

LICHENS OF THE SOUTH DEVON COASTAL SCHISTS

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ABSTRACT

The lichens of the coastal schists between Bolt Tail and Start Point, South Devon, are surveyed. 277 species have been reported of which five are erroneous or doubtful and 11 have not been found this century. Of the extant 261 species, 225 occur on rock or on the ground associated with the cliffs. The area is consequently one of the richest sites for coastal lichens known in the British Isles. Of particular interest is an element of extreme south-western species but the area is also rich in more widespread western and southern saxicolous species. Most of the species not refound belonged to an assemblage, requiring a high rainfall, which still persists on north-facing crags in a reduced state in two sites. Maps showing the past and present distributions of *Cladonia convoluta* and *Rocella fuciformis* in the British Isles, and of a further eight species in Devon, are presented. Lichenicolous fungi noted during the survey are mentioned, and one new combination is made: *Phycia tenella* subsp. *marina* (A. Nyl.) D. Hawksw. The lichen communities present are reviewed, with emphasis on the zonation on rocky shores, and transects prepared from shores of different aspects are included. Possible threats to the lichen flora and conservation measures are also discussed.

INTRODUCTION

The rocky coast of south-west England is exceptionally rich in lichens but few accounts of the species present and the communities they form have been prepared. In this region the only areas to have been surveyed in detail are The Lizard (Pentecost, 1969), the limestone at Berry Head, near Brixham (Hawksworth, 1973a), the dolerite at Black Head, Torquay (Hawksworth and Skinner, 1974), and the island of Lundy (Noon and Hawksworth, 1973). The rocky coastline between Bolt Tail and Start Point in south Devon differs geologically from these areas and is of outstanding scientific importance for the lichen communities developed and the rare species present. It is also used extensively by students examining the zonation of the flora and fauna on rocky shores. This paper aims both to document the scientific interest of the area for lichens and, at the same time, provide an introduction to it suitable for use by students and their teachers.

A useful key to the marine and maritime lichens of the Dale Peninsula, Pembrokeshire (Ferry and Sheard, 1969) includes many of the commoner species to be found in south Devon. This key can consequently be used in conjunction with the present paper. The comprehensive key to 428 species recorded from British coasts prepared by Fletcher (1975a, 1975b) is essential for more advanced students. Species on bark and wood are not treated in these keys and for their determination Duncan (1970) should be consulted.

TOPOGRAPHY, GEOLOGY AND CLIMATE

The coastline from Bolt Tail to Start Point (Fig. 1) is about 20 km in length and comprises two extensive ranges of cliffs bisected by the Kingsbridge Estuary. To the west of the estuary the cliffs are mainly 60-120 m high but reach 132 m at The Warren, immediately to the west of Bolt Head. Those to the east are substantially lower, mainly under 80 m in height, but do reach 93 m at Peartree Point, just to the

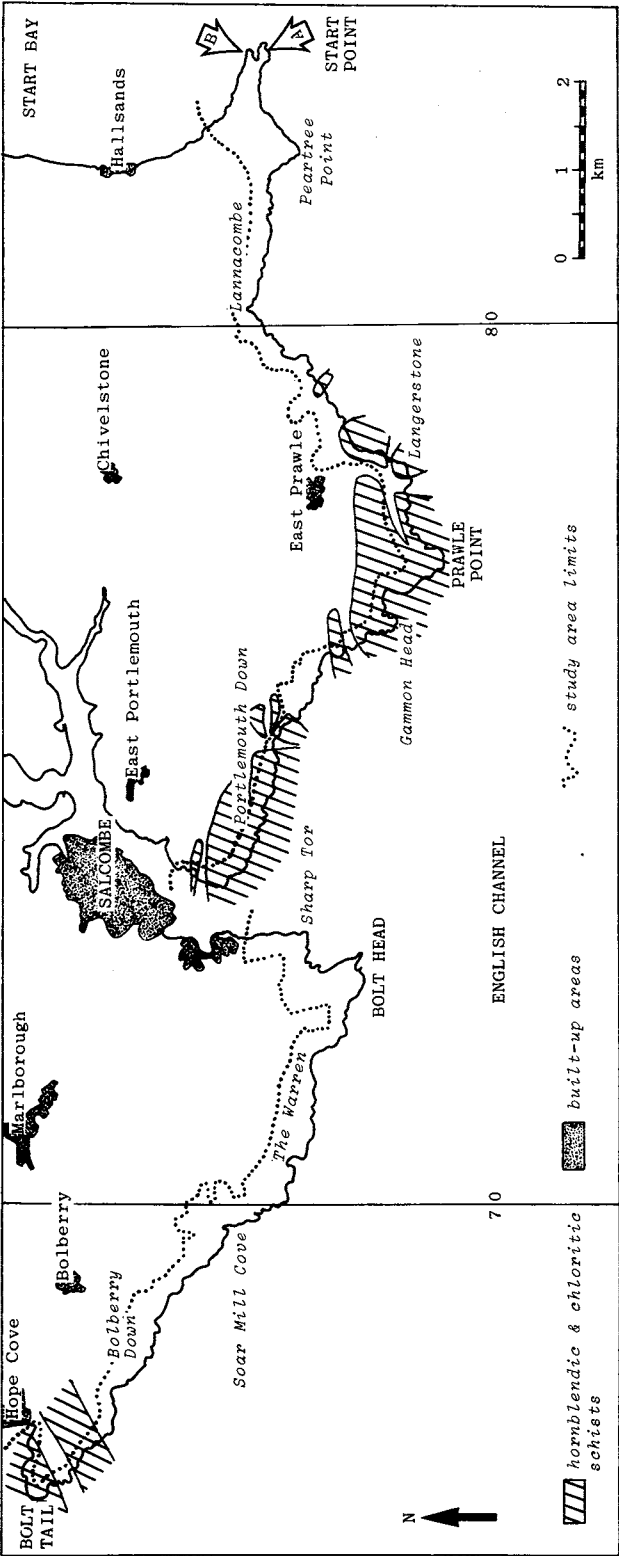


FIG. 1.
The study area. The coastline between Bolt Tail and Start Point is composed of quartz-mica schists except where indicated. Arrows (A-B) indicate the position of the transects presented in Fig. 2.

west of Start Point. The cliffs in the western portion are particularly precipitous (Plate 1A) and access to the sea is impossible along much of their length. In the eastern sector the cliff profiles are complicated by a distinctive system of raised beaches with associated crags which were formerly in direct contact with the sea (see Orme, 1960) but access to the sea is easier along this stretch of coast (Plate 1B).

This area constitutes the third most southerly rocky peninsula in England, the others being Land's End and The Lizard, both in Cornwall. All three are composed of hard igneous or metamorphic rocks but important geological differences exist between them. Land's End is entirely granite, The Lizard is predominantly serpentine, and the Bolt Tail to Start Point cliffs are composed of several types of schists. Gneiss and mica schists, sometimes with considerable amounts of quartz included, constitute the major part of the Bolt-Start cliffs, although the more basic hornblendic and chloritic schists dominate at Bolt Tail and from Rickham Common south-east to Prawle Point. The hornblendic and chloritic schists are softer than the gneiss, mica and quartz schists, weathering to a distinctive greenish colour which is particularly conspicuous in wind-cut hollows (Plate 2A). For further information on the geology of this region see Edmonds *et al.* (1969).

Precipitation in the study area is amongst the lowest in south-west England and has been estimated at under 89 mm (3.5 ins) per annum (Day, 1939) and also at about 102 mm (4.0 ins) per annum (Shorter *et al.*, 1969). Rainfall rises very rapidly proceeding inland. In the period 1901-30 the average humidity was about 80 per cent, and 40 per cent of the possible bright sunshine was received, making it one of the sunniest areas of the British Isles (Meteorological Office, 1952). Further, the temperature range is relatively small and snow falls on only about 5 days per annum. Meteorological observations have been made at the Slapton Ley Field Centre, about 8 km north-west of Start Point, and these provide an indication of the conditions at the cliffs themselves (Brookes and Burns, 1969; Ratsey, 1975); it must, however, be remembered that the Slapton station is in a sheltered position about 1 km from the sea. Severe storms occasionally occur, with waves over 15 m (50 ft) high recorded at Torcross in January 1979.

The area is sparsely inhabited, mainly agricultural, and with no industry. Consequently, there is no significant air pollution. The prevailing on-shore winds are from the south-west and travel several thousand miles over the open sea before reaching the coast. No air pollution recording gauges are located in this part of south Devon, but the lichen vegetation suggests that the mean winter sulphur dioxide levels are well below $30 \mu\text{g m}^{-3}$ with communities of zone 10 of Hawksworth and Rose (1970) developed.

HABITATS AND COMMUNITIES

In a single climatic region, under similar environmental conditions, each substrate tends to develop a particular assemblage of lichen species. When discussing the communities of lichens present in an area it is consequently desirable to note the assemblages that are present. To convey the concept of a community, without having to list the species present and give their abundance each time, a system of naming the communities themselves has been developed over the last fifty years. The main communities of lichens meriting recognition in this way which occur in the British Isles have been summarized by James *et al.* (1977) and the names used by these authors are adopted, where appropriate, here. The main unit in the classi-

fication of communities, the association (which may be compared to the concept of species in the classification of organisms) is given a latinized name based on the characteristic species present: the first name always ending in the suffix '-etum'. In order to facilitate the distinction between community names and species names, those of associations are placed in spaced italic type in this paper. As with species names, the name of the author who originally described the community is given after the name of the community for purposes of precision in the application of the names.

Within the study area, three broad categories of habitats are available for lichen colonisation; saxicolous (rocks, walls, etc.), terricolous (ground), and corticolous (bark) together with lignicolous (wood). These will now be considered in turn.

Saxicolous

Lichens growing on rock are the major and most conspicuous feature of the vegetation of the coastline, even to the casual observer. So extensive is the area of rock available for colonisation by lichens that they cover a greater surface area than that occupied by vascular plants and algae. A consideration of the lichens must consequently predominate in any discussions of the vegetation of this coastline and its scientific importance.

As a result of detailed investigations on Anglesey, Fletcher (1973*b*) was able to propose a notation for the zonation of lichen communities developed on rocky shores which incorporated some of the terms previously adopted by Lewis (1964). Subsequently, James *et al.* (1977) considered that it was most expedient to recognize three major lichen communities which partly correlate with Fletcher's system. These zones are summarized in Table 1.

Detailed studies of the zonation of lichens on rocky shores are available for Anglesey (Fletcher, 1973*a*, 1973*b*), the Dale Peninsula, Pembrokeshire (Ferry and Sheard, 1969), the Isle of May in the Firth of Forth (Sheard and Ferry, 1967), and Inishowen, Co. Donegal (Sheard, 1968). As no comparable investigations have been reported from south-west England, two contrasting shores on the north- and south-facing sides of Start Point were examined (Fig. 2). The survey was carried out by placing a 1 m rule horizontally across the rock at vertical intervals of 60 cm and recording the lichens present at 1 cm intervals along the horizontal rule. This method has the disadvantage that vertical rocks are over-sampled (Fletcher, 1973*a*) but is particularly convenient for establishing the major zonation patterns. In both transects made at Start Point sampling was stopped when the first *Ramalina siliquosa* specimen was reached, i.e. at the start of the xeric-supralittoral, as this zone frequently extends over the cliff tops in this region and may even be encountered on church walls 5-6 km inland and on some of the higher Dartmoor tors.

A consideration of the patterns found on the north- (Fig. 2B) and south-facing (Fig. 2A) shores shows some marked differences even though the rock type is the same in both cases (quartz-mica schists) and the sites are only about 100 m apart. The littoral zone on the north-facing shore, the *Verrucarietum maurae* Du Rietz, is much poorer in species: lacking *Verrucaria amphibia*, *V. mucosa*, and the *Lichina* species. *V. maura* also extends much further up the rock than on the south-facing shore. This clearly demonstrates the difference between exposed (Fig. 2A) and more sheltered (Fig. 2B) shores due to wave action (Fletcher, 1973*a*). The supralittoral zone, marked by the occurrence of *Caloplaca* species and named the *Caloplacetum*

Table 1. *Lichen zonation on siliceous rocky shores as interpreted by Fletcher (1973b) and the community names adopted by James et al. (1977)*

Ecological notation (Fletcher, 1973b)		Predominant or characteristic lichens	Community names (James et al., 1977)
Terrestrial region acid pH moisture regime; not, or only exceptionally, affected by sea spray	halophobic sea-water intolerant species present	mainly landward species occurring in sheltered sites, eg, <i>Parmelia glabratula</i> , <i>P. omphalodes</i> , <i>Sphaerophorus globosus</i>	the nomenclature depends on the communities present which in turn are related to the rock type, etc; in the Bolt Tail-Start Point area the <i>Lecanore-tum sordidae</i> and <i>Parmelietum glomelliferae</i> are most frequent
	halophilic sea-water tolerant species present	mainly landward species able to occur in more exposed situations, eg <i>Lecanora polytropia</i> , <i>Lecidella scabra</i> , <i>Parmelia saxatilis</i>	
Supralittoral zone neutral or alkaline pH moisture regime; not, or only exceptionally, sub- merged but affected by sea spray	xeric dries out very quickly after wetting by spray	<i>Anaphychia fusca</i> , <i>Lecidea sulphurea</i> , <i>Lecidella subincongrua</i> , <i>Parmelia pulla</i> , <i>Rhizocarpon constrictum</i> , and particularly <i>Ramalina siliquosa</i> predominate; in recesses <i>Arthonia lobata</i> , <i>Sclerophyton circumscriptum</i> , and <i>Roccella</i> species occur	<i>Ramalinetum scopularis</i> (with <i>Sclerophytetum circumscriptae</i> in recesses) ["Grey zone"]
	submesic	similar to the mesic but with <i>Xanthoria parietina</i> characteristic	<i>Caloplacetum marinae</i>
["Maritime"]		mesic <i>Caloplaca marina</i> , <i>C. thallinola</i> and <i>Lecanora heliopsis</i> are characteristic; <i>Verrucaria</i> species rarer and fewer than in the littoral fringe	 ["Orange zone"]
Littoral zone regularly submerged and splashed by waves	littoral fringe top indicated by the upper limit of <i>Littorina</i> (winkles)	<i>Verrucaria</i> species predominate but <i>Arthopyrenia halodytes</i> and <i>Lichina</i> species also occur	<i>Verrucarietum maurae</i> ["Black zone"]
	culittoral top indicated by the upper limit of barnacles	mostly devoid of lichens although <i>Arthopyrenia halodytes</i> and <i>Verrucaria striatula</i> may be present	Unnamed
["Marine"]			
Sublittoral zone not, or only exceptionally, emerged		devoid of lichens	Unnamed

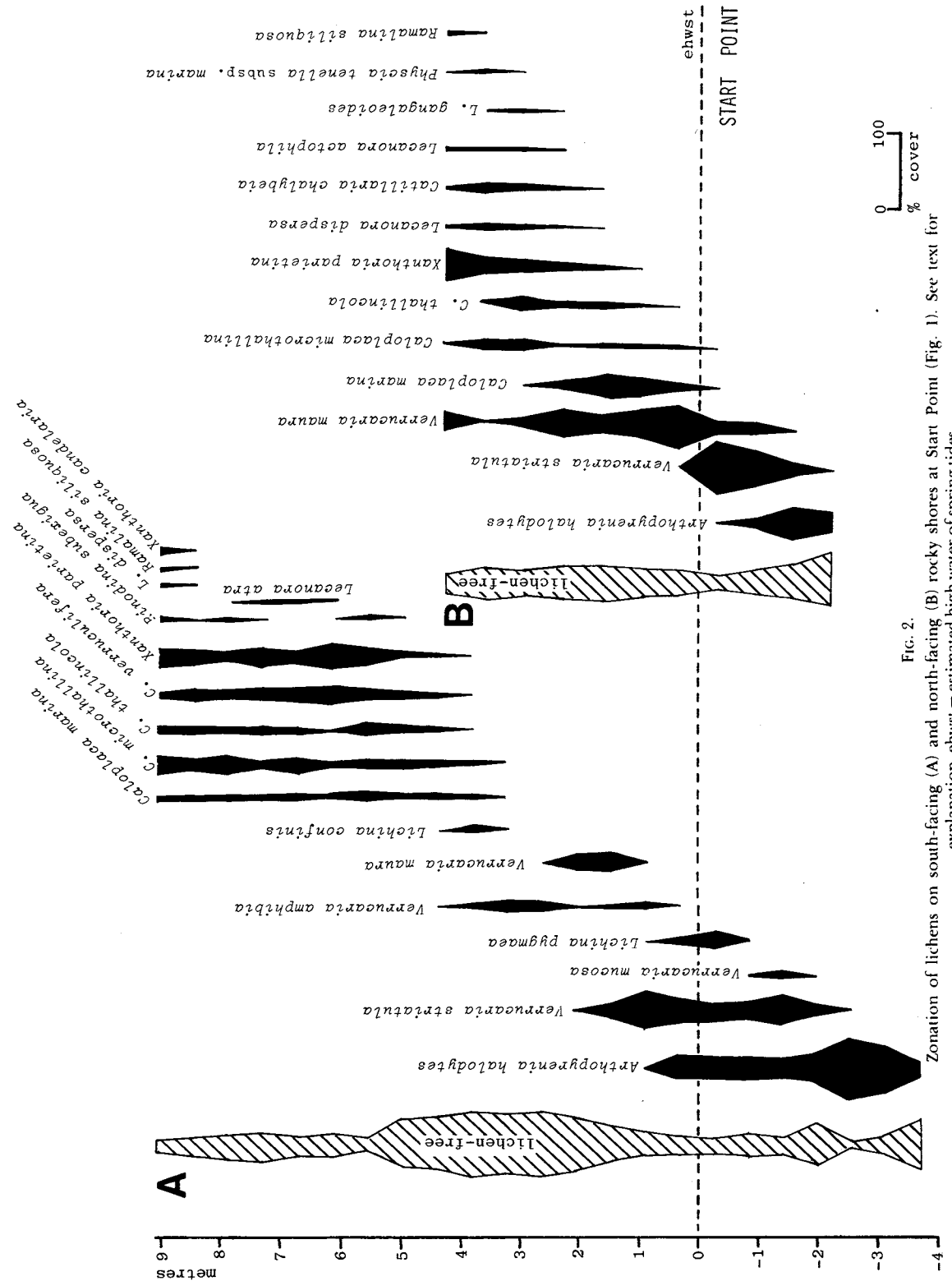


FIG. 2.

Zonation of lichens on south-facing (A) and north-facing (B) rocky shores at Start Point (Fig. 1). See text for explanation. ehwst = estimated high water of spring tides.

marinae Du Rietz, starts much lower down on the north-facing shore (Fig. 2B) and gives way to the xeric-supralittoral, the *Ramalinetum scopularis* Klem., at only about 4 m above the estimated high water of spring tides, as opposed to at about 9 m on the south-facing shore (Fig. 2A). These findings are in agreement with the results of previous workers in other parts of the British Isles (e.g. Ferry and Sheard, 1969; Fletcher, 1973*b*; Sheard, 1968) but attention should be brought to the following points. In the upper part of the south-facing shore (Fig. 2A) nutrient-rich run-off from gull nesting colonies contributes both to the abundance of *Caloplaca verruculifera* and to the occurrence of *Xanthoria candelaria*; cocks most affected by this run-off are completely devoid of lichens but these were not sampled during preparation of this figure. The scarcity of *Verrucaria maura* on the south-facing transect is also of interest but is not representative of the coastline as a whole to judge from more superficial observations. Indeed, the transects presented here should be treated only as a pilot study and many more must be prepared, from different sites along the coasts, before any definitive statement of patterns in the area can be attempted.

The lichen extending furthest down the shore in the area is *Arthopyrenia halodytes* which is ubiquitous on barnacles and limpets; it is exceptional to discover any barnacle, except the youngest spat, without the minute pits with black globose fruits diagnostic for this species. *A. halodytes* can also occur directly on basic rocks, particularly soft calcareous ones, but has not been found on schists. Excluding the macrophytic algae (seaweeds) *Ascophyllum nodosum* and *Pelvetia canaliculata*, which some authors view as lichenised with the fungi *Mycosphaerella ascophyllii* and *M. pelvetiae* respectively (the black pin-head fruits of the fungus are to be seen on every specimen of *P. canaliculata* if its sporangia are examined with a hand lens), the next lichens likely to be found are species of *Verrucaria*. The glaucous green *V. mucosa* is common on quartz but less frequent on schists and much rarer along this stretch of coast than it is on the hard sandstones to the north-east of the study area. The greenish black ridged thallus of *V. striatula* also originates very low down the shore becoming very abundant and extending up to the *Caloplacetum marinae*. *Lichina pygmaea* forms an often distinctive band at about the mean high water level of spring tides on south-facing shores and it is in approximately this position that *V. amphibia* and *V. maura* generally appear. *V. microspora* is evidently rather scarce on the schists and some other marine *Verrucaria* species known elsewhere in Devon have not been found in the study area (e.g. *V. sandstedei* from Southdown Cliffs). The *Verrucaria*-dominated zone, the *Verrucarietum maurae*, is predominantly black in colour and easily seen at a distance. It occupies the littoral fringe which is regularly submerged or swept by waves (Table 1).

In the spray zone, the start of which is often marked by *Lichina confinis*, orange rosette-forming lichens appear and become abundant so that the whole zone frequently appears orange in colour. *Caloplaca* species are conspicuous. *C. marina* and *C. thallincola* predominate with *C. microthallina* and *C. verruculifera* locally important. This zone, the *Caloplacetum marinae*, is not particularly rich in species but commonly includes *Catillaria chalybeia*, *Lecania aipospila*, *Lecanora actophila*, *L. helicopsis*, and *Rinodina subexigua*. The ubiquitous *Xanthoria parietina* becomes important towards the upper part of this zone extending through into the terrestrial region on nutrient-rich rocks and bark.

The richest zone on the shore for lichens is the xeric supralittoral, occupied by the

Ramalinetum scopularis, which, as mentioned above (p. 198), extends over the cliff-tops. Many greenish-grey, brownish and whitish species occur in this zone which characteristically appears grey when viewed from a distance. Amongst the commoner species in this community are *Anaptychia fusca*, *Buellia stellulata*, *B. subdisciformis*, *Caloplaca caesiorufa*, *C. ferruginea*, *Diploicia canescens*, *Diploschistes caesioplumbeus*, *Fuscidea cyathoides*, *Huilia albocaerulescens*, *Lecanora atra*, *L. gangaleoides*, *Lecidea sulphurea*, *Lecidella subincongrua*, *Parmelia delisei*, *P. loxodes*, *P. pulla*, *Pertusaria pseudocorallina*, *Physcia tenella* subsp. *marina*, *Ramalina cuspidata*, *R. siliquosa* (often forming turf-like swards), *R. subfarinacea*, *Rhizocarpon constrictum*, *R. geographicum* and *Rinodina* species. The proportions of these various species can differ even from rock to rock as each has its own particular ecological preference. Dry recesses in this zone, where no direct rain or spray reaches, are particularly frequent in the chloritic schists (Plate 2A), and form an especially important lichen habitat. Indeed, in such recesses several of the most interesting species are to be found. The species in this community form a distinctive assemblage; named the *Sclerophytetum circumscriptae* P. James *et al.*, and a key to many of the species in it is provided by James (1970). *Arthonia lobata*, *Sclerophyton circumscriptum*, *Rinodina subglauescens*, and *Rocella* species are well developed in such recesses throughout the area; *Caloplaca littorea* (also well-developed on quartz), *Buellia leptoclinoides*, *Lecanora praepostera*, and *L. tenera* prefer recesses in quartz-mica schists, while *Lecanactis dilleniana*, and *L. delimis* occur only in those in chloritic schists. The quickly eroding hornblendic and chloritic schists are often devoid of lichens in more exposed situations but *Rinodina subglauescens* is particularly adept at colonising them.

Some intergradation between the *Ramalinetum scopularis* and terrestrial communities occurs, depending on the exposure to spray, on the higher cliffs. Increasing abundance of *Lecanora rupicola* and *Ochrolechia parella* and the loss of *Ramalina* species indicates a transition to the *Lecanoretum sordidae* Hilitzer. The mainly corticolous *Parmelia caperata* and *P. perlata*, very common on trees inland, are also found on rock in the terrestrial region and may even extend down into the xeric supralittoral. Contrary to the implications of Brown and DiMeo (1972) this indicates that these species can tolerate at least a limited amount of sea spray. The allied *Parmelietum glomelliferae* Hilitzer, characterised in this area by *P. caperata*, *P. glabratula*, *P. omphalodes*, *P. saxatilis*, and *Trapelia coarctata*, is especially well developed on boulders which have broken away from the crags and may represent a stage in the development of the *Lecanoretum sordidae*, with which it tends to intergrade. The western *P. britannica* is locally abundant in the *Parmelietum glomelliferae* in sunny situations.

A most unexpected community is developed on mossy sheltered north-facing crags in very limited areas at both Bolt Head and Start Point; a fragment of the normally corticolous *Parmelietum laevigatae* P. James *et al.* This community is characteristic of areas with a very high rainfall (127-229 cm per annum) and many wet-days (over 180 per annum) and, in Devon, is largely restricted to the wettest parts of Dartmoor and north Devon (Fig. 5A, C). This occurrence is certainly due to small amounts of mist which commonly linger in these sites keeping the humidity high, helped by shading from the steep crags above. Species characteristic of this community are *Dimerella lutea* (on mosses and soil associated with the rocks), *Ochrolechia* cf. *tartarea*, *Parmelia laevigata*, *P. taylorensis*, *Platismatia glauca*, and *Sphaerophorus globosus*. This community appears formerly to have been much richer

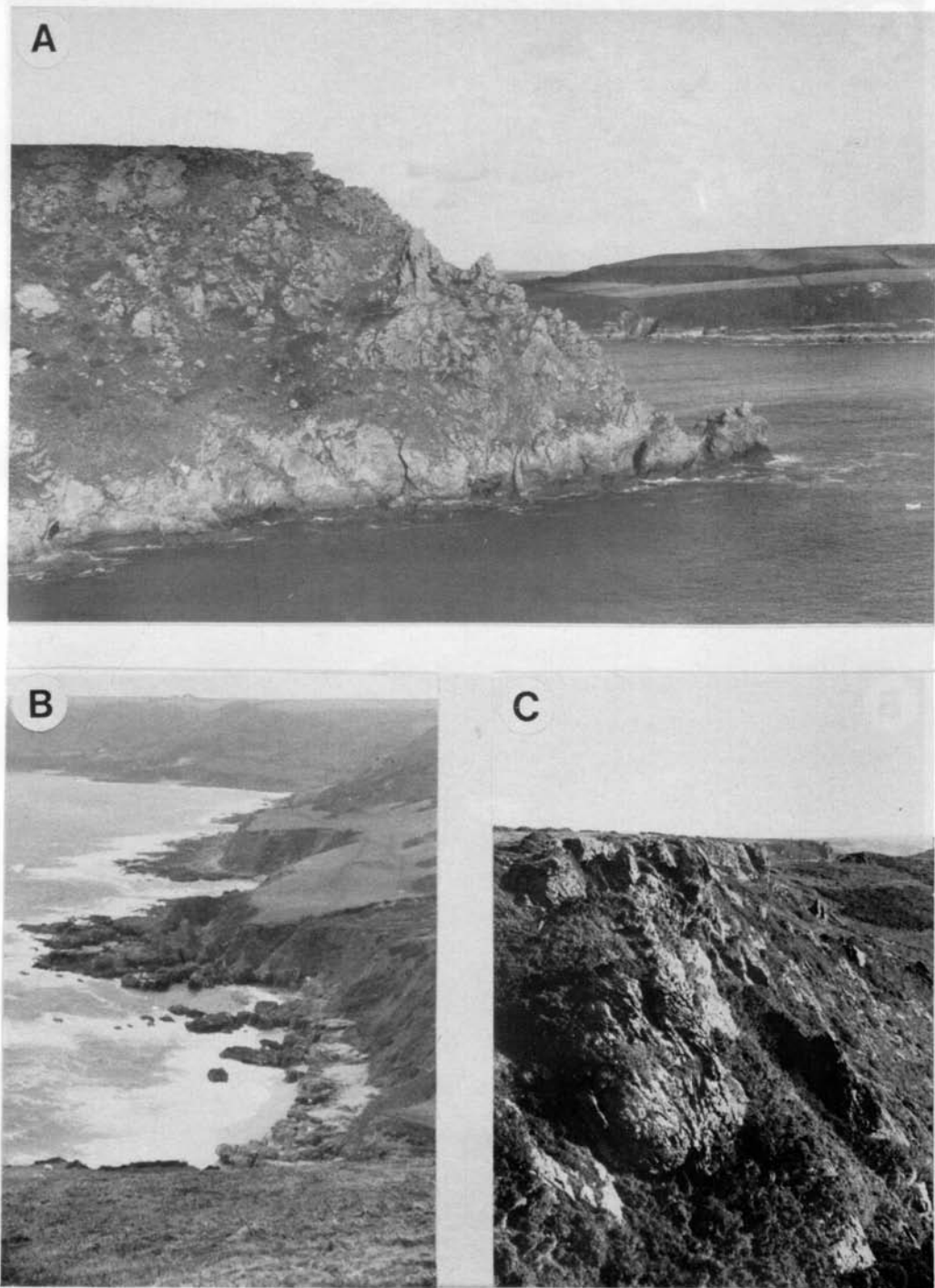


PLATE 1.

A, Sharp Tor as seen looking north from Bolt Head. B, Lannacombe Bay as seen looking west from the summit of Peartree Point, note the raised beach. C, Craggs immediately to the east of The Warren looking towards Bolt Head, note the extensive growths of gorse (*Ulex* species) and ericaceous shrubs.

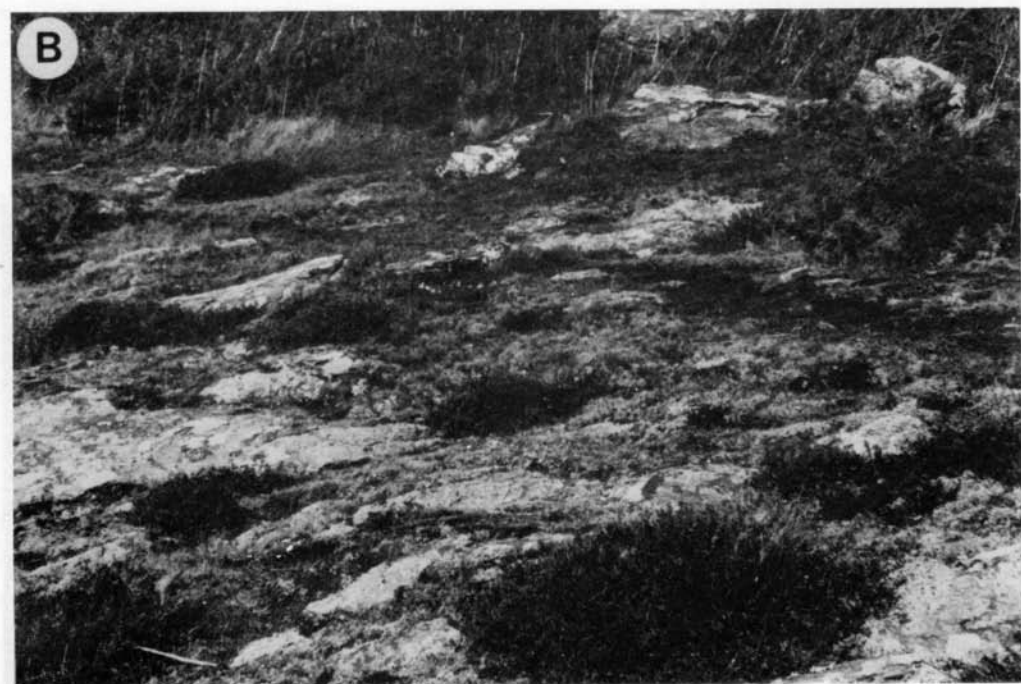


PLATE 2.

A, Wind-cut recesses in chloritic schists at Prawle point. B, Lichen dominated *Cladonietum alpicornis* between The Warren and Bolt Head which includes *Cladonia convoluta*.

in species at both Bolt Head and Start Point (see Discussion, p. 223).

Further saxicolous habitats in the area are provided by walls and other man-made structures although most are relatively modern and few in number. These, nevertheless, provide the only habitat available for species characteristic of highly basic rocks which are unable to colonise the more acid schists. Species noted on asbestos-cement, concrete posts, mortar, and walls not found elsewhere in the study area include *Candelariella aurella*, *Collema auriculatum*, *Lecidella stigmatea*, *Leptogium lichenoides*, *L. schraderi*, *Protoblastenia monticola*, *Sarcogyne regularis*, and *Verrucaria hochstetteri*.

Terricolous

Wherever the thin soil and wind prevent the establishment of all but the smallest rosette-forming flowering plants (e.g. *Pilosella officinarum*, *Rumex acetosella*) a luxuriant compact lichen turf forms. *Cladonia* species predominate, particularly *Cladonia foliacea*, *C. furcata*, *C. pityrea*, *C. rangiformis*, and *C. verticillata*; but others, for example *C. chlorophaea*, *C. ciliata*, *C. conistea* and *Cornicularia aculeata* can be locally important. This assemblage of species is very characteristic of exposed cliffs but also develops on stabilised shingle (as at Slapton Sands; Hawksworth, 1972) and sand dunes and is termed the *Cladonietum alcicornis* Klem. In one area of The Warren *Cladonia convoluta* is an important component of this community (Plate 2B). This species, which is very rare in the British Isles (Fig. 3), is a component of a further community elsewhere in Europe, the *Cladonietum convolutae* Th. Müller, which occurs on highly basic soils and within which it is characteristically associated with many calcicolous species not present in the Bolt-Start area (Ritschel, 1974).

Bare soil in exposed situations is generally colonised by *Lecidea wallrothii*, *Solenopsis vulturienensis*, *Trapelia coarctata*, and *T. involuta*. In more sheltered sites

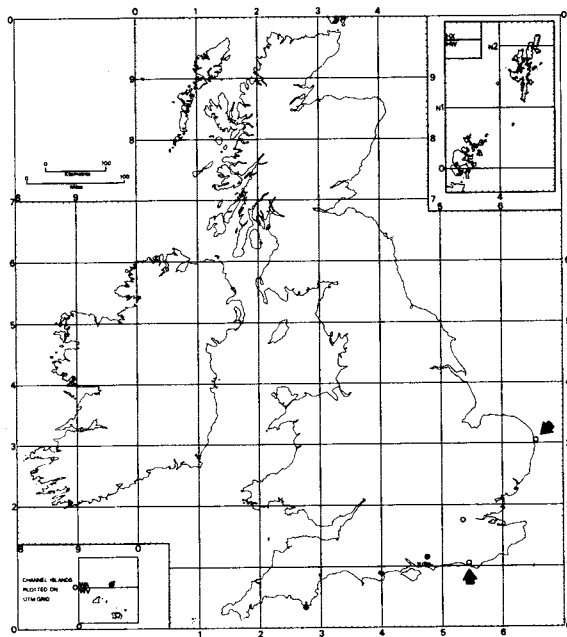


FIG. 3.

Distribution of *Cladonia convoluta* in the British Isles. open circle = pre-1900; closed circle = post-1960.

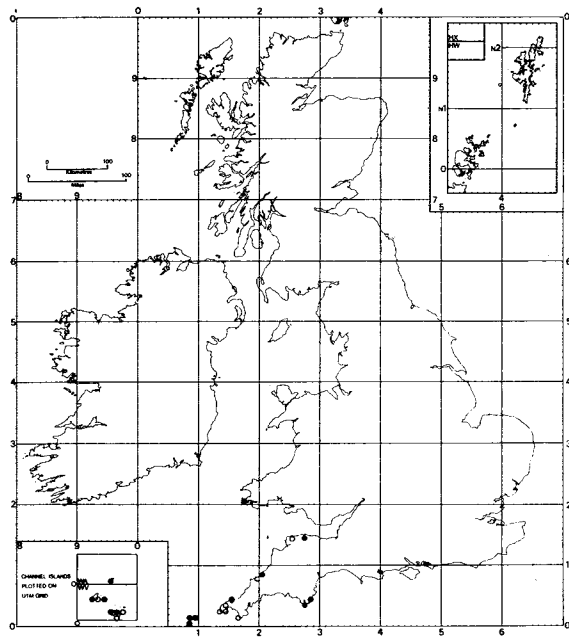


FIG. 4.

Distribution of *Rocella fuciformis* in the British Isles. open circle = pre-1960; closed circle = post-1960. Knowles (1929) mentions occurrences in Ireland in South Kerry (Tearaght Rock, 1850) and West Mayo (near Westport, 1907); no supporting specimen of the former exists and, as the species has not been seen by recent collectors on Tearaght, is probably an error for *Ramalina siliquosa*; the latter was re-identified as the non-British *Rocella montagnei* (Porter, 1948) and was presumably imported for dyeing or litmus production and not growing naturally.

Bacidia muscorum, *Lepraria incana*, *Leprocaulon microscopicum*, or *Micarea subviridescens* may occur. Mosses on schists in exposed sunny situations not uncommonly support *Lepraria neglecta*, a species otherwise known in Devon only from Dartmoor.

Corticolous and lignicolous

No very extensive woodland occurs in the study area and the woods just north of Rickham Common above Mill Bay and south of Stink Cove were deliberately excluded. The coast path runs through a small area of woodland south of Rickham Common but, apart from this, corticolous species are mainly confined to *Crataegus* (hawthorn) and *Prunus* (blackthorn) scrub, *Calluna* (heather) and *Erica* (heath) stems, occasional *Sambucus* (elder) thickets, and rare isolated dwarfed wind-cut *Quercus* (oak) trees. The communities developed on trees in the Slapton area were discussed in some detail by Hawksworth (1972) and those present in the study area belong to some of the associations described there. On twigs the *Lecanoretum subfuscae* Hiltizer, characterised by *Lecanora chlarotera*, *L. confusa*, *L. expallens*, and *Lecidella elaeochroma*, occurs except in nutrient-rich situations where the *Physcietum ascendens* Frey & Ochsner, with abundant *Physcia*, *Physconia*, and *Xanthoria* species develops. This latter association is particularly well developed on *Sambucus* where *Caloplaca cerina*, *C. citrina* and *Physciopsis adglutinata* also occur. Rather similar communities rich in *Ramalina* species developed on *Crataegus* may be more correctly interpreted as species-poor variants of the southern-Atlantic and montane-Mediterranean *Teloschistetum flavicantis* P. James *et al.* as evidenced by the former occurrence of *Teloschistes chrysophthalmus* in it near Start Point and its development

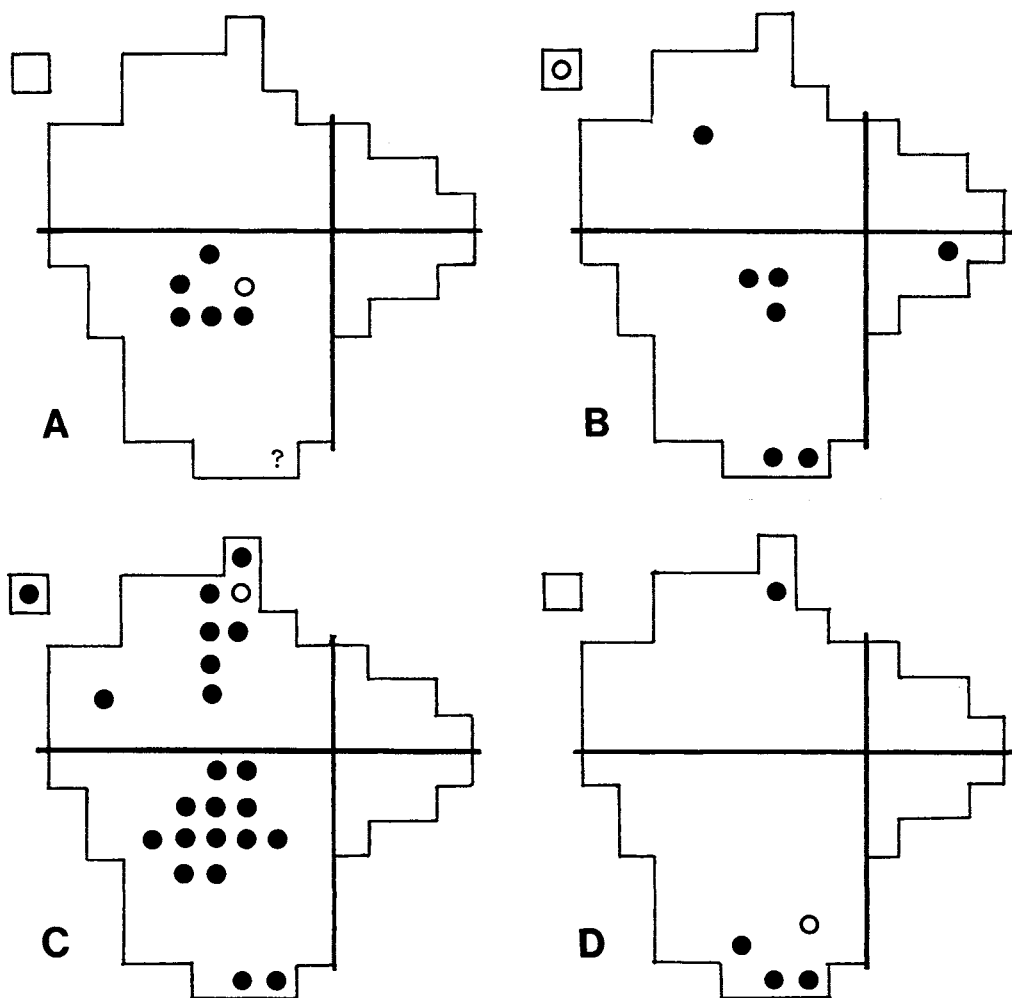


FIG. 5.

Distribution of selected species in Devon (by 10 km national grid squares). A, *Ochrolechia tartarea*. B, *Parmelia crinita*. C, *P. laevigata*. D, *Roccella phycopsis*. open circle = pre-1960; closed circle = post-1960.

just outside the study area, for example at Widdicombe House near Torcross and in Bigbury.

Moderately acid trunks are scarce (i.e. ones whose bark has not been enriched by sea spray or bird droppings) but when present do support fragments of the *Parmeliatum revolutae* Klem. which are characterised by *Parmelia caperata*, *P. perlata* and *P. sulcata*. Elements of this association are occasionally also found on the stems of ericaceous shrubs which also not uncommonly have *Hypogymnia physodes* and *Usnea flammea* growing on them.

At Berry Head, Hawksworth (1973a) noted that the most exposed twigs of *Prunus* scrub were almost entirely devoid of lichens and suggested that this might be due to the strength of salt-laden on-shore winds. This was also found to apply in the study area to this and other shrubs.

Fence posts and rails are rather few in the study area and mainly relatively recent

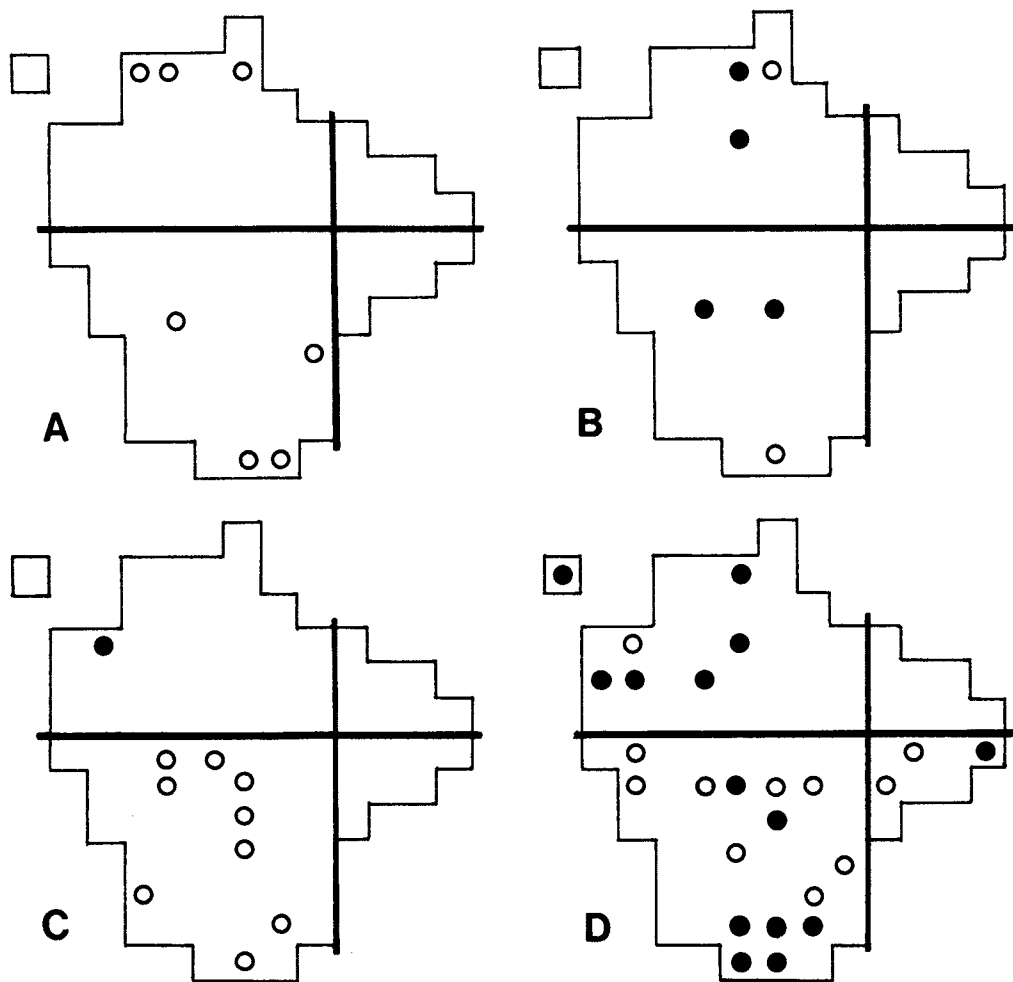


FIG. 6.

Distribution of selected species in Devon (by 10 km national grid squares). A, *Heterodermia leucomelos*. B, *H. obscurata*. C, *Parmeliella plumbea*. D, *Teloschistes flavicans*. open circle = pre-1960; closed circle = post-1960.

in origin. They most commonly support species of the *Lecanoretum subfuscae* or, in more sheltered sites, of the *Parmelietum revolutae*. *Lecanora conizaeoides*, a species which seems to be spread by man in Devon, most commonly occurs on fence posts and rails in south Devon but was not noted in the study area. The usually saxicolous *Lecanora polytropa* was exceptionally well developed on aged telegraph poles at Prawle Point, and a stile in this locality also yielded *Strangospora moriformis*, a species not previously found in the county.

THE LICHEN FLORA

The first lichenologist to visit the area appears to have been William Borrer (1781-1862) who collected at both Bolt Head and Start Point in August 1840. No list of his finds remains but an examination of his herbarium at Kew reveals that he found

Heterodermia leucomelos at Start and *Cladonia foliacea* at Bolt Head. Edward M. Holmes (1843-1930), while a pharmacist at Plymouth in the 1860's, discovered many interesting species at Bolt Head although several of these now appear to be extinct. After the publication of Holmes' (1872) account of the Devon lichen flora, Bolt Head became established as a site which all lichenologists visiting the area should study. Harvey B. Holl (1820-1886) made particularly extensive collections at Bolt Head in about 1870 and his material is now incorporated into the herbarium of the British Museum (Natural History). Somewhat surprisingly, Edward Parfitt (1820-1893), who published an account of the Devon lichens (Parfitt, 1883), appears to have spent little time in the study area although he did collect a few species at Prawle Point in 1877.

In the course of the last 100 years at least 20 other botanists have collected lichens in the study area but most of these have only been on short visits and no attempt to produce a comprehensive species list for it, or even a portion of it, appears to have been made. Of particular importance have been extensive collecting trips made by Mr P. W. James in 1961 and 1963, and Dr K. L. Alvin in 1961-66. Over the years 1969-78 I have been able to visit the coast at almost all points at which it is accessible, sometimes in the company of other lichenologists (including Mr P. W. James in 1971-72) or students on courses from the Slapton Ley Field Centre. The numerous lists made from particular sites are retained in both the Flora of Devon project data base at the University of Exeter and the British Lichen Society's Distribution Maps Scheme. In the following lists full details of records are consequently omitted in the case of the most widespread species although herbarium material examined is always indicated, at least by the herbarium abbreviation. Where no collector is cited the records are my own or confirmed by me in the same site since 1970. There are numerous references to the occurrence of particular species in the area in the literature but references to these are included here only where herbarium material supporting them has *not* been located.

Erroneous or doubtful records are placed in squared brackets and species not seen in the area since 1960 are prefixed by a cross(+).

Nomenclature mainly follows a new check-list of British lichen-forming and lichenicolous fungi currently in the course of preparation. Names used in the keys of Fletcher (1975*a*, 1975*b*) or by Duncan (1970) are indicated in parenthesis after the accepted name where these differ.

The following abbreviations have been employed in the species list:

AMB=A. M. Brand
 BM=British Museum (Natural History)
 DHD=D. H. Dalby
 E=Royal Botanic Garden, Edinburgh
 EMH=E. M. Holmes (1843-1930)
 EP=E. Parfitt (1820-1893)
 FAS=F. A. Sowter (1899-1972)
 FR=F. Rose
 GD=G. Dickie (1812-1882)
 GGG=G. G. Graham
 hb=herbarium of collector indicated
 HBH=H. B. Holl (1820-1886)
 IMI=Commonwealth Mycological Institute,
 Kew
 JMC=J. M. Crombie (1831-1906)

K-Borr=W. Borrer herbarium, Royal Botanic
 Gardens, Kew
 KLA=K. L. Alvin
 LSR=Leicestershire Museums, Leicester
 MRDS=M.R.D. Seaward
 NMW=National Museum of Wales, Cardiff
 NOT=Nottingham Natural History Museum,
 Wollaton Hall, Nottingham
 PWJ=P. W. James
 TDVS=T. D. V. Swinscow
 TTN=Somerset Archaeological and Natural History
 Society, Taunton
 WB=W. Borrer (1781-1862)
 WCR=Hampshire County Museum Service,
 Winchester.

Acarospora atrata Hue.

On sunny slatey rocks and schists. Prawle Point, PWJ; Start Point, PWJ. Otherwise recorded in Devon only from Hartland (Stoke) church, but probably often overlooked.

A. fuscata (Nyl.) Arnold.

On nutrient-enriched schists, occasional.

A. smaragdula (Wahlenb. ex Ach.) Massal.

On chloritic schists in sheltered situations, often poorly developed. Bolt Head, PWJ (BM); Start Point, PWJ.

Agonimia tristicula (Nyl.) Zahlbr. (*Polyblastia tristicula* (Nyl.) Arnold).

On mortar of old gun emplacement, Portlemouth Down, PWJ (BM).

Anapychia fusca (Huds.) Vainio.

An extremely common species of exposed schists in the xeric supralittoral, often abundantly fertile; occasionally also on ericaceous shrubs and in short turf (BM).

+ *A. mamillata* (Taylor) D. Hawksw.

Bolt Head, EMH (Holmes, 1872, as '*A. ciliaris* f. *saxicola*'). Although no supporting specimen has been located this western species would have been expected to occur in the study area.

Arthonia lobata (Flotow) Massal. aggr.

Locally abundant in dry recesses, especially in chloritic schists. Several morphotypes occur in Devon which appear genotypically distinct and merit further investigation.

A. punctiformis Ach.

Occasional on twigs, particularly of *Quercus*.

A. radiata (Pers.) Ach.

Frequent on twigs throughout the area.

Arthopyrenia biformis (Borrer) Massal.

On *Acer pseudoplatanus* on the coast, Portlemouth Down, PWJ.

A. halodytes (Nyl.) Arnold.

Extremely common on barnacles and limpets in the littoral zone (IMI 231671).

A. punctiformis (Pers.) Massal.

Occasional on twigs throughout the area.

A. sp. (of Fletcher, 1975a: 27)

On schists in the littoral zone, Lannacombe Bay, 1970, TDVS.

Aspicilia cinerea (L.) Körber (*Lecanora cinerea* (L.) Sommerf.)

Rare, on schists, Bolt Head.

A. gibbosa (Ach.) Körber aggr. (*Lecanora gibbosa* (Ach.) Nyl.)

Species of this taxonomically difficult complex are occasionally found in the xeric supralittoral.

A. leproscens (Sandst.) Havaas (*Lecanora leproscens* Sandst.)

Locally abundant on nutrient-enriched schists.

Bacidia arceutina (Ach.) Arnold.

On heather stems, Bolt Head, PWJ.

B. laurocerasi (Delise ex Duby) Vainio (*B. acerina* auct., *B. endoleuca* (Nyl.) Kickx)

On twigs, Bolt Tail.

B. muscorum (Ach.) Mudd.

On mosses, Bolt Head.

B. sabuletorum (Schreber) Lettau.

On mosses, Gammon Head, 1969, FR & TDVS.

B. scopulicola (Nyl.) A. L. Sm.

On shaded mica schists in the xeric supralittoral, locally abundant and often fertile (hb. KLA).

B. umbrina (Ach.) Bausch.

Locally abundant on nutrient enriched rocks.

Baeomyces roseus Pers.

On soil, Bolt Head, PWJ. Sterile material only found.

B. rufus (Huds.) Rebert.

On peaty soil and shaded schists, scarce, Bolt Head.

Buellia aethalea (Ach.) Th. Fr.

On schists, Bolt Head. Perhaps often overlooked for *B. stellulata*.

B. alboatra (Hoffm.) Branth & Rostrup aggr.

In sheltered crevices, scarce. Prawle Point, PWJ; Start Point, PWJ.

B. chlorophaea (Hepp ex Leighton) Lettau.

On sheltered underhang, scarce, Bolt Head, PWJ.

B. leptoclinoides (Nyl.) Steiner (*B. disciformis* var *saxicola* H. Olivier)

In recesses in mica schists, locally abundant. Bolt Tail, 1963, KLA (hb KLA); Gammon Head, 1962, KLA (hb KLA); cliffs below East Prawle; Prawle Point (IMI 215212); Sharp Tor.

B. punctata (Hoffm.) Massal.

On nutrient-rich bark and occasionally also schists, widespread.

B. stellulata (Taylor) Mudd.

Widespread in the xeric supralittoral but rarely abundant on any one rock (hb KLA).

B. subdisciformis (Leighton) Vainio.

Locally abundant in the xeric supralittoral, often forming extensive swards on mica schists in moderately exposed situations. Bolt Head; Gammon Head; Peartree Point, 1963, KLA (hb KLA); Prawle Point (hb KLA, IMI 215209); Sharp Tor; Start Point (hb KLA).

B. verruculosa (Sm.) Mudd.

Widespread in the xeric supralittoral, often with *B. stellulata*, but rarely abundant.

B. sp.

On schists, near Gammon Head, 1974, AMB (BM). An unidentified species.

Caloplaca caesiorufa (Wibel) Flagey.

Widespread and locally common in the submesic and xeric supralittoral. *Lichenodiplis lecanorae* (Vouaux) Dyko & D. Hawksw. in the apothecia at Bolt Head (IMI 168579).

C. cerina (Ehrh. ex Hedw.) Th. Fr.

On *Sambucus* sheltered by wall, scarce, just east of The Warren (IMI 233569).

C. citrina (Hoffm.) Th. Fr.

Widespread and common on mortar and concrete, occasional on schists in the xeric supralittoral, also on nutrient rich bark. *Muellerella lichenicola* (Sommerf. ex Fr.) D. Hawksw. in the apothecia east of The Warren (IMI 233568).

C. ferruginea (Huds.) Th. Fr.

Widespread in the xeric supralittoral and extending into the terrestrial region. Less frequent than *C. caesiorufa* with which it is often confused.

C. heppiana (Müll. Arg.) Zahlbr.

On mortar and basic brickwork, scarce. Bolt Tail; Gammon Head; Start Point.

C. holocarpa (Hoffm.) Wade.

On mortar, Portlemouth Down, PWJ.

C. littorea Tavares.

In recesses in schists, particularly quartz mica schists, locally abundant. Bolt Head; Bolt Tail; above Gorah Rocks; Gammon Head (IMI 159820); near Prawle Point, 1966, KLA (hb KLA); Sharp Tor, particularly abundant (IMI 159912).

C. marina (Wedd.) Flagey.

Widespread and very common in the mesic supralittoral throughout the area.

C. microthallina (Wedd.) Zahlbr.

Widespread in the mesic supralittoral but less frequent than *C. marina* and *C. thallincola* in this zone, predominantly in crevices.

C. saxicola (Hoffm.) Nordin (*C. murorum* (Ach.) Th. Fr.)

On mortar and basic brickwork, scarce but locally abundant. Bolt Tail; Gara Rock, 1962, DHD & PWJ; Lannacombe; Start Point.

C. thallincola (Wedd.) Du Rietz.

Widespread and very common in the mesic supralittoral throughout the area.

C. verruculifera (Vainio) Zahlbr. (*C. granulosa* auct. p. p.).

Widespread but rarely abundant in the mesic supralittoral except under gull nesting colonies where it can form extensive pure swards, fertile in the most nutrient enriched sites. Bolt Tail; Gammon Head, 1962, KLA (hb KLA); Prawle Point; below East Prawle; Peartree Point; Start Point, exceptionally abundant immediately south of the lighthouse (IMI 231676).

Candelariella aurella (Hoffm.) Zahlbr.

On mortar and cement, occasional throughout the area.

C. vitellina (Hoffm.) Müll. Arg.

On mortar, concrete, basic brickwork, and schists in the xeric supralittoral and terrestrial regions, widespread and locally abundant.

Catillaria biformigera (Leighton) P. James.

In sheltered recesses, scarce. Bolt Head, 1950, FAS; Start Point, PWJ.

C. chalybeia (Borrer) Massal.

Widespread and common in the mesic- and xeric supralittoral (hb KLA).

C. griffithii (Sm.) Malme.

On twigs and nutrient rich bark, old *Hedera* stems, and also on fence posts in exposed situations, common wherever these habitats occur (hb KLA).

C. littorella (Nyl.) Zahlbr.

On rock shaded by vegetation in hedge-bank near car park, Prawle Point (IMI 231581); amongst tall grass on very sheltered underhang, Start Point, PWJ. Only otherwise recently recorded in Devon from the Bovey Valley and Hartland point.

Cladonia arbuscula (Wallr.) Rabenh.

In short turf in exposed situations, very rare. Bolt Head.

C. caespiticia (Pers.) Flörke.

On lips of decaying vegetation in slightly shaded situation overhanging rocks, rare, Bolt Head.

- C. chlorophaea* (Flörke) Sprengel s. lat.
Occasional in short turf but avoiding the most exposed situations, widespread. The following chemotypes have been found in the study area: fumarprotocetraric acid alone (*C. chlorophaea* s. str.); fumarprotocetraric and merochlorophaeic acids (*C. merochlorophaea* Asah.); and fumarprotocetraric and cryptochlorophaeic acids (*C. cryptochlorophaea* Asah.).
- C. ciliata* var. *tenuis* (Flörke) Ahti
In short turf, Bolt Head, PWJ (BM).
- C. coccifera* (L.) Willd.
In short humus-rich turf, especially amongst ericaceous shrubs, occasional.
- C. conistea* (Delise) Asah.
Frequent on disturbed turf and soil banks on cliffs. Bolt Head, PWJ; Start Point, PWJ. A frequently overlooked species.
- C. convoluta* (Lam.) P. Cout.
Locally abundant in short turf on a south-facing slope (Plate 2B), forming extensive stands adjacent to *C. foliacea*, frequently fertile. The Warren (BM, IMI 231620). Also stated to have been found at Start Point by WB (Holmes, 1872) but material under the name *C. indivisifolia* (Dickson) Fr. in K-Borr. is *C. foliacea*. A continental and mediterranean species otherwise collected recently in the British Isles (Fig. 3) only from Alderney (PWJ) and Butser Hill, South Hampshire (2 March 1973, S. R. Davey, WCR); it may now be extinct in the Hampshire site (S. R. Davey *personal communication*). As noted by Hawksworth (1973a), other reports of this species from Devon are based on *C. foliacea*.
- C. digitata* (L.) Hoffm.
In short turf with mosses on north-facing shaded crags, rare, Bolt Head.
- C. fimbriata* (L.) Fr.
In short humus-rich turf, avoiding the most exposed situations, also on soil banks, occasional.
- C. firma* (Nyl.) Nyl. (*C. nylanderii* P. Cout.)
In short turf in sunny exposed situations, very local, The Warren, 1963, PWJ. A very rare south-western species only otherwise recently reported in the British Isles from the Channel Islands and Pembrokeshire.
- C. foliacea* (Huds.) Willd.
Widespread and locally very abundant in short lichen-dominated turf in exposed situations (IMI 231612, K-Borr.).
- C. furcata* (Huds.) Schrader.
In short turf, widespread and locally very abundant.
- C. macilentia* Hoffm.
In short turf on peaty soils, often under ericaceous shrubs, occasional.
- C. ochrochlora* Flörke.
In short turf on peaty soil in shaded situations, scarce, Bolt Head.
- C. pityrea* (Flörke) Fr.
In lichen dominated short turf in exposed situations, locally abundant (IMI 231614).
- C. polydactyla* (Flörke) Sprengel
In short turf, scarce, Bolt Head.
- C. portentosa* (Dufour) Arnold (*C. impexa* Harm.)
In short turf in moderately exposed situations, rare. West of Bolt Head (IMI 233574); Start Point, 1840, WB (K-Borr., a fragment associated with *Heterodermia leucomelos*).
- C. pyxidata* (L.) Hoffm.
On disturbed soil, rare, Bolberry Down, PWJ.
- C. rangiformis* Hoffm.
Extremely common and widespread in exposed situations, often forming extensive swards (NMW 26.535.2).
- C. squamosa* (Scop.) Hoffm.
In short turf on peaty soil in somewhat shaded situations and under ericaceous shrubs, scarce, Bolt Head. The var. *subsquamosa* (Nyl. ex Leighton) Vainio (var. *allosquamosa* Hennipm.) recorded from Bolberry Down, 1961, KLA.
- C. subcervicornis* (Vainio) Kernst.
On schists and peaty lips of soil overhanging rocks in the terrestrial region, usually in exposed situations, locally abundant.
- C. uncialis* subsp. *biuncialis* (Hoffm.) Choisy (subsp. *dicraea* (Ach.) D. Hawksw.)
In short turf in exposed situations on humus-rich soil, rare, Start Point.
- C. verticillata* (Hoffm.) Schaerer (*C. cervicornis* (Ach.) Flotow).
In short turf on peaty or shingly soil in exposed to shaded situations, often with *C. foliacea*, locally abundant with the *cervicornis* morphotype the most frequent.
- Collema auriculatum* Hoffm.
On mortar, Portlemouth Down, PWJ.
- C. flaccidum* (Ach.) Ach.
On well sheltered rocks, rare, Start Point, PWJ (BM).
- C. tenax* (Swartz) Ach.
On soil between rocks below an old fortification, Portlemouth Down, PWJ.

Cornicularia aculeata (Schreber) Ach.

In short turf in exposed situations, usually mixed with *Cladonia* species, widespread and locally abundant, particularly at The Warren and Start Point.

Dermatocarpon hepaticum (Ach.) Th. Fr.

On soil, Start Point, 1962, KLA (hb KLA). An unusual habitat for this species which prefers very calcareous soils.

+ *D. miniatum* (L.) Mann.

Start Point, EMH (BM). Although primarily a species of hard calcareous rocks it is known from other coastal sites.

Dimerella lutea (Dickson) Trevisan.

On peaty soil and decaying mosses in a small area on the north-facing side of Start Point, very rare (IMI 231560).

Diploicia canescens (Dickson) Massal. (*Buellia canescens* (Dickson) de Not.)

On nutrient rich or enriched bark, rocks, walls, etc, very common and widespread and occasionally fertile.

Diploschistes caesioplumbeus (Nyl.) Vainio.

On mica schists in the xeric supralittoral, widespread and locally abundant. Sometimes parasitising *Lecanora gangaleoides* (IMI 235806); with '*Leptosphaeria*' *oligospora* (Vainio) Sacc. & D. Sacc. parasitising the thallus at Gammon Head (IMI 178209).

D. scruposus (Schreber) Norman.

Overgrowing *Cladonia* sp., Portlemouth Down, PWJ.

Dirina stenhammarii (Fr.) Poelt & Follm. (*Lecanactis stenhammarii* (Fr.) Arnold).

In dry recess, rare, Bolt Head, PWJ. Usually a species of highly calcareous rocks and walls.

Enterographa crassa (DC.) Fée.

On shaded bark, frequent in suitable situations. Bolt Tail; Portlemouth Down; near Prawle Point.

E. hutchinsiae (Leighton) Massal.

On wet sheltered rocks, associated with *Oppegapha lithyriga*, very rare, Start Point, PWJ. Only otherwise recently recorded in Devon from The Hobby (near Clovelly), Shaugh Prior, and Watersmeet.

Evernia prunastri (L.) Ach.

On twigs and moderately acid bark sheltered from salt spray, more rarely on ericaceous shrubs and the ground attached to pebbles, widespread and locally abundant.

Fuscidea cyathoides (Ach.) V. Wirth & Vězda (*Lecidea cyathoides* (Ach.) Ach.)

On mica schists in slightly sheltered positions in the xeric supralittoral and terrestrial regions, locally abundant and forming extensive swards. Bolberry Down; Bolt Head; Bolt Tail; Start Point; The Warren.

F. tenebrica (Nyl.) V. Wirth & Vězda (*Lecidea tenebrica* Nyl.)

On sunny rocks, rare, Bolt Head, PWJ.

Graphis scripta (L.) Ach.

On twigs sheltered from salt spray and ericaceous shrubs, frequent in suitable situations. Bolt Head; Portlemouth Down; Start Point.

Gyalecta jenensis (Batsch) Zahlbr.

On damp siliceous rocks at the foot of the cliffs, East Prawle, 1963, KLA (hb KLA); in crevice of schist rock, Prawle Point, 1963, KLA.

Haematomma ochroleucum var. *porphyrium* (Pers.) Laundon (*H. coccineum* var. *porphyrium* (Pers.) Th. Fr.)

On shaded mica schists, locally abundant and forming extensive pure stands, occasionally abundantly fertile. Bolt Head; (IMI 186885); cliffs below east Prawle (hb KLA); The Warren (IMI 231603).

+ *Heterodermia leucomelos* (L.) Poelt (*Anaptychia 'leucomeleana'* (L.) Massal.)

On grassy ledges, among rocks, near the sea, Bolt Head, EMH (BM, NOT, TTN), HBH (BM); Start Point, 1840, WB (K-Borr.). Borrer's specimen is associated with *Cladonia portentosa*, *Parmelia crinita*, *P. omphalodes*, and *Xanthoria parietina*. The south Devon cliffs were once a stronghold for this species in the county (Fig. 6A) but it has only been found in south-west England in recent years at Kynance Cove and The Lizard (both in Cornwall).

+ *H. obscurata* (Nyl.) Trevisan (*Anaptychia obscurata* (Nyl.) Vainio)

'Bolt', JMC (Crombie, 1870); sparingly, Bolt Head, EMH (NOT), among stones near Bolt Head, rare, HBH (BM). Holl's specimen is intermixed with *Frullania tamarisci*. This species is now known in Devon (Fig. 6B) only from Arlington Court, Filleigh Park, Holne Chase, and Sampford Spiney, all woodland sites with a long history of ecological continuity.

Huilia albocaerulescens (Wulfen) Hertel (*Lecidea albocaerulescens* (Wulfen) Ach.)

On slightly shaded to exposed schists in the xeric supralittoral and terrestrial regions, widespread and locally abundant.

Hypogymnia physodes (L.) W. Watson (*Parmelia physodes* (L.) Ach.).

On mica schists, moderately acid bark, ericaceous shrubs, and occasionally lichen-dominated turf, widespread and locally abundant.

H. tubulosa (Schaerer) Havaas (*Parmelia tubulosa* (Schaerer) Bitter).

On mica schists and ericaceous shrubs, rarer than *H. physodes*. Bolt Head; Portlemouth Down; Start Point; The Warren.

Lecanactis delimis (Nyl.) A. L. Sm. (*L. monstrosa* auct.).

In a wind-cut recess in chloritic schists, associated with *L. dilleniana*, very rare, Gammon Head (IMI 159822). A western species otherwise known in the British Isles from the Channel Islands, Isles of Scilly, Tintagel (Cornwall), The Valley of Rocks (north Devon), Strumble Head (Pembroke), and Macrihanish (Kintyre).

L. dilleniana (Ach.) Körber.

In a wind-cut recess in chloritic schists, associated with *L. delimis*, very rare, Gammon Head (IMI 159867). The only other record of this western species from Devon is 'New Red Sandstone, South Devon', GD (Leighton, 1874: 173).

Lecania aipospila (Wahlenb. ex Ach.) Th.Fr.

On mica schists in the mesic supralittoral, widespread but rarely abundant and easily overlooked. Bolberry Down (IMI 159903); Gammon Head (hb KLA); Langerstone Point; Prawle Point (IMI 231583); Start Point.

L. erysibe (Ach.) Mudd.

On mortar and nutrient-enriched schists, occasional. Gammon Head, 1962, KLA; Prawle Point, 1963, KLA; Start Point.

Lecanora actophila Wedd.

On mica schists in the supralittoral zone, particularly the xeric supralittoral in sunny exposed situations, widespread and locally abundant. Bolt Head; Langerstone Point; Portlemouth Down; Prawle Point (IMI 215211); The Warren (IMI 231597); Start Point.

L. atra (Huds.) Ach.

On schists in the xeric supralittoral, widespread but easily overlooked for the commoner *L. gangaleoides* (which is also abundant in the terrestrial zone) without microscopic study.

L. badia (Hoffm.) Ach.

On schists in the xeric supralittoral and terrestrial regions, locally abundant. Bolberry Down, 1961, KLA; Bolt Head; Bolt Tail, PWJ; Prawle Point; The Warren (IMI 231611).

L. campestris (Schaerer) Hue.

Frequent on mortar, concrete and basic brickwork, widespread.

L. chlorotera Nyl.

Very common on twigs and fence-posts throughout the area, also on stems of ericaceous shrubs.

L. confusa Almb.

Very common on twigs, fence-posts and ericaceous shrubs throughout the area (hb KLA).

L. dispersa (Pers.) Sommerf.

Very common on concrete, mortar, asbestocement, brickwork, etc, but also on schists in the mesic and xeric supralittoral zones, and on nutrient enriched rocks and bark.

L. expallens Ach.

Very common and widespread on twigs, fence-posts, and bark throughout the area; rarely on rock, Start Point, PWJ.

L. fugiens Nyl.

On quartz inclusions in the supralittoral zone, Bolt Head, PWJ.

L. gangaleoides Nyl.

On mica schists in the xeric supralittoral and terrestrial zones, very common and widespread (IMI 159904). Apparently more frequent than the superficially rather similar *L. atra*.

L. helicopsis (Wahlenb. ex Ach.) Ach. aggr.

On mica schists in the mesic and xeric supralittoral, locally abundant and commoner than *L. actophila* in sheltered sites. Bolt Head; Langerstone Point; Portlemouth Down; Start Point.

L. muralis (Schreber) Rabenh.

On bird perching stone, Prawle Point, PWJ. The 'natural' habitat for this species which thrives on man-made substrates in many parts of the British Isles though it is still quite rare in Devon (Hawksworth *et al.*, 1974).

L. polytropa (Hoffm.) Rabenh.

On mica schists in the xeric supralittoral and terrestrial zones but rarely forming extensive colonies, widespread (BM); also abundant on old telegraph poles, Prawle Point (IMI 231579).

L. praepostera Nyl.

In recesses, particularly in chloritic and hornblendic schists, locally abundant. Gammon Head; Bolt Head; Prawle Point; The Warren (IMI 231600, 231606).

L. rupicola (L.) Zahlbr.

On mica schists in the xeric supralittoral and especially the terrestrial zone, locally very abundant and forming extensive swards. Not uncommonly with the parasymbiotic *Arthonia glaucomaria* (Nyl.) Nyl. in its apothecia (IMI 231608).

L. tenera (Nyl.) Crombie.

In recesses, particularly on mica schists, in the xeric supralittoral, widespread but easily overlooked, frequently fertile at Bolt Head. Bolt Head; Bolt Tail; Gammon Head (IMI 159861); Start Point (IMI 231661); The Warren (IMI 231610).

[Lecidea confluens (Wigg.) Ach.

Bolberry Down, 1961, KLA. Almost certainly an error for *Huilia albocaerulescens* but no herbarium specimen retained.]

L. erratica Körber.

On pebbles, Bolberry Down, 1961, KLA. Although not otherwise noted in the study area this species occurs at Slapton Sands (Hawksworth, 1972).

L. fuscoatra (L.) Ach.

On schists in the xeric supralittoral and terrestrial zones, scarce. Bolt Head (IMI 231596a); Gammon Head, 1961, KLA.

L. granulosa (Hoffm.) Ach.

On peaty soil and decaying vegetation, occasional; more rarely on rotting fence posts. Bolberry Down; Bolt Head; Bolt Tail; Prawle Point.

L. insularis Nyl.

Semi-parasitic on the thalli of *Lecanora rupicola*, locally abundant, Start Point, PWJ.

L. lapicida (Ach.) Ach.

On schists, local, Prawle Point, PWJ.

L. lucida (Ach.) Ach.

In recesses in mica schists, rare, Bolt Head.

L. orosthea (Ach.) Ach.

In recesses in mica schists, scarce. Bolt Head, HBH (Holmes, 1872); Bolt Tail (hb KLA).

L. percontigua Nyl.

On mica schists in the xeric supralittoral, occasional but perhaps often overlooked for *Huilia albocaerulescens*. Gammon Head (hb KLA); Start Point (NMW 14.353 g. 359); The Warren.

L. phaeops Nyl.

On damp mica schists, rare, Start Point, PWJ (BM).

L. sarcogynoides Körber.

On granite feldspar, Bolt Tail, PWJ (det. H. Hertel). Not previously reported from Devon.

L. sulphurea (Hoffm.) Wahlenb.

On mica schists in the xeric supralittoral and terrestrial zones, common and widespread (BM, hb KLA).

L. symmicta (Ach.) Ach.

On twigs, occasional throughout the area.

L. taylorii (Salwey) Mudd.

On semi-inundated schists, rare or overlooked. Bolt Head, HBH (BM); Bolt Tail, PWJ; Start Point, PWJ.

L. tenebrosa Flotow.

On exposed mica schists in sunny situations, rare, Bolt Head, PWJ.

L. tumida Massal.

On sandstone wall in a slightly shaded situation, rare, Bolt Tail.

L. uliginosa (Schrader) Ach.

On peaty soil and decaying vegetation, scarce. Bolt Head; Prawle Point.

L. wallrothii Flörke ex Sprengel.

On soil in exposed situations, locally abundant. Bolt Head (IMI 231607); Bolberry Down, 1961, KLA (hb KLA); Gammon Head (hb GGG); Prawle Point (IMI 231577); Sharp Tor (IMI 159915); Start Point (IMI 231556); The Warren.

Lecidella elaeochroma (Ach.) Hazslin (*Lecidea limitata* auct.)

On twigs in well-lit situations, locally abundant, more rarely on ericaceous shrubs. Not uncommonly accompanied by f. *soralifera* (Erichsen) D. Hawksw.

L. scabra (Taylor) Hertel & Leuckert (*Lecidea scabra* Taylor).

On slightly shaded mica schists in the xeric supralittoral, scarce. Bolberry Down, 1961, KLA; Bolt Head; Start Point (hb KLA); The Warren (IMI 233570).

L. stigmatæa (Ach.) Hertel & Leuckert (*Lecidea stigmatæa* Ach.).

On concrete and mortar, frequent throughout the area.

L. subincongrua (Nyl.) Hertel & Leuckert (*Lecidea subincongrua* Nyl.).

On schists in the xeric supralittoral, extremely common and widespread. (BM, hb KLA, LSR 757'1972-3610). The thallus colour varies considerably from the greenish var. *subincongrua* to the buff var. *elaeochromoides* (Nyl.) Hertel and Leuckert but all intergradations between these extremes occur.

Lepraria candelaris (L.) Fr.

On shaded bark, rare, Portlemouth Down; below East Prawle.

L. incana (L.) Ach. aggr.

On shaded bark, in recesses, on peaty soils and decaying vegetation, widespread and locally very abundant.

L. neglecta auct.

On mosses on mica schists in exposed sunny situations, locally frequent. Bolt Head; Sharp Tor (BM); Start Point (IMI 231604); The Warren (IMI 231601). Only otherwise known in Devon from the Dartmoor tors.

Leptocaulon microscopicum (Vill.) Gams ex D.

Hawksw. (*Stereocaulon microscopicum* (Vill.) Frey) On soil amongst rocks in somewhat shaded situations out of reach of sea spray, rare, Bolt Head. Common in the region inland associated with slates and sandstones (e.g. on walls in Slapton village).

Leptoplaca chrysodeta (Vainio ex Räsänen) Laundon.

In recess in mica schist, very rare, east of The Warren (IMI 231604). An unusual habitat for this species characteristic of highly calcareous rocks.

Leptogium lichenoides (L.) Zahlbr.

On mortar, occasional. Bolt Tail; Portlemouth Down; Start Point.

L. schraderi (Ach.) Nyl.

On mortar, Portlemouth Down, PWJ.

L. tremelloides auct. angl.

On mossy rocks, Bolt Tail, PWJ.

Lichina confinis (Müller) Agardh.

On schists forming a distinct band on sheltered shores at the base of the mesic supralittoral, locally abundant.

L. pygmaea (Lightf.) Agardh

On schists forming a distinct band at the base of the littoral fringe on exposed shores, widespread and locally very abundant (IMI 196221).

+ *Lobaria laetevirens* (Lightf.) Zahlbr.

Bolt Head, EMH (NOT). Primarily an old woodland species now restricted in Devon to Dartmoor valley woods and oak scrub on cliffs in the north-west of the county.

+ *Menegazzia terebrata* (Hoffm.) Massal.

Bolt Head, EMH (BM, NOT). A western species now known in England only from Sampford Spiney (Dartmoor), Trebartha (Cornwall), and Dalgarth (Cumberland). Holmes' material is associated with *Parmelia caperata* and *P. cf. laevigata*.

Micarea prasina Fr. (*Catillaria prasina* (Fr.) Th. Fr.)

On shaded twigs, scarce, Bolt Tail.

M. subviridescens (Nyl.) Hedl.

On decaying mosses and peaty soil, locally abundant, Prawle Point (E, IMI 231586). An overlooked western species not previously reported from south-west England.

M. violacea (Crouan) Hedl. (*Bacidia violacea* (Crouan) Arnold).

On mosses, Start Point, PWJ.

Nephroma laevigatum Ach.

Bolt Head, EMH (Holmes, 1872); on sheltered moist rocks, Start Point, PWJ (BM). The Start Point specimen is minute and sterile but agrees chemically with this species.

Normandina pulchella (Borrer) Nyl.

On *Frullania* on sheltered rocks, Start Point, PWJ (BM). The specimen is infected with the fungus *Sphaerulina chlorococca* (Leighton) R. Sant.

Ochrolechia androgyna (Hoffm.) Arnold.

Gammon Head, 1961, KLA; Bolt Head, HBH (BM). This species usually prefers more acid rocks in higher rainfall parts of Devon.

O. parella (L.) Massal.

On schists in the xeric supralittoral and terrestrial zones, extremely common and widespread. With *Leciographa parellaria* (Nyl.) Sacc. & D. Sacc. on the apothecia and thallus at Prawle Point (IMI 231574).

O. tartarea (L.) Massal.

A specimen which may represent this species was found in the *Parmelietum laevigatae* on the north side of Start Point but is small, sterile, and although papillate has possibly one soralium (IMI 231557). Now confined in Devon to the high-rainfall parts of Dartmoor (Fig. 5A). Reported by Smith (1918) from Bolt Head but the specimen on which that is based (BM) is *O. androgyna*.

Opograpta atra Pers.

On twigs in moderately well-lit situations, widespread.

O. cesareensis Nyl.

In sheltered, mainly dry, recesses facing the sea, rare. Bolt Head, PWJ; Prawle Point, PWJ; Start Point, PWJ.

O. chevallieri Leighton.

Langerstone Point, 1974, AMB; on mortar, Portlemouth Down, PWJ. This species is widespread on mortar and calcareous walls and brickwork inland in the region.

O. confluens (Ach.) Stizenb.

On mica schists in the xeric and sometimes submesic supralittoral, locally abundant. Bolt Tail; Bolt Head; Langerstone Point; Start Point (hb KLA).

O. gyrocarpa Flotow.

In recesses in the xeric supralittoral, scarce. Bolt Head; Bolt Tail; The Warren.

O. lithyrga Ach.

On wet sheltered rocks, Start Point, very rare, PWJ. Only otherwise known in Devon from Black Head (Hawksworth and Skinner 1974) and Hartland Point.

O. saxatilis DC.

On wall, rare, Bolt Tail.

O. saxicola Ach.

On mica schists in the xeric supralittoral, scarce. Gammon Head, 1961, KLA; Prawle Point (IMI 215210).

O. saxigena Taylor.

In recesses, rare, Bolt Head, PWJ (BM).

O. zonata Körber.

In recesses, scarce. Bolt Head; Prawle Point; Start Point; The Warren.

Parmelia britannica D. Hawksw. & P. James.

On mica schists in the xeric supralittoral and terrestrial zones in sunny situations, locally abundant. Bolberry Down (IMI 159895); Bolt Head; Gammon Head; Start Point; The Warren.

P. caperata (L.) Ach.

On mica schists, pebbles, ericaceous shrubs and moderately acid bark and fence posts, widespread and locally abundant (BM).

P. conspersa (Ehrh. ex Ach.) Ach.

On mica schists, commonest in the terrestrial region, locally very abundant. Some material from east of the Warren (IMI 231598) recalls *P. tinctoria* Mah. & Gillet in its habit and rounded isidia but the medulla contains stictic not salazinic acid; *P. tinctoria* is correctly reported from the British Isles only from the Channel Islands.

P. crinita Ach.

On mica schists, over mosses, on ericaceous shrubs and pebbles, locally very abundant. Bolt Head (BM, IMI 233572); Gammon Head (IMI 179180); Start Point (K-Borr, IMI 231559); The Warren. The frequency of this species in the study area is remarkable as it is primarily an old forest indicator species occurring otherwise in Devon in ancient woodlands (Fig. 5B).

With necrotic patches on the thallus caused by *Lichenocnium erodens* M. S. Christ. & D. Hawksw. at Bolt Head (IMI 233572); a further host for this destructive fungus (Hawksworth, 1977).

P. delisei (Duby) Nyl.

On mica schists in the submesic and xeric supralittoral, locally abundant. Bolberry Down (IMI 159896); Bolt Head (IMI 231617); Portlemouth Down (IMI 168501). Less frequent than the rather similar *P. pulla*.

+P. dissecta Nyl.

'Stone walls', Bolt Head, HBH (BM). An exceedingly rare western species not previously recognised as ever having occurred in Devon. The identity of this specimen was confirmed by Dr M. E. Hale.

P. glabratula (Lamy) Nyl.

On twigs, bark and ericaceous shrubs, widespread and locally abundant.

P. glabratula subsp. *fuliginosa* (Fr. ex Duby) Laundon.

On mica schists in the xeric supralittoral and terrestrial zones, widespread but rarely abundant.

P. laevigata (Sm.) Ach.

On north-facing sheltered mossy schists, very rare. Bolt Head (BM); Start Point (IMI 231566). This species is common in the high-rainfall areas of Dartmoor and north Devon but otherwise absent from the South Hams region (Fig. 5C).

P. loxodes Nyl.

On mica schists in the xeric supralittoral, occasional (K-Borr.).

P. mougeotii Schaerer.

On mica schists in the terrestrial region, rare, Bolt Head. This species is common on Dartmoor and frequent in churchyards throughout Devon but appears intolerant of sea spray.

P. omphalodes (L.) Ach.

On mica schists in the xeric supralittoral and terrestrial regions, locally abundant. Bolt Head; Bolt Tail; Gammon Head; Start Point (K-Borr.); The Warren. The allied *P. discordans* Nyl., which is known from Dartmoor, was not seen. Much of the *P. omphalodes* belongs to the grey-pruinose morphotype (f. *caesia* (Nyl.) Dalla Torre & Sarnth., f. *caesiopruinosa* (Nyl.) Boistel).

P. perlata (Huds.) Ach.

On mica schists, pebbles, ericaceous shrubs, moderately acid bark and fence posts, widespread and locally abundant (IMI 233571).

P. pulla Ach. (*P. proluxa* (Ach.) Carroll)

On mica schists in the submesic and xeric supralittoral, widespread and locally abundant (K-Borr, IMI 196223).

P. reticulata Taylor.

On chloritic schists, rare, Gammon Head. A predominantly eastern species most frequent on *Acer pseudoplatanus* in the low-rainfall parts of Devon.

P. saxatilis (L.) Ach.

On all but the most nutrient-rich or calcareous substrates, widespread and locally abundant, occasionally with apothecia.

P. subaurifera Nyl.

On slightly nutrient-enriched bark and twigs, widespread and locally abundant; occasionally also on ericaceous shrubs.

P. subrudecta Nyl.

On schists in the terrestrial region, moderately acid bark, ericaceous shrubs and fence-posts, widespread and common, occasionally with apothecia.

P. sulcata Taylor.

On all but the most nutrient-rich or calcareous substrates, widespread and common.

P. taylorensis Mitchell.

On sheltered mossy schists, north side of Start Point, PWJ (BM). A very small amount only but the identity was confirmed chemically (evernic and lecanoric acids in the medulla). As with *P. laevigata*, this species is otherwise known in Devon only from the high rainfall areas of Dartmoor and north Devon.

[P. tiliacea (Hoffm.) Ach.

Reported from Bolt Head, HBH (Holmes, 1872; Parfitt, 1883; Smith, 1918), but the specimen on which this record was based (BM) is *P. dissecta*. *P. tiliacea* is a predominantly eastern species which would not be expected in this area, although the allied more western *P. pastillifera* (Harm.) R. Schub & Klem, is known elsewhere in the Souths Hams (Dobson and Hawksworth, 1976).]

+*Parmeliella plumbea* (Lightf.) Vainio.

Bolt Head, in fruit, EMH (Holmes, 1872); Bolt Head, on rocks, HBH (BM). A western species, formerly also present at Slapton (HBH, BM), is now known in Devon only from Peppercombe (Fig. 6C) although it was once widespread on Dartmoor.

Peltigera horizontalis (Huds.) Baumg.

On mossy north-facing schists, very rare, Bolt Head.

P. membranacea (Ach.) Nyl. (*P. canina* auct. p.p.)

In short turf in moderately exposed situations, scarce. Bolt Head; Bolt Tail; Start Point.

P. polydactyla (Necker) Hoffm. s. lat.

In short turf in moderately exposed situations, occasional. Bolberry Down, 1961, KLA; Bolt Head; Prawle Point; Start Point.

P. praetextata (Flörke ex Sommerf.) Zopf.

On mossy north-facing schists, very rare, Bolt Head.

Pertusaria albescens (Huds.) Choisy & Werner.

On moderately acid bark, more rarely on rocks, occasional and widespread. The var. *corallina* (Zahlbr.) Laundon also occurs in similar situations but is commoner than var. *albescens* on rock.

P. amara (Ach.) Nyl.

On bark, more rarely on rocks and ericaceous shrubs, occasional and widespread.

P. corallina (L.) Arnold.

On mica schists in the xeric supralittoral and terrestrial regions, common and widespread.

P. flavicans Lamy.

On hornblendic and chloritic schists, more rarely mica schists. Bolt Head, PWJ; Gammon Head (hb KLA, IMI 159862); Prawle Point (IMI 233576).

P. hymenea (Ach.) Schaerer.

On moderately acid bark, occasional in sheltered situations.

P. leioplaca (Ach.) DC.

On smooth-barked trees, frequent in sheltered situations.

P. pertusa (L.) Tuck.

On moderately acid bark, occasional in sheltered situations; also on schists in the terrestrial zone, rare, Prawle Point, PWJ.

P. pseudocorallina (Liljebl.) Arnold.

On mica schists in the submesic, xeric supralittoral and terrestrial zones, widespread and very common (hb KLA, IMI 231616). A polymorphic species in need of critical study; especially frequent in this area is a morphotype with clumped isidia superficially recalling *P. lactea* (L.) Arnold but with the chemistry of *P. pseudocorallina*.

Phaeographis dendritica (Ach.) Müll. Arg.

On moderately acid smooth bark and twigs, occasional in sheltered situations.

Phaeophyscia orbicularis (Necker) Moberg (*Physcia orbicularis* (Necker) Poetsch).

On nutrient-rich bark and twigs, concrete, mortar, calcareous brickwork, and bird perching stones, widespread and common in suitable situations.

Physcia adscendens (Th. Fr.) H. Olivier.

On nutrient-rich bark and twigs, concrete, mortar, calcareous brickwork, and bird perching stones, widespread and common in suitable situations.

P. aipolia (Humb.) Fűrnrrohr.

On nutrient-enriched twigs, widespread and locally abundant.

P. semipinnata (Gmelin) Moberg (*P. leptalea* (Ach.) DC.)

On nutrient enriched twigs, occasional and commonly fertile but avoiding sea spray (BM).

P. tenella (Scop.) DC.

On nutrient rich bark, twigs, concrete and mortar, but not on mica schists, widespread and common in suitable situations.

P. tenella subsp. *marina* (A. Nyl.) D. Hawksw. **comb. nov.** [*P. stellaris* var. *marina* A. Nyl., *Notis. Sällsk. Fauna Fl. Fenn. Förh.* 3: 86 (1857)—basionym; *P. subobscura* (Nyl.) Nyl.]

On mica schists, particularly in crevices, rare in the submesic but locally abundant in the xeric supralittoral, widespread. Moberg (1977) treated this dark grey tufted taxon as a variety but if it is genotypically distinct (something requiring investigation by transplant studies) the rank of subspecies is more appropriate (Hawksworth, 1973b) as this type is confined to hard maritime siliceous rocks and consequently has a different ecology and distribution from subsp. *tenella*.

Physciopsis adglutinata (Flörke) Choisy (*Physcia elaeina* auct.).

On *Sambucus* in the shelter of a wall, rare, east of The Warren.

Platismatia glauca (L.) Culb & C. Culb. (*Cetraria glauca* (L.) Ach.) On north-facing mica schists, very rare, Bolt Head.

Porina chlorotica (Ach.) Müll. Arg.

On mica schists in somewhat shaded situations away from the sea, rare, Bolt Head; Sharp Tor. This species prefers smooth sandstones and slate in the South Hams region.

P. curnowii A. L. Sm. (*P. guentheri* var. *curnowii* (A. L. Sm.) Swinscow).

On mica schists, very rare or overlooked, Portlemouth Down, 1966, MRDS. A rarely recorded south-western species originally described from Penzance but perhaps better treated as a morphotype of *P. guentheri*.

P. taylorii (Carroll ex Nyl.) Swinscow.

On *Acer pseudoplatanus*, shady west-facing wood below Rickham Common, 1963, TDVS (BM, hb. TDVS). A very rare south-western species unknown elsewhere in Devon and the only modern record mentioned for the British Isles by Swinscow (1963).

Protoblastenia monticola (Ach.) Steiner.

On mortar, occasional. Gammon Head, 1962, KLA; Portlemouth Down, PWJ.

P. quercea (Dickson) Clauzade (*Lecidea quercea* (Dickson) Ach.)

On moderately nutrient-rich bark in fairly well-lit situations, locally abundant, particularly on *Acer pseudoplatanus*.

P. rupestris (Scop.) Steiner.

On concrete and mortar, widespread and common. The allied *P. calva* (Dickson) Zahlbr., characteristic of hard calcareous rocks, was not noted in the area but occurs on tombstones inland.

Pyrenula nitida (Weigel) Ach.

On moderately acid smooth shaded bark, rare. Langerstone Point; Portlemouth Down.

P. nitidella (Flörke) Müll. Arg. (*P. nitida* var. *nitidella* (Flörke) Schaerer)

On moderately acid smooth shaded bark, rare. Langerstone Point; Portlemouth Down.

Ramalina baltica Lettau (*R. obtusata* auct.).

On nutrient rich bark and twigs, more rarely on chloritic schists in the xeric supralittoral, locally abundant.

R. calicaris (L.) Fr.

On nutrient-rich twigs in well-lit situations away from sea-spray, occasional.

R. cuspidata (Ach.) Nyl. (*R. curnowii* Crombie ex Nyl.).

On schists in the xeric supralittoral, mainly on vertical rocks avoiding the most exposed faces, often in crevices and underhangs, locally very abundant and to 15 cm long, widespread and common (IMI 155015, 159818, 168512, 231573). No detailed study of the chemotypes has been made but at least those with no medullary compounds (*R. atlantica* Culb.) and norstictic and stictic acids (*R. curnowii* s. str.) occur.

R. duriaei (de Not.) Bagl. (*R. evernioides* auct.).

On nutrient-enriched rocks, very rare. Bolt Tail.

R. farinacea (L.) Ach.

On nutrient-rich bark and twigs in well-lit situations, locally abundant. No detailed study of the chemotypes has been made but at least the following occur: protocetraric acid (*R. farinacea* s. str.), salazinic and norstictic acids (*R. reagens* (B. de Lesd.) Culb.), and hypoprotocetraric acid (*R. hypoprotocetrarica* Culb.).

R. fastigiata (Pers.) Ach.

On nutrient-rich twigs in well-lit situations away from sea spray, locally abundant.

R. fraxinea (L.) Ach.

On nutrient-rich bark and twigs in well-lit situations, occasional.

R. siliquosa (Huds.) A. L. Sm.

On schists in the xeric supralittoral, extremely common and widespread, often forming extensive swards, stunted in the most exposed situations, very commonly with apothecia (IMI 153293, 215214, LSR 757'1972-4035). No detailed study of the chemotypes present has been made but at least those with hypoprotocetraric acid (*R. druidarum* Culb.) and salazinic acid (*R. crassa* (Delise ex Nyl.) Mot.) occur.

R. subfarinacea (Nyl.) Nyl.

On schists in the xeric supralittoral, often with *R. siliquosa* in somewhat nutrient-enriched situations as below bird nesting or perching areas, locally very abundant (IMI 159894, 231619).

Rhizocarpon constrictum Malme.

On mica schists in the xeric supralittoral, widespread and common but rarely forming extensive colonies (IMI 159858).

R. geographicum (L.) DC.

On mica schists in the xeric supralittoral and terrestrial zones, widespread and locally abundant (IMI 155064, 231599). Subsp. *geographicum* (*R. tinei* subsp. *vulgare* Runem.) is commonest in the area but on coarser rocks away from sea spray subsp. *prospectans* (Räsänen) D. Hawksw. & Sowter can also occur.

R. obscuratum (Ach.) Massal. (incl. var. *reductum* (Th. Fr.) Eitner).

On mica schists in the xeric supralittoral and especially the terrestrial region, widespread but rarely abundant.

Rinodina atrocinerea (Dickson) Körber.

On mica schists in the xeric supralittoral, occasional. Bolt Head; Bolt Tail.

R. confragosa (Ach.) Körber.

On mica schists, Start Point, PWJ.

[R. exigua (Ach.) Gray.

Gammon Head, 1961, KLA. Normally a species of the trunks of mature deciduous trees for which no suitable habitats occur at Gammon Head; perhaps an error for the similar twig-inhabiting *R. sophodes* (Ach.) Massal. not so far noted in the area but to be expected.]

R. luridescens (Anzi) Arnold.

On mica schists in the xeric supralittoral, rare, Bolt Head.

R. subexigua (Nyl.) H. Olivier.

On mica schists in the submesic and xeric supralittoral zones, also on mortar, widespread but easily overlooked (hb KLA, IMI 231672).

R. subglaucescens (Nyl.) Sheard

In recesses, particularly in chloritic schists but also in mica schists, very common and locally abundant in this habitat. Bolt Head (LSR 757'1972-4066); Gammon Head (IMI 159863); Prawle Point (IMI 231587); Sharp Tor (IMI 159914).

R. teichophila (Nyl.) Arnold

On mortar, Bolt Head, PWJ.

Roccella fuciformis DC.

In dry recesses and crevices, particularly chloritic schists, to 20 cm long and locally abundant but not found fertile. Bolt Head, EMH (BM), HBH (BM) [these specimens perhaps really from Sharp Tor]; Gammon Head; Prawle Point (BM, IMI 231584, NMW 64.222.14); cliffs below East Prawle; Sharp Tor (IMI 168582, 159909). A mediterranean species near its northern limit in south-west England but extending to the island of Skomer (Pembroke) (Fig. 4); now a very rare species which should not be collected.

R. phycopsis (Ach.) Ach.

In dry recesses and crevices, particularly on chloritic schists, locally abundant. Bolt Head (BM); Gammon Head (IMI 159818); Prawle Point (hb KLA—fertile, IMI 155092, 231573, NMW 64.222.13); cliffs below East Prawle (hb KLA); Sharp Tor; Start Point, a single small plant on north-facing crags (IMI 231563). A mediterranean species with a similar distribution in the British Isles to that of *R. fuciformis* but slightly more common in Devon; now a very rare species which should not be collected.

Sarcogyne regularis Körber.

On mortar, Portlemouth Down, PWJ.

S. simplex (Davies) Nyl.

On mica schists in the xeric supralittoral, occasional (hb KLA).

Sclerophyton circumscriptum (Taylor) Zahlbr.

In dry recesses, particularly on chloritic schists and underhangs, widespread and locally abundant (hb KLA, IMI 159821).

Solenopsora holophaea (Mont.) G. Samp.

In crevices in mica schists in the xeric supralittoral and sub-mesic supralittoral, scarce. Prawle Point (Watson, 1954); Start Point (also found here by EMH according to Leighton, 1879). Also still present in South Devon at Newton Ferrers and Slapton village on sandstones and slates.

S. vulturienensis Massal.

On mica schists, particularly in crevices, widespread in the xeric supralittoral but usually sterile and easily overlooked, fertile at Start Point (IMI 159910).

[*Sphaerophorus fragilis* (L.) Pers.

Bolberry Down, 1961, KLA. An upland species exceptional near the coast and in need of confirmation from this area although there is a, perhaps incorrectly localised, specimen from Slapton (Hawksworth, 1972). Frequent on Dartmoor./

S. globosus (Huds.) Vainio.

On mossy north-facing mica schists, very rare. Bolt Head; Start Point (IMI 231564). The only extant site for this species in the South Hams.

+*Sticta canariensis* Bory ex Delise (*S. dufourii* Delise phycotype).

Bolt Head, 1870, EMH (BM). A western species (James and Henssen, 1976) the *S. dufourii* phycotype of which was found on cliffs below Strete in 1961 (KLA); otherwise now known in Devon only from Dartmoor and North Devon where it is rare.

S. fuliginosa (Dickson) Ach.

On mossy schists, very rare, below East Prawle.

+*S. sylvatica* (Huds.) Ach.

Bolt Head, EMH (Holmes, 1872). This species is still widespread in Devon but mainly in woodlands away from the coast.

Strangospora moriformis (Ach.) Stein (*Biatorella moriformis* (Ach.) Th. Fr.)

On fence rail, abundant on one fence, Prawle Point (IMI 231576). Not previously reported from Devon.

Teloschistes chrysophthalmus (L.) Th. Fr.

On *Crataegus* twig, hedge by track down to beach (20/819.372), Start Point, 1966, KLA (BM). The only other records from the British Isles in recent years are from the Channel Islands and Isles of Scilly. The hedge on which

this species occurred was cut back in about 1968 to provide easier access to the beach and exhaustive searches have failed to reveal it on the remaining *Crataegus* shrubs or in surrounding areas.

T. flavicans (Swartz) Norman.

On maritime rocks in the xeric supralittoral in somewhat sheltered situations, formerly also on ericaceous shrubs, very rare but still abundant in a few sites. Bolberry Down; Bolt Head (IMI 231618); Gammon Head, on ericaceous shrubs but destroyed by fire in about 1971; Soar Mill Cove (IMI 159908). This species is declining in Devon (Fig. 6D) and the British Isles as a whole (Hawksworth *et al.*, 1974) and should not be collected.

+*Thelotrema lepadinum* (Ach.) Ach.

Near Bolt Head, EMH (Holmes, 1872). Generally a corticolous species of old woodland sites though it can occur on rock. It is possible Holmes saw this species in the woods around Stink Cove.

Toninia aromatica (Sm.) Massal.

On mortar, occasional. A report from maritime rocks at Bolt Head (Holmes, 1872) requires confirmation due to possible confusion with *T. mesoidea*.

T. mesoidea (Nyl.) Zahlbr.

On mica schists in the mesic supralittoral, scarce or overlooked. Gammon Head (IMI 215213); Start Point.

[*Tornabenia atlantica* (Ach.) Kurok.

'Promontorium Bolt in Devon', JMC (Crombie, 1870: 37). Holmes (1872) said 'I think this must be a mistake, as I have searched there for it in vain; nor has Dr Holl gathered it there'. This species, now extinct in the British Isles, formerly occurred in south-east England and would not be expected in Devon. Crombie's report may have been based on the not dissimilar *Heterodermia leucomelos*, a species he did not mention from Bolt./

Trapelia coarctata (Sm.) Choisy (*Lecidea coarctata* (Sm.) Nyl.)

On mica schists in the terrestrial region, also on soil in exposed situations, widespread and locally abundant (IMI 231621).

T. involuta (Taylor) Hertel (*T. ornata* (Sommerf.) Hertel).

On soil in exposed situations, locally abundant. Bolt Head; Prawle Point (IMI 231578); Start Point; The Warren.

Usnea flammea Stirton.

On mica schists and ericaceous shrubs in the terrestrial zone, locally abundant. Bolt Head; Peartree Point (hb KLA); Soar Mill Cove; Start Point (IMI 231565); The Warren (IMI 231602).

U. fragilescens (Havaas) Lyng.

On mica schists in the terrestrial region in sheltered north-facing situations, locally abundant. Bolt Head; Start Point (IMI 231562).

U. inflata Delise (*U. intexta* Stirton, *U. subpectinata* Stirton).

On schists, Start Point, PWJ. Frequent on trees inland in the South Hams.

U. subfloridana Stirton.

On twigs in well-lit situations in the terrestrial region away from sea spray, also on ericaceous shrubs and rocks, widespread and locally abundant.

Verrucaria amphibia Clemente.

On schists in the littoral fringe, locally very abundant. Langerstone Point; Lannacombe Bay, 1970, TDVS; Start Point (IMI 168605).

V. fusconigrescens Nyl.

On schists and boulders in the xeric supralittoral, particularly below bird nesting sites and perching stones, widespread. Bolt Head; Prawle Point; Start Point, PWJ.

V. hochstetteri Fr.

On mortar, Portlemouth Down, PWJ.

V. maura Wahlenb. ex Ach.

On schists in the littoral fringe, extending into the submesic supralittoral, widespread and common throughout the area, often forming extensive swards.

V. microspora auct.

On schists in the littoral fringe, widespread but rarely abundant. Gammon Head, 1961, KLA; Steeple Cove near Bolt Head, 1950, FAS (LSR 757) 1972-5979; below East Prawle; Lannacombe Bay; Prawle Point; Start Point.

V. mucosa Wahlenb. ex Ach.

On schists at the base of the littoral fringe, below *Lichina pygmaea* and commonly on quartz, widespread but rarely forming a continuous band (IMI 231674).

V. muralis (Schrader) Ach.

On mortar, widespread and common.

V. nigrescens Pers.

On mortar, widespread.

V. prominula Nyl.

In crevices, particularly in chloritic schists, submesic supralittoral, locally abundant. Gammon Head; Langerstone Point; Peartree Point (hb KLA); Portlemouth Down (IMI 196210).

V. striatula Wahlenb. ex Ach.

On schists in the littoral fringe, generally starting below *V. maura* and above *V. mucosa*, sometimes extending into the submesic supralittoral in crevices, widespread and common, often forming extensive swards (hb KLA).

V. viridula (Schrader) Ach.

On mortar and basic brickwork, widespread and locally abundant.

Xanthoria candelaria (L.) Th. Fr.

On mica schists on nutrient-enriched rocks below gull nesting colonies, locally abundant. Gammon Head, 1961, KLA; Start Point (IMI 231673).

X. parietina (L.) Th. Fr. (incl. var. *ectanea* (Ach.) Kickx).

On concrete, nutrient-rich bark and twigs, nutrient-enriched schists below gull nesting colonies, fence posts, and schists in the mesic and xeric supralittoral, widespread and very common (BM). Transplants carried out with material from near Slapton established that the narrow lobed deeper orange var. *ectanea* characteristic of exposed maritime rocks was merely an environmental modification of this species (Richardson, 1967).

X. polycarpa (Hoffm.) H. Olivier.

On nutrient-enriched twigs, scarce, Start Point.

DISCUSSION

From the preceding section, it will be seen that 277 lichen species are recorded from the study area. Of these, five are considered as erroneous or doubtful and eleven species have not been confirmed as present in the area this century. Of the extant 261 species, only 36 occur only on bark or wood. The remaining 225 species are all exclusively on rocky substrates, or on the ground associated with the cliffs. These figures may be compared with the 71 species reported from The Lizard (Pentecost, 1969), 130 from Lundy Island (Noon and Hawksworth, 1973), 125 from Bardsey Island (Sheard and Ferry, 1964), 85 from the Isle of May (Sheard and Ferry, 1967), and 102 on the coastal rocks of the Dale Peninsula (Ferry and Sheard, 1969). The only richer rocky coastal site in the British Isles, in terms of species numbers, to have been reported on in recent years is probably the Island of Mull (James, 1978); unfortunately the number associated with the cliffs was not indicated in that work, making comparisons difficult. The occurrence of such a large number of species, many of which are abundant along the coastline from Bolt Tail to Start Point, makes it a particularly good area in which to teach the identification and ecology of lichens on rocky shores. The range of shores with differing aspects and degrees of exposure also enables comparisons between them to be made (see pp. 198-201).

In addition to its value for education, the area is of outstanding scientific interest for its lichens; indeed much of the coastline has been scheduled as a Site of Special Scientific Interest by the Nature Conservancy Council on the basis of its lichen flora. Of particular interest in the lichen flora is an assemblage of species with mediterranean or lusitanian affinities. These broadly correspond to the "extreme south western" element recognised by Coppins (1976) in the British corticolous lichen flora, being known from some of the following areas only: the Channel Islands, Isles of Scilly, Cornwall, Devon, extreme south-west Ireland, and the Pembrokeshire islands (the latter added here). This element includes the now very rare species *Buellia leptoclinoides*, *Cladonia convoluta* (Fig. 3), *C. firma*, *Rocella fuciformis* (Fig. 4), *R. phycopsis*, *Teloschistes chrysophthalmus*, and *T. flavicans*. Other species perhaps belonging to this same phytogeographical element occur inland in the South Hams area of Devon, for example *Gyalectina carneolutea* and *Parmelia quercina* (syn. *P. carporrhizans*) (Hawksworth, 1972) although these extend further east coming into Coppins' (1976) "extreme southern" category.

A second element of importance includes species belonging to Coppins' (1976) "general western" and "western and southern" groups. This comprises species with a high rainfall or humidity requirement (e.g. *Dimerella lutea*, *Enterographa hutchinsiae*, *Leptogium tremelloides*, *Micarea subviridescens*, *M. violacea*, *Nephroma laevigatum*, *Ochrolechia* cf. *tartarea*, *Parmelia crinita*, *P. laevigata*, *P. taylorensis*) or ones with a temperature requirement avoiding direct rain by inhabiting crevices or recesses (e.g. *Caloplaca littorea*, *Lecanactis delimis*, *L. dilleniana*, *Opegrapha cesareenis*, *Rinodina subglauescens*).

Of the 11 species not found in the area this century (although present in the last), all apart from the exclusively saxicolous *Anaptychia mamillata* and *Dermatocarpon miniatum* are members of the "general western" group or are old forest indicator species able to occur on both trees and mossy rocks: *Heterodermia leucomelos*, *H. obscurata*, *Lobaria laetevirens*, *Menegazzia terebrata*, *Parmelia dissecta*, *Parmeliella plumbea*, *Sticta canariensis*, *S. sylvatica* and *Thelotrema lepadinum*. Several of these species have declined in Devon as a whole (e.g. *Parmeliella plumbea*, Fig. 6C) and *Heterodermia*

leucomelos (Fig. 6A) and *Parmelia dissecta* are now extinct in the county. As fragments of the high rainfall demanding *Parmelieta laevigatae* still occur in very restricted north-facing areas of both Bolt Head and Start Point (see p. 203) and suitable habitats are very limited it is probable that these species occurred in these same sites and were always very rare there. Only *H. leucomelos* was probably in a well-lit situation, as evidenced by fragments of *Xanthoria parietina* mixed with Borrer's specimen from Start Point. The reasons for the loss of these species are difficult to establish with any degree of certainty. The area has been unaffected by building, except for coastguard and light-house stations, though some of these are old; Start Point light-house, for example, was opened in 1838, before Borrer's visit. Visitor pressure is intense locally but coast more than a mile from the nearest car park is seldom visited and visitors may be fewer over much of the area than in Edwardian and Victorian times when interest in natural history was at a peak of popularity. Changes in the vegetation may have been important as most species not refound could have grown on mossy rocks or in short turf in very restricted areas because of their humidity requirements. Ericaceous shrubs, brambles, bracken and gorse now form extensive dense stands in some areas but have been well developed on the cliffs for many years (Fox, 1874). With the decline in rabbits due to myxomatosis from 1954-55 onwards, reduced grazing pressure must have allowed some encroachment of brambles etc., into areas of short-turf. However, Fox (1874: 180) gives the impression that the Bolt Head area was then so populated with various mammals that terricolous lichen communities might have been endangered by them:

"... the place teeming with animal life: rabbits burrowing in the ground; and polecats, stoats, and weasels skulking and hunting them from burrow to burrow."

The extinction of the Large Blue butterfly, *Maculinea (Nomiades) arion* L., in its former stronghold at Bolt Head may also be related to changes in the vegetation arising from alterations in grazing pressure. Burning must also be considered, but perhaps of major importance was the collecting of uninformed or over-enthusiastic naturalists in the closing decades of the nineteenth century. Fox (1874), for instance, casually mentions a lady who collected a *Roccella* species at Bolt Head. E. M. Holmes was a particularly avid collector; most of his specimens from Bolt Head are large; perhaps he gathered all he found?

The probable loss of 11 species from the area represents a decline of only about four per cent of the species reliably recorded. This figure is very much less than that found to have occurred in many other sites in the British Isles which also received considerable attention last century (Hawksworth, 1975). The persistence of the remaining lichen flora in the Bolt Tail to Start Point area may be threatened in the future by a number of factors and conservation measures should aim to ensure that such threats are averted: (1) Burning; accidental fires increase with increases in visitors. *Teloschistes flavicans* has been lost from one site in the area already due to a fire, and extensive fire damage has occurred east of The Warren. (2) Trampling; discourage visitors from areas with the most luxuriant terricolous lichen communities by the location of car parks and access points away from them; the terricolous communities at Berry Head (Hawksworth, 1973a) have deteriorated dramatically over the last four years with areas once dominated by *Cladonia* species now largely bare soil, and some species may have been lost entirely (e.g. *Squamarina crassa*). (3) Oil spillages; oil pollution has already damaged the littoral fringe and mesic supralittoral in some parts of the area but reductions have been local and no

species have been eliminated by oil or dispersants so far; very severe spillages could nevertheless lead to damage which would take many decades to repair although little accurate information on the effects of such spillages is available. (4) Air pollution; not currently a significant factor but any nearby major industrial development could affect some of the more pollution-sensitive species present. (5) Over-collecting; the collecting of many of the rarer species by students, amateur naturalists, and professional lichenologists cannot be condoned as the taxa are already available for study in the major British lichen herbaria.

In addition to its importance nationally for the rare species present and its educational value, any deterioration would be unfortunate on a more local level. No rocks comparably rich in lichens occur anywhere in South Devon. The coastal sandstones, breccias, slates, limestone and dolerite are relatively extremely poor in lichen species; fewer than 50 occur on rocks in many coastal sites and on breccias and soft sandstones less than 10 may be present. Further, 15 of the listed species are unknown elsewhere in Devon; many others are known from only a few other sites or are most abundant here (e.g. *Roccella phycopsis*, Fig. 5D); and disjunctions of high rainfall requiring species between Dartmoor and the coast (e.g. Fig. 5A, C) are of local phytogeographic interest. The area is also one of the strongholds for some species which are not primarily coastal, for example the extremely air-pollution-sensitive *Teloschistes flavicans* (Fig. 6D) which is declining nationally.

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