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978-0-521-23395-8 - Flora of Connemara and the Burren
D. A. Webb and Mary J. P. Scannell
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AND
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FLORA OF CONNEMARA AND THE BURREN

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and

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INTRODUCTION

Connemara and the Burren are two of the most interesting regions of Ireland for the botanist; Kerry alone can rival them. But whereas Kerry has had since 1916 a county Flora which, though badly in need of updating, is still very useful and informative, no systematic account of the plants of Connemara and the Burren has been attempted on a larger scale than the summaries given by Praeger in his *A Tourist's Flora of the West of Ireland* (1909), reprinted with only minor alterations in *The Botanist in Ireland* (1934). Stimulating and useful though they are, these accounts deal for the most part only with rare species, and indicate the distribution even of these only in broad outline. When, therefore, the Irish committee of the Botanical Society of the British Isles decided in 1963 to give a focus to its activities by encouraging the production of a local Flora, it was agreed after a short discussion that Connemara and the Burren would form a suitable region.

Before going further we should explain the sense in which we use these terms. Connemara has never been an administrative unit. Originally the name was used to denote the westernmost part of Co. Galway – west, roughly, of a line running from Costelloe through Maam Cross to Leenane – but by the middle of last century it was being used more and more in a wider sense, and it gradually came to indicate all that part of the county which lies to the west of Galway city and Lough Corrib. It is in this sense (corresponding exactly to the biological vice-county H16) that we use it here. It forms a natural unit, apart from an arbitrary delimitation from Co. Mayo in the north-east; and in this connection it should be pointed out that here the boundary follows not the present administrative boundary, but that which existed before 1898 (for details see Webb, 1980*b*).

Burren, on the other hand, is one of the baronies into which Co. Clare is divided, forming its north-west corner. But a realization of the unique character of the landscape and flora which were shared by the barony and the country to the east and south-east of it led some time ago to the use of the term 'the Burren' to include all the karstic limestones of north Clare and the adjacent parts of south-east Galway. In this sense it too is a natural region, though it lacks a clear eastern boundary. We have adopted as the most convenient the main road from Galway to Ennis, as this approximates to the line which divides the mainly bare rock on the west from the mainly drift-covered area on the east.

Connemara and the Burren, so defined, are not widely separated, but they are not actually contiguous, and it might have been thought wiser to treat them in two separate Floras. But as most botanical tourists who visit the west of Ireland sample both Connemara and the Burren we thought it better to include both in one volume. Although sharply contrasted in their land-forms and their soils they share an extreme Atlantic climate which gives to their floras a partial unity.

Two smaller areas are included in our survey which belong neither to Connemara nor to the Burren. One is the narrow strip of drift-covered limestone at the head of Galway Bay, which the tourist must traverse in driving from Connemara to the Burren or vice versa; and as he will often spend a night in Galway we have added a small area to the north and north-east of the city. The other is a zone of shale lying to the south of the Burren, running from near Ennis to the coast south of Leinch, and extending northwards in a large salient around Lisdoonvarna and Slieve Elva. The visitor to the Burren is likely to penetrate into this area, if only to see the Cliffs of

Moher, and we have therefore thought it worth while to draw his attention to the sharp contrast between the flora of the limestone and that of the shales.

We cover, therefore, in this volume the whole of the vice-county H16, a substantial part of H9 and small parts of H15 and H17. The precise limits of the region are set out on p. xii. So delimited, it occupies an area more than 1½ times that of an average vice-county, and there have been times when we wondered whether our project was too ambitious. To write a satisfactory regional Flora two conditions should be fulfilled; the author should live, or at least spend a large part of the year in or near his region, and he should have no other major botanical preoccupation. Neither of these conditions has been fulfilled for us. For most of the year we were both living in Dublin, separated from the Flora region by almost the entire breadth of Ireland, and our administrative commitments and editorial duties relating to other works meant that for long periods work on this Flora had to be set aside. Nor were many of our helpers more favourably situated, and although their contributions were invaluable they were made for the most part under difficulties – in flying visits, mostly in midsummer, and often hampered by the problems of organizing student field-trips or parties of very varied botanical expertise. Nevertheless we decided in 1978 that the work, imperfect though it was, should be hurried on towards publication, and we hope that we may be found to have provided at least a useful foundation (in earlier days we might have termed it a *Prodrumus* or a *Tentamen* rather than a definitive Flora), which our successors can in due course extend or amend. Like Praeger (*Irish Topographical Botany*, 1901, p. viii), we believe that ‘the chance of the remaining blanks . . . being filled up is much increased by their being herein pilloried and exposed to public notice’. For this reason we have tended in the case of most questionable records to err on the side of scepticism, in the belief that the omission of a true record is easily rectified later, while the insertion of a false one is likely to mislead for half a century or more.

We have as a general rule excluded casual aliens, by which we mean plants which do not reproduce themselves within the region and show no prospect of doing so; if they persist it is merely from constant re-introduction. This category includes not only many annuals of cultivated or waste ground, but also such plants as the vine and the fig, of which single plants have survived for several years in the city of Galway. Some species which we believe to have been merely casual, but which appear several times in the literature, are briefly mentioned, but casuals of which the latest record is more than 100 years old have been excluded. We have also gone to some trouble to distinguish between shrubs and trees which are naturalized (i.e. self-sown) and those which are merely planted – a distinction in which earlier writers have shown curiously little interest.

This book, like most local Floras, is meant to be used in the field in conjunction with an identificatory Flora which contains descriptions and keys. In practice, however, we realize that many users of it will not have such a book at hand, or may not be accustomed to its use. We have, therefore, within the limits of space available, included a little help towards identification of species within some of the genera, by indicating differential characters which can be described in simple language and which do not, in most cases, need the use of a lens for their recognition. There are, unfortunately, many genera such as *Callitriche*, *Potamogeton* and *Carex* for which this is impossible, but even for *Carex* we hope that our grouping of species in accordance with a few easily recognized characters may be of some help. We have also tried to give some assistance at generic level with those traditional bugbears of the amateur – umbellifers and yellow-flowered composites.

All records from 1959 onwards are treated as ‘recent’ rather than ‘historical’. This date was chosen because, although it was not until 1962 that we began to accumulate

INTRODUCTION

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records ourselves, 1959 was the year in which Ivimey-Cook and Proctor made most of the observations on which their masterly paper on the communities of the Burren (Ivimey-Cook & Proctor, 1966) was based. Our collection of records for the rare species was mostly done by *ad hoc* methods: search in the literature and in suitable herbaria, search in the field in recorded localities and in likely habitats, and the noting of chance finds. The data for the commoner species were accumulated, not by the now fashionable technique of searching 'tetrads' (squares of 2 × 2 km), since the large size of our region would not have permitted this with the man-power available, but by choosing a few (usually four or five) points in each 10 × 10 km square and recording all the plants to be seen within a radius of 400 m of the point. The points were chosen so as to give the maximum of ecological diversity; some were on mountain-tops, others on lake-shores or river-banks, some in bogs or marshes, some by the coast, and some in towns or villages. We believe that by this means we gained a fairly accurate estimate of the frequency of all the commoner species in each district of our region. The data were recorded on special cards, with coded information as to habitat and frequency. Time did not permit a search of all the points which were originally chosen, nor was there time to analyse some of the cards which came in rather late but, for each of our eight districts, lists from at least 20 points (and in several districts over 30) were analysed and the results entered in loose-leaf notebooks with a page for each species. From these, to which were added later data from the herbaria, the literature or other sources, were compiled the accounts which constitute the main text of this book. Only exceptionally are more than four localities cited for any one district; 5–7 occurrences are summarized as 'occasional', 8–11 as 'frequent'; 12–15 as 'very frequent'; and over 15 as 'abundant'.

In the collection of field data we were fortunate in receiving the help of a large number of botanists, both from Ireland and Britain, for without their help the total number of records would not have been much more than half of what it finally amounted to. In this respect, therefore, the Flora has a somewhat collegiate quality, and to emphasize this we have for recent records not cited the name of the recorder, except in a small number of cases where the rarity or the critical nature of the species makes such citation desirable. Similarly we have not given dates later than 1958 except for very rare species or those which seem to be showing a significant increase or decline.

It is perhaps invidious to pick out for special mention any names from the long list of our helpers, but we feel that we must mention the very special value of the work of Professor J. J. Moore (mainly in the Burren and Aran) and of Dr G. Halliday (mainly in district 8, and including the great majority of the mountain records). Our other helpers in the field included (and we say 'included', as we fear that our inadvertence or their modesty has led to the omission of some names) the following:

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In conclusion we should add that we have borne in mind not only those who will use this book in the field, but also readers who will never visit the region but will use it for reference or for armchair reading. With this in view we have tried to present our data in as readable a form as possible. We have preferred place-names to austere lists of grid-squares, and we have included as much information on ecology, plant-geography, history and infraspecific variation as space permits.

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THE FLORA REGION AND ITS EIGHT DISTRICTS

The region covered by this Flora has been defined in general terms on p. x, but a precise delimitation is desirable and is given here. On the west it is bounded by the Atlantic Ocean, but includes the Aran Islands, Inishbofin and Inishshark (though not Inishturk), as well as smaller islands nearer the shore. In the north, its boundary runs up the centre of Killary harbour to meet the land at the road-junction which lies less than 1 km south of the mouth of the Erriff R. It follows the county boundary as far as a point just east of the highest point 682 m (2239 ft) of the Maamtrasna plateau, but there diverges from it to follow the pre-1898 boundary, passing along the saddle south of Glenawough L. and north of the small lakes east of it to run first eastwards and then south-eastwards to reach the shore of L. Mask at a point 2½ km south-south-west of Toormakeady.

The eastern boundary of the region runs southwards from this point across L. Mask to meet the present county boundary east of Ferry Br., and then follows this boundary past Clonbur and Cong into L. Corrib. In L. Corrib it runs approximately down the middle (following the baronial boundary) to near the south end, where it cuts across to the east shore of the Menlough marble quarries. From here it follows by-roads through Ballindooly, Twomileditch and Doughiska to join the Galway–Limerick road just east of Rosshill Ho. The boundary then follows this main road as far as the major road-junction on the northern outskirts of Ennis.

From this road-junction the southern boundary follows the main road to Inagh and continues westwards along it for a further 4 km, but then diverges northwards to follow by-roads past White's Br. and Glenville Ho. to meet the sea just south of Moy Ho.

The total area of the region so delimited is approximately 3100 sq. km, including islands and all inland waters except those parts of L. Corrib and L. Mask which lie within the region.

It extends from 52° 51' to 53° 38' north latitude, and from 8° 48' to 10° 18' west longitude. It is covered by sheets 10, 11, 14 and 17 of the Ordnance Survey maps on a scale of ½ in. to a mile, and all the names mentioned here are to be found on these maps though in a few cases we have adopted a different spelling as more widely used.

We have divided it for floristic purposes into eight districts, as follows.

District 1. The Clare shales

Area, about 295 sq. km. Greatest height 348 m (1134 ft).

The southern and western boundaries are those of the region. On the north it is separated from district 2 by a line following by-roads from the coast at Fisherstreet past Ballynalackan Ho., Balliny and Ballyelly, thence round the north flank of Slieve Elva to Lismorahaun and Doonyvardan, passing later west of Noughaval to join the Ennis–Lisdoonvarna road 2 km east of Kilfenora and then following it eastwards to Roughan Ho. On the east it is separated from district 3 by this same road from Roughan Ho. to the point where it meets the Ennis–Inagh road 4 km north-west of Ennis.

The district coincides almost exactly with that part of the region composed of

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Carboniferous shales and sandstones. The limestone is exposed in some areas around Kilfenora and north-west of Lisdoonvarna, but here it is mostly covered by siliceous downwash from the shales, and harbours only a few calcicole species. Elsewhere the vegetation is mainly poor, wet grassland, with some high-level moorland and a few patches of bog and acid fen. On the northern and eastern margins slight deviations from the geological boundary lead to the inclusion in the district of small patches of better grassland over partly calcareous drift, while in a few places, notably near O'Dea's Castle and Elmvale Ho. there are outcrops of limestone which bring in a fair number of Burren species. There are a few lakes, of which Inchiquin L. is the largest. Apart from a few scraps, as by L. Goller, there is no natural woodland, and most of the landscape is remarkably treeless, but demesne woods at Ennistymon and Lisdoonvarna bring in some woodland species. There is a fine sandy beach at Lehinch; otherwise the coast is rocky, culminating in the Cliffs of Moher, which, unlike most other cliffs described as 'sheer', are actually vertical; one can drop a pebble into the sea from a height of 160 m (530 ft) (Plate 4). Besides these cliffs and the Lehinch dunes the chief places of floristic interest are Inchiquin L., L. Raha, L. Goller and the valley of the Aille R.

Recorded species total 519,* of which 33 have not been seen recently. The species known only from this district are *Vaccinium oxycoccos*, *Butomus umbellatus* and the hybrid *Potamogeton* × *nerviger*.

District 2. The Burren hills

Total area (including the Aran Islands) about 345 sq. km. Greatest height 329 m (1073 ft).

The western and northern boundaries are formed by the sea; the southern has been defined for district 1. On the east it is separated from district 3 by the 200 ft contour, running from Roughan Ho. northwards to where it meets the road on the east side of Abbey Hill; thence eastwards along the road to the head of Aughinish Bay and thence out to sea, passing south of Aughinish.

A karstic peneplain, consisting entirely of limestone, pierced on the north by two fairly broad dry valleys leading down to Ballyvaughan and Bealaclogga respectively, and on the west by the much narrower valley of the Caher R., the only river in the district. In the west and east the limestone is largely bare; in the centre considerable areas bear a nearly continuous cover of thin soil supporting calcareous grassland. Hazel-scrub is scanty in the west, but fairly plentiful in the east, where there are also a few fragments of natural woodland, notably at Poulavallan, near Clooncoose and on the side of Mullaghmore. There are no lakes, except for some brackish lakes along the north coast, but there are turloughs (p. xxxii) near Turlough village, in the Carran basin and at L. Aleenaun (the last, unfortunately, recently drained). The coast consists mainly of low cliffs and rocky shores, but there are good sand-dunes at Fanore and north-east of Ballyvaughan, while at Rine Point, north-west of Ballyvaughan, there is an interesting spit. Apart from the woods and turloughs mentioned above, the chief areas of floristic interest are Poulsallagh, Fanore and the Caher R. valley, Black Head and Cappanawalla.

The Aran Islands resemble the western part of the mainland, differing mainly in the sparser vegetation and the considerably higher cliffs of their coastline.

Recorded species total 635, of which 35 have not been seen recently. The species known only from this district are *Astragalus danicus*, *Pyrola media*, *Limonium*

* This and the corresponding figure for other districts refer to vascular plants only, and exclude microspecies of *Rubus*, *Taraxacum* and *Hieracium*.

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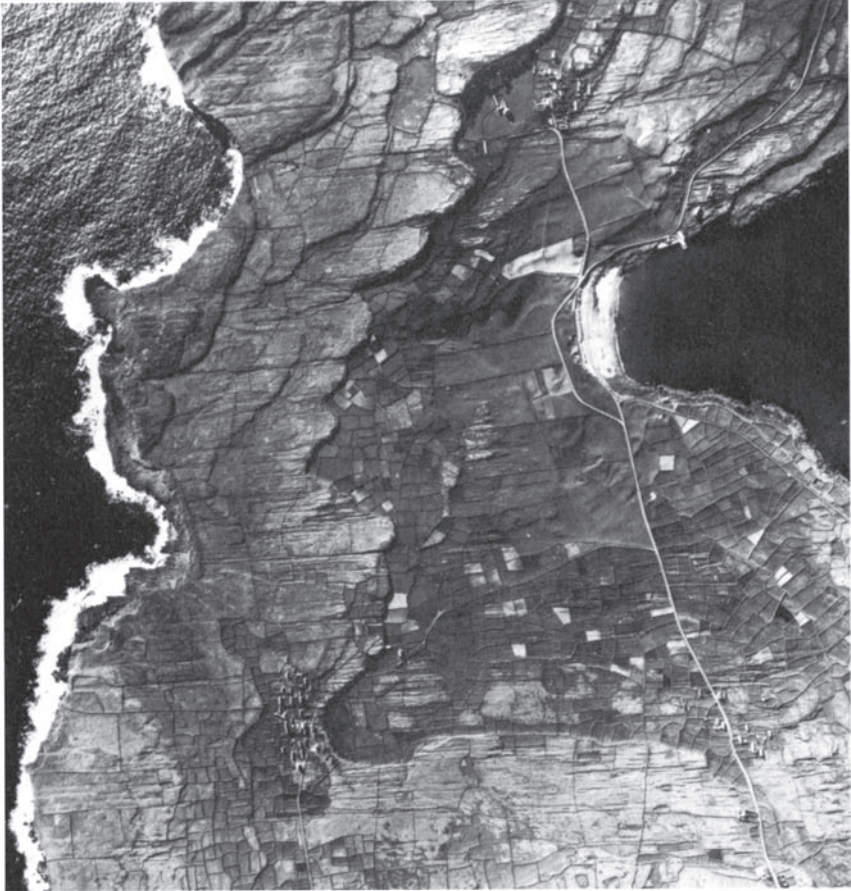


Fig. 1. Aerial view of Inishmore (Aran Islands), towards the western end. On the right is the beach of Portmurvy, with the village of Kilmurvy above it. Towards the bottom left is the village of Gortnagapple. The ground rises in successive terraces from Portmurvy to the cliffs of the south-west coast, which here vary from 25 to 40 m (80 to 125 ft) in height. The area around Portmurvy is drift-covered and furnishes reasonably good farmland. (Scale 7 cm = 1 km; 4½ ins = 1 mile.)

transwallianum, *Cuscuta epithymum*, *Carex strigosa*, the hybrid *Potamogeton* × *lanceolatus*, and also *Arenaria norvegica* and *Atriplex littoralis*, both of which have been seen once but cannot now be re-found.

District 3. The Burren lowlands

Total area about 420 sq. km. Greatest height 67 m (219 ft).

Separated on the west from districts 1 and 2 by boundaries defined above, and bounded on the east by the Ennis–Galway road. The northern boundary is formed

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Fig. 2. Aerial view of part of Inishmore (Aran Islands), S.W. of Kilronan. The cliffs towards the top of the picture are *c.* 65 m (over 200 ft) high. The terrain is composed entirely of bare limestone pavement, and is uninhabited; the flora, however, found mainly at the base of walls and in the crevices of the pavement, is richer than the photograph would suggest. (Scale 7 cm = 1 km; $4\frac{1}{2}$ ins = 1 mile.)

by the estuary of the Dunkellin R., and from its mouth runs into Galway Bay between Mweenish I. and Eddy I.

A very flat plain, with a few hillocks in the south-east; more than half the district, however, has an elevation of less than 30 m (100 ft). Bare limestone pavements prevail in the west, but in the east and extreme south the drift cover is plentiful. Lakes are very numerous, especially in the south, and the larger ones are fringed by extensive fens and reed-beds. There are a few surviving fragments of raised bog in the south-centre. The only river is the Fergus, which enters the region at Corofin and leaves it at Ennis. Turloughs (p. xxxii) are numerous. There is a good deal of hazel-scrub, mainly in the west, and a fair-sized wood at Garryland and Coole which, though it

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has been subject to much management, still preserves some of its natural features. The coastline is sheltered and comparatively short; the shores are muddy or stony, with considerable areas of salt-marsh. Floristic interest centres mainly on the turloughs, the lakes and their fens (especially L. Bunny), Garryland wood, and the country between Dromore and Ennis.

Recorded species total 607, of which 20 have not been seen recently. The species known only from this district are *Ceratophyllum demersum*, *Sium latifolium*, *Teucrium scordium*, *Carex spicata* and the hybrid *Potamogeton* × *salicifolius*; also *Elymus caninus*, only once collected in 1855, but quite possibly still surviving.

District 4. The northern limestones

Total area 143 sq. km. Greatest height 72 m (234 ft).

The northern boundary runs along the road from Oughterard to Oughterard quay and thence due east to meet the baronial boundary in the middle of L. Corrib. On the east the boundary is that of the Flora region; on the south it is separated from district 3 by the Dunkellin estuary. On the west it is separated from district 5 by the main road from Oughterard to Galway as far as the Cathedral bridge, and thence down the R. Corrib to the sea. Most of the city of Galway is in this district, but the Cathedral and the south-western suburbs are in district 5.

A district without a marked character, and perhaps the least natural of the eight. It represents an extension northwards of the limestone plain of district 3, running round the head of Galway Bay and then up the west shore of L. Corrib. Apart from some hillocks north-east of Galway it is very flat. On these hillocks, and around and north of Ross L., there are some exposures of limestone pavement, but elsewhere there is a mainly gravelly drift cover. On the western edge there are some very small areas of Connemara granite, and there are some bogs overlying the pavements north of Ross L. The shore of L. Corrib is stony and exposed, and most of the islands in the lake belonging to this district are grazed, but a few bear natural scrub or woodland. Apart from this there is no woodland in the district, but there is some hazel-scrub around Menlough. The coast is similar to that of district 3. The most interesting areas floristically are around Menlough and Ballindooly (N. of Galway), Ballycuirke L., where the floras of the limestone and granite are juxtaposed, and the country north and east of Ross L.

Recorded species total 613, of which 35 have not been seen recently. The species known only from this district are *Carex riparia*, *Puccinellia distans*, and the somewhat doubtful *Carex flava*.

District 5. Iar-connaught (south-east Connemara)

Total area about 540 sq. km. Greatest height 348 m (1138 ft).

Separated on the west from district 6 by the road from Maam Cross to Costelloe, and thence down the middle of Cashla Bay to Galway Bay; on the north from district 8 by the road from Maam Cross to Oughterard; on the east from district 4 by the line described above. On the south it is bounded by Galway Bay.

The largest, most compact, and most homogeneous of the districts. It is composed almost entirely of granite, low-lying in the south but rising in the north-west to a conspicuous escarpment. Most of the granite is covered with blanket-bog, but there is a coastal strip in which a fairly plentiful drift cover gives mineral soils, and along this strip there is intensive settlement. At one place 5 km west of Galway, marked on maps as Seaweed Point, but known universally in the literature and locally as Gentian

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Hill, there is a complex of highly calcareous gravelly drift on which many of the rare Burren plants find an outlying station. The coastline is elsewhere very uniform and unindented, mainly of low rocky shores, but with several sandy beaches; these, however, do not give rise to dune-systems of any size. Small lakes are numerous, but few of them have been investigated. The flora of much of the blanket-bog is monotonous: in one circle of 400 m radius we were unable to find more than 27 species of higher plants. For this reason, and because of the scarcity of roads, the district is less well explored than the others. There is a patch of natural woodland by the Owenboliska R. north of Spiddal and a semi-natural wood north-west of Moycullen. These, together with Gentian Hill and some fenny marshes near the boundary with district 4, are the regions of greatest floristic diversity.

Recorded species total 559, of which, however, 46 have not been seen recently. No species from the Flora region is confined to this district.

District 6. South-central Connemara

Total area about 365 sq. km, of which a considerable proportion consists of off-shore islands. Highest point 360 m (1178 ft).

Separated on the east from district 5 by the boundary described above; on the north from districts 7 and 8 by the Galway–Clifden road from Maam Cross to Canal Br.; on the west from district 7 by the road from Canal Br. to Toombeola and thence down Bertraghboy Bay to reach the ocean S. of Inishlackan; on the south bounded by the sea.

The general character of this district in its eastern and southern parts is similar to that of district 5 – fairly low granite hills covered partly by blanket-bog, but in some areas with a large proportion of bare rock. In the north and west the rock is mainly gneiss, with basic intrusion forming rather abrupt hills. The coastline is extremely complex and tortuous, with an extensive development of salt-marsh and of brackish inlets almost cut off from the sea, but in several places there are beaches of highly calcareous sand or occasionally of ‘maerl’ (p. 287). Lakes are numerous, though mostly fairly small; a few have wooded islands. There are semi-natural woods south of Glendollagh L. and north-north-east of Toombeola, but the latter has been largely underplanted with conifers.

Calcareous soils are confined to rather small patches of blown sand, and are less in extent than in any other district. Mainly for this reason the total flora is small, amounting to only 479 species, of which, however, only 13 have not been seen recently. The species known only from this region are *Spergularia rubra*, the alien *Juncus planifolius* and the somewhat doubtful *Ruppia cirrhosa*.

District 7. West Connemara

Total area about 495 sq. km. Greatest height 733 m (2395 ft).

The boundary separating this district from district 6 has been described above. From district 8 it is separated by the road running northwards from Weir Br. on the Galway–Clifden road, past L. Inagh to the junction with the Clifden–Leenane road, which it then follows eastwards to a point above Killary harbour due south of Bundorragha on the opposite shore, whence it runs down to join the regional boundary in Killary harbour. Elsewhere the district is bounded by the sea.

A district of very varied terrain, and including most of the Connemara localities best known to botanists. The eastern part is dominated by the mass of the Twelve Pins, composed of quartzite except for a few areas of mica-schist, which bring in the

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Fig. 3. Glaciated granite landscape near the centre of Gorumna I. (S. Connemara). The bush pressed against the boulder in the right foreground is *Juniperus communis*, subsp. *nana*.

greater part of their not very abundant alpine flora. To the north is a smaller mountain mass rising to 605 m (1975 ft) between Letterfrack and L. Fee. The Twelve Pins have a considerable area of foothills on their western flank, but elsewhere drop steeply down to the plain; the only two other hills of any consequence (Errisbeg and Tully Mt.) rise abruptly from the coastal plain. There is much low-level blanket-bog, but around the coast there is some bare granite, some grassland over podsols, and considerable areas, especially on the Slyne Head peninsula, in which the large quantities of blown calcareous sand give rise to extensive sheets of machair. The coast is very diversified, rocky headlands alternating with sandy beaches and a few muddy inlets. There are two fair-sized rivers, Dawros and Owenglin, but their banks harbour few species not to be found elsewhere; more important floristically are the innumerable lakes, including the three largest in Connemara: Inagh, Derryclare and Ballynahinch. Practically all are markedly oligotrophic, though not strongly acid. There are stands of natural or semi-natural woodland west of Derryclare and Ballynahinch Loughs, at Kylemore, Letterfrack, and east and north-west of Clifden, and on many lake-islands. There are numerous areas of great floristic interest; special mention may be made of the Roundstone area, the bogland north of Errisbeg, the Slyne Head peninsula, the coast west and south-west of Cleggan, and the neighbourhood of Letterfrack and Kylemore.

Recorded species total 655, of which 36 have not been seen recently. The species known only from this district are *Elatine hexandra*, *Saussurea alpina*, *Erica ciliaris*, *Erica erigena*, *Euphrasia frigida*, *Typha angustifolia*, *Hydrilla verticillata*, *Cryptogramma crispa* and *Asplenium septentrionale*.

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District 8. Joyce's country (north-east Connemara)

Area about 395 sq. km. Greatest height 706 m (2307 ft).

Although its highest point is slightly lower than that of district 7, this district contains far more high ground; it can, in fact, be described as a mountain massif, interrupted only by the Maam valley, and with a narrow fringe of low ground around Loughs Corrib and Mask and to the east of L. Inagh. The Maumturk Mts. and Leckavrea to the south of them consist largely of very bare quartzite, relieved only by a marble band at the Maumeen gap, but the mountains to the north and east are composed mostly of unaltered sediments, and are rather more hospitable to vegetation. The small hill of Lissoughter contains bands of marble and serpentine, but more important floristically is a band of magnesium-rich schist which harbours some alpiners at a remarkably low level. In the east the district includes some small exposures of Carboniferous limestone north of Clonbur and west of Cong; here there are some patches of Burren-like pavement, but not many of the characteristic Burren species are to be found. Elsewhere most of the low ground is covered with level blanket-bog, except for some sandy alluvial flats around the south-west part of L. Mask. The shore-lines on L. Mask and L. Corrib are extensive; elsewhere lakes are less frequent than in the other Connemara districts and have a very restricted flora. The coast is limited to some 7 km of low stony shore, with a little salt-marsh, in the upper part of Killary harbour, and the district therefore lacks a number of common maritime species. There are some woodlands around the shores of L. Corrib, but all have been subject to a fair amount of management; that on the Hill of Doon is the most natural, the others comprising estate woods at Ashford Castle and in some of the properties north-west of Oughterard.

The montane flora is interesting, but very scattered; on the low grounds the richest areas are at Cong and Maam and around the south-west corner of L. Mask.

A total of 577 species have been recorded from the district, of which 31 have not been seen recently. The species known only from this district are *Stellaria palustris*, *Hypericum canadense*, *Vaccinium vitis-idaea*, *Spiranthes romanzoffiana*, *Potamogeton filiformis*, *Carex aquatilis*, and the hybrid *Potamogeton* × *sparganifolius*.

GEOLOGY AND SOILS

In broad outline the geology of the region is simple enough. Connemara is built almost entirely of siliceous palaeozoic rocks (some igneous, some metamorphic, some sedimentary); the Burren proper consists entirely of Carboniferous limestone; and the area south of it, corresponding to our district 1, consists of the shales, together with some sandstones and siltstones, which overlie the Carboniferous limestone and constitute the younger strata of the lower Carboniferous. The boundaries between these areas are for the most part very clear, and the land-forms and vegetation characteristic of each contrast strongly with those of the other two. Although the whole region has been thoroughly glaciated the amount of drift cover now remaining is as low as anywhere in Ireland and does little to obscure the pattern imposed by the underlying rocks.

The rocks of Connemara present endless and complex problems for the student of petrology or of earth-movements, but from the point of view of the botanist or the tourist interested in landscape they may be described in fairly simple terms. It is only in the north-east that we find unaltered sedimentary rocks: sandstones and shales of Ordovician or Silurian age. They cover a fairly small area, but this includes the mountains surrounding L. Fee, L. Nafoeoy and the 'Narrow Lake' (the arm of L. Mask that lies to the west of Ferry Br.). Like most rocks of their age they are hard and slow to weather. On the south they are flanked by a large area of metamorphosed sediments, originally laid down in the Cambrian or pre-Cambrian era, and metamorphosed by earth movements not very long afterwards to form quartzites, interspersed here and there with mica- or hornblende-schists or veins of marble. The marble is mixed in some of its veins with green serpentine to form the 'Connemara marble' of commerce. These metamorphic rocks extend southwards as far as the Oughterard-Clifden road, and in places for a few kilometres beyond it. Most of southern Connemara is, however, composed of a large mass of granite of Devonian age, constituting the whole of our district 5 and the southern part of district 6, and continuing along the coast to beyond Roundstone, with detached fragments up the west coast as far north as the area west of Cleggan. The granite is, however, separated from the metasedimentary rocks by a relatively thin band of gneiss, best developed around Cashel and on the Slyne Head peninsula. This band is interrupted here and there by base-rich plutonic intrusions, which form the upper parts of Errisbeg and Cashel Hill. There are also a few small exposures of Tertiary basalt, contemporary with that which covers most of Co. Antrim; of these the most conspicuous is Bunowen Hill, near Ballyconneely.

This petrological diversity gives rise to a variety of land-forms, the gentle, rolling contours of the southern granite contrasting with the steep quartzite peaks of the Twelve Pins or the Maumturk Mts. But from the point of view of soils and vegetation the whole of Connemara is remarkably uniform. It is only in a few small areas that the base-rich character of the rock modifies the generally calcifuge aspect of the vegetation; Bunowen Hill, the mica-schists of Muckanaght and Bengower, Lissoughter (which has a band of a remarkable magnesium-rich schist) and a few calcareous bluffs at the Maumeen gap are the only examples of any consequence. Here and there on the low ground a vein of marble gives rise to a streak of green grass, interrupting the brown of the blanket-bog, but such land is nearly always farmed and the flora is merely that of neutral grassland. Far more important than the basic rocks in affording

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conditions congenial to calcicole species is the transport inland by wind of calcareous sands from the western beaches. Throughout Connemara the sea-sand has a high content of calcium carbonate, usually from the comminuted shells of molluscs, but sometimes, as at Dog's Bay, from a great abundance of Foraminifera, or, as in the well-known 'coral strands' of Ballyconneely and Carraroe, by the virtual replacement of quartz grains by fragments of the dead calcareous skeletons of red algae (*Lithothamnion* or *Phymatolithon* spp.). We find, accordingly, that the base-demanding *Euphrasia salisburgensis*, though absent from the upper part of Errisbeg, which is composed of an ultrabasic rock, occurs on the lower (granite) slopes, because here the influence of blown sand is significant.

The eastern boundary of the siliceous rocks of Connemara lies, in the northern part of our region, beneath the waters of L. Corrib, but further south it follows very closely the main road from Oughterard to Galway. Here even the tourist quite unversed in geology can hardly fail to notice the contrast between the green pastures, broken here and there by outcrops of white limestone, on the north-eastern side of the road, with the grey granite and purple-brown blanket-bog on the south-west side. This strip of limestone, lying between the road and L. Corrib, is a sort of no-man's-land; geologically it represents a northward extension of the Burren limestones, and harbours a somewhat reduced Burren flora, but topographically it falls within the limits of Connemara. Its transitional nature is further emphasized by the fact that over fair-sized tracts the limestone is overlaid by peat, which bears a flora somewhat intermediate between that of the midland raised bogs and the Connemara blanket-bog; and in places where mounds of calcareous glacial drift break through the peat a fascinating, if confusing, medley of calcicole and calcifuge species can be seen jostling each other.

The boundary between the granite and the limestone meets the sea actually in the city of Galway, and eastwards and southwards from the city the shores of Galway Bay consist of Carboniferous limestone. This is the territory which connects Connemara to the Burren, but belongs to neither. It bears a more continuous drift cover than does either of its neighbours, and on account of this, together with its relatively low rainfall, it bears a flora which is more midland than western in character.

As we drive southwards from Kilcolgan, however, the drift cover thins out, the outcrops of bare limestone on the west side of the road become more frequent, and we soon realize that we have reached the edge of the Burren. The whole of this tract, which extends over about a quarter of Co. Clare (H9) and the north-western corner of south-east Galway (H15) consists of limestones of Lower Carboniferous (Visean) age with almost horizontal bedding. There is, however, a very slight dip towards the south, and eventually, as will be seen later, the limestone beds disappear under the shales and sandstones of slightly later (Namurian) age, while in the south-east the strata have been subjected to some folding, seen most clearly on Mullaghmore. On the whole, however, the picture is of level pavements, for the most part bare of soil and with only a scanty cover of vegetation, interrupted on the sides of the hills by small vertical cliffs, giving a terraced effect. Most of the limestone is very pure and leaves little residue after weathering; here and there some beds contain a little chert, but only the trained eye of the geologist is likely to pick them out. They are, however, of some importance, in that their weathering gives rise to a thin film of mineral soil, and although the building up of peat can take place directly over the limestone, it goes ahead more vigorously if it is insulated by a thin layer of silt or clay.

Most of the Burren is free from drift, but there are substantial patches of it here and there. Being mainly calcareous in composition, it gives rise to good farmland, and it is only when it occurs in very small patches, not worth farming, that its natural



Fig. 4. Limestone pavement in the Burren. (a) Shattered type, with a scanty vegetation consisting mostly of *Prunus spinosa* (blackthorn) and *Rosa pimpinellifolia* (burnet rose). (b) Smooth type, with rounded angles and deep crevices. The shrub in the foreground is holly; in the background near the centre are some shoots of ash.

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vegetation can be seen; it differs only slightly from that of the shallow, peaty soils directly overlying the pavements. Whether the drift cover was much more extensive in the early post-glacial period is not clear, and different views on the question have been expressed. There is no doubt that some of the original drift cover has been washed down the joints in the pavements, but perhaps not on a very large scale.

The Burren falls fairly sharply into two regions, forming our districts 2 and 3. In the east it is low-lying and very flat; in the west it forms a table-land, with summits mostly around 300 m (1000 ft), to some extent dissected by valleys and enclosing a remarkable basin at Carran. This is the type of formation known to geographers as a *polje*: a basin with an entire rim, from which the drainage is entirely underground.

The level pavements of the Burren fall into two sharply contrasted types: the smooth and the shattered. Intermediates exist, but they are rare. The smooth type has very smooth, level surfaces, interrupted here and there by deep crevices which vary in width but are mostly 10–30 cm wide and often a metre or more in depth. There are no sharp angles: everything is rounded off, looking as though it has been licked or sucked. In the shattered type the surface of the pavement is irregular, but it can hardly be seen, so thickly covered is it with detached angular blocks of limestone of very varying size, strewn around apparently at random. Joints are few and shallow, being mostly blocked by rock-fragments. On the whole the smooth type predominates in the west and the shattered in the east, but there are many exceptions to this rule, and in several places extreme examples of both types can be seen within a few hundred metres of each other. There seems to be no generally agreed explanation of this variation, but it is of considerable importance to the flora; for the vegetation of the smooth type of pavement consists partly of shade-loving species in the crevices, and partly of a varied flora developing on peat found in small pockets on the surface, while the shattered pavements have a much more restricted flora, consisting mainly of *Rosa spinosissima*, *Prunus spinosa* and *Teucrium scorodonia*.

The denudation which removed the shales and sandstones originally overlying the limestone would seem to have taken place in the southern and western parts of the Burren in comparatively recent times (geologically speaking), and traces of the capping still exist. These traces consist mainly of clay soils derived from the shales, which are most extensively developed in the central and east-central part of our district 2 (on both sides of a line joining Ballyvaughan to Killinaboy), and account for the relatively continuous cover here of a grassy (and floristically rather poor) vegetation. But in a few places, notably Poulavallan, fragments of sandstone can be found. Apart from these, the only non-calcareous rocks to be seen in the Burren are occasional erratics of Connemara granite on the north shore.

To the south of the Burren limestones lies a band of Carboniferous shales, for the most part covered by a clayey drift, here and there in the form of drumlins. The shales are locally diversified by sandstones, which can be seen outcropping by L. Goller and elsewhere, while the Cliffs of Moher show a long sequence of alternating sandstones and silt-stones.

No extensive treatment of the soils of our region is called for, as its most striking feature is the very large areas of rock which carry no soil at all. This applies not only to the limestone pavements of the Burren, but also to much of the granite of southern Connemara and the quartzite summits of the mountains further north. Even where there is some cover on the rocks it is, over large areas, pure peat – scarcely a soil in the ordinary sense of the word. Where mineral soils exist they are for the most part shallow and immature. In Connemara podsoils prevail; they are to be seen mainly in the coastal belt, and in places on the foothills of the mountains. Elsewhere there is only peat, shallow on the mountains, locally of some depth on the low ground. On

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the lowland limestones by L. Corrib and Galway Bay brown earths are developed, which are for the most part farmed. Further south and west, where the bare limestones begin, the soil, such as it is, is a sort of rendzina, but usually of a very peaty type, with the limestone particles few and mostly in the lower layers. It is only when we reach the Carboniferous shales and their associated drift that mineral soils of any depth become at all widespread, and they are almost exclusively gleys with a remarkable water-retaining power, which leads to the pastures, even on the steep slopes of drumlins, being choked with rushes.

CLIMATE

The climate of the region is, as might be expected, of a markedly Atlantic type, but it is not as extreme, at least in some parts, as is generally supposed.

The most pronounced variation from one area to another is in respect of annual rainfall, the wettest area receiving almost $2\frac{1}{2}$ times as much as the driest, although they are less than 60 km apart. The driest part of the Flora region, and indeed of the whole of the west of Ireland, is the country at the head of Galway Bay. Praeger drew attention to this long ago, and to the fact that this low rainfall, coupled with a porous soil, provides a suitable habitat for several species more characteristic of eastern and central Ireland. The annual rainfall here is only just over 1000 mm, which is about the average for Ireland, and corresponds with that of the Welsh borders or Dorset in Britain. At the other end of the scale we find Maam, with an annual average of almost 2500 mm, and if it is realized that it lies only 18 m above sea-level, this is remarkably high; the precipitation on the surrounding mountains must be very much higher. The wettest parts of Kerry are about as wet, and the wettest parts of the Scottish highlands rather wetter, but otherwise it is hard to match Maam among the lowland stations of the British Isles. It is, however, only the mountain mass of north-east Connemara, in which Maam lies embosomed, that returns these very high figures. The Twelve Pins are wet, but not quite as wet; Ballynahinch, under their shadow, receives 1700 mm and Letterfrack, close to their northern flank, 1600 mm, but at none of the remaining 14 stations in Connemara does the rainfall exceed 1500 mm, and all those on the coast (except Roundstone with 1380) receive less than 1300.

In the eastern Burren, the rainfall is scarcely higher than at the head of Galway Bay, and on the west coast and in the Aran Islands it is only 1150–1200 mm. On and around the hills of the western Burren, however, it is a good deal higher; Corofin receives 1240 mm, Kilfenora 1330 mm and Ballyvaughan 1525 mm. The effect of height may be seen from the fact that at the top of the Corkscrew Hill, only 6 km distant from Ballyvaughan but 190 m higher, the rainfall is as high as 1729 mm.

To the vegetation the figures for absolute rainfall are probably less important than those for the frequency of rain and its distribution through the year. The number of rain-days in the year shows a regional variation parallel to that for total rainfall, but the contrast is less marked: the driest stations have about 170 rain-days in the year as against some 240 days for the wettest (high-level stations excepted). Absolute droughts, with three weeks or so without rain, occur, but they are very rare, and are more frequent in spring, when the temperatures are low and the skies often clouded, than during a summer anticyclone. Moreover, although there is everywhere a well-marked annual cycle with a rainfall minimum in April and May and a maximum in December, the 'dry season' is only moderately dry. In Connemara and the Burren alike, 12 % of the year's rain falls in April and May as against 23 % in December and January, and even in the driest month rain falls on an average on at least ten days.

It is this frequent, though not always very heavy rain that characterizes the climate of western Ireland, and with it, of course, goes a high average level of humidity of the air. This too is of great importance to plants, but it must be realized that its beneficial effects are experienced only in sheltered positions, because in exposed situations they are nullified by the influence of the wind. Ireland is a windy country, and the west coast is its windiest part; Praeger has described the winter climate in the west as a series of westerly gales, with westerly winds in between. No exact

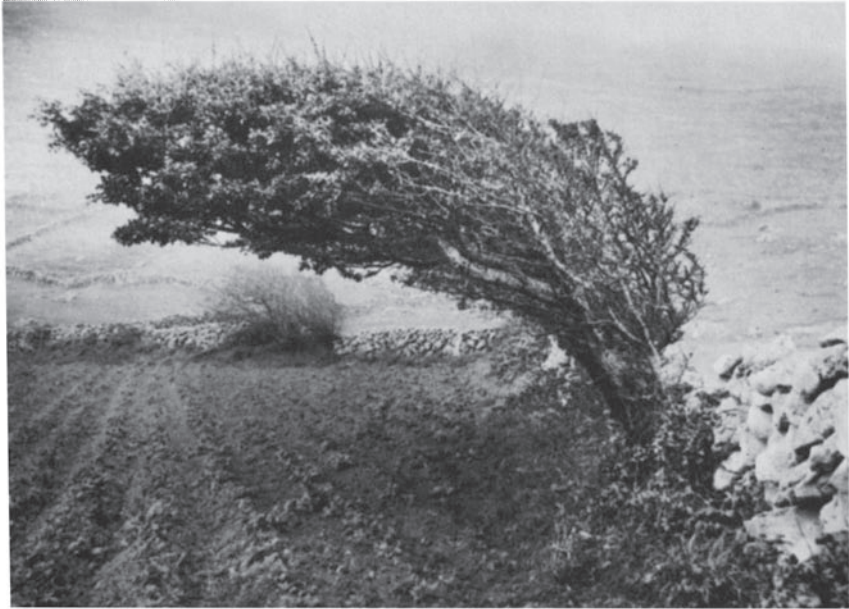


Fig. 5. Wind-shorn hawthorn at Gleninagh, near Black Head.

measurements are available for the Flora region, but conditions at Belmullet, in N.W. Mayo, are probably only slightly more severe than on the coasts of Clare and W. Connemara. At Belmullet, moderate to fresh winds (4 to 6 on the Beaufort scale) blow for 57 % of the year and gales for 6 %, leaving only 37 % for light winds or calm. At Shannon airport, to which the more sheltered parts of the Flora region approximate, the corresponding figures are 42 %, 3 % and 55 %. In the Flora region the average wind speed throughout the year varies from about 24 km per hour in the more exposed parts to 18 in the more sheltered. Even with very humid air, winds of this frequency and intensity have strong evaporating power, and we find, therefore, that the figures for potential evapotranspiration are in winter as high in the Burren and much of Connemara as anywhere in Ireland; in summer they are lower than on the south and south-east coasts, but distinctly higher than in the north-west midlands. These figures, of course, refer to more or less unsheltered stations; in the lee of a hill or even a boulder, in a hazel-copse, or in a crevice in the limestone pavement the evaporation rate will be very much less, and in these conditions woodland plants can thrive without the shelter of actual woodland. Even in more exposed positions it is probable that frequent cloud cover and frequent wetting by rain help to counteract the effects of wind.

The duration of sunshine is fairly low, the Burren receiving an average of about 3.7 hours a day and Connemara rather less (about 3.4 hours). These figures refer to lowland stations; on the mountain-tops, which are often clouded even on fine days, the figures are very much lower.

Temperatures are very equable, both the annual and diurnal variation being remarkably small. The mean temperature of the air throughout the year is just under 10 °C for most of the region – higher than in all parts of the British Isles except the

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southernmost fifth of Ireland, west and south Wales, and England south of the latitude of Cambridge. There is, however, only a very small difference between the coldest and the warmest month; the mean temperature for January and February is about 6 °C, that for July just under 15 °C. If we trace the January isotherm from the Burren coast we find that it cuts across southern Ireland and Devon and thence to south-west France and central Italy; Rome is no warmer in the winter than is Galway. The July isotherm, on the other hand, runs from Connemara obliquely across the Irish midlands to Co. Down, and thence along the Scottish borders to central Fennoscandia, so that Galway is no warmer in summer than subarctic Finland. There is, in fact, very little difference in temperature between a calm, sunny March day in Connemara and a wet and windy one in August.

Frost is by no means unknown, but it is seldom severe, the mean annual minimum being around -5 °C. What is perhaps more important to the vegetation is that it seldom lasts long. There are, however, three or four times in a century bouts of prolonged and severe frost, as in 1963, and these must to some extent limit the number of species of southern affinities that can establish themselves permanently in the region. Snow is of little importance; it falls only on a few days in the year and seldom lies on low ground for more than a day. And even the mountains are seldom snow-capped for more than two or three weeks throughout the winter.

To sum up then, the climate is fairly uniform throughout the region except in respect of rainfall. It is characterized by mild winters and cool summers, frequent and often strong winds, small incidence of frost or snow, and rainfall well distributed through the year, though with a distinct minimum in late spring. In the mountains of central and north-east Connemara the rainfall is very heavy; elsewhere it is, by the standards of the Atlantic coast, fairly moderate.

CHARACTER OF THE FLORA

The contrast between Connemara and the Burren is so sharp that what is true of one is seldom true of the other, and it is difficult, therefore, to make generalizations valid for the whole region. Admittedly the number of species common to the two is larger than one might conclude at first glance, for, apart from the fairly large number of tolerant species which are equally at home on calcareous and acid soils, a surprisingly large number of the Burren calcicoles crop up on the machair-like pastures of western Connemara, while several species characteristic of the Connemara blanket-bog hang on precariously in the fragments of raised bog which survive in the south-eastern part of the Burren. Nevertheless, the contrast between the two areas is undeniable. A second obstacle to generalizations about the region (which is to some extent a resultant of the first) is that its total flora is so rich as to constitute about three-quarters of the flora of Ireland, while if we exclude naturalized aliens and confine our attention to native species we find that out of 900 species for the whole island no fewer than 738 (82 %) are found in the region of this Flora. Generalizations must, therefore, start with a consideration of the species native to Ireland which are *not* to be found in Connemara or the Burren.

Of the 162 missing species, 73 may be reckoned as very rare in Ireland and 57 as rare, the criteria adopted being less than 6 and less than 25 dots respectively in the *Atlas of the Botanical Society of the British Isles*. The absence from the Flora region of these species demands no special explanation. Of the remaining 32 we find that almost half are confined to the south or the east of the country or to both. The most widespread of these is *Lepidium heterophyllum* (the only Irish native absent from Connemara and the Burren that can be considered common). Here also, though in less abundance, come *Luzula pilosa*, *Linaria vulgaris*, *Ononis repens*, *Linum bienne*, *Vulpia myuros*, *Echium vulgare* and *Scilla verna*. Essentially midland species which stop short of Galway include *Glyceria maxima*, *Cicuta virosa* and *Andromeda polifolia*. Five species, including *Prunus padus* and *Salix pentandra* (the latter freely planted in our region but not native there), are northern in their distribution. Finally, mention must be made of three species which one might reasonably expect to find in the region but do not occur there: *Cicendia filiformis*, *Euphorbia hyberna* and *Sisyrinchium bermudiana*. The first, centred on the south-west, is said to have an outlying station in Mayo, but it skips Connemara. The *Euphorbia*, centred also on the south-west, has also a few outlying stations further north, but although one is not far from the Burren and another close to Connemara they do not actually hit the target. *Sisyrinchium bermudiana*, which is almost entirely western, and which ranges from Kerry to Donegal, for some reason avoids our region altogether.

One interesting feature in the list of these absentees is the predominance of coastal (though not always strictly maritime) species, and the great scarcity of woodland species, only *Luzula pilosa*, *Euphorbia hyberna* and *Prunus padus* being assignable to this last category. This suggests that the destruction of woodland on which some authors lay so much stress, though it doubtless diminished the abundance of many species, led to the extinction of few or none. As regards the coastal species, among which we may number *Echium vulgare*, *Cynoglossum officinale*, *Myosotis ramosissima* and *Scilla verna*, it seems probable that they belong mostly to the last wave of immigrants from Britain and that they never got further than the eastern half of Ireland. The case of *Atriplex laciniata*, however, shows that some of these plants may still be on the move (see p. 176).

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Turning now from the consideration of absentees to a discussion of the more striking ingredients of the Burren and Connemara floras, we may note that there are eight species which are found nowhere else in Ireland. *Asplenium septentrionale*, *Erica ciliaris* and *Hydrilla verticillata* have their solitary and very restricted stations in Connemara, and *Deschampsia setacea*, though more widespread, does not transgress its limits. *Helianthemum canum* and *Limonium transwallianum* are confined to the Burren and Aran, *Astragalus danicus* to Aran alone, while *Ajuga pyramidalis* is found in the Burren, Connemara and Aran, but nowhere else. More important, however, than these highly localized rarities are the 28 species which, though sparingly represented elsewhere in Ireland, have their headquarters in Connemara or the Burren. It is these species which give to the region its botanical fame, and it is to Connemara or the Burren that any botanist must go if he wishes to make an intensive study of these species. Apart from the eight confined to our region, which have been listed above, the species of which it may fairly be said that the number of individuals in Connemara and the Burren greatly outnumbers those in the rest of Ireland (and, in the case of species marked with an asterisk, in the rest of the British Isles) comprise the following:

In the Burren (including Aran)

* <i>Adiantum capillus-veneris</i>	<i>Minuartia verna</i>
<i>Asperula cynanchica</i>	* <i>Neotinea maculata</i>
<i>Cerastium arvense</i>	* <i>Orobanche alba</i>
<i>Cystopteris fragilis</i>	<i>Polystichum aculeatum</i>
* <i>Dryas octopetala</i>	* <i>Potentilla fruticosa</i>
<i>Epipactis atrorubens</i>	<i>Rubia peregrina</i>
* <i>Euphrasia salisburgensis</i>	<i>Rubus saxatilis</i>
<i>Galium sternerii</i>	<i>Saxifraga hypnoides</i>
* <i>Gentiana verna</i>	<i>Sesleria albicans</i>
<i>Geranium sanguineum</i>	* <i>Viola persicifolia</i>
<i>Limosella aquatica</i>	

In Connemara

* <i>Daboecia cantabrica</i>	<i>Eriophorum gracile</i>
* <i>Erica mackaiana</i>	* <i>Hypericum canadense</i>
* <i>Eriocaulon aquaticum</i>	<i>Lepidotis inundata</i>

*In Connemara and the Burren**Allium babingtonii*

If we add to the eight species confined to the region the 28 which are exceptionally abundant there, and attempt a classification of them according to their total geographical range, the result is rather surprising. Of the Connemara species six are, predictably enough, strongly Atlantic in their European range (two of them, however, having their main centre in North America), and this is true also of *Allium babingtonii*. There are four, however, which show very different geographical affinities: *Asplenium septentrionale* and *Lepidotis* extend throughout the North Temperate zone, *Eriophorum gracile* is widespread in north and central Europe, and *Hydrilla verticillata* is subcosmopolitan, though the variety found in Connemara is known only from north Europe.



Fig. 6. *Dryas octopetala* (mountain avens) and *Neotinea maculata* (Irish orchid) growing together near Black Head. Nowhere else in the world can these two species be seen growing side by side.

Among the Burren specialities the diversity is greater still. It is often said that the peculiarity of the Burren flora consists in the juxtaposition of Mediterranean with arctic–alpine species. But *Dryas* is the only real arctic–alpine (*Ajuga pyramidalis* can perhaps be considered as boreal–montane, and *Gentiana* as a modified alpine), and *Neotinea* is the only species whose distribution is centred on the Mediterranean. *Adiantum* and *Rubia* are Mediterranean–Atlantic, while *Galium sternerii*, *Limonium transwallianum*, *Saxifraga hypnoides* and *Sesleria albicans* can be reckoned as Atlantic or subatlantic. There remain, however, fifteen species which are distributed throughout the greater part of Europe, in many cases extending to temperate Asia or North America. Why they should flourish so much more exuberantly in the Burren than elsewhere in Ireland is not at all clear. We must confess that a general explanation of the Burren flora is still to seek.

Note added in press

Glyceria maxima (pp. xxviii) grows in some quantity by the Dawros R., west of Tullywee Br. It seems to have been introduced some thirty years ago and to have increased greatly since then.

Glaucium flavum and *Trisetum flavescens* (pp. 13, 247) were seen in 1982 in their old stations on Inishmaan.