

AN ECOLOGICAL AND DISTRIBUTIONAL RESUMÉ OF
THE LIVERWORTS AND MOSSES OF INDIA

K. S. SRINIVASAN

Botanical Survey of India, Calcutta

ABSTRACT

A general account of the ecology and distribution of Indian Liverworts and Mosses is given. Points of interest as to the species which have originated from India, species which are in common with the various Continents and Insular areas etc. are given.

The liverworts are of considerable phylogenetic interest as they are considered to have given rise to the aerial habit of green plants. In India, both the *thallose* and the *leafy* liverworts are represented by several genera and species. The great majority of the *thallose* forms occur in very moist places or even under water or on exposed slopes. The *leafy* forms are generally restricted to very shady and moist places on rocks. Some grow also as epiphytic species or as epiphyllous ones. *Ricciocarpus natans* is an interesting floating liverwort of the Dal Lake in Kashmir and also in small pools and tanks in Bengal and other places. The mountain regions are much more favourable than the plains for many species to grow and flourish. Their best vegetative growth is seen during the rainy seasons. Some species as in *Marchantia* and *Lunularia* produce special kind of brood-buds—the gemmae—in special cup-like structures on their plant body, which help in the vegetative multiplication of the species, each gemma growing ultimately into new adult individuals on falling on suitable substrata.

As regards their occurrence in India, the Indian liverworts show great diversity of habit and altitudinal ranges.

A great majority of the liverworts are seen in the Alpine regions in the Himalayas. Among them are *Jungermannia atrata*, *J. rubida*, *J. lamigera*, *J. doniana*, *J. assimilis*, *J. hirtolla*, *J. setiformis*, *Scapania planifolia*, *Ptilidium trichophyllum*, *Mastigobryum deflexum*, *Plagiochasma articulatum*, *Sauchia spongiosa*, *Marchantia polymorpha*, *Riccia robusta* etc., reaching over 4575 m altitude.

In the Temperate Himalayas are met with such species as *Jungermannia concinnata*, *J. marcescens*, *J. lanceolata*, *Lophocolea flaccida*, *L. heterophylla*, *Reboulia hemispherica*, between 3050 m and 3355 m altitudes.

In the Sub-tropical and Tropical belts of the Himalayas, several species grow, among which are *Jungermannia haskerliana*, *Plagiochila wightii*, *P. ambigua*, *P. fimbriata*, *Calypogeia trichomanes*, *C. marginella* and *Isotactis indica* etc. In other places, in these belts and at moderate elevations are to be seen such species of thallose liverworts as *Marchantia polymorpha*, *M. palmata*, *M. linearis*, *Reboulia hemispherica*, *Dumortiera hirsuta*, quite a few species of *Fimbriaria*, *Plagiochasma appendiculatum*, *Targionia hypophylla* and several species of *Riccia*. One species of *Marchantia* seen only in its vegetative condition, is seen also quite under submerged conditions in a flowing mountain stream, growing on stones, on Kodaikanal hills on the Pulneys in South India. *Dumortiera hirsuta* is very often seen in very wet situations with either continuous flow or dripping of water in very shady situations, and in places, occur also as partially or completely submerged plants.

The open rock-cuttings and exposed slopes in mountainous areas, receiving the full effect of sunshine, harbour in favourable spots species of *Plagiochasma*, *Targionia hypophylla* etc., which are capable of withstanding extreme drought conditions. Several species of *Fimbriaria*, especially those with thin and more delicate thalli, prefer quite shady, cool and moist situations with constant dripping of water, and under the cover of other mesophytes. Species of *Riccia* show quite a varied range of distribution in altitude, from the plains to high altitudes. Several species grow in rosette forms on comparatively flat open grounds with practically no vegetation at all, except for a thin felt of blue-greens. Other species grow in amidst grasses and still others under low vegetation cover, on vertical faces of substrata, walls, rock cuttings etc. *Riccia fluitans* is interestingly seen in very moist places, in small rivulets,

channels with gently flowing or stagnant shallow water. In Madras, they are also seen in the channels feeding water to paddy fields. *Cyathodium tuberosum* is an interesting liverwort occurring at the mouth of caves and on the sides of deep wells, in shady and wet situations in South India. It is, however, seen in comparatively open situations on walls, garden structures, nursery pots and brick works etc. in Calcutta.

While a complete account of the various species found in the different localities in India would be un-wieldy for this communication, some of the interesting forms from Kumaon ranges, Nepal-Himalayas, Assam etc. are given which will be illustrative of the diversity of our liverwort flora. From the Kumaon, among the various species, *Metzgeria furcata*, *Anthoceros himalayensis*, *Notothylas levieri*, *Marchantia palmata*, *M. nepalensis*, *Plagiochasma articulatum*, *P. appendiculatum* are common. From Simla Hills are to be noticed, *Radula complanata*, *Madotheca platyphylloides*, *Metzgeria pubescens*, *Anthoceros longii*, *Grimaldia dichotoma*, *Marchantia simlana*, *Cryptomitrium himalayense*, *Fimbriaria blumeana*, *Plagiochasma simlensis* etc. In the Assam ranges are found, *Ptychanthus striatus*, *Lejeunia spathulistipa*, *L. khasiana*, *Frullania apiculata*, *Targionia michelii*, *Plagiochasma paradoxum*, *Fimbriaria khasiana*, *Anthoceros glandulosa*, *A. punctatus* etc. On the Nilgiris in South India are to be seen *Gottschea aligera*, *G. glaucescens*, *Madotheca acutifolia*, *M. perrottetii*, *M. nilghiriensis*, *Lejeunia minutissima*, *L. nilgiriana*, *Frullania glomerata*, *Marchantia nitida*, *Lunularia cruciata*, *Dumortiera hirsuta*, *Fimbriaria leptophylla*, *Reboulia hemispherica*, *Riccia fluitans*, etc. In the plains and on comparatively lower elevations, in South India, *Anthoceros erectus*, *Notothylas indica*, *Cyathodium tuberosum*, *Targionia hypophylla* and *Riccia* are common.

As early as 1861, Mitten's enumeration of Hepaticae included at least 39 genera with 205 species from India. Of the 39 genera, *Lejeunia*, *Plagiochila* and *Frullania* have the larger number of species each with 29, 26 and 21 species respectively. Some genera were with only one species represented in India; among them are *Leiocyphus*, *Sphagnocystis*, *Gymnanthe*, *Isotachis*, *Trichochloea*, *Bryopteris*, *Ptychanthes*, *Calycularia*, *Synhymenium*, *Targionia*, *Fegettella* and *Reboulia*. The two genera *Physotium* and *Askepos* do not appear to have been reported so far from India. Stephani in his *Species Hepati-*

carum, reported, however, 525 species from India. Kashyap added several new genera and species for India which may be mentioned *Stephensiella* with *S. brevipedunculata*, *Aitchinsoniella* with *A. himalayensis*, *Sauchia* with *S. spongiosa*, *Sewardiella* with *S. tubifera* etc. all from the Western Himalayas. Considerable number of new species have been added by subsequent workers like Pande, Khanna, Misra, Mahabale, Kachroo and others. According to Pande, by 1952, 550 species of liverworts are known from India and of these the E. Himalayas have the richest having about 330 representatives and South India 225, and W. Himalayas 170 species. The E. Himalayas Hepatic Flora shows affinities with the Hepatic flora of the Malayan region and some are in common with China (12 sp.), Japan (26 sp.) and Australia (11 sp.). The South Indian species have some in common with Malaya and a few with China (7 sp.), Japan (23 sp.) and E. Africa (17 sp.). The W. Himalayan species show greater affinity with Europe and China (12 sp.) and Japan (13 sp.). The Liverworts of the Western Ghats in South India show affinities with Africa and those of Eastern Ghats with those of Indo-Malaya, Java, Formosa, Sumatra and Borneo.

As in the case of the Liverworts, the Mosses in India also flourish in a variety of habitats. On dry faces of cliffs of gneiss and granites occur such species as *Anoetangium walkeri*, *Weissia eduntula*, *Hyophila cylindrica*, *Barbula comosa*, *Anomobryum cymbifolium*, *Brachymenium walkeri*. On pegmatites, lime and black loam, species like *Hyophila involuta*, *Barbula indica* and *Bryum giganteum* grow. *Campylopus nigrescens* occurs as large cushions on dry exposed gneiss. On banks of streams in shady places on clay, quite a number of Mosses grow, among which are *Trematodon ceylonensis*, *Dicranella griffithii*, *Fissidens lutescens*, *F. walkeri*, *F. elimpatus*, *Garekea phascoides*, *Bryum wightii* etc. On comparatively dry banks the forms met with are *Campylopodium khasianum*, *Dicranella pomiformis*, *Fumaria leptopoda*, *Bryum ramosum*, *B. erythrinum*, *B. doliolum* and others. *Hypnum procumbens* forms larger or smaller mat-like structures on dry clay banks and *Fissidens carnosus* grows on rocks in streams.

Several species also grow on dead wood and tree trunks which are decayed. Examples of this are to be seen in *Leucoloma walkeri*, *Leucobryum wightii*, *Fissidens anomalus*, *Tayloria schmidii*, *Bryum apalodictyoides*, *Trichosteleum monostichum*. In

dry open jungles, some species grow on tree trunks as *Leucobryum imbricatum*, *Macromitrium leptocarpum*, *Brachymerium nepalense*, *Trachypus blandus*, *T. crispatus* etc. In very dense jungles, on very large trees and their branches, several mosses colonise and grow as felts and among them are *Leucoloma renauldii*, *Tortella hyalinoblasta*, *Macromitrium moorcroftii*, *M. sulcatum* etc. Some species form also long felts and loosely hang from the trees and their branches in dense forests. Among such species are to be mentioned *Meterorium enerve*, *Aerobryum longissimum* etc. Some occur as mat formations on tree-trunks as in *Campylopus goughii*, *Brachymerium weissiae*, *Meterorium reclinatum*, *Porotrichum alopecuroides* etc. Some species occur on plantation crops such as *Meterorium tumidum*, *Papillaria fuscescens* on orange trees and *Acrocryphaea concavifolia*, *Meterorium filamentosum*, *Rhaphidostegium tristiculum* on coffee bushes. Species of *Sphagnum* are characteristic of bogs.

Mosses also exhibit interesting altitudinal range of distribution. Among those growing between 1220 m and 1825 m are *Mnium lycopodoides*, *Philonotis falcata*, *Bryum argenteum*, *Hypnum pseudopilosum*, *Tortula inermis*, *Eucladium verticillatum* etc. Between 1825 m and 2745 m are seen *Bryum turbinatum*, *Mnium medium*, *Bartramia oederi*, *Fumaria hygrometrica*, *Grimmia leucophaea*, *Desmatodon latifolius*. Between 2745 m and 3350 m the species to be met with are *Hypnum strigosum*, *Grimmia commutata*, *Orthotrichum anomalum*, *Amphidium lapponicum*, *Barbula alpineae*. The following are some of the high altitude species from Nepal Himalayas above 3000 m viz. *Dicranum himalayanum*, *Bryum ventricosum*, *Trachypodopsis crispatula*, *Herpetineuron toccoeae*, *Pleurozium scherberi*. *Rhytidium rugosum* grows at 4600 m and *Mnium laevinerve* at 4900 m elevations.

The distribution pattern of our Mosses are also interesting and a few illustrations are indicated below:

(i) *Species common to India and Europe*: *Sphagnum girgensohnii*, *Fissidens grandifrons*, *Distichium inclinatum*, *Dicranum spurium*, *Weisia wimmeriana*, *Mnium lycopodoides* (Himalayas), *Grimmia ovata* (Nilgiris & Pulneys), *Thamnum alopecurum* (S. India).

(ii) *Species common to India and N. America*: *Sphagnum teres*, *Ditrichum tortile*, *Dicranum undulatum*, *Hymenostylium curvirostre*, *Barbula vinealis* (Himalayas), *Timmiolla anomala* (S. India) etc.

(iii) *Species common to India and South America*: *Microdus brasiliensis*, *Herpetineuron toccoeae* (Himalayas) and *Campylopus comosus* (S. India).

(iv) *Species common to India and Africa*: *Ditrichum flexifolium*, *D. amoenum*, *Anoetangium euchloron* (S. India), *Trichostomum cylindricum*, *Grimmia commutata* (Himalayas), and with Madagascar, *Philonotis laxissima*, *Floribundaria floribunda* (S. India).

(v) *Species common to India and Australia, New Zealand etc.*: *Gymnostomum calcareum*, *Mniobryum albicans*, *Bartramia pomiformis* (Himalayas), *Myurium rufescens* (S. India).

(vi) *Species common to India and East Indies*: *Microdus brasiliensis*, *Dicranella setigera*, *Leucobryum javense*, *Philonotis falcata* (Himalayas), *Rhodobryum giganteum*, *Macromitrium goniorrhynchum* (Assam), *Fissidens splachnobryoides* (Western Ghats), *Fissidens silvaticus*, *Leucobryum aduncum*, *Philonotis mollis* (S. India).

(vii) *Species common to India and China*: *Sphagnum junghuhnianum*, *Fissidens nobilis*, *Dicranum perfalcatum*, *Hymenostylium inconspicuum*, *Tortella fragilis*, *Anomobryum nitidum*, *Orthotrichum hookeri* (Himalayas), *Cleistosoma ambigua*, *Trachypodopsis crispatula* (Assam), *Oreorveisia laxifolia*, *Ptychomitrium tortula*, *Rhacopilum schmidii*, *Papillaria fuscescens* (Nilgiris and Western Ghats), *Macromitrium nepalense*, *M. sulcatum* (S. India).

(viii) *Species common to India and Formosa*: *Sphagnum pseudocymbifolium*, *Pseudosporidontopsis horrida*, *Meteoriopsis ancistrodes* (Himalayas), *Barbula indica* (Bengal), *Holomitrium griffithianum*, *Trachypus bicolor* (S. India).

(ix) *Species common to India and Japan*: *Sphagnum acutifolium*, *Anisothecium rubra*, *Brothera laena*, *Amphidium japonicum*, *Plagiopus oederi* (Himalayas), *Leucobryum neilgherense*, *Meterium miguelianum* (Western Ghats and Nilgiris), *Thysanomitrium blumei*, *Leucoloma nitens* (S. India).

(x) *Species in common with various islands*: Insular Mosses. Canary Islands: *Fissidens asplenoides* (S. India). Hawaii Island: *Saelania glaucescens* (Kashmir). Tahiti Island: *Homaliodendron exiguum* (Kashmir). Solomon Islands: *Thuidium meyenianum* (Himalayas), Samoa Islands: *Cayptothecium tumidum*, *Acanthorrhynchium papillatum* (Nepal).

(xi) *Cosmopolitan species*: *Sphagnum palustre*, *Ceratodon purpurens*, *Distichium capillaceum*, *Dicranella heteromalla* (Himalayas), *Bryum argenteum*

(Assam), *Weisia viridula*, *Bryum coronatum*, *Mnium rostratum* (S. India) etc.

A general census of mosses indicate that out of 17 species of *Sphagnum* occurring in India, 6 species and one variety are indigenous, they being *Sphagnum acutifoloides*, *S. cuspidatum*, *S. khasianum*, *S. ovatum*, *S. griffithianum*, *S. contortum*, and *S. obtusifolium* var. *cymbifolium*. Among the other genera, *Bryum* and *Fissidens* are perhaps largely represented each with about 45 species occurring in India. Archidiaceae is represented by a single genus *Archidium* with 3 species from Kanara, Pulneys in South India and Eucalyptaceae with the genus *Eucalypta* with one species from Kashmir and N. W. Himalayas.

Some new genera and several new species of mosses have been described from India. Among the new genera are *Dendroclyathophorum*, *Oriholimno-*

bium etc., and among the new species with India as type locality, are *Fissidens rubricaulis*, *F. kalimpongensis*, *Microdus assamicus*, *Dicranella leptoneura*, *Brothera capillifolia*, *Syrrhopodon folia*, *S. pilulifer*, *Pseudosymbleharis pallidens*, *Ptychomitrium rhacomitrioides*, *Macromitrium hamatum*, *M. uncinatum*, *Splachnobryum assamicum*, *Trachypus pendulus*, *Fabronia assamica*, *Symphyodon complanatus*, *Cyathophorum burkillii*, *Leskea perstricta*, *Fissidens kalimpongensis* (Eastern India), *Pterobryopsis walkeri*, *P. kanarensis*, *P. maxwellii*, *Pinnatella limbata*, *Daltonia brevipedunculata* (Western India), *Macromitrium nigracans*, *M. nilgirense*, *M. uncinatum*, *M. polygonostomum* (Himalayas) and several others from different parts of the country, which would be suggestive of the wealth of information still remaining to be unravelled on Indian Mosses.