DEPARTMENT OF AGRICULTURE AND FISHERIES
FOR SCOTLAND

Memoirs of the Soil Survey of Great Britain

SCOTLAND

The soils of Carrick and the country round Girvan

(*Sheets 7 and 8*)

by C. J. BOWN, BSC

WITH AN ACCOUNT OF THE VEGETATION

by E. L. BIRSE, BSC and J. S. ROBERTSON, BSC

THE MACAULAY INSTITUTE FOR SOIL RESEARCH

EDINBURGH
HER MAJESTY'S STATIONERY OFFICE/1973

Preface

This publication is the seventh memoir of the Soil Survey of Scotland. The soils of the country round Girvan and Carrick were surveyed during the years 1958 to 1964. Work was commenced in 1958 by Dr W. Graham Jardine, now Department of Geology, The University of Glasgow, assisted by Mr A. D. Walker and was continued in 1959 by Mr C. J. Bown. On the resignation of Dr Jardine in 1960, Mr Bown took charge of the mapping assisted by Mr G. R. Dix. Mr J. S. Bibby helped with the survey in 1961, Mr D. W. Futty in 1962 and Mr R. E. F. Heslop thereafter. Field work was completed in 1964 and the survey of adjacent sheets 3 (Stranraer) and 4 (Wigtown) was commenced. Mr J. W. Muir and Mr R. Grant assisted in soil correlation and classification. The maps and diagrams were prepared by Mr W. S. Shirreffs assisted by Mr A. D. Moir of the Soil Survey Cartographic Section. The Survey is indebted to other departments and members of staff of the Macaulay Institute for Soil Research who have compiled data and contributed to the memoir in various ways: Dr H. G. M. Hardie and staff of the Soil Analysis Section of the Department of Pedology who did the chemical analysis with the exception of exchangeable cations which were carried out by Dr R. L. Mitchell and staff of the Department of Spectrochemistry: Dr Hardie checked the chapter on analytical data and Appendices II and III: Dr R. L. Mitchell wrote the section on trace elements: Mr B. D. Mitchell and Mr W. A. Mitchell of the Department of Pedology wrote the section on clay and fine sand fractions based on the differential thermal, X-ray and microscopical examinations: Mr R. A. Robertson and Mr P. Jowsey surveyed the peat and contributed the account and diagrams dealing with it.

Thanks are due to the farmers and land-owners without whose co-operation the soil survey could not have been made.

Fair copies of the field maps at the scale of 2½ inches to 1 mile are kept at headquarters of the Soil Survey where they may be inspected by appointment. Copies of the one-inch coloured soil map and previously published soil maps are obtainable from Ordnance Survey agents. Up-to-date 7th Series topography is used on the 1 inch soil maps, but on the 3rd Edition projection.

ROBERT GLENTWORTH

Head of the Soil Survey of Scotland

The Macaulay Institute for Soil Research
Craigiebuckler
Aberdeen
December 1968

Acknowledgements

Acknowledgement is made to Dr R. Laird, West of Scotland Agricultural College, who wrote the chapter on agriculture and to Mr J. D. Whitaker, Forestry Commission, Scotland, who wrote the chapter on forestry. The material for the chapter on climate was provided by the Meteorological Office, Edinburgh and thanks are due to Mr F. H. Dight of that office for his assistance in preparing the text. Thanks are also due to Dr G. H. Mitchell, formerly Assistant Director of the Geological Survey, Edinburgh, and staff of the Geological Survey for helpful comments on the chapter on geology. Acknowledgement is also made to Mr C. J. Lawrence of the Soil Science Laboratory, Oxford University, who drew the diagrams illustrating relief, and to the Royal Air Force for permission to publish certain air photographs.

Contents

LIST OF COLOUR PLATES

LIST OF PLATES

LIST OF FIGURES

LIST OF TABLES *(TEXT)*

APPENDICES

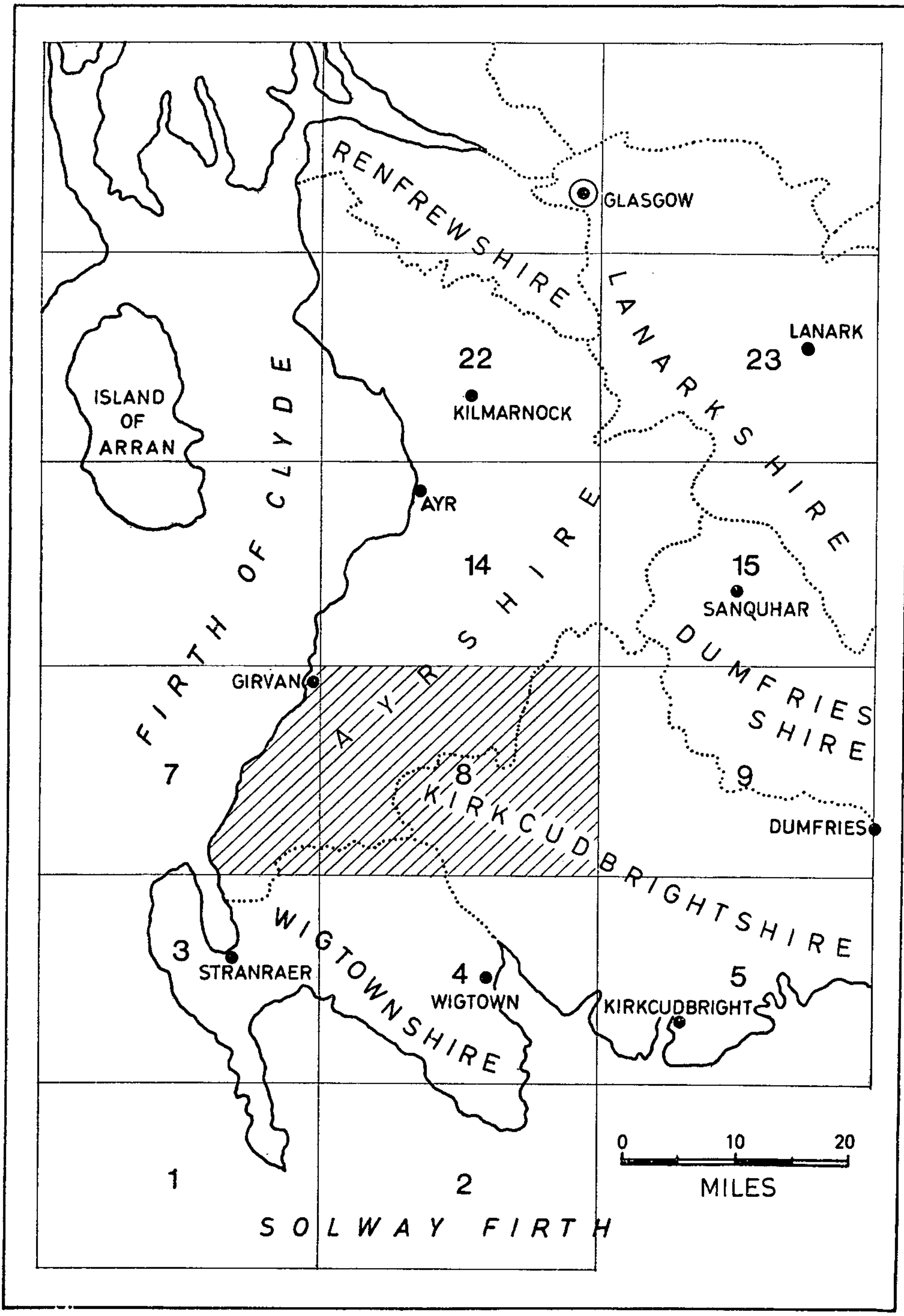


FIG. 1 Location of Area

1 General description of the area

LOCATION AND EXTENT

This memoir describes the soils covering approximately 534 square miles in south-west Scotland, an area comprising parts of south Ayrshire, Wigtownshire and Kirkcudbrightshire. The survey represents a continuation of the work started in north Ayrshire (Mitchell and Jarvis, 1956) and central Ayrshire (Grant, in preparation), and many of the soils mapped have already been described in these areas to the north; others are described for the first time. Some highly fertile arable and dairy farms occur in the north-west around Girvan and along the coast near Ballantrae, but much of the remaining country comprises mountains and moorlands, some forming part of the Glentrool National Forest Park. The remains of a considerable number of prehistoric chambered cairns occur throughout the area, which is famous historically for its association with Robert the Bruce and the Covenanters both of whom found shelter here in times of adversity.

Sheep farming was the major human activity until recently, when the Forestry Commission began afforestation in a number of districts. Girvan, a town of some 6000 people situated in the north-west of the area, is the only centre of population ranking as a burgh, and its main activities, apart from catering for summer tourists, are fishing, a woollen mill, and an alginate factory which utilizes the seaweed swept up on to the coast, mainly in north-west Scotland. However, a new industrial estate in course of establishment offers the hope of expanding employment, and a whisky distillery is already in operation. The villages, which constitute the only other population groupings in the area, are generally situated along water courses and are often picturesque, like the village of Barr in the valley of the Stinchar.

PHYSICAL FEATURES

Major Structural Divisions

The area, which lies at the western extremity of the Southern Uplands of Scotland, is a hill region formed mainly of Ordovician and Silurian sediments. The boundary fault which divides this region from the Scottish Central Lowlands crosses the area almost diagonally from Glen App to Genoch Hill. To the north of this fault, as far as the Girvan Water, rocks of varying lithology underlie an area of low hills. South of the fault the expanse of greywacke sediments is interrupted only by the three granitic masses of Loch Doon, Cairnsmore of Fleet, and Cairnsmore of Carsphairn, intruded during Old Red Sandstone times.

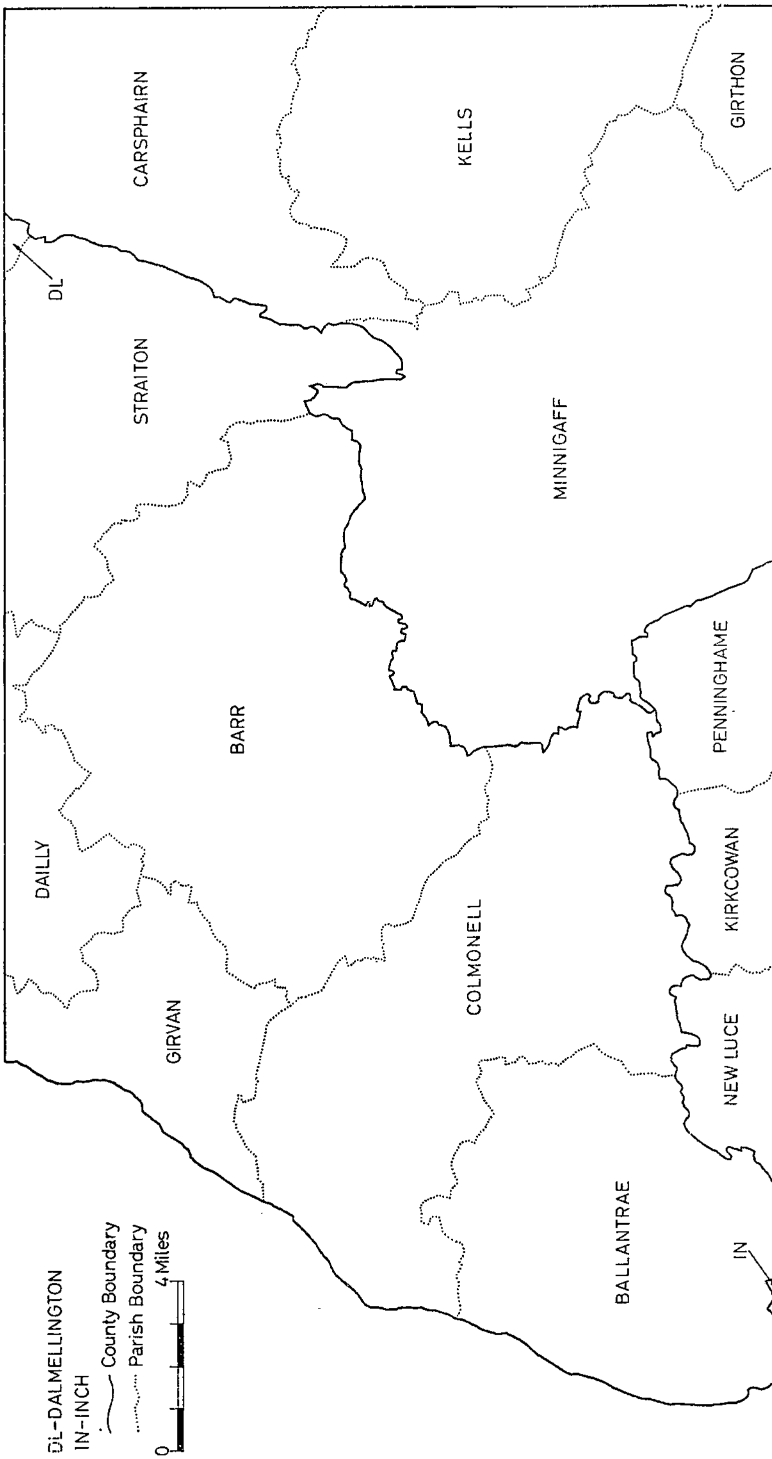


FIG. 2 **Civil Parishes**

The main structural divisions which can be distinguished in the area are therefore:

a. Southern Uplands Foot-hills, north of the Southern Uplands Fault.

b. Southern Uplands, south of the Southern Uplands Fault.

River Systems

The evolution of the Galloway drainage pattern has been discussed recently by Jardine (1959) who has traced in some detail the complex series of stream captures and diversions by which the present water course system evolved.

The rivers flow in two main directions, south-west along the strike of the rocks into the Firth of Clyde and south-east across the strike into the Solway Firth. The south-west flowing rivers are comparatively young streams which have rapidly exploited belts of weakness in the rock strata, cutting deep narrow valleys. The River Stinchar flowing into the sea at Ballantrae is the major stream in this group, while the relatively small App Water working in the shatter belt of the Southern Uplands Fault has excavated the impressive gorge of Glen App.

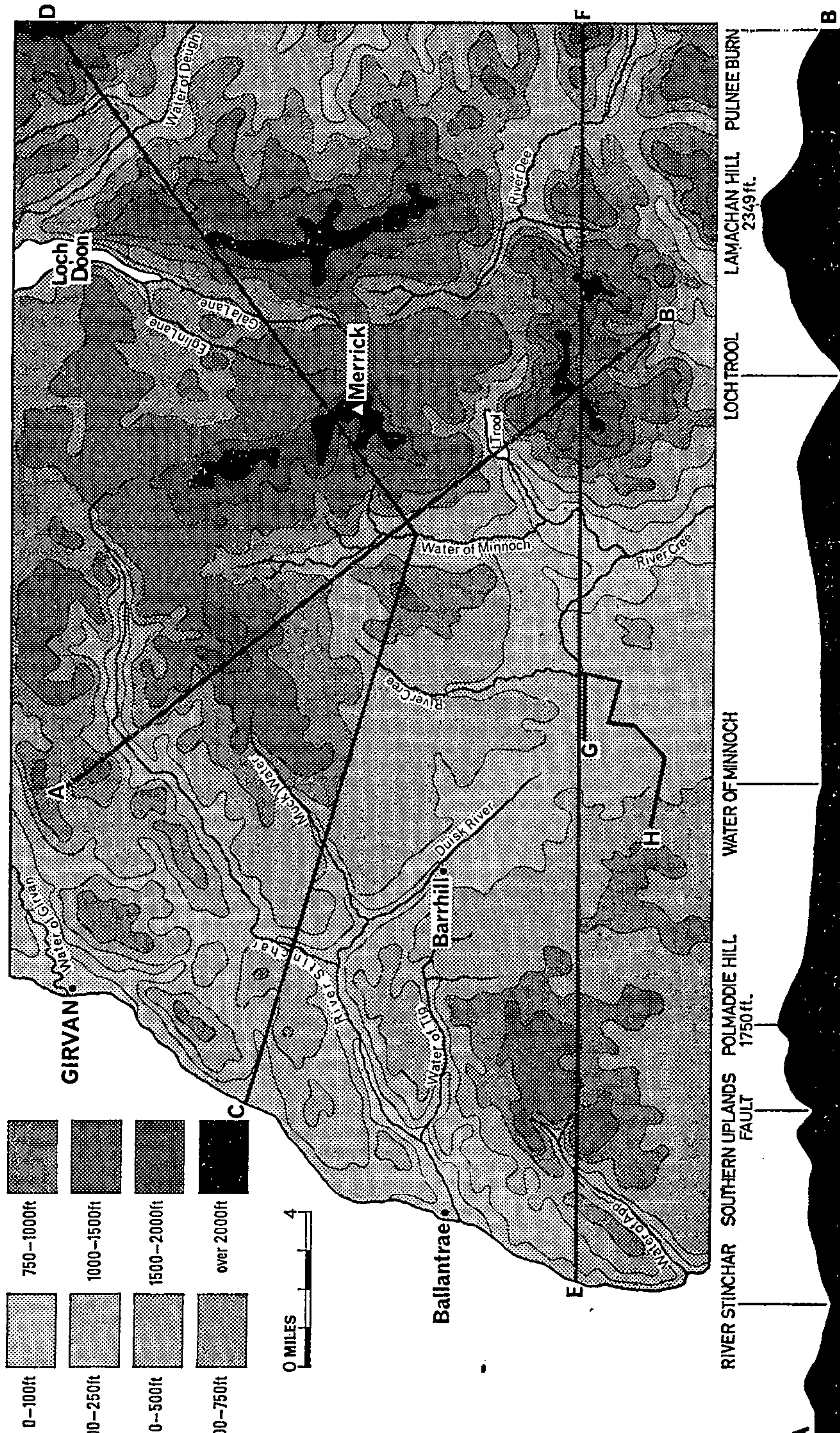
The second group of streams, flowing across the grain of the country, have been less successful in reducing the level of their beds and now flow in broad valleys and basins. Most important are the Luce Water, the River Bladnoch, the River Cree and its tributary the Minnoch Water, and the River Dee. Only the headwaters of these rivers are located in the area, their lower reaches flowing through Wigtownshire and southern Kirkcudbrightshire before entering the sea.

Two important rivers of central Ayrshire also have their source in this area, both rising on the Loch Doon granite outcrop. The River Doon from its source in Loch Enoch, and the Girvan Water from Loch Girvan Eye, both flow north into the Central Ayrshire Basin before turning westwards to enter the Firth of Clyde at Doonfoot and Girvan respectively.

Landform Regions

Several different types of landforms are associated with the major structural divisions detailed above.

Topography is a major influence on the type of soil occurring on a particular site, especially in areas of highly expressed relief. In delimiting the landform regions which comprise the major structural divisions an attempt has been made to establish areas, each characterized by its own typical assemblage of sites, where particular patterns of soils may be expected to occur. These patterns of sites, which are formed of the flats and slopes of various degrees making up the constituent elements of the topography, are in turn related to the lithology of the underlying rock strata and to the geomorphic history of the area. Jardine (1959) quotes the theory of Hollingsworth (1938), which has been supported by George (1956), that the Southern Uplands represent the remnants 'of a number of benches etched during pulsatory uplift—probably eustatic—in the Pliocene period'. He defines five separate erosion platforms between sea level and 1100 feet, and notes remnants of others at higher levels.


0–100ft
100–250ft
250–500ft
500–750ft
750–1000ft
1000–1500ft
1500–2000ft
over 2000ft
0 MILES 4
GIRVAN
Ballantrae
Barrhill
Merrick
Loch Doon
Trool
Water of Girvan
Water of Deugh
Gala Lane
Eglin Lane
River Dee
Water of Minnoch
River Cree
Muck Water
River Stinchar
Duisk River
Water of Tig
Water of App
A
B
C
D
E
F
G
H
RIVER STINCHAR
SOUTHERN UPLANDS FAULT
POLMADDIE HILL 1750ft.
WATER OF MINNOCH
LOCH TROOL
LAMACHAN HILL 2349ft.
PULNEE BURN

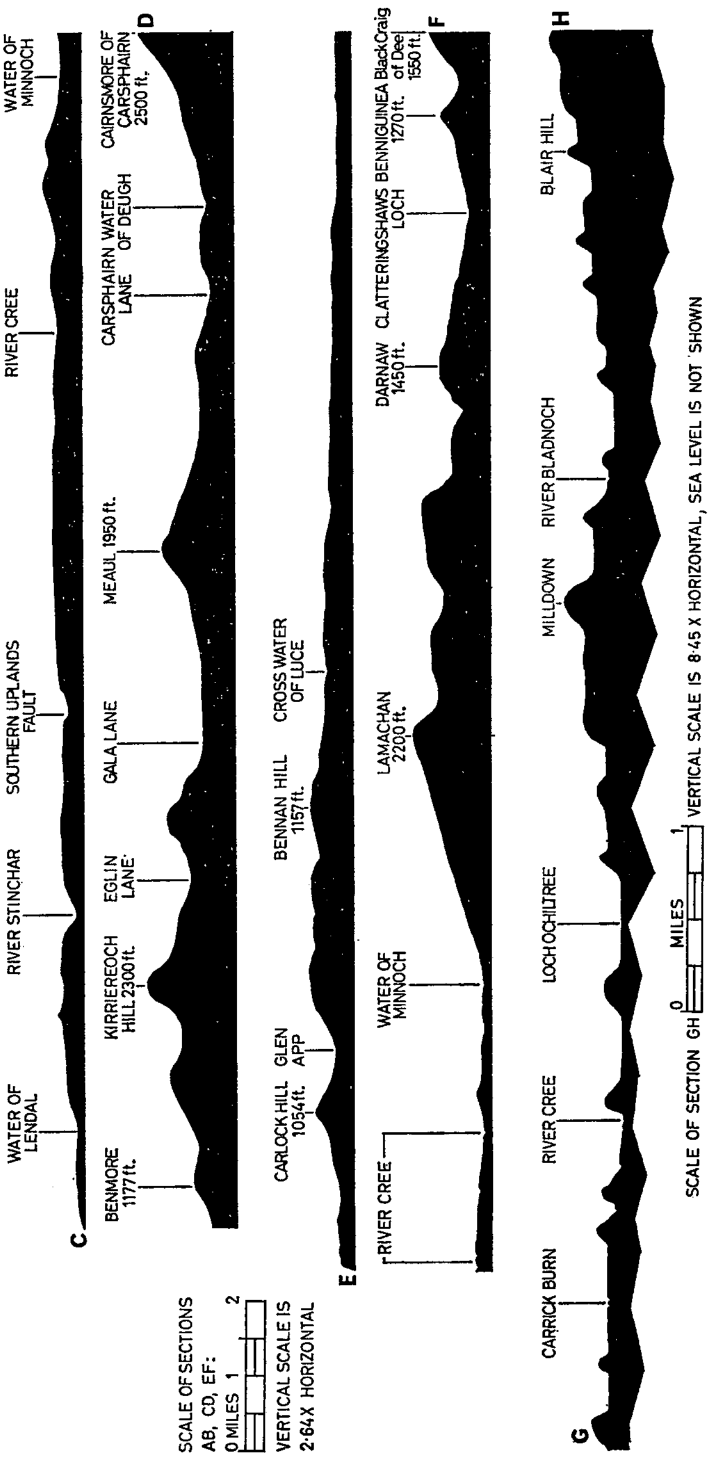


FIG. 3 Physical Map

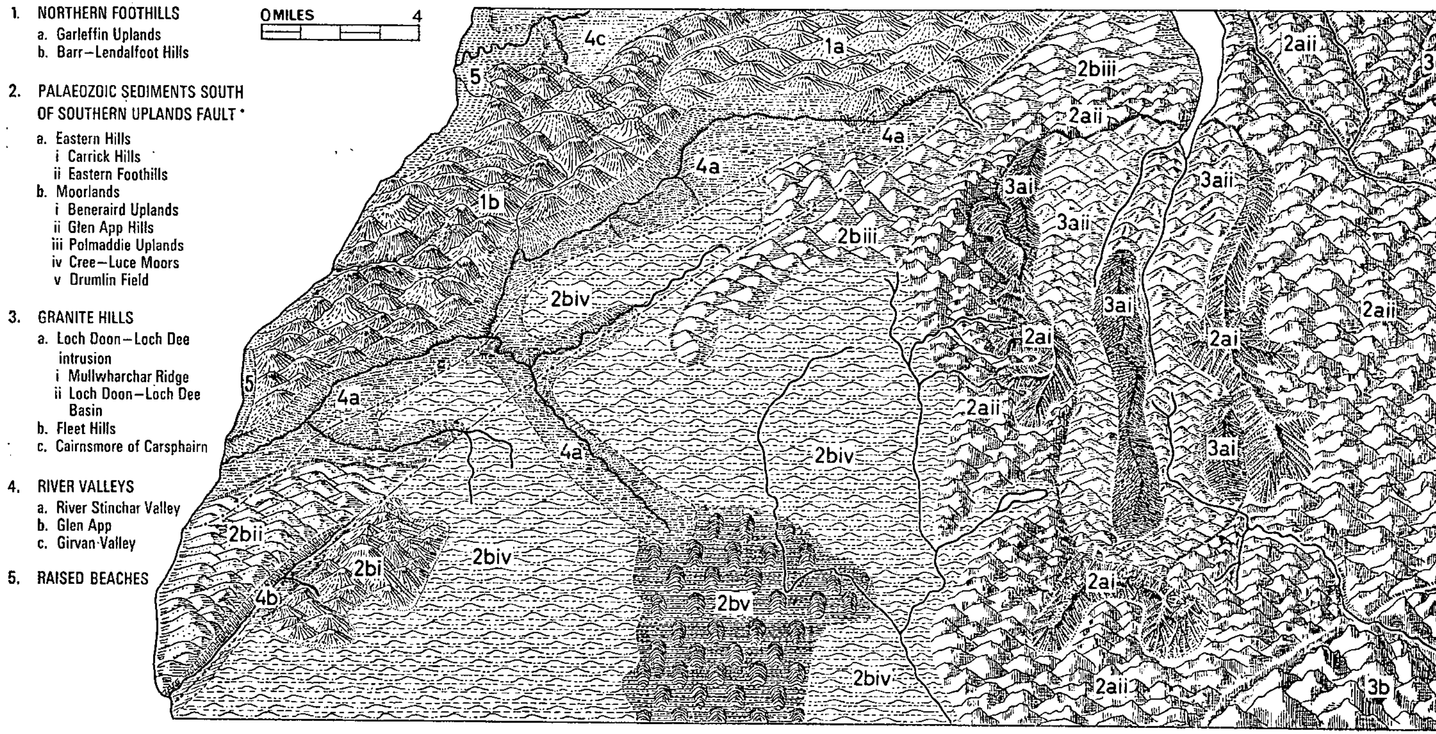


FIG. 4 Landform Regions

Figure 4 presents the structural units and landform regions which have been delineated and a brief description is given below.

1 AREA NORTH OF THE SOUTHERN UPLANDS FAULT

This is a belt of country running from Ballantrae to Tairlaw Ring and Knockdon underlain by a variety of rock types, chiefly Palaeozoic sediments of Ordovician, Silurian, Old Red Sandstone and Carboniferous age, together with their associated lava flows, and igneous intrusions. The region rises from sea level at the Girvan-Ballantrae coast to 1408 feet at Garleffin Fell.

Two sub-regions have been recognized:

(*a*) *Garleffin Uplands*

This sub-region is the plateau-like area, lying generally between 1000 feet and 1300 feet, overlooked by the felsite ridge of Garleffin Fell. The slopes are generally gentle to moderate, with a shallow but steep scarp at the boundary between the horizontally bedded Old Red Sandstone conglomerate and the steeply bedded Benan conglomerate. Along the River Stinchar the ground falls steeply from 1100 to 500 feet.

(*b*) *Barr–Lendalfoot Hills*

This is an area where the frequent hills occur in an irregular pattern. The general altitude is below 1000 feet and falls towards the coast. Steep slopes are common, and there are very few areas of level ground, but small areas of more gentle inclination do occur, especially near the coast where they are generally covered by till.

2 AREA OF PALEOZOIC SEDIMENTS SOUTH OF THE SOUTHERN UPLANDS FAULT

This area is divided by the Minnoch Water into two natural regions termed, for descriptive purposes, the Carrick Hills and the Moorlands. The former comprise the Merrick, Kells and Lamachan Mountains and their foothills; the latter is an undulating moorland from which rise a number of hills.

(*a*) *Carrick Hills*

i *Merrick, Kells and Lamachan Mountains* These are three separate areas which rise above 2000 feet and are composed of hardened greywacke rocks, metamorphosed during the intrusion of the Loch Doon granite. The Merrick and Kells Hills are two north–south lying ridges that have been strongly dissected, on their western and eastern faces respectively, by water and glacier action, the latter having eroded a number of cirque features such as that on the north-east of Merrick Hill and on Carlin's Cairn. The hill tops are often moderately sloping ridges or domes surrounded by crags or scree slopes which descend steeply into the narrow valleys. The Lamachan and Curleywee Hills are a relatively smaller mass, with steep craggy slopes.

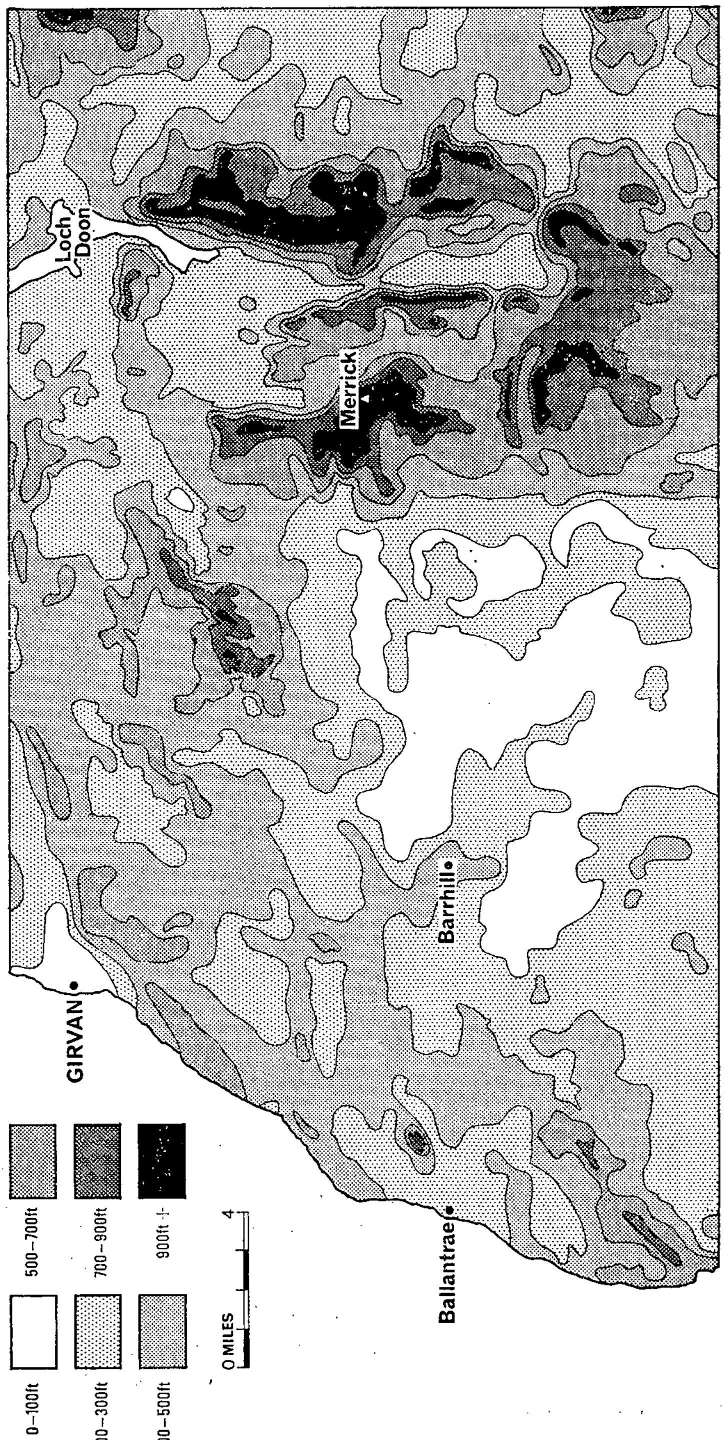


FIG. 5 Slope Analysis—Vertical Intervals per Grid Kilometre Square

ii *Eastern Foot-hills* These comprise the hill areas surrounding the mountains described above. The hills are much dissected by the streams flowing out from the mountains against which they abut. Glacial erosion appears to have been severe, bare rock surfaces are frequent, and the rugged and craggy outlines of the hills are unsoftened by the thin cover of drift present.

Slopes are generally moderately steep, but where crags are frequent have an intense micro-relief superimposed on them. This micro-relief and the different forms it takes has an important bearing on soil pattern, as will be apparent from later discussion.

(*b*) *The Moorlands*

Three upland areas of modest elevation have been distinguished in this region: the Beneraird Uplands and the Glen App Hills in the west, and the Polmaddie Uplands in the central area. In addition the drumlin field in the southern part of the region has been delineated from the moorland area further north.

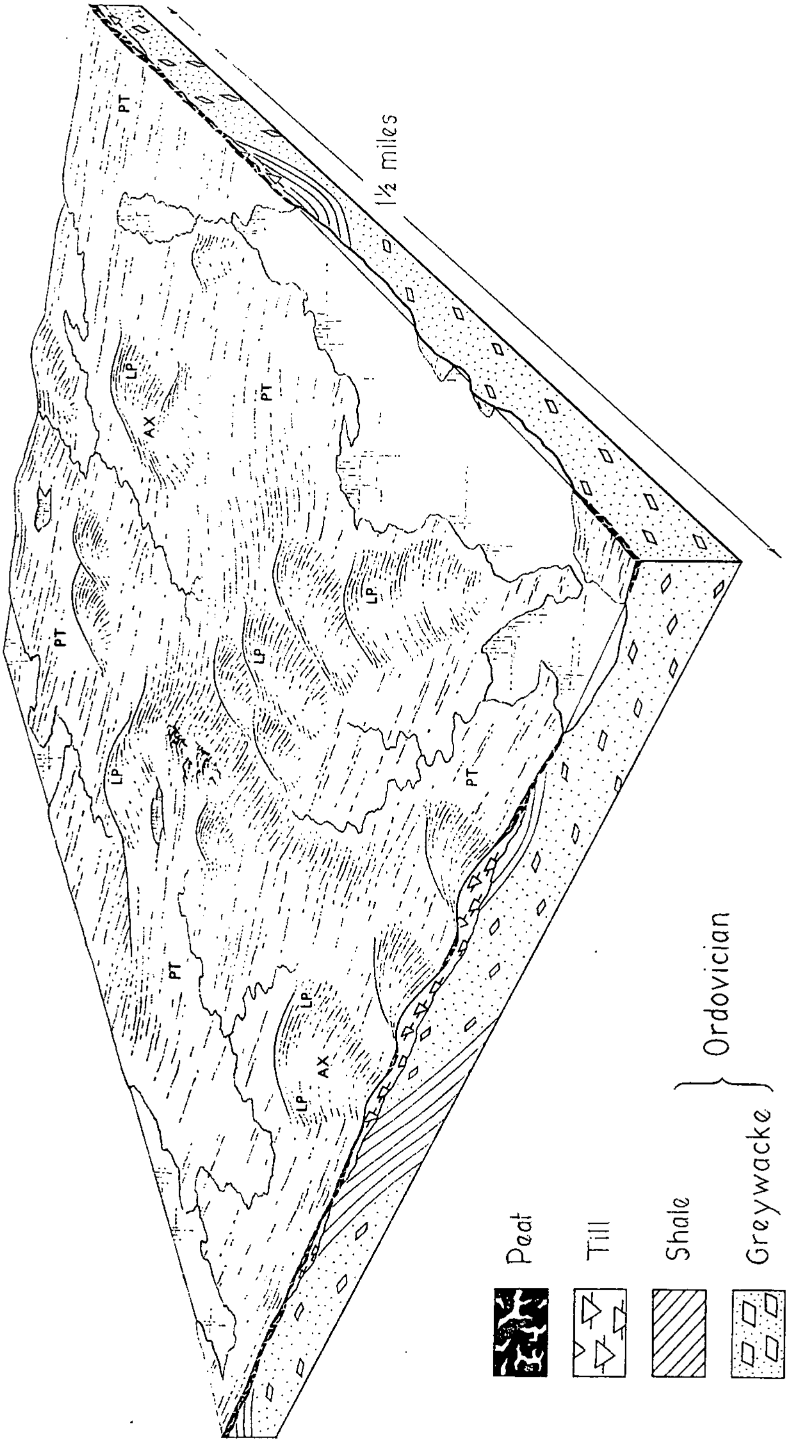
i *Beneraird Uplands* An upland area lying between 1000 feet and 1400 feet in which the long smooth hill slopes are moderate or gentle, except to the north-west where the head-waters of the Water of App are vigorously eroding along the Southern Uplands Fault.

ii *Glen App Hills* The line of hills from Sandloch Hill north-east to Balrazzie Fell rises steeply from 100 feet in Glen App to about 1000 feet along the hill crests. To the north the ground falls steeply to about 500 feet and then by more gentle slopes to the River Stinchar.

iii *Polmaddie Uplands* These run north-eastwards from Pindonnan Hill to Loch Finlas. Craigenreoch at 1854 feet is the highest point, and from this the general level falls to about 1000 feet in the north-east and south-west. The slopes around the central mass of Craigenreoch are steep or very steep, particularly along the Southern Uplands Fault, but away from this central area they become moderate to gentle.

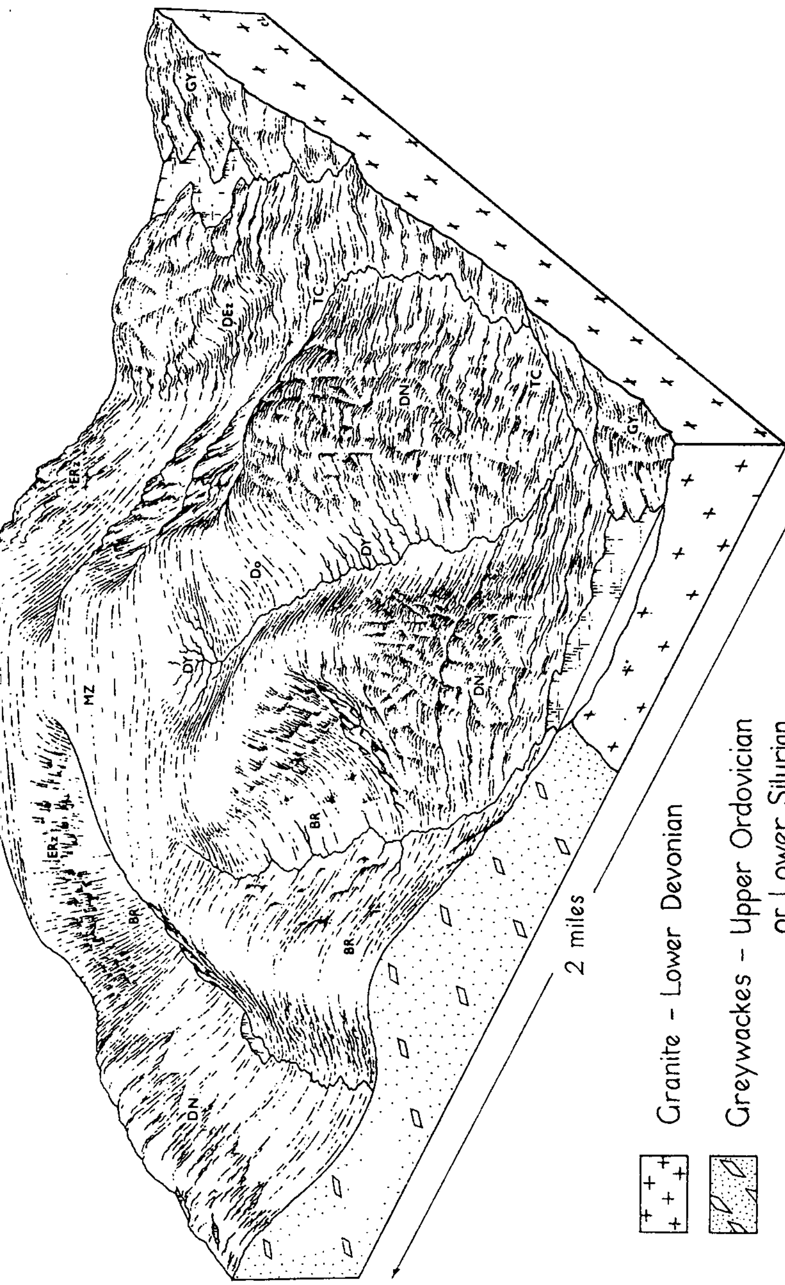
iv *Cree–Luce Moors* This is an area of rolling moorland occupying the greater part of the country west and south-west of the Minnoch Water. The general altitude varies between 400 feet and 800 feet and the relief is generally low and rolling, but is broken by a number of hills of about 1000 feet, notably Garwall Hill, Glencaird Hill, and Knapps Hill in the east, and Craigairie Fell in the west. Between the Merrick Hills and the Duisk Valley, deposits of coarse-textured glacial moraine have given rise to a moundy relief. This, like the craggy micro-relief previously noted, has an important bearing on the soil pattern.

v *Drumlin Field* Glacial debris deposited in elongated mounds up to 75 feet high makes the major contribution to relief in the relatively low lying area between Corwar House and Knowe. Although the deposits occasionally occur crowded together, so that several make up a composite hillock, more generally they form isolated mounds with flat areas between them. This pattern is typically developed about Loch Ochiltree.



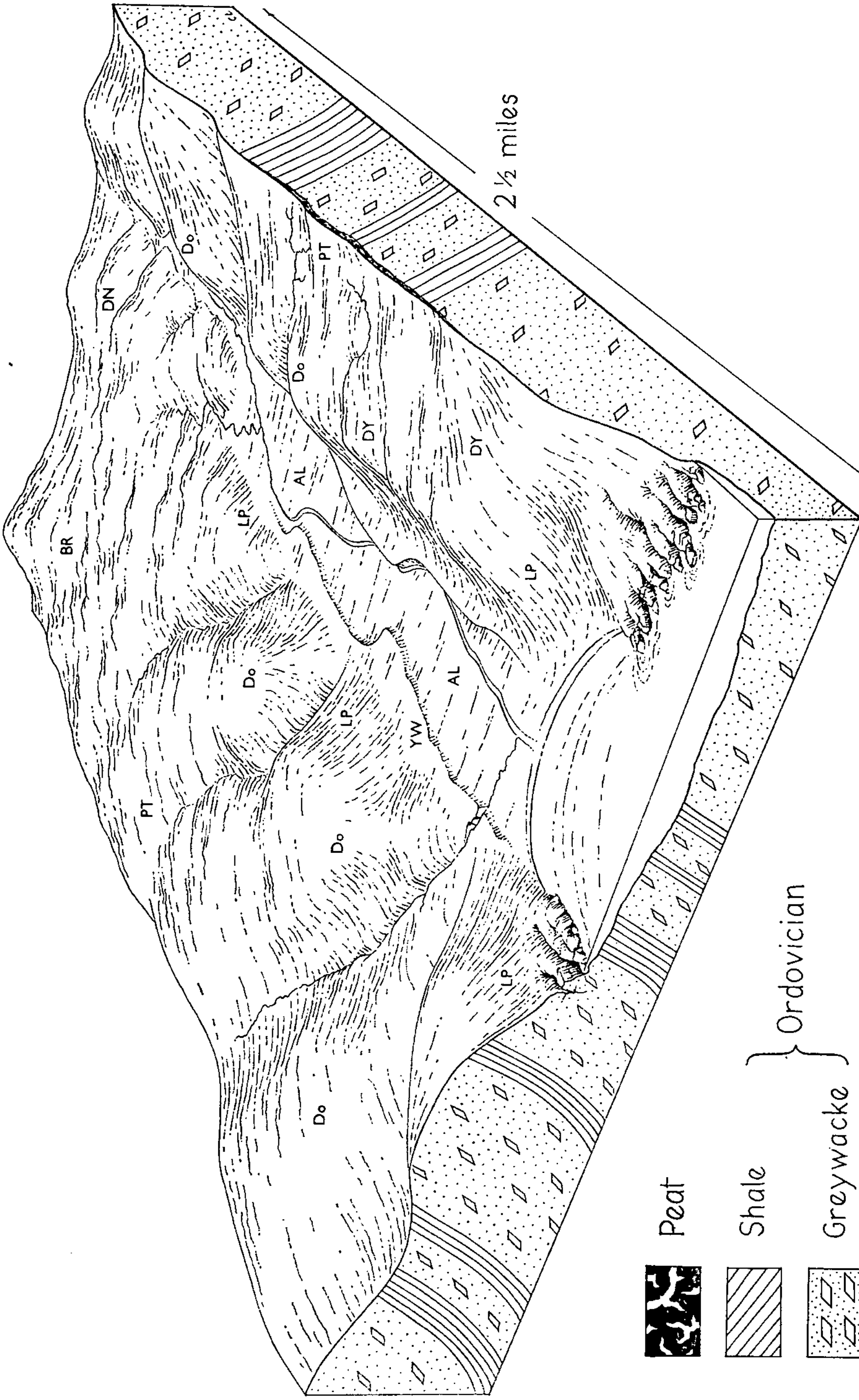
LP = Linhope series AX = Altimeg series PT = Peat

FIG. 6. Relationship between Landform and Soils near Kirkalla



MZ = Merrick series DO = Dod series DY = Dochroyle series DN = Darnaw complex
BR = Brochloch complex GY = Garrary complex ERz = Ettrick skeletal soils
DEz = Dalbeattie skeletal soils

FIG. 7 Relationship between Landform and Soils near Merrick



LP = Linhope series DO = Dod series DY = Dochroyle series YW = Yarrow series AL = Alluvium
PT = Peat DN = Darnaw complex BR = Brochloch complex

3 THE GRANITE HILLS

These hills are similar in many ways to the greywacke hills among which they occur, but they have several distinctive features as a group, and some differences within the group, so that they form convenient descriptive units.

(*a*) *Loch Doon–Loch Dee Intrusion*

This forms a relatively low basin-like area, lying within the rim of metamorphosed greywacke hills of the Merrick, Kells and Lamachan ranges. It consists of two main features, the basin-like area proper and a central ridge of hills.

i *Mullwharchar Ridge* This is a ridge-like line of hills running from Hoodens Hill to Snibe Hill within the general area of the basin, and reaching 2270 feet on Mullwharchar Hill. Macaterick and Craigeazle Hills are two elevated areas separate from the main mass. The slopes are generally steep or very steep and the rugged outline is emphasised by the abundance of bare rock.

ii *Loch Doon–Loch Dee Basin* The lower ground surrounding the central ridge is characterized by more gentle and moderate slopes, and the rugged outlines have been softened by moraine and solifluction deposits, as well as by the peat which blankets much of the area, in places to depths which exceed 6 feet. The region is bounded to the east and west respectively, by the huge almost vertical rock walls of Carlin's Cairn and Merrick which tower over 1000 feet above the valleys.

(*b*) *Fleet Hills*

The northern part of the Fleet granite outcrop occupies the south-east corner of the sheet. The hills which it forms are generally rugged and have steep slopes.

(*c*) *Cairnsmore of Carsphairn*

The summit and western part of this somewhat dome-shaped hill lie within the area under study. The slopes are generally steep and rugged with the exception of a small area around the summit where they are gentle to moderate.

4 THE RIVER VALLEYS

(*a*) *River Stinchar*

The valleys of the River Stinchar and its tributaries the Duisk and the Muck Water form a distinct unit of the landscape morphology. Their steep sides fall 300–400 feet from the overlooking moorlands to alluvial tracts, usually less than 300 yards wide, in the valley bottoms.

(*b*) *Glen App*

This is an impressive steep-sided gorge or slot, excavated in the shatter belt of the Southern Uplands Fault.

(*c*) *Girvan Valley*

In contrast to the valleys of the Stinchar and App this is a relatively broad valley in the north-west of the area, overlooked by the steep slopes of Hadyard Hill to the south and the somewhat lower ground of the Ayrshire till plain to the north. Several fairly broad level alluvial tracts occur along its lower reaches.

5 RAISED BEACHES

The 25-foot beach is the most conspicuous of these features, narrow tracts occurring along the coast north of Ballantrae and to the north and south of Girvan. Areas of higher beach levels have been mapped by the Geological Survey along the Girvan Water as far inland as Cairnhill Farm.

2 Climate and weather

The climatic picture of the Girvan-Carrick region is somewhat anomalous. This section of south-west Scotland is in close proximity to the relatively warm waters of the North Channel and the Irish Sea, which waters are subject to not infrequent surges of quite warm water from the Bay of Biscay. The region is also apparently reasonably open to the mild south-westerly winds. It might be thought that the area would experience the mild if wet winters—and correspondingly cool summers—to be expected in such a situation. Whilst a restricted area near the coast might claim this to be so, the overall picture is one of distinctly harsher winters with compensating spells of warmth in the middle part of the year.

It is true that the area of countryside below the 500 foot contour is not extensive, but some of the climatic variability must be ascribed in addition to the altitude factor, to the fact that the hill country lies directly across the track of the south-westerly winds.

Winds

The general wind regime is dictated for the most part by the approach and passage of the North Atlantic depressions. The area generally falls within the main circulation of the major systems, except when the storm tracks are well to northward toward the Icelandic area. An opposing synoptic pattern, which tends to recur during the first half of the year and can be persistent, is one with high pressure centred in northern latitudes.

The distribution of the winds in the 'free air' over the region resulting from these dominant synoptic patterns in conjunction with the more transient pressure distributions must conform closely to the winds as recorded by the anemometer on Lowther Hill. The predominance of westerly winds over the year is very marked, with a total frequency of 55 per cent to which the winds of the summer and autumn seasons make the largest contribution. In spring all directions are well represented in the wind regime, and winds from an easterly quarter have also a fair incidence in the winter period. Wind strengths in spring and autumn fall in the 'moderate to fresh' category of 13–24 m.p.h. on about 45 per cent of occasions, just about double the frequency of the strong winds of 25–38 m.p.h. Gales blow at these seasons for some 5·5–6 per cent of the time but in winter the gale frequency is nearly doubled, at 9·5 per cent, with a corresponding increase in the duration of strong winds.

At altitudes below about 2000 feet the airflow is no longer largely unimpeded and two factors operate to produce considerable changes in velocity. In addition to the normal backing and reduction in speed with decreasing altitude, the prevalence of large scale eddies in rugged hill country of this type produces considerable changes in both speed and direction, sometimes over appreciable areas. The most windy area, considering now the normal surface regime, is the western section, which has little effective shelter from the south-westerly and easterly winds and is particularly vulnerable to north-westerlies. Winds from the south are usually stable and 'soft'. Good shelter from the prevailing winds in the zone from Loch Doon to Loch Dee and Clatteringshaws is provided by the central massif, whilst Glen Ken enjoys the additional protection of the massive Rhinns of Kells. Easterlies, on the other hand, are less hindered in their approach and have reasonable access to these valleys and to the valley of the Black Water of Dee, but they are not normally strong winds.

Lines and Howell (1963), examining the degree of exposure suffered by various forestry sites in Scotland, measured the amount of tatter suffered by specially designed flags. Although the rate of tatter is not exclusively due to wind, it is of interest that they found the rate of tatter at a site in Carrick, at an altitude of 1400 feet, comparable to that obtained in Shetland (necessarily at a lower height) and higher than at any other of the other Scottish localities examined.

Rainfall

The rainfall pattern is much that to be expected and the records for a number of stations in the area are given in Table E. The humid rain-bearing south-westerly winds, after crossing Wigtownshire, enter the first stage of their forced ascent over the Southern Uplands. The same applies to the showery westerlies which normally supervene. A very narrow strip of the coastal zone and the lower reaches of the Stinchar Valley have an average of rather less than 45 inches annually. This is increased by some five inches at the 500 foot level and much of the south-western section of the area receives between 50 and 60 inches. Over the rising ground the average totals increase rapidly—70 inches at 1000 feet, 90 inches or more at 2000 feet, with probably 100 inches or more on the highest ground. At Carsphairn the rainfall is less than at similar altitudes in the area to the west on account of the rain shadow effect of the Merrick and the Rhinns of Kells.

Autumn and early winter is the really wet season, with around 45 per cent of the yearly total allocated to the four months October to January, January being slightly wetter than October in most places. February with nearly a 50 per cent reduction on the January totals usually initiates a decided change in the rainfall pattern. Successive reductions are associated with the increased liability to easterly winds in spring until May and June, normally somewhat wetter than the preceding months, signal the approach of the steady increase to the autumn/winter maximum.

An appreciable part of the summer increase in rainfall is attributable to the development of thunderstorms or areas of thundery rain in the mountainous districts both locally and in the Southern Uplands generally (see sections on thunder and temperature).

Statistics of daily rainfalls suggest that the very considerable variations in total rainfall from one locality to another are not at all closely related to the actual number of days on which rain occurs. The number of days

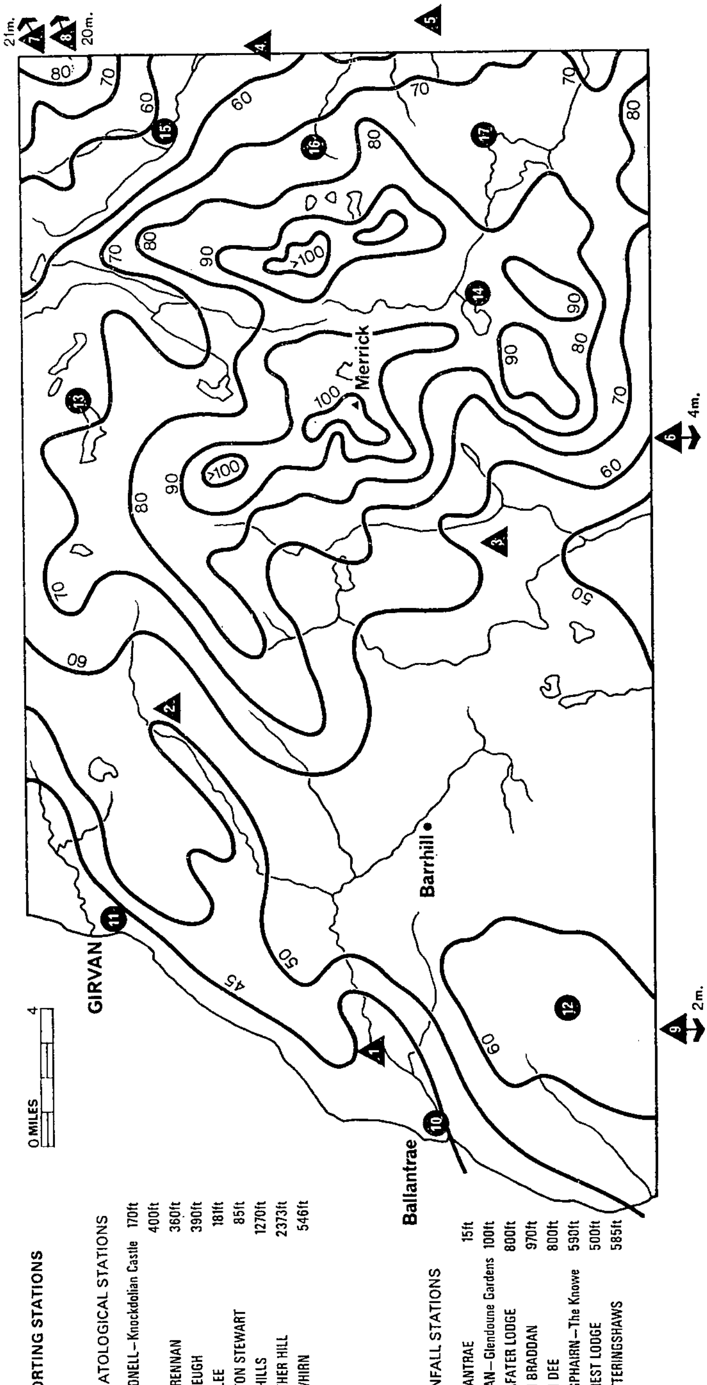


FIG. 9 Average Annual Rainfall in inches (1921–1950)

with measurable falls (0·01 inches or more) appears not to vary widely and averages out at some 200 to 220 days per annum over a wide area and at all altitudes ranging up to at least 1000 feet.

Frequent lengthy dry spells are hardly to be expected on the basis of these figures. Toward the coast, over the 20 years 1941–1960, some nine months have been credited with less than one inch as against nine months with over 7 inches. Four of these dry months had less than 0·5 inches. In all other districts however, a monthly rainfall of less than one inch has been rare, whereas falls of 10 to 12 inches or more are of relatively frequent occurrence.

Snow

Snow is infrequent and evanescent over at least most of the western half of the area, but increases to the north and east with higher altitude and greater distance from the sea. Towards sea level about 2 per cent of the average annual precipitation falls as snow; at around 1000 feet the figure is 12 to 14 per cent. During an average season some snow may be expected on 10 days at the lower levels, increasing to around 40 days at 1250 feet. Snowfall tends to occur in appreciable amounts, usually with a polar depression moving south-east from north of Ireland, and is quickly followed by a thaw at the lower levels—a rather familiar pattern on the western side of Britain.

In infrequent exceptional winters such as those of 1916–17, 1939–40, 1946–47 and in early 1963, when the 'continental winter' of Central Scotland encroaches far to the south-west, snow may cover the ground for 20–30 days, even toward the coast. The indications are then that in the glens and valleys and on high ground above 1300 feet the snow cover may be continuous for up to two months.

Temperature

The annual range of daily mean temperature at the lower altitudes is around 11·7°C, but is slightly lower than this near the coast and rather higher well inland and in the hill country. The coastal zone benefitting from the proximity of the warm sea and aided by the prevailing winds has long spells of mild weather during the colder part of the year. Here the monthly mean daily maximum and minimum temperatures of 6·7°C and 0·8°C respectively in January, the coldest month, have values one degree or so higher than those for inland stations. The mild surface layer does not appear to extend far inland. The bleakness of exposed localities even quite near the coast in the extreme south-west of the region at a height of about 500 feet is pin-pointed reasonably well by the temperature observations from Penwhirn. Here the monthly mean daily maximum in most months is 1·5°C lower than in more sheltered localities at not much lower altitudes (cf. Penwhirn and Barr, Table A). From mid-May onwards the advantage of warmer days is with the central and eastern inland districts where the monthly mean daily maximum in the warmest months of June and July is around 19°C, some 1·5°C higher than that near the coast. This is true for altitudes of up to 500 feet, and in the glens and folds of the rugged country the difference is probably even greater.

Table A/Short Period Mean Temperatures and Extreme Daily Readings March 1958–Feb 1965

	Barr			Bargrennan			Dundeugh		
	°C Max	°C Min	°C Mean	°C Max	°C Min	°C Mean	°C Max	°C Min	°C Mean
Jan	5·9	−0·9	2·5	5·6	−0·9	2·3	5·0	−2·3	1·4
Feb	7·2	0·0	3·6	6·5	−0·2	3·2	6·1	−1·7	2·2
Mar	8·5	0·9	4·7	8·4	1·2	4·8	7·8	0·1	3·9
Apl	11·7	2·9	7·3	11·9	3·0	7·4	11·3	2·2	6·8
May	15·1	4·9	10·0	15·2	5·0	10·1	14·7	4·1	9·4
Jun	17·3	7·9	12·6	17·3	7·8	12·5	17·1	7·3	12·2
Jul	17·8	9·2	13·5	17·6	8·8	13·2	17·6	8·6	13·1
Aug	17·3	9·1	13·2	17·4	8·9	13·2	17·3	8·7	13·0
Sep	16·4	7·5	11·9	16·2	7·6	11·9	16·0	6·9	11·4
Oct	12·8	6·1	9·4	12·9	6·1	9·5	12·7	5·2	8·9
Nov	8·9	2·3	5·6	9·2	2·6	5·9	8·8	1·6	5·2
Dec	5·9	−0·6	2·7	6·1	−0·3	2·9	5·7	−1·4	2·1
Year	12·1	4·1	8·1	12·0	4·1	8·1	11·7	3·3	7·5

6 yrs only

	Lowther Hill		
	°C Max	°C Min	°C Mean
Jan	0·9	−3·0	−1·1
Feb	0·8	−3·4	−1·3
Mar	2·4	−2·4	0·0
Apl	6·1	0·0	3·1
May	9·3	2·4	5·9
Jun	12·0	5·3	8·7
Jul	11·7	6·0	8·9
Aug	12·2	6·6	9·4
Sep	10·8	5·5	8·1
Oct	7·7	2·9	5·3
Nov	4·1	−0·1	2·0
Dec	1·3	−2·9	−0·8
Year	6·6	1·4	4·0

	Penwhirn		
	°C Max	°C Min	°C Mean
Jan	5·1	−0·9	2·1
Feb	5·6	−0·8	2·4
Mar	7·1	1·1	4·1
Apl	10·3	3·1	6·7
May	13·4	5·3	9·3
Jun	15·7	7·5	11·6
Jul	16·2	9·4	12·8
Aug	15·9	9·7	12·8
Sep	14·9	8·3	11·6
Oct	11·9	7·1	9·5
Nov	8·3	3·3	5·8
Dec	5·7	0·3	3·0
Year	10·8	4·5	7·7

At higher altitudes the normal rule of reduction of daily mean temperatures by 0·6°C per 100 metres appears to be correct. Thus at about 1300 feet the annual range is from 1°C to nearly 13°C, permitting estimated figures for 2200 feet of from −0·5°C in January to 10·5°C in July. On the whole the summer afternoons are somewhat cooler and the winter nights less cold than the direct application of the reduction factor would suggest.

At the really high altitudes the mean value of the summer afternoon maximum in July is around 13·5°C, whilst the mean night minimum temperature reaches freezing point about mid-November and remains well below this level through December to the middle of April. Freezing temperatures at these heights, virtually in the free atmosphere, are not greatly dependent on light winds and clear skies, and freezing winds with cloud cover on the mountains are sometimes responsible for heavy rime and ice deposits.

Table B/Averages of Temperature for Period 1931–60 with Extreme Daily Readings over Period Indicated

	Colmonell (1914–60)			Glenlee (1937–64)			Leadhills (1914–27, 1953–64)			Dundeugh*		
	°C Max	°C Min	°C Mean	°C Max	°C Min	°C Mean	°C Max	°C Min	°C Mean	°C Max	°C Min	°C Mean
Jan	6·7	0·9	3·8	5·9	−0·6	2·6	4·1	−1·7	1·2	5·3	−0·9	2·1
Feb	7·0	0·9	4·0	6·7	0·0	3·3	3·4	−1·4	1·0	6·1	−0·8	2·7
Mar	9·2	2·0	5·6	9·2	1·1	5·1	6·6	−0·1	3·3	8·5	0·4	4·5
Apl	11·4	3·6	7·5	12·1	2·8	7·4	9·4	1·5	5·4	11·1	1·8	6·4
May	14·8	5·5	10·2	15·7	4·9	10·3	13·3	3·4	8·3	14·8	3·9	9·3
Jun	17·0	8·6	12·8	18·3	8·2	13·3	16·2	6·6	11·4	17·5	7·3	12·4
Jul	18·0	10·6	14·3	19·3	10·2	14·8	16·9	8·8	12·8	18·1	9·5	13·8
Aug	18·0	10·4	14·2	18·9	9·6	14·3	16·6	8·6	12·6	17·8	8·9	13·3
Sep	16·1	8·7	12·4	16·5	7·9	12·2	14·0	7·0	10·5	15·7	7·6	11·6
Oct	13·0	6·3	9·7	12·8	5·0	8·9	10·3	4·7	7·5	12·2	4·6	8·4
Nov	9·7	3·7	6·7	9·2	2·3	5·8	6·7	1·8	4·3	8·9	2·0	5·5
Dec	7·8	2·2	5·0	7·1	0·9	4·0	4·6	0·3	2·4	6·8	0·4	3·6
Year	12·4	5·3	8·9	12·6	4·4	8·5	10·2	3·3	6·7	11·9	3·7	7·8

**Computed Average (Provisional)*

The incidence of night air frosts in the valley areas of the Rivers Stinchar and Cree over the recent nine year period (covering the very severe period of early 1963) averages 75 to 80 nights per annum as compared with about 65 near the coast. July is the only month practically free from air frost. The incidence of frost on the relatively flat plateaux-like locations at altitudes ranging from 600 feet to 1200 feet does not appear to be very sensitive to the altitude change, the number of frost nights approaching 100 in the course of an average winter season. An equally high incidence is found in the narrower glens and defiles even at considerably lower altitudes (*eg* Glenlee—Table C). At 2000 feet and above there is a fairly high proportion of 'wind frosts' with the general freezing level in the free atmosphere being below the level of the highest ground. A probable figure seems to be about 150 night frosts per season, allowing in an average season only three or four frost-free nights in each of the three months December to February.

Table C/Climatological Summaries

Average Number of Days of Specified Occurrences
Periods as Indicated

	Colmonell (18–20 years)									
	R	W	S	SL	H	T	F	AF*	GF	G
Jan	20·4	16·7	2·8	1·7	1·5	0·1	0·9	13·5	12·7	2·0
Feb	16·1	12·9	2·5	1·4	1·5	0·1	0·9	14·0	11·8	1·1
Mar	15·2	11·4	2·0	1·2	1·3	0·1	0·9	7·6	12·7	0·8
Apl	15·3	11·6	0·8	0·2	1·3	0	0·5	5·0	8·7	0·8
May	13·7	10·6	0·1	0	0·3	0·3	0·5	2·2	4·1	0·2
Jun	14·5	11·3	0	0	0	0·3	0·5	0·4	0·5	0†
Jul	17·3	13·6	0	0	0†	1·0	0·5	0	0	0†
Aug	17·9	13·8	0	0	0	0.9	0·5	0	0·1	0·2
Sep	18·0	14·5	0	0	0·1	0·5	0·4	0·2	1·1	0·6
Oct	19·1	15·7	0·2	0	0·7	0·4	0·5	1·0	4·0	1·1
Nov	19·0	15·5	0·6	0·3	1·5	0·3	1·0	4·0	9·0	1·4
Dec	21·4	18·2	1·9	1·0	2·1	0·4	1·3	9·2	10·9	1·7
Year	208†	166†	10·9	5·8	10·3	4·4	8·4	57†	76†	9·9

	Glenlee 1937–64 (28 years)									
	R	W	S	SL	H	T	F	AF*	GF	G
Jan	19·3	16·3	7·1	4·6	0·7	0·1	1·2	20·1	19·9	0·4
Feb	16·7	13·4	6·2	3·0	0·4	0·1	0·6	16·4	17·1	0·5
Mar	15·2	12·3	4·0	1·0	0·3	0†	1·0	12·7	15·9	0†
Apl	16·0	12·7	1·1	0	0·4	0	0·3	9·0	11·4	0·1
May	14·3	11·8	0·3	0†	0·4	0·8	0	3·3	6·4	0†
Jun	15·6	12·1	0	0	0·2	0·5	0	0·9	1·2	0·1
Jul	17·0	13·2	0	0	0	0·9	0	0	0†	0†
Aug	18·6	14·4	0	0	0†	0·8	0†	0·2	0·2	0·3
Sep	18·4	15·3	0	0	0·1	0·4	0·2	1·1	1·6	0·1
Oct	19·3	15·3	0·1	0	0·4	0·3	1·0	2·8	5·8	0·3
Nov	19·5	16·4	1·3	0·1	0·5	0·2	0·7	9·9	12·0	0·2
Dec	20·7	17·5	4·1	2·4	0·6	0·1	1·2	17·3	16·4	0·5
Year	211†	171†	24·2	11·1	4·0	4·2	6·2	94	108	2·5

KEY

R —Rain Day (0·01 in. or more)
W —Wet Day (0·04 in. or more)
S —Snow
SL —Snow lying at 09h
H —Hail
T —Thunder
F —Fog
AF—Air frost
GF—Ground frost
G —Gale
• —1956–64 only
† —rounded off to whole number

Table C (cont)/Climatological Summaries

	Penwhirn 1958–64 (7 years)								
	W	S	SL	H	T	F	AF	GF	G
Jan	15·4	4·9	6·7	1·3	0·6	3·6	18·0	23·1	3·1
Feb	12·9	4·0	6·6	2.0	0.1	3·0	13·9	17·1	2·3
Mar	12·9	3·7	3·4	1·4	0·3	3·3	11·7	17·1	1·9
Apl	15·1	1·0	0·6	0·7	0	2·1	5·1	10·1	0·9
May	11·3	0	0	0·1	2·1	1·3	1·1	5·0	0·7
Jun	11·9	0	0	0	0·9	1·0	0·1	1·1	0·4
Jul	13·1	0	0	0·1	1·3	1·1	0	0	0·7
Aug	16·0	0	0	0	1·3	1·0	0	0·4	0·4
Sep	15·9	0	0	0	0·9	1·3	0	0·7	0·7
Oct	16·0	0·1	0	0·7	1·0	2·0	0·3	4·3	2·0
Nov	17·7	1·4	0·1	1·7	0·3	2·4	5·3	12·0	1·6
Dec	16·0	3·4	2·1	1·0	1·1	2·7	12·9	20·3	2·6
Year	174†	18·5	19·5	9·0	9·9	24·8	68†	111†	17·3

	Leadhills 1914–27 and 1953–64 (25–26 years)									
	R	W	S	SL	H	T	F	AF	GF	G
Jan	21·7	18·3	9·4	11·0	0·8	0·2	1·6	20·1	21·7	1·8
Feb	18·8	15·4	8·7	11·3	0·6	0	0·8	17·7	19·8	1·4
Mar	16·8	13·7	6·8	7·3	0·9	0·2	0·7	13·2	18·5	0·6
Apl	17·5	14·6	4·3	2·5	1·2	0·3	0·5	9·9	15·3	0·2
May	17·2	14·2	1·9	0·6	0·9	1·2	0·9	4·3	9·4	0†
Jun	16·3	13·1	0†	0	0·7	1·2	0·1	1·4	3·0	0·4
Jul	18·9	15·7	0	0	0	1·4	0·3	0	0·6	0†
Aug	20·8	17·6	0	0	0·3	1·5	0·1	0·3	0·6	0·1
Sep	19·5	16·9	0·2	0†	0·6	0·7	0·6	1·0	2·3	0·5
Oct	19·3	16·2	1·2	0·6	0·7	0·4	0·4	2·7	6·5	0·7
Nov	19·4	16·1	3·2	4·9	0·5	0†	1·3	9·9	12·1	0·9
Dec	21·4	18·6	8·0	8·7	0·5	0†	1·4	16·6	17·1	1·6
Year	228†	190†	43·7	46·9	7·7	7·6	8·7	97†	127†	8·2

	Lowther Hill (4–5 years)					
	S	H	T	F	AF	G
Jan	12·8	0·4	0·2	19·4	27·8	11·4
Feb	8·2	0·8	0	17·4	24·5	9·4
Mar	9·6	1·0	0	20·2	24·5	9·0
Apl	6·4	1·4	0·2	17·2	12·8	7·0
May	3·4	1·2	1·0	13·2	5·8	8·2
Jun	0·5	0	0·8	13·0	1·2	4·8
Jul	0	0	1·5	16·0	0	5·5
Aug	0·2	0	0·5	20·0	0	6·0
Sep	0	0·5	0·8	18·7	0·6	7·8
Oct	3·3	0·8	1·0	22·8	4·8	9·5
Nov	6·7	0·2	0·2	21·0	16·4	9·3
Dec	13·0	0·5	0	19·3	28·2	10·8
Year	64·1	6·8	6·2	228†	147†	99†

	Dundeugh 1958–64 (7 years)							
	W	S	SL	H	T	F	AF	G
Jan	13·2	3·9	3·9	0	0	1·3	21·0	0·6
Feb	12·9	4·3	7·6	0	0	0·9	17·3	1·0
Mar	11·3	2·1	2·0	0	0	0·6	15·3	0·3
Apl	14·4	1·0	0·4	0·6	0·3	0	8·1	0·3
May	12·9	0	0	0	1·4	0·1	4·4	0
Jun	11·7	0	0	0	0·9	0·3	0·4	0·3
Jul	12·3	0	0	0	1·3	0·1	0·1	0
Aug	14·9	0	0	0	1·7	0	0·7	0·1
Sep	14·3	0	0	0	0·9	0·7	0·6	0·1
Oct	15·6	1·0	0	0	0·4	0·9	2·7	0·1
Nov	17·0	1·7	0·4	0·1	0·3	1·1	10·6	0·4
Dec	15·6	5·1	4·0	0·3	0·1	1·3	18·1	0·9
Year	16	19·1	18·3	1·0	7·3	7·3	99†	4·1

	Barr 1958–64 (6–7 years)							
	W	S	SL	H	T	F	AF	G
Jan	15·8	4·9	1·8‡	4·0	1·2	0·2	16·6‡	2·0
Feb	15·5	4·3	3·0	3·3	0·3	0·5	11·6	1·0
Mar	11·9	2·4	0·9	1·6	0·3	0	11·0	0·1
Apl	15·0	1·1	0·4	1·3	0	0	5·7	0·1
May	12·6	0	0	0·4	1·7	0·1	2·4	0·1
Jun	12·3	0	0	0	0·7	0·3	0·3	0·3
Jul	14·4	0	0	0	0·9	0·6	0	0·4
Aug	16·6	0	0	0·3	1·1	0·1	0·1	0·1
Sep	16·0	0	0	0·4	0·7	0·1	0·4	0·9
Oct	15·5	0	0	2·4	1·3	0·1	2·0	1·1
Nov	17·7	1·4	0·4	2·3	0·7	0	8·3	0·7
Dec	16·7	4·5‡	2·5‡	4·7	0·7	0·4	15·2‡	2·1
Year	180	18·6	9·0	20·7	9·4	2·4	74‡	8·9

‡ no obs. cold winter 1962-63

	Bargrennan 1958–64 (7 years)							
	W	S	SL	H	T	F	AF	GF
Jan	14·1	5·1	2·9	2·1	0·4	1·3	19·0	23·9
Feb	14·1	4·9	3·1	0·7	0·1	1·0	15·1	18·7
Mar	12·0	3·3	0·6	0·6	0	0·6	10·4	15·3
Apl	14·9	1·7	0·3	0·6	0·1	0·6	6·4	12·1
May	12·1	0	0	0·4	1·3	0·3	2·4	9·6
Jun	12·7	0	0	0	0·6	0·3	0·1	2·3
Jul	14·7	0	0	0	0·7	0·3	0	1·3
Aug	15·7	0	0	0·1	1·6	0·1	0·1	1·8
Sep	16·0	0	0	0	0·7	0·6	0·1	2·9
Oct	16·3	0	0	0·3	1·1	0·1	1·3	8·1
Nov	17·6	1·3	0·3	0·4	0·4	0·4	8·6	14·4
Dec	16·3	5·0	1·1	1·6	0·3	0·6	17·7	23·1
Year	177†	21·3	8·3	6·8	7·3	6·5	81†	133†

In spite of the frequent night frosts and the low temperatures reached at times, the glens often warm up quickly during the forenoon. Thus at Glenlee the average number of 'freezing days' per annum is 23—a 'freezing day' being defined as one in which the arithmetic mean of the maximum and minimum temperature for the day does not exceed 0·3°C. At 1200 feet there are 40 such days, January and February each having 13.

The Growing Season

The lower altitudes towards the west coast have a length of growing season (based on the usual threshold value of 5·6°C for the daily mean temperature) similar to that of the Ayrshire plain (Grant, in preparation). Thus in the Colmonell district the season begins about mid-March and is sustained until the end of November, the average length of the period being 262 days. At similarly low levels in the eastern valleys the period is some three weeks shorter. Superimposed on the west to east change, there is the steady reduction with increasing altitude, giving in the period from mid-April to near the end of October an average figure of 230 days at about 500 feet declining to 200 days at 1200 feet or so. On the wind-swept heights little growth is likely much before the end of May and the season is probably limited to about 150 days.

Evapotranspiration

Estimates of evapotranspiration for localities in such rugged and often elevated country must be subject to some reservation, the actual values doubtless being subject to variation, as are the other meteorological parameters, owing to topography etc. Only in exceptional years, however, is the rainfall likely to be insufficient to meet demands.

Potential Transpiration (P.T.) in the Stinchar Valley district is probably very like that in much of Ayrshire, the figure being among the highest in Scotland.

For the valleys drained by the River Cree the somewhat lower figure applicable to much of Kirkcudbrightshire seems a fair estimate, but for much of the rest of the region, with the possible exception of the valley of the Ken where some extra sunshine may more than compensate for lack of wind, an even lower figure must be expected, a figure more like that of north Dumfriesshire.

As some indication of the variability of the evapotranspiration over the region, the monthly totals for the growing season and the cumulative totals for summer and winter for the three county districts are given in inches in Table D (Irrigation, 1962).

Table D/Average Values of Potential Transpiration (P.T.)

County	*Apl*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Summer*	*Winter*	*Year*
Ayr	1·85	3·25	3·60	3·30	2·60	1·50	16·10	2·85	18·95
Kirkcudbright	1·90	2·95	3·35	3·20	2·80	1·55	15·75	3·00	18·75
North Dumfriesshire	1·60	2·85	3·05	2·80	2·40	1·20	13·90	2·60	16·50

Table E/Average Annual Rainfall in Inches—Period 1916–50

	January	February	March	April	May	June	July	August	September	October	November	December	Year
Ballantrae 15 ft.	4·86	2·93	2·67	2·32	2·67	2·71	3·37	3·67	4·11	4·95	4·59	4·90	43·75
Girvan 100 ft.	4·95	2·96	2·73	2·35	2·67	2·70	3·42	3·69	4·11	5·00	4·55	4·84	43·97
(Glendoune Gdns)	*11·3	6·7	6·2	5·3	6·1	6·1	7·8	8·4	9·3	11·4	10·4	11·0	
Colmonell 170 ft.	5·01	2·95	2·64	2·28	2·51	2·60	3·19	3·53	4·09	5·01	4·68	5·24	43·73
(Knockdolian Cas)	*11·5	6·7	6·0	5·2	5·7	5·9	7·3	8·1	9·4	11·5	10·7	12·0	
Glenlee 181 ft.	7·38	4·63	3·91	3·36	3·66	3·24	4·33	4·81	4·99	6·67	6·37	6·73	60·08
Bargrennan 360 ft.	6·97	4·28	3·75	3·63	3·45	3·33	4·40	4·88	5·47	6·72	6·19	6·42	59·49
Forrest Lodge 500 ft.	9·31	5·74	4·77	4·40	4·40	4·17	5·14	5·67	6·56	8·35	7·83	8·20	74·54
Clatteringshaws 585 ft.	10·09	6·31	5·33	4·75	5·00	4·35	5·90	6·89	7·13	8·94	8·53	8·77	81·99
Carsphairn 590 ft.	7·42	4·54	3·77	3·47	3·47	3·47	4·18	4·54	5·32	6·75	6·27	6·57	59·77
Loch Dee 800 ft.	10·75	6·64	5·59	5·33	5·24	4·63	6·20	7·16	7·77	9·71	9·17	9·17	87·36
	*12·1	7·1	6·2	5·7	5·6	5·9	7·3	7·7	9·4	11·6	10·5	10·9	
Lagafater Lodge 800 ft.	7·24	4·37	4·05	3·47	3·85	3·92	4·95	5·33	6·04	7·17	6·67	7·17	64·23
Loch Bradan 970 ft.	8·37	4·91	4·29	3·94	3·87	4·08	5·05	5·33	6·51	8·03	7·27	7·55	69·20

* Percentages of the Annual Average

Hail and Thunder

Hail, by the very nature of its formation, is a phenomenon of varied incidence, particularly over the very broken country of the region under review. The general and seasonal patterns are however very clearly delineated. Westwards towards the coast the frequency of hail storms increases in late autumn to reach a maximum in December and January when storms are especially frequent on and near the coast. The storms are developed at this season in polar air masses over the relatively warm sea and for the most part decay on moving inland. Thus this winter maximum falls progressively to the east and in eastern district is replaced by a spring maximum around April, when the necessary convection currents are generated over the land heated by the insolation. Thereafter over the whole region there is a rapid and sharp decline to quite low values during the summer.

The end of the hail season coincides with the onset of the thunderstorm season. The maximum frequency of storms is in July and August over the whole region. A significant frequency of thunder is however noticeable in the hill/mountain area in May, June, and early September.

Fog

Radiation fogs in the lower lying areas are infrequent in the colder half of the year, partly because there is little, if any, industrial pollution to assist their development or encourage their persistence. In summer, patches of sea fog are occasionally drifted in over the coast on a favourable breeze, but penetration inland is mostly thwarted by the rising contour behind the coast, although the fog does invade the Stinchar Valley.

Climatically the important 'fog' is either a sheet of thick lower cloud, with or without precipitation, which all too frequently envelopes the higher ground, usually following the onset of a mild humid south-westerly air mass, or the rather extensive cloud patches formed on the windward side by the forced ascent of moderately humid air by a particular section of higher ground. The incidence is again very variable, often extensive on the windward side and more broken and less persistent on the leeward side. Thus the highest ground is enveloped in cloud at 9.00 a.m. on considerably more than 200 days annually (perhaps on as many as 250 days). Except perhaps in mid-winter these cloud areas often break up and the cloud-base lifts to clear the hill-tops as the day advances.

General consideration of the rainfall and the prevailing winds indicates a fairly high average relative humidity for much of the year even at moderate to low altitudes, with prolonged spells of high humidity at the higher levels. The east winds of later spring and early summer are normally fairly dry winds and are responsible for lowering the average relative humidity in the early part of the afternoon—normally the time of day of lowest humidity—to around 66 per cent in June at altitudes around 650–700 feet and probably some 2–3 per cent lower in the valleys and glens. The average value rises sharply for July, to about 72 per cent. Local foehn effects lower the humidity very effectively in some areas, usually for periods of a few hours, but exceptionally for a day or more.

An interesting phenomenon is the occurrence of very low relative humidities at the really high altitudes. These low values are noted in certain anticyclonic conditions, which develop rather infrequently, when the normal inversion is brought very low by subsidence and any cloud sheets (or patches) come well below the height of the highest ground.

Sunshine

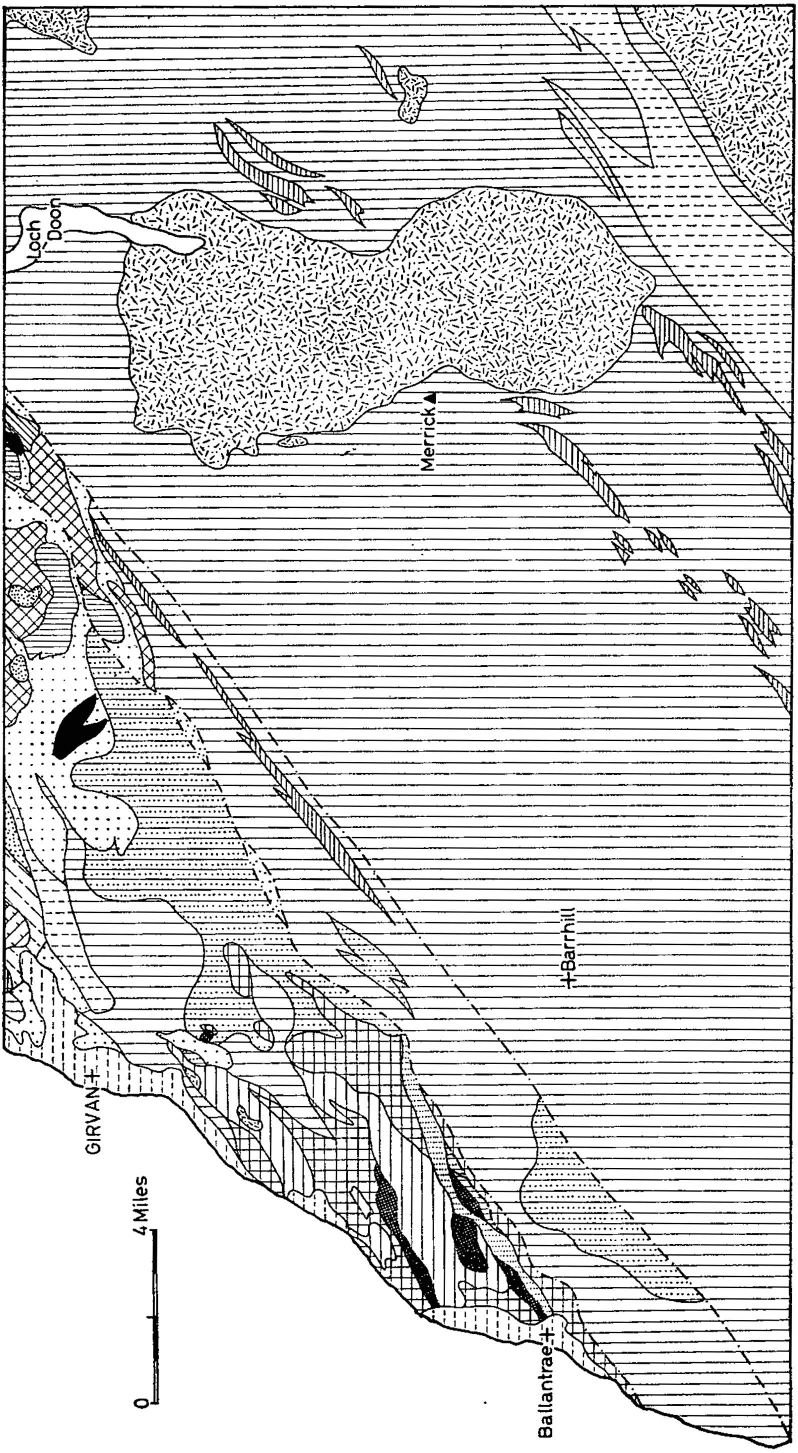
The average yearly total of sunshine over the coastal strip approximates closely to that over the Ayrshire coast and plain, with around 1300 hours in a reasonable summer. May and June are normally the sunniest months (Table F) with July and August much less reliable, but in view of the very

Table F/Short Period Mean Sunshine Values—Hours

	Jan	*Feb*	*Mar*	*Apl*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Year*
Lowther Hill (9*–10 yrs.)	27*	49*	61*	110	154	145	118	98	88	53	34	20	957
Penwhirn (6 yrs.)	59	73	95	147	201	189	155	147	118	75	50	42	1351

short daylight hours the relatively large totals in the later winter period deserve favourable mention. Sunshine totals in the major valleys are probably similar to those for the coastal strip; to the east and north-east, however, there would seem to be a steady decline in the amount of sunshine.

For the really high ground above 2000 feet the Lowther Hill figures, suggesting an average of about 900 hours annually, are probably a good indication of conditions in the hill areas. During the past 10 years the variations at Lowther Hill from the best sunshine year (1959) to the poorest (1961) is more than 400 hours.


Loch Doon
Merrick
Barrhill
GIRVAN
Ballantrae
0
4 Miles

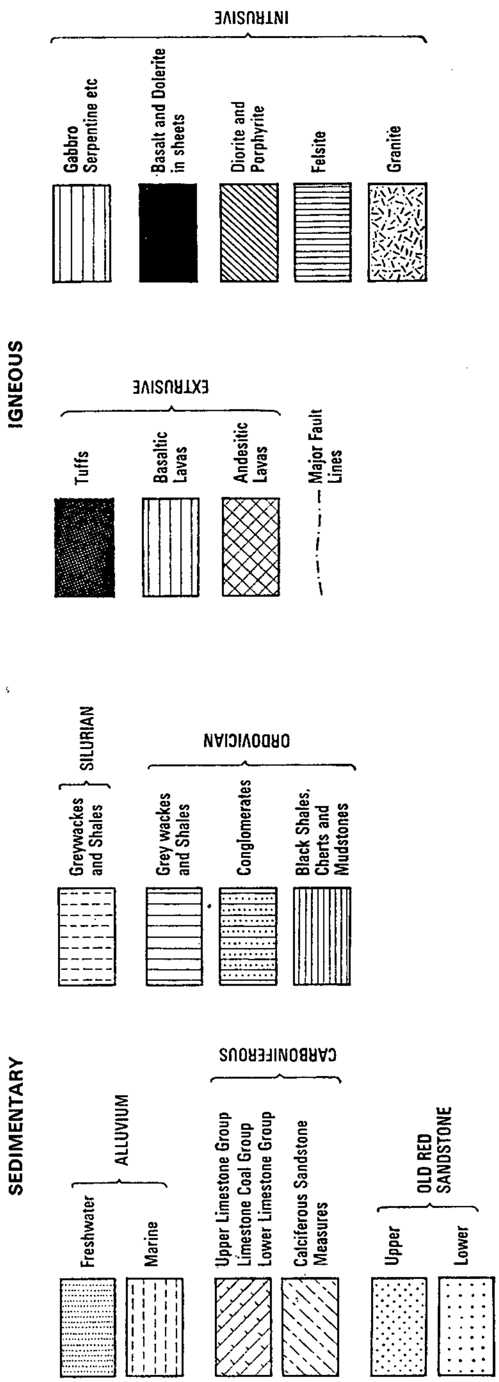


FIG. 10 Geological Map (*see also page 28*)

3 Geology and parent materials

All the consolidated sedimentary rocks and their associated igneous intrusions occurring in the area, with minor exceptions, belong to the Palaeozoic era, and the unconsolidated deposits of Pleistocene and Recent times have been derived from them.

The geological formations listed below are based on Sheets 7 and 8 of the Geological Survey of Scotland, and the areas in which they occur are shown in Fig. 10.

Recent and Pleistocene		Blown sand Peat Alluvium Raised beaches deposits Fluvio-glacial sands and gravels Solifluction deposits Moraine and till
Tertiary		Basic dykes etc.
Permian		Sandstones
Carboniferous	Upper Limestone Group Limestone Coal Group Lower Limestone Group	Limestones and coals
	Calciferous Sandstone Measures	Sandstones, shales and conglomerates
Old Red Sandstone	Upper	Sandstones, shales
	Lower	Sandstones and conglomerates
	Extrusive:	Basalts and andesites
	Intrusive:	Granites, acid porphyrites, basalts and doleritic rocks
Silurian	Wenlock	Flags, shales
	Llandovery	Conglomerates, greywackes, shales and mudstones
Ordovician	Ashgill	Conglomerates, greywackes, shales and mudstones
	Caradoc	Conglomerates, greywackes, shales and mudstones
	Arenig	Black shales and cherts
	Intrusive:	Serpentine,[1] dolerite, gabbro, granite
	Extrusive:	Spilitic lavas

[1] The serpentine is regarded by Bailey and McCallien (1957) as extrusive lava.

The ice sheets of the Pleistocene period eroded the pre-existing regolith, and either swept it away completely or may in some cases have incorporated it within the till. It is the glacial deposits, rock debris and bare rock surfaces left after the disappearance of the ice sheet, together with areas of recent accumulation, which form the parent materials from and on which the present soils have developed during recent times. These deposits were derived from the underlying consolidated rocks, but their form and composition, which greatly influence the soil pattern, have been largely determined by their mode of formation.

In the succeeding sections short accounts are given of the consolidated sediments, lavas and igneous intrusions (generally, and unless otherwise stated, following the accounts of Peach and Horne, 1899 and Pringle, 1948), the main features of the glaciation (following Charlesworth, 1925 and Pringle, 1948), and the nature and composition of the glacial deposits.

Ordovician

Rocks of the Ordovician system are both the oldest and the most extensive in the area; the base of the formation has not been recognised but the oldest fossiliferous rocks are Arenig-age black shales and radiolarian cherts, which occur as narrow lenticular outcrops. The rocks of this age which crop out most extensively in the area are the spilitic lavas with their associated agglomerates and the intrusions of serpentine and gabbroic type occurring in the Girvan-Ballantrae district. After deposition the Arenig strata were folded and uplifted, and subsequently subjected to a period of erosion prior to the deposition of further sediments during the Caradocian epoch.

The Ordovician rocks south of the Southern Upland Boundary Fault are mainly greywackes, with beds of shale, grit and conglomerate, of Caradocian age. Narrow lenticular belts of black shale containing 'Glenkiln' and 'Hartfell' fossils crop out in small areas, the most extensive being in the vicinities of the Garryhorn Burn and Curleywee Hill, and in an area north of Loch Trool.

The mudstones, grits and greywackes of the Tappins Group occur between the Southern Upland Fault and its branch fault running south of the River Stinchar and are overlain on Smirton Hill by beds of conglomerate, the Glen App Conglomerate (Walton, 1956).

North of the River Stinchar the Caradocian rocks comprise the Barr Series and lower beds of the Ardmillan Series; the upper beds of the Ardmillan are ascribed to Ashgillian times (Pringle, 1948). The Kirkland Conglomerate, Stinchar Limestone, and the Benan Conglomerate which make up the Barr Series crop out over a considerable area near the village of Barr and form an important and distinctive soil parent material, mainly due to a high content of basic cobbles and pebbles.

North of the Stinchar the rocks of the Ardmillan Series crop out over a considerable area and consist mainly of mudstones, shales, flagstones, sandstones, calcareous sandstones, grits and conglomerates.

The igneous rocks of the Ordovician system are of two main types: serpentines, dolerites and other intrusive rocks and extrusive lavas. The lavas, which are spilites, often exhibit the typical pillow structure and are thought to be submarine in origin. Pringle (1948) describes the rock as containing phenocrysts of altered greenish feldspar, augite, chlorite and ilmenite. Associated with the lavas are beds of tuff and agglomerate.

The intrusive rocks occur in two main belts, running in the general direction of the main Southern Uplands north-east—south-west strike. The southern belt runs from Drumore to Millenderdale, and the northern from Burnfoot to Byne Hill. Serpentine is the major rock type, together with smaller areas of gabbroic and doleritic rocks as at Balnowlart, Knockormal and Fell Hills. Bailey and McCallien (1957), however, interpret the serpentine as a lava flow within the spilites. Two small granite areas occur on Grey Hill and Byne Hill.

Silurian

Silurian strata crop out in the south-east of the region in limited areas between the Cairnsmore of Fleet and the Loch Doon granite masses, and in the north-west near Girvan.

In the Girvan area, the Llandovery epoch is represented by sediments of the Newlands Series and the Dailly Series. The Newlands Series consists mainly of shales, limestones, grits and conglomerates, and the larger outcrops occur north of Boghead Farm, on Saugh Hill and on Camregan Hill. The Dailly Series, the main outcrop of which occurs along the northern slope of Hadyard Hill, comprises mudstones, shales, flagstones and grits. Wenlock flags and shales occur over a small area west of Brackenhill Farm.

The Llandovery rocks, grits, greywackes and shales, which crop out in the south-east of the area have been correlated with Tarannon strata and the Gala rocks (Peach and Horne, 1899).

At the close of the Silurian period the pre-existing rocks and sediments were subject to folding and uplift during the Caledonian orogeny. The rocks thus formed from the upturned sediments were then subjected to a period of erosion before the next phase of deposition.

Old Red Sandstone

Sedimentary rocks of Lower Old Red Sandstone age occur north of the Southern Upland Fault, where they occupy small areas near Girvan and a somewhat larger area south of Dobbingstone. They consist mainly of near horizontally-bedded sandstones and conglomerates generally of a red or reddish brown colour, fading in places to a pale pink.

Two small areas of Upper Old Red Sandstone occur near Garleffin Fell. The rocks are sandstones and cornstones with a basal conglomerate containing pebbles of acid porphyrite (Bailey, 1926).

The granite masses of Loch Doon, Cairnsmore of Fleet and Cairnsmore of Carsphairn form batholiths within the Ordovician and Silurian strata and are the most extensive igneous rocks in the area. The Loch Doon mass covers the greatest area, its roughly hour-glass-shaped outline being about 11 miles long and 6 miles across at the widest point. The intrusion is composite (Gardiner and Reynolds, 1932), varying from granite to norite.

PLATE 1/Oats being harvested at South Balloch in the upper reaches of the Stinchar Valley. The alluvial tracts form some of the more fertile land in the hill areas.

PLATE 2/The eastern end of Loch Trool partly filled with alluvium and peat. The granite hills in the background form some of the most rugged land in south Scotland.

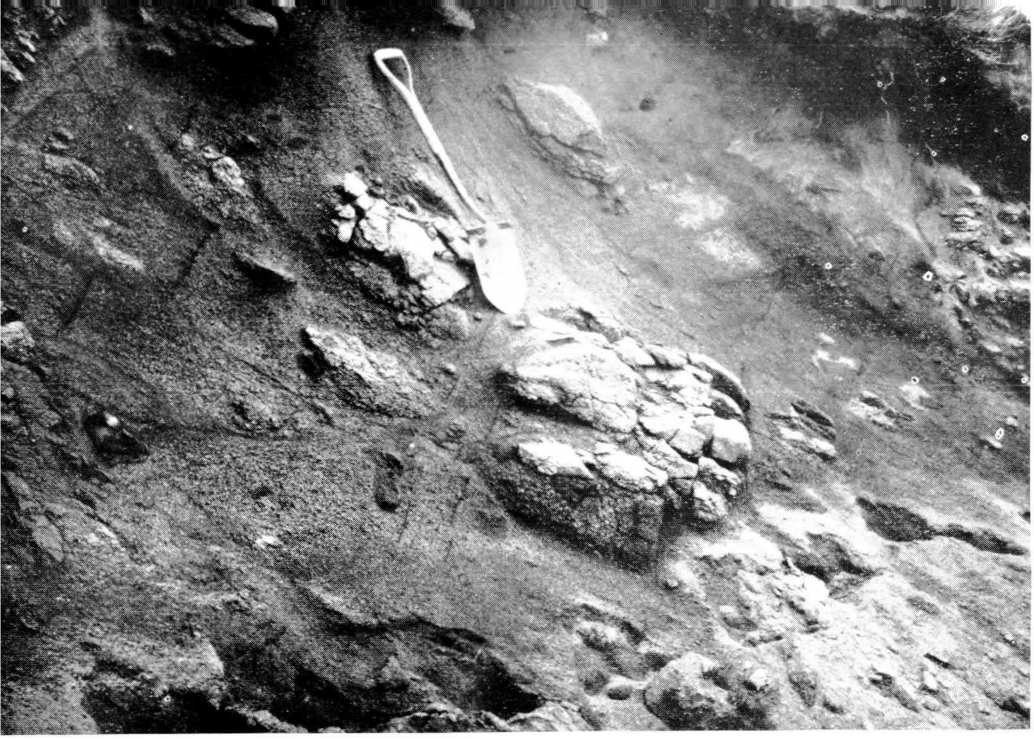


PLATE 3/Deeply weathered granite near Loch Doon showing 'core stones' in mass of disintegrated rock.

PLATE 4/Moraine deposits in the Minnoch Valley near Rowantree cottage. The soils on the mounds of moraine are peaty podzols of Dod series and peat occurs in the intervening hollows. This soil pattern has been mapped as the Minnoch complex.

The true granite, which forms the central ridge from Hoodens Hill to Snibe Hill, is coarse-grained and the principal minerals are quartz, biotite, orthoclase, with microcline and oligoclase feldspar. The rock on either side of the central ridge is a tonalite, which is of less coarse grain and is mainly composed of oligoclase, biotite and quartz. At the north-western and southern extremities of the outcrop are two small areas of the more basic norite, the principal minerals of which are plagioclase feldspar (dominantly labradorite), hypersthene, augite and biotite. A subsidiary associated intrusion at Burnhead, two miles to the east of the main Loch Doon mass, is a hornblende-tonalite with a narrow band of norite (Gardiner and Reynolds, 1932).

The north-western part of the Cairnsmore of Fleet intrusion, which covers 13 square miles in the south-east of the area, is the most acid of the granitic intrusions. It is composed of biotite-granite which, with the addition of muscovite, becomes a muscovite-biotite-granite towards the centre of the intrusion. The chief mineral constituents are biotite, quartz, alkali feldspar (dominantly microcline), oligoclase and muscovite (Gardiner and Reynolds, 1937).

The Cairnsmore of Carsphairn mass, lying to the north-east of Carsphairn village, is, like the Loch Doon mass, a complex intrusion of variable composition (Deer, 1935). The main rock types are granite, which forms the central part of the intrusion, passing outwards into an acid hybrid zone, which is succeeded by a band of tonalite, and beyond this lies an outer more basic zone in which several different rock types occur.

The sediments surrounding these granite intrusions have undergone a degree of metamorphism in belts one to two miles wide. The most obvious effect has been the hardening of the rocks around the Loch Doon mass. The resulting increased resistance to erosion has led to the Merrick and Kells Hills forming some of the highest ground in the Southern Uplands. There have also been considerable mineralogical changes; the gritty beds have developed brown biotite, while the flaggy beds have become a dark hornfels and the black shales have been altered to chiastolite slates in which graphite is present. It has not however proved possible to correlate important soil changes with these mineralogical alterations.

As soil parent materials, the other igneous rocks fall into two groups: acid rocks and basic and intermediate rocks. The first group comprises the acid porphyrite and felsite sills or laccoliths at Garleffin Fell, Lennie and Tairlaw.

The intrusive complex at Foreburn has been included with the second group because of its behaviour as a parent material; it consists of diorite, plagiophyre and acid porphyrite. Tourmaline, a boron-containing mineral, is locally abundant. Andesitic lavas outcrop between Tairlaw and the Pilot, and a number of dolerite sills occur, the largest of which crops out on Craiginmoddie Hill. A number of dykes outcrop throughout the region, but do not cover a sufficient area to affect the soils materially.

Carboniferous

Small areas of the Calciferous Sandstone Measures, the Lower Limestone Group, the Limestone Coal Group, and the Upper Limestone Group of the Carboniferous System occur near Dailly in the north-west of the sheet. The Calciferous Sandstone Measures consist largely of pale pink sandstones, with shales and cementstones. The soils derived from them in this area very closely resemble those on the Old Red Sandstone strata. The Lower Limestone Group, the Limestone Coal Group and the Upper Limestone Group appear to make little contribution to the soils of the area.

Permian

A very small outcrop of red sandstones of Permian or uppermost Carboniferous age occurs north of Ballantrae.

Pleistocene and Recent

As implied at the beginning of this chapter some knowledge of the glacial history of the region is necessary to the understanding of the form, composition and distribution of the soil parent materials. During the Pleistocene glaciations the Southern Uplands were buried under an ice sheet which covered northern and central Britain. The general directions of the major ice movements in the South of Scotland are shown in Fig. 11. These have been deduced largely from a study of the distribution of erratics, the directions of glacial striae, and the alignments of roche-moutonnées, crag-and-tail, and drumlin features. The Baron Stone of Killochan, a very large boulder of Loch Doon granite weighing several tons, is a notable example of a glacial erratic; it occurs on the hillside beside the Girvan Water, 2 or 3 miles north-east of Girvan. The ice which deposited it probably moved initially north-westwards from the Loch Doon outcrop before being deflected first westwards and then south-westwards by the ice advancing south from the Highlands. Roche-moutonnées and glacial striae have been noted in the hill areas around the Loch Doon granite, while drumlins are extremely well developed in the south of the area.

The presence of considerable numbers of Loch Doon granite boulders in central Ayrshire extending as far north as Darntaggart, south of Ochiltree and in the vicinity of Ayr, together with the absence of erratics of Highland origin in south Ayrshire, indicate that the area was not over-ridden by ice from the Highlands but formed a centre of snow accumulation and nourished glaciers of considerable strength. The main centre of accumulation was probably the area between the Merrick, Kells and Lammachan Hills. The presence of granite boulders on the summit of Merrick shows that the highest ground was at one time over-ridden by ice. During the waning of the ice sheet it is probable that valley and corrie glaciers were maintained in these hills after the ice had disappeared from the surrounding country.

The main area of ice accumulation has been severely eroded. Much of the higher ground has been left as bare rock or with a very thin cover of stony drift. This is particularly so in the area of the Loch Doon and Fleet granite outcrops, where hills such as Craignaw are virtually bare, while

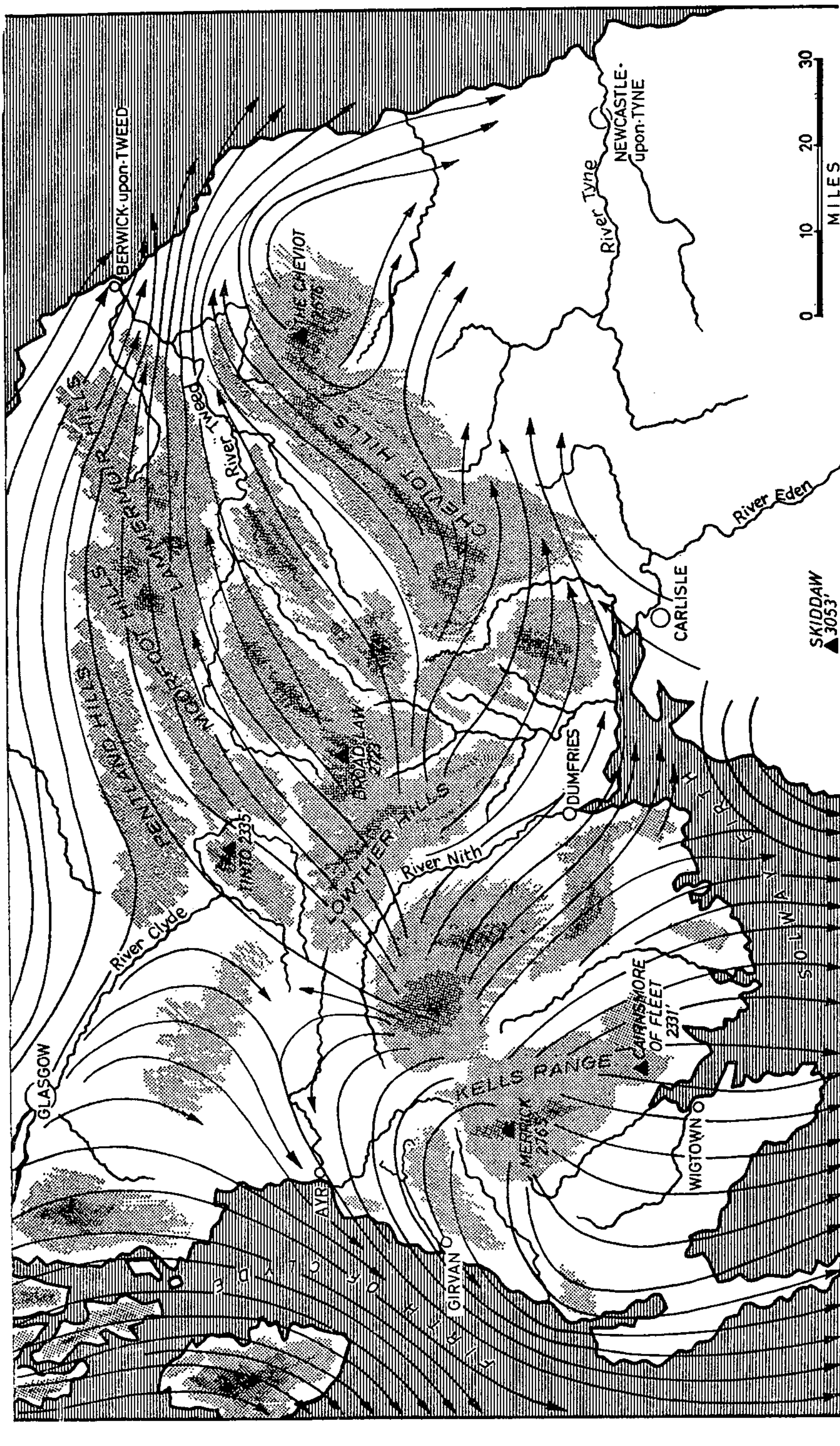


FIG. 11 Generalized Directions of Ice Movements in the South of Scotland

over much of the remaining area not covered by peat rock is within 12–20 inches of the mineral soil surface.

A further feature, probably associated with glacial agencies and greatly influencing the soil pattern, is the extremely rugged nature of such hills as Garwall Hill, Balunton Hill, Bennan and Eschoncan Fells to the west of Merrick, most of the hills of the Lamachan group, and Benbrack, Rig of Clenrie, Torrs, Gary Craig and others to the east of the Kells. It seems probable that these features are in part at least due to the plucking of blocks of rock by ice, as well as to the differential erosion of soft and hard strata. The various types of micro-relief so produced give rise to the large number of soil complexes discussed in the chapter on soils.

The corrie features, formed by the headward erosion of glaciers and associated with most of the hills over 2000 feet, account for a considerable number of steep bare rock slopes such as those on the north side of Merrick and Corserine. The steep sided, U-shaped valleys, typical of glacier erosion, are well exemplified in this locality. The effects of these steep slopes on soil formation are discussed in chapter 4.

Deposits of the material eroded and transported by the ice occur throughout the area. The till cover on the hill crests is thin, stony and of medium texture. Till of considerable depth has been deposited, however, on the lower hill slopes in the valleys of the north and west. Good exposures of these tills can be seen in the cuttings along the Laurie Burn near Auchenflower, along the Muck Water, at Dobbingstone, and along the Auchengairn Burn. The texture and nature of these tills varies according to the rocks from which they were formed.

In the south of the area covered by this memoir, between Creeside and Benbrake Hill west of Derry, till has been deposited in the form of scattered drumlins, generally aligned south–south-west in the direction of ice flow. The isolated pattern of occurrence and the characteristic topographic form of these deposits both play an important part in determining the soil pattern developed in the locality.

North of the drumlin field, on the moors to the north and west of Barrhill and extending eastwards into the Minnoch Valley, are a large number of mounds of moraine, of coarse-textured unbedded rock debris. These were deposited during the Minnoch stage of ice-wastage (Charlesworth, 1925). A similar extensive moraine field occurs around Carsphairn, and smaller extents of similar deposits occur in the area of the Loch Doon granite outcrop, in the valleys leading from the surrounding hills, and in the valley of the Dee south of Clatteringshaws Loch.

There is little evidence in the Girvan-Carrick area of fluvioglacial sands and gravels deposited by melt-waters flowing from the waning ice sheet.

Along the coast successive levels of raised beaches mark halt stages in the relative fall in sea-level, generally attributed to the isostatic recovery of the land surface after deglaciation. The 25-foot beach is the most extensive and its sandy deposits form a distinctive soil parent material.

After glaciation the drainage system re-established itself in a pattern which in its essentials resembled that existing before the ice age. The narrow tracts of alluvium along the stream banks are the most recent deposits on which soil formation is recognised.

SOIL PARENT MATERIALS

Ettrick Association

The rocks of the Ordovician and Silurian systems, which are predomiantly greywackes and shales, give rise to the parent materials of the Ettrick Association. The conglomerates of the Barr Series, on which soils of the Benan Association have been mapped, are an important exception. Walton (1955) following Pettijohn (1949) considers a typical greywacke to be a poorly-sorted sandstone which has as its principal constituents quartz, feldspar, and rock fragments set in a fine matrix of clay, chloritic or micaceous material. The rock is hard, generally grey in colour, the shade of which is variable.

The original sediments were formed by the rapid physical and incomplete chemical breakdown of pre-existing rocks, and were deposited rapidly after transport over a relatively short distance. Hence it is to be expected that the nature of the sediments will vary with that of the ancient rocks from which they were derived. From the analyses in Appendix VI it is evident that the elementary chemical composition varies from that approximating to the composition of an acid igneous rock such as granite to that of a rock of intermediate basicity like andesite.

Occasionally raw humus has accumulated and a rudimentary soil formed on virtually bare-rock surfaces, but more generally the soils are developed on unconsolidated detritus formed from the solid rocks. The least travelled of these materials is the debris resulting from physical weathering such as frost shattering of the underlying solid rock (Ragg and Bibby, 1966). It is of limited occurrence, but a good exposure can be seen in the cutting beside the track passing up the south side of Sandloch Hill in Glen App, and it probably also covers the tops of Corserine and Carlin's Cairn Hills. The fine material is of loam or sandy loam texture, and angular greywacke stones are frequent, becoming abundant with depth before merging into solid rock.

The other materials of this association have been formed as a result of the comminution and transport of the rock by ice. They are of two types, till and moraine. The till deposits are the more extensive, covering over half the area of the association. As at the eastern end of the Southern Uplands, there is both a stony medium-textured drift and a fine-textured till (Muir, 1956; Ragg, 1960).

The fine-textured till occurs in the north-east of the sheet in the valleys around Waterhead, and to the south-east of Girvan along the valleys of the Muck, Duisk, and Stinchar Rivers in the area between Ballaird and Glendrissaig and around Beneraird. The clay loam to clay till is pale greyish brown in colour, very firm when moist, becoming plastic when wet, with sub-angular to sub-rounded greywacke stones occurring frequently throughout the mass. In deep exposures the till is often compact or moderately indurated.

Over much of its area, however, this clay loam till is overlain by a thin cover of loam or sandy loam drift. The precise mode of formation of this coarser material is uncertain, indeed several different processes may have given rise to an apparently similar deposit in different areas. In some areas material carried on the surface and within the upper layers of the ice may have been deposited during melting on top of the main bulk of till as ablation moraine. Alternatively, as in other areas, a temporary readvance of the ice may have left a thin cover of sandy-textured drift, while areas overlooked by hill ground may have received a cover of the stony hill drift as a result of solifluction movements when periglacial conditions prevailed. Whatever the actual mode of formation, as a soil parent material its behaviour is similar to that of the medium-textured drift of the hills and drumlins, and the same soils occur on both. The different but related soils of the Ettrick, Kedslie and Alemoor series occur where the fine-textured till is not covered.

The stony loamy drift occurring as a thin covering over most of the hill areas, and to considerably greater depths in the drumlins to the south of the area, is very similar to that described for the east side of the Southern Uplands (Muir, 1956; Ragg, 1960). It gives rise to the same freely drained soils of the Dod and Linhope series, as well as to soils of the wetter Altimeg, Littleshalloch and Dochroyle series not previously mapped. This drift is a light brownish grey loam to sandy loam. Apart from a very slight tendency to platiness near the surface it is completely massive in structure, no units or aggregates being discernible. The material is stony; hard sub-angular greywacke stones varying in size from grit to large boulders are of frequent occurrence. The large numbers of small particles of rock impart a gritty feel which is typical of the soils of this association. Examination of the cavities left by removal of stones from the face of an exposure shows them to be set in a hard matrix of fine material in which there are a number of small vesicles, as described by Glentworth (1944) for indurated soils in Aberdeenshire and later by FitzPatrick (1956).

The extensive mounds of morainic debris constitute the other important parent material of the Ettrick Association. These occur mainly on the moors north and east of Barrhill, in the Minnoch Valley, and around Carsphairn. Seen in a large exposure such as a quarry face, the moraine resembles the medium-textured drift described above. The colour is generally greyer than that of the drift, varying from grey to light brownish grey, and the very gritty sandy loam or loamy sand texture is noticeably coarser than is usual for the drift. Evidence from a large number of quarries recently opened up by the Forestry Commission shows the deposits to be completely massive, entirely lacking in structural cracks or aggregates, and very strongly indurated throughout the exposures which are often 15–20 feet deep. The character of the induration is similar to that found in the till, the linings of the stone cavities having the same coatings of fine material with numerous small vesicles. The moraines have a very high stone content, hard sub-angular greywackes of all sizes up to boulders occurring throughout the mass without any indication of sorting or bedding. Usually the stones of the moraines show a higher degree of angularity than do those of the finer-textured till and are probably therefore less far-travelled. Well developed profiles of the Linhope and Dod series are the only soils which have been mapped on this parent material, apart from peat which occurs when the H horizon of the Dod (peaty podzol) series exceeds 12–15 inches, as often happens on the gently sloping tops of the mounds.

The nature of the induration which is such a notable feature of the drumlin and moraine deposits is not yet fully understood. The friable or slightly firm A and B soil horizons are developed above and pass down with a sharp change into the indurated greywacke drift which shows little further change with depth. Unlike the indurated layers in the north-east of Scotland (Glentworth, 1964) which are often less than 18 inches thick, those under consideration are very much deeper and have only rarely been observed to pass into non-indurated material with depth. In Scotland, where weathering conditions are relatively mild, pedological agencies in post-glacial times have had little effect at depths greater than 4 feet. It seems unlikely therefore that the induration of tills in this area to depths in excess of 10 feet can be ascribed to such processes, particularly as other signs of pedological action or weathering are absent at such depths.

The induration of these materials is probably best considered as a feature of the deposits, present before or during the very early stages of the initiation of soil formation, and a result of the mode of deposition by ice or to periglacial conditions operative immediately after deposition. The main features of these greywacke deposits noted above are the massive structure with a tendency to platiness and the vesicular sheaths of fine material surrounding stones, which accord well with the observations of Fitzpatrick (1956). He considers the induration to be the fossilized effect of permafrost, soil development having been confined to the surface layers subjected to freeze-thaw processes. The A and B soil horizons are certainly sharply differentiated from the underlying indurated C horizon, which appears to impede the percolation of drainage water on the tills, though not on the moraines, and to prevent the penetration of roots and other pedological agencies.

The A and B horizons of the freely drained soils on these drifts often appear slightly finer in texture than the underlying material and it has been suggested that this may be due to an addition of loess or cover sand in the immediate post-glacial period.

Benan Association

The parent materials of this association are the conglomerates of the Barr Series in the Girvan area and the tills derived from them. The rocks are dark grey and blue conglomerates, the cobbles of which are of mixed derivation but are mainly of a basic nature. The outcrops of the Stinchar Limestone which occur between the upper and lower conglomerate beds are too narrow in the steeply-sloping country of the main outcrop to contribute appreciably to the soils. Much of the area of the outcrop of the rocks of the Barr Series is virtually till-free and soils are developed on the weathering surface of the conglomerate. The rocks are extremely permeable, leading to the development of mainly freely drained soils.

Small areas of till derived mainly from the conglomerates do occur in the depressions, and are the parent material for the imperfectly drained Minuntion series and the poorly drained Lanes series of the Benan Association. The till is a clay or clay loam, has a massive structure and is generally less than 5 feet thick.

Generalized description of the till of the Benan Association: Reddish grey (5YR5/2*) clay loam, massive, very firm, containing many rounded basic igneous and sub-angular greywacke stones.

In an area to the north of Auchensoul Hill and another to the west of Knockeen, the conglomerate has weathered to give a well defined pattern of mounds and hollows. The hollows contain a thin cover of drift, while on the mounds the soils are developed directly on the weathering conglomerate. The resulting soil pattern is an intricate mixture of poor and freely drained soils, and has been called the Auchensoul complex. This form of weathering seems typical of the formation, since the tendency for a moundy micro-relief to develop occurs throughout the area. Where development is less pronounced than noted above the soils generally show only slight variation in their degree of free drainage and depth.

Darleith Association

The basic igneous rocks of the area together with their associated tills give rise to the parent materials of the Darleith Association. The rocks and the location of their outcrops have already been described. Analytical data for some of the rock types which make up this group are given in Appendix VI. The serpentine and other ultra-basic rocks differ in their composition from the other parent rocks of the association, having a particularly low silica content and a very high magnesium level, far exceeding that of all the other bases combined. The values for calcium, sodium and potassium are very low. In addition the content of total iron is relatively low, and that of aluminium very much less than in the other rock types of the group. Despite the unusual features of the ultra-basic rocks, however, all the rocks of this group have the common features of a low silica content and an abundance of bases in a form from which they can be fairly easily liberated by weathering.

Two types of soil parent material are formed from these rocks: a very thin cover of stony medium-textured drift or frost-shattered debris, and a thicker deposit of clay or clay loam till. The shallow deposit, which is usually *in situ* or little-travelled, is most common on the spilitic lavas which make up a number of the prominent hills in the Ballantrae area, such as Knockormal and Knockclaugh Hills. Because of its nature and topographic association it always gives rise to the freely drained Darleith series.

This type of material rarely occurs on the serpentine areas; these are covered by the second parent material of the association, the clayey till.

Generalized description of the fine-textured Darleith till: Brown (8.5YR5/2) extremely gritty clay loam; very firm, massive; abundant moderate to small sub-angular ultra-basic and spilitic lava stones, a few small faint, light olive-grey (5Y6/2) mottles.

The till generally consists of a mixture of the rock types of the group together with a small amount of greywacke material, as indicated by its content of erratics. From the evidence of the stone content of the till, as examined in profile pits and exposures, its composition is somewhat

* Notation used in Munsell soil colour charts (Munsell Color Co. Inc., 1954).

variable, being dominated by the underlying rock type with a lesser content of the other rocks of the group; nevertheless it behaves in a relatively uniform manner and no sub-division has been attempted. The soils are imperfectly and poorly drained.

Glenalmond Association

The sedimentary rocks of the Old Red Sandstone System in South Ayrshire give rise to the parent materials of the Glenalmond Association; as with the other formations this comprises a group of materials with a common or related origin. Analytical data are not available for the rocks of this area, but the sediments are generally quartzose.

The least-travelled material of the association is the frost-shattered sandstone of which good examples occur on the upper slopes of Brae Hill and Hadyard Hill, bordering the south side of the Girvan Valley. The permeability of the rock together with the good run-off characteristics of the relatively steep slopes ensure that the soils developed are freely drained brown forest soils or peaty podzols.

The more characteristic and generally occurring parent material of this group is a sandy clay loam till. The till is generally derived from sandstones, but in this area contributions from the occasional beds of conglomerate can be noted from the presence of rounded cobbles.

Generalized description of the fine-textured Glenalmond till: Reddish brown (2.5YR5/4) sandy clay loam; massive; firm; occasional rotting sandstone and greywacke stones; black staining, probably MnO_2, common.

The till is characterized by its red-brown colour and sandy clay loam texture, the coarse sand particles giving it an abrasive feel. All the soils developed are imperfectly or poorly drained.

The areas of this till occurring in the Girvan and Carrick area are the southernmost extension of a till which is of widespread occurrence further north and is described in the memoir (Grant, in preparation) for Sheet 14. As is often the case when a till is of widespread occurrence a number of local variations are found, particularly where it borders other contrasting tills. The more important occurrences of variations from the mode established in the area to the north are noted below. In the vicinity of the hills to the north-east of Ladywell Farm near Girvan, and around Burnhead the colour of the till changes to a pale dull reddish brown. A number of rotting white sandstones from nearby outcrops of Carboniferous rocks occur in the till, together with some greywackes and igneous stones from nearby formations, and these probably account for the slight change in its nature. The small deposit of till derived from Old Red Sandstone near Pinminnoch is fairly typical in its appearance but contains a number of round igneous cobbles from the Benan conglomerate and some locally outcropping greywacke.

The variant occupying the greatest area occurs on the middle slopes of the south side of the Girvan Valley, from Dobbingstone to just south of Camregan. In this locality the till contains a considerable number of erratics, mainly acid porphyrite, felsite, and greywacke. In an exposure beside Dobbingstone Farm, weathering has left these relatively hard erratics prominently exposed over the till face, giving it the appearance of being largely derived from these rocks. Examination of fresh material, however, shows the typical appearance of the red sandstone till with many soft weathering sandstones and a few unweathered erratics. The felsite and greywacke appear to contribute little to the fine fraction but are widespread, due to their resistance to abrasion during transport by ice. Further east the proportions of felsite and greywacke in the till increase, and soils of the Blair Association have been separated.

Along the lower slopes of the Girvan Valley and its tributary stream the Lindsayston Burn, the Old Red Sandstone till at depths greater than 3 feet is similar to that described above. The upper layers of the till, however, appear to have been modified. They are coarser in texture, varying from loam to sandy loam or occasionally to loamy sand. The depth to which modification has taken place and the intensity are variable, but it seems that in general the greater the depth of modification, the greater is the change in texture of the surface horizons. If modifications can only be detected to 12 inches the surface soil is unlikely to be coarser in texture than a loam, but if the unaltered till is at some depth, such as 5 feet, the upper 24 inches are likely to approximate to loamy coarse sand. This effect appears to be mainly associated throughout Scotland with the lower parts of hill slopes, at fairly low altitudes, and with drainage channels. It is possibly due to the effects of glacial melt-water percolating through and over the upper layers of till in late-glacial or post-glacial times, and being prevented by permafrost from escaping into the deeper layers of till. It is, however, emphasised that the cause of the change in texture of the till surface is not fully understood. The effect is important pedologically and agriculturally, and is further discussed in the chapter on soils. The soil developed on this parent material is generally the freely drained Tranew series, but in some areas the imperfectly drained Gallowshill series occurs.

Dalbeattie Association

The parent materials of this association are derived from the rocks of the granitic intrusions in the area. The complex nature and the mineralogy of these intrusions have already been described. Chemical analyses of representative rock types are quoted in Appendix VI. The percentage silica generally ranges from 60 per cent to a little over 70 per cent, except for the basic lobes of the Loch Doon mass and the lenses of the Carsphairn and Burnhead masses where the silica percentage may be as low as 51·5 per cent. Both the norite and the tonalite have a moderate magnesium and calcium status; the proportions of these elements in the granite are low.

The nature of a rock greatly affects the rate at which elements are released. Two important features of these rocks are the low rate of weathering of the minerals and the large average size of the crystals. As a consequence the rate of chemical breakdown of fresh rock is slow, although physical disintegration of the rock into its constituent mineral grains may, under certain circumstances, be very rapid. An example of this type of disintegration is well shown in a Forestry Commission quarry about one and a half miles south-west of Craigmalloch (NX 462935) at the south end of Loch

Doon where along a face of 20 to 30 yards and to a depth of about 15 feet the soft rock, which falls easily into its constituent grains, has been removed for the surfacing of forestry roads. This weathering probably pre-dates Glacial times, occurring under the warmer conditions existing in the Pliocene period. Hydrothermal alteration before sub-aerial exposure may also have contributed. In glacial till where the minerals have been ground to a fine powder changes may be much more rapid.

Glaciation has swept much of the granite area bare of detritus and exposed large numbers of polished rock surfaces, particularly on Craignaw Hill. Many of these surfaces are covered by shallow raw humus or peat, and on such sites soil development is very restricted.

Pedologic development has progressed somewhat further on the shallow till deposits against the lower hill slopes. The till is pale grey in colour and of gritty loam texture, and the coarse quartz and feldspar particles are easily distinguished in the fine material and largely account for its gritty feel.

Generalized description of the till of the Dalbeattie Association: Grey-brown (10YR5/2) very gritty loam; massive; very firm to weakly indurated; occasional sub-rounded granite stones.

Moraines composed of granite debris occur mainly in the valleys of the Cooran Lane, Black Water of Dee, and the Buchan Burn, and around Loch Twachtan. The moraines are a sandy loam to loamy sand in texture and contain many sub-angular to sub-rounded stones and large boulders; they are generally indurated in a manner similar to that described for the moraines derived from Ordovician and Silurian greywackes and shales.

Knockskae Association

The acid porphyrite and felsite intrusions and their detritus form the parent materials on which the soils of the Knockskae Association are developed. Analytical data for specimens of rocks from this area are not available, but similar rocks from elsewhere show that they resemble granite in chemical composition (Appendix VI). The rocks are extremely hard and resistant to physical and chemical weathering, and their detritus is extremely stony, being composed largely of small angular rock fragments with a limited amount of interstitial fine material. Frost-shattered debris is the most extensive material of the association. A small area of sandy clay loam to loam till does occur to the west of Garleffin Fell, but it is probable that some of the fine material is derived from nearby sandstones.

The stony frost-shattered debris usually carries freely drained soils, while those on the sandy clay loam till are poorly drained.

Blair Association

The soils of the Blair Association are developed on a mixed till derived from Old Red Sandstone sediments, acid porphyrites and felsites, greywackes and, locally, some basic lavas. The till was formed by ice moving north-westwards and westwards from the Loch Doon granite area, carrying considerable greywacke material, passing over the andesitic lavas around Tallaminnock and the felsites of Craig of Dalwine, Garleffin Fell, and Tairlaw on to the softer red sandstone between Doughty Hill and Dobbingstone. As would be expected from this mode of formation, the till is very variable; the proportions of the constituent rock types vary considerably in different localities, with the underlying rock generally appearing dominant. The till is usually confined to depressions and the lower slopes of hillsides underlain by sandstones of Old Red Sandstone age. The higher-lying areas carry a thin drift derived from the underlying rock. The main deposits in this area occur along the road from Milton to New Dailly and on the southern slopes of Glenalla Fell where the till is a reddish brown to brown sandy clay loam of massive structure and of very firm consistency. Sub-angular greywacke and felsite stones appear prominently throughout the till. The soils developed on this material are the poorly drained non-calcareous gley (Blair series) and the peaty gley (Falaird series).

Linfern Complex

In an area around Linfern Loch a number of moundy moraine deposits of very mixed origin occur. The material, derived mainly from greywacke, red sandstones and basic lavas, is a brown gritty loamy sand to sandy loam, of massive structure and generally strongly indurated, containing abundant greywacke and some sandstone and basic igneous stones.

Yarrow Association

Soils of the Yarrow Association have been mapped on sands and gravels occurring in a small area near Burnfoot on the south bank of the River Stinchar, in Glen App and at Larg. The deposits, which are probably of fluvioglacial origin, consist of coarse sand and gravel, the stones being well rounded and mainly greywackes.

Darvel Association

Soils of this association have been mapped on shallow deposits of sand and gravel occurring to the west of Dailly, where they are associated with modified deposits of till derived from Old Red Sandstone. The deposit is of mixed origin, containing fragments and pebbles of basic lavas, felsite and granite, while much of the sandy material is derived from the Old Red Sandstone and Carboniferous sediments outcropping locally.

Balig Association

A small area of gravel deposits near Corseclays Farm, derived from basic and ultra-basic rocks, has given rise to the soils of the Balig Association.

Dreghorn Association

The raised beach deposits which occur in a narrow strip along the coast from Girvan to Downan Point form the parent material on which soils of the Dreghorn Association are developed. The 25-foot beach is the most extensive with smaller areas of 50-foot and 100-foot beach. The beach deposits are coarse in texture—sandy loam or coarser—and are of mixed origin; grains of greywacke and dark mafic minerals are of frequent occurrence.

Links

Stabilized blown sand occurs on the 25-foot raised beach in two small areas, one north of Girvan and the other south of Bennane Head. The material consists of coarse sand and occurs as low mounds or stabilized dunes. The freely drained Links series has been mapped on this parent material.

Alluvium

Tracts of alluvium occur along all the major drainage courses of the area and along many small burns. Material is still accumulating on some of these areas, but little deposition is now taking place on the areas along the lower courses of the Rivers Stinchar and Girvan.

4 Soil formation, classification and mapping

Man has been familiar with soils from the earliest times, and their nature and ability to grow crops have exerted a major influence on his existence. As naturally-occurring bodies, soils have many different forms and their properties show wide variation. They consist of mineral and organic materials and are formed by the break-down of rock and mineral deposits through the agencies of physical and chemical weathering in conjunction with the action of plants, animals, and their organic remains. Rock which is weathering by physical and chemical agencies alone is not generally considered as soil, yet these agencies play such a large part in soil formation that the clear delimitation of soil from non-soil in both lateral extent and depth is difficult. From the recent finding of bacteria and micro-organisms in the weathering crust of boulders (Webley *et al.*, 1963) it seems probable that biotic influences are active on many exposed natural mineral materials, so that in a strict sense materials such as screes and lichen-covered rock surfaces are soils, if only in a very early stage of formation. In practice such materials are of limited occurrence in south-west Scotland and the surveyor is mainly concerned with soils in a more advanced stage of development on which there is a complete vegetation cover of higher plants and which are several feet in depth.

During soil formation the organic residues of plants and animals, together with the inorganic material of the system are broken down and the degradation products are removed or redistributed to form layers or horizons of soil, which differ in appearance and properties. The soil profile, which is a vertical section through these successive horizons, and is typified by their arrangement and properties, is a natural unit for soil study and is fundamental to the characterization of mapping units.

As previously stated, the soil results from the action of climatic and biotic agencies acting on rocks and other mineral materials, and the type of soil produced depends on the nature of these agents, the material on which they act and on the length of time for which they operate. Also, in practice it is found that soils show a high degree of correlation with topography, and although its influence is manifest largely through its effect in modifying the action of the factors mentioned above, it is extremely important in soil study and mapping. Jenny (1941) has termed these the five soil forming factors, namely, Parent Material, Climate, Organisms, Time and Relief. Before discussing them separately brief mention will be made of the main processes which these factors bring about in a temperate area such as Scotland.

The soils found in south Ayrshire and Galloway represent varying degrees of expression of characters associated with two main soil processes, leaching and gleying. These processes are most active under conditions of free drainage and good aeration, and impeded drainage and poor aeration, respectively.

Stated briefly, chemical weathering proceeds by the hydrolysis in a number of stages of primary rock minerals into the simple salts and oxides of their constituent elements. Soil clays are formed as part of this process. Unimpeded drainage leads to the removal in solution of the liberated basic ions, such as Na^+, K^+, Ca^{++} and Mg^{++}, except where these are held by the clay minerals and organic matter as part of the exchange complex. Under the cold and humid conditions prevailing in Scotland there is a strong tendency to the displacement of the exchangeable cations by hydrogen ions, with subsequent leaching of the cations. The acid condition induced by a high proportion of hydrogen ions on the exchange complex leads to the reduction of earthworm numbers and of other biotic activity, and consequently the breakdown of plant remains is slow and raw humus accumulates on the surface. It is thought that products of this raw humus and of plant litter are mainly responsible for the leaching from the upper horizons of podzolic soils of iron and aluminium oxides, which may be redeposited further down the profile. Under prolonged and intensive leaching the soil becomes very impoverished of plant nutrients.

Under impeded drainage conditions, water movement down through the profile is slow and often takes place laterally through the soil. The removal of bases is therefore limited, although the breakdown of primary minerals and clay formation appear to be somewhat more rapid than under drier conditions. The soil pores and spaces are largely water-filled for long periods, with consequent exclusion of air and oxygen. Reducing organisms dominate the soil micro-flora, and chemical radicals such as the ions of iron, which can exist in several valency states, become reduced and, in the case of the ferrous ion, soluble and liable to removal in the drainage water. The soil colour becomes dominated by grey and blue hues. Under persistent waterlogging the breakdown of plant remains is slow and they accumulate on the surface as peat deposits of variable thickness. The low oxygen tension renders soils unfavourable to plant roots other than those of specialized plants such as, for instance, species of *Equisetum*.

The five soil forming factors are now considered separately, but it is inherent in their nature that besides affecting the soil directly they interact with each other, as in the cases of climate and vegetation, parent material and topography, or relief and climate; and in the particular instance of the biotic factor they are strongly influenced in turn by soil conditions.

Parent Materials

Parent materials probably exert their main effects on soil formation by virtue of their base content and the impedance they offer to drainage. Rock materials rich in bases generally contain a high proportion of relatively easily weathered minerals, so that the bases as well as being abundant are also more readily and rapidly released in the soil. Bases lost by leaching are replenished and the appearance of characteristics typical of highly leached soils is retarded. Thus along the Stinchar Valley the freely drained soils of the Benan and Darleith Associations, formed on base-rich parent materials, only rarely show development of raw humus even at 900 feet, while in the Ettrick Association, on an intermediate to acid parent material, the peaty gleyed podzol (Dod series) is commonly well developed with six inches or so of peat or raw humus at 600 feet. Comparison of the brown forest soil profiles in these associations also shows differences between the Benan and Darleith series and the Linhope series. One of the striking features of the latter soil is the brightly coloured yellow-brown B horizon, strongly contrasted with the brown A horizon, while in the Benan and Darleith series the brown colours of the A and B horizons differ only slightly.

A prominent feature of the mineral soils of the Benan and Darleith Associations is the well developed strong crumb structure of their surface horizons. This is probably due in part to the high biological activity consequent on the relatively good base supply, with the ready breakdown of plant remains and production of mucilages and cementing agents by the micro-organisms, but is also thought to be connected with the high content of iron oxides, released from the abundant ferro-magnesian minerals. In this they resemble the B horizons of some freely drained soils with a lower base status and lower biological activity where the good crumb structure and highly friable nature are attributed to their iron oxide content.

It is mainly through variations in clay content that parent materials affect soil drainage, but drainage can also be influenced by the presence of indurated or compact layers ascribable to glaciological agencies—the effect on drainage of similar layers ascribable to pedological factors cannot be considered a parent material effect. The morainic deposits of greywacke and granitic detritus which are present in the Ettrick and Dalbeattie Associations respectively, give rise to soils having very free drainage, even under an average rainfall of 80–90 inches. Soils developed on the sands and gravels of the Darvel and Yarrow Association are also freely drained, and this clearly indicates that these coarse-textured materials readily allow the passage of water through them without becoming waterlogged. The clay and clay loam till of the Darleith Association, however, under the much lower rainfall of 40–45 inches, invariably carries soils with poor and imperfect drainage which show prominent signs of gleying.

The Dochroyle series, a peaty gley soil, is typically developed on medium-textured greywacke drift, and often occurs on hill slopes where good run-off would be expected. The apparently anomalous drainage impedance found in this series is probably due in part to the strong induration of the parent till, which often occurs at about 2–3 feet and extends downwards throughout the deposit.

Climate

The most important climatic elements affecting soil genesis are rainfall and temperature, governing the amount of water available for leaching or to cause gleying, and the energy for weathering and biotic activity. The climate of the area has been described in Chapter 2 and much of the variation in its elements is attributed to topographic factors.

The high rainfall away from the coastal strip is the most notable characteristic of the area, and because of it most of the soils are intensely leached or gleyed. South of the Southern Uplands Fault, persistent waterlogging has led to the accumulation of blanket peat over large areas. Dochroyle and Dod series, both of which have very well developed 'H' or 'peaty' horizons, are usually associated with the peat, and the brown forest soils belonging to Linhope and Altimeg series are of localized occurrence. In the area of the Loch Doon granite outcrop, where precipitation exceeds 70 inches, the brown forest soil associate (Dalbeattie series) is virtually absent.

North of the Southern Uplands Fault the rainfall is somewhat lower, 40–50 inches, and its effects are modified by the occurrence of base-rich parent material on which peat and organic soils are rare. Over the areas of Hadyard Hill and Garleffin Fell climatic conditions and the soils are similar to those further south.

Variations of temperature in the area are largely induced by, and conform to changes in altitude. The lower temperatures encountered at high altitudes such as on the Merrick and Kells Hills greatly reduce the length of the growing season, the rate of plant growth and of the bacterial and fungal activity causing breakdown of plant remains. It appears that, within limits, bacterial and fungal activity is affected more than plant growth, so that low temperatures reinforce other factors such as high moisture and acidity and lead to the build up of surface horizons of raw humus.

Another important effect of low temperatures results from freezing of the soil moisture, the consequent expansion of which breaks up many structural peds into smaller units. Over most of the area the ground is frozen only for short periods during each winter, but on the Merrick and Kells Hills the mean night minimum temperature is below freezing point for about five months of the year (Chapter 2). This, together with relatively low mean annual temperatures, is an important factor in the formation of the mountain or sub-alpine soils found on these hills. Notable features of these soils are the physical mixing of mineral matter and raw humus in the upper layers and the very loose open nature of the soils, both of which are thought to be a consequence of the soil heaving which takes place after each freeze-thaw cycle. The slow rate of chemical weathering of these soils is also influenced by the low annual temperature.

Relief

Relief influences pedogenesis through its effect on the water relationships of the soil and through its effect in locally modifying the climate. The latter effect, which is mainly a consequence of altitudinal variation, has already been discussed under climate. The hydrologic conditions in the soil are affected in two ways, firstly by the influence of the degree and configuration of the slope at any site on rainfall and infiltration and secondly by the role of relief in controlling the position of the water-table in the soil and rock.

The drumlins occurring between the River Cree and Derry afford a good illustration of the influence of slope. These deposits are especially useful for the study of the effects of slope because the other soil forming factors appear to be virtually constant. The parent material is a fairly uniform deposit of loam till, and as it is of small extent, rarely exceeding $\frac{1}{2}$ mile in length and 75 feet in height, there is no change in climatic soil forming factors other than aspect and slope. Drumlins are also found showing uniform effects of cultivation and period of soil development.

On the mound behind Ochiltree Cottage the steep sides carry the freely drained Linhope series while on the almost flat top is the imperfectly drained Altimeg series. Barnecallagh mound, north of Derry, carries the peaty gley Dochroyle series on its gently sloping top, while the steeper south-facing side has a well developed podzol Dod series. The north slope of the mound is even steeper and here the brown forest soil of the Linhope series has developed. The parent material of these features is not sufficiently permeable to prevent waterlogging on a level topography, but the considerable degree of slope connected with these deposits allows lateral movement of water out of the profile, thereby reducing the moisture available for leaching. Thus soil development on the north face is less intense and has only reached the acid brown forest soil stage whereas the south slope carries a peaty podzol. A similar effect is often seen on the moraines of the Minnoch Valley and around Black Clauchrie. Slope therefore appears to reduce the action of rainfall, the effect increasing with steepness of slope.

'Flush' soils of the Littleshalloch series commonly occur on concave hill slopes such as Greensides Hill and Cairnhill where the configuration of the slope is such that mineral-rich ground waters come to the surface, maintaining waterlogged conditions over long periods, but also maintaining a fairly high base status and thus retarding peat development.

Biological Agencies

The biotic factor as it operates in this area may be considered under two headings, the effect of natural and semi-natural plant communities and of the activities of man. Man's activities, within certain limits, are independent of soil and other conditions and come within Jenny's definition of an independent soil forming factor (Jenny, 1941). The natural and semi-natural plant communities, dependent as they are on climatic and soil conditions, are not a truly independent variable. Nevertheless an established plant community does affect the soil on which it grows. The amount of leaf fall and organic matter returned to the soil annually, the ease with which it is decomposed by micro-organisms, and its mineral content, play a large part in determining the form of humus in the soil and the rate of acidification.

Broadleaved trees promote a relatively high turnover of nutrients, which become readily available for plant growth owing to the ease with which their organic remains are broken down (Muir, 1935). The humus form is usually mull or moder, and is associated with brown forest soils. The remains from coniferous forest and ericaceous vegetation are less easily decomposed and usually form a mor or acid raw humus, and the turnover of plant nutrients is generally lower. Podzols and peaty gley soils are usually associated with these types of vegetation. The acid nature of the humus formed under these plant communities probably plays a significant part in increasing the rate of leaching (Crompton, 1956).

Earthworms are also important in determining the humus form of a soil, for they ingest soil and plant remains and excrete them as an intimate mixture thus converting the plant remains into the mull humus form. Where insects are the dominant form of animal activity the humus type is generally moder, and where earthworms and insect numbers are low, as is the case in acid soils, plant remains decompose slowly and accumulate on the surface as raw humus.

Man by his activity as a cultivator brings about great changes in soils. The operations involved vary widely, but are mainly devoted to making the soil a better environment for the growth of crop plants and to the establishment of these plants, although they also include many activities designed to make the natural vegetation more productive. The surface horizons, the organic H horizon and the organo-mineral A horizon are the most radically altered. Heather burning and peat stripping reduce or remove completely the surface organic horizon, while the H layer and A_1 and A_2 horizons of peaty podzols are completely destroyed by cultivation and liming. Regular application of fertilizers tends to counteract the effect of leaching, and mor and moder forms of humus may be converted to mull. In view of the drastic modification of the upper layers brought about by cultivation, the surface horizons of cultivated soils are designated separately in the system of horizon nomenclature as S horizons.

The installation of drains in poorly drained soils is a no less potent agent of change. Waterlogging is stopped or much reduced, and leaching may become dominant over gleying as the main soil process, with the consequent alteration of the profile from that of a gley to that of a brown forest soil with gleyed B and C horizons. Soil drainage is also improved by the disruption of an iron pan or indurated layer.

Time

The whole area under study was probably freed from the ice sheet at about the same time, so that soil differences attributable to differing times of development are of limited importance, except on the much younger deposits of blown sand and recently formed alluvium where horizon differentiation is limited to the development of an A horizon with very restricted B horizon formation.

SOIL CLASSIFICATION

The soils considered in this memoir have been classified according to the system provisionally adopted by the Soil Survey of England and Wales and the Soil Survey of Scotland. The soil series, which are the basic mapping units, have been placed into major soil groups and sub-groups which are further arranged into divisions, the highest category of the system.

The smallest soil unit suitable for taxonomic study is the soil profile or pedon (U.S. Dept. Agric., Soil Survey Staff, 1960), a vertical section through the soil as revealed in a pit or exposure, which consists of layers or horizons roughly parallel to the ground surface and differing from each other in such characteristics as colour, texture, stoniness, structure, and organic content, as a result of the differential removal and addition of material by pedologic processes. The soil series, which often extends over large areas, consists of many profiles which are not all precisely the same but show some variations of character at different sites. It is necessary for the pedologist to have a clear appreciation of the range of the general morphology of profile permissible in a series. In delimiting a series it is important that the whole morphology and horizon sequence of a profile be considered rather than any single character, and that in difficult instances full weight be given to those features understood to be fundamental to the genesis of the profile. The series as defined by the Soil Survey of Scotland comprises soils with similar type and arrangement of horizons developed on similar parent material.

Series with similar horizons arranged in the same sequence are placed in the same major soil sub-groups. The groups thus set up comprise soils on different parent materials which appear to have been formed by similar processes and to be at a similar stage of development. The major soil groups include two or more sub-groups, the soils of which show broad similarities in the arrangement but some variation in the nature of their horizons. The highest taxonomic category used is the division, in which major soil groups are placed according to which soil process, leaching or gleying, was dominant in their formation. The classification of the series in the area surveyed is shown in Table G, and the most important field properties of each category are described in this chapter.

The Soil Survey of Scotland also places soil series into soil associations according to the parent material on which they are developed. The association is defined as a group of soils developed on the same or related parent materials which characteristically occur together on the landscape. The parent materials found in this area have already been described in Chapter 3, but briefly the parent materials of an association consist of the drifts, including moraines and tills, derived from similar rocks. The soils of an association differ from each other principally in those features of their morphology conditioned by their hydrologic state or natural drainage. The association may thus serve to bring together for consideration the soils of a particular landscape formation and soils which have common features inherited from their parent material.

The higher taxonomic categories found in the area under consideration and their relationships are shown, together with the classification of soil series, in Table G. The more important field properties of each division, major soil group and sub-group are given below.

Division of Leached Soils

Leached soils are characterized by a uniformly coloured B horizon (some mottling may occur in brown forest soils with gleyed B and C horizons), absence of free lime in the upper horizons and an acid reaction.

MAJOR SOIL GROUP: NORMAL BROWN EARTHS

A uniformly coloured B horizon, a mull or moder humus formation and a moderately acid reaction are the characteristic features of the normal brown earth; usually each horizon merges into the one below.

Sub-group: Brown Forest Soils of low base status

Brown forest soils of low base status have a moderately acid reaction and humus of the moder type. Each soil horizon merges into the one below.

Sub-group: Brown Forest Soils with gleyed B and C horizons

Brown forest soils with gleyed B and C horizons are of moderate base status and moderately acid reaction. The B and C horizons show some gleying. The soils are frequently found on parent material of moderately fine to fine texture. Those of fine texture sometimes have a near neutral reaction in the C horizon or may contain a small amount of free carbonate.

Table G/Classification of Series

Division	Major Soil Group	Sub-group	Series
Leached soils	Normal brown earths	Brown forest soils of low base status	Darleith, Benan, Linhope, Dalbeattie, Balig, Darvel, Yarrow, Dreghorn
		Brown forest soils with gleyed B and C horizons	Dunlop, Minuntion, Glenalmond, Gallowshill, Altimeg, Kedslie, Drumyork
	Podzols	Iron podzols Peaty podzols (with thin iron pan)	Meadownay, Tranew, Knockskae Baidland, Knockinculloch, Hadyard, Dod, Carsphairn, Turgeny
	Sub-alpine soils	Sub-alpine ranker	Merrick
Gleys	Surface-water gleys	Non-calcareous gleys	Amlaird, Lanes, Altiwan, Littleshalloch, Ettrick, Blair, Whiterow
		Peaty gleys	Myres, Alemoor, Falaird, Eglin, Palmullan, Spallander, Dochroyle
Organic soils	Blanket peat Basin peat	Hill peat Low moor Raised moss	

MAJOR SOIL GROUP: PODZOLS

Podzols have a grey bleached A_2 horizon with weak structure, an H layer of raw humus and a strongly acid reaction. There is usually morphological and chemical evidence of the translocation of sesquioxides.

Sub-group: Iron Podzols

The iron podzol has a raw humus H horizon 1–3 inches thick. The A_1 horizon is dark in colour and incorporates raw humus while the A_2 horizon, having a low organic content, is paler. The B_2 horizon is well developed and bright in colour; there may be strong humus/iron staining at the top.

Sub-group: Peaty Podzols (with iron pan)

Peaty podzols have an H layer of raw humus up to 12 inches thick. The A_2 horizon may or may not be well defined; evidence of gleying, and a narrow layer of humus accumulation is usually present in the lower part. The B_1 horizon is a thin pan, often continuous, which is impermeable to water and roots. The B_2 horizon is bright coloured, while the B_3 horizon is paler, and there is little or no evidence of gleying in either horizon.

MAJOR SOIL GROUP: SUB-ALPINE SOILS

Sub-alpine soils occur at high altitudes where low winter temperatures prevail, freeze-thaw processes are important and biotic activity is low. Characteristically the soils are loose and stony and many have an acid reaction.

Sub-group: Sub-alpine Rankers

Sub-alpine rankers are shallow soils consisting of two main layers, an organo-mineral layer and the parent material. A surface layer of humus may also be present. The organo-mineral layer is high in organic matter, dark in colour, and somewhat resembles a raw humus horizon. In the upper part of the organo-mineral layer the stones and sand grains are white and bleached in appearance and in the lower part mineral particles and stones usually have a dark coating. Where the two layers have been distinguished they have been designated H/A and H/B horizons respectively. Where the organo-mineral layer has not been sub-divided in this way it has been recorded as an H/A horizon. A thin B horizon may occur occasionally. The organo-mineral layers are stony, loose, and have a very acid reaction.

DIVISION OF GLEYS

Gleys are mineral or peaty (H layer less than 12 inches) soils which have developed under conditions of intermittent or permanent waterlogging. A pale coloured A_2g horizon is often prominent in the upper mineral horizons beneath which the horizons are grey with a greenish or bluish tinge and ochreous mottling is present. These colours are of secondary origin and mask the colours inherited from the parent material.

MAJOR SOIL GROUP: SURFACE-WATER GLEYS

In a surface-water gley the effects of gleying are prominent in the upper horizons, but decrease with depth. In these soils the colour inherited from the parent material is more apparent in the B_3g and Cg horizons than in any other.

Sub-group: Non-calcareous Gleys

These soils have no free calcium in the upper mineral horizons. The H layer is usually not more than 1 inch thick and the A_2g horizon, often well defined, is present in the semi-natural soils.

Sub-group: Peaty Gleys

A peaty gley has no free calcium in the upper mineral layers but the H layer is usually well formed and over 2 inches thick. The A_2g horizon is always prominent.

Division of Organic Soils

Organic soils have more than 12 inches organic matter and are usually formed under waterlogged conditions.

MAJOR SOIL GROUP: BLANKET PEAT

Blanket peat is an organic formation which develops on both convex and concave slopes, generally as a result of climatic conditions of high rainfall, low temperature, and high humidity.

Sub-group: Hill Peat

Hill peat is found at high elevations on level ground or gently convex slopes, *eg* high level plateaux.

MAJOR SOIL GROUP: BASIN PEAT

Basin peat develops initially under the influence of ground water in depressions or poorly drained basins. The vegetation sequence in the profile is more complex than that of blanket peat.

Sub-group: Low Moor

Low moor is formed under marshy conditions with the level of the ground water at or above the surface of the formation.

Sub-group: Raised Moss

Raised moss is a more advanced stage in the development of basin peat than low moor. It is characterized by the position of the ground water which is below the surface of the formation.

SOIL SURVEY METHODS

The principal mapping units are the soil series and their extent and the boundaries between them are shown on the soil map. The series are established by a preliminary reconnaissance, during which profiles are examined in pits at widely spaced intervals. During the preparation of the detailed maps, the soil boundaries are established by digging small holes or by making auger borings at suitable intervals and recording the results on Ordnance Survey 1:25,000 maps. The soils are frequently found to be related to the topography, and once an understanding of the relationships has been gained an appreciation of landform can be of great help in the drawing of boundaries. Correlations of soil with vegetation are also helpful in indicating the extent of a soil type, particularly in natural or semi-natural areas.

Aerial photographs have proved a most effective cartographic aid in south-west Scotland. In moorland areas accurate location of ground positions on the Ordnance Survey map may be difficult, due to the scarcity of recognisable features, but it is usually relatively easy from the vegetational patterns or other fine detail shown on aerial photographs. Soil boundaries also may be related to the patterns shown by photographs, in which case much work is saved in establishing and tracing them, and in many cases improvements in accuracy are also obtained. It is, however, important to note that ground control by regular inspection is necessary.

During the survey of an area, profile pits are dug at selected sites typical of each soil series. The depth of each pit varies but is generally about 4 feet. The profile thus displayed is described in the standard terms which are defined and explained in Appendix I. The location and features of the site, and of the profile as a whole are recorded first, and then each horizon is described separately. The horizons are designated by symbols of common significance to the horizons in any major soil group, but when used in different major soil groups the same symbols indicate only a general similarity. The symbols and general characteristics of the horizons they designate in the various soil groups are given in Appendix I.

Each horizon, and occasionally each sub-division of a horizon, is sampled. The samples are given a routine physico-chemical examination, the results of which are shown in Appendix II and discussed in Chapter 10. Selected profiles are further analysed by mineralogical, differential thermal, spectrochemical and X-ray methods, and some clay fractions are subjected to silica-sesquioxide analysis by chemical methods.

It is necessary for the proper use and understanding of soil maps that the limitations of the method of representation should be appreciated. Soils are shown on the map as occurring in uniform areas, and boundaries with other soil types are represented by sharp lines. In practice, on passing from one soil to another the boundary is rarely abrupt and sharply defined; instead, there is generally a broad transitional belt over which the character of the soil changes gradually and progressively from that typical of one type to that of another. The boundary is drawn where the surveyor believes the critical change occurs, although near to this line the soils on either side will closely resemble each other, showing greater differences as they extend further from the boundary. The Soil Survey of Scotland uses field maps with a scale of 1:25,000 (about 2½ inches to 1 mile) and publishes maps with a scale of 1:63,360 (1 inch to 1 mile). On this latter scale it is not possible to delineate areas of less than 5 acres. Therefore on the published maps any uniformly coloured area may contain within it an area less than 5 acres in extent of some other soil. Any area containing a number of these small acreages is mapped as a soil complex.

A relatively large number of soil complexes have been delineated as cartographic units on the map for this area. They consist of an assemblage of soils each of which occurs repeatedly in small patches throughout the area of the complex. The individual complexes are characterized by the nature and relationships of their constituent soils and, like soil series, have a range of variation from the mode of the unit.

In this area it has been found that the common soil assemblages have a high degree of correlation with topography, particularly with micro-relief. In many cases therefore it has been convenient to consider the topography as a feature of the complex and to incorporate it into the definition of the unit. A further practical advantage of mapping units which are related to land form is that greater accuracy can be achieved in the recognition and placing of boundaries.

Broadly speaking the soil complexes mapped are of two types—those in which a group of soils occur in a repeating pattern with a constant relationship to each other and to the topography, and those in which the soils occur as assemblages but which have no well defined pattern. Soils in the first group are relatively easily distinguished and mapped as natural units. The categories delineated in the second group are more artificial. When defining soil complexes attention is first given to separating mapping units in which the assemblages of soils have peaty or raw humus layers from those having organo-mineral surface horizons. This follows the principle used by Muir (1956) and Ragg (1960) in south-east Scotland, and is based on factors of fundamental pedological importance, which are also likely to be of practical significance in relation to levels of fertility and to the possibilities of reclamation and improvement.

These groups are then further divided according to the presence or absence of rock outcrops, a feature with an important bearing on the possibility of cultivation, and exercising a large influence on the soil pattern. In general no other groupings have been recognised (there is an exception in the Dalbeattie Association), although in some areas variants have been noted.

The individual soil complexes so far recognised comprise soils developed on the parent material groups of one association or another and have therefore been grouped in the appropriate associations.

5 The soils

Thirty-nine soil series have been distinguished in the area, of which 25 are common to central Ayrshire (Grant, in preparation), 7 have previously been found in north Ayrshire (Mitchell and Jarvis, 1956) and 7 also occur in south-east Scotland (Muir, 1956; Ragg, 1960). Twenty-three soil complexes have also been mapped as have certain other categories *viz*, blanket peat, peat-alluvium, alluvium, links and mixed bottom land.

Table H shows the areas covered by the soil series and skeletal soils. The horizontal lines in the table contain soil series belonging to the same association and the vertical columns bring together soils in the same major soil sub-group and drainage class. The areas of the soil complexes and miscellaneous soil categories are given in Table I.

The relative extents of the various categories mapped can be calculated from the data in Tables H and I as percentages of the total area of 534 square miles. Peat has been mapped over 33 per cent of the area as well as being an important component of many soil complexes which account for a further 30 per cent. Therefore, almost two thirds of the land carries soils having very low natural fertility and posing problems which render improvement extremely difficult and costly. The soil series and skeletal soils cover 30 per cent of the area. The freely drained brown forest soils are the most extensive of the soils mapped as series, occupying 8 per cent of the area, while the freely drained iron podzols cover only 0·3 per cent. The land in these two categories is naturally well drained and requires no tile drainage; its small extent reflects the climate of the region. The brown forest soils with imperfect drainage occupy 7 per cent of the area and, since their natural drainage is at the wet end of the range of conditions included in the imperfectly drained class, drainage is generally required if arable agriculture is to be successfully carried out. This requirement is even more necessary on the poorly drained non-calcareous gley soils which cover 3 per cent of the area. Of the organo-mineral moorland soils the peaty podzols occupy 3 per cent, the poorly drained peaty gleys 0·6 per cent and the very poorly drained peaty gleys 5 per cent. The sub-alpine soils are restricted to the high mountain tops where they occupy almost 1 per cent of the area. The remaining area is taken up by skeletal soils (9 per cent), alluvium (4 per cent), mixed bottom land (1 per cent), expanses of fresh water (1 per cent), peat-alluvium (6 per cent) and links (·05 per cent).

A comparison between Tables H and I and similar tables for areas in south-east Scotland (Muir, 1956; Ragg, 1960) and for north Ayrshire (Mitchell and Jarvis 1956) shows a number of differences in the relative extents of the soils in various categories reflecting changes in the soil forming factors between the regions. The large extent of soil complexes

(30 per cent) is on account of the prevalence of rugged drift-free hills in this area in contrast with the smooth rounded hills of south-east Scotland and the rolling till plain of north Ayrshire. Peat deposits also occur over very much larger areas (33 per cent) than in the other regions of south Scotland. This is mainly because of the very much greater rainfall occurring in this area than farther east and to the greater average elevation of the south Ayrshire region compared to that in the north of the county. The organo-mineral soils having peaty surface horizons, however, are not more extensive than in the other regions. This is probably because wherever, in this area, conditions are conducive to the accumulation of organic remains peat formation is rapid, the depth of material soon exceeds 12 inches and the deposits are mapped as peat.

Eleven associations have been mapped, of which ten have previously been described; nine in the account accompanying Sheet 14 (Grant, in preparation) and three in that of the east Borders (Ragg, 1960). Balig Association is described for the first time and is the least extensive. Ettrick Association is the largest, occupying 43 per cent of the area, followed by Dalbeattie (8 per cent), Darleith (3 per cent), Benan (2·6 per cent), Glenalmond (1·6 per cent). Balig, Blair, Darvel, Dreghorn, Knockskae and Yarrow Associations each cover less than 1 per cent of the area.

In the account which follows the various associations and their component series are separately described.

Balig Association

Only one series, the Balig series, has been mapped in this association.

BALIG SERIES

The Balig series covers only about 38 acres of Corseclays Farm, near Ballantrae. It is a freely drained brown forest soil developed on gravels derived from basic and ultra-basic igneous rocks. Most of the series is cultivated in an arable rotation; the small area of semi-natural vegetation which does occur is a type of *Agrostis-Festuca* meadow grassland.

Profile Description

Slope		5°.
Altitude		150 feet.
Vegetation		*Agrostis-Festuca* meadow grassland—*Plantago lanceolata*, *Agrostis* spp., *Festuca ovina*, *Dactylis glomerata*, *Trifolium repens*, *Ranunculus repens*.
Drainage		free.
Horizon	*Depth*	
A	0–5″	Dark reddish brown (5YR3/3) loam; strong medium crumb; friable; organic matter moderate; roots abundant; stony; moist. Diffuse change into
B	5–12″	Dark brown (7·5YR4/3) gritty loam; moderate fine crumb; friable; organic matter low; roots common; very stony; moist. Gradual change into
C	12″+	Brown (10YR5/3) loamy sand; massive; weakly indurated; very stony.

Table H/Area of Soil Series (Sq. Miles)

Association	Brown Forest Soils		Non-Calcareous Gleys	Podzols		Peaty Gleys		Sub-Alpine Soils	Skeletal Soils	Totals
	Series									
	Freely Drained	Imperfectly Drained	Poorly Drained	Freely Drained	Freely Drained below B_1	Poorly Drained	Very Poorly Drained	Freely Drained		
Darleith	Darleith 5·96	Dunlop 5·57	Amlaird 1·67		Baidland 0·19	Myres 0·96			DL.z. 0·47	14·82
Benan	Benan 4·11	Minuntion 4·72	Lanes 2·76		Knockinculloch 0·05				BN.z. 0·15	11·79
Glenalmond		Glenalmond 2·96	Altiwan 1·45	Meadownay 0·28	Hadyard 0·97		Spallander 1·64			
		Gallowshill 1·41		Tranew 1·09						9·80
Ettrick	Linhope 28·94	Altimeg 6·59	Littleshalloch 4·14		Dod 16·25		Dochroyle 24·16	Merrick 4·39	ER.z. 6·07	
		Kedslie 9·81	Ettrick 6·76			Alemoor 0·67				107·78
Blair		Drumyork 0·14	Blair 0·98			Falaird 0·74				1·86
Dalbeattie	Dalbeattie 0·06				Carsphairn 0·51	Eglin 0·85			DE.z. 2·41	3·83
Knockskae			Whiterow 0·35	Knockskae 0·24	Turgeny 0·38	Palmullan 0·04			KA.z. 0·16	1·17
Balig	Balig 0·06									0·06
Darvel	Darvel 0·13									0·13
Yarrow	Yarrow 0·44									0·44
Dreghorn	Dreghorn 2·66									2·66
	42·36	31·20	18·11	1·61	18·35	3·26	25·80	4·39	9·26	154·34

Table I/Area of Soil Complexes and Miscellaneous Soils (Sq. Miles)

Association											
Darleith	Craig 0·94	Pinverains 0·74	Bennane 1·27								2·95
Ettrick	Minnoch 28·86	Stroan 2·72	Darnaw 34·70	Glenlee 4·88	Brochloch 23·17	Bush 16·68	Largmore 3·35	Finlas 1·26	Trool 4·70	Achie 2·01	122·33
Dalbeattie	Twachtan 4·21	Garrary 16·77	Gala 10·33	Riecawr 3·57	Mullwharchar 2·20	Cairnsmore 0·45	Dinnins 2·21				39·74
Knockskae	Clashverains 0·11										0·11
Benan	Auchensoul 1·11										1·11
Miscellaneous Soils	Blanket Peat 176·04	Peat-Alluvium 3·32	Alluvium 23·00	Links 0·26	Mixed Bottom Land 6·25	Linfern complex 0·53	Lochs and Fresh Water 5·02				214·42
											380·66

The well developed crumb structure of the A horizon is typical of soils formed on basic parent materials. The B horizon is intermediate in character between the surface soil and the underlying gravel.

LAND USE. Where conditions of slope allow this series forms a good arable soil suitable for a wide range of crops. There is sufficient clay in the loam textured A and B horizons to make the water-holding capacity adequate.

Benan Association

The Benan Association extends over 12·9 square miles or 2·6 per cent of the area. The largest unit of the association occurs to the north of the village of Barr. The name applied to this group of soils is that of one of the conglomerate formations, the Benan Conglomerate, which is an important parent material of the association, and which in turn probably took its name from the Benan Farm on the banks of the River Stinchar.

The soils of this association are developed from the Ordovician conglomerates of the Barr series, the most notable feature of which is their high proportion of basic constituents. The conglomerates weathering *in situ* form the most widespread soil parent material, giving rise to the freely drained series, while the till, generally confined to hollows, carries the poor and imperfectly drained series. Characteristically, soils with raw humus and peaty surface horizons occur only to a limited extent in the association, even at moderately high altitudes, due largely to the basic nature of the parent rock.

Distribution

The major part of the association occurs along the River Stinchar between the Dalquhairn Burn in the east and Kilpatrick in the west. It extends northwards to Dinvin Mote and Laggan Hill, and along the banks of the Water of Assel near Tormitchell to the Penwhapple reservoir, where it borders the Glenalmond Association. It also occurs on the Mull of Miljoan, Daljedburgh and Auchengairn Hills. Between Barr and Clashgulloch the association also occurs on the south bank of the River Stinchar. Smaller spreads are found on Genoch Hill, Aldons Hill and on the northern slopes of Fell Hill.

Parent Materials

As stated above the Ordovician conglomerates of the Barr series form the parent rocks of this association. They are dark blue or occasionally purple in colour, and in section the medium-sized rounded cobbles stand out prominently. The beds include fragments of Arenig lava, gabbro, dolerite, granite, black shale, chert and greywacke, together with some 'Highland' rocks. The high proportion of basic igneous constituents in the rocks is reflected in the profiles of the soils developed on them. The rock is fairly easily eroded and steep hill slopes are common. The conglomerate weathering *in situ* is the most common parent material and gives rise to soils that are freely drained, with profiles which are often shallow—less than 2 feet deep. The reddish brown clay loam till found in the hollows and depressions is mainly derived from the underlying conglomerates but also contains a certain proportion of greywacke material carried in by the ice.

A notable feature of these rocks is their tendency to erode into a pattern of low hummocks; this is well seen on the north side of Auchensoul Hill and at Clashgulloch. Where the general slope of the ground is gentle or flat, the hollows are generally occupied by a thin till deposit on which soil drainage is impeded, while on the intervening knolls there is no till and the drainage is free. The Auchensoul complex has been mapped where this pattern occurs. On steeper slopes with a similar unevenly eroded rock surface, the presence of till is not generally apparent and the hollows are occupied by deep soils on colluvium, while the soils on the knolls are shallow.

Soils

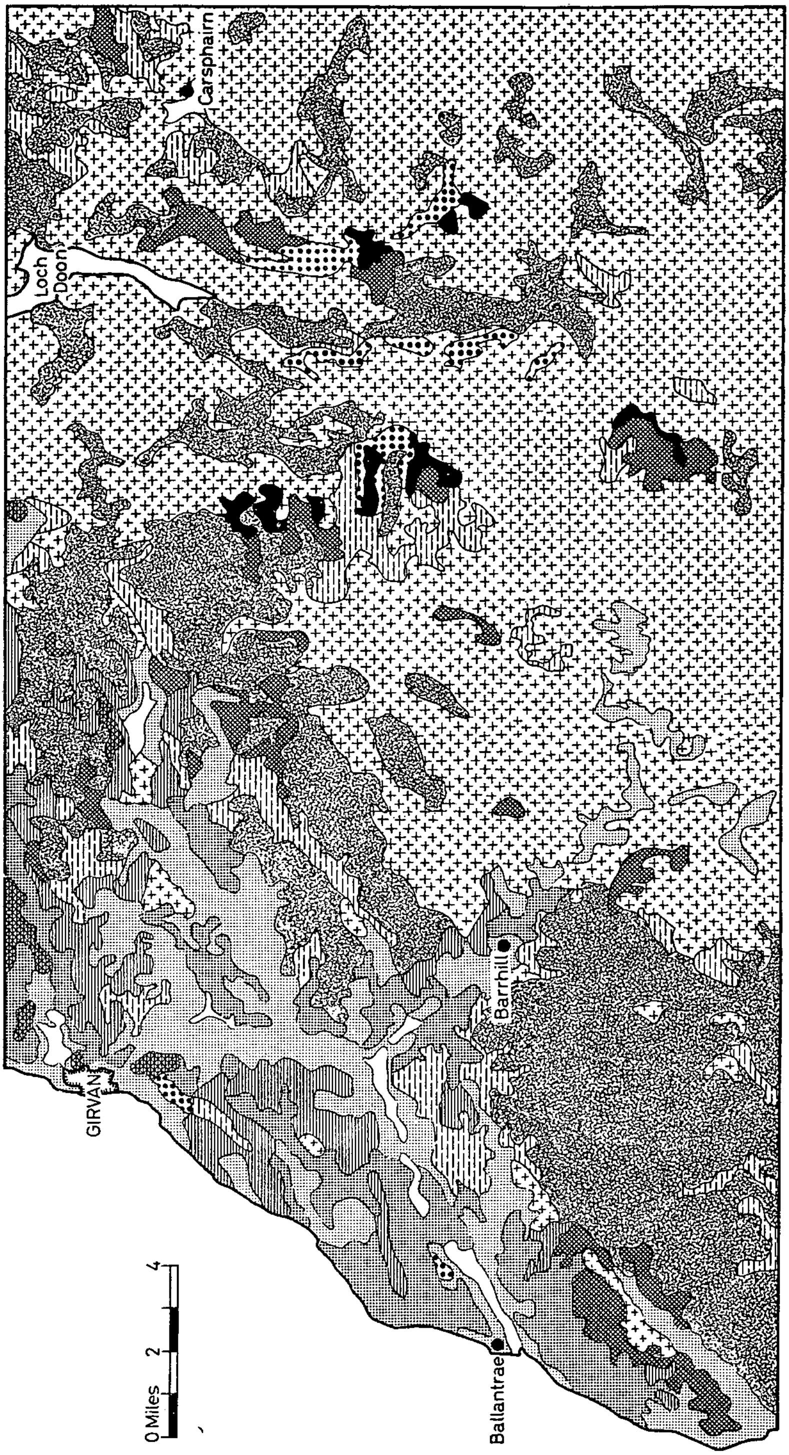
The three important series in this association, Benan series, Minuntion series and Lanes series, are mineral soils which do not have a raw humus or peaty surface horizon more than 1 inch thick. The peaty podzol Knockinculloch series only occurs on a small area.

The freely drained brown forest soil Benan series and the imperfectly drained Minuntion series are the most extensive of the association. The absence of raw humus formation at altitudes of 600–800 feet, together with good crumb structure and the predominance of the free and imperfectly drained series, made these soils particularly suited to cultivation during the early stages of agricultural development in the region. Traces of old earth walls and of rig and furrow cultivation are common, generally on the more gentle of the upper slopes of the valleys where they have escaped subsequent disturbance. At the present time cultivation is only sporadic above 500 feet and ploughing is infrequent at lower altitudes. Most of the soils carry semi-natural grassland, with some permanent or semi-permanent cultivated pasture.

BENAN SERIES

This is one of the more widespread soils of the association, occupying 4·11 square miles or 29·6 per cent of its area. The series is a freely drained brown forest soil and although it is often fairly acid it nevertheless has a good supply of fairly easily weathered minerals. It occurs along the steep hillside on the north of the Stinchar Valley from Dalquhairn to Kilpatrick and in other localities where the rock is free of till. The vegetation is generally *Agrostis-Festuca* acid grassland with some *Agrostis-Festuca* basic grassland. Much of the series will have been limed over a considerable period, partly as a result of its proximity to old kilns which formerly utilized the local outcrops of Stinchar Limestone.

The profile is shallow, often less than 24 inches, except when situated in a depression receiving colluvial material. The rich brown surface horizon has a stable well developed medium crumb structure, favourable for root development. The soil reaction and exchangeable bases indicate that the


Carsphairn
Loch Doon
GIRVAN
Barrhill
Ballantrae
0 Miles 2 4

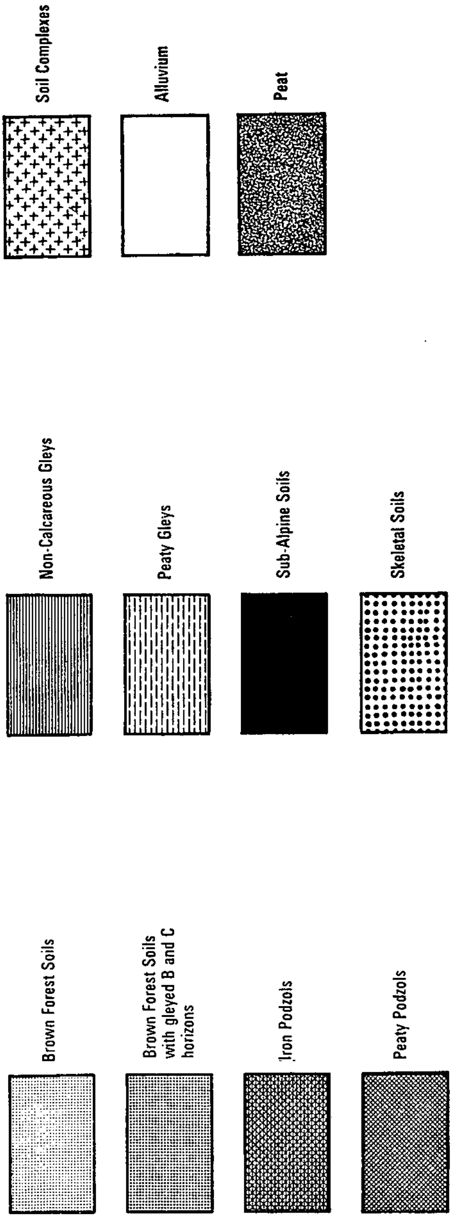
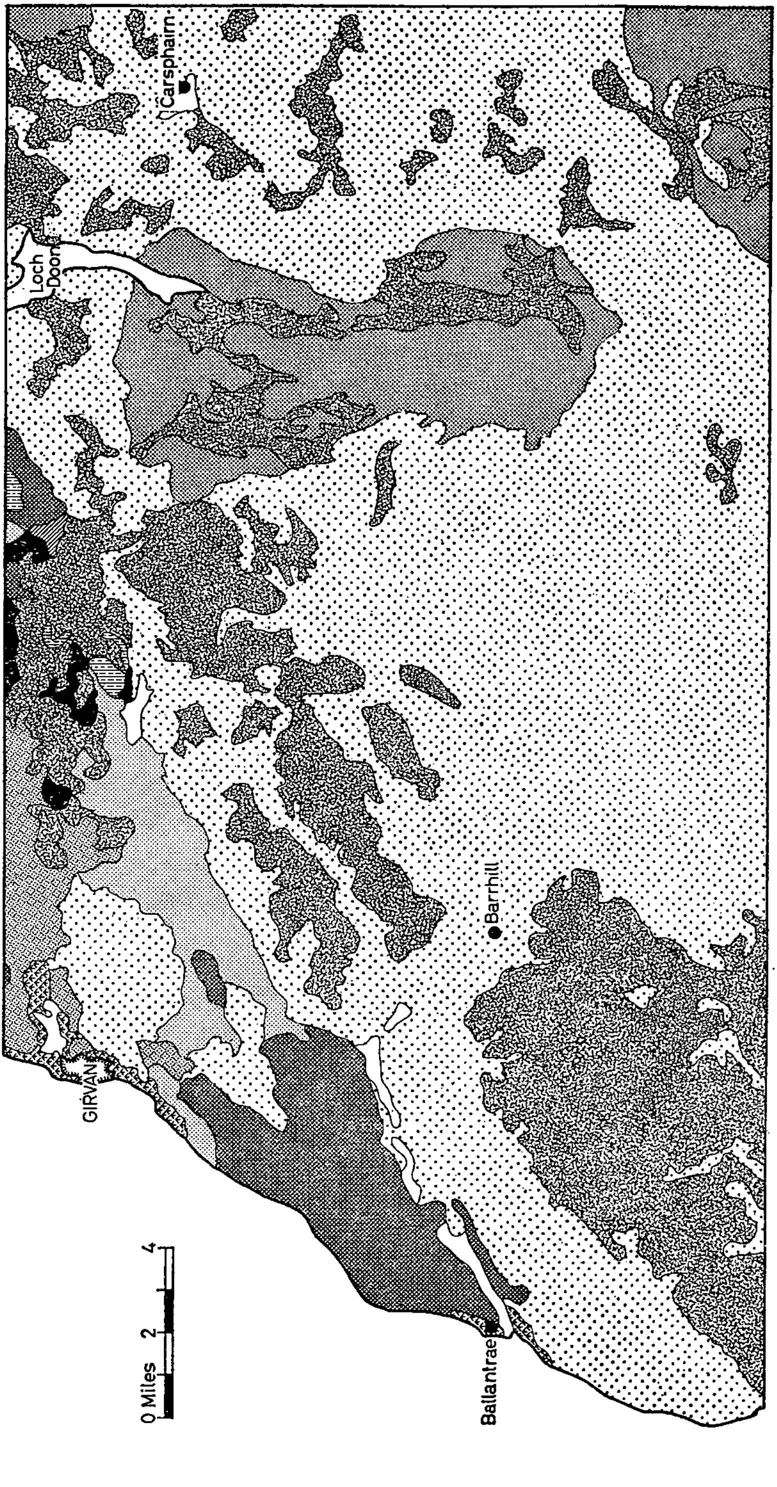


FIG. 12 Distribution of Major Soil sub-groups *(see also page 64)*


Carsphairn
Loch Doon
Barrhill
GIRVAN
Ballantrae
0 Miles 2 4

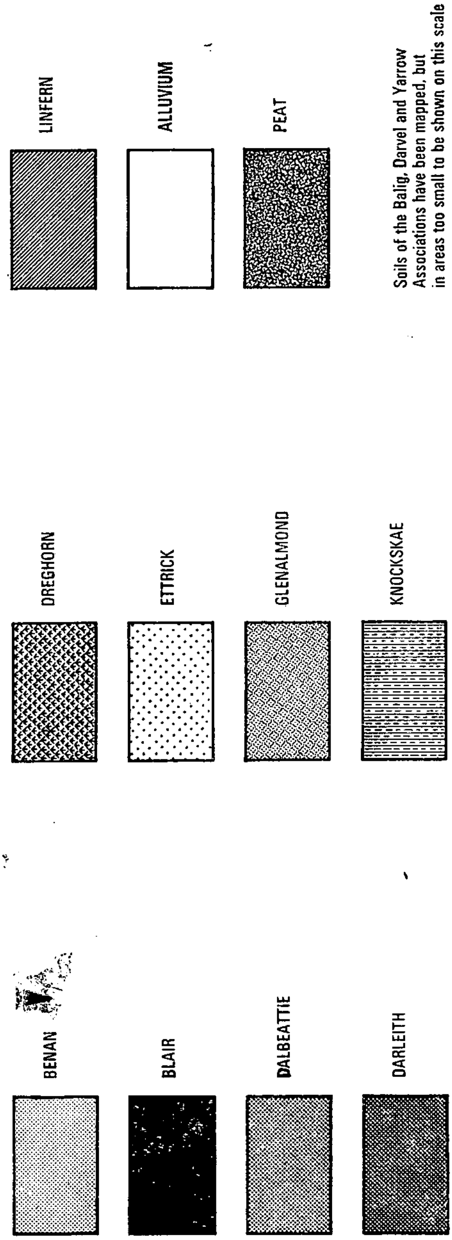


FIG. 13 Distribution of Soil Associations (*see also page 66*)

profile has been extensively leached, but signs of podzolisation are not apparent in the profile morphology. Generally, mineral grains in the surface horizon are coated and raw humus only begins to accumulate at the upper altitudinal limit of the series.

Profile Description

Slope		8°.
Altitude		500 feet.
Vegetation		*Agrostis-Festuca* basic grassland—*Festuca ovina, Agrostis tenuis, Anthoxanthum odoratum, Koeleria cristata, Sieglingia decumbens, Lotus corniculatus.*
Drainage		free.
Horizon	*Depth*	
L&F	1–0″	Litter and fermentation layers.
A	0–6″	Reddish brown (5YR4/3) loam; strong medium crumb; friable; organic matter moderate; roots abundant; a few stones; moist. Gradual change into
(B)	6–20″	Yellowish red (5YR4/6) gritty loam; moderate medium sub-angular blocky structure breaking easily to fine crumb; friable; organic matter low; roots common; stony, becoming very stony with depth; moist. Gradual change into
C	20″+	Benan Conglomerate rock.

The (B) horizon does not contrast strongly with the A horizon as in podzolic soils although the colour shows some increase in chroma in the lower layer, and while the consistence remains friable in the sub-surface horizon the structure is sub-angular blocky and is rather less strongly developed than in the overlying horizon. If the profile is shallow the transition from the (B) horizon to slightly weathered rock is usually fairly sharp, but where the solum is 30 inches or so in depth there may be a merging change from the (B) horizon to a layer of disintegrated conglomerate, part of which may appear indurated.

Although only a small proportion of this series is ploughed at regular intervals, owing to steep slopes and other factors, the profile nevertheless appears to be inherently well suited to arable cultivation. The good structure of the A horizon would be advantageous, while the nature of the (B) horizon renders deep ploughing practicable.

LAND USE. Farms with a considerable proportion of their land on this series are generally primarily grazing and rearing enterprises. Blackface and Greyface sheep and Aberdeen Angus and Galloway cattle are the chief stock. Cattle numbers are relatively high, and the stock-carrying capacity of the land is considered locally to be higher than that of the related Linhope series occurring nearby.

The semi-natural grassland has generally been dressed in the past with lime and ground mineral phosphate, but cultivation is often made difficult by steep slopes, although the deep well structured freely drained soil is eminently suitable for crop plants. Enclosures on this soil are generally large.

KNOCKINCULLOCH SERIES

The Knockinculloch series which covers 0·05 square miles extends over only a very small part of the association, 0·4 per cent. The profile is a peaty podzol with a thin iron pan. A small patch of the series occurs on

Doon Hill near Penwhapple reservoir, and several very small units occur along the slopes of the Mull of Miljoan, Daljedburgh and Auchengairn Hill to the north-east of Barr. This soil has also been found on Benan and Kirkland Hills, but not in areas extensive enough to be delineated on the present scale of mapping. Slopes are generally moderate or steep, and the vegetation is *Nardus* grassland or wet *Calluna* moor. The parent material, like that of the Benan series with which this soil usually occurs, is the till-free conglomerate weathering *in situ*.

Profile Description

Slope		4°.
Altitude		715 feet.
Vegetation		*Nardus* grassland—*Nardus stricta, Molinia caerulea, Calluna vulgaris, Juncus squarrosus, Erica tetralix, Vaccinium myrtillus.*
Drainage		free below the iron pan.
Horizon	*Depth*	
L	8–7″	Litter layer.
F	7–6″	Fermentation layer.
H	6–0″	Dark reddish brown (5YR2/2) fibrous peaty humus.
A_2g	0–6″	Dark grey-brown (10YR2/2) silt loam; weak medium sub-angular blocky; friable; organic matter moderate, mainly staining; roots common; a few stones; a few medium distinct reddish yellow (7·5YR6/5) mottles; moist. Sharp change with an irregular boundary into
B_1	6″	Thin iron pan with root mat on upper surface.
B_2	6–18″	Brown (10YR4/3) loam; weak sub-angular blocky breaking easily to crumb; friable; stony, small and medium rounded cobbles from the conglomerate; moist. Clear change into
C	18″+	Dark grey (10YR4/2) sandy loam; massive; indurated; very stony; moist. Merging into solid conglomerate rock.

The 'H' horizon is usually well developed, varying from 5 to 10 inches in thickness; it acts as a sponge, retaining water through relatively dry periods and helping to maintain anaerobic conditions in the A_2g horizon. The A_2g horizon is of variable depth, and although usually about 4 to 6 inches thick may in places be as thin as 1 inch. In the field it has a smooth silty feel and is strongly gleyed; much of the organic matter found in it is probably washed in as colloidal humus.

The iron pan impedes the penetration of both roots and water into the deeper layers of the profile, the roots generally forming a mat on the surface of the pan. The friable structure and brown colour of the B_2 horizon indicate the marked contrast between the waterlogged A_2g and the freely drained lower horizons. The stone content increases down the profile and becomes high in the C horizon, which is generally the partially broken-down surface of the conglomerate.

LAND USE. Grazing by sheep and cattle on the extensive pattern is the main form of land utilization.

MINUNTION SERIES

4·72 square miles or 34·0 per cent of the association have been mapped as the Minuntion series, the main area of which is on the slopes of Benan Hill. The profile is of an imperfectly drained brown forest soil, the B and C horizons of which show moderate signs of gleying; the soil is developed on the reddish brown loam to clay loam till derived from the Ordovician conglomerates of the Barr Series. Moderate depressions and the more gentle hill slopes commonly carry this series, and some of the areas mapped have a fairly wide variation in their degree of drainage impedance, especially where there is a tendency for the uneven micro-topography typical of the association to develop. The vegetation is commonly a sward of *Juncus acutiflorus* pasture or *Agrostis-Festuca* meadow grassland.

Profile Description

Slope		6°.
Altitude		500 feet.
Vegetation		*Juncus acutiflorus* pasture—*Juncus acutiflorus, Cynosurus cristatus, Anthoxanthum odoratum, Holcus lanatus, Trifolium repens, Ranunculus repens.*
Drainage		imperfect.
Horizon	*Depth*	
A	0–10″	Brown (7·5YR5/2) loam; moderate medium sub-angular blocky; friable; organic matter moderate; roots abundant; a few very fine distinct yellowish red (5YR5/6) mottles along root channels; moist. Clear change into
B_2(g)	10–24″	Brown (10YR5/3) clay loam; weak medium prismatic; firm; roots common; stony; frequent medium distinct strong brown (7·5YR5/6) mottles, together with some grey mottling and other colours associated with weathering stones; moist. Gradual change into
C(g)	24″+	Reddish grey (5YR5/2) clay loam; massive; firm; stony; frequent coarse faint brown (7·5YR5/4) mottles; moist.

The morphology of the profile contrasts sharply with that of the Benan series. The fine reddish brown mottles in the surface horizon, together with the slight greyish cast to its overall colour, indicate a considerable deterioration of drainage as compared with the Benan series. On passing down the profile there is a clear change from the friable organo-mineral A horizon into relatively raw plastic till, which, although it is penetrated by roots, has a low organic content. Mottling is prominent in the B_2(g) horizon, but gleying has only partially bleached the original reddish brown colour which is still clearly discernible. As mapped in the field, the mottling characteristics of the profile may show wide local variation. Only rarely has completely unaltered till been found at depth for some ochreous and grey mottling generally persists (although much reduced) into the C horizon which is generally massive and occasionally indurated.

LAND USE. Semi-natural grassland is the main form of plant cover, and is utilised by sheep and cattle grazing on the extensive system. Much of the soil has a history of lime and phosphate dressing, and drainage is generally adequate for cultivation, if other site factors present no problem. Tile drains are probably essential only in the small patches which are wetter than the average for the series. Fencing is generally widely spaced. The raw nature of the till of the B horizon makes deep ploughing less advisable than on the Benan series.

PLATE 5/The Corses Farm, south of Ballantrae. The slopes around the farm carry soils of the Kedslie series formed on clay loam till, and are formed mainly under grassland.

PLATE 6/Imperfectly and poorly drained soils of the Darleith Association on the slopes behind Colmonell village.

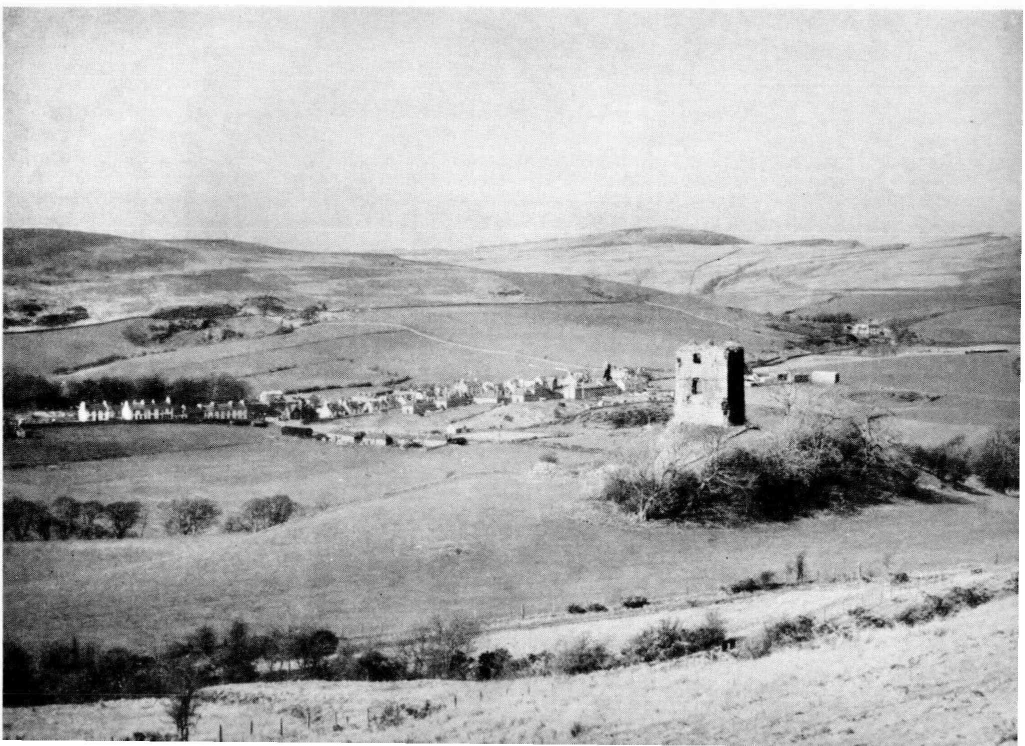


PLATE 7/Soils of the Garrary complex on northern slope of Millfore Hill. The abundant granite outcrops which characterize this unit can be clearly seen.

PLATE 8/Glen App looking north-eastwards. The brown forest soil Linhope series occupies the middle and lower hill slopes.

LANES SERIES

This soil, which covers 2·76 square miles or 19·9 per cent of the association, is found in the bottoms of hollows and near drainage channels. The profile is that of a non-calcareous gley of poor drainage status, and the soil is closely related to the Minuntion series on the same parent till alongside which it usually occurs. *Carex* wet pasture is the characteristic semi-natural vegetation.

Profile Description

Slope		2°.
Altitude		500 feet.
Vegetation		*Carex* wet pasture—*Carex flacca, Carex panicea, Carex hostiana, Juncus articulatus, Briza media, Carex echinata, Succisa pratensis, Molinia caerulea.*
Drainage		poor.
Horizon	*Depth*	
Ag	0–10″	Brown (7·5YR5/2) loam; moderate sub-angular blocky structure; friable; organic matter high; roots common; a few fine distinct reddish brown (2·5YR4/4) mottles; moist. Clear change into
B_2g	10–23″	Reddish brown (5YR5/3) clay loam; moderate coarse prismatic; plastic; a few weathering igneous stones; frequent coarse distinct reddish yellow (7·5YR6/8) mottles; wet. Gradual change into
B_3g	23–36″	Reddish brown (5YR5/3) clay loam; weak coarse prismatic; plastic; a few weathering igneous stones; many coarse prominent yellowish red (5YR5/8) mottles; wet. Gradual change into
Cg	36″+	Dark reddish grey (5YR4/2) clay loam; massive; plastic; a few weathering igneous stones; a few medium prominent yellowish red (5YR5/8) mottles along old root channels; wet.

The brown surface horizon has a friable consistency and the sub-angular blocky structure is fairly stable. Reddish brown iron staining along root channels occurs to within a few inches of the soil surface. The B_2g horizon has a well developed prismatic structure with smooth grey faces to the peds, and the interior of the structural units shows strong ochreous mottling which increases to a maximum 14–18 inches below the surface. On passing down the profile the structural units become larger until in the C horizon the clay loam till is massive. Mottling persists to a considerable depth in the C horizon, but becomes less intense and less common.

LAND USE. Like the soils of the Minuntion series with which it occurs, this series is grazed extensively by cattle and sheep. The productivity of the natural grassland is limited by the persistent waterlogging; unless the soil is first drained any attempt at improvement by cultivation or other means is unrewarding. Tile or mole drainage is not widely practised on this soil, probably because of the difficulty of installing drains in many of the hollow areas where satisfactory outfall is not easily attained.

AUCHENSOUL COMPLEX

Areas of the Auchensoul complex have been mapped on the north side of Auchensoul Hill and at Clashgulloch. It covers 1·11 square miles, or 7·8 per cent of the association. The complex is an intricate pattern of free, poor and imperfectly drained soils, generally corresponding to the

Benan, Lanes and Minuntion series. The soils are developed on a topography of low mounds and hollows, the formation of which seems to be typical of the erosion characteristic of the underlying conglomerate. The mounds are till free, while the hollows generally have a thin cover of drift. As would be expected, the Benan series occupies the mounds, while the poorly and imperfectly drained Lanes and Minuntion series occupy the hollows. The pattern as it exists on Auchensoul Hill is well illustrated in the air photograph reproduced in Plate 27. The isolated patches of the Benan series vary in size from a few square yards up to about 2 acres; where they are larger than this they have generally been mapped individually. The less well drained soils form an interconnecting pattern or matrix in which the mounds occur; the areas covered are generally too narrow for adequate representation on a one inch map.

LAND USE. These areas are utilized for cattle and sheep grazing. Any improvement of the present semi-natural grassland other than by liming and fertilizers is made difficult by the topography.

SKELETAL SOILS

Skeletal soils occupy 0·15 square miles or 8·5 per cent of the Benan Association; they occur on one or two steep hillsides such as the Byne Hill near Girvan and Daljedburgh Hill in the upper Stinchar Valley. Bare rock and scree are prominent and colonization by higher plants is only of limited extent on this unit. The soils generally consist of a shallow organo-mineral A horizon, overlying rock or scree, which has been little altered pedologically. At altitudes above about 700 feet a thin layer of raw humus may have developed. The vegetation, where present, is generally a form of acid grassland, and the areas have little value for forestry or agriculture.

Blair Association

The Blair Association is one of the smaller soil groupings; consisting of only three series it occupies 1·86 square miles (0·35 per cent) of the area in the northern part of the sheet, where it forms an extension southwards of soils already mapped and described by Grant (in preparation) in central Ayrshire.

Distribution

The major part of the association occurs as small individual patches around the Black Hill of Garleffin. Two of the larger areas are those at Glenalla and at Pinverains and there is a further small area to the west, beside Delamford.

Parent Material

The soils of the Blair Association are developed on a mixed till derived from Old Red Sandstone sediments, greywacke and acid porphyrites, with occasionally some basic igneous material. The till is a reddish brown sandy clay loam and bears a resemblance to that of the Glenalmond

Association, but whereas in the latter till some greywacke and felsite stones occur as erratics and appear to make no contribution to the fine material, in the Blair Association material from these rock types is much more abundant and makes an appreciable contribution to the till as a whole. The manner of formation of this till and some variations in its composition have been described in Chapter 3.

The till is generally found in hollows or low-lying areas, and usually rests on the foundation of Old Red Sandstone strata which generally underlie such areas. Occasionally the surface of the till would appear to have been partially resorted or overlain by hill-wash which can produce soils with upper horizons of loam or sandy loam texture.

Soils

Of the three series mapped in this association the imperfectly drained brown forest soil (Drumyork series) is the least extensive. The non-calcareous gley (Blair series) is the most widespread soil of the association, generally occurring on concave hill slopes at moderate elevations (800–1200 feet). The series has been cultivated at Glenalla but usually carries semi-natural vegetation. Falaird series is a peaty gley soil and occupies only a small area, the main unit occurring at Delamford.

DRUMYORK SERIES

Only one small patch of this series, which is a brown forest soil of imperfect drainage status, occurs in the area, and it is an extension of a larger unit mapped to the north (Grant, in preparation). The soil carries semi-natural grassland vegetation and is used for sheep and cattle grazing.

BLAIR SERIES

A poorly drained non-calcareous gley soil, the Blair series occupies 0·98 square miles or 53 per cent of the association. Gleying is generally due to the accumulation of water near the surface of the slightly permeable till rather than to ground-water present in the deeper soil layers. This soil is generally found on moderate and gentle concave hill slopes, at elevations of 800–1200 feet, mainly in areas peripheral to extensive blanket peat. The series occurs mainly at Glenalla and along the Dalquhairn to Crossmichael road, with a small area at Delamford; it is developed on the reddish brown sandy clay loam mixed till previously described, which is mainly derived from Old Red Sandstone sediments, felsite and greywacke rocks. The vegetation is generally *Juncus acutiflorus* pasture.

Greyish colours of low chroma dominate the soil, the pinkish colours inherited from the parent material appearing only at the base of the profile. The upper soil horizons Ag, A_2g and occasionally B_1g are noticeably less fine in texture than the B_2g and deeper layers. Occasionally a line of seepage is found at the surface of the till along which ground-water moves down the slope. Soil aggregation and structure are rather weakly developed in the upper soil horizons; the till appears to become massive in the B_2g horizon and below, while the prismatic structure generally found in the imperfectly drained Drumyork series is seldom present. Ochreous mottling is most strongly developed and most frequent in the B horizon, but even here is mainly confined to weathering stones and old root channels. Dead roots can often be seen in the deeper layers of soil.

LAND USE. A small area of this series at Glenalla has been reseeded. Elsewhere the semi-natural grassland forms part of unenclosed rough moorland grazings, mainly utilized by sheep. The ground is drained by open ditches in a varying state of repair.

Profile Description

Slope		5°.
Altitude		900 feet.
Vegetation		*Juncus acutiflorus* pasture—*Juncus acutiflorus, Poa trivialis, Trifolium repens, Anthoxanthum odoratum, Cynosurus cristatus, Lolium perenne, Deschampsia caespitosa.*
Drainage		poor.
Horizon	*Depth*	
A(g)	0–6″	Dark grey-brown (10YR4/2) loam; moderate sub-angular blocky; friable; organic matter moderate; roots abundant; a few stones; a few fine distinct yellowish red (5YR4/6) mottles along root channels; moist. Clear change into
A_2g	6–12″	Grey (7·5YR5/1) loam; very weak sub-angular; slightly firm; organic matter low; roots common; stony; frequent medium distinct strong brown (7·5YR5/8) mottles; moist. Clear change into
B_2g	12–36″	Reddish brown (5YR5/3) clay loam; massive to weak coarse prismatic; firm; stony, weathering greywacke and felsite; frequent coarse distinct yellowish red (5YR5/8) mottles; moist.
Cg	36″+	Weak red (2·5YR5/2) clay; massive; firm; no organic matter; no roots; occasional stones; common coarse distinct yellowish red (5YR5/8) mottles; moist.

FALAIRD SERIES

Falaird series covers only 0·74 square miles, 37·5 per cent of the association and is restricted to an area near Delamford and small units along the moorland road which leads southwards from Crosshill (Ayrshire). The soil is a peaty gley, usually with poor drainage, and the parent material is a reddish brown sandy clay loam mixed till derived from Old Red Sandstone sediments, greywackes and felsite. The vegetation is wet *Calluna* moor or *Molinia* grassland.

Profile Description

Slope		4°.
Altitude		1000 feet.
Vegetation		*Molinia* grassland—*Molinia caerulea, Deschampsia flexuosa, Juncus squarrosus, Vaccinium myrtillus, Festuca ovina, Nardus stricta.*
Drainage		poor.
Horizon	*Depth*	
L&F	5–4″	Litter and fermentation layers.
H	4–0″	Black (5YR5/1) peaty humus. Sharp change into
A_2g	0–10″	Grey-brown (2·5Y5/2) loam; very weak sub-angular blocky to massive; slightly plastic; roots common, often dead; organic matter low; few stones; wet. Clear change into
Bg	10–28″	Reddish brown (5YR5/8) sandy clay loam; massive; firm; a few dead roots; greywacke and felsite stones common; a few medium distinct strong brown (7·5YR5/6) mottles; moist to wet. Diffuse change into
C	28″+	Reddish brown (5YR5/4) sandy clay loam; massive; very firm; a few small stones; a few fine faint yellowish red (5YR4/8) mottles along old root channels; moist.

The thickness of the H layer is variable, but is usually 4 to 8 inches. The zone of maximum gleying is immediately below the peaty horizon; grey colours predominate and ochreous mottling is rare. Yellowish brown and strong brown mottles occur in the lower horizons but are generally restricted to old root channels and weathering stones. Dead roots occur throughout the profile. The texture of the surface horizon, as in the Blair series, is generally coarser than that of the underlying till.

LAND USE. The semi-natural moorland vegetation has a low productive capacity, and its utilization is mainly restricted to sheep grazing.

Dalbeattie Association

The Dalbeattie Association is the second most extensive in the area, of which it covers 43·57 square miles or 8·2 per cent. The association was first found near Dalbeattie (Soil Survey of Great Britain, 1958) and a small area has been described in the memoir accompanying Sheet 14 (Grant, in preparation) which is immediately north of the present area. The soils of this association occur in some of the more remote, rugged and desolate hill country in the Southern Uplands, the largest units being in the Loch Doon–Loch Dee area, the northern part of the Cairnsmore of Fleet granite outcrop, and part of the granite hill Cairnsmore of Carsphairn. The frequent rock outcrops and uneven topography in these localities have led to the extensive formation of soil complexes, with only limited areas mappable as individual series.

In the valley bottoms there are several large areas of deep peat, including the well known Silver Flowe beside the Cooran Lane. *Molinia* grass dominates the vegetation in the valleys and on lower slopes, while *Calluna vulgaris*, *Trichophorum caespitosum* and *Erica tetralix* are more common on the hills. Forestry, extensive sheep farming, and deer and grouse moors are the only forms of land use. Most of the association occurs under a rainfall of 70–90 inches.

Distribution

The association occurs in three major units and two subsidiary ones: the Loch Doon–Loch Dee granite, the portion of the Cairnsmore of Fleet mass occurring in the area, part of the Cairnsmore of Carsphairn granite outcrop, and the two smaller patches at Burnhead and the Grey Hill.

Parent Material

The parent rocks of the Dalbeattie Association and the parent materials derived from them have been described in Chapter 3. The rocks are coarse grained, generally acid and acid–intermediate, with a few areas where they are basic. Analyses of representative samples of these rock types are given in Appendix VI. The tonalites contain 8–10 per cent less silica than the granites and have appreciably higher amounts of ferrous iron and of the bases calcium and magnesium. These differences are even greater when the granites are compared with the basic rocks, which are also notable for their lower potassium content.

Three main types of parent material are derived from these rocks: glacial till, moraine, and rock *in situ* or shattered by frost action. The till and the moraine are made up of a mixture of the various rocks, and each behaves fairly uniformly in the field, while the rock *in situ* occurs mostly as part of the soil complexes, in which the pattern of relationship of the major soil groups to one another is the predominanting feature. Consequently soil differences occasioned by variations in rock composition are not as apparent or important as when the mapping units are soil series, and no differentiation related to this factor has been made.

Till is relatively scarce in this association and is mainly restricted to the lower slopes of hills. It is a pale grey gritty loam in which coarse feldspar particles are easily seen, and it is often slightly indurated. The moraines occur as scattered dumps in the valleys. They are coarse textured, sandy loam to loamy sand, are strongly indurated, and almost invariably carry freely drained soils. The frost-shattered stony rubble that has accumulated on and at the base of a few steep slopes is of limited extent and usually carries the freely drained Dalbeattie series.

It has already been noted that most of the country in this locality underlain by the granitic rocks is extremely rugged. The nature and form of these outcrops plays a large part in determining the soil pattern, which is usually very variable and is mapped into soil complexes. Other soil complexes have developed where the moraine or till deposits give an uneven hummocky surface to the ground, so that freely and poorly drained soils are formed in a repeating pattern.

Soils

Three soil series and seven soil complexes have been mapped in the Dalbeattie Association. The soil complexes are very much more extensive than the soil series, which are restricted to small areas of relatively smooth slopes. Almost all the soils have a very well developed raw humus or peaty surface horizon. Of the soil series the peaty podzol (Carsphairn series) and the peaty gley (Eglin series) are most common, while the brown forest soil (Dalbeattie series) is very small in extent. The soils which make up the complexes usually have a peaty surface horizon, brown forest soils or brown rankers occurring only as minor components of two of the smaller units.

Until recently the whole area of this association was unfenced, apart from a few very widely spaced stone walls which are now usually broken in a number of places, and cultivation was entirely lacking apart from the small deserted enclosures near isolated cottages, such as Tunskeen, Culsharg, or Laggan o'Dee. Since 1945, however, the Forestry Commission have fenced and drained considerable areas on which they have established coniferous forest.

DALBEATTIE SERIES

One of the least extensive soils in the area, the Dalbeattie series occupies only 0·06 square miles or 0·14 per cent of the association. It occurs in three small patches: at Ballochbeatties, at the southern end of Loch Doon, and at Laggan o'Dee. The parent material is a colluvial frost-shattered rock debris occurring on steep slopes, while the profile is classified as a brown forest soil of low base status and the drainage class is free. Indications of old tree roots and of charcoal derived from oak have been found at 20–30 inches depth in a profile near Loch Doon. The present vegetation is *Agrostis-Festuca* acid grassland often dominated by bracken (*Pteridium aquilinum*).

Profile Description

Slope		6°.
Altitude		700 feet.
Vegetation		*Agrostis-Festuca* acid grassland—*Pteridium aquilinum, Carex pilulifera, Agrostis canina, Festuca ovina, Potentilla erecta, Galium saxatile.*
Drainage		free.
Horizon	*Depth*	
L&F	1½–1″	Litter and fermentation layers.
H	1–0″	Black (5YR2/1) humus.
A	0–9″	Dark brown (7·5YR3/3) loam; strong fine crumb; friable; organic matter moderate; roots abundant—many bracken rhizomes; moist. Gradual change into
B_{21}	9–16″	Reddish brown (5YR4/4) gritty loam; weak crumb; friable; organic matter low; roots common; stony, weathering granite boulders; moist. Gradual change into
B_{22}	16–40″	Dark reddish brown (2·5YR2/4) with patches of strong brown (7·5YR5/6) gritty sandy loam; weak sub-angular blocky to massive; firm; many weathering granite stones; moist. Gradual change into
C	40″+	Brown (10YR5/3) gritty loamy sand; massive; firm; stony; moist.

This soil is generally acid and has up to an inch of raw humus in the surface horizon. Under bracken communities the dark brown loam has a good friable crumb structure, which is slightly less well developed under other vegetation. The B horizon as a whole is always well developed, with prominent reddish brown and dark reddish brown colours indicative of a high free iron oxide content. The B_2 horizon is of interest in that it may generally be subdivided into an upper and lower part. The upper horizon, designated B_{21}, is a reddish brown or strong brown colour, and has a friable sub-angular blocky structure which easily breaks into fine crumb. These characters change over a widely merging boundary so that the B_{22} is characterized by colours which are both darker and redder than in the B_{21}, generally dark reddish brown or yellowish red, and the structure tends to massive with a slightly firm consistence. The B_3 horizon is intermediate in character between the B_{22} and the parent material; if the profile is relatively shallow the boundary may be described as diffuse, and an intermediate horizon not delineated. The C horizon is very stony, coarse textured, and indurated, and is light brown in colour.

LAND USE. The small areas of this soil are utilized for sheep grazing or forestry, in accordance with the practice on the surrounding moorland.

CARSPHAIRN SERIES

This is a peaty podzol soil which occurs in small areas scattered throughout the association of which it covers only 0·51 square miles, or 1·2 per cent. The parent material is usually a coarse textured stony drift or moraine, which is often situated on steep slopes; the drainage is free below the iron pan. A quarry near the head of Loch Doon shows the soil well developed on thin drift overlying deeply weathered granite. The vegetation is commonly wet *Calluna* moor and *Molinia* grassland.

Profile Description

Slope		10°.
Altitude		650 feet.
Vegetation		Wet *Calluna* moor—*Calluna vulgaris, Molinia caerulea, Erica tetralix, Potentilla erecta, Deschampsia flexuosa.*
Drainage		free below the iron pan.
Horizon	*Depth*	
L & F	6–5″	Litter and fermentation layers.
H	5–0″	Black (5YR2/1) humified peaty humus.
A_2g	0–3″	Very dark grey (10YR3/1) gritty loam; very weak sub-angular blocky; slightly friable; organic matter high, mainly washed-in colloidal humus; roots common; moist. Sharp change with an irregular boundary into
B_1	3″	Thin iron pan.
B_2	3–17″	Yellowish red (7·5YR5/6) gritty loam; weak sub-angular blocky; slightly friable; organic matter low; stony; moist. Diffuse change into
B_3	17–23″	Yellowish brown (10YR5/4) gritty sandy loam; massive; slightly firm; stony; moist. Gradual change into
C	23″+	Pale brown (10YR6/3) gritty sandy loam; massive; indurated; stony.

The profile is typical of the peaty podzol major soil group. The peaty surface is usually between six and eight inches deep, and is underlain by a leached A_2g horizon which may be as thick as 5–6 inches or as thin as one inch or less but is commonly 2–3 inches in depth. The A_2g horizon is often partially obscured, when newly exposed, by the large amount of dark peaty staining present, particularly near the boundary with the peaty surface layer. On drying, the dark colour of the peat staining is less obvious, and the white colour of the bleached mineral matter is clearly seen. The iron pan is clearly developed, but often is not sufficiently strong to prevent root penetration into the B horizon. The strong brown and yellowish red colours typical of a high free iron oxide content are well developed in the B horizon. The sub-angular blocky structure is weakly developed and breaks into fine crumb, but the consistence of this horizon is rather less friable than is usual in this group of soils. Despite the high stone content of the parent material, the B horizon is much less stony; the reason for this is uncertain, but it is consistent with the addition of a fine material such as loess or cover sand to the surface.

LAND USE. The series occurs as small areas in open moorlands which are utilized either for extensive sheep grazing or forestry. The possibilities of improvement are limited, except where access is easy.

EGLIN SERIES

The Eglin series is the most extensive soil series of this association, but even so it covers only 0·85 square miles or 2·3 per cent of the association. It most commonly occurs on the till deposits along the more gentle lower slopes of hill sides and the drainage class is poor. The till is generally a grey-brown gritty loam, with frequent quartz and feldspar particles. *Molinia* grassland is the main form of vegetation, together with some *Molinia-Myrica* moor. The soil is classified as a peaty gley.

Profile Description

Slope		4°.
Altitude		575 feet.
Vegetation		*Molinia-Myrica* moor—*Molinia caerulea, Myrica gale, Erica tetralix.*
Drainage		poor.
Horizon	*Depth*	
L & F	7–6″	Litter and fermentation layers.
H	6–0″	Dark reddish brown (5YR2/2) fibrous peat.
A_2g	0–3″	Dark grey-brown (2·5Y4/2) very gritty sandy loam; very weak sub-angular blocky; slightly firm; organic matter moderate; roots common; a few large stones; no mottles; moist. Clear change into
B_2g	3–12″	Light brownish grey (10YR6/2) very gritty sandy loam; very weak coarse sub-angular blocky; sticky; stony; wet. Gradual change into
B_3g	12–33″	Dark grey-brown (10YR4/2) very gritty loam; massive; slightly plastic; stony, some large boulders; frequent coarse distinct yellowish brown (10YR5/5) mottles, particularly in association with weathering granite; wet. Gradual change into
Cg	33″+	Greyish brown (10YR5/2–3) very gritty sandy loam; massive; very firm or weakly indurated; stony.

The peaty surface horizon is usually well developed and between 6 and 12 inches thick. The A_2g is waterlogged for long periods, and is a uniform light brownish grey colour, with no ochreous colours from the localized oxidation and segregation of iron compounds. Yellowish brown mottling becomes common in the Bg horizon, but is mostly confined to softened, weathering granite stones. It becomes rarer with depth and is not common in the C horizon. Some brown streaks can be seen throughout the profile and are due to the remains of old dead roots. The C horizon is of massive structure and weakly indurated.

LAND USE. Except where recently afforested this soil occurs on open moorlands, on which sheep and occasionally cattle grazing are the only forms of land use. The poor-quality grazing is not very intensively utilized, but, as with the other soils of this association, it seems the only practicable form of agriculture.

TWACHTAN COMPLEX

First mapped around Loch Twachtan at the foot of the east slope of Merrick Hill, the Twachtan complex covers 4·21 square miles or 9·7 per cent of the association, mainly in the Loch Doon–Loch Dee area and the Black Water of Dee Valley. It is developed on a moundy topography of morainic hummocks and intervening hollows occurring on the gentle lower slopes of hills or valley bottoms. The moraines are made up of coarse textured loamy sand and sandy loam granitic detritus. The 70–90 inch rainfall is reflected in the peaty nature of the soils. Blanket peat, which varies from 1 to 3 feet in depth, occupies most of the depressions, while the moraines carry mainly the peaty podzol Carsphairn series (page 77) with some patches of the brown forest soil Dalbeattie series (page 76) on the steeper moraine faces. The vegetation is generally wet *Calluna* moor, with dense *Calluna* on a few of the drier knolls. The patches of Dalbeattie series which occur carry a bracken-dominated sward of acid grassland.

LAND USE. The grazing value of the sward is very low, and these units seem to be really suitable only for hill sheep farming, grouse and deer moors, or forestry.

GALA COMPLEX

The Gala complex has been mapped along the lower slopes of hills, where a slight unevenness of the till surface has led to the development of a pattern of freely and poorly drained soils in areas too small to be adequately represented on the scale of the present map. The parent material is a granitic till which is generally shallow and of a gritty loam texture. Rock outcrops may occur, but are generally few in number and widely scattered. The soils all have a peaty surface horizon, and are of the peaty podzol or peaty gley type, with the latter generally predominating. An exception is an area to the north-west of Loch Dee where the slopes are much steeper than usual and the peaty podzol profile is the more common, with occasional very small patches of brown forest soil. The profiles resemble those of the Eglin and Carsphairn series, but generally show a much wider range of variation in their characters. The vegetation is generally mainly *Molinia* grassland on the peaty gley areas with wet *Calluna* moor on the podzol patches. This unit occupies 10·33 square miles.

LAND USE. These areas are all utilized for hill sheep farming or forestry.

DINNINS COMPLEX

This is the only soil complex in the Dalbeattie Association, with the exception of the Twachtan complex previously described, in which a brown forest soil type of profile occurs. The unit is not extensive, covering only 2·21 square miles or 5·1 per cent of the association. The parent materials are granitic rocks and thin drifts and debris derived from them. The topography is generally one of short steep uneven slopes at altitudes up to about 800 feet, which is low in relation to the general level of the association. The micro-relief is varied; rock knolls and hollows occur in some areas, but in others there are only slight undulations. Areas of outcropping rock are usually small.

The soils are mainly freely drained and shallow, and while they resemble those of the series already described in the association they show a much wider range of variations in character. The brown forest soil and peaty podzol profiles are the most widespread, with smaller extents of peaty gley and peat in depressed areas. The vegetation is very varied, the different moorland communities occurring in accordance with local variations in conditions. The brown forest soils usually carry bracken-dominated *Agrostis-Festuca* acid grassland.

LAND USE. As on most of this association hill sheep farming and forestry are the main enterprises.

RIECAWR COMPLEX

Around Loch Riecawr there is an extensive area of deep blanket peat and rock outcrops, which has been called the Riecawr complex. It covers 3·57 square miles or 8·2 per cent of the association. The topography is generally level or only gently sloping ground, on which roche moutonnée-like rock knolls aligned in the direction of ice movement frequently occur. This pattern is illustrated in the aerial photograph reproduced in Plate 26. The knolls are mainly covered with shallow peaty or raw humus, ranker-like soils, with considerable areas of bare polished granite. Blanket peat covers the intervening areas to considerable depths (6 feet and over). *Molinia* grass is usually the dominant species in the vegetation growing on the peaty areas, while wet *Calluna* moor and dry *Calluna* moor occur most commonly on the drier ranker soils.

LAND USE. Extensive sheep farming has been the dominant form of land use in the past, but recently large areas have been afforested.

GARRARY COMPLEX

This soil complex is the dominant mapping unit of the association, of which it covers 16·77 square miles or 38·5 per cent. The topography is hilly and frequently has a micro-relief of knolls and crags; in some areas these are absent but numerous slabs of bare polished rock are exposed. Prominent rock outcrops are characteristic of this unit. In areas between outcrops a thin cover of broken down granite material is present, varying in thickness from 0 to 5 or 6 feet.

All the soils have a raw humus surface horizon but otherwise show considerable variation. Peaty podzols and peaty gley profiles are the most commonly occurring soils, each showing considerable variation according to the local micro-relief and the thickness of drift.

In general podzols are confined to mounds or steep slopes. Peat over 18 inches thick is usually present in the hollows and can locally make up a considerable proportion of the complex. Frequently occurring in the areas where the rock outcrops as polished slabs are ranker profiles, consisting of a raw humus surface horizon over a shallow leached mineral layer, passing into solid granite. Where the bleached mineral horizon is absent, the profile consists of raw humus or peat resting on polished granite.

The vegetation of this complex is extremely varied.

LAND USE. Extensive sheep farming and forestry are the only forms of land use.

MULLWHARCHAR COMPLEX

This mapping unit includes most of the higher hills which form the central spine of the Loch Doon granite mass. It covers 2·20 square miles or 5·0 per cent of the association. A considerable amount of bare rock is exposed on the surface as ice-polished slabs. The soils between these outcrops are very shallow rankers formed on a thin residue of weathered frost-shattered debris overlying solid granite. Peaty or raw humus surface horizons occur on all the soils, and frequently raw humus is developed directly on the polished rock. Small areas of peat of over 12 inches thick do occur, but they are not common. The vegetation in these areas is varied, but is generally a form of heath.

LAND USE. These areas are mainly deer and grouse moors where a few sheep graze occasionally.

CAIRNSMORE COMPLEX

This complex has only been mapped around the top of Cairnsmore of Carsphairn where it covers 0·45 square miles or 1·1 per cent of the association. The slopes on the dome-like mountain top are generally moderate and only occasionally steep, and the high altitudes (2000–2600 feet) have led to the formation of a mountain or sub-alpine soil—the Cairnsmore series. The parent material is a light brown sandy loam derived from granite; its mode of formation is uncertain, but it may be a type of till formed by ice action, or it may have been formed *in situ* by frost action or other processes in post-glacial times. The dominant soil profile is a type of mountain podzol, but the ground surface is so littered with large granite boulders that this mapping unit has been grouped with the soil complexes.

A brief description of the profile is as follows:

Profile Description

Slope		moderate.
Aspect		south-west.
Altitude		2,600 feet.
Vegetation		*Vaccinium—Carex bigelowii-Rhacomitrium* heath—*Salix herbacea, Carex bigelowii, Vaccinium myrtillus, Rhacomitrium lanuginosum.*
Drainage		free.
Horizon	*Depth*	
L	1″–½″	Litter layer.
F	½″–0	Fermentation layer
H/A_2	0–3½″	Dark grey (10YR4/1) gritty humose loamy sand; weak fine crumb; friable; organic matter very high; roots common; large boulders common; no mottles; moist. Clear change into
H/B_2	3½–18″	Dark reddish brown (5YR3/1–2) humose gritty loam; moderate fine crumb; very friable; organic matter high; roots few to common; very stony with many large angular granites; a few very dusky red (2·5YR2/2) patches; no mottles; moist. Clear change into
B	18–22″	Dark brown (7·5YR3/2) gritty sandy loam; very weak structure; friable; roots few; organic matter moderate in localised patches; frequent large angular granite stones, many small sub-angular to sub-rounded gravel stones; no mottles; moist. Clear change into
C	22″+	Brown (10YR4/3) gritty loamy sand; massive; slightly firm; no organic matter; no roots; a few larger stones and many small sub-rounded to sub-angular gravel sized stones often in localized pockets; moist.

This soil closely resembles the mountain ranker Merrick series of the Ettrick Association; the very loose upper horizons of mixed black humus and mineral matter and the light brown sandy loam to loamy sand parent material are common to both profiles. Apart from their parent rocks, the other important difference is the reddish brown colour indicating the occurrence of free iron oxide in the B horizon of the profile. There is a concentration of bleached sand grains in the surface. Thus the characteristics of a podzol soil appear to be superimposed on those of a mountain ranker soil. It is not clear whether the profile has developed continuously by a single group of processes acting under one environmental regime, or whether the podzolic and ranker-forming processes operated separately at different periods giving a soil that is bisequal in nature.

LAND USE. The herbage provides very limited grazing over a short period of the summer for small numbers of sheep.

SKELETAL SOILS

These soils occur mainly on the central granite ridge of the Loch Dee–Loch Doon basin. In all they cover 2·41 square miles or 5·5 per cent of the association. Although rock outcrops and areas of bare rock are important components of several of the soil complexes previously described, in none of them do they cover such a large proportion of the unit as in the areas mapped as carrying skeletal soils where vegetation cover is generally sparse and bare rock accounts for about 25–50 per cent of the unit. Soil formation in the areas between the rock outcrops is mainly restricted to humus accumulation, and under the high rainfall (about 80 inches per annum) of the region this is generally in the mor form. The profile generally consists of up to 6–8 inches of peat material overlying a rock pavement, or of a shallow layer of raw humus on a thin horizon of mixed mineral matter and black mor type humus. This unit is well seen on Craignaw Hill and Hoodens Hill.

These areas have little or no value for agriculture or forestry, but they contribute to the amenities of the locality.

Darleith Association

The Darleith Association covers 17·77 square miles or 3·3 per cent of the area. It was first mapped by Mitchell and Jarvis (1956) in north Ayrshire, and some series of the association in south-east Scotland have since been described by Ragg (1960) and some in central Ayrshire (Grant, in preparation). The association occurs as a compact unit extending inland from the coast in the north-west, and as a few small patches near Tairlaw. Five series, all previously described by Mitchell and Jarvis (1956), one soil complex described by Grant (in preparation) and two complexes not previously found have been mapped. North of Ballantrae the association includes some good agricultural land, but at the slightly higher altitudes farther inland extensive grazing on semi-natural pasture is the usual form of land use.

Distribution

The major part of this association lies within the triangle formed by the coast between Ballantrae and Girvan, the Girvan to Pinwherry road, and the River Stinchar below Pinwherry. A few small areas occur south of the river between Downan Point and Sallachan, farther east at Daldowie, and to the north at Craighead Hill; in addition, small patches have been mapped on the moors between Craiginmoddie and Tallaminnock.

Parent Material

The parent materials of the Darleith Association are derived from the Palaeozoic basic igneous rocks of the area. These include a number of different rock types, of which the most important are the intrusive ultra-basic rocks and spilitic lavas of the Ballantrae area, and the basaltic lavas between The Pilot and Tairlaw. These rocks and the parent materials derived from them are described in Chapter 3.

The rocks give rise to two soil parent materials: a thin stony light textured material, and a clay loam to clay till. The clay loam till in this area differs somewhat from the corresponding drift originally mapped in north Ayrshire as a parent material of the association. In particular, the reddish brown colour characteristic of the north Ayrshire till is much less pronounced in south Ayrshire. This may be due to the greywacke contamination mentioned above, or to other circumstances not fully understood. The two sets of soil profiles are however similar.

Soils

Five soil series and three complexes have been mapped in the association. The freely drained brown forest soil (Darleith series) is the most extensive, while the peaty podzol (Baidland series) is of very limited extent. Of the soils with impeded drainage, Dunlop series, which is the imperfectly drained associate, is of widespread occurrence, the non-calcareous gley (Amlaird series) is restricted to hollows, and the peaty gley (Myres series) is confined to a few higher-lying areas. Bennane complex and Pinverains complex have been mapped for the first time on this sheet. Craig complex has been mapped on the sheet to the north (Grant, in preparation). Each of these three complexes has a pattern of soils developed on uneven rugged topography under certain conditions of slope, altitude and rainfall.

DARLEITH SERIES

The Darleith series, a brown forest soil, is developed on the stony parent material described above, and usually occupies the moderate and steep hill slopes and hill tops. It is the most extensive series, covering 5·96 square miles or 33·4 per cent of the association. The drainage is free and *Agrostis-Festuca* basic grassland is the dominant form of vegetation.

At altitudes approaching 800 feet or so a surface horizon of raw humus up to 1 inch thick may develop, but at lower altitudes it is generally absent, as might be expected from the basic nature of the parent material. The organo-mineral A horizon is characterized by a well developed crumb structure and friable consistence. The boundary with the underlying material is not marked, and merges over 4–6 inches into a (B) horizon whose main differentiating characteristics are a slight colour difference and lower organic content. The structure may be sub-angular blocky but the units are friable and break readily into fine crumbs. The generally angular stones which are common on the surface become more abundant with depth, before the shattered rock is reached.

Profile Description

Slope		5°.
Altitude		500 feet.
Vegetation		*Agrostis-Festuca* basic grassland—*Festuca ovina, Anthoxanthum odoratum, Luzula campestris, Campanula rotundiflora, Koeleria gracilis.*
Drainage		free.
Horizon	*Depth*	
A	0–10″	Dark yellowish brown (10YR4/4) loam; strong medium crumb structure; friable; organic matter moderate; roots abundant; stony; moist. Gradual change into
(B)	10–24″	Reddish brown (5YR4/4) very gritty loam; medium fine crumb; friable; organic matter low; roots common; very stony; moist. Gradual change into
C	24″+	Shattered spilitic lava.

The soil profile is usually thin, although since it is most commonly developed on uneven rock surfaces, deep colluvial soils occur in pockets. Limited amounts of outcropping rock are typical of the series, but, as described later, any area in which outcrops are frequent is mapped as a complex.

LAND USE. Because of its situation on steep hillsides and its stoniness and the tendency for rock to outcrop, the soil is often unsuitable for arable cultivation in this area, despite its advantages of stable structure and free drainage. The semi-natural grassland which is the usual type of vegetation does, however, provide healthy grazing for sheep and cattle. The soil, like most in western Scotland, would benefit from regular dressings of lime, particularly at the higher altitudes where raw humus has developed.

BAIDLAND SERIES

The Baidland series, mapped extensively in north Ayrshire, is limited in this area to a few small patches around The Pilot and Dunamoddie, where it covers only 0·19 square miles or 1·1 per cent of the association. The series is a peaty podzol which is freely drained below the iron pan and the natural vegetation is dominated by *Calluna vulgaris, Trichophorum caespitosum* or *Nardus stricta*. The soil is restricted to a few steep slopes and small knolls at high altitudes.

The peaty surface horizon is generally from 4–8 inches thick but may be as much as 12 inches. The eluviated A_2g horizon is usually thin (1–3 inches) and darker and browner than is usual in this major soil group. Its structure is very weak and the horizon is gleyed. The iron pan is generally thin, and roots are occasionally able to penetrate to the deeper layers of soil.

The B_2 horizon shows the strong brown colour typical of a freely drained soil with a high content of free iron oxides. The weak sub-angular blocky structure breaks easily into fine crumb. The C horizon is generally shattered rock, although in the example quoted above the rock surface is smooth, having been polished by ice movement.

LAND USE. This soil usually forms small patches in open seldom-fenced moorland areas, used chiefly for sheep grazing, with occasional cattle, or for forestry.

Profile Description

Slope		5°.
Altitude		630 feet.
Vegetation		Wet *Calluna* moor—*Calluna vulgaris, Trichophorum caespitosum, Nardus stricta, Festuca ovina, Potentilla erecta.*
Drainage		free below iron pan.
Horizon	*Depth*	
L	8–7″	Litter layer
H	7–0″	Peat.
A_2g	0–2″	Dark grey-brown (10YR4/2) loam; very weak sub-angular blocky; slightly friable; organic matter low, but some staining; a few roots; stony; moist. Sharp change with an irregular boundary into
B_1	2″	Thin iron pan.
B_2	2–9″	Strong brown (7·5YR5/6) loam; weak sub-angular blocky, breaking easily to small crumb; friable; a few roots; stony; moist. Sharp change into polished lava rock.

DUNLOP SERIES

The Dunlop series is concentrated mainly on the moderate lower slopes of hills and some gently rolling ground between Millenderdale and Ballantrae. It covers 5·57 square miles or 31·2 per cent of the association. The soil is classified as a brown forest soil with gleyed B and C horizons but is similar in many ways to a weakly developed gley. At low altitudes near the coast the drainage is typically imperfect, but inland at 500–600 feet along the Lendalfoot–Colmonell road it is generally verging on poor. A similar dichotomy exists in the pattern of land-use and vegetation; the better drained ground is cultivated while semi-natural pasture occurs where the drainage impedance is greater. The vegetation ranges from *Agrostis-Festuca* basic grassland to *Carex* wet pasture and is rich in species. The parent material is a clay loam to clay till in which the proportion of ultra-basic material is noticeable.

Profile Description

Slope		3°.
Altitude		300 feet.
Vegetation		*Carex* wet pasture—*Carex panicea, C. pulicaris, Anthoxanthum odoratum, Festuca ovina, Molinia caerulea, Nardus stricta, Potentilla erecta, Lotus corniculatus, Trifolium repens.*
Drainage		imperfect.
Horizon	*Depth*	
A	0–9″	Dark brown (7·5YR4/3) loam; strong medium sub-angular blocky; friable; organic matter high; roots common; a few stones; moist. Clear change into
$B_2(g)$	9–18″	Brown (7·5YR5/3) clay loam; moderate prismatic; firm; roots few; stony; frequent medium yellowish brown (5YR5/2) and a few grey-brown (10YR5/2) mottles; moist. Diffuse change into
$B_3(g)$	18–30″	Grey-brown (2·5Y5/2) (with some brown (7·5YR5/2) areas) clay loam; weak coarse prismatic; firm; a few stones; a few medium distinct strong brown (7·5YR5/8) mottles; moist. Gradual change into
C(g)	30″+	Brown (7·5YR5/3) gritty clay loam; massive; stony.

The dark brown loam A horizon is notable for its well developed strong structure and high organic content. The colours of the soils at the drier end of the continuum are generally slightly higher in chroma than quoted.

The B_2(g) has a well developed prismatic structure and coarse ochreous mottles are frequent, being rather more abundant in the wetter soil under semi-natural vegetation. The parent till in the C horizon is grey-brown to brown in colour, and at the depths reached in normal inspection pits shows some ochreous mottling. Chemical analysis shows this series to have only a moderately acid reaction of about pH 6 in the top-soil rising down the profile to near neutrality. The soil is unusual in that magnesium replaces calcium as the dominant ion on the exchange complex. This position, however, is reversed in the topsoils of cultivated ground with a history of liming although the lower horizons of these soils again show the dominance of magnesium.

LAND USE. Near the coast north of Ballantrae mixed dairy farming with some sheep and cattle grazing and arable cropping is the main form of land use. Further east, at somewhat higher altitudes, fences are less frequent and pastures are grazed by sheep and cattle on an extensive pattern. The clay soils lie naturally wet and for successful cultivation need artificial drainage; even then, despite their strong structure, they are still liable to winter poaching. The high magnesium contents may contribute to the prevention of grass staggers, although the cause of this disorder is not yet fully understood.

AMLAIRD SERIES

The Amlaird series which occupies 1·67 square miles or 9·4 per cent of the association occurs in the hollows and along the drainage channels in the same area between Millenderdale and Ballantrae as the Dunlop series and is developed on the same fine textured basic igneous till. The soil is a non-calcareous gley with a good base status and the vegetation is *Carex* wet pasture or *Agrostis-Festuca* meadow grassland, with a rich variety of species.

Profile Description

Slope		1°.
Altitude		350 feet.
Vegetation		*Agrostis-Festuca* meadow grassland—*Cynosurus cristatus, Anthoxanthum odoratum, Nardus stricta, Potentilla erecta, Plantago lanceolata.*
Drainage		poor.
Horizon	*Depth*	
Ag	0–10″	Very dark grey (5YR3/1) loam; moderate medium sub-angular blocky to crumb; friable; organic matter high; roots abundant; a few stones; a few fine distinct dark red (2·5YR3/6) mottles; moist. Clear change into
B_2g	10–20″	Grey (2·5Y5/1) clay loam; weak coarse prismatic; plastic; organic matter low; fine roots; many weathering stones; many coarse distinct yellowish brown (10YR5/6) mottles; wet. Gradual change into
B_3g	20–30″	Grey (2·5Y5/1) clay loam; massive; plastic; stony; frequent fine faint light olive-brown (2·5Y5/4) mottles; wet. Diffuse change into
Cg	30″+	Grey-brown (10YR5/2) gritty clay loam; massive; very firm to slightly plastic; stony; a few coarse grey (2·5Y5/6) mottles; moist to wet.

The organic content of the dark grey surface horizon is high, as is the case in the Dunlop series, but the sub-angular blocky structure is less strongly developed.

The grey colours of the Bg horizon are broken by a great deal of ochreous mottling, while the coarse prismatic structure is only weakly developed and is often not easily discerned; the wet clay of this horizon is generally very plastic. The texture of the Cg horizon is usually slightly less fine than that of the overlying material, and the ochreous mottling is much less prominent.

The reaction and base saturation of these soils is moderate in the surface horizon and rises to neutral or near neutral; at about 30 inches saturation is complete. As with the Dunlop series on similar parent material, magnesium rather than calcium is the dominant exchangeable cation. The calcium values, however, are higher in the surface layer than in the others, and probably reflect past liming treatments.

LAND USE. Without intensive artificial draining these soils are generally unsuitable for any form of arable cultivation, and in this connection difficulty is caused by the lack of satisfactory outfall brought about by topographic position; in any event the land would tend to remain wet because of run-off from surrounding higher ground. The strong tendency of the soils to poach must be borne in mind when considering any form of land management. Sheep and cattle grazing are the common methods of land utilization. The high magnesium content may be important in relation to grass tetany, as mentioned for the Dunlop series.

MYRES SERIES

Myres series is of very limited extent, the main occurrences being an area on Cairn Hill and the flat area south of Knockdaw Hill. It comprises 0·96 square miles in all or 5·4 per cent of the association. A peaty gley profile of poor drainage, its occurrence is restricted to areas of till at an altitude of 600–800 feet. Slopes are very gentle, except on Cairn Hill where the soil is found on a steep hillside. The vegetation is wet *Calluna* moor, and on Cairn Hill *Molinia* grassland.

Profile Description

Slope		3°.
Altitude		575 feet.
Vegetation		Wet *Calluna* moor—*Calluna vulgaris, Molinia caerulea, Trichophorum caespitosum, Erica tetralix, Carex nigra.*
Drainage		poor.
Horizon	*Depth*	
L & F	7–6″	Litter and fermentation layers.
H	6–0″	Black (5YR2/1) fibrous peat.
A_2g	0–4″	Grey-brown (10YR5/2) clay loam; moderate coarse prismatic; plastic; organic matter low; roots common; stony; frequent coarse distinct strong brown (7·5YR5/8) mottles; wet. Gradual change into
B_2g	4–20″	Light grey (2·5Y6/2) clay loam; weak coarse prismatic; slightly plastic; stony (occasional large boulders, many weathering ultrabasic stones); many medium distinct strong brown (7·5YR5/8) mottles; wet. Gradual change into
Cg	20″+	Brown (8·5YR5/2) gritty clay loam; massive; firm; stony; a few fine faint light olive-grey (5Y6/2) mottles.

The surface horizon of dark peat, which is usually about 6 inches deep, is underlain by a grey to dark grey organo-mineral A_2g horizon in which strong ochreous mottling is common. Ochreous mottling reaches a high degree of intensity in the Bg horizon, in which the clay content is also at a maximum. When wet this clay becomes plastic. On the sites selected for sampling the till proved to be shallow, and at a depth of 30 inches or so became both coarser in texture and more stony. The weak coarse prismatic structure of the Bg horizon grades to massive in the C horizon till which is very firm and shows some mottling.

LAND USE. This series occurs in open unfenced areas and, in common with the soils of the surrounding country, is utilized for grazing cattle and sheep. Appreciable improvement must involve considerable labour and expense.

BENNANE COMPLEX

The Bennane complex covers 1·27 square miles or 7·2 per cent of the association, and mainly occurs on low hills of spilitic lava, with rugged rocky topography, below about 800 feet. Outcrops of rock are frequent and while Darleith series is developed on most of the intervening areas the nature of the soil varies from shallow brown rankers (Kubiena, 1953) to deep colluvial soils occurring in small patches. The soils are similar, however, in being freely drained and not having a raw humus surface horizon more than 1 inch deep. The slopes are generally steep, and the vegetation is *Agrostis-Festuca* acid grassland and *Agrostis-Festuca* meadow grassland.

LAND USE. Probably most of the areas of this complex were formerly occupied by the gorse and broom which is now restricted to patches around rock outcrops. The present grassland pasture provides healthy grazing for sheep and store cattle. Where the rock is near the surface, however, the soils are liable to suffer from drought in prolonged dry spells. The herbage quality may be maintained or improved by the application of lime and fertilizers, but the use of mechanical implements is restricted by the nature of the terrain, although they have been successfully employed for reseeding in a few instances where conditions were especially favourable. Wear and tear of implements must obviously be high.

CRAIG COMPLEX

This complex is found on rugged hills of basic lavas at altitudes of 700–1300 feet. It covers only 0·94 square miles or 5·3 per cent of the association, the principal areas being on Craig Hill, Aldons Hill and at Tairlaw Ring. The topography of frequent rock outcrops and intervening hollows is the major influence on the soil pattern. The land form is very similar to that on which the Bennane complex is developed but the altitude is generally higher, so that most of the soils have a raw humus or peaty surface horizon. On the knolls there is generally a certain amount of bare rock, together with very shallow stony peaty podzol and podzol ranker (Kubiena, 1953) soils. On Craig Hill and the lower slopes of Aldons Hill there is also a considerable proportion of a stony brown forest soil similar to the Darleith series. In the intervening hollows the soils are wet peaty gleys, developed on thin drift and colluvium and peat. The vegetation pattern is extremely variable, but in general the podzolic soils carry dry *Calluna* moor, while *Agrostis-Festuca* acid grassland occurs on the brown forest soils and wet *Calluna* moor on the peat and peaty gleys.

LAND USE. Sheep grazing, together with some cattle grazing is the main form of land use on Craig Hill and Aldons Hill. At Tairlaw Ring the complex area has been recently afforested by the Forestry Commission. The altitude and terrain appear to make improvement of these hill pastures unlikely.

PINVERAINS COMPLEX

Only small patches of Pinverains complex have been mapped, as on the northern slopes of Pinverains Hill and on Knockronal Hill. The complex covers only 0·74 square miles, 4·2 per cent of the association. The topography is typically a gently sloping area on which a number of knolls occur. The parent materials are basic lavas, which make up the knolls, and a thin mixed drift in which basic igneous material predominates. Very little bare rock occurs in the soil pattern, and the lava knolls carry a thin stony soil of the Darleith series which may, however, have a raw humus horizon several inches thick. Peat or peaty gley soils occupy the gently sloping areas of thin drift.

Nardus and *Agrostis-Festuca* acid grasslands are the most common vegetation types on the brown forest soils, and *Molinia* grassland or wet *Calluna* moor on the peats and peaty gleys.

LAND USE. These areas are managed as hill pastures for sheep and cattle grazing.

SKELETAL SOILS

Occurring mainly on the west coast between Girvan and Ballantrae, skeletal soils of the Darleith Association have been mapped on 0·47 square miles or 2·6 per cent of the association. These soils are generally found on rocky hill tops as on Knockdolian Hill, or on steep hillsides as on Pinbain Hill. Bare rock occurs frequently but is usually less abundant than in the skeletal units of the Ettrick and Dalbeattie Associations, and the vegetation cover although still sparse is correspondingly greater. The soils generally have an organo-mineral A horizon in which the humus form is mull or moder. At altitudes over about 600 feet a thin surface H layer of raw humus may be present. The A horizon usually overlies stony rock rubble or rock which has been little affected by pedological processes. B horizons, if discernible, are rudimentary; hence the soil profiles are similar to those called rankers by Kubiena (1953). The vegetation is *Agrostis-Festuca* acid grassland. The soils have little or no agricultural value apart from providing some grazing for sheep, and in the areas where they occur they are not likely to be thought to contribute materially to amenity.

Darvel Association

The Darvel Association occupies only 0·13 square miles or 0·03 per cent of the area, but it has been mapped extensively in north Ayrshire by Mitchell and Jarvis (1956), in central Ayrshire by Grant (in preparation), and in the Lothians by Ragg and Futty (1967).

Parent Material

West of Dailly in the Girvan Valley a shallow deposit of sand and gravel overlies the till in a small area. The composition of the deposit reflects that of the rocks and drifts occurring further up the valley—Carboniferous and Old Red Sandstone sediments with some greywacke, basic lava, felsite and granite materials. The deposit occurs associated with modified deposits of till derived from Old Red Sandstone rocks.

Soils

DARVEL SERIES

The freely drained Darvel series, which has been classified as a brown forest soil of low base status, is the only soil of this association mapped in the area. It is restricted to one small patch west of Dailly where it is developed on the sand and gravel deposit described above. The topography is flat or gently sloping with a micro-relief of low mounds. The whole of the area covered by the series is cultivated at fairly frequent intervals.

Profile Description

Slope		flat.
Altitude		100 feet.
Vegetation		temporary grass ley.
Drainage		free.
Horizon	*Depth*	
S	0–9″	Brown (10YR4/3) sandy loam; weak sub-angular blocky breaking to fine crumb; friable; organic matter moderate; roots common; occasional pebbles; moist. Clear change into
B_2	9–14″	Strong brown (7·5YR5/6) loamy sand; single grain; friable; organic matter low; roots common; common pebbles; moist. Diffuse change into
C	14″+	Light brown (7·5YR6/4) sand; single grain; slightly friable; a few roots near the top of the horizon; rounded stones of wide size-range common.

Under conditions of frequent cultivation the coarse textured surface horizon has a fairly weakly developed structure. Small stones are common in this series but do not interfere appreciably with cultivation. The clay content decreases down the profile, the texture becoming loamy sand and sand in the B_2 and C horizons respectively. The high chroma generally found in soils of this major sub-group is only moderately developed in this series. The C horizon of mixed sand and gravel is often underlain at a depth of 5 feet or so by till, and for this reason may in this area show a few weak ochreous mottles, but these are not typical of the series.

LAND USE. The small area of this series in the lower part of the Girvan Valley is cultivated for the growing of oats, turnips and ley grass.

Dreghorn Association

The Dreghorn Association was first mapped on the coarse textured sandy deposits of the raised beaches in north Ayrshire by Mitchell and Jarvis (1956) and later along the central Ayrshire coast by Grant (in preparation);

in the present area it has been mapped on the southern extension of these raised beach tracts. Only the freely drained Dreghorn series has been found; it covers 2·6 square miles, 0·50 per cent of the area, and is valuable for the growing of early potatoes.

Distribution

The major unit of the association is found in the north-west of the area around the town of Girvan where the river deposits of the Girvan Valley merge with the raised beach deposits of the coast. Further south the soil is restricted to very narrow coastal strips, the most extensive of which are at Lendalfoot and at Ballantrae.

Parent Material

The coarse textured raised beach deposits form the parent material of the Dreghorn Association. The deposits are generally of sandy loam or loamy sand texture, and there are occasional layers or lenses of shingle or gravel. Partially rounded stones occur frequently in the small areas of the 100-foot beach. The composition of the deposits is mixed; in addition to quartz grains, particles of greywacke and dark coloured basic igneous rocks are common. In many places there is probably a thin cover of blown sand.

Soils

DREGHORN SERIES

The Dreghorn series has been classified as a brown forest soil. The sandy textures allow free drainage, and together with the low organic contents lead to a somewhat low water retention capacity. The low flat topography, however, helps to keep the water-table near the surface, and this, allied to the rainfall of 35 inches per annum, means that the soils do not suffer unduly from drought, although the growth of the valuable early potato crops may on occasion be less than its full potential because of limited water supplies in late May and June. Irrigation is practised on some farms. The entire area of the series is intensively cultivated and mainly devoted to growing early potatoes.

Profile Description

Slope		flat.
Altitude		25 feet.
Vegetation		fallow, following early potatoes.
Drainage		free.
Horizon	*Depth*	
S	0–10″	Dark brown (7·5YR4/2) sandy loam; weak sub-angular blocky; very friable; organic matter low; roots few; occasional rounded stones; moist. Clear change into
B_2	10–21″	Dark yellowish brown (10YR4/4) loamy sand; weak fine sub-angular blocky; friable to slightly firm; organic matter very low; roots few; occasional rounded stones; moist. Diffuse change into
C	21″+	Yellowish brown (10YR5/4) sand; single grain to massive; slightly firm; occasional rounded stones; moist.

Although the surface horizon is of coarse texture, the clay content is higher here than in the other layers of the soil; the decrease down the profile is progressive with depth. The intensive cultivation necessary for each crop is probably partly responsible for the low accumulation of organic matter, and, in the absence of a high organic content, is conducive to the weak soil structure. The B horizon is only weakly differentiated from the A and C horizons, and there is little indication of an appreciable free iron content. This may be partly connected with the fairly high percentage base saturation and the near neutral reaction of the soil, which is often pH 6–7, both of which indicate that leaching has not been intense or proceeded very far. This situation seems somewhat anomalous in view of the rainfall and coarse soil textures, but a partial explanation may be found in the proximity of this soil to the sea and the consequent effect of the large amounts of salt spray produced by waves breaking on the rocky coast. Another factor which helps to explain the good base status of this soil is a considerable history of intensive cultivation and fertilization; dressing with seaweed gathered from the shore is still common practice, and was probably of even greater relative importance before mineral fertilizers became generally available.

Mottling is absent from the profile and the stone content of the soil is generally low, although locally flat beach-rounded greywackes may be frequent and basic igneous pebbles are common near Ballantrae and Lendalfoot.

LAND USE. It has already been mentioned that the growing of early potatoes is the most usual and most profitable agricultural activity. Because of its location the land is also especially suitable for such non-agricultural developments as building and caravan sites. Freedom from late frosts is the prime factor which allows the successful growing of early potatoes on these soils. They enjoy this favourable climate because they are situated at a low altitude near to the western sea. Pedological factors are also favourable, but they are not of such vital importance. The main features are the free drainage, which allows cultivation early in the year, and rapid spring warming of the soil, together with the coarse soil texture which enables a tilth to be obtained with a minimum of cultivation operations and allows easy harvesting of a relatively soil-free crop.

After the lifting of the potato crop, some farmers sow a vigorous species of grass such as Italian rye-grass at a high seed rate to obtain a rapidly growing dense sward. Cattle, or more commonly lambs, are then fattened on this pasture during the late summer and autumn. This practice has the advantages of utilizing some of the fertilizers left over from the growing of the potato crop, adding valuable humus to the soil, and making use of the ground for the second half of the year, with the reaping of any profits which may thus accrue.

Ettrick Association

The Ettrick Association, first mapped in south-east Scotland (Muir, 1956; Ragg, 1960; Ragg and Futty, 1967), is the most extensive considered in this memoir, occupying 228 square miles or 42·9 per cent of the area. The soils range from the well cultivated intensively farmed brown forest soils south-east of Ballantrae to the uncultivated mountain soils on the desolate hill tops of the Merrick and Kells ranges. Extensive areas of rugged and uneven topography have led to the widespread development of soil complexes. Blanket peat is developed in many places throughout the general area of the association.

Distribution

Stretching in a continuous belt from Waterhead Hill in the north-east to Glen App in the south-west, the association occupies almost the whole of the area south of the Southern Uplands Fault, apart from the granite outcrops. North of the Fault it occupies limited areas; one of the more extensive runs from Hadyard Hill over Troweir Hill and Saugh Hill to the Dow Hill south of Girvan, and another extends from Meikle Littlejohn to Laigh Knocklaugh.

Parent Material

The parent rocks and the materials derived from them have been described in Chapter 3. The Ordovician and Silurian sedimentary strata consist mainly of greywackes and shales, with some mudstones and conglomeratic beds. The analyses in Appendix VI show that the composition of the rock varies from that of an acid igneous rock such as granite to that of a rock of intermediate basicity such as andesite.

Glacial till and moraine are the most extensive parent materials in the association. The till may be divided into two types, a compact or firm clay loam and an indurated loam till. The clay loam till, which gives rise to soils with impeded drainage, occurs in a small area along the lower slopes of the valley sides around Waterhead near Carsphairn. It is well developed on Saugh Hill and near High Troweir, where it contains a high proportion of shale and most closely resembles the mode first established around Jedburgh and Morebattle (Muir, 1956). Further south along the lower reaches of the Stinchar Valley, the Muck Water, and around Beneraird the basal till is a clay loam and contains a relatively high proportion of hard little-weathered greywacke stones. In this area also it is frequently overlain by a stony coarse textured drift, which may be indurated. Where this occurs to a depth of 18 inches or so in the soil a distinctive group of soils has been separated—the Altimeg, Littleshalloch and Dochroyle series.

The medium textured till is found around the hills in the eastern part of the area and includes the drumlins in the southern part of the sheet. Cuttings and deep exposures in these latter features show the till to be strongly indurated throughout its depth, of a greyish colour, and stony.

The moraine occurs as mounds, grouped together to form fields, which are seen well developed around Carsphairn in the eastern part of the area and in the Minnoch Valley, from which they spread westwards across the moors to Shalloch Well and to Barrhill. The morainic material is of coarse texture, sandy loam to loamy sand, has a high content of angular greywacke stones and is strongly indurated throughout the depth of the deposit as seen in quarries.

Soils

Five series of the association have been previously mapped in south-east Scotland (Muir; 1956, Ragg, 1960) and four new series are described for the first time. In addition extensive areas of ten different soil complexes which have not been encountered before have been mapped. The brown forest soils, the freely drained Linhope series and the imperfectly drained Kedslie series and Altimeg series, underlie most of the cultivated land of the association in the western parts of the sheet.

Further east in the hill and moorland tracts the peaty podzol (Dod series) and the peaty gley (Dochroyle series) are the dominant soils in areas not covered by blanket bog or heterogeneous soils mapped as complexes. The Alemoor series, a peaty gley soil, is restricted to small hill areas near Girvan where it has been mapped on the shale-dominant till.

On 'flush' sites and on a few concave hill slopes the poorly drained non-calcareous gley belonging to the Littleshalloch series occupies small areas. The *Juncus* species which are generally dominant in the plant communities growing on this soil contrast strongly with the surrounding heath vegetation. The sub-alpine soil (Merrick series) occurs on the higher hill tops, generally over 2000 feet.

Complex soil mapping units are widespread throughout the eastern part of the area and occur sporadically elsewhere. The Darnaw complex, an important unit on rocky hill ground, is seen well developed on Darnaw Hill near Clatteringshaws Loch, while Glenlee complex, which is found on somewhat similar topography, occurs in the nearby glen of that name. Further north, on the south side of the Garroch Glen, are good examples of the Largmore complex, while Bush complex—a rather similar unit—is widespread in the Forrest Glen. The Trool and Finlas complexes are characteristically developed near the respective lochs after which they are named.

The morainic Minnoch and Stroan complexes show their typical pattern in the upper and lower parts of the Minnoch Valley respectively. Brochloch complex is mainly confined to the area east of the Minnoch Valley, while Achie complex, comprising brown forest soils and rock outcrops, is most common further west.

LINHOPE SERIES

The Linhope series is widespread below about 600 feet throughout the association. It occurs on the stony screes, moraine, and medium textured tills described in Chapter 3, generally on moderate or steep slopes along valley sides. A freely drained brown forest soil of low base status, it covers 28·94 square miles or 12·6 per cent of the association. Much of the series is uncultivated and the vegetation is commonly a form of *Agrostis-Festuca* acid grassland, which may frequently be invaded and dominated by bracken (*Pteridium aquilinum*).

In the absence of cultivation the surface litter layer is well developed and in some cases may pass into a very thin raw humus horizon. More generally it rests directly on the organo-mineral A horizon which has a high organic content; the humus form is usually moder. This horizon is generally shallow and is succeeded by a layer having a lower, but substantial organic content, transitional in character between the A and B horizons. This distinction is destroyed in soils that have been cultivated at some time during their history and these have a uniform brown-coloured surface horizon. The B_2 horizon has a bright ochreous colour that contrasts markedly with the rest of the profile. It has a friable consistence but the structure may vary from sub-angular blocky to crumb. The colour of the B_3 horizon is of lower chroma and the consistence is less friable. In soils developed on colluvial frost-shattered debris this horizon is transitional between the B_2 and C horizons, but in soils developed on moraine or till the boundary between the B_2 and C horizons is clear. The C horizon is very stony and grey or grey-brown in colour.

Profile Description

Slope		6°.
Altitude		400 feet.
Vegetation		*Agrostis-Festuca* acid grassland—*Pteridium aquilinum, Festuca ovina, Agrostis* sp., *Anthoxanthum odoratum, Galium saxatile.*
Drainage		free.
Horizon	*Depth*	
L	1–0″	Litter.
A_1	0–3″	Very dark grey-brown (10YR3/2) loam; strong to moderate medium crumb structure; friable; organic matter high; abundant roots; stony; moist. Clear change into
A/B	3–7″	Dark yellowish brown (10YR4/5) loam; moderate medium crumb; friable; organic matter low; roots common; stony; moist. Gradual change into
B_2	7–15″	Strong brown (10YR5/8) loam; weak sub-angular blocky structure breaking to fine crumb; friable; roots common; organic matter low; stony; moist. Gradual change into
B_3	15–23″	Brown (10YR5/3) loam; weak medium sub-angular blocky; slightly friable; roots few; stony; moist. Clear change into
C	23″+	Grey-brown (2·5Y5/2) very gritty sandy loam; massive, with occasional tendency to platy; strongly indurated; very stony; some very small patches of yellowish brown (10YR5/6) staining.

LAND USE. Where it occurs in the moorland tracts of the area, this soil is often accessible to mechanical implements only with difficulty, and is therefore not cultivated. It does however provide healthy grazing and frequently the only areas on which sheep and cattle may lie dry. Areas of several acres have often been enclosed by walls in the past for better grazing control. Where access is possible occasional reseeding, liming and fertilizer application will give large increases in sward productivity.

Where access is good, as in the valleys, the soil is usually cultivated on a rotation of long ley grass, oats and turnips. The soil may suffer from drought in prolonged dry spells, but leaching is active and frequent attention to lime and fertilizer status is necessary for the maintenance of fertility levels.

ALTIMEG SERIES

The Altimeg series occurs in small areas throughout the association of which it occupies 6·59 square miles or 2·8 per cent. It is well developed on some of the broader gently sloping tops of drumlins and along the slopes of the Stinchar Valley and its tributaries. The parent material is the stony medium-textured till or drift which may overlie a finer-textured clay loam till as described in Chapter 3. The soil is a brown forest soil, with gleying in the B and C horizons and its drainage class is imperfect. Where access allows this series is cultivated, but under semi-natural conditions the vegetation is *Agrostis-Festuca* meadow grassland, a form of acid grassland in which *Juncus* species are more or less common.

Profile Description

Slope		2°.
Altitude		480 feet.
Vegetation		*Agrostis-Festuca* meadow grassland—*Poa pratensis, Festuca rubra, Poa trivialis, Trifolium repens, Agrostis tenuis, Anthoxanthum odoratum, Ranunculus repens, Juncus articulatus.*
Drainage		imperfect.
Horizon	*Depth*	
S	0–9″	Brown (10YR5/3) loam; moderate medium sub-angular blocky; friable; moderate organic content; roots abundant; stony; moist. Clear change into
B(g)	9–22″	Light yellowish brown (2·5Y6/4) gritty loam; moderate medium sub-angular blocky; firm; organic matter low; a few roots; stony; frequent medium distinct yellowish brown (10YR5/5) mottles; moist. Clear change into
C	22″+	Grey-brown (2·5Y5/3) gritty loam; massive; indurated; stony; frequent fine faint yellowish brown (10YR5/6) mottles; some dark manganiferous stains.

A characteristic feature of this profile is the clear change on passing from the brown friable surface horizon into the contrasting B(g) horizon; this becomes even more prominent where the induration occurs immediately below the A horizon.

The subsoil horizons give the impression of being predominantly grey in colour, but this is thought to be in large measure inherited from the parent material rather than due to the effects of gleying. Ochreous mottling is not prominent in the profile, which may be shallow where the induration has apparently retarded the penetration of pedologic agencies. Little change appears to have taken place in or below the indurated layer.

LAND USE. A large proportion of this series is cultivated, generally in a rotation of long ley grassland with short breaks for oats and turnips. The soil has a satisfactory water regime in that it has fairly good resistance to drought without being unduly liable to poaching in wet spells. Attention to liming is necessary to prevent undue acidity.

KEDSLIE SERIES

The Kedslie series occurs on hill slopes south-east of Girvan and on the gentle and moderately steep valle·y sides along the lower Stinchar Valley. It occupies 9·81 square miles or 43 per cent of the association. The soil is developed on the clay loam till, derived from greywacke and shale, described in Chapter 3. The drainage class is imperfect, and the profile is grouped as a brown forest soil with gleying in the B and C horizons, although at the wetter end of its range the series shows a close relationship to the non-calcareous gleys. Under semi-natural conditions the vegetation is a form of acid grassland in which species of *Juncus* are present or *Agrostis-Festuca* meadow grassland.

Profile Description

Slope		5°.
Altitude		500 feet.
Vegetation		*Agrostis-Festuca* meadow grassland—*Festuca ovina, Agrostis tenuis, Trifolium repens, Festuca rubra, Juncus acutiflorus, Nardus stricta, Mnium undulatum.*
Drainage		imperfect.
Horizon	*Depth*	
A	0–9″	Yellowish brown (10YR5/4) loam; moderate medium sub-angular blocky; slightly friable; organic matter moderate; roots common; stony; moist. Gradual change into
A/B_2(g)	9–14″	Brown (10YR5/3) loam; weak medium sub-angular blocky; slightly firm; organic matter low; common roots; stony; frequent fine distinct strong brown (7·5YR5/6) mottles; moist. Clear change into
(B_2g)	14–26″	Light brownish grey (10YR6/2) clay loam; moderate medium prismatic; firm; stony; frequent coarse distinct strong brown (7·5YR5/8) mottles; moist. Gradual change into
B_2(g)	26–40″	Grey (10YR6/1) clay loam; massive; firm; stony; frequent medium distinct strong brown (7·5YR5/8) mottles; moist. Diffuse change into
C(g)	40″+	Yellowish brown (10YR5/4) clay loam; massive; very firm; stony; frequent medium distinct light grey (10YR6/1) mottles.

The structure in the A horizon is only moderately stable and fine ochreous mottling may occur in the surface layer, particularly under old grassland. The prismatic structural units of the B_2(g) horizon have a grey smooth skin of orientated clay and are most strongly developed in the drier soils of the series. The well marked pattern of grey and ochreous mottling in this horizon is typical of the series.

LAND USE. In a small area near Girvan this soil is frequently cultivated for the growth of arable crops, but under the rather higher rainfall prevailing elsewhere in the area it is generally farmed in a rotation of long ley grassland with short breaks for roots and oats.

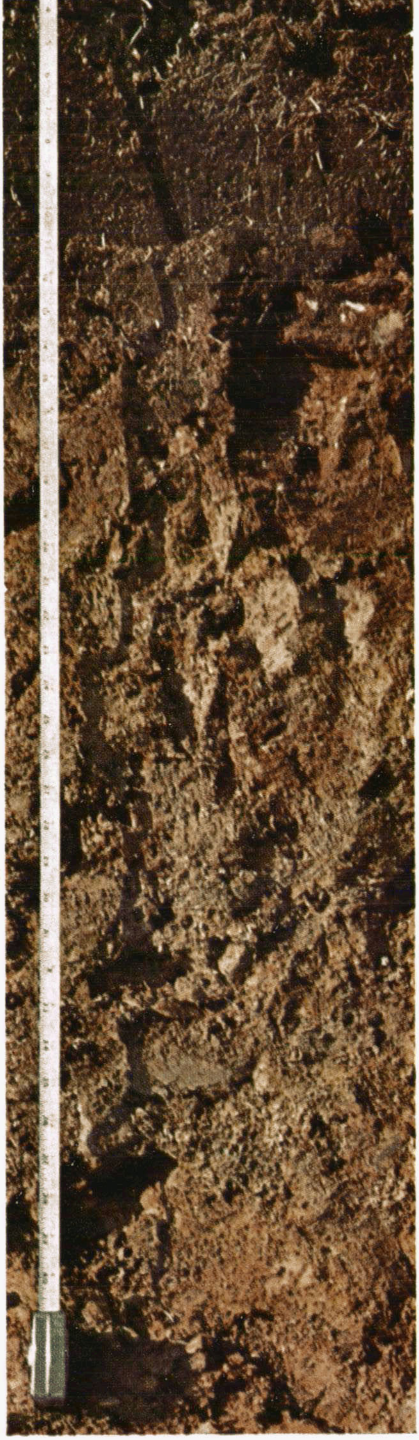
Some care is needed to avoid poaching in winter and to maintain the relatively weak structure during cultivation or grazing. The lime requirement of this series is rather less than that of other soils of the association occurring in the area. Tile drains are essential to proper cultivation.

DOD SERIES

One of the more widespread soils of the association, of which it forms 7·1 per cent, the Dod series occurs commonly throughout the hill and moorland tracts and covers 16·25 square miles. It is also an important component of several soil complexes. The series generally occurs on moderate and steep slopes, and on drumlins and morainic mounds. The parent materials are the coarse- and medium-textured drifts described above and in Chapter 3. The drainage class is imperfect above the iron pan and free below. On the steep slopes around the Merrick and Kells Hills, and occasionally elsewhere, a creep phase of the series occurs in

I

II



Ettrick Association/*Dod Series*

PLATE I/One of the more widespread soils on the moorlands of south Ayrshire, the orange-brown colour of the B horizon marks the zone of iron accumulation. Compare with Plate II.

Ettrick Association/*Dochroyle Series*

PLATE II/A common soil of the south Ayrshire moorlands, the grey colours which predominate below the peaty layer are caused by the intense gleying which occurs under the conditions of very poor drainage.

III

IV

DARLEITH ASSOCIATION/*Darleith Series*

PLATE III/A freely drained soil developed on basic lavas, the Darleith series is characterized by the relatively uniform brown colour throughout the profile.

ETTRICK ASSOCIATION/*Linhope Series*

PLATE IV/A freely drained soil developed on greywacke drift, the Linhope series is classified as a brown forest soil of low base status.

which the horizon differentiation is less well developed than is usual in this soil, apparently because of soil instability, and profiles on these sites show considerable variation from the normal. The description of the modal form of this variant presents considerable difficulties and is not attempted here, but the basic sequence of horizons is within the range of the Dod series. Dry *Calluna* moor or *Nardus* grassland are the plant communities on the drier sites, but wet *Calluna* moor with *Erica tetralix*, *Trichophorum caespitosum*, *Vaccinium myrtillus*, *Molinia caerulea* and *Juncus squarrosus* is more common.

Profile Description

Slope	10°.
Altitude	600 feet.
Vegetation	Wet *Calluna* moor—*Calluna vulgaris*, *Molinia caerulea*, *Nardus stricta*, *Agrostis* spp., *Juncus squarrosus*.
Drainage	imperfect above the iron pan, free below.

Horizon	*Depth*	
L & F	10–9″	Litter and fermentation layer.
H	9–0″	Black (5YR2/1) fibrous peat.
A_2g	0–2″	Dark grey (10YR4/1) loam; weak coarse sub-angular blocky; friable; organic matter moderate; roots common; stony; moist. Sharp change with irregular boundary into
B_1	2″	Strongly developed thin iron pan.
B_2	2–10″	Strong brown (7·5YR5/8) loam; weak sub-angular blocky, breaking easily to fine crumb; friable; stony; moist. Gradual change into
B_3	10–21″	Light yellowish brown (2·5YR6/4) gritty sandy loam; weak sub-angular blocky; firm; very stony; moist. Gradual change into
C	21″+	Grey-brown (2·5Y5/2) gritty sandy loam; massive with slight tendency to platy; indurated; very stony greywacke drift.

The surface organic horizon of this series is generally more than 8 inches deep. Well developed podzol profiles have been found with more than 24 inches of peat, although areas where the organic horizons are more than 12 inches deep have been mapped as peat. The H horizon tends to act as a sponge, maintaining wet conditions in the upper part of the profile for considerable periods of the year. The bleached A_2g horizon, therefore, as well as being strongly leached, is also gleyed. Most commonly this horizon is shallow (2–4 inches) and may be partially masked, when seen in a fresh exposure, by washed-in organic matter; the characteristic ashy appearance, however, becomes prominent as the profile dries. Deep A_2g horizons of 24 inches or more do occur, and in such cases the B horizons are often attenuated, consisting only of the iron pan with a mere 1 or 2 inches of faintly ochreous material below. With slightly greater depths of A_2g horizon the B horizons may become a mere trace of iron pan and the profile essentially that of a gley.

The strongly developed iron pan is about $\frac{1}{8}$th inch thick, with small stones and grit particles strongly cemented into the pan matrix. Below the pan the B_2 horizon varies in colour between strong brown and yellowish brown, and has a characteristic silty loam feel in the field. The B_3 horizon, of which rather dull olive hues are typical, is transitional in nature between the B_2 and C horizons. A few areas of the iron podzol belonging to the Minchmoor series (Ragg, 1960) have been mapped with Dod series on account of their small extent.

LAND USE. The low productivity of the herbage commonly growing on this series together with the wet nature of the surface horizons restricts its utilization to extensive sheep and cattle grazing. Provided conditions of slope and altitude are favourable, reclamation of soils with a shallow peat horizon (say <6 inches) can be successfully carried out, and productive grassland swards established. It is important for the success of this operation that cultivation should be sufficiently deep to disrupt the iron pan, in order that the best natural drainage is obtained. It has been found, however, that in some reclaimed pastures rushes have appeared. Large initial applications of lime and fertilizer are also necessary for successful reclamation.

Following deep ploughing to break up the pan and provide surface drainage considerable areas of the series have been afforested, often with Sitka spruce.

ETTRICK SERIES

The Ettrick series is one of the less extensive soils of the group, occupying 6·76 square miles or 2·9 per cent of the association. It occurs mainly on the hill slopes near Girvan and in the valley of the River Stinchar. The parent material is the clay loam till described in Chapter 3, and the soil is classified as a non-calcareous surface-water gley of poor drainage status. The commonly occurring vegetation is *Juncus acutiflorus* pasture.

Profile Description

Slope		5°.
Altitude		500 feet.
Vegetation		*Juncus acutiflorus* pasture—*Juncus acutiflorus, Anthoxanthum odoratum, Festuca ovina, Agrostis tenuis, Holcus lanatus, Rhytidiadelphus squarrosus.*
Drainage		poor.
Horizon	*Depth*	
A_1	0–6″	Dark grey-brown (2·5Y4/2) loam; weak fine sub-angular blocky; slightly friable; organic matter moderate; roots common; a few stones; frequent fine yellowish brown (10YR5/4) mottles along root channels; moist. Gradual change into
A_2g	6–11″	Light grey-brown (2·5Y6/2) loam; weak coarse sub-angular blocky; slightly firm; organic matter low; roots common; a few stones; frequent fine faint yellowish brown (10YR5/4) mottles and a few fine distinct yellowish red (5YR5/6) mottles along root channels; moist. Clear change into
B_2g	11–20″	Light grey-brown (2·5Y6/2) clay loam; weak coarse prismatic to blocky; firm (plastic when wet); a few roots; a few stones; many medium distinct yellowish brown (10YR5/6) mottles; moist. Diffuse change into
B_3g/Cg	20–35″	Grey (10YR6/1) clay loam; massive; very firm; stony; frequent coarse distinct yellowish brown (10YR5/4) mottles; moist. Diffuse change into
Cg	35″+	Grey (10YR6/1) clay; massive; very firm; stony; frequent coarse distinct yellowish brown (10YR5/4) mottles; moist.

The profile is characterized by grey colours which extend upwards to the organo-mineral surface horizon. The B_2g horizon is the zone of maximum gleying and presents a bright, ochreous and grey speckled appearance, The structure is difficult to observe and is coarse blocky or prismatic.

merging to massive; the very plastic consistency when wet is typical of the soil. Gleying extends down into the C horizon but is less intense than in the B horizon. Also the soil becomes physically less moist or wet with depth, and the very firm consistency changes much less readily to plastic on wetting.

LAND USE. The major part of this series is under semi-natural or long ley grassland. Plant growth and production are limited by the ease with which the soil becomes waterlogged and sward utilization is restricted by the propensity of the soil to poach. Artificial drainage can improve these conditions considerably, and generally to an extent which permits arable cultivation.

LITTLESHALLOCH SERIES

A non-calcareous surface-water gley of poor drainage status, the Littleshalloch series occurs mainly in flush sites and on concave hill slopes in the eastern and central part of the area. It occupies 4·14 square miles or 1·8 per cent of the association. The parent material is the medium-textured drift described in Chapter 3, and the vegetation is a form of wet pasture in which *Juncus* species and *Deschampsia caespitosa* are prominent.

Profile Description

Slope		2°.
Altitude		600 feet.
Vegetation		*Juncus acutiflorus* pasture—*Juncus acutiflorus, Anthoxanthum odoratum, Molinia caerulea, Pteridium aquilinum, Potentilla erecta.*
Drainage		poor.
Horizon	*Depth*	
A_1	0–5″	Grey-brown (10YR5/2) loam; weak medium crumb; slightly friable; organic matter high; roots abundant; stony; a few fine faint ochreous mottles; moist. Clear change into
A_2g/B_2g	5–12″	Light brownish grey (2·5Y6/2) loam; very weak coarse sub-angular blocky; slightly friable; organic matter low; roots common; stony; frequent fine prominent yellowish red (5YR5/6) mottles; moist. Gradual change into
B_2g	12–23″	Light brownish grey (2·5Y6/2) and dark grey-brown (2·5Y4/2) loam; massive or very weak sub-angular blocky; sticky; old roots common; stony; many coarse prominent yellowish brown (10YR5/6) mottles; wet. Gradual change into
Cg	23″+	Light brownish grey (2·5Y6/2–6/1) gritty loam; massive; very firm; very stony; frequent fine prominent reddish brown (5YR4/4) mottles; moist.

Gleying is strongly expressed throughout the profile, being present in the surface horizon as shown by its pale grey-brown colour. The intensity of gleying is at a maximum in the B_2g horizon, and decreases with depth into the Cg horizon. The consistence of the parent material is very firm, or occasionally indurated, and seepage down the slope may occur through the soil over the surface of the induration. The structure is weakly developed throughout the soil. In the western part of the area clay loam textures may occur in the deeper horizons of the profile.

LAND USE. Most of this series occurs in flush sites in hill or moorland areas where it may or may not be drained by open ditches. In these areas it forms grazing for sheep and sometimes cattle on the extensive pattern, and it is relatively heavily grazed due to the comparative sweetness and high palatability of its herbage compared with other parts of the moorland. These areas are also the habitats of the liver fluke-bearing snails.

ALEMOOR SERIES

The Alemoor series occurs principally on the top of Saugh Hill near Girvan where it occupies only 0·67 square miles or 0·3 per cent of the association. Developed on the clayey till described in Chapter 3, the profile is a peaty gley of poor drainage status, and carries wet *Calluna* moor vegetation, in which *Calluna vulgaris, Juncus squarrosus* and *Erica tetralix* are prominent.

Profile Description

Slope		2°.
Altitude		850 feet.
Vegetation		Wet *Calluna* moor—*Calluna vulgaris, Juncus squarrosus, Empetrum nigrum, Erica tetralix, Sphagnum* spp., *Dicranum scoparium.*
Drainage		poor.
Horizon	*Depth*	
L	8–7½″	Litter layer.
H	7½–0″	Brown (7·5YR4/2) well humified peat.
A_2g	0–10″	Light brownish grey (2·5Y6/3) clay loam; weak medium sub-angular blocky; slightly firm; organic matter low; roots common; a few stones; a few fine prominent yellowish red (5YR5/8) mottles; moist. Clear change into
B_2g	10–23″	Grey (2·5Y5/1) clay loam; massive; very firm; organic matter low; a few dead roots; a few stones; frequent medium prominent yellowish red (5YR5/6) mottles; moist. Diffuse change into
B_3g	23–32″	Light grey (10YR6/1) clay loam; massive; firm; stony; many very coarse prominent strong brown (7·5YR5/6) mottles; moist. Clear change into
Cg	32″+	Dark grey (10YR4/1) clay loam; massive; firm; stony; a few ochreous mottles; moist.

The H horizon is well developed and usually more than 6 inches thick. The mineral horizons have a silty feel, probably on account of the high proportion of weathered shale present. Ochreous mottling is limited in the A_2g horizon which presents an overall grey colour, but it becomes intense in the B_2g and B_3g horizons which appear a bright orange and grey speckled colour. This contrasts with the Dochroyle series, the mineral horizons of which are an overall dark grey colour with little ochreous mottling.

LAND USE. The series is utilized entirely for hill sheep and cattle grazing.

DOCHROYLE SERIES

This series is widespread throughout the association of which it covers 10·1 per cent, 24·16 square miles. Its topographic associations are varied, the soil occurring in depressions where occasionally peat development does not exceed 12 inches, on the tops and gentler slopes of drumlins, and to some extent on moderately steep hill slopes. In the last two instances it is possible that a podzolic iron pan may exist, but at depths too great (over 3 feet) for field observation. The parent materials are the medium-textured tills and drifts described in Chaper 3. The vegetation ranges from *Calluna-Eriophorum vaginatum-Trichophorum* moor to wet *Calluna* moor and *Molinia* grassland. The profile is classified as a peaty gley of very poor drainage status.

Profile Description

Slope		5°.
Altitude		550 feet.
Vegetation		Wet *Calluna* moor—*Molinia caerulea, Trichophorum caespitosum, Calluna vulgaris, Erica tetralix, Juncus squarrosus, Deschampsia flexuosa.*
Drainage		very poor.
Horizon	*Depth*	
L	11–10″	Litter layer.
H	10–0″	Black (5YR2/1) greasy humus.
A_2g	0–9″	Light brownish grey (2·5Y6/2) loam; massive, breaking easily to weak coarse blocky; firm; organic matter low, with some humus staining along root channels and root mats along stone faces; roots common; stony; a few fine distinct reddish yellow (7·5YR6/6) mottles; moist. Gradual change into
B_2g	9–23″	Grey (2·5Y5/1) gritty loam; massive; firm; stony; a few fine distinct yellowish brown (10YR5/5) mottles; moist. Gradual change into
Cg	23″+	Light brownish grey (2·5Y6/2) loam; massive; indurated; stony; a few medium faint pale brown (10YR6/3) mottles; moist.

The well developed peaty surface horizon acts as a sponge absorbing considerable amounts of water and rarely drying out during dry spells. Intense gleying conditions are therefore maintained in the mineral soil, in which uniform grey colours with virtually complete absence of mottling may persist to depths of 24 inches or into the Cg horizon. The soil is moderately stony and the lower horizons are frequently indurated. The clay content of the B_3g and Cg horizons rises to 30 per cent in some soils of this series, but more generally it is below 27 per cent throughout the profile. When wet the soil is very much less plastic than is characteristic of the Alemoor and Hardlee series (Muir, 1956; Ragg, 1960).

LAND USE. This series is almost entirely utilized for hill sheep and cattle grazing. The overall stock-carrying capacity of the sward is small, partly due to the low productivity of the *Molinia* grass in spring as compared to its relatively high production during a short period of summer. Some areas of this soil along the moorland edges have been reclaimed and long ley grassland established, but success is rather more difficult to achieve than with the Dod series, for drainage improvement is much more difficult and if it is not carried out the probability of heavy rush infestation is much higher. As with the Dod series, areas where the H horizon is shallow appear to offer the most favourable opportunities for improvement.

Considerable areas of the series have been successfully afforested after drainage by deep ploughing.

MERRICK SERIES

This series occurs on hills above about 2000 feet and in the area under consideration is restricted to the Merrick, Kells and Lamachan ranges. It is not extensive, occupying only 4·39 square miles or 1·9 per cent of the association. It is classified as a sub-alpine soil and probably belongs to the group of rankers as defined by Kubiena (1953), although correlation with other European soils has not yet been effected; the drainage is free. The vegetation is sparse and local patches of bare ground and open moss heath occur.

Profile Description

Slope		5°.
Altitude		2275 feet.
Vegetation		*Vaccinium-Carex bigelowii-Rhacomitrium* heath—*Festuca ovina* (var. *vivipara*), *Deschampsia flexuosa*, *Vaccinium myrtillus*, *Carex bigelowii*, *Rhacomitrium lanuginosum*.
Drainage		free.
Horizon	*Depth*	
L	½–0″	Litter layer.
H/A_2	0–6″	Black (5YR2/1) humose loam; weak medium crumb; friable; organic matter high; roots abundant; stony; bleached fine sand grains prominent; moist. Gradual change into
H/B_2	6–20″	Dark reddish brown (5YR2/2) humose loam; weak fine crumb; friable; organic matter high; roots common; very stony—angular greywackes and pockets of partially rounded gravelly greywackes—the stones and mineral grains having coatings of black greasy humus; moist. Clear change into
C	20″+	Brown (10YR5/3) fine sandy loam; massive; friable; stony.

The sub-alpine soils may be distinguished from those occurring at lower altitudes by the extreme looseness of the organic horizons. This feature is probably caused by heaving associated with freeze-thaw processes in winter, when the ground may be frozen to depths of more than 2 feet. The humus in the profile is very black and greasy, but whether or not it is a form of mor is not clearly established. It is therefore uncertain whether the intimate mixing is due to churning of the ground by physical processes such as regelation or to biotic agencies. In the upper part of the organo-mineral layers the stones and mineral grains are bleached and free from coatings and are easily seen, whereas in the horizon below they have greasy black stains or coatings of organic matter and are more difficult to distinguish.

Occasionally a shallow horizon of reddish brown ochreous staining occurs below the organo-mineral layers, but it has not proved possible to map this soil separately on the present scale. The brown fine sandy loam parent material is generally less stony than the overlying soil, but where the rock comes close to the surface fine material may be restricted to cracks in the disintegrating rock. It is thought that the fine material has been produced by processes of physical disintegration more or less *in situ*, rather than by glacier or ice action (Ragg and Bibby, 1966).

LAND USE. The environment in which Merrick series occurs renders it suitable only for summer grazing of sheep. Altitudinal and environmental factors preclude afforestation and the productivity of the sward is very low because of the short growing season and low temperatures.

STROAN COMPLEX

The Stroan complex has been mapped in the southern part of the Minnoch Valley and around Carsphairn; it covers 2·72 square miles or 1·2 per cent of the association. It is developed on a moundy topography of morainic hummocks and intervening hollows. The freely drained soil, Linhope series, is developed on the greywacke moraine which is very stony, coarse-textured, and strongly indurated as described in Chapter 3. The profile is well developed and typical of the series, the transition between B and C horizons being usually sharp, and the soil is strongly acid. Peat is developed in the hollows between moraines, usually to a depth of between 1 and 3 feet. The soil pattern, therefore, is one of frequent but small patches of brown forest soil in an area of peat. The vegetation on the moraine mounds is a form of *Agrostis-Festuca* acid grassland, which may sometimes be dominated by *Pteridium aquilinum.* The peaty areas usually carry *Molinia* grassland.

LAND USE. In the lower Minnoch Valley most of the area of this complex has been afforested. Sitka spruce with some lodgepole pine and Norway spruce are planted on the peat, while Japanese or hybrid larch is planted on free draining brown forest soils.

Around Carsphairn some areas of the complex carry long ley grassland and are used for controlled sheep and cattle grazing, but more generally grazing is on the extensive pattern. Where access is possible and conditions of slope allow, herbage production can be considerably increased by the application of lime and fertilizer on the patches of brown forest soil, and still further increased if reseeding is possible.

MINNOCH COMPLEX

Developed on similar parent material and topography to the Stroan complex described above, the Minnoch complex covers a fairly large area—28·86 square miles or 11·9 per cent of the association, mainly in the Minnoch Valley and on the moors which stretch westwards to Shalloch Well and Black Clauchrie. The mounds of greywacke moraine carry mainly peaty podzol (Dod series), with some areas of brown forest soil (Linhope series) developed on some steeply sloping moraine sides, and some areas of peat on the flatter tops of the mounds where the H horizon of the peaty podzol profile may be up to 2 feet thick. Peat covers the hollows between mounds and is generally between 1 and 3 feet thick, but may occasionally be more. An important variant of this complex occurs near the source of the Polmaddy Burn, below Craignelder Gairy, where the moraines are derived from black shales. The dark colour of the shale is inherited by the soils, making the B_2 horizon a dark olive colour, and the A_2g a very dark grey. The usual soil pattern, however, consists of frequent small patches of peaty podzol soil in an area of peat, with some mounds carrying brown forest soil, peaty podzol, and peat arranged in a catenary manner following variation of slope. *Molinia* grassland or *Calluna-Eriphorum vaginatum-Trichophorum* moor occupies the areas of peat, while the peaty podzol (Dod series) usually carries wet *Calluna* moor although on steep slopes dry *Calluna* moor may occur. A type of *Agrostis-Festuca* acid grassland, often with abundant bracken (*Pteridium aquilinum*), occurs on the small areas of brown forest soil.

LAND USE. Much of the area of this complex has been recently afforested by the Forestry Commission. Sitka spruce is the species most commonly used, together with some lodgepole pine and Norway spruce while small areas of larch have been planted on the brown forest soil and on the drier podzol areas. The complex occurs at moderate to low altitudes, so that problems of exposure are few. Agriculturally, the area of the complex is utilized for hill sheep grazing. Problems of access occasioned by the peaty hollows, together with the thickness of the H horizon of the peaty podzol soils, present major obstacles to soil and herbage improvement.

TROOL COMPLEX

The Trool complex is not extensive, covering only 4·70 square miles or 2·0 per cent of the association. It occupies most of the valley opening westwards from Loch Trool, where frequent large rock knolls of greywacke and shale stand up from the very gently sloping valley floor. Shallow stony soils, mainly brown forest soils, occupy the knolls. These soils have a similar sequence of horizons and are developed on the same parent material as Linhope series, but because of their shallowness and very stony nature they differ somewhat from the modal profile of that series. In addition soils of the iron podzol group occur. These have developed surface horizons of raw humus, several inches thick, together with a thin grey bleached layer overlying the very stony ochreous B horizon. The areas between the knolls are occupied by peat which may be up to 14 feet deep.

The vegetation on the knolls is *Agrostis-Festuca* acid grassland generally with abundant *Pteridium aquilinum* on the brown forest soils and dry *Calluna* moor on the few iron podzols. The peaty areas carry mainly *Molinia* grassland, with *Molinia-Myrica* moor in the wetter patches.

LAND USE. The Forestry Commission have planted much of the Trool Valley with trees, the species grown being generally similar to those used on the Stroan complex nearby, *ie* Sitka spruce, with some lodgepole pine and Norway spruce on the peaty soils and some larch on the drier rocky soils. Where not afforested this complex is utilized for extensive sheep and cattle grazing. The rock knolls provide some shelter and dry lying for the livestock.

FINLAS COMPLEX

Finlas complex has been called after the loch of that name in the north of the area near Straiton, where frequent rocky knolls of greywacke and shale outcrop on gentle slopes. The complex has also been mapped near Bargrennan, and in all it covers 1·26 square miles or 0·5 per cent of the association. The topography is very similar to that of the Trool complex.

The soil pattern, however, differs in that the rock knolls carry soil with well developed raw humus or peaty surface horizons and bare rock occurs more frequently. The soils range from shallow accumulations of raw humus on the polished rock surfaces of roche moutonnées and podzol rankers (Kubiena, 1953), in which a thin layer of stony bleached rubble occurs between the peaty horizon and the rock, to peaty podzols in which a thin iron pan and stony ochreous B horizon are present. This profile is similar to that of Dod series, but is much shallower and stonier. The peaty podzol also occurs relatively infrequently as compared with the skeletal soils described above. Peat of varying depth occupies the areas between knolls and carries a varied vegetation of *Molinia* grassland and *Calluna-Eriophorum vaginatum-Trichophorum* moor. Dry *Calluna* moor and wet *Calluna* moor usually occur on the knolls.

LAND USE. The greater part of the area of this complex is utilized for extensive sheep and cattle grazing, and some areas have been afforested. The productivity of the sward is low and possibility of improvement is slight.

ACHIE COMPLEX

This complex is not extensive, occurring mainly in small areas between the River Stinchar and Glen App; it occupies only 2·01 square miles or 0·9 per cent of the association. It is found on gentle or moderate slopes on which moderate or low rock outcrops occur. The soils are developed on stony rock debris, colluvium and thin till derived from greywacke, and can have a raw humus or peaty horizon not more than 1 inch thick. shallow stony soils of the Linhope series occur around the rock outcrops and gradually merge into deeper colluvial soils. In the depressions between outcrops the soils may be similar to the imperfectly drained Altimeg series and occasionally in deeper hollows to the poorly drained Little-shalloch or Ettrick series. Under semi-natural conditions the vegetation is *Agrostis-Festuca* acid grassland, with *Agrostis-Festuca* meadow grassland and *Juncus acutiflorus* pasture in the wet areas.

LAND USE. Much of the area of this complex is cultivated. Ploughing and other mechanical operations are effected either by going around rock out-crops or by lifting the implements out of the ground when passing over outcrops. Wear and tear on implements on the thin stony soils is high, and the varying moisture regime means that the ripening of crops tends to be uneven. In some areas of the complex physical difficulties may render cultivation uneconomic.

BUSH COMPLEX

This complex covers 16·68 square miles or 7·0 per cent of the association. In the Forrest Glen and near the village of Knowe the soil pattern is typically developed on moderate and gentle uneven hill slopes. The Linhope series occurs on very slightly raised areas; the profile is generally shallow and developed on frost-shattered rock debris derived from Ordovician greywackes and shales. Around these patches of Linhope series are wet areas of peat and peaty gley soils. The peaty gley profile is developed on shallow till or rock and is similar to the Dochroyle series, but shows more variation in characters such as depth, stoniness and parent material.

The striking vegetation pattern is typical of the complex, and is closely related to the soils. The Linhope series carries *Agrostis-Festuca* acid grassland with dense bracken (*Pteridium aquilinum*), while the peat and peaty gleys carry *Calluna-Eriophorum vaginatum-Trichophorum* moor with *Molinia-Myrica* moor in the wettest areas.

LAND USE. The greater part of this unit is under semi-natural vegetation of low productivity, utilized for extensive sheep and some cattle grazing. The Linhope soils afford dry lying for stock. Owing to the smallness of area of the freely drained soils and the depths of peat development in the wet areas the possibilities of soil improvement are very limited.

Some areas of the complex have been afforested.

GLENLEE COMPLEX

Rugged areas with abundant rock outcrops of Ordovician-Silurian greywacke or shale, generally on steep hill slopes below about 500 feet, are typical of the sites on which Glenlee complex occurs. The unit is not extensive, occupying only 4·88 square miles or 2·1 per cent of the association. typical of the sites on which Glenlee complex occurs. The unit is not extensive, occupying only 4·85 square miles or 2·1 per cent of the area. The soils are mainly freely drained and raw humus does not usually develop to a depth of more than 1 inch. At higher altitudes on similar topography raw humus and peaty surface horizons become general, and the soils have been placed in the mapping unit Darnaw complex (described below). Skeletal brown soils or brown rankers (Kubiena, 1953) are common, and the Linhope series occurs wherever the rock rubble is of sufficient thickness and stability to allow its development. A few small areas with impeded drainage occur in local depressions. Observed as a whole this unit gives the impression of being dominated by rock, but more careful assessment indicates that bare rock outcrops probably do not occupy more than 15 per cent of the area. The typical vegetation is *Agrostis-Festuca* acid grassland.

LAND USE. This unit is suitable only for sheep grazing, with possibly some cattle grazing on the less steep areas; forestry may be practicable on some sites.

DARNAW COMPLEX

The Darnaw complex is much more extensive than the Glenlee, covering 34·70 square miles or 15·2 per cent of the association, and is widespread throughout the eastern part of the area. It occurs on similar rugged hilly sites to Glenlee complex but at higher altitudes, usually over 800 feet, although it has been mapped in some instances at lesser heights. Bare rock, Ordovician and Silurian greywacke and shale, appears very prominently in the unit, but generally covers less than 15 per cent of its area. The soil profiles are extremely variable in character, ranging from shallow accumulations of raw humus and peat on rock surfaces to freely drained podzols and poorly drained peaty gleys and peat. The freely drained soils occur on shedding sites around rock eminences or small screes; the most shallow are the thin accumulations of raw humus on rock surfaces, while podzol rankers occur where some inches of bleached fine material and rock rubble underlie the raw humus. Where this coarse-textured rock debris is more than 12 to 15 inches thick an ochreous B horizon is usually present, and the profile is either an iron podzol or, if a strong pan is also present, a peaty podzol (Dod series). The peaty gley soils occur in depressions or around the fringes of depressions where the depth of rock detritus is usually greater than 2 feet, and are similar to the Dochroyle series. In the larger depressions peat accumulation may be up to 3 feet deep. A pattern of sub-alpine soils of Merrick series and rock outcrops occurring on some hills of over 2000 feet have also been mapped in this complex.

The large number of soil types carry very varied vegetation communities, including *Nardus* grassland, wet *Calluna* moor and *Molinia* grassland.

LAND USE. Hill sheep grazing and forestry are the common forms of land use on this unit. It seems unlikely that any marked improvements of soil and herbage can be achieved.

LARGMORE COMPLEX

Largmore complex has been mapped below about 800 feet on moderate slightly uneven hill slopes, which carry a pattern of free, poor, and imperfectly drained soils. The complex is not extensive, covering only 3·35 square miles or 1·5 per cent of the association, but it is well developed on the south side of the Garroch Glen. The parent materials are thin drifts and rock rubble derived from Ordovician and Silurian greywacke and shale. Because of the slight unevenness of the ground surface the drainage waters and run-off are concentrated in fairly broad bands, which form a reticular pattern around drier areas. These areas carry well developed soils of the freely drained Linhope series, while the poorly drained Littleshalloch series is developed on the wetter areas and the Altimeg series where the drainage is intermediate in character. The vegetation is generally *Agrostis-Festuca* acid grassland with bracken (*Pteridium aquilinum*) and *Juncus acutiflorus* pasture.

LAND USE. This complex is mainly utilized as rough grazing ground for sheep and cattle, but some areas are afforested. The herbage on the soils of the Linhope series can be improved by liming and fertilizers and by cultivation and reseeding. Provision of adequate drainage is the most important factor in the improvement of wet areas. The network of open ditches usually present in these soils does not prevent waterlogging for considerable periods of the year, while tile drains may be difficult to lay because of the bouldery nature of the subsoil.

BROCHLOCH COMPLEX

Brochloch complex is one of the larger mapping units, covering 23·17 square miles or 10·0 per cent of the association mainly in the eastern part of the area. The topography is generally uneven hills with very little or no outcropping bare rock. The parent materials are thin stony drifts and rock rubble derived from Ordovician or Silurian greywacke and shale. The soils all have a well developed raw humus or peaty surface horizon, but are otherwise very varied. The more important profiles can be grouped as podzol rankers, in which a shallow layer of grey bleached rock detritus is overlain by a raw humus horizon and passes down into rock, peaty podzols similar to the Dod series but varying widely in characters such as stoniness, thickness of A_2g horizon and development of B_2 horizons, and peaty gleys which are similar to the Dochroyle series. Peat is frequently developed in small local depressions or on gentle slopes. This complex has also been mapped on some fairly steep slopes near the Backhill of Bush on which the peaty podzol Dod series, peat, and the peaty gley Dochroyle series occur. It is thought however that many of the profiles considered as peaty gleys in this locality have iron pans and possibly B horizons at depths too great for them to be detected by normal methods of inspection.

Drainage and other soil differences have produced a large number of plant communities in this complex unit.

LAND USE. Most of this unit is utilized as grazing for hill sheep and cattle, and for forestry. Soil or herbage improvement is rarely practicable owing to the nature of the terrain and difficulties of drainage.

SKELETAL SOILS

Skeletal soils have been mapped over 6·07 square miles or 2·7 per cent of the association, mainly around the Merrick, Kells and Lamachan Hills. Most of the corrie features of the Southern Uplands occur in these hills and generally consist of a steep face of almost bare rock, below which is an area of scree, generally resting at a steep angle and only partially covered with vegetation. These, together with the almost bare, rock debris-covered ridge of Carlin's Cairn Hill comprise most of the areas on which skeletal soils have been mapped. About 25–50 per cent of the mapping unit is generally bare rock. The soils are usually shallow, about 6–8 inches deep, and the humus form may be mull, moder or mor. However, under the heavy rainfall and at the high altitudes at which these soils have been mapped the humus is most often of the mor type and has accumulated on the surfaces of rocks and rock debris, although the open nature of the latter allows organic material to be incorporated to a depth of several inches and an organo-mineral horizon is usually present. These soils appear similar to those termed rankers by Kubiena (1953).

LAND USE. The agricultural value is practically nil, and although trees may be established on some areas at a suitable altitude growth is likely to be poor.

Glenalmond Association

The Glenalmond Association was first reported in central Ayrshire (Grant, in preparation) In the present area, of which it covers 8·80 square miles or 1·6 per cent, the association is confined to the north-west, occurring mainly along the slopes of the Girvan Valley. The soils are developed on parent materials derived from Old Red Sandstone sediments under a rainfall varying from 35 to 50 inches per annum.

Distribution

The main outcrop of the Old Red Sandstone sediments occurs between Hadyard Hill and Doughty Hill, but much of this area is covered by blanket peat so that the soils of the Glenalmond Association are restricted to the lower slopes of hills and local steep areas. Along the north side of the Girvan Valley small areas have been mapped around Chapeldonnan and north-eastwards to Bargany Mains. The association is more extensive along the south side of the valley, where it has been mapped in a strip from Houdston north-eastwards to Dobbingstone where it links up with the main area of Old Red Sandstone sediments. Small outlying patches of the association occur at Glendrissaig 2 miles south of Girvan, Pinclanty in the Stinchar Valley, on Auchensoul Hill north of Barr, and in small areas between North Balloch and Genoch Hill.

Parent Materials

The Old Red Sandstone sediments and the detritus formed from them which make up the parent materials of the Glenalmond Association have already been described in Chapter 3.

The parent rocks are generally quartzose sandstones, with occasional beds of conglomerate where the pebble content may be of igneous or greywacke origin. The sandstone weathering *in situ* is the simplest parent material, but the glacial till is the more widespread material and is generally reddish brown in colour and of sandy clay loam texture. Near Maxwellston the pale pink sandstones of the Calciferous Sandstone Measures of the Carboniferous system give rise to a till which in the field cannot be distinguished with any certainty from the surrounding drift derived from the Old Red Sandstone strata, and consequently the soils developed on this till have been included in the Glenalmond Association. The till in this area shows a number of variations from the mode established to the north and these are described in Chapter 3. Where the till occurs along the lower slopes of hills and near stream courses the surface layers have undergone modification, the most noticeable effect of which is a coarser texture.

Soils

Each of the commonly occurring major soil groups of Scotland is represented in the association, apart from the brown forest soils with free drainage and the sub-alpine soils. The soils with raw humus surface horizons are the peaty podzol Hadyard series, found on Hadyard Hill and around the edges of the blanket peat areas of Craiginmoddie Hill, and the peaty gley Spallander series, occurring on gentle slopes and in hollows of the upland tracts of the association. The freely and imperfectly drained organo-mineral soils may be divided into two groups, those developed directly on till or rock and those formed on modified till. Of the freely drained series, Meadownay usually occurs on the steep upper valley slopes, while Tranew is confined to valley bottoms where textural modifications have been greatest. The imperfectly drained series occupy intermediate positions on the slopes.

MEADOWNAY SERIES

The Meadownay series is found in small units throughout the area of the association; two of the larger patches occur at Brae Hill and Glendrissaig near Girvan. The series covers only 0·28 square miles or 2·9 per cent of the association. It has been classified as an iron podzol and the drainage status is free. The parent material is generally the Old Red Sandstone rock weathering *in situ*, but the soil may also develop on thin till deposits. The characteristic sites are the steep upper slopes of valleys, or other local areas of steep-land. The vegetation is generally *Agrostis-Festuca* meadow grassland or *Agrostis-Festuca* acid grassland.

Profile Description

Slope		8°.
Altitude		200 feet.
Vegetation		*Agrostis-Festuca* meadow grassland—*Holcus lanatus, Lolium perenne, Trifolium repens, Ranunculus repens, Pterdium aquilinum.*
Drainage		free.
Horizon	*Depth*	
L & F	1–0″	Litter and fermentation layers.
A_1	0–5″	Dark reddish brown (5YR3/3) loam; moderate medium sub-angular blocky; friable; organic matter low; roots abundant; a few stones; earthworms present; moist. Gradual change into
B_2	5–12″	Reddish brown (5YR4/4) loam; weak sub-angular blocky; friable; roots common; stony, weathering sandstone; moist. Gradual change into
B_2	12–20″	Reddish brown (5YR5/3) loam; massive; firm; many sandstone stones; moist. Gradual change into
C	20″+	Shattered sandstone.

The soil has inherited the red-brown colour of the parent material and this has tended to mask the yellow-brown colours usually associated with iron oxides in the B horizon. The B horizon does however have a slightly higher chroma than either the A or C horizons. The loam textured S horizon usually has a well developed sub-angular blocky or crumb structure under grassland, and is readily friable. In the B horizon the structure is weaker but the consistence remains friable. The C horizon, where it is not the solid rock, is massive and indurated. The stone content of the upper horizons is moderate, and generally consists of the relatively soft sandstones.

LAND USE. In this area the only moderately productive grass sward is generally utilized for cattle and sheep grazing on mixed farms. The steep slopes often render cultivation difficult, but where frequent cropping is possible care is needed to maintain the organic matter content and structure of the soil.

HADYARD SERIES

A peaty podzol, this soil has not been previously mapped. It occurs on the upper slopes of Hadyard Hill and in a few other small steep areas at moderately high elevations. In all, the series covers only 0·97 square miles or 10·0 per cent of the association. The profile is often shallow, being developed directly on the weathering sandstone, and the vegetation is mainly dry *Calluna* moor.

The H horizon is relatively thin, about 4 inches on average, and the pale brown A_2g horizon is only weakly gleyed. The iron pan is continuous and is covered with a mat of fine roots, some of which nevertheless penetrate into the B horizon. The iron enrichment of the underlying B_2 horizon is partially masked by the reddish brown colour of the parent material, but there is some rise in the chroma of this horizon.

Profile Description

Slope		15°.
Altitude		450 feet.
Vegetation		Dry *Calluna* moor—*Calluna vulgaris, Vaccinium myrtillus, Deschampsia flexuosa, Juncus squarrosus, Erica cinerea.*
Drainage		free below the iron pan.
Horizon	*Depth*	
L & F	5–3″	Litter and fermentation layers.
H	3–0″	Black (5YR2/1) well humified organic matter.
A_2g	0–2″	Light brownish grey (10YR6/2) fine sandy loam; weak sub-angular blocky; friable; organic matter low; roots abundant; moist. Sharp change with an irregular boundary into
B_1	2″	Thin iron pan with dense root mat.
B_2	2–19″	Reddish brown (5YR4/5) fine sandy loam; weak sub-angular blocky; friable; stony, acid sandstone fragments; moist. Gradual change into
C	19″+	Frost-shattered red sandstones.

LAND USE. The relatively thin H and A_2g horizons would probably allow relatively easy reclamation and improvement of this soil were other factors favourable. Unfortunately slopes are often too steep and the small areas are sometimes located in a moorland environment where access is difficult. Grazing by sheep and some cattle on the extensive system is the common way of utilizing the relatively unproductive sward.

GLENALMOND SERIES

Glenalmond series occupies 2·96 square miles or 30·1 per cent of the association, a much lower proportion than further north where it is the dominant soil of this group. The series occurs mainly along the Girvan Valley, on the reddish brown sandy clay loam till derived from Old Red Sandstone sediments commonly found on the middle and lower hill slopes. The Glenalmond series is generally confined to the middle slopes, above the level at which the till shows appreciable modification of the surface textures. The profile is classified as a brown forest soil with gleying in the B and C horizons. Very few areas of natural or semi-natural vegetation were found on this series, which was usually cultivated and carried long ley grassland.

The organic matter content of the surface horizon is low to moderate, and the sub-angular blocky structure is only weakly developed. Rusty mottling is not usually found in this horizon. The structure in the $B_2(g)$ horizon is prismatic, although in this area it is often only weakly developed and may break into coarse sub-angular blocky aggregates. The prism faces have the smooth grey surfaces typical of this type of structure in Scotland, while rusty mottling occurs internally throughout the units. The structures become larger with depth and are massive in the C horizon, where the consistence becomes firm or very firm. The rusty mottling decreases progressively on passing into the parent material.

Profile Description

Slope		4°.
Altitude		225 feet.
Vegetation		ley grassland.
Drainage		imperfect.
Horizon	*Depth*	
A	0–9″	Brown (10YR5/3) loam; weak sub-angular blocky, breaking easily to fine crumb; friable; organic matter low; roots abundant; a few stones; moist. Clear change into
$B_2(g)$	9–18″	Brown (7·5YR5/4) sandy clay loam; medium blocky to prismatic; firm; organic matter low; roots few; stony; frequent medium distinct strong brown (7·5YR5/8) mottles, and pale brown (10YR7/3) faces to peds; moist. Gradual change into
C(g)	18–40″	Reddish brown (5YR5/3) sandy clay loam; massive; firm; stony; a few fine distinct strong brown (7·5YR5/8) mottles.

LAND USE. If environmental conditions such as slope and altitude are favourable this series forms a good agricultural soil, as has been observed in central Ayrshire (Grant, in preparation). Unfortunately in this area the soil often occurs in sites having some disadvantages, such as moderately steep slopes or high rainfall which militate against frequent cultivation. The series therefore is generally in grassland which is frequently of good quality.

TRANEW SERIES

An iron podzol of free drainage status, this series is confined in this area to the valleys of the Girvan Water and its tributaries where it covers 1·09 square miles or 10·2 per cent of the association. It occurs mainly on the lower hillslopes beside the tracts of alluvium or raised beach, where textural modification of the sandy clay loam till has been most intense and has taken place to greater than average depths, the unaltered till being at depths of 24–30 inches or more. The series is also well developed in several areas near Dobbingstone where it reaches altitudes of 700 feet. The profile forms an excellent agricultural soil in a favourable environment, and areas of semi-natural vegetation found are usually *Agrostis-Festuca* acid grassland.

The sandy loam to loam surface horizon has a low organic content and a weak sub-angular blocky or fine crumb structure, and the consistence when moist is very friable. The B_2 horizon, which exhibits the slight peak in the chroma values associated with free iron oxides, is thin and passes rapidly into the light textured, massive and indurated, modified till which forms the B_3 horizon. This horizon may be divided into two sub-horizons of some thickness; the upper layer is of coarser texture, less strongly indurated and less red in colour than the lower layer which is transitional to the parent material. The colour varies throughout the profile, becoming progressively redder with depth. The reddish brown unaltered massive till is reached at about 30 inches. Stones are common in the surface horizons but are generally small and of little account during cultivation.

LAND USE. The light texture of the surface soil together with the water holding capacity of the underlying till makes this a very favourable agricultural soil. The easily worked qualities of sandy soils are in this instance allied in considerable degree to the drought resistance of more clayey soils. The loss of clay from the surface together with the low organic content probably means that the basic or inherent fertility is somewhat less than that of the Glenalmond series, but the soil may be expected to respond well to fertilizers. It occurs most commonly in the favourable climatic regime of the lower slopes of valley sides.

Profile Description

Slope		6°.
Altitude		600 feet.
Vegetation		*Agrostis-Festuca* acid grassland—*Festuca ovina, Potentilla erecta, Agrostis tenuis, Luzula campestris, Sieglingia decumbens.*
Drainage		free.
Horizon	*Depth*	
L & F	½–0″	Litter and fermentation layer.
A_1	0–7″	Brown (10YR4/3) loam; moderate sub-angular blocky to fine crumb; friable; organic matter moderate; roots abundant; stony; moist. Clear change into
B_2	7–12″	Brown (7·5YR5/5) loamy sand; weak fine crumb; friable; roots common; stony; moist. Gradual change into
B_{31}	12–19″	Brown (7·5YR5/3) loamy sand; massive; weekly indurated; stony: moist. Gradual change into
B_{32}	19–30″	Reddish brown (5YR5/3) sandy loam; massive; indurated; stony; a few medium distinct strong brown (7·5YR5/6) mottles; moist. Gradual change into
C	30″+	Reddish brown (2·5YR5/4) sandy clay loam; massive; firm; stony; a few fine distinct strong brown (7·5YR5/6) mottles.

GALLOWSHILL SERIES

The Gallowshill series, a brown forest soil with gleying in the B and C horizons, occupies 1·41 square miles or 14·4 per cent of the association. It is formed on a modified reddish brown sandy clay loam till derived from Old Red Sandstone sandstones, and occurs mainly along the Girvan Valley in a belt slightly above that of the Tranew series, developed on more heavily modified till, and below the level of the Glenalmond series on unmodified till. The degree of textural modification is less, and the modified layer is shallower than in Tranew series. The proximity of the slightly permeable till to the surface causes drainage impedance throughout the profile. Slopes are generally moderate, so that much of the series is under arable cultivation or cultivated grassland and there are very few areas of semi-natural vegetation.

The texture varies from loam in the A or S horizon to sandy loam in the B(g) and rises to sandy clay loam in the C(g) horizon. The soil colour becomes redder with depth and the highest chroma is in the C horizon. The structure varies from moderate sub-angular blocky in the A or S horizons to weak sub-angular blocky in the B(g) and massive to coarse prismatic in the C(g) horizon. The organic matter content of the S horizon, although slightly higher than in the Tranew series, is only moderate. Ochreous mottling and grey faces to the structural units are present in varying degrees in the B(g) horizon but decrease to only a few in the parent till, where black manganiferous staining is generally present and is sometimes prominent.

Profile Description

Slope		2°.
Altitude		100 feet.
Vegetation		short ley grassland.
Drainage		imperfect.
Horizon	*Depth*	
S	0–8″	Reddish brown (5YR4/3) loam; moderate sub-angular blocky; friable; organic matter moderate; roots common; few stones; moist. Clear change into
B_2(g)	8–16″	Weak red (2·5YR5/3) sandy loam; very weak sub-angular blocky; slightly firm; a few small stones; frequent medium distinct yellowish red (5YR5/6) mottles; moist. Gradual change into
C(g)	16–36″	Reddish brown (2·5YR5/4) sandy clay loam; massive; firm; a few stones; a few medium faint yellowish red (5YR5/8) mottles, and coarse diffuse black manganiferous staining.

LAND USE. As with Tranew series, this soil has coarse-textured easily worked surface horizons overlying a water-retentive sandy clay loam till. The textures are slightly stiffer and water retention considerably greater than in the freely drained series. Field drains may be necessary to prevent occasional waterlogging. In some areas near Girvan this soil is very productive, being intensively cultivated for the production of early potatoes and other cash crops. Further inland, at slightly higher altitudes, the slope, climate and other environmental factors are less favourable, and grass forms a larger portion of the rotation.

ALTIWAN SERIES

Developed on a similar Old Red Sandstone sandy clay loam parent till to the other soils of the association, this series occurs at fairly high levels on the slopes of the Girvan Valley, and in some lower lying areas of the moorland and semi-moorland tracts of the association between Hadyard Hill and Craiginmoddie Hill. In the former locality slopes may be moderate to steep, but are usually gentle elsewhere. The series is not extensive, covering only 1·45 square miles or 14·9 per cent of the association. The soil is a non-calcareous, low-humic surface-water gley and is poorly drained. Semi-natural vegetation occurs over most of the series, generally *Juncus acutiflorus* pasture.

Profile Description

Slope		5°.
Altitude		575 feet.
Vegetation		*Juncus acutiflorus* pasture—*Juncus acutiflorus, Festuca ovina, Deschampsia flexuosa, Pedicularis sylvatica.*
Drainage		poor.
Horizon	*Depth*	
A_1	0–5″	Dark brown (10YR4/2) loam; moderate sub-angular blocky; friable; organic matter moderate to low; abundant roots; a few small stones; moist. Clear change into
A_2g	5–10″	Grey-brown (10YR5/2) loam; weak sub-angular blocky; friable; organic matter low; roots common; a few small stones; frequent fine faint ochreous mottles; moist. Clear change into
B_2g	10–26″	Light brownish grey (10YR6/2) sandy clay loam; weak prismatic to massive; firm to plastic; stony; frequent medium distinct reddish yellow (5YR6/8) mottles; moist to wet. Gradual change into
B_3g/Cg	26″+	Reddish brown (5YR5/3) sandy clay loam; massive; firm to plastic; stony—mainly disintegrating sandstone fragments; frequent coarse distinct reddish yellow (7·5YR6/8) mottles; moist to wet.

Pale colours predominate throughout the profile, for the reddish brown colour typical of the association is masked by the grey colours produced by gleying and is only readily distinguishable in the B_3 and C horizons. A few fine rusty mottles along root channels may occur in the A or S horizons, but the zone of maximum gleying is the A_2g and the upper part of the B and hence grey colours are most prominent in these horizons. Ochreous mottles are common in the zone of maximum gleying but rather more frequent in the horizon below. Stones, which are common throughout the profile, are generally small greywackes and felsites. Although the typical texture of the B and C horizons of this series is a sandy clay loam there are a number of areas in which coarser textures (loams) predominate in the upper horizons; these have not been separately delineated.

LAND USE. Along the Girvan Valley a few areas of this series are cultivated for oats and other crops, but rough pasture is more usual and is generally grazed by cattle as well as by sheep.

SPALLANDER SERIES

This is the most common soil in the moorland area between Lanes Farm and Doughty, apart from the extensive areas of blanket peat. It covers 1·64 square miles or 16·8 per cent of the association, and occurs mainly on gentle slopes between 600 and 900 feet. The profile is a peaty gley and the drainage class is very poor. The parent material is a reddish brown sandy clay loam till derived from Old Red Sandstone sediments. As in the case of the Altiwan series a number of areas are found where the upper horizons are of relatively coarse texture; this may be due to a modification of the till or to a thin wash of material from higher slopes. These areas have not been separately delineated. The vegetation is often wet *Calluna* moor, with areas of *Molinia* grassland.

Profile Description

Slope		7°.
Altitude		775 feet.
Vegetation		*Molinia* grassland—*Molinia caerulea, Deschampsia flexuosa, Vaccinium myrtillus, Juncus squarrosus, Festuca ovina, Potentilla erecta.*
Drainage		very poor.
Horizon	*Depth*	
L & F	7–6″	Litter and fermentation layer.
H	6–0″	Dark reddish brown (5YR2/2) humified peat.
A_1g	0–2″	Brown (10YR5/3) loam; very weak sub-angular blocky; slightly firm to sticky; organic matter moderate to low; roots common; a few stones; moist to wet. Clear change into
A_2g	2–6″	Dark grey-brown (2·5Y4/2) loam; very weak sub-angular blocky; firm to sticky; frequent small weathering sandstones; a few fine faint ochreous mottles; moist to wet. Gradual change into
B_2g	6–17″	Dark grey-brown (10YR4/2) loam; very weak sub-angular blocky; slightly firm to slightly plastic; a few stones; a few fine distinct ochreous mottles; moist to wet. Gradual change into
B_3g	17–27″	Reddish brown (5YR5/3) sandy clay loam; massive; firm; stony; a few distinct ochreous mottles and some black manganiferous staining; moist. Diffuse change into
Cg	27″+	Reddish brown (5YR4/4) sandy clay loam; massive; firm; stony.

The peaty surface layer is of variable thickness, ranging from 3 inches up to 10 inches. Where the peaty horizon is shallow, it is usually underlain by an A_1g mixed organo-mineral horizon which is strongly gleyed, as is the underlying A_2g horizon. Below the A_2g horizon the colours become somewhat brown, and then reddish in the B_3g and Cg layers. The structure is very weak in the A and B horizons, discrete aggregates being hard to discern, and becomes massive in the C horizon. Ochreous mottling is most strongly developed in the Bg horizons, while black patches and staining in the C horizon are probably due to oxides of manganese.

LAND USE. This is a moorland soil carrying a vegetation of low productivity. It is utilized for hill sheep farming with some cattle grazing.

Knockskae Association

The Knockskae Association was first mapped to the north of the present area in central Ayrshire. In south Ayrshire the association has been mapped on several small areas near the northern boundary of the region where it occupies 1·28 square miles or 0·24 per cent of the area. The soils are developed on parent material derived from fine-grained acid intrusive rocks, the outcrops of which usually occur at fairly high altitudes and are often covered with extensive blanket peat. The soils are mainly restricted to steep slopes and the peripheral areas of the outcrops. Four soil series, three of which have been previously described, and one soil complex have been mapped in this area.

Distribution

This association is restricted to the three felsitic outcrops on Tairlaw, Garleffin Fell and Craig of Dalwine.

Parent Material

The parent materials are formed from fine-grained acid porphyrite and felsite rocks. Areas of till derived from these rocks are rare, partly on account of the hardness of the rocks and their resistance to weathering and comminution by ice, and partly because of the small area of each outcrop. Two patches of sandy clay loam or loam till do occur, one south-east of Tairlaw Farm and the other west of Garleffin Fell; both carry poorly drained soils. The freely drained soils are developed on the more common very stony coarse- or medium-textured frost-shattered debris.

Soils

The freely drained iron podzol (Knockskae series) and the peaty podzol (Turgeny series), both developed on frost-shattered rock rubble, occur at high and moderate altitudes respectively, usually on steep but short slopes. The poorly drained non-calcareous gley (Whiterow series) is developed on till and is found in only two small areas: on the slope below Whiterow Scaurs, and west of Garleffin Fell. The peaty gley (Palmullan series) has been encountered at only one site, to the east of Tairlaw Toll. The soil complex (Clashverains), comprising areas of freely and poorly drained soils, occurs in two small units on Clashverains and Pinverains Hills. The soils all carry semi-natural vegetation utilized as rough grazing, except in a few areas at Tairlaw which have been afforested.

KNOCKSKAE SERIES

The Knockskae series is an iron podzol developed on screes and other stony felsitic debris. It is restricted to a few small areas on steep slopes, covering only 0·24 square miles or 19·7 per cent of the association. The humus form is generally mor, and the vegetation is *Agrostis-Festuca* acid grassland with abundant bracken (*Pteridium aquilinum*).

Profile Description

Slope		12°.
Altitude		1000 feet.
Vegetation		*Agrostis-Festuca* acid grassland—*Festuca ovina, Agrostis tenuis, Festuca rubra, Anthoxanthum odoratum, Luzula campestris, Galium saxatile.*
Drainage		free.
Horizon	*Depth*	
L & F	1–½″	Litter and fermentation layers.
H	½–0″	Black (5YR2/1) raw humus.
A_1	0–9″	Dark reddish brown (5YR2/2) loam; strong very fine crumb; very friable; organic matter high; roots abundant; stony, angular felsites; moist. Clear change into
B_2	9–20″	Dark reddish brown (5YR3/4) gritty loam; weak sub-angular blocky, breaking to fine crumb; friable; organic matter moderate; a few roots; very stony, angular felsites; moist. Gradual change into
C	20″+	Reddish brown (5YR5/4) gritty sandy loam; weak sub-angular blocky; friable; very stony; moist. Merging into rock with depth.

Stones occur frequently throughout the profile and become very abundant in the C horizon, which usually overlies the solid rock. The reddish brown colours which predominate throughout the profile become gradually paler with depth, while the chroma in the B horizon, although greater than that of the A, is not markedly higher than that of the parent material. Nevertheless it seems likely that the content of free iron oxides is at a maximum in the B horizon, the colour changes normally associated with this phenomenon being largely masked by the pinkish red colour of the parent material. The whole profile has a friable consistence, but the structure deteriorates from a strong fine crumb in the surface to weak sub-angular blocky in the lower horizons. On the steep slopes and at the fairly high altitudes at which this series is found, downhill soil movement may take place at certain periods of the year, and may lead to some mixing of the soil horizons.

LAND USE. This soil occurs as part of rough grazings on hill and moorland areas. The productivity of the sward is low and improvements such as bracken eradication are difficult, owing to remoteness, surface rock and boulders, and the small size of the areas involved.

TURGENY SERIES

The total area of this series is small, 0·38 square miles or 30·0 per cent of the association. The parent material is stony felsitic rock debris, either in the form of screes or as shallow frost-shattered rubble. The soil, a peaty podzol, is generally restricted to steep slopes, peat having accumulated to a depth of over 12 inches on flat and gently sloping areas. The main area of the series occurs on the north side of Craig of Dalwine Hill. The vegetation is usually *Nardus* grassland with very abundant *Vaccinium myrtillus*.

Profile Description

Slope		15°.
Altitude		900 feet.
Vegetation		*Nardus* grassland—*Vaccinium myrtillus, Nardus stricta, Festuca ovina, Agrostis canina, Carex binervis, Deschampsia flexuosa.*
Drainage		free below the iron pan.
Horizon	*Depth*	
L & F	8–6″	Litter and fermentation layers.
H	6–0″	Dark reddish brown (5YR2/2) well humified peat.
A_2g	0–7″	Dark grey-brown (10YR4/2) gritty loam; medium sub-angular blocky; slightly friable; organic matter low, some washed-in colloidal black humus; roots common; stony, many felsite chips; moist. Sharp change into
B_1	7–7½″	Dark reddish brown (5YR3/2)/diffuse iron pan.
B_2	7½–16″	Yellowish brown (10YR5/6) loamy fine sand; fine material mainly interstitial between shattered felsite.
C/D	16″+	Shattered felsite.

The profile is generally shallow, shattered felsite rock occurring within about 2 feet of the surface. The depth of the peaty horizon varies, but is usually between 3 and 8 inches. The fine mineral material has a gritty feel which is to some extent a feature of all the soils of the association. The grey A_2g horizon shows darkening by humus staining and some lighter coloured patches where felsite stones are weathering. The iron pan is ill-defined and diffuse, and occasionally restricted to reddish brown staining on the abundant stones. The B_2 horizon usually consists of some reddish brown or yellowish brown fine material in the spaces between stones, but in a few deeper profiles it may be of a friable reddish brown gritty loam with a sub-angular blocky structure.

LAND USE. The soil occurs in hill areas, where the vegetation provides rough grazing for sheep or, occasionally, for cattle.

WHITEROW SERIES

The Whiterow series is a poorly drained non-calcareous gley developed on till derived from felsite rocks. It is not extensive, being limited to small units near Whiterow Scaurs, the Dalquhairn Burn and Garleffin Fell, occupying a total of 0·35 square miles or 27·3 per cent of the association. The slopes are mainly gentle, but may be steep locally. The vegetation is usually *Juncus acutiflorus* pasture.

Profile Description

Slope		6°.
Altitude		850 feet.
Vegetation		*Juncus acutiflorus* pasture—*Juncus acutiflorus, Juncus effusus, Holcus lanatus, Deschampsia caespitosa, Potentilla erecta.*
Drainage		poor.
Horizon	*Depth*	
L & F	½–0″	Litter and fermentation layers.
A_1g	0–7″	Light brownish grey (10YR6/2) loam; weak fine sub-angular blocky structure; slightly friable; organic matter low; roots common; a few stones; a few medium distinct strong brown (7·5YR5/8) mottles; moist. Clear change into

B_2g	7–34″	Grey-brown (10YR5/2) loam; massive; slightly firm; a few roots; stony, many weathered felsite stones having a tendency to occur in bands; many coarse prominent reddish yellow (7·5YR6/8) mottles, often associated with weathering stones; moist. Gradual change into
Cg	34″+	Grey (10YR5/1) loam; massive; plastic; a few stones; a few medium prominent reddish yellow (7·5YR5/6) mottles along old root channels; slightly wet.

The ochreous mottling which occurs throughout the profile is most intense in the B horizon at about 20 inches from the surface. The natural structural aggregates are weak in the A horizon, and the structure becomes massive in the B and C horizons. The organic matter content of the soil is low. The soil receives considerable run-off from higher-lying areas and tends to be waterlogged for long periods, although this tendency is reduced to some extent by open ditches.

LAND USE. The vegetation on these soils forms part of the rough grazing for sheep and cattle which is the main form of land use of the association.

PALMULLAN SERIES

This soil has been mapped in one small area near Tairlaw where it occupies only 0·04 of a square mile or 2·4 per cent of the association. The profile, which is poorly drained and classified as a peaty gley, is developed on felsite till of loam to sandy clay loam texture.

Profile Description

Slope		8°.
Altitude		900 feet.
Vegetation		*Calluna-Eriophorum vaginatum-Trichophorum* moor—*Molinia caerulea, Eriophorum vaginatum, Deschampsia flexuosa, Vaccinium myrtillus, Calluna vulgaris, Trichophorum caespitosum.*
Drainage		poor.
Horizon	*Depth*	
L & F	9–7″	Litter and fermentation layers.
H	7–0″	Dark reddish brown (5YR2/2) well humified peaty humus.
A_1g	0–4″	Dark grey-brown (10YR4/2) humose loam; very weak sub-angular blocky; slightly firm; organic matter high; roots common; a few stones; moist. Clear change into
A_2g	4–10″	Pinkish grey (7·5YR6/2) gritty loam; very weak sub-angular blocky to massive; slightly firm; organic matter low; roots common; stony, many weathering felsites; a few fine faint ochreous mottles associated with weathering stones; moist. Gradual change into
B_2g	10–16″	Brown (7·5YR5/2) gritty loam; massive; organic matter low; roots common, many dead; stones common, mainly felsite, with some greywacke and lava; frequent medium faint ochreous mottles associated with weathering stones and old root channels; moist. Clear change into
B_3g	16–20″	Grey-brown (10YR5/2) gritty loam; massive; firm; dead roots common; stony, weathering felsites; frequent medium distinct ochreous mottles, often associated with weathering stones; moist. Gradual change into
Cg/Dg	20″+	Grey (2·5Y5/0) gritty sandy clay loam; massive; very firm; stony; a few fine faint ochreous mottles.

The peaty horizon is well developed and is underlain by a dark grey-brown humose loam A_1g horizon. Grey colours are predominant in the soil, chromas of over 2 being restricted to ochreous mottles. The A_2g

horizon appears to be the zone of maximum gleying, while ochreous mottling is most intense in the B_2g horizon.

LAND USE. Rough grazing for sheep and cattle is the only form of land use on this soil.

CLASHVERAINS COMPLEX

The north sides of Clashverains and Pinverains Hills carry an intricate pattern of freely and poorly drained soils. The general slopes are moderate to steep, with a micro-topography of knolls and depressions. The knolls are of felsite rock on which shallow, stony, freely drained iron podzols are developed on frost-shattered rock debris. A thin drift, with felsitic material as its major component, occurs in the depressions and carries poorly drained peaty gley or non-calcareous gley soils.

This is a very varied soil mapping unit. The soil profiles in many instances resemble those of the individual series described in the association, but wide variations from the established modes are common. Similarly the general pattern of soils described is liable to variations, the most striking of which is probably the occurrence of peaty podzols and podzol rankers instead of the iron podzols.

The vegetation varies widely with the drainage and soil conditions.

LAND USE. Rough grazing by sheep and some cattle is the main form of land use on this complex, but a small area is afforested.

SKELETAL SOILS

Two small areas of skeletal soils have been mapped in the Knockskae Association; together they total 0·16 square miles or 12·5 per cent of the association, and both occur on the Craig of Dalwine Hill. The area on the south side of the hill is a long cliff of bare felsite rock below which is a scree only partially covered with vegetation. The feature is known as Whiterow Scaurs, probably on account of the pale pink colour of the rock. Where the bare rock does not outcrop the soils are shallow and very stony. They also show considerable variation, organo-mineral A horizons occurring at the surface in some places while elsewhere surface accumulations of raw humus overlie little-altered scree. The soils conform generally to the definition of rankers given by Kubiena (1953).

LAND USE. These areas are of very limited value for forestry or agriculture.

Yarrow Association

Only one series of the Yarrow Association, the Yarrow series has been encountered. Occupying 0·08 per cent of the area, it is one of the smaller associations in the region. A small area of this soil was first mapped at the eastern end of the Southern Uplands by Ragg (1960) and a slightly larger area was later described by Ragg and Futty (1967).

Distribution

Very small patches of Yarrow series are found at Burnfoot on the south bank of the River Stinchar opposite Colmonell, as terraces along the lower part of the App Valley, and near Larg on the east bank of the River Cree.

Parent Material

The Yarrow series is developed on deposits of sands and gravel derived mainly from greywacke. The material at Burnfoot has a moundy topography and is associated with glacial terraces, while that at Larg, although it also has a moundy topography, has no connection with any clearly recognised feature indicating the mode of origin. The deposits in Glen App have a nearly flat topography and are in the form of river terraces; some of the lower terraces have been mapped by the Geological Survey as raised beaches, but the soils have a close relationship with the Yarrow series.

Soils

YARROW SERIES

The Yarrow series, a brown forest soil of low base status, occupies only 0·44 square miles.

Profile Description

Slope		3°.
Altitude		100 feet.
Vegetation		long ley grassland.
Drainage		free.
Horizon	*Depth*	
S	0–8″	Brown (10YR4/3) loam; moderate medium sub-angular blocky structure, breaking into fine crumb; friable; organic matter moderate; roots abundant; small rounded and sub-angular stones common; moist. Diffuse change into
A_1	8–14″	Brown (7·5YR4/4) gritty loam; weak sub-angular blocky; friable; organic matter low; frequent rounded greywacke stones; frequent roots; moist. Diffuse change into
B_2	14–30″	Strong brown (7·5YR5/8) loam; weak sub-angular blocky; friable; no organic matter; a few roots; frequent stones, some large boulders; moist. Diffuse change into
C	30″+	Grey (10YR5/1) coarse sand and gravel, derived from greywacke; massive; firm; abundant stones.

The S horizon appears to have been formed by repeated cultivation in the upper part of what was previously a deep A_1 horizon, the unaltered remains of which still exist below the plough layer. Cultivation may also be responsible for the deterioration of the structure from the well developed crumb usually found under semi-natural or permanent grass. The B_2 horizon is strongly developed and bears a resemblance to the equivalent horizon of the Linhope series. The colour of the parent material is difficult to describe because of the fine stippled effect given by the differently coloured coarse sand grains. The sand may be loose with a single grain structure, or it may cohere slightly, when the structure is described as massive. Stones are abundant throughout the profile but are rather less frequent in the S horizon.

LAND USE. Most of this series carries long ley grassland, with some areas cultivated for the growing of oats or turnips. One area of semi-natural oakwood occurs near Larg.

Linfern Complex

The Linfern complex covers 0·53 square miles in the northern part of the area near Linfern Loch and Tairlaw Toll. In these localities blanket peat developed on gently sloping ground is interrupted by frequent dumps of moraine which carry peaty podzols and brown forest soils, to give a soil pattern of some complexity. Individually the constituent soils occupy areas too small to be shown separately on the present scale of mapping, and they have therefore been grouped into one mapping unit, the Linfern complex.

The unit consists of small areas of peaty podzol and brown forest soil profiles, together with blanket peat which may occasionally become thin and give a peaty gley soil. The moraine is of very mixed composition and origin, but greywackes, red sandstones and basic lavas are the major constituents, the relative proportions varying considerably. The material is light brown or grey-brown in colour and loamy sand or sand in texture; it is strongly indurated below about 2 feet. It was probably formed by ice moving locally north-westwards off the Ordovician strata, which lie immediately to the south, and on to the beds of sandstone and lava which underlie the deposits.

The annual rainfall is between 70 and 80 inches and together with the prevailing gentle slopes is the main factor in promoting the extensive blanket peat formation typical of the area. The vegetation communities vary according to the conditions; *Calluna-Eriophorum vaginatum-Trichophorum* moor and *Molinia* grassland are most common on the peaty areas, with wet *Calluna* moor on the peaty podzols, and *Agrostis-Festuca* acid grassland with bracken occurring on the brown forest soils.

The peaty surface layer is generally well developed and may be more than 12 inches thick, when technically it may be considered as peat. The A_2g horizon shows considerable variation, but is generally at least partially gleyed, the gleying becoming more intense as the H layer becomes thicker and the iron pan better developed. However several profiles were encountered in which the iron pan was absent, and where only weak gleying had occurred in the A_2 horizon. The B_2 horizon shows the high chromas and friable crumb structure typical of this major soil group. The stones which are common or frequent throughout the upper part of the profile become abundant in the parent material, which like the other moraine deposits in the area is strongly indurated.

Profile description—Peaty Podzol

Slope		gentle.
Altitude		950 feet.
Vegetation		Wet *Calluna* moor—*Trichophorum caespitosum*, *Calluna vulgaris*, *Erica tetralix*, *Molinia caerulea*, *Juncus squarrosus*, *Sphagnum* sp., *Cladonia* sp.
Drainage		free below the iron pan.
Horizon	*Depth*	
L & F	8–7″	Litter and fibrous plant remains.
H	7–0″	Dark reddish brown (5YR3/2) peat with some mineral matter. Clear change into
A_2g	0–2″	Brown (7·5YR5/2) loam; weak sub-angular blocky; slightly firm; organic matter low; roots common; stones common; moist. Clear change (irregular boundary) into

B_1	2″	Irregular iron pan.
B_2	2–9″	Yellowish red (5YR4/6) loam; moderate medium crumb; friable; roots common; organic matter low; stones frequent; moist. Clear change into
B_3/C	9–16″	Reddish brown (5YR5/4) sandy loam; weak sub-angular blocky; slightly firm; a few roots; stones frequent; moist. Clear change into
C	16″+	Brown (10YR5/3) loamy sand; massive; indurated; no organic matter; no roots; stones frequent; slightly moist.

Profile description—Brown forest soil

Slope	gentle.
Altitude	950 feet.
Vegetation	*Agrostis-Festuca* acid grassland—*Deschampsia flexuosa, Festuca ovina, Galium saxatile, Potentilla erecta, Calluna vulgaris.*
Drainage	free.

Horizon	*Depth*	
L & F	1½–0″	Litter and fibrous plant remains.
H/A	0–1½″	Very dark grey (5YR3/1) sandy loam; friable; moderate crumb; organic matter high; roots abundant; a few stones; moist. Clear change into
A_1	1½–6″	Dark reddish brown (5YR3/3) loam; moderate sub-angular blocky; friable; organic matter moderate; roots common; sub-angular basic igneous and greywacke stones common; moist. Clear change into
B_2	6–10″	Strong brown (7·5YR5/6) loam; moderate medium sub-angular blocky; friable; organic matter low; roots common; stones frequent; moist. Clear change into
B_3	10–14″	Brown (7·5YR5/4) gritty sandy loam; weak sub-angular blocky; friable; organic matter low; roots common; stones frequent; moist. Clear change into
B_3/C	14–22″	Brown (10YR5/3) sandy loam; weak sub-angular blocky to massive; firm; no organic matter; a few roots; stones frequent; moist. Clear change into
C	22″+	Dark grey-brown (10YR4/2) loamy sand; massive; indurated; no organic matter; stones frequent; moist.

Some podzolisation of the profile is indicated by the accumulation of an appreciable layer of raw humus, and by the frequent bleached sand grains in the A_1 horizon. The coarse texture and friable consistence are characteristic of this soil. Induration is a feature of the parent material. The B_2 horizon is well developed, the strong brown colour clearly differentiating it from other horizons. Stones are frequent throughout the profile.

The other important component of the complex is blanket peat, which varies in depth from about 12 inches to 3 feet; occasionally it is less than 12 inches thick, giving a type of peaty gley soil which is not extensive. The parent material is a medium textured drift of mixed origin and not unlike that of the moraines in composition.

LAND USE. Formerly the whole area of this complex was rough pasture grazed by hill sheep. However, in the last few years much of it has been afforested and the remainder is likely to be planted shortly.

Links

Blown sand deposits occur in two small areas along the coast north of Girvan and south of Bennane Head, covering in all only 0·26 square miles. The deposits are in the form of low dunes, most of which have been stabilized by a continuous vegetation cover. A narrow belt of unstabilized dunes does occur along the shore between Bennane Head and Ballantrae; these consist of bare sand with only occasional tufts of marram grass (*Ammophila arenaria*).

The weak development of the soil profiles on the stabilized sands would appear to indicate that they are of very recent origin, or have only recently become stabilized, but no precise information on this point is available. Besides quartz grains, the sands contain a considerable proportion of dark coloured particles of ferromagnesian minerals from the nearby basic igneous rocks and fragments of greywacke—shell fragments have not been seen.

The topography is generally a micro-relief of low mounds on an otherwise flat area. Near Girvan the grassland vegetation is largely man-controlled since the area forms part of a golf course. In the southern locality *Agrostis-Festuca* meadow grassland is the major vegetation type.

Profile Description

Slope		3°.
Altitude		25 feet.
Vegetation		*Agrostis-Festuca* meadow grassland—*Festuca ovina, Cynosurus cristatus, Trifolium repens.*
Drainage		Free.
Horizon	*Depth*	
L, F & H	1–0″	Plant litter overlying a very thin layer of black greasy humus.
(A_1)	0–4″	Dark brown (7·5YR3/2) humose loamy sand; weak medium subangular blocky, easily breaking to single grain; very friable; organic matter moderate; roots common; bleached sand grains abundant; moist. Clear change into
(B_2)	4–12″	Brown (7·5YR5/4) sand; moderate angular blocky, breaking easily to single grain; friable; a few roots; moist. Gradual change into
C	12″+	Pinkish grey (7·5YR6/2) and light brown (7·5YR6/4) sand; single grain; loose; no organic matter; rare roots, disappearing with depth; no stones; no mottles, but occasional bands of dark minerals; moist.

The soil is very sandy and has been leached, although the reaction is only moderately acid (pH 5·7). The accumulation of raw humus and the abundance of bleached sand grains may indicate some incipient podzolisation, but there is as yet no clear development of an eluviated A_2 horizon. The B horizon is only weakly developed, and this, together with the limited formation of an organo-mineral complex and weak soil aggregation in the A horizon, can be taken as evidence that soil formation has taken place over a fairly short time and that the soil is still at an immature stage of development.

LAND USE. The agricultural value of this soil is low, and near Girvan it forms part of a golf course. South of Bennane Head it is fenced, and the grass sward is grazed by sheep and cattle. Some areas may occasionally be cultivated, but the soil is not generally used for the growing of early potatoes as is the Dreghorn series nearby, despite the fact that the links soil enjoys similar climatic advantages.

Alluvium

Tracts of alluvium are encountered throughout the area, mainly as narrow strips along the major water courses and their tributary streams and burns.

PLATE 9/The '25 foot raised beach' north of Lendalfoot showing old sea stacks and former cliffs. The soils of the Dreghorn series which occur on the former beach are much valued for the growing of early potatoes.

PLATE 10/Tracts of alluvium and raised beach merging near the mouth of the River Stinchar. Soils of the Bennane complex have been mapped on the rocky area in the foreground.

PLATE 11/Crawler tractors being used in tandem for the intensive drainage of shallow peat prior to afforestation. Shalloch on Minnoch Hill in the background rises to 2520 feet.

PLATE 12/Drumlins at Kirkalla Farm carrying soils of the Linhope series. The flat area in the middle distance is underlain by peat.

In all they occupy 23·0 square miles or 4·31 per cent of the area. The more extensive units are found along the banks of the River Stinchar below Aldinna, along the Girvan Water, and along the River Cree below Bargrennan. Further deposits of some size occur at Carsphairn, where the Water of Deugh meets the Carsphairn Lane, and smaller tracts have been mapped along the App Valley, the Water of Assel, the Duisk and Muck Waters, and along the Minnoch Water at Tarfessock and at Holm. Areas where peat has developed on alluvial deposits to depths of more than 12 inches, as in the Trool Valley, at Culsharg, or around Loch Slochy, have been considered with the other peat areas. Alluvium is an unconsolidated water-laid sedimentary deposit, and in this area has been laid down during the post-glacial period. It may be divided into types according to the environmental conditions under which it was laid down: fluviatile deposits are by far the most common in the area under consideration, with a few deposits of possibly lacustrine origin. In contrast to till and moraine laid down by ice, water-laid deposits are sorted according to particle size. The degree of sorting varies considerably with conditions, but is generally sufficient to achieve a considerable separation of coarse and fine material. Banded or interbanded layers of varying texture are often found and are due to changes of depositional conditions. Textural variations may also occur in rapid succession over a deposit surface, so that it is possible to pass from sandy material to clay and back to sand within a short distance. In this area coarse-textured deposits are the most common, often underlain by gravel or boulder beds.

In the hill and high-lying areas, where the streams rise in spate during periods of heavy rain and overflow their banks, alluvium is still being deposited annually. Further down stream where the alluvial terraces may be slightly higher, or have been protected by man-made banks, flooding only occurs under exceptional conditions and deposition is only intermittent. Raised alluvial terraces and lacustrine deposits are not often flooded nowadays and active deposition has ceased.

Alluvial soils show a range in degree of profile development according to their age and activity. Soils formed on young active alluvium show only weak development, generally confined to some humus accumulation in the surface layers, and, if the drainage is impeded, only weak ochreous mottling. Buried soils and peat layers are also found in these deposits.

On less active alluvium soil development has proceeded further, for the organo-mineral surface horizons are better developed, as is the ochreous mottling in the lower layers of soils with impeded drainage. In these latter horizons dark bands of deposition of iron or manganese oxides often occur, usually at an interface between beds of different texture. Alluvium of definite lacustrine origin has not been identified in this area.

LAND USE. Alluvial soils which are free from waterlogging have a high natural fertility. They are generally level and easily cultivated and have the environmental advantage of a low or moderate altitude, and a sheltered situation. Along the lower parts of the Stinchar and Girvan Valleys these soils are cultivated for the growing of oats, turnips, and the valuable cash crop potatoes, usually with short breaks in permanent grassland. Along the valley of the Cree near Clachaneasy, an area liable to flooding, and in the upper Stinchar Valley, long ley grassland is prominent in the rotation.

In hill areas some of the larger alluvial tracts have been fenced to allow better control of their relatively superior grazing, but more generally these areas are unfenced and form part of uncontrolled moorland grazing.

Poorly drained alluvium is not easily cultivated, unless tile drained, and is usually left as permanent grassland, the productivity of which is not high.

Peat-Alluvium

Complexes of peat and alluvium have been mapped over 3·32 square miles or 0·6 per cent of the area. They generally occur along water courses, particularly in the moorland areas, and also occupy the sites of former shallow lochs. The peat may be either interbedded with alluvial sediments or occur intermingled with alluvium on the surface. These soils are almost invariably found in depressed sites where the water table is high and drainage difficult. Their agricultural value is low.

Some of the larger tracts of this complex in the eastern part of the region occur along the Carsphairn Lane, on the Polharrow Burn at the Forrest Lodge and near Murray's Monument, while in the west the main areas are at Kilchrennie, North Ballaird and Knockdaw Hill.

Mixed Bottom Land

Mixed bottom land is the cartographic unit used to represent the complex of soils occurring along narrow stream channels. The unit comprises narrow tracts of alluvial soils, too small to be shown individually, and soils, often skeletal, on the steep banks which may also occur along water courses. The soils are very varied in profile morphology, age and parent material. This unit has been mapped over 6·25 square miles or 1·1 per cent of the area.

Peat

Peat is the most extensive soil occurring in the area; it has been mapped over 176 square miles or 33 per cent of the area and is also a frequent and large component of soil complexes. It consists of accumulations on the land surface of organic matter more than 12 inches thick. Similar accumulations less than 12 inches deep also occur and these form the surface horizons of soils classified in the peaty podzol or peaty gley major soil groups. The mode of formation, composition and properties of peat are described in Chapter 6.

LAND USE. The areas of peat, which carry semi-natural plant communities (Chapter 7) of low productivity, are mainly used for sheep and cattle grazing on the extensive pattern. The peat is waterlogged for the greater part of the year. The difficulty of drainage and large amounts of fertilizer needed for improvement of the sward make reclamation expensive and it is rarely attempted under present economic conditions.

Coniferous forest has, however, been established extensively by the Forestry Commission in recent years.

6 Peat

Peat may be defined in general terms as an accumulation of partially decayed plant remains formed on sites where excess water at the soil surface has inhibited the normal aerobic processes of decomposition. Other conditions conducive to the formation of peat include low average temperature, high acidity and nutrient deficiency. Such conditions are effective in depressing the level of microbiological activity upon which the decomposition of organic matter largely depends. In areas where peat has accumulated, the rate of decomposition during the time of peat formation was reduced to a level at which it was exceeded by the rate of deposition of plant remains. The net result was the slow build-up of the beds of plant tissues which are described as peat. Since peat is, by definition, almost wholly organic in origin, it may generally be identified on this basis and it is conventional to accept that a soil having an organic matter content of 60 per cent or more is peat. In soil mapping, a soil profile having a surface organic horizon more than 12 inches thick is classed as peat. In cases where the organic surface horizon is less than 12 inches thick, or where the ash content exceeds 40 per cent, the term 'peaty' is sometimes applied to the material.

In the south-west of Scotland, as in other regions with extensive deposits of peat, the material was, in the past, extensively utilized by the local inhabitants as a domestic fuel, and much time and labour were expended annually in cutting, drying, transporting and stacking the year's supply. By the middle of the last century, however, coal was beginning to compete seriously as a domestic fuel in spite of its apparent high cost. Several writers in the New Statistical Account of Scotland (1845), reporting on Parishes in the south-west, mention that good quality fuel peat was becoming scarce and, as one puts it, 'the higher classes use coal generally' and 'the poorer classes use very generally peats with small quantities of coals occasionally'. The swing from peat to coal was welcomed by many who rightly regarded the hand-cutting of peats as a costly business in terms of man-hours diverted from pressing agricultural work.

Within the area surveyed, two main types of deposit can be distinguished: basin bogs and blanket bogs. The former are found on sites where the main initiating factor was impeded drainage, resulting in a more or less constantly water-logged surface horizon. Such sites are particularly frequent in the south-west of the area where the glaciers of the Ice Age left a large number of the hog-backed deposits of till known as drumlins. Between these formations, steep-sided valleys occurred in which water collected in innumerable small lakes, constantly replenished by drainage water. Beginning at the margins of these lakes, aquatic and semi-aquatic vegetation grew and slowly encroached on the area of open water until a swamp was formed. Partly decomposed vegetable material accumulated on the beds of the lakes. In samples from these sites, the remains of such vegetation are found preserved as lacustrine peat which contains recognisable fragments of sedges, reeds and other water-loving plants. Accumulation progressed until mineral-rich drainage water no longer reached the central parts of the developing bogs. At this point the character of the plant cover changed to show a dominance of species tolerant of lower concentrations of nutrients as, for example, species of bog-moss (*Sphagnum* spp.); the upper strata of the bogs are composed mainly of the remains of these. Wood remains, usually of birch (*Betula*), occur frequently, mainly in the lower horizons, indicating that the developing bog was colonised by birch scrub at a fairly early stage. Amorphous peat of indeterminate origin is widely distributed and its presence implies the occurrence, at least intermittently, of a combination of plant species and an environment conducive to the fairly rapid decomposition of organic remains.

The blanket bog formations, which cover large tracts of the higher ground in the area, were formed under somewhat different conditions although basically the cause of deposition was the same, *ie* the suppression or inhibition of the decomposition process. The most notable difference was the complete or almost complete absence of relatively nutrient-rich drainage water in which marsh species could survive in large numbers. The main and often the only source of moisture over most of the area was precipitation, which contains insufficient nutrients to support any but the most undemanding plants. Apart from the rare occurrence of traces of some marsh plants, the greater part of the peat in blanket bog is formed from species of *Sphagnum*, with lesser amounts of a few associated and almost equally undemanding species. A constant characteristic of high level blanket or hill peat is the uniformity of the material throughout the profile and the lack of differentiation into distinct strata, a feature which reflects the uniformity of the environment during formation. It is usually possible to distinguish only 'old' and 'young' *Sphagnum* peat. The few traces of marsh species which sometimes occur are found in slight hollows on the hillsides where there could have been a slight accumulation of relatively nutrient-rich water.

Of the three areas surveyed in detail, Dornal Bog is a complex of basin deposits lying in the hollows between drumlins; Cairnadloch Bog is an area of high-level blanket or hill peat; Backhill of Bush, is, in the main, a high-level blanket bog but includes the Silver Flowe Nature Reserve, a string of raised bogs in the valley of the Cooran Lane.

All the deposits were surveyed by the standard grid method of the Peat Survey of Scotland. From a baseline lying across or alongside the bog, secondary lines were laid out at right angles at intervals of 100, 200 or 400 metres depending upon the size and complexity of the area. Depth soundings and surface levels were taken at similar intervals along these lines. Samples of peat were taken from the full profile at wider intervals. Field examination of the peat included an assessment of the degree of decomposition ('humification' or H-value of von Post) and identification, where possible, of the main peat-forming plants. Sealed samples were taken to the laboratory for determination of the moisture and ash contents and confirmation of the botanical identity of the plant remains present. Selected profiles were sampled on a stratigraphical basis for detailed chemical analysis. A fuller account of the standard survey procedure has been published elsewhere (Department of Agriculture and Fisheries for Scotland, Scottish Peat Surveys, 1964).

Dornal Bog

This bog lies about 10 miles (16 km) north-west of Newton Stewart on the north side of the B7027 and, as already indicated, comprises a complex of basin deposits of the inter-drumlin type common in the south-west of the surveyed area where such formations cover extensive tracts of land. The formation is not isolated in the topographic sense as are the typical basin deposits of, for example, the midland valley of Scotland, and the area surveyed is simply a selected part of the much larger formation.

The area examined covers 497 acres (201 hectares) and the surface lies between 374 and 433 feet (114 and 129 m) above Ordnance Datum. The summits of the drumlins rise to a little over 450 feet (137 m). The bog surface slopes downwards from the north-west and south-east boundaries towards the Carrick Burn, which crosses the area in an approximate west to east direction and forms the boundary between Ayrshire and Wigtownshire. Five drumlins protrude through the peat and appear in aerial view as sharply-defined oval 'islands' in the bog surface. Below the bog surface a number of mineral mounds were discovered, at least one of which has the appearance of being a small drumlin now submerged in peat. There is one particularly deep hollow in the floor of the bog, with a bottom level of 358 feet (109 m), in which the peat is 24·6 feet (7·5 m) thick.

Between the drumlins, the bog surface is undulating, fairly smooth and generally firm. Loch Dornal lies on part of the western boundary and just within the eastern boundary is the smaller Blanyvaird Loch. Peat extends to the shore of both these lochs and, particularly in the case of the latter, marsh and bog vegetation are invading the open water.

The vegetation on the bog surface is generally short and compact in habit except where influenced by a higher than average level of nutrients as, for example, along the banks of the burn and immediately below the slopes of the drumlins. Over most of the area, heather (*Calluna vulgaris*) is the dominant species and is associated with varying amounts of deer-grass (*Trichophorum caespitosum*) and the cotton-grasses (*Eriophorum vaginatum* and *E. angustifolium*). The last three species vary from frequent to locally abundant and occasionally one or other of the first two approaches a state of co-dominance with the heather. Over small areas, the bog-mosses (*Sphagnum* spp.) are dominant, and other species occurring locally in significant amounts include bog myrtle (*Myrica gale*), wavy hair-grass (*Deschampsia flexuosa*), moor mat-grass (*Nardus stricta*), blaeberry (*Vaccinium myrtillus*), sedges (*Carex* spp.) and the common rush (*Juncus communis*). In a very few wet places, bogbean (*Menyanthes trifoliata*), water-lilies (*Nymphaea alba* and *Nuphar lutea*) are common. The lower slopes of the drumlins are generally dominated by bracken (*Pteridium* *aquilinum*), whilst the upper slopes are grassy, with a little heather and miscellaneous herbaceous species. Only one tree, a rowan (*Sorbus aucuparia*), was recorded near the burn.

Traces of very old peat cuttings are present in a number of places but only one bank, on the shore of Loch Dornal, had been cut recently and peats were being dried there at the time of the survey.

The maximum thickness of peat recorded was 24·6 feet (7·5 m) and the average for the whole area was 9·5 feet (2·9 m). As the sections (Fig. 16) show, a feature of this type of deposit is the rapid variation in the thickness of the peat on lines at right angles to the long axes of the drumlins. The remains of aquatic and semi-aquatic plants are generally found in the deeper parts of these inter-drumlin valleys, and indicate that peat formation was initiated here in conditions of impeded drainage. At a much later date the peat 'overflowed' from the outlets of the valleys and eventually joined up round the ends of the drumlins to complete the peat cover. The data presented in the stratification diagrams (Fig. 14) are derived from an examination of samples taken at 20 inch (0·5 m) vertical intervals from selected boreholes. The deepest bore found, D3:0:50N, had 3 feet (1·0 m) of pasty black amorphous organic mud immediately overlying the basal soil. This mud is characteristic of a lake deposit and comprises sedimented organic particles derived not only from aquatic plant species but probably from animal and insect remains also. Above this is a very considerable accumulation of sedge peat, at this point about 11·5 feet (3·5 m) thick. Almost pure sedge peat at the bottom merges upwards into a sedge-dominated peat containing a large proportion of wood remains and some amorphous material. Over this is a 3 feet (1 m) band of woody peat with some amorphous material and cotton-grass fragments, and the upper 6 feet (2m) comprise a *Sphagnum* peat with traces of wood and cotton-grass. The humification values on the von Post scale increase from the surface downwards through the *Sphagnum* peat from H6 to H8 and then drop suddenly to H5 at the woody layer, increasing again at the bottom and older part of this stratum. The sedge peat below this has very characteristically low H values (H2), particularly when uncontaminated with other species; when wood remains and amorphous peat are present the values range from H3 to H5. The von Post method of assessing degree of decomposition is not strictly applicable to material such as organic mud but the 'apparent H values' on the criteria of firmness and texture were H4–H5. This profile shows a succession of species conforming in almost every respect with the generally accepted theory concerning the mode of growth of a basin bog. The sedge-dominated peat is rather thicker than is usually found and the persistence of the trees is perhaps a little unusual, but both phenomena indicate the peculiarity of the site with respect to the supply of nutrient-rich water in the earlier stages of development. Run-off from the very steep sides of the drumlins is fast and soluble mineral salts must have reached the peaty hollow in considerable quantities over a very long period of time. That trees continued to grow for so long after the bog surface became dominated by *Sphagnum* spp. would seem to indicate that the store of nutrients at rooting level was sufficient to maintain them even when the input diminished.

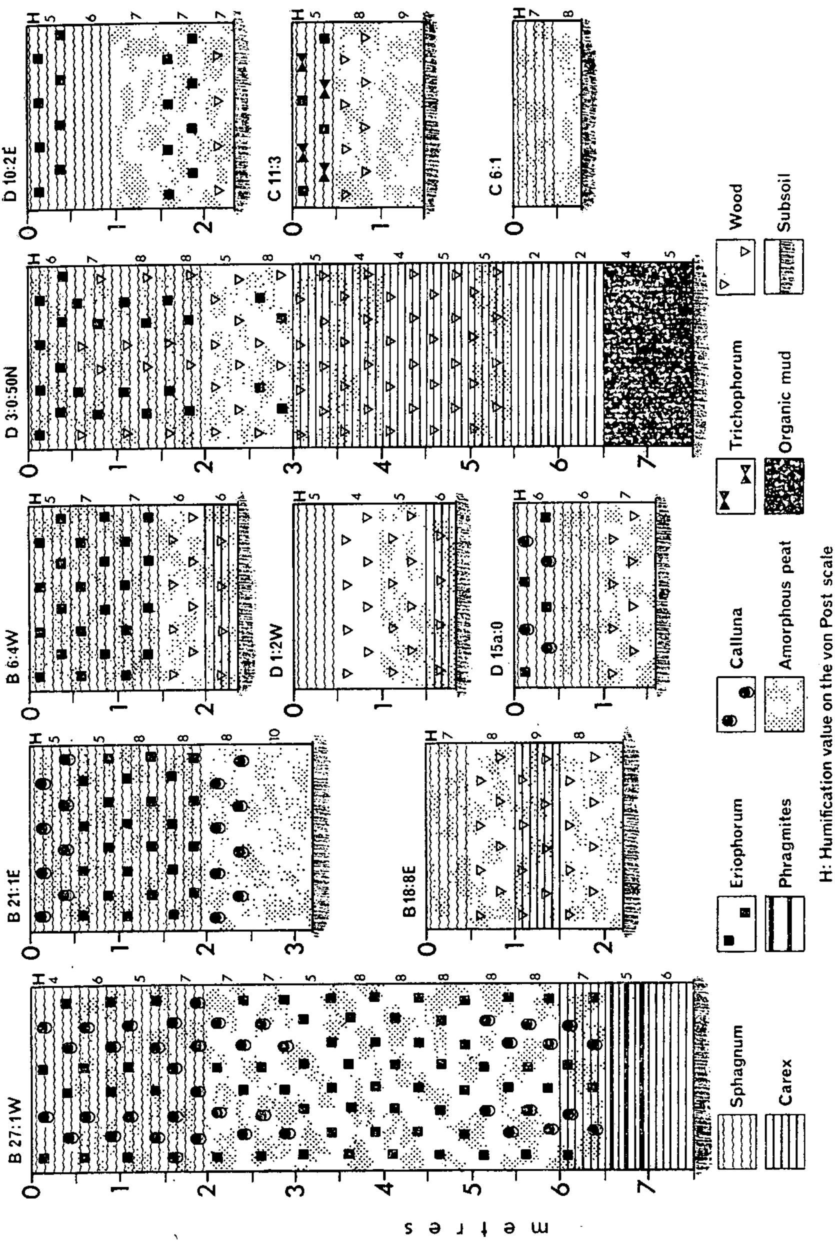


FIG. 14 Peat Stratification—Botanical Composition

Profile D10:2E shows the succession on a site outwith the deeper part of a basin. The organic mud and the sedge peat are absent and most of the upper stratum comprises *Sphagnum* remains with a small amount of cotton-grass. Amorphous peat makes up the bulk of the lower strata, with some cotton-grass and wood remains near the bottom. In profile D1:2W there is a trace of *Carex* amongst wood and amorphous material near the bottom, followed by a stratum of almost pure wood remains. Above this is the *Sphagnum* layer which forms the present surface horizon. D15a:0 is a variation in which heather remains occur in the upper horizon in appreciable amounts.

The frequent presence of amorphous material shows that waterlogging was probably not permanent and that sometimes conditions favoured decomposition rather than accumulation. In some profiles, thick horizons of almost entirely amorphous material were found.

The histograms showing the variations with depth of H-value, moisture content and ash content (Fig. 15) are drawn from the average values calculated from the examination and analysis of routine 20 inches (0·5 m) samples. Variations in botanical compositions are reflected fairly closely in the histogram for H value, the most obvious change being the fall due to the presence of pure sedge peat between 18 and 21·5 feet (5·5–6 m). Moisture content increases with increasing depth from the top of the sedge-dominated strata to a maximum in the pure sedge horizon mentioned above. The ash contents are unremarkable; the high content in the lower horizons is due to contamination with mineral matter.

Cairnadloch Bog

From the very large area of peat-covered hill land in the district, a part of the north-west slopes of Cairnadloch was selected as a typical example. The area lies about 18 miles (29 km) north of Newton Stewart on the east side of the unclassified road to Straiton. The survey covered 232 acres (93·9 ha) of ground lying between 1264 and 1531 feet (387–467 m). The baseline was laid along the road forming the north-west boundary and secondary lines were set out on a magnetic bearing at intervals of approximately 100 m, their length being determined by the distance to the steeper slopes of Cairnadloch on which the peat thickness diminished to below 20 inches (0·5 m); the maximum length was about half a mile (800 m).

The terrain is, in general, roughly undulating. An initial fall from the road is followed on most lines by a long sweeping upslope to the foot of Cairnadloch or by one or more short, sharp rises over intervening mounds or spurs. Numerous rock exposures occur and an unnamed burn crosses the area from south-west to north-east, roughly parallel to the road. As well as the sharply defined course of the burn, which runs on the mineral soil at all points, there are numerous flushes where mobile ground water rises to the surface, runs an indistinct course for a relatively short distance and is then reabsorbed. The clear difference in the character and compsosition of the vegetation distinguishing these areas from their surroundings is due to the local concentration of nutrients brought up in solution by the water.

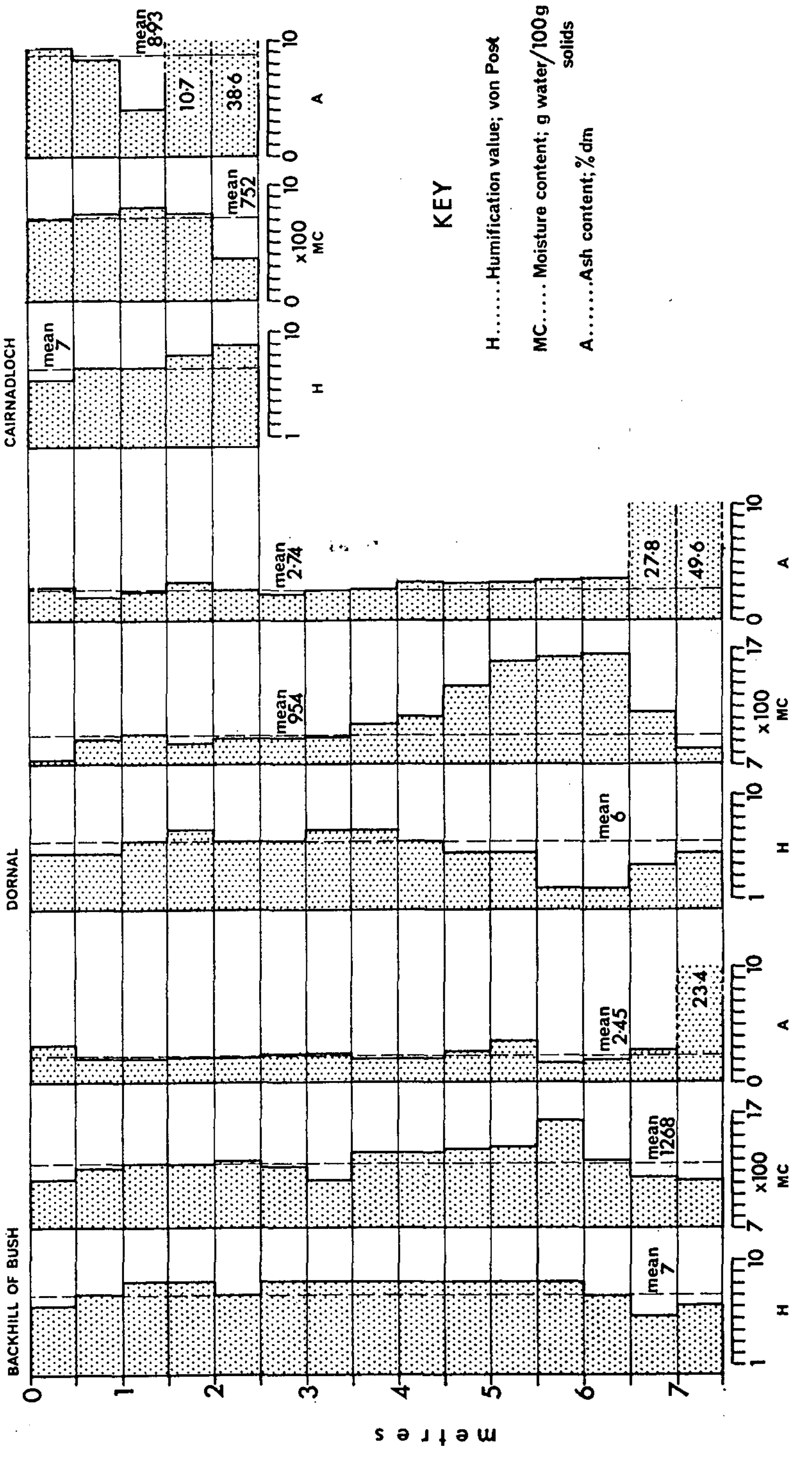


FIG. 15 Peat Stratification—Humification, Moisture Content and Ash Content

A number of peat hags occur and patches of bare peat show where erosive forces are, or have been, operating. The stripped areas are of limited extent, and in general the mat of vegetation effectively restricts erosion. Several re-colonised erosion channels are present.

The maximum thickness of peat recorded was 8·2 feet (2·5 m) and the average for the whole area surveyed was 3·9 feet (1·2 m). As would be expected, since the peat layer is relatively thin, the topography of the bog floor approximates very closely to that of the present surface. The Sections through the area (Fig. 16) show the disposition of the peat upon the mineral sub-stratum and incidentally demonstrate the inconsistency of the relationship between peat thickness and degree of slope. It might at first sight seem reasonable to suppose that the peat would be thicker in hollows and on slopes of low gradient, locations apparently favourable to accumulation, than on steeper slopes, but there is no evidence of any such correlation. Several factors may account for this, including, for example, different rates of decomposition, shrinkage due to drainage, and instability and erosion, but it is difficult to show convincing evidence of the effects of any of these.

Over most of the area, deer grass (*Trichophorum caespitosum*) is the dominant plant species, although heather (*Calluna vulgaris*) assumes dominance in limited areas. Frequently occurring are the cotton-grasses (*Eriophorum vaginatum* and *E. angustifolium*), cross-leaved heath (*Erica tetralix*), bog-mosses (*Sphagnum* spp.) and the common rush (*Juncus communis*). The flushes generally have a ground layer dominated by *Sphagnum* spp. with sedges (*Carex* spp.) and *E. angustifolium* present in varying amounts.

There are no signs of peat-cutting or ditching in the area. Two profiles from Cairnadloch are presented in Fig. 14, one from peat of near-average depth (C 11:3) and one from very typical shallower peat. One of the main characteristics of high-level blanket peat of this type is the lack of clear differentiation into readily separable horizons. In C 11:3, a little over 3 feet (1·0 m) of amorphous peat overlies the mineral base and this is topped by a thin stratum of *Sphagnum* peat. A trace of wood occurs in the upper horizon of the amorphous layer and the surface peat includes the remains of cotton-grass and deer grass. The H-values, indicating degree of decomposition, increase steadily with increasing depth to a maximum of H9 which signifies almost completely decomposed, black pasty material of indeterminate botanical origin.

In C 6:1, the profile differentiation is even simpler; a surface layer of *Sphagnum* peat containing some amorphous material overlies and merges into a purely amorphous stratum which rests on the mineral base. As mentioned previously, it is usually possible to distinguish only the younger from the older peat in deposits of this type and the profiles shown are very typical of the formation. Quite often the change is clear and the line of division obvious; in other situations the boundary is diffuse and cannot be located accurately.

The average values for degree of humification, moisture content and ash content shown in Fig. 15 are typical for hill peat. The degree of humification increases steadily downwards, reaching a high value (H9) at the base; the mean value (H7) is relatively high. As might be expected in peat that is for the most part thin and well-drained, moisture content shows little variation down the profile. The sharp fall in moisture content in the lowest horizon is probably due to the very high ash content (almost 40 per cent) of the peat which reduces its water-holding capacity.

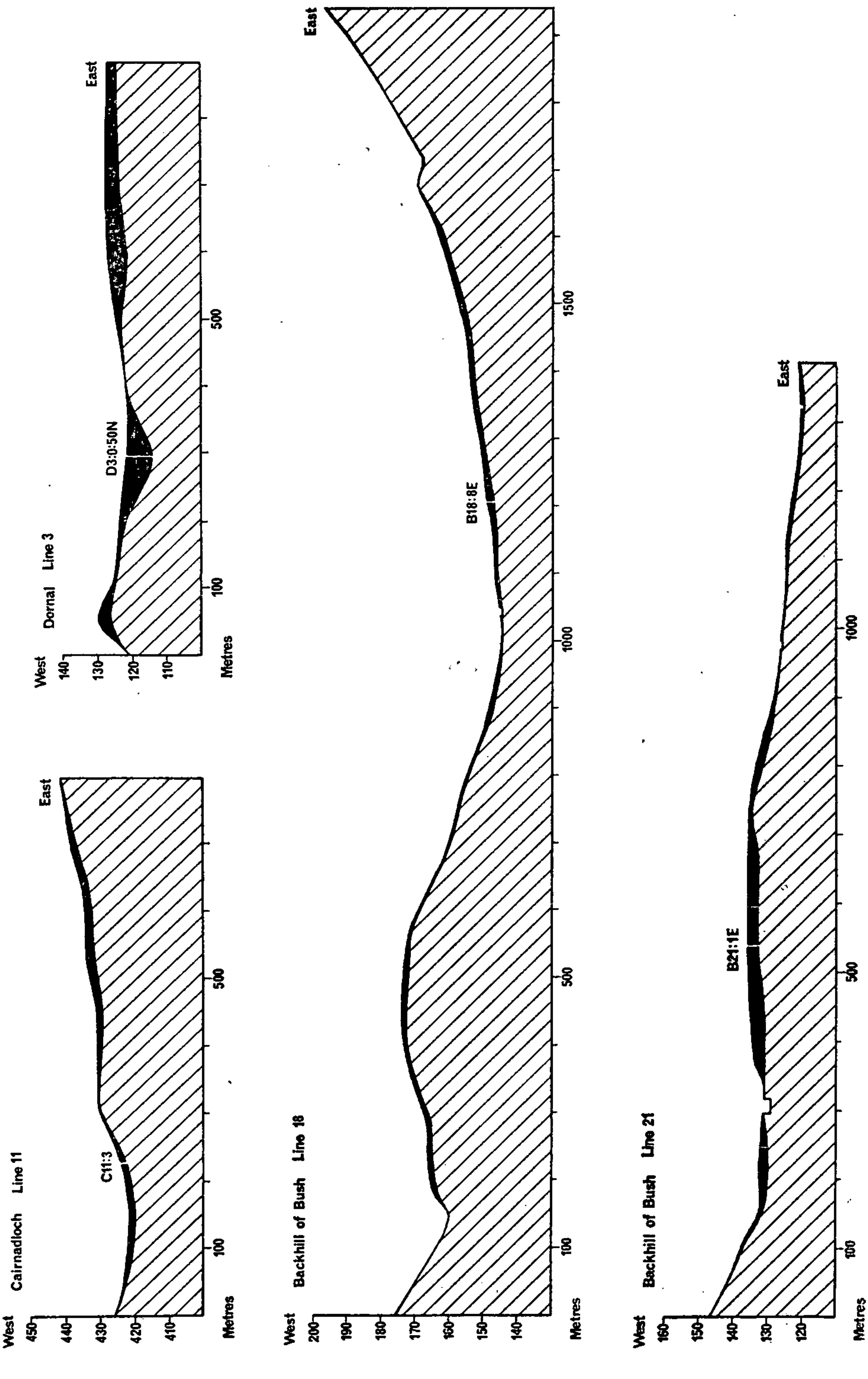
Backhill of Bush Bog

This large bog occupies a long, narrow area lying in a mountain valley some 11 miles (17·6 km) north-west of New Galloway in Kirkcudbrightshire. The area surveyed totalled 3037 acres (1229 ha). North to south, the length is over 7 miles (12 km) and the width varies between one third of a mile and one and three quarter miles (500–2000 m). Because of the shape of the area and the distance involved, the survey was carried out on a structure of four baselines, continuous in line but at differing angles, selected to cover the ground most effectively. The secondary lines at right angles to the baselines were extended to where the peat thinned to below 20 inches (0·5 m) on the slopes of the mountains. The bog surface lies at an altitude of between 756 and 1139 feet (230·5–344 m) approximately. Because of the long distances from accurately levelled Ordnance Survey bench marks, it was considered sufficient to work from an assumed datum which was subsequently estimated to be some 490 feet (150 m) below the true level.

The ground rises steadily for about 3 miles (4800 m) from the south end to the highest point on the watershed, after which it falls equally steadily northwards. Of the three small lochs on or near the watershed, two, the Long Loch of the Dungeon and the Round Loch of the Dungeon are drained southwards by the Cooran Lane which discharges into the River Dee; the mis-named Dry Loch is drained northwards by the Gala Lane which discharges into Loch Doon.

There is a geat variety of terrain over the seven miles surveyed, ranging from the deep bogs south of the watershed which are incorporated into the Silver Flowe Nature Reserve to the thin hill peat on the undulating ground to the north. Large areas to the south have been planted by the Forestry Commission whose operations are steadily extending northwards, excluding of course the area occupied by the Reserve. The hills to the west of the bog are impressively precipitious and rise to over 2000 feet (610 m). East of the bog the near slopes are less severe.

The bogs of the Silver Flowe Nature Reserve are a chain of deposits in which peat is still being formed and the surface conditions are extremely wet, with many pools or dubh-lochs and hummocks forming an intricate mosaic. Peat depths of up to 24·6 feet (7·5 m) were found and a profile B27:1W is shown in Fig. 14. At the bottom of the profile is a thick layer of sedge and reed peat, indicating an aquatic origin for the deposit. Above the sedge peat a considerable mass of dark amorphous peat, mainly of a high degree of humification (H8) and containing heather and cotton-grass remains, extends to within 6 ft of the surface. Above this amorphous peat is the 'young' *Sphagnum* peat of recent origin, also containing heather and cotton-grass remains but of a much lower degree of decomposition (H4–H6) and lighter in colour. Some amorphous material is present but


West
Cairnadloch Line 11
C11:3
East
Metres
West
Dornal Line 3
D3:0:50N
East
Metres
West
Backhill of Bush Line 18
B18:8E
East
Metres
West
Backhill of Bush Line 21
B21:1E
East
Metres

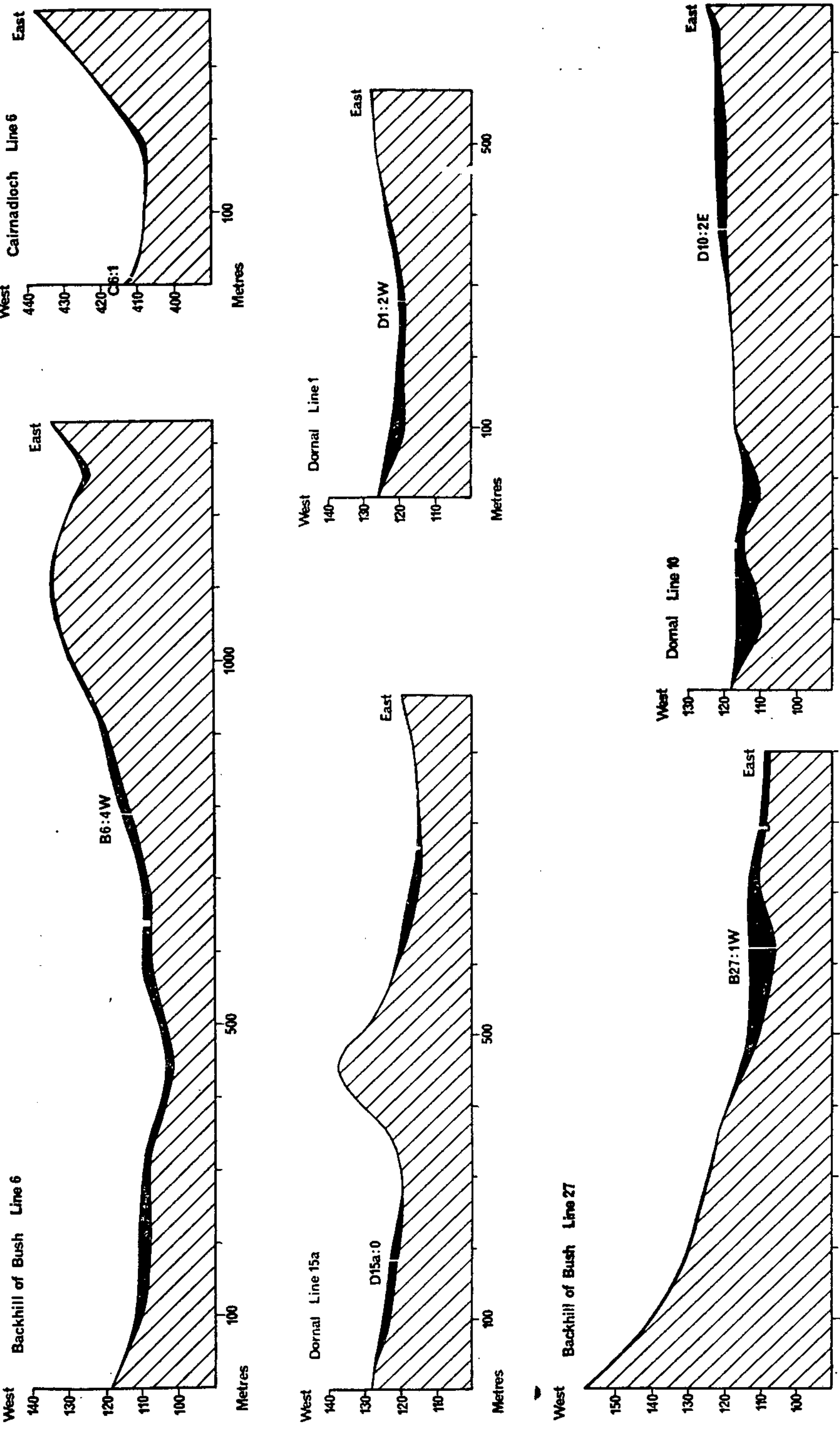


FIG. 16 Peat-Sections across Bogs showing Surface and Basal Topography (*see also page 138*)

the bulk is little decomposed. Traces of *Molinia* were recorded throughout the profile. The stratification diagram for borehole B27:1W (Fig. 14) shows that the H value of the upper peat varies between H4 and H6 whilst in the lower peat the range is from H5 to H8, the latter figure occurring most frequently. In many similar sites in this area, the upper peat has a humification value of H2 or H3, and occasionally of H1. The overall average values for the degree of decomposition shown in the histogram in Fig. 15 are weighted by a preponderance of samples taken from shallow hill peat in which the degree of humification is generally higher than that of peat from a similar depth in raised deposits.

Apart from the peat in the Silver Flowe, most of the area is covered by high-level blanket bog. Profile B21:1E (Fig. 14) shows the type of deposit present near the northern fringe of the Silver Flowe. A mass of *Sphagnum*-dominated peat with inclusions of heather and cotton-grass, and with a proportion of amorphous material, overlies an amorphous lower stratum which has traces of heather in the upper horizon. There is no deposit of aquatic peat. In profile B18:8E the young *Sphagnum* stratum is thin and most of the profile is made up of a woody amorphous peat with an intercalated stratum of sedge peat at 1–1.5 m. The presence of the sedge layer indicates that at this stage of development the existing surface of the bog became flooded with relatively mineral-rich water which supported a population of marsh plants. The presence of wood remains distributed extensively throughout the profile tends to confirm the view that the nutrient level was higher than is usual. Profile B6:4W shows a peat developed over a shallow basin in a predominantly hill peat area. The thinness of the stratum of sedge peat is a measure of the shallow proportions of the basin. Wood is present at and above the sedge peat level, together with a band of amorphous peat, and this is topped by a uniform *Sphagnum* peat containing cotton-grass remains and a proportion of amorphous material.

The histogram of humification, moisture content and ash content (Fig. 15) is characteristic of blanket bog in that there is relatively little variation in the figures for H value and moisture content with depth. This is particularly evident if the values relating to the lower strata of the few deep bores are excluded. Most of the samples were taken from the upper 10 feet (3·0 m) of the profile and consequently few values for depths between 10 feet (3·0 m) and 18 feet (5·5 m) and only one value for each 20 inches (0·5 m) below this are shown in the diagram. The sudden increase in ash content at the bottom of the profile is common and is attributed to contamination of the peat with mineral matter. An excellent account of the Silver Flowe has been published by Ratcliffe and Walker, (1958). The survey data briefly reported here substantially confirms their findings, with one interesting addition. Stratigraphical evidence now allows re-classification of the deposits as 'raised bogs' (in Ratcliffe and Walker's terminology).

ANALYTICAL DATA

Analysis of profile samples from all three bogs are presented in Appendix X. Because of the infinitely variable combination of environmental factors which are possible during the course of development of a bog over many thousands of years, positively identifiable trends in any profile are difficult to find and many inexplicable inconsistencies occur.

Ash contents in the profile from Cairnadloch are relatively high; in the other two they are low, although in the lowest horizons there is the commonly occurring rise due to contamination by mineral matter from the basal soil.

The pH values are generally low and those for the Backhill of Bush profile show a remarkable consistency. The known tendency for the pH of basin peat to increase with increasing depth is demonstrated clearly by the data for Dornal Bog. The pH values for the hill peat of Cairnadloch are not as low as is usual for this type although they are, characteristically, restricted in range.

Calcium is low in the Backhill and Cairnadloch profiles but higher in the Dornal one. In both Backhill and Dornal the values increase with increasing depth.

Sodium, potassium and magnesium values are extremely low in all the profiles with no apparent trend. Total phosphorus is low in all and no trend is apparent except in the values from Dornal where there is a marked crop from the surface to the lower strata.

With one exception, the content of carbon exceeds 49 per cent in all samples. The exception is a value of 29·8 per cent at the bottom of the Cairnadloch profile, and this undoubtedly due to a contamination of the peat with mineral matter, as the very high ash content shows.

Nitrogen values are moderate and no trend is apparent.

7 Vegetation

Outwith the Highlands, the influence of man on the vegetation in Scotland is least pronounced in this area. Within it are included a number of the highest land-masses in southern Scotland and, in addition to the adverse effects of altitude on the agricultural potential of the land, there are the high rainfall of the region and the stony nature of the soil parent materials which make the area largely unsuitable for arable agriculture.

Much of the land is given over to pastoral agriculture which down the centuries has resulted in the destruction of the natural forests and their replacement by grassland and low shrub communities. In more recent years the planting of large tracts with the native Scots pine and exotic conifers is reversing the denudation of forest land and this will eventually bring about a change from the open moor and grassland vegetation to related woodland floor communities.

With Merrick rising to an altitude of 2770 feet the low alpine zone is reached on its uppermost slopes and also on the summits of the other high mountains. The open low shrub communities on the summits provide little of grazing value for sheep and can be considered natural, but the closed grassy communities which usually occur at a slightly lower level are perhaps more heavily grazed by sheep than they would be under entirely natural conditions.

The other terrestrial plant communities show in varying degree man's interference and modification due to his activities. The more extensive communities are described by the methods elaborated in Appendix VII. The weed communities of arable fields are not included nor are the earlier stages of long ley pasture.

FOREST ZONE

WOODLAND COMMUNITIES

There are no known examples of untouched natural forest, although certain sites, such as Wood of Cree, may have carried woodland modified by man in only small degree since Boreal times. The trees have generally been planted, as in the case of the coniferous plantations, or have regenerated from stumps in felled woodland, as in some oakwoods and birchwoods. The tree layer is thus unreliable as a basis in drawing up the communities, and the species of the forest floor, from small shrubs to bryophytes and lichens, have been used as the means of setting up and differentiating the separate woodland communities. This does not mean that the tree species are ignored; seedlings within samples are treated in the same way as non-tree species. Where a species such as *Fraxinus excelsior* is highly constant in the canopy layer, it is noted as such.

Woodland with *Cirriphyllum piliferum, Eurhynchium striatum* and *E. praelongum*

Woodland of base-rich sites is characterized by the three plagiotropic mosses *Cirriphyllum piliferum, Eurhynchium striatum* and *E. praelongum* which occur as constants.

The average number of field and ground layer species recorded per stand is 18, ranging from 10 to 27, and the total for 26 stands is 104 species (Table 19). The stands of this woodland are perhaps the least homogeneous of those investigated and thus, with the method of sampling employed in the survey, the average number of species in a sample of 4 square metres is rather low. A number of these small samples in each stand might more adequately characterize the vegetation, but this is scarcely practicable as the base-rich community is often fragmentary within more extensive and less base-rich vegetation and a standard number of samples per stand might be difficult to maintain. The floristic richness of this community, therefore, is best assessed from the total number of species within it.

The altitude ranges from almost sea-level to over 600 feet, and, although it may occur above this recorded height, the community is distinctly a lowland one. Soil conditions suitable for its development are usually found along the steep banks of watercourses and on small terraces along these watercourses. The slopes noted are thus generally steep or gentle, with moderate slopes much less common.

The soils are mainly brown forest soils but one stand occurs on a brown calcareous soil and two on non-calcareous gleys. The brown forest soils range from freely to imperfectly drained. Although the pH of the surface horizon can be as low as 4·7, it is more commonly around 5·4. In about one quarter of the stands the base saturation of the A horizon is less than 50 per cent, but in half of these the lower horizons are much more saturated with bases. The soil textures vary from sandy loam to clay loam, and horizons within a soil profile may vary over the same range. In the more acid soils the content of exchangeable calcium is low and in the other soils it is medium or high. Exchangeable magnesium content is adequate or high in all profiles and in all horizons of these, and in some cases it is higher than the calcium content. The levels, however, are apparently not so high as to cause imbalance in nutrient uptake, or else the species present in the vegetation can tolerate these higher levels, as there are no observable differences in the species content of stands on soils with high magnesium. Potassium content is medium in all surface horizons but low in the majority of the lower B and C horizons.

The most commonly occurring tree is *Fraxinus excelsior* which is present as a constancy class IV species. Quite often it is also the most abundant tree in the canopy layer, but a more frequent dominant of these base-rich woodlands is *Ulmus glabra*. In other stands *Acer pseudoplatanus, Fagus sylvatica* and *Quercus* spp. are abundant. Coniferous species are frequently planted along with broad-leaved trees and the canopy is a mixed one with no clear dominant.

A layer of tall shrubs is not a constant feature of this woodland. Less than half the stands have a shrub-layer giving a cover-abundance value of 3 or higher. *Corylus avellana* shows the highest presence value and also the highest cover values, and *Sambucus nigra* is second in importance. *Rubus fruticosus* agg. and *R. idaeus* occur throughout the community, but seldom have high cover values.

The shade cast by the tree layer is often heavy and the ground vegetation does not form a turfy mat of dead leaves and stems as in grassy communities so that certain tree seedlings readily become established. Ash (*Fraxinus*) and sycamore (*Acer pseudoplatanus*) are the most common, although occasional seedlings of elm (*Ulmus glabra*) are encountered. Tall ferns of *Dryopteris* spp., *Athyrium filix-femina* and occasionally *Pteridium aquilinum* occur throughout much of the community and locally have fairly high cover values. Grasses are an unimportant element, and the forbs which give the highest cover in the field layer are species demanding a fairly high level of nutrients. These exacting species are *Allium ursinum*, *Circaea lutetiana*, *Asperula odorata*, *Geum urbanum*, *Mercurialis perennis*, *Ranunculus ficaria* and *Sanicula europaea*. Other species fairly characteristic of these base-rich sites which frequently also have a good nitrogen status are *Galium aparine*, *Geranium robertianum*, *Silene dioica*, *Epilobium montanum*, *Fragaria vesca* and *Veronica montana*. This latter group of species seldom has the high cover values sometimes reached by individual species of the former group, and both groups usually have medium or low constancy values. The more general and widely tolerant woodland species *Oxalis acetosella* and *Anemone nemorosa* show high cover in individual stands, yet again constancy is rather low.

Because of the lack of vascular plants in the field layer occurring as constant species in what appears, at the present stage of recording, a fairly distinct plant community, constant species of the ground layer have been used to distinguish and name it. The two species of *Eurhynchium* and *Cirriphyllum piliferum* have already been referred to, and *C. piliferum* occurs scattered throughout the more abundant *Eurhynchium* spp. which, although mingling together, do tend to separate into discrete areas. *E. striatum* covers ground where the field layer is less dense and *E. praelongum*, more tolerant of shade, forms a mat under the shade of the field layer. The only other fairly constant bryophyte is *Mnium undulatum*, which has a presence value of 69 per cent, but *Brachythecium rutabulum* and *Thuidium tamariscinum* are also quite common. The two small species of *Fissidens*, *F. bryoides* and *F. taxifolius*, are characteristic but of low constancy.

Three facies have been separated, based on the presence and dominance of three field layer species. The first is characterized by the constant presence of *Geum urbanum* and the stands in it are not dominated by either *Mercurialis perennis* or *Allium ursinum*. The constant mosses are the three constant in the community as a whole, while in the tree layer *Fraxinus excelsior* is constant. There is a greater number of constancy class IV species with *Acer pseudoplatanus* and *Ulmus glabra* in the tree layer and *Mnium undulatum*, *Fraxinus excelsior* seedlings, *Galium aparine* and *Urtica dioica* in the woodland floor vegetation. The average number of field and ground layer species per stand is 19 and for 11 lists the total number is 81.

The habitat characteristics of the first and second facies are very similar. No slopes over 20°, however, have been recorded in the first and the average pH of the surface horizon is 5·7. The two stands on gley soils are in this group, as also is the stand on a brown calcareous soil.

Only one stand in the present region on the Dunlop series is recorded in Table 19. The greatest extent of this facies is in the lower Stinchar Valley mainly on the Darleith series and with a total of 32 species in the sample area it is floristically the richest stand recorded in the facies.

The second facies is characterized by the dominance of *Mercurialis perennis* in the field layer. The tree canopy is very mixed and none of the species has a presence value as high as 70 per cent. This facies is less floristically rich than the first, with a field and ground layer species density of 15 per stand and a total of 66 for 12 lists. *Mercurialis perennis* is, of course, constant, and in the ground layer *Mnium undulatum* replaces *Eurhynchium striatum* as a constant and the *Eurhynchium* is in constancy class IV.

The habitat characteristics differ from those of the first facies in that a number of stands are on very steep slopes and the average pH is 5·4 as opposed to 5·7.

In the field layer species are usually sparse, although in individual stands a second species, such as *Anemone nemorosa, Allium ursinum, Chrysosplenium oppositifolium, Circaea lutetiana* or *Ranunculus ficaria,* may be abundant. The constants of the ground layer are also usually the most abundant species, although there are stands in which *Thuidium tamariscinum, Eurhynchium swartzii* and *Plagiochila asplenioides* give fairly high cover values.

One stand at the base of Knockdolian on the Dunlop series and one at Old Garroch on the Altimeg series have been described. With species densities of 23 and 28 these stands are among the most floristically rich in the facies and *Corylus avellana* is present in both. *Anemone nemorosa* is also present and *Dryopteris filix-mas* occurs as scattered plants in the immediate neighbourhood of the sample plots.

The third facies, in which *Allium ursinum* is dominant, is represented by only three lists. It is usually found on steep river banks and is limited in extent, so that it is perhaps best considered as a variant of the second facies. The shading effect of the trees, of the dominant field species and of the topographical position of the stands has a strong influence on the ground layer which is usually sparse. The influence of shade is seen also in the constant presence of the ferns *Athyrium filix-femina* and *Dryopteris filix-mas.*

McVean and Ratcliffe (1962) refer to a distinctive *Mercurialis perennis-Allium ursinum* field layer in mixed deciduous woods but do not give a table of analysis of the vegetation. More recently McVean (in Burnett, 1964) alludes to patches of an oakwood flora of *Allium ursinum, Mercurialis perennis, Silene dioica* and other tall herbs in Sutherland birchwoods. Apart from these no up-to-date analysis of this type of woodland in Scotland has been found, other than the account by Birse and Robertson in an earlier Soil Survey memoir (Ragg and Futty, 1967). Similar vegetation is described by Tansley (1953), and from his account the equivalent plant communities in England are the societies of *Mercurialis perennis* and *Sanicula europaea* in pedunculate oakwood on heavier soils, the vegetation in Pennine sessile oakwoods on damp soil with mild humus and part of the vegetation of beechwood and oakwood.

Woodland with *Endymion non-scriptus*

A woodland community characterized by an abundance of *Endymion non-scriptus* is frequently encountered in south-west Scotland and has been seen as small remnants in Aberdeenshire and Easter Ross. The constancy class V species are *Endymion non-scriptus*, *Oxalis acetosella* and *Eurhynchium praelongum* and in constancy class IV are *Dryopteris dilatata*, *Mnium hornum* and *Thuidium tamariscinum*.

The average number of field and ground species per stand is 21 and for 14 lists the total number is 96 (Table 20). It is thus as floristically rich as the closely related *Cirriphyllum piliferum*, *Eurhynchium striatum* and *E. praelongum* woodland but the exacting species do not occur with high cover-abundance values as in that community.

The *Endymion non-scriptus* community is also a lowland one—the greatest altitude at which it has so far been recorded being 405 feet. Slopes range from level to very steep and there is no evident preference for aspect. The soils are all brown forest soils and are, in the main, freely drained. The average pH of the surface soil is 4·7 and the base saturation is low, with a few exceptions in the lower horizons of some profiles. By agricultural standards the soils are low in nearly all the major nutrients, except total phosphorus, but as seen from the carbon : nitrogen ratio, which ranges from 10 to 15 in the surface horizons, there is an adequate level of biological activity in the soil and no accumulation of raw humus.

Betula pubescens is the most constant tree in the canopy layer, but it is seldom dominant. The most usual dominants are *Quercus* spp., with *Q. petraea* the more common. In the shrub layer *Corylus avellana* is the most prevalent species, occurring in half the stands, and in undisturbed natural woodlands it would probably be a constant feature.

Tree seedlings are present in most stands, *Acer pseudoplatanus* and *Fraxinus excelsior* being commonest, but few survive beyond the early stages of growth. Under a moderate tree canopy the foliage of *Endymion non-scriptus* covers over 75 per cent of the ground at its maximum stage of development, but under heavier canopy its cover is less complete and *Oxalis acetosella* may be more abundant. Other commonly occurring field layer species are *Anemone nemorosa*, *Lysimachia nemorum* and *Viola riviniana*. In a few stands *Holcus mollis* is fairly abundant and these are clearly related to the *Endymion non-scriptus* facies of *Holcus mollis-Dryopteris dilatata* woodland (see below). This is one of many cases where the boundary between two communities is not sharp and the assignment of a particular stand to one or other of the related communities is sometimes the subjective choice of the individual analysing the data. The fern *Dryopteris dilatata* is in constancy class IV while *D. filix-mas* occurs in almost as many stands but with lower cover values. The most prevalent grass species is *Poa trivialis*.

In the ground layer *Eurhynchium praelongum* does not provide much cover and the most abundant species is often *Thuidium tamariscinum*. The other constancy class IV species, *Mnium hornum*, is not abundant.

As already indicated this community is more characteristic of western than eastern Scotland and five stands have been examined in the valleys of the Cree and the Stinchar. These occur on the Linhope series in the Cree Valley and on the Darleith series in the Stinchar. Sessile oak, *Quercus petraea*, is constant in these and *Corylus avellana* is present in four stands. Fern species are less constant than in the whole community. *Anemone nemorosa*, *Lysimachia nemorum* and *Viola riviniana* are fairly constant. In the ground layer *Eurhynchium praelongum* is present in only three stands, while *Mnium hornum* and *Thuidium tamariscinum* are the mosses with the highest presence values.

This community is intermediate between the base-rich woodland and the *Endymion non-scriptus* facies of *Holcus mollis-Dryopteris dilatata* woodland. The index of similarity (based on the percentage presence figures of all species in the communities except the trees and large shrubs and corticolous lichens and bryophytes) between this community and the base-rich woodland is 48 per cent, and between it and the *Holcus mollis-Dryopteris dilatata* woodland 57 per cent. It is also closely related to the *Rubus-Dryopteris* woodland (index of similarity—53 per cent) and slightly less closely to the *Holcus mollis-Anthoxanthum odoratum* woodland (index of similarity—46 per cent). It clearly has less affinity with the *Vaccinium myrtillus* woodland where the index of similarity is 24 per cent.

No comparable community has been described for the Highlands by McVean and Ratcliffe (1962), although there are affinities to their herb-rich birchwood. Discussing English woodland, Tansley (1953) refers to the *Endymion non-scriptus* society on light soils in pedunculate oakwood and sessile oakwood, which is clearly very similar to the Scottish vegetation dominated by this species.

Woodland with *Holcus mollis* and *Dryopteris dilatata*

This general type of woodland occurs throughout much of lowland Scotland. The constant species are *Holcus mollis*, *Dryopteris dilatata* and *Oxalis acetosella* and constancy class IV species are *Galium saxatile* and *Eurhynchium praelongum*. The average number of field and ground layer species is 15 and the range is from 6 to 30 with a total of 87 species (Table 20).

The altitude ranges from near sea-level to the highest recorded value of 630 feet. The majority of the stands are on gentle slopes, but occasionally the community is found on slopes of over 20°. The soils are mainly brown forest soils or weakly podzolised soils and the soil drainage is free or imperfect. One of the facies is found on non-calcareous gleys as well as on the better drained soils. The surface pH of the soils is from 3·8 to 4·5 and, with the exception of a colluvial soil where the lower horizons are well saturated with bases, the base saturation in all horizons of the freely-drained soils is low. In the imperfectly and poorly drained soils base saturation may again be low in samples from all horizons, but there is a tendency for the C horizons to be moderately or highly saturated with bases. If the anomalous values for exchangeable bases in the F horizon is ignored, the calcium content is almost invariably low. The amount of exchangeable magnesium is often moderate, but some profiles, especially the freely drained, show a low value for magnesium throughout. Potassium content is also low, except in residual soils on basaltic lavas. There is a moderate amount of total (as distinct from readily soluble) phosphorus in about half the soils sampled. The carbon : nitrogen ratio of the upper horizons, if the values for the L and F horizons are disregarded, is greater than 15 in almost two thirds of the profiles, so that there is some accumulation of a more raw type of humus than that under the first two communities.

About one third of the stands recorded have oak as the dominant tree, either *Quercus petraea* or *Q. robur* or a mixture of the two species with intermediate forms. In about one quarter of the stands birch is the dominant tree, either *Betula pubescens* alone or a mixture of *B. pubescens* and *B. pendula*. Most of the other stands are under planted conifers and *Pinus sylvestris* is the species most commonly found. The canopies of the birch and oak are moderate, but that of the coniferous plantations is moderate to heavy.

There is seldom a shrub layer in the vegetation, but lianes of *Lonicera periclymenum* are more common. Tree seedlings are infrequent, while species of *Rubus* are frequent although seldom abundant. The aggregate species *R. fruticosus* is present in more than half the stands.

In the oakwood and birchwood *Holcus mollis* is often the abundant species; *Dryopteris dilatata* is less abundant and less constant. In the coniferous plantations *D. dilatata* is the more abundant. *Pteridium aquilinum* occasionally dominates the field layer and *Oxalis acetosella* forms about 20 per cent of the cover in most quadrat samples. The only other flowering plants which occur in any degree of abundance are *Anemone nemorosa*, *Deschampsia flexuosa* and *Viola riviniana*.

The ground layer species do not usually provide a great deal of cover and the one constancy class IV species *Eurhynchium praelongum* is abundant in only one stand. Species more often abundant, although less constant, are *Pseudoscleropodium purum* and *Thuidium tamariscinum*.

Three facies have been distinguished in the community. The first has *Endymion non-scriptus* present usually as an abundant species. It differs from the second facies, and also to some extent from the third, in that the soils on which it has been recorded are freely drained. It is also more often found on moderate or steep slopes. The canopy layer is normally oak or birch but the facies does occur in coniferous plantations. *Dryopteris dilatata* is not a constant or even a constancy class IV species, and in its stead *Pteridium aquilinum* occurs in over 70 per cent of the stands. Other features which distinguish this facies from the rest of the community are the constant presence of *Eurhynchium praelongum* and the low presence value of *Galium saxatile*. One stand of this facies, at Haggstone on the Linhope series, has been recorded. It is part of a Sitka spruce plantation and *Endymion non-scriptus* is only sparsely present due, in all likelihood, to the shading effect of the dense spruce at an earlier stage in the development of the plantation.

The second facies is characterized by the abundance of *Lonicera periclymenum* as a field layer species. The facies is usually found on fairly level ground and is widely tolerant of soil drainage conditions. The soils range from non-calcareous gleys to freely drained brown forest soils. As in the first facies oak and birch generally form the canopy layer. Constants in the field layer include the grass *Deschampsia flexuosa* as well as *Holcus mollis, Dryopteris dilatata* and *Lonicera periclymenum.* Wood sorrel, *Oxalis acetosella,* is not constant but occurs along with *Rubus fruticosus* and *Galium saxatile* as constancy class IV species; *Eurhynchium praelongum* is not a constancy class IV species. *Blechnum spicant* and *Anemone nemorosa* also are often present. Although *Endymion non-scriptus* and *Eurhynchium praelongum* are present the stand recorded in Aldons Wood on the Darleith series has been placed in this facies because of the abundance of *Lonicera periclymenum* and the presence of *Deschampsia flexuosa, Galium saxatile* and *Rubus fruticosus.*

The third facies contains neither *Endymion non-scriptus* nor *Lonicera periclymenum* and the characteristic species is *Rhytidiadelphus squarrosus.* It is generally found on gentle slopes and the soils are freely or imperfectly drained. The chief difference between this facies and the other two is that it occurs mainly in coniferous plantations. It is thus influenced by the heavy shade cast by the trees and the disturbance of fairly frequent clear felling. No stands of this facies were recorded in south-west Scotland.

The sum of the indices of similarity of the *Holcus mollis-Dryopteris dilatata* woodland compared with the other types of woodland is the greatest of the totals for woodland communities. It is thus a central type of woodland with respect to the communities so far distinguished. With the base-rich woodland it has an index of similarity of 53 per cent, and it has even higher similarity indices with the *Endymion non-scriptus* woodland, the *Dryopteris-Rubus* woodland and the *Holcus mollis-Anthoxanthum odoratum* woodland. Its lowest index of similarity is 29 per cent with the *Calluna vulgaris* woodland.

The Betula-herb *nodum* of McVean and Ratcliffe (1962) is the most nearly related community distinguished in the Highlands, but it has only one constant species, *Oxalis acetosella,* in common with the *Holcus mollis-Dryopteris dilatata* woodland. The equivalent communities described by Tansley (1953) in England are the 'complementary society' of *Pterdium-Holcus-Endymion* in oakwood and the more general dry facies of that woodland.

Woodland with *Dryopteris* and *Rubus*

This type of woodland is perhaps best considered as a seral stage to other closely related communities. The constant species are *Rubus fruticosus* agg., *Dryopteris dilatata, Chamaenerion angustifolium* and the moss, *Eurhynchium praelongum.* In constancy class IV are *Rubus idaeus* and the tree *Pinus sylvestris* which is almost invariably planted.

The range in number of species in the ground vegetation is 13 to 27 and the average is 17. The total number of field and ground species is 84, and of trees, shrubs and climbers 21 (Table 21).

The highest altitude at which this community has been recorded is 650 feet, so that it is part of the complex of lowland woodland communities. It is generally found on very gentle slopes in the agricultural plains but occasionally occurs on moderate hill slopes. The soils, in the main, are freely or imperfectly drained brown forest soils but some are podzolised. The community has also been noted on a non-calcareous gley and in one instance has been found on drained peat. The pH of the surface horizon ranges from 3·8 to 5·0, with half the samples having a pH value less than 4·3. In two thirds of the profiles the base saturation of the upper horizons is low and in the remaining one third it is medium. About one third of the profiles show high base saturation in the C horizon, but the proportion may be greater as not all profiles were sampled down to and including the C horizon. The exchangeable calcium is low in nearly all the humus/mineral A horizons, with an occasional medium value. Magnesium, on the other hand, is moderate in most of these A horizons, while about half the profiles show moderate potassium content and the other half low. The total phosphorus content is low in half the A horizons and moderate or even high in the others.

The canopy layer is composed of planted coniferous trees in half the stands described and in others it is secondary birchwood following the felling of coniferous or mixed plantations. In a few stands *Fagus sylvatica*, *Acer pseudoplatanus* or *Quercus* spp. are the dominant trees and in the remainder the woodland has been partially felled, leaving a number of broad-leaved and coniferous trees. It is evident from the sharp boundary between the A and B horizons in the soil and the straight boundary fences bordering arable land that much of this woodland is on former agricultural land. It is ungrazed but the field layer is periodically partly destroyed by clear or partial felling. After felling there is often a flush of rosebay willow-herb, *Chamaenerion angustifolium*, which may completely dominate the field layer at this stage.

With increasing tree cover, due to planting or natural regeneration, the willow-herb, where present, decreases in vigour and abundance and *Rubus* spp. and *Dryopteris* spp. become the dominants. Where the canopy is light to moderate *Rubus idaeus* is sometimes abundant, where it is moderate *R. fruticosus* agg. is abundant or even dominant and under moderate to heavy canopy *Dryopteris dilatata* is abundant and dominant. This fern is also often the most abundant species under fairly light canopy, and the sequence given in the previous statement is not a seral one but indicates the tolerance of the species to increasing tree cover. These tall field layer species have under them fairly open layers of vegetation, so that shade-tolerant tree seedlings can readily germinate and become established. Seedlings of *Acer pseudoplatanus* are the most frequent, having a presence value in the community of 56 per cent. *Lonicera periclymenum* is present as a ground species in one quarter of the stands, but it occurs as lianes only in one birchwood stand. Occasionally *Pteridium aquilinum* is the most abundant fern species. In the lower field layer *Oxalis acetosella* is the most constant and abundant species.

Under the shading effect of the tall ferns and stems of the *Rubus* spp. the ground layer cover is usually less than 30 per cent. The shade tolerant species *Eurhynchium praelongum* is the most constant and abundant, but its cover/abundance value does not exceed 5. Sometimes fairly abundant *Lophocolea bidentata* is associated with it. In two stands on imperfectly drained sites, where the lower field layer vegetation is very sparse, there is very abundant *Thuidium tamariscinum*.

The community has been divided into two facies—one based on the presence of *Viola riviniana* and the other on the presence of *Mnium hornum*. The canopy tends to be lighter in the first facies and only in it is *Lonicera periclymenum* recorded. At the same time *Dryopteris filix-mas* is more frequent and more abundant and grass species, although sparse, are more often present. In the second facies certain bryophytic species, such as *Hypnum cupressiforme*, *Plagiothecium denticulatum*, *P. undulatum* and *Lophocolea bidentata* are more constantly present. There seems little difference in the site characteristics to cause this division into two facies and it is probably due to historical factors.

One stand belonging to the second facies has been recorded at Glen Tachur on the Linhope series. The canopy is a mixed one of *Acer pseudoplatanus*, *Alnus incana*, *Pinus sylvestris* and *Picea abies*. The dominant species of the field layer is *Dryopteris dilatata*, and *Rubus fruticosus* is present only as scattered seedlings.

The *Dryopteris-Rubus* woodland has indices of similarity greater than 50 per cent with *Endymion non-scriptus* woodland and *Holcus mollis-Dryopteris dilatata* woodland. It has an index of similarity of 41 per cent with the *Holcus mollis-Anthoxanthum odoratum* woodland, a community with a grassy ground vegetation, and an even lower index, 26 per cent with *Anthoxanthum odoratum* woodland. The index of similarity with the *Deschampsia flexuosa* woodland is slightly higher, 28 per cent, and this greater similarity to a woodland on more acid podzolised soils is due to the presence of highly shade-tolerant species in both communities.

No exact counterpart to this woodland community has been recorded in the Highlands by McVean and Ratcliffe (1962) and the closest affinities are with their Betula-herb *nodum*. The equivalent communities in English vegetation are the *Rubus* or *Rubus-Pteridium* societies in oakwood and *Fagetum rubosum* (Tansley, 1953).

Woodland with *Holcus mollis* and *Anthoxanthum odoratum*

The *Holcus mollis-Anthoxanthum odoratum* woodland is sometimes influenced by grazing but grazing does not appear to be a necessary factor for its maintenance. The constant species of the community are *Holcus mollis*, *Anthoxanthum odoratum*, *Galium saxatile*, *Oxalis acetosella* and *Rhytidiadelphus squarrosus*. There are also five species in constancy class IV, namely, *Agrostis tenuis*, *Veronica chamaedrys*, *Viola riviniana*, *Pseudoscleropodium purum* and *Lophocolea bidentata*.

The range in field and ground species is from 12 to 42 and the average is 24. The total for the field and ground layers is 111 species and if trees, tall shrubs and climbers are included the number of species is 130 for the 21 stands recorded (Table 21).

This woodland is mainly a lowland one, but it has been recorded at an altitude of 1350 feet. One third of the stands occur on north-facing slopes while one half face south, so there may be a tendency for the community to be present on south slopes. The slopes are moderate or steep with an occasional stand on a flat terrace. The community is one which occurs on valley sides, towards the base of slopes, and with increasing altitude it grades into *Vaccinium myrtillus* woodland. The soils are freely drained brown forest soils or related weakly podzolised soils. The range in pH in the surface layers is from 3·8 to 5·7, rather a wide range for one community, indicating that some factor other than soil determines its occurrence. The level of bases is higher in the soils under this community than under the closely related *Holcus mollis-Dryopteris dilatata* woodland. This probably reflects the influence of flushing and soil movement resulting from the topographic position of the soils. Exchangeable calcium is moderate in half the A horizon samples and low in the others, while the exchangeable magnesium and potassium contents are moderate in all samples of this horizon. The content of total phosphorus moderate is also medium apart from an occasional high or low value.

Quercus spp. are usually dominant in the canopy layer, and planted *Q. robur* more often than *Q. petraea*, the reputedly native oak of Scotland. The oak is often slow growing and not of high timber value so that it is likely to be replaced by more economically valuable coniferous species. Secondary birchwood also sometimes has this type of woodland floor vegetation and occasionally it is seen in mature Scots pine and larch plantations. In the primitive forests of Scotland, before clearance by man, this community in all probability was an important part of the valley oakwoods.

There is a shrub layer of *Corylus avellana* in over a quarter of the stands and it is most often present in secondary birchwoods where forest management has not been strict. Climbing *Lonicera periclymenum* is recorded in one stand but it is infrequent.

Although the seedlings of ten species of broad-leaved trees are noted as occurring in the community the numbers of seedlings are few and constancy is low, except in the case of the *Fraxinus excelsior* seedlings which have a constancy value of 33 per cent. *Rubus fruticosus* agg. and *R. idaeus* are seldom found and the characteristic fern is *Pteridium aquilinum* which is present in more than half the stands.

The field layer is dominated by grasses with no one species dominant. The most abundant species are the two constants *Holcus mollis* and *Anthoxanthum odoratum*, *Agrostis tenuis*, *Deschampsia flexuosa* and, in one facies, *Festuca rubra* and *Poa pratensis*. The constant forb *Oxalis acetosella* is usually abundant but the other constant, *Galium saxatile*, seldom gives high cover values. The other forbs are rarely abundant, although *Melampyrum pratense*, *Stellaria holostea*, *Teucrium scorodonia* or *Viola riviniana* are abundant in particular stands.

Cover of the ground layer is very variable—from less than 1 per cent to over 80 per cent. The constant species *Rhytidiadelphus squarrosus* is fairly abundant in about one-third of the stands but in individual stands the less constant species *Hylocomium splendens*, *Pseudoscleropodium purum* and *Thuidium tamariscinum* are the most abundant.

Two fairly distinct facies are evident in the community, and the biotic factor of grazing is probably the operative one dividing the stands. The facies where grazing, either past or present, is assumed to be more heavy is distinguished by the presence of *Festuca rubra* and *Poa pratensis*. *Agrostis tenuis* and *Pseudoscleropodium purum*, both common grassland species, are constant, while *Oxalis acetosella* drops to constancy class IV. *Veronica chamaedrys*, another species commonly found in pasture, is in the same constancy class. The exchangeable calcium in the A horizon of the soil is generally moderate in this facies and low in the second.

The second facies is characterized by the presence of *Pteridium aquilinum* and is perhaps more truly woodland in nature, with a more frequent shrub layer of hazel (*Corylus avellana*) and with *Oxalis acetosella* as a constant species. *Dryopteris* spp. are also more often present as scattered plants and the bryophytes *Rhytidiadelphus triquetrus*, *R. loreus*, *Thuidium tamariscinum* and *Lophocolea bidentata* are more constant.

Two stands of the second facies have been recorded at Glenhead, on the Dalbeattie series, one at Wood of Cree on the Linhope series and one at Old Garroch on the Linhope series. The Glenhead sites are grazed for part of the year by cattle and sheep and *Pseudoscleropodium purum* is present in both, but the other differential species place them in this facies. There is little doubt as to the woodland character of the other two stands, although the Wood of Cree site was grazed in the past. *Holcus mollis* is not present in this latter stand, and in both stands *Rhytidiadelphus squarrosus* is replaced by *R. loreus*.

The woodland most closely resembling this community is the *Holcus mollis-Dryopteris dilatata* woodland, the index of similarity being 58 per cent. The communities may, indeed, be considered as one, but in the combined community there are then only two constant species, *Holcus mollis* and *Oxalis acetosella* and one constancy class IV species, *Galium saxatile*. The only other community with an index of similarity with *Holcus mollis-Anthoxanthum odoratum* woodland exceeding 50 per cent is the small number of stands provisionally distinguished as *Anthoxanthum odoratum* woodland. The community with the lowest index of similarity is the base-rich woodland. As the soil is often more fertile under the *Holcus mollis-Anthoxanthum odoratum* community than under the *Holcus mollis-Dryopteris dilatata* woodland or the *Dryopteris-Rubus* woodland, which are both more similar to the base-rich woodland, factors other than the base status of the soil must cause this dissimilarity between the *Holcus mollis-Anthoxanthum odoratum* community and the base-rich woodland. The two other communities with low indices of similarity with the *Holcus mollis-Anthoxanthum odoratum* community are the *Calluna vulgaris* woodland and the *Juncus acutiflorus* woodland. In both cases differences in soil conditions are sufficient to be the causal agencies in producing the dissimilarity—base status and acidity in the case of the heath woodland and soil drainage in the case of the rush woodland.

In the Highlands the Betula-herb *nodum* (McVean and Ratcliffe, 1962) is again most nearly the counterpart. It has three constants, *Anthoxanthum odoratum*, *Galium saxatile* and *Oxalis acetosella*, in common with the *Holcus mollis-Anthoxanthum odoratum* woodland and both communities are grazed by wild or domestic animals.

In Tansley's (1953) descriptions of woodland south of the Scottish border sessile oakwoods in Wales, which show evidence of grazing, are very similar to this community.

Woodland with *Anthoxanthum odoratum*

A few stands of woodland with a grassy vegetation in which *Holcus mollis* is absent and *Anthoxanthum odoratum* and *Agrostis tenuis* are constant species have been provisionally designated as *Anthoxanthum odoratum* woodland. Closely related to the *Holcus mollis-Anthoxanthum odoratum* woodland, it may be considered a facies. The lists noted are too few for any definitely constant species to be abstracted, but in the collection of data so far *Anthoxanthum odoratum, Agrostis tenuis, Luzula pilosa, Oxalis acetosella* and *Viola riviniana* are constant species.

None of the stands recorded on the area covered by Sheets 7 and 8 falls within this community.

Woodland with *Vaccinium myrtillus*

Woodland dominated by *Vaccinium myrtillus* in the ground vegetation is very common on podzolic soils. The constant species are *Vaccinium myrtillus, Deschampsia flexuosa* and *Pleurozium schreberi* and in constancy class IV are *Luzula pilosa, Hylocomium splendens* and *Hypnum cupressiforme* var. *ericetorum.*

In the 22 stands recorded there is a total of 78 field and ground layer species and 14 species in the tree and shrub layers. The average for the field and ground layers is 16 species and the range is from 11 to 23 species (Table 22).

The recorded range in altitude is from 150 feet to 1350 feet, but the actual range is from near sea-level to at least 1700 feet. The community occurs on level to steep land and has been recorded more often on north-facing slopes. The relatively small number of stands recorded prevents much reliability being placed on this as an indication of preference for aspect, yet it is likely that the warmer south-facing slopes will have a grassy type of vegetation to a higher altitude than the north-facing; that *Holcus mollis-Anthoxanthum odoratum* woodland tends to occur on south-facing slopes has already been noted. Over one half the soils are podzols—iron podzols or humus-iron podzols—and one third are podzolised brown forest soils. Two stands are on brown forest soils, but both soils are quite acid with surface pH values of 3·5 and 4·3. Drainage of the soils is generally free with an occasional imperfectly drained site. The surface pH ranges from 3·5 to 4·9 with half the values 4·0 or less. Below the F and H horizons all the soil profiles are deficient in exchangeable calcium and about half the A horizons are low in exchangeable magnesium. The values for potassium and total phosphate are slightly higher, with almost two thirds of the A horizon samples having a moderate amount of each. The carbon: nitrogen ratios in all A horizons are greater than 15, as would be expected in these podzolic profiles.

Oak is the dominant or co-dominant tree in half the stands. In some woods either *Quercus robur* or *Q. petraea* is the dominant, but more often the canopy layer is formed of a mixture of the two species with intermediates.

Birch is frequently an abundant associate with the oak, and in about a third of the stands either *Betula pubescens* or *B. pendula* is the dominant. Like the oak, the birch is often present as a mixture of the two species. *Sorbus aucuparia* occurs as scattered trees in the different types of canopy, and coniferous plantations also may have this community as the ground vegetation.

A shrub layer is usually absent and scattered juniper is recorded in only one birchwood stand. Tree seedlings are not abundant and the most constant species is *Sorbus aucuparia* with a presence value of 41 per cent. The seedlings of this species, however, are usually grazed by rabbits or deer and many never grow taller than the field layer of *Vaccinium*. Seedlings of birch and oak are present in about one fifth of the sample quadrats, but these seedlings are also grazed and oak especially may remain stunted in the field layer.

Vaccinium myrtillus is the dominant of the field layer and forms a distinctive and often very uniform woodland community. The stands recorded so far have been in the southern or more low-lying regions of Scotland and consequently the other species of *Vaccinium*, *V. vitis-idaea*, appears as an infrequent member of the community; data from northern and more upland areas, as in the related Highland vegetation (McVean and Ratcliffe, 1962), would show it as an important constituent in this type of woodland. The other dwarf shrubs are *Calluna vulgaris* in over half the stands, *Erica cinerea* in a few stands and *E. tetralix* rarely present. *Lonicera periclymenum* also occurs in one stand. *Calluna* is never abundant in the stands recorded, but its abundance will increase in the seral stages after felling when the canopy is lightened and the ground vegetation partially destroyed. Indeed *Vaccinium myrtillus* woodland and *Calluna vulgaris* woodland are alternative communities over a considerable part of their range and the presence of one or the other depends on the stage of development of the canopy layer and the availability of seed sources of *Calluna* and *Vaccinium*.

Ferns are infrequent and *Blechnum spicant* is the species most commonly found. Under heavy canopy *Dryopteris dilatata* is occasionally abundant and the cover of *Vaccinium* is diminished.

The constant grass *Deschampsia flexuosa* is abundant and may exceed *Vaccinium* in abundance, being able either to tolerate lower light intensity or to spread more rapidly when the tree canopy lightens due to partial felling or ageing of the canopy layer. *Luzula pilosa*, although present in 73 per cent of the stands, never attains a cover-abundance value higher than 3. The three herbs *Melampyrum pratense*, *Oxalis acetosella* and *Galium saxatile* are occasionally abundant in individual quadrats, but other flowering plants are sporadic in their occurrence.

Under the canopy of the *Vaccinium* there is often a dense ground layer, except where the cover of the field dominant is very complete. The deciduous nature of the dwarf shrub may be favourable to the growth of bryophytes since, after leaf-fall, the shading effect of the upright stems is relatively slight. The dominant mosses are usually the highly constant species *Pleurozium schreberi* and *Hylocomium splendens*, but less constant species such as *Rhytidiadelphus triquetrus*, *Thuidium tamariscinum* and

Dicranum majus are dominant in some stands. An unusual and striking feature is the dominance of *Ptilium crista-castrensis* in the ground layer of the stand recorded at the highest altitude.

The community has been divided into two facies—one based on the presence of *Oxalis acetosella* and a number of associated species and the other a species-poor facies where these are absent or much less constant. In the first facies the canopy is usually dominated by oak and the A horizon of the soils has higher exchangeable potassium and total phosphorus than the second facies. Apart from these differences the site characteristics appear to be the same. In the first facies the constant species include *Oxalis acetosella, Luzula pilosa* and *Hylocomium splendens* and the constancy class IV species are *Hypnum cupressiforme* var. *ericetorum, Dicranum majus, D. scoparium* and *Lophocolea bidentata.* Other species such as *Galium saxatile, Potentilla erecta* and *Thuidium tamariscinum* are more constant in this facies than in the community as a whole. The second facies, as already stated, cannot be characterized by any particular species, but is distinguished by the lack of species occurring in the first facies. The constant species now include *Hypnum cupressiforme* var. *ericetorum* and the constancy class IV species are *Calluna vulgaris* and *Hylocomium splendens.* It is this facies which is usually the alternative to the dry facies of *Calluna vulgaris* woodland.

One stand of the first facies was described at Wood of Cree on a podzol ranker in the Ettrick Association and one at Old Garroch on the Linhope series. All the facies constant species are present in the two stands except for *Oxalis acetosella* in the Wood of Cree. The soil there is imperfectly drained and *Molinia caerulea* is present.

The community which most resembles the *Vaccinium myrtillus* woodland is the *Deschampsia flexuosa* woodland, the index of similarity being 60 per cent. Like much of the *Calluna vulgaris* woodland, this community is an alternative to the *Vaccinium* one and possibly should be regarded as a facies of it. The *Calluna vulgaris* woodland also shows a high index of similarity—58 per cent—with the *Vaccinium myrtillus* woodland and the next most nearly related community is the *Holcus mollis-Anthoxanthum odoratum* woodland. This last community often has a close topographic relationship with the *Vaccinium* woodland and it is not surprising that they have a considerable floristic element in common. The woodland least resembling the present community is the base-rich woodland; the index of similarity is only 11 per cent.

Woodland in the Highlands which closely resembles the *Vaccinium myrtillus* woodland is Betuletum Oxaleto-Vaccinetum (McVean and Ratcliffe, 1962). The three constant species of the *Vaccinium* community are present as constant species in Betuletum Oxaleto-Vaccinetum. If the *Oxalis acetosella* facies only is compared with the Highland *nodum* the correspondence is even greater and *Oxalis acetosella* and *Hylocomium splendens* are constants in both. The second facies is perhaps more closely related to Pinetum Hylocomieto-Vaccinetum, for although they share only one species, *Vaccinium myrtillus,* as a constant, the species lists of the two are very similar and many of the more abundant and relatively constant species appear as such in both.

In England the heathy woods with *Vaccinium myrtillus* as field dominant in the Pennine oakwoods (Tansley, 1953) are very similar to the *Vaccinium myrtillus* woodland of lowland Scotland.

Woodland with *Deschampsia flexuosa*

A small number of stands has been separated from the closely related *Vaccinium myrtillus* woodland and designated as *Deschampsia flexuosa* woodland. *Vaccinium myrtillus* is absent and *Deschampsia flexuosa* is either dominant or one of the abundant species. With only four stands recorded (Table 22) little reliance can be placed on the naming of constant species, but in the lists collected so far they are very similar to those of the *Vaccinium* community. The high index of similarity between the two has already been mentioned.

This is the community under many dense stands of planted conifers and it is also found where *Fagus sylvatica* forms much of the canopy layer.

One stand, at Caldons beside Loch Trool, was recorded under mature Scots pine. *Deschampsia flexuosa* is the most abundant field layer species but there is an upper field layer of fairly abundant *Pteridium aquilinum*. In the ground layer *Thuidium tamariscinum* is the most abundant species.

Woodland with *Calluna vulgaris*

Woodland with *Calluna vulgaris* and the three plagiotropic mosses *Hylocomium splendens*, *Hypnum cupressiforme* var. *ericetorum* and *Pleurozium schreberi* as constant species was not recorded in this area.

The range in field and ground layer species in this woodland is from 10 to 17 and the average is 14. The total for 14 lists is 77 field and ground layer species, 7 trees and tall shrubs and 6 lichens epiphytic on fallen branches.

The community occurs throughout the forest zone on acid gleys and podzols. The pH of the surface horizons varies from 3·5 to 4·2—about half the values being less than 3·8. Exchangeable calcium is low under all the stands, and in more than half the A horizon samples exchangeable magnesium is low. In less than a third of the samples are the contents of exchangeable potassium and total phosphorus moderate in the A horizon.

Calluna vulgaris is dominant only where the canopy is light or moderate; where the canopy is dense, or has been in the recent past, the mosses are dominant.

The community has not as yet been sufficiently recorded for definite division into facies, but three provisional facies have been drawn up. The first is characterized by the constant presence of *Erica tetralix* and *Polytrichum commune* and is confined to the acid gleys and imperfectly drained podzolic soils. The second has *Goodyera repens* as a constant species and two constant species of bryophytes, *Dicranum scoparium* and *Lophocolea bidentata* additional to the community constants. This facies occurs on freely drained and imperfectly drained podzols. The third facies occurs on similar soils to the second and is characterized by the abundance of *Erica cinerea*. It closely resembles the second facies and often bears a seral relationship to it.

The *Calluna vulgaris* woodland is commonly found under the canopy of secondary birchwoods and in coniferous plantations. Less frequently it is seen under oak canopy.

The sum of its indices of similarity with the other woodlands recorded is low, so that it is an extreme as opposed to a central type of woodland. The community most nearly related to it is the *Vaccinium myrtillus* woodland which, as already stated, may replace it under certain conditions.

PASTURE COMMUNITIES

Agrostis-Festuca Basic Grassland

The basic grassland is found on soils derived from base-rich parent materials, and although the soils are leached and may have a pH value as low as 4·9 in the surface horizon, they are yet able to support grassland with a strong calcicolous or basiphilous element in it. There are twelve constant species, the grasses *Agrostis tenuis, Festuca ovina* and *Koeleria cristata,* the dwarf shrub *Thymus drucei,* the woodrush *Luzula campestris,* the forbs *Achillea millefolium, Campanula rotundifolia, Galium verum* and *Lotus corniculatus,* and the three moss species, *Hylocomium splendens, Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus.*

The average number of species is 33, ranging from 22 to 40, and the total for 8 lists is 84 (Table 23).

Stands have been recorded between 20 feet and 850 feet in altitude but the upper limit of occurrence is much higher. The slopes are mainly steep and south facing. The steepness of the slopes is probably characteristic, as the community is often associated with rock outcrops on basic lava flows. The aspect, on the other hand, has less influence on its occurrence, except perhaps at the higher altitudes. Two of the soils are brown calcareous soils and the others are all freely drained brown forest soils. Of the brown forest soils two are shallow soils on ultrabasic rock where the amount of exchangeable magnesium in the soils is at least four times as great as that of exchangeable calcium. These soils are perhaps worthy of separation as a different group, but their extent in the present area is very limited and they have been included with the soils on basic rocks. The surface horizons of all the soils are moderately or highly saturated with bases. There is a moderate amount of exchangeable calcium in the A horizons, except in the brown calcareous soils and one of the brown forest soils where it is high. The lower horizons of nearly all the soils show a high content of calcium. The exchangeable magnesium is moderate in half the soils and high or exceptionally high in the others. The contents of exchangeable potassium and total phosphate are moderate in nearly all surface samples. With one exception the carbon: nitrogen ratio is less than 15.

The constant dwarf shrub *Thymus drucei* is abundant in most stands and *Helianthemum chamaecistus,* with a presence value of 50 per cent, is abundant in the stands where it occurs. The other dwarf shrubs commonly found are *Calluna vulgaris* and *Erica cinerea* but these are usually less abundant.

In the majority of the stands *Festuca ovina* is the most abundant grass but in occasional quadrats *Agrostis tenuis* is more abundant. *Helictotrichon*

PLATE 15/Section through a deposit of moraine near Fardin showing the extremely stony nature of the material.

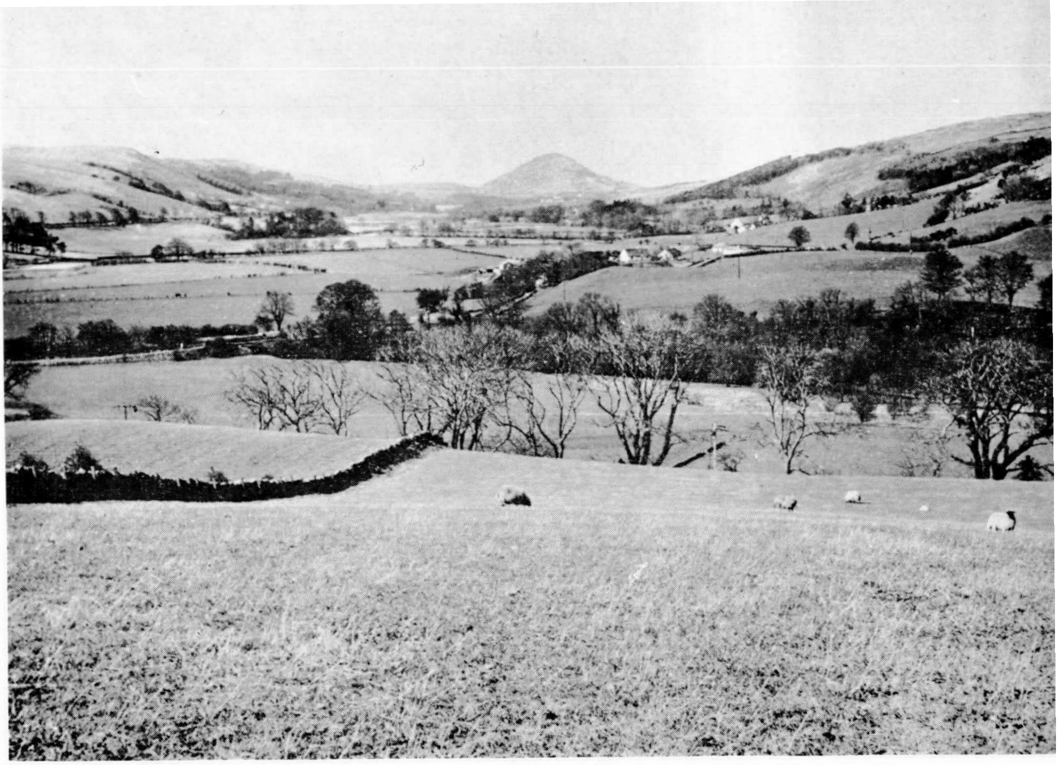


PLATE 13/The valley of the River Stinchar below Pinwherry. The areas of alluvium form the only level land and many of the slopes on the valley sides are too steep for cultivation.

PLATE 14/Dinvin Mote, site of an old fort, occurring in an area of freely drained soils of the Benan series. The Benan conglomerate rock outcrops in the foreground.

pratense is often abundant on the brown calcareous soils and on the soils with high magnesium content.

The dominant element in the vegetation is the grasses, and the other herbaceous plants are seldom abundant in more than a quarter of the stands in which they occur. This applies to the constant species *Luzula campestris, Achillea millefolium, Campanula rotundifolia, Galium verum* and *Lotus corniculatus.* The other forbs are more sporadic in their occurrence, except *Plantago lanceolata* which on the brown calcareous and on magnesium-rich soils is abundant. On the magnesium-rich soils there is abundant *Plantago maritima* and this species is also abundant on a brown calcareous soil on a sea cliff.

The cover of the ground layer is not high, unless grazing pressure is heavy, so that the cover-abundance values of individual species are never very high. The one exception is *Camptothecium lutescens* on the brown calcareous soil on the sea-cliff mentioned above. In other stands the two constant species *Hylocomium splendens* and *Rhytidiadelphus squarrosus* are most abundant.

There are too few lists for the separation of different facies. With the collection of more data it may be possible to separate a facies on the ultra-basic soils, with *Carex panicea, Plantago maritima* and *Succisa pratensis* as constant species.

Three stands have been recorded west of Colmonell, at Bougang and Garnaburn, on the Darleith series and one on Cantersty Hill on the Benan series. The two sites at Bougang are on ultra-basic rock and, as already stated, have a very high level of exchangeable magnesium. In the other two soils the content of exchangeable magnesium is almost as high as or slightly higher than that of exchangeable calcium, so that they are still relatively rich in magnesium. The constant species of the community are present in all the sample quadrats, with the exception of *Achillea millefolium, Galium verum* and *Pseudoscleropodium purum* which are present in three out of the four stands. *Calluna vulgaris* and *Erica cinerea* are present in all four stands and the constancy class IV species for the community *Potentilla erecta, Dicranum scoparium* and *Pleurozium schreberi* are also constant.

The community most akin to the basic grassland is the *Agrostis-Festuca* acid grassland with an index of similarity of 58·5 per cent. The two communities clearly merge into one another and the assignment of transitional stands to one or other community is somewhat arbitrary.

Agrostis-Festuca meadow grassland occurs on sites with almost comparable base status and pH but differing in other characteristics such as slope, drainage and past history, and it has an index of similarity of 41 per cent with the basic grassland. The other pasture communities have indices of similarity of less than 35 per cent with the basic grassland and the community with least in common is the *Molinia caerulea* grassland which has an index of similarity of 24 per cent.

In the Highland area (McVean and Ratcliffe, 1962) the species-rich Agrosto-Festucetum has considerable resemblance to the basic grassland here described. Constant species in common are *Agrostis tenuis, Festuca ovina, Thymus drucei, Hylocomium splendens* and *Rhytidiadelphus squar-*

rosus. The other constants in the basic grassland are not uncommon in the Agrosto-Festucetum although cover-abundance values are often low. The two striking differences are the absence of the basic grassland constant *Koeleria cristata* in the Highland vegetation and the absence in the basic grassland of *Ranunculus acris*, a constant in the Highland stands. Three quarters of the Highland stands are recorded from altitudes over 1000 feet whereas none of the basic grassland sites is higher than 850 feet, and this may largely account for the difference. In the account of Scottish grasslands by King and Nicholson (in Burnett, 1964) the *Festuca-Agrostis* community type 9 on relatively basic soils is comparable to the basic grassland community. Constant species common to both are *Agrostis tenuis*, *Festuca ovina*, *Thymus drucei*, *Hylocomium splendens*, *Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus*. The community they describe, however, includes *Agrostis canina*, *Carex pilulifera* and *Galium saxatile* as constant species, which would indicate a majority of stands on rather less basic soils than recorded here.

The most nearly equivalent English vegetation described by Tansley (1953) is grassland on limestone in Yorkshire and Derbyshire. The floristic lists for the limestone are much richer—due in part to the sample size—but there is a close parallel between constancy and amount of the grass species in the limestone grassland and the Scottish basic grassland.

Agrostis-Festuca Meadow Grassland

The term 'meadow' has been adopted as a name for this grassland in preference to 'neutral' used by Tansley (1953). 'Neutral' is unsatisfactory as the surface soil reaction is generally mildly acid and the community is not intermediate between the basic and acid *Agrostis-Festuca* grasslands. The constant species are *Agrostis tenuis*, *Festuca rubra*, *Anthoxanthum odoratum*, *Cynosurus cristatus*, *Holcus lanatus*, *Poa pratensis*, *Luzula campestris*, *Cerastium holosteoides*, *Trifolium repens* and the moss *Rhytidiadelphus squarrosus*. In constancy class IV are the grass *Poa trivialis* and the four forbs *Potentilla erecta*, *Veronica chamaedrys*, *Plantago lanceolata* and *Rumex acetosa*.

The average number of species per stand is 28 and the range is 18 to 50 species. In the 10 lists recorded there is a total of 98 species (Table 23).

The community occurs over the same recorded range of altitude as the basic grassland and the highest stand is at 925 feet. The slopes on which the community is found are gentle to moderate and the soil drainage is free or imperfect. It is usually absent from the coarse-textured soils and is common on moist soils of medium or fine texture. These are brown forest soils and in the samples recorded the surface pH is from 5·0 to 6·1. The base saturation is over 60 per cent in more than half the A horizons. The exchangeable calcium content is high in half the surface horizons and moderate in the other half. In some cases the high values for calcium are due to liming but in others the soils are naturally flushed. The magnesium content is moderate and the values for potassium and total phosphate are generally medium. With two exceptions, which are 16 and a little over 16, the carbon: nitrogen ratios are less than 15.

This grassland community is usually found in close proximity to arable land and has in the past often been ploughed and sown out with an artificial grass-seed mixture. In time the sown-out species die out, unless conditions are favourable to them, and a stable community of natural grasses and persisting sown-out species results. The stocking of land with this community is often heavy and application of fertilizers is more frequent than for rough hill grazing.

The dominant or most abundant species are *Agrostis tenuis* and *Festuca rubra*. *F. ovina* is infrequent in this community although it may on occasion be abundant. Of the other constant grasses *Cynosurus cristatus* is abundant in half the stands and *Poa pratensis* in the same number, while *Anthoxanthum odoratum* and *Holcus lanatus* are less abundant. *Lolium perenne* and *Poa trivialis*, which may have been present in the original grass-seed mixture, are abundant in some pastures.

The woodrush *Luzula campestris* is constant yet its cover-abundance value seldom reaches 4. The constant dicotyledonous herb *Cerastium holosteoides* is never abundant, but in contrast *Trifolium repens* is almost invariably abundant and in well grazed pastures may be the most abundant plant in the vegetation. Other forbs which often contribute considerably to the sward are *Lotus corniculatus, Plantago lanceolata, Potentilla erecta, Ranunculus acris, R. repens* and *Veronica chamaedrys*. The abundance of *Ranunculus acris* is partly due to selective grazing as it is avoided by cattle.

The ground layer, with a few exceptions, is sparse and in the exceptions it is the constant species *Rhytidiadelphus squarrosus* which has high cover-abundance values. In occasional stands *Acrocladium cuspidatum, Pseudoscleropodium purum* or *Mnium undulatum* give cover values of around 5 per cent.

Four stands have been recorded in this area; three are old pastures after ploughing and the fourth is on a steep portion of an arable field. The sites are on Saugh Hill on the Kedslie series and The Pilot on the Drumyork series and on the farms of Altimeg and Blair on the Altimeg series. The community constant species are present in three or four of the stands with the exception of *Poa pratensis* which is absent from two. These are the stands on Saugh Hill and Blair which have been under pasture for the longest period and contain such species as *Sieglingia decumbens* and *Achillea millefolium* which are absent from the other two stands. *Ranunculus acris* is present in three stands and its higher constancy in this area is not surprising, as it is a very characteristic plant in the long ley pastures of the dairying area to the north.

The highest index of similarity with this meadow grassland is that of the *Juncus acutiflorus* pasture. The value is 50·5 per cent and reflects the presence in both of species of grazed communities growing on soils which are moist and moderately fertile. The lowest index of similarity with this community, 11 per cent, is that of *Molinia caerulea* grassland and this is the lowest value between any two pasture communities. This extreme value can be attributed to the differences in soil characteristics, the grazing intensity and the past history of the communities.

The related Highland community is species-rich Agrosto-Festucetum

(McVean and Ratcliffe, 1962), but although they share four constants, *Agrostis tenuis*, *Anthoxanthum odoratum*, *Festuca rubra* and *Rhytidiadelphus squarrosus*, and have many other species in common, the two communities are not strictly comparable. The *Agrostis-Festuca* community type 10 on mesotrophic soils with impeded drainage (Burnett, 1964) is more comparable to the meadow grassland. The communities have six constant species in common and the main difference lies in the greater abundance and constancy of *Deschampsia caespitosa*, *Juncus* spp. and *Carex* spp. in the *Agrostis-Festuca* type 10 community. This is clearly related to soil drainage.

The grassland as described here is practically synonymous with the neutral grassland described by Tansley (1953). There is, however, some shift in emphasis of the dominant grasses: in the Scottish community *Agrostis tenuis* and *Festuca rubra* are usually the dominant species. The stands so far described for Scotland are on rather more acid soils than those on which Tansley bases his description and the grazing intensity is perhaps less.

Agrostis-Festuca Acid Grassland

This community forms a considerable part of the rough grazing on the Scottish hills and from its grazing value to sheep (Hunter, 1962) is a semi-natural community of economic importance. The eight constant species are *Agrostis tenuis*, *Anthoxanthum odoratum*, *Festuca ovina*, *Luzula campestris*, *Galium saxatile*, *Potentilla erecta*, *Rhytidiadelphus squarrosus* and *Hylocomium splendens*. Constancy class IV species are *Veronica officinalis* and the two mosses *Pleurozium schreberi* and *Pseudoscleropodium purum*.

Twenty nine lists have been recorded of this community with a total of 99 species. The average number of species per stand is 24 and the range is from 16 to 33 (Table 24).

The range in altitude in the recorded stands is from 200 feet to 1050 feet and the actual range extends to at least 3000 feet (McVean and Ratcliffe, 1962). More than half the sites are on slopes too steep for arable agriculture and those on less steep slopes are near the upper limit of cultivation or on shallow rocky soils. The soils are largely brown forest soils of low base status, but there is often some degree of podzolisation. Drainage is free in three-quarters of the stands examined and imperfect in the others. The range in pH is from 3·8 to 5·3, with an abnormally high value of 6·3 where there was evidence of the recent application of lime. The modal pH value in the A horizon is between 4·7 and 4·8 and the base saturation is almost invariably low, except where there has been recent liming. About one third of the soils have less than a moderate amount of exchangeable calcium and total phosphorus, while the exchangeable magnesium and potassium are moderate in the A horizon. Half the soils have a carbon:nitrogen ratio greater than 15.

Bracken, *Pteridium aquilinum*, dominates large areas of this grassland and often greatly reduces the grazing value of the pasture. With ageing of the bracken community there is a decrease in abundance and vigour of the fern (Watt, 1947). This does not, however, always hold good on steep soils subject to a degree of creep or flushing, or else the succession there from establishment of the bracken to the degenerate phase covers a much longer span of time than that reported by Watt.

Gorse, *Ulex europaeus*, also infests much of the acid grassland. The young shoots are grazed by cattle, sheep and rabbits, but unless the grazing pressure is very heavy this cropping achieves little in diminishing the vigour and growth of the gorse. The gorse bushes cast such dense shade that few if any plants grow under them and round their base the taller grass species such as *Festuca rubra* are favoured.

The dominant or co-dominant species in the open pasture are usually the two constants *Agrostis tenuis* and *Festuca ovina*, but there are stands in which *Anthoxanthum odoratum*, *Deschampsia flexuosa* or *Festuca rubra* are abundant and one of these may be the dominant species. In many instances, however, no one species of grass stands out as the dominant and several species are abundant.

The field woodrush, *Luzula campestris*, is a constant species in this grassland, as it is in the basic and meadow grasslands, and it is often abundant, which it seldom is in the others. The two sedges *Carex caryophyllea* and *C. pilulifera* are frequently present but do not usually occur in the same quadrat.

The two constant forbs, *Potentilla erecta* and *Galium saxatile*, are a very characteristic feature of this grassland community, as both are often abundant, and the yellow flowers of the tormentil and the white of the bedstraw are prominent in the green foliage of the grasses. Other dicotyledonous herbs which are common and sometimes abundant are *Achillea millefolium*, *Campanula rotundifolia*, *Lotus corniculatus*, *Trifolium repens*, *Veronica chamaedrys*, *V. offiicinalis* and *Viola riviniana*.

The ground layer gives heavier cover in this community than in the grassland on more fertile soils. One or more of the constancy class V and class IV species are abundant and together with the grasses of the field layer they form a tightly knit turf.

In this group of vegetation stands there is more a 'network of variation' (Gimingham, 1961) than clear-cut gradients or facies. Two facies, however, have been tentatively separated, one with constant *Deschampsia flexuosa* and *Vaccinium myrtillus* as a constancy class IV species, and the other with constant *Trifolium repens* and *Thymus drucei* as a constancy class IV species. There is considerable overlap of species occurrence within the two facies, but species preferential to the first facies are the two already named, *Carex pilulifera*, which is rather weakly preferential, and *Pleurozium schreberi*. The soils under this facies are slightly more acid and base deficient than those under the second. The difference is not great, and possibly some other factor such as grazing is causative.

Species preferential to the second facies are *Carex caryophyllea*, *Achillea millefolium*, *Campanula rotundifolia*, *Lotus corniculatus*, *Trifolium repens* and *Viola riviniana*. In addition *Thymus drucei* is exclusive to this facies and *Plantago lanceolata* almost exclusive to it, so that they can be considered as species differentiating the two facies.

Five stands of the second facies have been recorded from Saugh Hill in the north-west of the area to Knockreoch in the east, and all are at altitudes between 500 feet and 1000 feet. The soils under these stands are the Linhope, Kedslie, Knockskae, Tranew and Dalbeattie series. All the community constants are present in the five stands except *Hylocomium splendens* in one stand. The main differences in the vegetation recorded in this area from the community as a whole are the greater constancy of *Sieglingia decumbens* and *Carex caryophyllea* and the lower constancy of *Festuca rubra* and *Lotus corniculatus.*

The sum of the indices of similarity between this community and the other pasture communities is the highest in the table for pasture communities, indicating that this a central type in relation to the others sampled and described. The highest indices of similarity are with the basic grassland and *Nardus* grassland where the values are greater than 55 per cent. The meadow grassland and *Juncus acutiflorus* pasture have indices of similarity of 45 per cent and 44 per cent respectively and *Molinia* grassland is less similar with a value of 35 per cent. The community least resembling the *Agrostis-Festuca* acid grassland is the *Carex* wet pasture where the index of similarity is 30 per cent.

The species-poor Agrosto-Festucetum of McVean and Ratcliffe (1962) is essentially the same community as the *Agrostis-Festuca* acid grassland. Seven constants are common to both communities and the average number of species per stand and the total number of species are practically the same. Noteworthy differences are the absence of *Poa pratensis* and *Carex caryophyllea* in the Highland vegetation and, of course, species such as *Carex bigelowii* have not been noted outwith the Highlands since no stands have been recorded at altitudes exceeding 1050 feet.

The *Festuca-Agrostis* community type 5 described by King and Nicholson (in Burnett, 1964) is also the same type of vegetation. The community they define is perhaps, on the average, on slightly less fertile soils as *Thymus drucei* is absent and *Trifolium repens* of very low constancy.

The bent-fescue grassland described by Tansley (1953) corresponds closely to the *Agrostis-Festuca* acid grassland of this account, but the community delineated by him covers a wider range of vegetation.

Nardus Grassland

The *Nardus* grassland is often found in the altitudinal zone above the *Agrostis-Festuca* acid grassland. The constant species include five grasses, *Nardus stricta*, *Agrostis canina* ssp. *montana*, *Anthoxanthum odoratum*, *Deschampsia flexuosa* and *Festuca ovina*, two forbs, *Galium saxatile* and *Potentilla erecta*, and two mosses, *Pleurozium schreberi* and *Rhytidiadelphus squarrosus*.

The species density or average number per sample area is 21, which is somewhat less than in the *Agrostis-Festuca* acid grassland, but the total number of species in 33 lists is 103 (Table 25) which is practically the same as the *Agrostis-Festuca* total.

The range in altitude of the recorded stands is from 460 feet to 1750 feet. Occasionally stands are found below the lower limit and fairly extensive areas of the community are to be found above the recorded upper limit. The community has been recorded more often from east-facing than from west-facing slopes, while south-facing slopes are recorded more often than north-facing. This apparent aspect preference may be due to the land form where the samples have been collected, yet an analysis of the data of McVean and Ratcliffe (1962) for the related Nardetum subalpinum shows that the majority of the slopes on which it occurs are south and south-east facing. Three-quarters of the *Nardus* grassland stands are on flat or gently to moderately sloping sites and the remainder on steep slopes up to as much as 30°.

The range in major soil groups is very wide under this community, but all the soils are acid and base deficient in the surface horizons. At one extreme there is a freely drained brown forest soil and at the other hill peat. The range in pH of the surface soil is from 3·7 to 5·6 and the modal value is 4·2. The exchangeable calcium is low in nearly all the A horizons but the magnesium content tends to be moderate. Most of the upper horizons have an adequate amount of exchangeable potassium and in practically all the soils the total phosphorus content is moderate. The carbon: nitrogen ratio of one third of the surface horizon samples is less than 15, which can be compared with the *Agrostis-Festuca* acid grassland where 50 per cent of the samples had a value less than 15.

Although *Calluna vulgaris* is scattered throughout the *Nardus* grassland and *Erica tetralix* and *E. cinerea* occur occasionally, it is *Vaccinium myrtillus* that is the characteristic and often abundant dwarf shrub. *Ulex europaeus* and *Pteridium aquilinum* are far less likely to invade this grassland than the *Agrostis-Festuca* pastures.

Nardus stricta is dominant or an abundant species in the community and the tussocky habit of the plant imparts a distinctive appearance to the turf. This is accentuated in the cold months of the year by the greyish white colour of the dead leaves. *Festuca ovina* and *Deschampsia flexuosa* are often as abundant as *Nardus*, but the other two constant grasses, *Agrostis canina* ssp. *montana* and *Anthoxanthum odoratum* are rarely as abundant. There is abundant *Agrostis tenuis* in certain stands and in one of the facies *Sieglingia decumbens* is frequent. Apart from these and the constant species other grasses are rarely encountered in the vegetation, except where it is transitional to *Molinia* grassland.

Carex pilulifera is the most common sedge in the community and *Luzula multiflora* occurs as a constancy class IV species. The other wood-rush, *L. campestris*, a constant in the three grassland communities already described, is now present in about 50 per cent of the stands, while *Juncus squarrosus*, a rare species in the other grasslands, is now a constancy class IV species.

The two constant forbs, *Galium saxatile* and *Potentilla erecta* are even more conspicuous in the *Nardus* grassland than in the acid *Agrostis-Festuca* community, as very few other dicotyledonous plants are present.

Cover of the ground layer varies from 2 per cent to 75 per cent and *Pleurozium schreberi* is abundant in almost two thirds of the stands and the other constant *Rhytidiadelphus squarrosus* in one third. Other abundant species are *Hylocomium splendens* and *Hypnum cupressiforme* var. *ericetorum*, and in certain stands there is very abundant *Polytrichum* *commune*. This tall moss rivals the vegetative parts of the grasses in stature and where it occurs in abundance the vegetation has a distinctive dark green colour.

Two facies have been distinguished in the community, leaving a residue of 13 stands which are not characterized by any particular species or group of species. The differential species on which the first facies is based is *Sieglingia decumbens*. The stands are usually below 1000 feet and the soils are brown forest soils, iron podzols, peaty podzols and one non-calcareous gley. The modal pH is about 4·7 which is higher than that for the whole community, and the content of exchangeable magnesium and potassium is usually moderate while it is more often low in the second facies. Total phosphorus also tends to be higher in the stands of this facies than in the second and the carbon: nitrogen ratio exceeds 15 in only 30 per cent of the stands. In the rest of the community it exceeds that figure in over 80 per cent of the stands.

The constant species in the facies includes all the constants of the community except *Deschampsia flexuosa* which is in the next lower constancy class. As well as *Sieglingia decumbens* additional constants are *Vaccinium myrtillus, Carex pilulifera, Hylocomium splendens* and *Hypnum cupressiforme* var. *ericetorum*. The list of constancy class IV species differs from that of the whole community in that there are now 8 species which include *Agrostis tenuis* and *Luzula campestris*, both constant species in the *Agrostis-Festuca* grassland. The stands are also richer in species with an average of 26 species and a total of 75 species for ten lists. The same number of lists in the second facies has an average of 20 and a total of 51 species.

Seven stands of this first facies have been described from Benawhirter in the south-west of the area to Dunool in the north-east. The soil series include the Glenalmond, Dod, Knockinculloch and Linhope. These stands are the major basis for separating out the first facies, so their species content and site characteristics must obviously be those of the facies as a whole.

The second facies is characterized by the presence of *Carex nigra*. The sites are generally above 1000 feet and the soils are peaty podzols, peaty gleys, imperfectly drained podzols and imperfectly drained soils intermediate between podzols and brown forest soils. There is also one stand on hill peat. In general the soils are less fertile than those of the first facies and, indeed, than those which have not been placed in either facies. In addition to *Carex nigra* the constant species now include *Juncus squarrosus* and *Luzula multiflora*, but *Vaccinium myrtillus*, also a constancy class IV species in the community as a whole, is now of less constant occurrence. There are two additional constancy class IV bryophytes, *Plagiothecium undulatum* and *Lophocolea bidentata*.

One stand of this facies has been described at Saugh Hill on the Dod series and one at Craig of Dalwine on an intergrade between the Turgeny and Knockskae series. They differ from the facies as a whole in that *Vaccinium myrtillus* is frequent or abundant and *Luzula multiflora* is sparsely present in one of the stands.

There remains a group of stands, with neither *Sieglingia decumbens* nor *Carex nigra*, which occur mainly on freely drained iron podzol soils. These soils are similar to those under the first facies as regards content of exchangeable bases, but as the soils are podzols the carbon:nitrogen ratios of the surface layers are high. The stands are poor in species with an average of 18 per sample area and a total of 53 for 13 stands. They are mainly at altitudes over 1000 feet and *Nardus* is often very abundant in them. This and the poverty of species are the only noteworthy vegetational features distinguishing it from the first two facies.

One stand at Carlin's Cairn, on an iron podzol of the Minchmoor series, and one at Benawhirter, on a peaty podzol ranker, have been placed in this group. The presence of frequent *Carex panicea* in both stands and of *Rhytidiadelphus loreus* in both distinguish them from the remainder of the group. In other respects, apart from being somewhat richer in species, they are very similar to the others.

The community with the highest index of similarity, 60 per cent, with *Nardus* grassland is *Molinia* grassland, and with the next highest index, 56 per cent, *Agrostis-Festuca* acid grassland. Both these related communities are often found in close juxtaposition to the *Nardus* community, and vegetation transitional between them is frequently found. Meadow grassland is least like the *Nardus* grassland, the index of similarity between them being 22 per cent. The differences in fertility of soil and in biotic pressure must be the main factors causing the dissimilarity in floristic composition and constancy of species in these two communities.

The species-poor facies of Nardetum sub-alpinum (McVean and Ratcliffe, 1962) is the comparable community recorded in the Highlands. Each community has nine constant species; six are common to both, while the others constant in one community are also of fairly high constancy in the other. The constants common to both are *Nardus stricta, Anthoxanthum odoratum, Festuca ovina, Galium saxatile, Potentilla erecta, Rhytidiadelphus squarrosus.*

The *Nardus* grassland is equivalent to the *Nardus-Festuca-Deschampsia* community type 2 and the *Festuca-Deschampsia-(Nardus)* type 3 described in Burnett (1964). The species in the higher constancy classes are more or less the same and the range in soils is similar.

Comparable *Nardus* grassland is described for the Pennines (Tansley, 1953), but *Deschampsia flexuosa* seems to play a more important role in the community composition than *Festuca ovina* which tends to be the more abundant in the Scottish vegetation recorded so far.

Molinia Grassland

In the high rainfall areas of Scotland a type of grassland is common which has *Molinia caerulea* as an abundant or as the dominant species. The other constant species are *Vaccinium myrtillus, Deschampsia flexuosa, Festuca ovina, Potentilla erecta, Hypnum cupressiforme* var. *ericetorum* and *Plagiothecium undulatum.*

The average number of species is 20, ranging from 11 to 28 per sample area, and the total for 18 lists is 68 species (Table 26).

Altitude ranges from 500 feet to 1300 feet, the same altitudinal zone as for *Nardus* grassland. Almost all the stands are on gentle to moderate slopes with only two stands on slopes over 12°. There is a marked preponderance of south-facing slopes over north-facing in the stands recorded, and this bias is unlikely to be due to the element of chance in recording. North-facing slopes, with a more active build-up of peat than south-facing, are likely to carry blanket peat vegetation, and while this community does occur on blanket peat, it is more prevalent on peaty gley and peaty podzol soils. The range in surface soil pH is from 3·5 to 4·4 and the modal pH is 3·9. The base saturation of the upper horizons is low, while in the lower horizons of the gley soils it can be high. Exchangeable calcium is low and exchangeable magnesium in the organic A horizon is moderate. In this horizon values for total phosphorus are usually medium with an occasional rather low value, and the carbon:nitrogen ratio is almost invariably greater than 15.

As in the related heather moor communities the vegetation is often periodically burned to get rid of the mat of dead leaves and shoots. Smith (1918) advocates the burning of *Molinia* once every 7 years. This, together with grazing, probably influences the maintenance of a *Molinia*-dominated community.

The dwarf shrub *Vaccinium myrtillus*, with a presence value of over 80 per cent, is abundant in over half the stands. It is grazed and does not grow to the height of *Molinia. Molinia caerulea* itself is usually tussocky in habit, but it is more evenly mingled with the other species in some stands and the sward is more uniform. Of the subordinate but constant species *Deschampsia flexuosa* is the most abundant while the other narrow-leaved grass, *Festuca ovina*, is also often abundant. Dicotyledonous herbs are very rare, except for the constant *Potentilla erecta* and for *Galium saxatile* which is present in about half the stands. The tormentil, although highly constant, is seldom as abundant as in the other acid grasslands and the heath bedstraw is very inconspicuous.

The three constancy class IV species *Juncus squarrosus, Luzula multiflora* and *Trichophorum caespitosum* are a characteristic element in the community and the heath rush and deer-grass are occasionally abundant. A few stands which are flushed have abundant *Juncus acutiflorus.*

Cover in the ground layer varies from low to high and no one species gives consistently high cover values. Only the constant species *Hypnum cupressiforme* var. *ericetorum* and *Plagiothecium undulatum* are occasionally abundant, yet these mat species (Gimingham and Birse, 1957) are perhaps complementary to the dense tussocky growth of *Molinia* which provides a certain amount of space at ground level while at the same time casting heavy shade when the foliage is fully expanded. Other species which are abundant in some of the quadrats are *Pleurozium schreberi, Polytrichum commune* and *Sphagnum capillaceum.*

Two facies have been distinguished, based on the presence of one or other of two bryophytic species. Soil conditions are to some degree the differentiating factors, as one facies occurs typically on peaty gley soils and the other on peaty podzol soils. The second facies, however, is characterized by the presence of species of orthotropic mosses which are prevalent in the early stages of the burn sub-sere on heather moors, and it may be a seral stage or a stable community produced by more frequent fires.

Polytrichum commune is the diagnostic species of the first facies and along with *Hylocomium splendens, Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus* differentiates the facies from the second. The plagiotropic moss *Pleurozium schreberi* is also more constant and abundant, as is the mat-forming liverwort *Lophocolea bidentata*. This facies is slightly richer in flowering plants with *Juncus squarrosus, Luzula multiflora* and *Galium saxatile* as constant species and *Anthoxanthum odoratum* and *Nardus stricta* in constancy class IV.

The second facies is characterized by constant *Campylopus flexuosus* and a greater prevalence of *Dicranum scoparium* and *Pohlia nutans*. Among the flowering plants *Vaccinium myrtillus* and *Festuca ovina* are no longer constant, but *Trichophorum caespitosum* is now a constant species.

Molinia grassland is a common type of pasture community in this area, often associated with the blanket peat vegetation. Ten stands have been described, three of which can be placed in the first facies while the remaining seven form the basis for the second facies. The first three stands have all been recorded in the north of the area, from The Pilot, Dobbingstone and Farroch, although the facies may be more widespread. They fit extremely well into the facies as regards constant species, and differ only in the constant and abundant presence of *Sphagnum capillaceum* and the presence of *Eriophorum angustifolium* and *E. vaginatum*. The second facies is the more general one for the area and has been recorded from Dochroyle near Barrhill in the south-west to Garryhorn in the north-east. The soil series on which it occurs include the Dod, Dochroyle, Baidland and Spallander, and it occurs on blanket peat also.

The *Molinia* grassland is most nearly related to the *Nardus* grassland, the index of similarity being 60 per cent. With the *Agrostis-Festuca* acid grassland it has an index of similarity of only 35 per cent, and with the other pasture communities the indices are even lower. The community has, however, a closer relationship with the wet heather moor, with an index of similarity of 57 per cent. It is, indeed, the milder and moister climate counterpart of wet heather moor and in a drier climate may replace that community under conditions of moderate flushing and heavy grazing.

Molinia grassland has not been studied in detail by McVean and Ratcliffe (1962) in the Highlands as they considered it adequately covered by the closely related *noda*, Molinieto-Callunetum, *Molinia-Myrica* nodum, etc.

King and Nicholson (in Burnett, 1964) describe mainly for more eastern areas of the Southern Uplands, grassland dominated by *Molinia* on peaty podzol and peaty gley soils. It is essentially the same community as here described, especially when the *Polytrichum commune* facies is equated with their community. The high constancy of *Rhytidiadelphus squarrosus* and the absence of *Sphagnum* spp. in their sample areas are the main points of difference from the *Polytrichum* facies.

Similar *Molinia* grassland in England has been described for the Pennines (Tansley, 1953).

Juncus acutiflorus Pasture

A community on wet gleyed soils in which *Juncus acutiflorus* is dominant or abundant has been designated as *Juncus acutiflorus* pasture. The ten constant species include four grasses, *Agrostis canina, Festuca rubra, Holcus lanatus* and *Anthoxanthum odoratum,* which are an important element in the vegetation. The other constants are *Luzula multiflora,* the forbs, *Cirsium palustre, Potentilla erecta* and *Ranunculus acris,* and the almost ubiquitous moss of pastures, *Rhytidiadelphus squarrosus.*

The species density is 29, ranging from 17 to 40, and the total number of species in 13 sample areas is 97 (Table 27).

This is a community of the forest zone and the highest stand recorded is at 1100 feet. The slopes on which the community occurs are gentle or moderate and, although the samples are rather few for drawing definite conclusions, it tends to occur on north-facing rather than south-facing slopes. The soils, with one exception—a peaty gley—are non-calcareous gleys and are mainly poorly drained. The range in surface soil pH is from 4·3, the rather low value in the peaty gley soil, to 5·8, with a modal value around 5·2. There is a moderate or high content of exchangeable calcium in the A horizon, and magnesium and potassium are usually moderate in amount. Total phosphorus is moderate or high and the base saturation is either high or low with few intermediate values. There is generally a satisfactory level of nitrification in the soils, as the carbon: nitrogen ratio is seldom higher than 15.

The aerial portion of *Juncus acutiflorus* does not form high cover because of its habit of almost vertical growth, but the subterranean parts of the plant, the rhizome and cord roots, occupy a considerable volume of soil. It can thus be considered the community dominant even where a species of grass has a higher cover-abundance value. As already stated, the grasses are an important element and the constant species are usually the most abundant. Individual stands may have abundant *Festuca ovina, Molinia caerulea, Agrostis tenuis* or *Poa trivialis,* and the sedges *Carex panicea* and *C. pulicaris* are sometimes abundant. *Luzula multiflora,* although constant, never has a high cover-abundance value.

Cirsium palustre is a tall, conspicuous member of the community, but in relation to the standard sample area of 4 sq. m. its occurrence can only be described as sparse. Dicotyledonous herbs of smaller stature such as *Galium saxatile, Potentilla erecta, Ranunculus acris* and *Trifolium repens* often give much higher cover values.

Cover of the ground layer is low to medium with an occasional high value. The constant species, *Rhytidiadelphus squarrosus,* is abundant in most quadrats, but certain species of low constancy, such as *Acrocladium cuspidatum* and *Climacium dendroides,* give high cover values where they occur. Other species, such as *Hylocomium splendens, Mnium undulatum* and *Thuidium tamariscinum,* which are of intermediate constancy, are sometimes present in abundance.

The two facies distinguished are based on the grasses *Poa trivialis* and *Molinia caerulea.* The first facies, with constant *Poa trivialis,* has sixteen constant species, namely the community constants already listed, the grasses *Deschampsia caespitosa* and *Poa pratensis* and *Mnium undulatum.*

The exchangeable calcium in the A horizon of the soils is high or moderate and nearly all the soils are well saturated with bases. The base saturation in the A horizon of the second facies is low and this accounts for the base saturation for the whole community having two peak occurrences at high and low values.

The second facies with constant *Molinia caerulea* has the bryophytes *Pseudoscleropodium purum* and *Lophocolea bidentata* in over 80 per cent of the samples. The two constancy class IV species *Carex panicea* and *Hylocomium splendens* are also characteristic of this facies.

One stand of the first facies was recorded at Sandloch near Glen App on the Littleshalloch series and it is typical of the facies. Four stands of the second facies have been described and perhaps this is the facies more characteristic of an area of relatively high rainfall. The sites extend from Saugh Hill in the north-west to Carsphairn in the north-east. They occur on the Blair, Littleshalloch and Ettrick series. Differences in these stands from the facies as a whole are the highly constant presence of *Trifolium repens* and of *Polytrichum commune* which are absent from the other stands.

The community with the highest index of similarity with the *Juncus* pasture is the *Agrostis-Festuca* meadow grassland. The value is 51 per cent and the species which largely contribute to this figure are the grasses *Agrostis tenuis*, *Anthoxanthum odoratum*, *Festuca rubra*, *Holcus lanatus* and *Poa pratensis*, the white clover, *Trifolium repens*, and the moss *Rhytidiadelphus squarrosus*. The other grassland communities have indices of similarity between 35 per cent and 44 per cent with the *Juncus* community, except for *Molinia* grassland which has an index value of 25 per cent. Although both have *Molinia caerulea* as a member, these two communities as sampled and described here are quite distinct.

The most nearly related community in the Highlands to the *Juncus acutiflorus* pasture is the *Juncus acutiflorus-Acrocladium cuspidatum* nodum (McVean and Ratcliffe, 1962). Certain lists recorded outwith the Highlands fit the *nodum*, but from present data it would seem that the *nodum* is part of the *Juncus acutiflorus* community described here rather than the reverse.

The *Juncus acutiflorus* bogs described by Ratcliffe (1959) for north Wales are related to this community and the two communities have certain fairly constant species in common. These are *Agrostis canina*, *Anthoxanthum odoratum*, *Cirsium palustre*, *Festuca rubra*, *Potentilla erecta*, *Ranunculus acris* and *Rhytidiadelphus squarrosus*. They differ, however, in that the Welsh stands clearly occur on peaty soils or flushed peat, and have *Eriophorum angustifolium* and *Carex nigra* as constant species and species of *Sphagnum* often abundant.

Carex Wet Pasture

A number of stands characterized by abundant *Carex* spp. have been named *Carex* wet pasture. The community thus assembled is heterogeneous in nature, if the test of homogeneity is used as a criterion, as there are only 5 constancy class V species as opposed to 13 constancy class IV species. The constant species are *Carex panicea*, *C. pulicaris*, *Molinia caerulea*, *Potentilla erecta* and *Succisa pratensis*.

There are a total of 134 field and ground layer species in 10 lists and the average is 34, ranging from 26 to 43 (Table 28). It is thus floristically the richest of the pasture communities.

It has been recorded from only a very narrow range in altitude, between 50 feet and 500 feet but from McVean and Ratcliffe's (1962) data on the related vegetation in the Highlands the upper limit can extend to a much greater height. The slopes on which it occurs are gentle to moderate, but again in rugged country at higher altitudes this would not probably hold true. The soils are mainly gleys with a highly organic A horizon. Some of the soils are intergrades between a peaty gley with a base-rich type of peaty horizon and other forms of gley. Their precise classification presents some difficulty as the exchange complex of some is dominated by magnesium instead of calcium ions; these soils may thus be justifiably termed 'magnesian gleys' on a par with calcareous gleys. One stand is on a soil which is imperfectly drained and is classified as a brown forest soil. It also has magnesium as the dominant ion in the exchange complex and could be called a 'gleyed brown magnesian soil'. The range in pH in the surface layer is from 5·2 to 7·3, and all the soils are well saturated with bases. In the magnesian type of gley exchangeable calcium is moderate in the A horizon and magnesium content is high, whereas in the normal type of eutrophic gley exchangeable calcium is high and magnesium moderate. The contents of exchangeable potassium and total phosphorus tend to be low in both groups.

As already stated this is a heterogeneous assortment of stands and reflects the early stage of sampling this kind of vegetation as much as its nature. The dwarf shrubs present on the gleys are *Calluna vulgaris* and *Erica tetralix* with *E. tetralix* the more abundant. On the imperfectly drained soil *E. cinerea* and *Thymus drucei* are present as the only dwarf shrubs and *Salix repens* occurs in two of the gley stands. Grass species are often as abundant as the sedges which define the community and species occurring in quantity are *Festuca ovina*, *F. rubra*, *Molinia caerulea* and, more rarely, *Agrostis stolonifera*, *Anthoxanthum odoratum* and *Briza media*. The constant sedges *Carex panicea* and *C. pulicaris* are often the abundant ones, but some stands have abundant *C. flacca*, *C. dioica* or *C. hostiana*. There is a long list of forbs present in the community and the most abundant are the two constants *Potentilla erecta* and *Succisa pratensis*.

Two facies have been set up and one stand separated as a possible third. The ground layer cover is rather low in one of the facies and high in the other two. The species giving fairly consistently high cover figures when present are *Acrocladium cuspidatum*, *Campylium stellatum* and *Ctenidium molluscum*. In occasional stands *Climacium dendroides*, *Ditrichum flexicaule* and *Drepanocladus revolvens* var. *intermedius* are very abundant.

The first facies, which is defined by the constant presence of *Erica tetralix* and *Juncus acutiflorus*, comprises the vegetation on the soils rich in magnesium, but only 4 stands have been described and all these occur within an area of two to three square miles. The imbalance of nutrients due to the high ratio of magnesium to calcium is considered toxic to certain plants (Kruckeberg, 1951), and the effect of chrome and nickel toxicity on cultivated plants on serpentine soils is well known (Hunter and Vergano, 1952). The influence of these toxic agents on the non-cultivated plants in Britain has not been studied in detail other than in Spence's work in Shetland (1957). In spite of the possibly harmful effects of minor elements in high concentration, the flora on the magnesium-rich soils near Colmonell is rich in species and includes *Helictotrichon pratense* which is characteristic of the basic grassland.

Grasses and sedges are abundant, as in the whole community, and in addition *Juncus acutiflorus* is usually present in quantity. Twenty-five forbs are listed in the four stands but these, apart from *Potentilla erecta* and *Succisa pratensis*, are neither abundant nor very constant. The cover of the ground layer is light to moderate but it is rich in species.

The second facies, on eutrophic soils or soils rich in calcium, has *Juncus articulatus* as a constant species differentiating it from the first. The soils have a normal ratio of calcium to magnesium and are highly saturated with bases, yet the total phosphorus is sometimes low so that the pasture may not always be economically of high value. *Festuca rubra* is constant, as distinct from *F. ovina* in the first facies, and the sedges are clearly the dominant element in this facies. Cover of the ground layer is high and *Campylium stellatum* and *Ctenidium molluscum* are usually the abundant species.

One stand with abundant *Salix repens* has been separated from the others as a possible third facies. It differs from them in that the surface soil pH is as low as 5·2 and *Galium saxatile*, *Carex nigra* and *Agrostis canina* are abundant species.

The four stands on the magnesium-rich soils near Colmonell have already been discussed. The soils under them are the Dunlop, Amlaird and Myres series. One other stand, on Cantersty Hill on the Lanes series, is described. It belongs to the second facies and is on a flushed gley soil. *Briza media* and *Drepanocladus revolvens* var. *intermedius* are abundant in it and absent from the other stands recorded.

Most of the indices of similarity between the *Carex* wet pasture and the other pasture communities are less than 30 per cent. The highest value, 37 per cent, is with the *Juncus acutiflorus* pasture. The reason for this affinity can be readily seen in the drainage characteristics and mineral nutrient levels of the soils on which the two communities occur.

The comparable community in McVean and Ratcliffe's (1962) survey is the *Carex panicea-Campylium stellatum* nodum, but they too admit that their unit is a variable one. With constant *Selaginella selaginoides*, *Juncus articulatus* and *Pinguicula vulgaris*, as well as *Carex panicea* and *Campylium stellatum* which define the *nodum*, the second facies of the *Carex* wet pasture corresponds most closely to the *nodum* where these five species are the constants.

MOORLAND COMMUNITIES

Dry *Calluna* Moor

Communities dominated by dwarf shrubs are ubiquitous and often extensive in Scotland and for this reason alone are perhaps difficult to separate into distinct types. McVean and Ratcliffe (1962) treat these communities largely from the standpoint of altitudinal zonation, while Gimingham (in Burnett, 1964) deals with the forest zone heaths from the viewpoint of geographical distribution, based on the geographical distribution patterns of constituent species and the existence of similar communities in Europe and other neighbouring land masses. In this account the emphasis tends to be on relationship with the different types of soil.

Dry heath vegetation dominated by *Calluna vulgaris* has been named dry *Calluna* moor and the constant species, in addition to the dominant, are *Vaccinium myrtillus*, *Deschampsia flexuosa*, *Dicranum scoparium* and *Hypnum cupressiforme* var. *ericetorum*. Constancy class IV species are *Potentilla erecta*, *Pleurozium schreberi* and *Pohlia nutans*.

There is a wide range in species content from 8 to 36, and the average is 17. Forty-six stands have been described with a total of 114 species (Table 29).

The lowest altitude recorded is 400 feet, but the community can occur at lower levels than this, whereas the highest altitude noted, 1840 feet, is probably near its upper limit. There is no preference for aspect (except possibly on individual hills), and slopes are from 0° to over 30°. The soils range from freely drained acid brown forest soils to imperfectly drained peaty podzols, with iron podzols by far the most common. The drainage is imperfect in one fifth of the samples and free or almost free in the others. There is one abnormal soil classified as a peaty gley. It occurs on a slope of 21°, and this probably outweighs the periodically waterlogged conditions in the lower horizons of the soil. The range in surface pH is from 3·5 to 4·5 and the modal value is between 3·8 and 3·9. The base saturation is normally very low and only rarely is there a moderate amount of exchangeable calcium. In three-quarters of the samples the contents of exchangeable magnesium and total phosporus are moderate and in the remainder they are low. The amount of exchangeable potassium is adequate in nearly all the soils, but the carbon:nitrogen ratio exceeds 20 in the surface horizon of most of the soils and is always higher than 15.

Calluna vulgaris forms a canopy layer above its associated dwarf shrubs and dominates much of the vegetation. It lends a characteristic colour to vast areas of the Scottish landscape. For much of the year the colour is dark brown and in late spring and summer there is a greenish bloom on the hills from the fresh growth of heather. In August the plant is in full flower and the landscape takes on its distinctive pinkish purple hue. *Erica cinerea* is often present and may be abundant in the community. Its stature is usually less than that of *Calluna*, but where it is present in a mature heather canopy its straggling shoots may be seen permeating the upper levels of the canopy. The two species of *Vaccinium*, *V. myrtillus* and *V. vitis-idaea*, form a second storey in the vegetation or fill the gaps in the canopy. *V. myrtillus* is constant in the community so far recorded, as many of the stands are from southern and lowland Scotland, and *V. vitis-idaea* is infrequent except in the sub-alpine facies. *Empetrum nigrum* and *Arctostaphylos uva-ursi* are present in some stands, but apart from the *Empetrum nigrum* sub-alpine facies the vegetation in which they occur has not hitherto been examined to any extent in this survey.

The canopy layer of *Calluna* and its associated dwarf shrubs is periodically burned to provide young growth of heather for grazing animals. No ideal interval between 'burns' can be laid down, as this depends on the nature of the vegetation and on the weather conditions at the time of burning, but about every 12 years is reasonable for maintaining a good rotational crop of heather. The dangers of too high a temperature at the time of burning are indicated by Whittaker and Gimingham (1962), and immediately after a burn the relative abundance of species in the vegetation may differ greatly from that under a mature canopy of *Calluna*. Evidence of these seral stages is seen in those stands where the orthotropic moss *Pohlia nutans* and the juvenile stages of *Cladonia* spp. are more abundant.

Ferns are infrequent in the vegetation although *Blechnum spicant* and *Pteridium aquilinum* are occasionally seen. The two clubmosses *Lycopodium clavatum* and *L. selago* are also present but are not regular members of the community.

The grass *Deschampsia flexuosa* is constant and often abundant, especially after the burning of a canopy of old heather where the regeneration of heather is by seed and very slow. Other grasses often sparsely present are *Agrostis canina* ssp. *montana*, *Festuca ovina* and *Nardus stricta*. They tend to occur in the same stands, indicating an early stage of transition to one of the acid grassland communities.

The two commonest sedges in the dry heather moor are *Carex binervis* and *C. pilulifera*. They occur in about one fifth of the sample areas but are only sparsely present. *Luzula multiflora* and *Juncus squarrosus* occur with similar constancy and in similar amount.

Potentilla erecta is present in 60 per cent of the stands and may be frequent in some of the grass-rich stands. The only other forbs which occur with any degree of regularity are *Galium saxatile* and the orchid *Listera cordata*.

The ground layer of bryophytes and lichens is usually well developed but may be sparse after a severe burn or under very heavy canopy of *Calluna*. The abundant species are *Hypnum cupressiforme* var. *ericetorum* and *Pleurozium schreberi*. *Hylocomium splendens* and *Dicranum scoparium* also are abundant in a few stands, and *Pohlia nutans* in a number of stands lacking a dense carpet of plagiotropic mosses. Species of *Cladonia* become constant and more abundant towards the upper altitudinal limit of the community, but they are frequent in the early stages of the burn sub-sere and often in the degenerate phase of very old *Calluna*.

Three facies have been distinguished in the community, leaving a residue of 23 stands which have been designated the 'normal' facies.

The first facies has been differentiated on the presence of *Empetrum nigrum*. It is a sub-alpine or perhaps pre-alpine facies recorded only in north-eastern Scotland. *Vaccinium vitis-idaea* as well as *V. myrtillus* is a constant species and three species of *Cladonia* and *Dicranum fuscenscens* are constant.

The second, or *Nardus*, facies with four species of grass and *Potentilla erecta* as constant species is more widespread. The grasses, in addition to the community constant *Deschampsia flexuosa*, are *Agrostis canina* ssp. *montana*, *Festuca ovina* and *Nardus stricta*. *Vaccinium myrtillus* is less constant and *Juncus squarrosus* is often present. Intensity of grazing may be partly responsible for the greater wealth of grass species.

The third facies has constant *Lathyrus montanus* and may be a herb-rich facies on soils of rather higher base status. Only three stands have been described, but all are on acid brown forest soils or weakly podzolised soils.

Dry *Calluna* moor in its typical form is not common in this area, and only two stands have been recorded, one near Loch Trool on the Carsphairn series and the other near Grey Mare's Tail on the Minchmoor series. Both belong to the second facies with frequent grasses present. They differ from the other stands recorded in the facies in that *Erica cinerea* is very abundant and *Vaccinium myrtillus* is absent.

The dry *Calluna* moor has an index of similarity of 58 per cent with wet *Calluna* moor and the next most closely related moorland community is upland *Calluna-Eriophorum vaginatum* moor with which it has an index of similarity of 47 per cent. The dwarf shrub communities least like it are the two recorded in the sub-alpine to low alpine zone—*Calluna*-lichen heath and *Vaccinium-Carex bigelowii-Rhacomitrium* heath.

The equivalent community described by McVean and Ratcliffe (1962) is Callunetum vulgaris. Some differences are seen on comparing the two tables of stands. *Vaccinium myrtillus* and *Deschampsia flexuosa* are more constant in the stands outwith the Highlands and *Hylocomium splendens* is much more constant in the Highland stands. *Pohlia nutans* is absent from the Highland stands and this may indicate selection of more mature stands.

Gimingham (in Burnett, 1964) covers a wider range of dry heath communities than are described here, but he points out that the *Calluna-Vaccinium* heaths he describes are probably the most important in Scotland and the most characteristic of the country as a whole. Most of the stands described in this survey can be placed in this group, and, with the exception of the *Empetrum nigrum* sub-alpine facies, in the group variant lacking *Vaccinium vitis-idaea.*

The two stands recorded at Glen Trool and the Grey Mare's Tail, with abundant *Erica cinerea* in both and both species of *Vaccinium* absent, can possibly be included in the *Calluna-Erica cinerea* heaths which Gimingham describes.

Both these groups of heaths are part of the Scano-Danish (Scotch) series—so named by Bøcher (1943).

Wet *Calluna* Moor

A wet *Calluna* moor has been distinguished on the basis of constant and often abundant *Erica tetralix,* and general absence of *E. cinerea* and the two species of *Vaccinium, V. myrtillus* and *V. vitis-idaea.* The constant species are *Calluna vulgaris, Erica tetralix, Trichophorum caespitosum* and the mosses *Dicranum scoparium* and *Hypnum cupressiforme* var. *ericetorum.*

The average number of species per sample area is 20 and the range is from 13 to 34 species. For the 27 stands recorded there is a total of 115 species (Table 29).

The recorded range in altitude is from 350 feet to 1150 feet. The potential limits are wider than this, as the lower is restricted by agriculture and the upper by the development of thick peat which carries a different moorland community. The topography on which the community occurs is either flat or gently sloping; only rarely does it occur on slopes of as much as 15°. It also tends to occur on eastern slopes rather than western. The soils are peaty podzols and peaty gleys and some of the gleys have a shallow raw humus layer. All the soils have extremely acid humus horizons with pH ranging from 3·3 to 4·1 and a modal value of 3·8. Base saturation is very low, with low exchangeable calcium. Exchangeable magnesium is low in two thirds of the mineral/humus A horizons and potassium is low in half these horizons. Total phosphorus is also low in 50 per cent of the samples, and the carbon:nitrogen ratios are very high in the surface humus layers.

This type of vegetation is periodically burned over in the same way as the dry *Calluna* moor. There are thus seral stages in the recovery of the vegetation after burning, but because of the moist nature of the habitat the effect of a burn is likely to be less severe. *Calluna vulgaris* is generally dominant, except in the stands with a strong grass element. In some instances the constant species *Erica tetralix* equals or even exceeds *Calluna* in abundance. The other dwarf shrubs *Empetrum nigrum*, *Erica cinerea*, *Vaccinium myrtillus* and *V. vitis-idaea* are infrequently present and only rarely attain a cover-abundance value of 4.

Species of grass are common in one of the facies and *Molinia caerulea* is often co-dominant with *Calluna* in that facies. The other grasses present are *Agrostis canina* ssp. *montana*, *Anthoxanthum odoratum*, *Deschampsia flexuosa*, *Festuca ovina* and *Nardus stricta*.

The sedges *Carex binervis* and *C. pilulifera* are less common than in the dry moorland, but *Carex panicea* is more frequent and *C. nigra*, not recorded on the drier soils, is now present in one third of the stands. *Juncus squarrosus* is a constancy class IV species and the deer-grass, *Trichophorum caespitosum*, is constant and often abundant.

The ground layer is frequently very complete and in the *Molinia* facies the constant *Hypnum cupressiforme* var. *ericetorum* is usually the abundant species. In the other facies it is less often abundant and the abundant species may be *Pleurozium schreberi*, *Sphagnum compactum* or the lichen *Cladonia impexa*.

As already indicated, two facies have been distinguished, based on the presence of *Cladonia impexa* and *Molinia caerulea*. These two species are not mutually exclusive, but each is highly constant in one facies and thus the best species for characterizing it. The stands in the first facies are on soils less influenced by flushing and are on level or very gently sloping sites. The levels of bases and total phosphorus are much the same in both facies, but the carbon:nitrogen ratio in the humus horizons is generally over 30 in the first facies and less than 30 in the second.

Characteristic species for the first facies are *Sphagnum compactum*, *Diplophyllum albicans*, *Gymnocolea inflata* and species of *Cladonia* (except *C. arbuscula*). The second facies, characterized by *Molinia caerulea*, has frequent and more constant grasses and is richer in forbs. On the other hand it is floristically poorer in leafy liverworts and lichens. Characteristic species are *Potentilla erecta* and the grasses listed above.

Four stands of the second facies have been recorded in the western part of the area from Sandloch near Glen App to Saugh Hill east of Girvan. The soil series on which they occur are the Dod, Dochroyle, Alemoor and Myres series. *Molinia caerulea* is present in only two of the stands—*Nardus stricta* is frequent in one of the stands lacking *Molinia* and *Festuca ovina* is abundant in the other—and *Vaccinium myrtillus* is present in three. Apart from these two slightly aberrant features, the stands fit well in the facies.

From the indices of similarity the wet *Calluna* moor is intermediate between dry *Calluna* moor and *Calluna-Eriophorum vaginatum-Trichophorum* moor. The values are 58 per cent and 59 per cent respectively. It is also related to upland *Calluna-Eriophorum vaginatum* moor, the index of similarity being 54 per cent, and is often replaced by that community towards the upper altitudinal limit of its occurrence. Its total of indices of similarity is the highest in the moorland communities and thus it holds a central position among those examined and described.

No equivalent single community is described by McVean and Ratcliffe (1962) in the Highland area, but the two facies can very well be equated with the Trichophoreto-Callunetum and Molineto-Callunetum of that area. The *Cladonia impexa* facies is comparable to the Trichophoreto-Callunetum but differs from it in that *Trichophorum* is much less abundant and that the Highland community is a more upland one. There is possibly a clear resemblance between the *Molinia caerulea* facies and the Molinieto-Callunetum, as they occur in similar altitudinal zones, but in the Highland association *Molinia* is relatively more abundant and *Potentilla erecta* is a constant species.

Calluna-Erica tetralix wet heaths described by Gimingham (in Burnett, 1964) for a wider region of Scotland are more or less equivalent to the wet *Calluna* moorland community.

Calluna-Eriophorum vaginatum-Trichophorum Moor

The third moorland community is the extensive *Calluna-Eriophorum vaginatum-Trichophorum* moor. Constant species in it are *Calluna vulgaris*, *Erica tetralix*, *Eriophorum vaginatum* and *Trichophorum caespitosum*. Constancy class IV species are *Eriophorum angustifolium* and the two mosses *Hypnum cupressiforme* var. *ericetorum* and *Pleurozium schreberi*.

The average number of species in a sample area is 20, ranging from 10 to 29, and the total for 50 stands is 123 species (Table 30).

The altitudinal range of the stands is from 50 feet to 1600 feet and all the sites are level or gently sloping, with the exception of one on a more moderate slope facing north-east. The community is found on acid blanket peat and raised moss peat. Occasionally the peat is shallow and the soil is classified as a peaty gley or peaty gleyed podzol, but the surface organic horizon is essentially of the same type as the deeper peat. The modal pH in the surface peat is 3·7 and the range is from 3·2 to 4·5. The upper value is unusually high for the community and is due to flushing from mineral soils adjacent to the stand sampled. The saturation with bases is low in the surface peat and is 11·7 per cent on the average. The carbon:nitrogen ratio is around 30, except in the *Myrica gale* facies where it is lower.

There is no clear dominant in the community and in most cases dominance is shared between *Calluna vulgaris* and *Eriophorum vaginatum*. Where the peat has to some extent dried out *Calluna* is often dominant and where grazing is heavy *Eriophorum* may be more abundant. *Trichophorum caespitosum* is usually abundant and is the dominant species in a few of the stands. The other constant dwarf shrub *Erica tetralix* has cover abundance values greater than 3 in about half the sample areas. *Vaccinium oxycoccus* is a characteristic species and sometimes there is an abundance of its thin wiry stems permeating the other species of the community.

Deschampsia flexuosa and *Molinia caerulea* are the only grasses that occur with any degree of regularity and in certain facies they may be constant and fairly abundant. *Carex nigra* is the sedge most commonly found and it is constant in one of the facies. The common cotton-grass, *Eriophorum angustifolium*, is constant in the wetter facies but is often absent in others where the peat has dried out.

Potentilla erecta is present as scattered plants in about a quarter of the stands and the only other fairly constant species in the same group of plants are *Drosera rotundifolia* and *Narthecium ossifragum*.

The two fairly constant mosses *Hypnum cupressiforme* var. *ericetorum* and *Pleurozium schreberi* are not often abundant. The species of *Sphagnum* are usually the abundant species, especially in the wetter facies where they can be considered dominants of the ground layer. In these facies either *Sphagnum papillosum* or *S. magellanicum* is present in abundance and *S. cuspidatum* is locally present in the deeper hollows and small pools. Other species such as *S. recurvum* and *S. plumulosum* are present throughout the whole range of the community, except the *Calluna* dried-out facies, but are rather low in constancy although abundant where they do occur. A number of leafy liverworts, including the species *Cephalozia connivens*, *Mylia anomala* and *Odontoschisma sphagni*, are characteristic of this community and of the related upland *Calluna-Eriophorum vaginatum* moor.

Lichens are more common on the drier peat and are sometimes very abundant in vegetation which has escaped burning for a long period. Burning of the vegetation is not such a regular feature as on the drier moorland, but it is usually difficult to find areas long untouched by fire.

Four facies have been distinguished although there are rather few stands in two and the transitions between the facies are broad. The first of these is the facies on hill peat where grazing and burning are fairly heavy. *Carex nigra* and *Deschampsia flexuosa* are constant species and *Erica tetralix* and *Pleurozium schreberi* in constancy class IV. *Sphagna* of the Palustria series are infrequent, and the most prevalent *Sphagnum* species is *S. recurvum* which is abundant in half the stands. *Polytrichum alpestre* is abundant in a number of stands and *Rhytidiadelphus loreus* is present in a third of them. The peat under this facies is the most acid, with a surface pH of 3·7 or less, and the base status is the lowest for the four facies. The carbon:nitrogen ratio is on average over 30 and only slightly lower than in the dried-out peat and hummock facies of the raised mosses.

The second facies is represented by only five stands and differs from the others in that *Trichophorum caespitosum* is virtually absent. The stands are too few to give a reliable description of the floristic composition and there are more species of constancy class IV than of constancy class V. The peat has a slightly higher base saturation than in the first facies, while the carbon : nitrogen ratio—over 32 on average—is the highest of the four facies.

The third facies, characterized by *Narthecium ossifragum*, is the central type for the community. Flowering plant constant species include *Eriophorum angustifolium* as well as *Narthecium* and the community constants. In the ground layer *Sphagna* of the Palustria series are constant, but no one species of the series is constant—either *S. papillosum* or *S. magellanicum* being present—the two are only occasionally mixed in one stand. *Drosera rotundifolia*, not uncommon in two of the other facies, is a constancy class IV species. The facies occurs on the blanket peat of the hills, usually below 1000 feet, and on the raised mosses. The peat is slightly less acid and less depleted of bases than that of the first facies. The carbon:nitrogen ratio is also normally less than 30.

The fourth facies has abundant *Myrica gale* and usually occurs on the wetter parts of the bogs or where there is some slight influence of flushing. Acidity and base saturation are similar to those of the two preceding facies, but the carbon:nitrogen ratio is usually less than 20. *Molinia caerulea* and *Narthecium ossifragum* are abundant and *Potentilla erecta* is usually present. In the ground layer either *Sphagnum papillosum* or *S. magellanicum* is usually the most abundant species.

The first facies is common to the north of Sheets 7 and 8 but was not recorded in these sheets. The dried-out facies is present on the higher hummocks at Silver Flowe. It differs from the other stands in the facies in the great abundance of *Rhacomitrium lanuginosum*. The *Narthecium ossifragum* facies is well represented and five stands were recorded in the eastern part of the area. The one record of *Andromeda polifolia* in the facies is in the stand at Silver Flowe, and *Molinia caerulea* is more constant in these five stands than in the whole facies. The stands are generally wetter than the others in the facies so that hypnaceous mosses are less constant and *Sphagnum papillosum* is abundant and constant. *S. tenellum* is also highly constant. Two of the four records of the *Myrica gale* facies were described at Loch Doon and Dochroyle.

The *Calluna-Eriophorum vaginatum-Trichophorum* moor has an index of similarity of 64 per cent with the *Calluna-Eriophorum vaginatum* upland moor, so that the two communities are very closely related and the upland moor could be considered a facies of this community. There is also a close kinship with the wet *Calluna* moor, the index of similarity being 59 per cent. With the other dwarf shrub communities the indices of similarity are less than 25 per cent, except for dry *Calluna* moor where the value is 41 per cent.

The comparable community described by McVean and Ratcliffe (1962) is the association Trichophoreto-Eriophoretum typicum. The four constants of the moor described in this survey are included in the twelve constants of the Trichophoreto-Eriophoretum. The Highland community, however, seems more or less equivalent to the *Myrica gale* facies of the *Calluna-Eriophorum vaginatum-Trichophorum* moor, as they have nine constant species in common.

In a subsequent account of lowland bog communities Ratcliffe (in Burnett, 1964) describes two lowland communities on deep peat. The one is lowland *Calluna-Eriophorum* bog on raised bog peat and the other lowland *Trichophorum-Eriophorum* bog on blanket bog peat. The latter is the same community as Trichophoreto-Eriophoretum described for the Highlands. The former is closely related to the five stands designated as the dried-out facies in this account and the collection of more data would probably warrant elevation of this facies as a separate community, equivalent to Ratcliffe's *Calluna-Eriophorum* bog.

There are vast areas of similar vegetation on the blanket peat and raised moss peat in Ireland and less extents in Wales and north-west England (Tansley, 1953).

Molinia-Myrica Moor

Four stands of flushed vegetation, often at the margin of deep peat, have been designated *Molinia-Myrica* moor. Constant species occurring in the four sample areas are *Molinia caerulea, Myrica gale, Juncus acutiflorus, Carex panicea* and *Potentilla erecta.*

The average number of species in a sample area is 19 and the total for the four stands is 39 (Table 31).

The altitude of the stands varies between 100 ft. and 500 ft., but the upper limit of the community is much higher. The slopes recorded are gentle to moderate and the soils range from non-calcareous gleys to flushed blanket peat. The gleys, although not peaty gleys, have highly organic surface horizons. The pH of the surface soil ranges from 4·2 to 5·6 and the base saturation is rather low to high. In spite of the highly organic surface soils and, in some cases, the low saturation with bases, the carbon: nitrogen ratio is less than 12.

The dominant species are *Molinia caerulea* and *Myrica gale* although *Carex panicea* and *Juncus acutiflorus* are sometimes very abundant. Other abundant species are *Carex echinata, Potentilla erecta, Narthecium ossifragum* and, in the base-rich stand, *Schoenus nigricans.*

The most constant mosses are *Acrocladium cuspidatum* and *Hypnum cupressiforme* var. *ericetorum*, but the most abundant are usually species of *Sphagnum.* These include *S. palustre, S. plumulosum* and *S. teres.*

The four stands range from Garnaburn in the west to Knockreoch in the east and the community is largely confined to western Scotland. The stands are recorded on the Amlaird series and Largmore complex and also on flushed peat mentioned above.

This community is based on very few stands but the indices of similarity with the other wet moorland communities are very low—less than 22 per cent. It shows a closer relationship with the wet pasture communities where the indices of similarity range from 28 per cent with the *Juncus acutiflorus* pasture to 43 per cent with the *Carex* wet pasture.

The *Molinia-Myrica* nodum of McVean and Ratcliffe (1962) is the same as the community described here. The range in soil conditions and other site characteristics as well as the range in floristic composition of the stands are very similar.

A similar community of *Molinia* and *Myrica* is described by Pearsall (1918) in the Lake District, in an area of fens where there is slow sedimentation and little mineral material in the peat.

Upland *Calluna-Eriophorum vaginatum* Moor

In the upland blanket peat community there are six constant species—*Calluna vulgaris, Empetrum nigrum, Eriophorum vaginatum* and the mosses *Dicranum scoparium, Pleurozium schreberi* and *Rhytidiadelphus loreus.*

The average number of species per sample area is 21 and for the twelve stands recorded there is a total of 69 species (Table 31).

The range in altitude of the stands is from 1250 feet to 2440 feet and this is more or less the full range of the community in the area outside the Highlands. The slopes on which it occurs are level to moderate and the soil is upland blanket peat or hill peat. This is often a pseudo-fibrous peat (Fraser, 1943) with abundant dead cord roots and some remains of *Eriophorum* and *Calluna.* In some parts it may be less decomposed and there are often recognisable remains of *Sphagnum.* The range in pH is from 3·3 to 3·9 and the base saturation is very low. At the same time the carbon:nitrogen ratio is high, yet not as high as in some of the lowland peats.

Calluna vulgaris is often the dominant field layer plant, but in many stands there is no clear dominant and a number of species are abundant. These include *Calluna* itself, *Empetrum nigrum, Vaccinium myrtillus, Eriophorum vaginatum* and *Juncus squarrosus.* Where grazing is heavy *Calluna* may be entirely absent. A characteristic montane species, and often an abundant species, is *Rubus chamaemorus. Vaccinium vitis-idaea* also differentiates this community from the lowland peat vegetation. *Erica tetralix* is less constant than in the lowland vegetation, while *Vaccinium oxycoccus,* a species of rather low constancy, links the community with the lowland one.

As in the lowland community, the constant hypnaceous mosses are seldom the dominant or most abundant species. These are usually the species of *Sphagnum, S. capillaceum, S. plumulosum, S. papillosum* and *S. rubellum.* In some stands *Hypnum cupressiforme* var. *ericetorum* is very abundant, and occasionally there is abundant *Polytrichum alpestre* or *P. commune.* There is a long list of leafy liverworts but of these only *Calypogeia muelleriana* is fairly constant.

Five stands were recorded, ranging from Beneraird in the west to Dunool in the north-east of the area. The stand on Meikle Millyea, at 2440 feet, is at the highest altitude for the community. *Calluna* is absent from this stand and the most abundant species are *Deschampsia flexuosa, Eriophorum angustifolium* and *Juncus squarrosus. E. angustifolium* is a constant species in the stands and *Deschampsia flexuosa* is present in four out of the five stands. These features and the absence of *Rubus chamae-*

morus differentiate them as a group from the stands recorded in eastern Scotland.

As already stated this community is closely related to the *Calluna-Eriophorum vaginatum-Trichophorum* moor and can be considered the upland extension of it. It is also linked with wet *Calluna* moor where the index of similarity is 54 per cent and to a less degree with dry *Calluna* moor—index of similarity 47 per cent. With the montane heath whose lower altitudinal limit overlaps its upper limit the index of similarity is only 33 per cent.

Calluneto-Eriophoretum of the Highland area (McVean and Ratcliffe, 1962) is practically the same community. There are differences between the two. For instance *Empetrum hermaphroditum* is constant in the Highland vegetation and *E. nigrum* outwith the Highlands. Recording of the aggregate species may, however, account for this, and a clearer and more striking difference is the absence of *Hylocomium splendens*, a constant in the Highland association, from the community described here. In this community also *Dicranum scoparium* and *Calypogeia muelleriana* are far more common than in Calluneto-Eriophoretum.

In England the hill peat on the Pennines carries a very similar type of vegetation, although the dominance of *Eriophorum vaginatum* appears more marked in that area (Tansley, 1953).

MONTANE ZONE

The extent of montane vegetation is not large and only two communities have been distinguished in this zone of high winds and soils exposed to severe conditions of frost and late snow-lie.

Vaccinium-Carex bigelowii-Rhacomitrium Heath

The most distinctive of these communities is the *Vaccinium-Carex bigelowii-Rhacomitrium* heath on the summits and exposed spurs of the Merrick and Kells Ranges. Nine constant species are present—*Vaccinium myrtillus, Agrostis canina* ssp. *montana, Deschampsia flexuosa, Festuca ovina, Carex bigelowii, Galium saxatile, Rhacomitrium lanuginosum, Cladonia uncialis* and *Cornicularia aculeata.*

There is an average of 20 species in a stand with a range of 13 to 25 species, and for the ten lists recorded the total is 50 species (Table 32).

The range in altitude is from 2280 feet on Meaul to 2760 feet on the summit of Merrick. The slopes are either gentle or moderate, and although northern and western aspects have been recorded more often than southern and eastern this is most likely due to the small number of samples and cannot be taken as indicating a tendency for the community to occur on these aspects. The soils are sub-alpine podzolic soils which are strongly leached of bases but show less evidence of chemical weathering than more lowland soils. The range in surface pH is from 3·7 to 4·5 and the base saturation is extremely low, being on the average 4·9 per cent. The content of exchangeable calcium is low in all the surface horizons. Exchangeable magnesium is moderate in less than half the samples and low in the others, and the content of exchangeable potassium and total phosphorus is moderate.

This community is found on the most exposed parts of the mountains and the height of the vegetation rarely exceeds 1 inch. Cover of vascular plants varies from rather low to moderate, but bryophytes and lichens often cover the intervening ground fairly completely. The crustaceous lichens on exposed stones which form quite an appreciable area of some stands have not been recorded.

The abundant plants are usually some of the constant species, but in one of the facies *Salix herbacea* is abundant and occasionally there is abundant *Vaccinium vitis-idaea, Agrostis tenuis* or *Carex pilulifera. Salix herbacea* is a characteristic species and exclusive to the community in this part of Scotland.

Rhacomitrium lanuginosum is the only bryophyte to occur with high cover-abundance values, although its cover is usually less than in the *Rhacomitrium* heath of the Highlands (McVean and Ratcliffe, 1962). Other fairly characteristic bryophytes are *Polytrichum alpinum, Diplophyllum albicans* and, in this fairly open community, *Polytrichum piliferum* and *Dicranella heteromalla.* Individual species of lichens are not often abundant except in stands with plentiful basal squamules of *Cladonia cervicornis* and other unidentified *Cladonia* spp. Occasionally *C. uncialis* and *C. coccifera* have cover-abundance values of 4 and the grey and rich dark brown thalli of *Cetraria islandica* are numerous.

One facies has been separated, comprising 7 out of the 10 stands. It has *Salix herbacea* as a constant species, while *Festuca ovina, Galium saxatile* and *Cladonia uncialis* are no longer constant. *Dicranella heteromalla,* however, is a constant and *Polytrichum piliferum* and *Diplophyllum albicans* are in constancy class IV.

The remaining 3 stands are distinguished by the absence of *Salix herbacea* and the presence of *Polytrichum aurantiacum* in place of *P. piliferum.* In them *Festuca ovina* and *Cetraria islandica* are constant species.

Since, with the exception of one on Ben Cleugh in the Ochils, all the stands recorded are from this area no comparison can be made with other regions of Scotland. The stands occur on the Merrick series and the Cairnsmore complex.

The index of similarity between this community and the dry *Calluna* moor is 35 per cent, and the indices with the wet moorlands less than 25 per cent. When the community is compared with the *Calluna*-lichen heath of north-eastern Scotland the index of similarity is only 37 per cent. Both occur at roughly the same altitude, but exposure to wind may be relatively greater in this south-western community and the climate is more oceanic.

None of the montane dwarf heaths or moss heaths of McVean and Ratcliffe (1962) is exactly comparable to this community. It appears to be part of a number of their associations and individual stands could be incorporated into several of their floristic tables. The most closely related community is Cariceto-Rhacomitretum lanuginosi where all five constant species of this association are constants in the *Vaccinium-Carex bigelowii-Rhacomitrium* heath, but on the summits of the Merrick and Kells Ranges

Rhacomitrium seldom dominates the vegetation to the degree that it does in the Highland association. The dwarf shrubs *Vaccinium myrtillus* and *Salix herbacea* and the grasses common to both are more abundant in the Southern Upland community.

Evans (1932) describes a similar community from the summit of Cader Idris, where *Rhacomitrium lanuginosum* is the most abundant plant and in the Pennines the same vegetation type occurs on the higher summits (Tansley, 1953).

Montane *Juncus squarrosus* Moor

Only two stands of this type of vegetation were examined, on Merrick and Corserine. More must be recorded before it can be definitely established as a separate community. The related *Nardus stricta* vegetation also requires sampling and description as part of the complex of montane communities on the higher mountain masses of the Southern Uplands.

Flowering plants present in the two stands are *Juncus squarrosus, Vaccinium myrtillus, Agrostis canina* ssp. *montana, Deschampsia flexuosa, Carex bigelowii* and *Galium saxatile.* There are also six bryophytes—*Dicranum scoparium, Hypnum cupressiforme* var. *ericetorum, Pleurozium schreberi, Polytrichum aurantiacum, Rhytidiadelphus loreus* and *Ptilidium ciliare*—present in both stands.

The sites are at 2550 feet and 2650 feet; the first, on Merrick, is a level site while the site on Corserine is on a gentle concave slope. Both are sites receiving water, as opposed to shedding it, and while snow may not accumulate on them to a much greater degree, they are flushed with melt-water from the surrounding ground. The soils are sub-alpine podzolic soils with slightly impeded drainage. The surface pH of the Merrick soil is 4·0 and of the Corserine soil 3·8. In both soils base saturation is very low throughout the whole profile and calcium especially is deficient. The carbon:nitrogen ratio of the surface horizon just exceeds 15 and is much lower than in the average lowland podzolic soil. The soils are included in the Merrick series although differing slightly from the normal soil of the series in their drainage status.

Juncus squarrosus by its mode of growth dominates the vegetation, although its cover values are not very high. The other flowering plants occurring in both stands are abundant, except for *Carex bigelowii* and *Galium saxatile* in the Corserine stand. In this stand the most abundant bryophytes are *Polytrichum alpestre* and *Barbilophozia floerkei,* while in the Merrick stand the two hypnaceous mosses *Pleurozium schreberi* and *Rhytidiadelphus loreus* are most abundant.

The stands are too few in number for index of similarity calculations, but from a comparison of lists of species this community is related to the *Vaccinium-Carex bigelowii-Rhacomitrium* heath and to *Nardus* and *Molinia* grasslands.

Highland vegetation more or less equivalent is the Juncetum squarrosi sub-alpinum association of McVean and Ratcliffe (1962). Differences are the greater abundance of *Vaccinium myrtillus* and the absence of *Anthoxanthum odoratum* in the Southern Upland vegetation. McVean and Ratcliffe state that the association often occurs in the same zone as their low-alpine Nardeta and may then be a chionophilous type of vegetation, but the effects of late snow-cover and impeded drainage are difficult to separate.

RELATIONSHIP BETWEEN SOILS AND PLANT COMMUNITIES

There is a clear relationship between the major soil groups and their sub-divisions and many of the plant communities, although certain communities occur over a wide range of soils with some other factor in their environment exerting a controlling influence on their distribution.

The following account indicates the plant communities occurring on the different sub-divisions of the major soil groups as distinguished in this area. Some indication of the range in properties of these sub-divisions is also given in the light of the vegetation types growing on them and the laboratory analyses of the profiles sampled under the vegetation. Sub-divisions of very small extent and minor variants of sub-divisions are not mapped, and are therefore absent from the soil key (Chapter 5), but they are included in this description because of the distinctive plant communities which grow on them, and are placed in the sub-divisions to which they are most closely related.

Brown Forest Soils of low base status

For the most part these soils fit the description 'low base status' but there are a number where the base saturation of the A horizon is more than 50 per cent and the lower horizons are well saturated with bases. On these fairly base-rich soils, which are almost indistinguishable morphologically from the low base status soils and are mapped with them, are found plant communities which contain species exacting in their nutrient requirements. Near Colmonell the *Allium ursinum* facies of the base-rich woodland has been recorded, but the other two facies of this woodland can equally well be found on this type of soil. The grassland communities on it are the *Agrostis-Festuca* basic grassland and the *Agrostis-Festuca* meadow grassland.

A variant of this base-rich soil occurs where magnesium is the dominant cation in the exchange complex and greatly exceeds the content of exchangeable calcium (Chapter 10). On this soil only two stands of the basic grassland have been recorded, on a very small area, and it is thus difficult to pick out reliable differences in the vegetation from that on other base-rich soils. *Helictotrichon pratense* is perhaps more constant on these magnesium-rich soils and *Carex panicea* more abundant.

On the true low base status brown forest soils is found a wide range of woodland communities. The *Endymion* woodland is confined almost entirely to this soil type and both the *Endymion non-scriptus* and the *Lonicera periclymenum* facies of the *Holcus mollis-Dryopteris dilatata* woodland are found on it. Four stands of the *Pterdium aquilinum* facies of the *Holcus mollis-Anthoxanthum odoratum* woodland have been recorded in this area on freely drained acid brown forest soils, and less commonly seen communities are the *Mnium hornum* facies of *Dryopteris-Rubus* woodland and the *Oxalis acetosella* facies of *Vaccinium myrtillus* woodland.

The range in surface pH of the true low base status woodland soils is from 3·8 to 4·7 and the content of exchangeable calcium is low in the surface horizon, except in the *Endymion* woodland where it is usually moderate or even high.

The communities recorded on the non-woodland sites are the *Trifolium repens-Thymus drucei* facies of the *Agrostis-Festuca* acid grassland and the *Sieglingia decumbens* facies of *Nardus* grassland.

Brown Forest Soils with gleyed B and C horizons

There is a range in base status in these soils also, but they are predominantly moderately to well saturated with bases. On the more fertile or base-rich members of the group are found the three facies of the base-rich woodland and *Agrostis-Festuca* meadow grassland.

Communities on the more acid soils where base saturation of the surface horizon is 30 per cent or less are the *Trifolium repens-Thymus drucei* facies of *Agrostis-Festuca* acid grassland and the *Sieglingia decumbens* facies of *Nardus* grassland.

There is a magnesium-rich variant of this major soil sub-group also (Chapter 10). Only one stand has been recorded on it, near Colmonell, and the vegetation is part of the *Erica tetralix-Juncus acutiflorus* facies of the *Carex* pasture. As all the stands of this facies are on magnesium-rich soils the vegetation of this stand differs only in the presence of species characteristic of drier edaphic conditions, all the other soils being gleys.

Freely drained Iron Podzols

This soil sub-group does not cover a large area and the only woodland community recorded on it is *Deschampsia flexuosa* woodland in a Scots pine plantation. With the increased afforestation this community may extend its range considerably.

Nardus grassland is the only grassland community on freely drained iron podzols and both the *Sieglingia decumbens* facies and the remainder group of indeterminate stands have been recorded. Under the *Nardus* community drainage of the soils is often slightly impeded.

This is the soil type on which dry *Calluna* moor occurs, although the vegetation is not extensive in this region and usually grades into one of the acid grassland communities or blanket peat vegetation. It is the *Nardus* facies which has been recorded and this is characteristic of areas of fairly heavy stocking.

The freely drained iron podzols and the undermentioned imperfectly drained podzols are both low in bases and acid throughout their profiles.

Areas of imperfectly drained podzols too small to be mapped are occasionally seen and on them one community has been recorded, namely the *Carex nigra* facies of the *Nardus* grassland which occurs in the upland zone of active peat formation.

One stand of *Vaccinium myrtillus* woodland has been recorded on a gleyed podzol ranker the upper horizons of which are indistinguishable from those of the imperfectly drained podzol. The stand is under oak canopy in the Wood of Cree and covers only a small area, but it is sharply defined from the surrounding grassy woodland floor vegetation on brown forest soils.

Peaty Podzols

No woodland stands have been recorded on peaty podzols in this area, although all the stands are within the forest zone. Grassland communities are the most extensive on these soils and include the *Nardus* and *Molinia* grasslands. The *Sieglingia decumbens* facies of *Nardus* grassland has been recorded on peaty podzols and one stand of the remainder group on a peaty podzolic ranker. In other areas the *Carex nigra* facies occurs on peaty podzolic soils so that the full range of the *Nardus* grassland can be found on this type of soil. The *Campylopus flexuosus* facies of *Molinia* grassland is characteristic of the peaty podzols and is widespread in south-western Scotland.

The related *Molinia caerulea* facies of wet *Calluna* moor is also found on this soil, but owing to fairly heavy grazing and high rainfall does not cover a large extent of land.

The base status and pH of the peaty podzols are similar to those of the iron podzols.

Non-calcareous Gleys

Woodland communities have not been recorded on non-calcareous gley soils in this area. Although these soils are not rare in woodland they are somewhat infrequent in an area which, until the recent planting programme, has been largely devoid of trees.

Pasture on the gleys has usually abundant *Juncus acutiflorus* and both the *Poa trivialis* and the *Molinia caerulea* facies of *J. acutiflorus* pasture have been recorded. The first facies generally occurs on soils of medium or high base status, although the base status of the stand recorded at Sandloch is rather low. The second facies is more typical of this high rainfall region.

Molinia-Myrica moor has been recorded on non-calcareous gleys, but only where the soils are transitional to gleys with organic surface horizons.

A variant rich in magnesium (Chapter 10) has been described and sampled at Garnaburn. The vegetation is part of the *Erica tetralix-Juncus acutiflorus* facies of the *Carex* wet pasture and is similar to that on the gleys with more organic topsoils. This soil is, indeed, an intergrade between a low humic non-calcareous gley and a peaty gley of high base status.

Peaty Gleys

On the peaty gley soils no woodland has been sampled and described and the main communities are *Molinia* grassland and wet *Calluna* moor. Both the *Polytrichum commune* and the *Campylopus flexuosus* facies of the grassland are found on these gleys. There is no obvious difference in the nutrient levels of the soils under the two facies and, as already stated, the difference may lie in the frequency of burning the vegetation.

The *Molinia caerulea* facies of the wet *Calluna* moor has been recorded on Saugh Hill and at Dochroyle but it is secondary in importance to the *Molinia* grassland.

In the organic horizons these soils have only slightly higher nutrient levels than the peaty podzols, but in the lower horizons they are moderately to highly saturated with bases whereas the peaty podzols are extremely deficient. In a region of high rainfall the influence of the high nutrient levels in the lower soil horizons on the species content of grass-dominated communities appears to be slight.

One stand of the *Molinia caerulea* facies of wet *Calluna* moor is noted on a magnesium-rich variant of the peaty gleys (Chapter 10). In this soil the content of exchangeable magnesium is twice that of calcium in the organic horizon, but it is below 8 inches that the amount of magnesium in the profile reaches high levels of concentration. This again appears to have little influence on the species content of the plant community.

The *Carex* wet pasture has been recorded on a group of peaty or humic gleys which have high levels of base saturation in the organic horizon. These soils are flushed with water charged with mineral nutrients. On the normal soil the *Juncus articulatus* facies of the community occurs and on the magnesium-rich variant the *Erica tetralix-J. acutiflorus* facies is found.

Blanket Peat

The extensive blanket peat is considered as one unit although minor sub-divisions could be separated, such as raised moss at Silver Flowe. There is a continuous range in vegetation from the lower to the higher altitudes where peat accumulates, and the placing of stands into two main communities is somewhat arbitrary. The lowland areas of flushed peat with abundant *Myrica* and *Molinia* are more distinct as regards vegetation and the nutrient status of the peat than the more general moorland.

One stand of *Molinia* grassland on blanket peat has been recorded, at Loch Doon. It does not differ greatly from the *Molinia* grassland on soils with mineral B horizons, except in the absence of subsidiary grasses and the greater abundance of *Erica tetralix* and *Trichophorum caespitosum*.

Three facies of the *Calluna-Eriophorum vaginatum-Trichophorum* moor have been noted. The facies of dried-out raised moss peat and hummocks in raised moss has been recorded at Silver Flowe. The *Narthecium ossifragum* facies is widespread, and associated with it, where there is flushing with water weakly charged with mineral nutrients, is the *Myrica gale* facies. As already noted the peat under the *Myrica gale* facies differs little in nutrient content from that of the *Narthecium ossifragum* facies but the carbon:nitrogen ratio is lower.

The third community noted, *Myrica-Molinia* moor, is on more strongly flushed peat and the nutrient levels and base status are higher. The carbon:nitrogen ratio at a value of 11 is comparable with that of soils of arable agriculture.

The stands at higher altitude have been placed in the upland *Calluna-Eriophorum vaginatum* moor, although, as already noted, they might equally well be considered as an upland facies of the *Calluna-Eriophorum vaginatum-Trichophorum* moor. The pH and the base status of the peat under the two communities are similar, but the carbon:nitrogen ratio under the upland moor tends to be higher.

Sub-alpine Soils

The parent material of this group of leached podzolic soils has been influenced by physical movement and re-sorting under periglacial conditions in the past. Under present conditions the soils are still greatly influenced by frost movement and exposure to winds of high velocity.

The plant communities so far recorded on these soils in southern Scotland are the *Vaccinium-Carex bigelowii-Rhacomitrium* heath and the montane *Juncus squarrosus* moor. The heath is on exposed sites where snow-cover is of less duration than on the sites with *Juncus squarrosus* moor.

Possibly the differences in the habitats of the two facies of the *Vaccinium-Carex bigelowii-Rhacomitrium* heath lies in a greater degree of frost movement under the *Salix herbacea* facies. The height of the *Juncus squarrosus* community is 3–4 inches as opposed to 1–2 inches in the heath and the only demonstrable difference in the soils is in the water regime. In all the soils the level of exchangeable calcium is almost invariably very low and the base saturation is always very low.

8 | Agriculture

by R. Laird, BSC, PHD, NDA, NDD
West of Scotland Agricultural College

The topographic features, climate and soils of the area under consideration have already been described. Early potatoes are grown on the coastal strip, and as this part of the country is furthest south and derives most benefit from the Gulf Stream they can be lifted a few days earlier than those grown further north. Dairying is practised on some of these farms and on the more inland soils at lower altitudes. The higher lands in Ayrshire and north-west Kirkcudbrightshire, where not planted with trees by the Forestry Commission, are largely devoted to hill farming, with Blackface ewes and hill cattle. The only area of mixed farming, including potato growing, is the area in the lower Girvan Valley to the east and north-east of the town of that name.

Historical

The part of Ayrshire surveyed is the southern half of the Carrick division of the county in which the Kennedys were the chief landed proprietors, the Marquis of Ailsa who resided at Culzean Castle being the head of the family. The south-western corner includes farms on the Glenapp Estate owned by the Earl of Inchcape. In the latter part of last century and until after the formation of the Scottish Milk Marketing Board in 1933 most of the dairy farms made cheese, and the cows were invariably of the Ayrshire breed. More recently Friesian bulls have been introduced into some non-pedigree herds on account of the greater value of the calf for barley beef production. In the past few years, with milk production becoming much less profitable, a number of farmers have changed over to suckler cow herds, hill cow and calf subsidies being regarded as an assurance of a better return. Early potatoes have been grown on the coastal farms for the past hundred years and a few fields have grown this crop for most of these years.

The portion of the map covering Kirkcudbrightshire embraces the high-lying Merrick and Kells hill ranges. This area has the most rugged topography in the south of Scotland, a type of country which offered escape-routes and hiding places during the periods of inter-clan and inter-country rivalry. Today, this region is the home of the red deer, and the wild goat and the golden eagle.

It is essentially Blackface sheep country, but due to its remoteness much of the hinterland no longer carries sheep stocks. The Forestry Commission has purchased large areas in the Water of Minnoch Valley, in Glentrool, and alongside the New Galloway–Newton Stewart road (A 712). Norwegian interests have acquired the Forrest Estate for afforestation. Most of the area will thus be planted with trees up to the planting limit except for the Carsphairn region and a few other sheep farms. The Glentrool region is now a National Park.

Size of farm

The cropping farms mostly comprise 200 acres of low ground and a few have been consolidated into units twice that size. A number have associated hill land which often exceeds the low ground in area. Most of the dairy farms in the area are between 140 and 200 acres, some of these also having a considerable area of hill land. Most of the hill sheep farms comprise more than a thousand acres, several being around the 2000 mark and even 3000 being occasionally exceeded. Many sheep farms have been lost to afforestation and others have suffered through considerable losses of their better land. Only one Department of Agriculture Small Holding Scheme, namely that immediately south of Ballantrae, is in the area.

Land tenure

While there are more rented farms in the area than in most other parts of Ayrshire an increasing number have been sold to occupiers or are being farmed by some of the estates. There are few long-term leases, year to year tenancies being the rule. When farms for letting become vacant they are often sold. If offers to rent are invited considerable increases are obtained. With the high prices prevalent for farms sold, the high rents for those let, and the large amount of capital required to start farming, young men are finding it difficult to take up farming on their own account.

Soil fertility

While less intensive soil sampling was done here by the West of Scotland Agricultural College during the late 1920's and early 1930's than in the other parts of Ayrshire, basic slag and other phosphatic manures were being used to improve grassland during the years of depression between the 1914–18 and the 1939–45 wars. The resulting improvements were a benefit for the more intensive cropping required during the war years. Due to the remoteness from the Glasgow market for liquid milk and the practice of summer cheesemaking, accompanied with little milk production during the winter months, there was less residual fertility from the use of imported feeding stuffs than in the north of the country.

The present manuring practice is largely confined to the use of concentrated complete fertilizers or the older type of compound manures for arable crops, hay and silage, and of basic slag and ground phosphate for grazing land. For the latter potash is not so necessary as in central Ayrshire. Lime deficiencies are less common and less serious than thirty years ago with a soil pH of around 6·0 compared with just above 5·0 at that time. Boron deficiency, as evidenced by the occurrence of 'raan' ('brown heart') in the turnip crop is common and has become more widespread as a result of the improvement in the lime status. Boronated turnip fertilizers are accordingly invariably employed. Hypomagnesaemia ('grass staggers') in both dairy and hill cattle also occurs widely.

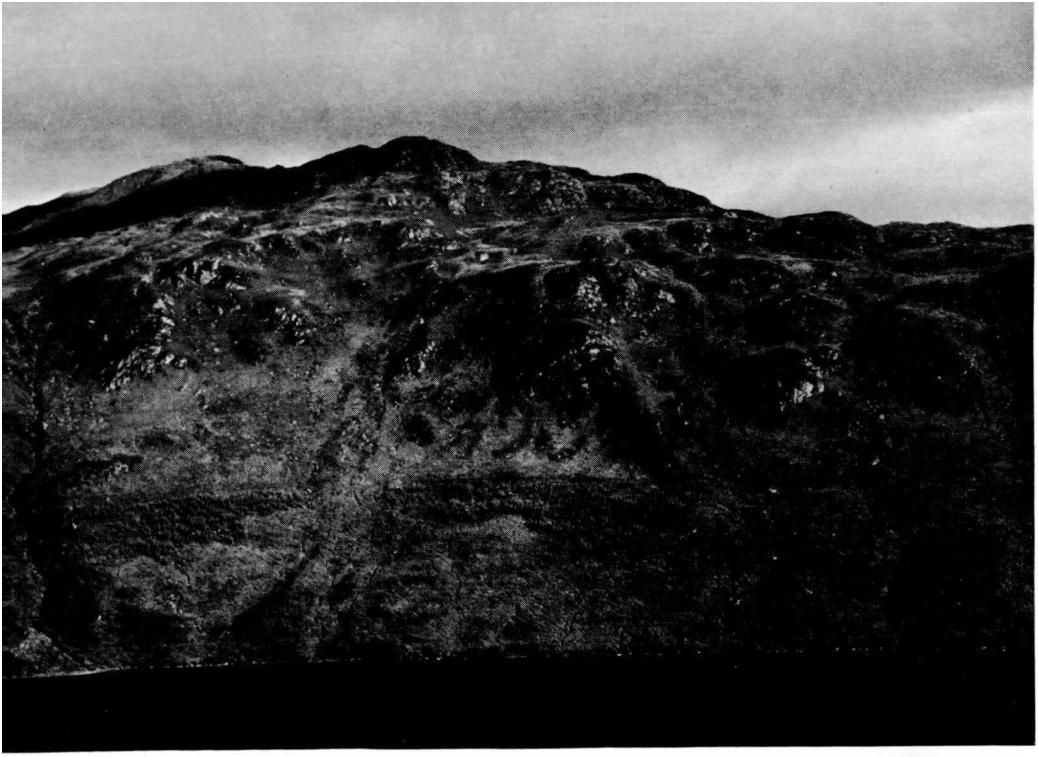


PLATE 18/Slopes of Mulldonoch Hill on south side of Loch Trool. The extremely rocky upper slopes have been mapped in the Darnaw complex.

PLATE 19/The village of Barr with Changue Forest and the Polmaddie Hills in the background. The lower slopes to the right of the village are underlain by soils of the Minuntion series.

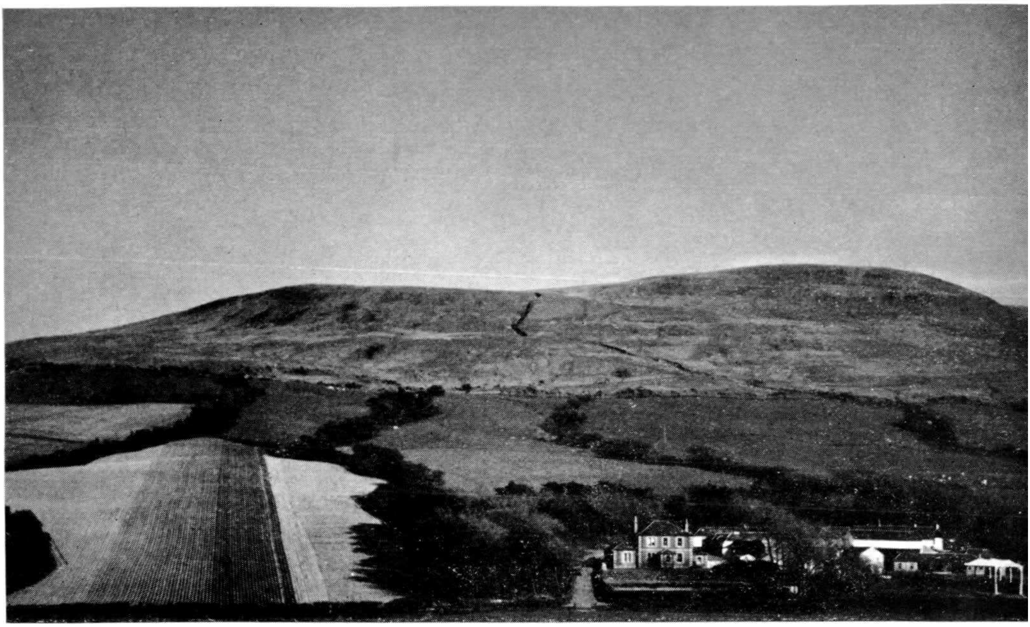
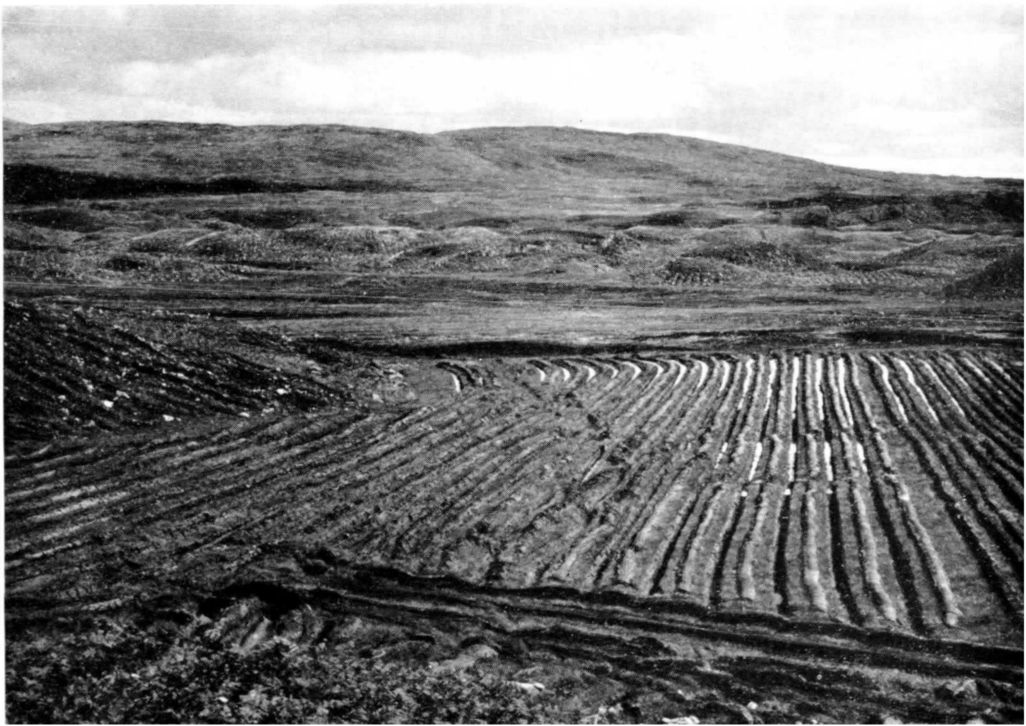


PLATE 16/Houdston Farm in the Girvan Valley. The cultivated lower slopes carry soils of the Kedslie series while on the upper slopes soils of the Ettrick series are utilised for rough grazing.

PLATE 17/The Trool complex near Loch Trool—a pattern of outcrops of greywacke rocks carrying brown forest soils surrounded by deposits of peat. The land here is ploughed prior to afforestation.



Systems of farming

Of the total acreage of almost 150,000 acres in the Ayrshire section approximately one-sixth is classified in the Agricultural Reports as crops and grass, the arable crop acreage at 5500 being only a little over 20 per cent of the area returned as crops and grass. In Barr parish, the most upland in Ayrshire, crops and grass constitute only 7 per cent of the total area, with the crops only 1 per cent of the land of the parish. In the Ayrshire parishes rather more than 20 per cent of the low ground improved grass is mown each year for hay or silage, chiefly the former.

Potato growing is combined with either dairying or cattle feeding. The potatoes, having been sprouted in boxes during the winter, are planted during the second half of February or in March when the weather is suitable, and receive a liberal dressing of fertilizer—around 12 cwt of concentrated complete fertilizer or up to 20 cwt of the less concentrated compound manure. In addition either dung or seaweed is applied in the preceeding autumn and ploughed in during the winter.

The most common potato variety is Epicure, but newer varieties are being continually tried out with a view to obtaining a better shaped tuber with shallow eyes. So far none of those tested can withstand the storms from the sea so successfully or recover from the late frosts. The shore fields are generally lifted during the second half of June by labour employed either by the farmer or the merchant.

Arable crops on most of the dairy farms further inland are confined to those for stock feeding and generally include turnips and swedes in addition to oats—a number of farms also make silage. Hay forms the greater part of the winter fodder on most of these farms. With no cash crops being taken most fields lie in grass for long periods and reasonable crops of oats are obtained when they are ploughed. Hitherto oats have been the chief cereal but some barley is now being grown. On the hill farms which form the eastern portion and constitute considerably more than half the total acreage of the area farming is confined to Blackface hill sheep flocks and a number of cattle, either suckler cows and calves or dairy heifers sold at the calving.

The Blackface sheep are mostly of the Newton Stewart type and many hill farmers run the hardy black native Galloway cattle. These cattle have done much to improve the sheep grazings, and where there is also a slagging policy in operation on the better grazing areas some outstanding increases in sheep output have been obtained. On the high hills lambing percentages tend to be around 70 per cent. In some years, 'yellowses' or 'head grit' can be particularly troublesome and would appear to be associated with the granite regions.

Rotations

The early potato farms have no definite rotation and potatoes may be grown continuously on the same early fields or taken after lea on the more inland fields which lie in grass for short periods. On the dairy farms oats are generally taken after lea followed by the turnip crop and another oat crop. Occasionally the turnip crop may be taken as the first crop after grass. The second cereal crop is undersown and hay is usually taken in the following year. Hay may also be grown for a period of years on meadowland or suitable land elsewhere on the farm. Silage is generally made from first or second year's grass—it is only occasionally that special mixtures are used. Owing to the liability of many soils to poach, first year swards are seldom grazed. Oat yields after lea generally lie between 20 and 30 cwts per acre and turnip yields are usually around 20 to 25 tons.

The pig population has fallen considerably since the formation of the Scottish Milk Marketing Board and the cessation of cheesemaking and butter-making in the district. The scarcity of feeding stuffs during the war years greatly restricted the numbers which could be kept on farms and this reduction has continued to the present day. Most of the pigs are in Colmonell and Ballantrae parishes which account for 400 of the 414 in the June, 1963 Agricultural Reports. The number of horses has also fallen greatly in the past twenty years, the majority of farms having dispensed with them entirely. Because of the small cropping areas the development of mechanization has been largely restricted to the hay crop and grass silage. Poultry are also of much less importance than in the north Ayrshire parishes, the poultry population (June 1963 Agricultural Returns) in the four parishes of Girvan, Ballantrae, Colmonell and Barr being just under 10,000.

Labour supplies

The great development in mechanization has enabled farms to be operated with fewer hired workers than at the beginning of the century. Outwith the cropping area, on many farms the work can be undertaken by the farmer and his family. Casual workers are scarce and the assistance of seasonal Irish workers is now required to lift the potato crop. Workers' cottages are much less common on the dairy farms, but with the advent of milking machines hired labour is less necessary. The provision of milking machines and the modernization of the farm kitchen has also lessened the need for girls in the dairy and farmhouse. Very few country blacksmiths now remain and farmers have some difficulty in getting the few remaining horses shod or implement repairs effected.

Social

Most farmers are members of the National Farmers' Union and there is also quite a strong development of Women's Rural Institutes and Young Farmers' Clubs. A few of the parishes have still their local farmers' society which holds an annual show, but difficulties are being experienced in attracting sufficient entries and an adequate attendance to make them pay.

Farm cottages have been largely modernized during the past quarter century and a number of new ones have been built on farms. Farmhouses have also been greatly improved, extended and equipped with modern conveniences including electric cookers, washing machines and television.

9 | Forestry

by J. D. Whitaker, BA (FORESTRY)
Forestry Commission (Scotland)

Prior to 1939 woodlands in the region described in this memoir had been mainly confined to the more sheltered valley slopes and particularly to the valleys of the Cree and the Stinchar and their tributaries. These plantations, generally on a reasonably fertile mineral soil, were largely of broad-leaved trees—oak, sycamore, ash and beech. In addition, there were shelterbelts of coniferous species planted on higher ground, particularly in south-west Ayrshire at the head of Glen App and above the valleys of the Stinchar and the Duisk, which were largely made to protect the higher-lying arable land. Further east and north, where the higher ground is unsuitable for arable farming and sheep were the main farm stock, shelterbelts were mainly planted for the direct shelter of houses and were therefore more scattered and much less extensive. Since 1945 the use of heavy tractors for draining and cultivating the uplands has altered the countryside, and it is now scarcely possible to traverse any part of the region and lose sight of trees entirely. Forestry now has a great and rapidly growing importance throughout the region. These new plantations are almost entirely coniferous, partly because coniferous trees are most in demand and partly because the sites available, even with cultivation, are rarely suitable for the economic growth of hardwood crops.

By far the greater part of these new woodlands has been planted by the Forestry Commission, their share being about 55,000 acres or about 16 per cent of the total land area. Private woodlands in the area under study amount to about 5900 acres under the Dedication and Approved Woodlands Schemes with a further 700–800 acres in Small Woods.

STATE FORESTS

The plantations of the Forestry Commission are mainly on the exposed uplands of the region, from 400 to 1800 feet above sea level.

The area planted covers a great variety of site types; small areas of deep brown loam soils are found occasionally on the lower slopes of some valleys especially in Changue Forest near Barr, but deep stony morainic deposits occur more commonly, while in general rocky outcrops and fairly shallow soils are interspersed with peat of varying depths from a few inches up to 20 or 30 feet. Remnants of trees turned up by the plough from the deeper peats show that there was in the past a rather poor-quality mixed hardwood here, with birch, alder, willow, rowan and the occasional small oak.

The forests of the region are: Arecleoch, Glentrool, Changue, Carrick, Dundeugh, Garraries and parts of Cairn Edward and Kirroughtree. While these forests cover a wide variety of soil series and soil complexes, they are almost entirely situated on old sheep grazings, generally somewhat degraded, the degradation being due largely to regular muirburning.

Arecleoch Forest

This is a forest in course of formation with approximately 2500 acres planted. The main block, at an elevation between 700 and 1000 feet, is on gentle slopes almost entirely covered with hill peat, but with small areas of peaty podzols and peaty gleys of the Dod and Dochroyle series. This block is planted entirely with coniferous species, mainly Sitka spruce and lodgepole pine with some Norway spruce and Japanese larch occurring where mineral soil is found below shallow peat.

Glentrool Forest

Glentrool is a forest of 53,000 acres of which some 21,000 have been planted. The elevation of the plantations varies from 200 to 1700 feet, and aspects are mainly between west and south. Since the prevailing wind is south-west exposure is generally high.

The greater part of the forest is covered by soils of the Ettrick Association underlain by Ordovician and Silurian greywackes and shales, but in the south-east corner a small area of granitic soils of the Dalbeattie Association is found. The best of the comparatively few hardwoods growing in the forest are found in the latter area, namely two natural stands of pure sessile oak, relics of the original forest here. Most of these trees are growing on brown forest soil, a component of the Dinnins complex. It is notable that natural oak growing nearby on soils of the Glenlee complex, a mapping unit belonging to the Ettrick Association, are not of such good form or growth.

Other old stands of hardwood within the forest are of mixed oak and hazel coppice with birch, growing on the Glenlee, Achie and Trool complexes of the Ettrick Association, that is to say standing mainly on mineral soils without peat. The stands are mainly of pedunculate oak and on these soils do not make good timber crops.

All these hardwood stands are on the lower-lying sheltered sites in the valley of Loch Trool or the Lower Minnoch and Cree Valleys, and taken together they account for little more than one per cent of the total planted area.

Of the coniferous species, which cover the major part of the forest, since they alone can make economic crops on these poor and exposed sites, by far the most important in terms of area is Sitka spruce, followed by lodgepole pine, Japanese larch and Norway spruce. On the rather better sites will be found Scots pine, Douglas fir, Grand fir and other species which make more demands on the soil and are more sensitive to exposure.

Changue Forest

Changue Forest is a small one covering 3127 acres mainly within the catchment area of the Water of Gregg which flows into the River Stinchar at Barr. The plantations in this main block vary from an altitude of 500 to 1500 feet. The soils are mainly those of the Ettrick Association, brown forest soils of the Linhope and Altimeg series on the lower ground giving way to podzols and gleys of the Dod and Dochroyle series at higher elevations. Over a small area the underlying geology changes and soils of the Minuntion and Lane series, members of the Benan Association, occur. There are in addition three small outlying blocks on soils of the Darleith Association, two lying wholly on brown forest soils of the Darleith series and one, at a higher elevation, largely on the Amlaird series.

The plantations are almost entirely coniferous, the only hardwood plantation being on a low-lying sheltered part of one of the outlying blocks, the greater part of which is too exposed to allow good growth of hardwoods. On another of the outlying blocks there existed at the time of acquisition by the Forestry Commission a poor scrubby stand of coppiced hardwood, mainly oak with some birch. This has been thinned and underplanted with shade-bearing coniferous species (spruces, Douglas fir and Grand fir), with larch in the open patches and along the open edge to form a firebreak.

In the main block by far the most common species are Norway and Sitka spruce. The former species occurs on brown forest soils, generally with gleying in the B and C horizons, on the lower-lying sites; climatic factors limit its growth higher up.

Carrick Forest

Carrick Forest, which marches with the Forests of Changue to the west and Glentrool to the south, covers the northern slopes of the main hill block of the area. It is a forest of nearly 33,000 acres of which 11,000 have been planted. Geologically it is underlain by three formations, Old Red Sandstone in the extreme north, a broad band of Silurian shales in the middle, and granite in the south. Topographically it is divided into two—an area of rounded hills with deep narrow steep-sided valleys in the north and west, and a large area in the south-east with more broken, rocky ground interspersed with peat flats and lochs. The soils naturally show a very wide variation over the area, many soil series and complexes of the Ettrick, Dalbeattie and Knockskae Associations occurring. Peat covers a large part of the forest.

The species planted are Norway and Sitka spruce, lodgepole pine and Japanese larch, together with Scots pine and other species on the better sites. Norway spruce occurs mainly on the lower slopes and in the valleys while Sitka spruce and lodgepole pine occupy the more exposed sites and the poorer soils.

Dundeugh Forest

Dundeugh, a forest of 6000 acres with 5000 planted, is situated on a ridge sloping eastward from the northern end of the Rhinns of Kells range. The soils are all members of the Ettrick Association, mainly the

Bush, Darnaw and Brochloch complexes with small areas of the Dod and Dochroyle series on the higher ground. The greater part of the area is peat covered, and since the average rainfall is 60 inches on the low ground and 75 inches at the upper planting limit this is not surprising.

The species planted are mainly Sitka and Norway spruce and the larches. Sitka spruce is the commonest species, Norway spruce being restricted to areas below 1000 feet and larches to some of the drier sites. Lodgepole pine is rare, because before planting there was very little heather mainly as a result of continued burning, and occurs only on the poorest areas in mixture with Sitka spruce.

Garraries Forest

Garraries Forest, covering a total area of 10,000 acres, with 4000 planted, lies in a long valley running north and south in the uplands between Loch Doon and Clatteringshaws Loch. The lowest elevation is 600 feet, and the highest plantations are over 1700 feet. The underlying rock is granite, but for the most part the mineral soil is covered with peat of varying depth and the ground is very broken. The valley floor is almost entirely under deep peat while the Garrary, Gala and Twachtan soil complexes occur on the slopes. The vegetation is purple moor-grass (*Molinia caerulea*) with very little heather (*Calluna vulgaris*), and spruces make up the greater part of the planted crop, Sitka spruce predominating. Larch occurs on the thinner soils, but there is comparatively little pine.

Cairn Edward Forest

Cairn Edward is a large forest of which approximately 5000 planted acres fall within the area under review. The consolidated rocks are granites and Silurian shales. The plantations lie between 600 and 1700 feet and nearly the whole area is covered with peat of varying depth. Soils in the granite area on the slopes of Round Fell and the Black Craig of Dee are members of the Garrary, Gala and Twachtan complexes, while those on the shales are units of the Minnoch, Brochloch and Darnaw complexes. Certain small patches within the area of mineral soils in the Glenlee and Largmore complexes are not planted but are still under agriculture.

The Round Fell block carries a vegetation which is almost entirely purple moor-grass, and the species planted is mainly Sitka spruce. Over the rest of the area heather is present in variable abundance, and the tree species used include high proportions of Japanese larch and lodgepole pine, sometimes in pure stands and sometimes in mixture with Sitka spruce.

Kirroughtree Forest

The part of Kirroughtree Forest falling within the area under review covers about 3000 acres of plantation, all lying on shales and greywackes of the Silurian system, the soils being mainly components of the Darnaw and Brochloch complexes, with some areas of the Stroan, Largmore and Glenlee complexes. Purple moor-grass covers more than half the area but heather is also widespread, and bracken and the softer grasses occur occasionally on patches of the better mineral soils. The elevation of the plantations varies from 300 to 1680 feet. The species planted are Sitka spruce and lodgepole pine, with Norway spruce and Japanese larch common on the lower ground and on the better soils. Douglas fir, Noble fir and Grand fir are found in small patches.

PRIVATE WOODLANDS

Of the privately-owned woodlands within the area most are coniferous; the few hardwood crops are rarely of good growth. There are some exceptions worthy of note. On the Garroch Estate, in a sheltered valley on brown forest soils of the Linhope series there are some excellent hardwood stands with a crop mainly of oak but including some fine specimens of Norway spruce, Scots pine and European larch. Some fine hardwoods are also found on the Alton Albany Estate, again mixed with excellent specimens of conifers and standing in a well-sheltered valley, the soils in this case being brown forest soils of the Benan series. It is notable that on the upper slopes where exposure is more extreme, these hardwoods give way to pure conifer crops, though the soil is still of the Benan series. Ash and beech reach their best growth in Bargany Estate, in the extreme north of the region, standing on a brown forest soil of the Glenalmond series.

Glen App Estate

The woodlands of this estate stand mainly on the steep slopes of Glen App itself and on the ridge between Glen App and the Stinchar Valley, the soils being brown forest soils of the Linhope and Kedslie series and gleys of the Littleshalloch and Ettrick series. Most sites are to some extent exposed to strong winds and to salt blast.

Drumlamford Estate

This estate stands on an area of peat with islands of brown forest soils of the Linhope and Altimeg series. It is situated on an open moorland exposed in all directions and lies at a height of about 450 feet. The woodlands, consisting of strips and wide blocks for shelter and amenity purposes, and standing both on the peat and mineral soils, are largely of Sitka spruce but contain also areas of Scots pine, larches and Norway spruce.

Forrest estate

This is a private estate of about 10,000 acres, mainly devoted to commercial forestry. Planting began in 1953 and so far about half of the portion managed under a Dedication scheme has been planted, that is 3500 acres. The underlying rocks are mainly Silurian shales and greywackes with many of the soils mapped as Darnaw and Minnoch complexes. There are, however, considerable areas of peat and small patches of the Dod and Linhope series, the latter occurring on the lower valley sides. There is also a small granitic outcrop in the middle of the estate and there the soils are members of the Dinnins and Garrary complexes.

The estate lies in the headwaters of an eastward flowing burn, so that there are few westerly exposures and the planting range is between 450 and 1500 feet. The average rainfall on the lower ground is 70 inches.

The planting stock is wholly coniferous and the spruces and lodgepole pine together account for more than 90 per cent of the planted area, Sitka spruce alone covering more than 60 per cent.

SHELTERBELTS

On the open moorlands of the Doon Valley Scots pine has been principally used to provide shelterbelts near houses and along the roadside, and has generally been planted in narrow strips. Occasionally wider plantations have been laid out on the open hill as shelter for stock. Beech and sycamore mixed with conifers have been used for these in the past, but more recent plantations have been mainly of Sitka spruce, sometimes mixed with larch.

In the north-west of the area, as elsewhere in Galloway, on the hills between the Water of Girvan and the River Stinchar, single rows of beech have sometimes been used as roadside shelter strips and have sometimes resulted in avenues arching over the road.

Most of the shelterbelts in south-west Ayrshire are situated at the head of Glen App on Auchairne Estate and above Barrhill. These are set out at close, though irregular, spacings and often enclose fields or groups of fields on all sides. Sitka spruce and Japanese larch are the species which have been most commonly used in these large shelterbelt schemes. Once they are established and well grown narrow shelterbelts such as these are sufficiently effective in breaking wind force over agricultural crops. In later years they tend to become somewhat open at the foot and are improved by the addition of a shrub layer. They can never function as good timber-producing areas, however, since the exposure effect acts all through such narrow belts, which in general are not more than 20 yards wide and are sometimes less. Wider belts capable of producing good timber as well as providing shelter would not be possible in this situation, since they would absorb the greater part of the arable land they are designed to protect. In such conditions where lack of ground limits the width of shelterbelts so that little or no revenue can be expected from the timber produced, it is clear that the belts should be kept as narrow as is possible, consistent with their function of providing adequate shelter.

On hill ground where shelterbelts are required for sheep grazings and availability of land does not limit their size it is more economic to ensure that they perform the additional function of providing a good timber revenue. For this purpose, the minimum width should be 50 yards, and the economics of fencing would generally require a much wider strip than this. The difficulty of access for production working is a factor which should be taken into account when determining the total extent of such a shelterbelt, but few of those which have been planted are in fact sufficiently extensive to make normal thinning an economic proposition. Regular thinning is essential for the general health of a plantation and to prevent the occurrence of windthrow, and it appears that knowledge of this problem was insufficient when some of the hill shelterbelts were first established. The total extent of these hill shelterbelts, however, is at present not above 200 acres so the problem is not of major importance.

MODERN PLANTING PRACTICE

It will be apparent from the descriptions of these woodlands that the soil type has had less effect on the choice of species for planting than other factors. Elevation and exposure are important factors to consider, since however good the soil, exposure will limit the species that can be grown satisfactorily. Modern marketing conditions are also important, since small-sized coppice hardwood, mainly used for turnery, is no longer in great demand, while the demand for small-sized softwoods for pulp and chipwood is steadily increasing.

Ground preparation

Modern methods of ground preparation now enable at least some of the physical defects in soils to be overcome. Deep ploughing gives adequate drainage to allow aeration of a gley soil, while the sock of a tined plough is designed to shatter the iron pan often present in a podzol, allowing roots to penetrate it and bring nutrients to the surface.

On brown forest soils such as those of the Linhope and Darleith series, while ploughing brings no physical benefit to the soil itself, it is nevertheless economical since it holds back vegetation which would otherwise compete with the planted species and cause a loss of growth of as much as three years. Income from the crop is therefore brought nearer in time, and up to three years' weeding costs may be saved.

Deep peats, formerly considered unplantable, can be adequately drained by deep ploughing to allow good tree growth, but since peats are generally low in nutrient supply the addition of phosphate at the time of planting is necessary on most types, and other nutrients, especially potash, may be needed later.

Choice of species

The species chosen for a site is generally that which will give the best economic return, although other factors may have to be considered. Hardwoods in general can only be grown economically on the better brown forest soils, and then only where exposure is comparatively slight. Even on these favourable sites a pure crop of hardwoods will not be economic since it can give no early intermediate returns. The modern practice is to plant hardwoods on suitable sites in mixture with conifer species which will shelter and assist their early growth and provide the early intermediate returns.

Elsewhere on brown forest soils, where hardwoods would not be satisfactory, the species chosen depends on the degree of exposure, the incidence of frost, the elevation and the aspect. Near the sea coast the liability to salt spray, which may drift up to several miles inland, must also be considered. On any soil the vegetation existing on a site may sometimes be a factor influencing the choice of species. For instance, Sitka spruce will not grow well on a site with deep heather, but were the heather eliminated from that site by, say, continued burning it might be ideal for this species. Most vegetation types can be taken as indicators of the site quality, but in the case mentioned the heather itself is a factor as important as the soil.

An additional factor which may have to be considered is the availability at any time of suitable stock of a desired species. There can be considerable variation of characteristics within a species according to its origin. For instance, Scots pine grown from seed collected in East Scotland where the rainfall is not more than 20 inches is quite unsuitable for planting in this region where the rainfall is twice or three times that amount. In choosing a species its origin can be as important as the species itself.

PRODUCTION

Most of the major forests in the area were recently planted by the Forestry Commission and are only just beginning to come into production. At present, therefore, private woodlands within the region and other forest areas in the vicinity supply the needs of timber users in the area.

As the extensive areas of recent plantations come into production new teams of production workers will be needed to extract the timber and new industries may arise in the area to absorb it. The present system of extraction by small groups of workers with portable sawbenches will eventually be replaced or supplemented by large scale sawmills. Much of the smaller timber produced within the region as thinnings will be taken outside the region to pulp and chipboard mills; the demand for timber from the south Ayrshire coalfield is declining as one by one the pits are closed.

10 Discussion of analytical data

Soil profiles representative of the soil series present in this area have been sampled during the period of the survey. Each sample has been analysed for loss on ignition, soil separates, exchangeable cations, percentage base saturation, pH, carbon, nitrogen and readily soluble and total phosphorus. A number of profiles have been considered worthy of more detailed investigation involving specialized techniques. Clay samples from these profiles have been analysed chemically for total silica, iron and aluminium; the clay mineral composition has been determined by X-ray and differential thermal methods; the minerals in the fine sand fractions have been identified and their frequencies estimated by specific gravity and optical methods; and the trace element content has been obtained by spectrochemical methods.

The data from the routine analyses are given in Appendix II, each profile receiving a number which provides a ready means of identification whenever a profile is referred to in other sections of this chapter; the other data are grouped in Appendices III–VI. The general significance of these analyses is discussed below, after which chemical characteristics of the soils are discussed in detail. For the four major associations data are discussed under individual soil series, while the data for the less widespread associations are considered under association headings.

It is important to note that chemical data for any one soil series may show a wide range of variation, and that in general only average or mean values are discussed, although if the range of values appears well established these may also be considered.

Loss on Ignition

Loss on ignition measures the percentage mass lost when a sample of oven dry (105°C) soil is heated at a high temperature (850°C) for two hours. This weight loss is due chiefly to the oxidation of organic matter to carbon dioxide, the elimination of water molecules combined with clays and other soil material, and to the loss of carbon dioxide from the calcium carbonate in calcareous soils. In the surface horizons of non-calcareous soils of moderate clay content the value for loss on ignition gives a rough estimate of the organic content of the soil (Ball, 1964).

Soil Separates

The soil separates sand, silt and clay are determined by mechanical analysis. The relative proportion of these fractions present is referred to as texture. This is an important physical property of soil which greatly influences moisture retention and drainage, tillage properties and liability to 'poaching' by stock and machinery, as well as the type of soil structure and the base exchange properties of the soil.

Cation Exchange Capacity

The cation exchange capacity is a quantitative expression of the ability of a soil to take up, release, and exchange one cation for another. Many of these cations are plant nutrients and the content of exchangeable bases gives some indication as to the presence of nutrients easily available to plants.

The exchangeable ions are held primarily on the organic matter and the clay fractions of the soil. Soils with high organic and clay contents have high exchange capacities. Thus in most soils the base exchange capacity decreases with depth in the profile, in parallel with the fall in organic matter content, while the non-organic horizons of soils with a high clay content generally have higher exchange capacities than those of sandy soils. For example, the base exchange capacities of many very coarse-textured parent materials are extremely low (5 me 100/g soil).

Percentage Base Saturation and pH

The total of exchangeable bases expressed as a percentage of the exchange capacity of the soil is termed the percentage base saturation. That part of the exchange complex not carrying basic ions is assumed to be occupied by hydrogen ions.

The pH is a measure of the hydrogen ion concentration in the soil. An acid soil has a low pH of 4·0 to 5·0, a neutral or near neutral soil has a pH of 6·0–7·0, and an alkaline soil a pH greater than 7·0.

Acid soils generally have a low percentage base saturation, while in neutral and near neutral soils the exchange complex is completely saturated. However, a soil with a low percentage base saturation but a high exchange capacity may have a greater content of the total exchangeable bases than a soil with higher percentage base saturation but lower exchange capacity.

A number of important soil properties and processes are correlated with and affected by the soil pH. Earthworm and other biotic activity is reduced under acid conditions and the natural plant communities are strongly influenced by the soil reaction. In addition the availability of some plant nutrients, *eg* manganese and boron, is markedly affected by pH as is the liability of plants to attack by some diseases.

Carbon and Nitrogen

The carbon content of a soil is closely correlated with the amount of organic matter present, which is usually computed by multiplying the value for soil carbon by a factor (1·72).

The organic matter is generally concentrated in the surface soil horizon and decreases down the profile, although the B horizons of some podzols are an exception in having a local concentration of organic matter at some depth. The amount and nature of the organic matter in a soil has a major role in influencing the type and stability of soil structure; it also forms a reserve source of plant nutrients, and is the seat of much of the soil base exchange activity.

An important characteristic of soil horizons in which the humus content is greater than 25 per cent is their low bulk density (Birse, priv. com.). As a consequence of this feature such soils, although they may have a high content of nutrients or other elements as judged per unit weight of soil, have relatively lower amounts per unit volume as compared with mineral horizons. This, together with the assumption that there is a limit to the volume of soil which any one plant is able to exploit, helps to explain why the raw humus horizons of podzols, peaty podzols and peaty gleys which often have high contents of exchangeable bases and of phosphate per unit weight of soil are yet poor media for plant growth.

The amount of soil nitrogen is used to compute the carbon to nitrogen ratios of the soil organic matter. C:N ratios of about 8–13 indicate organic matter existing under conditions of fairly rapid humification and high biotic activity, while wide C:N ratios of 15–25 are typical of peats and mor humus where the rate of decomposition is very slow.

The soil organic fraction is also a major source of nitrogen, an important plant nutrient.

Phosphorus

The soils have been analysed for their total content of phosphorus, which is expressed as units of phosphorus pentoxide, and for readily soluble phosphorus, which is an indication of the phosphate fraction readily available as a plant nutrient.

Balig Association

BALIG SERIES

Although the parent material of this soil is a gravel the clay percentage rises as high as 27 per cent at a depth of about one foot in the profile.

Both the exchangeable calcium and magnesium are high in the surface, but while the values for calcium decline with depth, those for magnesium rise to 14 me/100 g in the parent material. These high magnesium values can be accounted for by the weathering of ultra-basic stones in the parent gravel, while the calcium values reflect the relative concentration of this ion by plants. The exchangeable sodium is high in the surface and varies little with depth, but exchangeable potassium is moderate in the surface and declines with depth. The percentage saturation of the exchange complex is high (68–93 per cent) and varies irregularly with depth, while the pH rises from pH 5·9 in the A horizon to pH 6·5 at 2 feet.

Under semi-natural conditions the organic content of the surface 2 inches is high and has a low (11:1) carbon:nitrogen ratio. Although high in the surface horizon, both total and readily soluble phosphorus decline to low and moderate values respectively at 15 inches.

Benan Association

BENAN SERIES

The influence of the parent conglomerate is reflected in the high sand (U.S.D.A, 1951) content of the soil. The clay content is usually between 10 and 20 per cent, but amounts less than 10 per cent may occur in the C horizon.

The base exchange capacity is generally between 20 and 30 me/100 g soil and varies irregularly through the profile, while values for pH and degree of base saturation have a wide range. Generally, however, the soil is acid to moderately acid throughout the profile, and the degree of base saturation which is moderate (20–50 per cent) in the surface may rise to high with depth, although in one profile analysed (No. 3) it fell to a low value.

The values for exchangeable bases have a wide range; sodium and potassium are generally moderate to low and change little with depth, while both high and low values for calcium have been encountered. Some profiles are notable in that the exchangeable magnesium exceeds the calcium, probably indicating some serpentine influence in the parent conglomerate.

The organic matter content is generally high, with a moderate (12–14) carbon:nitrogen ratio. The total phosphorous status in the surface is only moderate and decreases with depth, while the readily soluble phosphorus is low throughout the profile.

The analyses for silica and sesquioxides in the clay fraction show that the percentages of silica and iron are highest in the surface horizon and decrease down the profile, while the alumina percentage is lower in the surface than in the subsoil. There appears therefore to have been some differential movement of alumina relative to silica and iron, but there are no zones of marked differential leaching and accumulation of iron.

KNOCKINCULLOCH SERIES

Only a very small area of this series has been mapped. The salient features shown by analytical data are a high degree of acidity (pH 3·9) in the surface and higher pH values (5–5·5) in the subsoil, together with a low degree of base saturation throughout the profile. The carbon:nitrogen ratio of the surface organic horizon is high, and the values for both total and readily soluble phosphorus are low.

The trends of the silica and sesquioxide contents of the clay fraction are unusual for a soil with the morphology of a peaty podzol. The silica percentage is lowest in the A_2g horizon while the percentages of iron and aluminium are highest in the surface and decrease regularly with depth, apart from some accumulation in the thin iron pan. Weathering therefore seems to be more active than leaching in the surface layers and movement of iron under the influence of solutions from the raw humus layer is very slight.

MINUNTION SERIES

Despite the apparently tenacious nature of the parent till of this soil in the field, laboratory determinations show that the clay content is in the range of 20–25 per cent.

The base exchange capacity of between 13 and 30 me/100 g soil in the surface is moderate and declines very little with depth, while the degree of saturation increases from 35–40 per cent in the A horizon to 70–80 per cent in the subsoil, and pH values rise with depth from 4·8 to between pH 5·0 and 6·0. The amounts of calcium and magnesium on the exchange complex are moderate in the surface and increase with depth, whereas the sodium and potassium status, moderate in the surface, decreases down the profile.

The organic content of the uncultivated soil is high and has a low to medium carbon:nitrogen ratio. Phosphorus, the total amounts of which are moderate throughout the profile but decline somewhat with depth, becomes more readily soluble on passing down the profile. Values for readily soluble phosphorus are very high in the C horizon.

The silica: sesquioxide ratio increases steadily with depth, indicating the gradual change in the degree of weathering and leaching which is typical of the brown forest soil major group without prominent zones of illuviation or eluviation.

LANES SERIES

Analytical data for this series are very similar to those for Minuntion series, although they show some trends to be slightly more pronounced. The percentage of clay lies mainly between 18 and 32 per cent although in the field the soil appears to be of finer texture than these figures would suggest.

The base exchange capacity, which is in the range of 18–43 me/100 g soil, decreases slightly or changes irregularly with depth. The degree of acidity is commonly only moderate (pH 5·5–6·0) in the surface and decreases with depth (pH 6·5), although in some profiles (*eg* No. 27) conditions are quite acid (pH 4·5). While the saturation of the exchange complex is quite high in the surface (30–70 per cent), it increases in the subsoil. Of the exchangeable bases, the amounts of calcium are high and increase with depth, and magnesium shows a similar trend although the actual amounts vary widely. The sodium and potassium status of the surface horizons is high to moderate, but there is a decline with depth.

The upper 6 inches of the soil have a very high organic content, the carbon:nitrogen ratio of which is surprisingly high (16), in view of the only mildly acid condition. The total phosphorus status declines from high to moderate in the surface to low at some depth, while the readily soluble phosphorus figures show a pronounced trend in the other direction, with high values in the subsoil.

There is a marked difference between the silica:sesquioxide ratios in the Ag horizon and in the lower layers. Iron appears to be most actively removed relative to silica in the surface horizon, probably, due to the waterlogged conditions, in the reduced state.

In the subsoil the percentage of silica rises gradually with depth, as does the ratio of iron to silica. The values for aluminium fall gradually with depth.

Blair Association

The clay content of soils of this association determined in the laboratory is often less than estimated in the field. This is probably due to the anomalous behaviour of fragments of weathering sandstone such as is noted for the Glenalmond Association. The peaty layer of the peaty gley Falaird series (No. 35) has a high base exchange capacity, but in the surface horizon of the poorly and imperfectly drained Blair and Drumyork series the base exchange capacity is only moderate, although higher values may occur in these series in association with unusually large amounts of organic matter. The values for exchange capacity tend to decrease down the profile, but occasionally remain steady. The degree of base saturation is generally moderate at the surface, and rises on passing into the subsoil. This trend is paralleled by the pH values which rise from 4·5–5·5 in the upper layers to 5·5–6·0 at depth. Rather more acid conditions prevail in the organic horizon of Falaird series where the pH is 3·8–4·0.

The amounts of exchangeable calcium and magnesium are moderate to low in the surface horizon, although higher figures occur where fertilizers have been used. After a slight fall in the A_2g horizon values tend to rise with depth, except in Drumyork series where they rise irregularly. Sodium and potassium generally decrease with depth from moderate amounts in the surface to very low values in the C horizon.

The organic content of these soils varies widely although the carbon: nitrogen ratio is fairly consistently low, except in the Falaird series where it is medium (16). In the subsoils and parent till, total and readily soluble phosphorus are low and high respectively, while in the surface total phosphorus is moderate to high and amounts of readily soluble phosphorus have a wide range.

Dalbeattie Association

DALBEATTIE SERIES

The clay content of this soil, developed on rock rubble and moraine, rarely exceeds 16 per cent and is often less than 5 per cent; the sand (U.S.D.A, 1951) fraction is usually more than 50 per cent.

The base exchange capacity, the greater part of which is associated with organic matter, is moderate in the surface but decreases, in parallel with the decline in humus, to very low values in the parent material. The degree of saturation of this soil is low even in the surface, but becomes extremely low in the subsoil. Very acid (pH 3·8–4·5) conditions prevail throughout the profile, but there is some amelioration in the lower horizons (pH 4·5–5·0). The intense leaching indicated by these values has resulted in very low levels of exchangeable mineral nutrients.

Although the organic content is high in the surface, the carbon:nitrogen ratio is relatively low (11·5–15) despite the very acid conditions. The amounts of readily soluble phosphorus are generally low throughout the profile, while total phosphorus is medium to low (200–64 mg P_2O_5/100 g soil).

CARSPHAIRN SERIES

The parent materials of this soil are similar to those of Dalbeattie series and the soils have similar very low clay (10 per cent) and high sand (60–80 per cent) fractions.

The base exchange capacity of the organic surface layer is very high (86–120 me/100 g soil) but falls to very low (5 me/100 g soil) with the decrease in organic matter on passing down the profile. The pH values range from about 4·0 near the surface to about 4·8 in the parent material, and the base saturation is very low in all horizons except the surface where it reaches 15–20 per cent. The content of exchangeable bases, calcium, magnesium, sodium and potassium is high in the organic layer but very low in the subsoil.

As well as in the H horizon, the organic matter content in the upper 24 inches of the mineral soil is appreciable, varying between 17 and 30 per cent. The status of the organic layer with regard to total and readily soluble phosphorus is moderate and high respectively. In the middle layers of the profile only small amounts of the phosphorus fractions are present, but high values for readily soluble phosphorus occur in the C horizons.

The results of the silica and sesquioxide analyses of the clay fraction are striking. Iron has been strongly leached from the A_2g horizon and has accumulated in the B_1, B_2 and B_3 horizons, while some aluminium has accumulated in the B_2 horizon. The percentage silica shows a pronounced maximum in the A_2g horizon, and provides some explanation of the very high silica:iron oxide ratio. This ratio falls to a very low value in the B_2 horizon and rises with depth. The percentage of alumina is high in the upper mineral horizons and rises to a very high value (>50 per cent) in the C horizon. This is three times the alumina content of the parent rock and is not easily accounted for, unless as a result of redistribution of material from nearer the surface.

EGLIN SERIES

Only limited analytical data for this series are available. The salient features are a low clay content, high acidity which decreases only slightly with depth (pH 4·5–5·2), low base exchange capacity in the mineral soil, and only weak saturation of the exchange complex. The phosphorus status is low for both total and readily soluble phosphorus, although higher values may occur in the organic surface layer.

The molecular silica:iron oxide ratio is very high in the A_2g and B_2g horizons, and shows a sharp minimum in the B_3g horizon. Strong iron eluviation from the upper mineral layers under the prevailing wet conditions is a general feature of peaty gley soils, as is some rise in the percentage iron in the B_2g horizon in association with ochreous mottles and segregations. In this profile, however, the large increase is more typical of the peaty podzol than the peaty gley group of soils, although there is no morphological evidence of a spodic horizon.

CAIRNSMORE SERIES

The series is developed under conditions of strong physical and weak chemical weathering and consequently the clay content rarely rises above 6 per cent. The base exchange phenomena are largely associated with the organic matter; the exchange capacity is moderate in the upper horizons but very low in the parent material. The pH of 4·0 in the surface rises slightly with depth to pH 5·0 in the C horizon. The soil is impoverished of exchangeable bases throughout.

The organic content of 13 to 17 per cent is relatively low for this subalpine soil, and the carbon:nitrogen ratio is variable. Total phosphorus is moderate in the upper horizons, but becomes low at depth, and readily soluble phosphorus is low throughout the profile.

Darleith Association

DARLEITH SERIES

The relative proportions of the particle size grades are variable in this soil developed on a stony parent material but the clay content is normally within the 7–27 per cent range of the loam textured class; some sandy loams may occur where the silt fraction is low.

Generally in the range of 20 to 40 me/100 g in the A horizon, the base exchange capacity varies somewhat with depth. The pH values of 5·0–5·6 in the surface rise to about pH 6·0 in the C horizon. The moderately acid conditions are reflected by the data for the degree of base saturation which is moderately high, rising from 30–50 per cent in the surface to 50–80 per cent at depth. The exchangeable bases calcium, magnesium, sodium and potassium occur rather irregularly but are usually present in high to moderate amounts. Values for calcium rise down the profile.

The organic content of the surface is moderate to high and has a low carbon:nitrogen ratio (10–12). There are high to moderate amounts of total phosphorus, but only a low proportion of this is readily soluble.

The clay fraction has a fairly uniform sesquioxide content throughout the profile. Silica however is much more abundant in the surface layers than in the C horizon, and accounts for the higher silica:sesquioxide ratios in the A and B horizons.

There is no evidence of differential leaching and accumulation of sesquioxides in the profile, but the silica:iron oxide ratio is low in comparison with other soils in the region and is probably a reflection of the low silica percentage in the parent spilitic lavas. A comparison of the percentage of silica, iron and aluminium oxides in the weathering products, *ie* the clay fraction, with those in the original spilitic lava (Appendix VI) shows that there has been a considerable concentration of iron relative to silica.

BAIDLAND SERIES

Data for only one profile (No. 52) of this series in the area are available. The important features are the high acidity (pH 4·0–4·5) and low base saturation (<9 per cent), together with a high exchange capacity (90 me/100 g soil) in the raw humus horizon, with lower values in the mineral soil. The amounts of the principal exchangeable bases are moderate to high in the organic horizon, but the lower horizons are very impoverished. Both the total and readily soluble phosphorus values are medium in the surface layer, but the lower horizons are very low in readily soluble phosphorus.

DUNLOP SERIES

This fairly fine-textured soil has a clay content in the range of 25–35 per cent with silt (U.S.D.A.) between 30 and 40 per cent. Where the till is shallow much smaller clay percentages are found in the lower horizons.

The exchange complex has a capacity of between 20 and 30 me/100 g soil in the surface, which falls only slowly with depth. The degree of saturation is high (50–90 per cent) in the A horizon, rising to 100 per cent at depth, and the pH of 5·5 in the surface rises to near neutrality at 24 inches. Values for exchangeable calcium, magnesium and sodium are medium to high in the surface horizon, and the potassium status is moderate. On passing down the profile the amount of calcium becomes moderate or low, while the exchangeable magnesium values are high or very high in the C horizon, reflecting the serpentine influence in the parent till. Sodium and potassium levels are medium to low in the subsoil.

The organic content is generally moderate in cultivated soils but may be high under semi-natural conditions; the carbon:nitrogen ratio (10–11) is low. Total phosphorus is moderate in the upper horizons but becomes low in the subsoil layers; readily soluble phosphorus, on the other hand, is low in the A horizon, apart from where heavy dressings of fertilizer have been used, and high in the subsoil.

The small but steady increase in the silica:sesquioxide ratio in the clay fraction down the profile, together with the fairly steady percentages of iron and aluminium, indicates that weathering and leaching are proceeding consistently down the profile with no fluctuations of intensity in different horizons. The percentage silica is lowest and the percentage iron highest in the surface horizon where weathering has probably been most active.

AMLAIRD SERIES

The clay content of this soil is generally between 27 and 40 per cent except in the basal layers of very shallow tills when it may fall to 10–15 per cent.

The base exchange capacity in the surface is generally high (30–50 me/100 g soil), and may be even higher if the organic content is very high. These values fall slowly with depth to about 15 me/100 g soil. The exchange complex is about 50 per cent saturated in the organo-mineral horizon and fully saturated in the subsoil layers. The pH values follow a very similar trend, rising from 5·5 in the surface to near neutral at 24 inches.

Of the exchangeable bases, the calcium, magnesium and sodium contents are high in the surface and the potassium moderate. In the subsoil calcium and potassium are low, sodium moderate and magnesium very high. The serpentine influence is very marked in the samples of this series—values for exchangeable magnesium exceed calcium even in the surface.

The organic content (16–25 per cent) is high in the surface and has a low carbon:nitrogen ratio. Total phosphorus is moderate to low in the surface and low in the subsoil layers, while readily soluble phosphorus is low in the surface and becomes very high (up to 60 mg P_2O_5/100 g soil) in the parent material.

The percentage of sesquioxides in the clay fraction is highest in the surface horizon and falls steadily with depth, while the silica:iron oxide and silica: alumina ratios are at a minimum in the A horizon and rise gradually down the profile. Weathering thus appears to be most intense in the surface horizons. The low figures for alumina in the clay fraction probably reflect the fairly high proportion of serpentine, a rock low in aluminium (Appendix VI), in the parent material.

MYRES SERIES

In this area these soils are developed on shallow till and have a range of texture, but the values for clay reach a peak in the B_2g horizon.

The base exchange capacity is high (70–80 me/100 g soil) in the organic layer and falls to medium (20–40 me/100 g soil) down the profile. The base saturation varies widely from 20–80 per cent in the surface but rises to near complete saturation in the subsoil. The pH values behave similarly, ranging from pH 4·0–6·0 in the surface and rising to pH 6·0–6·5 in the C horizon.

The carbon:nitrogen ratio varies from 10 to 22 in the peat layer. Total phosphorus is medium (200 mg P_2O_5/100 g soil) in this layer, but becomes low (50 mg P_2O_5/100 g soil) in the mineral soil. Readily soluble phosphorus follows the reverse trend, being low in the surface and rising to high in the C horizon.

Darvel Association

DARVEL SERIES

Only a very small area of this soil has been mapped and the analytical data available are limited. The main chemical features of the series are a very low clay content, a moderate to low capacity of the exchange complex, which is highly saturated, and a high pH value. Values for the exchange capacity decline with depth to very low. The content of exchangeable bases is low except in the A horizon where calcium and magnesium values are high and medium respectively, most probably due to lime application.

The organic content is low with a low carbon:nitrogen ratio. Total phosphorus is high in the surface, and readily soluble phosphorus high throughout the profile.

Dreghorn Association

DREGHORN SERIES

The upper 18 inches of soil have a clay content of about 12 per cent; below this depth it appears to be much less. The soil status with respect to pH, base exchange, and phosphate has probably been much modified in recent years by frequent large fertilizer applications for the growth of potato crops.

The base exchange capacity is moderate to low and declines with depth, while the degree of saturation is high and rises slightly on passing down the profile. The pH rises from 6·0 in the surface to 6·6 in the parent material. The contents of exchangeable calcium, magnesium, sodium, and potassium are all high to moderate in the A horizon and decrease at depth.

The organic content is low and in relation to pH has a high carbon: nitrogen ratio (14). Both total and readily soluble phosphorus are high in the surface and decrease with depth.

Ettrick Association

LINHOPE SERIES

The parent material of this series is of sandy loam or loam texture, with a clay content of 7–15 per cent which generally shows little change through the profile, but in some instances may rise to 27 per cent.

The base exchange capacity of the A or S horizon lies between 20 and 32 me/100 g soil, but may rise to over 60 me in the thin H layer when this is present. The exchange capacity falls with depth to very low values, usually less than 5 me/100 g. The degree of saturation of the exchange complex in the uncultivated soil is low in the surface horizons, generally less than 20 per cent and often as low as 5 per cent, and may fall to very low in the parent material. The surface horizons of cultivated soils have a markedly higher but variable degree of saturation, due probably to lime and fertilizer application. Under semi-natural conditions the soil is acid to very acid (pH 4·0–5·0) in the surface. The pH values usually rise slightly with depth but occasionally show a fall. The cultivated soils normally have medium to low pH values which vary little with depth.

The surface horizons have the highest content of exchangeable bases, and of these calcium shows a wide range of variation from high to low, magnesium is moderate to low, and sodium and potassium are moderate. These values fall sharply on passing from the A or S horizon to the B and C horizons.

The semi-natural and infrequently cultivated soils have a high organic matter content in the surface horizons, particularly in the top 2 to 3 inches where values as high as 18–24 per cent may occur. The carbon: nitrogen ratio usually lies between 13 and 18, reflecting the moderately acid conditions. A few more frequently cultivated soils have a low to moderate organic content, with a correspondingly lower carbon:nitrogen ratio.

The total phosphorus status of these soils varies considerably between medium and high (150–400 mg P_2O_5/100 g soil) in the surface horizons, but more consistent medium values obtain in the B and C horizons. The figures for readily soluble phosphorus are almost invariably low.

The data for the profile on which the silica and sesquioxide analyses of the clay fraction were carried out show that iron and aluminium have been leached from the A horizon, that there is strong accumulation of iron in the B_2 horizon and, to a lesser extent, aluminium accumulation in the B_2 and B_3 horizons. These findings are unusual for a soil with the morphology of a brown forest soil (Muir and Fraser, 1939; Glentworth, (1954), and also differ from the findings of Ragg (1960) and Muir (1956) for this series in east Scotland. It therefore seems likely that the profile analysed was in an area reclaimed from the peaty podzol Dod series, and that over a considerable period its morphology has been so altered as to make it appear identical with Linhope series.

DOD SERIES

The series is developed on similar parent materials to Linhope series, and the clay content is usually below 10 per cent in the C horizon on morainic materials rising to 10–15 per cent near the surface. On tills and solifluction deposits, clay contents of up to 20 per cent are common and occasionally higher values are found. The base exchange capacity of the peaty surface horizon is very high, most commonly between 70 and 100 me/100 g soil, with a few values outside this range. Parallel with the decrease in organic content is a sharp fall in exchange capacity on passing down into the mineral soil, but washed-in organic matter may contribute to exchange capacities of between 30 and 60 me/100 g soil in the upper mineral layers, while less than 10 me are found in the C horizon. Very acid conditions prevail throughout the profile; the pH is 3·5–4·0 in the peat layer and rises slightly to pH 4·0–5·0 in the C horizon. Following a similar trend the base saturation is usually less than 10 per cent in the surface and falls down the profile to less than 5 per cent. A few instances in which the percentage base saturation is between 20 and 40 per cent in the peat layer are probably the result of burning. The exchange complex is characterized by relatively high sodium, medium to high potassium and medium magnesium, but calcium values are low. However, in those cases in which the percentage saturation is markedly greater than the average for the series in this area, all the above bases may be present in relatively large amounts. The analyses for the parent materials all show very low values for the exchangeable bases.

As would be expected under these very acid conditions the carbon: nitrogen ratio of the peaty layer is very high, most commonly between 20 and 25. The organic matter is mainly restricted to the peaty surface horizon, with some material washed into the upper mineral layers.

Both total and readily soluble phosphorus are high to medium in the organic horizon and decrease in the mineral soil. Total phosphorus tends to show minimum values in the A_2g horizon, probably because of its greater solubility under wet conditions, and in the B horizon fixation by iron and aluminium seems the probable cause of the minimum values for readily soluble phosphorus.

The figures for the silica and sesquioxides in the clay fraction show that iron has been intensively leached from the A_2g horizon and deposited in the B_2 and B_3 horizons. The movement of aluminium is not so apparent, but, relative to silica, there has been some movement from the A to the B_2 and B_3 horizons. These results confirm the inferences made from the study of profile morphology.

ALTIMEG SERIES

The Altimeg series is characterized by loamy textures, with a clay content of between 18 and 30 per cent, and sand and silt (U.S.D.A.) often present in approximately equal amounts.

The base exchange capacity is between 13 and 20 me/100 g soil in the organo-mineral A or S horizon and decreases down the profile to about 5 me in the parent material. The soil is acid—pH 5·0 being general in the A horizon (pH 6·0–6·5 may occur in some cultivated areas)—and varies little down the profile. On cultivated soils base saturation is between 30 and 60 per cent and there is little evidence of any general trend with depth; very low base saturation values (less than 5 per cent *eg* No. 20) may obtain on unlimed rarely cultivated areas. Under cultivation the values for exchangeable calcium, magnesium, sodium, and potassium are high to medium in the surface. The behaviour of these bases with depth varies, calcium showing only a moderate fall, magnesium a minimum value in the B_3, potassium a marked fall, and sodium changing little. The effects of fertilizer treatment on the exchange complex are seen to be quite substantial when comparison is made with rarely cultivated soils where the content of exchangeable ions appears to be low throughout the profile.

The organic matter content of the A horizon is moderate, 8–13 per cent, and has a low carbon:nitrogen ratio (10–14); under semi-natural conditions the values are higher.

The total phosphorus status is moderate to high in the surface and moderate in the subsoil. The readily soluble phosphorus is moderate in the surface of cultivated soils but low in the A horizon of uncultivated soils. In both cases medium values for readily soluble phosphorus occur in the subsoil.

The silica:sesquioxide analyses of the clay fraction show that the percentage of iron is rather low and that of aluminium a maximum in the A horizon. There are however no clear differential movements of sesquioxides or silica, nor are there any obvious horizons of accumulation.

KEDSLIE SERIES

In this area the clay content of the Kedslie series varies between 25 and 35 per cent and shows little change with depth. Some soils with clay contents in the lower part of this range often show field characteristics typical of soils with finer texture. The silt (U.S.D.A.) content is generally between 30 and 40 per cent.

The base exchange capacity lies between 15 and 25 me/100 g and shows no clear trend with depth. The surface horizons are moderately acid, with pH values of 5·0–5·5 rising with depth to 6·0–6·5. A similar trend is shown by the values for base saturation, which rise from 40–64 per cent in the surface to 70–100 per cent in the parent material. The surface horizons have a moderate content of the principal exchangeable bases with some high values for calcium. The magnesium status rises markedly with depth but in general the other ions show little change.

The organic content is moderate to low with fairly low carbon: nitrogen ratios of between 10 and 14. Total phosphorus is moderate in the surface horizons but decreases to a minimum in the B horizons. Values for readily soluble phosphorus are low throughout the profile, although there may be some rise in the C horizon.

The results of silica:sesquioxide analyses of the clay fraction show that relative to silica there has been little or no leaching of iron and aluminium from the surface layers. There has however been some differential accumulation of iron in the B_2(g) horizon, probably in association with ochreous mottles, and of aluminium at a somewhat lower level in the horizon.

ETTRICK SERIES

In the field this soil generally behaves as a clay loam, and laboratory determinations of the percentage clay are generally in the range 27–35 per cent, although a number of lower values occur. Silt (U.S.D.A.) is usually between 30 and 40 per cent.

The base exchange capacity of 15–25 per cent changes only irregularly with depth, any decrease due to a fall in organic content being made up by increasing clay content. Moderately acid conditions prevail throughout the profile, the surface pH of 5·5 rising with depth to about 6·5. There is a parallel trend in the degree of base saturation, from 35–70 per cent to 70–100 per cent. The organic content is moderate (10–12 per cent) and has a carbon:nitrogen ratio in the middle range. The surface soil has a moderate total phosphorus content which falls markedly in the subsoil, whereas the values for readily soluble phosphorus, which are low in the surface, increase down the profile.

The figures for the silica:sesquioxide percentage in the clay fraction show no clear trends pointing to differential movement of constituents, but the silica:iron oxide ratios are at a minimum in the B_2g, thus showing accumulation of iron, probably in association with ochreous mottles.

LITTLESHALLOCH SERIES

This series generally has a clay content of 15–25 per cent, but values outside this range do occasionally occur. The sand (U.S.D.A.) is between 40 and 50 per cent. The base exchange capacity is between 15 and 30 me/100 g in the surface and falls to 5 me in the parent material. The soil is acid, having a pH of 4·5–5·0 in the A horizon rising to 5·5–6·0 in the parent material. The degree of base saturation is between 15 and 30 per cent and there is no evident trend with depth, although in some profiles there is a steady rise to fairly high values. The calcium status of the soil is low in both topsoil and subsoil, although locally this may be modified by lime applications. Magnesium and potassium are moderate throughout the profile and sodium is relatively high.

Both the organic content and the carbon:nitrogen ratios appear to vary widely; organic matter values ranging from 10–25 per cent and carbon: nitrogen ratios of 10–20 have been found.

Much of the total phosphorus, which is generally high in the surface and falls markedly with depth, is probably associated with organic matter. Some profiles (No. 30) do not show this trend. Readily soluble phosphorus, which is generally low in the surface horizon, may show a marked rise with depth.

Relatively small amounts of iron and aluminium appear to have been leached from the A horizon. The high iron in the B_2g is probably due to iron oxides segregated as ochreous mottles and iron tubules.

ALEMOOR SERIES

A fairly fine-textured soil, Alemoor series has a clay content in this area of between 27 and 35 per cent, with no general trend associated with depth, and a silt (U.S.D.A.) fraction of 30–40 per cent.

The organic layer has a high base exchange capacity of 50–90 me/100 g which falls markedly to moderate (15–30 me/100 g) in the mineral horizons. The degree of acidity which is high (pH 4·0) in the surface becomes gradually less with depth, the C horizon having a pH of 5·5–6·5. Parallel with this, the degree of base saturation which is low (5–15 per cent) near the surface rises to nearly 100 per cent in the parent material. The values for exchangeable calcium are low to medium in the organic surface horizons and rise with depth from a minimum in the A_2g to become high in the parent till. Values for exchangeable magnesium, while high to medium in the organic surface horizon, show a marked rise with depth to exceed the values for calcium. This is unusual and probably indicates that the parent shale and greywacke was derived in part from local serpentine rocks. Sodium and potassium values are fairly high throughout the profile but show a minimum in the A_2g.

The peaty surface horizon has a high carbon:nitrogen ratio of about 20.

Total phosphorus is moderate in the peaty layer, low in the gleyed A_2g and B_2g horizons, and may rise somewhat in the parent material. The values for readily soluble phosphorus have a wide range in the surface, are low in the upper mineral layers, but may show some rise in the C horizon.

There is little differential movement of sesquioxides relative to silica in the clay fraction in the deeper layers of this profile, although the A_2g has a lower iron and a higher aluminium content than underlying horizons. This agrees well with the findings of Muir (1956) and Ragg (1960) for Hardlee series, a closely related soil.

DOCHROYLE SERIES

Developed on loam parent materials, this soil has a clay content usually between 15 and 27 per cent, although higher values occur, particularly at depth. Occasional profiles (No. 38) have very low clay contents. The silt (U.S.D.A.) content is usually between 30 and 40 per cent.

The base exchange capacity of the organic surface layer lies between 60 and 80 me/100 g and its fall with depth is parallel to the fall in organic content to about 5 me/100 g soil. Very low pH values of 3·5–4·2 occur in the peaty layer, but these rise somewhat down the profile to 4·7–5·3. The base saturation is also very low throughout the solum, generally below 10 per cent and often less than 5 per cent, although higher values occasionally occur in the parent material.

In the organic layer, values for exchangeable calcium are low, magnesium and potassium medium, and sodium relatively high. All values show a sharp fall in the mineral soil, which is impoverished of all exchangeable bases.

The carbon:nitrogen ratios of the peat are variable but mainly in the range 15–25. The peat layer also has a high to moderate total phosphorus status, but values become low in the A_2g and B_2g horizons, where the wet conditions lead to mobilization and leaching. Some rise in total phosphorus values is found in the C horizon. Readily soluble phosphorus is generally low in the upper horizons with medium to high values in the parent material.

The silica and sesquioxides of the clay fraction were analysed on samples from two profiles of this series. One profile (No. 40) shows strong leaching of iron from the A_2g horizon, and a maximum aluminium content in this layer. These trends are much less obvious in the other profile of this series which was analysed in which there has not only been some leaching of iron from the A_2g but also considerable accumulation in the B_2g. This feature was not suspected from the profile morphology and is difficult to explain. The values for aluminium show a slight maximum in the B_2g horizon of this profile.

MERRICK SERIES

Developed under conditions of intense physical and weak chemical weathering this soil has a low clay content, generally less than 10 per cent.

The base exchange properties are therefore associated mainly with the organic matter. The humose layers have a fairly high capacity, 30–50 me/100 g, but values in the parent material are usually only about 5 me/100 g. Very acid conditions prevail throughout the profile, the pH of about 4 in the surface rising to about 5 in the C horizon. Similarly both the degree of base saturation (<5 per cent) and the exchangeable base content are very low throughout the soil.

The organic content in the upper part of the humose layer is high, between 20 and 30 per cent, while values in the lower part of the horizon are slightly less. The carbon:nitrogen ratios are variable but are generally high. Throughout the profile total phosphorus values are medium and readily soluble phosphorus is low.

The most striking feature of the silica and sesquioxide analyses of the clay fraction is the high iron content of the humose layers of the profile and in particular the marked iron accumulation at the base of this horizon, as shown by the very definite minimum value for the silica:iron oxide ratio. In contrast to iron, the aluminium content of the humose layer is very much less than in the parent material, although it should be noted that the C horizon of this profile has a higher aluminium content than that of any other profile of this association. The amount of chemical weathering and translocation indicated by these analyses is higher than might have been inferred from profile morphology and consideration of environmental factors.

Glenalmond Association

This association covers a relatively small proportion of the area under consideration, and includes soils from a number of major soil groups.

In the field, there is a clear distinction between the textures of the Meadownay and Hadyard series developed on sandstone weathering *in situ*, together with the upper horizons of the Tranew and Gallowshill series formed on modified till, and those of the Glenalmond, Altiwan and Spallander series developed directly on till. This distinction is much less clearly seen from the analytical determinations of the soil separates. The difficulty is probably due to the fragments of weathering sandstone which appear as stones in the field but behave as incoherent material in the laboratory.

The Spallander and Hadyard series have high (70–100 me/100 g) base exchange capacities in the surface organic layers, and values decrease with depth to become very low in the B_3 and C horizons. The organo-mineral surface soils of the other series of the association have a low to moderate (10–18 me/100 g) base exchange capacity, which in the freely drained Meadownay and Tranew series decreases down the profile to very low values (5 me/100 g) and in the imperfectly and poorly drained Glenalmond, Gallowshill and Altiwan series decreases only slightly with depth.

Hadyard and Spallander series are the most acid (pH 3·6–4·2) and the least base saturated (7–15 per cent) soils of the association. pH values increase with depth in both, but whereas base saturation decreases with depth in the peaty podzol Hadyard series it increases somewhat in the lower layers of the peaty gley Spallander series. In the other soils of the association both the pH value (5·0–6·5) and the degree of base saturation (25–75 per cent) are medium to high in the surface and increase with depth. Occasional lower values occur in the freely drained Meadownay and Tranew series.

The exchangeable base content is very low throughout the peaty podzol Hadyard series. In the Spallander series calcium, magnesium and sodium values are medium and potassium high in the organic surface layer, but the values fall to low in the A_2g; calcium and magnesium values show some rise with depth. The freely drained Meadownay and Tranew series generally have a low base status, and the values for calcium and magnesium increase with depth; markedly higher values may be obtained where repeated applications of fertilizer have been made. In the remaining soils, the Glenalmond, Gallowshill and Altiwan series, the exchangeable bases are generally moderate to high in the surface; sodium and potassium decrease to low values with depth and calcium and magnesium increase consistently down the profile, although where fertilizer applications have been made there may be an initial fall below the S horizon. Carbon: nitrogen ratios are high in the organic horizons of Hadyard and Spallander series, and in the other soils of the association are low in the organo-mineral layers in which the total organic content is generally low.

The parent materials of this association are generally low in both total and readily soluble phosphorus, although somewhat higher values for readily soluble phosphorus may be found under conditions of poor drainage. In the surface horizons values for total phosphorus are generally medium, except in raw humus layers and where fertilizers have been applied, when they may be high; readily soluble phosphorus values vary widely.

Knockskae Association

The Knockskae and Turgeny series, developed on stony rock rubble under conditions of free drainage, have clay contents less than 10 per cent. In the Whiterow and Palmullan series, under poor drainage conditions, clay percentages are between 15 and 22 per cent.

The base exchange capacities of the organic layers of Turgeny and Palmullan series are high (60–90 me/100 g) but values decline with depth to become low (5 me/100 g) in the C horizon. In the Whiterow series, exchange capacities are moderate to low and change irregularly with depth, while in the Knockskae series values are medium to high and decline slightly with depth. The Knockskae and Turgeny series have a low degree of saturation of the exchange complex (< 5 per cent) throughout the profile, except in the organic layer of the Turgeny series, and are very acid; pH values rise from 4·3–4·5 to 4·8–5·0 with depth. The Palmullan series is also acid (pH 3·9), but the base saturation is moderate in the organic layer and, after a fall to low values in the A_1g and A_2g, rises with depth. The Whiterow series is less acid (pH 5·5) and has a relatively high degree of base saturation which varies irregularly with depth. Values for exchangeable bases vary considerably, but in the freely drained Knockskae and Turgeny series they fall to very low levels in the parent material, while in the poorly drained Palmullan and Whiterow series the values for exchangeable calcium and magnesium rise from the A_2g to the C horizon.

Under the prevailing acid conditions, carbon:nitrogen ratios are high, except in Whiterow series where the low ratio is probably due to the 'flush' conditions at the site sampled. The Whiterow series is very low in both total and readily soluble phosphorus throughout the profile. While medium to high values may prevail for both phosphorus fractions in the surface horizons of the Turgeny and Palmullan series, at depth their phosphorus status is similar to that of the Whiterow series. The values for total phosphorus are medium to high in all horizons of the Knockskae series.

Linfern Complex

The principal soils of this complex are a peaty podzol and a brown forest soil, neither of which has been given a series name. Both soils have however been sampled and analysed. The results available show that the clay content is low (<10 per cent) in both soils, and that the pH values and degree of saturation of the exchange complex are also very low. The base exchange capacity, however, is fairly high in the surface horizons (40–60 me/100 g) but declines to low values in the parent material. Exchangeable bases are present only in trace amounts in the C horizon, but moderate amounts of magnesium, sodium and potassium are found in the surface layers; calcium, however, is very low.

The organic matter content is very high in the H horizons of the peaty podzol profiles and in the upper 5 inches of the brown forest soil, and the carbon:nitrogen ratio is moderate. The organic-rich horizons have a high content of total phosphorus of which moderate to low quantities are readily soluble.

Links

This soil is developed on blown sand and clay is not present in sufficient quantity for measurement. Below 6 inches the soil is 100 per cent sand.

The content of exchangeable bases is low throughout the profile, except in the top 4 inches of soil in which calcium, magnesium, and potassium are present in moderate amounts and sodium (0·26 me/100 g) is relatively high. The samples were taken close to the shore and the high exchangeable sodium values may in part reflect the effect of sea spray. The total exchange capacity of the soil is very low and the small quantities of bases present are sufficient for complete saturation below 4 inches, while the pH rises with depth from 5·7 to 6·4.

The organic content of the surface layer is very low (4 per cent) and while values for total phosphorus are low throughout the profile, readily soluble phosphorus is medium and rises slightly with depth.

Alluvium

The clay content varies from 12–17 per cent in the surface to 4–8 per cent at 2 feet, and there is a similar marked decline in the silt content down the profile.

The content of exchangeable bases is moderate in the surface, but there is considerable variation between different sites. The values generally fall with depth but rise again somewhat at about 24 inches. The base exchange capacity is moderate to low in the surface and declines to low values in the parent material, while the percentage saturation rises from 40–56 per cent in the surface to about 80 per cent at depth. The pH values show a similar trend, from 5·6 in the moderately acid surface layer to about 6·0 in the C horizon.

The surface horizon has a moderate organic content but this decreases rapidly with depth. The values for total phosphorus are generally medium to low but one high value was found in a surface sample (No. 63). Readily soluble phosphorus tends to decline down the profile; values in the surface range from 9–45 mg P_2O_5/100 g soil.

Peat

Exchangeable calcium is moderate to high in the upper 6 inches and declines to moderate to low at about 2 feet, while exchangeable magnesium, sodium, and potassium are high in the surface layer and decline with depth, although the magnesium values alter less than those of the other ions. An interesting feature of these results is that the amount of exchangeable magnesium generally exceeds that of the exchangeable calcium. The exchange capacity is very high (100 me/100 g) and is little affected by depth, but the degree of saturation is low (20 per cent) and declines irregularly with depth. It is clear, therefore, that the high amount of exchangeable hydrogen accounts for the high acidity of the material (pH 3·7–4·0).

Under the very acid conditions the carbon:nitrogen ratio is commonly in the range of 20–25. Total phosphorus is usually medium to low throughout the profile, but high values for readily soluble phosphorus commonly occur in the top 6 inches of the material.

Major Soil sub-groups: Summary of Analytical Data

Brown Forest Soils, Freely Drained

The clay content of these soils is generally under 27 per cent and may often be less than 10 per cent in the parent materials.

The base exchange capacity of the surface soils is moderate, in the range 15–30 me/100 g soil, and is closely linked with the organic content of the soil. It is generally greater under semi-natural conditions than in cultivated areas, and where a thin layer of raw humus is present may rise as high as 70 me/100 g soil. These values decline on passing down the profile, generally to very low amounts in coarse textured intermediate and acid parent materials, although the fall is rather less in soils developed on basic parent materials. The soils are strongly leached and under semi-natural conditions the A horizons have a low degree of base saturation, generally less than 30 per cent on acid and intermediate parent materials, but frequently between 30 and 50 per cent on materials derived from basic rocks. In the former group of soils the degree of saturation may fall on passing down the profile while in the latter, more basic group it may rise. The soils are acid, the pH in the surface horizon being generally 4·5–5·5, with rather higher values occurring in soils under cultivation and in some soils developed on basic materials.

The content of exchangeable bases varies fairly widely; under semi-natural conditions exchangeable calcium and magnesium are generally low to moderate in the surface soil and fall to low or very low values with depth. Some soils developed on basic parent materials, however, may have rather higher amounts of these ions in the surface and the values may rise in the subsoil. The values for exchangeable sodium and potassium may be medium to high in the top 3 to 4 inches of uncultivated soils but fall in the deeper horizons (soils developed on basic materials may show different trends). The amounts of these ions are often considerably lower in cultivated surface horizons.

The organic content of the surface layers is generally high, 15–23 per cent, but falls to moderate or low where cultivation is common. The carbon:nitrogen ratios are usually moderate (12–15), with rather higher or lower values associated with unusually high or low amounts respectively of organic matter.

Total phosphorus is generally medium to high in the surface horizons, the high values being associated with cultivation or basic parent materials. Values generally decline somewhat with depth to become medium or low, but where soils occur on basic parent materials little change may be found. Readily soluble phosphorus is usually low, although some high values may occur in 'H' horizons.

Brown Forest Soils with Gleyed B and C Horizons

Although in this area there is a greater amount of clay in the brown forest soils with imperfect drainage and consequent gleying in the B and C horizons than in the freely drained brown forest soils discussed above, the range is 22–33 per cent, rather lower than that commonly found in central and north Ayrshire (Mitchell and Jarvis, 1956; Grant, in preparation).

The base exchange capacity is generally between 15 and 30 me/100 g soil in the surface and declines somewhat with depth; the fall is most marked in the Altimeg series. The soils are less intensely leached than the brown forest soils with free drainage; the degree of saturation of the exchange complex is usually between 40 and 70 per cent in the surface and rises down the profile to 70–100 per cent. Some profiles of the Altimeg series may show a decline in values with depth. The soils are only moderately acid, pH 5·0–5·8, in the surface and in the subsoil may be near neutral.

The values for exchangeable calcium are medium to high and generally decline with depth, but in some cases (*eg* the Glenalmond series) a rise may occur. The values of exchangeable magnesium are generally medium in the topsoil rising to high with depth; some profiles of the Dunlop series (Nos. 17 and 18) in the Girvan-Colmonell-Lendalfoot area have exceptionally large amounts. Exchangeable sodium and potassium are present in variable amounts and changes with depth tend to be irregular.

The organic content is commonly moderate to low (5–10 per cent) with carbon:nitrogen ratios in the range 10 to 14. Total phosphorus, which is moderate in the A horizon, may fall to low amounts in the subsoil, while readily soluble phosphorus, which is low in the surface, usually rises in the subsoil, often to very high values. Cultivation may occasionally alter this pattern.

Iron Podzols

The iron podzols are of relatively minor extent in the area under consideration, and the profiles are very similar to those of the freely drained brown forest soils. This likeness is also apparent in their chemical characteristics.

The clay contents are generally between 10 and 20 per cent.

The base exchange capacity of the surface layers is between 10 and 20 me/100 g soil and declines to 5 me/100 g in the subsoil, except in the Knockskae series, where the exchange capacity associated with a higher than average organic content is about 40 me/100 g soil in the A horizon and does not decline as greatly with depth. The soils, which are strongly leached, have a low degree of base saturation, less than 15 me/100 g soil in the surface, and this usually decreases with depth, although in the Tranew series a marked rise takes place below 34 inches on passing into the unmodified till. Soil acidity is high; the pH of 4·5 in the surface rises to 5·0–5·5 in the C horizon.

The contents of the exchangeable bases calcium, magnesium, sodium and potassium are low throughout the profile and are generally very low in the C horizon. The basal layers (below 34 inches) of the Tranew series are, however, exceptional in showing a rise in the amounts of exchangeable calcium and magnesium.

The organic content of the surface soil varies from high to low, 21–6 per cent, and the carbon:nitrogen ratio ranges from 10 to 16. Total phosphorus is moderate to high in the surface and shows no regular trend with depth, while readily soluble phosphorus is low to moderate in the surface with no consistent trend with depth.

Peaty Podzols

The peaty podzols are developed most commonly on coarse-textured parent materials having clay contents of less than 10 per cent. They have, however, also been mapped on materials with clay contents of about 20 per cent or greater (*eg* No. 53).

The cation exchange capacity is very high in the surface organic layers, 60–110 me/100 g soil, and falls with depth through medium values, 15–45 me/100 g soil, in the A_2g horizon to very low values, less than 10 me/100 g soil, in the parent material. The degree of saturation, which is low throughout the profile, is commonly between 10 and 20 per cent in the organic layers and falls to less than 10 per cent, and often to less than 5 per cent, in the mineral horizons. These soils are very strongly leached and have a high degree of acidity; the pH value in the organic horizon varies between pH 3·6 and 4·0 and values rise with depth to about 5·0 in the C horizon.

The greater part of the exchangeable bases in the soil occur in the surface organic layer where the values are generally medium to low for exchangeable calcium, medium to high for magnesium, and high for sodium and potassium. The mineral horizons contain only low amounts of each of the exchangeable bases.

The organic content of the surface horizon generally varies between 60 and 90 per cent and has a high carbon:nitrogen ratio (20–25). Total phosphorus is medium in the surface layer and generally declines with depth although the values may show a minimum in the gleyed A_2g horizon where the leaching of iron and aluminium, together with the strong gleying conditions, have rendered the phosphorus more liable to leaching than in the lower horizons. In contrast to the A_2g horizon, a peak value for total phosphorus often occurs in the B horizon, where conditions are aerobic and the high content of free iron and aluminium oxides tends to encourage the fixation of phosphorus. Readily soluble phosphorus is generally medium to high in the organic layer and falls to low values in the mineral horizons; there may be a minimum value in the B horizon.

Non-Calcareous Gleys

Generally developed on medium to fine-textured parent materials, these soils have a clay content ranging from 20–33 per cent. Occasional values occur outside this range, particularly in the Littleshalloch series.

The base exchange capacity of the surface horizon is generally in the range of 15–30 me/100 g soil, but values as high as 60 me/100 g may occur in some humose A horizons. The degree of saturation is in the range 25–70 per cent in the surface and rises to 60–100 per cent in the C horizon. pH values follow a similar trend rising from 4·5–5·5 in the A horizon to 5·5–6·5 in the subsoil. Rather lower values for both saturation of the exchange complex and for pH occur in the Littleshalloch series.

A wide range of exchangeable calcium values occur and these vary widely from low to high, while with depth they show no consistent trend. The exchangeable magnesium is generally in the moderate to low range in the surface soil and commonly increases with depth. The Amlaird series (No. 29), however, is exceptional in this area.

Under semi-natural conditions the values for exchangeable sodium and potassium are medium to high in the surface and decrease with depth.

Both the total amount of organic matter and the carbon:nitrogen ratio vary widely in this group of soils. Trends in the phosphorus values, however, are fairly uniform; total phosphorus is medium to high in the surface horizons and falls to low values in the subsoil whereas readily soluble phosphorus is low in the surface and very high in the subsoil.

Peaty Gleys

These soils are generally developed on fine-textured parent materials having a clay content greater than 20 per cent. In the hill districts of this area, however, the contents of clay may be as low as 10 per cent (*eg* No. 36).

In the peaty surface horizon the base exchange capacity is very high, between 70 and 100 me/100 g soil, but it falls abruptly on passing into the mineral soil and generally reaches very low values in the Cg horizon. The degree of saturation is low in the surface, only rarely exceeding 15 per cent, but with depth a marked rise occurs often to nearly 90 per cent saturation in the C horizon. In one series, the Dochroyle, the behaviour is different. The peaty layers are all strongly acid, pH values being generally between 3·7 and 4·3. In the mineral soil, however, the degree of acidity generally falls with depth; pH values of 5·5 to 6·5 are common in the C horizon.

The content of exchangeable bases is moderate to high in the organic surface horizon, but there is a sharp fall to low values in the A_2g horizon. In the lower layers the amounts of exchangeable calcium and magnesium show some rise but Myres series (No. 37) and Alemoor series (No. 42) are exceptionally high. Sodium and potassium generally remain low throughout the 'mineral' soil.

The organic content of the H layer is of course very high, the amounts found ranging from 50–90 per cent and the carbon:nitrogen ratios are high, between 15 and 24. Appreciable amounts, although generally less than 10 per cent, of organic matter are also present in the A_2g horizon. Total phosphorus is high in the organic horizon but values fall to a minimum, which is generally low to medium in amount, in the A_2g or B_2g horizons. Below this a slight rise occurs in the B_3g and Cg horizons. The amount of readily soluble phosphorus in the surface layer varies widely from high to low, and generally shows a rise with depth, although minimum values often occur in the A_2g horizon.

Sub-Alpine Soils

The sub-alpine soils are developed on parent materials thought to have been formed under periglacial conditions. These materials are relatively uniform in texture and are characterized by low clay contents (less than 7 per cent) and high amounts of silt as measured on the American scale.

The humose layers have a fairly high base exchange capacity, generally between 26 and 50 me/100 g soil, but this becomes low in the parent material. The soils are very strongly leached, for the degree of base saturation is less than 10 per cent in the surface and falls to less than 5 per cent in the C horizon, while the pH is about 4·0 in the topsoil and rises to near 5·0 in the parent material. The amounts of exchangeable bases are generally low throughout the profile, although some medium values for magnesium, sodium, and potassium may occur in the surface layer.

The organic content of the upper 18–24 inches is generally between 12 and 25 per cent and has a high carbon:nitrogen ratio (15–25). Moderate amounts of total phosphorus occur throughout the profile and there is no clear trend with depth, while amounts of readily soluble phosphorus are generally low, with medium values sometimes occurring in the top 5 inches of the profile.

MINERALOGY OF THE CLAY FRACTION ($<1.4\mu$.)

The clay mineralogy of the predominant soil associations of the area has been investigated (Appendix V), 17 soil profiles from five associations being examined by X-ray diffraction and thermal methods of analysis. The profiles were selected so as to characterize and distinguish soil differences at various categorical levels in particular major soil groups and sub-groups. The principal parent material is glacial drift derived from Ordovician and Silurian shales and greywackes, with smaller areas of drift from granites, basic igneous rocks and Old Red Sandstone sediments.

The assemblages of clay minerals can be correlated broadly with the mineralogy of the parent materials and where these correlations obtain they result from the inheritance of clay minerals from the parent rocks with little structural alteration but frequently with variations in their proportions.

Many of the soils in this area appear to contain a large proportion of very poorly crystallized inorganic material, frequently associated with high organic matter contents in the upper horizons. This makes quantitative estimation of the proportions of clay minerals in such soils almost impossible. For this reason the results quoted in Table 17 are not expressed numerically. The nature of this 'X-ray amorphous' fraction of these soils is not well known and from differential thermal analysis it does not appear to be as highly hydrated as allophane.

The soils of two associations in the area are developed on parent material of basic igneous origin; those of the Darleith Association formed on materials derived from basic igneous rocks and those of the Benan Association formed on materials derived from Ordovician conglomerates composed largely of boulders of basic igneous rocks. Within the Benan Association, chlorite predominates in freely and imperfectly drained brown forest soils and in the poorly drained non-calcareous gley. Montmorillonite was found only in the imperfectly and poorly drained members and gibbsite in the Bg horizon of the Minuntion series. The same drainage classes within the Darleith Association were examined, and in these vermiculite predominates in the freely drained brown forest soil, while montmorillonite is the principal mineral in the imperfectly and poorly drained representatives. The scarcity of illite in these associations is typical of soils derived from basic igneous rocks, presumably because of their low potash content.

The soils of the Dalbeattie Association are developed on granitic rocks and their tills, and both the brown forest soil and peaty podzol examined are highly leached. Although their clay mineralogy is similar to the Countesswells soils, *ie* illite, vermiculite and kaolin, the Ayrshire soils appear to contain a much higher proportion of poorly crystallized material. Neither gibbsite nor goethite were detected in any horizon of these soils.

Although the soils of the Ettrick Association are divided on a parent material basis into a morainic and a till phase and contain representatives of the sub-groups brown forest soils (freely and imperfectly drained), peaty podzols, non-calcareous gleys and peaty gleys, the clay mineralogy of the soils is remarkably constant. Illite predominates with chlorite, kaolin and a small amount of gibbsite invariably present. All the poorly drained sub-groups have in addition a small amount of montmorillonite. The Merrick series is an example of a sub-alpine soil in the area and has a very distinctive clay mineralogy. It contains a large amount of poorly crystallized material, especially in the surface horizons. The basal horizon contains, in addition, 20–25 per cent gibbsite along with small amounts of illite, chlorite and kaolin.

In the Glenalmond Association, two soils developed on Old Red Sandstone sediments and their derived tills were analysed. The mineralogy of the dominant series, an imperfectly drained brown forest soil, was found to be dominantly illitic with small amounts of kaolin and chlorite. In contrast the iron podzol soil contained a high proportion of kaolinite with less illite and a little vermiculite. The soils of this association did not seem to have as much poorly crystallized material as the others examined.

THE MINERALOGY OF THE FINE SAND FRACTION

The fine sand fractions of the principal soil series of the area were separated by standard sedimentation procedures and the minerals were identified by their optical properties, using a polarizing microscope. The 75–150μ fraction was isolated by sieving, and was separated into a light and heavy fraction by gravity separation, using tetrabromoethane (S.G. 2·9). The minerals were identified under the microscope and a count was made of the number of grains of each species. For the light fractions, a total of 200 grains was counted, a staining procedure (Reeder and McAllister, 1957) being used to simplify the identification of the three principal components, quartz, potash-feldspar and plagioclase. The heavy fractions always contain a much larger number of species, and a total of 500 grains were identified and counted, care being taken to make a representative random selection of grains.

The results are shown in Appendix IV, the figures representing the relative proportions on an approximately logarithmic frequency scale used to illustrate the proportions of some minerals of diagnostic importance which may be present only to the extent of about one per cent.

It can be seen that quartz is the dominant light mineral, although its content, especially in soils with a large amount of sesquioxides, is occasionally exceeded by unidentifiable weathered and coated grains. If all the grains could be identified, it is probable that quartz would still predominate. The ratio of potash-feldspars to plagioclases varies with the nature of the parent rocks, as would be expected, but this ratio is often uncertain as many of the feldspar grains are too weathered to be recognised.

Heavy mineral fractions normally contain many minerals which serve as indicators of provenance of the parent materials, but in soils from heavily glaciated areas, like the region studied here, the mixing together of drifts from a number of different sources tends to mask these characteristic differences. It should also be remembered that some sedimentary rocks, *eg* the Ordovician and Silurian shales and greywackes in this area, have been derived from various rock types, including both igneous and sedimentary, and may contain a large range of heavy minerals.

The distribution of augite in the different soil associations is interesting. Its occurrence in the Darleith and Benan Associations, derived from basic igneous rocks, and its absence in the granite soils of the Dalbeattie Association are to be expected. Its appearance in the Ettrick Association, however, is very erratic. Tourmaline and rutile are very rare in the Darleith, Benan and Dalbeattie Associations, but occur sporadically in the Ettrick soils.

The figures for zircon show a rather different distribution, being more uniform, and usually higher, in the Ettrick Association than for any of the other associations. This may have resulted from repeated weathering, erosion and transportation in a number of geological cycles leading to a relative concentration of the very resistant zircon in these lower Paleozoic sediments.

Changes in the mineralogy down the profiles of the soils as a result of pedological processes are small. This is generally true for all Scottish soils because of their youthful nature. Only the least stable minerals would be expected to show significant changes. As is seen from the results, apatite, which is fairly soluble in the acid conditions of surface soils, tends to be more abundant in the lower horizons.

TRACE ELEMENTS

Seventeen profiles from nine of the constituent series of the Ettrick Association, the most important in the area, have been examined for trace elements. In these the average total trace element contents in the lower horizons (*ie* generally below 40 cm) are at a level that would be considered normal for Scottish soils in respect of all the elements determined, and are in line with the amounts that would be anticipated in parent materials derived from rocks composed basically of the sandstone-feldspar-ferromagnesian mineral mixture that constitutes greywackes. The biologically essential trace metals have contents around Co 20 ppm, Cu 20 ppm, Mn 1000 ppm and Mo 1 ppm. The Zn content in these soils, as in all other soils examined from this area, is below 300 ppm. Levels of potentially toxic elements such as Pb and Sn are <12 ppm and <3 ppm respectively, as they are also in the subsoils of other associations. The content of Ni is around 100 ppm. Metals which are biologically unimportant as far as uptake into vegetation is concerned showed the following mean levels: Ba 1000 ppm, Sr 250 ppm, Li 100 ppm, Rb 150 ppm, Cr 300 ppm, V 150 ppm, Y 40 ppm, La 60 ppm, Zr 500 ppm, Sc 10 ppm, Ga 20 ppm and Be 3 ppm, all of which are within the normal ranges for soil parent materials. The variation in mean total content of the lower horizons of this association seldom exceeds ± 50 per cent from profile to profile and is normally less, but one or two elements, notably Cr and Ni, show wider variations. These are the trace elements that are relatively more abundant in basic and ultrabasic rocks and the higher contents of 1000 and 200 ppm respectively found in one or two profiles may well be related to the presence of material from such rocks. The two sub-alpine soils of the Merrick series are exceptional in showing relatively high total Pb contents in the deeper horizons, levels of 20–100 ppm being found, although the normal content is probably well below 10 ppm. This may be related to the penetration of surface organic matter, which contains over 100 ppm Pb in these soils. Over all, the total contents do not indicate any inherent probability of major trace element deficiency or excess.

As none of the Ettrick Association profiles is from an area currently under arable cultivation, it is somewhat difficult to compare trace element availability in the different series. This is normally best done on the mixed surface soil resulting from the processes of cultivation. The position with uncultivated soils is complicated by the high and variable organic matter content of the uppermost layers. The Co status of the old pasture herbage on the freely drained Linhope series would therefore have to be assessed by plant analysis, as the values for extractable Co in the surface and subsurface horizons suggest that it might be marginal. When the drainage is less free the increased mobilization of Co, largely as a result of weathering of ferromagnesian minerals, has resulted in much higher levels of extractable Co in the lower horizons and less likelihood of herbage with a Co content low enough to produce deficiency in grazing animals. The acetic-acid-extractable Co contents of such sub-surface soils are of the order of 0·5–1·0 ppm Co compared with 0·1–0·2 ppm in freely drained series. The levels of extractable Ni are never high enough to indicate a risk of Ni toxicity of vegetation, but once again restricted natural drainage, resulting in gleying in the lower horizons is related to increased mobilization. The EDTA-extractable Cu contents of the upper horizons, generally in the 1–3 ppm range for all the series examined, indicates that the Cu status is probably adequate, but might be marginal if any attempt were made to grow cereals.

The soils of the Dalbeattie Association derived from granite and tonalite with some greywacke contamination are, as would be expected, much lower than those of the Ettrick Association in the trace elements typical of basic igneous rocks. In the five profiles examined, typical total contents in subsoils are Co 5 ppm, Ni 30 ppm, Cu <3 ppm, Mn 400 ppm and Mo <1 ppm, although one profile (Doon No. 1) shows contents about twice as high. Arable soils on this association might well carry Co and Cu deficient herbage, as even the gleyed soils contain very low extractable Co ($<0·1$ ppm) and Cu ($<0·7$ ppm) in the sub-surface horizons.

The parent materials of the Darleith Association tend to be very variable throughout the south of Scotland, and this is illustrated once again by the trace element contents of the 5 profiles submitted for examination from this area. In the soils apparently derived from spilitic lavas the total Co and Ni contents of the lower horizons are both about 50 ppm but in others, obviously largely of ultra-basic origin, the Ni contents rise to more than 1000 ppm. The Cr range is from 120 to 4000 ppm. All these soils contain 1–2 ppm Mo, and about 1500 ppm Mn, while the total Cu contents are relatively high at around 50 ppm. In the brown forest soils of the Darleith and Dunlop series, the extractable Co (2–5 ppm) and Cu (1–3 ppm) contents throughout the profiles indicate adequate reserves. In the less freely drained Dunlop series an acetic-acid-soluble Ni content of over 30 ppm in the lower horizons is decidedly high, and on the gleyed Amlaird series contents of around 100 ppm extractable Ni suggest the possibility of Ni toxicity of plants occurring on this series should appropriate conditions arise.

The parent materials of the Benan Association are attributed largely to conglomerates derived from basic igneous rocks and the trace element contents generally substantiate this, with, in the lower horizons, total contents of around Co 25 ppm, Ni 200–400 ppm, Cr 1000–2000 ppm, Cu 25 ppm, Mn 500–1500 ppm and Mo 1 ppm. One of the 7 profiles examined, the non-calcareous gley of the Lanes series, from Lanes No. 2 site, obviously contains much more material of ultra-basic origin, with total contents of Co 50 ppm, Ni 2500 ppm, Cr 5000 ppm, Cu 150 ppm, Mn 1500 ppm and Mo 2 ppm. The extractable trace elements in the six normal soils of this association do not suggest any likelihood of deficiencies or excesses of biologically important metals, but the Ni level in the seventh might on occasion be sufficiently high to restrict the growth of some plant species.

SUMMARY OF ANALYTICAL METHODS

1. Soil separates (sand, silt and clay) were determined by a modification of the hydrometer method (Bouyoucos, 1927a, 1927b).
2. The exchangeable cations were determined in a neutral normal ammonium acetate leachate, calcium, sodium and potassium being determined by flame photometry (Ure, 1954) and magnesium colorimetrically (Hunter, 1950), or by direct photometry (Scott and Ure, 1958).
3. Exchangeable hydrogen was determined by electrometric titration of a neutral normal barium acetate leachate (Parker, 1929). pH was determined in aqueous suspension by means of the glass electrode.
4. Total carbon was determined by a wet combustion method using standard potassium dichromate solution (Walkley and Black, 1934).
5. Total nitrogen was determined by a semi-micro-Kjeldahl method (Markham, 1942).
6. Total phosphorus was determined by a colorimetric method using hydrazine sulphate, after fusing the soil with sodium carbonate (Muir, 1952).
7. Acetic soluble phosphorus was determined colorimetrically in a 2·5 per cent acetic acid extract (Williams and Stewart, 1941).
8. Silica-sesquioxide determinations of the clay fraction: approximately 0·5 g of ignited clay was fused with sodium carbonate (Robinson, 1939), and the silica determined after a double evaporation with hydrochloric acid. Aluminium (Robertson, 1950) and iron (Scott, 1941) were determined colorimetrically in aliquots of the filtrate from the silica.
9. The trace element determinations were made spectrochemically according to the methods described by Mitchell (1964).
10. The mineralogy of the clay fractions was determined by differential thermal analysis and X-ray diffraction. Differential thermal curves were determined according to methods described by Mitchell and Mackenzie (1959). Diffraction patterns of the soil clays were obtained on film with a Raymax 60 X-ray generator.

11 Land use capability

The object of a land capability classification is to arrange areas of land into groups according to their characteristics and potential for the production of agricultural crops and to some degree for tree growth. The crops mainly considered are the common arable crops in the region and the areas of land are shown by means of a map.

The system of land use capability classification adopted for Galloway is a modification of those used by the soil surveys of the U.S.A. and of Canada (Klingebiel and Montgomery, 1961; Smith and Ehrlich, 1964) and used with some alterations by Mackney and Burnham (1966) and Bibby and Orbell (1966) in Britain. Before describing the classification in detail, however, it will be useful to mention some of the principles and assumptions on which it is based.

In classifying land in a particular region attention is focussed on the crops and other forms of land use in the order in which they are thought to make increasing demands on their environmental conditions. Thus arable crops need a more fertile soil and a narrower range of climate and of conditions of slope than improved grassland, which in turn needs better conditions than rough grazing or forestry. Land which has no agricultural value and is suitable only for amenity purposes is placed in the lowest class. In using this type of progressive order of forms of land use it is assumed that land capable of growing a particular crop or plant is also suitable, should it be necessary or the farmer so desire, for uses less demanding of the environment. Consequently it is possible to indicate on one map the whole range of agricultural use to which an area of land can be put.

Throughout this discussion the phrases land capability and land suitability are used with certain qualifications and limitations. As already mentioned, in the consideration of arable crops the land is classified only with regard to those crops commonly grown in the region. Thus, whilst it may be necessary or possible to grow different crops in areas in the south-east of England and the north of Scotland, the land in these regions may be placed in similar classes. These classes, however, refer to different ranges of crops and it is important that this should be understood.

Another point fundamental to this assessment of land capability is that only normal farm cultivation practices, or operations that can be carried out with normal farm machinery, or at least by the individual farmer acting alone, are considered. Improvements which require co-operative action by a number of farmers or are carried out regionally are not taken into account. Thus, whereas tile drainage is regarded as part of normal farm practice, the pump drainage schemes carried out by some river boards

PLATE 22/Polgowan—a hill-sheep farm in the Minnoch Valley. An area of Glenlee complex can be seen above the farm.

PLATE 23/A young forest plantation on rocky ground of the Darnaw complex. Murray's Monument is on the right of the picture.

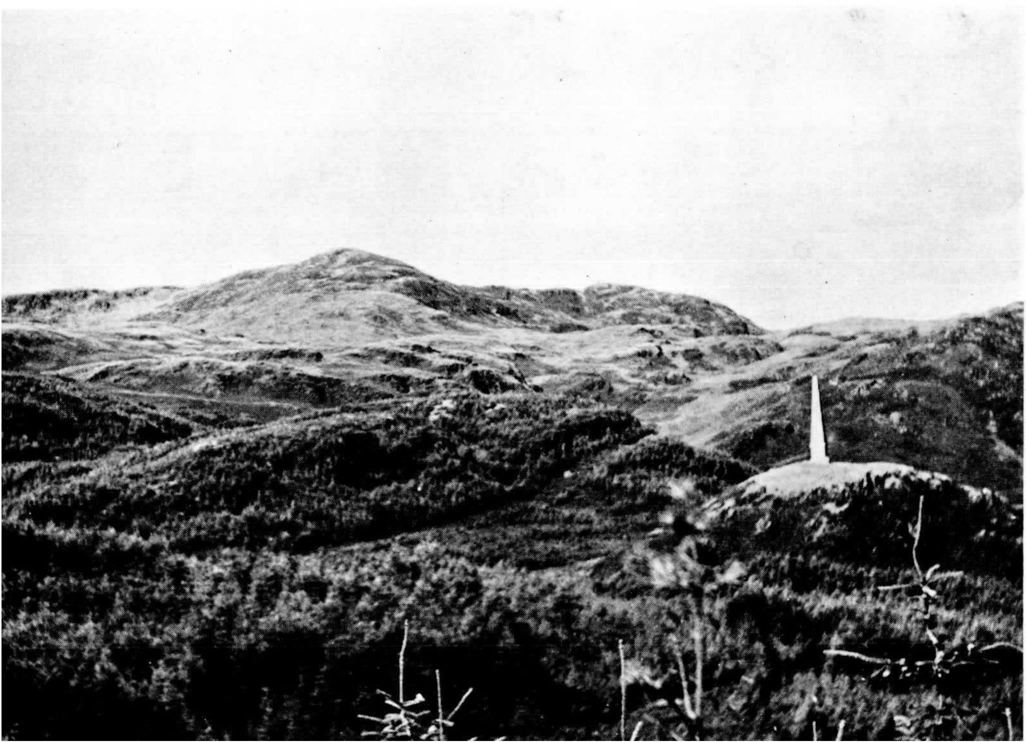
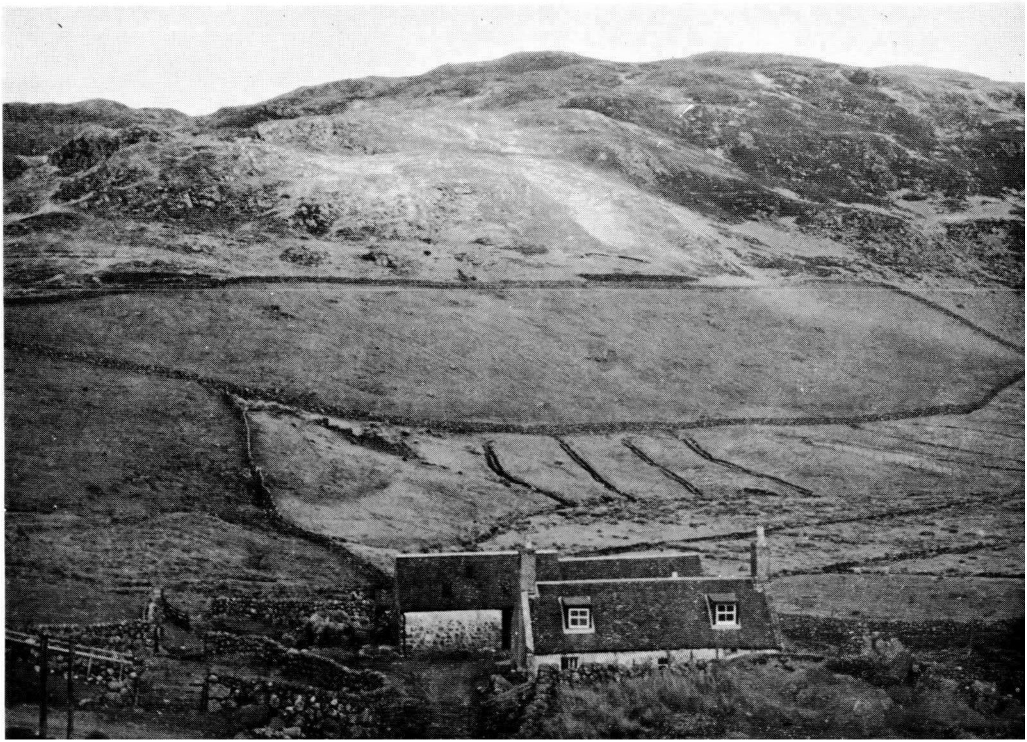


PLATE 20/Benan Farm with soils of the Benan Association on the hillslopes.

PLATE 21/A small area of Dalbeattie series enclosed as 'in-bye' on Ballochbeatties, a hill farm on the Loch Doon granite. The extremely rugged nature of much of this locality can be seen above the enclosure.



are not. A further assumption is that the land is assessed on the basis of its performance under a good standard of management, and where conditions for crop growth could be improved by the application of normal farming methods, such as tile or mole drainage, as already mentioned, the addition of adequate fertilizer, or the ploughing and reseeding of areas of permanent pasture, the land is classified as if these improvements had already been effected.

The Law of the Minimum, which was first formulated by Leibig (Russell, 1912), states that the amount of plant growth is regulated by the factor, plant nutrient or other environmental condition, present in minimum amount, and rises or falls accordingly as this is increased or decreased in amount. The validity of this 'Law' is limited, for if a number of factors are low but none of them too low growth can be increased by improving any one of them. Nevertheless, when considering the suitability of some areas for growing arable crops and the incapacity of others, it is apparent in many cases that restriction on arable cropping is due to a particular factor the unfavourable effect of which is of paramount importance. The concept of Leibig is therefore used to the extent of classifying land capability according to the factor judged most restrictive to arable agriculture; this is generally termed the limiting factor.

The factors which affect crop growth in an area are both numerous and varied in type, but they may generally be considered as belonging to one or another of the following main groups—soil conditions, including drainage; topography; climate; and what may be termed human factors. These several factors and their agronomic significance are now considered as follows.

HUMAN FACTORS

Human factors comprise those agencies affecting crop production which have their origin in, or operate through the accidents of human behaviour, history, or short-term economic fluctuations. Thus the economic practicability of growing certain crops can be greatly influenced by the existence of a nearby city or town to provide a ready market for the products. In sparsely populated areas, such as Carrick, the absence of a good network of roads may cause serious difficulties in getting machinery and harvesting equipment to an area, and to the removal of the crop. The pattern of land tenure may also affect the use to which land may reasonably be put; for instance the high capital cost of much modern machinery and its capacity to work over large areas, means that arable farming is less practicable on land held in small units. Reclamation and land drainge are often more difficult where the ownership and the farming of land are not in the same hands. On individual farms the use to which the land is put is greatly affected by the farmer's circumstances, his wishes, skill and the amount of working capital available.

Since the effects of these factors are highly individual, often of short term significance and extremely difficult to assess, they are not taken into account in studying land capability.

SOIL CONDITIONS

Soil factors include all those characters which are features of the soil profile as examined in the field or are ascertained by laboratory investigation of samples collected from the various soil series and types. The chief soil features affecting the choice of crop and plant growth are root zone characteristics, drainage, and the presence of a well developed peaty or organic layer.

Root Zone Characters

These comprise a wide range of soil properties, many of which can impose important limitations on land capability. The more important properties are soil texture, structure, depth, stoniness and infertility, each of which will be considered individually.

Soil Texture

Texture is the relative content in the soil of particles of different size grade and is generally determined by mechanical analysis. It affects a number of other soil properties, both physical and chemical, and its agronomic significance has been commented on by Mackney and Burnham (1966). The principal soil physical properties influenced by texture are structure, consistence, ease of cultivation, the water holding capacity of the soil and the amount of this water available to plants.

The effect of texture on the chemical properties of soil is mainly due to the content of clay and depends to some extent on the type as well as the amount. The lime requirement of a soil at a particular pH varies according to its exchange capacity which is principally related to the clay and organic fractions. Many sandy soils have low exchange capacities and this may have something to do with their natural fertility being on occasion less than that of loamy or of clayey soils. The capacity of a soil to 'fix' potassium added as a fertilizer is frequently due to the presence of illite or hydrous micas among the clay minerals. The limitations of a soil for crop production due to chemical features attributable to soil texture can, however, usually be overcome by a suitable fertilizer policy, although this must involve some expense. These limitations, therefore, do not greatly affect the land capability classification except at the level of the soil capability unit, which is referred to later.

Adverse physical factors due to soil texture, however, can usually be altered only after unrealistically high expenditure. In many areas where dry spells of some weeks can occur during the summer, the water-holding capacity of the soil can have a major effect on crop growth. The high rainfall over most of the area at present under consideration, however, restricts the chances of water shortage being an important factor limiting crop production to soils in the coastal districts, and in other districts to years when summer rainfall is abnormally low. The capacity of a soil to supply water to the plant is generally expressed as the available water capacity (A.W.C.) of the soil. This is defined as the difference in moisture content between a soil when it has been saturated and allowed to drain freely, but without evaporation, and its state when plants growing in it begin to wilt. The available water capacity for the top 12 inches of soils of different textural classes has been determined by Salter and Williams (1965) and is shown in Table J.

Table J/Available Water Capacity for the Top 12 inches of Soil Summarized as Means per Textural Class

Textural Class	A.W.C. (in)
Sand	0·79
Loamy sand	2·15
Sandy loam	1·90(1·42–2·35)*
Fine sandy loam	2·56
Very fine sandy loam	2·58(2·32–2·86)*
Loam	2·51(2·27–2·96)*
Silt loam	2·82(1·89–3·31)*
Sandy clay loam	1·82(1·64–1·95)*
Clay loam	1·66
Silty clay loam	1·92
Clay	1·93(1·71–2·14)*
Peat	3·62

* Figures in parentheses refer to the range within the class.

The medium textured loamy soils have a higher capacity for holding water available to plants than either the coarse or fine-textured soils.

The cultivation of soils with a high clay content is difficult in that more tractive power is needed than for loamy or sandy soils and operations need to be carried out under optimum moisture conditions. If the soil is worked when it is too wet its structure is destroyed by smearing, so that large hard clods are formed, whilst if it is worked when too dry the soil aggregates are too hard to be readily broken up.

Thus the suitability of fine-textured soils for arable agriculture may be restricted both by their water relationships and by the difficulty of cultivating them, while with the coarse-textured soils limitations may occur on account of lowered fertility or lack of water-holding capacity. The agricultural possibilities of loamy soils are not generally restricted by features associated with their texture.

Soil Structure

The particles of the soil normally cohere together, to a greater or lesser degree, into aggregates. The soil structure describes the size and shape of these aggregates, the stability of which, under the action of farm implements, of treading by cattle or of rainfall, is another important property to be considered in determining land use. The soil structure largely determines the pore space of the soil which in turn plays a major part in the soil aeration and water relationships.

Tilth is a difficult concept to define, but two of its more important aspects are the type of soil structure and its degree of hardness when dry or moist. These qualities mainly determine the character of the soil as a seed bed and medium for plant growth. In soils with a good tilth the structure is generally a medium crumb or blocky and is stable under wetting and drying. Such structures are generally found in soils with a loam or sandy loam texture which have a fairly high organic content, as for example under old grassland or woodland, or in soils which have a high content of free sesquioxides, as for example soils developed from basic igneous rocks, or in strongly weathered soils.

Soil structure is also strongly influenced by farm management, for the structures conducive to a good tilth are promoted by crop rotations which incorporate long breaks in grassland and large additions of farmyard manure, while the repeated growth of arable crops without large returns of organic matter to the soil leads to the progressive deterioration of structure. Soil structures can also be impaired, in the short term, by tillage or treading when the moisture content is such as to render the soil plastic. This effect becomes progressively more serious as the clay content of the soil increases. Soils with poor structure need a greater number of cultivations for the growth of arable crops and the moisture range over which these can be carried out is restricted.

The limitations on land use which can be imposed by poor structure are a consequence of the tendency for large hard clods to form in fine-textured soils. In silty soils the 'cap' formed under the action of rain on the bare soil can become sufficiently pronounced to prevent shoot emergence and in this way make the soil less suitable for arable cropping. The presence of a massive indurated layer in the subsoil yet sufficiently near the surface to reduce rooting depth can also lower crop yields, but this is better considered as a problem of soil depth.

Soil Depth

Little is known about the effect of soil depth on plant growth or crop performance. From a pedological point of view soil depth may be understood to mean the depth from the surface down to and including the parent material, while many farmers and agronomists use the term in the restricted sense of the thickness of the organo-mineral plough layer. Taking the former view the soil depth may be as much as 4 feet; taking the latter it is usually 10 to 12 inches. An alternative is to take soil depth as the depth to which the roots of crop plants commonly penetrate—that is, about 24 inches.

The depth of soil is most commonly restricted to less than the normal rooting zone by the occurrence near the surface of bedrock, an indurated layer, or an unbroken iron pan. Such restrictions of the rooting zone can affect plant growth in a number of different ways, direct and indirect.

The direct effects stem from the smaller volume of soil available for exploitation by roots, which may lead to a shortage of mineral nutrients—this is most noticeable where the organo-mineral plough layer is thin—and to shortage of available water caused by the inability of roots to reach deeper soil layers which dry out less readily than the surface horizons. Other effects associated with shallowness of soil are excessive drainage,

drainage impedance, excessive stoniness, and the presence of rock near the surface which may impede the use of mechanical implements.

Although shallow soils occupy a considerable area in south-west Scotland, shallowness is only rarely the principal limitation to plant growth; factors such as high altitude, steepness of slope or occurrence of rock outcrops are usually of greater importance. Lack of depth of soil does not, therefore, play a prominent part in the land classification of the area.

Stoniness

Many soils in the area under consideration have a considerable stone content but, as in the case of shallow soils, this is only occasionally a principal factor restricting their use. Generally stoniness occurs in soils at high altitudes or on steep slopes, factors which themselves have a much greater influence on land utilization.

Where stoniness is of importance it can have a deleterious effect on mechanical implements, and can, by acting as an inert dilutant of the soil, reduce the volume of soil available to supply nutrients and water to the plant.

Infertility

In Scotland, infertility in the sense of an inadequate supply of plant nutrients in the soil, even after the application of fertilizers, seriously restricts the choice of crops in only a few instances, generally where highly podzolized soils are developed on very quartzose parent materials. Hence it plays only a minor role in the land use classification at the class and sub-class level, although it is expected to be important when it becomes possible to determine capability units.

Drainage

Poor water relationships which affect the growth of the crop may take one of three forms: inundation, generally due to the overflow of rivers, a high ground-water-table, or surface waterlogging. Excessive drainage or lack of adequate water-holding capacity is generally associated with shallow soils overlying shattered rock or with very sandy soils, and the consequent limitations upon land-use are included with these causes.

Inundation because of the overflow of water courses is generally restricted to alluvial tracts along rivers, and commonly occurs in the winter season. It is not a widespread phenomenon in south-west Scotland, but where it recurs frequently land use is usually restricted to grazing. Where affected areas are small, improvement may be within the power of the individual farmers, but for large tracts of country regional drainage schemes are necessary. The liability of an area to occasional flooding cannot be inferred from the soil profile.

Information concerning the general moisture conditions in a soil is given by the soil map, on which soils are classified into drainage classes. It is not yet possible to give an exact correlation of soil morphology with moisture state, but the drainage categories do allow a general assessment of the relative amount of waterlogging to which the profile is subject and of the depth and thickness of the zone of maximum wetness.

Freely drained soils are only rarely waterlogged; while their use is not restricted by excessive wetness they may, if the texture is sandy or if rainfall is low, be liable to drought. In the present area, however, this is usually limited to some wind-blown sands and some areas of gravel.

Imperfectly drained soils in south-west Scotland are generally wet for considerable periods of the winter and opportunities for cultivation are less than for freely drained soils, particularly where the texture is clayey. For arable cropping and intensive grazing artificial drainage is necessary, and once this is carried out these soils are suitable for a wide range of crops. In wetter than average spring and autumn seasons some difficulties are likely to occur with both harvesting and sowing, and in these seasons grazing may be curtailed to some extent because of the liability of the land to poach.

Poorly drained soils have limitations similar to those with imperfect drainage, but the unfavourable characteristics are developed to a much higher degree. The soils are wet for prolonged periods of the winter, and, except in dry seasons, spring and autumn cultivations are usually difficult. To avoid severe poaching damage the grazing season must frequently be restricted. Artificial drainage is essential to the best utilization of these soils, which may then be capable of carrying some arable crops and good quality grassland. Both yield and choice of crop, however, are to some extent restricted, and without the installation of artificial drains only poor quality grazing can be maintained.

Very poorly drained soils in this area generally have a well developed peaty surface horizon and are suitable only for rough grazing.

Peaty Surface Horizons

The major soil groups with well developed peaty layers are the peaty gleys, peaty podzols, and peats; iron podzols are not included, the 'H' layer being generally thin.

These soils with peaty surface horizons as they occur in Scotland have a number of features in common, either associated with the presence of the peaty layer or directly attributable to its character. The properties of the peat or peaty horizons are not in themselves such as to preclude the growing of arable crops; indeed, high yields of a variety of crops are obtained on the fen peats of England. These high yields, however, are obtained only after extensive regional drainage schemes have been carried out often necessitating the removal of surplus water by pumping. Improvements on such a scale are beyond the scope of individual farmers, so that their feasibility cannot be taken into consideration in a scheme of land classification.

Although some peats have been reclaimed in Scotland in the past, only small areas have been improved in recent years, and it is those features of peaty soils which make reclamation both difficult and expensive that justify treating the presence of a peaty horizon as a limiting factor in land classification.

All the soils under discussion suffer from a high degree of waterlogging, although peaty podzols are rather less affected than the others. The organic horizon in all peaty soils has an extremely high exchange capacity and is very acid, so that large additions of lime and fertilizers are necessary; the peaty layer is also soft, making consolidation difficult, and it retains large amounts of water, which means that the sward is extremely liable to damage by treading. The combination of these factors is such that although remedial measures on the individual farm are often physically possible, the return is not considered sufficient to justify the cost involved. Thus, while such work may be carried out in special instances it cannot be regarded as part of normal farm technology.

In the past many areas of peaty soils have been reclaimed by the cutting and removal of the peat followed by cultivation of the underlying mineral soils. This seems to have happened in a number of instances in the present area, where the profiles now resemble those of mineral soils. In some areas the land has been drained and ploughed, and in these cases the peaty layer is still recognisable. Unreclaimed areas with peaty surface horizons are generally only suitable for rough grazing.

CLIMATE

Climate, as already stated in Chapter 4, is an important soil forming factor and its nature is to some extent reflected in the soil profile. Its direct effect on plant growth is, however, more critical to the choice of crops and land-use than its influence through the soil.

The principal climatic factors affecting crop growth are temperature, in particular the length of growing season, which is arbitrarily defined as the number of days when the average temperature is above 42°F, and the amount and seasonal distribution of rainfall. Other climatic factors are the incidence of frost, the amount of wind, and hours of sunshine. Information on these elements and their variation over the area is given in Chapter 2, but little precise knowledge is available of the affects of climate on crop growth. In general, however, rainfall throughout the region is adequate for most crops and could often be considered excessive. Locally, climatic changes follow altitudinal variation; with rising altitude rainfall increases, in the western part of the area by about 5 inches per annum per 250 feet of altitude, and the daily mean temperature falls by 1°F for each 300 feet of elevation while the strength of the wind and the incidence of exposure both increase. In general, then, it can be seen that the climate becomes less favourable for crop growth as altitude rises, and in making a land capability map altitude is used as a parameter of climatic variation. The small extent of the arable areas above 500 feet, however, makes it difficult to distinguish the effects of climate on arable agriculture above this altitude. The following arbitrary limits have nevertheless been chosen: good arable farming is considered feasible, as far as climate is concerned, up to 500 feet, from 500 to 1000 feet restricted arable crops may be grown, together with improved grassland, and above 1000 feet only rough grazing and forestry are considered possible. The upper limit of afforestation varies somewhat according to aspect and the existence of shelter, but may be taken as about 1650 feet; above this altitude rough grazing also is of little value.

TOPOGRAPHY

Topography may be regarded as consisting of two elements, height and slope; the former influences agriculture mainly by its affect on climate and has already been considered. Slope, which varies in character according to length, shape and gradient, affects land use chiefly through the limitations imposed by gradient on the use of mechanical implements, while the influence of length and shape of slope is mainly on the movement of water and on soil formation. Erosion, a major danger in many parts of the world, is of minor significance in Scotland.

Mackney and Burnham (1966) have defined ranges of slope significant to various management practices and these are adopted here. Normal arable farming operations may readily be carried out on slopes of 11° or less, although slight erosion may occur between 7° and 11°. On slopes between 11° and 15° arable farming is possible but combine harvesting is very difficult and erosion may be a danger in some seasons. The improvement of grassland is possible on slopes up to 20°, but land of slope between 15° and 20° is not suitable for normal arable rotations and is generally in grassland. The agricultural utilization of slopes over 20° is restricted to rough grazing, as the operations involved in ploughing, liming and fertilizing are dangerous; normal forestry operations, however, are possible on rather steeper slopes, probably up to 25–30°.

LAND CAPABILITY CLASSIFICATION

The present land capability classification is an attempt to interpret the information on the soil of the area acquired during the course of the soil survey, and to integrate this with knowledge of climate and topography in order to place areas of land into groups according to their suitability for various agricultural crops and mangement practices.

The information concerning the soils is taken from the soil maps, that regarding topography has been obtained by examination of topographic maps, supplemented in cases of doubt by field observations and that for climate by interpolation from observations supplied by the Meteorological Office for the stations mentioned in Chapter 2. Where it is uncertain whether factors connected with the soil or with site are the more important to land use, precedence in classification is given to the nature of the soil since the available information on soil characters has been obtained more directly and in greater detail.

In the highest category the classification is concerned with the arable crops commonly grown in the region. In this area arable agriculture is mainly restricted to the north and west around Girvan and Ballantrae. In the past the principal crops have been oats and turnips; recently in the more favoured areas barley has begun to displace oats, which are now less commonly grown than formerly but are still an important nurse crop for reseeding grassland. Some winter wheat is grown. Main crop potatoes are also grown, and in a narrow belt of land along the coast which enjoys a particular freedom from late frosts early potatoes form an especially valuable cash crop. Early potatoes, however, are not typical of the area as a whole. The arable crops common to the region are therefore oats, barley, winter wheat, turnips and potatoes. The classification of the land is consequently from the standpoint of its suitability for the continued growing of these crops.

The American Land Capability Classification (Klingebiel and Montgomery, 1961) contains three categories, the Land Capability Class, Land Capability Sub-class, and the lowest category the Land Capability Unit. The land capability units are groups of soils which resemble one another in two respects: in being suitable for growing the same range of crops under similar management practices and in that over a number of years they give approximately the same yields, assuming a constant level of management. The differentiation of capability units requires quantitative information regarding the relationship of crop yields to soil and other site factors, such as may be obtained from accurate records kept over a number of years and from field experiments. Such information is not likely to become available in Britain for some years, so that it is not possible meantime to divide land into capability units. The classification used in south-west Scotland therefore, like that of Mackney and Burnham (1966) and Bibby and Orbell (1966), is reduced to two categories similar to the capability class and sub-class of the American system. The omission of the capability units, however, means that considerably less information can be provided by the classification, thus limiting its usefulness. While it is not possible to compensate for the lack of yield data, it is possible by expanding the number of capability sub-classes as described below to arrange the areas of land into groups calling for similar management techniques. The Canadians (Smith and Ehrlich, 1964), who have also been unable to place land in capability units, have made similar modifications to the American system.

The capability sub-class which is the middle category in the American system and the lowest in the Canadian classification places soils or areas of land into groups according to the kind of limitation on their use. The American classification recognises four sub-classes characterized by the following limitations: erosion hazard, excess water, soil limitation within the rooting zone, and climatic limitation. With respect to their general character and the type of management practice necessary for their use, areas of land in some of these groups show considerable heterogeneity. This heterogeneity is eliminated at the capability unit level in the American system. While lack of yield data prevents the use of capability units in a British classification, the formation of groups of soils requiring similar management techniques may be achieved to some extent in the lowest category by increasing the number of capability sub-classes. In defining the capability sub-classes for this area separate consideration is given to the limitations on land use imposed by the various types of soil and other site factors. Rooting zone defects, such as excessively sandy or clayey textures, poor structure, stoniness and shallowness, are considered separately, as are the various types of drainage imperfection, namely surface waterlogging, ground waterlogging and flooding. Special attention is also given to the presence of a well developed peaty layer. In this area deterioration in climatic elements tends to parallel increase in altitude, but in areas where the individual climatic factors vary separately each may be used to define a capability sub-class. Limitations imposed by slope alone do not admit of further sub-division, those imposed by soil pattern, for example by rockiness, are considered irrespective of slope.

CAPABILITY SUB-CLASSES

The principal features of the capability sub-classes and the symbols used for them are listed below. Not all these sub-classes have occurred in the Girvan and Carrick areas, but it is expected that they will be encountered when the survey is extended to the rest of Galloway.

Sub-class CY	Excessive content of clay means that the soil readily becomes plastic and this restricts cultivation and grazing.
Sub-class SA	Low clay content means a low waterholding capacity and a soil liable to suffer drought.
Sub-class ST	Weak soil structure leads to easy soil 'capping' of bare surfaces, or to difficulty in obtaining a seed-bed.
Sub-class SH	Shallowness of soil imposes limitations on use associated with difficulty in using tined implements, waterholding capacity, and ability to supply plant nutrients.
Sub-class SN	Excessive stoniness renders use of certain implements difficult and restricts the volume of soil available for root exploitation.
Sub-class SW	Surface waterlogging occasions lateness, restriction of opportunities for cultivation and grazing, and limitation of the depth of rooting. Soils are generally of fine texture.
Sub-class GW	Ground waterlogging imposes limitations on rooting depth and length of growing season. Soils are generally of medium or coarse texture.
Sub-class FW	Where land is subject to flooding arable crops may be swept away or damaged and difficulties arise in the keeping of livestock.
Sub-class OR	Peaty surface layer imposes extreme limitations resulting from low fertility, high acidity, excessive wetness and liability to treading damage.
Sub-class CL	Climatic limitations are the chief hazard.
Sub-class TP	Steepness of slope limits land-use in this class.
Sub-class PM	A complicated soil pattern is responsible for difficulties.
Sub-class RK	Frequent rock outcrops cause difficulties.

LAND CAPABILITY CLASSES

The capability sub-classes are grouped into capability classes, the highest category in the classification, according to their adaptability to arable cropping and the severity of the limitation on their use. The American system already mentioned and the adaptation of it by Mackney and Burnham (1966) employ eight capability classes. Following Bibby and Orbell (1966) however, in this region, these have been reduced to seven. Arable agriculture, at varying degrees of intensity, is possible on land of classes 1 to 4, improved grassland may be established on class 5 land, while land in class 6 is restricted to rough grazing, moorland and forestry. Land not suitable for forestry and of little value for rough grazing, which is used largely for amenity purposes, is placed in class 7.

Class 1 contains land which is highly adaptable and suitable for intensive arable cropping, and as there are no significant limitations to land use it has no sub-classes. Class 2 land like that in class 1 is suited to the sustained production of arable crops and is capable of giving good yields; it suffers, however, from some minor limitations which affect the choice of crops or cultivations. Arable agriculture can be carried out on land in classes 3 and 4, but the choice of crop is restricted; good yields are obtained only in favourable seasons, and management practices have to be adapted to overcome the limitations to which the soils are subject. Class 5 land is not suitable for arable agriculture, but moderate to good quality grassland can be maintained with the use of normal improvement techniques; moderate to good tree growth may also be expected on this land. Land on which normal improvement operations cannot be carried out is restricted in its capability to rough grazing, moorland, and forestry and is placed in class 6. Land on which afforestation is not feasible and which is of very low grazing value, is classified in class 7 as being mainly suitable for amenity purposes: these include various types of sport, walking and climbing.

LAND CAPABILITY MAPPING UNITS

The land capability classes and sub-classes delineated in the present area, together with the soils included in each unit, are shown in Table K. A brief description of the land capability sub-classes which have been distinguished is given below.

Class 1

Land placed in class 1 occupies only a very small part of the area, and is restricted to the lower part of the Girvan Valley and the coastal belt. It includes only those soils of the Tranew and Dreghorn series which occur on level or gently sloping ground and at low elevations. The soils are free draining, of sandy loam to loam texture in the surface, and present no difficulties to cultivation. Rainfall, at about 35 inches *per annum*, is adequate for arable cropping and weather at harvest is good for the region. A wide range of crops may be grown on this land with little difficulty.

Class 2

Sub-class 2SH

The depth of soils in this sub-class is liable to be restricted, at least in patches, by the presence of an indurated layer or rock occurring within 24 inches of the surface. The soils belong to the brown forest soil and iron podzol major soil groups and have an appreciable stone content. The topsoil texture is generally a loam with sandy loams to loams in the subsoil. The ground is level or moderately sloping and occurs at low or medium altitudes. Drainage is free and in dry seasons crops may suffer from drought. In general, however, a wide range of crops may be grown with little difficulty. Damage from poaching by stock or machinery is likely to be minimal but appreciable applications of lime and phosphate are necessary to maintain fertility.

Sub-class 2SN

This sub-class includes some areas of brown forest soils which have not been placed in class 1 on account of their appreciable stone content. The soils are free draining, with loam topsoils and are sandy loam to loam in the subsoil. The land occurs at moderate altitudes and slopes are generally gentle. A wide range of crops may be grown with little difficulty.

Sub-class 2SW

The imperfectly drained brown forest soils of the Glenalmond Association occurring on gentle and moderate slopes at low altitude make up the sub-class, which is restricted to the north-western part of the area. The topsoils are generally loams, but poorly structured sandy clay loam till occurs in the subsoil. Surface waterlogging may occur to a limited extent in spring and autumn because of the low permeability of the subsoil. Artificial drainage is necessary and care must be exercised with the timing of cultivations. The soils have a good level of natural fertility, however, and high yields may be obtained from a wide range of crops.

Sub-class 2GW

A few small areas of alluvial soils which occur at low altitude have been placed in this sub-class. The topsoils are generally loams to sandy loams and the subsoils are usually gravelly loamy sands to sandy loams. During late autumn, winter and spring the ground water-table is likely to be high and may have some effect in restricting cultivations and the penetration of roots. All the usual crops of the region may be grown, however, though in some parts the possibility of flooding in abnormal seasons may have to be faced.

Sub-class 2TP

Only a small area of land has been placed in this sub-class, which comprises those areas of the Tranew series which occur on moderate slopes. In some seasons and under repeated cultivation this land may be liable to slight erosion, but in most other respects it is similar to land in class 1 and a wide range of crops may be grown with little difficulty.

Class 3

Sub-class 3SN

This sub-class is made up of soils which are developed on gravel parent materials and occur at moderate altitudes. In some places the topography may be moundy. Rounded stones make up a considerable proportion of the plough-layer, and are very abundant in the subsoil. The soils are very free draining and in dry seasons are liable to suffer drought. Growth in these areas will generally be early and the soils may be cultivated under a wide range of moisture conditions, but yields will generally be only moderate. Land in this sub-class is classified according to the limitation imposed by stoniness; this, however, is very much aggravated by its liability to drought. Continuous cultivation is likely to lead to a rapid decline in the organic matter content and structure of the soil.

Sub-class 3SW

The brown forest soils with gleyed B and C horizons, other than those of the Glenalmond Association, which occur at moderate altitudes and on gentle or moderate slopes have been placed in this sub-class. Waterlogging of the upper layers of soil occurs in both spring and autumn, at which times care is needed to avoid damage by poaching. Artificial drainage is essential for the best utilization of these soils. The surface layers are generally of loam to silt loam texture and the subsoils are loam to clay loam. A number of crops may be grown on this land, but in some seasons difficulties may be encountered at seed-time and harvest, and the crop rotation will usually include a substantial period in grassland, generally of moderate to good quality.

Sub-class 3GW

Only small areas of alluvial soils have been included in this sub-class. They usually occur along the middle reaches of rivers and streams and the limitations imposed by a high ground-water-table in spring, autumn and winter seasons are aggravated by high rainfall and other unfavourable climatic elements associated with surrounding high ground. There may in some cases be a liability to flooding. Some arable crops may be grown, but the crop rotation usually includes a considerable period in grassland.

Sub-class 3TP

Slope exercises an important influence on the management of land in this sub-class which has been delineated on moderately steep slopes at medium and low altitudes. The majority of the soils are freely drained brown forest soils, but some areas at moderate altitudes of the imperfectly drained series of the Glenalmond Association have also been included. Use of the combine harvester is difficult on these slopes and it may be that certain cultivation operations can be carried out in only one direction. The topsoils are generally loam, but the subsoils range from sandy loams to clay loams. Many of the freely drained soils are developed on somewhat stony parent materials and in dry season may be liable to drought. It is possible to grow most crops on these soils, but management difficulties are fairly severe and the rotation will usually include a considerable period in grassland which may be of good quality.

Class 4

Sub-class 4SW

This sub-class includes the non-calcareous gley soils which have no peaty horizon and occur at moderate altitudes, together with the imperfectly drained brown forest soils which occur at somewhat higher elevations. All these soils are subject to severe waterlogging in their natural state and artificial drainage is essential. Although the drainage impedance is greater in the poorly drained soils than in the imperfectly drained, those of the latter category which are included in this sub-class are subject to higher rainfall and less favourable climatic conditions than the soils of this drainage class at lower elevations, and these climatic factors add to the difficulties associated with drainage. In particular the ripening of grain crops may be delayed and conditions at harvest are likely to be difficult. The textures of these soils vary from loam to clay loam in both topsoils and subsoils, although the latter are mostly clay loam. Liability to poaching damage is high and the periods when either cultivation or grazing can be carried out are restricted.

Sub-class 4GW

This sub-class is restricted to a few alluvial soils along the higher reaches of the rivers and their tributaries. The water-table is high in these soils during the autumn, winter, and spring, but during the summer may be very low. These areas are also liable to flooding. Topsoils are generally sandy loam to silt loam in texture and the subsoils a gravelly loamy sand.

Sub-class 4TP

The steep gradients which characterize this sub-class are a major impediment to frequent cultivation of the land. The use of combine harvesters is not generally feasible and many cultivations must be performed in only one direction. Downhill creep of soils has usually resulted in the plough layer being shallow near the top of a field and deep along the downslope wall or embankment. Under frequent cultivation erosion is likely to become a considerable hazard. The soils are mainly the freely drained iron podzols and brown forest soils, with some brown forest soils having gleyed B and C horizons. In dry seasons drainage is liable to be excessive and plant growth to suffer from drought. Soil textures are mainly loams and subsoils are often stony. This land is generally farmed in a rotation which includes long breaks in grassland.

Sub-class 4CL

Land in this sub-class does not suffer from any severe impediment to cultivation other than poor climatic conditions. In this region land above 500 feet in altitude generally has a rainfall of over 50 inches per annum and is subject to considerable exposure. Growth commences somewhat later than at lower elevations, crops mature later and conditions at harvest are often difficult. Yields are generally below average. The soils in this group include iron podzols and brown forest soils with both free and imperfect drainage. Many of these areas have been reclaimed from former moorland generally for a considerable period. Soil textures in the plough layer are mainly loams, but the subsoils show considerable variation from stony sandy loams in the freely drained soils to clay loam till in the imperfectly drained. Land in this sub-class is usually kept in grassland for considerable periods. On upland farms it will often include much of the relatively good quality 'in-by' land.

Class 5

Sub-class 5SA

Small areas of land which occur along the coast between Girvan and Ballantrae have been placed in this sub-class. The soils are formed on deposits of wind blown sand and have been mapped as Links. The clay and organic contents are low and consequently the natural drainage is excessive and the water holding capacity low. The climatic conditions are mild but the rainfall, at about 35 inches per annum, is not sufficient to prevent these soils suffering from drought. These areas are only rarely cultivated, but improvement of the pasture by sowing with good quality seed and by fertilization presents no great difficulties.

Sub-class 5SH

Land in this sub-class is of limited extent and is restricted to small areas of iron podzols and brown forest soils where the soil profiles are of less than average depth due to the occurrence of rock or an indurated layer near the surface. The soils are generally of loam texture, stony and freely drained, and occur most commonly at moderately high altitude. The land is only rarely cultivated, partly because of the shallowness of the soil and partly because of the unfavourable climatic conditions. With the use of fertilizers and control of grazing moderate quality grassland may be maintained, although in dry years the sward may be affected by drought.

Sub-class 5SW

This sub-class comprises the areas of poorly drained non-calcareous gley soils which do not have a peaty surface horizon and which occur at altitudes between 500 and 1000 feet. The limitations imposed by poor drainage are rendered more severe by the unfavourable climatic conditions which include high rainfall and low spring and autumn temperatures. The soil textures are generally loam in the plough layer and loam to clay loam in the subsoil. The poor drainage is often due to 'flushing' by water running downhill through the soil from springs, and tile drains are essential to any significant improvement of the grazing. Where artificial drainage has been installed, however, it is possible to cultivate the land sufficiently often to renew the sward and to maintain moderate quality grassland.

Sub-class 5GW

A few small areas of alluvial soils at moderate to high altitudes, which have a high water-table and are also liable to flooding have been placed in this sub-class. These areas are not usually cultivated and are often difficult of access.

Sub-class 5TP

In the areas of land which have been placed in this sub-class, steepness of slope is near the limit for the use of wheeled tractors, and, although some cultivation is possible, it is restricted to reseeding of the pasture and distribution of fertilizer. The soils, which are iron podzols and brown forest soils with free drainage, are generally stony and suffer badly from drought in prolonged dry spells. With care moderate to poor quality grazing can be maintained.

Sub-class 5RK

This sub-class is restricted to areas of complex soil mapping units (Table I) which consist mainly of brown forest soil and rock outcrops. In the Girvan and Carrick areas these complexes frequently occur at moderate altitudes where climatic conditions are less than ideal. The soils show considerable variation from deep to very shallow and stony; parts of the areas are bare rock. It is generally possible to cultivate some of the ground between rock outcrops, but cultivation is generally restricted to operations necessary for reseeding. The land stays for long periods in pasture, but with the use of adequate fertilizers a moderate to good sward may be maintained on the areas of deeper soil.

Sub-class 5PM

Land from four soil complexes has been placed in this sub-class. In each of the soil mapping units free, imperfect, and poorly drained soils occur in a complex pattern. The principal limitation on the use of this land is associated with the poorly drained soils and is rendered more severe by the somewhat unfavourable climatic conditions above 500 feet where these mapping units mainly occur. The grassland on the free and imperfectly drained soils can be readily improved by tillage, reseeding, and use of fertilizers, but these areas are usually so small as to make the use of normal mechanical implements inconvenient. Artificial drainage is essential to the improvement of the poorly drained soils and this may be difficult on account of the intricate soil pattern and uneven topography. At present much of this land is rough grazing, but with suitable treatment it is possible to maintain a moderate quality grass sward.

Sub-class 5CL

A very small area of the brown forest soil, Dalbeattie series, which occurs at a high altitude under high rainfall and where the growing of arable crops is impracticable, has been placed in this sub-class.

Class 6

Sub-class 6OR

All the soils in this area which have peaty surface horizons have been placed in this sub-class, which therefore covers a very large area. The high rainfall under which these soils occur together with the very high water-holding capacity of the peaty layer means that this land remains waterlogged for long periods of the year. Although surface seeding and

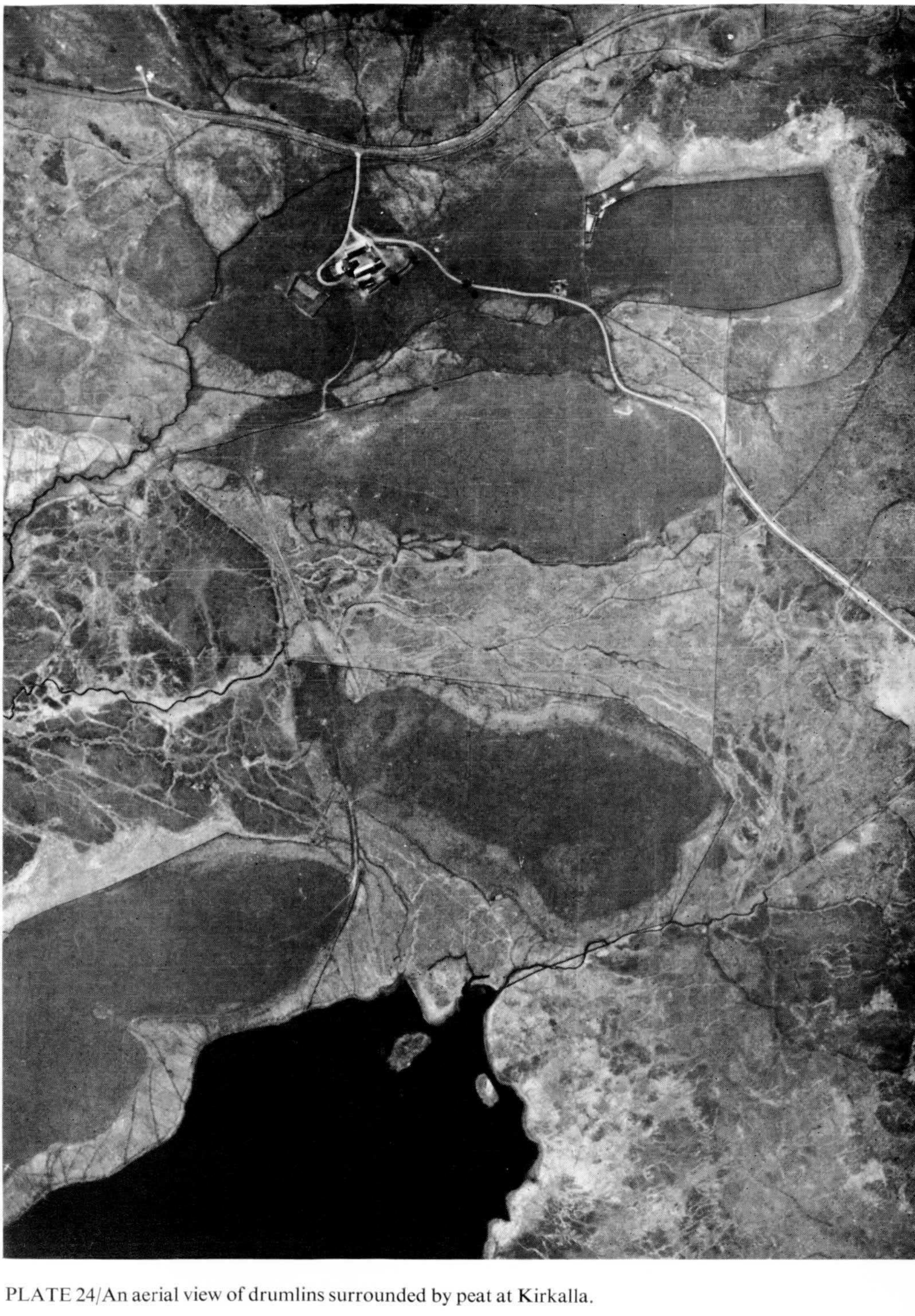


PLATE 24/An aerial view of drumlins surrounded by peat at Kirkalla.

Royal Air Force Photograph

PLATE 25/An aerial view of the Trool complex at Brigton where the Water of Minnoch flows into the River Cree.

Royal Air Force Photograph

PLATE 26/Ice-scoured rock knolls—roche moutonnées—south east of Loch Reicawr after which the soil complex, the Reicawr complex, has been named.

Royal Air Force Photograph

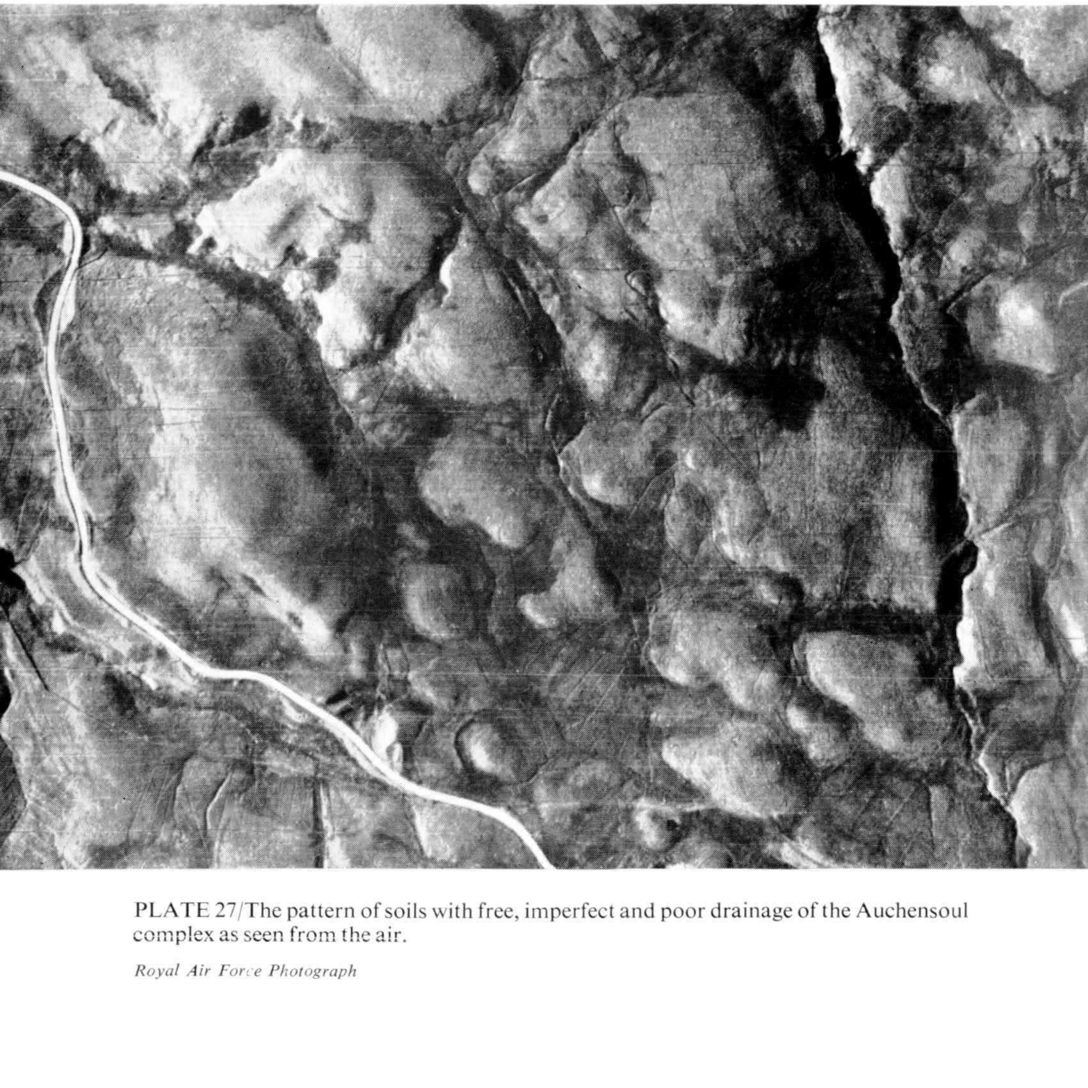


PLATE 27/The pattern of soils with free, imperfect and poor drainage of the Auchensoul complex as seen from the air.

Royal Air Force Photograph

other techniques are available for its improvement, unless artificial drainage is carried out the degree of improvement is limited and the land will remain liable to excessive damage from poaching. Intensive artificial drainage, large additions of lime and fertilizer, tillage and reseeding are all feasible on these soils in theory, but circumstances are such that in the foreseeable future only a very small proportion of this land is likely to be improved. The principal limitations of wetness, difficulty of consolidation and low fertility are all associated with the nature of the peaty surface horizon, and are of such severity that the land is thought suitable only for poor quality rough grazing and for forestry. The greater part of the moorland areas (below 1650 feet) in this region have been included in this sub-class.

Sub-class 6SW

A few poorly drained non-calcareous gley soils which have no peaty surface layer and occur at or above 1000 feet have been placed in this sub-class. The wetness and non-peaty nature of these soils is due to 'flushing' by mineral-rich ground-water. The inaccessibility of these areas makes artificial drainage difficult, and even if it were carried out the high rainfall and unfavourable climatic environment render them unsuitable for anything more than rough grazing by sheep and hill cattle and for forestry.

Sub-class 6GW

A small area of very poorly drained alluvial soils has been placed in this sub-class.

Sub-class 6TP

Land in this sub-class is too steep for the use of wheeled tractors and improvement of the grazing is therefore difficult. The soils, mainly free draining iron podzols and brown forest soils, are stony, loam to sandy loam in texture, and sometimes have a thin raw humus horizon. The herbage is frequently a form of acid grassland such as *Agrostis-Festuca* pasture which provides rough grazing of relatively good quality. This land is also very suitable for forestry, since recent work (Pyatt, 1965) suggests that trees established on these soils are less likely to be endangered by windfall when near maturity than forests established in areas with impeded drainage.

Sub-class 6RK

The complex soil mapping units in which outcropping rock is a dominant feature have been placed in this sub-class. Their use is restricted to rough grazing and forestry by the difficulties of improving land with such an abundance of rock and the extremely shallow nature of many of the soils. Well developed peaty or raw humus horizons are also common in many of these mapping units.

Sub-class 6PM

Much of the land in this sub-class has been mapped in soil complexes. The range of soils is wide, but the most frequent pattern is of freely drained brown forest soils occurring in small patches scattered through an area of peat, peaty gleys or low humic gleys. The principal limitations to the improvement of these areas are associated with the peat or poorly drained areas and are similar to those for sub-classes 6C and 6SW. Improvement of the freely drained areas is made difficult by the smallness of the areas and the unfavourable climatic conditions. Land use is restricted to rough grazing, which overall may be of moderate quality, and to forestry which, because of the varied soil, may involve planting several tree species. Trees planted on the freely drained soils, which are often raised above the wetter areas, may at a later stage of growth provide some protection against windblow to trees planted on the wetter soils (Pyatt, 1965).

Class 7

Sub-class 7RK

Most of the land placed in this sub-class is shown on the soil map as belonging to the skeletal group of soils. Both soil and vegetative cover are often sparse, and the steep rock cliffs which occur at the heads of corries make up a considerable proportion of the mapping unit. Such land, far from being of agricultural value, can be a hazard to animals. Apart from its scenic value, it is only of use for activities such as climbing.

Sub-class 7CL

Land in this sub-class is characterized by the high degree of exposure to which it is subject and the shortness of the growing season. In considering the gradual deterioration in value of hill and rough grazings as climate becomes less favourable with rising altitude, the most significant change is generally taken as that of the planting limit for forestry. Above this level exposure and other factors are so extreme that tree growth is very stunted if not impossible. In this area the limit is about 1650 feet. Much of the land above this altitude still has some value as rough grazing, but the shortness of the growing season and poor climate make this very small. All the land over 1650 feet (except sub-class 7RK) therefore has been included in this sub-class, which is mainly used for amenity and sporting purposes although it has a small rough grazing value; afforestation is not possible.

CONCLUSION

From Table K and the foregoing descriptions of the capability sub-classes it will be seen that most soil series occur in several capability sub-classes; only those soils which occupy very small areas are restricted to one sub-class. Mackney and Burnham (1966) in discussing the land capability of Shropshire have remarked on a similar relationship in that area.

The wide range in land capability of many of the soils in Galloway is due to the hilly nature of the topography and the large variation in climate associated with differences of altitude, which means that soils of widespread occurrence are inevitably found under many different environmental conditions. Thus the Linhope series, which occurs in this area between sea-level and 1000 feet and on a range of slopes from level to very steep, has been placed in four capability classes according to slope, while additional sub-classes have been delineated to take account of climatic variations and areas where the profile is excessively shallow, although such phase differences have not been shown on the soil map. The Darleith series occurs in a similar range of classes and sub-classes. Soils such as the Dreghorn, Balig or Darvel series, which do not cover extensive areas (Table H), are found under a narrow range of environmental conditions and therefore occur in only one capability class and sub-class.

An additional factor influencing the number of classes and sub-classes in which a soil may appear is the severity of the limitation on its use imposed by features characteristic of the soil profile. Thus the Linhope series whose capability is only slightly affected by the nature of the typical soil profile occurs, as stated, in a wide variety of classes and sub-classes. In contrast, the Littleshalloch series, the capability of which is severely limited (class 4) by poor drainage even under favourable environmental conditions, occurs in only three classes. A similar example is the Dochroyle series which although very widespread throughout the area appears in only two classes, since the characteristics associated with the peaty surface horizon make it unsuitable for any class higher than class 6.

Table K/Land Capability Classes and Sub-classes and their Soils

Capability class	Capability sub-class	Soil Series or Complex
Class 1		Tranew, Dreghorn
Class 2	2 SH	Benan, Darleith, Linhope, Meadownay
	2 SN	Darleith, Linhope
	2 SW	Gallowshill, Glenalmond
	2 GW	Some Alluvial soils
	2 TP	Tranew
Class 3	3 SN	Balig, Darvel, Yarrow, and some Alluvial soils
	3 SW	Altimeg, Dunlop, Glenalmond, Kedslie, Minuntion
	3 GW	Some Alluvial soils
	3 TP	Benan, Darleith, Gallowshill, Glenalmond, Linhope, Meadownay, Tranew

TABLE K—*continued*

Class 4	4 SW	Altimeg, Altiwan, Amlaird, Blair, Drumyork, Dunlop, Ettrick, Kedslie, Lanes, Littleshalloch, Minuntion
	4 GW	Some Alluvial soils
	4 TP	Altimeg, Benan, Darleith, Gallowshill, Glenalmond, Kedslie, Linhope, Meadownay, Minuntion, Tranew
	4 CL	Benan, Darleith, Glenalmond, Linhope, Meadownay, Tranew
Class 5	5 SA	Links
	5 SH	Benan, Darleith, Knockskae, Meadownay, Linhope
	5 SW	Altiwan, Amlaird, Blair, Ettrick, Lanes, Littleshalloch, Whiterow
	5 GW	Some Alluvial soils
Class 5	5 TP	Benan, Darleith, Drumyork, Linhope, Meadownay, Minuntion, Tranew
	5 RK	Benan, Achie
	5 PM	Auchensoul, Bush, Dinnins, Largmore
	5 CL	Dalbeattie
Class 6	6 OR	Alemoor, Baidland, Brochloch, Carsphairn, Dochroyle, Dod, Eglin, Falaird, Finlas, Gala, Hadyard, Linfern, Minnoch, Myres, Palmullan, Peat, Peat-Alluvium, Riecawr, Spallander, Trool, Turgeny, Twachtan, Knockinculloch
	6 SW	Blair, Ettrick, Littleshalloch, Whiterow
	6 GW	Some Alluvial soils
	6 TP	Darleith, Dunlop, Amlaird, Minuntion, Lanes, Benan, Meadownay, Linhope, Kedslie, Ettrick, Altimeg, Knockskae
	6 RK	Benan, Craig, Darnaw, Garrary, Glenlee, Mullwharchar
	6 PM	Auchensoul, Bush, Dinnins, Largmore, Pinverains, Stroan, Clashverains
Class 7	7 RK	Skeletal soils of the following associations: Benan, Dalbeattie, Darleith, Ettrick, Knockskae
	7 CL	Brochloch, Cairnsmore, Darnaw, Dochroyle, Dod, Garrary, Merrick, Mullwharchar

References

Bailey, E. B. (1926). District Report: Ayrshire. *Mem. geol. Surv. Summ. Prog.*, p. 58.

Bailey, E. B. and McCallien, W. J. (1957). The Ballantrae Serpentine, Ayrshire. *Trans. Edinb. geol. Soc.*, **17**, 33.

Ball, D. F. (1964). Loss-on-Ignition as an Estimate of Organic Matter and Organic Carbon in Non-calcareous Soils. *J. Soil Sci.*, **15**, 84.

Balsillie, D. (1932). The Ballantrae Igneous Complex, South Ayrshire. *Geol. Mag.*, **69**, 107.

Bibby, J. S. and Orbell, G. E. (1966). Soils and Land Use Capability of the Livingston Hinterland. Aberdeen: Macaulay Institute for Soil Research. (Restricted Circulation).

Bøcher, T. W. (1943). Studies on the Plant Geography of the North-Atlantic Heath Formation. II. Danish Dwarf Shrub Heaths in Relation to those of North Europe. *Biol. Skr.* **2**, 1.

Bouyoucos, G. J. (1927a). The Hydrometer as a New and Rapid Method for Determining the Colloidal Content of Soils. *Soil Sci.*, **23**, 319.

Bouyoucos, G. J. (1927b). The Hydrometer as a New Method for the Mechanica Analysis of Soils. *Soil Sci.*, **23**, 343.

Braun-Blanquet, J. (1964). Pflanzenoziologie. 3rd revd. ed. Vienna: Springer.

Burnett, J. H. (1964). The Vegetation of Scotland. Edinburgh: Oliver and Boyd.

Charlesworth, J. K. (1925). The Glacial Geology of the Southern Uplands of Scotland, West of Annandale and Upper Clydesdale. *Trans. R. Soc. Edinb.*, **55**, Pt. 1, No. 1.

Clapham, A. R., Tutin, T. G. and Warburg, E. F. (1962). Flora of the British Isles. 2nd ed. Cambridge: University Press.

Crompton, E. (1956). The Environmental and Pedological Relationships of Peaty Gleyed Podzols. *Trans. 6th int. Congr. Soil Sci., Paris, E*, 155.

Deer, W. A. (1935). The Cairnsmore of Carsphairn Igneous Complex. *Q. Jl. geol. Soc. Lond.*, **91**, 47.

Department of Agriculture and Fisheries for Scotland (1964). Scottish Peat Surveys, I, South West Scotland, 3. Edinburgh: HMSO.

Ellis, J. H. (1932). A Field Classification of Soils for Use in Soil Survey. *Scient. Agric.*, **12**, 6.

Evans, E. Price (1932). Cader Idris: a Study of Certain Plant Communities in South-west Merionethshire. *J. Ecol.* **20**, 1.

FitzPatrick, E. A. (1956). An Indurated Soil Horizon Formed by Permafrost. *J. Soil Sci.*, **7**, 248.

Fraser, G. K. (1943). Peat Deposits of Scotland, Pt. I. *Wartime Pamph. geol. Surv. Scotl.*, No. 36.

Gardiner, C. I. and Reynolds, S. H. (1932). The Loch Doon 'Granite' Area, Galloway. *Q. Jl. geol. Soc. Lond.*, **88**, 1.

Gardiner, C. I. and Reynolds, S. H. (1937). The Cairnsmore of Fleet Granite and its Metamorphic Aureole. *Geol. Mag.*, **74**, 289.

George, T. N. (1956). Drainage in the Southern Uplands: Clyde, Nith, Annan. *Trans. geol. Soc. Glasg.*, **22**, 1.

Gimingham, C. H. (1961). North European Heath Communities: A 'Network of Variation'. *J. Ecol.*, **49**, 655.

Gimingham, C. H. and Birse, E. M. (1957). Ecological Studies on Growth-form in Bryophytes. I. Correlations between Growth-form and Habitat. *J. Ecol.*, **45**, 533.

Glentworth, R. (1944). Studies on the Soils Developed on Basic Igneous Rocks in Central Aberdeenshire. *Trans. R. Soc. Edinb.*, **61**, Pt. 1, No. 5.

Glentworth, R. (1954). The Soils of the Country round Banff, Huntly, and Turriff. (Sheets 86 and 96). *Mem. Soil Surv. Scotl.* Edinburgh: HMSO.

Grant, R. (in preparation). The Soils of the Country round Ayr. (Sheet 14 and part of 13). *Mem. Soil Surv. Scotl.* Edinburgh: HMSO.
Guppy, E. M. (1956). Chemical Analyses of Igneous Rocks, Metamorphic Rocks and Minerals, 1931–54. With Petrographic Descriptions by P. A. Sabine. *Mem. geol. Surv. U.K.* London: HMSO.
Hollingsworth, S. E. (1938). The Recognition and Correlation of High-level Erosional Surfaces in Britain: a Statistical Study. *Q. Jl. geol. Soc. Lond.*, **94**, 55.
Hunter, J. G. (1950). An Absorptiometric Method for the Determination of Magnesium. *Analyst, Lond.*, **75**, 91.
Hunter, J. G. and Vergnano, O. (1952). Nickel Toxicity in Plants. *Ann. appl. Biol.*, **39**, 279.
Hunter, R. F. (1962). Hill Sheep and their Pasture; A Study of Sheep-grazing in South-east Scotland. *J. Ecol.*, **50**, 615.
Irrigation (1962). *Bull. Minist. Agric., Lond.*, No. 138.
James, P. W. (1965). A New Check-list of British Lichens. *Lichenologist*, **3**, 95.
Jardine, W. G. (1959). River Development in Galloway. *Scott. geogr. Mag.*, **75**, 65.
Jenny, H. (1941). Factors of Soil Formation. New York: McGraw Hill.
Jones, E. W. (1958). An Annotated List of British Hepatics. *Trans. Br. bryol. Soc.*, **3**, 353.
Klingebiel, A. A. and Montgomery, P. H. (1961). Land-Capability Classification. *Agric. Handb. Soil Conserv. Serv. U.S. Dep. Agric.*, No. 210.
Kruckeberg, A. R. (1951). Intraspecific Variability in the Response of Certain Native Plant Species to Serpentine Soils. *Am. J. Bot.*, **38**, 408.
Kubiena, W. L. (1953). The Soils of Europe. London: Murby.
Lines, R. and Howell, R. S. (1963). The Use of Flags to Estimate the Relative Exposure of Trial Plantations. *Forest Rec., Lond.*, No. 51.
Mackney, D. and Burnham, C. P. (1966). The Soils of the Church Stretton District of Shropshire. (Sheet 166). *Mem. Soil Surv. Engl. Wales.* London: HMSO.
McVean, D. N. and Ratcliffe, D. A. (1962). Plant Communities of the Scottish Highlands. *Monogr. Nature Conservancy*, No. 1. London: HMSO.
Markham, R. (1942). A Steam-distillation Apparatus Suitable for Micro-Kjeldahl Analysis. *Biochem. J.*, **36**, 790.
Mitchell, B. D. and Jarvis, R. A. (1956). The Soils of the Country round Kilmarnock. (Sheet 22 and part of Sheet 21). *Mem. Soil Surv. Scotl.* Edinburgh: HMSO.
Mitchell, B. D. and Mackenzie, R. C. (1959). An Apparatus for Differential Thermal Analysis under Controlled-atmosphere Conditions. *Clay Miner. Bull.*, **4**, 31.
Mitchell, R. L. (1964). The Spectrographic Analysis of Soil, Plants and Related Materials. With addendum. *Tech. Commun. Commonw. Bur. Soil Sci.*, No. 44A.
Muir, A. (1935). The Soils of Drummond Hill. *Forestry*, **9**, 116.
Muir, A. and Fraser, G. K. (1939). The Soils and Vegetation of the Bin and Clashindarroch Forests. *Trans. R. Soc. Edinb.*, **60**, Pt. 1, No. 8.
Muir, J. W. (1952). The Determination of Total Phosphorus in Soil with Particular Reference to the Control of Interference by Soluble Silica. *Analyst, Lond.* **77**, 313.
Muir, J. W. (1956). The Soils of the Country round Jedburgh and Morebattle. (Sheets 17 and 18). *Mem. Soil Surv. Scotl.* Edinburgh: HMSO.
Munsell Color Company Inc. (1954). Soil Color Charts. Baltimore: Munsell Color Company Inc.
New Statistical Account of Scotland (1845). Vol. IV, Dumfries, Kirkcudbright, Wigtown. Vol. V, Ayr, Bute.
Parker, F. W. (1929). The Determination of Exchangeable Hydrogen in Soils. *J. Am. Soc. Agron.*, **21**, 1030.
Peach, B. M. and Horne, S. (1899). The Silurian Rocks of Britain, Vol. I, Scotland. *Mem. geol. Surv. U.K.* Glasgow: HMSO.
Pearsall, W. H. (1918). The Aquatic and Marsh Vegetation of Esthwaite Water. *J. Ecol.* **6**, 53.
Pettijohn, F. J. (1949). Sedimentary Rocks. New York: Harper.
Poore, M. E. D. (1955a). The Use of Phytosociological Methods in Ecological Investigations. I. The Braun-Blanquet System, *J. Ecol.* **43**, 226.
Poore, M. E. D. (1955b). The Use of Phytosociological Methods in Ecological Investigations. Practical Issues Involved in an Attempt to Apply the Braun-Blanquet System. *J. Ecol.* **43**, 245.
Pringle, J. (1948). The South of Scotland. *Br. reg. Geol.* London: HMSO.

Pyatt, D. G. (1965). The Soil and Windthrow Surveys of Newcastleton Forest, Roxburghshire. *Rep. Forest Res., Lond., 1964/65.* p. 204.

Ragg, J. M. (1960). The Soils of the Country round Kelso and Lauder. (Sheets 25 and 26). *Mem. Soil Surv. Scotl.* Edinburgh: HMSO.

Ragg, J. M. and Bibby, J. S. (1966). Frost Weathering and Solifluction Products in Southern Scotland. *Geogr. Annlr.*, **48**, 12.

Ragg, J. M. and Futty, D. W. (1967). The Soils of the Country round Haddington and Eyemouth. (Sheets 33 and 34 and part of Sheet 41). *Mem. Soil Surv. Scotl.* Edinburgh: HMSO.

Ratcliffe, D. A. (1959). The Vegetation of the Carneddau, North Wales. I. Grasslands, Heaths and Bogs. *J. Ecol.* **47**, 371.

Ratcliffe, D. A. and Walker, D. (1958). The Silver Flowe, Galloway, Scotland. *J. Ecol.*, **46**, 407.

Reeder, S. W. and McAllister, A. L. (1957). A Staining Method for the Quantitative Determination of Feldspars in Rocks and Sands from Soils. *Can. J. Soil Sci.*, **37**, 57.

Robertson, G. (1950). The Colorimetric Determination of Aluminium in Silicate Materials. *J. Sci. Fd Agric.*, **1**, 59.

Robinson, W. O. (1939). Methods and Procedures of Soil Analysis Used in the Division of Soil Chemistry and Physics. *Circ. U.S. Dep. Agric.*, No. 139.

Russell, E. J. (1912). Soil Conditions and Plant Growth. London: Longmans.

Salter, P. J. and Williams, J. B. (1965). The Influence of Texture on the Moisture Characteristics of Soils. Pt. II. Available-water Capacity and Moisture Release Characteristics. *J. Soil Sci.* **16**, 310.

Scott, R. O. (1941). The Colorimetric Estimation of Iron with Sodium Salicylate. *Analyst, Lond.* **66**, 142.

Scott, R. O. and Ure, A. M. (1958). The Determination of Magnesium in Solution by Direct Photometry. *Analyst, Lond.* **83**, 561.

Smith, R. E. and Erhlich, W. A. (1964). Soil Survey of the South-eastern Map Sheet Area. *Soils Rep. Manitoba Soil Surv.*, No. 14.

Smith, W. G. (1918). Improvement of Hill Pasture. *Scott. J. Agric.*, **1**, 261.

Soil Survey of Great Britain (1958). Rep. Soil Surv. Res. B., No. 9. London: HMSO.

Spence, D. H. N. (1957). Studies on the Vegetation of Shetland. I. The Serpentine Debris Vegetation in Unst. *J. Ecol.*, **45**, 917.

Tansley, A. G. (1953). The British Isles and their Vegetation. Cambridge: University Press.

Tüxen, R. (1937). Die Pflanzengesellschaften Nordwestdeutschlands. *Mitt. flor.-soz. ArbGemein.*, **3**, 1.

Ure, A. M. (1954). The Application of Electronics to Spectrochemistry. Thesis, University of Aberdeen, Scotland.

U.S. Department Agriculture (1951). Soil Survey Manual. Handbk. U.S. Dep. Agric., No. 18. Washington: Government Printing Office.

U.S. Department Agriculture Soil Survey Staff (1960). Soil Classification—A Comprehensive System. 7th Approximation. Washington: Government Printing Office.

Walkley, A. and Black, I. A. (1934). An Examination of the Degtjareff Method for Determining Soil Organic Matter, and a Proposed Modification of the Chromic Acid Titration Method. *Soil Sci.*, **37**, 29.

Walton, E. K. (1955). Silurian Greywackes in Peeblesshire. *Proc. R. Soc. Edinb.*, **B65**, 327.

Walton, E. K. (1956). Two Ordovician Conglomerates in South Ayrshire. *Trans. geol. Soc. Glasg.*, **22**, 133.

Warburg, E. F. (1963). Census Catalogue of British Mosses. 3rd ed. Ipswich: British Bryological Society.

Watt, A. S. (1947). Pattern and Process in the Plant Community. *J. Ecol.*, **35**, 1.

Webley, D. M., Henderson, Moira E. K. and Taylor, Irene F. (1963). The Microbiology of Rocks and Weathered Stones. *J. Soil Sci.*, **14**, 102.

Whittaker, E. and Gimingham, C. H. (1962). The Effects of Fire on Regeneration of *Calluna vulgaris* (L.) Hull. from Seed. *J. Ecol.*, **50**, 815.

Williams, E. G. and Stewart, A. B. (1941). The Colorimetric Determination of Readily Soluble Phosphate in Soils. *J. Soc. Chem. Ind., Lond.*, **60**, 291.

APPENDIX I

PROFILE DESCRIPTION

The standard terms used in profile description are:

a. Terms relating to the site:
   Relief and Slope, Vegetation, Aspect, and Altitude
b. Terms relating to the profile as a whole:
   Horizon Notation and Drainage Class
c. Terms describing horizon properties:
   Colour, Texture, Structure, Consistence, Induration, Organic Matter Content, Stoniness, Mottling and Horizon Boundaries.

RELIEF AND SLOPE CLASS

Single slope classes (U.S.D.A. 1951) are defined by a range of angles of slope, while the relief class describes the frequency of undulation of the landscape which is dependent on and defines lengths of slope.

Class A	Single Slope Class	Relief Class
Limits		
Lower 0 per cent (0°)	Level	Depressional to flat
Upper 1–3 per cent (½–1½°)		Very gently undulating
Class B		
Limits		
Lower 1–3 per cent (½–1½°)	Gentle	Gently rolling slopes of low frequency
Upper 5–8 per cent (3–4½°)		Undulating slopes of higher frequency
Class C		
Limits		
Lower 5–8 per cent (3–4½°)	Moderate	Rolling slopes of low frequency
Upper 10–16 per cent (6–9°)		Strongly undulating slopes of high frequency
		Moundy slopes of very high frequency
Class D		
Limits		
Lower 10–16 per cent (6–9°)	Moderately steep	Strongly rolling to hilly
Upper 20–30 per cent (12–17°)		
Class E		
Limits		
Lower 20–30 per cent (12–17°)	Steep	Steeply hilly or dissected
Upper 45–65 per cent (24–33°)		
Class F		
Limits		
Lower 45–65 per cent (24–33°)	Very steep	
Upper none (90°)		

HORIZON NOTATION

Soil horizons are referred to by letter symbols as follows:

- L — a superficial layer of relatively undecomposed plant litter generally of the preceding year.
- F — a superficial layer of partially decomposed litter with recognisable plant remains.
- H — a superficial layer of decomposed organic matter with few or no recognisable plant remains.
- A — upper organo-mineral and mineral layers under natural or semi-natural conditions.
- S — surface layer of a cultivated soil.
- B — lower layers of the solum which have undergone pedological change.
- C — the parent material from which the soil has developed.
- D — rock from which C horizon has been formed, or layer underlying the solum not related to the parent material.
- g — when following another horizon symbol indicates that the layer is strongly gleyed.
- (g) — used when gley characters are only slightly expressed.

These symbols have more precise significance when applied to specified major soil groups as follows.

HORIZON NOTATION OF THE MAJOR SOIL GROUPS

Peaty Podzol (with iron pan)

- L — undecomposed plant litter.
- F — partially decomposed litter.
- H — decomposed organic matter or black, raw humus, usually >2 inches thick.
- A_1 — the uppermost mineral layer, dark organic matter mixed with mineral matter relatively rich in silica.
- A_2 — a layer immediately below the A_1 which is low in organic matter, pale grey in colour and rich in silica, and may show signs of gleying; it is designated either A_2(g) when gleying is slight or A_2g when gleying is strong. A concentration of roots may be present at the bottom of this layer and they may be partially decomposed.
- B_1 — a thin iron pan about $\frac{1}{16}''$ thick. Maximum enrichment of sesquioxides. May be continuous and impermeable to water and impenetrable to roots; then there is a strong tendency for gleying and for roots to concentrate immediately above in the A_2.
- B_2 — brighter in colour than the A or C horizons. Relative enrichment of free sesquioxides.
- B_3 — not so bright as B_2. Shows some relative enrichment of free sesquioxides and may show some degree of induration.
- C — the relatively unweathered parent material.

Iron Podzol

- L — undecomposed plant litter.
- F — partially decomposed litter.
- H — decomposed organic matter—dark brown or black raw humus, usually 4 inches.
- A_1 — the uppermost mineral layer, dark coloured organic matter mixed with mineral matter, relatively rich in silica.
- A_2 — a layer immediately below A_1 containing less organic matter, grey or grey-brown in colour and rich in silica.
- B_2 — brighter than A or C horizon. Relative enrichment of sesquioxides.
- B_3 — not so bright as B_2. Shows some relative enrichment of free sesquioxides and may be indurated.
- C — the relatively unweathered parent material.

Brown Forest Soil (low base status)

- L — undecomposed plant litter.
- F — partially decomposed plant litter.
- H — trace of decomposed organic matter—may be absent.
- A — brown colour with medium organic content, moder type; crumb structure. No differentiation into A_1 or A_2.
- B_2 — brighter brown colour than the A horizon. A relative enrichment of free sesquioxides.
- B_3 — less bright than the B_2 horizon and nearer to the colour of the parent material. May show some degree of induration.
- C — the relatively unweathered parent material.

Brown Forest Soil with Gleyed B and C Horizons

- L — undecomposed plant litter.
- F — partially decomposed litter.
- H — trace of decomposed organic matter.
- A — mixed mineral and organic layer, moder type. No differentiation.
- $B_2(g)$ — well defined blocky or prismatic structure. Horizon of maximum gleying, mottles within and sometimes on peds. May have greater clay content than A or C horizons.
- $B_3(g)$ — less well defined blocky or prismatic structure. Mottling within and sometimes on peds.
- C(g) — structure usually massive, less mottled than B horizons.

Peaty Gley

- L — undecomposed plant litter.
- F — partially decomposed litter.
- H — raw humus usually $>$ 2 inches thick, black in colour.
- A_1g — mixed organic and mineral layer. A little ochreous mottling along roots, weak structure.
- A_2g — pale brown layer, humus stained, low in organic matter, weak structure.
- B_2g — pale coloured with slight ochreous mottling and iron tubes surrounding root tracks, blocky structure.
- B_3g — grey to blue-grey with distinct iron tubes, no mottling, massive structure.
- Cg — blue-grey, no iron tubes, massive.

Non-calcareous Gley

- L undecomposed plant litter.
- F partially decomposed litter.
- H trace of decomposed organic matter—often absent.
- A_1g mixed mineral organic layer. Some ochreous mottling associated with roots. Weak structure.
- A_2g pale coloured mineral layer low in organic matter. Structure weak. May be some ochreous mottling.
- B_2g well defined blocky or prismatic structure. Peds coated with grey; ochreous and grey mottles within.
- B_3g less well-defined blocky or prismatic structure. Peds coated with grey; ochreous and grey mottles within.
- Cg original colour of parent material more apparent. Structure more massive, although peds may still have grey coatings and ochreous and grey mottles within.

Sub-alpine Soil

- L undecomposed plant litter.
- F partially decomposed plant litter.
- H/A_1 organo-mineral layer with black greasy humus.
- H/A_2 organo-mineral layer with black greasy humus and bleached sand grains.
- H/B_2 organo-mineral layer with black greasy humus and humus-coated stones and coarse particles.
- C light brown sandy loam layer. May be very stony.

DRAINAGE CLASS

Drainage class is assessed on and defined according to the degree of gleying in the soil. The general characters of each class are given below. Precise descriptions are only possible with individual series.

Drainage: Excessive

Soil horizons are shallower than is normal and B horizons are bright and uniform in colour. Profiles of this category are of small extent and are not shown on the soil map.

Drainage: Free

The B horizons are bright and uniformly coloured; soils with B horizons showing only slight dullness and only a small number of mottles are included in this class.

Drainage: Imperfect

The B horizons are less bright than those of the well drained soils and have appreciable mottling.

Drainage: Poor

The Bg horizons are dull and mottling is evident.

Drainage: Very Poor

The Bg horizons are dull and mottling is very evident.

COLOUR

Soil colours are defined by reference to the Munsell Soil Color Charts (Munsell Color Company. Inc., 1954) and described according to their notation and nomenclature. The Munsell system describescolour in term of Hue, Value, and Chroma. Hue refers to the dominant spectral colour (red or yellow), Value to the apparent lightness as compared with absolute white, and Chroma refers to the purity of the Hue or departure therefrom. Colours or groups of colours thus defined are given standard names *eg* pale brown—10YR6/3 (Hue10YR, Value 6 and Chroma 3).

TEXTURE

The texture of a soil refers to the relative proportions, according to size, of those primary particles of which it is composed which pass through a 2 mm. sieve.

Particles larger than 2 *mm* are indicated by terms descriptive of their nature, such as stony, pebbly, gritty etc.

Particles less than 2 *mm* are grouped in separates according to their effective diameters when subjected to the techniques of mechanical analysis. The size ranges of the separates—sand, silt, and clay—according to the U.S. Department of Agriculture and the International schemes, are given below.

U.S.D.A. Scheme			International Scheme		
Name of Separate		Effective Diameter (range) μ	Fraction		Effective Diameter (range) μ
sand	very coarse sand	2000–1000			
sand	coarse sand	1000–500	sand	coarse sand I	2000–200
sand	medium sand	500–250	sand	fine sand II	200–20
sand	fine sand	250–100			
sand	very fine sand	100–50	silt III		20–2
	silt	50–2	clay IV		<2
	clay	<2			

The textural classes and their range of composition (U.S.D.A. scheme) are shown in the triangular diagram (Fig. 17). Soil textures are assigned by noting the area in which the size grade composition occurs when plotted on the diagram.

General terms referring to broad classes of soil texture are defined by grouping the basic textural classes (U.S.D.A., 1951) as shown below.

	General terms	Basic textural classes
sandy soils	coarse-textured soils	sands loamy sands
loamy soils	moderately coarse-textured soils	sandy loams
	medium-textured soils	loams silt loams silts
	moderately fine-textured soils	clay loams sandy clay loams silty clay loams
clayey soils	fine-textured soils	sandy clays silty clays clays

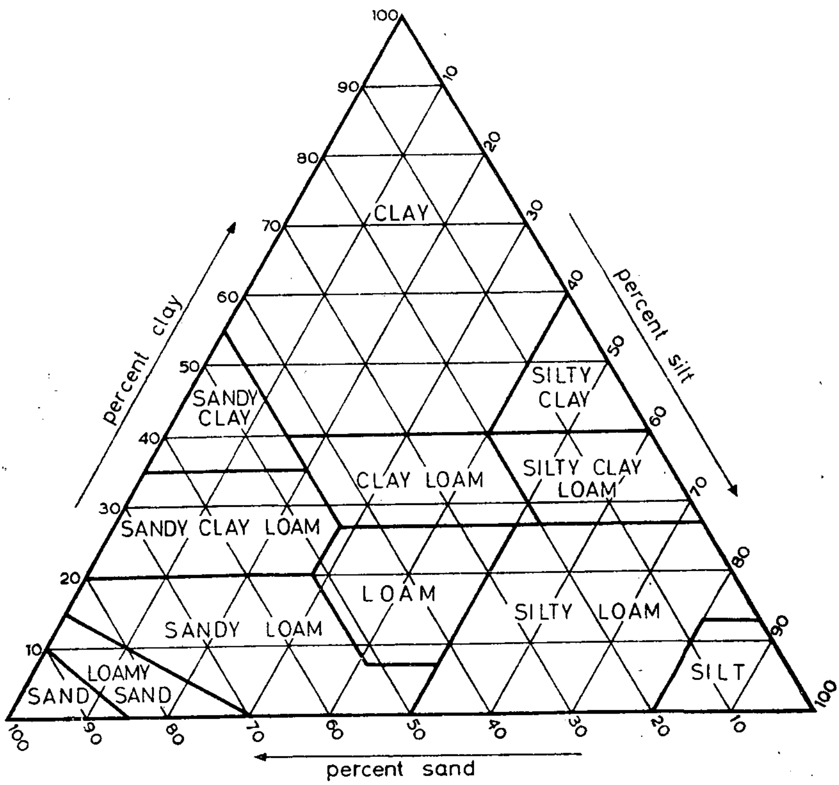


FIG. 17 The Percentages of Clay ($<2\mu$), Silt (2–50μ) and Sand (50–$2000\ \mu$)in the Basic Soil Textural Classes.

STRUCTURE

The structure of a soil is the aggregation of its primary particles into compound units, peds, which are largely independent of one another. Field descriptions of structure record these features of the peds:

i shape and arrangement
ii size
iii distinctness and durability.

Primary types of structure

I. Platy —with one dimension, the vertical, much less than the other two.

II. Prismlike —with the two horizontal dimensions much less than the vertical.

III. Blocklike —with three dimensions of the same order of magnitude, but having plane or curved surfaces that are casts of the moulds formed by the faces of the surrounding peds.

IV. Spheroidal—with three dimensions of the same order of magnitude, having plane or curved surfaces which have slight or no accommodation to the faces of the surrounding peds.

Class designates the size of the aggregates; five are recognised for each type. The terms used are very fine, fine, medium, coarse and very coarse. The types and classes of soil structure are given in Table 1.

Grade of structure is the degree of aggregation and expresses the differential between cohesion within aggregates and adhesion between aggregates, and in practice is determined mainly by observing the durability of the aggregates. Terms used for grade of structure are:

1. Weak —units barely observable *in situ*. When disturbed the soil material breaks into a mixture of a few unbroken units and many broken with much unaggregated material.
2. Moderate—well formed units but not distinct in undisturbed soil. When disturbed there are many unbroken units, some broken units and a little unaggregated material.
3. Strong —well formed units distinct in undisturbed soil; adhere only slightly to one another. When disturbed consist of entire units with few broken and very little unaggregated material.

Soils without structure are either:

a. Single grain—primary particles do not cohere.
b. Massive —primary particles cohere.

CONSISTENCE

Soil consistence is a quality of soil material which is expressed by the degree of cohesion or adhesion, and is measured by the resistance of soil material to deformation or rupture.

The following terms are used to describe consistence under various conditions of moisture (U.S.D.A., 1951).

Consistence when wet

To evaluate, roll soil material between thumb and forefinger.

0. Non-plastic —no wire formable.
1. Slightly plastic—wire formable and soil mass easily deformed.
2. Plastic —wire formable and moderate pressure required to deform soil mass.
3. Very plastic —wire formable and much pressure required to deform soil mass.

Consistence when moist

To evaluate, attempt to crush in the hand.

0. Loose —non-coherent.
1. Friable —soil material crushes under very gentle pressure but coheres when pressed together.
2. Firm —soil material crushes under very moderate pressure between thumb and forefinger but resistance distinctly noticeable.
3. Very firm—soil material crushes only under strong pressure; sometimes not crushable between thumb and forefinger.

Consistence when dry

To evaluate, break an air-dry mass in the hand.

0. Loose —non-coherent.
1. Soft —breaks to powder or individual grains under very slight pressure.
2. Hard —can be broken easily in the hand but only with difficulty between thumb and forefinger.
3. Very hard—can normally be broken in the hands but only with difficulty.

INDURATION

Induration of soil material refers to a handling property of the soil which unlike consistence appears not to be markedly affected by moisture content. Three terms are used to describe induration and they are defined below.

1. Weakly indurated —not usually detected when digging but presence shown by stabbing a knife into profile face. Breaks easily in the hand.
2. Moderately indurated—detected when digging. Breaks in the hand by using moderate pressure.
3. Strongly indurated —detected when digging and in fact causes difficulty. Not readily broken in the hand.

TABLE 1. TYPES AND CLASSES OF SOIL STRUCTURE

Type (Shape and arrangement of peds)

Class (Size)	Platelike with one dimension (the vertical) limited and greatly less than the other two; arranged around a horizontal plane; faces mostly horizontal.	Prismlike with two dimensions (the horizontal) considerably less than the vertical; arranged around a vertical line; vertical faces well defined; vertices angular.		Blocklike: polyhedronlike, or spheroidal, with 3 dimensions of the same order of magnitude; arranged round a point.			
				Blocklike: blocks or polyhedrons having plane or curved surfaces that are casts of the moulds formed by the faces of surrounding peds.		Spheroids or polyhedrons having plane or curved surfaces which have slight or no accommodation to the faces of surrounding peds.	
		Without rounded caps	With rounded caps	Faces flattened: most vertices sharply angular	Mixed rounded and flattened faces with many rounded vertices	Relatively non-porous peds	Porous peds
	Platy	Prismatic	Columnar	(Angular) Blocky	Sub-angular Blocky	Granular	Crumb
very fine	very fine platy <1 mm.	very fine prismatic <10 mm.	very fine columnar <10 mm.	very fine angular blocky <5 mm.	very fine sub-angular blocky <5 mm.	very fine granular <1 mm.	very fine crumb <1 mm.
fine	fine platy 1–2 mm.	fine prismatic 10–20 mm.	fine columnar 10–20 mm.	fine angular blocky 5–10 mm.	fine sub-angular blocky 5–10 mm.	fine granular 1–2 mm.	fine crumb 1–2 mm.
medium	medium platy 2–5 mm.	medium prismatic 20–50 mm.	medium columnar 20–50 mm.	medium angular blocky 10–20 mm.	medium sub-angular blocky 10–20 mm.	medium granular 2–5 mm.	medium crumb 2–5 mm.
coarse	coarse platy 5–10 mm.	coarse prismatic 50–100 mm.	coarse columnar 50–100 mm.	coarse angular blocky 20–50 mm.	coarse sub-angular blocky 20–50 mm.	coarse granular 5–10 mm.	
very coarse	very coarse platy >10 mm.	very coarse prismatic >100 mm.	very coarse columnar >100 mm.	very coarse angular blocky >50 mm.	very coarse sub-angular blocky >50 mm.	very coarse granular >10 mm.	

ORGANIC MATTER

Organic matter may be described quantitatively and qualitatively.

a. *Quantitatively*

i.	Organic soil	>20 per cent organic matter
ii.	High	13–20 per cent
iii.	Moderate	8–13 per cent
iv.	Low	<8 per cent

b. *Qualitatively* (Kubiena, 1953)

i. Mull humus —an intimate mixture of mineral and organic matter in the A horizon with the constituent parts indistinguishable by a lens.

ii. Silicate moder —appears similar to mull but its organic and inorganic constituents may be distinguishable with a good lens.

iii. Raw humus (mor)—a distinct organic horizon less than 12 inches thick having little mineral material.

STONINESS

Few stones—<15 per cent by volume
Stony —15–50 per cent by volume
Very stony —>50 per cent by volume.

MOTTLING

Mottling is described according to the abundance, size and colour of mottles and colour contrast between mottles and unmottled soil material.

1. Colour —Munsell color chart notation
2. Abundance
   - few —mottles <2 per cent of surface
   - frequent —mottles 2–20 per cent of surface
   - many —mottles >20 per cent of surface
3. Size
   - fine —<5 mm
   - medium —5–15 mm
   - coarse —>15 mm
4. Contrast
   - faint —hue and chroma of matrix closely related.
   - distinct —matrix and mottles vary 1–2 units in hue and several units in value and chroma.
   - prominent —matrix and mottles vary several units in hue, value, and chroma.

HORIZON BOUNDARIES

Horizon Boundaries are described in terms of distinctness and regularity. The terms used for distinctness are based on the width of the boundary and are given below.

1. Sharp —1 inch
2. Clear —1–2½ inches
3. Gradual—2½–5 inches
4. Diffuse —5 inches

Standard Analytical Data

TABLE 2. BROWN FOREST SOILS, FREELY DRAINED

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
1.								BALIG ASSOCIATION; Balig Series. Hilltop, 188958–188962											
A	0–2	19·8	55	22	68	9	9	15·7	11·3	0·27	0·63	4·04	87·4	5·9	9·33	0·854	302	20·0	Very high exchangeable Mg throughout, and in B and C horizons exceeding exchangeable Ca. pH is moderate to high throughout.
A/B	3–6	8·9	60	19	67	13	16	7·42	8·31	0·27	0·24	7·60	68·1	5·8	3·48	0·335	169	3·3	
B/C	10–13	5·8	49	21	55	15	27	3·25	11·5	0·32	0·11	3·69	80·5	6·3			90	3·5	
C	15–18	6·0	59	17	63	13	20	4·03	14·5	0·34	0·09	2·27	89·3	6·5			95	3·6	
C	24–27	4·7	70	11	73	8	17	2·00	14·8	0·25	0·09	1·35	92·7	6·5			156	8·7	
2.								BENAN ASSOCIATION; Benan Series. The Lanes, 137643–137648											
A_{11}	1–5	17·4	52	18	58	11	17	8·17	1·72	0·17	0·09	13·8	42·4	5·9	7·45	0·518	293	1·0	Very high sand in C. Moderate to high exchangeable Ca in C and high exchangeable Mg. Little change in pH with depth. Low total phosphorus in C.
A_{12}	7–11	11·7	60	21	68	13	13	1·45	0·75	0·11	0·10	13·5	15·2	5·7	4·22	0·317	240	0·6	
B_2	13–17	8·8	68	16	74	10	11	4·40	3·17	0·12	0·07	10·7	42·1	6·1	1·53	0·150	143	0·9	
C	20–24	6·2	80	12	85	5	5	5·85	4·31	0·13	0·06	11·9	46·6	5·7			95	8·3	
C	26–30	4·8	91	3	94	1	3	7·92	7·87	0·17	0.08	9·06	63·9	5·5			91	3·9	
C	32–36	4·5	90	4	92	2	4	8·37	10·2	0·20	0·11	8·34	69·4	5·6			97	4·0	

3. BENAN ASSOCIATION; Benan Series. Cantersty Hill, 153030–153032

A	1–4	20·4	51	21	64	7	13	2·57	2·12	0·14	0·67	23·8	18·8	4·3	8·35	0·576	268	0·6	Low Ca throughout. High acidity. Moderate total P_2O_5 content but low readily soluble P_2O_5 throughout.
B	5–8	13·5	40	30	56	14	23	0·48	0·78	0·16	0·16	16·3	8·8	4·2	4·03	0·318	209	—	
B	12–16	11·4	50	26	60	15	19	0·48	0·66	0·12	0·14	13·6	9·3	4·4			171	—	

4. DALBEATTIE ASSOCIATION; Dalbeattie Series. Glenhead, 179299–179305

A_1(H)	0–1	18·0	65	17	76	5	5	1·56	1·00	0·12	0·25	76·4	3·7	4·5	10·0	0·862	161	1·6	Very low exchangeable cations, and percentage saturation of all horizons below top 1 in. of soil. High acidity. Low readily soluble P_2O_5 except in B_3 and C horizons.
A_1	2–4	11·0	64	27	77	14	3	0·46	0·22	0·07	0·12	19·6	4·2	4·6	5·26	0·480	123	0·5	
B_{21}	7–10	7·4	68	21	79	10	7	—	0·04	0·03	0·03	6·13	1·6	4·5	3·29	0·190	87	0·2	
B_{22}	13–17	13·7	68	23	80	11	1	—	0·04	0·04	—	15·7	0·5	4·6	5·15	0·222	124	0·6	
B_{22}	21–25	7·2	71	20	83	9	5	—	0·05	0·04	—	6·90	1·3	4·5	2·60	0·152	96	1·7	
B_3	29–33	4·9	74	19	84	9	4	—	0·05	0·04	—	9·69	0·9	4·6	1·63	0·063	101	4·7	
C	41–44	2·2	75	21	87	9	4	—	0·01	0·03	—	2·22	1·8	4·5	0·69	0·043	85	11·6	

5. DALBEATTIE ASSOCIATION; Dalbeattie Series. Darrou, 170836–170839

A	3–6	13·0	72	16	81	7	5	0·47	0·31	0·13	0·23	9·10	11·1	4·6	6·72	0·448	194	0·8	Very low exchangeable bases and high acidity throughout. % saturation of C horizon appears anomalous but is explained by the very low exchange capacity.
B_{21}	10–14	12·8	75	16	84	7	3	0·47	0·08	0·08	—	16·5	3·7	4·8	5·02	0·266	152	1·2	
B_{22}	24–32	3·8	92	6	94	4	2	0·30	0·04	0·05	—	4·25	8·4	4·8	1·29	0·102	148	3·9	
C	44–48	1·4	93	5	97	2	1	—	0·03	0·04	—	—	100	4·9	0·78	0·086	106	19·7	

n.d. Not determined —Less than lower limit of determination

TABLE 2: Brown Forest Soils, Freely Drained—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
6.								DARLEITH ASSOCIATION; Darleith Series. Almont, 161948–161950											
A	2–6	16·7	38	29	50	16	21	6·77	1·95	0·16	0·17	15·8	36·4	5·5	7·13	0·573	369	—	Moderate to high exchangeable Ca, moderate exchangeable Mg. Moderate pH throughout. High total P_2O_5 and low readily soluble P_2O_5 throughout.
B	8–12	13·1	38	30	48	20	25	8·70	1·47	0·14	0·07	11·5	47·5	5·9	4·79	0·418	361	0·5	
B	17–20	10·3	44	37	58	23	14	8·44	1·00	0·13	—	9·18	51·0	6·0			318	0·5	
7.								DARLEITH ASSOCIATION; Darleith Series. Garnaburn, 161896–161898											
A	3–7	21·4	25	28	37	16	31	5·62	5·45	0·26	0·56	15·6	43·2	5·2	9·02	0·898	332	1·1	Moderate-high exchangeable Ca and K and high exchangeable Mg and Na throughout. Moderate acidity and low readily soluble P_2O_5 throughout.
B	12–16	14·7	52	29	69	13	11	11·7	12·2	0·43	0·15	12·2	66·8	5·6	4·44	0·457	284	0·3	
B	19–22	13·2	60	22	71	11	11	15·1	12·3	0·50	0·20	10·1	73·6	5·7			237	0·5	

8.						DARVEL ASSOCIATION; Darvel Series. Lady Farm, 173730–173734													
A	3–6	6·5	65	23	77	11	9	12·9	0·56	0·08	0·16	16·3	83·8	6·8	2·71	0·254	475	77·7	Low percentage clay throughout. High exchangeable Ca in A horizon. High pH in surface horizon. High readily soluble P_2O_5 throughout.
B	10–13	2·8	81	15	89	7	4	4·25	0·20	0·06	0·03	7·40	61·4	6·3	1·11	0·104	240	18·1	
C	20–24	2·0	81	16	89	7	4	0·91	0·09	0·02	0·02	3·05	34·1	5·7			157	17·0	
C	30–34	1·2	81	17	91	7	2	0·91	0·09	0·06	0·02	1·86	58·1	5·9			137	20·3	
C	43–46	1·3	82	15	91	7	3	0·91	0·16	0·01	0·02	1·10	100	6·8			115	21·5	
9.						DREGHORN ASSOCIATION; Dreghorn Series. Straid, 161869–161872													
A_1	3–7	8·0	72	12	75	8	13	7·84	4·72	0·23	1·28	4·04	77·7	6·0	2·94	0·207	367	99·0	Moderately high exchangeable cations in the surface horizon. High percentage saturation throughout for a coarse textured soil. High total and readily soluble P_2O_5 in surface.
A_1	14–17	4·2	78	7	81	4	12	4·88	3·33	0·16	0·71	1·73	82·4	6·2	1·22	0·129	186	21·5	
B_3/C	24–28	3·1	96	2	96	1	2	2·73	2·07	0·17	0·50	1·01	84·4	6·3			120	9·6	
C	40–44	2·8	98	1	98	1	1	1·97	1·61	0·12	0·46	0·96	81·3	6·7			105	11·4	
10.						ETTRICK ASSOCIATION; Linhope Series. Creebank, 152926–152930													
A_1	1–4	20·6	49	26	66	8	10	0·48	0·40	0·14	0·50	28·3	5·1	4·8	11·8	0·853	318	2·5	Very low exchangeable Ca throughout. Very low total exchangeable bases in C. Very low percentage saturation throughout, and low readily soluble P_2O_5 in A and B horizons.
A_1/A_2	6–8	10·1	32	47	56	23	16	0·31	0·11	0·07	0·15	11·4	5·3	4·8	4·01	0·304	187	—	
B_2	11–13	10·4	49	38	68	19	7	—	0·09	0·09	0·10	13·6	2·0	5·0			205	1·0	
B_3	16–18	6·8	49	35	67	17	13	—	—	0·07	0·07	9·00	1·5	5·0			166	0·8	
C	29–33	3·2	36	38	51	23	26	—	—	0·05	0·09	3·77	4·8	5·2			141	6·1	

n.d. Not determined —Less than lower limit of determination

TABLE 2: Brown Forest Soils, Freely Drained—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
11.	ETTRICK ASSOCIATION; Linhope Series. Polmaddy Burn, 170818–170822																		
A	0–2	26·7	n.d.	n.d.	n.d.	n.d.	n.d.	1·26	0·78	0·27	0·15	28·5	7·9	4·5	13·8	0·831	188	2·0	Low exchangeable Ca throughout. High acidity. High organic carbon in A horizon. Low readily soluble P_2O_5 throughout.
A	5–9	28·5	n.d.	n.d.	n.d.	n.d.	n.d.	0·31	0·21	0·18	0·16	37·9	2·2	4·7	11·9	0·664	161	1·6	
B_2	16–20	9·13	59	26	70	16	9	—	0·06	0·08	—	6·73	2·0	5·0			80	0·8	
C	30–34	4·15	61	29	73	17	8	—	0·02	0·06	—	2·88	2·7	4·9			69	0·5	
C	40–44	4·03	65	26	79	11	7	0·15	0·04	0·06	—	2·45	9·3	4·9			96	0·8	
12.	ETTRICK ASSOCIATION; Linhope Series. Smirton, 161951–161954																		
L & F	1–0	75·1	n.d.	n.d.	n.d.	n.d.	n.d.	16·9	5·53	1·24	7·05	35·6	46·4	5·1	44·8	2·16	490	70·7	High exchangeable base content in the litter layer. Very low exchangeable bases in C horizon. Low percentage saturation. High acidity in mineral soil.
A	2–5	16·3	55	21	65	10	12	1·56	0·60	0·11	0·33	18·1	12·6	4·8	7·37	0·665	225	0·9	
B	10–14	11·0	50	31	65	16	14	—	0·01	0·06	0·04	15·4	0·8	4·8			145	0·5	
C	24–28	4·8	52	30	65	17	15	—	0·01	0·01	0·02	5·45	0·7	4·6			140	2·4	

13. ETTRICK ASSOCIATION; Linhope Series. Liglatree, 152955–152958

A	4–8	13·7	15	49	39	25	29	7·75	0·64	0·18	0·23	11·4	43·6	5·8	4·22	0·416	338	1·3	High clay in A and B horizons. Moderate exchangeable base content in surface. Moderate acidity throughout profile. Low available P_2O_5 throughout.
B	14–18	8·1	19	43	34	26	34	5·33	1·15	0·17	0·18	8·36	45·0	6·0	2·92	0·292	269	—	
B	22–25	8·4	30	38	64	4	27	4·70	1·25	0·18	0·14	7·89	44·3	5·9			227	—	
C	30–34	2·9	58	31	71	18	11	1·37	0·37	0·07	0·05	3·23	36·5	5·9			108	1·8	

14. YARROW ASSOCIATION; Yarrow Series. Burnfoot, 161905–161909

A	2–6	11·8	33	34	47	19	27	10·6	1·00	0·10	0·17	7·45	61·4	5·6	5·19	0·483	490	11·8	High exchangeable Ca in surface. Moderate acidity and uniform pH with depth. High total P_2O_5 in A horizon and high readily soluble P_2O_5 in surface.
A	9–12	9·2	42	34	55	21	19	4·80	0·71	0·10	0·06	9·81	36·6	5·5	2·99	0·317	371	0·8	
B	16–20	9·7	43	40	62	21	12	4·56	0·56	0·07	0·05	9·66	35·2	5·5			334	0·4	
B	24–28	6·3	60	22	71	11	15	2·61	0·33	0·06	0·02	5·65	34·8	5·5			201	1·0	
C	30–34	4·8	87	3	89	2	7	1·06	0·16	0·03	0·02	2·04	38·4	5·5			153	1·4	

n.d. Not determined —Less than lower limit of determination

TABLE 3. BROWN FOREST SOILS WITH GLEYED B AND C HORIZONS

Horizon	Depth in.	% Loss on Ignition	Soil Separates % Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Exchangeable Cations me/100 g Ca	Mg	Na	K	H	% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
15.								BENAN ASSOCIATION; Minuntion Series. Minuntion, 153022–153024											
A	2–6	20·0	40	32	59	13	13	5·93	1·45	0·28	0·41	15·0	35·0	4·8	10·3	0·678	286	0·5	Low exchangeable Ca and low percentage saturation in B horizon. Low readily soluble P_2O_5 in A and B horizons but high value in C horizon.
B_2g	9–14	6·0	54	20	61	14	23	0·94	0·43	0·12	0·05	12·3	11·1	4·6	1·25	0·060	124	1·7	
B_3g/Cg	25–28	2·7	49	37	66	20	14	4·48	4·32	0·19	0·05	3·82	70·3	5·1			145	20·8	
16.								BENAN ASSOCIATION; Minuntion Series. Cantersty, 153033–153038											
A	2–4	17·0	36	29	50	15	22	7·66	4·12	0·35	0·32	14·3	46·6	4·7	7·70	0·676	232	1·3	Moderate exchangeable Ca, Mg and K in A horizon. High exchangeable Na. Low pH in surface. Low readily soluble P_2O_5 in surface, but high values in subsoil.
A	7–9	12·0	33	34	47	19	27	7·89	2·99	0·27	0·16	12·2	48·1	4·7	4·39	0·350	202	0·6	
B_2g	14–18	4·2	38	37	54	21	22	7·71	3·18	0·16	0·07	5·53	66·8	4·9			112	20·6	
B_2g	20–24	3·6	39	38	47	30	23	9·74	3·82	0·19	0·09	4·81	74·2	5·3			139	35·9	
B_3g/Cg	30–36	4·1	41	35	57	19	22	9·74	3·69	0·18	0·09	3·77	78·4	5·5			156	52·8	
Cg	44–48	3·4	38	38	56	21	23	10·3	4·54	0·15	0·09	3·97	79·1	5·9			158	58·3	

17. DARLEITH ASSOCIATION; Dunlop Series. Garnaburn, 161882–161886

A	2–6	29·8	n.d.	n.d.	n.d.	n.d.	n.d.	8·57	21·7	0·44	0·44	1·24	96·2	5·6	14·5	1·28	157	2·1	Low clay content in D horizon. Very high exchangeable Mg values. High pH in subsoil. Low total P_2O_5 and high readily soluble P_2O_5 in subsoil.
B_2g	12–18	8·2	24	32	36	20	40	5·22	24·8	0·24	0·14	0·06	99·8	6·2	1·11	0·119	32	1·1	
B_3g	22–25	6·4	28	34	41	20	35	4·00	24·2	0·25	0·20	—	100	6·5			43	8·5	
B_3g/Cg	26–30	7·9	42	34	57	19	20	2·64	13·6	0·12	0·06	—	100	6·8			66	34·4	
D	34–38	7·2	64	29	80	13	3	1·07	8·29	0·07	0·02	—	100	6·9			60	27·7	

18. DARLEITH ASSOCIATION; Dunlop Series. Bougang, 161972–161975

A	2–6	8·9	38	32	53	18	25	12·9	5·61	0·12	0·12	7·75	70·8	5·7	4·05	0·375	177	11·9	High exchangeable Ca in A and B_2g horizons. High exchangeable Mg in subsoil. High pH in subsoil. Low total P_2O_5 in subsoil. High readily soluble P_2O_5 except in B_2g horizon.
B_2g	11–14	5·0	36	31	50	17	30	9·74	15·9	0·17	0·16	3·30	88·7	6·3	1·15	0·127	37	0·8	
B_2g	20–24	4·0	41	30	56	16	28	4·70	21·1	0·17	0·23	1·65	94·1	6·4			61	18·2	
Cg	38–42	3·5	47	27	60	15	25	1·24	13·5	0·12	0·13	—	100	7·4			97	48·0	

19. ETTRICK ASSOCIATION; Altimeg Series. Bents, 161941–161944

A	3–7	12·4	21	42	35	27	32	4·67	0·33	0·11	0·39	10·0	35·4	5·1	4·86	0·489	199	5·5	High clay content in A horizon. Moderate base saturation and acidity throughout. Low total P_2O_5 and moderate readily soluble P_2O_5 throughout.
B_2g	11–15	5·7	33	38	47	24	25	2·14	0·16	0·06	0·04	5·46	30·5	5·1	1·87	0·197	68	2·0	
B_3g	20–24	4·8	54	29	64	18	15	0·46	0·08	0·03	0·01	3·38	14·6	5·2			99	7·3	
Cg	32–36	4·7	36	47	49	34	14	1·22	0·34	0·04	0·05	3·77	30·4	5·2			129	6·1	

n.d. Not determined —Less than lower limit of determination

TABLE 3: Brown Forest Soils with Gleyed B and C Horizons—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
20.								**ETTRICK ASSOCIATION; Altimeg Series. Waterside, 170919–170922**											
A	2–6	13·4	41	32	55	18	20	—	0·21	0·09	0·11	14·0	2·8	4·9	6·10	0·423	219	2·1	Exchangeable Ca very low and exchangeable Mg, Na, K low. High acidity.
B_2g	9–13	6·5	39	31	50	21	26	—	0·09	0·08	0·05	7·28	2·9	4·8	1·87	0·176	147	1·6	
B_2g	16–20	4·9	40	34	54	20	24	—	0·07	0·07	0·02	5·17	3·0	4·9			127	2·3	
Cg	23–27	3·8	52	29	63	19	18	—	0·05	0·06	0·06	3·33	4·9	4·9			114	8·8	
21.								**ETTRICK ASSOCIATION; Altimeg Series. Glenduisk, 161938–161940**											
A	4–8	11·8	35	44	55	24	15	5·76	0·58	0·09	1·66	9·57	45·8	5·45	5·40	0·534	382	9·0	High exchangeable K in A horizon. Moderate acidity. High total P_2O_5 and moderate readily soluble P_2O_5 in surface.
B_2g	16–20	3·7	41	35	56	19	25	1·83	0·31	0·05	0·36	2·76	48·0	5·21	1·58	0·175	122	1·1	
B_3g/ Cg	30–34	3·5	38	33	49	22	29	2·74	1·68	0·09	0·21	1·85	71·8	5·08			164	14·1	

22. ETTRICK ASSOCIATION; Kedslie Series. Glendrissaig, 184629–184634

A	2–6	14·0	48	29	60	16	16	10·9	1·75	0·24	0·23	10·7	55·1	5·5	5·26	0·486	171	3·4	High exchangeable Ca in A horizon. High pH in subsoil. Low total P_2O_5 in subsoil except Cg horizon.
A_2g	10–13	4·82	45	30	58	17	22	5·46	1·76	0·15	0·02	2·15	77·5	5·5	1·42	0·128	63	4·3	
B_2g	15–18	4·00	41	35	57	20	24	5·70	2·54	0·16	0·05	4·06	67·6	5·9	1·02	0·098	44	3·0	
B_3g/Cg	22–26	3·98	42	32	56	18	26	6·15	4·16	0·18	0·06	5·15	67·2	6·2			47	2·2	
Cg	30–34	4·78	40	30	53	18	27	7·55	7·09	0·24	0·10	4·77	75·8	6·4			68	2·2	
Cg	40–44	3·79	47	27	57	16	26	8·01	8·71	0·19	0·11	5·40	75·9	6·8			117	8·3	

23. ETTRICK ASSOCIATION; Kedslie Series. Currarie, 184635–184639

A	2–6	11·9	28	36	38	26	29	11·9	1·98	0·24	0·16	6·76	67·9	5·9	4·38	0·354	155	1·5	High exchangeable Ca in A horizon. High exchangeable Mg in C horizon. Moderate acidity. Low total P_2O_5 in B_2g horizon.
A_2g/Bg	9–12	4·9	41	32	54	19	25	5·25	2·06	0·15	0·06	3·17	70·3	5·9	1·41	0·137	50	0·7	
B_2g	16–20	4·4	33	39	49	22	26	4·81	4·03	0·15	0·04	2·27	79·9	5·8			46	0·7	
B_2g	24–27	4·2	39	37	54	23	22	9·78	9·84	0·33	0·10	1·42	93·4	6·1			57	3·7	
B_3g/Cg	30–34	3·7	48	28	57	19	24	5·29	7·44	0·23	0·08	—	100	6·5			118	9·5	

24. GLENALMOND ASSOCIATION; Glenalmond Series. Ladywell, 173725–173729

A	1–4	6·9	48	28	59	18	20	7·21	0·91	0·18	0·08	4·38	65·7	5·7	2·25	0·233	178	7·0	High exchangeable Ca throughout. High pH in subsoil. Low total P_2O_5 in subsoil.
A	6–9	6·2	47	28	58	17	22	8·57	0·95	0·18	0·08	3·14	75·7	5·8	1·76	0·189	158	4·2	
Bg	11–14	3·9	53	24	62	15	22	9·35	1·54	0·15	0·08	0·92	92·4	6·2			44	0·6	
B_3g/Cg	20–24	3·3	59	22	68	13	19	9·96	2·61	0·15	0·08	2·70	82·6	6·5			52	2·0	
Cg	35–39	3·4	57	24	66	13	20	11·2	6·55	0·20	0·08	2·09	89·6	6·9			75	14·1	

n.d. Not determined —Less than lower limit of determination

TABLE 3: Brown Forest Soils with Gleyed B and C Horizons—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
25.	GLENALMOND ASSOCIATION; Gallowshill Series. Girvan Mains, 173735–173738																		
A	2–5	7·3	55	22	62	16	19	9·36	1·94	0·20	0·41	5·72	67·6	6·3	2·68	0·261	477	43·2	High exchangeable Ca in A horizon. High total and readily soluble P_2O_5 in A horizon but low values in parent material.
B_2g	8–10	3·2	61	24	70	14	16	5·49	1·00	0·15	0·21	2·80	71·0	5·9	0·76	0·073	192	10·3	
B_3g	18–22	3·0	56	24	66	14	20	5·80	1·88	0·19	0·16	1·52	84·1	6·1			73	1·0	
B_3g/Cg	30–33	2·8	52	28	64	16	20	6·73	2·28	0·21	0·15	2·02	82·3	6·2			64	0·8	

TABLE 4. NON-CALCAREOUS GLEYS

26. BENAN ASSOCIATION; Lanes Series. Lanes, 137649–137654

A/H	1–5	43·2	n.d.	n.d.	n.d.	n.d.	n.d.	14·2	9·91	0·58	0·56	17·5	59·0	5·7	21·3	1·570	406	0·9	High organic content in surface. High clay content in B_2g horizon. High exchangeable Ca and Mg throughout. High readily soluble and low total P_2O_5 in subsoil.
A_2g	9–13	22·8	54	21	52	13	18	10·4	8·86	0·38	0·12	13·4	59·7	6·0	10·6	0·688	418	0·4	
B_2g	16–20	7·2	31	33	45	19	32	8·94	8·92	0·23	0·08	3·54	83·7	6·7	1·35	0·084	75	2·5	
B_3g/Cg	28–32	6·6	35	39	49	25	23	16·5	15·5	0·35	0·12	5·12	86·4	6·0			86	10·9	
Cg	36–40	6·4	38	40	54	24	19	24·0	19·2	0·60	0·15	3·32	93·0	6·3			95	11·4	
Cg	42–46	6·9	41	35	57	19	20	23·0	17·4	0·36	0·12	1·83	95·7	6·6			73	17·3	

27. BENAN ASSOCIATION; Lanes Series. Minuntion, 153025–153029

A_1g	3–7	23·0	48	21	59	10	14	6·46	1·33	0·28	0·28	19·2	30·4	4·6	13·2	0·640	222	0·2	High clay in Cg horizon. High exchangeable Mg in B_2g and B_3g horizons. Low total P_2O_5 in Bg horizon. High readily soluble P_2O_5 in Cg horizon.
B_2g	13–16	4·3	27	41	43	26	29	5·73	3·70	0·19	0·07	5·44	64·0	4·7	0·66	0·038	43	1·4	
B_2g	18–21	3·7	31	43	48	26	25	8·43	8·16	0·21	0·09	4·43	79·2	5·1			65	0·6	
B_3g	26–30	3·7	37	44	52	23	25	8·67	9·65	0·19	0·09	3·90	82·7	5·5			96	8·5	
Cg	38–42	3·5	27	29	36	21	43	7·78	4·71	0·18	0·19	5·89	68·6	4·3			163	31·5	

28. BLAIR ASSOCIATION; Blair Series. Doughty, 173748–173752

A_1	3–6	8·9	59	22	71	10	15	2·01	0·85	0·18	0·08	8·66	26·5	4·8	3·74	0·306	134	1·4	Low exchangeable Ca except in C. Low total P_2O_5 and moderate readily soluble P_2O_5 in subsoil.
B_2g	11–14	3·7	65	20	75	11	14	2·28	1·19	0·12	0·05	3·89	48·3	5·0	1·12	0·115	76	7·3	
B_2g	16–20	3·2	61	22	72	12	17	2·28	1·22	0·11	0·05	4·59	44·4	5·1			67	7·9	
B_3g	24–30	3·1	67	19	76	10	14	1·52	0·57	0·10	0·02	4·93	31·0	5·4			110	10·5	
Cg	35–39	3·2	62	21	72	12	16	3·67	2·00	0·11	0·06	2·58	69·4	5·5			65	9·4	

n.d. Not determined —Less than lower limit of determination

TABLE 4: Non-Calcareous Gleys—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
29.	DARLEITH ASSOCIATION; Amlaird Series. South Ballaird, 161964–161968																		
A_1/H	2–5	29·4	n.d.	n.d.	n.d.	n.d.	n.d.	11·5	21·6	0·53	0·42	24·5	58·2	5·5	14·9	1·21	139	0·8	Low clay in B_3g and Cg. Very high exchangeable Mg throughout. High carbon in A_1/H. Low total but very high readily soluble P_2O_5 in subsoil.
A_2g	11–15	6·8	29	36	45	21	31	5·41	25·9	0·28	0·13	2·78	91·9	6·1	1·98	0·210	49	2·8	
B_2g	18–22	5·9	32	37	46	23	28	4·79	31·9	0·29	0·17	0·73	98·1	6·6			97	54·3	
B_3g	26–30	6·7	44	40	63	21	13	3·12	15·1	0·19	0·07	0·03	99·8	6·7			97	60·1	
Cg	38–40	7·2	55	30	68	17	11	1·84	9·93	0·16	0·07	—	100	6·5			86	53·2	
30.	ETTRICK ASSOCIATION; Littleshalloch Series. Glenlee, 170896–170899																		
A_1g	1–4	13·1	57	26	67	15	10	1·25	0·37	0·18	0·21	11·9	14·4	4·7	5·82	0·397	139	2·5	Low exchangeable Ca throughout. Sharp rise in pH in C horizon. High readily soluble P_2O_5 in B_2g and Cg horizons.
A_2g	7–10	5·8	50	30	63	17	17	0·62	0·13	0·09	0·05	7·19	11·0	4·8	2·93	0·194	139	7·3	
B_2g	16–20	4·4	58	25	70	12	15	0·61	0·07	0·08	—	4·36	14·8	5·0			155	14·0	
Cg	31–34	2·6	50	34	66	18	15	2·12	0·38	0·08	0·03	—	100	6·0			162	80·8	

Printed in Scotland for Her Majesty's Stationery Office by Bell and Bain Ltd., Glasgow
Dd. 230128/2455 K8 12/72

31. ETTRICK ASSOCIATION; Littleshalloch Series. Largmore, 170882–170886

A_1g	1–5	26·4	n.d.	n.d.	n.d.	n.d.	n.d.	2·05	0·94	0·35	0·46	25·0	13·2	4·6	13·8	0·790	300	2·1	Low exchangeable Ca throughout. High organic content in surface horizon. High readily soluble P_2O_5 in B_3g/Cg and Cg horizons.
A_2g	7–11	15·1	40	34	52	21	19	2·01	0·33	0·21	0·46	15·5	16·3	4·6	7·57	0·400	211	2·1	
B_2g	15–20	8·6	38	39	53	24	18	0·46	0·15	0·10	—	11·3	5·9	4·9			142	3·0	
B_3g/Cg	27–30	4·1	40	39	56	22	19	0·45	0·18	0·07	—	4·02	14·8	5·1			130	27·7	
Cg	40–44	3·6	50	34	64	20	15	1·36	0·31	0·09	0·03	3·61	33·1	5·7			144	33·3	

32. ETTRICK ASSOCIATION; Ettrick Series. Saugh Hill, 179306–179311

A_1	1–5	12·5	43	36	60	19	15	7·41	3·98	0·27	0·27	16·8	71·2	5·7	6·83	0·475	162	2·7	High exchangeable Mg in Cg horizon. Low total P_2O_5 in A_2g, B_2g, B_3g/Cg horizons. Very high readily soluble P_2O_5 in Cg horizon.
A_2g	7–10	6·8	39	33	54	18	24	4·89	2·85	0·15	0·09	10·9	73·4	5·8	2·55	0·230	73	2·4	
B_2g	14–17	4·0	31	40	45	23	27	4·27	3·96	0·11	0·04	8·86	94·6	6·2	0·56	0·061	50	3·7	
B_3g/Cg	24–28	4·0	38	34	50	22	26	5·81	4·90	0·11	0·07	10·9	100	6·6			75	8·1	
Cg	36–39	4·0	35	36	45	26	28	7·05	5·86	0·12	0·10	13·1	100	6·5			120	33·3	
Cg	46–48	3·8	32	40	44	27	28	6·43	5·45	0·11	0·10	12·1	100	6·6			121	36·9	

33. GLENALMOND ASSOCIATION; Altiwan Series. Maxwellston, 137667–137672

A_1g	1–5	8·4	53	26	65	14	17	2·16	0·98	0·12	0·2	10·9	25·0	5·0	3·40	0·254	113	1·4	Exchangeable Mg equals exchangeable Ca in B_2g and Cg horizons. Low total P_2O_5 in subsoil. Moderate readily soluble P_2O_5 in B_3g and Cg.
A_2g	5½–9½	6·8	46	28	58	16	20	1·07	0·76	0·09	0·11	9·61	17·4	5·2	2·31	0·186	84	1·9	
B_2g	10–14	4·6	55	24	66	13	18	0·92	0·84	0·08	0·06	7·26	20·7	5·2	1·05	0·091	72	1·2	
B_3g	15–19	3·0	70	17	77	10	10	0·61	0·67	0·07	0·04	6·13	18·5	5·4			77	7·9	
Cg	28–32	3·4	49	25	62	12	23	3·21	3·99	0·08	0·13	3·00	71·2	6·0			51	3·4	
Cg	36–40	4·1	53	24	67	20	21	4·77	4·82	0·08	0·13	1·89	83·8	5·9			66	7·6	

n.d. Not determined —Less than lower limit of determination

T

TABLE 4: Non-Calcareous Gleys—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates % Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Exchangeable Cations me/100 g Ca	Mg	Na	K	H	% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
34.						KNOCKSKAE ASSOCIATION; Whiterow Series. Craig of Dalwine, 173739–173742													
A_1g	2–4	7·9	42	29	57	14	25	7·23	4·29	0·22	0·21	5·01	70·5	5·5	3·42	0·292	64	1·0	Moderate exchangeable Ca, Mg and K in A_1g. Low total and readily soluble P_2O_5 throughout.
B_2g	9–12	3·0	57	25	70	12	18	4·86	2·54	0·13	0·08	2·19	77·7	5·4	1·11	0·110	46	0·8	
B_2g	18–24	2·7	63	22	75	10	15	4·25	2·41	0·12	0·05	1·45	82·5	5·4			47	1·1	
Cg	36–40	4·5	40	44	50	29	14	6·12	2·46	0·18	0·08	4·59	65·8	5·2			55	0·2	

TABLE 5. PEATY GLEYS

35. BLAIR ASSOCIATION; Falaird Series. The Pilot, 179615–179621

H	4–1	78·0	n.d.	n.d.	n.d.	n.d.	n.d.	5·98	4·67	1·00	1·69	69·5	16·1	3·8	44·3	2·69	474	11·4	High exchangeable Na and K and moderate exchangeable Mg in H layer. High total and readily soluble P_2O_5 in H layer and low total but high readily soluble P_2O_5 in C horizon.
A_2g	2–4	9·3	55	32	68	18	8	0·61	0·25	0·08	0·05	7·72	11·4	4·2	4·23	0·316	129	1·1	
A_2g	6–8	5·2	61	22	71	12	14	0·61	0·27	0·05	—	2·90	24·3	4·7	2·16	0·172	97	4·1	
B_1g	12–15	3·4	68	23	79	12	9	2·66	0·14	0·02	—	2·61	51·9	5·0			108	14·9	
B_2g	20–24	2·6	67	21	79	9	12	1·06	1·10	0·05	—	4·53	32·8	5·3			53	6·9	
Cg	30–36	2·3	63	24	74	13	12	4·09	1·57	0·09	0·11	1·62	78·3	5·1			65	7·5	
Cg	44–48	2·4	65	23	75	13	11	1·97	1·34	0·05	0·04	0·39	89·7	4·9			99	10·1	

36. DALBEATTIE ASSOCIATION; Eglin Series. Laggan O'Dee, 170812–170817

H	2½–0	49·1	n.d.	n.d.	n.d.	n.d.	n.d.	1·98	1·14	0·29	0·83	39·9	11·4	4·5	28·8	1·93	196	2·2	Low clay content throughout. Low exchangeable Ca throughout. Low total P_2O_5 in mineral soil. Low readily soluble P_2O_5 throughout.
A_2g	0–3	8·3	73	18	82	82	6	0·61	0·21	0·10	0·10	7·96	11·4	4·4	4·68	0·342	68	1·1	
B_2g	5–10	2·2	79	14	86	7	6	—	0·11	0·06	0·03	2·12	8·6	4·8	1·18	0·870	55	0·9	
B_3g	14–18	3·8	72	19	83	8	9	1·45	0·13	0·08	0·03	4·72	28·6	4·9			63	1·2	
B_3g	24–28	3·7	76	17	85	8	7	0·61	0·16	0·07	—	4·91	14·6	5·0			75	1·6	
Cg	35–39	2·9	69	22	79	13	8	0·61	0·14	0·07	—	2·61	23·9	5·2			88	0·5	

37. DARLEITH ASSOCIATION; Myres Series. Garnaburn, 161891–161895

H	5–1	89·5	n.d.	n.d.	n.d.	n.d.	n.d.	3·60	7·17	0·96	1·68	61·0	18·0	4·14	45·8	2·06	191	4·9	High clay in B_2g. Extremely high exchangeable Mg in Bg and Cg horizons. High readily soluble P_2O_5 in Cg horizon.
A_2g	2–3	12·1	34	29	50	17	30	1·11	3·47	0·12	0·06	17·5	21·4	4·86	3·81	0·411	67	0·3	
B_2g	8–12	6·94	23	32	35	21	41	4·16	22·9	0·29	0·19	3·94	87·5	5·47			32	—	
B_3g/Cg	19–22	5·94	39	32	53	19	25	2·68	19·4	0·16	0·09	—	100	6·35			92	2·0	
Cg	30–36	6·80	43	33	57	19	21	2·03	19·4	0·15	0·09	—	100	6·50			105	33·5	

n.d. Not determined —Less than lower limit of determination

TABLE 5: Peaty Gleys—*continued*

Horizon	Depth in	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
38.			ETTRICK ASSOCIATION; Dochroyle Series. Benniguinea, 170840–170844																
H	8–4	68·1	n.d.	n.d.	n.d.	n.d.	n.d.	1·04	0·35	0·37	—	70·1	2·5	4·3	32·5	1·97	474	1·6	Low clay content throughout. Low exchangeable Ca throughout. High total P_2O_5 in H layer. High readily soluble P_2O_5 in mineral soil.
A_2g	4–8	4·4	71	24	84	10	3	1·06	0·14	0·07	—	3·25	28·1	5·6	1·62	0·119	110	27·2	
B_2g	14–18	3·5	72	26	86	12	2	0·76	0·17	0·06	—	1·10	47·4	5·4			150	37·1	
B_3g/Cg	26–30	2·7	60	33	74	18	8	1·21	0·37	0·08	0·17	—	100	5·7			175	56·4	
Cg	39–43	2·3	60	33	77	16	7	1·37	0·38	0·07	0·10	—	100	5·8			159	65·9	
39.			ETTRICK ASSOCIATION; Dochroyle Series. Creebank, 152921–152925																
H	4–2	74·3	n.d.	n.d.	n.d.	n.d.	n.d.	2·05	3·49	0·84	1·16	62·1	10·8	3·6	40·8	1·96	278	4·4	High exchangeable Na and K in H layer. Very high acidity throughout. Low total and readily soluble P_2O_5 in A_2g horizon.
A_2g	3–6	7·0	36	39	54	21	21	—	0·11	0·10	0·05	14·8	1·7	3·7	3·21	0·108	91	—	
A_2g	9–14	10·6	46	33	64	15	15	—	0·08	0·10	0·05	19·6	1·2	3·9			205	0·1	
B_3g	17–22	3·4	40	36	56	20	23	—	0·06	0·05	0·05	3·99	3·8	3·9			133	0·6	
Cg	32–36	3·3	34	38	48	24	28	—	0·17	0·08	0·11	5·75	5·9	3·9			146	6·4	

40. ETTRICK ASSOCIATION; Dochroyle Series. Dochroyle, 152965–152968

H	10–5	94·1	n.d.	n.d.	n.d.	n.d.	n.d.	0·36	3·56	1·25	0·92	80·6	7·0	3·7	55·5	2·30	215	0·8	Marked rise in exchangeable Ca, Mg and percentage saturation in Cg. Low readily soluble P_2O_5.
A_2g	2–6	11·4	36	35	50	21	23	—	0·27	0·19	0·05	22·2	2·2	4·9	4·21	0·326	123	—	
B_2g	11–15	4·3	57	20	66	11	21	0·15	0·17	0·09	0·05	4·85	8·7	5·3			94	0·5	
Cg	29–33	3·4	37	35	48	24	28	1·54	1·77	0·13	0·09	5·90	37·4	5·3			155	—	

41. ETTRICK ASSOCIATION; Dochroyle Series. Halfmark, 170850–170853

H	6–2	71·9	n.d.	n.d.	n.d.	n.d.	n.d.	1·02	0·82	0·44	0·16	68·1	3·5	4·2	37·1	2·85	543	1·9	Very low exchangeable base content and percentage saturation. High total P_2O_5 in H layer, low values in mineral soil.
A_2g	2–6	4·6	53	29	68	15	15	—	0·04	0·03	—	5·76	1·2	4·3	2·43	0·238	40	1·1	
B_2g	11–15	4·8	65	22	75	12	10	—	0·09	0·01	—	4·74	2·1	4·5			55	2·6	
Cg	25–30	4·4	57	28	71	14	13	—	0·03	0·03	—	3·90	1·5	4·7			89	6·9	

42. ETTRICK ASSOCIATION; Alemoor Series. High Trowier, 152979–152984

H	6–2	43·0	n.d.	n.d.	n.d.	n.d.	n.d.	0·99	1·18	0·41	1·05	56·1	6·1	4·3	25·6	1·24	298	2·5	High exchangeable Mg in B_2g and Cg horizons. Low total P_2O_5 in B_2g and B_3g horizons.
A_2g	2–5	8·8	31	35	45	21	29	0·16	0·21	0·12	0·05	15·6	3·3	5·0	2·67	0·175	105	—	
B_2g	8–10	5·2	30	34	42	22	33	1·56	2·79	0·22	0·05	9·96	31·7	5·5	0·73	0·058	49	—	
B_2g	13–16	5·4	26	33	38	22	37	5·05	11·3	0·35	0·12	5·94	73·9	5·9			53	—	
B_3g/Cg	20–24	4·1	33	31	42	22	34	7·70	14·6	0·37	0·12	2·93	88·6	6·6			79	0·2	
Cg	36–40	3·7	33	35	44	24	32	9·95	14·4	0·35	0·14	3·63	87·3	6·8			129	4·6	

n.d. Not determined —Less than lower limit of determination

TABLE 5: Peaty Gleys—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
43.			ETTRICK ASSOCIATION; Alemoor Series. Saugh Hill, 179561–179566																
H_1	6–4	81·5	n.d.	n.d.	n.d.	n.d.	n.d.	4·37	6·88	1·24	2·31	78·6	15·8	3·8	44·6	2·14	204	15·3	High exchangeable Mg in H_1, B_2g and Cg. Low total P_2O_5 in A_2g and $B_{21}g$ and high readily soluble P_2O_5 in H_1.
H_2	3–1	32·3	n.d.	n.d.	n.d.	n.d.	n.d.	1·65	1·02	0·43	0·47	37·7	8·7	3·9	17·3	1·18	180	1·8	
A_2g	3–7	7·7	24	37	34	26	35	—	0·67	0·10	0·04	10·8	8·0	4·6	2·07	0·194	51	0·2	
$B_{21}g$	13–17	5·5	31	37	42	26	29	2·92	8·42	0·19	0·11	3·57	76·5	5·3			54	—	
$B_{22}g$	27–30	5·4	37	32	45	24	28	3·71	6·60	0·16	0·11	3·42	75·6	5·2			108	0·2	
Cg	34–37	4·6	36	34	46	24	28	5·92	7·31	0·19	0·09	1·20	91·8	5·5			142	3·5	
44.			GLENALMOND ASSOCIATION; Spallander Series. Dobbingstone, 179595–179601																
H	8–4	69·8	n.d.	n.d.	n.d.	n.d.	n.d.	3·36	1·96	0·73	1·02	76·4	8·5	3·7	38·3	2·37	329	2·7	Low exchangeable Ca, in the mineral soil except in C horizon. High acidity in upper mineral layers. Low readily soluble P_2O_5 throughout.
A_1g	0–2	19·2	50	21	59	11	15	—	0·52	0·07	0·06	22·2	2·8	3·8	9·66	0·587	163	0·4	
A_2g	3–6	9·8	46	28	58	15	22	—	0·34	0·08	0·04	12·7	3·5	4·5	4·53	0·305	108	0·1	
B_2g	8–11	9·2	48	36	60	13	22	1·08	0·53	0·12	0·04	13·1	11·9	4·8			129	0·1	
B_2g/B_3g	13–17	6·0	47	28	61	14	22	1·07	0·46	0·11	0·04	7·34	18·2	5·0			102	0·2	
B_3g	20–24	3·9	54	25	66	14	20	1·06	0·57	0·08	0·03	2·70	39·2	5·4			88	2·0	
C	36–40	3·5	51	25	61	14	24	3·85	2·23	0·11	0·09	4·94	56·0	5·1			100	1·6	

45. KNOCKSKAE ASSOCIATION; Palmullan Series. Farroch, 179609–179614

H	6–2	77·6	n.d.	n.d.	n.d.	n.d.	n.d.	16·1	5·58	0·91	0·73	68·8	35·3	3·9	39·2	2·48	304	2·9	High exchangeable Ca, Mg, Na in H layer. High organic content in A_2g horizon. Low total P_2O_5 below A_1g horizon and low readily soluble P_2O_5 throughout.
A_1g	2–4	36·2	n.d.	n.d.	n.d.	n.d.	n.d.	0·84	0·85	0·20	0·09	40·9	4·6	3·7	20·7	1·40	315	0·4	
A_2g	7–10	9·7	48	29	60	17	18	0·62	0·29	0·08	0·03	12·4	7·6	4·4	3·31	0·22	85	—	
B_3g	13–16	5·7	52	28	64	16	17	1·07	0·40	0·06	—	5·91	20·6	4·7			33	0·1	
B_3g/Cg	18–20	4·4	56	25	70	11	16	0·79	0·40	0·06	—	3·90	24·3	5·0			41	1·8	
Cg/Dg	24–28	4·1	49	27	62	14	21	1·06	0·56	0·07	—	3·08	35·4	5·0			54	0·5	

n.d. Not determined —Less than lower limit of determination

TABLE 6. IRON PODZOLS, FREELY DRAINED

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
46.								GLENALMOND ASSOCIATION; Meadownay Series. Glendrissaig, 161987–161989											
A	4–8	9·9	45	28	59	14	22	1·27	0·35	0·07	0·10	12·9	12·2	4·6	4·05	0·413	443	5·4	Low exchangeable bases throughout. Low pH. High total P_2O_5 in surface.
B	13–17	8·2	53	30	65	17	14	0·47	0·08	0·05	—	10·4	5·4	4·9	2·30	0·244	232	0·8	
C	28–32	4·7	66	21	76	11	11	0·46	0·12	0·05	—	3·64	14·8	5·2			131	2·0	
47.								GLENALMOND ASSOCIATION; Tranew Series. Dobbingstone, 179589–179594											
A	2–4	10·7	61	25	76	11	8	0·62	0·24	0·09	0·15	9·27	10·6	4·7	3·97	0·306	160	1·1	Rise in clay content, exchangeable Ca and percentage saturation in C horizon. Low total P_2O_5 in subsoil. High readily soluble P_2O_5 in B_{31} horizon.
B_2	7–9	5·6	70	19	80	8	9	0·61	0·05	0·08	0·05	5·54	12·5	5·2	1·83	0·157	128	1·4	
B_{31}	13–17	2·1	67	27	83	11	6	—	0·02	0·05	—	1·29	5·1	5·2	0·49	0·037	85	10·7	
B_{32}	25–29	3·4	55	26	67	14	19	—	0·11	0·04	0·03	2·79	6·1	5·6			56	3·4	
C	34–36	3·3	55	27	66	15	18	1·52	0·33	0·05	0·05	1·26	60·7	5·6			57	0·9	
C	38–42	3·4	52	29	65	16	20	1·52	0·46	0·05	0·05	2·92	41·6	5·6			79	2·0	

48. KNOCKSKAE ASSOCIATION; Knockskae Series. Doughty, 173753–173755

A	3–6	24·2	45	31	64	13	6	—	0·26	0·15	0·20	42·5	1·4	4·5	12·6	0·762	291	0·5	Very low exchangeable bases throughout. High acidity. High organic content in A horizon. Very high total P_2O_5 in B horizon.
B	14–18	15·1	63	21	72	12	8	—	0·07	0·08	0·11	34·1	0·8	4·7	6·09	0·360	789	7·9	
C	28–33	3·7	76	16	83	8	8	—	0·07	0·05	0·02	23·6	0·7	4·8			258	1·5	

n.d. Not determined —Less than lower limit of determination

TABLE 7. PEATY PODZOLS WITH IRON PAN

Horizon	Depth in.	% Loss on Ignition	Soil Separates: % Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Exchangeable Cations me/100 g: Ca	Mg	Na	K	H	% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
49.	BENAN ASSOCIATION; Knockinculloch Series. Balcletchie, 137721–137722, 137655–137658																		
L & F	9–7	98·0	n.d.	n.d.	n.d.	n.d.	n.d.	3·20	5·43	0·83	3·35	64·9	18·6	3·9	56·0	1·65	84	19·4	Low percentage base saturation, and high acidity below L and F horizons. High readily soluble P_2O_5 in L and F horizons.
H	6–1	73·9	n.d.	n.d.	n.d.	n.d.	n.d.	1·03	1·03	0·69	1·24	66·1	5·7	4·1	33·2	1·90	103	2·1	
A_2g	3–7	17·5	62	15	67	9	10	0·12	0·15	0·09	0·04	33·0	1·2	5·0	7·16	0·429	172	0·7	
B_2	11–15	5·7	50	27	61	17	19	0·15	0·15	0·05	0·04	8·24	2·8	5·2	1·01	0·102	84	1·1	
B_3/C	20–24	3·7	59	31	70	19	6	0·15	0·11	0·04	0·04	3·90	4·6	5·2			122	5·9	
C	31–35	2·7	61	30	73	19	5	0·15	0·23	0·05	0·04	2·77	10·4	5·4			105	7·5	
50.	DALBEATTIE ASSOCIATION; Carsphairn Series. Cooran Lane, 170845–170849																		
H	7–3	88·4	n.d.	n.d.	n.d.	n.d.	n.d.	5·99	7·13	1·20	0·97	101	13·2	4·1	48·6	1·87	159	14·6	Very low exchangeable bases in mineral horizons. High acidity throughout. Low total P_2O_5 in mineral soil. High readily soluble P_2O_5 in C horizon.
A_2g/H	1–4	8·4	76	17	83	10	2	—	0·12	0·06	—	19·4	0·9	4·1	4·84	0·175	43	2·1	
B_2	7–12	9·0	81	13	85	9	2	—	0·11	0·02	—	9·31	1·4	4·6	4·00	0·151	81	0·8	
B_3	20–25	3·2	80	16	87	9	4	—	0·04	0·02	—	2·73	2·2	4·7	0·97	0·062	82	1·2	
C	36–40	1·4	76	23	85	14	2	—	—	0·01	—	0·74	8·6	4·7	0·64	0·063	123	19·3	

51. DALBEATTIE ASSOCIATION; Carsphairn Series. Doon, 180036–180041

H	4–1	84·6	n.d.	n.d.	n.d.	n.d.	n.d.	11·0	10·2	1·13	1·47	92·1	20·5	4·0	43·2	1·76	218	20·2	Low clay content. Very low exchangeable base content in mineral soil. High acidity. High readily soluble P_2O_5 in C horizon.
A_2g	0–2	16·3	65	18	76	7	5	0·62	0·61	0·07	0·30	22·3	6·7	4·1	7·87	0·521	99	2·9	
B_2	3–6	9·1	68	20	77	10	8	—	—	0·07	0·05	14·0	0·8	4·5	3·54	0·153	100	0·2	
B_2	10–14	5·5	70	18	77	10	10	—	0·02	0·06	0·03	6·34	1·7	4·6	1·89	0·097	101	0·2	
B_3/C	18–21	4·8	80	8	85	4	9	—	—	0·06	0·03	2·57	3·4	4·7			124	0·2	
C	25–28	3·5	90	6	92	4	4	—	—	0·13	0·15	5·01	5·3	4·8			202	13·5	

52. DARLEITH ASSOCIATION; Baidland Series. Almont, 161945–161947

H	6–3	80·0	n.d.	n.d.	n.d.	n.d.	n.d.	2·38	3·71	0·88	1·29	86·6	8·7	4·0	42·5	2·700	192	4·6	High organic carbon in A_2g horizon. High acidity throughout. Low readily soluble P_2O_5 in mineral soil.
A_2g	0–1	27·2	n.d.	n.d.	n.d.	n.d.	n.d.	—	0·41	0·21	0·07	46·2	1·5	4·1	15·9	0·788	124	0·6	
B_2	2–6	18·6	42	32	59	15	12	—	—	0·07	0·04	17·5	0·6	4·5			136	—	

53. ETTRICK ASSOCIATION; Dod Series. Sandloch, 161932, 161933, 161935–161937

H	8–4	93·5	n.d.	n.d.	n.d.	n.d.	n.d.	1·72	3·95	1·03	1·01	92·0	8·4	3·8	60·8	2·62	226	8·0	Low exchangeable Ca throughout. High acidity. High organic carbon in A_2g. Low readily soluble P_2O_5 below H layer.
A_2g	0–3	21·8	42	29	58	13	12	—	0·44	0·20	0·14	51·2	1·5	4·0	12·6	0·758	179	0·4	
B_2	4–8	9·2	36	43	53	27	15	—	0·13	0·08	0·03	15·7	1·5	4·4			184	—	
B_3	13–17	5·1	42	33	57	19	21	—	0·07	0·06	0·03	7·11	2·3	4·5			142	3·0	
C	20–24	7·0	37	29	48	19	30	—	0·11	0·05	0·03	8·83	2·2	4·5			167	1·1	

n.d. Not determined —Less than lower limit of determination

TABLE 7: Peaty Podzols with Iron Pan—*continued*

Horizon	Depth in	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
54.	ETTRICK ASSOCIATION; Dod Series. Leadmines, 170907, 170908, 170910–170912																		
H	10–5	86·5	n.d.	n.d.	n.d.	n.d.	n.d.	0·69	0·98	0·29	0·10	97·8	2·1	3·6	43·0	1·95	166	3·9	Low clay content. Very low exchangeable bases in mineral horizons. High acidity. Low readily soluble P_2O_5 below H layer.
A_2g	0–2	7·3	59	28	73	14	9	—	0·11	0·09	—	14·8	1·3	4·1	3·63	0·188	38	0·8	
B_2	6–9	9·5	64	25	78	12	6	—	0·05	0·06	—	14·2	0·8	4·4			115	0·6	
B_3	11–15	4·3	52	36	69	19	10	—	—	0·04	—	4·17	1·0	4·6			61	0·4	
C	20–24	2·2	75	19	88	6	6	—	0·07	0·02	—	1·34	6·3	4·7			76	1·7	
55.	ETTRICK ASSOCIATION; Dod Series. Arnisheen, 152969–152973																		
H	4–1	70·0	n.d.	n.d.	n.d.	n.d.	n.d.	5·54	4·18	0·85	1·55	60·7	16·7	4·0	34·9	1·86	295	7·4	Low exchangeable Ca below H layer. Low percentage saturation and high acidity throughout.
A_2g	0–2	15·4	57	24	71	10	11	0·79	0·48	0·18	0·20	29·8	5·2	4·2	9·23	0·514	145	1·1	
B_2	4–8	7·9	43	40	66	17	13	0·16	0·13	0·12	0·02	13·3	3·1	4·8			160	—	
B_3	14–18	6·1	54	34	70	17	10	0·15	0·05	0·07	0·02	9·31	3·0	4·9			143	—	
C	29–33	2·1	62	31	75	18	7	—	0·04	0·06	0·01	2·25	4·3	4·9			139	3·1	

56. ETTRICK ASSOCIATION; Dod Series. Tarfessock, 152914–152920

L & F	14–12	76·0	n.d.	n.d.	n.d.	n.d.	n.d.	5·76	5·64	1·81	2·60	48·1	24·7	4·1	48·2	1·90	401	60·3	Very low clay content in B and C horizons. Low exchangeable bases in mineral soil. Very high acidity throughout.
H	9–4	77·8	n.d.	n.d.	n.d.	n.d.	n.d.	3·07	1·50	0·68	0·20	92·1	5·6	3·3	48·1	1·93	245	4·7	
A_2g	0–2	16·7	46	30	59	16	12	0·32	0·21	0·18	0·05	37·9	2·0	3·4	9·86	0·414	112	1·1	
B_2	4–6	13·9	67	19	80	7	6	0·16	0·13	0·14	—	23·5	1·8	3·8			281	1·4	
B_3	12–16	3·6	66	27	81	12	6	—	—	0·07	—	3·91	1·8	3·9			154	2·5	
C	23–27	2·9	69	26	82	13	5	—	—	0·05	0·05	1·85	5·1	3·9			168	4·2	
C	30–36	2·8	86	11	93	5	2	—	—	0·04	0·05	0·55	14·1	3·9			152	2·6	

57. GLENALMOND ASSOCIATION; Hadyard Series. Brae, 137723, 137724, 137659–137661

L & F	3½–1½	80·8	n.d.	n.d.	n.d.	n.d.	n.d.	2·45	1·64	0·63	2·52	86·9	7·7	3·6	45·2	1·98	164	2·3	Very low exchangeable base content in mineral soil. Very high acidity throughout. Low total and readily soluble P_2O_5 in mineral soil.
H	1½–0	72·9	n.d.	n.d.	n.d.	n.d.	n.d.	0·52	1·85	0·52	1·40	77·1	5·3	3·6	40·9	1·59	262	4·4	
A	0–2	6·2	56	22	68	10	18	0·15	0·24	0·05	0·14	7·72	5·3	3·9	2·24	0·118	54	1·5	
B_2	4–8	4·5	63	12	67	7	23	0·15	0·09	0·02	0·04	6·36	2·3	4·5	0·23	0·036	73	1·1	
B_2	13–17	4·8	60	14	64	9	24	0·15	0·11	0·03	0·04	6·06	2·9	4·6			74	0·4	

58. KNOCKSKAE ASSOCIATION; Turgeny Series. Craig of Dalwine, 173743–173747

H	2–0	74·7	n.d.	n.d.	n.d.	n.d.	n.d.	5·04	4·88	0·78	2·26	48·8	21·0	4·2	43·1	2·02	286	31·2	Very low exchangeable bases in mineral layers. High acidity. Low readily soluble P_2O_5 in A_2, B_2 and C horizons.
A_1	3–6	11·8	60	26	72	14	8	—	0·31	0·10	0·10	15·8	3·1	4·3	6·39	0·429	89	2·1	
A_2	11–14	4·79	47	34	63	18	17	—	0·07	0·04	0·02	12·0	1·1	4·5	2·12	0·133	47	0·2	
B_2	17–20	13·80	72	14	79	7	7	1·59	0·05	0·12	0·04	24·6	6·8	4·8	5·34	0·251	132	0·3	
C	28–30	5·10	66	16	70	12	15	—	0·02	0·06	0·02	6·66	1·5	5·1	1·09	0·087	66	0·2	

n.d. Not determined —Less than lower limit of determination

TABLE 8. SUB-ALPINE SOILS

Horizon	Depth in.	% Loss on Ignition	Soil Separates: % Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Exchangeable Cations me/100 g: Ca	Mg	Na	K	H	% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
59.								ETTRICK ASSOCIATION; Merrick Series. Corserine, 170831–170835											
H/A_1	0–3	21·3	45	33	65	13	6	0·62	0·57	0·10	0·27	24·6	6·0	3·7	12·0	0·606	175	5·4	Very low clay content throughout. Low exchangeable bases and high acidity throughout. High total P_2O_5 in H/B_2 horizon.
H/A_1	4–9	23·8	34	42	55	20	6	0·64	0·13	0·11	—	40·7	2·1	4·4	11·2	0·460	250	0·4	
H/B_2	13–18	39·3	n.d.	n.d.	n.d.	n.d.	n.d.	0·68	0·11	0·11	—	50·8	1·7	4·7	18·8	0·852	394	0·6	
H/B_2	24–30	13·6	53	33	71	15	7	0·32	0·05	0·12	—	16·5	2·9	4·9	6·94	0·302	265	0·6	
C	44–48	13·6	60	26	72	15	6	—	0·08	0·12	—	14·6	1·4	4·9	4·61	0·258	256	1·7	
60.								ETTRICK ASSOCIATION; Merrick Series. Merrick, 170927–170929											
H/A_1	1–4	23·3	41	38	69	11	3	—	0·57	0·27	0·31	44·6	2·5	4·1	11·8	0·877	230	1·5	Very low clay throughout. Low exchangeable Ca throughout. High acidity, low readily soluble P_2O_5 throughout.
H/B_2	8–12	18·1	40	43	64	19	3	—	0·04	0·17	0·15	28·0	1·3	4·5	7·92	0·385	213	1·5	
C	28–32	5·9	29	60	57	33	8	—	0·03	0·10	0·05	5·00	3·5	4·8	1·12	0·109	111	0·9	

60a. DALBEATTIE ASSOCIATION. Cairnsmore of Carsphairn, 180031–180035

H/A_2	1–3	13·8	69	20	78	11	4	0·62	0·31	0·11	0·23	20·4	5·9	4·0	7·88	0·761	169	0·5	Very low clay content. Very low exchangeable bases below H/A_2.
H/B_2	5–8	21·4	52	26	63	16	6	—	0·03	0·09	0·63	32·1	0·8	4·8	9·91	0·615	246	0·2	
H/B_2	12–15	8·75	78	12	84	6	5	—	—	0·05	0·05	13·1	0·8	4·8			89	0·2	
H/B_3	19–21	5·0	75	17	84	8	5	—	—	0·05	0·05	7·53	1·3	4·7			110	0·6	
C	27–30	2·8	78	14	86	6	8	—	—	0·20	0·05	2·33	9·7	4·9			68	2·2	

n.d. Not determined —Less than lower limit of determination

TABLE 9. MISCELLANEOUS SOILS

Horizon	Depth in.	% Loss on Ignition	Soil Separates: % Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Exchangeable Cations me/100 g: Ca	Mg	Na	K	H	% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
61.								**LINKS; Corseclays, 173720–173724**											
A	1–4	5·3	89	9	93	5	—	4·57	0·71	0·26	0·16	4·87	53·7	5·7	2·29	0·240	68	4·3	Very low clay and silt throughout. Moderate exchangeable Ca in A. Low total but moderate readily soluble P_2O_5 throughout.
A/C	6–10	1·1	100	—	100	—	—	0·90	0·59	0·09	0·02	—	100	6·2	0·50	0·054	54	6·9	
C	15–20	0·7	100	—	100	—	—	0·60	0·50	0·07	0·18	—	100	6·0			55	7·7	
C	28–32	0·7	100	—	100	—	—	—	0·59	0·06	0·03	—	100	6·3			52	7·6	
C	40–44	0·9	100	—	100	—	—	—	0·70	0·04	0·02	—	100	6·4			53	7·5	
62.								**ALLUVIUM; Muck, 188963–188966**											
A	0–2	7·9	49	35	74	10	12	1·84	1·57	0·12	0·24	5·42	41·0	5·7	3·62	0·252	141	8·9	Low clay content throughout. Moderate pH throughout.
A/(B)	6–10	4·0	81	10	87	4	9	1·21	0·84	0·05	0·08	2·37	47·9	5·7	1·43	0·137	104	8·0	
(B)	12–14	4·0	83	4	90	2	8	1.67	0·98	0·04	0·08	3·09	47·3	6·1			102	1·1	
C	22–24	3·7	88	4	88	4	8	3·34	1·56	0·11	0·11	1·24	80·5	5·9			132	4·2	

63. ALLUVIUM; Auchensoul, 188967–188971

A	2–5	9·8	56	23	66	11	17	9·39	1·88	0·12	0·23	9·20	56·2	5·6	4·42	0·393	410	45·4	Low clay content in C horizon. Fairly high exchangeable bases. High total P_2O_5 in A horizon. High readily soluble P_2O_5 throughout.
A/B	7–10	4·8	80	7	83	4	10	6·78	1·03	0·07	0·14	2·67	75·0	5·9	1·28	0·131	147	14·7	
B/C	11–14	3·6	80	12	88	4	8	3·20	1·43	0·05	0·09	1·54	75·6	5·9			109	16·3	
C	16–20	2·2	93	2	94	1	5	4·41	1·47	0·05	0·06	1·04	85·2	6·1			122	11·8	
C	24–27	3·2	92	4	92	4	4	4·26	1·62	0·05	0·09	1·01	85·6	6·2			114	11·8	

64. LINFERN COMPLEX; (Peaty Podzol). Linfern Loch, 179576–179582

H	5–2	45·4	n.d.	n.d.	n.d.	n.d.	n.d.	—	1·46	0·43	0·70	43·2	5·7	3·8	25·1	1·58	351	3·5	Low clay content throughout. Very low exchangeable Ca. High total P_2O_5 in H layer. High readily soluble P_2O_5 in upper part of C horizon.
A_2g	0–1½	15·6	64	17	72	9	11	—	0·35	0·17	0·10	24·3	2·5	4·3	6·39	0·484	184	0·4	
B_{21}	2–5	10·3	61	26	74	13	8	—	0·11	0·08	0·03	13·6	1·6	4·6	3·25	0·261	255	0·2	
B_{22}	8–11	6·2	60	27	76	11	10	—	0·10	0·06	—	11·0	1·4	4·9			128	0·5	
B_3	12–16	3·7	65	27	78	14	8	—	0·01	0·04	—	2·90	1·7	4·9			107	8·2	
C	22–24	3·2	79	15	86	9	5	—	0·01	0·04	—	2·06	1·9	5·0			115	10·8	
C	36–38	3·2	77	15	84	9	7	—	0·04	0·05	0·03	1·66	30·5	5·1			115	4·9	

65. LINFERN COMPLEX; (Brown Forest Soil). Tairlaw, 179644–179649

H/A	0–1½	51·1	n.d.	n.d.	n.d.	n.d.	n.d.	—	1·22	0·44	1·72	38·8	8·0	4·2	27·6	1·95	310	8·5	High organic content in the A_1 horizon. Very low exchangeable Ca throughout. High total P_2O_5 in A_1 horizon. Moderately high readily soluble P_2O_5 in surface 1½ inches.
A_1	2–5	26·7	n.d.	n.d.	n.d.	n.d.	n.d.	—	0·29	0·15	0·48	33·4	2·7	4·9	13·7	1·06	323	1·0	
B_2	7–9	15·2	63	21	73	11	8	—	0·07	0·07	0·05	17·8	1·1	5·5	5·87	0·375	194	—	
B_3	10–14	9·2	60	27	71	16	8	—	0·07	0·04	0·03	8·03	1·7	5·2			150	—	
B_3/C	16–20	4·9	65	26	79	11	7	—	—	0·03	0·03	2·72	2·2	5·1			123	1·2	
C	24–28	3·8	67	26	82	12	7	—	0·01	0·03	—	2·34	1·7	5·1			143	3·2	

n.d. Not determined —Less than lower limit of determination

TABLE 9: Miscellaneous Soils—*continued*

Horizon	Depth in	% Loss on Ignition	Soil Separates					Exchangeable Cations me/100 g					% Saturation	pH	% Carbon	% Nitrogen	mg/100 g Total P_2O_5	mg/100 g Read. Sol. P_2O_5	Remarks
			% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H							
66.								PEAT; Loch Doon, 179855–179857											
Pt	1–5	92·4	n.d.	n.d.	n.d.	n.d.	n.d.	9·33	8·48	1·24	1·24	86·8	18·9	3·8	47·5	2·69	136	16·1	High exchangeable bases in top 5 in. Very low pH throughout. High readily soluble P_2O_5 in top 5 inches.
Pt	11–15	71·8	n.d.	n.d.	n.d.	n.d.	n.d.	—	2·72	0·61	0·01	94·0	3·4	3·8	36·2	1·67	109	0·9	
Pt	18–22	71·2	n.d.	n.d.	n.d.	n.d.	n.d.	—	3·89	0·56	0·01	77·9	5·4	3·8			108	0·3	
67.								PEAT; Meaul, 179841–179843											
Pt	2–6	96·4	n.d.	n.d.	n.d.	n.d.	n.d.	5·95	10·3	1·25	1·14	87·4	17·5	3·7	48·1	1·84	142	15·9	Moderate to high exchangeable bases in surface horizon. Very acid throughout. High readily soluble P_2O_5 in top 6 inches.
Pt	9–13	94·4	n.d.	n.d.	n.d.	n.d.	n.d.	3·42	8·79	1·08	0·46	94·4	12·7	3·7	50·3	2·05	119	5·5	
Pt	18–20	86·5	n.d.	n.d.	n.d.	n.d.	n.d.	3·41	7·00	0·74	0·74	100	10·1	3·7			94	1·8	

68. PEAT; Beneraird, 179368–179370

Pt Pt Pt	1–5	97·5	n.d.	n.d.	n.d.	n.d.	n.d.	6·06	10·5	1·90	0·81	81·2	19·2	4·0	56·2	1·54	177	0·3	High exchangeable Mg throughout. Low pH. Low readily soluble P_2O_5 in top 5 inches.
	9–13	98·6	n.d.	n.d.	n.d.	n.d.	n.d.	6·02	9·40	1·55	0·30	75·0	18·7	3·9	53·1	2·11	126	9·3	
	14–17	87·5	n.d.	n.d.	n.d.	n.d.	n.d.	4·29	10·2	1·09	0·01	81·7	16·0	3·6			84	3·1	

n.d. Not determined —Less than lower limit of determination

APPENDIX III

Silca-sesquioxide Ratios of the Clay Fraction

TABLE 10. BROWN FOREST SOILS, FREELY DRAINED

Association	Series	Profile No.	Horizon	Percentages			Ratios			
				SiO_2	Fe_2O_3	Al_2O_3	SiO_2/R_2O_3	SiO_2/Fe_2O_3	SiO_2/Al_2O_3	Al_2O_3/Fe_2O_3
Benan	Benan	3	A	44·58	19·05	17·40	2·56	6·24	4·34	1·44
			B	44·30	17·65	18·05	2·56	6·74	4·16	1·59
			B	36·52	16·75	22·85	1·85	5·80	2·71	2·14
Darleith	Darleith	7	A	35·30	24·45	15·80	1·91	3·84	3·79	1·01
			B	30·54	25·00	16·10	1·61	3·24	3·22	1·01
			B	27·46	24·80	14·80	1·53	2·96	3·16	0·94
Ettrick	Linhope	10	A_1	48·52	10·10	24·65	2·65	12·83	3·34	3·84
			$A_{1/2}$	46·14	10·50	25·25	2·44	11·62	3·10	3·76
			B_2	35·90	17·35	28·55	1·54	5·48	2·14	2·57
			B_3	40·28	11·40	28·45	1·91	9·33	2·41	3·88
			C	45·52	12·15	24·50	2·40	10·00	3·16	3·16

TABLE 11. BROWN FOREST SOILS WITH GLEYED B AND C HORIZONS

Association	Series	Profile No.	Horizon	Percentages			Ratios			
				SiO_2	Fe_2O_3	Al_2O_3	SiO_2/R_2O_3	SiO_2/Fe_2O_3	SiO_2/Al_2O_3	Al_2O_3/Fe_2O_3
Benan	Minuntion	16	A	42·24	15·90	20·35	2·36	7·11	3·54	2·01
			A	42·72	16·20	20·75	2·34	7·06	3·50	2·02
			B_2g	41·88	16·75	17·60	2·52	6·66	4·04	1·65
			B_2g	43·94	16·15	18·45	2·60	7·26	4·34	1·79
			B_3/Cg	45·84	14·90	16·85	2·96	8·21	4·63	1·77
			Cg	45·70	16·60	17·30	2·78	7·32	4·48	1·64
Darleith	Dunlop	18	A	47·94	17·80	14·95	3·09	7·17	5·44	1·33
			B_2g	51·32	17·60	14·90	3·34	7·76	5·85	1·33
			B_3g	53·96	16·80	13·60	3·78	8·56	6·76	1·27
			Cg	51·78	14·00	14·20	3·80	9·81	6·21	1·58
Ettrick	Altimeg	21	A	46·68	11·45	25·10	2·44	10·79	3·16	3·42
			B_2g	47·88	12·50	23·80	2·55	10·22	2·41	3·01
			B_3/Cg	47·14	14·05	22·70	2·52	8·91	3·52	2·54
Ettrick	Kedslie	23	A	45·94	15·55	21·55	2·54	7·81	3·61	2·16
			A_2g/Bg	43·56	15·70	20·85	2·40	7·40	3·55	2·08
			B_2g	43·06	18·00	20·60	2·21	6·36	3·39	1·88
			B_2g	49·04	13·25	24·90	2·40	9·85	3·35	2·94
			B_3g/Cg	46·86	16·75	20·15	2·59	7·44	3·97	1·88

TABLE 12. PEATY PODZOLS WITH IRON PAN

Association	Series	Profile No.	Horizon	Percentages			Ratios			
				SiO_2	Fe_2O_3	Al_2O_3	SiO_2/R_2O_3	SiO_2/Fe_2O_3	SiO_2/Al_2O_3	Al_2O_3/Fe_2O_3
Benan	Knockin-culloch	49	A_2g	38·20	15·00	28·50	1·71	6·77	2·28	2·96
			B_2	41·64	14·85	20·00	2·40	7·45	3·54	2·11
			B_3/C	38·42	12·25	19·45	2·39	8·32	3·35	2·48
			C	39·34	12·90	18·80	2·48	8·10	3·57	2·28
Dalbeattie	Carsphairn	50	A_2g/H	50·76	4·25	29·00	2·71	31·30	2·96	10·56
			B_2	21·16	15·05	45·00	0·66	3·52	0·80	4·69
			B_3	34·86	14·10	40·30	1·20	6·59	1·47	4·50
			C	31·44	8·95	50·50	0·95	9·36	1·06	8·90
Ettrick	Dod	54	A_2g	55·54	2·45	31·75	2·84	61·70	2·98	20·08
			B_2	24·00	46·10	26·00	0·74	1·43	1·57	0·89
			B_3	35·52	22·45	29·70	1·37	4·22	2·03	2·08
			C	41·94	13·60	34·70	1·64	8·23	2·06	4·01
Ettrick	Dod	55	A_2g	54·36	4·30	24·25	3·42	33·52	3·80	8·82
			B_2	34·68	25·00	23·65	1·49	3·70	2·49	1·49
			B_3	29·48	12·30	26·60	1·45	6·37	1·88	3·39
			C	40·68	12·75	24·40	2·13	8·50	2·85	2·99

TABLE 13. NON-CALCAREOUS GLEYS

Association	Series	Profile No.	Horizon	Percentages			Ratios			
				SiO_2	Fe_2O_3	Al_2O_3	SiO_2/R_2O_3	SiO_2/Fe_2O_3	SiO_2/Al_2O_3	Al_2O_3/Fe_2O_3
Benan	Lanes	27	A_1g	51·82	9·00	19·45	3·50	15·45	4·53	3·42
			B_2g	38·22	18·10	20·70	2·02	5·63	3·14	1·84
			B_2g	39·84	17·45	19·60	2·21	6·09	3·46	1·61
			B_3g	48·00	14·40	16·80	3·14	8·88	4·85	1·83
			Cg	44·82	19·85	13·50	2·92	6·04	5·66	1·06
Darleith	Amlaird	29	A_2g	49·78	21·45	13·70	3·09	6·19	6·19	1·00
			B_2g	54·72	19·35	10·50	4·06	7·52	8·84	0·85
			B_3g	52·08	14·60	8·90	4·90	9·55	10·10	0·95
			Cg	51·08	14·95	8·80	4·79	9·17	10·03	0·92
Ettrick	Little-shalloch	30	A_1g	51·82	10·90	27·35	2·57	12·70	3·22	3·94
			A_2g	49·88	10·55	28·40	2·42	12·60	2·99	4·22
			B_2g	43·94	14·65	28·05	1·99	7·95	2·66	2·99
			Cg	49·92	10·60	36·05	1·98	12·60	2·36	5·34
Ettrick	Ettrick	32	A_1	43·86	13·35	22·00	2·44	8·70	3·38	2·58
			A_2g	43·68	16·25	25·20	2·09	7·14	2·95	2·42
			B_2g	45·10	17·95	20·60	2·39	6·70	3·72	1·80
			B_3g/Cg	45·90	17·20	20·40	2·50	7·09	3·83	1·85
			Cg	47·18	15·85	23·25	2·40	7·95	3·45	2·30
			Cg	46·96	15·90	22·50	2·44	7·83	3·54	2·21

TABLE 14. PEATY GLEYS

Association	Series	Profile No.	Horizon	Percentages			Ratios			
				SiO_2	Fe_2O_3	Al_2O_3	SiO_2/R_2O_3	SiO_2/Fe_2O_3	SiO_2/Al_2O_3	Al_2O_3/Fe_2O_3
Dalbeattie	Eglin	36	A_2g	53·64	3·40	20·40	4·04	42·50	4·46	9·54
			B_2g	52·82	5·10	25·20	3·15	27·50	3·56	7·73
			B_3g	43·60	17·45	23·40	2·15	6·66	3·17	2·10
			B_3g	47·96	7·80	28·05	2·46	16·30	2·75	5·61
			Cg	46·30	7·05	29·55	2·31	17·50	2·66	6·59
Ettrick	Dochroyle	40	A_2g	50·52	5·95	27·00	2·79	22·80	3·18	7·16
			B_2g	46·56	11·80	24·70	2·46	10·50	3·20	3·27
			Cg	45·84	15·30	23·00	2·38	7·95	3·38	2·36
Ettrick	Dochroyle	41	A_2g	48·44	13·20	27·90	2·26	9·72	2·94	3·30
			B_2g	43·84	20·70	29·55	1·74	5·62	2·52	2·23
			Cg	44·68	15·65	28·90	1·95	7·60	2·63	2·90
Ettrick	Alemoor	43	A_2g	47·08	11·40	26·10	2·40	11·18	3·06	3·61
			$B_{21}g$	46·86	14·75	21·30	2·60	8·50	3·74	2·28
			$B_{22}g$	46·54	17·55	21·35	2·42	7·05	3·69	1·91
			Cg	47·54	16·00	21·50	2·55	7·92	3·76	2·11

TABLE 15. SUB-ALPINE SOILS

Association	Series	Profile No.	Horizon	Percentages			Ratios			
				SiO_2	Fe_2O_3	Al_2O_3	SiO_2/R_2O_3	SiO_2/Fe_2O_3	SiO_2/Al_2O_3	Al_2O_3/Fe_2O_3
Ettrick	Merrick	60	H/A_1	43·56	13·10	27·50	2·06	8·84	2·69	3·29
			H/B_2	36·22	17·05	26·00	1·67	5·65	2·37	2·38
			C	37·96	8·75	37·60	1·49	11·50	1·72	6·69

APPENDIX IV

TABLE 16. PERCENTAGE OF MINERAL GROUPS AND MINERAL FREQUENCIES IN THE FINE SAND FRACTIONS (20–200μ)

				Light Fraction (S.G. < 2·9)*						Heavy Fraction (S.G. > 2·9)*															
Association	Series	Profile	Horizon	Weight % Light	Quartz	Plagioclase	Potash Feldspars	Micas	Weathered Material	Apatite	Augite	Biotite	Epidote	Garnet	Hornblende	Hypersthene	Iron oxides	Muscovite	Rutile	Sphene	Staurolite	Tourmaline	Zircon	Rock Particles	Weathered Material
Benan	Benan	Cantersty Hill No. 1	A	72·5						0	2	0	0	0	5	0	9	0	0	0	0	0	0	3	3
			B	83·0	6	1	4	0	9	0	3	0	1	0	5	0	9	0	0	0	0	0	0	4	3
	Minuntion	Cantersty Hill No. 2	A	91·1						0	5	0	2	0	7	2	7	0	0	0	0	0	0	2	4
			Cg	89·1	9	2	4	0	6	0	4	0	1	1	6	1	8	0	0	0	0	0	0	3	3
	Lanes	Minuntion No. 2	A_1g	95·8						0	4	0	3	0	6	1	8	0	0	0	0	0	1	3	5
			Cg	94·1	9	3	3	0	6	1	5	1	1	0	6	1	8	0	0	0	0	0	0	4	3
	Knockinculloch	Balcletchie No. 1	A_2g	67·8						0	4	0	2	0	8	0	6	0	0	0	0	0	0	3	5
			Cg	77·8	7	2	2	3	8	0	5	0	1	0	7	0	7	0	0	0	0	0	0	4	4
Dalbeattie	Eglin	Laggan O'Dee No. 3	A_2g	100						0	0	0	3	2	5	0	8	2	1	0	0	0	5	4	0
			Cg	100	8	0	6	5	4																
	Dalbeattie	Darrou No. 1	A	81·3						0	0	0	0	0	10	3	3	0	0	0	0	0	0	1	0
			C	96·7	8	5	4	5	5	0	0	4	1	0	9	1	6	0	0	0	0	0	1	2	2
	Carsphairn	Cooran Lane No. 1	A_2g/H	94·4						0	0	0	0	0	10	0	3	0	0	0	0	0	1	2	0
			C	99·4	7	3	6	4	6	1	0	3	0	0	9	0	4	0	0	0	0	2	3	3	2
Darleith	Darleith	Garnaburn No. 4	A	91·7						0	3	0	0	1	7	0	7	0	0	0	0	0	0	3	4
			C	99·3	0	0	0	0	10	0	2	0	1	1	2	1	9	0	0	0	0	0	0	4	3
	Dunlop	Bougang No. 3	A	93·6						0	5	0	3	3	6	1	8	0	0	0	0	0	2	3	3
			Cg	98·4	8	0	3	0	7	2	6	0	0	2	5	0	8	0	0	0	0	0	2	5	4
	Amlaird	S. Ballaird No. 1	A_1/H	86·4						0	4	0	0	1	6	0	8	0	0	0	0	0	0	2	4
			Cg	87·8	6	0	2	0	9	0	3	0	0	2	7	0	6	0	0	0	0	0	0	5	5

Ettrick	Linhope	Creebank No. 2	A_1	99·8						0	0	1	0	4	5	0	8	0	1	0	0	3	5	5	3
	(till phase)		C	99·5	9	0	4	0	5	1	0	2	0	3	4	0	8	0	1	0	0	2	4	5	3
	Linhope	Polmaddy Burn No. 1	A	99·2						0	4	1	2	5	5	0	8	0	0	0	0	0	4	4	5
	(moraine phase)		C	99·0	8	0	3	0	7	0	6	0	0	5	5	0	7	0	0	0	0	1	4	5	5
	Dod	Arnisheen No. 1	A_2g	99·4						0	4	0	0	4	4	3	8	0	2	0	0	2	4	4	3
	(till phase)		C	99·4	9	2	0	1	6	1	6	0	0	4	4	3	8	0	0	0	0	1	4	4	4
	Dod	Leadmines No. 3	A_2g	99·4						0	0	0	1	2	1	0	9	0	0	0	0	3	4	5	3
	(moraine phase)		C	98·6	8	0	2	0	6	0	3	0	0	4	1	0	9	0	0	0	0	0	3	4	3
	Dochroyle	Dochroyle No. 2	A_2g	99·6						0	5	2	0	5	5	0	7	0	1	0	0	3	4	4	5
			Cg	97·1	9	2	2	0	6	0	6	0	0	3	3	0	8	0	0	0	0	0	3	4	2
	Dochroyle	Halfmark No. 1	A_2g	98·5						0	1	2	1	4	3	0	8	0	0	0	0	2	5	4	4
			Cg	98·8	9	1	0	1	6	2	0	0	0	4	6	0	8	0	0	0	0	1	4	5	5
	Altimeg	Glenduisk No. 1	A	96·3						1	4	2	0	4	6	2	8	0	0	0	0	3	3	4	5
			B_3g/Cg	99·4	8	0	2	0	7	1	2	2	0	4	4	0	8	0	0	0	0	2	4	4	3
	Littleshalloch	Glenlee No. 1	A_1g	98·9						1	3	1	1	3	5	4	8	0	0	0	0	2	4	5	4
			Cg	99·3	8	2	3	2	7	0	0	0	1	3	6	3	8	0	0	0	0	2	4	5	4
	Kedslie	Currarie No. 1	A	97·4						0	4	1	3	3	5	2	8	0	0	0	0	0	2	3	6
			B_3g/Cg	96·4	8	0	3	0	7	0	3	0	4	2	6	3	8	0	0	0	0	0	1	4	5
	Ettrick	Saugh Hill No. 1	A_1g	95·1						0	6	0	2	2	6	4	7	0	0	0	0	0	2	3	5
			Cg	93·5	9	3	1	1	6	0	5	0	1	2	5	1	8	0	0	0	0	0	2	5	4
	Alemoor	Saugh Hill No. 3	A_2g	98·5						0	6	1	3	3	6	2	7	0	0	0	0	0	3	3	6
			Cg	91·8	9	0	2	0	6	0	5	0	2	2	6	1	7	0	0	0	0	0	1	4	5
	Merrick	Merrick No. 3	H/A_1	98·7						0	0	0	0	0	9	0	6	0	0	0	0	2	3	2	2
			C	99·4	9	2	0	0	5	0	0	0	0	2	5	0	7	0	0	0	0	2	3	5	5

*Frequency scale used:—0 = < ½%, 1 = ½–1%, 2 = 1–2%, 3 = 2–4%, 4 = 4–7%, 5 = 7–15%, 6 = 15–30%, 7 = 30–50%, 8 = 50–70%, 9 = 70–90%, 10 = 90–100%

APPENDIX V

TABLE 17. MINERALS IN THE CLAY FRACTION ($<1{\cdot}4\mu$)

Association	Series	Soil No.	Illite	Chlorite	Kaolin	Mont-morillonite	Vermiculite	Mixed layer	Gibbsite	Amorphous Material
Benan	Benan	153632	+	++	+	–	–	–	–	++
	Minuntion	153034 38	– –	++ ++	+ +	– +	– –	– –	+ –	+ +
	Lanes	153029	+	++	+	+	–	–	–	++
Dalbeattie	Dalbeattie	176839	++	–	+	–	+	–	–	++
	Carsphairn	170845 49	– +	– ++	– +	– –	– +	– +	– –	+++ +
Darleith	Darleith	161898	–	+	–	–	++	+	–	++
	Dunlop	161975	+	+	+	++	–	+	–	–
	Amlaird	161964 68	+ +	++ ++	+ +	+ ++	– –	+ +	– –	– –

TABLE 17. Minerals in the Clay Fraction—*continued*

Ettrick	Linhope	152930	+++	+	+	–	–	–	+	+
	Linhope	170822	+++	++	+	–	–	–	+	+
	Dod	170908	+++	+	+	–	–	–	–	–
		12	+++	++	++	–	–	–	+	–
	Dochroyle	152966	+++	++	+	–	–	–	–	–
		68	+++	++	+	–	–	–	–	–
	Altimeg	161938	+++	++	+	–	–	–	+	–
		40	+++	++	+	–	–	–	–	–
	Ettrick	179307	+	+++	+	+	–	–	–	–
		11	++	++	+	++	–	+	–	–
	Merrick	170928	–	–	–	–	–	–	–	+++
		29	+	+	+	–	–	–	+++	++
Glenalmond	Glenalmond	111048	++	+	+	–	–	–	–	–
		51	+++	–	+	–	–	–	–	–
	Meadownay	134527	++	–	+++	–	–	–	–	–
		31	++	–	+++	–	+	–	–	–

+++ Dominant ++ Frequent + Present – Not observed

APPENDIX VI

Table 18. Rock Analyses

	1	2	3	4
SiO_2	68·68	61·52	74·33	59·96
TiO_2	1·12	0·62	1·02	0·85
Al_2O_3	12·84	13·42	10·02	12·48
Fe_2O_3	0·16	1·72	1·36	0·87
FeO	5·58	4·45	3·85	6·60
MnO	0·23	—	0·07	0·09
MgO	2·95	3·39	2·43	5·34
CaO	1·32	3·46	2·02	5·62
Na_2O	2·04	3·73	1·32	2·94
K_2O	1·47	2·17	1·48	1·57
P_2O_5	0·17	—	0·10	0·05
CO_2	—	3·04	0·34	tr.
$H_2O > 105°C$	0·10	0·06	0·09	0·34
$H_2O < 105°C$	2·98	2·33	1·82	3·48
	99·64	99·91	100·25	100·19

No. 1 Greywacke:—Loch Doon complex (Ordovician), Walton, E. K. (1955). (from MacIntyre—private communication).

No. 2 Greywacke:—Average of three samples, Pettijohn, (1949) (from Todd, 1928).

No. 3 Greywacke:—Holywell, Holylee, Peeblesshire (Silurian), Walton, E. K. (1955),

No. 4 Greywacke:—Edston Quarry, Peeblesshire (Silurian), Walton, E. K. (1955).

TABLE 18—*continued*

	5	6	7	8
SiO_2	70·40	60·10	51·52	56·90
TiO_2	0·68	1·17	2·39	1·13
Al_2O_3	14·89	16·29	16·37	16·49
Fe_2O_3	0·50	1·49	1·44	0·98
FeO	1·75	3·93	7·45	5·66
MnO	—	—	0·10	0·24
MgO	0·83	2·83	6·29	5·64
CaO	1·61	4·85	7·67	6·14
Na_2O	3·88	3·92	4·02	3·86
K_2O	4·85	3·41	1·42	1·92
P_2O_5	0·08	0·31	0·23	0·04
CO_2	0·03	0·15	—	0·40
$H_2O > 105°C$	0·52	1·32	1·28	0·31
$H_2O < 105°C$	0·28	0·24	0·12	0·18
$(Co+Ni)O$	—	—	—	0·15
	100·30	100·01	100·30	100·04

No. 5 Granite:—Cairnsmore of Carsphairn, Deer, W. A. (1935).

No. 6 Tonalite:—Gairy of Cairnsmore, Deer, W. A. (1935).

No. 7 Hornblende Hybrid:—West of Poultrihuie Burn, Deer, W. A. (1935).

No. 8 Norite:—South-west of Loch Girvan Eye, Loch Doon area (E. G. Radley, Anal.), Gardiner and Reynolds (1932).

TABLE 18—*continued*—**Rock Analyses**

	9	10	11	12
SiO_2	62·95	70·63	73·26	71·18
TiO_2	0·73	0·41	0·30	0·47
Al_2O_3	14·59	14·65	14·29	14·78
Fe_2O_3	1·00	0·54	0·98	1·20
FeO	3·87	1·93	0·97	1·35
MnO	0·19	0·09	0·04	0·06
MgO	4·02	1·45	0·69	0·82
CaO	3·81	1·83	1·14	1·58
Na_2O	3·36	3·55	3·48	3·10
K_2O	4·52	4·29	4·04	4·82
P_2O_5	0·01	0·07	0·25	0·38
CO_2	—	0·18	0·45	0·29
$H_2O > 105°C$	0·69	0·42	0·42	0·15
$H_2O < 105°C$	0·22	0·12	0·04	0·11
(Co, Ni)O	0·09	0·05	—	tr.
LiO_2	tr.	tr.	tr.	—
BaO	—	tr.	—	—
	100·05	100·21	100·35	100·29

No. 9 Tonalite:—Fore Starr, S. of Loch Doon (E. G. Radley, Anal.), Gardiner and Reynolds (1932).

No. 10 Granite:—Between Hoodens Hill and Mullwharchar (E. G. Radley, Anal.), Gardiner and Reynolds (1932).

No. 11 Muscovite-Biotite-Granite:—Fleet Mass (E. G. Radley, Anal.), Gardiner and Reynolds (1937).

No. 12 Biotite-Granite:—Fleet Mass (E. G. Radley, Anal.), Gardiner and Reynolds (1937).

TABLE 18—*continued*

	13	14	15	16
SiO_2	38·58	45·70	48·89	45·80
TiO_2	0·04	2·60	2·42	3·02
Al_2O_3	1·65	13·60	18·87	16·34
Fe_2O_3	3·94	2·32	2·55	1·67
FeO	2·49	9·47	5·77	12·53
MnO	—	—	—	—
MgO	37·84	10·53	3·84	5·39
CaO	0·04	10·08	7·56	8·44
Na_2O	0·62	3·74	4·14	3·11
K_2O	0·11	0·56	1·06	0·73
P_2O_5	0·04	0·26	0·39	0·10
CO_2	0·10	—	0·80	tr.
$H_2O > 105·C$	12·68	1·19	2·93	2·03
$H_2O < 105°C$	1·49	0·01	0·66	0·23
Cr_2O_3	0·24	0·14	—	—
(Co, Ni)O	0·06	—	—	—
FeS_2	0·10	0·08	0·10	0·50
	100·02	100·28	99·98	99·89

No. 13 Bastatite Serpentine:—South slope of Balhamie Hill (B. E. Dixon, Anal.), Balsillie (1932).

No. 14 Hornblende Granulite:—800 yards north of Bougang Farm (B. E. Dixon, Anal.), Balsillie (1932).

No. 15 Spilitic Lava:—Cliff at Port Vad (B. E. Dixon, Anal.), Guppy and Sabine (1956).

No. 16 Gabbro:—Mainshill south-east of Ardmillan House, (B. E. Dixon, Anal.), Guppy and Sabine (1956).

APPENDIX VII

Methods of Recording and Analysing the Vegetation

The methods of recording in the field and later analysing the data are based on those of Poore (1955) with some minor modifications.

Collection of Field Data

Homogeneous stands of natural and semi-natural vegetation are selected for investigation. The test of homogeneity is a subjective one and depends on the experience of the recorder or recorders. Nevertheless different recorders arrive at approximately the same conclusion as to what is a uniform stand and the method saves a considerable amount of time and effort compared with a more objective one.

The vegetation described includes all communities on soils mapped by the soil survey and thus excludes aquatic communities, those of minor extent, such as vegetation of springs, waysides and sea-cliffs, and epiphytic and saxicolous communities. 'Minor extent' in this context refers to what can be shown on a map of scale 1 inch equivalent to 1 mile. The weed communities of arable land have not been included in the vegetation survey.

A basic standard plot of 1 square metre is used for sampling the vegetation. The species present in the plot are noted and given a cover-abundance value according to the Domin scale (Poore, 1955).

The ratings for the scale are:

Cover about 100 per cent	10
Cover >75 per cent	9
Cover 50–75 per cent	8
Cover 33–50 per cent	7
Cover 25–33 per cent	6
Abundant, cover about 20 per cent	5
Abundant, cover about 5 per cent	4
Scattered, cover small	3
Very scattered, cover small	2
Scarce, cover small	1
Isolated, cover small	X

An additional value of (x) for isolated species outside the final sample plot but still considered constituents of the vegetation being studied is used.

The size of the original sample plot is doubled to 2 square metres and the extra species noted with their cover-abundance values. The cover-abundance values of the species recorded in the original 1 square metre are adjusted where necessary. The plot is doubled once more to 4 square metres and the new species in the sample plot recorded by the same procedure. At this stage there is usually no need to increase the plot size as most of the species in the stand have been included, but if quite a number of new species are recorded in the increase from 2 square metres to 4 square metres it may be necessary to increase the size of the sample plot still farther.

In woodland the ground and field layers are used as the basis for analysis, as a 'minimal area' large enough to include the tree and large shrub layers would often lose the homogeneous nature of the ground vegetation, especially in woodland on the more base-rich sites. An even more cogent reason for disregarding the tree layer as a necessary part of the basic unit is that many trees in Scotland are planted and the canopy layer is thus artificial in its composition. Although not forming part of the basic sampling unit, the tree and shrub layers, being very important constituents of woodland vegetation, are sampled in a circular area of radius 15 yards centered on the sample plot. The species are noted and given cover-abundance values in similar fashion to the ground vegetation. Tree and shrub seedlings are recorded in the basic sample plot along with the field and ground layer species.

Major site characteristics are recorded for each sample area and include altitude, aspect and slope. The percentage cover of the different layers of the vegetation is noted and also the height of the trees, shrubs and field layer.

A soil pit is dug and the exposed profile described. The different horizons are sampled for laboratory analysis. The soil is also placed in the appropriate soil series and association and the drainage category, parent material and genetic soil group are noted.

Construction of Floristic Tables

The field data are transferred to cards for ease of grouping and regrouping. The card for each stand, as well as showing the data enumerated above, has also a serial number, the actual date of collection and the locality and map reference. The serial number is composed of the figures for the year of collection less the two figures for the century, followed by the number for the stand as part of a sequence for that particular year.

The stands are then grouped into the major physiognomic units of woodland, grassland and moorland. This is in no sense a zonal sequence as used by McVean and Ratcliffe (1962) but a convenient life-form grouping until the firm establishment of the higher plant sociological units for Scotland. A group of maritime communities and one of montane communities are also separated. Subdivision of these groups is then based on the dominant and the constant species of the field and ground layers. Major habitat characteristics are also used as a guide in the selection of related stands.

The presence of individual species in the community is shown as a percentage of the number of stands and noted as a value of K. The presence of species in facies is shown in a like manner.

Five constancy classes for the species in the stands are as follows:

Presence values in stands	*Class*
0–19·9 per cent	I
20–39·9 per cent	II
40–59·9 per cent	III
60–79·9 per cent	IV
80–100 per cent	V

To ensure that the communities distinguished have a certain degree of homogeneity an empirical test of homogeneity is applied to the floristic table constructed for each (McVean and Ratcliffe, 1962). For a table to be sufficiently homogeneous the species in constancy class V (80–100 per cent) must exceed the number of species in constancy class IV (60–79·9 per cent).

Within the tables sub-division is made into facies, based on the presence or absence of a small number of species.

The total number of species is given for each stand and the total and average number of species for each facies and community. In the case of the woodland communities the average for the field and ground layers is given, as well as the average for the total number of species. The epiphytes on fallen branches are not included in either value.

A table of indices of similarity is compiled for the communities in the three main groups of woodland, grassland and moorland. The montane communities are included in the moorland group because of the small number of montane communities so far distinguished. The index is based on the formula $2w/a+b$ where a is the sum of the presence values of all species in the one community, b is the sum of the presence values of all species in the second community and w is the sum of the lower of the two presence values of species common to both communities. The value of the index is given as a percentage. Certain values are calculated for two communities occurring in different physiognomic groups where it is realized that the two communities are closely related and a measure of the relationship is desired.

As new records are collected these are included in the floristic tables and the change in presence values of the species may alter the list of constant species and the designation of the facies of a community. Certain communities may even be divided into two or more separate communities. Such 'Progressive approximation' (Poore, 1955) will continue until sufficient records of the full range of a particular type of vegetation have been collected. It also serves to combat any bias due to the restricted area of recording when originally setting up communities.

APPENDIX VIII

Classification of Plant Communities

The communities distinguished in the survey hitherto have been placed in the higher phytosociological units of Continental Europe. This allocation has been based on the species present and the major site characteristics and at this stage is only provisional.

Certain communities, such as dry *Calluna* moor, appear to be part of more than one class and others, such as the *Agrostis-Festuca* communities which, from their indices of similarity, are fairly closely related, belong to separate classes. The creation of a separate class of Agrostio-Festucetea for the northern and western areas of the British Isles might be justifiable, but would obscure the relationships of the different communities with their nearest continental counterparts.

The classes are taken from the synopsis of European vegetation classes in 'Pflanzensoziologie' by J. Braun-Blanquet (1964) pp. 134 and 135, and the information on orders and alliances from R. Tüxen (1937) and other sources.

I Class: Querco-Fagetea (Braun-Blanquet and Vlieger, 1937)

Deciduous woodland on nutrient-rich soils
Order: Fagetalia silvaticae (Pawlowski, 1928)
Alliance: Fraxino-Carpinion (Tüxen, 1936)
(*a*) Base-rich woodland
(*b*) *Endymion non-scriptus* woodland
(*c*) *Dryopteris-Rubus* woodland (part)

II Class: Quercetea roboris-petraeae (Braun-Blanquet and Tüxen, 1943)

Deciduous woodland on acid soils
Order: Quercetalia roboris-petraeae (Tüxen, 1931)
Alliance: Quercion roboris-petraeae (Braun-Blanquet, 1932)
(*a*) *Holcus mollis—Dryopteris dilatata* woodland
(*b*) *Holcus mollis—Anthoxanthum odoratum* woodland
(*c*) *Anthoxanthum odoratum* woodland
(*d*) *Dryopteris—Rubus* woodland (part)
(*e*) *Vaccinium myrtillus* woodland (part)

III Class: Vaccinio-Piceetea (Braun-Blanquet, 1939)

Coniferous woodland and related dwarf shrub communities on acid soils
Order: Vaccinio-Piceetalia (Braun-Blanquet, 1939)
Alliance: Vaccinio-Piceion (Braun-Blanquet, 1938)
(*a*) *Vaccinium myrtillus* woodland (part)
(*b*) *Calluna vulgaris* woodland
(*c*) *Deschampsia flexuosa* woodland
(*d*) Dry *Calluna* moor (part)

IV Class: Arrhenatheretea (Tüxen, 1937)

Rich meadow grassland communities
Order: Arrhenatheretalia (Pawlowski, 1928)
Alliance: Cynosurion cristati (Tüxen, 1947)
Agrostis-Festuca meadow grassland (part)

V Class: Festuca-Brometea (Braun-Blanquet and Tüxen, 1943)

Dry grassland communities (on basic soils)
Order: Brometalia erecti (Braun-Blanquet, 1936)
Sub-Alliance: Mesobromion erecti (Braun-Blanquet and Moor, 1938)
Agrostis-Festuca basic grassland

VI Class: Calluno-Ulicetea (Braun-Blanquet and Tüxen, 1943)

Heaths with ericaceous plants and gorse
1. Order: Nardetalia (Preising, 1949)
Alliance: Nardo-Galion saxatilis (Preising, 1949)
(*a*) *Agrostis-Festuca* meadow grassland (part)
(*b*) *Agrostis-Festuca* acid grassland
(*c*) *Nardus* grassland
(*d*) *Molinia* grassland (part)

2. Order: Calluno-Ulicetalia
   Alliance: Ulicion (Malcuit, 1929)
   (*a*) Dry *Calluna* moor (part)
   (*b*) Wet *Calluna* moor (part)
   (*c*) *Molinia* grassland (part)

VII Class: Molinio-Juncetea (Braun-Blanquet, 1947)

"Litter" meadow communities
Order: Molinietalia (Koch, 1926)

1. Alliance: Juncion acutiflori (Braun-Blanquet, 1947)
   Juncus acutiflorus pasture (? part)
2. Alliance: Molinion caerulane (Koch, 1926)
   (*a*) *Juncus acutiflorus* pasture
   (*b*) *Carex* wet pasture (part)

VIII Class: Scheuchzerio-Caricetea fuscae (Nordhagen, 1936)

Acid northern alpine fen or mire communities
Order: Caricetalia davallianae (Braun-Blanquet, 1949)
Alliance: Caricon davallianae (Klika, 1934)
Carex wet pasture (part)

IX Class: Oxycocco-Sphagnetea (Braun-Blanquet and Tüxen, 1943)

Raised moss (and blanket peat) communities

1. Order: Sphagno-Ericetalia (Braun-Blanquet, 1949)
   Alliance: Ericion tetralicis (Schwickerath, 1933)
   (*a*) *Calluna-Eriophorum vaginatum-Trichophorum* moor
   (*b*) Upland *Calluna-Eriophorum* moor (part)
   (*c*) *Molinia-Myrica* moor
   (*d*) Wet *Calluna* moor (part)
   (*e*) *Molinia* grassland (part)
2. Order: Oxycocco-Ledetalia (Nordhagen, 1943)
   Alliance: Oxycocco-Empetrion hermaphroditi (Nordhagen, 1936)
   Upland *Calluna-Eriophorum vaginatum* moor (part)

X Class: Caricetea curvulae (Braun-Blanquet, 1948)

Acid alpine-northern mountain heaths
Order: Caricetalia curvulae (Braun-Blanquet, 1926)
Alliance: Arctostaphyleto-Cetrarion nivalis (Dahl, 1956)
Vaccinium—Carex bigelowii—Rhacomitrium heath

XI

Order: Deschampsieto-Myrtilletalia (Dahl, 1956)
Alliance: Phyllodoco-Vaccinion myrtilli (Nordhagen, 1936)
Montane *Juncus squarrosus* moor.

APPENDIX IX

Plant Communities

Stands of Vegetation

Tables of stands of vegetation occurring in Sheets 7 and 8 are grouped according to communities and facies.

Values of K over 80 per cent are in heavier type and underlined to indicate the constant species (Class V). The constancy Class IV species (*ie* present in 60 per cent to 79·9 per cent of the stands) are indicated by the use of heavier type only.

In the tables the figures enclosed in square brackets —[ ]—indicate that two or more species share the same cover value.

Those species in the vicinity of the sample quadrats which were considered to be part of the facies or community are shown by the symbol (x).

Figures with an asterisk—*—indicate species which occur on fallen twigs, tree trunks or boulders within the quadrats.

The following abbreviations for the sub-groups of the major soil grousp have been used:

BFS	Freely drained brown forest soil of medium to high base status
BMS	Magnesium-rich variant of above
BP	Freely drained brown forest soil of low base status
GBP	Brown forest soil with gleyed B and C horizons
MBP	Magnesium-rich variant of above
IP	Freely drained iron podzol
GP	Imperfectly drained podzol
RP	Imperfectly drained podzol ranker
PP	Peaty podzol
RPP	Peaty podzol ranker
G	Non-calcareous gley
MG	Magnesium-rich variant of above
PG	Peaty gley—low base status in A horizon
MPG	Magnesium-rich variant of above
HG	Peaty (or humic) gley of medium to high base status in A horizon
MHG	Magnesium-rich variant of above
BPt	Blanket peat
MP	Freely drained (sub-alpine) soil
GMP	Imperfectly drained (sub-alpine) soil

Abbreviations used for drainage categories of the soils (Ellis, 1932) are as follows:

P	freely drained (phytomorphic)
PPH	imperfectly drained (phytomorphic-phytohydromorphic)
PH	poorly drained (phytohydromorphic)
HP	very poorly drained (hydrophytomorphic)

The nomenclature of the vascular plants is that of Clapham, Tutin and Warburg (1962), of mosses that of Warburg (1963), of liverworts that of Jones (1958), and of lichens that of James (1965).

The species are listed alphabetically in the following groups:

1 Trees
2 Large shrubs
3 Climbing shrubs
4 Dwarf shrubs and tree seedlings
5 Ferns, clubmosses and horsetails
6 Grasses
7 Rushes, woodrushes, sedges and other members of Cyperaceae
8 Dicotyledonous herbs and the remainder of the monocotyledons
9 Mosses
10 Liverworts
11 Lichens

Major Soil Sub-groups and Plant Communities

Table of stands of the plant communities and facies which occur on the different soil sub-groups, showing major site characteristics.

The following abbreviations for the communities and facies have been used:

W1	Woodland with *Cirriphyllum piliferum, Eurhynchium striatum* and *E. praelongum*
W1a	*Geum urbanum* facies
W1b	*Mercurialis perennis* facies
W1c	*Allium ursinum* facies
W2	Woodland with *Endymion non-scriptus*
W3	Woodland with *Holcus mollis* and *Dryopteris dilatata*
W3a	*Endymion non-scriptus* facies
W3b	*Lonicera periclymenum* facies
W4	Woodland with *Dryopteris* and *Rubus*
W4b	*Mnium hornum* facies
W5	Woodland with *Holcus mollis* and *Anthoxanthum odoratum*
W5b	*Pteridium aquilinum* facies
W7	Woodland with *Vaccinium myrtillus*
W7a	*Oxalis acetosella* facies
W8	Woodland with *Deschampsia flexuosa*
P1	*Agrostis-Festuca* basic grassland
P2	*Agrostis-Festuca* meadow grassland
P3	*Agrostis-Festuca* acid grassland
P3b	*Trifolium repens-Thymus drucei* facies
P4	*Nardus* grassland
P4a	*Sieglingia decumbens* facies
P4b	*Carex nigra* facies
P4c	Remainder
P6	*Molinia* grassland
P6a	*Polytrichum commune* facies

P6b	*Campylopus flexuosus* facies
P7	*Juncus acutiflorus* pasture
P7a	*Poa trivialis* facies
P7b	*Molinia caerulea* facies
P8	*Carex* wet pasture
P8a	*Erica tetralix-Juncus acutiflorus* facies
P8b	*Juncus articulatus* facies
M1	Dry *Calluna* moor
M1b	*Nardus stricta* facies
M2	Wet *Calluna* moor
M2b	*Molinia caerulea* facies
M3	*Calluna-Eriophorum vaginatum-Trichophorum* moor
M3b	Dried out peat and hummock facies
M3c	*Narthecium ossifragum* facies
M3d	*Myrica gale* facies
M4	*Molinia-Myrica* moor
M5	Upland *Calluna-Eriophorum vaginatum* moor
M8	*Vaccinium-Carex bigelowii-Rhacomitrium* heath
M8a	*Salix herbacea* facies
M8b	Remainder
M9	Montane *Juncus squarrosus* moor

TABLE 19. WOODLAND WITH CIRRIPHYLLUM PILIFERUM, EURHYNCHIUM STRIATUM AND E. PRAELONGUM

		Geum urbanum facies		Mercurialis perennis facies			Allium ursinum facies			
			K—Presence within the facies			K—Presence within the facies			K—Presence within the facies	K—Presence within the Community
Reference no.		6333		6331	6387		6332	6340		
Map reference		NX 118 847		NX 118 847	NX 599 813		NX 118 847	NX 197 890		
Altitude	ft.	50		50	300		50	350		
Aspect		E		SE	E		SE	E		
Slope		17°		19°	6°		24°	31°		
Cover— trees and shrubs	%	70		80	65		90	75		
field	%	95		100	65		98	85		
ground	%	50		5	95		20	7		
Height— trees and shrubs	ft.	60		70	90		80	50		
field	ins.	12–14		20	12		18	17–24		
Plot Area	sq. m.	4		4	4		4	4		
Soil		GBP		GBP	GBP		GBP	BFS		
Drainage		PPH		PPH	PPH		PPH	P(PH)		
pH		5·6		4·7	5·1		6·1	5·6		
Soil Series		DP		DP	AX		DP	DL		
Acer platanoides		—	0	—	—	8	—	—	0	4
A. pseudoplatanus		—	73	6	—	50	7	—	33	58
Aesculus hippocastanum		—	9	—	—	0	—	—	0	4
Alnus glutinosa		1	9	—	—	8	—	—	33	12
Betula pendula		—	0	—	—	8	—	—	0	4
B. pubescens		—	9	1	1	33	—	—	33	23
Chamaecyparis lawsoniana		—	9	—	—	0	—	—	0	4
Fagus sylvatica		—	9	—	—	8	—	—	0	8
Fraxinus excelsior		8	82	4	7	50	7	5	100	69
Ilex aquifolium		—	18	—	—	8	—	—	0	12
Larix decidua		—	9	—	—	0	—	—	0	4
Picea abies		—	0	3	3	17	—	—	0	8
Pinus nigra		6	9	—	—	0	—	—	0	4
P. sylvestris		—	18	6	—	17	—	—	0	15
Pinus sp.		—	0	—	—	8	—	—	0	4
Populus italica		—	0	—	—	8	—	—	0	4
Prunus avium		—	9	—	—	0	—	—	0	4
Quercus petraea		—	9	5		8	—	8	33	12
Q. petraea/robur		1	27	—	—	0	—	—	33	15
Q. robur		—	18	—	1	33	—	—	0	23
Sequoia sp.		—	9	—	—	0	—	—	0	4
Sorbus aucuparia		—	9	—	—	0	—	—	0	4
Taxus baccata		—	9	—	—	8	—	—	0	8
Ulmus glabra		1	73	—	—	33	7	1	67	54
Corylus avellana		3	9	1	5	42	1	3	100	35
Crataegus monogyna		—	9	—	—	8	—	—	0	8
Prunus spinosa		—	0	—	—	8	—	—	0	4
Salix caprea		—	9	—	—	0	—	—	0	4
Sambucus nigra		—	36	4	—	25	—	—	0	27
Syringa sp.		—	9	—	—	0	—	—	0	4
Acer platanoides seedlings		—	0	—	—	8	—	—	0	4
A. pseudoplatanus seedlings		—	18	—	—	25	—	—	0	19
Corylus avellana seedlings		X	9	—	—	0	—	—	0	4

TABLE 19—*continued*

Crataegus monogyna seedlings	—	9	—	(X)	8	—	—	0	8
Fagus sylvatica seedlings	—	18	—	—	0	—	—	0	8
Fraxinus excelsior seedlings	X	73	—	4	33	—	—	0	46
Hedera helix	—	9	—	—	8	—	—	0	8
Ilex aquifolium seedlings	—	9	—	—	0	—	—	0	4
Lonicera periclymenum	—	27	—	—	0	—	—	0	12
Prunus spinosa seedlings	—	0	—	—	8	—	—	0	4
Rhododendron ponticum	—	9	—	—	0	—	—	0	4
Rubus fruticosus agg.	—	55	—	—	0	—	(X)	33	27
R. idaeus	—	9	—	(X)	33	—	—	0	19
Taxus baccata seedlings	—	9	—	—	0	—	—	0	4
Ulmus glabra seedlings	X	36	—	—	0	—	(X)	33	19
Athyrium filix-femina	3	36	—	X	17	X	5	100	35
Blechnum spicant	—	0	—	—	0	—	—	33	4
Dryopteris borreri	—	9	(X)	—	8	—	(X)	33	12
D. dilatata	—	36	(X)	—	50	—	—	33	42
D. filix-mas	2	27	(X)	(X)	58	X	X	100	50
Pteridium aquilinum	(X)	18	—	—	17	—	—	0	15
Agrostis canina	—	9	—	—	0	—	—	0	4
Deschampsia caespitosa	—	18	—	—	0	—	—	0	8
Festuca gigantea	—	0	—	—	8	—	—	0	4
Poa pratensis	—	9	—	—	0	—	—	0	4
P. trivialis	5	36	—	—	8	—	—	0	19
Carex sp.	—	0	—	—	8	—	—	0	4
Ajuga reptans	—	0	—	5	17	—	—	0	8
Allium ursinum	5	9	—	—	8	9	8	100	19
Anemone nemorosa	X	18	X	5	25	3	X	100	31
Angelica sylvestris	—	18	—	—	0	—	—	0	8
Asperula odorata	—	18	—	—	0	—	—	0	8
Cardamine sp.	—	0	—	—	8	—	—	0	4
Chamaenerion angustifolium	—	0	—	—	17	—	—	0	8
Chrysosplenium oppositifolium	—	9	—	—	8	—	—	0	8
Circaea lutetiana	7	36	—	—	8	4	3	67	27
Endymion non-scriptus	2	18	6	—	25	1	X	67	27
Epilobium montanum	—	27	—	—	25	—	—	0	23
E. obscurum	—	9	—	—	0	—	—	0	4
E. parviflorum	—	9	—	—	8	—	—	0	8
Filipendula ulmaria	—	0	—	3	8	—	—	0	4
Fragaria vesca	—	36	—	—	17	—	—	0	23
Galium aparine	3	73	—	—	25	4	—	33	46
Geranium robertianum	—	27	—	—	0	—	—	0	12
Geum urbanum	1	91	—	(X)	42	—	—	0	58
Glechoma hederacea	—	27	—	—	8	—	—	0	15
Lysimachia nemorum	2	9	—	1	17	—	—	0	12
Mercurialis perennis	4	18	10	7	100	4	7	67	62
Moehringia trinervia	—	9	—	—	17	—	—	0	12
Myosotis arvensis	—	18	—	—	0	—	—	0	8
Oxalis acetosella	—	36	X	—	17	—	1	67	31
Potentilla sterilis	—	9	—	1	8	—	—	0	8
Primula vulgaris	—	0	—	—	0	—	—	33	4
Ranunculus ficaria	—	9	—	—	8	—	—	0	8
R. repens	—	18	—	—	17	—	—	0	15
Rumex sanguineus	—	9	—	—	0	—	—	0	4
Sanicula europaea	—	27	—	—	0	—	—	0	12
Scrophularia nodosa	—	0	—	(X)	8	—	—	0	4

TABLE 19—*continued*

WOODLAND WITH CIRRIPHYLLUM PILIFERUM, EURHYNCHIUM STRIATUM AND E. PRAELONGUM

	Geum urbanum facies		Mercurialis perennis facies			Allium ursinum facies			
Reference no.	6333	K—Presence within the facies	6331	6387	K—Presence within the facies	6332	6340	K—Presence within the facies	K—Presence within the community
Map reference	NX 118 847		NX 118 847	NX 599 813		NX 118 847	NX 197 890		
Altitude ft.	50		50	300		50	350		
Aspect	E		SE	E		SE	E		
Slope	17°		19°	6°		24°	31°		
Cover—									
trees and shrubs %	70		80	65		90	75		
field %	95		100	65		98	85		
ground %	50		5	95		20	7		
Height—									
trees and shrubs ft.	60		70	90		80	50		
field ins.	12–14		20	12		18	17–24		
Plot Area sq. m.	4		4	4		4	4		
Soil	GBP		GBP	GBP		GBP	BFS		
Drainage	PPH		PPH	PPH		PPH	P(PH)		
pH	5·6		4·7	5·1		6·1	5·6		
Soil Series	DP		DP	AX		DP	DL		
Silene dioica	2	18	—	—	17	—	—	0	15
Stachys sylvatica	—	9	—	—	0	—	—	0	4
Stellaria media	—	9	—	—	8	—	—	0	8
S. nemorum	—	9	—	—	0	—	—	0	4
Urtica dioica	(X)	64	—	—	42	(X)	—	33	50
Valeriana officinalis	—	0	—	—	0	—	3	33	4
Veronica chamaedrys	—	18	—	—	0	—	—	0	8
V. montana	—	27	—	—	0	—	—	0	12
V. serpyllifolia	—	9	—	—	0	—	—	0	4
Viola odorata	—	9	—	—	0	—	—	0	4
V. riviniana	X	36	—	X	17	—	—	0	27
Amblystegium serpens	—	0	—	—	8	—	—	0	4
Atrichum undulatum	—	45	—	2	25	—	—	0	31
Brachythecium plumulosum	—	0	—	—	0	—	1	33	4
Brachythecium populeum	—	0	—	—	8	—	—	0	4
B. rutabulum	—	55	—	—	25	2	—	67	42
B. velutinum	—	9	—	—	0	—	—	0	4
Cirriphyllum piliferum	1	82	3	—	83	—	1	67	81
Ctenidium molluscum	—	0	—	—	0	—	X	33	4
Eurhynchium confertum	—	0	—	—	8	—	—	0	4
E. praelongum	6	100	4	5	100	5	3	100	100
E. striatum	3	91	2	8	75	5	4	100	85
E. swartzii	—	9	—	—	25	—	—	0	15
Fissidens bryoides	—	18	—	—	8	—	—	0	12
F. taxifolius	—	18	—	—	25	—	1	33	23
Fissidens spp.	—	0	—	—	8	—	—	33	8
Heterocladium heteropterum	—	0	—	—	0	—	1	33	4
Homalia trichomanoides	—	9	—	—	0	X	—	33	8
Hypnum cupressiforme	—	0	*X	—	8	—	—	0	4
Isothecium myosuroides	—	0	(X)	—	25	—	—	0	12
Mnium hornum	—	9	—	—	17	—	X	67	19

TABLE 19—*continued*

Mnium punctatum	—	9	—	1	17	—	—	33	15
M. undulatum	6	64	—	3	83	—	—	33	69
Mnium sp.	—	9	—	—	0	—	—	0	4
Plagiothecium denticulatum	—	0	—	—	8	—	2	67	12
Plagiothecium sylvaticum	—	0	—	—	8	—	—	0	4
Polytrichum aurantiacum	—	9	—	—	0	—	—	0	4
Rhytidiadelphus loreus	—	9	—	—	0	—	—	0	4
R. triquetrus	—	9	—	1	8	—	—	0	8
Thamnium alopecurum	3	9	—	—	0	4	—	33	8
Thuidium tamariscinum	—	27	(X)	6	50	(X)	3	100	46
Chiloscyphus polyanthos	—	9	—	—	0	—	—	0	4
Lophocolea bidentata	1	9	—	3	17	—	—	0	12
L. cuspidata	—	9	1	—	17	—	2	67	19
L. heterophylla	1	9	1	—	33	—	—	0	19
Pellia epiphylla	—	0	—	—	0	—	—	33	4
Plagiochila asplenioides	1	18	X	6	42	—	1	33	31
Cetraria glauca	—	0	—	*1	8	—	—	0	4
Parmelia physodes	—	18	—	(*X)	17	—	—	33	19
Number of species—									
trees and shrubs	6	24	8	5	20	4	4	8	30
field and ground	26	81	15	23	66	15	24	37	104
epiphytes	—	1	1	2	3	—	—	1	3
Average—									
total species		24			19			24	22
field and ground		19			15			20	18
Number of stands		11			12			3	26

TABLE 20

	Woodland with Endymion non-scriptus						Woodland with Holcus mollis and Dryopteris dilatata				
							Endymion non-scriptus facies		Lonicera periclymenum facies		
						K—Presence within the community		K—Presence within the facies		K—Presence within the facies	K—Presence within the community
Reference no.	6334	6335	6336	6341	6342		6369		6339		
Map reference	NX 386 701	NX 381 711	NX 369 729	NX 196 888	NX 196 887		NX 602 733		NX 198 892		
Altitude ft.	130	150	200	300	200		400		400		
Aspect	NIL	SW	S	E	SE		NW		SE		
Slope	0°	5°	9°	18°	28°		24°		18°		
Cover—											
trees and shrubs %	75	90	75	75	75		60		50		
field %	95	95	75	90	90		95		50		
ground %	40	2	5	5	3		70		5		
Height—											
trees and shrubs ft.	15–40	20–30	6–45	30	30		60		35		
field ins.	20	5–12	3	3–12	15–24		5–14		8–22		
Plot Area sq. m.	4	4	4	4	4		4		4		
Soil	BP	BFS	BP		BP				BP		
Drainage	P	P	P	P	P		P(PH)		P		
pH	4·8	5·4	4·3	4·4	4·6		4·7		4·4		
Soil Series	LP	LP	LP	DL	—		LP		—		
Acer pseudoplatanus	—	—	—	—	—	38	—	29	—	0	24
Betula pendula/pubescens	—	—	—	—	—	0	—	0	—	29	10
B. pubescens	7	1	3	5	—	57	—	43	2	43	48
Fagus sylvatica	—	—	—	—	—	0	—	14	—	0	10
Fraxinus excelsior	—	—	—	—	—	21	—	14	—	0	5
Larix decidua	—	—	—	—	—	14	—	14	—	0	14
Malus sylvestris	1	—	—	—	—	7	—	0	—	0	0
Picea sitchensis	—	—	—	—	—	0	8	14	—	0	5
Pinus sylvestris	—	—	—	—	—	7	—	14	—	29	38
Quercus cerris	—	—	—	—	—	0	—	14	—	0	5
Q. petraea	5	9	—	8	8	43	—	0	—	29	10
Q. petraea/robur	—	—	8	—	—	14	—	14	7	29	19
Q. robur	—	—	—	—	1	14	—	29	—	14	14
Quercus sp.	—	—	—	—	—	0	—	0	—	0	5
Sorbus aucuparia	1	—	1	—	—	21	—	0	—	29	14
Tilia x europaea	—	—	—	—	—	7	—	0	—	0	0
Ulmus glabra	—	—	—	—	—	0	—	14	—	0	5
Corylus avellana	6	7	—	3	1	50	—	14	—	0	5
Crataegus monogyna	X	1	1	—	—	29	—	0	—	0	5
Salix cinerea ssp. atrocinerea	—	—	—	—	—	7	—	0	—	0	0
Lonicera periclymenum	—	—	—	—	—	0	—	0	—	43	14
Acer pseudoplatanus seedlings	—	—	—	X	X	29	—	29	—	0	14
Betula pendula seedlings	—	—	—	—	—	0	—	14	—	0	5
B. pubescens seedlings	—	—	—	X	—	7	—	14	—	0	5
Corylus avellana seedlings	—	—	—	X	X	14	—	0	X	14	5
Crataegus monogyna seedlings	—	X	—	X	—	14	—	0	—	14	5

TABLE 20—*continued*

Fraxinus excelsior seedlings	—	X	(X)	X	—	43	—	0	X	14	5
Lonicera periclymenum	4	—	—	5	6	43	—	14	6	100	38
Quercus cerris seedlings	—	—	—	—	—	0	—	14	—	0	5
Q. petraea/robur seedlings	—	—	—	—	—	0	—	0	1	14	5
Rubus fruticosus agg.	—	—	(X)	X	X	36	—	43	1	71	52
R. idaeus	—	—	—	—	—	14	—	29	—	14	24
Sorbus aucuparia seedlings	—	—	1	—	—	7	—	0	—	29	10
Vaccinium myrtillus	—	—	—	—	—	0	—	0	—	14	5
Athyrium filix-femina	—	(X)	(X)	—	—	14	—	0	—	0	5
Blechnum spicant	—	—	—	—	—	0	—	14	—	43	19
Dryopteris borreri	—	—	—	—	—	7	3	14	—	0	10
D. carthusiana	—	—	(X)	—	—	7	—	0	—	14	5
D. dilatata	X	(X)	—	—	—	64	1	57	—	86	81
D. filix-mas	(X)	—	—	(X)	—	57	—	29	—	29	29
Pteridium aquilinum	X	—	—	—	X	43	1	71	X	57	48
Agrostis canina	—	—	—	—	—	0	2	14	—	29	19
A. stolonifera	—	—	—	—	—	14	—	0	—	14	5
A. tenuis	(X)	—	—	—	—	14	—	0	—	14	24
Anthoxanthum odoratum	4	—	—	3	5	29	—	0	5	43	14
Arrhenatherum elatius	(X)	—	—	—	—	7	—	0	—	0	0
Deschampsia caespitosa	—	—	—	—	—	7	2	14	—	0	14
D. flexuosa	—	—	—	—	—	0	—	14	3	86	43
Holcus lanatus	—	—	—	—	—	0	—	0	—	14	5
H. mollis	4	—	—	(X)	8	43	2	100	(X)	100	100
Poa trivialis	—	—	1	—	—	57	—	0	—	0	5
Carex pilulifera	—	—	—	—	—	0	—	0	—	14	10
Carex sp.	—	—	(X)	—	—	7	—	0	—	0	0
Luzula multiflora	—	—	—	—	—	0	—	14	—	0	5
L. pilosa	—	—	—	X	1	21	—	14	2	29	19
L. sylvatica	—	—	—	—	—	0	—	0	—	29	10
Ajuga reptans	1	—	—	3	—	21	—	0	—	43	14
Allium ursinum	—	(X)	—	—	—	7	—	0	—	0	0
Anemone nemorosa	(X)	3	4	—	2	50	—	0	4	57	19
Angelica sylvestris	—	—	—	—	—	7	—	0	—	0	0
Cardamine sp.	X	—	—	—	—	7	—	0	—	0	0
Chamaenerion angustifolium	—	—	—	—	—	0	—	29	—	0	14
Circaea lutetiana	—	—	—	(X)	—	7	—	0	—	0	0
Conopodium majus	—	—	—	X	—	29	1	14	—	0	5
Corydalis claviculata	—	—	—	—	—	7	—	0	—	0	0
Crepis sp.	—	(X)	—	—	—	7	—	0	—	0	0
Digitalis purpurea	—	—	—	—	—	14	—	29	—	0	14
Endymion non-scriptus	8	7	7	8	6	100	1	100	3	14	38
Epilobium parviflorum	—	—	—	—	—	7	—	0	—	0	0
Epilobium spp.	—	—	—	—	—	14	—	0	—	0	0
Fragaria vesca	—	—	—	—	—	0	—	0	X	14	5
Galeopsis tetrahit	—	—	—	—	—	7	—	0	—	0	0
Galium aparine	—	—	—	—	—	21	—	0	—	14	5
G. saxatile	X	—	—	—	X	21	—	29	X	71	62
Geranium robertianum	2	—	—	—	—	7	—	0	—	0	0
Geum rivale	—	—	—	—	—	7	—	0	—	0	0
G. urbanum	X	—	—	—	—	7	—	0	—	0	0
Glechoma hederacea	—	—	—	—	—	7	—	0	—	0	0
Heracleum sphondylium	—	—	—	—	—	7	—	0	—	0	0
Lysimachia nemorum	3	5	—	4	1	36	—	0	—	14	5
Moehringia trinervia	X	—	—	3	—	21	—	14	—	0	10
Oxalis acetosella	7	9	8	8	5	100	9	100	4	71	86
Potentilla erecta	—	—	—	—	—	0	—	0	2	29	10
P. sterilis	—	—	—	—	—	0	—	0	X	14	5
Primula vulgaris	—	1	—	—	—	14	—	0	—	14	5

TABLE 20—*continued*

	WOODLAND WITH ENDYMION NON-SCRIPTUS						WOODLAND WITH HOLCUS MOLLIS AND DRYOPTERIS DILATATA				
							Endymion non-scriptus facies		Lonicera periclymenum facies		
Reference no.	6334	6335	6336	6341	6342	K—Presence within the community	6369	K—Presence within the facies	6339	K—Presence within the facies	K—Presence within the community
Map reference	NX 386 701	NX 381 711	NX 369 729	NX 196 888	NX 196 887		NX 602 733		NX 198 892		
Altitude ft.	130	150	200	300	200		400		400		
Aspect	NIL	SW	S	E	SE		NW		SE		
Slope	0°	5°	9°	18°	28°		24°		18°		
Cover—											
trees and shrubs %	75	90	75	75	75		60		50		
field %	95	95	75	90	90		95		50		
ground %	40	2	5	5	3		70		5		
Height—											
trees and shrubs ft.	15–40	20–30	6–45	30	30		60		35		
field ins.	20	5–12	3	3–12	15–24		5–14		8–22		
Plot Area sq. m.	4	4	4	4	4		4		4		
Soil	BP	BFS	BP		BP				BP		
Drainage	P	P	P	P	P		P(PH)		P		
pH	4·8	5·4	4·3	4·4	4·6		4·7		4·4		
Soil Series	LP	LP	LP	DL	—		LP		—		
Ranunculus ficaria	—	—	—	—	—	14	—	0	—	0	0
R. repens	—	—	—	—	—	0	—	14	—	0	5
Rumex acetosa	X	—	—	—	—	21	—	14	—	14	10
R. obtusifolius	—	—	—	—	—	7	—	0	—	0	0
Scrophularia nodosa	—	—	—	—	—	14	—	14	—	0	5
Senecio jacobaea	—	—	—	—	—	7	—	0	—	0	0
Silene dioica	(X)	—	2	—	1	21	—	14	—	0	5
Solidago virgaurea	—	X	—	—	—	7	—	0	—	0	0
Stellaria holostea	—	—	—	—	—	7	—	0	2	29	10
Taraxacum officinale	—	—	—	—	—	7	—	0	—	0	0
Teucrium scorodonia	(X)	—	—	(X)	5	29	—	29	2	29	19
Trientalis europaea	—	—	—	—	—	7	—	0	—	0	0
Urtica dioica	—	—	—	—	—	7	—	0	—	0	0
Valeriana officinalis	—	—	—	—	1	7	—	0	—	0	10
Veronica chamaedrys	2	—	—	2	—	29	—	0	—	0	0
V. officinalis	—	—	—	—	—	0	—	0	1	29	10
V. serpyllifolia	—	—	—	—	—	7	—	0	—	0	0
Viola riviniana	X	—	X	X	3	50	3	43	3	57	43
Atrichum undulatum	—	—	(X)	1	2	29	—	0	—	0	5
Brachythecium populeum	—	X	—	—	—	7	—	0	—	0	0
B. rutabulum	—	—	—	—	—	14	1	57	—	29	29
Campylopus flexuosus	—	—	—	—	—	0	—	0	1	14	5
Ceratodon purpureus	—	—	—	—	—	0	—	14	—	0	5
Cirriphyllum piliferum	—	—	—	—	—	7	—	14	—	0	5
Dicranella sp.	—	—	—	—	—	0	—	14	—	0	5
Dicranum majus	—	X	2	1	2	36	—	0	(X)	29	10
D. scoparium	1	—	X	X	—	21	—	0	—	14	10
Eurhynchium praelongum	3	—	—	4	3	86	(X)	86	1	57	71
E. striatum	—	—	—	2	—	29	—	0	—	0	0
Fissidens bryoides	—	—	—	—	—	7	—	0	—	0	0
Heterocladium heteropterum	2	—	—	—	—	7	—	0	—	0	

TABLE 20—*continued*

Hylocomium brevirostre	4	—	—	—	—	7	—	0	—	0	0
H. splendens	—	—	—	—	—	0	—	0	—	0	5
Hypnum cupressiforme	X	X	*3	*1	—	43	—	43	*2	43	38
Isopterygium elegans	—	—	—	—	X	14	(X)	29	—	0	10
Isothecium myosuroides	3	X	3	—	—	21	—	0	—	0	0
I. myurum	—	—	—	—	—	14	—	0	—	0	0
Mnium hornum	(X)	X	1	2	—	79	—	0	—	14	24
M. longirostrum	—	—	—	—	—	0	—	14	—	0	5
M. punctatum	X	—	—	—	—	7	—	0	—	0	0
M. undulatum	X	—	—	—	—	21	5	29	—	0	14
Plagiothecium denticulatum	—	—	—	—	—	21	—	0	—	14	10
P. undulatum	—	—	—	—	—	14	—	0	—	29	24
Pleurozium schreberi	—	—	—	—	—	0	—	0	(X)	14	5
Pohlia nutans	—	—	—	—	—	0	—	0	1	14	10
Polytrichum aurantiacum	—	—	—	—	—	0	—	0	—	0	5
P. commune	—	—	—	—	—	7	—	0	—	29	10
P. formosum	—	—	—	—	—	0	—	0	2	29	10
Pseudoscleropodium purum	X	—	—	2	—	29	1	29	4	57	48
Rhytidiadelphus loreus	—	—	—	—	—	7	—	0	—	0	0
R. squarrosus	—	—	—	X	X	21	3	29	—	14	38
R. triquetrus	—	—	—	—	—	7	—	0	—	14	5
Thuidium tamariscinum	6	1	1	3	2	79	8	14	—	29	33
Ulota crispa	—	—	*1	—	—	7	—	0	—	0	0
Lophocolea bidentata	—	—	—	1	1	29	4	43	2	57	48
L. cuspidata	2	X	X	—	—	21	—	0	—	0	19
L. heterophylla	—	—	—	—	—	21	—	0	—	14	5
Metzgeria fruticulosa	—	—	1	—	—	7	—	0	—	0	0
Pellia sp.	—	—	—	—	—	0	1	14	—	0	5
Plagiochila asplenioides	2	X	—	1	—	57	3	14	—	14	10
Cetraria glauca	—	—	*1	—	—	7	—	0	—	0	5
Cladonia cornuta	—	—	—	—	—	0	—	0	*1	14	5
C. fimbriata	—	—	—	—	—	0	—	0	(X)	14	5
Evernia prunastri	—	—	*1	—	—	7	—	0	—	14	5
Parmelia physodes	—	—	*2	—	—	7	—	0	—	29	24
Parmelia spp.	—	—	*X	—	—	7	—	0	—	29	10
Usnea subfloridana	—	—	*X	—	—	7	—	0	—	0	0
Usnea sp.	—	—	—	—	—	0	—	0	—	0	5
Number of species—											
trees, shrubs and	6	4	4	3	3	14	1	12	2	8	18
climbers field and	36	20	20	32	24	96	20	46	30	59	87
ground epiphytes	—	—	7	1	—	7	—	1	2	7	9
Average—											
total species						24		16		21	17
field and ground						21		14		19	15
Number of stands						14		7		7	21

TABLE 21

	WOODLAND WITH DRYOPTERIS AND RUBUS			WOODLAND WITH HOLCUS MOLLIS AND ANTHOXANTHUM ODORATUM					
	Mnium hornum facies			Pteridium aquilinum facies					
		K—Presence within the facies	K—Presence within the community					K—Presence within the facies	K—Presence within the community
Reference no.	6363			635	636	6337	6385		
Map reference	NX 217 832			NX 428 803	NX 429 803	NX 375 729	NX 597 824		
Altitude ft.	350			350	350	200	350		
Aspect	N			W	SW	NIL	SW		
Slope	10°			22°	14°	0°	12°		
Cover—									
trees and shrubs %	40			40	40	55	60		
field %	80			75	90	80	50		
ground %	20			30	10	20	30		
Height—									
trees and shrubs ft.	50			60	40	35	60		
field ins.	4–28			5–16	3	5	4–16		
Plot Area sq. m.	8			4	4	4	4		
Soil	BP			BP	BP	BP	BP		
Drainage	P			P	P	P	P		
pH	3·9			4·5	3·8	4·3	4·0		
Soil Series	LP			DE	DE	LP	LP		
Acer pseudoplatanus	5	43	44	—	—	—	—	0	0
Alnus incana	5	14	6	—	—	—	—	0	0
Betula pendula	—	0	6	—	—	—	—	20	14
B. pendula/pubescens	—	0	0	—	—	7	—	10	5
B. pubescens	—	29	31	7	6	—	2	50	43
B. pubescens ssp. odorata	—	0	0	—	—	—	—	10	5
Castanea sativa	—	0	6	—	—	—	—	10	5
Fagus sylvatica	—	14	13	—	—	—	—	10	10
Fraxinus excelsior	—	14	25	—	—	—	—	20	14
Ilex aquifolium	—	14	6	—	—	—	—	0	0
Larix decidua	—	0	25	—	—	—	—	10	14
Larix sp.	—	0	6	—	—	—	—	0	0
Picea abies	2	29	19	—	—	—	—	0	5
P. sitchensis	—	0	6	—	—	—	—	0	0
Pinus sylvestris	4	86	**68**	—	—	—	—	0	5
Quercus petraea	—	0	0	1	—	6	—	20	14
Q. petraea/robur	—	14	6	—	—	—	8	30	24
Q. robur	—	0	0	—	—	—	—	10	38
Sorbus aucuparia	—	43	19	1	—	—	—	30	14
Ulmus glabra	—	14	13	—	—	—	—	0	0
Corylus avellana	—	0	0	4	5	3	—	50	29
Crataegus monogyna	—	0	0	—	4	—	—	10	5
Juniperus communis	—	0	0	—	—	—	—	0	5
Rosa sp.	—	0	6	—	—	—	—	0	0
Salix caprea	—	0	6	—	—	—	—	10	5
S. cinerea ssp. atrocinerea	—	14	13	—	—	—	—	0	0
Sambucus nigra	—	29	25	—	—	—	—	0	0
Sarothamnus scoparius	—	0	6	—	—	—	—	0	10
Ulex europaeus	—	0	0	—	—	—	—	0	5
Lonicera periclymenum	—	0	6	—	—	—	—	10	5

TABLE 21—*continued*

Acer platanoides seedlings	—	0	0	—	—	—	—	0	5
A. pseudoplatanus seedlings	5	43	56	—	—	—	—	0	5
Betula pubescens seedlings	—	43	19	—	—	—	X	30	19
Crataegus monogyna seedlings	1	29	13	—	2	—	X	30	14
Fagus sylvatica seedlings	—	14	13	—	—	—	—	0	5
Fraxinus excelsior seedlings	X	29	19	—	—	—	1	20	33
Lonicera periclymenum	—	0	25	—	—	1	4	40	29
Prunus avium seedlings	—	0	0	—	—	—	—	0	5
Quercus seedlings	—	14	13	—	X	—	1	30	29
Rubus fruticosus agg.	1	86	88	—	—	(X)	—	10	10
R. idaeus	—	43	68	—	—	—	—	0	10
Sorbus aucuparia seedlings	—	29	19	—	—	—	—	20	19
Ulmus glabra seedlings	—	14	6	—	—	—	—	0	5
Vaccinium myrtillus	—	0	0	—	—	—	—	0	10
V. vitis-idaea	—	0	0	—	—	—	—	0	5
Athyrium filix-femina	1	57	50	—	—	—	1	10	5
Blechnum spicant	—	0	6	—	—	—	(X)	20	14
Dryopteris borreri	1	14	25	(X)	—	—	—	20	10
D. carthusiana	—	14	6	—	—	—	—	0	0
D. dilatata	8	100	100	—	—	—	—	20	14
D. filix-mas	(X)	29	50	(X)	—	—	X	30	19
Pteridium aquilinum	4	29	31	2	3	1	1	80	52
Thelypteris dryopteris	—	0	0	—	—	—	—	0	5
T. limbosperma	—	0	0	X	—	—	—	10	5
Agrostis canina	—	14	6	—	—	4	—	30	24
A. tenuis	—	0	31	—	—	3	—	60	71
Anthoxanthum odoratum	—	0	0	7	3	4	3	90	95
Arrhenatherum elatius	—	0	6	—	—	—	—	10	10
Dactylis glomerata	—	0	0	—	—	—	—	0	5
Deschampsia caespitosa	—	0	13	—	—	—	—	0	0
D. flexuosa	—	0	0	—	—	6	(X)	60	57
Festuca ovina	—	0	0	—	—	—	—	10	19
F. rubra	—	0	0	—	—	—	—	0	48
Holcus lanatus	—	0	6	—	—	—	—	0	0
H. mollis	—	14	13	3	8	—	7	80	86
Poa annua	—	29	13	—	—	—	—	0	0
P. pratensis	—	0	0	—	—	—	—	0	48
P. trivialis	4	43	44	—	4	—	—	20	14
Carex binervis	—	14	6	—	—	—	—	0	0
C. pilulifera	—	14	13	—	—	2	—	20	14
Carex sp.	—	0	0	—	—	—	—	10	5
Juncus conglomeratus	—	0	13	—	—	—	—	0	0
J. effusus	—	0	6	—	—	—	—	10	5
Luzula campestris	—	0	0	—	—	—	—	0	14
L. multiflora	—	0	6	—	—	X	X	50	24
L. pilosa	—	14	6	—	—	—	X	30	24
L. sylvatica	—	0	0	—	—	—	—	0	5
Ajuga reptans	—	0	0	—	—	—	—	10	14
Anemone nemorosa	4	14	6	—	—	—	1	10	14
Angelica sylvestris	—	0	6	—	—	—	—	0	0
Campanula rotundifolia	—	0	0	—	—	—	—	0	5
Cerastium holosteoides	X	14	6	—	X	—	—	30	24
Chamaenerion angustifolium	—	71	81	—	—	—	—	0	0
Conopodium majus	X	14	6	—	—	—	—	0	5
Digitalis purpurea	—	14	13	(X)	—	—	—	20	10
Endymion non-scriptus	X	14	6	—	—	2	—	10	5
Epilobium parviflorum	—	14	6	—	—	—	—	0	0
Epilobium sp.	—	0	6	—	—	—	—	0	0
Fragaria vesca	—	0	0	—	—	—	—	0	5

TABLE 21—*continued*

		WOODLAND WITH DRYOPTERIS AND RUBUS			WOODLAND WITH HOLCUS MOLLIS AND ANTHOXANTHUM ODORATUM					
		Mnium hornum facies			Pteridium aquilinum facies					
Reference no.		6363	K—Presence within the facies	K—Presence within the community	635	636	6337	6385	K—Presence within the facies	K—Presence within the community
Map reference		NX 217 832			NX 428 803	NX 429 803	NX 375 729	NX 597 824		
Altitude	ft.	350			350	350	200	350		
Aspect		N			W	SW	NIL	SW		
Slope		10°			22°	14°	0°	12°		
Cover—										
trees and shrubs	%	40			40	40	55	60		
field	%	80			75	90	80	50		
ground	%	20			30	10	20	30		
Height—										
trees and shrubs	ft.	50			60	40	35	60		
field	ins.	4–28			5–16	3	5	4–16		
Plot Area	sq. m.	8			4	4	4	4		
Soil		BP			BP	BP	BP	BP		
Drainage		P			P	P	P	P		
pH		3·9			4·5	3·8	4·3	4·0		
Soil Series		LP			DE	DE	LP	LP		
Galium aparine		—	29	25	—	—	—	—	10	14
G. saxatile		—	14	19	3	3	—	2	90	90
Geum urbanum		—	14	6	—	—	—	—	0	0
Hieracium sp.		—	0	0	—	—	—	—	0	5
Hypericum pulchrum		—	0	0	X	—	(X)	—	50	33
Hypochoeris radicata		—	0	0	—	—	—	—	0	5
Lathyrus montanus		—	0	0	—	—	—	—	0	5
Lysimachia nemorum		—	0	0	2	—	—	—	10	5
Melampyrum pratense		—	0	0	—	—	—	—	0	14
Melandrium rubrum		—	14	19	—	—	—	—	0	0
Moehringia trinervia		2	29	25	—	—	—	—	0	0
Myosotis sylvatica		—	0	6	—	—	—	—	0	0
Oxalis acetosella		4	57	56	5	7	7	4	100	86
Potentilla erecta		—	14	19	—	—	X	X	40	43
P. sterilis		—	14	6	—	—	—	—	0	0
Pyrola minor		—	0	0	—	—	—	—	0	5
Ranunculus repens		—	0	0	—	X	—	—	20	10
Rumex acetosa		—	0	0	—	—	—	—	10	24
R. acetosella		—	0	0	—	—	—	—	20	10
R. obtusifolius		—	0	6	—	—	—	—	0	0
Senecio jacobaea		—	0	0	—	—	—	—	0	5
S. sylvaticus		—	0	6	—	—	—	—	0	0
Stellaria holostea		—	0	0	—	—	—	—	20	29
S. media		—	43	31	—	—	—	—	0	0
Succisa pratensis		—	0	0	—	—	—	—	0	10
Taraxacum sp.		—	0	0	—	—	—	—	0	5
Teucrium scorodonia		—	0	0	—	—	X	2	40	29
Trientalis europaea		—	0	0	—	—	—	—	20	19
Urtica dioica		—	14	19	—	—	—	—	0	0
Veronica chamaedrys		—	14	19	—	X	—	—	50	62
V. officinalis		—	0	0	1	—	—	—	20	14
V. serpyllifolia		—	14	6	—	—	—	—	0	0

TABLE 21—*continued*

Viola riviniana	—	0	50	1	2	(X)	X	80	76
Acrocladium cuspidatum	—	0	0	—	—	—	—	10	5
Atrichum undulatum	—	29	25	X	—	—	—	30	19
Brachythecium rutabulum	—	29	38	—	—	—	—	0	0
Bryum sp.	—	0	0	—	—	—	—	0	5
Campylopus flexuosus	—	0	0	—	—	—	1*	10	5
Ceratodon purpureus	—	14	6	—	—	—	—	0	5
Cirriphyllum piliferum	—	0	0	—	—	—	—	20	19
Dicranella heteromalla	—	14	6	X	—	—	—	30	19
Dicranum majus	—	0	0	1	—	2	4	30	24
D. scoparium	—	0	0	—	—	—	1*	20	14
Eurhynchium praelongum	5	100	94	—	2	—	—	40	43
E. striatum	—	14	13	—	—	—	—	10	5
Fissidens bryoides	—	0	6	—	—	—	—	10	5
F. taxifolius	—	0	6	—	—	—	—	0	0
Fissidens sp.	—	0	6	—	—	—	—	0	0
Hylocomium splendens	—	0	0	X	—	4	—	50	43
Hypnum cupressiforme	1	86	38	X	—	—	1*	50	57
Isothecium myosuroides	—	14	6	—	—	—	—	0	5
I. myurum	—	14	6	—	—	—	—	0	0
Mnium hornum	3	86	38	—	—	—	X*	50	29
M. longirostrum	—	0	0	—	—	—	—	0	10
M. undulatum	1	14	19	—	—	—	—	30	19
Plagiothecium denticulatum	—	57	25	—	—	—	—	0	0
P. succulentum	—	0	0	—	—	—	—	0	5
P. undulatum	—	57	25	—	—	—	1	20	19
Pleurozium schreberi	—	0	0	—	—	3	3	20	19
Pohlia nutans	—	14	6	—	—	—	—	10	5
Polytrichum aurantiacum	—	29	13	—	—	2	5	40	24
P. formosum	—	0	0	—	—	—	—	0	10
Pseudoscleropodium purum	—	29	31	3	2	—	—	50	71
Ptilium crista-castrensis	—	0	0	—	—	—	—	0	5
Rhytidiadelphus loreus	—	0	0	—	—	2	4	30	14
R. squarrosus	X	14	13	4	4	—	—	80	81
R. triquetrus	—	0	13	4	—	3	2	60	43
Thuidium tamariscinum	—	0	13	4	2	—	3	70	57
Barbilophozia attenuata	—	0	0	—	—	—	X*	10	5
Diplophyllum albicans	—	0	0	—	—	—	—	10	5
Lophocolea bidentata	X	57	38	1	X	5	3	90	71
L. cuspidata	1	14	13	—	—	1	—	10	5
L. heterophylla	—	29	25	—	—	—	—	0	0
Nardia scalaris	—	0	0	—	—	—	—	10	5
Pellia epiphylla	—	0	13	—	—	—	—	0	0
Pellia sp.	—	0	0	—	—	—	—	10	5
Plagiochila asplenioides	—	0	0	—	—	—	—	20	14
Radula complanata	—	0	0	—	—	—	—	10	5
Cladonia digitata	—	0	0	—	—	—	X*	10	5
C. fimbriata	—	0	0	—	—	—	—	0	5
C. squamosa	—	0	0	—	—	—	1*	10	5
Cetraria glauca	—	0	6	—	—	—	—	0	5
Evernia prunastri	—	0	0	—	—	1*	X*	20	24
Parmelia physodes	—	0	13	—	—	1*	1*	20	38
P. sulcata	—	0	6	—	—	—	X*	10	5
Usnea hirta	—	0	6	—	—	—	—	0	0
Usnea spp.	—	0	0	—	—	X*	X*	20	19
Number of species—									
trees, shrubs and climbers	4	13	21	4	3	3	2	16	19
field and ground	23	62	84	23	17	23	28	76	111
epiphytes	—	1	6	—	—	3	11	11	12
Average—									
total species		22	21					27	26
field and ground		19	17					24	24
Number of stands		7	16					10	21

TABLE 22

		WOODLAND WITH VACCINIUM MYRTILLUS Oxalis acetosella facies				WOODLAND WITH DESCHAMPSIA FLEXUOSA	
				K—Presence within the facies	K—Presence within the community		K—Presence within the community
Reference no.		6338	6386			6365	
Map reference		NX	NX			NX	
		375	594			407	
		719	826			795	
Altitude	ft.	200	350			300	
Aspect		nil	N			N	
Slope		0°	16°			10°	
Cover—							
trees and shrubs	%	70	40			40	
field	%	75	90			80	
ground	%	40	30			50	
Height—							
trees and shrubs	ft.	25	50			70	
field	ins.	6	8			4–36	
Plot Area	sq. m.	1	4			4	
Soil		RP	BP			IP	
Drainage		PPH	P			P	
pH		4·2	4·3			3·7	
Soil Series		—	LP			—	
Abies sp.		—	—	8	5	—	0
Acer pseudoplatanus		—	—	0	5	—	0
Betula pendula		3	—	25	36	—	0
B. pendula/pubescens		—	—	8	5	—	0
B. pubescens		4	1	58	45	2	25
Fagus sylvatica		—	—	8	5	—	25
Larix decidua		—	—	8	9	1	25
Picea sitchensis		—	—	0	5	—	25
Pinus sylvestris		—	—	8	14	7	75
Quercus petraea		8	—	8	9	—	0
Q. petraea/robur		—	7	50	41	—	0
Q. robur		—	—	17	9	—	25
Sorbus aucuparia		X	1	42	36	—	0
Juniperus communis		—	—	8	5	—	0
Sarothamnus scoparius		—	—	0	0	—	25
Abies sp. seedlings		—	—	0	5	—	0
Betula pubescens seedlings		—	(X)	8	23	X	50
Calluna vulgaris		1	—	58	59	—	25
Erica cinerea		—	—	0	14	—	0
E. tetralix		—	—	0	5	—	0
Fagus sylvatica seedlings		—	—	8	9	—	0
Fraxinus excelsior seedlings		—	—	0	0	—	25
Lonicera periclymenum		(X)	—	8	5	—	25
Picea abies seedlings		—	—	0	5	—	25
Pseudotsuga taxifolia seedlings		—	—	0	0	—	25
Quercus petraea seedlings		—	—	0	5	—	0
Q. petraea/robur seedlings		X	—	25	18	—	0
Q. robur seedlings		—	—	0	0	—	25
Sorbus aucuparia seedlings		—	X	50	41	—	25
Vaccinium myrtillus		8	9	<u>100</u>	<u>100</u>	—	0
V. vitis-idaea		—	—	8	5	—	0

TABLE 22—*continued*

Blechnum spicant	—	(X)	25	27	—	0
Dryopteris borreri	—	—	0	5	—	25
D. dilitata	—	—	8	18	—	50
D. filix-mas	—	—	0	0	—	25
Lycopodium clavatum	—	—	8	5	—	25
Pteridium aquilinum	—	(X)	25	14	7	25
Thelypteris dryopteris	—	—	8	5	—	0
Agrostis canina ssp. montana	1	—	33	23	1	25
A. tenuis	—	—	0	5	—	0
Anthoxanthum odoratum	—	—	25	23	—	0
Deschampsia flexuosa	5	5	100	95	8	100
Festuca ovina	—	—	8	27	—	0
F. rubra	—	—	0	5	—	0
Holcus mollis	—	—	8	5	—	0
Molinia caerulea	1	—	8	5	—	0
Poa pratensis	—	—	8	5	—	0
Carex pilulifera	—	—	8	9	1	25
Carex spp.	—	—	0	5	—	25
Luzula multiflora	—	—	17	14	—	0
L. pilosa	(X)	3	92	73	—	25
L. sylvatica	—	—	8	5	—	0
Campanula rotundifolia	—	—	8	5	—	0
Chamaenerion angustifolium	—	—	0	0	—	25
Galium saxatile	—	1	50	36	4	50
Goodyera repens	—	—	0	5	—	0
Hypericum pulchrum	—	—	8	5	—	0
Lathyrus montanus	—	—	0	5	—	0
Melampyrum pratense	—	—	8	9	—	0
Oxalis acetosella	—	3	83	45	5	25
Potentilla erecta	(X)	1	50	41	—	0
Teucrium scorodonia	—	—	0	5	—	0
Trientalis europaea	—	—	17	18	—	0
Viola riviniana	—	—	8	9	—	0
Campylopus flexuosus	1	—	17	9	—	0
Dicranella heteromalla	—	—	0	5	—	25
Dicranum majus	2	6	67	41	4	50
D. scoparium	1	—	67	59	—	50
Eurhynchium praelongum	—	—	8	5	—	0
Hylocomium splendens	3	1	83	77	1	75
Hypnum cupressiforme	—	—	17	9	—	0
H. cupressiforme var. ericetorum	2	1	67	73	1	75
Isothecium myosuroides	—	—	0	0	—	25
Mnium hornum	X	—	25	18	—	25
Plagiothecium undulatum	—	—	50	41	1	50
Pleurozium schreberi	2	2	100	91	2	100
Polytrichum aurantiacum	4	—	33	23	1	50
P. commune	—	—	17	9	—	0
P. formosum	—	1	33	23	—	25
Pseudoscleropodium purum	3	—	42	41	2	50
Ptilium crista-castrensis	—	—	8	5	—	0
Rhytidiadelphus loreus	3	X	58	41	4	50
R. squarrosus	—	—	25	36	4	25
R. triquetrus	—	—	42	36	1	50
Sphagnum girgensohnii	—	—	8	5	—	0
S. plumulosum	—	1	8	5	—	0
Thuidium tamariscinum	5	X	42	23	5	75
Barbilophozia attenuata	1	—	8	5	—	0
Calypogeia (muelleriana)	—	—	0	5	—	0
Cephalozia bicuspidata	—	—	0	5	(X)	25
Diplophyllum albicans	—	—	0	0	—	25
Lepidozia reptans	—	—	0	0	2*	50

TABLE 22—*continued*

		WOODLAND WITH VACCINIUM MYRTILLUS Oxalis acetosella facies				WOODLAND WITH DESCHAMPSIA FLEXUOSA	
				K—Presence within the facies	K—Presence within the community		K—Presence within the community
Reference no.		6338	6386			6365	
Map reference		NX 375 719	NX 594 826			NX 407 795	
Altitude	ft.	200	350			300	
Aspect		nil	N			N	
Slope		0°	16°			10°	
Cover—							
trees and shrubs	%	70	40			40	
field	%	75	90			80	
ground	%	40	30			50	
Height—							
trees and shrubs	ft.	25	50			70	
field	ins.	6	8			4–36	
Plot Area	sq. m.	1	4			4	
Soil		RP	BP			IP	
Drainage		PPH	P			P	
pH		4·2	4·3			3·7	
Soil Series		—	LP			—	
Lophocolea bidentata		—	4	67	59	4	50
L. cuspidata		3	—	8	5	—	25
L. heterophylla		—	—	8	5	—	0
Nowellia curvifolia		—	—	0	5	3*	25
Plagiochila asplenioides		—	4	17	9	3	50
Ptilidium ciliare		—	—	8	5	—	0
Cetraria glauca		—	—	17	18	—	25
Cladonia cornuta		—	X*	17	9	—	0
C. digitata		—	—	0	5	—	25
C. furcata		—	—	0	0	—	25
C. impexa		—	—	0	0	—	25
C. pityrea		—	—	0	5	2*	25
C. pyxidata		—	—	8	5	—	0
Cladonia spp.		—	—	0	9	—	0
Evernia prunastri		—	X*	33	23	—	0
Parmelia physodes		—	X*	67	64	2*	100
P. saxatilis		—	—	8	9	—	0
P. subaurifera		—	—	0	5	—	0
P. sulcata		—	1*	17	9	—	0
Usnea subfloridana		—	—	0	5	—	0
Usnea spp.		—	—	17	9	—	0
Number of species—							
trees and shrubs		4	3	12	14	3	7
field and ground		22	20	59	78	21	46
epiphytes		—	4	9	12	4	5
Average—							
total species				21	19		20
field and ground				18	16		18
Number of stands				12	22		4

TABLE 23

	AGROSTIS-FESTUCA BASIC GRASSLAND					AGROSTIS-FESTUCA MEADOW GRASSLAND				
Reference no.	6318	6325	6326	6354	K—Presence within the community	639	6320	6351	6362	K—Presence within the community
Map reference	NX 149 833	NX 120 864	NX 118 863	NX 241 926		NX 206 976	NX 095 765	NS 347 004	NX 242 818	
Altitude ft.	500	400	400	600		500	480	925	300	
Aspect	E	S	S	SW		W	W	S	SW	
Slope	7°	17°	16°	28°		10°	12°	5°	18°	
Cover— field %	100	95	95	95		98	85	95	90	
ground %	5	30	20	20		10	1	5	5	
Height— field ins.	5–8	3–8	3–11	1–5		5	2–5	3	3–11	
Plot Area sq. m.	4	4	4	4		4	4	4	4	
Soil	BFS	BMS	BMS	BFS		GBP	GBP	GBP	BFS	
Drainage	P	P	P	P		PPH	PPH	PPH	P	
pH	5·2	5·7	6·0	5·4		5·3	6·1	5·4	6·0	
Soil Series	DL	DL	DL	BN		KZ	AX	DJ	LP	
Calluna vulgaris	1	5	3	4	50	—	—	—	—	0
Crataegus monogyna seedlings	—	—	—	—	0	(X)	—	—	(X)	20
Erica cinerea	1	3	3	3	50	—	—	—	—	0
Helianthemum chamaecistus	—	—	—	4	50	—	—	—	—	0
Juniperus communis	—	—	—	—	13	—	—	—	—	0
Rosa rubiginosa	—	—	—	—	13	—	—	—	—	0
Thymus drucei	4	7	5	5	88	—	—	—	—	0
Ulex europaeus	—	—	—	—	0	—	—	—	—	10
Agrostis canina ssp. montana	—	2	2	—	38	—	—	2	—	10
A. tenuis	3	3	3	4	88	5	4	—	5	90
Alopecurus geniculatus	—	—	—	—	0	—	—	(X)	—	10
Anthoxanthum odoratum	6	4	4	4	63	3	4	5	3	80
Brachypodium sylvaticum	—	—	—	—	13	—	—	—	—	0
Briza media	—	—	—	—	13	—	—	—	—	0
Cynosurus cristatus	—	—	—	—	0	4	X	4	5	100
Dactylis glomerata	—	—	—	—	25	—	—	X	4	30
Deschampsia caespitosa	—	—	—	—	0	—	—	3	—	20
Festuca arundinacea	—	—	—	—	13	—	—	—	—	0
F. ovina	9	7	7	6	100	5	—	—	—	20
F. pratensis	—	—	—	—	0	—	—	—	X	10
F. rubra	—	—	2	4	75	5	6	2	5	100
Helictotrichon pratense	—	3	4	—	50	—	—	—	—	0
H. pubescens	—	—	—	—	13	—	—	—	—	0
Holcus lanatus	—	—	—	—	0	2	3	2	X	90
H. mollis	—	1	—	—	13	—	—	—	—	0
Koeleria cristata	5	4	4	5	100	—	—	—	—	0
Lolium perenne	—	—	—	—	0	—	—	4	—	30
Molinia caerulea	—	3	—	—	13	—	—	—	—	0
Nardus stricta	—	—	—	—	0	4	X	—	—	20
Phleum bertolonii	—	—	—	—	0	—	—	—	3	10
P. pratense	—	—	—	—	0	—	—	X	—	20
Poa annua	—	—	—	—	0	—	3	3	—	20
P. pratensis	1	—	—	—	38	—	5	4	—	80
P. trivialis	—	—	—	—	0	—	5	7	1	60
Sieglingia decumbens	1	3	5	4	63	X	—	—	X	20
Trisetum flavescens	—	—	—	—	13	—	—	—	—	30
Carex caryophyllea	3	2	2	5	75	—	—	—	1	30
C. curta	—	—	—	—	0	—	—	—	X	10

TABLE 23—*continued*

		AGROSTIS-FESTUCA BASIC GRASSLAND					AGROSTIS-FESTUCA MEADOW GRASSLAND				
Reference no.		6318	6325	6326	6354	K—Presence within the community	639	6320	6351	6362	K—Presence within the community
Map reference		NX 149 833	NX 120 864	NX 118 863	NX 241 926		NX 206 976	NX 095 765	NS 347 004	NX 242 818	
Altitude	ft.	500	400	400	600		500	480	925	300	
Aspect		E	S	S	SW		W	W	S	SW	
Slope		7°	17°	16°	28°		10°	12°	5°	18°	
Cover—											
field	%	100	95	95	95		98	85	95	90	
ground	%	5	30	20	20		10	1	5	5	
Height—											
field	ins.	5–8	3–8	3–11	1–5		5	2–5	3	3–11	
Plot Area	sq. m.	4	4	4	4		4	4	4	4	
Soil		BFS	BMS	BMS	BFS		GBP	GBP	GBP	BFS	
Drainage		P	P	P	P		PPH	PPH	PPH	P	
pH		5·2	5·7	6·0	5·4		5·3	6·1	5·4	6·0	
Soil Series		DL	DL	DL	BN		KZ	AX	DJ	LP	
Carex flacca		—	—	—	—	0	—	—	—	3	20
C. nigra		—	—	—	—	0	2	—	—	—	10
C. ovalis		—	—	—	—	0	—	—	1	—	10
C. panicea		—	3	4	1	36	—	—	—	—	0
C. pulicaris		—	X	—	—	13	—	—	—	—	0
Carex spp.		—	—	—	—	0	3	—	—	—	20
Juncus acutiflorus		—	—	—	—	0	4	—	—	—	10
J. conglomeratus		—	—	—	—	0	—	—	—	—	10
J. squarrosus		—	—	—	—	0	(X)	—	—	—	10
Luzula campestris		4	X	(X)	3	88	4	2	—	X	80
L. multiflora		—	—	(X)	—	13	2	—	—	—	10
Achillea millefolium		(X)	2	—	2	88	X	—	—	5	40
A. ptarmica		—	—	—	—	0	X	X	—	—	20
Ajuga reptans		—	—	—	—	0	—	—	—	1	10
Alchemilla glabra		—	—	—	—	0	—	—	—	1	10
Astragalus danicus		—	—	—	—	13	—	—	—	—	0
Bellis perennis		—	—	—	—	0	—	—	2	3	20
Campanula rotundifolia		5	2	2	1	100	—	—	—	X	10
Carlina vulgaris		—	—	—	—	13	—	—	—	—	0
Centaurea nigra		—	—	—	—	0	—	—	—	5	10
Cerastium holosteoides		—	—	(X)	—	13	X	3	3	3	100
Chrysanthemum leucanthemum		—	—	—	—	0	—	—	—	1	10
Cirsium arvense		—	—	—	—	38	—	—	—	X	50
C. palustre		—	—	—	—	0	1	(X)	—	—	20
C. vulgare		—	—	—	—	0	—	3	—	—	10
Conopodium majus		X	—	—	—	13	—	—	—	—	30
Euphrasia nemorosa		—	—	—	—	25	—	—	—	—	0
Euphrasia spp.		—	1	—	X	25	—	—	—	—	0
Fragaria vesca		—	—	—	—	0	—	—	—	—	10
Galium saxatile		2	—	—	(X)	38	—	—	—	—	0
G. uliginosum		—	—	—	—	0	—	—	—	—	10
G. verum		—	3	2	2	88	—	—	—	1	40
Geranium molle		—	—	—	—	0	—	—	—	—	10
Heracleum sphondylium		—	—	—	—	0	—	—	—	(X)	10
Hieracium pilosella		X	—	—	3	50	—	—	—	—	0
Hypericum pulchrum		—	X	1	—	25	—	—	—	—	0
Hypochoeris radicata		—	—	—	—	0	—	—	—	(X)	30
Lathyrus montanus		—	X	(X)	—	38	—	—	—	—	0
L. pratensis		—	—	—	—	13	—	—	—	X	20

TABLE 23—*continued*

Leontodon autumnalis	—	—	—	—	0	—	X	—	1	30
Linum catharticum	—	1	X	—	38	—	—	—	1	10
Lotus corniculatus	X	2	4	5	100	—	—	—	4	50
L. ulignosus	—	—	—	—	0	3	—	—	—	10
Oxalis acetosella	—	—	—	—	0	—	—	—	—	10
Oxytropis halleri	—	—	—	—	13	—	—	—	—	0
Pimpinella saxifraga	—	—	—	—	0	—	—	—	2	10
Plantago lanceolata	—	4	4	3	63	4	X	—	5	70
P. maritima	—	4	4	3	50	—	—	—	—	0
Polygala serpyllifolia	—	2	(X)	X	38	—	—	—	—	0
Polygala sp.	—	—	—	—	13	—	—	—	—	0
Potentilla erecta	3	4	4	3	75	2	2	—	4	60
P. sterilis	—	—	—	—	13	—	—	—	—	20
Prunella vulgaris	—	X	1	X	50	2	—	—	1	30
Ranunculus acris	—	—	—	—	0	4	—	3	3	40
R. bulbosus	—	—	—	—	13	—	—	—	—	30
R. repens	—	—	—	—	0	—	4	4	—	40
Rhinanthus sp.	—	—	—	—	0	—	—	—	1	10
Rumex acetosa	—	—	—	—	13	—	3	—	(X)	60
R. acetosella	—	—	—	—	0	—	—	—	—	10
R. conglomeratus	—	—	—	—	0	—	—	(X)	—	10
Sagina procumbens	—	—	—	—	0	X	(X)	—	—	20
Senecio jacobaea	—	X	—	—	13	—	(X)	—	2	30
Stellaria graminea	—	—	—	—	0	—	—	—	X	20
Succisa pratensis	—	4	1	3	50	X	—	—	—	10
Taraxacum officinale	—	—	—	—	0	—	—	—	(X)	10
Trifolium dubium	—	—	—	—	0	—	—	—	—	10
T. pratense	—	—	—	—	0	—	—	—	(X)	10
T. repens	—	1	3	2	63	6	6	8	5	100
Urtica dioica	—	—	—	—	0	—	—	—	—	10
Veronica chamaedrys	—	—	—	—	38	—	—	—	X	70
V. officinalis	—	—	—	—	13	—	—	—	—	0
V. serpyllifolia	—	—	—	—	0	—	X	—	—	10
Veronica sp.	—	—	—	—	0	—	—	—	—	10
Vicia angustifolia	—	—	—	—	0	X	—	—	—	20
V. cracca	—	—	—	—	13	—	—	—	—	0
Viola riviniana	—	2	3	3	75	—	—	—	—	30
Acrocladium cuspidatum	—	—	—	—	25	—	X	2	4	40
Atrichum undulatum	—	—	—	—	0	—	—	—	—	10
Brachythecium rutabulum	—	—	—	—	0	—	—	4	1	30
Bryum capillare	—	—	—	—	13	—	—	—	—	0
Camptothecium lutescens	—	—	—	—	25	—	—	—	—	0
Ctenidium molluscum	—	—	—	—	0	—	—	—	2	10
Dicranum scoparium	3	2	3	4	75	—	—	—	—	0
Entodon orthocarpus	—	—	—	—	13	—	—	—	—	0
Eurhynchium praelongum	—	—	—	—	0	—	—	—	—	30
Fissidens taxifolius	—	—	—	—	0	—	—	—	1	10
Grimmia apocarpa	—	—	—	—	0	—	—	—	X	10
Hylocomium splendens	4	4	5	3	88	1	—	—	—	20
Hypnum cupressiforme										
var. ericetorum	1	X	—	X	38	—	—	—	—	0
var. lacunosum	—	—	—	4	38	—	—	—	—	0
Mnium longirostrum	—	—	—	—	13	—	—	—	—	0
M. undulatum	X	—	—	—	25	4	—	1	—	30
Pleurozium schreberi	2	X	1	1	75	—	—	—	—	0
Pohlia nutans	X	—	—	—	13	—	—	—	—	0
Pseudoscleropodium purum	—	1	2	1	88	3	—	—	—	30
Rhodobryum roseum	—	—	—	—	13	—	—	—	—	0
Rhytidiadelphus squarrosus	3	5	3	3	88	4	1	3	—	90
R. triquetrus	1	—	2	—	25	—	—	—	—	0
Thuidium delicatulum	—	—	—	—	0	—	—	—	X	10
T. tamariscinum	—	2	4	X	50	1	—	—	—	10
Weissia sp.	—	—	—	—	13	—	—	—	—	0

TABLE 23—*continued*

		AGROSTIS-FESTUCA BASIC GRASSLAND					AGROSTIS-FESTUCA MEADOW GRASSLAND				
Reference no.		6318	6325	6326	6354	K—Presence within the community	639	6320	6351	6362	K—Presence within the community
Map reference		NX 149 833	NX 120 864	NX 118 863	NX 241 926		NX 206 976	NX 095 765	NS 347 004	NX 242 818	
Altitude	ft.	500	400	400	600		500	480	925	300	
Aspect		E	S	S	SW		W	W	S	SW	
Slope		7°	17°	16°	28°		10°	12°	5°	18°	
Cover—											
field	%	100	95	95	95		98	85	95	90	
ground	%	5	30	20	20		10	1	5	5	
Height—											
field	ins.	5–8	3–8	3–11	1–5		5	2–5	3	3–11	
Plot Area	sq. m.	4	4	4	4		4	4	4	4	
Soil		BFS	BMS	BMS	BFS		GBP	GBP	GBP	BFS	
Drainage		P	P	P	P		PPH	PPH	PPH	P	
pH		5·2	5·7	6·0	5·4		5·3	6·1	5·4	6·0	
Soil Series		DL	DL	DL	BN		KZ	AX	DJ	LP	
Frullania tamarisci		—	—	—	1	13	—	—	—	—	0
Lophocolea bidentata		1	—	1	1	50	X	—	1	—	20
Cladonia tenuis		X	—	—	X	25	—	—	—	—	0
Cladonia sp.		—	—	—	—	13	—	—	—	—	0
Number of species		28	40	38	39	84	34	25	25	50	98
Average						33					28
Number of stands						8					10

TABLE 24. AGROSTIS-FESTUCA ACID GRASSLAND

Trifolium repens-Thymus drucei facies

							K—Presence within the facies	K—Presence within the community
Reference no.		6310	6328	6346	6370	6372		
Map reference		NX 207 977	NX 335 982	NS 303 003	NX 577 862	NX 544 857		
Altitude	ft.	750	1000	675	500	750		
Aspect		NW	S	N	SW	S		
Slope		19°	20°	8°	9°	13°		
Cover—								
field	%	90	95	95	95	95		
ground	%	30	8	30	8	25		
Height—								
field	ins.	6	4	2–8	8–13	3–8		
Plot area	sq. m.	4	4	4	4	4		
Soil		GBP	BP	BP	BP	BP		
Drainage		PPH	P	P	P	P		
pH		4·6	4·5	4·7	4·7	4·9		
Soil Series		KZ			LP	DE		
Calluna vulgaris		—	—	1	2	—	31	31
Crataegus monogyna seedlings		—	—	X	—	—	6	3
Empetrum nigrum		—	—	—	—	—	6	3
Erica cinerea		—	—	—	1	—	6	3
Sarothamnus scoparius		—	—	—	—	—	0	3
Thymus drucei		2	3	3	—	(X)	63	34
Ulex europaeus		—	—	—	—	—	13	10
Vaccinium myrtillus		3	—	5	—	—	25	41
Blechnum spicant		—	—	—	—	—	6	3
Pteridium aquilinum		—	—	—	4	X	25	28
Agrostis canina ssp. montana		4	—	1	4	—	50	55
A. tenuis		5	7	5	4	7	100	100
Anthoxanthum odoratum		5	4	4	5	6	88	93
Deschampsia caespitosa		—	—	—	—	—	6	3
D. flexuosa		—	—	—	—	—	25	52
Festuca ovina		6	8	8	7	7	94	90
F. rubra		4	4	—	—	—	63	59
Holcus lanatus		—	—	—	—	—	31	34
H. mollis		—	—	—	—	—	13	17
Koeleria cristata		—	—	—	—	—	0	3
Nardus stricta		5	—	1	—	—	13	10
Poa pratensis		—	—	—	—	X	38	28
Sieglingia decumbens		2	2	4	—	3	44	31
Carex binervis		—	—	—	—	—	0	3
C. caryophyllea		1	3	—	4	3	50	31
C. flacca		—	—	—	—	—	6	3
C. panicea		—	—	—	—	—	6	7
C. pilulifera		—	—	3	—	1	31	41
Carex spp.		1	—	—	—	—	13	10
Juncus squarrosus		—	—	—	—	—	0	3
Luzula campestris		2	4	5	5	4	81	86
L. multiflora		1	—	—	—	—	13	14
L. pilosa		—	—	—	—	—	0	10
Achillea millefolium		X	—	1	4	—	63	41
Anemone nemorosa		—	—	—	—	—	6	7
Angelica sylvestris		—	—	—	—	—	6	3

TABLE 24—*continued*

AGROSTIS-FESTUCA ACID GRASSLAND

Trifolium repens-Thymus drucei facies

							K—Presence within the facies	K—Presence within the community
Reference no.		6310	6328	6346	6370	6372		
Map reference		NX 207 977	NX 335 982	NS 303 003	NX 577 862	NX 544 857		
Altitude	ft.	750	1000	675	500	750		
Aspect		NW	S	N	SW	S		
Slope		19°	20°	8°	9°	13°		
Cover—								
field	%	90	95	95	95	95		
ground	%	30	8	30	8	25		
Height—								
field	ins.	6	4	2–8	8–13	3–8		
Plot area	sq. m.	4	4	4	4	4		
Soil		GBP	BP	BP	BP	BP		
Drainage		PPH	P	P	P	P		
pH		4·6	4·5	4·7	4·7	4·9		
Soil Series		KZ			LP	DE		
Bellis perennis		—	—	—	—	—	0	3
Campanula rotundifolia		—	—	—	1	4	**68**	52
Cerastium holosteoides		—	—	—	—	1	31	38
Cirsium arvense		—	—	—	—	—	0	3
C. palustre		—	—	—	—	—	0	3
Conopodium majus		—	—	X	—	—	19	17
Endymion non-scriptus		—	—	—	—	—	0	3
Euphrasia nemorosa		—	—	—	—	—	6	3
Euphrasia sp.		—	3	—	—	—	6	3
Galium saxatile		3	4	3	5	6	**100**	**97**
G. verum		—	—	—	—	—	13	10
Hieracium pilosella		—	—	—	—	—	13	7
Hypericum pulchrum		—	—	—	—	—	6	3
Lathyrus montanus		—	—	—	—	—	19	21
L. pratensis		—	—	—	—	—	6	3
Lotus corniculatus		X	—	—	—	—	**63**	45
L. uliginosus		—	—	—	—	—	0	3
Oxalis acetosella		—	—	—	—	—	0	7
Plantago lanceolata		3	3	1	—	—	**63**	38
Polygala serpyllifolia		—	—	X	—	—	31	21
Potentilla erecta		5	(X)	7	5	6	**94**	**97**
P. sterilis		—	—	—	—	—	6	3
Ranunculus acris		—	—	—	—	—	19	10
R. bulbosus		—	1	—	—	—	6	3
R. repens		—	—	—	—	—	0	17
Rhinanthus sp.		—	—	—	—	—	6	3
Rumex acetosa		—	X	—	—	—	38	31
R. acetosella		—	—	—	—	—	0	7
Senecio jacobaea		—	—	—	—	—	6	10
Succisa pratensis		—	—	—	—	—	6	3
Taraxacum officinale		—	—	—	—	—	6	3
Trientalis europaea		—	—	—	—	—	0	3
Trifiolium repens		2	1	1	—	4	**81**	59
Veronica chamaedrys		—	—	—	—	—	38	41
V. officinalis		—	(X)	—	X	3	**68**	62
V. serpyllifolia		—	—	—	—	—	0	3
Viola lutea		—	—	—	—	—	13	7
V. riviniana		X	2	—	—	—	**75**	59
Atrichum undulatum		—	—	—	—	—	0	3
Campylopus flexuosus		—	—	—	—	1	6	3
Dicranum scoparium		—	—	2	—	1	44	45

TABLE 24—*continued*

Eurhynchium praelongum	—	2	—	—	—	13	10
Eurhynchium sp.	—	—	—	—	—	0	3
Hylocomium splendens	5	—	5	3	2	81	86
Hypnum cupressiforme var. ericetorum	2	3	—	2	3	56	59
Mnium longirostrum	—	X	—	—	—	13	10
M. undulatum	—	—	—	—	—	13	7
Mnium sp.	—	—	—	—	—	6	3
Polytrichum alpinum	—	—	X	—	—	19	17
P. aurantiacum	2	—	—	—	—	6	7
P. commune	—	—	—	—	—	6	10
P. formosum	—	—	—	—	—	0	3
P. juniperinum	—	—	—	—	—	13	10
Pleurozium schreberi	5	—	4	4	4	56	69
Pseudoscleropodium purum	4	1	—	1	—	68	72
Rhytidiadelphus squarrosus	3	4	3	4	5	100	100
R. triquetrus	—	—	1	—	—	38	24
Thuidium tamariscinum	—	—	3	—	—	19	14
Lophocolea bidentata	—	—	2	—	—	44	38
Plagiochila asplenioides	—	—	—	—	—	0	3
Ptilidium ciliare	—	—	—	—	—	6	7
Peltigera canina	—	—	—	—	—	13	7
Peltigera sp.	—	—	—	—	—	6	3
Number of species	26	22	27	19	22	80	99
Average						26	24
Number of stands						16	29

TABLE 25. NARDUS GRASSLAND

		Sieglingia decumbens facies								Carex nigra facies			Remainder			
Reference no.		633	6314	6344	6352	6353	6377	6388	K—Presence within the facies	6312	6327	K—Presence within the facies	634	6373	K—Presence within the facies	K—Presence within the community
Map reference		NX 125 794	NX 322 855	NX 267 982	NS 350 004	NX 241 934	NX 515 935	NX 578 960		NX 220 976	NX 339 967		NX 127 796	NX 501 903		
Altitude	ft.	1060	700	780	900	900	1500	1350		900	950		1000	1650		
Aspect		E	E	S	S	NE	SE	S		SW	N		E	NE		
Slope		8°	10°	7°	15°	9°	30°	17°		6°	24°		13°	21°		
Cover—field	%	95	90	90	80	85	85	90		100	70		95	85		
—ground	%	20	40	60	30	60	10	20		5	75		30	70		
Height—field	ins.	4	3–5	12	8	7	4–10	8		5	7		6	4–8		
Plot Area	sq. m.	4	4	4	4	4	4	4		4	4		4	4		
Soil		PP	BP	GBP	GBP	IP	IP	PP		PP	GP		RPP	IP		
Drainage		PPH	P	PPH	PPH	P(PH)	P(PH)	PPH		PPH	PPH		PPH	P		
pH		4·1	4·8	4·1	5·0	4·2	3·9	4·0		4·0	4·0		4·5	4·2		
Soil Series		DO	LP	GD	—	KU	MM	DO		—	—		—	MM		
Calluna vulgaris		—	1	—	X	—	—	—	40	—	—	40	—	—	15	30
Empetrum nigrum		—	—	—	—	—	—	—	0	—	—	0	—	—	8	3
Erica cinerea		X	—	—	—	—	—	2	20	—	—	0	—	—	0	6
E. tetralix		—	—	—	—	—	—	(X)	10	—	—	0	2	—	8	6
Thymus drucei		—	—	—	2	—	—	—	10	—	—	0	—	—	0	3
Ulex europaeus		—	—	—	—	—	—	—	10	—	—	10	—	—	0	6
Vaccinium myrtillus		6	6	(X)	1	5	8	7	90	3	7	50	6	7	85	76
V. vitis-idaea		—	—	—	—	—	—	—	0	—	—	0	—	X	15	6
Pteridium aquilinum		—	X	—	—	—	—	—	10	—	—	0	—	—	0	3
Agrostis canina ssp. montana		4	—	4	(X)	4	5	4	90	3	4	100	1	3	85	91
A. tenuis		—	5	4	5	—	—	—	60	—	—	10	—	3	62	45
Anthoxanthum odoratum		—	4	3	4	3	4	5	90	3	X	90	1	4	92	91
Deschampsia caespitosa		—	—	1	—	—	—	—	10	—	—	0	—	—	0	3
D. flexuosa		—	3	6	—	4	5	3	60	7	4	100	—	5	85	82

TABLE 25—*continued*

Festuca ovina	7	7	4	6	7	6	6	**100**	6	5	**100**	7	5	**100**	**100**
F. rubra	—	—	—	—	—	—	—	20	—	—	0	—	—	8	9
F. vivipara	—	—	—	—	—	—	—	0	—	—	0	—	—	8	3
Holcus lanatus	—	—	X	—	—	—	—	10	—	—	10	—	—	0	6
Lolium perenne	—	—	—	—	—	—	—	10	—	—	0	—	—	0	3
Molinia caerulea	—	—	—	1	—	—	—	20	—	—	20	—	—	8	15
Nardus stricta	8	4	5	6	7	5	6	**100**	4	6	**100**	7	7	**100**	**100**
Poa pratensis	—	—	—	—	—	—	—	10	—	—	0	—	—	0	3
Sieglingia decumbens	3	1	1	2	1	4	4	**100**	—	—	0	—	—	0	30
Carex binervis	2	—	—	2	4	2	4	**60**	—	2	20	2	—	31	36
C. caryophyllea	—	4	—	(X)	—	—	—	**40**	—	—	0	—	—	0	12
C. nigra	—	—	—	—	—	—	—	0	3	X	**80**	—	—	0	24
C. panicea	3	—	1	1	X	—	4	**60**	—	1	20	3	3	31	36
C. pilulifera	5	—	1	4	X	5	4	**90**	—	—	20	1	2	46	52
Carex sp.	—	—	—	—	—	—	—	0	—	—	10	—	—	0	3
Eriophorum vaginatum	—	—	—	—	—	—	—	0	—	—	10	—	—	0	3
Juncus conglomeratus	—	—	—	—	—	—	—	0	—	—	10	—	—	0	3
J. effusus	—	—	—	—	—	—	—	10	—	—	0	—	—	0	3
J. squarrosus	—	X	3	2	X	—	—	**60**	6	—	**90**	—	—	38	**61**
Luzula campestris	—	5	3	4	2	—	—	**70**	—	—	20	1	—	54	48
L. multiflora	—	—	3	3	1	—	X	50	—	X	**80**	—	—	54	**64**
L. pilosa	—	—	—	—	—	—	—	0	—	—	10	—	—	8	6
Luzula sp.	—	—	—	—	—	—	—	0	2	—	10	—	—	0	3
Trichophorum caespitosum	1	—	—	—	—	—	1	20	—	(X)	10	1	—	8	12
Achillea millefolium	—	—	—	1	—	—	—	20	—	—	0	—	—	0	6
A. ptarmica	—	—	—	—	—	—	—	0	—	—	0	—	—	8	3
Anemone nemorosa	—	—	—	—	—	—	—	20	—	—	0	—	—	0	6
Campanula rotundifolia	—	—	—	—	—	—	—	10	—	—	0	—	—	0	3
Cerastium holosteoides	—	(X)	—	—	—	—	—	20	—	—	0	—	—	0	6
Dactylorchis maculata ssp. ericetorum	—	—	—	—	—	—	—	10	—	—	0	—	—	0	3
Euphrasia sp.	—	2	—	—	—	—	—	10	—	—	0	—	—	0	3
Galium saxatile	1	4	4	3	3	4	3	**100**	3	X	**100**	1	4	**92**	**97**
Hieracium pilosella	—	—	—	(X)	—	—	—	10	—	—	0	—	—	0	3
Hypochoeris radicata	—	—	—	—	—	—	—	10	—	—	0	—	—	0	3
Lathyrus montanus	—	—	—	—	—	—	—	10	—	—	0	—	—	0	3
Narthecium ossifragum	4	—	—	—	—	—	4	20	—	—	0	—	—	0	6

TABLE—25 *continued*

Oxalis acetosella	—	—	—	—	—	—	—	0	X	—	10	—	—	0	3
Plantago lanceolata	—	—	—	1	—	—	—	20	—	—	0	—	—	0	6
Polygala serpyllifolia	—	—	—	—	—	—	—	10	—	—	0	—	—	8	6
Potentilla erecta	3	5	5	5	7	4	5	**100**	4	4	**100**	3	3	**85**	**94**
Rumex acetosa	—	—	—	X	—	—	—	20	—	—	0	—	—	0	6
R. acetosella	—	—	—	—	—	—	—	0	—	—	10	—	—	0	3
Succisa pratensis	—	—	—	—	—	—	—	20	—	—	0	—	—	0	6
Trifolium repens	—	—	—	3	—	—	—	10	—	—	0	—	—	0	3
Veronica officinalis	—	—	—	—	—	—	—	10	—	—	0	—	—	8	6
Viola lutea	—	—	—	—	—	—	—	10	—	—	0	—	—	0	3
V. riviniana	—	—	—	X	—	—	—	10	—	—	0	—	—	0	3
Acrocladium stramineum	—	—	—	—	—	—	—	0	—	—	10	—	—	0	3
Aulacomnium palustre	—	—	—	—	—	—	—	0	—	—	10	—	—	0	3
Campylopus flexuosus	[4]	—	—	—	—	[1]	2	30	—	1	20	—	—	8	18
C. fragilis	—	—	—	—	—	—	—	0	—	—	0	—	—	8	3
C. piriformis	—	—	—	—	—	[1]	—	10	—	—	10	—	—	0	6
Ceratodon purpureus	—	—	—	—	—	—	—	20	—	—	0	—	—	0	6
Dicranella heteromalla	—	—	—	—	—	—	—	0	—	—	0	—	—	8	3
Dicranum scoparium	[4]	—	—	4	1	4	4	70	—	2	20	X	1	46	45
Drepanocladus revolvens var. intermedius	—	—	—	—	—	—	—	0	—	—	10	—	—	0	3
Hylocomium splendens	—	3	1	4	X	3	1	**90**	1	4	40	—	—	31	52
Hypnum cupressiforme var. ericetorum	5	1	3	4	5	4	5	**90**	—	4	70	4	6	69	**76**
Leptodontium flexifolium	—	—	—	—	—	—	—	0	—	—	0	—	—	8	3
Leucobryum glaucum	—	—	—	—	—	—	2	10	—	—	0	—	—	0	3
Mnium hornum	—	—	—	—	—	—	—	10	1	—	40	—	—	0	15
Plagiothecium undulatum	—	—	—	—	3	—	—	10	—	3	60	X	—	38	36
Pleurozium schreberi	—	5	5	4	7	3	3	**90**	1	5	**80**	5	7	**85**	**85**
Pohlia nutans	1	—	—	—	X	1	—	30	—	—	20	—	—	8	18
Polytrichum alpinum	—	6	—	X	1	—	—	40	—	—	0	—	—	8	15
P. aurantiacum	—	—	—	—	—	X	—	10	1	—	20	—	—	15	15
P. commune	—	—	7	—	—	—	—	20	—	—	50	—	3	46	39
P. juniperinum	—	—	—	X	—	—	—	20	—	—	0	—	2	8	9
P. piliferum	—	—	—	—	—	—	—	10	—	—	0	—	—	0	3
Pseudoscleropodium purum	—	—	3	2	—	—	—	30	—	—	30	—	—	23	27
Rhacomitrium lanuginosum	—	—	—	—	—	—	—	0	—	—	0	—	X	8	3
Rhytidiadelphus loreus	—	—	—	—	—	—	—	0	—	4	10	1	4	24	12
R. squarrosus	—	3	3	2	1	3	1	**90**	X	1	**90**	3	—	77	**85**

TABLE 25—*continued*

Sphagnum capillaceum	—	—	—	—	—	—	—	0	—	4	10	—	—	0	3
Thuidium tamariscinum	—	—	—	X	—	—	—	20	—	—	0	—	—	0	6
Anastrepta orcadensis	—	—	—	—	—	—	—	0	—	X	10	—	—	0	3
Barbilophozia floerkei	—	—	—	—	—	—	—	0	—	1	10	—	—	0	3
Calypogeia fissa	—	—	—	—	—	—	—	0	—	1	30	—	—	0	9
C. (muelleriana)	3	—	—	—	—	—	—	10	—	—	10	—	—	8	9
Cephaloziella starkei	—	—	—	—	—	1	—	10	—	—	0	—	—	0	3
Diplophyllum albicans	1	—	—	—	—	—	—	10	—	—	0	—	—	8	6
Gymnocolea inflata	—	—	—	—	—	—	—	0	—	—	0	—	—	15	6
Lophocolea bidentata	—	1	1	2	X	—	—	60	4	2	60	1	—	46	55
Ptilidium ciliare	—	3	—	—	—	2	3	30	—	—	0	—	X	23	18
Cladonia fimbriata	—	—	—	—	—	3	—	10	—	—	0	—	—	0	3
C. impexa	—	—	—	—	—	1	—	10	—	—	0	—	—	0	3
C. pyxidata	—	—	—	—	—	—	—	0	—	—	0	—	—	8	3
Cladonia sp.	—	—	—	—	—	—	—	0	—	—	0	—	(X)	8	3
Cornicularia aculeata	—	—	—	—	—	—	—	0	—	—	0	—	X	8	3
Number of species	19	23	24	35	24	24	25	75	18	26	51	20	22	53	103
Average								26			20			18	21
Number of stands								10			10			13	33

TABLE 26. MOLINIA GRASSLAND

	Polytrichum commune facies				Campylopus flexuosus facies								
Reference no.	6345	6347	6348	K—Presence within the facies	6313	6315	6343	6350	6359	6378	6384	K—Presence within the facies	K—Presence within the community
Map reference	NS 311 003	NS 413 004	NS 329 008		NX 320 853	NX 315 854	NX 267 982	NS 329 006	NX 239 795	NX 528 940	NX 478 938		
Altitude ft.	825	900	1050		710	750	775	1100	500	1050	800		
Aspect	SW	NE	SE		E	S	SW	SE	SW	SE	NW		
Slope	8°	8°	6°		6°	11°	7°	15°	8°	11°	5°		
Cover— field %	70	65	80		80	75	60	80	70	90	70		
ground %		80	65		25	15	30	10	40	3	60		
Height— field ins.	6	8	8		4	7	6	6	3–9	10	9		
Plot Area sq. m.	4	4	4		4	4	4	4	4	4	4		
Soil	PG	PG	PG		PP	PP	PG	PP	PP	PG	BPt		
Drainage	PH	PH	PH		PPH	PPH	PH	PPH	PPH	PH	—		
pH	3·7	4·0	3·8		3·6	3·7	4·1	3·9	3·9	3·8	3·8		
Soil Series	SD	PM	FL		DO	DO	SD	BD	DO	DY	—		
Calluna vulgaris	—	4	—	40	X	—	(X)	—	3	—	4	63	50
Empetrum nigrum	—	—	—	20	—	—	—	—	—	—	—	0	11
Erica tetralix	—	—	—	10	3	—	—	(X)	—	—	4	38	22
Vaccinium myrtillus	5	5	6	90	6	5	6	6	—	4	—	75	83
Agrostis canina	1	—	—	50	—	—	1	1	—	3	—	38	44
A. canina ssp. montana	—	—	—	10	—	—	—	—	—	—	—	0	6
A. tenuis	—	—	—	10	—	—	—	—	—	—	—	0	6
Anthoxanthum odoratum	—	—	—	60	—	1	—	—	—	—	—	13	39
Deschampsia flexuosa	5	5	5	100	5	6	3	4	3	5	—	88	94
Festuca ovina	5	1	4	90	—	3	5	5	5	5	—	75	83
Molinia caerulea	7	6	6	100	7	7	8	8	8	8	8	100	100
Nardus stricta	1	—	4	60	—	—	4	4	2	—	—	50	56
Carex binervis	—	—	—	0	—	—	X	—	—	—	—	13	6
C. echinata	—	—	X	10	—	—	—	—	—	—	—	0	6
C. nigra	X	—	—	50	—	X	—	—	X	—	—	25	39
C. pilulifera	—	—	—	0	—	—	X	—	—	3	—	25	11
Eriophorum angustifolium	—	2	3	20	—	—	—	—	—	—	3	13	17
E. vaginatum	—	5	—	10	3	—	—	—	—	—	—	13	11
Juncus acutiflorus	—	—	—	20	—	—	—	—	—	3	—	13	17
J. squarrosus	5	2	5	80	2	—	3	4	3	—	(X)	63	72
Luzula multiflora	(X)	2	2	90	X	X	X	—	—	—	—	50	72
Trichophorum caespitosum	—	4	1	60	2	(X)	1	1	3	3	5	100	78
Galium saxatile	X	—	X	80	—	—	(X)	—	—	3	—	25	56
Narthecium ossifragum	—	—	—	10	—	—	—	—	—	1	—	13	11
Pedicularis palustris	—	—	—	0	—	—	X	—	—	—	—	13	6
Polygala serpyllifolia	—	—	—	10	—	—	—	—	—	—	—	0	6
Potentilla erecta	4	(X)	3	90	2	(X)	4	1	2	6	X	100	94
Aulacomnium palustre	3	—	—	40	—	—	—	—	X	—	—	13	28
Campylopus flexuosus	—	—	—	0	5	—	3	2	2	1	3	88	39
C. fragilis	—	—	—	0	—	3	—	—	—	—	—	13	6
Campylopus sp.	—	—	—	10	—	—	—	—	—	—	—	0	6
Dicranum bonjeani	—	—	—	20	—	—	—	—	—	—	—	0	11
D. scoparium	—	1	4	50	1	3	3	3	5	1	4	100	72
Eurhynchium praelongum	—	—	—	10	—	—	—	—	—	—	—	0	6
Hylocomium splendens	1	X	2	60	—	—	—	—	—	—	—	0	33

TABLE 26—*continued*

Hypnum cupressiforme var. ericetorum	1	1	3	<u>90</u>	1	2	5	3	3	4	7	<u>100</u>	94
Leptodontium flexifolium	—	—	—	0	—	—	—	—	(X)	—	—	13	6
Leucobryum glaucum	—	—	—	0	(X)	—	—	—	—	—	2	25	11
Mnium hornum	—	—	—	30	—	—	1	—	—	—	—	13	22
Plagiothecium undulatum	3	—	1	80	2	4	3	2	4	1	3	<u>88</u>	83
Pleurozium schreberi	2	6	5	<u>80</u>	1	—	—	4	2	—	2	50	67
Pohlia nutans	—	—	—	10	—	3	1	—	5	—	(X)	50	28
Polytrichum alpestre	—	—	5	10	—	—	—	—	—	—	1	13	11
P. commune	6	4	4	<u>80</u>	—	—	—	2	—	—	—	13	50
Pseudoscleropodium purum	—	—	—	20	—	—	—	—	—	—	—	0	11
Rhytidiadelphus loreus	—	2	3	30	1	—	—	X	—	—	—	25	28
R. squarrosus	—	—	—	30	—	—	—	—	—	—	—	0	17
Sphagnum capillaceum	4	6	7	30	—	2	4	—	3	—	3	50	39
S. palustre	—	5	—	10	2	—	—	—	1	—	—	25	17
S. papillosum	—	—	—	10	—	—	—	—	—	—	—	0	6
S. plumulosum	—	—	—	10	—	—	—	—	—	—	—	0	6
S. recurvum	—	—	—	10	3	—	—	—	—	—	—	13	11
Sphagnum sp.	—	—	—	10	—	—	—	—	—	—	—	0	6
Barbilophozia floerkei	1	—	3	30	—	—	2	2	—	—	—	25	28
Calypogeia fissa	1	—	—	20	—	—	—	—	3	—	—	13	17
C. (muelleriana)	—	—	3	30	3	—	2	2	—	—	3	50	39
Calypogeia sp.	—	—	—	10	—	—	—	—	—	—	—	0	6
Cephalozia connivens	—	—	—	0	3	—	2	—	1	—	1	50	22
Cephaloziella hampeana	2	—	—	10	—	—	X	—	—	—	1	25	17
Lepidozia sp.	—	—	—	0	—	—	—	—	—	—	(X)	13	6
Lophocolea bidentata	3	—	—	50	—	2	—	—	—	—	—	13	33
Lophozia alpestris	—	—	—	0	—	2	—	—	—	—	—	13	6
L. ventricosa	3	—	—	20	3	—	—	3	1	—	3	50	33
Lophozia sp.	—	3	—	10	—	—	—	—	—	—	—	0	6
Liverwort sp.	—	—	—	10	—	—	—	—	—	—	—	0	6
Ptilidium ciliare	—	—	—	20	—	—	—	—	—	—	—	0	11
Cladonia furcata	—	—	—	0	—	—	—	—	—	—	X	13	6
Cladonia sp.	—	—	—	0	—	—	—	—	X	—	—	13	6
Number of species	23	20	23	56	22	17	26	20	23	15	22	50	68
Average				21								20	20
Number of stands				10								8	18

TABLE 27. JUNCUS ACUTIFLORUS PASTURE

		Poa trivialis facies		Molinia facies					
Reference no.		6322	K—Presence within the facies	638	6329	6349	6391	K—Presence within the facies	K—Presence within the community
Map Reference		NX 058 747		NX 204 974	NX 335 982	NS 329 007	NX 578 914		
Altitude	ft.	670		500	1000	1050	750		
Aspect		W		NW	SW	S	NE		
Slope		9°		10°	11°	8°	4°		
Cover— field	%	90		95	65	90	90		
ground	%	1		15	85	50	30		
Height— field	ins.	8–14		6	3–10	11	15		
Plot Area	sq. m.	4		4	4	4	4		
Soil		G		G	G	G	G		
Drainage		PH		PH	PH	PH	PH		
pH		5·0		5·7	5·4	4·4	4·9		
Soil Series		LQ		ER	BJ	BJ	LQ		
Fraxinus excelsior seedling		X	20	—	—	—	—	0	8
Agrostis canina		5	80	1	—	7	7	86	85
A. tenuis		3	60	4	3	1	—	57	62
Anthoxanthum odoratum		4	100	4	3	4	5	100	100
Briza media		—	40	—	—	—	—	0	15
Cynosurus cristatus		—	40	1	2	—	—	29	31
Deschampsia caespitosa		4	100	—	—	1	—	57	77
Festuca ovina		—	0	5	4	4	2	71	38
F. pratensis		—	40	—	—	—	—	0	15
F. rubra		4	100	3	4	4	3	100	100
Helictotrichon pubescens		—	0	—	—	—	—	14	8
Holcus lanatus		3	100	4	2	2	1	86	92
H. mollis		—	20	—	—	—	—	14	15
Molinia caerulea		—	0	(X)	2	—	5	86	46
Nardus stricta		—	40	1	—	—	—	29	38
Poa pratensis		4	80	2	1	4	—	71	69
P. trivialis		1	100	—	—	—	—	0	38
Sieglingia decumbens		—	20	X	—	—	—	14	15
Carex flacca		—	20	1	—	—	—	29	23
C. hirta		—	0	—	—	—	—	14	8
C. hostiana		—	0	—	—	—	—	14	8
C. nigra		—	0	2	1	1	—	43	23
C. ovalis		—	20	—	—	—	—	0	8
C. panicea		—	20	—	4	X	4	71	46
C. pilulifera		—	0	—	—	—	—	14	8
C. pulicaris		—	40	—	4	—	—	14	23
Carex spp.		—	20	—	—	—	—	14	8
Juncus acutiflorus		7	100	6	5	6	6	100	100
J. conglomeratus		—	20	—	—	—	—	29	38
J. effusus		—	0	—	—	(X)	—	14	8
J. squarrosus		—	0	—	—	—	—	14	8
Juncus sp.		X	20	—	—	—	—	0	8
Luzula campestris		—	0	X	—	[1]	—	29	15
L. multiflora		—	80	1	1	[1]	2	100	92
Achillea ptarmica		—	20	—	—	—	2	43	31
Anemone nemorosa		—	0	—	—	—	3	29	15

TABLE 27—*continued*

Angelica sylvestris	—	0	—	—	—	—	14	8
Cardamine pratensis	2	40	X	X	—	—	43	38
Cardamine spp.	—	40	—	—	—	—	0	15
Carum verticillatum	—	0	—	—	—	1	14	8
Centaurea nigra	—	0	—	—	—	—	14	8
Cerastium holosteoides	—	60	X	X	—	—	29	38
Cirsium arvense	—	20	—	—	—	—	0	8
C. palustre	—	80	1	4	3	3	86	85
Crepis paludosa	—	0	—	—	—	—	14	8
Dactylorchis maculata ssp. ericetorum	—	0	—	—	—	—	14	8
D. purpurella	—	0	—	—	—	—	14	8
Dactylorchis sp.	—	0	—	—	—	—	14	8
Epilobium palustre	1	60	—	—	—	—	0	23
Euphrasia sp.	—	20	—	—	—	—	0	8
Filipendula ulmaria	—	20	—	—	—	—	14	15
Galium palustre	X	60	—	—	—	—	0	23
G. saxatile	—	0	—	1	5	4	57	38
G. uliginosum	—	40	—	3	—	—	14	23
Geranium sylvaticum	—	0	—	—	—	—	14	8
Lathyrus pratensis	—	40	—	—	—	—	0	15
Leontodon autumnalis	—	40	—	—	—	—	0	15
Listera ovata	—	0	—	—	—	—	14	8
Lotus corniculatus	—	20	—	—	—	—	0	8
L. uliginosus	—	20	3	—	—	—	29	23
Pedicularis sylvatica	—	0	—	—	—	—	14	8
Plantago lanceolata	—	20	1	2	1	—	71	46
Potentilla erecta	X	100	(X)	3	4	4	100	100
Prunella vulgaris	—	20	2	2	—	—	29	23
Ranunculus acris	2	100	4	5	3	(X)	86	92
R. ficaria	5	20	—	—	—	—	0	8
R. repens	—	60	—	—	—	—	0	23
Rumex acetosa	—	60	—	—	—	—	14	38
Sagina procumbens	—	0	—	1	—	—	14	8
Stellaria alsine	—	0	—	2	—	—	14	8
Succisa pratensis	—	0	X	—	—	—	29	15
Taraxacum palustre	X	40	—	—	—	—	0	15
Taraxacum sp.	—	20	—	—	—	—	0	8
Trifolium repens	X	100	2	3	4	(X)	57	69
Trollius europaeus	—	0	—	—	—	—	14	8
Veronica chamaedrys	—	20	—	—	—	—	0	8
Vicia angustifolia	—	0	1	—	—	—	14	8
Viola palustris	—	0	—	—	5	4	43	31
V. riviniana	—	0	—	1	—	—	14	8
Acrocladium cuspidatum	—	40	—	—	—	—	14	23
Atrichum undulatum	—	0	—	—	—	1	14	8
Brachythecium rutabulum	1	40	—	—	—	—	14	23
Bryum sp.	—	0	—	—	—	X	14	8
Climacium dendroides	—	20	—	2	—	—	14	15
Ditrichum heteromallum	—	0	—	—	—	1	14	8
Eurhynchium praelongum	2	80	—	—	4	1	57	62
Hylocomium splendens	—	20	1	7	4	—	71	46
Hypnum cupressiforme	—	0	—	—	—	2	29	15
Mnium undulatum	1	80	2	4	—	2	57	69
Pleuridium subulatum	—	0	1	—	—	—	14	8
Pleurozium schreberi	—	0	—	—	—	—	14	8
Polytrichum commune	—	0	—	2	4	3	43	31
Pseudoscleropodium purum	X	60	3	6	2	4	86	77
Rhytidiadelphus squarrosus	1	100	5	4	6	5	100	100
Thuidium tamariscinum	—	20	—	4	—	1	57	38
Chiloscyphus polyanthos	—	0	—	—	—	—	14	8
Lophocolea bidentata	1	60	—	1	4	2	86	77
Number of species	25	60	32	34	27	29	78	97
Average		30					30	29
Number of stands		5					7	13

TABLE 28. CAREX WET PASTURE

		Erica tetralix—Juncus acutiflorus facies					Juncus articulatus facies		
						K—Presence within the facies		K—Presence within the facies	K—Presence within the community
Reference no.		6316	6319	6323	6324		6355		
Map reference		NX 142 877	NX 153 883	NX 126 868	NX 124 868		NX 239 925		
Altitude	ft.	400	500	550	525		550		
Aspect		S	NW	NW	NW		E		
Slope		8°	5°	1°	6°		12°		
Cover— field	%	85	95	85	90		60		
ground	%	3	8	20	25		80		
Height— field	ins.	4–8	5	6			4		
Plot Area	sq. m.	4	4	4	4		1		
Soil		MBP	MG	MHG	MHG		HG		
Drainage		PPH	PH	PH	PH		PH–HP		
pH		5·6	5·3	5·5	6·3		6·0		
Soil Series		DP	AM	MS	MS		—		
Betula pubescens ssp. odorata		—	—	—	—	0	—	20	10
Pinus sylvestris		—	—	—	—	0	—	40	20
Juniperus communis		—	—	—	—	0	—	20	10
Betula pubescens seedlings		—	—	—	—	0	—	40	20
Calluna vulgaris		2	1	X	1	100	—	0	40
Crataegus monogyna seedlings		—	—	X	—	25	—	0	10
Erica cinerea		3	—	—	—	25	—	0	10
E. tetralix		3	6	5	3	100	—	40	60
Salix aurita/(cinerea ssp. atrocinerea)		—	—	—	—	0	—	0	10
S. repens		—	—	—	—	0	—	20	20
Thymus drucei		3	—	—	—	25	—	0	10
Equisetum palustre		—	—	—	—	0	—	60	30
Selaginella selaginoides		—	2	—	3	50	X	80	60
Agrostis canina		2	—	—	—	25	—	0	20
A. stolonifera		—	—	—	—	0	—	60	30
A. tenuis		1	—	—	—	25	—	0	10
Anthoxanthum odoratum		4	2	2	—	75	—	20	50
Briza media		—	—	—	—	0	4	20	10
Cynosurus cristatus		—	—	—	—	0	—	20	10
Festuca ovina		5	3	3	5	100	—	20	50
F. rubra		—	—	1	—	25	2	100	70
Helictotrichon pratense		1	—	—	—	25	—	0	10
Holcus lanatus		X	—	—	—	25	—	20	30
Koeleria cristata		3	X	—	—	50	—	0	20
Molinia caerulea		5	5	6	5	100	4	100	90
Nardus stricta		3	—	1	—	50	—	20	50
Poa pratensis		—	—	—	—	0	—	20	10
Sieglingia decumbens		1	1	—	—	50	—	20	30
Carex capillaris		—	—	—	—	0	—	20	10
C. caryophyllea		2	—	—	—	25	—	0	10
C. curta		—	—	—	2	25	—	0	10
C. demissa		—	—	—	—	0	2	20	10

TABLE 28—*continued*

Carex dioica	—	—	—	6	25	4	60	40
C. echinata	—	—	—	—	0	4	20	10
C. flacca	3	—	—	—	25	[7]	60	40
C. hostiana	—	3	3	3	75	4	60	60
C. lepidocarpa	—	—	—	—	0	—	40	20
C. nigra	—	—	—	3	25	3	20	30
C. ovalis	—	—	—	—	0	—	0	10
C. panicea	5	5	6	4	100	[7]	80	90
C. pulicaris	5	5	5	3	100	—	60	80
Eleocharis quinqueflora	—	—	—	—	0	3	60	30
Eriophorum angustifolium	—	—	—	X	25	2	80	50
E. latifolium	—	—	—	—	0	—	40	20
Juncus acutiflorus	4	4	4	1	100	—	0	40
J. articulatus	—	—	—	—	0	4	100	60
J. bulbosus	—	—	—	1	25	—	0	10
J. conglomeratus	—	—	—	—	0	—	0	10
Juncus sp.	—	—	—	—	0	1	20	10
Luzula campestris	(X)	—	—	—	25	—	0	10
Schoenus nigricans	—	—	—	6	25	—	20	20
Triglochin palustris	—	—	—	—	0	—	20	10
Achillea ptarmica	—	1	2	—	50	—	20	40
Ajuga reptans	—	—	—	—	0	—	20	10
Bellis perennis	—	—	—	—	0	—	20	10
Campanula rotundifolia	2	—	—	—	25	—	0	10
Cerastium holosteoides	—	—	—	—	0	—	40	20
Dactylorchis spp.	—	—	—	X	25	—	40	30
Drosera rotundifolia	—	—	—	X	25	—	0	10
Euphrasia micrantha	—	—	—	—	0	—	40	20
Euphrasia spp.	1	X	—	—	50	—	0	20
Filipendula ulmaria	—	—	—	—	0	X	40	20
Galium boreale	—	2	—	—	25	—	0	10
G. palustre	—	—	—	X	25	—	0	10
G. saxatile	—	—	—	—	0	—	0	10
G. uliginosum	—	—	—	—	0	—	0	10
Hydrocotyle vulgaris	—	—	—	—	0	—	20	10
Hypericum pulchrum	1	1	—	1	75	—	0	30
Leontodon autumnalis	—	—	—	—	0	—	20	10
Linum catharticum	1	—	—	—	25	—	40	30
Lotus corniculatus	3	—	—	—	25	—	0	10
Narthecium ossifragum	—	1	X	—	50	—	0	20
Parnassia palustris	—	—	—	X	25	1	60	40
Pedicularis palustris	—	—	—	1	25	—	60	40
P. sylvatica	—	—	X	—	25	—	0	10
Pinguicula vulgaris	—	X	—	X	50	3	80	60
Plantago lanceolata	2	—	—	—	25	—	20	20
Polygala serpyllifolia	—	—	—	X	25	—	0	10
P. vulgaris	(X)	—	—	—	25	—	0	10
Polygala sp.	—	—	—	—	0	—	20	10
Potentilla erecta	5	4	4	4	100	1	100	100
Prunella vulgaris	—	2	X	—	50	—	60	60
Ranunculus acris	X	1	2	—	75	—	40	60
R. flammula	—	—	—	—	0	X	20	20
Sagina nodosa	—	—	—	—	0	—	20	10
S. procumbens	—	—	—	—	0	—	20	10
Saxifraga azoides	—	—	—	—	0	—	20	10
Succisa pratensis	1	3	3	4	100	6	100	100
Trifolium repens	3	X	1	—	75	1	40	60
Veronica officinalis	—	—	—	—	0	—	40	20
Viola riviniana	2	—	—	—	25	—	0	10
Acrocladium cuspidatum	3	1	—	5	75	3	60	70
Aulacomnium palustre	—	—	—	—	0	—	0	10
Brachythecium mildeanum	—	—	—	—	0	—	20	10

TABLE 28—*continued*
CAREX WET PASTURE

	Erica tetralix—Juncus acutiflorus facies					Juncus articulatus facies		
Reference no.	6316	6319	6323	6324	K—Presence within the facies	6355	K—Presence within the facies	K—Presence within the comunity
Map reference	NX 142 877	NX 153 883	NX 126 868	NX 124 868		NX 239 925		
Altitude ft.	400	500	550	525		550		
Aspect	S	NW	NW	NW		E		
Slope	8°	5°	1°	6°		12°		
Cover— field %	85	95	85	90		60		
ground %	3	8	20	25		80		
Height— field ins.	4–8	5	6			4		
Plot Area sq. m.	4	4	4	4		1		
Soil	MBP	MG	MHG	MHG		HG		
Drainage	PPH	PH	PH	PH		PH–HP		
pH	5·6	5·3	5·5	6·3		6·0		
Soil Series	DP	AM	MS	MS		—		
Breutelia chrysocoma	—	—	1	—	25	—	0	10
Bryum pallens	—	—	—	X	25	—	0	10
B. pseudotriquetrum	—	—	—	—	0	—	60	30
Bryum sp.	—	—	—	—	0	1	20	10
Campylium stellatum	—	3	—	3	50	—	80	60
Cratoneuron filicinum	—	—	—	—	0	—	20	10
Climacium dendroides	—	—	—	—	0	—	20	20
Ctenidium molluscum	—	1	—	3	50	1	100	70
Dicranum bonjeani	—	—	—	1	25	—	0	10
D. scoparium	1	—	1	—	50	—	0	20
Ditrichum flexicaule	—	—	—	—	0	—	20	10
Drepanocladus revolvens	—	—	—	—	0	—	40	20
D. revolvens var. intermedius	—	—	—	3	25	8	20	20
D. vernicosus	—	—	—	—	0	—	20	10
Drepanocladus sp.	—	—	—	—	0	—	20	10
Eurhynchium praelongum	—	—	1	—	25	—	20	20
Fissidens adianthoides	—	—	—	2	25	2	100	60
Hylocomium brevirostre	—	—	2	—	25	—	0	10
H. splendens	2	1	3	—	75	—	20	40
Hypnum cupressiforme var. ericetorum	1	—	3	—	50	—	0	20
Mnium hornum	X	—	2	—	50	—	0	20
M. undulatum	—	—	—	—	0	—	20	10
Philonotis fontana	—	—	—	—	0	4	40	20
Pleurozium schreberi	—	1	X	—	50	—	0	20
Pseudoscleropodium purum	X	X	—	—	50	—	20	30
Rhytidiadelphus squarrosus	X	—	1	—	50	—	0	30
R. triquetrus	—	—	—	—	0	—	40	30
Scorpidium scorpioides	—	—	—	—	0	—	20	10
Thuidium delicatulum	—	—	(X)	—	25	—	0	10
T. tamariscinum	2	3	4	—	75	—	20	40
Calypogeia fissa	—	X	2	2	75	—	20	40
Cephalozia bicuspidata var. lammersiana	—	—	2	—	25	—	0	10
Cephalozia sp.	—	—	—	2	25	—	0	10
Lejeunea lamacerina	—	1	—	—	25	—	0	10

TABLE 28—*continued*

Lophocolea bidentata	—	—	1	—	25	—	40	30
Lophozia ventricosa	—	—	—	—	0	—	20	10
Pellia fabbroniana	—	—	—	—	0	—	40	20
Riccardia multifida	—	—	—	1	25	—	40	30
R. pinguis	—	—	—	X	25	—	0	10
Riccardia sp.	—	—	1	—	25	—	0	10
Cladonia pyxidata	—	—	—	—	0	—	20	10
Nitella	—	—	—	—	0	—	20	10
Number of species—(field and ground)	40	32	36	36	82	28	87	134
Average					36		35	34
Number of stands					4		5	10

TABLE 29

		DRY CALLUNA MOOR Nardus stricta facies				WET CALLUNA MOOR Molinia caerulea facies					
				K—Presence within the facies	K—Presence within the community					K—Presence within the facies	K—Presence within the community
Reference no.		637	63102			6311	6317	6321	6361		
Map reference		NX 428 806	NX 493 724			NX 211 972	NX 157 800	NX 054 743	NX 224 793		
Altitude	ft.	500	600			850	575	610	560		
Aspect		S	NW			NW	NW	NE	N		
Slope		32°	26°			3°	3°	15°	5°		
Cover—											
field	%	95	95			85	80	40	80		
ground	%	10	80			60	60	10	70		
Height—											
field	ins.	12	12			4	3	3	6		
Plot Area	sq. m.	4	4			4	4	4	4		
Soil		IP	IP			PG	MPG	PP	PG		
Drainage		P	P			PH	PH	PPH	PH		
pH		4·0	4·0			3·8	4·1	3·9	3·7		
Age of Calluna	years							1			
Soil Series		—	MM			AR	MS	DO	DY		
Pinus sylvestris (small trees)		—	—	0	0	—	—	—	—	0	4
Arctostaphylos uva-ursi		—	—	0	4	—	—	—	—	0	0
Betula pubescens seedlings		—	—	0	2	—	—	—	—	0	0
Calluna vulgaris		8	8	100	100	7	7	5	6	100	100
Empetrum nigrum		—	—	8	22	4	—	—	—	33	19
Erica cinerea		6	7	54	57	—	—	—	—	8	11
E. tetralix		—	—	8	7	3	4	3	3	100	96
Pinus sylvestris seedlings		—	—	0	2	—	—	—	—	0	7
Sarothamnus scoparius		—	—	8	2	—	—	—	—	0	0
Sorbus aucuparia seedlings		—	(X)	15	7	—	—	—	—	8	4
Vaccinium myrtillus		—	—	69	83	3	—	4	(X)	33	24
V. vitis-idaea		—	—	0	26	—	—	—	—	0	7
Blechnum spicant		—	(X)	8	7	—	—	—	—	0	0
Lycopodium clavatum		—	—	0	4	—	—	—	—	0	0
L. selago		—	—	0	4	—	—	—	—	0	0
Pteridium aquilinum		X	—	8	2	—	—	—	—	0	0
Agrostis canina ssp. montana		2	3	92	54	—	—	—	—	25	11
A. tenuis		—	—	0	9	—	—	—	—	0	8
Anthoxanthum odoratum		—	—	0	2	—	X	(X)	—	25	11
Deschampsia flexuosa		2	4	85	91	1	—	5	2	67	37
Festuca ovina		3	—	85	41	X	1	4	1	75	33
F. rubra		—	—	0	0	—	—	—	—	8	4
Holcus mollis		—	—	0	2	—	—	—	—	0	0
Molinia caerulea		—	—	23	7	—	6	—	3	83	54
Nardus stricta		1	1	85	28	3	X	—	—	67	37
Poa annua		—	—	0	0	—	—	—	—	0	4
P. pratensis		—	—	0	0	X	—	—	—	8	4
Sieglingia decumbens		1	4	31	9	—	—	—	—	0	0
Carex binervis		—	—	23	17	—	—	—	—	8	15
C. echinata		—	—	0	0	—	—	—	—	8	7
C. nigra		—	—	0	0	—	3	4	—	33	33
C. panicea		—	—	15	9	—	X	—	—	17	24
C. pilulifera		—	—	15	20	—	—	—	—	8	7
Carex spp.		—	—	8	7	—	—	—	—	8	4
Eriophorum angustifolium		—	—	0	0	—	—	—	3	25	22
E. vaginatum		—	—	0	0	—	—	—	3	8	7

TABLE 29—*continued*

Juncus effusus	—	—	8	2	—	—	—	—	0	0
J. kochii	—	—	0	0	—	—	—	—	8	4
J. squarrosus	—	—	54	22	6	—	1	4	75	63
Luzula multiflora	—	—	31	17	—	—	—	—	17	11
L. pilosa	—	—	8	11	—	—	—	—	0	0
Luzula sp.	—	—	8	2	—	—	—	—	0	0
Trichophorum caespitosum	—	—	8	2	1	5	3	8	83	89
Antennaria dioica	—	—	0	2	—	—	—	—	0	0
Campanula rotundifolia	—	—	0	4	—	—	—	—	0	0
Dactylorchis maculata ssp. ericetorum	—	—	0	0	—	—	—	—	8	7
Drosera rotundifolia	—	—	0	0	—	—	—	—	0	4
Euphrasia sp.	—	—	0	0	—	X	—	—	8	4
Galium saxatile	—	1	23	22	—	—	—	—	8	4
Lathyrus montanus	—	—	0	7	—	—	—	—	0	0
Listera cordata	—	—	15	13	3	—	—	—	17	7
Lotus corniculatus	—	—	0	2	—	—	—	—	0	0
Narthecium ossifragum	—	—	0	0	—	—	—	—	25	19
Polygala serpyllifolia	—	—	0	2	—	—	—	—	8	7
Potentilla erecta	1	2	92	61	—	X	(X)	(X)	50	30
Rumex acetosella	—	—	0	0	—	—	X	—	8	4
Succisa pratensis	—	—	0	0	—	—	—	—	8	4
Trientalis europaea	—	—	8	9	—	—	—	—	0	0
Veronica officinalis	—	—	0	2	—	—	X	—	8	4
Acrocladium cuspidatum	—	—	0	0	—	—	—	—	8	4
Aulacomnium palustre	—	—	0	0	—	—	—	—	25	11
Breutelia chrysocoma	—	—	0	0	—	—	—	—	8	4
Campylopus flexuosus	—	—	23	15	—	—	—	2	17	26
C. piriformis	—	—	0	4	—	—	—	—	8	4
Campylopus sp.	—	—	0	0	—	—	3	—	8	4
Ceratodon purpureus	—	—	0	2	—	—	—	1	8	4
Dicranella heteromalla	—	—	0	2	—	—	—	—	0	0
Dicranum fuscescens	—	—	0	15	—	—	—	—	0	4
D. majus	—	1	8	2	—	—	—	—	0	0
D. scoparium	—	X	77	85	5	4	—	7	92	93
Drepanocladus uncinatus	—	—	0	0	—	—	—	—	8	4
Hylocomium splendens	2	X	38	37	—	—	—	—	33	26
Hypnum cupressiforme var. ericetorum	2	8	100	91	3	4	3	4	100	96
Leptodontium flexifolium	—	—	8	7	—	—	4	—	8	4
Leucobryum glaucum	—	—	0	2	—	7	—	—	25	19
Mnium hornum	—	—	0	4	—	—	1	—	17	11
Plagiothecium undulatum	—	—	15	13	X	—	—	6	42	33
Pleurozium schreberi	3	5	77	78	2	—	—	2	67	63
Pohlia nutans	—	—	54	67	—	—	1	2	33	37
Polytrichum aurantiacum	—	—	15	4	—	—	—	—	0	0
P. commune	—	—	31	30	—	—	—	—	8	26
P. formosum	—	—	0	2	—	—	—	—	0	0
P. juniperinum	—	—	8	11	—	—	—	—	0	0
P. piliferum	—	—	0	4	—	—	—	—	0	0
Pseudoscleropodium purum	—	1	8	7	—	—	—	—	0	0
Rhacomitrium canescens	—	—	0	0	—	—	—	—	0	4
R. lanuginosum	—	—	0	0	—	—	—	—	0	19
Rhytidiadelphus loreus	—	—	8	4	4	—	—	—	25	15
R. squarrosus	—	2	38	22	—	—	—	—	17	7
R. triquetrus	—	—	0	9	—	—	—	—	0	4
Sphagnum capillaceum	—	—	0	0	6	—	—	—	17	7
S. compactum	—	—	0	0	—	—	—	—	17	41
S. papillosum	—	—	0	0	—	—	—	—	0	4
S. plumulosum	—	—	0	0	—	—	—	4	17	15
S. rubellum	—	—	0	0	—	—	—	—	8	15
S. subsecundum var. auriculatum	—	—	0	0	—	—	—	—	0	4

TABLE 29—*continued*

		DRY CALLUNA MOOR Nardu sstricta facies				WET CALLUNA MOOR Molinia caerulea facies					
Reference no.		637	63102	K—Presence within the facies	K—Presence within the community	6311	6317	6321	6361	K—Presence within the facies	K—Presence within the community
Map reference		NX 428 806	NX 493 724			NX 211 972	NX 157 800	NX 054 743	NX 224 793		
Altitude	ft.	500	600			850	575	610	560		
Aspect		S	NW			NW	NW	NE	N		
Slope		32°	26°			3°	3°	15°	5°		
Cover— field	%	95	95			85	80	40	80		
ground	%	10	80			60	60	10	70		
Height— field	ins.	12	12			4	3	3	6		
Plot Area	sq. m.	4	4			4	4	4	4		
Soil		IP	IP			PG	MPG	PP	PG		
Drainage		P	P			PH	PH	PPH	PH		
pH		4·0	4·0			3·8	4·1	3·9	3·7		
Age of Calluna	years							1			
Soil Series		—	MM			AR	MS	DO	DY		
Sphagnum subsecundum var. inundatum		—	—	0	0	—	—	—	—	8	4
S. tenellum		—	—	0	0	—	—	—	—	0	15
Sphagnum sp.		—	—	0	0	—	—	—	—	8	4
Barbilophozia attenuata		—	—	0	0	—	—	—	—	0	4
B. floerkei		—	—	0	13	—	—	—	—	8	15
B. hatcheri		—	—	0	2	—	—	—	—	0	0
Calypogeia fissa		—	—	8	2	—	X	—	3	25	19
C. (muelleriana)		—	—	15	9	3	—	—	—	17	19
C. neesiana		—	—	0	0	—	—	—	—	0	4
Cephalozia bicuspidata		—	—	0	4	—	—	—	—	8	7
C. connivens		—	—	0	0	—	—	—	—	8	15
C. media		—	—	0	2	—	—	—	—	0	7
Cephalozia spp.		—	—	0	0	—	—	1	—	0	7
Cephaloziella hampeana		—	—	0	4	—	—	—	—	0	7
C. starkei		—	—	0	9	—	—	—	—	0	0
Cephaloziella sp.		—	—	0	0	—	—	—	—	8	4
Diplophyllum albicans		—	—	0	7	—	—	—	—	0	19
Gymnocolea inflata		—	—	0	2	—	—	—	—	0	26
Gymnomitrion concinnatum		—	—	0	2	—	—	—	—	0	0
Lepidozia setacea		—	—	0	0	—	—	—	—	0	7
L. trichoclados		—	—	0	0	—	X	—	—	8	19
Lophocolea bidentata		—	2	54	28	—	—	—	—	25	15
Lophozia alpestris		—	—	0	2	—	—	—	—	0	0
L. bicrenata		—	—	0	4	—	—	—	—	0	0
L. incisa		—	—	0	2	—	—	—	—	0	0
L. porphyroleuca		—	—	0	4	—	—	—	—	0	0
L. ventricosa		—	—	8	4	1	—	—	3	17	37
Lophozia sp.		—	—	0	2	—	—	—	—	0	0
Marsupella emarginata		—	—	0	2	—	—	—	—	0	0
Mylia anomala		—	—	0	0	—	—	—	—	8	7
Odontoschisma sphagni		—	—	0	0	—	—	—	—	8	7
Ptilidium ciliare		—	—	0	7	2	—	—	—	17	7
Sphenolobus minutus		—	—	0	4	—	—	—	—	0	11
Tritomaria exsectiformis		—	—	0	0	—	—	—	—	0	4
Cladonia arbuscula		—	—	8	11	—	—	—	—	25	22
C. bellidiflora		—	—	0	0	—	—	—	—	0	4
C. cenotea		—	—	0	2	—	—	—	—	0	0

TABLE 29—*continued*

Cladonia cervicornis	—	—	0	2	—	—	—	—	0	0
C. chlorophaea	—	—	0	2	—	—	—	—	0	0
C. coccifera	—	—	0	11	—	—	—	—	0	11
C. coniocraea	—	—	0	2	—	—	—	—	0	0
C. cornuta	—	—	0	9	—	—	—	—	0	0
C. crispata	—	—	0	0	—	—	—	—	0	11
C. deformis	—	—	0	9	—	—	—	—	0	7
C. digitata	—	—	0	7	—	—	—	—	0	0
C. fimbriata	—	—	8	7	—	—	—	—	0	0
C. floerkeana	—	—	8	30	—	—	—	—	0	22
C. furcata	—	—	0	13	—	—	—	—	0	7
C. glauca	—	—	0	15	—	—	—	—	0	4
C. gracilis	—	—	0	11	—	—	—	—	0	4
C. impexa	—	—	15	41	—	—	—	—	17	48
C. macilenta	—	—	0	0	—	—	—	—	0	4
C. pityrea	—	—	0	2	—	—	—	—	0	0
C. pyxidata	—	—	0	28	—	—	—	—	0	26
C. rangiferina	—	—	0	0	—	—	—	—	0	4
C. rangiformis	—	—	0	2	—	—	—	—	0	0
C. scabriuscula	—	—	0	0	—	—	—	—	0	4
C. squamosa	—	—	0	26	—	—	—	—	17	26
C. tenuis	—	—	8	2	—	—	—	—	0	0
C. uncialis	—	—	0	7	—	—	—	—	0	15
Cladonia spp.	—	—	8	28	—	—	—	—	0	15
Cornicularia aculeata	—	—	0	4	—	—	—	—	0	4
Ochrolechia frigida	—	—	0	2	—	—	—	—	0	0
Parmelia physodes	—	—	8	33	—	—	—	—	0	30
Number of species	12	18	55	114	20	16	18	21	77	115
Average			16	17					19	20
Number of stands			13	46					12	27

TABLE 30. CALLUNA-ERIOPHORUM VAGINATUM-TRICHOPHORUM MOOR

	Dried-out Peat and Hummock facies		Narthecium ossifragum facies						Myrica gale facies			
Reference no.	6399	K—Presence within the facies	6374	6376	6390	6397	6398	K—Presence within the facies	6360	6383	K—Presence within the facies	K—Presence within the community
Map reference	NX 475 818		NX 506 895	NX 538 935	NX 582 913	NX 477 832	NX 477 832		NX 237 796	NX 448 932		
Altitude ft.	820		1400	800	740	830	830		450	950		
Aspect	NIL		NE	NNW	SE	NIL	NIL		SW	NIL		
Slope	0°		6°	1°	1°	0°	0°		3°	0°		
Cover— field %	68		65	70	75	50	40		80	60		
ground %	90		95	45	90	95	98		30	95		
Height— field ins.	10		9	5	10	8	8		10	12		
Plot Area sq. m.	1		4	4	4	4	4		4	4		
Soil	BPt		BPt	BPt	BPt	BPt	BPt		BPt	BPt		
Drainage	—		—	—	—	—	—		—	—		
pH	3·8		4·5	3·6	3·8	4·0	4·2		4·2	4·0		
Pinus sylvestris	—	0	—	—	—	—	—	4	—	—	0	2
Andromeda polifolia	—	0	—	—	—	—	4	4	—	—	0	2
Betula pubescens seedlings	—	20	—	—	—	—	—	4	—	—	25	6
Calluna vulgaris	7	100	3	6	—	4	(X)	96	—	3	75	94
Empetrum nigrum	6	20	—	—	—	—	—	33	—	—	0	34
Erica tetralix	—	80	4	4	6	4	5	100	3	4	100	90
Myrica gale	—	0	—	—	—	—	—	0	7	5	100	8
Vaccinium myrtillus	—	0	—	1	—	—	—	21	—	—	0	28
V. oxycoccus	—	0	—	—	—	—	—	38	1	—	25	28
Dryopteris carthusiana	—	0	—	—	—	—	—	0	—	—	25	4
Dryopteris sp.	—	0	—	—	—	—	—	0	—	—	0	2
Agrostis canina	—	0	2	—	—	—	—	4	—	—	0	2
Anthoxanthum odoratum	—	0	—	—	—	—	—	4	—	—	0	2
Deschampsia flexuosa	—	0	—	—	—	—	—	33	—	—	0	44
Festuca ovina	—	0	—	—	—	—	—	4	1	—	25	6
Molinia caerulea	—	0	2	5	—	5	5	29	8	5	75	24
Nardus stricta	—	0	2	—	—	—	—	4	—	—	25	4
Poa pratensis	—	0	—	X	—	—	—	4	—	—	0	2
P. trivialis	—	0	—	X	—	—	—	4	—	—	0	2
Carex curta	—	0	—	—	—	—	—	0	—	—	0	4
C. nigra	—	0	—	—	—	—	—	17	—	—	0	36
C. panicea	—	0	—	—	—	—	—	0	3	—	50	4
C. pauciflora	—	0	1	—	—	—	X	8	—	—	0	4
Carex spp.	—	0	—	—	—	—	—	4	—	—	25	6
Eriophorum angustifolium	4	40	6	4	4	5	5	83	3	4	75	70
Eriophorum vaginatum	4	100	3	2	5	—	1	96	3	4	75	96
Juncus kochii	—	0	X	—	—	—	—	4	—	—	0	2
J. squarrosus	—	0	—	5	—	—	—	13	—	—	25	18
Luzula multiflora	—	0	—	—	—	—	—	8	—	—	0	8
Luzula sp.	—	0	—	—	—	—	—	0	—	—	0	2
Rhynchospora alba	—	40	—	—	—	4	1	8	—	—	0	8
Trichophorum caespitosum	—	20	5	7	6	5	3	88	4	5	75	82
Cerastium holosteoides	—	0	—	X	—	—	—	4	—	—	0	2

TABLE 30—*continued*

Dactylorchis maculata ssp. ericetorum	—	0	—	—	—	—	—	0	—	—	0	2
Drosera intermedia	—	0	—	—	—	X	—	4	—	—	0	2
D. rotundifolia	1	60	4	—	X	5	4	79	—	4	25	46
Galium saxatile	—	0	—	—	—	—	—	0	—	—	0	8
Listera cordata	—	0	—	—	—	—	—	4	—	—	0	2
Menyanthes trifoliata	—	0	—	—	—	—	4	4	—	—	0	2
Narthecium ossifragum	—	0	5	3	6	5	4	88	4	4	100	52
Polygala serpyllifolia	—	0	*X*	—	—	—	—	4	—	—	0	2
Polygala sp.	—	0	—	—	—	—	—	0	2	—	25	2
Potentilla erecta	—	0	4	2	—	—	—	29	2	3	75	28
Aulacomnium palustre	—	20	—	—	—	—	—	42	1	—	50	44
Campylopus flexuosus	—	20	—	4	3	—	—	21	3	—	50	24
C. piriformis	—	20	—	—	—	—	—	4	—	—	0	14
Campylopus sp.	—	0	—	—	—	—	—	4	—	—	0	2
Dicranum scoparium	—	40	—	4	1	—	—	58	—	—	25	54
Drepanocladus fluitans	—	0	—	—	—	—	—	0	—	—	0	2
Hylocomium splendens	—	0	—	—	—	—	—	8	—	—	0	4
Hypnum cupressiforme var. ericetorum	6	60	—	1	3	—	—	58	1	1	75	68
H. imponens	—	0	—	—	—	—	—	0	—	—	0	2
Leucobryum glaucum	—	0	—	—	—	—	—	8	—	—	25	8
Mnium hornum	—	0	—	—	—	—	—	4	—	—	0	2
Plagiothecium undulatum	—	0	—	1	—	—	—	29	—	—	0	38
Pleurozium schreberi	1	40	—	3	—	—	—	54	2	—	50	60
Pohlia nutans	—	60	—	—	1	—	—	29	1	X	75	38
P. commune	—	0	—	—	—	—	—	38	—	—	25	24
P. juniperinum	—	20	—	—	—	—	—	4	—	—	0	8
Rhacomitrium lanuginosum	8	20	—	4	—	2	—	13	—	—	0	8
Rhytidiadelphus loreus	—	0	—	2	—	—	—	17	—	—	0	20
Rhytidiadelphus squarrosus	—	0	—	—	—	—	—	8	1	—	25	18
Sphagnum capillaceum	4	40	—	6	—	—	—	17	[4]	5	75	24
S. compactum	—	40	—	—	—	—	—	0	—	—	0	4
S. cuspidatum	—	20	6	—	—	—	4	29	—	—	25	22
S. magellanicum	—	40	—	—	—	—	[8]	46	—	[8]	50	32
S. molle	—	40	—	—	—	—	—	0	—	—	0	4
S. palustre	—	40	—	—	—	—	—	4	—	—	0	6
S. papillosum	—	0	8	3	6	8	[8]	54	4	[8]	50	40
S. plumulosum	—	0	—	—	—	5	2	38	—	—	25	30
S. recurvum	—	0	—	—	—	—	7	29	—	—	0	30
S. rubellum	—	0	5	—	6	—	—	25	[4]	-	25	18
S. subsecundum	—	0	—	—	—	4	—	4	—	—	0	2
S. tenellum	—	40	3	—	5	4	3	21	—	3	50	20
Sphagnum ssp.	—	0	—	—	—	—	—	13	—	—	0	8
Barbilophozia floerkei	—	0	—	—	—	—	—	4	—	—	0	6
Calypogeia fissa	—	0	—	—	4	—	—	8	4	—	50	12
Calypogeia (muelleriana)	—	0	—	3	—	—	—	54	—	1	50	58
C. sphagnicola	2	60	—	—	—	—	—	0	—	—	0	6
Calypogeia spp.	—	0	—	—	—	—	X	8	—	—	0	4
Cephalozia bicuspidata	—	20	—	—	[2]	—	—	4	—	—	0	8
C. connivens	—	60	—	2	[2]	—	—	33	1	3	50	32
C. leucantha	—	0	—	—	—	—	—	4	—	—	0	2
C. media	—	0	—	—	—	—	—	4	—	—	0	2
Cephalozia spp.	—	20	—	—	—	—	—	8	—	—	0	10
Cephaloziella hampeana	—	0	—	—	—	—	—	0	—	—	0	2
Cephaloziella spp.	—	0	—	—	—	—	—	8	—	—	0	4

TABLE 30—*continued*

CALLUNA-ERIOPHORUM VAGINATUM-TRICHOPHORUM MOOR

	Dried-out Peat and Hummock facies		Narthecium ossifragum facies						Myrica gale facies			
		K—Presence within the facies						K—Presence within the facies			K—Presence within the facies	K—Presence within the community
Reference no.	6399		6374	6376	6390	6397	6398		6360	6383		
Map reference	NX 475 818		NX 506 895	NX 538 935	NX 582 913	NX 477 832	NX 477 832		NX 237 796	NX 448 932		
Altitude ft.	820		1400	800	740	830	830		450	950		
Aspect	NIL		NE	NNW	SE	NIL	NIL		SW	NIL		
Slope	0°		6°	1°	1°	0°	0°		3°	0°		
Cover— field %	68		65	70	75	50	40		80	60		
ground %	90		95	45	90	95	98		30	95		
Height— field ins.	10		9	5	10	8	8		10	12		
Plot Area sq. m.	1		4	4	4	4	4		4	4		
Soil	BPt		BPt	BPt	BPt	BPt	BPt		BPt	BPt		
Drainage	—		—	—	—	—	—		—	—		
pH	3·8		4·5	3·6	3·8	4·0	4·2		4·2	4·0		
Diplophyllum albicans	—	0	—	—	—	—	—	0	—	2	25	2
Gymnocolea inflata	—	0	—	—	—	2	—	8	—	—	0	6
Lepidozia reptans	—	0	—	—	—	—	—	4	—	—	0	2
L. setacea	—	20	—	—	1	4	—	8	—	4	25	8
L. trichoclados	—	40	—	—	—	—	—	17	—	—	0	12
Ledidozia spp.	—	20	—	—	—	—	—	4	—	—	0	4
Lophocolea bidentata	—	0	—	—	—	—	—	0	—	—	0	6
Lophozia porphyroleuca	—	0	—	—	—	—	—	17	—	—	0	8
L. ventricosa	3	20	—	—	—	—	—	21	—	—	0	26
Lophozia spp.	—	0	—	—	—	—	—	8	—	—	0	8
Mylia anomala	—	40	—	2	2	—	—	33	—	—	0	22
M. taylori	—	0	—	—	5	1	—	8	—	—	0	4
Mylia sp.	—	0	—	—	—	—	—	0	—	2	25	2
Odontoschisma denudatum	—	0	—	—	5	—	—	4	—	—	0	2
O. sphagni	1	60	—	3	—	2	—	50	3	3	50	34
Pleurozia purpurea	—	0	—	—	—	4	—	4	—	—	0	2
Ptilidium ciliare	—	0	—	—	—	—	—	13	—	—	0	14
Riccardia sp.	—	0	—	—	—	—	—	0	—	1	25	2
Scapania gracilis	—	0	—	—	—	—	—	4	—	—	0	2
Sphenolobus minutus	—	0	—	—	—	—	—	8	—	—	0	4
Cladonia arbuscula	—	0	—	4	—	—	—	8	—	—	0	4
C. cornuta	—	20	—	—	—	—	—	0	—	—	0	2
C. crispata	—	20	—	—	—	—	—	0	—	—	0	2
C. deformis	—	0	—	—	—	—	—	4	—	—	0	2
C. fimbriata	—	20	—	—	—	—	—	0	—	—	0	2
C. floerkeana	—	20	—	—	—	—	—	0	—	—	0	2
C. furcata	—	20	—	—	—	—	—	0	—	—	0	2
C. glauca	—	0	—	—	—	—	—	8	—	—	0	4
C. gracilis	3	20	—	—	—	—	—	4	—	—	0	4
C. impexa	4	60	—	—	—	2	—	21	—	—	0	16
C. pyxidata	X	20	—	—	—	—	—	4	—	—	0	6
C. squamosa	—	20	—	—	—	—	—	0	—	—	0	6
C. unicalis	1	20	—	4	—	3	—	13	—	—	0	8
Cladonia spp.	—	20	—	—	—	—	—	8	—	—	0	12
Parmelia physodes	—	20	—	—	—	—	—	4	—	—	0	6
Mirasmius androsaceus	—	0	X	—	—	—	—	4	—	—	0	2
Number of species	16	47	19	28	20	21	19	98	24	23	43	123
Average		17						21			20	20
Number of stands		5						24			4	50

TABLE 31

	MOLINIA-MYRICA GALE MIRE					UPLAND CALLUNA-ERIOPHORUM VAGINATUM MOOR					
					K—Presence within the community						K—Presence within the community
Reference no.	6330	6366	6367	6371		631	632	6379	6389	63100	
Map reference	NX 146 883	NX 363 748	NX 367 739	NX 577 862		NX 132 785	NX 133 783	NX 508 913	NX 583 966	NX 517 827	
Altitude ft.	440	100	130	500		1375	1375	1800	1750	2440	
Aspect	SE	W	W	S		NIL	E	NW	NIL	SE	
Slope	8°	3°	2°	5°		0°	2°	6°	0°	5°	
Cover— field %	85	95	85	90		80	90	80	70	45	
ground %	1	50	70	70		85	55	90	95	90	
Height— field ins.	10	20	10	15		7	8	8	10	6	
Plot Area sq. m.	4	4	4	4		4	4	4	4	4	
Soil	G	BPt	BPt	G		BPt	BPt	BPt	BPt	BPt	
Drainage	PH	—	—	PH		—	—	—	—	—	
pH	5·6	4·6	4·8	4·2		3·9	3·5	3·9	3·9	3·9	
Soil Series	AM	—	—	LQ		—	—	—	—	—	
Calluna vulgaris	—	—	—	—	0	7	7	7	—	—	83
Empetrum nigrum	—	—	—	—	0	5	5	5	2	—	92
Erica tetralix	—	—	—	3	25	3	2	—	—	—	50
Myrica gale	6	6	6	7	100	—	—	—	—	—	0
Vaccinium myrtillus	—	—	—	—	0	1	5	7	7	3	75
V. oxycoccus	—	—	—	—	0	4	3	—	—	—	25
V. vitis-idaea	—	—	—	—	0	4	4	—	—	—	50
Dryopteris dilatata	—	(X)	—	—	25	—	—	—	—	—	0
Agrostis canina	—	—	5	4	50	—	—	—	X	1	17
Deschampsia flexuosa	—	—	—	—	0	X	2	—	5	5	42
Festuca ovina	—	—	—	—	0	—	—	—	X	—	8
Molinia caerulea	6	7	6	7	100	—	—	—	—	—	0
Sieglingia decumbens	4	—	—	1	50	—	—	—	—	—	0
Carex echinata	5	—	5	2	75	—	—	—	—	—	0
C. nigra	—	—	—	—	0	—	—	—	1	—	8
C. panicea	6	2	7	4	100	—	—	—	—	—	0
C. pulicaris	3	—	3	—	50	—	—	—	—	—	0
Eriophorum angustifolium	—	—	2	—	25	4	6	3	4	5	58
E. vaginatum	—	—	—	—	0	6	3	5	7	4	100
Juncus acutiflorus	3	6	3	4	100	—	—	—	—	—	0
J. squarrosus	—	—	—	—	0	—	1	5	3	5	67
Luzula multiflora	—	(X)	2	—	50	—	—	—	3	—	8
Schoenus nigricans	5	—	—	—	25	—	—	—	—	—	0
Trichophorum caespitosum	—	—	—	—	0	—	1	6	2	—	42
Angelica sylvestris	—	2	—	—	25	—	—	—	—	—	0
Carum verticillatum	—	(X)	—	—	25	—	—	—	—	—	0
Cirsium palustre	—	(X)	—	—	25	—	—	—	—	—	0
Dactylorchis maculata ssp. ericetorum	—	2	1	—	50	—	—	—	—	—	0
Drosera rotundifolia	—	—	1	—	25	—	—	(X)	—	—	8
Epilobium palustre	—	1	—	—	25	—	—	—	—	—	0
Galium saxatile	—	—	—	—	0	—	—	—	4	X	17
Listera cordata	—	—	—	—	0	X	—	—	—	—	17
Narthecium ossifragum	—	3	5	5	75	—	—	—	—	—	0
Pinguicula vulgaris	(X)	—	—	—	25	—	—	—	—	—	0
Potentilla erecta	5	4	4	2	100	—	—	—	X	—	8

TABLE 31—*continued*

	MOLINIA-MYRICA GALE MIRE					UPLAND CALLUNA-ERIOPHORUM VAGINATUM MOOR					
Reference no.	6330	6366	6367	6371	K—Presence within the community	631	632	6379	6389	63100	K—Presence within the community
Map reference	NX 146 883	NX 363 748	NX 367 739	NX 577 862		NX 132 785	NX 133 783	NX 508 913	NX 583 966	NX 517 827	
Altitude ft.	440	100	130	500		1375	1375	1800	1750	2440	
Aspect	SE	W	W	S		NIL	E	NW	NIL	SE	
Slope	8°	3°	2°	5°		0°	2°	6°	0°	5°	
Cover— field %	85	95	85	90		80	90	80	70	45	
ground %	1	50	70	70		85	55	90	95	90	
Height— field ins.	10	20	10	15		7	8	8	10	6	
Plot Area sq. m.	4	4	4	4		4	4	4	4	4	
Soil	G	BPt	BPt	G		BPt	BPt	BPt	BPt	BPt	
Drainage	PH	—	—	PH		—	—	—	—	—	
pH	5·6	4·6	4·8	4·2		3·9	3·5	3·9	3·9	3·9	
Soil Series	AM	—	—	LQ		—	—	—	—	—	
Rubus chamaemorus	—	—	—	—	0	—	—	—	—	—	33
Succisa pratensis	X	—	4	—	50	—	—	—	—	—	0
Viola riviniana	—	5	—	—	25	—	—	—	—	—	0
Acrocladium cuspidatum	1	3	2	—	75	—	—	—	—	—	0
Aulacomnium palustre	—	—	—	1	25	—	—	—	—	1	33
Campylium stellatum	2	—	—	—	25	—	—	—	—	—	0
Campylopus flexuosus	—	—	—	—	0	1	X	—	—	—	17
Dicranum scoparium	—	—	—	—	0	2	3	3	2	3	83
Fissidens adianthoides	1	—	—	—	25	—	—	—	—	—	0
Hylocomium splendens	—	—	—	1	25	—	—	—	—	—	0
Hypnum cupressiforme var. ericetorum	—	1	4	4	75	6	8	6	2	—	75
Plagiothecium undulatum	—	—	—	—	0	—	—	3	—	—	42
Pleurozium schreberi	—	—	—	—	0	3	2	4	5	1	100
Pohlia nutans	—	—	—	—	0	1	2	—	—	—	50
Polytrichum alpestre	—	—	—	—	0	—	—	—	6	4	42
P. commune	—	—	—	—	0	3	—	—	2	7	50
P. juniperinum	—	—	—	—	0	—	—	—	—	—	8
Pseudoscleropodium purum	—	—	4	3	50	—	—	—	—	—	0
Rhacomitrium lanuginosum	—	—	—	—	0	—	—	4	—	—	8
Rhytidiadelphus loreus	—	—	—	—	0	3	—	5	3	4	83
R. squarrosus	—	—	3	2	50	—	—	—	—	—	0
Sphagnum capillaceum	—	—	—	—	0	1	—	[7]	—	6	33
S. palustre	—	6	—	6	50	—	—	—	—	—	0
S. papillosum	—	—	—	—	0	6	—	—	6	—	33
S. plumulosum	—	—	7	—	25	(X)	—	—	—	—	58
S. recurvum	—	—	—	—	0	—	—	—	—	—	8
S. rubellum	—	—	—	—	0	—	—	[7]	—	—	17
S. subsecundum var. auriculatum	—	—	—	3	25	—	—	—	—	—	0
S. teres	—	—	—	5	25	—	—	—	—	—	0
Thuidium tamariscinum	—	—	3	1	50	—	—	—	—	—	0
Drepanocladus fluitans	—	—	—	—	0	—	—	—	—	—	8
Anastrepta orcadensis	—	—	—	—	0	—	—	2	—	—	8

TABLE 31—*continued*

Barbilophozia floerkei	—	—	—	—	0	—	—	—	—	1	17
Calypogeia fissa	—	3	3	—	50	5	—	—	4	—	17
C. (muelleriana)	X	—	—	2	50	—	2	4	—	—	75
C. neesiana	—	—	—	—	0	—	—	—	—	—	8
Cephalozia connivens	—	—	—	—	0	—	(X)	2	1	—	25
Cephaloziella hampeana	—	—	—	—	0	—	—	—	—	X	8
Diplophyllum albicans	—	—	—	—	0	—	—	—	—	—	8
Gymnocolea inflata	—	—	—	—	0	—	—	—	—	—	17
Lepidozia pearsonii	—	—	—	—	0	—	—	1	1	—	17
Lophozia incisa	—	—	—	—	0	—	—	1	—	1	17
L. porphyroleuca	—	—	—	—	0	—	—	—	—	—	8
L. ventricosa	—	—	—	—	0	X	—	2	3	1	50
Lophozia sp.	—	—	—	—	0	—	—	—	—	—	8
Mylia anomala	—	—	—	—	0	5	—	—	—	—	25
Odontoschisma sphagni	—	—	—	—	0	—	—	—	—	—	8
Ptilidium ciliare	—	—	—	—	0	—	—	X	4	5	42
Scapania sp.	—	—	—	—	0	—	—	3	—	—	8
Sphenolobus minutus	—	—	—	—	0	—	(X)	—	—	—	8
Cetraria islandica	—	—	—	—	0	—	—	1	—	—	8
Cladonia arbuscula	—	—	—	—	0	—	—	4	—	—	42
C. deformis	—	—	—	—	0	—	—	—	—	—	8
C. floerkeana	—	—	—	—	0	—	—	—	—	X	8
C. furcata	—	—	—	—	0	—	—	—	2	X	17
C. glauca	—	—	—	—	0	—	—	—	—	—	8
C. gracilis	—	—	—	—	0	—	—	—	—	—	8
C. impexa	—	—	—	—	0	2	—	—	—	—	25
C. pyxidata	—	—	—	—	0	—	—	—	3	—	8
C. uncialis	—	—	—	—	0	—	—	3	—	—	8
Cladonia spp.	—	—	—	—	0	—	—	—	—	X	33
Parmelia physodes	—	—	—	—	0	—	—	—	—	—	8
Number of species	15	18	21	20	39	24	19	27	27	22	69
Average					19						21
Number of stands					4						12

TABLE 32

		VACCINIUM-CAREX BIGELOWII-RHACOMITRIUM HEATH												MONTANE JUNCUS SQUARROSUS MOOR	
		Salix herbacea facies							Remainder						
								K—Presence within the facies				K—Presence within the facies	K—Presence within the community		
Reference no.		6358	6380	6381	6392	6393	63101		6356	6382	6394			6357	6395
Map reference		NX 428 855	NX 502 911	NX 594 980	NX 497 872	NX 493 873	NX 516 826		NX 419 853	— — —	NX 499 872			NX 420 853	NX 499 871
Altitude	ft.	2760	2280	2600	2660	2650	2450		2500	2600	2650			2550	2650
Aspect		NE	NW	SW	NW	NW	NW		SW	NE	NE			NIL	S
Slope		8°	7°	6°	4°	6°	5°		9°	6°	3°			0°	5°
Cover—field	%	30	45	65	40	50	50		70	70	30			85	90
ground	%	35	60	70	25	85	60		50	80	98			90	60
Height—field	ins.	1	1	2	½–1	1	1½		1	2	1			4	3
Plot Area	sq. m.	4	4	4	4	4	4		4	4	4			4	4
Soil		MP	MP	MP	MP	MP	MP		MP	MP	MP			MP	MP
Drainage		P	P	P	P	P	P		P	P	P			PPH	PPH
pH		4·4	4·0	4·0	4·5	3·8	3·9		4·2	3·9	3·7			4·0	4·3
Soil Series		MZ	MZ	—	MZ	MZ	MZ		MZ	—	MZ			MZ	MZ
Salix herbacea		5	6	6	7	7	5	100	—	—	—	0	70	—	—
Vaccinium myrtillus		6	5	5	2	4	5	100	6	7	5	100	100	4	5
V. vitis-idaea		—	3	5	—	—	1	57	—	1	—	33	50	—	—
Lycopodium selago		—	X	—	—	—	—	14	—	—	—	0	10	—	—
Agrostis canina ssp. montana		3	3	2	4	4	3	100	3	4	5	100	100	5	5
A. tenuis		(X)	—	—	—	—	—	29	—	—	—	0	20	4	—
Deschampsia flexuosa		5	5	6	4	5	4	100	5	5	5	100	100	4	5
Festuca ovina		[5]	4	4	—	[4]	—	71	6	4	1	100	80	5	7
F. vivipara		[5]	—	—	3	[4]	5	57	—	2	—	33	50	—	—
Carex bigelowii		4	7	5	2	2	5	100	6	6	3	100	100	5	2
C. pilulifera		—	—	—	—	—	—	14	4	—	—	33	20	—	—
Juncus squarrosus		—	X	—	—	—	—	14	—	—	—	0	10	7	7
Campanula rotundifolia		—	—	—	—	—	—	0	2	—	—	33	10	—	—
Galium saxatile		—	1	5	(X)	1	—	71	2	5	X	100	80	4	2
Potentilla erecta		—	—	—	—	—	X	29	—	—	—	0	20	—	1
Solidago virgaurea		—	—	—	X	—	—	14	—	—	—	0	10	—	—

Campylopus flexuosus	—	[4]	—	—	2	—	29	—	—	X	33	30	—	—	
Campylopus sp.	—	—	—	—	—	1	14	—	—	—	0	10	—	—	
Dicranella heteromalla	1	[4]	—	1	(X)	X	88	—	—	—	0	60	—	—	
Dicranum fuscescens	—	—	1	—	2	—	29	—	5	1	67	40	—	X	
D. scoparium	—	—	4	—	—	X	29	1	4	—	67	40	3	2	
Hypnum cupressiforme var. ericetorum	—	—	—	—	—	—	14	1	X	—	67	30	4	3	
Plagiothecium undulatum	—	—	—	—	—	—	0	—	—	—	0	0	—	X	
Pleurozium schreberi	—	—	—	—	—	—	14	—	—	—	0	10	7	3	
Pohlia nutans	—	—	—	2	1	1	57	—	—	—	0	40	—	—	
Polytrichum alpestre	—	—	—	—	—	—	0	—	—	—	0	0	—	6	
P. alpinum	—	—	1	—	3	3	57	—	—	—	0	40	—	—	
P. aurantiacum	—	X	—	—	—	—	14	1	5	1	100	40	4	4	
P. piliferum	—	3	—	3	2	(X)	71	—	—	—	0	50	—	—	
Rhacomitrium heterostichum	—	—	—	4	—	—	14	—	—	—	0	10	—	—	
R. lanuginosum	7	6	8	3	8	6	100	7	6	10	100	100	—	3	
Rhytidiadelphus loreus	—	—	X	—	—	—	14	—	—	—	0	10	7	4	
Anastrepta orcadensis	—	—	—	—	—	—	0	—	—	—	0	0	1	—	
Barbilophozia floerkei	—	—	—	—	—	—	0	—	—	—	0	0	—	6	
Cephaloziella starkei	—	—	—	—	—	—	0	—	—	—	0	0	—	X	
Diplophyllum albicans	—	[2]	—	1	2	1	71	—	—	—	0	50	—	3	
Gymnocolea inflata	—	—	—	—	—	—	14	—	—	—	0	10	—	—	
Lophozia ventricosa	—	X	—	—	—	—	14	—	1	—	33	20	—	—	
Lophozia spp.	—	—	—	—	1	1	29	—	—	—	0	20	—	—	
Nardia scalaris	—	—	—	4	—	2	43	—	—	—	0	30	—	—	
Ptilidium ciliare	—	—	—	—	—	—	0	—	X	—	33	10	2	2	
Scapania gracilis	—	[2]	—	—	—	—	14	—	1	—	33	20	—	—	
Scapania sp.	—	—	—	—	(X)	—	14	—	—	—	0	10	—	—	
Cetraria islandica	—	1	3	—	2	2	57	3	4	1	100	70	—	X	
Cladonia cervicornis	—	2	—	4	3	4	57	—	—	—	0	40	—	—	
C. coccifera	—	—	1	—	—	4	29	—	1	—	33	30	—	—	
C. floerkeana	—	—	[2]	—	—	—	14	—	—	X	33	20	—	—	
C. furcata	—	—	[2]	—	—	—	14	—	—	—	0	10	—	—	
C. gracilis	—	3	—	—	—	(X)	29	—	1	—	33	30	—	—	
C. squamosa	—	—	—	—	1	—	14	—	—	—	0	10	—	—	
C. uncialis	—	X	3	—	3	1	71	4	4	1	100	80	—	X	
Cladonia spp.	3	5	—	1	4	—	71	3	1	—	67	70	—	X	
Cornicularia aculeata	1	1	3	—	3	3	88	X	—	X	67	80	—	—	
Lichen spp.	1	—	—	—	—	—	29	—	—	—	0	20	—	—	
Ochrolechia frigida	—	—	—	—	2	—	14	—	—	—	0	10	—	—	
Number of species	13	24	19	17	25	24	48	16	21	14	26	50	15	24	26
Average							21				17	20			20
Number of stands							7				3	10			2

TABLE 37. BACKHILL OF BUSH BOG

Depth cms	Botanical* composition	Ash per cent	pH	Per cent total O.D.							C:N
				CaO	Na_2O	K_2O	MgO	P_2O_5	C	N	
0–50	ES	2·95	4·33	0·14	0·03	0·02	0·26	0·06	49·4	2·31	21·4
50–100	SEAP	1·85	4·35	0·10	0·03	0·01	0·27	0·04	53·2	2·05	25·6
100–150	SECAP	1·58	4·57	0·09	0·04	0·01	0·24	0·03	55·9	1·80	31·1
150–200	SEAP	1·21	4·62	0·07	0·05	0·02	0·41	0·03	54·6	1·27	43·0
200–250	SEAP	1·19	4·61	0·06	0·05	0·02	0·46	0·04	55·1	1·15	47·9
250–290	SEAP	1·78	4·61	0·07	0·05	0·02	0·38	0·03	55·6	1·16	48·0
290–350	SEWAP	1·20	4·60	0·10	0·05	0·02	0·39	0·03	55·2	1·10	50·2
350–400	ECxAP	1·47	4·62	0·20	0·05	0·02	0·34	0·03	55·4	1·32	42·0
400–470	EAP	1·98	4·72	0·27	0·05	0·03	0·28	0·04	57·0	1·43	39·8
470–500	WAP	2·30	4·74	0·32	0·04	0·01	0·23	0·06	57·0	1·45	39·3

* S: Sphagnum E: Eriphorum C: Calluna Cx: Carex W: Wood AP: Amorphous peat

APPENDIX X

Peat Analysis

TABLE 35. DORNAL BOG

Depth cms	Botanical* composition	Ash per cent	pH	Per cent total O.D. CaO	Na_2O	K_2O	MgO	P_2O_5	C	N	C:N
0–50	ETS	2·36	3·64	0·11	0·04	0·03	0·21	0·08	52·4	1·96	26·7
50–100	ETS	1·44	3·84	0·11	0·05	0·01	0·27	0·04	53·0	1·36	39·0
100–150	ES	1·38	4·10	0·11	0·04	0·01	0·25	0·04	53·3	1·32	40·4
150–195	ES	1·42	4·23	0·16	0·05	0·01	0·24	0·04	54·0	1·21	44·6
195–250	SEAP	1·65	4·44	0·26	0·05	0·01	0·24	0·05	54·3	1·38	39·3
250–300	WCAP	2·13	4·50	0·48	0·05	0·01	0·28	0·05	55·0	1·45	37·9
300–350	WCCx	2·74	4·64	0·59	0·05	0·01	0·27	0·05	55·8	1·70	32·8
350–380	WCx	3·20	4·81	0·72	0·05	0·01	0·28	0·07	53·6	1·61	33·3
380–400	WCx	3·49	4·82	0·78	0·05	0·01	0·28	0·06	54·6	1·64	33·3
400–450	WAP	3·54	4·89	1·00	0·05	0·01	0·32	0·05	54·4	1·63	33·4
450–500	WAP	3·39	4·97	1·03	0·05	0·01	0·34	0·04	54·7	1·66	33·0
500–550	WCAP	3·20	4·96	1·11	0·04	0·01	0·36	0·03	54·6	1·54	35·5
550–600	WCAP	3·87	4·88	1·19	0·04	0·01	0·49	0·04	54·3	1·42	38·2
600–650	CxW	4·79	4·92	1·09	0·04	0·02	0·39	0·09	54·1	1·40	38·6

*S: Sphagnum E: Eriophorum T: Trichophorum C: Calluna Cx: Carex W: Wood AP: Amorphous peat.

TABLE 36. CAIRNADLOCH BOG

Depth cms	Botanical* composition	Ash per cent	pH	Per cent total O.D. CaO	Na_2O	K_2O	MgO	P_2O_5	C	N	C:N
0–45	ES	4·79	3·89	0·16	0·02	0·02	0·13	0·10	50·6	1·87	27·0
45–80	EWS	10·2	4·21	0·15	0·02	0·03	0·13	0·12	50·1	1·92	26·1
80–100	ES	4·34	4·29	0·20	0·02	0·01	0·11	0·11	52·4	2·17	24·2
100–180	EWCxAPS	3·24	4·30	0·31	0·02	0·01	0·11	0·11	53·5	2·28	23·5
180–240	WAP	48·6	4·59	0·32	0·02	0·08	0·41	0·41	29·8	1·30	22·9

*S: Sphagnum E: Eriophorum Cx: Carex W: Wood AP: Amorphous peat

TABLE 34. INDICES OF SIMILARITY BETWEEN PLANT COMMUNITIES

	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	P1	P2	P3	P4	P5	P6	P7	P8	M1	M2	M3	M4	M5	M6	M7	M8	M9	
W—Woodland																													Total in W
W1—Base-rich woodland		48·2	52·9	45·3	26·5	17·9	11·4	18·6	7·2	35·7	21·0																		284·7
W2—*Endymion non-scriptus* woodland	48·2		56·9	52·7	45·6	34·4	24·4	32·2	16·8	46·2	29·3																		386·7
W3—*Holcus mollis-Dryopteris dilatata* woodland	52·9	56·9		54·7	57·8	38·8	38·4	37·5	28·6	47·9	34·6																		448·1
W4—*Dryopteris-Rubus* woodland	45·3	52·7	54·7		40·6	26·5	25·7	28·0	20·4	47·3	23·9																		365·1
W5—*Holcus mollis-Anthoxanthum odoratum* woodland	26·5	45·6	57·8	40·6		56·5	47·7	41·6	32·7	43·4	31·8																		424·2
W6—*Anthoxanthum odoratum* woodland	17·9	34·4	38·8	26·5	56·5		42·2	36·0	24·5	30·7	27·9																		335·4
W7—*Vaccinium myrtillus* woodland	11·4	24·4	38·4	25·7	47·7	42·2		60·1	58·3	22·4	17·1																		347·7
W8—*Deschampsia flexuosa* woodland	18·6	32·2	37·5	28·0	41·6	36·0	60·1		47·3	24·7	14·0																		340·0
W9—*Calluna vulgaris* woodland	7·2	16·8	28·6	20·4	32·7	24·5	58·3	47·3		17·6	11·6																		265·0
W10—*Deschampsia caespitosa* woodland	35·7	46·2	47·9	47·3	43·4	30·7	22·4	24·7	17·6		42·6																		358·5
W11—*Juncus acutiflorus* woodland	21·0	29·3	34·6	23·9	31·8	27·9	17·1	14·0	11·6	42·6																			253·8
P—Pasture																													Total in P
P1—*Agrostis-Festuca* basic grassland													41·0	58·5	34·4		24·2	34·7	32·9										225·7
P2—*Agrostis-Festuca* meadow grassland												41·0		45·4	22·2		11·1	50·5	27·9										199·1
P3—*Agrostis-Festuca* acid grassland												58·5	45·4		56·2		35·3	44·0	29·8										269·2
P4—*Nardus* grassland												34·4	22·2	56·2			59·7	38·3	25·6										236·4
P5—*Vaccinium* heath																													
P6—*Molinia* grassland												24·2	11·1	35·3	59·7			24·7	25·3		56·5		30·9						180·3
P7—*Juncus acutiflorus* pasture												34·7	50·5	44·0	38·3		24·7		36·7				28·2						228·9
P8—*Carex* wet pasture												32·9	27·9	29·8	25·6		25·3	36·7					43·5						178·2
M—Moorland																													Total in M
M1—Dry *Calluna* moor																					58·1	40·8	16·6	47·3	34·4		35·0		232·2
M2—Wet *Calluna* moor																	56·5			58·1		59·4	21·5	53·6	25·3		24·1		242·0
M3—*Calluna-Eriophorum vaginatum-Trichophorum* moor																				40·8	59·4		21·3	63·8	22·9		18·2		226·4
M4—*Molinia-Myrica* moor																	30·9	28·2	43·5	16·6	21·5	21·3		14·3	4·0		5·4		83·1
M5—Upland *Calluna-Eriophorum vaginatum* moor																				47·3	53·6	63·8	14·3		32·8		24·7		236·5
M6—*Calluna*-lichen heath																				34·4	25·3	22·9	4·0	32·8			36·6		144·1
M7—*Vaccinium*-lichen heath																													
M8—*Vaccinium-Carex bigelowii-Rhacomitrium* heath																				35·0	24·1	18·2	5·4	24·7	36·6				144·0
M9—Montane *Juncus squarrosus* moor																													

Note: The values for certain communities are not calculated because of the small number of stands sampled.

TABLE 33—*continued*

Major Soil Sub-group	Peaty Gleys											Montane Podzols										
Additional Sub-division and Variants	PG							MPG	HG	MHG		MP									GMP	
Soil Series	SD	PM	FL	SD	DY	AR	DY	MS	—	MS	MS	MZ	MZ	—	MZ	MZ	MZ	MZ	—	MZ	MZ	MZ
Plant Community or Facies	P6a	P6a	P6a	P6b	P6b	M2b	M2b	M2b	P8b	P8a	P8a	M8a	M8a	M8a	M8a	M8a	M8a	M8b	M8b	M8b	M9	M9
Reference Number	6345	6347	6348	6343	6378	6311	6361	6317	6355	6323	6324	6358	6380	6381	6392	6393	63101	6356	6382	6394	6357	6395
Altitude— in feet	825	900	1050	775	1050	850	560	575	550	550	525	2760	2280	2600	2660	2650	2450	2500	2600	2650	2550	2650
Aspect— Compass point	SW	NE	SE	SW	SE	NW	N	NW	E	NW	NW	NE	NW	SW	NW	NW	NW	SW	NE	NE	Nil	S
Slope— in degrees	8°	8°	6°	7°	11°	3°	5°	3°	12°	1°	6°	8°	7°	6°	4°	6°	5°	9°	6°	3°	0°	5°
Soil Drainage Category	PH	PH	PH	PH	PH	PH	PH	PH	PH-HP	PH	PH	P	P	P	P	P	P	P	P	P	PPH	PPH
pH of Surface Horizon	3·7	4·0	3·8	4·1	3·8	3·8	3·7	4·1	6·0	5·5	6·3	4·4	4·0	4·0	4·5	3·7	3·9	4·2	3·9	3·7	4·0	3·8
Percentage Base Saturation of Surface Horizon	8·5	25·3	16·1	12·4	10·9	15·8	7·0	18·0	78·6	74·8	91·3	13·7	5·1	5·9	1·5	3·8	7·1	2·9	1·0	6·0	3·4	3·9
Percentage Base Saturation of B horizon	11·9	20·6	51·9	12·2		76·5	8·7	87·5	89·9	90·3	100	0·9	2·0	0·8	0·5	1·1	1·0	0·9	0·8	1·7	1·3	1·2
Percentage Base Saturation of C Horizon	56·0	35·4	89·7	87·8		91·8	37·4	100	82·3	100	100	1·5		9·7	1·5	3·7		3·2	0·4		4·5	1·5
Exchangeable Calcium* me/100 g—surface	3·36 2·03	16·05 9·61	5·98 3·39	3·41 2·01	2·91 1·68	4·37 2·47	0·36 0·18	3·60 2·02	49·60 33·31	15·80 11·40	14·59 8·96	3·94 3·22	0·0 0·0	0·62 0·55	0·0 0·0	0·0 0·0	0·0 0·0	0·32 0·26	0·0 0·0	0·62 0·51	0·0 0·0	1·18 0·69
Exchangeable Magnesium* me/100 g—surface	1·96 1·18	5·58 3·34	4·67 2·65	2·90 1·71	3·59 2·07	6·88 3·89	3·56 1·82	7·17 4·02	6·61 4·44	30·72 22·16	45·88 28·18	0·58 0·47	0·84 0·53	0·31 0·27	0·17 0·15	0·36 0·26	0·63 0·54	0·34 0·27	0·17 0·13	0·57 0·47	0·89 0·74	0·93 0·55
Carbon: Nitrogen Ratio in Surface Horizon	16	16	16·5	13	17	21	24	22	17	12	19	15	15	11	11	20	10	13	19	20	15	16
Total P_2O_5-mg/100 g* in Surface Horizon	329 198	304 182	474 269	413 244	215 124	204 115	215 110	191 107	178 120	202 148	149 92	244 199	409 256	169 149	181 158	271 194	185 158	234 188	160 123	175 145	196 162	417 245

TABLE 33—*continued*

Major Soil Sub-group	Peaty Podzols								Non-calcareous Gleys							
Additional Sub-division and Variants	PP							RPP	G							MG
Soil Series	DO	DO	DO	DO	BD	DO	DO	—	LQ	ER	BJ	BJ	LQ	AM	LQ	AM
Plant Community or Facies	P4a	P4a	P6b	P6b	P6b	P6b	M2b	P4c	P7a	P7b	P7b	P7b	P7b	M4	M4	P8a
Reference Number	633	6388	6313	6315	6350	6359	6321	634	6322	638	6329	6349	6391	6330	6371	6319
Altitude— in feet	1060	1350	710	750	1100	500	610	1000	670	500	1000	1050	750	440	500	500
Aspect— Compass point	E	S	E	S	SE	SW	NE	E	W	NW	SW	S	NE	SE	S	NW
Slope— in degrees	8°	17°	6°	11°	15°	8°	15°	13°	9°	10°	11°	8°	4°	8°	5°	5°
Soil Drainage Category	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PH	PH	PH	PH	PH	PH	PH	PH
pH of Surface Horizon	4·1	4·0	3·6	3·7	3·9	3·9	3·9	4·5	5·1	5·7	5·4	4·4	4·9	5·6	4·6	5·3
Percentage Base Saturation of Surface Horizon	12·1	6·0	12·6	9·6	15·4	6·8	8·4	3·4	28·1	71·2	62·1	18·3	21·9	91·4	20·9	63·0
Percentage Base Saturation of B horizon	1·2	0·5	0·9	0·8	1·1	1·4	1·5		62·6	94·6	78·0	20·1	24·4	100	22·3	88·3
Percentage Base Saturation of C Horizon		0·8	0·5	0·8		2·3	2·2		58·8	100	88·5	85·9	50·3	100	41·9	
Exchangeable Calcium* me/100 g—surface	3·37	1·63	2·81	0·85	5·91 3·25	0·35 0·20	1·72 0·86	3·34 0·34	4·19 3·31	7·41 6·63	13·46 11·39	3·73 2·60	4·44 3·70	22·77 18·24	2·72 2·38	8·18 6·11
Exchangeable Magnesium* me/100 g—surface	2·36 1·33	1·14 0·78	7·83 4·24	7·05 3·75	5·40 2·97	3·30 1·86	3·95 1·98	3·68 0·60	4·10 3·24	3·98 3·56	4·33 3·66	4·09 2·85	0·87 0·73	24·09 19·30	1·67 1·46	22·08 16·50
Carbon: Nitrogen Ratio in Surface Horizon	15	17	22	20	18	21	23	17	12	14	10	11	14·5	10·5	11	15
Total P_2O_5-mg/100 g* in Surface Horizon	377 212	228 156	259 140	384 208	502 276	342 193	226 113	242 170	393 311	162 145	269 227	633 441	317 264	125 100	126 110	210 157

TABLE 33—*continued*

Major Soil Sub-group	Blanket Peat															
Additional Sub-division and Variants																
Soil Series																
Plant Community or Facies	P6b	M3b	M3c	M3c	M3c	M3c	M3c	M3d	M3d	M4	M4	M5	M5	M5	M5	M5
Reference Number	6384	6399	6374	6376	6390	6397	6398	6360	6383	6366	6367	631	632	6379	6389	63100
Altitude— in feet	800	820	1400	800	740	830	830	450	950	100	130	1375	1375	1800	1750	2440
Aspect— Compass point	NW	Nil	NE	NNW	SE	Nil	Nil	SW	Nil	W	W	Nil	E	NW	Nil	SE
Slope— in degrees	5°	0°	6°	1°	1°	0°	0°	3°	0°	3°	2°	0°	2°	6°	0°	5°
Soil Drainage Category																
pH of Surface Horizon	3·8	3·8	4·6	3·6	3·8	4·0	4·2	4·2	4·1	4·2	4·9	4·0	3·7	3·7	3·9	3·9
Percentage Base Saturation of Surface Horizon	18·9		12·3	2·1	19·7			13·4	17·0	32·0	58·7	19·2	21·0	17·5	13·6	10·4
Percentage Base Saturation of B horizon																
Percentage Base Saturation of C Horizon																
Exchangeable Calcium* me/100 g—surface	9·33 5·14		8·47 4·73	0·69 0·40	8·65 4·88			6·04 3·41	5·96 3·41	9·54 5·81	25·59 17·49	6·06 3·08	8·55 4·44	5·95 3·26	5·94 3·21	0·0 0·0
Exchangeable Magnesium* me/100 g—surface	8·48 4·67		1·86 1·04	0·98 0·56	5·43			5·12 2·89	6·19 3·54	9·76 5·97	5·28 3·61	10·54 5·35	13·17 6·84	10·25 5·61	5·43 2·94	6·01 3·19
Carbon: Nitrogen Ratio in Surface Horizon	18		29	22	26			16	17·5	11	11	36	30	26	23	24
Total P_2O_5-mg/100 g* in Surface Horizon	136 75		147 82	166 95	131 74			208 117	173 99	235 143	195 133	177 90	182 95	142 78	246 133	252 134

TABLE 33. MAJOR SOIL SUB-GROUPS AND VARIANTS—PLANT COMMUNITIES AND FACIES WITH MAIN SITE CHARACTERISTICS

Major Soil Sub-group	Brown forest Soils of low base status																							
Additional Sub-division and Variants	BFS				BMS		BP																	
Soil Series	DL	DL	BN	LP	DL	DL	LP	LP	LP	DL	—	LP	—	LP	DE	LP	DE	LP	LP	—	—	LP	DE	LP
Plant Community or Facies	W1c	P1	P1	P2	P1	P1	W2	W2	W2	W2	W2	W3a	W3b	W4b	W5b	W5b	W5b	W5b	W7a	P3b	P3b	P3b	P3b	P4a
Reference Number	6340	6318	6354	6362	6325	6326	6334	6335	6336	6341	6342	6369	6339	6363	635	636	6337	6385	6386	6328	6346	6370	6372	6314
Altitude—in feet	350	500	600	300	400	400	130	150	200	300	200	400	400	350	350	350	200	350	350	1000	675	500	750	700
Aspect—Compass point	E	E	SW	SW	S	S	Nil	SW	S	E	SE	NW	SE	N	W	SW	Nil	SW	N	S	N	SW	S	E
Slope—in degrees	31°	7°	28°	18°	17°	16°	0°	5°	9°	18°	28°	24°	18°	10°	22°	14°	0°	12°	16°	20°	8°	9°	13°	10°
Soil Drainage Category	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
pH of Surface Horizon	5·1	5·2	5·4	6·0	5·8	6·0	4·3	4·7	4·1	4·5	4·3	4·1	4·3	3·9	4·5	3·8	4·3	4·0	3·8	4·5	4·7	4·7	4·9	4·8
Percentage Base Saturation of Surface Horizon	53·1	43·2	56·5	64·8	66·5	72·7	25·6	35·2	13·6	12·9	12·6	4·2	8·2	2·2	3·7	9·8	8·7	4·6	11·1	1·4	10·6	18·9	6·3	17·9
Percentage Base Saturation of B horizon	82·4	73·6	76·0	49·8		82·7	8·8	10·8	1·3	6·5	2·1	3·8	11·5		1·6	0·2	1·4	2·4	1·4	0·8	12·5	2·1	1·0	2·2
Percentage Base Saturation of C Horizon				57·9						1·5	3·9				1·8	0·6	5·1		0·7		41·6	2·5	2·4	3·0
Exchangeable Calcium* me/100 g—surface	8·55 7·76	5·62 4·87	6·31 5·59	19·07 16·15	7·51 6·48	7·91 6·63	7·99 6·19	11·81 9·42	5·65 4·35	2·54 2·07	1·26 1·04	0·0 Nil	1·58 1·32	1·15 0·79	1·56 1·33	1·25 1·09	0·0 0·0	0·0 0·0	0·0 0·0	0·0 0·0	0·62 0·58	3·19 2·48	0·0 0·0	3·40 3·03
Exchangeable Magnesium* me/100 g—surface	3·48 3·16	5·45 4·72	9·89 8·76	1·74 1·47	29·83 25·52	34·83 29·20	4·81 3·73	3·56 2·84	2·21 1·70	1·47 1·20	1·43 1·18	0·38 0·34	0·95 0·79	0·26 0·18	1·00 0·85	1·00 0·87	3·00 2·34	1·22 0·92	7·78 4·67	0·26 0·21	0·24 0·23	1·97 1·53	0·96 0·80	1·34 1·19
Carbon: Nitrogen Ratio in Surface Horizon	12	10	13	10	12	12	10	15	10	12	13	14	14	12·5	12	10	12·5	16	18	16·5	13	14·5	11	11
Total P_2O_5-mg/100 g* in Surface Horizon	187 170	332 287	134 119	307 260	152 130	162 136	454 352	246 196	325 250	313 255	253 208	199 181	255 213	322 221	161 137	211 183	225 176	217 164	229 137	291 239	160 150	355 276	315 263	332 296

**Note*: Two values for exchangeable calcium, exchangeable magnesium and total phosphorus are given. The specific gravity of organic soil material is less than that of mineral soil material and in order to compare the levels of different nutrients more realistically, a correction factor for the amount of organic matter present has been applied. The second value is the corrected figure and the correction factor is $100/(x+100)$ where x is the percentage of organic matter. The correction factor is based on the fact that the specific gravity of soil organic matter is 1·35 and an average specific gravity of soil mineral matter is 2·7 (the S.G. of granite).

TABLE 33—*continued*

Major Soil Sub-group	Brown Forest Soils with gleyed B and C horizons										Iron Podzols									
Additional Sub-division and Variants	GBP										MBP	IP						GP		RP
Soil Series	DP	DP	AX	DP	KZ	AX	DJ	KZ	GD	—	DP	—	KU	MM	MM	—	MM	—	—	—
Plant Community or Facies	W1a	W1b	W1b	W1c	P2	P2	P2	P3b	P4a	P4a	P8a	W8	P4a	P4a	P4c	M1b	M1b	P4b	P4b	W7a
Reference Number	6333	6331	6387	6332	639	6320	6351	6310	6344	6352	6316	6365	6353	6377	6373	637	63102	6312	6327	6338
Altitude—in feet	50	50	300	50	500	480	925	750	780	900	400	300	900	1500	1650	500	600	900	950	200
Aspect—Compass point	E	SE	E	SE	W	W	S	NW	S	S	S	N	NE	SE	NE	S	NW	SW	N	Nil
Slope—in degrees	17°	19°	6°	24°	10°	12°	5°	19°	7°	15°	8°	10°	9°	30°	21°	32°	26°	6°	24°	0°
Soil Drainage Category	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	P	P	P	P	P	P	PPH	PPH	PPH
pH of Surface Horizon	5·6	5·3	5·1	6·0	5·3	6·1	5·4	4·6	4·1	5·0		3·7	4·2	3·9	4·2	4·0	4·1	4·0	4·0	3·8
Percentage Base Saturation of Surface Horizon	86·3	69·5	43·6	81·7	49·9	64·6	72·2	30·9	18·1	18·7	58·7	12·6	3·1	4·4	5·8	14·8	14·5	14·8	11·71	15·1
Percentage Base Saturation of B horizon	71·4	100	73·6	100	60·8	26·4	97·9	40·6	15·8	9·8	99·8	0·5	2·1	1·1	1·2	0·7	1·8	3·0	0·9	
Percentage Base Saturation of C Horizon	94·2	100	83·2	100	97·7	12·7	95·7	48·1	3·5	11·5	100	1·0	2·9	1·1	1·1					
Exchangeable Calcium* me/100 g—surface	13·31 11·35	6·68 6·08	5·93 5·21	25·38 22·28	4·65 4·28	12·06 10·58	10·42 9·57	2·48 2·29	5·82 3·66	1·56 1·39	8·57 6·86	8·41 4·89	0·67 0·40	0·0 0·0	0·0 0·0	3·13 2·57	5·86 3·38	8·49	4·30	5·83
Exchangeable Magnesium* me/100 g—surface	13·89 11·83	7·90 7·19	1·62 1·42	9·42 8·23	1·90 1·75	1·25 1·10	2·37 2·18	2·28 2·11	4·21 2·64	0·79 0·70	21·66 17·33	6·06 3·52	0·85 0·51	1·25 0·91	1·49 1·06	0·63 0·52	4·30 2·48	4·75 2·48	4·24 2·45	7·27 4·33
Carbon: Nitrogen Ratio in Surface Horizon	11	15	10	10	13	12·5	11	13	17	11	11	19	15	14	13	24	27	20	14	16
Total P_2O_5-mg/100 g* in Surface Horizon	206 175	128 116	143 126	201 176	128 118	175 154	257 236	126 116	446 280	197 175	157 126	166 97	406 245	316 223	305 216	115 95	218 126	295 154	417 241	262 146

(continued overleaf)

Index

C

E

F

N

S

Printed in Scotland for Her Majesty's Stationery Office by Bell and Bain Ltd., Glasgow
Dd. 230128/2455 K8 12/72

ORDNANCE SURVEY OF GREAT BRITAIN

SOIL SURVEY OF SCOTLAND

LAND USE CAPABILITY

CARRICK – SHEET 8 & PART OF GIRVAN – SHEET 7

LAND USE CAPABILITY

EXPLANATION OF SYMBOLS AND COLOURS

LAND SUITABLE FOR THE GROWING OF ARABLE CROPS

CLASS AND SEVERITY OF LIMITATIONS	SUBCLASS - Type of limitation on use						
	No limitations on use	SOIL LIMITATIONS				SITE LIMITATIONS	
		Root zone defects		Drainage defects		Topography	Climate
		Shallow soils	Stony soils	Surface-water logging	Ground-water logging	Steep slopes	
1 No limitations	(colour)						
2 Minor limitations		SH	SN	SW	GW	TP	
3 Moderately severe limitations			SN	SW	GW	TP	
4 Severe limitations				SW	GW	TP	CL

LAND UNSUITABLE FOR THE GROWING OF ARABLE CROPS

CLASS AND SEVERITY OF LIMITATIONS	SUBCLASS - Type of limitation on use								
	SOIL LIMITATIONS					SITE LIMITATIONS			
	Root zone defects		Peaty Layer	Drainage defects		Topography			Climate
	Excessively sandy soils	Shallow soils		Surface-water logging	Ground-water logging	Steep slopes	Rocky areas	Soil pattern limitations	
5 Severe limitations restrict use to improved grassland and forestry	SA	SH		SW	GW	TP	RK	PM	CL
6 Very severe limitations restrict use to rough grazing and forestry			OR	SW	GW	TP	RK	PM	
7 Extremely severe limitations, land unsuitable for forestry, some rough grazing and amenity value							RK		CL

Built up areas

Quarries etc.

This classification is an interpretation derived from the soil map, the topography and the climate. It is not intended to give direct information of crop yield agricultural profitability or the monetary value of land.

Land Classes assessed by C. J. Bown & R. E. F. Heslop.
Soil Survey Cartographers W.S. Shirreffs & A. D. Moir.
Head of Soil Survey, R. Glentworth.
THE MACAULAY INSTITUTE FOR SOIL RESEARCH, ABERDEEN, 1967.

1500/69

Scale: One Inch to One Statute Mile = 1:63,360
" One Centimetre to ·6336 of a Kilometre

Heights are in feet above Mean Sea Level. Contours are at 50 feet vertical intervals.

The submarine contours are given in fathoms and are taken from the soundings of Admiralty surveys.

Contours in lochs are given in feet and are taken from the bathymetrical survey of fresh water lochs of Scotland.

Based on the Seventh Series One-Inch Map, parts of Sheets 67, 72, 73 & 79 dated 1955.

The representation on this map of a road, track or footpath is no evidence of the existence of a right of way.

Made and published by the Director General *of the* Ordnance Survey, Southampton, 1969, *for the* Macaulay Institute for Soil Research, Soil Survey of Scotland.