

Liverworts and hornworts of Kedarnath Wild Life Sanctuary, Garhwal Himalaya, Uttarakhand, India

Y. M. Bahuguna¹, S. K. Singh² and A. B. Bhatt¹

¹Department of Botany, H. N. B. Garhwal University, Srinagar (Garhwal)-246174, India

²Botanical Survey of India, Eastern Regional Centre, Shillong-793003, India

E-mail: ymbahuguna@gmail.com; sksbsinc@rediffmail.com; bhatab2011@gmail.com

ABSTRACT

Bahuguna Y. M., Singh S. K. & Bhatt A. B. 2011. Liverworts and hornworts of Kedarnath Wild Life Sanctuary, Garhwal Himalaya, Uttarakhand, India. *Geophytology* 40(1-2): 29-45.

Thirty nine species of liverworts (Marchantiophyta) and two species of hornworts (Anthocerotophyta) are enumerated from Kedarnath Wild Life Sanctuary, Uttarakhand for the first time. Of which, *Marchantia emarginata*, *Porella campylophylla* subsp. *lancistipula*, *Schiffneria hyalina*, *Kurzia makinoana* are new record for Western Himalaya, while *Riccia beyrichiana*, *Solenostoma purpuratum*, *S. subrubrum* are new to Uttarakhand State. *Asterella multiflora*, *Wiesnerella denudata*, *Metzgeria lindbergii*, *Frullania neurota*, *Ptychanthus striatus*, *Solenostoma truncatum*, *Plagiochila sciophila*, *Scapania ciliatospinosa* and *Anthoceros angustus* are recorded for the first time from Garhwal Hills, Uttarakhand.

Key-words: Liverworts, hornworts, Kedarnath Wild Life Sanctuary, Garhwal Himalaya, Uttarakhand, India

INTRODUCTION

Kedarnath Wild Life Sanctuary is the largest protected area in Western Himalaya and harbours diversified and rich flora. It is located in Rudraprayag and Chamoli districts of Uttarakhand with an area of 975 km² at elevations between 1160 m (near Phata) to 7068 m (at Chaukhamba peak) and coordinates of 30°25' - 30°45' N and 78°55' - 79°36' E. 44.4-48.8% area of the sanctuary is forested, 7.7% comprises alpine meadows and scrub, 42.1% is rocky or under permanent snow and 1.5% represents formerly forested areas that have been degraded. The climate of the Sanctuary is diverse. During summer, the temperature reaches up to 25°C while in the winter it falls up to -10°C at elevated areas. The annual precipitation is about 310 cm. Glaciers also characterize the high altitude areas of the sanctuary. The sanctuary abodes number of alpine meadows, very rich fauna, flora, and diverse habitat. As far as bryophyte is concerned, there is no

consolidated report available till date.

During an ecological study, a field survey was conducted and bryophytes were collected from the area by one of the authors (Y.M.B.) in the year 2006 which were sent to the second author (S.K.S.) for identification. The samples have been identified with the help of published monograph and other relevant literature. A total of 41 species of liverworts and hornworts belonging to 28 genera, 24 families, 8 orders and 2 phylums are recognized from the area. The same are enumerated here for the first time. All the specimens are deposited at H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand (GUH) and a set of specimens also deposited at BSI, ERC, Shillong (Meghalaya). The classification, followed here, is after Renzaglia et al. (2009) for liverworts and Crandall-Stotler et al. (2009) for hornworts. However, within order the families are arranged alphabetically. The author's abbreviations follow Brummitt and Powell (1992).

SYSTEMATIC ENUMERATIONS

Phylum: Marchantiophyta Stotler & Crand.-Stotl.

Class: Marchantiopsida Conquist, Takht.
& W. Zimm.

Order: Marchantiales Limpr.

Family: Aytoniaceae Cavers

Genus: *Asterella* P. Beauv.

Asterella multiflora (Steph.) Pande et al. [in J. Hattori Bot. Lab. 11: 8. 1954 comb. inval. Art. 33.2] ex Kachroo in J. Hattori Bot. Lab. 19: 3. 1958; D. G. Long in Bryophyt. Biblioth. 63: 209. 2006. *Fimbriaria multiflora* Steph., Sp. Hepat. 1: 124. 1899.

Plate 1, figure 2

Specimen examined: Terrestrial, grows in moist and exposed soil, Gaurikund, September 2006, YMB 18611.

Distribution: India [Western Himalaya: Uttarakhand (Mohand Pass, Nainital, NW Kumaon), Himachal Pradesh; Eastern Himalaya: Assam, West Bengal Hills; Punjab & West Rajasthan: Punjab], Pakistan, Nepal, China (Pande et al. 1954, Long 2006a). **New to Garhwal Hills.**

Asterella wallichiana (Lehm. & Lindenb.) Grolle, Untern. Forsch. Unternehmen Nepal Himalaya 1(4): 262. 1966. *Fimbriaria wallichiana* Lehm. & Lindenb. in Lehm., Nov. Strip. Pug. 4: 4. 1832.

Specimen examined: Terrestrial, grows on dry exposed rocks and boulders, Guptkashi, September 2006, YMB 18620.

Distribution: India [Western Himalaya: Uttarakhand (Pithoragarh, Nainital, Dehradun, Mussoorie) Himachal Pradesh; Eastern Himalaya: West Bengal Hills, Sikkim, Assam; Central India: Madhya Pradesh; Gangetic Plains: Uttar Pradesh; Western Ghats: Maharashtra, Kerala, Tamil Nadu, Karnataka],

Nepal, Bhutan, Bangladesh, China, Pakistan, Myanmar, Thailand, Philippines, Japan (Pande et al. 1954, Udar & Jain 1983, Long 2006a).

Asterella khasyana (Griff.) Pande, K. P. Srivast. & Sultan Khan in J. Hattori Bot. Lab. 11: 7. 1954 'khasiana'; D. G. Long in Bryophyt. Biblioth. 63: 169. 2006. *Octokepos khasyanum* Griff., Not. Pl. Asiat. 2: 343. 1849. *Asterella blumeana* auct. plur. non (Nees) Kachroo; Kachroo in J. Hattori Bot. Lab. 12: 36. 1954. *Fimbriaria blumeana* auct. plur non Nees; Steph., Sp. Hepat. 1: 89. 1899; Kashyap, Liverw. W. Himal. 1: 62. 1929.

Specimen examined: Terrestrial, grows in moist and shady places in association with *Cyathodium aureonitens*, Kalimath, September 2006, YMB 18604a.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Kumaon, Nainital, Mussoorie); Eastern Himalaya: West Bengal Hills, Sikkim, Assam, Manipur, Meghalaya; Punjab & West Rajasthan: Rajasthan; Central India: Madhya Pradesh; Western Ghats: Karnataka, Maharashtra, Tamil Nadu], Pakistan, Nepal, Bhutan, China, Indonesia, Thailand (Kashyap 1929 as *Fimbriaria blumeana*, Pande & Srivastava 1952, Pande et al. 1953, 1954, Bapna & Vyas 1962, Hattori 1975, Kachroo 1977, Gupta & Udar 1986 as *Asterella blumeana* (Nees) Kachroo, Long 2006a).

Genus: *Mannia* Opiz

Mannia indica (Steph.) Kachroo in J. Hattori Bot. Lab. 19: 4. 1958; Udar & V. Chandra in Canad. J. Bot. 43: 155. 1965. Sushil K. Singh & D. K. Singh in Phytotaxonomy 3: 39. 2003. *Grimaldia indica* Steph., Sp. Hepat. 6: 10. 1917; Kashyap, Liverw. W. Himal. 1: 70. 1929.

Specimen examined: Terrestrial, grows on moist soil surfaces of shady places or on rocks, Gaurikund, September 2006, YMB 18759.

Plate 1

1. *Anthoceros angustus*. 2. *Asterella multiflora*. 3. *Marchantia emarginata* (inset: antheridiophore). 4. *Riccia beyrichiana*. 5. *Wiesnerella denudata*. 6. *Metzgeria lindbergii*.

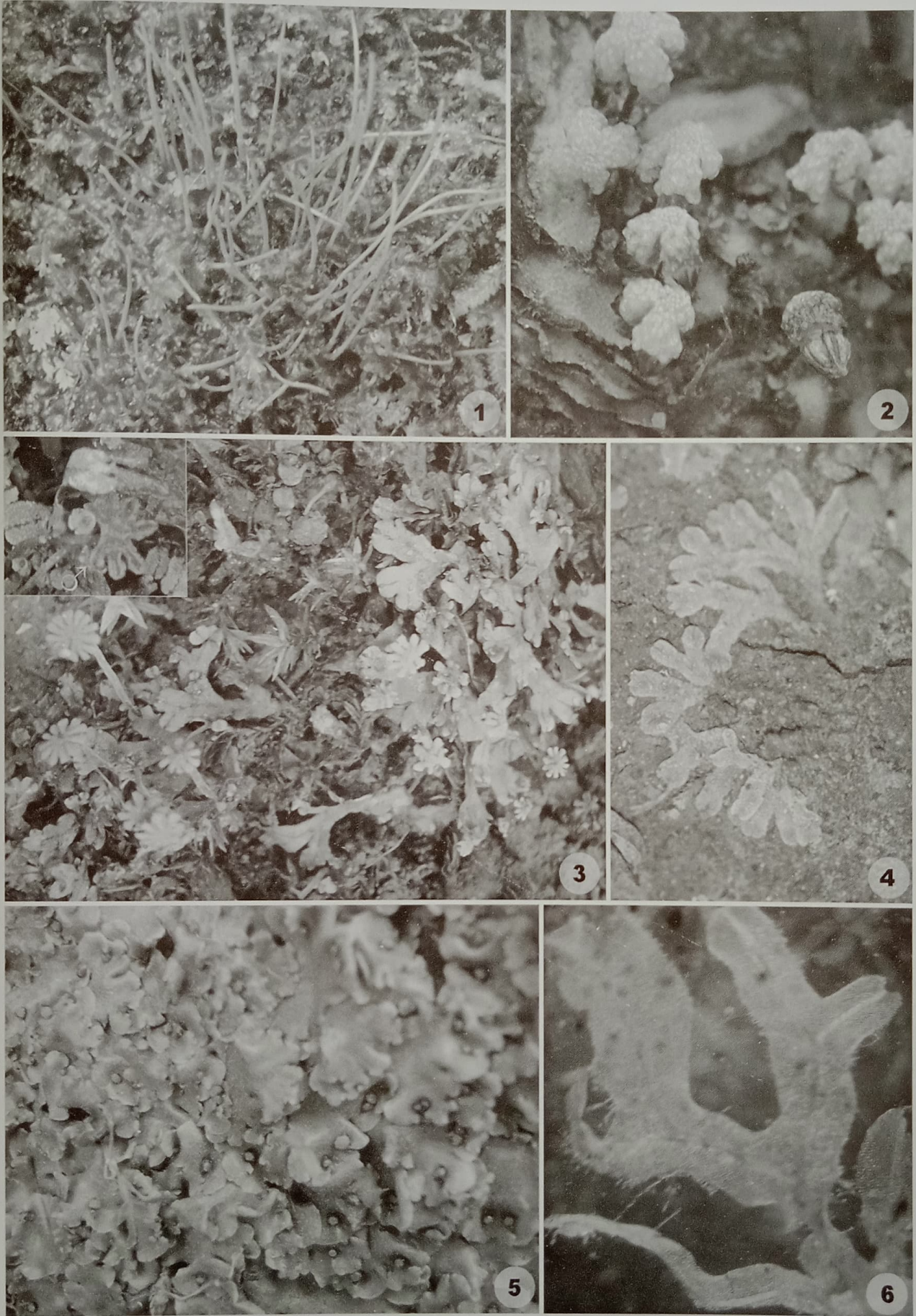


Plate 1

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Mussoorie); Punjab & West Rajasthan: Punjab; Gangetic Plains: Uttar Pradesh], Pakistan, C.I.S. (Caucasus), Africa, Europe (Stephani 1917, Kashyap 1929 as *Grimaldia indica*, Kachroo 1958, Udar & Chandra 1965, Singh & Singh 2003).

Genus: *Plagiochasma* Lehm. & Lindenb.

Plagiochasma appendiculatum Lehm. & Lindenb. in Lehm., Nov. Stirp. Pug. 4: 14. 1832; Kashyap, Liverw. W. Himal. 1: 76. 1929; Sushil K. Singh & D. K. Singh in Phytotaxonomy 3: 40. 2003.

Specimen examined: Terrestrial, grows on thin layer of soil at moist exposed places, Soanprayag to Triyuginarayan, September 2006, YMB 18741, Phata, September 2006, YMB 18748, 18673b.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Dehradun, Mussoorie, Nainital, Kumaon, Garhwal); Eastern Himalaya: Sikkim, West Bengal Hills, Assam; Punjab & West Rajasthan: Punjab, Rajasthan; Gangetic Plains: Uttar Pradesh; Central India: Madhya Pradesh; Western Ghats: Maharashtra, Tamil Nadu], Pakistan, Afghanistan, Nepal, Bhutan, China, Bangladesh, Myanmar, Indonesia, Philippines, Vietnam, Arabia, Yemen, Africa (Kashyap 1929, Pande & Srivastava 1952, Bapna & Vyas 1962, Hattori 1966, Bischler 1979, Piippo 1990, Long & Grolle 1990, Bapna & Kachroo 2000, Singh & Singh 2003).

Plagiochasma cordatum Lehm. & Lindenb. in Lehm., Nov. Stirp. Pug. 4: 13. 1832; Bischl. in J. Hattori Bot. Lab. 45: 48. 1979.

Specimen examined: Terrestrial, grows in moist places, under the crevices of big boulders, Gaurikund, September 2006, YMB 18645.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Dehradun, Mussoorie, Kumaon); Eastern Himalaya: West Bengal Hills, Assam, Meghalaya; Western Ghats: Tamil Nadu], Afghanistan, Bhutan, Nepal, China, Taiwan, Polynesia (Hawaii) (Bischler 1979, Piippo 1990, Bapna & Kachroo 2000).

Family: Conocephalaceae Müll. Frib. ex Grolle

Genus: *Conocephalum* Hill

Conocephalum conicum (L.) Dumort., Comment. Bot.: 115. 1822; Kashyap, Liverw. W.

Himal. 1: 44. 1929. *Marchantia conica* L., Sp. Pl.: 1138. 1753.

Specimen examined: Terrestrial, grows in moist and sheltered places in large patches, Kalimath, September 2006, YMB 18661.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Nainital, Ranikhet, Kumaon, Garhwal); Eastern Himalaya: West Bengal Hills, Sikkim], Pakistan, Nepal, Bhutan, China, Japan, Korea, C.I.S. (Caucasus, Siberia), Macronesia (Madeira, Azores), Europe, North Africa, North America (Kashyap 1929, Hattori et al. 1962, Hattori 1975, Long & Grolle 1990, Piippo 1990, Schuster 1992, Furuki et al. 1993, Yamada & Choe 1997, Bapna & Kachroo 1990, Grolle & Long 2000, Yamada & Iwatsuki 2006, Singh & Singh 2009, Long 2006b as *Conocephalum salebrosum* Szweykowski et al.).

Family: Cyathodiaceae Stotler & Crand.-Stotl.

Genus: *Cyathodium* Kunze

Cyathodium aureonitens (Griff.) Mitt. in J. Linn. Soc., Bot. 22: 327. 1887; S. C. Srivast. & Renu Dixit in J. Hattori Bot. Lab. 80: 177. 1996; Sushil K. Singh & D. K. Singh in Cryptog. Bryol. 28: 262. 2007. *Synhymenium aureonitens* Griff., Not. Pl. Asiat. 2: 344. 1849.

Specimen examined: Terrestrial, grows in moist and shady places in association with *Asterella khasyana*, Kalimath, September 2006, YMB 18604b.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Dehradun, Mussoorie, Chakrata); Eastern Himalaya: West Bengal Hills, Sikkim, Assam; Gangetic Plains: West Bengal Plains (Kolkata); Western Ghats: Maharashtra], Myanmar, Indonesia, Vietnam, Africa (Srivastava & Dixit 1996a, Asthana et al. 2008, Singh & Singh 2009).

Cyathodium cavernarum Kunze in Lehm., Nov. Strip. Pug. 6: 17. 1834.

Specimen examined: Terrestrial, Grows on moist and shady rocks, Triyuginarayan, September 2006, YMB 18629, 18698.

Distribution: India [Western Himalaya: Uttarakhand (Dehradun, Gumkhal, Karn Prayag, Salkuli, Mussoorie); Eastern Himalaya: West Bengal

Hills, Meghalaya; Punjab & West Rajasthan: Punjab, Rajasthan; Central India: Gujarat, Madhya Pradesh; Gangetic plains: Uttar Pradesh; Western Ghats: Maharashtra], China, Myanmar, Indonesia, Africa, Central and South America (Piippo 1990, Srivastava & Dixit 1996a, Salazar Allen & Korpelainen 2006).

Family: Dumortieraceae D. G. Long

Genus: Dumortiera Nees

Dumortiera hirsuta (Sw.) Nees in Reinw. et al. in Nova Acta Phys.-Med. Acad. Caes. Leop. Carol. Nat. Cur. 12: 410 1824; Kashyap, Liverw. W. Himal. 1: 42. 1929. *Marchantia hirsuta* Sw., Prodr.: 145. 1788.

Specimen examined: Terrestrial, grows on humus rich moist soil or near waterfalls and streams, Devharital, September 2006, YMB 18632, Sershi, September 2006, YMB 18656.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Kumaon, Mussoorie); Eastern Himalaya: Sikkim, West Bengal Hills, Assam, Arunachal Pradesh; Central India: Madhya Pradesh; Western Ghats: Tamil Nadu], Nepal, China, Japan, Korea, Philippines, Sri Lanka, Indonesia, Polynesia (Hawaiian Islands, New Zealand, Samoa), Africa, Europe, North America, South America (Kashyap 1929, Pande & Srivastava 1952, Hattori et al. 1962, Hattori 1966, 1975, Yano 1984, Srivastava & Sharma 1987, Menzel 1988, Schuster 1992, Piippo 1990, Yamada & Choe 1997, Paton 1999, Grolle & Long 1900, Langer & Tanwir 2002, Gradstein et al. 2003, Long 2006b, Yamada & Iwatsuki 2006, Singh & Singh 2009).

Family: Marchantiaceae Lindl.

Genus: Marchantia L.

Marchantia emarginata Reinw., Blume et Nees., Ann. Sci. Nat. Bot. (ser. 2) 9: 43. 1838; Bischl., Brophyt. Biblioth. 38: 183. 1989. subsp. *emarginata*.

Plate 1, figure 3

Specimen examined: Terrestrial, grows in moist and exposed places, Soanprayag, September 2006, YMB 18721; Bhujgali, September 2006, YMB 18753.

Distribution: India [Western Ghats: Tamil Nadu, Karnataka, Kerala; Andaman & Nicobar], Sri Lanka,

Philippines, Malaysia, Indonesia, Melanesia (New Guinea), Europe (Bischler 1989, Chopra 1938b). **New to Western Himalaya.** Bischler (1989) treated *Marchantia palmata* Reinw. et al., under the synonym of this species and remarked that reports like Kashyap (1929), Chopra (1938a, 1943), Pande & Srivastava (1952), Mehra (1959), Singh (1966), Bir and Chopra (1972) probably belongs to *M. papillata* subsp. *grossibarba* not to this species. Hence, the report of this species constitutes first authentic record of this species from Western Himalaya.

Marchantia paleacea Bertol. in Opusc. Sci. 1: 242. 1817; Bischl. in Bryophyt. Biblioth. 38: 91. 1989. *Marchantia nepalensis* Lehm. & Lindenb. in Lehm., Nov. Stirp. Pug. 4: 10. 1832; Kashyap, Liverw. W. Himal. 1: 36. 1929; V. B. Singh in Bull. Lucknow Natl. Bot. Gard. 156: 15. 1966. subsp. *paleacea*.

Specimen examined: Terrestrial, grows in moist places on sandy soils, Phata, September 2006, YMB 18673a.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Garhwal, Kumaon); Eastern Himalaya: West Bengal Hills, Sikkim, Assam, Manipur, Meghalaya; Punjab & West Rajasthan: Punjab; Gangetic plains: West Bengal Plains, Uttar Pradesh; Central India: Madhya Pradesh; Western Ghats: Tamil Nadu], Afghanistan, Pakistan, Bhutan, Nepal, China, Myanmar, Vietnam, Japan, Indonesia, Philippines, Turkey, Iran, Korea, Polynesia (Hawaiian Islands, New Zealand, Samoa, Tahiti), Melanesia (Fiji, New Guinea), Macronesia (Azores), Africa, Europe, North America, South America (Kashyap 1929, Pande & Srivastava 1952 as *Marchantia nepalensis*, Hattori 1966, 1971, 1975, Singh 1966 as *Marchantia nepalensis*, Bischler 1989, Schuster 1992, Long & Grolle 1990, Piippo 1990, Yamada & Choe 1997, Grolle & Long 2000, Long 2006b, Yamada & Iwatsuki 2006, Singh & Singh 2009).

Marchantia polymorpha L., Sp. Pl.: 1137. 1753; Mitt. in J. Proc. Linn. Soc., Bot. 5: 125. 1861; Kashyap, Liverw. W. Himal. 1: 32. 1929; V. B. Singh in Bull. Lucknow Natl. Bot. Gard. 156: 20. 1966; Bischl. in Bryophyt. Biblioth. 38: 74. 1989. subsp. *polymorpha*.

Specimen examined: Terrestrial, grows in moist places in pure populations, Bhujgali, September 2006, YMB 18776.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Garhwal, Kedarnath); Eastern Himalaya: West Bengal Hills, Sikkim, Assam, Meghalaya; Punjab & West Rajasthan: Punjab, Rajasthan; Gangetic plains: Uttar Pradesh; Western Ghats: Tamil Nadu], Pakistan, Afghanistan, Nepal, Bhutan, China, Sri Lanka, Myanmar, Japan, Korea, Vietnam, Turkey, Iran, Iraq, Israel, Indonesia, Malaysia, Philippines, C.I.S. (Caucasus, Siberia), Melanesia (New Guinea), Polynesia (New Zealand), Australia, Europe, North & South America (Kashyap 1929, Bapna & Vyas 1962, Singh 1966, Crundwell & Nyholm 1979, Yano 1984, Menzel 1988, Bischler 1989, Long & Grolle 1990, Piippo 1990, Schuster 1992b, Furuki et al. 1993, Yamada & Choe 1997, Paton 1999, Grolle & Long 2000, Gradstein et al. 2003, Long 2006b, Yamada & Iwatsuki 2006).

Family: Ricciaceae Rehb.

Genus: Riccia L.

Riccia beyrichiana Hampe in Lehm., Nov. Stirp. Pug. 7: 1. 1838; Pande & Udar in Proc. Natl. Inst. Sci. India, B 25: 97. 1959; K. P. Srivast. in Bull. Lucknow Natl. Bot. Gard. 104: 25. 1964; Sushil K. Singh & D. K. Singh in Cryptog. Bryol. 28: 260. 2007.

Plate 1, figure 4

Specimen examined: Terrestrial, grows in moist and sheltered places or in crevices of rocks, Gaurikund, September 2006, YMB 18643.

Distribution: India [Western Himalaya: Himachal Pradesh; Eastern Himalaya: Meghalaya], Pakistan, Macronesia (Azores), Europe, North Africa, North America (Pande & Udar 1959, Srivastava 1964, Schuster 1992, Furuki et al. 1993, Paton 1999, Grolle & Long 2000). **New to Uttarakhand.**

Family: Targioniaceae Dumort.

Genus: Targionia L.

Targionia indica Udar & Asha Gupta in Geophytology 13: 83. 1983; Sushil K. Singh & D. K. Singh in Phytotaxonomy 3: 38. 2003.

Specimen examined: Terrestrial, grows in exposed places in patches, Kalimath, September 2006, YMB 18661.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Nainital); Central India: Madhya Pradesh; Western Ghats: Maharashtra], endemic (Udar & Gupta 1983, Singh & Singh 2002, 2003, Singh & Singh 2009).

Family: Wiesnerellaceae Inoue

Genus: Wiesnerella Schiffn.

Wiesnerella denudata (Mitt.) Steph., Sp. Hepat. 1: 154. 1899; Kashyap. Liverw. W. Himal. 1: 40. 1929. *Dumortiera denudata* Mitt. J. Proc. Linn. Soc. Bot. 5: 125. 1861.

Plate 1, figure 5

Specimen examined: Terrestrial, grows on moist rock surfaces near streams, Gaurikund, September 2006, YMB 18781.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Kumaon); Eastern Himalaya: West Bengal Hills, Sikkim; Punjab & West Rajasthan: Punjab], Afghanistan, Nepal, China, Taiwan, Korea, Japan, Indonesia, Melanesia (Hunon Peninsula), Polynesia (Hawaii) (Kashyap 1929, Piippo 1990, Bapna & Kchroo 2000, Langer & Tanwir 2002). **New to Garhwal Hills.**

Class: Jungermanniopsida Stotler & Crand.-Stotl.

Order: Pelliiales He-Nygrén, Juslén, Ahonen, Glenny & Piippo

Family: Pelliaceae H. Klinggr.

Genus: Pellia Raddi

Pellia endiviifolia (Dicks.) Dumort., Recueil Observ. Jungerm.: 27. 1835; S. C. Srivast. in Nova Hedwigia 63: 336. 1979. *Jungermannia endiviifolia* Dicks., Fasc. Pl. Crypt. Brit. 4: 19. 1801.

Specimen examined: Terrestrial, grows on moist rock surfaces near streams, Gaurikund, September 2006, YMB 18720.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Kumaon, Mussoorie); Eastern Himalaya: West Bengal Hills,

Sikkim, Assam], Pakistan, Nepal, Bhutan, China, Korea, Japan, Turkey, Iran, C.I.S. (Caucasus, Russia, Siberia), Africa, Europe, North America, widespread in temperate regions of Northern hemisphere (Srivastava & Udar 1979, Crundwell & Nyholm 1979, Srivastava 1979, Long & Grolle 1990, Piippo 1990, Furuki et al. 1993, Yamada & Choe 1997, Paton 1999, Grolle & Long 2000, Langer & Tanwir 2002, Yamada & Iwatsuki 2006, Singh & Singh 2009).

Order: Fossombroniales Schljakov

Family: Calyculariaceae He-Nygrén, Juslén, Ahonen, Glenny & Piippo

Genus: *Calycularia* Mitt.

Calycularia crispula Mitt. in J. Proc. Linn. Soc., Bot. 5: 122. 1861; Kashyap, Liverw. W. Himal. 1: 109. 1929; R. S. Chopra in J. Indian Bot. Soc. 22: 240. 1943; *Calycularia birmensis* Steph., Sp. Hepat. 1: 359. 1900; R. S. Chopra in J. Indian Bot. Soc. 22: 240. 1943.

Specimen examined: Terrestrial, grows in moist and shaded places on soil and rock surfaces, Dugalbitta, September 2006, YMB 18623.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Gaurikund-Rudraprayag, Gangolihat-Pithoragarh); Eastern Himalaya: West Bengal Hills, Sikkim; Punjab & West Rajasthan: Rajasthan], Nepal, Bhutan, China, Taiwan, Myanmar, Korea, Japan, Thailand, Mexico, Tanzania, Ethiopia (Mitten 1861, Kashyap 1929, Pande & Udar 1956, Bapna & Vyas 1962, Hattori 1966, Piippo 1990, Long & Grolle 1990, Bapna & Kachroo 2000, Yamada & Iwatsuki 2006, Singh & Singh 2009).

Order: Metzgeriales Chalaud

Family: Metzgeriaceae H. Klinggr.

Genus: *Metzgeria* Raddi

Metzgeria lindbergii Schiffn. in Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. 67: 182. 1898; M. L. So in J. Hattori Bot. Lab. 94: 170. 2003; Sushil K. Singh & D. K. Singh in Cryptog. Bryol. 28: 258. 2007. *M. conjugata* Lindb. subsp. *japonica* (S. Hatt.) Kuwah. in J. Hattori Bot. Lab. 20: 135. 1958; S. C. Srivast. & Udar in New Botanist, Int. Quart. J.

Pl. Sci. Res. 2: 43. 1975.

Plate 1, figure 6

Specimen examined: Moist and shaded rocks surfaces, Chopta, September 2006, YMB 18603; Epiphytic, grows on moist-shady places, associated with moist hanging mosses, Dugalbitta, September 2006, YMB 18690.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Nainital); Eastern Himalaya: West Bengal Hills, Sikkim, Meghalaya], Bhutan, China, Indonesia, Sri Lanka, Nepal, Philippines, Japan, Korea, C.I.S (Sakhalin), Malaysia (Hattori 1955, 1966, 1975 as *M. conjugata* var. *japonica* S. Hatt., Kuwahara 1958, 1975, Hattori et al. 1962, Srivastava & Udar 1975 as *M. conjugata* subsp. *japonica* (S. Hatt.) Kuwah., Piippo 1990, Long & Grolle 1990, Yamada & Choe 1997, So 1903, Yamada & Iwatsuki 1906, Singh & Singh 1909). **New to Garhwal Hills.**

Order: Porellales Schljakov

Family: Frullaniaceae Lorch

Genus: *Frullania* Raddi

Frullania muscicola Steph. in Hedwigia 33: 146. 1894 & Mém. Soc. Sci. Nat. Cherbourg 29: 213. 1894 & Sp. Hepat. 4: 444. 1910; Kashyap, Liverw. W. Himal. 2: 14. 1932; B. Narayan et al. in Indian J. Forest. 24: 275. 2001.

Specimen examined: Epiphytic, grows on bark of trees in moist places, Bhujgali, September 2006, YMB 18657.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Mussoorie, N. Garhwal, Tapovan); Eastern Himalaya: Sikkim, Assam; Central India: Madhya Pradesh; Western Ghats: Tamil Nadu], Nepal, China, Japan, Korea, C.I.S (Sakhalin) (Kashyap 1932, Kamimura 1961, Hattori et al. 1962, Hattori 1966, 1975, Hattori & Thaithong 1978, Mizutani 1979, Nath & Asthana 1998, Piippo 1990, Yamada & Choe 1997, Bapna & Kachroo 1900, Srivastava & Alam 1902, Langer & Tanwir 1902, Yamada & Iwatsuki 1906, Singh & Singh 1909).

Frullania neurota Taylor in London J. Bot. 5: 400. 1846.

F. breviscula Mitt., Proc. Linn. Soc. 5: 120. 1861.

Plate 2, figure 1

Specimen examined: Epiphytic, grows on bark of trees in moist places, Triyuginarayan, September 2006, YMB 18792.

Distribution: India [Western Himalaya: Uttarakhand (Kumaon-Sobhla Forests) Eastern Himalaya: Meghalaya, Sikkim, West Bengal Hills, Western Ghats: Tamil Nadu], East Nepal, China, Sri Lanka, Myanmar, Thailand, Indonesia, Polynesia (Hawaii), North America (Mitten 1861, Hattori 1966, Kachroo 1970, Udar & Nath 1971, Hattori & Thaithong 1978, Nath & Asthana 1991, 1998, Singh et al. 1908). **New to Garhwal Hills.**

Family: Lejeuneaceae Cavers

Genus: Ptychanthus Nees

Ptychanthus striatus (Lehm. & Lindenb.) Nees, Naturgesch. eur. Leberm. 3: 212. 1838; Kashyap, Liverw. W. Himal. 2: 25. 1932; U. S. Awasthi & S. C. Srivast. in Geophytology 17: 12. 1987; Sushil K. Singh & D. K. Singh in Cryptog. Bryol. 28: 257. 2007. *Jungermannia striatus* Lehm. & Lindenb. in Lehm., Nov. Stirp. Pug. 4: 16. 1832.

Plate 2, figure 2

Specimen examined: Epiphytic, Pothivasha, September 2006, YMB 18642.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Kumaon); Eastern Himalaya: West Bengal Hills, Sikkim, Meghalaya; Central India: Madhya Pradesh; Western Ghats: Maharashtra, Karnataka, Kerala, Tamil Nadu; Andaman & Nicobar Islands], Nepal, Bhutan, China, Myanmar, Philippines, Indonesia, Japan, Malaysia, Sri Lanka, Polynesia (New Zealand, Samoa), Melanesia (New Guinea), Australia, Africa, widely distributed in tropical and subtropical

regions (Kashyap 1932, Hattori 1966, 1971, 1975, Mizutani 1961, 1976, Awasthi & Srivastava 1987, Menzel 1988, Long & Grolle 1990, Streimann 1991, Piippo 1990, Zhu & So 1901, Zhu & Long 1903, Singh & Singh 1909). **New to Garhwal Hills.**

Family: Porellaceae Cavers

Genus: Porella L.

Porella campylophylla (Lehm. & Lindenb.) Trevis. in Mem. Reale Ist. Lombardo Sci., Ser. 3, Cl. Sci. Mat. 4: 408. 1877; Shaheen & S. C. Srivast. in Geophytology 19: 34. 1989; Sushil K. Singh & D. K. Singh in Geophytology 36: 94. 2006. *Jungermannia campylophylla* Lehm. & Lindenb. in Lehm., Nov. Stirp. Pug. 6: 40. 1834. *Madotheca campylobhylla* Lehm. & Lindenb. in Gottsche et al., Syn. Hepat. 2: 265. 1845; Kashyap, Liverw. W. Himal. 2: 29. 1932. *Madotheca gollanii* Steph., Sp. Hepat. 4: 304. 1910; Kashyap, Liverw. W. Himal. 2: 29. 1932. *Madotheca denticulata* Kashyap, Liverw. W. Himal. 2: 31. 1932. var. *campylophylla*.

Specimen examined: Terrestrial, grows on moist rocks, Triyuginarayan, September 2006, YMB 18728.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Mussoorie, Ranikhet, Nainital, Pindari); Eastern Himalaya: West Bengal Hills, Sikkim, Arunachal Pradesh, Meghalaya; Western Ghats: Tamil Nadu], Nepal, Bhutan, China Thailand, Myanmar Vietnam (Kashyap 1932 as *Madotheca campylophylla*, *M. gollanii* and *M. denticulata*, Hattori 1966, 1969, 1971, 1975, 1976, 1978, Pócs 1968, Kitagawa 1979, Shaheen & Srivastava 1989, Piippo 1990, Long & Grolle 1990, Singh & Singh 2009).

Porella campylophylla (Lehm. & Lindenb.) Trevis. subsp. *lancistipula* (Steph.) S. Hatt. in J. Hattori Bot. Lab. 44: 102. 1978; Shaheen & S. C. Srivast. in Geophytology 19: 37. 1989. *Madotheca*

Plate 2

1. *Frullania neurota*. 2. *Ptychanthus striatus*. 3. *Porella campylophylla* subsp. *lancistipula*. 4. *Schiffneria hyalina*. 5. *Solenostoma purpuratum*. 6. *Solenostoma subrubrum*; 7. *Solenostoma truncatum*; 8. *Kurzia makinoana*.

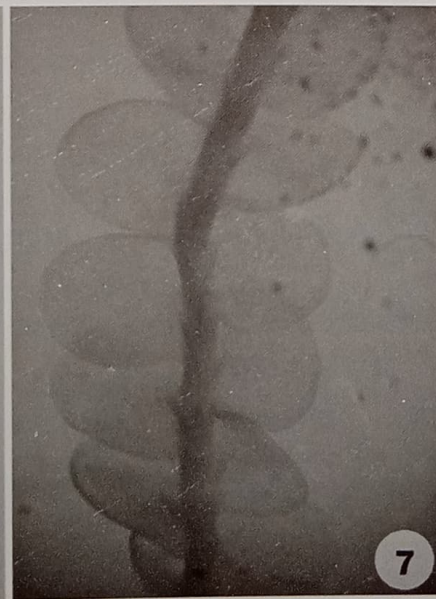
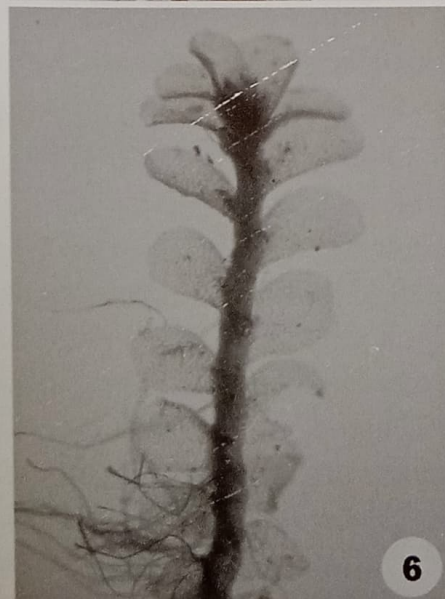
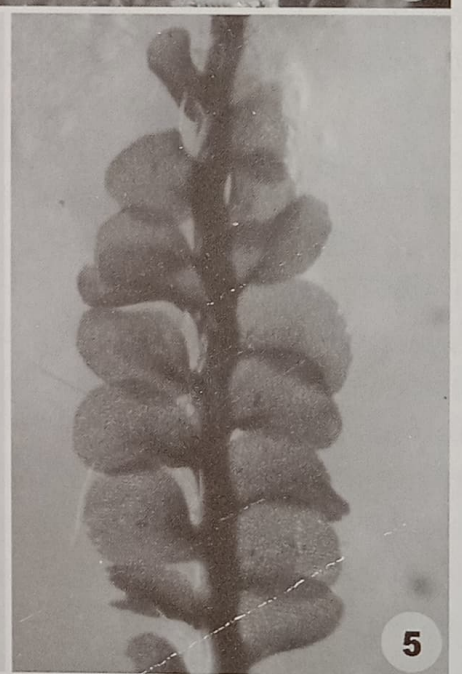
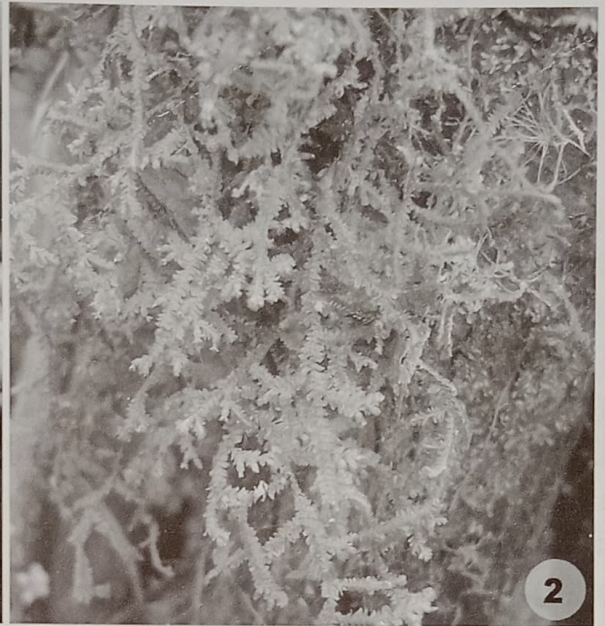


Plate 2

lancistipula Steph., Sp. Hepat. 6: 524. 1924. *Porella lancistipula* (Steph.) S. Hatt. in J. Hattori Bot. Lab. 30: 138. 1967.

Plate 2, figure 3

Specimen examined: Terrestrial, grows in moist and shady places on rocks, Bhujgali, September 2006, YMB 18668a; Dugalbitta, September 2006, YMB 18631b; Chopta, September 2006, YMB 18672.

Distribution: India [Western Ghats: Kerala, Karnataka, Tamil Nadu] endemic (Hattori 1978, Shaheen & Srivastava 1989). **New to Western Himalaya.**

Porella plumosa (Mitt.) Inoue in Bull. Natl. Sci. Mus. Tokyo 9: 385. 1966; S. Hatt. in J. Hattori Bot. Lab. 30: 144. 1967; Udar & Shaheen in Misc. Bryol. Lichenol. 9: 196. 1983; Sushil K. Singh & D. K. Singh in Geophytology 36. 103. 2006. *Madotheca plumosa* Mitt. in J. Proc. Linn. Soc., Bot. 5: 108. 1961; Steph., Sp. Hepat. 4: 308. 1910; Kashyap, Liverw. W. Himal. 2: 30. 1932.

Specimen examined: Epiphytic, grows in association with mosses, Bhujgali, September 2006, YMB 18683.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Nainital, Mussoorie); Eastern Himalaya: Meghalaya; Western Ghats: Tamil Nadu], Pakistan, Nepal, China, Myanmar, Philippines, Thailand, Vietnam (Kashyap 1932 as *Madotheca plumosa*, Pócs 1968, Hattori 1970, Udar & Shaheen 1983, Piippo 1990, Furuki et al. 1993, Singh & Singh 2009).

Order: Jungermanniales H. Klinggr.

Family: Calypogeiaceae Arnell

Genus: Calypogeia Raddi

Calypogeia lunata Mitt. in J. Proc. Linn. Soc., Bot. 5: 107. 1861; D. Sharma & S. C. Srivast. in Bryophyt. Biblioth. 47: 189. 1993.

Specimen examined: Epiphytic, grows on rotten wood, Devharital, September 2006, YMB 18614.

Distribution: India [Western Himalaya: Uttarakhand (Mussoorie) Eastern Himalaya: Sikkim, West Bengal Hills, Assam, Meghalaya], Nepal, Bhutan,

China, Thailand (Mitten 1861, Chopra 1943, Long & Grolle 1990, Sharma & Srivastava 1993).

Family: Cephaloziaceae Mig.

Genus: Schiffneria Steph.

Schiffneria hyalina Steph. in Oesterr. Bot. Z. 44: 1. 1894. *Schiffneria viridis* Steph., Sp. Hepat. 3: 278. 1908; R. S. Chopra in J. Indian Bot. Soc. 22: 245. 1943.

Plate 2, figure 4

Specimen examined: Terrestrial, grows on moist rocks, Rambara (enroute Kedarnath), September 2006, YMB 18678.

Distribution: India [Eastern Himalaya: West Bengal Hills, Sikkim], Bhutan, China, Taiwan, Philippines, Thailand, Indonesia, Malaysia, Japan, Melanesia (New Guinea) (Chopra 1943, Long & Grolle 1990, Asthana et al. 1994). **New to Western Himalaya.**

Family: Geocalycaceae H. Klinggr.

Genus: Geocalyx Nees

Geocalyx graveolens (Schrad.) Nees, Naturgesch. eur. Leberm. 2: 397. 1836; Udar et al. in Proc. Indian Acad. Sci., Pl. Sci. 91: 139. 1982; Abha Srivast. & S. C. Srivast., Indian Geocalyc.: 209. 2002; Sushil K. Singh & D. K. Singh in Cryptog. Bryol. 28: 256. 2007. *Jungermannia graveolens* Schrad., Syst. Samml. Krypt. Gew. 2: 6. 1797.

Specimen examined: Epiphytic, grows on decaying wood in moist places, Pothivasha September 2006, YMB 18608; Terrestrial grows on moist soil-covered rocks, Kanchula-khark, September 2006, YMB 18650.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Pithoragarh-Munsyari, Lilam, Bogdiyar, Chamoli-Ghangaria, Hemkund, Valley of Flowers); Eastern Himalaya: Sikkim, Arunachal Pradesh] Nepal, China, Bhutan, Japan, C.I.S. (Siberia, Caucasus), Macronesia (Azores, Madeira), Europe, North America (Schuster 1980, Udar et al. 1982, Long & Grolle 1990, Piippo 1990, Singh 1997, Paton 1999, Grolle & Long 2000, Long 2005, Yamada & Iwatsuki 2006, Singh & Singh 2009).

Family: Jungermanniaceae Rchb.**Genus: Solenostoma Mitt.**

Solenostoma purpuratum (Mitt.) Steph. Sp. Hepat. 2: 51. 1901; Váňa & D. G. Long in Nova Hedwigia 89: 506. 2009. *Jungermannia purpurata* Mitt. in J. Proc. Linn. Soc., Bot. 5: 91. 1861; S. Hatt. in Hara, Fl. East. Himal. 512. 1966. *Aplozia purpurata* (Mitt.) R. S. Chopra in Proc. Indian Acad. Sci. 8B: 430. 1938 & in J. Indian Bot. Soc. 22: 241. 1943. *Haplozia purpurata* (Mitt.) Herzog in Ann. Bryol. 12: 74. 1939.

Plate 2, figure 5

Specimen examined: Grows on moist humus rich soil on rocks, Gaurikund, September 2006, YMB 18742.

Distribution: India [Western Himalaya: Himachal Pradesh; Eastern Himalaya: Sikkim, West Bengal Hills, Meghalaya, Assam; Western Ghats: Tamil Nadu] Nepal, China (Hattori 1966, Váňa 1972b as *Jungermannia purpurata* Mitt., Váňa & Long 2009). **New to Uttarakhand.**

Solenostoma truncatum (Nees) R. M. Schust. [Austral Hepat. 2: 378. 2002, nom. inval.] ex Váňa et D. G. Long in Nova Hedwigia 89: 509. 2009. *Jungermannia truncata* Nees, Hepat. Jav. 29. 1830; S. Hatt. in Ohashi, Fl. East. Himal. 3: 220. 1975. *Jungermannia polyrhiza* Hook., in Lehm., Nov. Strip. Pug. 6: 34. 1834; R. S. Chopra in J. Indian Bot. Soc. 22: 242. 1943.

Plate 2, figure 7

Specimen examined: Terrestrial, grows in moist places Dugalbitta, September 2006, YMB 18615; Chopta to Kanchula-khark area September 2006, YMB 18622; Rambara (en route Kedarnath), September 2006, YMB 18647; Kanchula-khark, September 2006, YMB 18765b.

Distribution: India [Western Himalaya: Jammu & Kashmir, Uttarakhand (Kumaon); Eastern Himalaya: West Bengal Hills, Sikkim, Assam, Meghalaya; Western Ghats: Kerala] Nepal, Bhutan, Pakistan, China, Taiwan, Sri Lanka, Myanmar, Thailand, Indonesia, Japan, Korea, Vietnam, Malaysia, Philippines, West Iran, Cambodia, Melanesia (Papua New Guinea), Australia

(Amakawa 1972, Hattori 1975, Váňa 1972a, Long & Grolle 1990, Langer & Tanwir 2002, Manju et al. 2008 as *Jungermannia truncata* Nees, Váňa & Long 2009, Daniels 2010). **New to Garhwal Hills.**

Solenostoma subrubrum (Schiffn. ex Steph.) Váňa et D. G. Long in Nova Hedwigia 89: 508. 2009. *Jungermannia subrubra* Schiffn. ex Steph., Sp. Hepat. 6: 93. 1924; Amakawa in J. Hattori Bot. Lab. 30: 185. 1967; S. C. Srivast. & Panzy Singh in Yushania 3: 20. 1986; Sushil K. Singh & D. K. Singh in Cryptog. Bryol. 28: 257. 2007.

Plate 2, figure 6

Specimen examined: Terrestrial, grows in moist and shady places on rocks, Bhujgali, September 2006, YMB 18668b, 18669; Devharital, September 2006, YMB 18701.

Distribution: India [Western Himalaya: Himachal Pradesh; Eastern Himalaya: West Bengal Hills, Sikkim, Meghalaya], Nepal, Bhutan, Taiwan, China (Amakawa 1967, Hattori 1975, Srivastava & Singh 1986, Piippo 1990, Long & Grolle 1990 as *Jungermannia subrubra* Schiffn. ex Steph., Váňa & Long 2009). **New to Uttarakhand.**

Family: Lepidoziaceae Limpr.**Genus: Kurzia G. Martens**

Kurzia makinoana (Steph.) Grolle in Rev. Bryol. Lichenol. 32: 171. 1963 '1964'; S. Hatt. in Hara, Fl. East. Himal. 506. 1966; D. Sharma & S. C. Srivast. in Bryophyt. Biblioth. 47: 81. 1993. *Lepidozia makinoana* Steph. in Bull. Herb. Boiss. 5: 94. 1897.

Plate 2, figure 8

Specimen examined: Terrestrial, grows in moist and shady places, Chopta, September 2006, YMB 18686.

Distribution: India [Eastern Himalaya: Sikkim, Meghalaya], Nepal, Bhutan, China, Taiwan, Korea, Japan, Philippines, Europe, North America (Hattori 1966, 1975, Long & Grolle 1990, Sharma & Srivastava 1993). **New to Western Himalaya.**

Genus: Lepidozia (Dumort.) Dumort.

Lepidozia reptans (L.) Dumort., Recueil Observ. Jungerm. 19. 1835; Mitt. in J. Proc. Linn. Soc., Bot. 5:

104. 1861; D. Sharma & S. C. Srivast. in Bryophyt. Biblioth. 47: 64. 1993. *Jungermannia reptans* L., Sp. Pl. 2: 1133. 1753. *Lepidozia tridens* Steph., Sp. Hepat. 3: 617. 1909; R. S. Chopra in J. Indian Bot. Soc. 22: 246. 1943. *Lepidozia macrocalyx* Steph. in Mem. Soc. Sci. Nat. Cherbourg 29: 216. 1894; R. S. Chopra in J. Indian Bot. Soc. 22: 246. 1943.

Specimen examined: Terrestrial, grows in caespitose patches, Kanchula-khark, September 2006, YMB 18765a.

Distribution: India [Western Himalaya: Jammu & Kashmir, Uttarakhand (Nainital, Valley of Flowers); Eastern Himalaya: Sikkim, West Bengal Hills, Meghalaya, Manipur, Assam; Western Ghats: Tamil Nadu], Nepal, Pakistan, China, Taiwan, Bhutan, Japan, Thailand, C.I.S. (Siberia, Sakhalin), Macronesia (Azores, Madeira), Europe, North, South and Central America (Long & Grolle 1990, Sharma & Srivastava 1993).

Family: Lophocoleaceae Vanden Berghen

Genus: *Chiloscyphus* Corda

Chiloscyphus himalayensis Steph., Sp. Hepat. 3: 209. 1907; Kashyap, Liverw. W. Himal. 2: 62. 1932; Abha Srivast. & S. C. Srivast., Indian Geocalyc.: 51. 2002; Sushil K. Singh & D. K. Singh in Cryptog. Bryol. 28: 255. 2007.

Specimen examined: Epiphytic, grows on decaying wood, Guptkashi, September 2006, YMB 18699.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Bhowali, Cahubatia, Kausani, Kilbury, Nainital, Seetalkhet, Mussoorie)], endemic (Stephani 1906-1909, Kashyap 1932, Srivastava & Srivastava 2002, Langer & Tanwir 2002, Singh & Singh 2009).

Genus: *Lophocolea* (Dumort.) Dumort.

Lophocolea bidentata (L.) Dumort. Recueil Observ. Jungerm.: 17. 1835; R. M. Schust., Hepat.

Anthocerotae N. Amer. 4: 190. 1980; Grolle in Bryophyt. Biblioth. 48: 91. 1995; Abha Srivast. & S. C. Srivast, Indian Geocalyc.: 187. 2002; Konstant. et al. in Arctoa 18: 18. 2009. *Jungermannia bidentata* L. Sp. Pl.: 1132. 1753.

Specimen examined: Terrestrial, grows on thin layer of soil at moist places, Tungnath, September 2006, YMB 18788.

Distribution: India [Western Himalaya: Uttarakhand (Mussoorie, Nainital, Bhowali); Eastern Himalaya: Sikkim, West Bengal Hills; Western Ghats: Tamil Nadu], Nepal, Bhutan, China, Indonesia, Japan, Russia, Polynesia (New Zealand), Europe, North, Central & South America, Africa, Australia (Schuster 1980, Long & Grolle 1990, Piippo 1990, Grolle 1995, Paton 1999, Srivastava & Srivastava 2002, Yamada & Iwatsuki 2006, Konstantinova et al. 2009).

Family: Plagiochilaceae Müll. Frib. & Herzog

Genus: *Plagiochila* (Dumort.) Dumort.

Plagiochila korthalsiana Molk. in Sande Lac., Ned. Kruidk. Arch. 3: 416. 1855; Steph., Sp. Hepat. 2: 291. 1906; Inoue, *Plagiochila* S.E. Asia: 113. 1984; Bapna & Kachroo, Hepaticol. India 2: 101. 2000. *Plagiochila accedens* Steph., Sp. Hepat. 2: 341. 1906; Kashyap, Liverw. W. Himal. 2: 73. 1932; S. C. Srivast. & Renu Dixit in Geophytology 25: 99. 1996.

Specimen examined: Terrestrial, grows in moist and shady places, Bhujgali, September 2006, YMB 18670.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Mussoorie, Pithoragarh); Andaman & Nicobar Islands: South Andaman], Indonesia, Philippines (Kashyap 1932, Menzel 1988, Srivastava & Dixit 1996b, Langer & Tanwir 2002 as *Plagiochila accedens*, Inoue 1984, Singh & Singh 2009).

Plagiochila sciophila Nees ex Lindenb., Sp. Hepat. (*Plagiochila* Fasc. 2 - 4): 100. 1840; Gottsche

Plate 3

1. *Plagiochila sciophila*. 2. *Scapania ciliatospinosa* (inset: a portion in dorsal view).

et al., Syn. Hepat. 1: 37. 1844; Steph., Sp. Hepat. 2: 299. 1906; Inoue in J. Hattori Bot. Lab. 25: 95. 1962 & Bull. Natl. Sci. Mus. Tokyo 8: 396. 1965; M. L. So in Syst. Bot. Monogr. 60: 112. 2001; Sushil K. Singh & D. K. Singh in Cryptog. Bryol. 28: 260. 2007. *Plagiochila acanthophylla* Gottsche, Bot. Zeitung (Berlin) 16, Beil. 37, 38. 1858. *P. flavovirens* Steph., Sp. Hepat. 6: 156. 1918. *P. vygensis* Steph., Sp. Hepat. 6: 237. 1921.

Plate 3, figure 1

Specimen examined: Terrestrial, grows in moist and shady places on wet rocks, Triyuginarayan, September 2006, YMB 18601, 18607; Dugalbitta, September 2006, YMB 18631a, 18638; Sershi, Kanchula-khark, September 2006, YMB 18677; Epiphytic, Rambara (enroute Kedarnath), September 2006, YMB 18743.

Distribution: India [Western Himalaya: Jammu & Kashmir, Himachal Pradesh, Uttarakhand

(Pithoragarh); Eastern Himalaya: West Bengal Hills, Sikkim, Assam, Meghalaya; Western Ghats: Tamil Nadu], Pakistan, Nepal, Bhutan, China, Japan, Korea, Philippines, Malayasia, Vietnam, Thailand, Indonesia, Melanesia (New Guinea), Polynesia (Samoa), North America (Hattori 1966, 1975, Schuster 1980, Inoue 1984, Piippo 1990, Long & Grolle 1990, Furuki et al. 1993, So 2001, Zhu & So 2001, Nair et al. 1905, Yamada & Iwatsuki 2006, Rawat & Srivastava 2007, Singh & Singh 2009). **New to Garhwal Hills.**

Plagiochila uniformis Mitt. in J. Proc. Linn. Soc., Bot. 5: 98. 1861; Steph., Sp. Hepat. 2: 342. 1906; Inoue in Bull. Natl. Sci. Mus. Tokyo 8: 389. 1965; D. G. Long & Grolle in J. Hattori Bot. Lab. 68: 408. 1990; So and Grolle; J. Bryol. 22: 26. 2000; K. K. Rawat & S. C. Srivast. Genus *Plagiochila* East. Himal. India. 197. 2007. *P. ambigua* Mitt., J. Proc. Linn. Soc., Bot. 5: 98. 1861. *P. mittenii* Steph., Bull. Herb. Boiss. 5: 83. 1897. *P. simlana* Mitt. ex Steph., Bull. Herb. Boiss. (ser. 2) 3: 525. 1903.

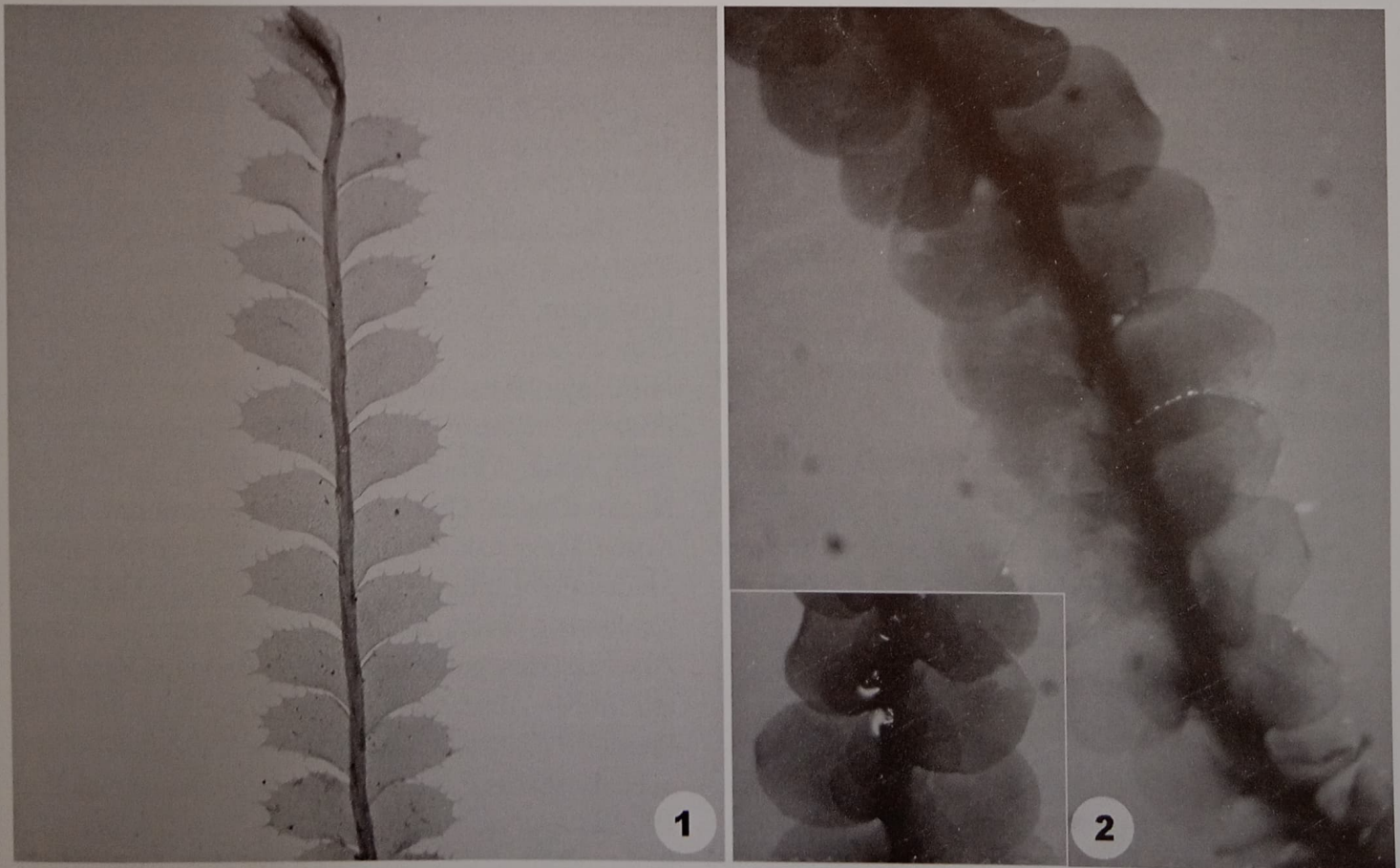


Plate 3

Specimen examined: Terrestrial, grows in moist and shady places on wet rocks, Dugalbitta, September 2006, YMB 18631c, Bhujgali, September 2006, YMB 18682.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Mussoorie); Eastern Himalaya: West Bengal Hills, Assam, Meghalaya, Manipur; Western Ghats: Tamil Nadu], Pakistan, Nepal, Bhutan, Thailand (Mitten 1861, Stephani 1906, Inoue 1965, Long & Grolle 1990, Bapna & Kachroo 2000, So & Grolle 2000, Rawat & Srivastava 2007, Singh & Singh 2009).

Family: Scapaniaceae Mig.

Genus: *Scapania* (Dumort.) Dumort.

Scapania ciliatospinosa Horik. in J. Sci. Hiroshima Univ. ser. B, 2: 222. 1934; S. C. Srivast. & A. Srivast. in Geophytology 24: 138. 1995. *Scapania ferruginea* (Lehm. & Lindenb.) Gottsche et al. var. *minor* Amakawa in J. Hattori Bot. Lab. 27: 9. 1964.

Plate 3, figure 2

Specimen examined: Terrestrial, grows in moist and sheltered places near streams, Gaurikund, September 2006, YMB 18634; Devharital, September 2006, YMB 18660; September 2006, YMB 18694; Kalimath, September 2006, YMB 18700.

Distribution: India [Western Himalaya: Uttarakhand (Pithoragarh); Eastern Himalaya: West Bengal Hills, Sikkim], Nepal, Bhutan, China, Taiwan, Indonesia, Japan, (Amakawa 1964, Srivastava & Srivastava 1995, Long & Grolle 1990). **New to Garhwal Hills.**

Phylum: Anthocerotophyta Rothm. Ex Stotler & Crand.-Stotler (Hornwort)

Class: Anthocerotopsida De Bary Ex Jancz.
Corr. Prosk.

Order: Anthocerotales Limpr.

Family: Anthocerotaceae (Gray) Dumort. Corr.
Trevis. Emend. Hässel

Genus: *Anthoceros* L.

Anthoceros angustus Steph., Sp. Hepat. 5: 1001. 1916; A. K. Asthana & S. C. Srivast. in Bryophyt. Biblioth. 42: 34. 1991. *Anthoceros* cf

gemmulosus (S. Hatt.) Pande ex D. C. Bharad. in J. Indian Bot. Soc. 37: 76. 1958.

Plate 1, figure 1

Specimen examined: Terrestrial, grows on moist and sheltered places, Chopta to Kanchula khark area, September 2006, YMB 18617.

Distribution: India [Western Himalaya: Uttarakhand (Munsyari); Eastern Himalaya: West Bengal Hills, Sikkim], Japan (Asthana & Srivastava 1991). **New to Garhwal Hills.**

Order: Notothyladales Hyvönen & Piippo

Family: Notothyladaceae (Milde)
Müll. Frib. Ex Prosk.

Genus: *Phaeoceros* Prosk.

Phaeoceros carolinianus (Michx.) Prosk. in Bull. Torrey Bot. Club 78: 347. 1951; Sushil K. Singh & D. K. Singh in Cryptog. Bryol. 28: 254. 2007. *Anthoceros carolinianus* Michx., Fl. bor. -amer. 1: 280. 1803. *Phaeoceros laevis* (L.) Prosk. subsp. *carolinianus* (Michx.) Prosk. in Rapp. et Commun., VIII Congr. Int. Bot. Paris 14 – 16: 69. 1954; A. K. Asthana & S. C. Srivast. in Bryophyt. Biblioth. 42: 125. 1991.

Specimen examined: Terrestrial, grows on moist soil in pure population, Kalimath, September 2006, YMB 18602.

Distribution: India [Western Himalaya: Himachal Pradesh, Uttarakhand (Mussoorie, Pauri, Jarmula, Gwaldam, Nainital, Caubatia, Binsar, Ranikhet, Pithoragarh, Kausani, Baijnath, Almora); Eastern Himalaya: West Bengal Hills, Sikkim, Arunachal Pradesh; Punjab & West Rajasthan: Rajasthan; Central India: Madhya Pradesh; Western Ghats: Tamil Nadu], Nepal, Bhutan, China, Sri Lanka, Myanmar, Japan, Korea, Melanesia (Fiji), Macronesia (Canary Islands, Madeira), Australia, Polynesia (Hawaiian Islands, New Zealand), Africa, Europe, North America, South America (Hasegawa 1984, 1991, Bapna & Vyas 1962 as *P. laevis* subsp. *carolinianus*, Long & Grolle 1990, Piippo 1990, Asthana & Srivastava 1991 and Asthana & Nath 1994 as *P. laevis* subsp. *carolinianus*, Schuster 1992 as *Anthoceros laevis* subsp. *carolinianus* (L.) R. M. Schust., Paton 1999, Grolle & Long 2000, Yamada & Iwatsuki 2006, Singh & Singh 2009).

ACKNOWLEDGEMENT

The authors are grateful to the Director, Botanical Survey of India, Kolkata and Head, Eastern Regional Centre, BSI, Shillong for facilities and encouragement and to the officials of Forest Department of Uttarakhand for rendering logistic support during field exploration.

REFERENCES

- Amakawa T. 1964. A short revision of Himalayan *Scapania* (Hepaticae). J. Hattori Bot. Lab. 27: 1-19.
- Amakawa T. 1967. New or little known Asiatic species of the family Jungermanniaceae III. J. Hattori Bot. Lab. 30: 181-198.
- Amakawa T. 1972. New or little known Asiatic species of the family Jungermanniaceae VII. *Jungermannia truncata* complex. J. Hattori Bot. Lab. 35: 382-390.
- Asthana G., Verma P. K., Murti & Shukla A. 2008. *Cyathodium* (Bryophyta: Hepaticae) from Chakrata, Uttarakhand, Western Himalaya, India. Curr. Sci. 94: 442-443.
- Asthana A. K. & Nath V. 1994. Distributional pattern of *Phaeoceros* Prosk. in Kumaon and Garhwal regions: Western Himalayas. Cryptog. Bryol. Lichénol. 15: 129-134.
- Asthana A. K. & Srivastava S. C. 1991. Indian hornworts. Bryophyt. Biblioth. 42: 1-158.
- Asthana A. K., Nath V. & Kumar A. 1994. Studies on a rare Indian liverwort: *Schiffneria hyalina* Steph. Geophytology 23: 279-284.
- Awasthi U. S. & Srivastava S. C. 1987. *Ptychanthus* Nees and *Tuzibeanthus* Hatt. in India. Geophytology 17: 12-20.
- Bapna K. R. & Kachroo P. 2000. Hepaticology in India II. Himanshu Publication, Delhi.
- Bapna K. R. & Vyas G. G. 1962. Studies in the liverworts of Mount Abu (India) I. A preliminary account. J. Hattori Bot. Lab. 25: 81-90.
- Bir S. S. & Chopra R. N. 1972. Thallose Liverworts from Dalhousie, North Western Himalayas. Bryologist 75: 371-372.
- Bischler-Causse H. 1979. *Plagiochasma* Lehm. & Lindenb. III. Les taxa d'Asie et d'océanie. J. Hattori Bot. Lab. 45: 25-79.
- Bischler-Causse H. 1989. *Marchantia* L. The Asiatic and Oceanic taxa. Bryophyt. Biblioth. 38: 1-317.
- Brummitt R. K. & Powell C. E. 1992. Authors of plant names - A list of authors of scientific names of plants, with recommended standard forms of their names, including abbreviations. Royal Botanical Gardens, Kew.
- Chopra R. S. 1938a. Notes on Indian Hepatics. I. South India. Proc. Indian Acad. Sci. 7B: 239-251.
- Chopra R. S. 1938b. Notes on Indian Hepatics. II. Sikkim Himalayas and Bengal. Proc. Indian Acad. Sci. 8B: 427-445.
- Chopra R. S. 1943. A census on Indian hepatics. J. Indian Bot. Soc. 22: 237-259.
- Crandall-Stotler B., Stotler R. E. & Long D. G. 2009. Morphology and classification of the Marchantiophyta. In: Goffinet, B. & A. J. Shaw (eds.) Bryophyte Biology (2nd edition). Cambridge University Press U.K. & New York.
- Crundwell A. C. & Nyholm E. 1979. Some additions to the bryophyte flora of Turkey I. Hepaticae. J. Bryol. 10: 479-489.
- Daniels A. E. D. 2010. Checklist of the bryophytes of Tamil Nadu, India. Arch. Bryol. 65: 1-117.
- Furuki T., Yamada K., Hattori S. & Nishimura N. 1993. Hepaticae collected from Pakistan in 1991. In: Nakaike T. & Malik S. (eds.), Cryptogamic flora of Pakistan 2: 221- 229. National Science Museum, Tokyo.
- Gradstein S. R., Meneses-Q R. I. & Arbe B. A. 2003. Catalogue of the Hepaticae and Anthocerotae of Bolivia. J. Hattori Bot. Lab. 93: 1-67.
- Grolle R. 1995. The Hepaticae and Anthocerotae of the East African islands: an annotated catalogue. Bryophyt. Biblioth. 48: 1-178.
- Grolle R. & Long D. G. 2000. An annotated check-list of the Hepaticae and Anthocerotae of Europe and Macronesia. J. Bryol. 22: 103-140.
- Gupta A. & Udar R. 1986. Palynotaxonomy of selected Indian liverworts. Bryophyt. Biblioth. 29: 1-202.
- Hasegawa J. 1984. Taxonomical studies on Asian Anthocerotae IV. A revision of the genera *Anthoceros*, *Phaeoceros* and *Folioceros* in Japan. J. Hattori Bot. Lab. 57: 241-272.
- Hasegawa J. 1991. Taxonomy of *Phaeoceros laevis* subsp. *carolinianus* and its allied taxa in Japan and its adjacent region. J. Hattori Bot. Lab. 69: 101-106.
- Hattori S. 1955. Hepaticae of Hokkaido I. On the Hepaticae of Southern Hidaka, with special reference to Hepaticae occurring on serpentine on Mt. Apoi. J. Hattori Bot. Lab. 15: 75-92.
- Hattori S. 1966. Anthocerotae and Hepaticae. In: Hara, H. (ed.), The flora of Eastern Himalaya, pp.501-536. University of Tokyo press, Japan.
- Hattori S. 1969. Studies on the Asiatic species of the genus *Porella* (Hepaticae) II. J. Hattori Bot. Lab. 32: 319-359.
- Hattori S. 1970. Studies on the Asiatic species of the genus *Porella* (Hepaticae) III. J. Hattori Bot. Lab. 33: 41-87.
- Hattori S. 1971. Hepaticae. In: Hara, H. (ed.), The flora of Eastern Himalaya, second report, pp. 222- 240. University of Tokyo press, Japan.
- Hattori S. 1975. Bryophyta. In: Ohashi, H. (ed.), The flora of Eastern Himalaya, third report, pp 206-242. University of Tokyo press, Japan.
- Hattori S. 1976. Studies on the Asiatic species of the genus *Porella* (Hepaticae) VI. J. Hattori Bot. Lab. 40: 121-138.
- Hattori S. 1978. Studies on the Asiatic species of the genus *Porella* (Hepaticae) VII. A synopsis of Asiatic Porellaceae. J. Hattori Bot. Lab. 44: 91-120.
- Hattori S., Hong W. & Inoue H. 1962. On a small collection of Hepaticae made on Quelpart islands (Korea). J. Hattori Bot. Lab. 25: 126-134.
- Hattori S. & Thaithong O. 1978. Mrs. Ruth D. Svihla's *Frullania* collections in India, Burma and Singapore. Bull. Natl. Sci. Mus. Tokyo, B 4: 65-69.
- Inoue H. 1965. Contributions to the knowledge of the Plagiochilaceae of Southeastern Asia VII. Synopsis of *Plagiochila* Dum. in the Himalayan region. Bull. Natl. Sci. Mus. Tokyo 8: 375-403.
- Inoue H. 1984. The genus *Plagiochila* (Dum.) Dum. in South-east Asia. Academia Scientific Book Inc., Tokyo.
- Kachroo P. 1958. Morphology of Rebouliaceae III. Development of sex organs, sporogonium and interrelationships of various genera. J. Hattori Bot. Lab. 19: 1-24.
- Kachroo P., Bapna K. R. & Dhar G. L. 1977. Hepaticae of India – A taxonomic survey and census V (Cocclid.). Fossombroniaceae through Anthocerotaceae. J. Indian Bot. Soc. 56: 63-86.
- Kamimura M. 1961. A monograph of Japanese *Frullaniaceae*. J. Hattori Bot. Lab. 24: 1-108.

- Srivastava S. C. & Dixit R. 1996a. The genus *Cyathodium* Kunze. J. Hattori Bot. Lab. 80: 149-215.
- Srivastava S. C. & Dixit R. 1996b. Species of *Plagiochila* (Dum.) Dum. (Plagiochilaceae) from Lilam in Kumaon, Western Himalayas, India. Geophytology 25: 91-103.
- Srivastava S. C. & Sharma D. 1987. Morpho-taxonomic study of Indian *Dumortiera*. Yushania 4: 1-9.
- Srivastava S. C. & Singh P. 1986. Morpho-taxonomic details of *Jungermannia (Solenostoma) subrubra* Steph. Yushania 3: 19-23.
- Srivastava S. C. & Srivastava A. 1995. Species of *Scapania* from Lilam in Kumaon (Western Himalayas), Uttar Pradesh, India. Geophytology 24: 137-145.
- Srivastava S. C. & Udar R. 1975. Taxonomy of the Indian Metzgeriaceae – a monographic study. New Botanist, Int. Quart. J. Pl. Sci. Res. 2: 1-57.
- Srivastava S. C. & Udar R. 1979. Distribution of Metzgeriales in India. J. Indian Bot. Soc. 58: 33-39.
- Stephani F. 1906. Species Hepaticarum II. Georg et Cie, Lyon, même Maison, Genève & Bale.
- Stephani F. 1906 – 1909. Species Hepaticarum III. Georg et Cie, Lyon, même Maison, Genève & Bale.
- Stephani F. 1917. Species Hepaticarum V. Georg et Cie, Lyon, même Maison, Genève & Bale.
- Streimann H. 1991. New hepatic records from New Guinea. J. Hattori Bot. Lab. 69: 1-19.
- Udar R. & Chandra V. 1965. On two new species of *Mannia*, *M. foreaui* Udar et Chandra and *M. perssonii* Udar et Chandra with a note on the genus and its Indian species. Canad. J. Bot. 43: 147-160.
- Udar R. & Gupta A. 1983. Differentiation of the genus *Targionia* L. in India II. The East Himalayan and South Indian complex and description of a new species of *Targionia*. Geophytology 13: 83-87.
- Udar R. & Jain A. 1983. Polymorphism in *Asterella wallichiana* (Lehm. et Lindenb.) Grolle from India. J. Indian Bot. Soc. 62: 361-366.
- Udar R. & Shaheen F. 1983. Fertile plants of *Porella plumosa* (Mitt.) Inoue from India and their affinities with *P. hattorii* Udar et Shaheen. Misc. Bryol. Lichénol. 9: 196-198.
- Udar R., Srivastava S. C. & Kumar D. 1982. *Geocalyx* Nees – a rare marsupial genus from India. Proc. Indian Acad. Sci., Pl. Sci. 91: 139-143.
- Váňa J. 1972a. Miscellaneous notes on the Asiatic Jungermannioideae. J. Hattori Bot. Lab. 35: 312-318.
- Váňa J. 1972b. Miscellaneous notes on the Asiatic Jungermannioideae II. J. Hattori Bot. Lab. 36: 57-74.
- Váňa J. & Long D. G. 2009. Jungermanniaceae of the Sino-Himalayan region. Nova Hedwigia 89: 485-517.
- Yamada K. & Choe D. M. 1997. A checklist of Hepaticae and Anthocerotae in the Korean Peninsula. J. Hattori Bot. Lab. 81: 281-306.
- Yamada K. & Iwatsuki Z. 2006. Catalogue of hepatics of Japan. J. Hattori Bot. Lab. 99: 1-106.
- Yano O. 1984. Checklist of Brazilian liverworts and hornworts. J. Hattori Bot. Lab. 56: 481-548.
- Zhu R. L. & So M. L. 2001. Epiphyllous liverworts of China. Nova Hedwigia 121: 1-418.
- Zhu R. L. & Long D. G. 2003. Lejeuneaceae (Hepaticae) from several recent collections from Himalaya. J. Hattori Bot. Lab. 93: 101-115.