SOME NEW RECORDS OF SUB-FOSSIL *SPHAGNUM* FROM WESTERN HIMALAYAS

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ABSTRACT

Present paper deals with four sub-fossil *Sphagnum* taxa recovered while pollen-analysing Late-Quaternary sediments from the two Lake sites — namely Khajiar and Rewalsar in the districts Chamba and Mandi respectively in Himachal Pradesh. The recovered taxa are *Sphagnum recurvum* P. Beauv., *Sphagnum* sp. belonging to Sect. Sphagnum (Palustre *sensu* Abramova), *Sphagnum* sp. belonging to Sect. Cuspidata and *Sphagnum teres* (Schimp.) Aongstr. First three taxa are new records from Western Himalaya and the fourth, i.e. *Sphagnum teres* (Schimp.) Aongstr. has so far not been reported from Himachal Pradesh.

With available C-14 dates for both the profiles, the occurrence of new sub-fossil *Sphagnum* records can be dated to about 1,500-2,000 years B.P. and that of *Sphagnum teres*, which is very common throughout both the sequences, 3500 years B.P. or so.

INTRODUCTION

SPHAGNUM L. is represented in India by 22 species (Gangulee, 1969), confined mostly in the Eastern Himalaya and its adjoining ridges. The concentration of species in the eastern region of Indian subcontinent is attributed to comparatively more humid conditions prevalent in the region inspite of the fact that mostly the species occur in isolated patches, in dripping water or near springs, extending up to an elevation of 2,500 m and descending down to 1,300 m in Khasi and Jaintia Hills in very moist situations. Contrary to Eastern Himalaya, the genus *Sphagnum* has a very poor representation in Western Himalaya, and only three species are hitherto known from the region, namely *Sphagnum fimbriatum* Wils., *S. Squarrosum* Crom. in Hopp., and *S. teres* (Schimp.) Aongstr. However, Vishnu-Mittre and Gupta (1971) have reported a sub-fossil sterile frond of *Sphagnum papillosum* Lindb. from the sediments of Bhim Tal situated about 24 km from Naini Tal.

The present communication deals with four sub-fossil *Sphagnum* taxa, recovered from the Late-Quaternary sediments of Himachal Pradesh, three of them are new distributional records for Western Himalaya and so far not reported in living condition. These sub-fossil *Sphagnum* fragments are the result of author's studies on the Late-Quaternary vegetational history through pollen analysis from the two lake sites, viz., Khajiar — situated at a height of *c.* 1950 m a.s.l. which is about 13 km north-east of Dalhousie on the forest track to Chamba and Rewalsar — situated at a height of *c.* 1280 m a.s.l. about 16 km south-west of Mandi. The examination of macroscopic plant remains brought to light the different types of seeds, fruits and sterile moss fragments. On further examination, some of the moss fragments turned out to be *Sphagnum*. The various species of *Sphagnum* are identified by the unique branching system — in whorls, distinct stem and branch leaves and the peculiar differentiation of tissues of the leaf to give a regular pattern of the alternate hyaline and green cells (Wadhwa & Vohra, 1966). The specific identification, however, is done by Dr Abramova of Botanic Institute, Leningrad (U.S.S.R.).

The sediments from which the *Sphagnum* fragments are reported, comprised of either organic detritus (0-250 cm depth) or *Phragmites*-peat (250-300 cm depth) at Khajiar and coarse organic detritus (650-700 cm depth) at Rewalsar respectively.

Through the pollen-analysis, the vegetation could be deduced back to about 4,000 years B.P., which comprised chiefly Oak-mixed-conifer forests in the region. At Khajiar, the encountered colonies of *Pediastrum* show an increasing trend in its frequencies between 200 and 300 cm level, followed by the colonies of *Botryococcus*, together with stray occurrence of *Potamogeton* and *Nymphaea* indicating local aquatic

habitat. On the other hand, aquatic vegetation at Rewalsar is poorly represented. Colonies of *Botryococcus* starting in good number at 790 cm diminished completely at 690 cm. Stray occurrence of *Polygonum plebejum* is, however, noticed at 690 cm (Sharma & Singh, 1974a, b).

Since the sub-fossil *Sphagnum* fragments recovered from the sediments were fragmentary and sterile, it could not be possible to determine two of them beyond section level. Of the four taxa accounted below, *Sphagnum recurvum* P. Beauv. and one species each belonging to the Sect. Cuspidata Lindb. and Sect. Sphagnum (Sect. Palustre *sensu* Abramova) are so far not recovered from Western Himalaya, whereas *S. teres* (Schimp.) Aongstr. is being reported from a locality much further west to its known westward distributional limits in Darjeeling area.

Sphagnum teres (Schimp.) Aongstr.

Pl. 1, figs. 1-3

Branch-epidermis afibrose with retort cells. Branch leaves 1·2 to 1·8 mm long, 0·6 to 0·8 mm broad, ovate or ovate-lanceolate, tapering into an acute, 3-4 toothed apex. Hyaline cells fibrose with large rounded pores on both faces.

This cosmopolitan species is known in Eastern Himalaya from Bhutan westwards (Sharma, 1949) and from Darjeeling region based on Gamble's collection from 3,660 m high Tongloo Peak (Gangulee, 1969). Its present known distribution does not extend further west to Sikkim-Darjeeling Himalaya but its recovery in sub-fossil state from 10 cm, 150 cm, 200 cm and 300 cm from Khajiar and 300 cm and 690 cm from Rewalsar pollen profiles indicate not only the continuous occurrence of this species in the past but also the possibility of its existence in the Western Himalaya. In sediments, it is the most commonly encountered species.

Sphagnum recurvum P. Beauv.

Pl. 2, figs. 8-9

Branch-leaf *c.* 3 mm long, *c.* 1 mm broad, broadly lanceolate, above the middle gradually narrowed into a toothed cuspidate tip, margins entire, incurved at the apex, narrowly bordered with much elongated compressed fibrose cells. Hyaline cells with small round or oval pores on dorsal face.

A cosmopolitan species. In India, known from Darjeeling and extends to east Nepal Himalaya only (Gangulee, 1969). The species is hitherto unknown from Western Himalaya and it is quite interesting to report from 300 cm depth of the pollen profile from Khajiar.

Sphagnum sp. Sect. Cuspidata Lindb. cf. *S. recurvum*

Pl. 2, figs. 6, 7

Branch-epidermis afibrose, with retort cells. Branch-leaf 1·2 to 2 mm long, 0·5 to 0·8 mm broad, ovate-lanceolate, somewhat secund, narrowed into an acute toothed tip, margins entire, slightly wavy, recurved towards apex. Hyaline cells with generally round, few pores on dorsal face.

Two branches recovered from a depth of 200 cm are identifiable upto the Sect. Cuspidata Lindb. only. None of the species belonging to the above Sect. has so far been recorded from Western Himalaya.

Sphagnum sp. Sect. Sphagnum (Sect. Palustre *sensu* Abramova)

Pl. 1, figs. 4, 5

Branch-leaves 1·2 to 1·4 mm long, 0·7 to 0·9 mm broad, broadly ovate or sometimes rounded oval when explanate, tapering into an acute tip, margins entire, narrowly bordered with elongated fibrose cells.

This record is based on solitary branch fragment recovered at 300 cm depth of the profile from Khajiar and is quite distinct in having comparatively much shorter chlorophyllous cells enclosing generally 3-4 hyaline cells, but is identifiable only up to Section level. None of the species belonging to the above section has been reported from Western Himalaya except sub-fossil *Sphagnum papillosum* Lindb. belonging to the Sub-series Papillosa Warnst.

DISCUSSION

In the light of the sub-fossil discovery of the above discussed species of *Sphagnum* from different levels from Khajiar and Rewalsar profiles, it would be worthwhile to explore the area thoroughly for their presence in living state too, or to ascertain the factors responsible for the disappearance of these species from the area. The frequent occurrence of *Sphagnum* corresponds with the increased values of aquatics in the Khajiar pollen profile and thus indicates the better climatic conditions (moist) for *Sphagnum* to flourish in the past in this region.

Interestingly, out of the three species known from Western Himalaya, two have been reported from different areas in Himachal Pradesh. *Sphagnum fimbriatum* Wils. from Chamba-Pangi, Sanch Valley by Martin, 1839 and *S. squarrosum* Pers. from Kalpa, Himachal Pradesh by Nair, 1962 (Wadhwa & Vohra, 1966).

Both Khajiar and Rewalsar profiles are C-14 dated at different levels (1800 ± 55 B.P. at 220-230 cm WIS-416; 1830 ± 50 B.P. at 240-250 cm WIS-428 and 1250 ± 60 B.P. at 450-460 cm WIS-418 at Khajiar and 520 ± 55 B.P. at 160-170 cm WIS-419 and 1410-± 60 B.P. at 280-290 cm WIS-417 at Rewalsar) and by extrapolation the approximate age of these profiles goes back to 4,000 years B.P. or so. The levels at which the new records have been encountered can be estimated to about 1,500-2,000 years B.P. *Sphagnum teres* is, however, reported from still deeper levels dating about 2,000 years B.P. at Khajiar and about 3,500 years B.P. at Rewalsar.

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EXPLANATION OF PLATES

PLATE 1

1. *Sphagnum teres* (Schimp.) Aongstr., branch fragment recovered from Khajiar — Lake sediment (depth 300 cm).

2. *Sphagnum teres* (Schimp.) Aongstr., branch fragment recovered from Rewalsar — Lake sediment (depth 690 cm).

3. Same, leaf-apex magnified.

4. A, *Sphagnum recurvum*, portion of branch leaves. B, *Sphagnum* sp. Sect. Sphagnum (Sect. Palustre *sensu* Abramova), branch fragment recovered from Khajiar—Lake—sediment (depth 300 cm).

PLATE 2

6. *Sphagnum* sp. Sect. Cuspidata, branch recovered from Khajiar — Lake sediment (depth 200 cm).

7. Same, leaf-apex magnified.

8. A, *Sphagnum recurvum* P. Beauv., branch leaves recovered from Khajiar — Lake sediment (depth 300 cm). B, *Sphagnum* sp. Sect. Sphagnum, branch fragment.

9. Same (A), leaf-apex magnified.

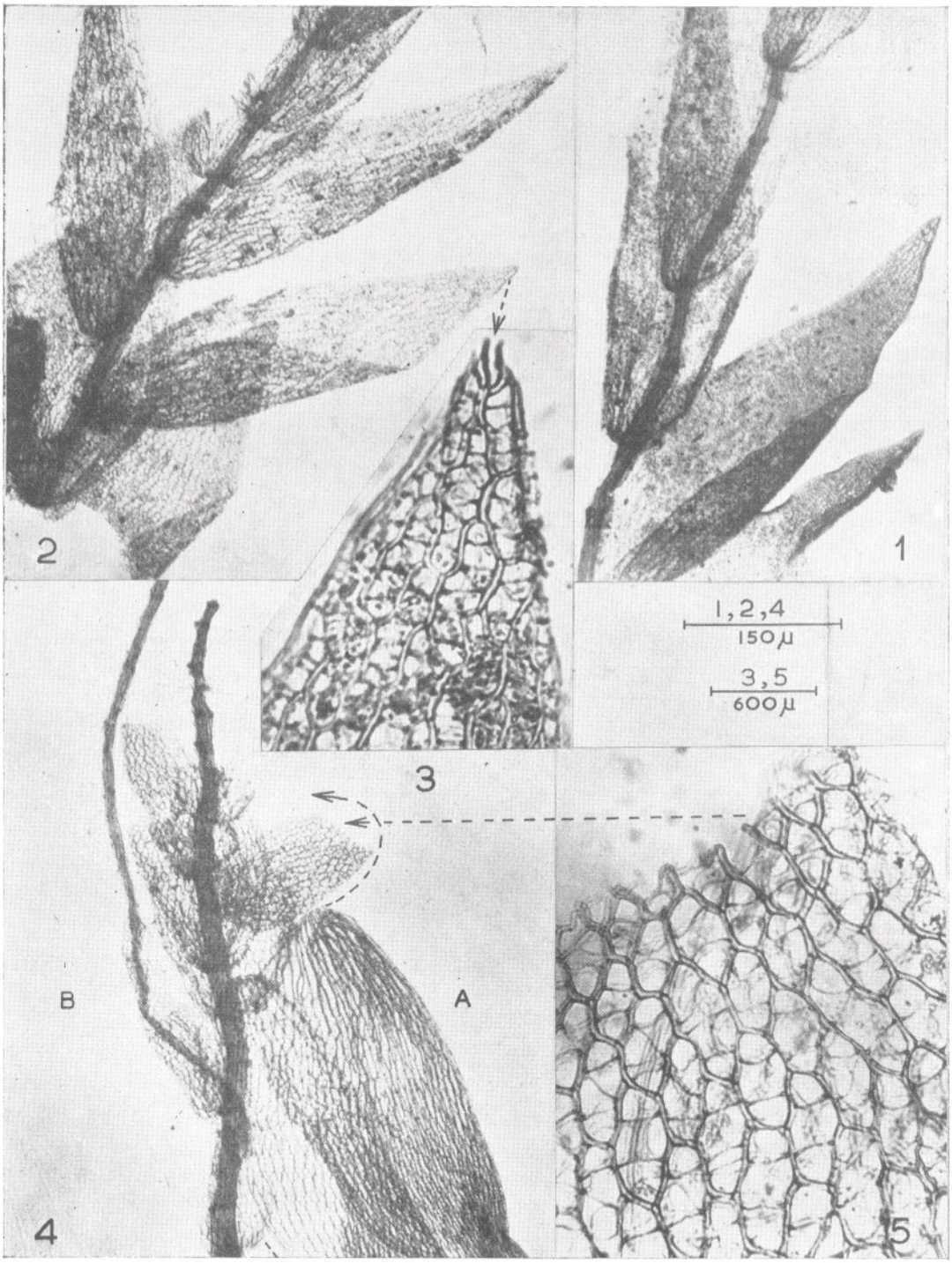

PLATE 1

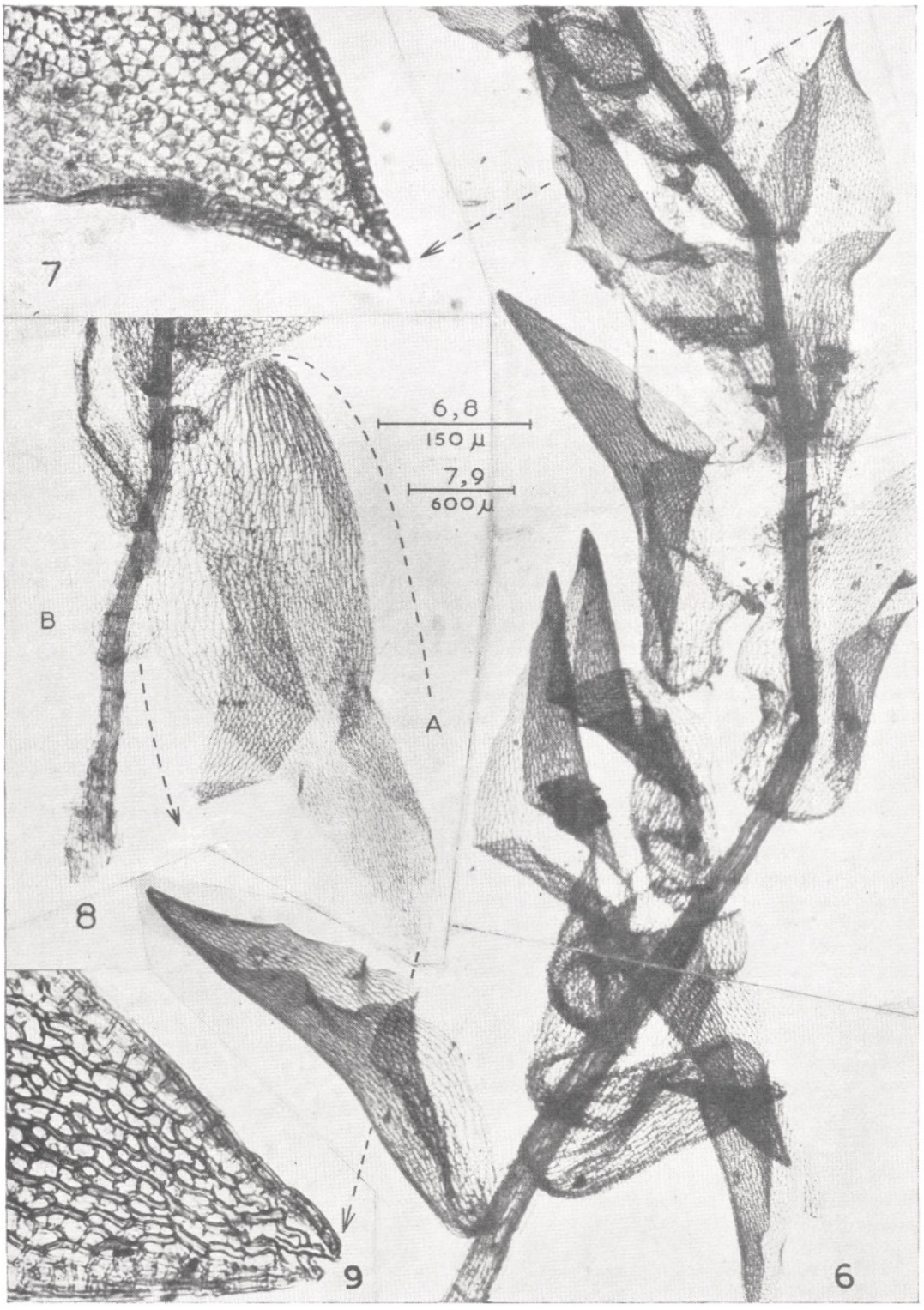

PLATE 2