

in an open boat. No other environment so quickly spot-lights ability and weakness. It takes some time to acquire real nautical skill but it is the boy who is adaptable and unafraid of hard work who stands out in a course such as this. Indeed, the mere theorists and those to whom cinemas, dance halls and pubs are essential on holiday just do not wish to come.

THE STUDY OF MOSSES AND LIVERWORTS IN THE REGION OF JUNIPER HALL, DORKING, SURREY

by FRANCIS ROSE

Department of Botany, Bedford College, University of London

THE Bryophyta (Mosses and Liverworts) are a group of plants rather neglected by the amateur botanist. It is true that a microscope is necessary to obtain a full knowledge of all the species, and in this sense they are not an easy group to master. Yet many of the commoner species can be quite easily recognized in the field and it is pleasing to observe that field naturalists in general are paying them more attention than before. The reprinting of Dixon's invaluable *Handbook of British Mosses*, so long out of print, will undoubtedly further this trend.

Bryophytes are small plants which, like the higher plants, contain chlorophyll and are therefore green in colour. In the case of all the mosses and many species of liverworts, they have a distinct stem and leaves and no true roots, merely root-hairs, or rhizoids, which absorb water from the soil and provide means of attachment. Some liverworts (e.g. the genus *Pellia*, familiar in schools) have no distinct leaves, but the plant instead consists of a forked, strapshaped body, rather like some of the seaweeds in form.

The Bryophyta bear minute male and female organs, called *antheridia* and *archegonia* respectively, in groups at the apex of the shoots or among the leaves. Swimming male germ cells or sperms are formed in the *antheridia* and after release these become splashed, by rain drops as a rule, on to the female organs and fuse with the eggs in these organs. The fertilized eggs then grow into small stalked "fruits" which in the larger species may be one or two inches in height. The "fruits" or capsules

when ripe liberate tiny spores which grow into new plants. In mosses the fruits are green at first and have a lid which falls off to reveal at the tip a crown of hygroscopic teeth (the peristome) which controls the escape of the spores by closing in moist weather and opening when the weather is dry and conditions are therefore better for spore dispersal. In liverworts the capsules, which in most cases are devoid of chlorophyll, open simply by splitting into four valves or teeth.

Apart from the attractiveness of their own structure and biology, Bryophytes are of much potential interest to the field naturalist and of importance to the scientific ecologist for two main reasons. In the first place they are valuable indicators of soil and habitat conditions; secondly, they form well-marked communities with structure as definite, on a small scale, as that of the communities of flowering plants more familiar to most naturalists. Each type of higher plant community (e.g. chalk grassland, beechwood, heath) has as a rule one or more types of bryophyte community associated with it and to some extent dependent on it.

The neighbourhood of Juniper Hall in central Surrey is a singularly good one for the study of bryophytes. A wide range of soil types and habitats occurs here in a small area which shows as much variety as any district in south-east England, and this range produces a rich flora of over two hundred species of bryophytes within about twelve miles of the Field Centre. Calcareous and acid soils, dry sands and waterlogged clays, as well as wet bogs, all occur in the district and produce a variety of plant communities—though naturally alpine habitats are lacking.

The chalk range of the North Downs, in the midst of which Juniper Hall lies, provides in Box Hill what is probably the richest locality for bryophytes on the English Chalk. This is because it combines a wide selection of slopes of different aspects and degrees of steepness with a rich variety of vegetation types. The steep escarpment face of Box Hill, which overlooks the Weald to the south, is very warm, dry and exposed. On the northern side, there is a series of steep-sided dry valleys where conditions are more sheltered, with round-topped ridges between them. The summit plateau, capped with clay-with-flints, provides acid soil conditions because no calcium carbonate is present to neutralize the acid humus formed by vegetation. The open chalk areas were formerly sheepwalk, dominated largely by a short close turf of Sheep's Fescue Grass (*Festuca ovina*), but

owing to the cessation of grazing (even by rabbits) large areas are now dominated by the taller Upright Brome Grass (*Bromus erectus*), while locally the coarse aggressive Tor Grass (*Brachypodium pinnatum*) is crowding out the other species of grasses and the rich flora of associated flowering plants. Areas of Juniper scrub still exist, but much of this has been invaded by Yew woods, whilst elsewhere scrub of deciduous shrubs, such as Dogwood and Wayfaring Tree, has developed in grassland as a stage in the succession to the "climax" vegetation of beechwood. The Clay Plateau has developed birch scrub which in places has culminated in the typical oakwood climax.

Each of these communities has its own bryophyte flora. On the warm, dry south face of the escarpment, typical "calcicole" or chalk-loving mosses are found. Some of these, such as *Pleurochaete squarrosa*, which studs the turf locally with tiny yellow-green stars in winter, are confined to warm spots in southern England and their distribution abroad is centred in the Mediterranean area. *Thuidium hystricosum*, which has prostrate yellow-brown feather-like shoots, is abundant here, and elsewhere eastwards along the North Downs on their south face, but scarce otherwise in Britain.

The chalk turf of the north and north-east facing slopes of the hill is in general deeper and damper. Here the sun's rays fall at a steeper angle at mid-day and so less heat energy reaches any given surface area than on the south-facing slopes. These slopes, being in valleys, are also more sheltered and thus the humidity of the air just above soil level is usually high. This is shown by the way in which both dew in mild weather and hoar frost in wintry weather lie far longer on these slopes than on the southern ones. As a result a much more luxuriant bryophyte growth is found. Such mosses as the robust red-stemmed *Hylocomium*s (*H. splendens* with fronds like tiny ferns, and *H. triquetrum* with large triangular yellow-green leaves), and also *Brachythecium purum* with turgid shoots like yellow worms, are abundant. On steeper banks the turf is shorter and the chalk is exposed at the surface. Here such characteristic calcicole mosses as *Neckera crispa* (Plate I), with its robust olive-green, flattened, curled stems and wrinkled leaves, and *Hypnum molluscum*, which forms golden-green glossy carpets of feathery shoots with curled leaves, are a feature of the vegetation. Also in the short turf of the northern slopes there occur some remarkable calcicole bryophytes whose main home in Britain is on the

limestone hills of the wetter northern and western parts of the country. Four of these in particular deserve notice, as they are confined on the North Downs to the north slopes of Box Hill, though widespread on the escarpment of the western South Downs, which faces north and has a higher rainfall. These are: *Trichostomum tortuosum*, a moss which forms bright green cushions of shoots with rosettes of narrow wavy leaves, and is confined to one bank above the valley with the "zig-zag" road; and the three leafy liverworts—*Scapania aspera* (green), *Frullania tamarisci* (unusual in being brownish-red) and *Madothea laevigata* (dark olive green). The last requires most shelter and is most plentiful in the Dogwood scrub of Juniper Top.

A comparison of the north-east and south-west-facing slopes of the zig-zag Valley brings out very well the effect of aspect of slope on the bryophyte vegetation, the gradient and soil being similar on each side. On the north-east-facing slope are found thirty-two species of mosses and eight of liverworts—a total of forty bryophytes of which sixteen are very abundant. But on the south-west-facing slope there are present only eighteen species of mosses and one liverwort, a total of nineteen bryophytes of which only nine are even locally abundant. Only one species (the warmth-loving *Thuidium hystricosum*) is found on the south-west-facing slope and not on the north-east-facing slope.

Bare chalk soil on Juniper Top yields many tiny tufted mosses and some with minute capsules, almost stalkless, which can only survive where conditions are open and there is little competition. Examples of these are to be seen among the genera *Weissia*, *Pottia* and *Phascum*.

The beech woods have few mosses, as the acid leaf-litter formed in autumn covers the ground too thickly, and mosses are here mostly confined to the bases of the beech boles. In the oak woods of the plateau a number of "lime-hating", or calcifuge, mosses occur on the tree stumps, rotten logs and paths, some of them quite rare in general.

To the south of the chalk escarpment, across the Vale of Homesdale in which Dorking lies, is the Greensand ridge, culminating in Leith Hill. Here the soil is a stony sand or loam, acid and lime-free, and heaths and pine woods with bilberry are well developed on the high ground, while in hollows *Sphagnum* bogs are found where springs arise. A quite different series of bryophytes occurs on Leith Hill, but it is almost as numerous in

species as that of Box Hill. In the pine woods, the large erect opaque-leaved moss *Polytrichum formosum* is abundant in shade (Plate II), while banks are covered locally with *Plagiothecium undulatum*, a moss with large flattened shoots all pointing downwards, giving the appearance of a pale green waterfall. The bright green *Dicranum majus*, with shoots two or three inches high bearing narrow sickle-shaped leaves in dense tufts, is very abundant, beautiful and characteristic. On the open heaths among the heather, other *Polytrichums* of smaller size, with hair-pointed leaves, are to be found, such as *P. juniperinum* (with brown hair-points) on peaty soil, and *P. piliferum* (with white hair-points) on stony soil, especially around old chert diggings (which have their own rich flora of bryophytes). Under the heather, *Hypnum schreberi*, with red stems and branched shoots bearing close-set, translucent golden leaves, is plentiful as well as *Hypnum cupressiforme*, fancifully likened to the leafy twigs of a cypress in miniature. Leafy liverworts of many kinds are plentiful on the acid banks of Leith Hill; these differ from mosses partly in having nerveless leaves and flattened shoots.

In the bogs, hummocks of the grey-green, stout-branched *Sphagnum palustre* and the delicate red *Sphagnum rubellum* are characteristic. The *Sphagnums* soak up water like a sponge into the empty cells which comprise the bulk of their leaves, and actually create acid conditions by removing what alkaline salts there may be in the soil water and retaining these in an inactive form in their tissues. It is in a matrix of *Sphagnum* that such bog plants as Sundew and Bog Asphodel grow. Less acid springs in alder woods on Leith Hill harbour bryophytes of a different type, such as the beautiful moss *Hookeria lucens*, with large flattened shoots of wonderfully glossy, translucent leaves, and the creamy-yellow, spongy-looking liverwort *Trichocolea tomentella*, with its minutely divided leaves. Larger and better developed bogs and heaths can be seen at Thursley Common within an easy coach journey.

I hope this short review will have given some idea of how rich in interest is the neighbourhood of Juniper Hall to the student of mosses and liverworts; the Field Centre is as well-placed from this point of view as it is for the study of botany in general. It is worth mentioning in conclusion that Courses for the study of Bryophytes are usually held at the Centre in the early spring and have so far proved very successful.