

THE BRYOPHYTES OF THE PARISH OF DALE

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INTRODUCTION

THE moss and liverwort flora of Dale is not rich, either in the number of species so far recorded or in the actual number of individual plants present. This probably reflects the combined effects of climate and history of farming practice in the parish. Nevertheless, there are some interesting features to be noted, such as the characteristic flora of fallow fields and other disturbed habitats, the presence in the parish of certain western coastal species, and the almost total lack of calcicoles.

Bryophytes contribute extensively to the ground flora in certain habitats, and it is unfortunate that their small size, lack of attractive flowers and relative difficulty in identification has often led to their being neglected by naturalists and ecologists. In the present account, a short discussion of the principal ecological factors determining bryophyte distribution and growth is followed by a list of those species so far recorded from the parish of Dale. In conjunction, these should help in the selection of further topics which might be followed up by detailed field work, whilst the publication of any species list is an immediate challenge to others to add new records.

COLLECTION AND IDENTIFICATION

Bryophytes are very easily collected (this very ease should not be allowed to become an excuse for over-collection of possibly rare species), and they preserve well dry. General advice, together with details of convenient paper packets, etc. are given by Proctor (1960) and Watson (1955). It cannot be too strongly emphasized that specimens should not be left for days in polythene bags, but that they should be spread on newspaper to dry, perhaps under gentle pressure. This is especially important if the plants are wet when gathered, since they rapidly go mouldy if kept enclosed and also develop thin and unnatural flagelliform branches with surprising speed.

The standard textbooks by Macvicar (1926) and Dixon (1924) should be supplemented by Watson (1955), which includes much more ecological information than do either of the earlier works. Proctor (1960) also lists a number of other general books and articles which may help with identification. A later number of *Field Studies* will contain an illustrated key to all the species listed in the present account. A list of the bryophytes of Skokholm Island is given by Gillham (1954).

A map of Dale Parish, giving the main named localities, is included here as Fig. 1.

PRINCIPAL HABITAT FACTORS

(i) Humidity

Humidity is probably the most important environmental factor affecting bryophyte distribution at Dale. In mosses and liverworts the leaf cuticle is either very thin or wholly lacking, and the plants consequently dry very easily. Most can resist temporary desiccation without harm, but this ability varies from species to species, and the least resistant can survive only in permanently wet habitats. Aquatic mosses such as *Fontinalis antipyretica* and *Eurhynchium riparioides* come into this category, whilst others, such as *Pellia endiviaefolia*, seem to require a permanently moist soil and periodic soaking of the thallus. The other extreme is found in the species of wall tops, such as *Barbula unguiculata* and *Tortula muralis*, which survive long periods in the summer in a physiologically inert state when the thin soil becomes dried out. *Epipterygium tozeri*, *Hookeria lucens* and some other species are restricted at Dale to damp banks near to water, usually in woods. It is, however, difficult to separate their humidity requirements from their probable intolerance of high light intensities.

Due mainly to the contours of the land, there is little permanently wet ground at Dale except along the margins of some of the small streams, and there is usually only a scanty bryophyte flora due to competition and shading by grasses, *Juncus*, etc. *Acrocladium cordifolium* from near Moorlands Farm is probably the most typical marsh species on the Dale list. There are no oligotrophic mires of any kind, and rather curiously the nearest *Sphagnum* to Dale appears to be on Skomer.

Evaporation of water depends largely on (a) rate of air movement, and (b) the air saturation deficit* (rather than relative humidity directly). Both are lowered near the ground since air movement is slowed by friction with vegetation, etc. and because continuous evaporation from the soil increases the actual air humidity close to the ground. Shading in a wood lowers the air temperature by several degrees on a warm sunny day, and this also gives lower saturation deficit values. At Dale Fort on a summer day with a light breeze of 6 m.p.h. at the Meteorological station, the air saturation deficit on the open hill top was about twice that a foot above ground on the path in Castlebeach Wood, and four times the value a foot above the water in the small incised stream close by. This effect is best seen on calm days, when the results of air mixing by wind are least.

Owing to its maritime situation, the Dale peninsula is noteworthy for its high air humidities (Oliver, 1959). Approximately two-thirds of the winds come in from over 60 miles of sea, with less than 4 miles of flat land intervening. Nevertheless, as elsewhere in Britain, during the summer water loss by transpiration and evaporation exceeds rainfall. Reference to the map prepared by Green (1964), shows that the 2 in. isopleth for average potential water deficit for the 6 summer months lies quite close to Dale. The extremes, using Green's map, are 0.05 inches for the west Highlands, and 8 inches for the Essex coast. Soil moisture deficits, calculated on a gross scale in this way, probably do not correlate well with bryophyte distribution patterns, as these plants can hardly

* Saturation deficit = difference between saturation vapour pressure at a given air temperature and the actual vapour pressure at this temperature.

be said to root in the soil and may be expected to be influenced more by microclimatic factors.

(2) *Chemical nature of the substratum*

The soils of the Dale peninsula are very uniform, being mostly derived from the Red Marls of the Lower Old Red Sandstone, or from drift deposits which are partially at least of local origin. These soils are slightly acid, varying in pH from about 5.5 to 6.5. There are few markedly acid soils, the lowest values observed in this study (4.4 and 4.6) being associated with rotting wood or shallow soils overlying rock and presumably much leached. There are also very few alkaline soils at Dale, the highest pH values (8.4 and 8.8) being recorded from the calcareous soils on walls, etc. with many mortar fragments. Dale is thus not surprisingly poor in species normally regarded as calcicoles. *Tortella nitida* and *Barbula revoluta* are probably strict calcicoles at Dale and are found only on old mortared walls. The effects of the predominantly lime-free soils on the land mollusca is discussed by Stratton (1964), who mentions the absence of most typically calcicolous species, and the thin shells of others with less exacting lime requirements.

The small streams in the district always seem to have a slightly higher pH than the soils, being around 6.5 to 7.0. This is probably associated with the relatively large amount of bases in solution, derived from fertilizers applied to the fields and leached out by rain. Dresser (1959) comments on the richness of the Dale soils agriculturally "particularly those which are treated with lime". There is sufficient lime in the small stream running into the quarry by Dale Castle for small-scale tufa deposition to occur, in association with *Cratoneuron filicinum* and *Pellia endiviifolia*. The precise origin of this lime remains uncertain, however.

Each bryophyte species probably has its own range of pH tolerance—some wide, others narrow. Whilst pH is not, in itself, perhaps of fundamental importance to a plant (it is the actual availability of chemicals necessary for growth which matters more, although the two are sometimes closely linked), it is nevertheless a useful ecological index, especially when considered in relation to the situation of the site and the soil types present. Representative pH ranges for a number of Dale species are given in Fig. 2. Further data of this kind may easily be obtained, and may be extended to other species. Pairs of species, such as *Eurhynchium swartzii* and *E. praelongum*, and *Barbula unguiculata* and *B. convoluta* are separated by soil preferences, the first of each pair being found on neutral to slightly basic soils, whilst the second extend into more acidic habitats.

A site so maritime as Dale is certain to be under the influence of sea spray, especially in open places. The actual amounts of saline water reaching different parts of the peninsula are not yet known, but they are certainly appreciable on the cliffs on the west coast. The sensitivity of bryophytes to different soil salinities is also not generally known, but it is clear that only a few can survive immersion in or direct spraying by sea-water. Salt-tolerant halophytic species at Dale include *Grimmia maritima* (abundant in the splash zone above rocky shores), and *Pottia heimii* (rare, in the Gann estuary). Some species on Pickle-ridge probably endure considerable salinity changes depending on rainfall and

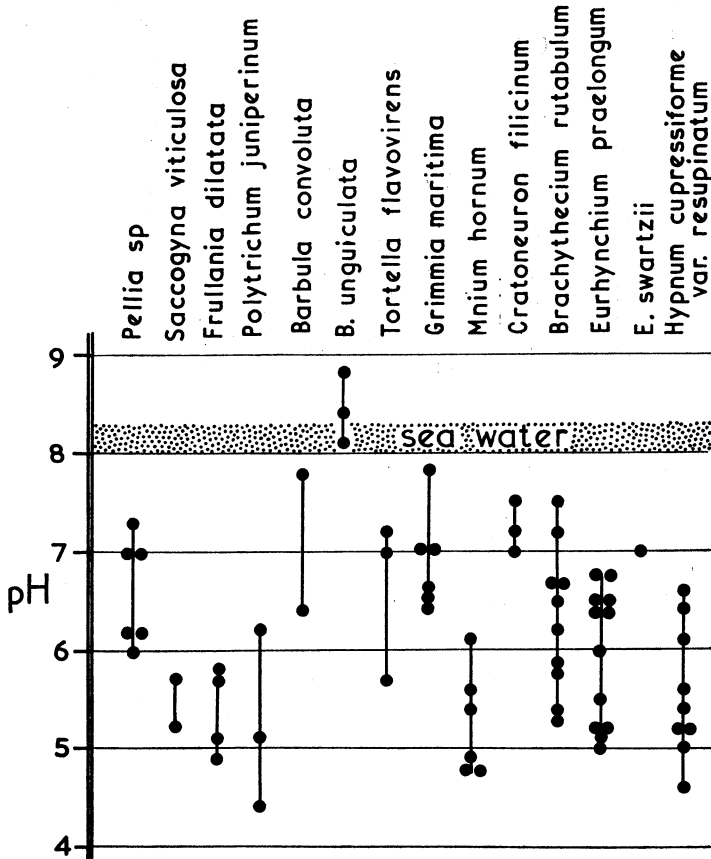


FIG. 2.

pH tolerance ranges shown for selected bryophytes in Dale parish. Each dot represents one glass-electrode determination.

the height of the tide. *Grimmia maritima* is considered by Gillham (1954) to be harmed by sea spray, and its vertical zonation in relation to exposure is easily measured and is worth further study. This relationship (shown in Fig. 3) extends above high water mark the concept of exposure discussed by Ballantine (1961). It should be noted that Moyses and Nelson-Smith (1963) have extended this concept up the cliff face, but unfortunately did not include any bryophytes in their studies. *Grimmia maritima* comes lowest on the sheltered shores of the Gann below Cliff Cottages, and is highest on the exposed cliffs of Skomer. The same relationship may even be seen on a small scale on a single rock in Castlebeach Bay (Fig. 4).

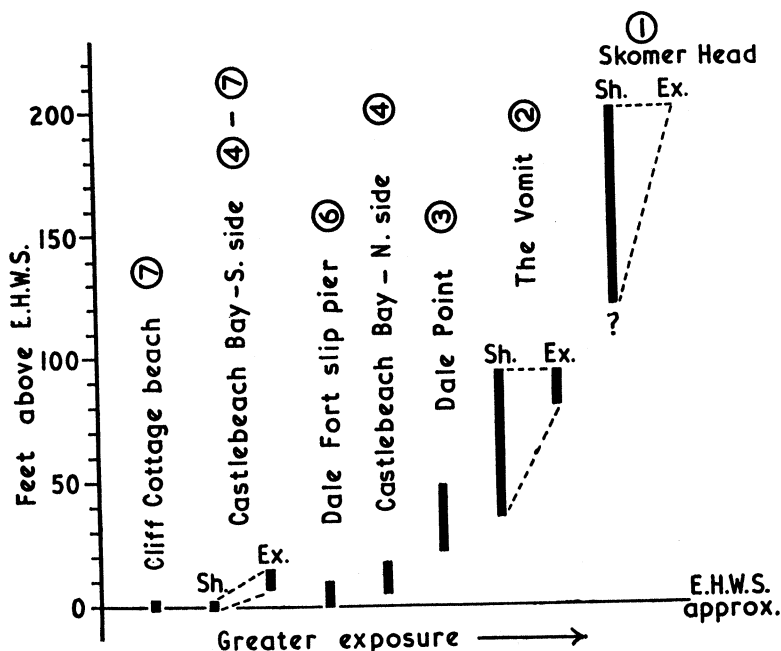


FIG. 3.

Vertical ranges for *Grimmia maritima* at selected points on the coast of the Dale peninsula and Skomer. Sh . . . sheltered. Ex . . . exposed. The lower limit for Skomer Head is uncertain, as the cliff becomes almost vertical.

(3) Light

All green plants need light for photosynthesis, but they vary very much in their photosynthetic efficiency. Some bryophytes are able to grow at very low light intensities, or at least can survive in these conditions. For woodland species, it may be that active growth takes place only during periodic increases in illumination, whilst it is also not easy to separate their light requirements from their need for high humidity. High humidity in nature is often associated with deep shade.

Hookeria lucens is often regarded as a species which is actually intolerant of bright light, and at Dale it is confined to shaded streambanks in woods. High light intensities seem to kill the leaf cells, producing white "bleached" patches in the foliage. Table 1 shows some simple data for two *Hookeria* sites at Dale. The figures have been extrapolated to show likely values for April (similar total irradiation as for September, but using the January percentage reduction from full daylight because of the lack of tree foliage). It is clear that appreciable amounts of light will reach the woodland floor just before the trees come into leaf—a point made by Anderson (1964) in a discussion of light values in wood-

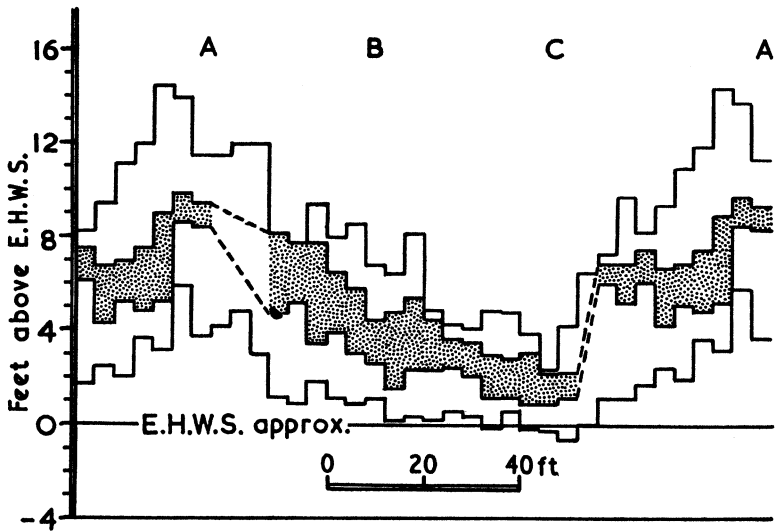


FIG. 4.

Vertical ranges for *Grimmia maritima* round a single rock on the south side of Castlebeach Bay. The zone of moss was divided into 2-ft. strips, and the upper and lower limits recorded for each strip. The region of greatest abundance is shown stippled. A, B and C mark the corners of the rock, which is approximately triangular in plan, A being the most exposed and C the most sheltered.

Table 1. *Light intensities at two Hookeria lucens sites.* The April estimates are for similar weather conditions, viz. clear sunny days. When measuring full daylight, the photocell was shielded from direct sunlight.

	January no foliage on trees		September dense foliage on trees		Estimated light intensity at site in April (foot candles)
	Light intensity (foot candles)	Fraction of full daylight reaching site	Light intensity (foot candles)	Fraction of full daylight reaching site	
Cemetery Hill Wood ..	98	0.400	46	0.025	c. 735
Castlebeach Wood ..	125	0.200	19	0.001	c. 385

lands. She also demonstrates how the proportion of total daylight which actually reaches the floor varies considerably from day to day according to weather conditions.

Much more detailed work remains to be done to solve the light requirements of individual bryophyte species, especially in view of the number of variables involved.

(4) *Temperature*

The Dale climate is very mild, with but few frosts (Oliver, 1959), and temperature may be assumed not to be a limiting factor for bryophytes at Dale. This mildness of climate will, however, allow non-frost-tolerant species to survive, as happens with certain flowering plants such as *Plantago coronopus* var. *ceratophyllum*. *Lophocolea fragrans*, a rather rare and predominantly coastal species, has its range probably largely determined by temperature (see Milne-Redhead, 1963, giving a distribution map for the British Isles). Other western coastal species (such as *Porella thuja*, *Cololejeunea minutissima* and *Scleropodium tourretii*) almost certainly have distributional ranges mainly limited by temperature in other parts of Britain.

In bright sunshine, the temperature of plant tissues can rise surprisingly high, producing actual physical damage. This is most marked at high altitudes, and the nearness to sea level of the Dale peninsula reduces the likelihood of damage. Furthermore, during dry periods in the summer, bryophytes of exposed sites are dried up and are physiologically virtually inactive and so remain unaffected by temporary heat and drought. This applies particularly to species such as *Polytrichum juniperinum*, *Tortella nitida* and *Barbula* spp. where the leaf lamina becomes very strongly inflexed in the dry state and where the midrib may also become contorted.

SOME IMPORTANT BRYOPHYTE COMMUNITIES

(1) *Fallow fields, walls and other open sites*

Bryophytes generally come in early in the colonization of open ground, as a result of efficient dispersal by spores, gemmae and vegetative fragments carried by wind, rain splashing, etc. but are intolerant of competition from the taller and more vigorous flowering plants which succeed them.

At Dale, we frequently see such early pioneer communities in, for example, fallow fields. Several species are quite characteristic of these temporary habitats, such as *Fossombronina* spp., *Funaria fascicularis*, *Pottia* spp., *Pseudephemerum nitidum* and *Phascum cuspidatum*, whilst *Physcomitrium pyriforme* and *Anthoceros punctatus* grow on open soil that is more permanently moist. Young growths of *Eurhynchium praelongum* are almost invariably present. The critical species of the *Bryum erythrocarpum* complex are more species frequent on rather damp bare soil, and other species (see Crundwell and Nyholm, 1964) in addition to *B. rubens* and *B. ruderale* should be expected to turn up at Dale. In this group the shining red or yellowish rhizoid gemmae can be more conspicuous than the slender leafy shoots if the latter have dried up.

The faces and tops of stone walls provide another habitat free from competition, suitable for bryophyte colonization. The walls in Dale village, together with those at Mullock Bridge, have been constructed with much mortar and a highly calcareous "soil" has developed which supports the most calcicole species in the Dale flora, such as *Tortella nitida*, *Barbula revoluta* and the abundant *B. unguiculata*. The old stone and earth field boundary banks also provide habitats locally for bryophytes, but they are non-calcareous and for much of the year overhung by grasses and other angiosperms. Woodland species such as *Plagiothecium succulentum* and *Mnium hornum* are frequent in such places, in addition to the ubiquitous *Eurhynchium praelongum*.

It should be noted that the Carboniferous Limestone used in the construction of the Fort walls has no effect on the bryophyte flora, presumably because there is too little free lime. In any case, very few plants can get a hold, except at the extreme base of the walls. The most calcicole flora within the Fort is to be found on old cement on the wall above the garages. *Cratoneuron filicinum* grows here, by far the driest habitat for this species so far found in the parish. Quite a rich flora, including an acute-leaved form of *Tortula ruralis*, grows on the concrete base of an old Nissen hut in Barrack Field just outside the Fort. This same *Tortula* also occurs at the foot of a mortared wall by Dale Castle, and has been confused with *T. ruraliformis* (a sand-dune species with a more hyaline leaf apex).

Paths and roadsides have a few characteristic species, especially *Bryum argenteum*, a world-wide anthropochore which probably owes its wide distribution to short deciduous branches adhering to footwear and vehicle wheels. *Barbula convoluta* is also most frequent in this kind of habitat at Dale.

(2) Grasslands

The grasslands of Dale parish are mostly artificial in origin, and are cut for hay (see Dresser, 1959). There is very little permanent grassland, apart from the coarse growths on the cliff slopes. These are all unsuitable for bryophytes in general, and their flora contrasts markedly with that on the shallow soils on rock outcrops along the cliff tops. These are noteworthy for the frequency of *Polytrichum juniperinum*. *Pseudoscleropodium purum*, elsewhere usually found amongst grass, seems to be very rare at Dale, as also is *Rhytidiadelphus squarrosus*, another grassland species.

The pioneer communities in fallow fields have been referred to above, and are best regarded as the first stages in the bryophyte succession which culminates in the extremely restricted flora of established grasslands (little beyond scattered, thin stems of a few pleurocarpous mosses, mostly *Eurhynchium praelongum*).

(3) Woodlands

The woodlands at Dale are the richest areas for bryophytes, both in total number of species and in their total cover. The woods and copses are now mostly restricted to steep slopes and small valleys, and are consequently often associated with small stream-cut ravines. The woodland flora is thus enhanced by the presence of those shade-tolerant and humidity-demanding species which grow on the vertical or overhanging and constantly eroding stream banks. Others, such as *Brachythecium rivulare* and *Conocephalum conicum*, are more or less restricted to stones in and close to streams.

The Dale woodlands are not natural, as is shown by both the tree species present and the general appearance of the woods. Like the grasslands, they have had a history much disturbed by Man. Nevertheless, there may have been considerable tree cover for long periods in parts of areas such as the present Castlebeach Wood, according to the evidence of earlier maps. This particular wood has a relatively rich bryophyte flora, including *Lophocolea fragrans*,

Epipterygium tozeri, *Hookeria lucens*, *Amblystegium varium* and *Rhynchostegiella pumila*.

The trees generally bear a poor epiphytic flora with only a few noteworthy species. *Zygodon viridissimus* has been seen to be particularly abundant on tree trunks close to the edge of Point Wood on the cliff top, whilst a similar preference for the outward-facing trunks of marginal trees has been observed at Monk Haven on the north side of Milford Haven. Pleurocarpous mosses often extend a short distance up tree trunks from the ground, and the factors controlling the change to the more typical trunk species could well be studied in detail.

Bryophyte epiphytes are more common on small trees and shrubs in copses such as those near Broomhill and Maryborough Farms, and on thinly scattered trees such as those in Dale churchyard. Elder has a particularly rich epiphytic flora (as elsewhere in Britain), with *Cryphaea heteromalla* and *Tortula laevipila* var. *laevipiliformis* as the most interesting species. The commonest epiphytic liverworts are *Cololejeunea minutissima* and *Frullania dilatata*. Ash also carries several characteristic species, although its bark texture is very different. More attention should be given to the factors determining which bryophytes grow on which tree species. Much relevant information is to be found in Barkman's (1958) studies on cryptogamic epiphytes. Reference may also be made to Kershaw (1964).

A reduced flora, related to that of the woodland floor, occurs on old field boundary banks and similar places which are shaded during the summer by taller flowering plants. This shading protects the bryophytes from the drying effects of direct sunshine and wind as does the tree canopy in a wood. Partially concealed hollows on rock outcrops also have some of these woodland species, often with much *Lophocolea*, and sometimes *Lejeunea patens*. This kind of habitat is analogous to rock crevices in mountain crags (on a similar scale) and to stream-cut gorges and gills on mountain slopes (on a much larger scale). It is clear that site microclimate is fundamental in determining the detailed distribution of particular species, but we are usually ignorant of the precise range of tolerance of any given plant.

ANNOTATED SPECIES LIST

The area covered in the compilation of this list of records is the parish of Dale, together with a small extension inland to include Crabhall Marsh, and the old gravel pits and quarry near Crabhall Farm. Mullock Bridge is also included. Unless otherwise stated, habitat details refer only to these geographical limits.

Details of most of the records are available in the card index maintained by Dale Fort Field Centre, on which this list is based. Records which I have not confirmed personally are attributed to those who made them. All those without initials have been confirmed, or first made, by me personally. I am particularly grateful to Mr. T. Laffin for supplying me with a list of his own records from Pickleridge and the stone quarry near Crabhall Farm. Various members of the British Bryological Society have kindly helped me in the determination of some of the species, and their names are included in the following list of abbreviations.

F.W.A.	F. W. Adams	C.D.P.	C. D. Pigott
P.B.	P. Bell	J.A.P.	Mrs. J. A. Paton
M.P.J.	M. P. Jones	E.C.W.	E. C. Wallace
E.L.	E. Lodge	E.V.W.	E. V. Watson
T.L.	T. Laffin	H.L.K.W.	H. L. K. Whitehouse
A.H.N.	A. H. Norkett		

Nomenclature and systematic order follow Paton (1965) for the liverworts and Warburg (1963) for the mosses.

Class *ANTHOCEROTOPSIDA* (Anthocerotae)

Anthocerotaceae

ANTHOCEROS PUNCTATUS L.

Damp bared soil, old stone quarry near Crabhall Farm; between *Carex paniculata* tussocks, field north west of Crabhall Marsh.

Class *HEPATICOPSIDA* (Hepaticae)

Marchantiaceae

REBOULIA HEMISPHERICA (L.) Raddi

Stonework on wall of Mullock Bridge.

CONOCEPHALUM CONIGUM (L.) Underw.

Damp places near streams. Valley between Snailston and Mill Bay; Castlebeach Wood; Cemetery Hill Wood.

LUNULARIA CRUCIATA (L.) Dum.

Wet ground at top of Cemetery Hill Wood; base of cliff below Cliff Cottages.

Riccardiaceae

RICCARDIA PINGUIS (L.) Gray

Wet sandy soil in gravel pit north east of Crabhall Farm.

Pelliaceae

PELLIA ENDIVIIFOLIA Dicks.

Watwick Bay; top of Cemetery Hill Wood. These are the only localities so far established certainly for this species. However, plants of this genus are frequently encountered in damp places near streams, etc. in Dale, but the material is normally sterile and determination consequently usually impossible. I suspect that all will prove to be *P. endiviifolia*, rather than *P. epiphylla*.

Metzgeriaceae

METZGERIA FURCATA (L.) Dum.

Widespread on tree trunks and branches, but also known from stone walls, old boundary banks and similar sites, growing on exposed roots and dead plant remains.

METZGERIA FRUTICULOSA (Dicks.) Evans

Branches and trunks of small trees near Broomhill Farm.

Fossombroniaceae

FOSSOMBRONIA PUSILLA (L.) Dum.

Fallow field above gravel pit between Spedlands and Crabhall Farm.

FOSSOMBRONIA WONDRACZEKII (Corda) Dum.

Bare soil in wet cattle-trodden meadow, Keystacks west of Broomhill Farm (conf. J.A.P. New to v.c. 45, see Paton, 1964).

Calypogeiaceae**CALYPOGEIA FISSA (L.) Raddi**

Growing on *Carex paniculata* tussocks, Mill Bay; rock outcrop in Castlebeach Wood; base of cliff below Cliff Cottages.

CALYPOGEIA ARGUTA Nees & Mont.

Characteristic of bare soil on rather damp banks, often overhung by other vegetation.

Lophoziaaceae**LOPHOZIA VENTRICOSA (Dicks.) Dum.**

Old gravel pit between Jubilee and Crabhall Farm.

Plagiochilaceae**PLAGIOCHILA ASPLENIODES (L.) Dum.**

Damp banks, rocks, etc. usually in rather shaded sites.

Harpanthaceae**LOPHOCOLEA BIDENTATA (L.) Dum.**

Widespread amongst grass on banks and in damp sites in woods, often near streams.

LOPHOCOLEA CUSPIDATA (Nees) Limpr.

Field boundary bank south of Snailston; Watwick Bay; rocks above Dale Fort lawn; beside track to Dale Fort slip. Clearly less common at Dale than *L. bidentata*.

LOPHOCOLEA HETEROPHYLLA (Schrad.) Dum.

Growing over dead plant material, old field boundary bank near Vomit Point; rotting wood, Cemetery Hill Wood.

LOPHOCOLEA FRAGRANS (Moris & De Not.) Moris & De Not.

On mosses at bases of tree trunk, Castlebeach Wood.

SACCOGYNA VITICULOSA (L.) Dum.

Sheltered places on rocky cliffs, Castlebeach Bay.

Cephaloziellaceae**CEPHALOZIELLA**

Sterile material has been gathered from several localities, but it has not proved possible to identify these plants beyond the genus. Plants from West Dale Bay and Vomit Point grew on bare soil on the cliff tops.

Cephaloziaceae**CEPHALOZIA BICUSPIDATA (L.) Dum.**

Damp soil at base of cliff below Cliff Cottages (det. J.A.P.).

Scapaniaceae**DIPLOPHYLLUM ALBIGANS (L.) Dum.**

Rock outcrop in Castlebeach Wood.

Radulaceae**RADULA COMPLANATA (L.) Dum.**

Epiphytic on trees. Castlebeach Wood; Cemetery Hill Wood.

Porellaceae**PORELLA THUJA (Dicks.) C. Jens.**

Exposed rock face, Great Castle Head, West Dale Bay.

Lejeuneaceae**LEJEUNEA PATENS Lindb.**

Mill Bay; around base of shrub, Watwick Bay; shaded rock on cliff near Frenchman's Path, Dale Fort; mossy wall in Dale churchyard. There is some uncertainty about the precise identity of these plants, different names having been given to the same

material by those who have looked at them for me. I originally named most as being *L. patens*, using leaf shape as my guide, but there is a strong possibility that when the oil bodies are examined in living material the Dale plants may prove to be *L. cavifolia*. *L. patens* is regarded by Paton (1965) as being only doubtfully recorded for v.c. 45.

COLOLEJEUNEA MINUTISSIMA (Sm.) Schiffn.

Widespread as a tree epiphyte, often on *Sambucus nigra*.

Frullaniaceae

FRULLANIA DILATATA (L.) Dum.

Widespread on trees and fallen logs. Concrete base of Nissen hut, Barrack Field, Dale Fort; beside path to Dale Fort slip; rocks near Frenchman's Path, Dale Fort; wall by track to West Dale Bay, below Dale Castle.

Class BRYOPSIDA (Musci)

Polytrichaceae

ATRICHUM UNDULATUM (Hedw.) P. Beauv.

Lane bank near Broomhill Farm; Castlebeach Wood (M.P.J.); Point Wood; old stone quarry near Crabhall Farm.

POLYTRICHUM ALOIDES Hedw.

Colonizer of bared soil round upturned tree roots, small earth cliffs, etc. The perennial protonema forms a conspicuous green sheet on the soil. Mill Bay; Cemetery Hill Wood; cliff below Cliff Cottages.

POLYTRICHUM JUNIPERINUM Hedw.

Widespread on shallow soils overlying rock along cliff tops. St. Ann's Head to Dale Fort; sand and pebbles, Pickleridge.

POLYTRICHUM FORMOSUM Hedw.

Point Wood.

Fissidentaceae

FISSIDENS VIRIDULUS Wahlenb.

Old stone quarry near Crabhall Farm (T.L. det A.H.N.); Castlebeach Wood (conf. A.H.N.).

FISSIDENS BRYOIDES Hedw.

Widespread on bare soil along streamsides, roadside banks, etc. often overhung and shaded by other vegetation. (Several gatherings conf. A.H.N., others may be *F. viridulus* or *F. incurvus*. The specific limits in this group seem rather unsatisfactory.)

FISSIDENS INCURVUS Starke ex Web. & Mohr

Roadside bank at S.E. end of Dale village (det. A.H.N.).

FISSIDENS TAXIFOLIUS Hedw.

Damp soil and rocks, usually near streams. Watwick Bay (E.L.); Castlebeach Wood (E.L.); Cemetery Hill Wood.

FISSIDENS CRISTATUS Wils.

Watwick Bay. Probably in rather flushed situation.

Dicranaceae

PLEURIDIUM SUBULATUM (Hedw.) Lindb.

Shaded earth bank at foot of cliff (with *Epipterygium tozeri*), Mill Bay; disturbed soil, Watwick Bay.

CERATODON PURPUREUS (Hedw.) Brid.

Old boundary bank, Great Castle Head, West Dale Bay; Barrack Field, Dale Fort; old stone quarry near Crabhall Farm (T.L.); sand and pebbles, Pickleridge.

PSEUDEPHEMERUM NITIDUM (Hedw.) Reim.

Damp soil in cattle-trodden meadow, Keystacks, near Broomhill Farm; old stone quarry near Crabhall Farm (T.L.).

DICRANELLA SCHREBERANA (Hedw.) Dix.

Old stone quarry near Crabhall Farm (T.L.).

DICRANELLA HETEROMALLA (Hedw.) Schimp.

Field boundary bank, Vomit Point; old gravel pit between Jubilee and Crabhall Farm; lower part of cliff below Cliff Cottages.

DICRANUM SCOPARIUM Hedw.

Grassland immediately above Dale Fort (E.L.); sand and pebbles, Pickleridge. This polymorphic species seems unexpectedly scarce at Dale.

CAMPYLOPUS FRAGILIS (Brid.) B., S. & G.

Disturbed soil, Mill Bay. Conspicuous owing to the numerous light-coloured, contorted, deciduous leaves.

Pottiaceae**TORTULA RURALIS** (Hedw.) Chrome

Concrete base of Nissen hut, Barrack Field, Dale Fort; foot of wall below Dale Castle. Apparently calcicole at Dale. These plants all have rather more pointed leaves than is usual for *T. ruralis*, and in shape approach *T. ruraliformis*, although they are not so hyaline towards the apex as in that species. *T. ruraliformis* also differs in being a plant of unfixed sandy habitats.

TORTULA LAEVIPILA (Brid.) Schwaegr.

Common on trees, usually *Sambucus* or *Fraxinus*. All the Dale specimens are referable to the var. *laevipiliformis* (De Not.) Limpr., a predominantly southern and western plant in the rest of Britain, distinguished by a conspicuous yellowish margin to the leaves, and often with small deciduous branchlets near the stem apex.

TORTULA MURALIS Hedw.

Widespread on stone walls, concrete, etc.; less commonly on natural rock outcrops, e.g. above lawn, Dale Fort.

ALOINA AMBIGUA (B. & S.) Limpr.

Gravel pit N.E. of Crabhall Farm. This species is normally indicative of somewhat calcareous soils.

POTTIA HEIMII (Hedw.) Fűrnr.

Muddy shore track N.E. of Crabhall Farm (conf. E.C.W.). This site, close to the extreme high water mark, supports the general impression that this species is a true halophyte, being tolerant of high soil salinities.

POTTIA TRUNCATA (Hedw.) Fűrnr.

Open soil in fallow fields, and in other disturbed and temporary habitats. Several localities in Dale, including cracks in old concrete on Dale aerodrome (closely associated with *Orthotrichum diaphanum*).

POTTIA CRINITA Wils. ex B., S. & G.

Clay on cliffs just above shore, slightly west of Dale Fort slip.

POTTIA DAVALLIANA (Sm.) C. Jens.

Fallow field above gravel pit between Jubilee and Crabhall Farm.

POTTIA RECTA (Sm.) Mitt.

Disturbed soil, Watwick Bay.

PHASCUM CUSPIDATUM Hedw.

Watwick Bay; gravel pit between Jubilee and Crabhall Farm.

BARBULA CONVOLUTA Hedw.

Semi-natural habitats, such as wall tops, track sides, gravel pits, etc.

BARBULA UNGUICULATA Hedw.

Habitats similar to those of *B. convoluta*, but probably in general rather more calcicole. One of the most conspicuous species on the walls in Dale village.

BARBULA REVOLUTA Brid.

Old mortared walls. Mullock Bridge; wall by track to West Dale Bay, below Dale Castle.

BARBULA FALLAX Hedw.

Cliff top above Watwick Bay (F.W.A.); concrete base of Nissen hut, Barrack Field, Dale Fort.

BARBULA TOPHACEA (Brid.) Mitt.

Wet seepage areas on walls, cliffs and on flushed woodland soil near stream in Cemetery Hill Wood. A less usual habitat is on the sand and shingle of Pickleridge (T.L.), where its normally high base requirements are presumably met by the periodic availability of diluted seawater.

BARBULA CYLINDRICA (Tayl.) Schimp.

Streamsides, Watwick Bay (F.W.A.); old stone quarry near Crabhall Farm (T.L.).

BARBULA VINEALIS Brid.

Roadside wall in Dale village.

BARBULA RECURVIOSTRA (Hedw.) Dix.

Rocks by sea, Castlebeach Bay (F.W.A.); wall top, Mullock Bridge; rocks above lawn, Dale Fort.

TORTELLA NITIDA (Lindb.) Broth.

Conspicuous compact cushions on wall top, Mullock Bridge.

TORTELLA FLAVOVIRENS (Bruch) Broth.

Generally near to high water mark, but on the cliff top on the exposed west coast of Dale peninsula. Watwick Bay; field boundary bank, Vomit Point; Mill Bay; just west of Dale Fort slip; amongst *Grimmia maritima* on rock platform below Cliff Cottages; Pickleridge.

TRICHOSTOMUM BRACHYDONTIUM Bruch

Roadside bank south of Snailston; Watwick Bay; old gravel pit between Jubilee and Crabhall Farm; cliff top, West Dale Bay.

WEISSIA CONTROVERSA Hedw.

Several localities on old field and roadside banks, and in the gravel pit and quarry near Crabhall Farm (T.L.).

WEISSIA MICROSTOMA (Hedw.) C. Müll.

Vomit Field, St. Ann's Head.

Grimmiaceae

GRIMMIA MARITIMA Turn.

Very common on rocky coasts, generally forming a band above high water mark. The actual level of this band is clearly related to the degree of exposure of the site.

GRIMMIA PULVINATA (Hedw.) Sm.

Wall tops in Dale village (C.D.P.); wall top, Mullock Bridge (M.P.J.); rocks, Great Castle Head, West Dale Bay.

RHACOMITRIUM LANUGINOSUM (Hedw.) Brid.

On soil, cliffs on west side of Mill Bay (coll. P.B.). This species is rather unexpected for Dale, and the habitat is not wholly normal. In the hill country of Britain it is not uncommon on wet ground, and in Sussex it grows on chalk.

Funariaceae

FUNARIA HYGROMETRICA Hedw.

Watwick Bay; cliffs just above shore, west of Dale Fort slip; gardens in Dale village (E.L.); base of cliffs below Cliff Cottages.

FUNARIA FASCICULARIS (Hedw.) Schimp.

Disturbed soil in wet cattle-trodden meadow, Keystacks, near Broomhill Farm. This site is wetter than one would normally associate with this species, and in the absence of the characteristically placed calyptra it would have been regarded as the next plant.

PHYSCOMITRIUM PYRIFORME (Hedw.) Brid.

Damp mud by stream, Castlebeach Bay; wet ground amongst *Carex paniculata*, field north west of Crabhall Marsh.

Bryaceae**LEPTOBRYUM PYRIFORME** (Hedw.) Wils.

Bare muddy ground at edge of runnel, north of Dale village, grid square 12/8006 (T.L. New to v.c. 45, see Warburg, 1964); wet ground amongst *Carex paniculata*, field north west of Crabhall Marsh (det. H.L.K.W.).

POHLIA NUTANS (Hedw.) Lindb.

On rocks and banks in wood, Castlebeach Wood (E.L.).

POHLIA DELICATULA (Hedw.) Grout

Shaded earth banks near streams. Watwick Bay; Castlebeach Wood; base of cliff below Cliff Cottages.

EPIPTERYGIUM TOZERI (Grev.) Lindb.

Shaded earth banks and cliffs near streams. Mill Bay; Castlebeach Wood; Cemetery Hill Wood; base of cliff below Cliff Cottages.

BRYUM

Several sterile and unidentified species have been encountered in addition to the species listed below.

BRYUM PENDULUM (Hornsch.) Schimp.

Sand and shingle, Pickleridge (T.L.).

BRYUM INCLINATUM (Brid.) Bland.

Old gravel pit north east of Crabhall Farm.

BRYUM CAESPITICIMUM Hedw.

Cliff top, West Dale Bay; between paving stones outside Geography Room, Dale Fort.

BRYUM ARGENTEUM Hedw.

Cracks in old concrete runway, Dale aerodrome (E.L.); between paving stones outside Geography Room, and outside garages, Dale Fort. One of the best examples amongst the mosses of a species dispersed by man (it has even reached MacMurdo Sound, Antarctica), and usually establishing itself in artificial habitats beside paths, etc.

BRYUM BICOLOR Dicks.

Concrete base of Nissen hut, Barrack Field, Dale Fort (det. E.V.W.).

BRYUM RUBENS Mitt.

Watwick Bay; edge of fallow field above old gravel pit between Jubilee and Crabhall Farm.

BRYUM RUDERALE Crundw. & Nyh.

Concrete base of Nissen hut, Barrack Field, Dale Fort (det. E.V.W.).

BRYUM CAPILLARE Hedw.

Base of shrub, Watwick Bay; common round Dale Fort on rocks, concrete and in turf (E.L.).

Mniaceae**MNIUM HORNUM** Hedw.

On soil, rock outcrops and fallen logs. Castlebeach Wood; Point Wood; Cemetery Hill Wood; old lane bank near Broomhill Farm; mossy wall in Dale churchyard.

MNIUM LONGIROSTRUM Brid.

Bases of trees in Castlebeach Wood.

MNIUM UNDULATUM Hedw.

Usually on soil under trees in woods. Castlebeach Wood; Point Wood; Cemetery Hill Wood.

MNIUM PUNCTATUM Hedw.

Fallen tree trunks and on ground near stream, Castlebeach Wood.

Orthotrichaceae

ZYGODON VIRIDISSIMUS (Dicks.) R.Br.

Widespread as a tree epiphyte, less commonly on stone walls, as in Dale village. All material examined proved to be var. *viridissimus*.

ORTHOTRICHUM AFFINE Brid.

Epiphytic on trees, Castlebeach Wood (F.W.A.).

ORTHOTRICHUM DIAPHANUM Brid.

Trunk of *Acer pseudoplatanus*, Castlebeach Wood (F.W.A.); epiphytic on *Sambucus nigra*, near Crabhall Farm; old concrete, Dale aerodrome; stone walls, Mullock Bridge (M.P.J.).

ULOTA PHYLLANTHA Brid.

Epiphytic on trees, Castlebeach Wood; near Maryborough Farm (C.D.P.); near Broomhill Farm; cliffs near Frenchman's Path, Dale Fort; Point Wood.

ULOTA CRISPA (Hedw.) Brid.

Epiphytic on trees, Castlebeach Wood.

Cryphaeaceae

CRYPHAEA HETEROMALLA (Hedw.) Mohr

Epiphytic on trees, usually *Sambucus nigra*. Watwick Bay; Castlebeach Wood; near Maryborough Farm (C.D.P.); near Crabhall Farm.

Leucodontaceae

PTEROGONIUM gracile (Hedw.) Sm.

Rock outcrop, north side of Castlebeach Bay (C.D.P.).

Neckeraceae

NECKERA COMPLANATA (Hedw.) Hüben.

Rocks (M.P.J.) and trees, Castlebeach Wood; mossy wall, Dale churchyard.

THAMNIUM ALOPECURUM (Hedw.) B., S. & G.

Near stream and on rock outcrops, Castlebeach Wood; mossy wall in Dale churchyard.

Hookeriaceae

HOOKERIA LUCENS (Hedw.) Sm.

Wet rock and earth along sides of stream in Castlebeach Wood; steep shaded bank by stream, Cemetery Hill Wood.

Leskeaceae

HETEROCLADIUM HETEROPTERUM (Bruch ex Schwaegr.) B., S. & G.

Damp stone near stream, Watwick Bay; small rock outcrop, Castlebeach Wood.

Thuidiaceae

THUIDIUM TAMARISCINUM (Hedw.) B., S. & G.

Banks of stream (M.P.J.) and rock outcrop in Castlebeach Wood.

Hypnaceae

CRATONEURON FILICINUM (Hedw.) Spruce

Numerous places near streams and springs, and on wet ground in woods. Less typical is the site on concrete above the garages at Dale Fort.

AMBLYSTEGIUM SERPENS (Hedw.) B., S. & G.

Watwick Bay; wall of old lime kiln, Castlebeach Bay; stonework outside garages, Dale Fort; trees in Castlebeach Wood and Cemetery Hill Wood.

AMBLYSTEGIUM VARIUM (Hedw.) Lindb.

Castlebeach Wood (conf. E.C.W.).

ACROCLADIUM CORDIFOLIUM (Hedw.) Rich. & Wall.

Wet marshy ground near Moorlands Farm.

ACROCLADIUM CUSPIDATUM (Hedw.) Lindb.

Wet ground, N.E. side of Crabhall Marsh.

ISOTHECIUM MYOSUROIDES Brid.

Rocks (E.L.) and trees, Castlebeach Wood; Cemetery Hill Wood.

CAMPTOTHECIUM SERICEUM (Hedw.) Kindb.

Widespread on walls and stonework, much less frequent on trees, as in Castlebeach Wood and Point Wood.

BRACHYTHECIUM ALBICANS (Hedw.) B., S. & G.

In turf on rock outcrops above Dale Fort (E.L.); concrete base to Nissen hut, Barrack Field, Dale Fort; old stone quarry near Crabhall Farm (T.L.); sand and pebbles, Pickleridge.

BRACHYTHECIUM RUTABULUM (Hedw.) B., S. & G.

Very common, usually amongst grass in rather damp sites, but also on rocks and stone walls.

BRACHYTHECIUM RIVULARE B., S. & G.

Stones in stream just below road, in Point Wood.

BRACHYTHECIUM VELUTINUM (Hedw.) B., S. & G.

Old field boundary bank, West Dale Bay.

SCLEROPODIUM TOURRETHI (Brid.) L. F. Koch

Amongst grass in turf on rock outcrop, meteorological station, Dale Fort.

EURHYNCHIUM STRIATUM (Hedw.) Schimp.

On ground, Point Wood.

EURHYNCHIUM PRAELONGUM (Hedw.) Hobk.

Certainly the commonest and most widespread bryophyte at Dale. It occurs in almost all kinds of habitat, except close to the shore and actually immersed in streams.

EURHYNCHIUM SWARTZII (Turn.) Curn.

On ground between *Carex paniculata* tussocks, Mill Bay; wall tops in Dale village; floor of old gravel pit between Jubilee and Crabhall Farm.

EURHYNCHIUM RIPARIOIDES (Hedw.) Rich.

Widespread in streams, and on rocks and stones close to the water.

EURHYNCHIUM CONFERTUM (Dicks.) Milde

Usually about the bases of trees in woods. Watwick Bay; Castlebeach Wood; Point Wood; near Crabhall Farm. Less usual is the site on the concrete base of a Nissen hut, Barrack Field, Dale Fort.

RHYNCHOSTEGIELLA PUMILA (Wils.) E. F. Warb.

Castlebeach Wood.

RHYNCHOSTEGIELLA TENELLA (Dicks.) Limpr.

Wall of old lime kiln, Castlebeach Bay; roadside walls in Dale village; stone wall, Mullock Bridge.

PSEUDOSCLEROPODIUM PURUM (Limpr.) Fleisch.

Old stone quarry near Crabhall Farm (T.L.); sand and pebbles, Pickleridge.

ISOPTERYGIUM ELEGANS (Hook.) Lindb.

Shaded places in Castlebeach Wood; old lane near Broomhill Farm.

PLAGIOTHECIUM SUCCULENTUM (Wils.) Lindb.

Soil in shady sites in woods. Mill Bay; Castlebeach Wood; Point Wood; Cemetery Hill Wood; old lane bank near Broomhill Farm. No other species of the critical *P. denticulatum-sylvaticum* group have so far been found at Dale.

HYPNUM CUPRESSIFORME Hedw.

This polymorphic species is represented at Dale by several varieties, but it is not

always possible to allocate gatherings to named varieties. In particular, the plants from the sand and shingle of Pickleridge seem difficult to place. Var. *cupressiforme* is known from tree trunks in Castlebeach Wood, var. *resupinatum* (Wils.) Schimp. is widespread on tree trunks and branches and also occurs on rock outcrops in and near Dale Fort, whilst var. *filiforme* Brid. is known from a tree trunk in Castlebeach Wood. RHYTTIDAEDELPHUS SQUARROSUS (Hedw.) Warnst. Lawns, and in turf on rock outcrop above Dale Fort (E.L.).

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