CHAPTER - VII

# DISCUSSIONS

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# A) CHARACTERISTIC FEATURES

Liverworts have an affinity for shade and moisture, but they are found to occur in a wide range of habitats. The most important environmental parameters affecting the growth of liverworts appear to be relative humidity, rainfall, light, temperature and altitude. To cope with the fluctuations of the above mentioned parameters and other environmental irregularities, the liverworts studied develop certain morphological as well as anatomical adaptive features which are discussed below.

Kashyap (1929) was referred a new plant as *Fysonia tenera* Kash. but later he reduced this plant as a form of *Riccia fluitans*. According to Verdoorn (1932) it occurs on the surface of warm, stagnant water rich in nutrients but poor in lime. *R. fluitans* collected initially in the stagnant water of pool in the month of September 1998. In this aquatic habitat it lacks rhizoids. In the next month the same was collected in terrestrial form which was having rhizoids. According to Verdoorn (loc.cit) and Vashista (1996) *R. fluitans* occurs floating or partly submerged in still water in ponds, lakes or pools; which continues to live and grow but fruits only when it comes in contact with mud at the bottom. Our observation is same as that of Verdoon (loc.cit ) and Vashista (loc.cit). It is also observed that whenever it touches to the mud it develops smooth rhizoids,

which are necessary at that stage. It forms large air chambers in aquatic forms. Cavers (1964) has reported the presence of large air cavities in the aquatic species *R. fluitans* and *R. natans* but the same species growing on wet banks lack such cavities, which is a good indication for adaptation for buoyancy in water.

Four new species of *Riccia* proposed by Kashyap (1916) included *Riccia robusta* (synonym of *R. crystallina* L.). The species collected by us grows in the cracks between bricks of the wall, densely overlapping in Gopaltirth bag. Pande (1932) found that in Lahul specimens, densely overlapping tuberculate rhizoids are absent or rarely found. In our specimen tuberculate rhizoids are rarely seen and are few It is also observed that air channels are wide and larger as was found by Vashista (loc.cit). Chopra and Sood (1973) from their observations on *R. crystallina* stated that, the presence of light and exposure to low temperature are the important prerequisitie gametangial initiation. Same is the case with our collected specimen. During unfavourable conditions thallus rolls up like grass leaves and protects itself and the growing points from desiccation (Puri, 1981). Such leaf tolerance is found in this species.

Kashyap (loc.cit ) proposed *Riccia sanguinea* Kash. (Very near *to R. frostii* Aust. Udar (1957), Pande and Udar (1957a), treated *R.*

*sanguinea* as synonym under *R. frostii.* In *R. frostii* the neck of archegonium almost reaches the surface of the thallus and not projects above the surface of thallus was noted by Vashista (loc.cit). This is also noticed in our specimen. Thus *R. frostii* posses the sex organs as well as sporangium sunken in the thallus which is also an adaptation to protect them from desiccation (Cavers, loc.cit ).

Mitten (1861) reported *Targionia michelii.* Corda from the North-West Himalayas, which Stephani (1900) has treated as a synonym of T. *hypophylla* L. In moist and shady places the plants form masses of deep green overlapping individuals, while in exposed places the plants are closely creeping, almost, always dichotomously divided and light green. The specimen which has been collected by us from Ambarkhana, where moist and shade is available, the thalli are found to be overlapping and deep green. Thalli exposed to sunlight collected from Teen Darwaja are found to be light green and dichotomously divided. Internally well defined assimilatory zone with air-chamber and photosynthetic filaments is found to be prominent. The sporangium is found under the thallus protected from direct sunlight. According to Cavers (loc.cit) and Puri (loc.cit) the presence of well defined assimilatory zone, two types of rhizoids, and protected sporangium are adaptations for growth in drier areas. Daniels (1998) has also reported the same. Mahabale and Mahajan

(1955) collected *T. hypophylla* L. from several localities in the Peninsular India. They found that plants are generally dioecious in which smaller plants are male thalli and quite distinct are female thalli. Antheridia are found on the disc shaped lobes which represents a condensed branched system. In our specimen the ventral shoots might be representing the condensed branched system. According to Kashyap (1972) the exposed plants have smaller spores and long elaters. The specimen collected from Teen Darwaja shows the same condition. He is also of the opinion that short ventral male shoots are nearly greatly condensed ordinary shoots which latter become obscure. These are found to be extremely reduced in our specimens.

Kashyap (1914) instituted a new species of *Cyathodium, C. tuberosum* Kash. from Western Himalayas. subsequently Kashyap (loc.cit) treated *C. penicillatum* st. as a synonym of *C. tuberosum.* According to him tubers are formed only in the Himalayan plants and not in those growing in the plains. In our observation tubers are not at all found even late in the winter. The plants growing in dark and moist places are found to be yellowish phosphorescence, while plants growing in open places are found to be very much larger. The female plants are found to be large and fan shaped. The same was observed by Kashyap (loc.cit ). It is also found that the lid (operculum) consists usually 8 cells,

while elaters are limited in number and has one broader end. All these characteristics were also found by Kashyap (loc.cit) from the specimens of Mount Abu and Western Himalayas. It prefers more moist, shady habitat therefore externally there is complete absence of scales and presence of only smooth rhizoids (Daniels, loc.cit ).

The genus *Plagiochasma* prefers the habitats such as on rock and boulders, on moist stones- the building blocks of retaining wall, in between the gaps (cementing material) of constituent stone walls, on soil clipped stony walls. Watson (1981) has reported same habitats in Britain. Externally *Plagiochasma* possess ventral appendiculate scales. Internally there is well defined assimilatory zone but no specialised air chamber with filaments. The lower epidermis sends out smooth and tuberculate rhizoids. During unfavourable conditions the thallus rolls upward exposing only the ventral scales as in *R. crystallina.* Daniels (loc.cit ) has reported similar observations as the adaptations during unfavourable conditions. W.A. Cannon (1914) studied a species of *Plagiochasma* which was having great resisting powers than actually it required. Female receptacles are distinctly dorsal in all the species. According to Kashyap (loc.cit) these are at first terminal but the thallus goes on growing invariably by an adventitious shoot immediately after the formation of the receptacles so that a distinct line of articulation is always clearly visible in

*P. appendiculatum* which is found to be only apparent but in case *of P. articulatum* thallus is distinctly articulated showing complete line of articulation and the female receptacles are borne at the deep articulation. *P. articulatum* has been described by Mahabale and Deshpande (1947) in which thalli showed typical articulated appearance. The female receptacle was found to be terminal at first which become dorsal by the growth of the thallus. The same characters are observed in our specimens. The number of cells bounding the pores is variable. There are usually 8-9 cells in each ring as many as 10 may be present. Kashyap (loc.cit) has observed 6-8 cells in each ring as many as 10 may be present. Kashyap (loc.cit) has observed 6-8 cells in each ring but as many as 10 were also observed. Kalgaonkar (1990) has also observed the same variation in the *Plagiochasma* sp. Kashyap (loc.cit) observed that sometimes in *Plagiochasma* sp. elaters develops no spiral bands probably when the plants do not get sufficient moisture. In our specimens not only elaters are without spiral bands but branching is also observed. This might be an adaptation against the insufficient moisture. Although the *P. articulatum* often occurs along with *P. appendiculatum*, it is more commonly met within dry localities. The elaters, like those in *P. appendiculatum* sometimes do not develop the spiral bands.

Stephani (1899) described *Plagiochasma intermedium* from medico, while Evans (1915) described it from several localities like America, China and Japan. According to them the elaters are without or with only rudimentary spirals. According to Udar and Chandra (1965) a characteristic feature of *P. intermedium* is that the elaters are devoid of spiral thickening bands instead, uniform thickening develops over the elater surface. As pointed out by Kashyap (loc.cit) in connection with *P. articulatum* and *P. appendiculatum* spirals on the elaters may or may not be present in the same species and the absence of spirals, therefore has no specific importance. Probably the absence of spirals is associated with a decrease in the amount of moisture available at the time when the spores and elaters are approaching maturity. It is also observed by us that the above three *Plagiochasma* species take longer time to mature.

In rainy season among the liverworts which has been collected the population of *Asterella angusta* was found to be dominating. It grows on soil covered rocks. The plant is strictly dioecious, which bear beaked sporophytes on upraised archegoniophores, on the dorsal surface towards apical region. Thus, sporangium get exposed to sunlight. According to Daniels (loc.cit), *Asterella* and *Targionia* grow in similar habitat well exposed to direct sunlight on moist banks along road sides and soil covered rocks. Internally a well defined assimilatory zone with air

chambers and photosynthetic filaments can be seen but less prominent in *Asterella* than in *Targionia*. In *Asterella* the sporangium is exposed to sunlight whereas in *Targionia* it is kept under the thallus protected from sunlight. Puri (loc.cit) has also reported the occurrence of these genera in similar habitats. In our specimen well defined assimilatory zone and two types of rhizoids and appropriate scales may be the adaptations for growth in drier areas. Kashyap (loc.cit) has reported *A. angusta* as very xerophytic species forming large patches on dry rocks common in Himalayas. Thalli of *Asterella* growing in shady, cool and moist situation are observed to be smaller, thin than growing in those are growing under exposed situation (Kalgaonkar, loc.cit). Mahabale and Bhate (1945) showed that in *A. angusta* the air chambers are devoid of assimilatory filaments. In *Asterella* (earlier described by Kashyap (loc.cit), as *Fimbriaria*) elaters are short, simple or furcate, mono. or bi-spiral. The same characters are observed in our specimen.

Kashyap (1915) described a new species of *Fossombronia himalayensis* Kash. from Western Himalayas. Kashyap (loc.cit) also further reduced *F. levieri* st. as a synonym of F. *himalayensis*. Pande, Mahabale, Raje and Srivastava (1954) gave details of the life history of F. himalayensis giving an account of the thallus structure, embryogeny and structure of the sporophyte. According to them *Fossombronia* is found on

moist rocks or among grasses and mosses, singly or in groups. Our specimen grows in compact clusters on moist soil in exposed places. Rhizoids are smooth walled and hyaline spores are found to be rounded, tetrahedral with furcate lamellae as well as elaters show bi- or tri-spiral thickening. The same character have been noted by Kashyap (loc.cit) and Kalgaonkar (loc.cit).