

Liverwort and hornwort flora of Patnitop and its adjoining areas (J&K), Western Himalaya, India

Mohd. Tanwir, Anima Langer and Monika Bhandari

Department of Botany, University of Jammu, Jammu-180 006, J&K, India

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The paper deals with the distribution of liverwort and hornwort taxa in Patnitop and its adjoining areas. It includes 38 species belonging to 24 genera, 17 families and 4 orders. Three species viz., *Lophocolea himalayensis* Srivast. et Srivast., *Frullania gaudichaudii* Nees. et Mont. and *Riccia aravalliensis* Pande et Udar are reported for the first time from the state of Jammu and Kashmir.

Key-words – Liverwort, Hornwort, Patnitop, J&K, India.

INTRODUCTION

THE state of Jammu and Kashmir which forms a part of Western Himalaya comprises three regions, i.e., Jammu, Kashmir and Ladakh. Patnitop is the most popular hill station of Jammu region. It is located 109km North of Jammu city on Jammu-Srinagar highway at 2,060m altitude. It lies at the border of districts Udhampur and Doda of Jammu region. The adjoining areas explored presently include Udhampur, Chenani, Sudh Mahadev, Mantalai, Latti, Krimchi, Panchari, Kud (Udhampur District), Batote, Nathatop and Sanasar (Doda District). The entire study area lies between 33°01' to 33°08' N Latitude and 75°15' to 75°23' E Longitude, and is situated on both East and West of Jammu-Srinagar National Highway. Altitude of the area ranges between 510m to 2,360m. The vegetation and climatic conditions range from subtropical to temperate.

The areas at higher elevations are covered with snow during winter months (December to February). In major portion of the area where moist temperate climate prevails, winters are very cold and severe whereas summers are moderate and pleasant. The low lying areas experience subtropical climate with mild to moderate winters and very hot summers. While the area has been explored for its tracheophyte diversity (Sharma, 1997), no effort has earlier been made to study its bryoflora. Present exploration has revealed its richness in bryodiversity, both for liverworts as well as mosses. In the present paper, diversity recorded only for liverworts and hornworts has been included.

MATERIAL AND METHODS

Diverse habitats in Patnitop and its adjoining areas were explored for their bryodiversity through periodic field trips undertaken during 2002 to March 2006 (Pl. I, Figs 1-6). Data on various ecological characters (altitude, habitat, soil, pH, etc.) were collected in the field itself. Details

regarding the morphology and anatomy of various gametophytic and sporophytic characters were studied in the laboratory under Stereo- and Compound microscopes.

OBSERVATIONS

A total of 38 species belonging to 24 genera, 17 families and 4 orders have been collected during the present investigation (Pls 2 & 3, Figs 7-16). Of these, three species (*Lophocolea himalayensis* Srivast. & Srivast., *Frullania gaudichaudii* Nees & Mont. and *Riccia aravalliensis* Pande & Udar) are new records for the Jammu and Kashmir state. A complete list of taxa collected presently, along with ecological notes, has been provided.

Metzgeriales

Fossombroniaceae

1. *Fossombronia himalayensis* Kash.

Ecology—Plants grow in small patches on moist soil at pH 7.5.

Specimens examined—Sanasar 2080m (GBP-222)

2. *Fossombronia wondraczekii* (Corda) Dum.

Ecology—Plants grow in small patches on moist soil at pH 7.9.

Specimens examined—Latti, 2000m (GBP-48); Batote, 1750m (GBP-80), Nathatop, 2350m (GBP-208).

3. *Fossombronia* sp.

Ecology - Plants grow in small patches with irregularly arranged individuals on sandy clay soil at pH 6.9

Specimen examined : Batote, 1700 m (GRP-74).

Pelliaceae

4. *Pellia endivaefolia* (Dicks.) Dum.

Ecology—Plants grow in large patches on moist sandy loam, loam or sandy clay, loam soil, with overlapping

individuals at pH 7.5-9.2.

Specimens examined—Patnitop, 2010m (GBP-16, GBP-23, GBP-25, GBP-228); Sanasar, 2080m (GBP-40, GBP-44, GBP-219); Tehra, 2000m (GBP-46); Latti, 2000m (GBP-47); Batote, 1600-1850m (GBP-57, GBP-58, GBP-76, GBP-82); Bahast, 1470m (GBP-134, GBP-142); Sudh mahadev, 1480m (GBP-130, GBP-135); Mantalai, 1610m (GBP-134).

Aneuraceae

5. *Aneura pinguis* (L.) Dum.

Ecology—Plants grow on sandy loam soil among grasses at pH 8.2.

Specimens examined—Ramnagar, 890m (GBP-113).

6. *Riccardia* sp.

Ecology—Plants grow on sandy loam soil at pH 8.5.

Specimens examined—Patnitop, 2020m (GBP-17).

Jungermanniales

Jungermanniaceae

7. *Jungermannia (Jungermannia) lanceolata* L.

Ecology—The plants inhabit moist sandy loam soil at pH 6.9.

Specimens examined—Batote, 1650m (GBP-74).

8. *Jungermannia (Luridae) gollanii* St.

Ecology—Plants inhabit moist sandy loam soil at pH 7.6-8.5.

Specimens examined—Udhampur, 510m (GBP-88); Ramnagar, 890m (GBP-109).

9. *Jungermannia (Plectocolea) truncata* Nees.

Ecology—Plants grow on moist loamy soil at pH 7.6.

Specimens examined—Latti, 2000m (GBP-48); Sanasar, 2080m (GBP-215).

10. *Jungermannia (Solenostoma) kanaii* Amak.

Ecology—Plants inhabit moist loam soil at pH 8.5.

Specimens examined—Batote, 1680m (GBP-60); Sanasar, 2060m (GBP-212, GBP-216, GBP-217, GBP-219, GBP-220, GBP-227, GBP-229).

Geocalycaceae

11. *Chiloscyphus himalayensis* St.

Ecology—Plants inhabit sandy loam or loamy soil at pH 7.0-7.8.

Specimens examined—Patnitop, 2030m (GBP-26); Batote, 1650-1820m (GBP-61, GBP-70, GBP-72, GBP-78); Sanasar, 2080m (GBP-217).

12. *Heteroscyphus argutus* (Nees) Schiffn.

Ecology—Plants grow in small patches strongly adhered to stones in extremely moist and shady area at pH 8.0.

Specimens examined—Lander (GBP-279).

13. *Heteroscyphus pandei* Srivast. & Srivast.

Ecology—Plants grow in small patches on moist sandy loam soil at pH 8.2.

Specimens examined—Tehra, 2000m (GBP-46).

14. *Lophocolea himalayensis* Srivast. & Srivast.

Ecology: Plants inhabit moist loamy soil at pH 8.2.

Specimens examined—Sanasar, 2080m (GBP-215); Nathatop, 2350m (GBP-235).

Plagiochilaceae

15. *Plagiochila mittenii* St.

Ecology—Plants grow on loamy soil-covered rock at pH 7.6.

Specimens examined—Sanasar, 2090m (GBP-39, GBP-206).

16. *Plagiochila phalangea* Tayl.

Ecology—Plants grow pendulous on rock on sandy loam soil at pH 7.3.

Specimens examined—Sanasar, 2080m (GBP-35, GBP-206).

Scapaniaceae

17. *Scapania parva* St.

Ecology—Plants grow on loamy soil at pH 8.2.

Specimens examined—Sanasar, 2080m (GBP-215); Nathatop, 2366m (GBP-236, GBP-240).

Radulaceae

18. *Radula complanata* (L.) Dum.

Ecology—Epiphytic on bark of *Pinus* species (pH 7.0) or terricolous on sandy loam soil (pH 8.5).

Specimens examined—Sanasar, 2090m (GBP-35, GBP-38, GBP-210, GBP-241, GBP-244); Batote, 1670-1800m (GBP-53, GBP-64); Nathatop, 2350m (GBP-233, GBP-238).

Porellaceae

19. *Porella platyphylla* (L.) PfiEFF.

Ecology—Epiphytic on bark of *Quercus leucotrichophora* (pH 7.8) or terricolous on sandy loam soil (pH 8.5).

Specimens examined—Sanasar, 2080m (GBP-36, GBP-37, GBP-224).

Jubulaceae

20. *Frullania gaudichaudii* Nees. & Mont.

Ecology—Epiphytic on bark of *Cedrus deodara* at pH 5.3.

Specimens examined—Batote, 1680m (GBP-68).

21. *Frullania muscicola* St.

Ecology—Epiphytic on *Cedrus deodara* bark at pH 5.3 or terricolous on sandy loam soil at pH 5.6-8.3.

Specimens examined—Patnitop, 2010m (GBP-21, GBP-22); Batote, 1670m (GBP-53, GBP-65, GBP-66).

Marchantiales

Aytoniaceae

22. *Asterella angusta* (St.) Kachroo

Ecology—Plants grow on sandy loam soil at pH 8.7-9.7.

Specimens examined – Batote, 1650m (GBP-51);
Udhampur, 510-520m (GBP-91, GBP-92, GBP-93); Ramnagar,
810m (GBP-112); Patnitop, 2150m (GBP-230).

23. *A. pathankotensis* (Kash.) Kachroo

Ecology—Plants grow on sandy clay soil at pH 8.5-9.2.

Specimens examined – Udhampur, 510m (GBP-94);
Ramnagar, 810m (GBP-114).

24. *Plagiochasma appendiculatum* L. & L.

Ecology—Plants grow in large patches on sandy loam,
loam sandy clay soil at pH 7.4-9.2.

Specimens examined—Patnitop, 2010m (GBP-10, GBP-30);
Sanasar, 2090m (GBP-38); Batote, 1680m (GBP-54, GBP-79);

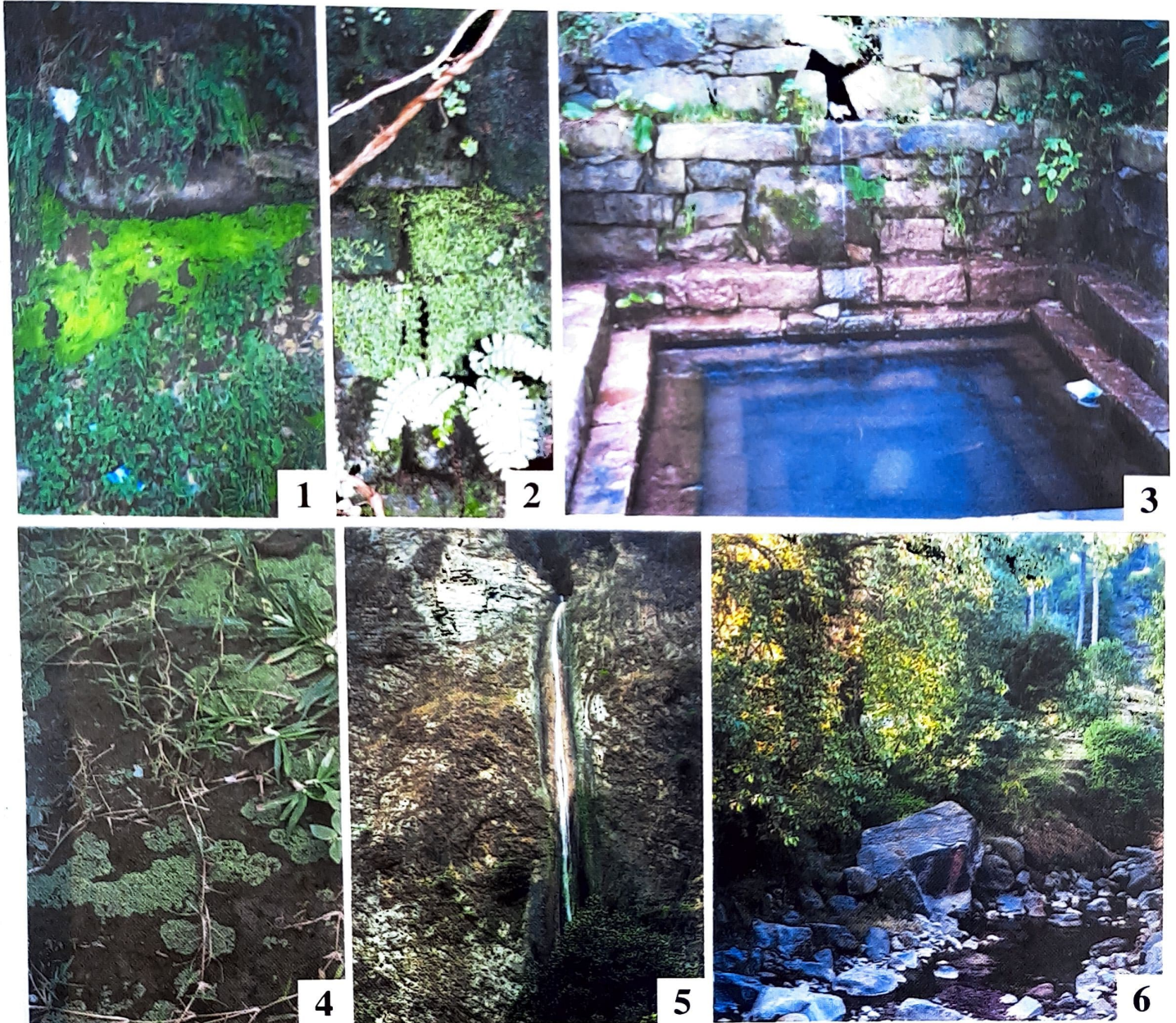


PLATE-1

Figs 1-6: Photographs showing various habitats —

Fig.1. Patch of *Cyathodium cavernarum* growing on rock surface. Fig.2. Thalli of *Asterella angusta* growing on stone wall. Fig.3. Patches of *Pellia endivaefolia* on a moist stone wall. Fig.4. Patches of *Riccia discolor* growing on soil surface. Fig.5. Semi-aquatic habitat near a waterfall. Fig.6. A shallow water body with stones.

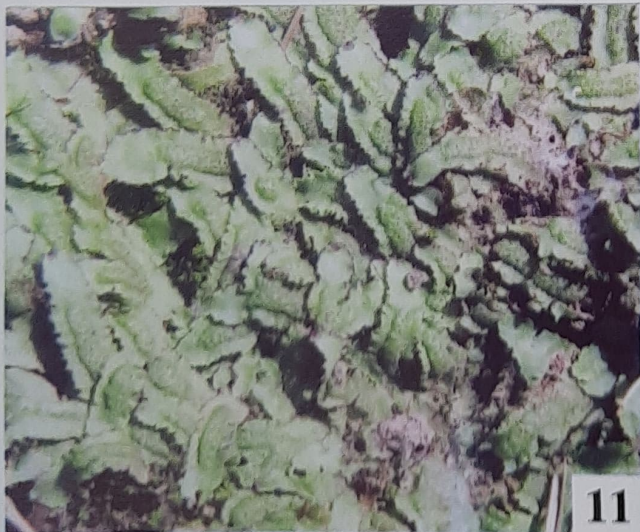


PLATE-2

Figs 7-12 Photographs showing patches of -
 Fig.7. *Marchantia palmata* (male). Fig.8. *Plagiochasma appendiculatum* (female). Fig.9. *Conocephalum conicum* (male). Fig.10. *Reboulia hemispherica* (female). Fig.11. *Asterella angusta* (male). Fig.12. *Targionia hypophylla* (female).

Udhampur, 510m (GBP-84); Ritti, 570m (GBP-98); Ramnagar, 810m (GBP-108, GBP-109, GBP-111); Bahast, 1430m (GBP-112).

25. *P. articulatum* Kash.

Ecology—Plants grow on loamy soil at pH 8.2.

Specimens examined—Batote, 1600m (GBP-67).

26. *P. intermedium* L. & G.

Ecology—Plants grow on sandy loam or sandy clay soil at pH 7.5-9.5.

Specimens examined—Patnitop, 2010m (GBP-20); Ritti, 510m (GBP-90); Ramnagar, 890m (GBP-116).

27. *Reboulia hemispherica* (L.) Raddi.

Ecology—Plants have been collected from loam, sandy loam, sandy clay, sandy clay loam soil at pH 7.4-8.9.

Specimens examined—Patnitop, 2010m (GBP-11, GBP-32, GBP-228); Tehra, 2000m (GBP-45); Batote, 1650m (GBP-81); Lati, 1800m (GBP-48, GBP-49); Bahast, 1390m (GBP-80, GBP-123, GBP-129); Udhampur, 510m (GBP-87); Nathatop, 2350m (GBP-207, GBP-208); Sanasar, 2080m (GBP-221).

28. *Mannia* sp.

Ecology—Plants inhabit sandy clay soil at pH 8.5-8.9.

Specimens examined—Ritti, 570m (GBP-97); Ramnagar, 890m (GBP-104).

Conocephalaceae

29. *Conocephalum conicum* (L.) Dum.

Ecology—Plants inhabit sandy loam or clay loam soil at pH 7.8-9.0.

Specimens examined—Patnitop, 2010m (GBP-02, GBP-05, GBP-75); Batote, 1650m (GBP-82); Sudh Mahadev, 1530m (GBP-134); Nathatop, 2360m (GBP-240); Sanasar, 2070m (GBP-212).

Marchantiaceae

30. *Dumortiera hirsuta* Reinw. Bl. & Nees.

Ecology—Plants grow on moist sandy soil at pH 8.5.

Specimens examined—Patnitop, 2010m (GBP-03, GBP-05, GBP-06).

31. *Marchantia nepalensis* L. & L.

Ecology—Plants grow on moist loam, sandy loam or clay loam soil at pH 7.9-9.2.

Specimens examined—Patnitop, 2010m (GBP-07, GBP-31, GBP-41, GBP-228); Sanasar, 2090m (GBP-34); Batote, 1650m (GBP-52, GBP-58, GBP-73); Sudh Mahadev, 1450m (GBP-125, GBP-131); Nathatop, 2350m (GBP-208).

32. *M. palmata* Nees.

Ecology—Plants grow on sandy clay loam soil at pH 8.2.

Specimens examined—Sanasar, 2060m (GBP-42).

33. *M. polymorpha* L.

Ecology—Plants grow on sandy clay loam soil at pH 7.6.

Specimens examined—Batote, 1650m (GBP-80); Sanasar, 2360m (GBP-242, GBP-243).

Targioniaceae

34. *Targionia hypophylla* L.

Ecology—Plants grow on moist sandy soil at pH 8.3.

Specimens examined—Patnitop, 2030m (GBP-228); Nathatop, 2350m (GBP-208).

Cyathodiaceae

35. *Cyathodium cavernarum* Kunze

Ecology—Plants grow on sandy loam soil at pH 7.5.

Specimens examined—Ramnagar, 890m (GBP-116, GBP-118).

Ricciaceae

36. *Riccia aravalliensis* Pande & Udar

Ecology—Plants grow on sandy clay soil at pH 8.5.

Specimens examined—Ritti, 570m (GBP-96).

37. *R. discolor* L. & L.

Ecology—Plants grow in large patches on moist sandy clay soil at pH 8.5.

Specimens examined—Udhampur, 510m (GBP-95); Ritti, 540m (GBP-99).

Anthocerotales

Phaeocerotaceae

38. *Phaeoceros laevis* (L.) Prosk. subsp. *laevis* Prosk.

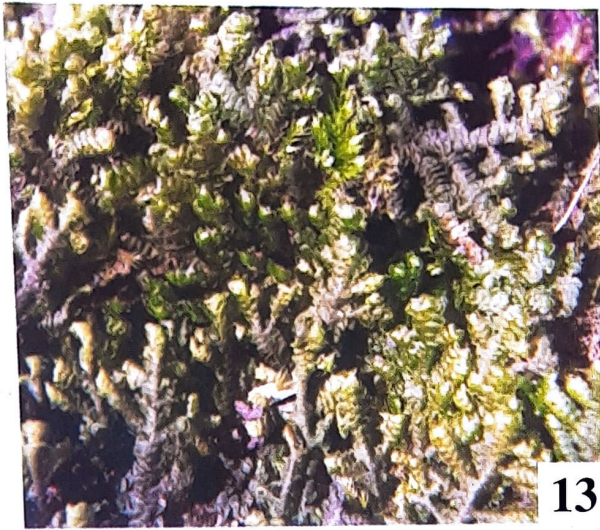
Ecology—Plants grow on sandy soil at pH 7.9.

Specimens examined—Sanasar, 2080m (GBP-219).

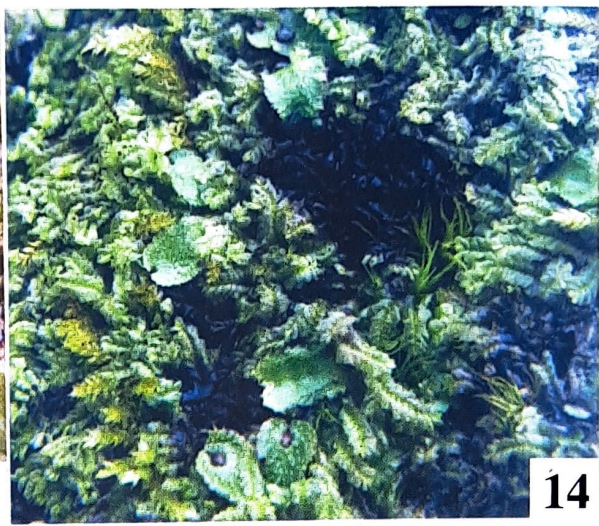
DISCUSSION

The Himalayas are one of the richest repositories of bryodiversity, ranking third at global (Uniyal, 1999) and first at National level (Pande, 1958). Out of 625 himalayan liverworts, 30% are endemic; maximum endemism being found in Eastern Himalaya (44%), followed by Central Himalaya (31%) and Western Himalaya (25%) (Udar & Srivastava, 1983). During last few decades, the entire Himalayan ranges have suffered tremendous habitat destruction on account of tourism, urbanization, over-exploitation and deforestation, leading to the decline/disappearance of large number of bryophyte taxa including many rare and threatened ones. Need of the hour, therefore, is to explore un-explored areas and inventorise the diversity which is otherwise likely to disappear even before getting documented.

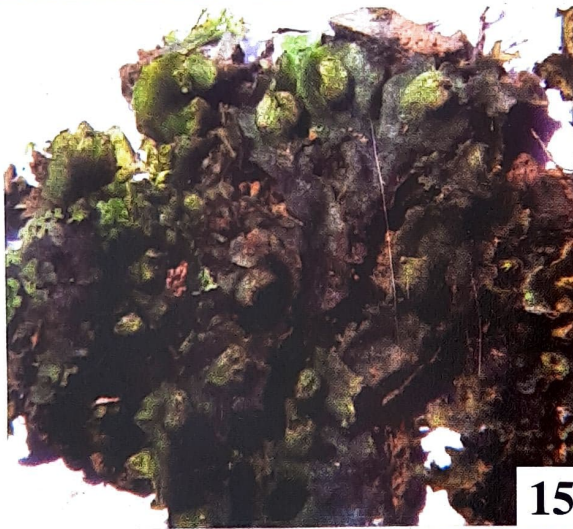
Lying in the North-West Himalaya, Patnitop is the most famous tourist resort of Jammu. It lies 109 km North of Jammu city on Jammu-Srinagar National Highway. On an average, 1500 tourists visit the area per day in winters and 4,000 in summers. This earns an annual revenue to the tune of lacs of rupees to the State. In order to cater to the boarding and lodging requirements of the tourists, there has been a mushroom growth in the number of huts,



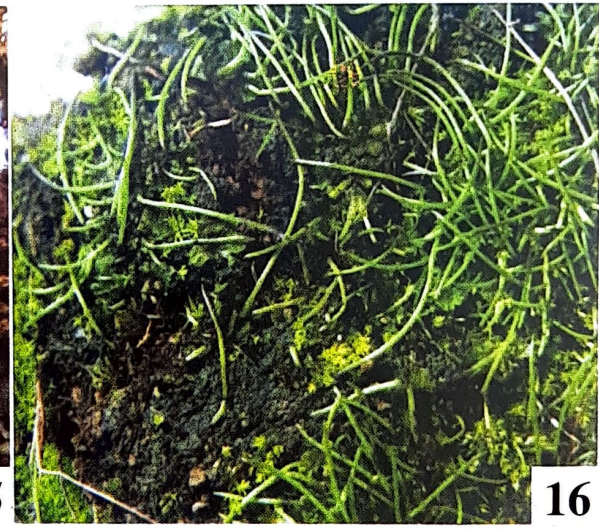
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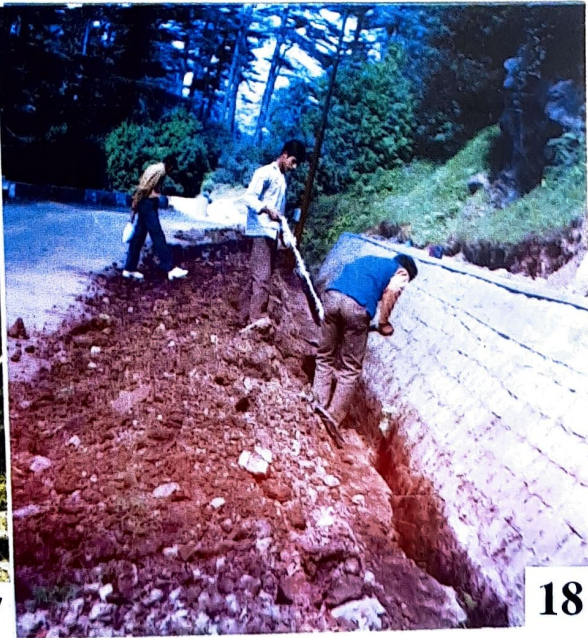
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PLATE-3

Figs 13-18 Photographs showing patches of—
 Fig.13. *Porella platyphylla*. Fig.14. *Chiloscypus himalayensis* along with *Reboulia hemisphaerica*. Fig.15. *Pellia endivaefolia* (female).
 Fig.16. *Phaeoceros laevis* subsp. *laevis* (female). Fig.17. A tree stump in *Cedrus* forest in Panchari area. Fig.18. Construction work going on at the circular road (Patnitop). The site was densely inhabited by *Reboulia hemisphaerica* and *Marchantia nepalensis* prior to the construction work.

hotels, rest houses, dak bungalows, shops at Kud, Batote and Patnitop. This has involved large scale land clearance and deforestation, (Kant & Sharma, 1998) causing severe threat to survival of the flora of the area. Many tree trunks have been transformed into mere stumps, to be used as chairs by the tourists (Pl. 3, fig.17). Road construction and wall cementing has deprived a number of hepatics from their natural habitats (Pl. 3 fig.18). The area is also a home to a number of liverworts (*Reboulia hemispherica*, *Conocephalum conicum*, *Dumortiera hirsuta*, *Fossombronina himalayensis*) which are reported to have disappeared from other parts of Western Himalaya (Nainital) where they used to grow luxuriantly during yesteryears (Pant, 1983). It would be worthwhile to mention that *Reboulia hemisphaerica* is one of the commonest hepatic taxa of the area, besides *Plagiochasma appendiculatum* and *Pellia endivaefolia*.

Present collections also include 4 endemic taxa (*Chiloscyphus himalayensis*, *Asterella angusta*, *Plagiochila phalangea* and *Riccia aravalliensis*). *Riccia aravalliensis* needs special mention as the species is reported to be rare and endemic to Rajasthan (Srivastava, 1998). Further explorations of the area are likely to reveal occurrence of many more endemic/ rare taxa.

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