

STUDIES ON BRYOPHYTES IN BOTANICAL SURVEY OF INDIA, WITH PARTICULAR REFERENCE TO MUSCI

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Bryophytes form an important constituent of the cryptogamic flora of the temperate and subtropical regions, as well as the humid tropics of the world, where they form a conspicuous green covering on rocks, stones, soil, trunks, branches and leaves of trees.

Apart from taxonomists, who have always been fascinated by the challenge, which the taxonomy of this group provides, bryophytes have also attracted the attention of ecologists and evolutionists alike. The former have been interested because of the role they play in plant succession, by colonising the bare surfaces, and the latter, because of the presumed connections they have with the vascular plants on the one hand and the green algae on the other.

Kashyap (1929, 1932) made a significant contribution to the taxonomy of Indian liverworts, by providing a manual for quick identification of Western Himalayan liverworts. This stimulated further interest in the field and opened the possibilities for further research. Notable among subsequent workers are : Mehra, Pande, Ram Udar and Kachroo.

While the liverworts have enjoyed an element of recognition in the publications of workers, as indicated above, the more varied mosses do not appear to have any comparable

attention paid to them until very recently. Although distinct floras devoted exclusively to mosses have appeared for various other countries, such as North America (Grout, 1928-1940), Britain (Dixon, 1924), Java (Dozy & Molkenboer, 1855-1870 ; Max Fleischer, 1900-1923), South Africa (Sims, 1926) and the Philippines (Bartram, 1939), in addition to the classical works like *Bryologia Europaea* (Bruch, Schimper & Guembel, 1836-1866), no such efforts have even been attempted for the vast area of India.

In a historical review of studies on the Musci, two aspects need to be considered, the extent and area of moss collections in the country and the publications based on such collections. The earliest collection of mosses from India is that by Francis Buchanan-Hamilton during the years 1802-1803. Subsequently these elegant little plants have received the attention of several other pioneering botanists, such as Wallich, Griffith, Hooker & T. Thomson, Kurz, followed by King, Duthie, Gollan, and more recently by Burkill and Bor. In peninsular India, the pioneer collections have been made by Wight, Schmid, Gardner, Thomson, Walker and Foreau among others.

Based on these collections, descriptions of

the species have been provided by various authors such as W. J. Hooker (1808-1836), Harvey (1840), Griffith (1842-1849), C. Mueller (1853-1854), Mitten (1859), Brotherus (1898, 1928), Renauld & Cardot (1895-1903), Dixon (1909-1942) and Potier de la Varde (1922-1930).

Of the collections, on which the descriptions have been based, and which are of great importance, in view of their being TYPES, a set of specimens named by Brotherus, C. Mueller, collections by Gollan and some remnants of the collections each by Griffith (Bhutan, Sikkim, Khasia Hills, Assam), J. D. Hooker (Sikkim), Burkill (NEFA) are present in the cryptogamic section of the Central National Herbarium. The rest of them, including the entire lot by Wallich (Nepal), T. Thomson (W. Himalaya) and Bor (Assam, NEFA,—now Arunachal Pradesh, Naga Hills), apart from the British Museum (which has the largest collection of Types of Indian species), are distributed in various European and American Herbaria abroad.

For example, the entire collection on which Mitten published (1859), and which included 777 species from India, Ceylon and Pegu in the work, is in the New York Botanical Garden. Some of the collections of Wallich from Nepal are in Edinburgh Herbarium. The originals of Brotherus are in Helsinki. Some of the species described by Renauld and Cardot and a part of the collections of J. D. Hooker are present in Riksmuseum, Stockholm, which also has some collections of Handel-Mazzetti from Yunnan. Types of species described more recently by Dixon and Badhwar (1938) from Himachal Pradesh and those by Dixon in his several publications, including those based on the collections made from Waziristan by Fernandez in 1927 and Blatter and Fernandez in 1930 are in the British Museum.

Some of the collections present in the U.S. Herbaria, have recently been published by Robinson. Among the main collections are those made by Cole, from Upper Assam (Jorhat, Misamari and Chabua) in 1944 (Robinson, 1964). These are now present in the U. S. National Herbarium, Smithsonian Institution, Washington D.C., with a set in the University of Tennessee. The collections made by L. Webster and Eugene Nasir (Robinson, 1965) are also in the U.S. National Herbarium, Herbarium of Purdue University and partially in the University of Tennessee. The collections of Walter Koelz (Robinson, 1968) from Central Himalayas, made during 1948, are again in the U.S. National Herbarium, and that from Assam during 1949-1953, is in the University of Michigan, with duplicates in the U.S. National Herbarium. Two earlier Himalayan collections by Koelz were reported by Bartram (1955, 1960).

Besides the above, Noguchi reported several collections from the Himalayas, as well as the adjoining Pakistan, which included several new species. The collections are present in several Japanese Herbaria. Some of them are Zimmermann's collection from Nepal, during 1952, 1954 (Noguchi, 1964) and K. Yoda's collection from Eastern Nepal during 1963 (Noguchi et al, 1966), collections made by F. Schmid from Kashmir and some areas of Pakistan in 1953, 1954 (Noguchi, 1964). His earlier reports from Pakistan, were in 1956, 1959. Mosses collected by Tokyo University. Expeditions and included in the three reports of the Flora of Eastern Himalaya, were also compiled by Noguchi (1966, 1971) and Noguchi & Iwatsuki (1975).

For a number of species, which have not been collected subsequently, the Type remains the only source material for further work, which in most cases, as mentioned above is not available in Indian Herbaria. This, along

with non-availability of relevant literature, has been the main stumbling block towards the preparation of a critical moss flora for the country.

In the Central National Herbarium, apart from the scanty Type material that we have, there are also a large number of identified specimens, named by various workers. Perhaps the single largest collection of this kind is by Duthie (1879-1895) from various parts of Western Himalaya, supplemented by the collections of Inayat, Harsukh and Kabirkhan. Other important collections are by Kurz (1867-1871) from Sikkim, Bengal, Rajmahal Hills, Andamans, Burma, (much of his Andaman collection still remains unidentified); King (1893-1902) from Sikkim, Darjeeling; Martin (1899-1901) from Chamba, Manali; Falconer, from N.W. Himalaya. There are also a few specimens by Prain (1886) from Naga Hills; Hartless (1900-1901) from Darjeeling; and Walker (1898-1899) from Coorg.

Besides, there are collections from neighbouring countries of India, such as Ceylon, Burma and the Philippines. There are also collections by Scortechini from Perak and a few sets of *Exsiccatae*. But other countries of Asia and Africa are not represented. There is also a representation of European and North American mosses and a large collection of unidentified specimens from South America.

Botanical Survey of India, after its re-organisation and early few years of organisational effort, has also devoted attention to bryophytes in addition to the flowering plants. The moss materials were collected by various circles, as well as the headquarters, as part of the general programme of Survey of plant resources of the country. However such a generalized type of collection cannot be expected to provide certain crucial and essential field data including associations that are very relevant to this very specialized group of

plants. For such satisfactory field data training is necessary. For example some of the species such as *Hymenostyliella involuta* (Card. et Ther.) Bartr., occur at Dehra Dun, usually as isolated individuals mixed in a larger patch of *Hymenostylium recurvirostre* (Hedw.) Dix., are likely to be missed in the field if looked for as such. Many species have preferences for particular habitats. In the Himalayas, within genus *Thuidium*, species like *Thuidium meyenianum* (Hamp.) Doz. et Molk., *T. squarrosulum* Ren. et Card., *T. contortulum* (Mitt.) Jaeg., and *T. haplohymenium* (Harv.) Jaeg., occur on bark of trees, whereas *T. sparsifolium* (Mitt.) Jaeg., and *T. cymbifolium* (Doz. et Molk.) Doz. et Molk., occur on rocks, soil or humus. Hence they are to be looked for in their respective habitats. Special training as well as techniques are required for their proper study. Only subsequent to the availability of such trained observers making collections with appropriate field data could the moss specialist in the herbarium do proper justice to the study of mosses. Considerable emphasis on such specific collections should therefore be laid in any projected programme for a moss flora of India.

To a limited extent, such specific collections have been made in the Botanical Survey of India, mostly by Wadhwa, Vohra, and more recently by Jagdish Lal, from certain areas of the Western Himalaya, the Eastern Himalaya, Bhutan, Western Ghats, the Sahyadris, the Nilgiris and also from the Eastern Ghats, which are being organised in the bryophyte herbarium of the Cryptogamic section at Calcutta and in the Poona Herbarium. Based on this material 26 papers (see appendix) enumerating the moss flora and new discoveries and new records of mosses and liverworts have been published, mainly by these workers. In an elaborate study of the moss flora of the Sahyadri ranges, Wadhwa has accounted for

nearly 300 species with several of them possible novelties. He has also reported several species from Sahyadris, which were formerly considered endemic to Palni Hills or Coorg. A monograph on Hypnobryales (Musci) of the Himalayas (Families: Theliaceae, Fabroniaceae, Leskeaceae, Thuidiaceae, Amblystegiaceae and Brachytheciaceae) has been completed by Vohra. This contains descriptions and illustrations of 155 species, of which about a dozen are new to science. Also there are several additions and new combinations. Jagdish Lal is now working on the Hepaticae of the Eastern Himalaya and is particularly interested in the genus *Mastigolejeunea*.

Efforts are also being made to obtain collections through exchange/gifts. Late Rev. Father Foreau donated a part of his collections from the Palni hills to the Botanical Survey of India, Calcutta. Among the specimens received under exchange, are about 350 specimens of Canadian mosses from the University of British Columbia, Vancouver, about 100 Danish mosses from Aarhus University, Denmark and also some collections from Mamatkolov Botanical Institute, Tjikisthan. Dhuzhanbe, U.S.S.R.

In recent years significant contributions have been made by Gangulee through his several publications, besides his monographs on mosses of Eastern India (Gangulee, 1969-1976). Other notable publications are by Chopra who has recently published "Taxonomy of Indian Mosses" (Chopra, 1975), besides his previous work. Earlier Bruehl & Sarkar (1929) and Sharma (1949) also published accounts of mosses. Others who have recently published on mosses include Foreau (1961), N. Chopra (1961), Chavan (1961), Srinivasan (1962), R. N. Chopra (1966), Srivastava (1966), Dabhade (1970, 1974), Lal (1971), Udar (1971), Matthew (1973) and Parihar (1975).

However, many areas, such as the North

Eastern Region, with its predominantly hilly topography and a temperate climate, promoting rich moss vegetation, the subhimalayan tract and the Western Ghats are poorly represented in the collections; and many other parts of the country, such as the Eastern Ghats, the detached mountain areas between Eastern and Western Ghats, like Biligirirangan Hills and many pockets all over the country have hardly been touched. All these areas await detailed collection and study.

The need for further exploration cannot be over emphasised because, still new genera, species and new records are being published even from areas comparatively well-explored. In this regard, mention may be made of the recent discovery of a new species of *Plagiothecium* from Dehra Dun (Vohra, 1974) and collection of *Hymenostyliella involuta* (Card. et Ther.) Bartr., also from Dehra Dun (Vohra, 1969). The latter was earlier known only from the Philippines, where it does not produce capsules. However Dehra Dun specimens are fertile. Other interesting discoveries during the recent years, is the collection of *Mitrobryum koelzii* Robins., by Dr. M. A. Rau from Tehri in 1968. This genus, which is unique in its characteristic outgrowths from the calyptra, was described by Robinson (1968), from the material collected by Koelz from Tehri. Incidentally, this emphasises the need for building up a collection of authentic topotypes from the Type localities and the absolute need to ensure access to Type specimens, wherever they may be, either by travel or by loan, for a satisfactory moss flora.

In summary, with adequate specialized collections, from the different parts of the country, access to Types, authentic specimens and references, a satisfactory scientific study of the mosses can be completed. With such preparation, opportunities and collections, there is every reason to believe, that soon

along with the other floras the moss flora will also find its due place on our book shelves.

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WIJK VAN DER, R. AND R. S. CHOPRA. A preliminary key to the genera of Indian mosses. *Res. Bull. Panjab Univ. N.S. Sc.* 17(1-11): 149-191. 1966.

APPENDIX

List of publications on mosses, from Botanical Survey of India.

DEB, D. B. Mosses of Manipur. *Bull. bot. Soc. Bengal* 9: 81-83. 1955.

LAL, JAGDISH. *Colura* Dum. (Hepaticae)—A genus new to Indian Flora. *Curr. Sci.* 46 (17): 618. 1977.

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— AND B. M. WADHWA. *Andreaea rupestris* Hedw., a new record from Western Himalaya. *Ibid.* 5: 149-150. 1963.

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