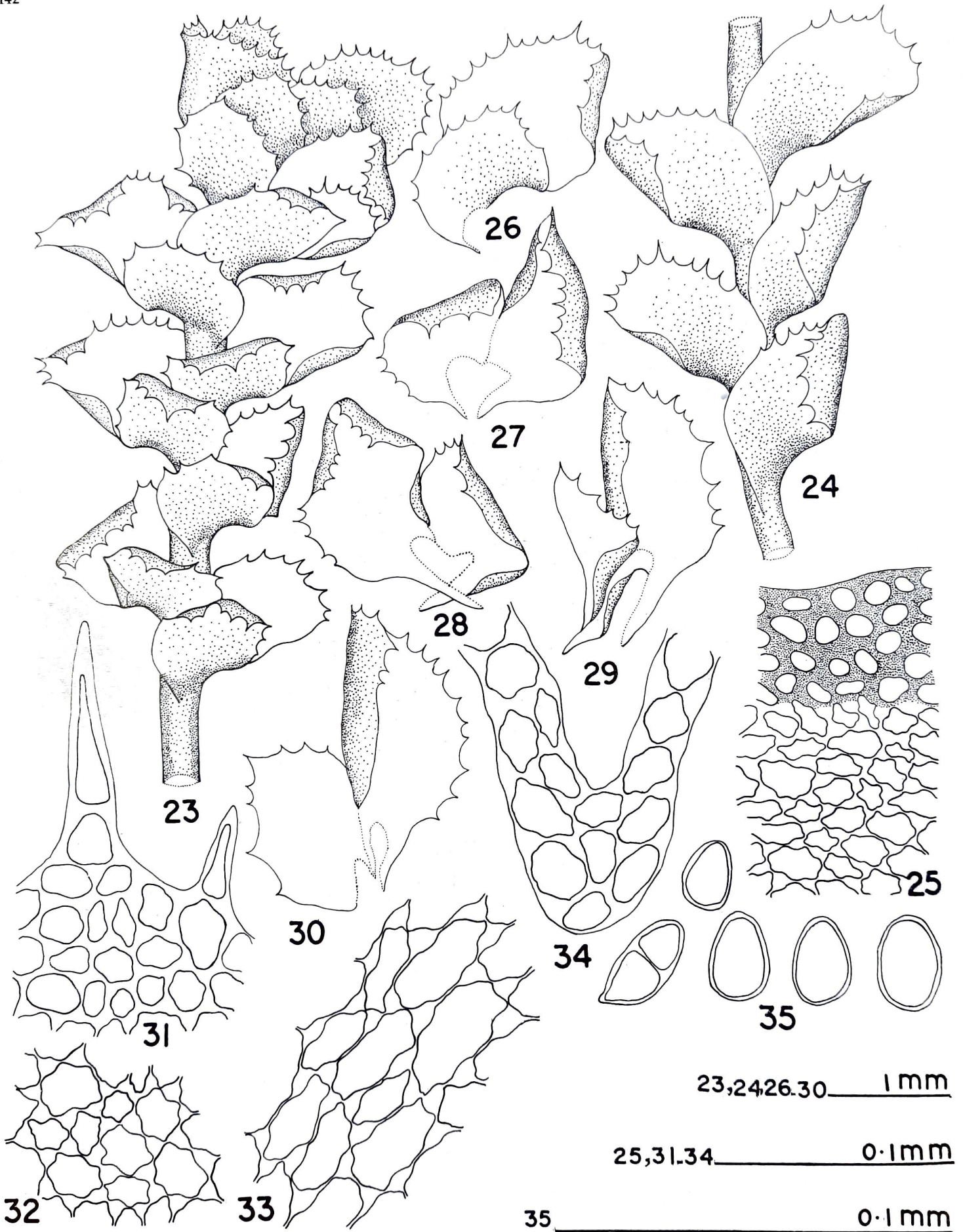
Text figs 23-35

Diplophyllum orientale (St.) St., *Sp. Hep.*, 4: 115(1910); Kashyap, *Liverworts of the Western Himalayas and the Panjab Plain*. 2: 47-48 (1932); *S. orientalis* Amakawa in *Journ. Hattori Bot. Lab.* 27: 13(1964).

Plants small, slender, light brown, in caespitose patches, prostrate, 10-15 mm long and 1.4-1.8 mm wide (with leaves); branching rare, lateral intercalary and short. Rhizoids numerous, pale, long and fairly scattered along the ventral surface of the stem. Stem rigid, dark brown, broadly elliptical in cross-section, 20-22 cells across diameter, cortex 3-4 cell layers thick, dark brown, cells rounded, oblong and elliptical, 11-15 x 8-15 µm, medullary cells distinctly different from cortical cells in prominent trigones, 19-30 x 11-15 µm. Leaves approximate obliquely to widely spreading, complicate bilobed, dorsal lobe small, obtuse, obliquely inserted on the stem, 0.8-1.2 mm long and 0.7-0.9 mm



Text-figs 10-22: *Scapania parva* St. 10. Plant in dorsal view, 11. Portion of plant in ventral view, 12. Cross section of stem, 13-17. Leaves, 18. Marginal cells of leaf, 19. Middle cells of leaf, 20. Basal cells of leaf, 21. Cross section of leaf through keel, 22. Gemmae.



Text-figs 23-35: *Scapania orientalis* St. 23. Plant in dorsal view, 24. Portion of plant in ventral view, 25. Cross section of stem, 26- 30. Leaves, 31. Marginal cells of leaf, 32. Middle cells of leaf, 33. Basal cells of leaf, 34. Cross section of leaf through keel, 35. Gemmae.

wide, apex subacute to acute with a point, margin distantly ciliate-dentate; ventral lobe large, convex, obovate, 1.2 - 2.0 mm long and 0.9 - 1.2 mm wide, inserted with a line of insertion curved upward and ending down below the level of the base of the keel, apex subacute to obtuse with a point, margin ciliate-dentate, keel large, slightly curved, arching outward, extended upto 1/3 of the ventral lobe length, teeth 1-celled, 38-94 μm long, cells along the margin quadrate-oblong, 11-19 \times 8-19 μm , trigones large, median cells hexagonal, thin-walled, bulging trigones, 15-26 \times 11-15 μm , basal cells oblong, thin-walled with bulging trigones, 26-49 \times 15-19 μm . Cuticle smooth. Gemmae in clusters at apex, broadly oblong to elliptical, frequently 1-celled, 20-25 \times 13-18 μm . Fertile plants not found.

Locality: Lilam to Bogdiyar, district Pithoragarh (U.P.), Western Himalayas, India.

Range: India-Eastern Himalayas-Sikkim, Western Himalayas- Lilam to Bogdiyar; Nepal.

Specimens examined: NICH 358739/1977, *Scapania orientalis* St., Himalayan expedition of Chiba University, alt. 3300 m, Loc.: Pati, E. Nepal, on rock in association with *Herbertus dicrana*, *Metacalypogeia alternifolia*, *Bazzania* sp., *Jungermannia appressifolia* Mitt., *Anastrepta orcadensis*, Coll.: S. Takiguchi. Herbarium E. Levier. Fondation Stephani, 18345, *Diplophyllum orientalis* St. Typus, Loc.: N.W. India, Ganges Valley above Jalla, alt. ca. 1100-1200 ft, Date: October 1882, Leg.: J.F. Duthie. LWU 9798/88, 9800/88, 9854/88, *S. orientalis* St., Loc., Liam to Bogdiyar (alt. ca 1850-2450 m), W.H., India, Date: 18.6.88, Habitat: on soil, in association with *Calypogeia* sp. and *Riccardia* sp., Leg.: D. Sharma, Det.: S.C. Srivastava and Anshu Srivastava.

Discussion: Stephani (1910) recorded *Scapania orientalis* as *Diplophyllum orientalis* (St.) St. from Himalayas. Kashyap (1932) also treated it as *D. orientalis* from Ganges valley and Dalhousie (W.H.). About over three decades later Amakawa (1964) recorded it from Sikkim as *S. orientalis*.

Scapania orientalis is close to *S. verrucosa* Heeg. in slender plants and irregularly denticulate to dentate leaf margin, but the latter differs in rhomboidal to oblong, transversely inserted dorsal lobe and verrucose cuticle.

Scapania orientalis is also very close to *S. ferruginea* var. *ferruginea* (Lehm. et Lindenb.) Gott., Lindenb. et Nees., but can be distinguished from the latter in having large, slightly curved keel (short and semicircularly curved keel in *S. ferruginea* var. *ferruginea*), distant marginal teeth of the lobes (more continuous teeth in the latter). The most characteristic feature is the slender and elegant habit of the plant of *S. orientalis* in comparison to robust habit of *S. ferruginea* var. *ferruginea*.

4. *Scapania verrucosa* Heeg., *Revue Bryol.* 1893, p. 81.

Text-figs 36-51

Scapania verrucosa Kashyap, *Liverworts of the Western Himalayas and the Panjab Plain.* 2: 49 (1932).

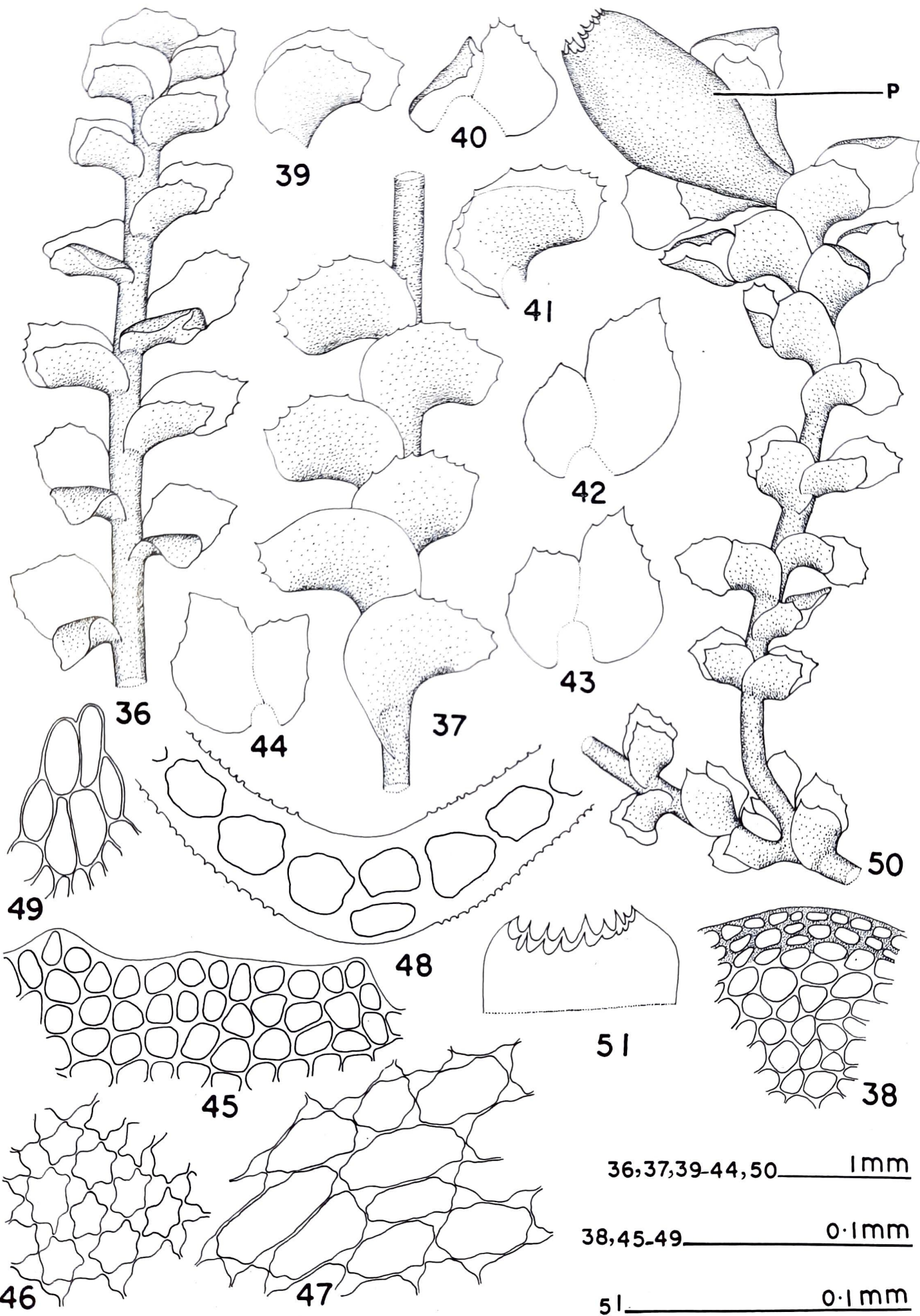
Plants small, dark brown, in loose caespitose patches, prostrate, 15-20 mm long, 1.0-1.6 mm wide (with leaves); branching rare, lateral intercalary, branches short. Rhizoids pale, short and fairly scattered along the ventral surface of the stem. Stem rigid, often light brown to dark brown from upper end to base, broadly elliptical in cross section, 19-22 cells across diameter, cortex 2-3 cell layers thick, dark brown or light brown, cells subquadrate, 8-11 \times 8-15 μm ; medullary cells distantly different from cortical cells, large, quadrate to subquadrate, ellipsoidal, thin-walled, 8-11 \times 11-19 μm . Leaves imbricate, strongly decurrent, complicate bilobed, widely spreading, dorsal lobe small, rhomboidal-oblong nearly obliquely inserted, 0.9-1.2 mm long and 0.8-1.0 mm wide, obtuse to acute apex, margins irregularly denticulate with small unicellular teeth; ventral lobe large, obliquely elliptical-oblong, 1.7-2.0 mm long and 0.9-1.1 mm wide, having a prominent insertion, shortly curved upward on the stem and ending down below the level of the base of the keel, apex usually acute and rarely obtuse, margins irregularly denticulate, keel large, arching outward to the stem, extend upto 1/2 of the ventral lobe length, teeth very small, usually 1-celled, cells at margin and apex quadrate to subquadrate, thick-walled, 11-15 \times 15-19 μm , median cells thin-walled with conspicuous trigones, 19-26 \times 15-19 μm and basal cells thin-walled with nodulose trigones, 30-60 \times 15-19 μm . Cuticle verrucose. Gemmae in clusters at apex and margin of leaves which develop into a gemmiparous branch.

Dioecious. Female inflorescence terminal. Perianth 2.1 mm long and 1.2 mm wide, brown, cylindrical, truncate, mouth contracted and fairly dentate. Sporophyte and male plants not seen.

Locality: Lilam to Bogdiyar, district Pithoragarh (U.P.), Western Himalayas, India.

Range: India-Western Himalayas-Lilam to Bogdiyar, Dalhousie.

Specimens examined: V. Schiffner, *Hepaticae europaeae exsiccatae*, 763, *Scapania verrucosa* Heeg. Part. c. Per., Loc.: Salzburg, ober Pinzgau, bei den Krimler Wasser fallen, in Bereiche des Spruuhregens an Felsblocken (Setten an Baumen), alt. ca 1100m., Date: 8 September 1903, Leg.: V. Schiffner. LWU 9763/88, 9766/88, 9846/88, *S. verrucosa* Heeg., Loc.: Lilam to Bogdiyar (alt. ca 1850 m - 2450 m) W.H., India, Date: 18.6.88, Habitat: on soil, in association with *Jungermannia* sp., *Cephalozia* sp., *Lophozia* sp. and *Marchantia* sp., Leg.: D. Sharma, Det.: S.C. Srivastava and Anshu Srivastava. KU (Nainital): H.N. HL51 *Scapania verrucosa* Heeg.:



Text-figs. 36-51: *Scapania verrucosa* Heeg. 36. Plant in dorsal view, 37. Portion of plant in ventral view, 38. Cross section of stem, 39 - 44. Leaves, 45. Marginal cells of leaf, 46. Middle cells of leaf, 47. Basal cells of leaf, 48. Cross section of leaf through keel, 49. Gemmae (at the margin of leaf), 50. Plant with Perianth, 51. Perianth mouth.

Loc: Pindari (alt. ca 3700 m), Date: 14.6.83, Leg.: S.D. Tewari, Det.: S.C. Srivastava and Anshu Srivastava.

Discussion - *Scapania verrucosa* is also recorded from Himalayas (Stephani 1910). Kashyap (1932) recorded it from Dalhousie.

This species approaches *S. orientalis* St. in slender and elegant habit of plant, irregularly, distantly denticulate to dentate leaf margin but the latter differs in obcuneate to reniform, obliquely inserted dorsal lobe and smooth cuticle.

Scapania verrucosa is also very close to *S. parva* St., but it is distinct from the latter in small size of the plant (*S. parva* has large size and robust nature of plant), pale to dark-brown stem from upper end to base, distantly arranged unicellular teeth at the leaf margin (in latter regular unicellular teeth at the leaf margin), frequent gemmae at the apex of the leaf and at the leaf margin which develop into a gemmiparous branch. In the latter, however, the gemmae are found in cluster at the apex.

A recently described *S. udarii* Srivast. et Srivast. (Srivastava & Srivastava, 1993) is apparently identical to *S. verrucosa* Heeg. But the authentic specimens of the latter collected by Schiffner from Salzburg evidently show single celled ovoid gemmae unlike those of the stellate, triangular to polyangular gemmae of *S. udarii* - rather typical of the genus *Diplophyllum*. Müller (1905) has, however, illustrated more or less similar gemmae in *S. verrucosa* also.

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REFERENCES

- Amakawa, T. 1964. A short revision of Himalayan *Scapania* (Hepaticae). *J. Hattori bot. Lab.* 27: 1-19.
- Chopra, R.S. 1938. Notes on Indian Hepatics II Sikkim Himalayas and Bengal. *Proc. Indian Acad. Sci. Ser. B*, 8: 427-439.
- Chopra, R.S. 1943. A census of Indian Hepatics. *J. Indian bot. Soc.* 22: 237-259.
- Grolle, R. 1966. Die Lebermoose Nepals-Ergebn Forsch. Unternehmen Nepal Himalaya. 1(4): 262-298, Springer, Berlin.
- Hattori, S. 1966. *Anthocerotae and Hepaticae*. In: Hara, H. (Ed.) - *The flora of Eastern Himalayas*, Univ. of Tokyo, Japan: 501-536.
- Hattori, S. 1971. *Hepaticae*. In: Hara, H. (Ed.) - *The Flora of Eastern Himalayas*. Second Report. Univ. of Tokyo, Japan. Bull. No. 2: 222-240.
- Hattori, S. 1975. *Anthocerotae and Hepaticae*. In: Hara, H. (Ed.) - *The Flora of Eastern Himalayas*. Third Report. Univ. Mus. Univ. of Tokyo, Japan. Bull No. 8: 206-242.
- Horikawa, Y. 1934. Monographi Hepaticarum australi-Japonicarum. *J. Sci. Hiroshima Univ.* B.II 2: 222.
- Kachroo, P. 1969. Hepaticae of India- A taxonomic survey and census. I. Floristic and taxonomic consideration. *Kashmir Sciences* Vol. 6 No. (1-2): 39-55.
- Kachroo, P. 1973. Hepaticae of India- A taxonomic survey and census III. Plagiochilaceae through Pleuroziaceae. *J. Sci. Univ. of Kashmir.* 1(1-2): 141-161.
- Kashyap, S.R. 1929. *Liverworts of the Western Himalayas and the Panjab plain*. Part I. The University of Panjab, Lahore.
- Kashyap, S.R. 1932. *Liverworts of the Western Himalayas and the Panjab plain*. Part II. The University of Panjab, Lahore.
- Muller, K. 1905. Monographie der Lebermoosgattung. *Scapania* Dum. *Nova Acta Leop. Carol. Akad.* 88: 1-312.
- Parihar, N.S. 1961-62. *An annotated revised census of Indian Hepatics*. Univ. Allahabad Studies, Botany Section, Senate House, Allahabad. 1-56.
- Schuster, R.M. 1974. *The Hepaticae and Anthocerotae of North America east of the hundredth Meridian*. Vol. III. Columbia Univ. Press, New York.
- Srivastava, S.C. & Srivastava, A. (1993). A remarkable *Scapania* (Scapaniaceae) from Manali (Himachal Pradesh; Western Himalaya). *J. Indian bot. Soc.* 72: 237-240.
- Stephani, F. 1910. *Species Hepaticarum*. Vol. 4: 108-151, Geneva
- Tewari, S.D., Pant, G., Joshi, S. & Airi, S.K. 1993-94. High altitude (above timber-line) bryoflora of Kumaon Himalaya. In: Pangtey, Y.P.S. & Rawal, R.S. (eds.) - *High Altitudes of the Himalaya*. *Gjanodaya*, Nainital: 263-280.
- Udar, R. 1976. *Bryology in India*. The Chronica Botanica Co., New Delhi.