THE SOILS ROUND PERTH, ARBROATH AND DUNDEE

THE SOIL SURVEY OF SCOTLAND

The Macaulay Institute for Soil Research, Aberdeen

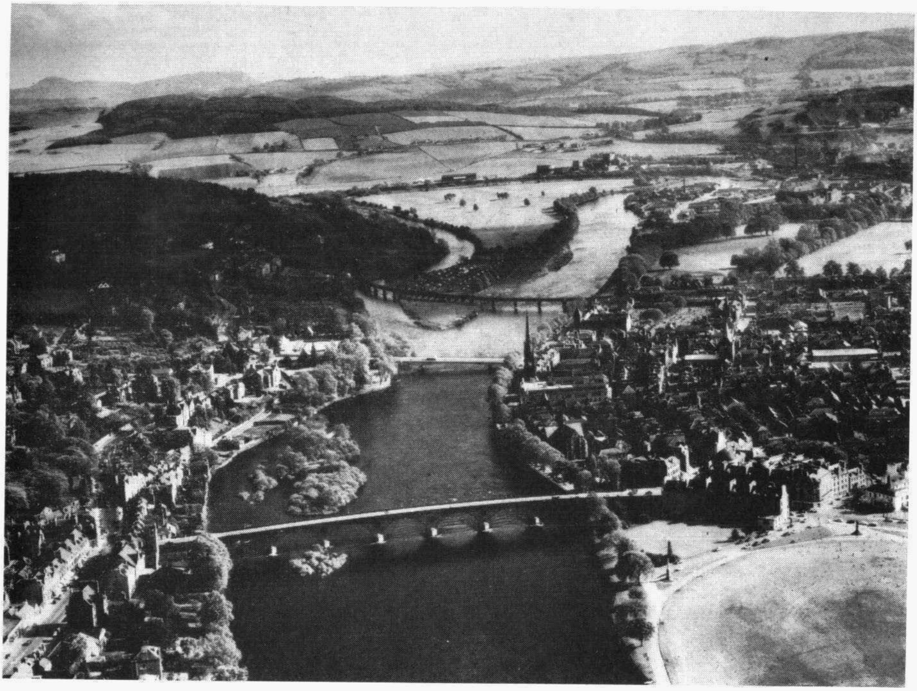

PLATE 1

Perth and the River Tay with Ochil Hills in background.

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DEPARTMENT OF AGRICULTURE AND FISHERIES
FOR SCOTLAND

MEMOIRS OF
THE SOIL SURVEY OF GREAT BRITAIN

SCOTLAND

The Soils of the Country round Perth, Arbroath and Dundee

(Sheets 48 and 49)

By D. LAING, B.SC. A.R.I.C.

With an account of the Vegetation

By J. S. ROBERTSON, B.SC. *and* E. L. BIRSE, B.SC.

The Macaulay Institute for Soil Research

EDINBURGH

HER MAJESTY'S STATIONERY OFFICE

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Preface

THIS PUBLICATION is the eighth memoir of the Soil Survey of Scotland. The survey was made between 1956 and 1963 by Mr. D. Laing assisted, during different periods by Mr. J. C. C. Romans, Mr. E. Lawrence, Mr. A. D. Walker, Mr. C. J. Bown and Mr. R. D. Law. Correlation of the work was done by Mr. R. Grant. The maps and diagrams were prepared by Mr. W. S. Shirreffs and Mr. A. D. Moir of the Soil Survey Cartographic Section. Members of staff from other departments in the Macaulay Institute for Soil Research have contributed to this memoir in various ways: Dr. H. G. M. Hardie and staff of the Soil Analysis Section of the Department of Pedology 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 discussion of analytical data and Appendices III and IV: Dr. R. L. Mitchell wrote the section on trace elements: Mr. B. D. Mitchell and the late Mr. W. A. Mitchell of the Department of Pedology wrote the section on clay and fine sand fractions based on their differential thermal, X-ray and microscopical examinations: Mr. P. Jowsey contributed the section on peat. Miss A. M. B. Geddes and Mr. J. W. Muir read the manuscript and offered much helpful advice.

Copies of the field maps at the 1:25,000 scale are kept at the headquarters of the Soil Survey where they may be inspected by appointment.

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January, 1974.

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LOCATION AND EXTENT

The district described in this memoir covers the area of Sheets 48 and 49 of the Ordnance Survey 3rd Edition and extends over 550 square miles, of which 150 square miles lie in south-east Angus, 275 square miles in Perthshire and 125 square miles in north-east Fife. The wide estuary of the River Tay, covering 27 square miles separates Fife from north-east Perthshire and Angus (Figs. 1 and 2).

On the north side, the boundary runs from Dunkeld eastwards to Arbroath, on the west side, from Dunkeld southwards to Dunning, and on the south side, from Dunning eastwards to Babbet Ness some 6 miles down the coast from St. Andrews. The cities of Perth and Dundee and the smaller towns of St. Andrews, Cupar and Arbroath are included in this area. Perth, the Gateway to the Highlands is an agricultural market while Dundee with its suburbs forms the commercial and industrial centre of the district. St. Andrews, seat of the oldest university in Scotland, and at one time the ecclesiastical capital of the country, has long been famed throughout the world as the headquarters of golf.

PHYSICAL FEATURES

With the exception of a small area of the Grampian Highlands around Dunkeld in the north west, the district surveyed lies wholly within the Midland Valley of Scotland (Fig. 3). Eight landform regions can be distinguished, and are listed and discussed below; some regions divide naturally into sub-regions (Fig. 4).

1. The Grampian Foothills
2. Strathmore
3. The Sidlaw Range
4. The Carse
5. The Coastal Fringe of Fife and Angus
6. The Ochil Range
7. Strath Eden
8. The East Fife Uplands

1. The Grampian Foothills cover the high ground in the north-west of the district, and, in addition to the foothills of the Grampian Highlands, include the lower hills about Caputh and Gourdie which lie to the east of the Highland Boundary Fault. On the south side of the River Tay, which crosses the region through the Birnam gap, a maximum height of 1324 feet is reached in Birnam Hill, while Craig Obney, further south, rises to 1232 feet. On the

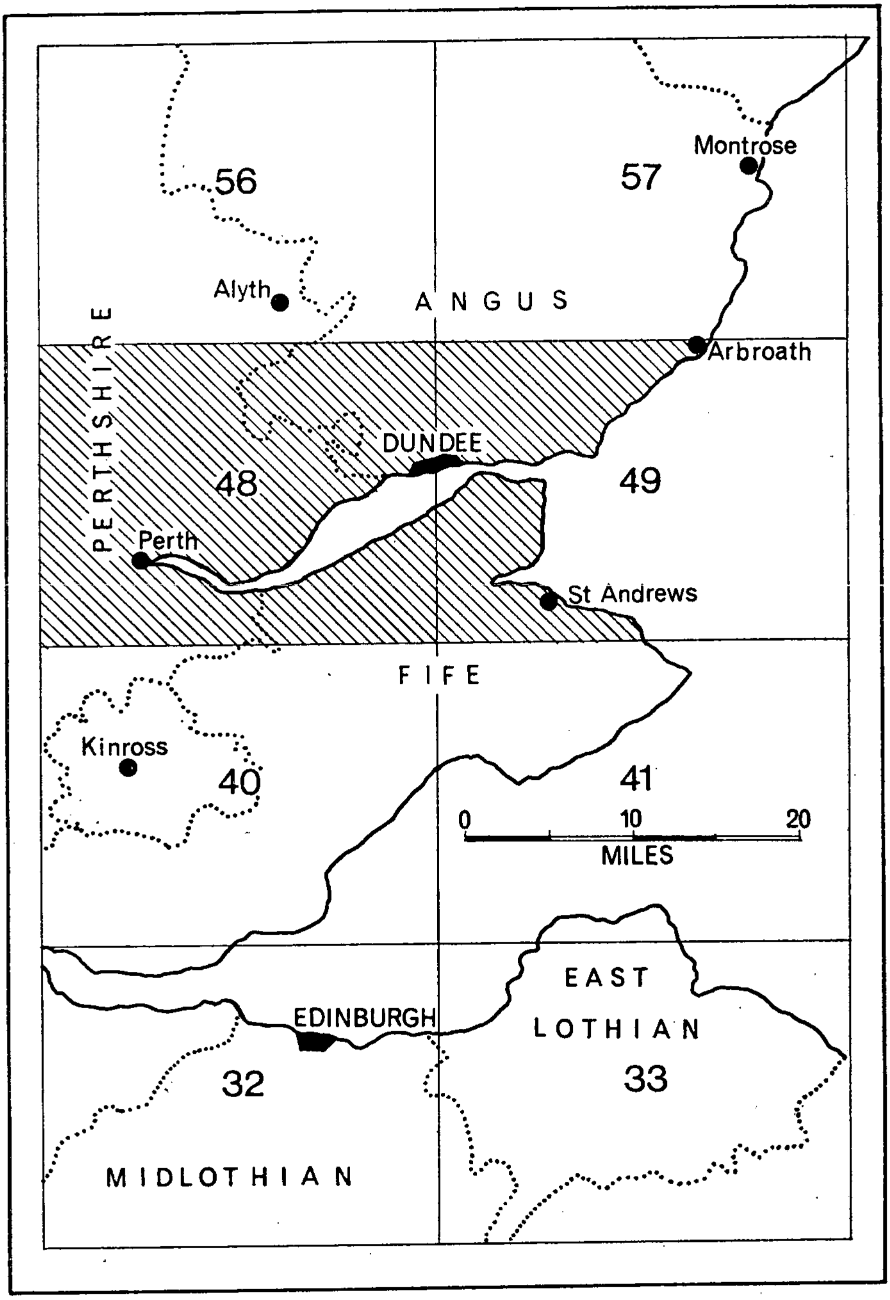


FIG. 1: Location of area.

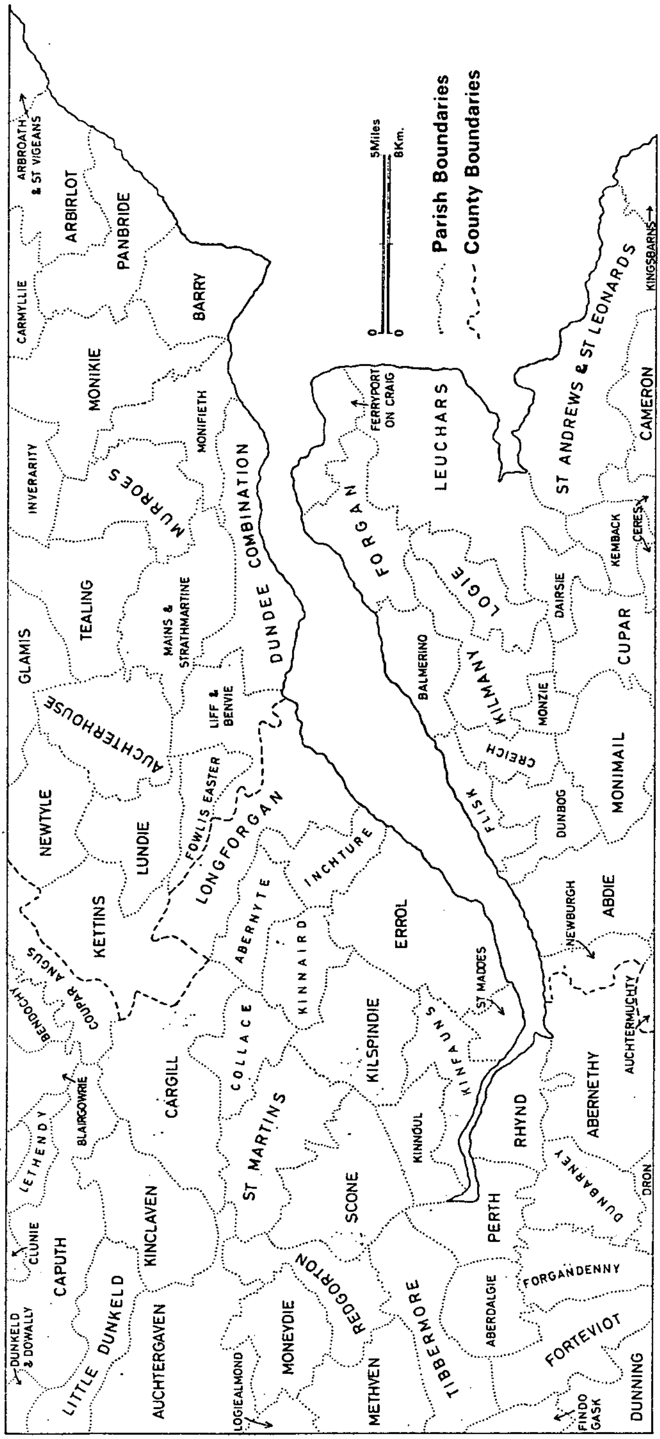


FIG. 2: Civil Parishes.

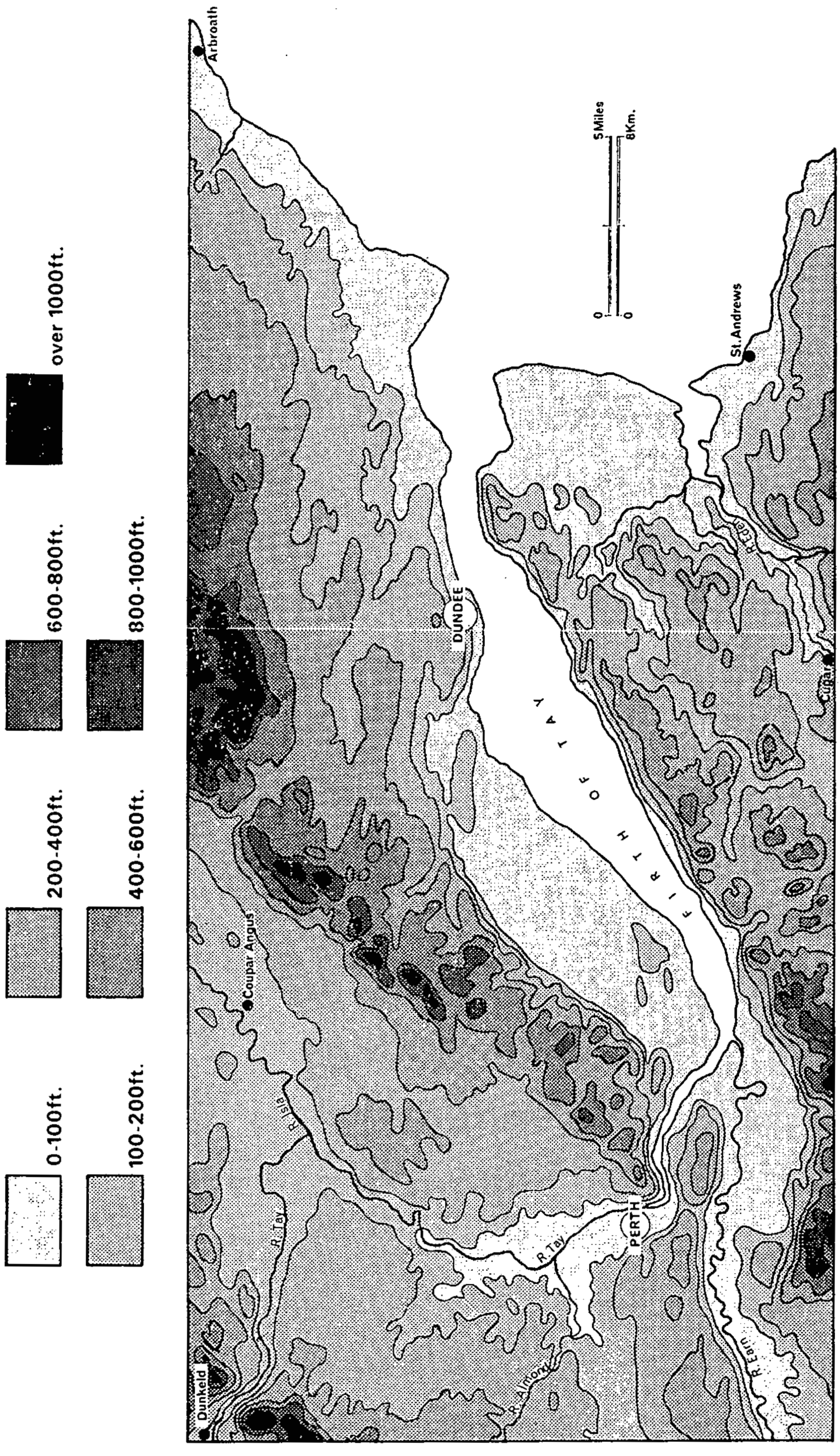


FIG. 3: Physical features.

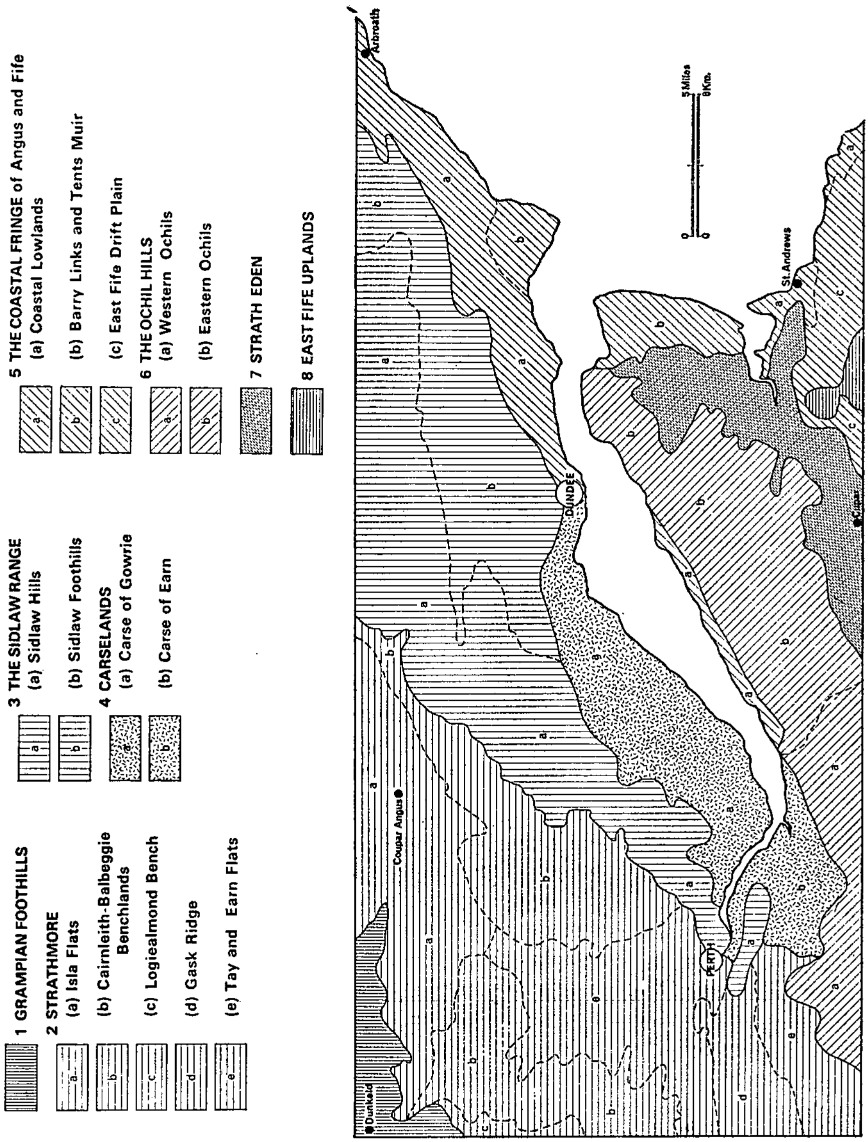


FIG. 4: Landform regions.

north side of the river the highest peak is Newtyle Hill (1041 feet), while to the east of the Highland Boundary Fault the elevation falls to 572 feet in Caputh Hill and 517 feet in Hill of Gourdie.

2. The Strathmore region, extending from the northern margin south-eastwards by Perth to Dunning, forms part of the wide valley which lies between the Grampian Highlands and the Sidlaw and Ochil Hills. The main portion of the region, lying to the north and north-east of Perth, is drained by the River Tay and its tributaries, the Isla and the Almond; to the south of Perth, the lower Earn forms the main drainage channel. The region can be divided into five sub-regions, the most northerly of which, the Isla Flats, occurs around and to the west of Coupar Angus. The Flats comprise large level areas of recent alluvium and higher river terraces associated with the Isla and, to a lesser extent, with the Tay. The alluvial flats, occurring at levels up to 125 feet, are composed of sandy or loamy material, while the terraces, which reach a height of 200 to 250 feet, consist mainly of coarser fluvio-glacial deposits.

Southwards the ground rises gradually to between 300 and 400 feet in the Benchlands of Cairnleith and Balbeggie, which form the second sub-region: between Stanley and Bridge of Isla they are separated by the valley of the Tay.

Rising from the Cairnleith Benchland, at an elevation of 500 to 700 feet, the eastern extremity of the Logiealmond Bench forms the third sub-region, the main portion extending westwards across the boundary of the district to the Grampian Foothills. Below Stanley, the narrow valley separating the Benchlands opens out into the lowlands of the Tay and Earn Flats, a sub-region extending beyond Perth to the south-west limit of Strathmore. In addition to the alluvial flats bordering the rivers Tay and Almond in the vicinity of Perth, the region includes alluvial areas in the valley of the River Earn to the south and south-west of the city. Following the line of the Earn, at a height of 400 to 500 feet, a portion of the Gask Ridge rises above the Earn Flats and stretches from the western margin to the village of Aberdalgie.

3. The Sidlaw Range extends from Kinnoull Hill (792 feet) on the outskirts of Perth some 12 miles along the eastern edge of Strathmore to the Perthshire border and thence a further 12 miles into Angus as far as Labothie Hill (750 feet) at the northern margin of Sheet 49.

The Sidlaw Hills form the main hill portion of the Range, which attains its greatest width and height in Angus just north of Dundee. Auchterhouse Hill (1399 feet) Craigowl (1492 feet) and Gallow Hill (1242 feet), the highest points, form the crest of a great terraced escarpment overlooking the Strathmartine district behind Dundee. Within the county of Perth the general level of the hill-tops is around 900 feet, but several peaks, such as Black Hill (1182 feet) and King's Seat (1236 feet), are over 1000 feet. Towards the south-west the elevation is lower, not much over 700 feet.

Over a large part of the region, the configuration of the hills is determined by the distribution and thickness of the lava flows of which they are mainly composed. In the east, where the flows thin out and are separated by lines of sandstones, the ridges and valleys of the Sidlaws occur; in the higher central parts of the Range sheets of intrusive igneous rocks have broken through the sandstone, giving the irregular terraced appearance of Craigowl and other summits. On the south side of the River Tay, Moncreiffe Hill (725 feet) is an outlier of the Range.

On the eastern side of the Range the Sidlaw Foothills slope down from a height of between 500 and 600 feet to meet the Coastal Fringe of Angus at about 250 feet. The relief is generally undulating, with drumlins or mounds of glacial till rising to 500 feet and dominating much of the landscape, although in the area round Dundee igneous plugs form sharply defined hills such as Dundee Law.

4. The Carse of Gowrie extends from Longforgan, just west of Dundee, along the northern edge of the Firth of Tay as far as Perth. Over the greater part of the Carse, which is a raised plain of estuarine clays, general elevation is below 50 feet, except where several small sandstone hills protruding through the clay rise to between 50 and 100 feet. These often carry farmsteads or villages, Inchture and Errol being typical examples. On the south side of the River Tay, the Carse of Earn, which is also composed of estuarine clays and has many of the features of the Carse of Gowrie, reaches an elevation of between 30 and 35 feet. A little to the north of Bridge of Earn, Moncrieffe Hill rises above the Carse and partly separates the area of carseland bordering the Tay from that bordering the Earn.

5. The Coastal Fringe of Fife and Angus can be divided into three sub-regions. The Coastal Lowlands sub-region extends over the areas of raised beach lying between the 25-foot and 125-foot contours. Around the coast of Angus, and extending inland, traces of three beach levels can be recognized, at 100 feet, 50 feet and 25 feet. The 100-foot beach can be traced as a shelf running from Arbroath through Panbride and Barry almost to Dundee. There is a sharp drop to the 50-foot beach which can be seen at East Haven and Carnoustie. Much of Broughty Ferry is built on this terrace which ends about one and a half miles west of the town. On the south side of the River Tay, the Coastal Lowlands stretch as a narrow strip of raised beach from the mouth of the River Earn to Wormit. The sub-region is also represented in the vicinity of St. Andrews and further to the east where it extends down the coast from Buddo Ness to the southern margin of Sheet 49.

The 25-foot beach, which is the most conspicuous of the marine features in the district, constitutes the second sub-region. Extending almost continuously from Arbroath to Dundee, it forms the Barry Links by Carnoustie; in Fife, it is represented by the Pilmore Links and by Tents Muir, where the largest area of wind-blown sand on the east coast of Scotland has accumulated.

The East Fife Drift Plain covers the remainder of the Fife Coastal Fringe and extends from the Eden Valley eastwards to the 100-foot beach line. Varying in elevation from 100 feet to 350 feet, the plain is penetrated by the volcanic mass of the East Fife Uplands.

6. The Ochil Hills can be divided into the Western and Eastern Ochils. From the southern margin near Dunning in Perthshire, the Western Ochils extend to the outskirts of Newburgh in Fife. The highest point is Culteuchar Hill (1028 feet) 5 miles south of Perth. Some 6 miles to the east is Glen Farg through which the main road from Perth passes to Kinross and the Forth Road Bridge and the River Farg drains north-eastwards to the River Earn.

Still further east, Abernethy Glen provides another traffic route through the hills and a channel for the Ballo Burn which flows northwards to join the Earn. East of Glen Farg the hills skirt the Carse of Earn and come close to the River Tay, the sub-region terminating in Ormiston Hill (777 feet) outside Newburgh.

Beyond the transverse valley of Lindores, which runs south-eastwards from Newburgh to Collessie, the Ochil Range continues as the Eastern or Fifeshire Ochils. With the exception of Norman's Law, 5 miles north-west of Cupar, the eastern hills are generally lower than the western. From Lindores eastwards a longitudinal valley containing the Motray Water divides the hills into two minor ranges. The northern range rises to 936 feet in Norman's Law before dipping steeply to the Firth of Tay at Newport, while the southern, 3 miles wide above Cupar, narrows to the north east and ends abruptly in Lucklaw Hill (626 feet) 4 miles south of Newport. The Motray Water, draining a large portion of this sub-region, makes its way round the flank of Lucklaw Hill to its outlet in the Eden estuary by Guardbridge.

7. Strath Eden, lying to the south of the Eastern Ochils, extends some 12 miles in a north-easterly direction from Monimail at the southern margin of the district to St. Andrews Bay. The valley narrows considerably at Cupar where the hills of the East Fife Uplands stretch northwards towards the foot-hills of the Eastern Ochils. The River Eden follows a winding course through the Strath, passing into the Bay by a wide and rather muddy estuary. As no stream of any size flows into the Tay from the south, most of the drainage from the north-east corner of Fife finds its way into the Eden and its tributaries. The main tributary on the north bank is the Motray Water, which flows into the estuary at Guardbridge, while on the south bank the Ceres Burn flows through the well-known ravine of Dura Den to join the river near Dairsie.

8. The East Fife Uplands, extending from the southern margin of Sheet 49 almost to Strath Eden, represent the northern extremity of a much larger mass of volcanic rock. Penetrating the Coastal Fringe, the uplands rise in more or less isolated hills or rocky knolls, the highest of which is Clatto Hill (547 feet). The topography is essentially "crag and tail", with the hills often presenting steep fronts to the west while their eastern sides merge gently into the surrounding lowland.

Chapter 2. Climate

The natural features in and around the mapped area have a marked influence on its climate. Much of the region is protected by the Highlands north and west of the Highland Boundary Fault from the winds from these quarters. In addition, this sheltering barrier causes "rain-shadow" formation and cloud break-up, with the result that rainfall over the lower lying areas is relatively low and sunshine averages high for the latitude. The cloud clearance can give low night temperatures, partly compensated for by warmer afternoons. South-westerly winds, on the other hand, have comparatively easy access to the area, the Firth of Tay in particular forming a wind funnel directed at the Dundee District.

Proximity of the North Sea also has its effect, for in summer sea breezes reinforce the easterly winds to which the area, in common with much of east Scotland, is subject in spring and early summer, and this causes a sharp fall in afternoon and evening temperatures in areas near the coast. The easterly winds in these seasons can also bring in sea "haar", a form of very low cloud or fog.

Winds

Unfortunately, wind records for the area are inadequate. The lie of the land suggests that southwesterly winds should predominate, but maps of average pressure show that in the area of the Grampians the isobars deviate from their normal southwest to northeast course and swing towards the southeast, particularly in the second half of the year. This indicates winds from a more westerly or northwesterly point, at least in the north of the area.

Wind roses are available for Auchterhouse (750 feet) in the Sidlaws some six miles to the north-west of Dundee and for Leuchars Airfield (35 feet) in the Strath Eden region six miles to the south-east. Both wind roses show the prevalence of winds from between north and east in spring and early summer, one of the more unpleasant features of the climate. Winds from the more northerly directions are often showery, the showers dying away at night to give place to frost, while those from a more easterly point are usually "raw" and frequently bring haar.

As already mentioned, sea breezes are liable to develop in the afternoons of the warmer days of summer. If the general wind is from an easterly point the sea breeze reinforces it and can increase its strength quite markedly.

GALES

The incidence of gale force winds varies throughout the region, depending on the topographical shelter (see Table J). The average number of days of gale per annum is about 7. Dundee, as might be expected from its exposed position, has rather more.

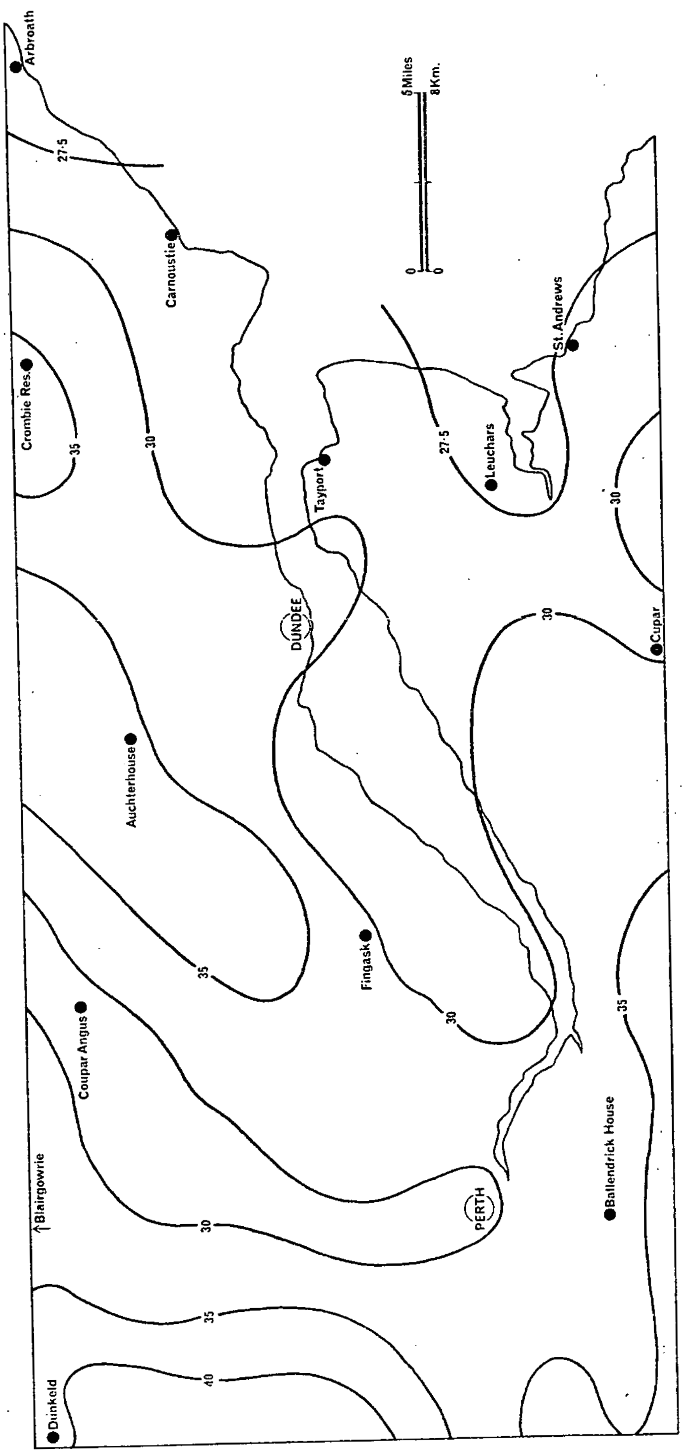


FIG. 5: Average annual rainfall.

Gales are most frequent from December to February, although not uncommon at any time during the winter months, and they can come from practically any point of the compass. Westerly gales are usually worst while gales from an unusual direction, e.g. the northerly gale of 31st January 1953, can be very destructive. Gales from the west or northwest usually follow a cold front. They tend to be very gusty, particularly in the lee of hill masses, and are often accompanied by violent squalls. Gales from a more southerly point, ahead of a depression or associated with a warm front, are not normally so squally, and the gust speeds are relatively low in relation to the mean wind speed.

Rainfall

The average annual rainfall in inches over the area is indicated in Fig. 5. Monthly and annual figures for a number of stations are given in Table A.

TABLE A. Averages of Monthly and Annual Rainfall (Inches)—Period 1916–50

Station	Alt. (ft.)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Crombie Reservoir	528	3·33	2·62	2·33	2·19	2·80	2·22	3·41	3·47	3·07	3·73	3·48	3·09	35·74
Ballendrick House	50	3·36	2·26	2·12	2·00	2·61	2·11	3·34	3·22	2·91	3·43	3·00	3·05	33·41
Tayport Lighthouse	27	2·64	1·90	1·79	1·65	2·48	1·93	3·02	3·05	2·55	3·02	2·68	2·35	29·06
Fingask E.	545	2·99	2·19	1·91	1·73	2·44	1·97	3·12	3·09	2·59	3·19	2·96	2·69	30·87
Arbroath (Springfield Park) E.	95	2·28	1·86	1·60	1·55	2·13	1·65	2·63	2·44	2·49	2·89	2·52	2·21	26·25
Leuchars	35	2·46	1·71	1·63	1·53	2·21	1·70	2·84	2·68	2·42	2·82	2·54	2·15	26·69
Dundee, Camperdown Works	286	2·79	2·18	1·95	1·76	2·60	2·01	3·22	3·42	2·70	3·26	2·83	2·42	31·14
Perth	77	3·02	2·19	1·91	1·72	2·31	1·92	3·18	2·97	2·65	3·30	2·80	2·72	30·69
Blairgowrie, Burnhead E.	440	3·27	2·33	1·84	1·69	2·33	1·93	2·89	2·98	2·58	3·27	2·99	3·02	31·12
Cupar E.	82	2·91	1·94	1·85	1·62	2·29	1·94	2·93	2·84	2·55	2·95	2·69	2·46	28·97

E = Estimated short-term station average

Although Blairgowrie lies outside the area of the present survey, data from the climatological station there are included as representative of the north-western part of the district. All figures include the contribution from melted snow.

Over the area the average annual rainfall is around 30 inches. It is lowest on the eastern coastal belt (the annual average at Leuchars and Arbroath is just over 26 inches) and rises inland to about 35 inches on the higher ground. It is only in the few cases where the ground rises sharply, that the rainfall increases to over 40 inches per annum. The "rain shadow" effect of the high ground to the west is particularly apparent in Strathmore.

The seasonal distribution is in general fairly consistent over the area. February to June is the driest period, with April usually the driest month. A sharp increase, of about one inch, in rainfall in July marks the beginning of the wetter part of the year which lasts until January. October is usually the wettest month, but there is a secondary maximum in the period July/August. The "Lammas Floods" are a distinctive feature of the climate of the Lothians and the eastern Border counties and they can affect the area under consideration.

Measurable rain falls on between 170 and 190 days in the year, the value of 170–180 days near the coast increasing with distance inland and with rise in altitude. "Wet days" (i.e. when ·04 inch or more falls in a day) amount to just over 120 on the coast and 140 or so inland. Details are given in Table B.

WET AND DRY SPELLS

Falls of 3 inches or more in 24 hours have been recorded for most places in the area. Dundee College Gardens had 3·60 inches on the 7th July 1916, and on the same date 3·42 inches fell at Perth. Arbroath recorded 3·09 inches in September 1927. Leuchars and St. Andrews had falls of 2·46 and 2·55 inches respectively on the 3rd August 1966, and St. Andrews had 2·62 inches in July 1916.

Dry spells are rather difficult to tabulate, but on the basis of at least 7 consecutive days with no appreciable rain the average over the period 1926–1945 at Dundee College Gardens was 6·7 spells per year, with as few as three such spells in one year and as many as eleven in another. In 1938 one spell lasted from 22nd March to 26th April. Perth over the period 1926–45 had an average of 5·9 dry spells, and again there was a wide annual variation, from 2 per year to 11 per year, with a 22-day spell occurring twice.

SNOW

About 6 or 7 per cent of the average annual precipitation falls as snow over the main lowland area. This percentage increases the further north in the area and also with increasing height above sea level. Examination of the snow records for various stations shows that the number of days of "snow lying" and the depth of the snow both increase with increasing height above sea level. A day of "snow lying" is one when snow covers at 0900 hours one half or more of the ground representative of the station.

Table B gives the monthly averages of the number of days of rain and snow or sleet and also of the number of days of snow lying. It should be borne in mind that the number of days of snow or sleet covers the occurrence of these phenomena at any time during the 24 hours, whereas the number of days of snow lying refers to conditions at 0900 h. G.M.T.

The area is one of relatively moderate snowfall, situated as it is between the more snowy Highlands and the Southern Uplands. January and February are the months of most snow. In November and April the snow normally lies no longer than the day on which it falls. The average number of days per year with snow lying increases inland to about 23 at Kettering in Strathmore (218 feet), and snow probably lies for about 60 days of the year on the higher

TABLE B. Average Number of Days of Rain and Snow

	Arbroath (50–51 yrs.)				Perth (52–53 yrs.)				Dundee (College Gardens) (51–52 yrs.)				St. Andrews R & W (52–53 yrs.) S & SL (44–51 yrs.)				Cupar (Sugar Factory) (11–12 yrs.)				Blairgowrie R & W (6–7 yrs.) S (4 yrs.)			
	R	W	S	SL	R	W	S	SL	R	W	S	SL	R	W	S	SL	R	W	S	SL	R	W	S	SL
January	15·7	11·1	4·3	3·0	17·2	13·0	5·5	4·4	16·7	12·1	5·2	6·4	15·9	12·1	3·9	2·6	14·3	11·9	5·2	5·6	16·3	11·5	2·8	State of Ground not observed
February	13·7	9·1	4·3	3·3	14·8	11·2	4·8	4·2	14·3	9·8	4·8	5·2	13·9	9·9	4·0	2·8	12·1	9·5	5·1	6·0	14·0	8·8	3·0	
March	13·1	9·1	3·4	1·8	14·8	9·9	3·5	2·4	14·2	9·5	3·8	3·3	13·5	9·2	3·1	1·0	12·5	9·1	2·9	1·2	13·7	9·2	2·5	
April	13·1	7·8	1·1	0·1	13·5	9·5	1·6	0·1	14·0	9·5	1·5	0·4	12·9	8·6	1·1	0·1	13·1	9·8	1·8	0·1	15·2	10·2	0·7	
May	13·1	9·2	0·2	0	14·0	10·7	0·4	0	14·3	10·8	0·5	0+	13·5	9·7	0·2	0	12·6	9·2	0·7	0	14·0	11·8	0	
June	11·9	8·5	0	0	13·1	10·1	0	0	13·6	10·4	0	0	13·0	9·5	0+	0	13·9	11·2	0·2	0	13·6	10·1	0	
July	14·7	11·1	0	0	14·8	12·1	0	0	15·6	12·1	0	0	14·8	11·3	0	0	11·8	9·4	0	0	12·7	9·3	0	
August	14·9	10·8	0	0	15·9	11·8	0	0	15·9	11·9	0	0	15·3	11·3	0	0	15·7	12·2	0	0	17·6	13·9	0	
September	12·6	9·2	0	0	15·0	11·0	0+	0	14·5	10·3	0	0+	13·7	9·8	0	0	13·9	10·7	0	0	16·7	13·0	0	
October	15·4	10·8	0·2	0+	16·5	12·0	0·3	0	16·3	12·0	0·2	0+	15·5	10·9	0+	0	13·2	9·4	0·1	0	16·9	11·6	0	
November	15·1	11·2	0·7	0·4	16·8	12·2	1·1	0·5	16·5	12·1	0·9	0·5	15·4	11·7	0·5	0·1	14·7	11·2	0·9	0·2	16·4	11·9	2·0	
December	15·9	11·1	2·4	1·6	18·1	13·4	3·8	2·8	17·2	12·1	2·9	2·9	16·1	12·1	2·2	1·0	16·7	12·9	3·5	2·7	16·7	12·1	3·3	
Year	169	119	16·6	10·2	185	137	21·0	14·4	183	133	19·8	18·7	173	126	15·0	7·6	165	127	20·4	15·8	184	133	14·3	—

0+ Denotes less than 0·05.
R = a day with 0·01 in. or more of rain (0900–0900 hr.)
W = a day with 0·04 in. or more of rain.
S = a day with snow or sleet falling.
SL = a day with snow lying (snow covering one-half or more of the ground representative of the station at 0900 hr.).

parts of the Sidlaw Hills. The number of days of snow experienced naturally varies widely from year to year.

Thawing snow can cause flooding, particularly when rain accompanying an intrusion of warmer air falls on snow when the ground is frozen.

Temperature

The mean monthly temperature through the year ranges from just over 11°C near the coast to 12° or 13°C inland.

TABLE C. Average Monthly Mean Temperatures, °C—Period 1931–60

	Arbroath 95 ft.		Perth 77 ft.		Dundee (College Gardens) 147 ft.		St. Andrews 13 ft.		Blairgowrie 200 ft.		Auchterhouse 760 ft.	
	Average Max.	Min.	Average Max.	Min.	Average Max.	Min.	Average Max.	Min.	Average Max.	Min.	Average Max.	Min.
January	5·8	0·2	5·6	−0·8	5·2	0·0	6·0	0·1	5·2	−1·1	3·9	−1·4
February	6·6	0·7	6·6	−0·3	6·2	0·5	6·7	0·5	6·1	−0·8	4·8	−1·4
March	8·4	1·9	8·9	1·4	8·3	1·8	8·5	1·8	8·5	0·9	7·1	−0·1
April	11·1	3·5	12·2	3·2	11·4	3·5	11·2	3·5	11·9	2·5	10·2	1·2
May	13·4	5·6	15·5	5·6	14·4	5·7	13·4	5·8	15·2	4·8	13·2	3·6
June	16·4	8·3	18·6	8·7	17·6	8·7	16·7	8·6	18·3	8·0	16·0	6·4
July	18·2	10·5	19·9	10·7	19·4	10·8	18·7	10·7	19·4	10·4	17·7	8·2
August	17·8	10·3	18·8	10·2	18·7	10·4	18·0	10·4	18·4	9·6	17·4	8·5
September	15·9	8·5	16·8	8·1	16·5	8·3	16·2	8·6	16·5	7·4	15·0	6·8
October	12·5	6·0	12·8	5·4	12·6	5·6	12·8	6·1	12·3	4·9	11·2	3·9
November	9·1	3·2	8·9	2·1	8·7	2·7	9·1	3·0	8·6	1·8	7·6	1·4
December	6·9	1·7	6·7	0·7	6·5	1·2	7·1	1·6	6·2	0·2	5·4	−0·1
Year	11·8	5·0	12·6	4·6	12·1	4·9	12·0	5·1	12·2	4·1	10·8	3·1

Table C gives average monthly and annual temperatures in °C for a selection of stations. The averages refer to the period 1931–60, but for several stations records are available for only part of this period. The 1931–60 averages for each short-term station have been estimated by comparison with a nearby long-term station.

January is the coldest month, with a mean temperature of around 2·5°C, and July is the warmest, with its mean temperature 14° or 15°C. In July the afternoon maxima average around 18°C, though inland they are nearer to 20°C (Perth's average is 19·9°C), while in January, except in places on the coast, the minima have a mean below 0°C. In some of the higher places inland the night minima are still below freezing point in February.

FROSTS

Table J gives the average number of days of ground frost and air frost at several stations. The dates of the first and last frosts are of importance and the mean dates over the period 1911–40 are given in Table D.

TABLE D. Mean Dates of First and Last Frosts

Station	*First Frost*	*Last Frost*
Perth	2nd Oct.	10th May
Carnoustie	24th Oct.	26th Apr.
Kettins	27th Sept.	18th May
Dundee (College Gdns)	22nd Oct.	25th Apr.
St. Andrews	16th Oct.	5th May
Leuchars	16th Oct.	8th May

These dates are subject to considerable variation from year to year. At Perth the date of the last frost over the period 1911–58 varied from the 14th June in 1911 to the 5th April in 1947. The first frost varied from the 5th September in 1918 to the 21st November in 1938.

SUNSHINE

This part of Scotland is one of the sunniest on the mainland, a fact which is attributable in part to the föhn effect described later.

The winter months are often bright though cold. The spring is sunny, with May usually the sunniest month over most of the area and June the sunniest month near the coast. In summer there is a considerable increase in the cloud inland and the coast becomes the sunnier. With the autumnal rains the amount of sunshine falls again, especially over the higher ground inland.

In valleys, where surrounding hills are a barrier to sunlight penetration, there is a reduction in the amount of bright sunshine which can be considerable during the winter months when the sun is lower in the sky.

Table E gives the average number of hours of bright sunshine for each month, and also for the year, for several stations. It should be noted that not all the averages given are from long term records taken over the period 1931 to 1960; those from the stations marked E have been computed by comparison with the data for a nearby longterm station. For some months (denoted by S) the averages given could be more than 5 per cent lower than the actual figure.

TABLE E. Averages of Bright Sunshine—Period 1931–60
(Hours)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Arbroath	56	86	115	166	198	200	180	157	139	102	63	43	1505
Perth	41	74	100	147	180	186	163	136	120	85	49	31	1312
Dundee (C.G.)	53	81	104	146	174	174	158	142	125	93	57	41	1348
Leuchars	56	84	115	162	194	198	178	152	137	100	64	45	1485
St. Andrews	55	82	110	161	189	198	177	150	134	99	63	43	1461
Carnoustie E.	51	81	111	163	192	195	176	158	137	99	58	39	1460
Blairgowrie E.	52s	81	106	149	178	173	156	141	122	83	54s	36s	1331
Dundee (Mylnefield) E.	53	82	105	155	185	182	169	147	129	91	57	41	1396
Auchterhouse E.	61	87	105	146	181	167	159	135	120	88	60	48	1357

E = Estimated Average. s = Cut Off.

GROWING SEASON

The growing season is the period during which the mean daily temperature reaches or exceeds a certain value, 5·6°C being the base temperature used by most workers in the British Isles. The growing season, defined in this way, normally starts about the third week in April and, in the coastal areas, including Dundee and Perth, lasts until middle or late November. Table F gives the length of the growing season for some stations. While, in general, the season becomes shorter as the height above mean sea-level increases, there is no great variation in this district and the length of the growing season is around 240 days per annum. In marked contrast, Balmoral, situated to the north of the district at a height of 927 feet, has a growing season of 196 days.

TABLE F. Length of Growing Season

	Altitude Ft.		*Total No. of Days*
Arbroath	95	24th March–23rd November	244
Leuchars	35	21st March–23rd November	247
St. Andrews	13	23rd March–23rd November	245
Perth	77	22nd March–15th November	238
Dundee (C.G.)	147	24th March–18th November	239

To give an indication of the heat energy available for growth and ripening, the concept of "accumulated temperature" is used. Accumulated temperature is the summation of the length of time that the temperature exceeds the threshold of 5·6°C, and it is expressed in degree-days. Yearly values of over 2500 degree-days are attained near the coast, but the value becomes gradually lower over the lowlands to the northwest. The decrease is more rapid, as altitude increases, but this has only limited application in this area. The maximum occurs in July or August, and the slow rate of increase in early spring is followed by a slow rate of decrease in the autumn. Table G gives selected accumulated temperatures.

TABLE G. Accumulated Temperatures Above 5·6°C
In Degree Days

	Alt. (ft.)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Arbroath	95	37	51	96	126	220	363	487	477	360	211	78	53	2559
Leuchars	35	43	52	95	124	220	384	511	484	360	205	66	54	2598

EARTH AND SOIL TEMPERATURES

Earth temperatures are recorded at depths of 1 foot and 4 feet under short grass. Soil temperatures are recorded at 4 inches and 8 inches under a bare soil surface. Both are important for plant growth, and both depend to a large extent on soil type, drainage etc. Table H gives values of earth temperatures at 1 and 4 feet for selected stations in the area.

TABLE H. Averages of Earth Temperatures (°C) at 1 Foot and 4 Feet Below Surface—Period 1931–60

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Cupar 1 ft. (30 cm.)	2·8	3·0	4·6	6·8	10·0	13·3	15·0	14·7	12·5	9·3	5·7	4·1	8·5
Dundee (Mayfield) 1 ft. (30 cm.)	2·0	2·2	4·2	7·4	11·0	14·4	16·2	15·7	13·2	9·5	5·6	3·3	8·7
Dundee (Mylnefield)													
1 ft. (30 cm.)	2·1	2·4	4·1	6·9	10·1	13·8	15·8	15·1	12·7	9·2	5·4	3·3	8·4
4 ft. (122 cm.)	5·1	4·4	5·0	6·3	8·3	10·6	12·4	13·2	12·6	10·8	8·6	6·5	8·6
St. Andrews													
1 ft. (30 cm.)	3·2	3·3	4·7	7·5	10·6	13·6	15·5	15·1	13·2	10·1	6·5	4·4	8·9
4 ft. (122 cm.)	5·4	4·9	5·2	6·9	8·8	11·3	13·0	13·8	13·1	11·3	8·6	6·7	9·1

EVAPO-TRANSPIRATION

The availability of soil moisture to the growing plant is highly important, and in assessing this the water loss due to evaporation and transpiration must be considered. Availability of soil moisture can be determined by comparing the amount and incidence of rain with evapo-transpiration. Temperature, sunshine, wind and vapour pressure are used to calculate the "potential" evapo-transpiration from a grass covered surface; where supply of soil water is at all times adequate, this is the actual evapo-transpiration.

TABLE I. Averages for Potential Evapo-transpiration—Period 1931–60 (inches of water)

	Alt. (ft.)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Angus	420	0·00	0·25	0·95	2·00	2·90	3·20	3·10	2·40	1·60	0·65	0·10	−0·05	17·10
Fife East	250	0·05	0·35	1·10	2·10	3·00	3·45	3·40	2·60	1·60	0·75	0·10	−0·05	18·45
Fife West	370	0·00	0·30	1·10	2·05	2·95	3·40	3·30	2·55	1·55	0·75	0·10	−0·05	18·00
Perth	500	0·00	0·30	0·95	1·90	2·85	3·15	3·05	2·35	1·50	0·70	0·00	−0·05	16·75
		Coastal Areas (within 5 miles of the coast)												
Angus		0·15	0·40	1·15	2·20	3·05	3·45	3·40	2·65	1·70	0·95	0·25	0·15	19·50
Fife		0·15	0·40	1·20	2·20	3·10	3·55	3·50	2·70	1·70	0·90	0·20	0·10	19·70

Table I gives values of potential evapo-transpiration, the first part covering complete counties, for which average altitudes are given, and the second part referring only to coastal areas. The summer totals range from 14·80 inches in Perth to 16·75 inches in Fife coastal areas. The rates increase steadily to a maximum in June or July.

FÖHN WINDS

Föhn winds are of importance in the climate of the area, especially in the north where the highlands provide shelter. Here the westerly winds in crossing the mountains lose some of their moisture. As the air descends the mountainside it is warmed by increasing pressure, and consequently the relative humidity falls. The lower clouds tend to break up and even to disperse. The result is less rain and more sunshine. This tends to give higher afternoon

TABLE J. Average Number of Days of Occurrence of Specified Phenomena—Periods as shown

	95 ft. ARBROATH						77 ft. PERTH						147 ft. DUNDEE (CG)					
	(51 years)						49–50 years		25–27 years	11 years	17–22 years	42–44 years	50–51 years	50–51 years		11 years	49–52 years	48 years
	H	T	F	AF	GF	G	H	T	F	AF	GF	G	H	T	F	AF	GF	G
January	0·6	0_{+}	1·7	13·9	17·7	1·3	0·2	0·1	4·0	17·5	20·4	1·5	0·7	0_{+}	No Observations	14·1	21·3	1·7
February	0·6	0	1·9	11·8	15·8	1·0	0·4	0·1	3·0	15·1	17·0	1·4	0·5	0·1		12·5	18·5	1·1
March	0·6	0	2·1	4·2	13·6	0·9	0·6	0·1	1·4	7·9	15·1	0·5	1·1	0·1		5·7	15·9	0·5
April	0·9	0·2	0·9	1·8	9·9	0·6	1·1	0·1	0·3	5·3	9·9	0·7	1·8	0·3		2·1	11·2	0·6
May	0·7	0·8	1·3	0·1	4·9	0·1	1·0	1·1	0·6	0·7	3·7	0·1	1·3	1·4		0	4·7	0·3
June	0·2	0·7	0·7	0	1·2	0·2	0·3	1·0	0·3	0	0·6	0·2	0·3	1·4		0	0·6	0·5
July	0_{+}	1·7	0·9	0	0_{+}	0_{+}	0_{+}	1·6	0·7	0	0	0·1	0·2	2·4		0	0·1	0·2
August	0·1	1·3	1·0	0	0·3	0·2	0·1	1·0	1·3	0	0	0·2	0·1	1·6		0	0·4	0·3
September	0_{+}	0·5	1·0	0	2·7	0·5	0_{+}	0·5	1·1	0·3	1·7	0·4	0·1	0·6		0	2·4	0·8
October	0·1	0·2	1·3	0·1	6·1	0·9	0·1	0·2	3·6	1·8	6·7	0·5	0·1	0·2		0·3	7·9	1·2
November	0·4	0·1	1·7	4·4	12·6	1·0	0·2	0_{+}	3·6	10·2	13·6	0·6	0·4	0·1		6·7	16·1	0·9
December	0·6	0_{+}	1·6	10·3	16·5	1·1	0·2	0·1	3·8	14·7	19·2	0·1	0·3	0·1		11·4	20·1	1·3
Year	4·8	5·5	16·1	46·6	101	7·8	4·2	5·9	23·7	73·5	108	6·3	6·9	8·3		52·8	119	9·4

	13 ft. St. ANDREWS						210 ft. CUPAR						200 ft. BLAIRGOWRIE					
	39–41 years	40–41 years	49–52 years	9–11 years	50–53 years	36–38 years	(9–12 years)						4 years		2–3 years	9–10 years	7–8 years	6–7 years
	H	T	F	AF	GF	G	H	T	F	AF	GF	G	H	T	F	AF	GF	G
January	0·5	0·1	0·9	13·2	16·9	0·9	0·4	0·1	1·7	16·4	20·8	0·2	0	0	1·7	19·6	25·1	1·4
February	0·5	0_+	0·6	12·2	15·0	0·4	0·1	0	1·4	15·2	18·9	0·4	0·3	0	2·3	15·4	19·3	1·1
March	0·8	0·1	0·9	7·2	13·7	0·4	0·5	0	1·1	7·6	14·1	0·1	0	0	2·0	9·2	16·6	0·3
April	0·9	0·1	0·5	3·2	9·0	0·6	1·1	0·3	0·2	5·6	12·8	0	0	0	0·3	7·6	13·4	0·4
May	0·9	1·0	0·9	0·5	3·4	0·2	0·8	0·6	0·1	1·0	6·5	0	0	0·5	0·3	1·6	8·3	0·3
June	2·0	0·9	0·5	0·1	0·5	0·2	0·1	0·8	0·3	0·1	1·3	0·1	0	2·0	0·3	0·1	1·5	0·7
July	0·1	1·4	0·6	0	0_+	0·1	0·1	0·8	0·1	0	0·1	0·3	0	0	0·7	0	0·4	0
August	0·1	0·9	0·9	0	0_+	0·2	0	0·7	0·4	0	0·8	0	0	0·3	0·3	0	0·5	0·7
September	0·1	0·3	0·7	0	1·3	0·4	0	0·4	0·4	0·3	1·2	0·2	0	0	2·0	0·6	2·6	0·5
October	0·2	0·2	0·9	0·7	4·9	0·5	0·1	0·1	1·1	2·0	6·2	0·1	0	0	2·7	3·2	8·9	0·7
November	0·5	0·1	0·7	9·8	11·7	0·5	0·3	0·1	1·4	10·5	14·4	0·1	0	0	2·7	12·7	18·9	0·9
December	0·4	0_+	0·7	13·6	15·4	1·1	0·3	0·1	1·1	15·5	18·3	0·5	0	0	4·3	18·5	25·9	0·9
Year	7·0	5·1	8·8	60·5	92	5·5	3·8	4·0	9·3	74·2	115	2·0	0·3	2·8	19·6	88·5	141	7·9

H—Hail.
T—Thunder.
F—Fog at 0900 hrs.

AF—Air frost.
GF—Ground frost.
G—Gale.

0_+—Denotes less than 0·05.

N.B. Since recordings were made, the definition of air frost has been amended and the average frequencies shown are therefore a little higher than if the present more precise definition had been operative. Statistics for ground frost also require some qualification as new procedures for determination are now in use.

temperatures, compensated by lower night temperatures. The föhn effect is felt in the south of the area but not to the same extent as in the north. This warming of westerly winds can be a major factor in snow clearance.

HAAR

Haar is probably one of the best known meteorological phenomena in this area. A pleasant warm day with a light westerly wind can be ruined suddenly by the onset of an easterly wind followed by very low cloud or the cold damp sea fog which is the true haar.

Haar occurs with easterly winds blowing across the North Sea. Warm air from the Continent is cooled and moistened from below by the cold sea; by the time the air reaches the east coast it can be fog-laden. This haar or fog occurs mainly in the spring and early summer when easterly winds are most frequent and the sea is more likely to be cooler than the air. Sea fog has little or no diurnal variation over the sea, but inland it is usually cleared by the heat of the sun, returning again at night when it spreads in from the sea as the land cools by radiation.

HUMIDITY

In this part of Scotland the relative humidity is variable. Humidity varies with the seasons and with the time of day—as the temperature rises, the relative humidity falls and vice versa. High humidities occur in rain and fog and in the haar. With a föhn wind blowing the humidity tends to fall. Most of the low humidities occur with the föhn, and in the foothills some very low humidities can occur.

THUNDER

Thunder is comparatively rare in the winter months from October to March. From May, when the thunder can be expected on about one day in the month, the risk of thunderstorms increases, the maximum incidence coming in July and August. Some of the thunderstorms move up from the south, but the greater number originate over the hills and drift on the west or north-west winds to the coast, sometimes continuing as extensive rain areas when the thunder has died away. Table J gives the thunder data for a number of places.

FOG

Table J also shows the average number of days of fog at various stations. The average varies from place to place, and the fogs are of different types. Radiation fog is rare, but when it occurs in the industrial areas near the Tay it is reinforced by smoke. True radiation fog is more likely to occur in the late summer when the skies clear, after heavy or thundery rains, but this fog is usually short lived. Fog over high ground, especially prevalent in the winter months, is caused by low cloud and can be persistent. Haar, which has already been described, can reduce visibility seriously before it lifts. It occurs throughout the area, and can be very persistent near the coast.

HAIL

Table J also gives the average number of days of hail per year for selected stations. It should be noted that reports of hail include hard hail, small hail and soft hail. True hail stones are generated by thunderstorms, and are hard and often of considerable size; small hail consists of small grains covered with ice; soft hail is easily compressible. Hail can occur in any month, but is less common in the autumn. The months of April and May, with their cold unstable northeasterly winds, are most likely to bring large hail stones.

Chapter 3. Parent Materials

Because there is a close relationship between the soil and the underlying rock or drift deposit, a brief account of the geology of the area will give a better understanding of why the soils differ and how their distribution has been governed.

The Geological Systems represented in the area and the main rock types are shown in Table K. From the geological map, Fig. 6 on page 24, it can be seen that the oldest rocks, mainly metasediments belonging to the Dalradian System, are confined to the north-west of the area. They constitute part of the Grampian Foothills, and are separated by the Highland Boundary Fault from the sediments occupying the remainder of the map, which thus lies wholly within the Midland Valley.

The rocks of the Midland Valley consist of a succession of Old Red Sandstone and Carboniferous sediments, gently folded and containing contemporaneous volcanic lavas and tuffs, together with igneous intrusions of various ages. From the generalized geological section on page 25 it will be seen that the low-lying area of Strathmore is composed of Old Red Sandstone sediments folded into an asymmetrical syncline, with the axis running north-east to south-west, parallel to the Highland Boundary Fault. This is followed by the Sidlaw–Ochil arch or anticline. Here hard volcanic lavas outcrop, and give rise to the steep scarp slopes on both sides of the Tay estuary. The crest of the anticline has been faulted downwards, and this has led to the preservation in the Carse of Gowrie of rocks of Upper Old Red Sandstone age, together with a small area of Carboniferous strata. On the south-east side of the Ochils the Upper Old Red Sandstone rests uncomformably on lavas of Lower Old Red Sandstone age, and is believed to be overlain by succeeding Carboniferous deposits. All traces of rocks deposited after the Carboniferous and prior to the relatively recent Pleistocene deposits have long since disappeared, probably as a result of erosion in Tertiary times following earth movements initiated during the late Carboniferous.

A more detailed account is given below of the petrology of the systems found in the areas mentioned.

1. Dalradian

This series is composed mainly of metamorphosed sediments, and schistose grits and mica-schists are the dominant rock types. A narrow slate band runs north-east to south-west in the vicinity of Dunkeld.

2. Old Red Sandstone

(*a*) Lower Old Red Sandstone: This series is the most widespread on the sheet. The main types of sediment are as follows:

Sandstones: These are the most common. Although usually thick-bedded, soft and rather coarse, they are occasionally fine grained and hard. Flaggy

TABLE K. Summary of Geology.

ERA	SYSTEM AND SUBDIVISIONS		SEDIMENTARY DEPOSITS	CONTEMPORANEOUS IGNEOUS ROCKS	INTRUSIVE IGNEOUS ROCKS
QUATERNARY	PLEISTOCENE AND RECENT	Superficial Deposits	Blown Sand Peat Alluvium Raised Beach Deposits Fluvio-glacial Sands and Gravels Glacial Deposits—till etc.	—	—
TERTIARY EROSION FOLLOWING LATE AND POST CARBONIFEROUS EARTH MOVEMENTS					
PALAEOZIC	CARBONIFEROUS	Limestone Coal Group Lower Limestone Group Calciferous Sandstone Measures	Alternations of sandstone, shales, coal and limestone		Dolerite and Basalt Sills and dykes Volcanic Necks
	OLD RED SANDSTONE	Upper	Dominantly sandstones with only occasional marls; conglomerates and pebbly grits locally common at base of Series		
		UNCONFORMITY			
		Lower	Mainly sandstones with some marls; conglomerates abundant and characteristic of lower part of Series	Basaltic and andesitic lavas with tuffs and felsites	Sills and dykes Volcanic Necks
UNCONFORMITY FOLLOWING CALEDONIAN OROGENY AND EROSION OF LOWER PALAEOZICS					
PRE-CAMBRIAN (?)	DALRADIAN	—	Schistose grit, mica schists and slates	—	—

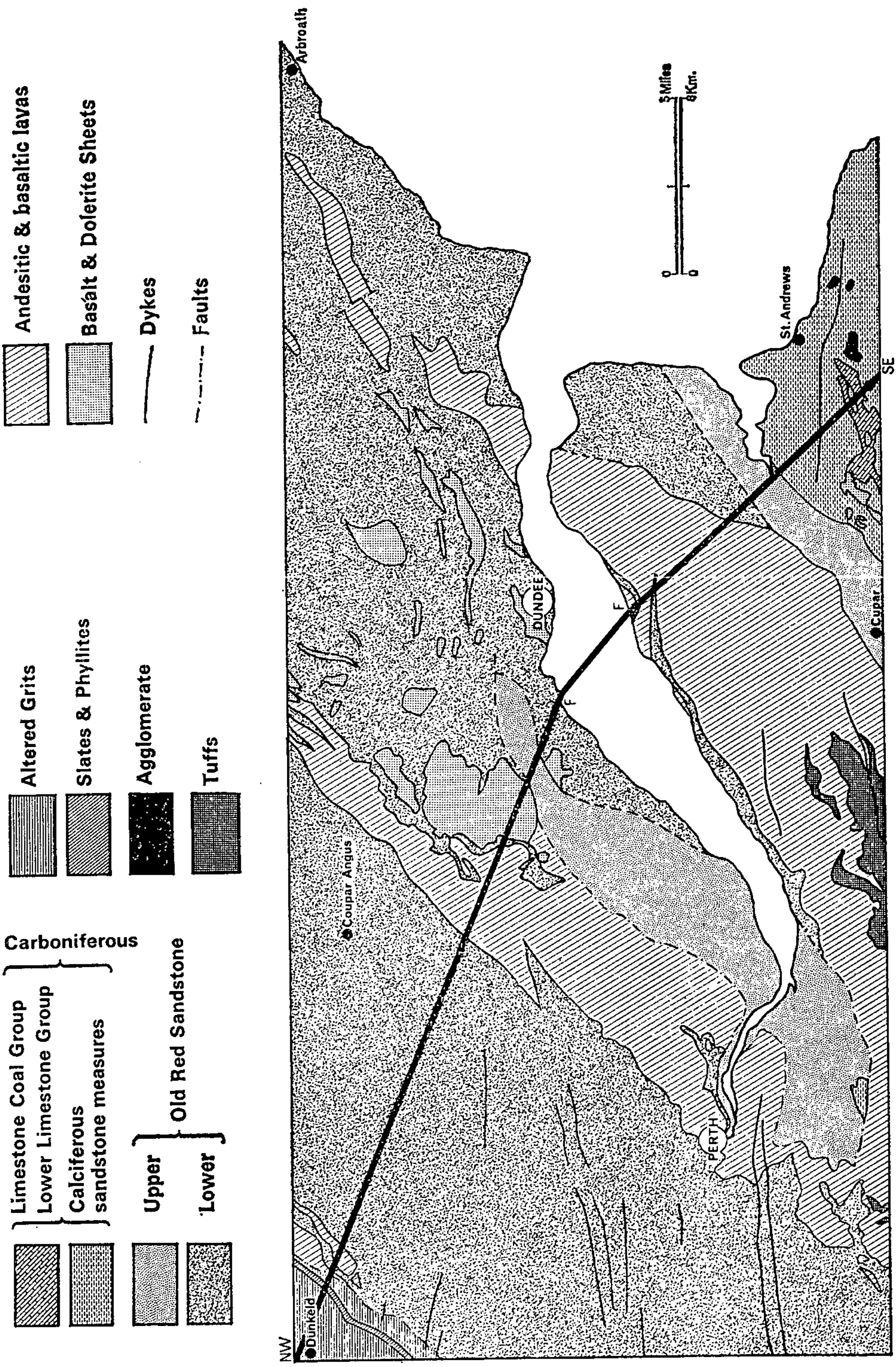


Fig. 6: Geology.

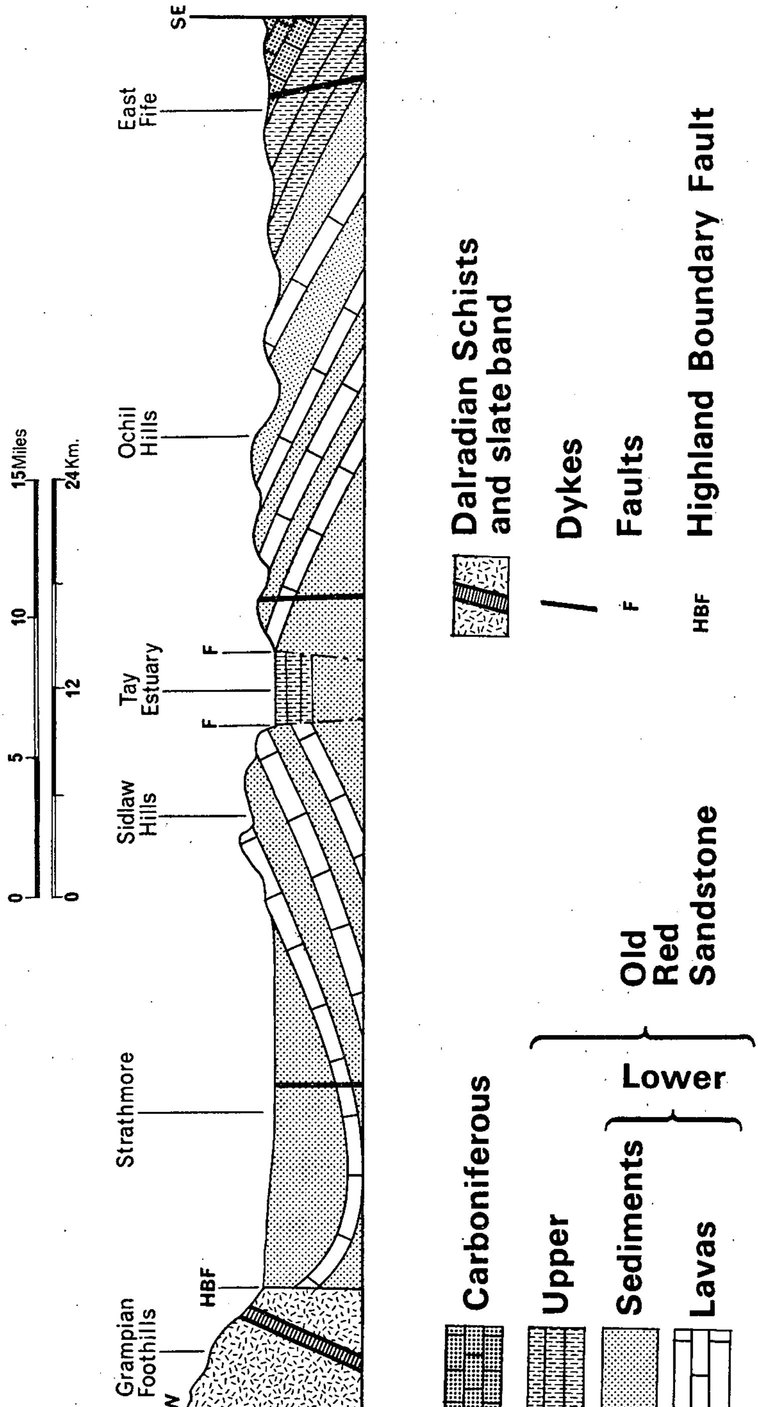


FIG. 7: Geological Section.

sandstones occur in some areas, e.g. around Dundee. The colour of the sandstones is usually dull red to reddish brown, though yellowish or greenish brown sandstones do occur.

Marls: These are characteristic of the higher beds present in Strathmore; they are bright red and may be associated with variously tinted shales. Marls are well exposed along the steep banks of the River Almond.

Conglomerates: These are best developed in the vicinity of the Highland Boundary Fault, and are specially characteristic of the lower part of the series, although outcrops do occur throughout the whole of the Lower Old Red Sandstone.

Igneous rocks (contemporaneous lavas): Within the district volcanic rocks form extensive areas of relatively high relief. The Sidlaw Hills consist of interbedded lavas and conglomerates, the former varying in thickness from a few feet to approximately 80 feet.

The following rocks, listed in order of abundance make up the Sidlaw lavas: olivine-basalts, andesitic basalts, andesites and trachyandesites (Harry, 1956).

The Ochil Hills of Fife consist mainly of andesitic and basaltic lavas, with occasional felsitic bodies. The lavas vary in type from hard, compact and crystalline to soft, vesicular and decomposed; autobreccias are common (Geikie, 1902). Associated with the lavas are occasional intercalations of sandstone or conglomerate, mainly composed of volcanic detritus.

Igneous rocks (intrusions): The most notable igneous intrusions occur in the Dundee district. Balsillie (1934) has separated two main field types, dark-coloured basic rocks (diabases) and light-coloured acidic rocks (felsites). The diabases include quartz-hypersthene-dolerites, basalts, augite-porphyrites and andesites. The felsites include trachytes, andesine-albite-porphyrites and plagiophyres.

(*b*) Upper Old Red Sandstone: Rocks of this series, besides underlying part of the Tay estuary, the Carse of Gowrie and the Carse of Earn, extend from the vicinity of Cupar north-eastwards through the Eden Valley to the coast, and occur again in a small outlier on the Angus coast near Arbroath.

The main sedimentary rock types are similar to those of the Lower Old Red Sandstone. Sandstone is again dominant, but typically bright red and more quartzose. Light yellow and whitish sandstones also occur, especially in the upper part. (e.g. at Dura Den, some 2¼ miles east of Cupar (Geikie, 1902)). By analogy with other areas, the Upper Old Red Sandstone is believed to pass comformably up into the Carboniferous System. Occasional bands of clay or mudstone are also found intercalated with the sandstones.

3. Carboniferous

The whole area east of the Eden Valley is occupied by rocks of the Carboniferous System, and three sub-divisions can be recognized, viz.:

Limestone Coal Group
Lower Limestone Group
Calciferous Sandstone Measures

The Calciferous Sandstone Measures lie comformably on, and indeed merge interceptibly with, the underlying Upper Old Red Sandstone. All the rocks of Carboniferous age are included in the Calciferous Sandstone Measures, with the exception of a narrow tongue extending north-eastwards from Ladeddie on the southern margin to Cairnsmill Den a little south-west of St. Andrews.

Taken as a whole, the Carboniferous rocks consist of alternations of sandstone and shale, with subordinate limestones and iron-stones, fireclays and coals. The sandstones are chiefly white, yellow or brown with faint pink to red occurring in some areas. In a small outlier south of Bridge of Earn there are white and red sandstones, red and greenish shales and mudstones, and a fine conglomerate.

Igneous rocks: The masses of igneous rocks which have been intruded into the Carboniferous of East Fife follow a line from the southern margin of the region almost to St. Andrews, and are the north-eastern extension of the great band of igneous rocks forming the backbone of Fife. They can be divided into two types: sills and dykes, and volcanic necks or vents (Geikie, 1902). Examples of the first type are dolerites at Ladeddie Hill, Blebocraigs and Denork Hill. Many volcanic vents occur in the eastern part of the parish of St. Andrews, varying greatly in size but sometimes sufficiently large to rise above the general surface level of the country in smooth rounded domes or conical hills, e.g. Clatto Hill (547 feet) which is composed of rather fine agglomerate. Most of the vents are filled with agglomerate and volcanic ash.

PLEISTOCENE AND RECENT DEPOSITS

During much of the Pleistocene Period, the whole of Scotland was covered by an ice-sheet many hundreds of feet thick. The ice-cover moved outwards from the higher parts of the country where it was continuously renewed by precipitation. The effect of ice moving southwards off the Highlands and northwards off the Southern Uplands was a general west to east ice-movement over the district described in this memoir. The region was affected by at least three distinct phases of glaciation; successive ice-currents with different trends were produced by the varied pressures exerted by Highland ice, Southern Upland Ice and Scandinavian or North Sea ice lying just off the east coast of Scotland (Charlesworth, 1926; Simpson, 1933).

From a variety of evidence, the following sequence of events has been deduced (Macgregor and Macgregor, 1948):

(1) Highland ice moving south-eastwards was given a north-north-east to south-south-west trend by the pressure of Scandinavian ice. Glacial material deposited during this phase was probably derived in part from the schistose rocks of the Highlands.

(2) An ice-sheet moved north-eastwards across the Lower Old Red Sandstone rocks of Strathmore giving rise to a red or reddish brown till.

(3) Finally, a restricted south-easterly advance of Highland ice occurred, which did not everywhere reach the coast. The till left by this ice-sheet is generally grey in colour (Bremner, 1937). Correlated with this concept is the theory postulated by Simpson in 1933 that a late readvance of ice took place at one stage in the final retreat of the great ice-sheets. Ice re-advanced along

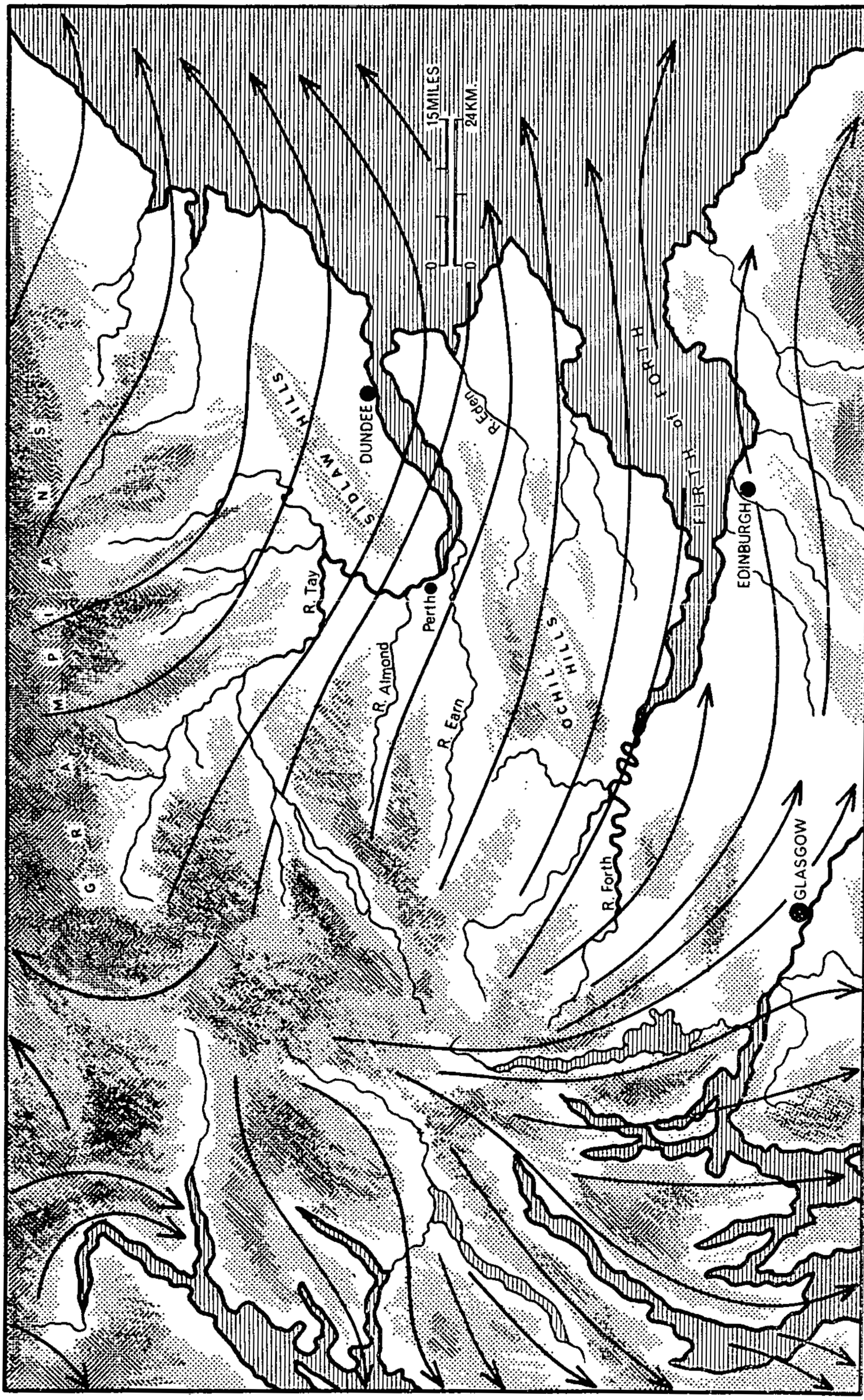


FIG. 8: Ice Movements in Central Scotland.

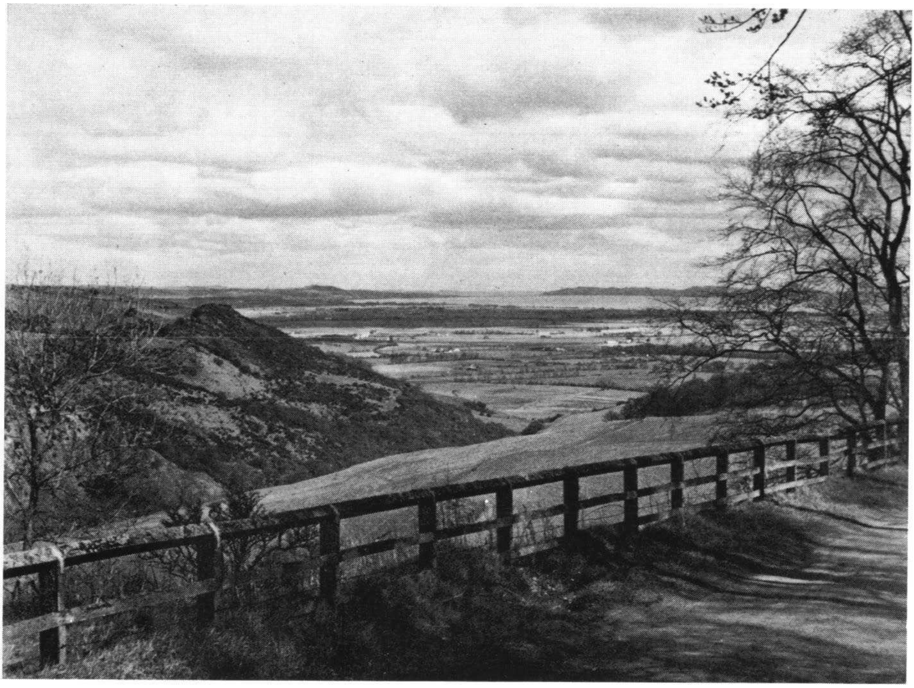


PLATE 4
The Earn Flats with Ochil Hills beyond.

PLATE 5
Dredging sand and gravel at Perth harbour.
By courtesy of the Scotsman Publications Ltd.

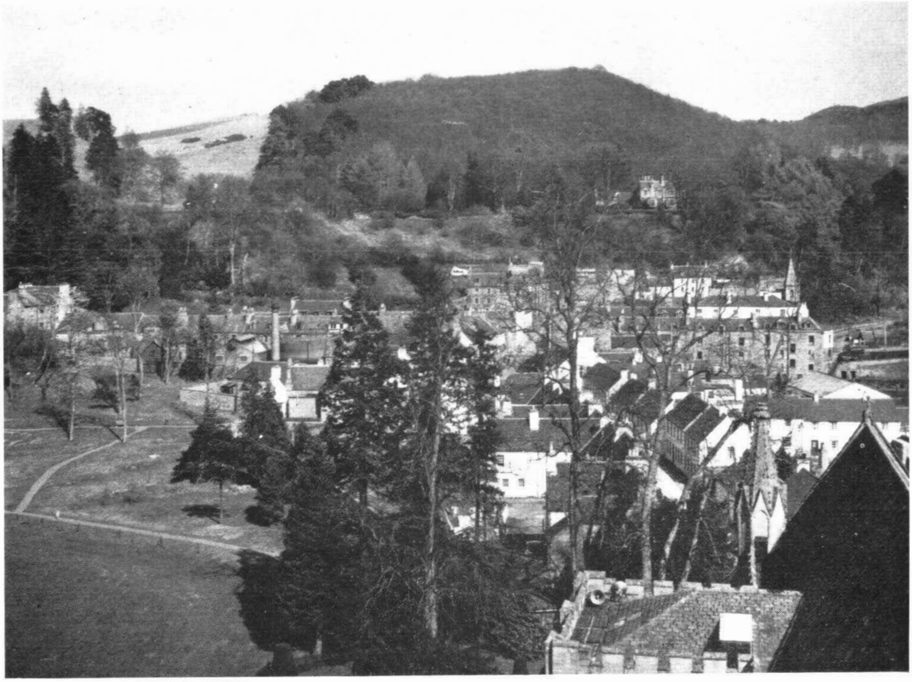


PLATE 2
Dunkeld and Grampian Foothills: Strichen Association.

PLATE 3
Grampian Foothills: shallow soils of Strichen Association with outcrops of schistose rock.

the Teith Valley through Strath Allan into lower Strath Earn, uniting with glaciers from upper Strath Earn and other valleys to form a piedmont glacier. The high ground to the west of the district caused the ice to divide into two portions. The larger of these continued through the Earn Valley into the Firth of Tay, while the smaller moved east-north-east, filling the depression towards Methven, and thereafter joining a glacier moving down the Almond Valley. Continuing eastwards, the ice crossed what is now the Tay Valley at Perth and came to a halt just short of New Scone. Simpson has termed this movement the Perth Readvance. It should be noted, however, that opinions differ as to the actual limits of this readvance (Synge, 1956; Rice, 1959; Sissons, 1963).

At the end of the Pleistocene Period, with the approach of milder climatic conditions, the ice started to disappear, producing abundant melt-waters which, in addition to causing notable local erosion, transported and deposited over wide areas vast amounts of sand and gravel. Much of this material came to rest in the late-Glacial outwash terraces and raised beaches. There are marine clays of the same general age in Strath Earn, the Carse of Gowrie and Strath Eden. Following a period of low sea-level in Boreal times, a renewed marine transgression gave rise to the estuarine clays of the Carse of Gowrie and elsewhere and to the post-glacial raised beaches which fringe the coastal areas. Extensive accumulations of blown sand have been built up on the coast at Buddon Ness and Tents Muir at the mouth of the Tay.

From the various superficial deposits which overlie the district the following soil parent materials have been distinguished.

1. Till and associated drifts derived from Dalradian schists.

Thin till, derived mainly from micaceous schists and schistose grits, covers the major portion of the Grampian Foothills. Generally yellowish brown to light yellowish brown in colour, it varies in texture from sandy loam to fine sandy loam, and contains many angular or sub-angular schists and other stones of Highland origin. The soils developed on this till have been classified as belonging to the Strichen Association already mapped in north-east Scotland (Glentworth, 1954; Glentworth and Muir, 1963). On some of the hill-tops decomposing schistose rocks or rock rubble yield residual soils of the association.

The narrow band of slates which crosses the region a little to the south-east of Dunkeld has influenced the composition of the glacial deposits in the immediate vicinity. In consequence, the soil here has a silty texture and is more akin to the Foudland Association found in Aberdeenshire. (Glentworth, 1954; Glentworth and Muir, 1963).

The schist till extends for a few miles east of the Highland Boundary Fault where it becomes mixed with sandstone deposits. The resulting till, containing Highland schists, sandstone and a small proportion of igneous rocks from the intrusions in the area, forms the parent material of the Gourdie Association.

2. Till and associated drifts derived from Lower Old Red Sandstone sediments.

The greater part of Strathmore is covered by glacial till of variable thickness derived mainly from Lower Old Red Sandstone sediments. The till, which is

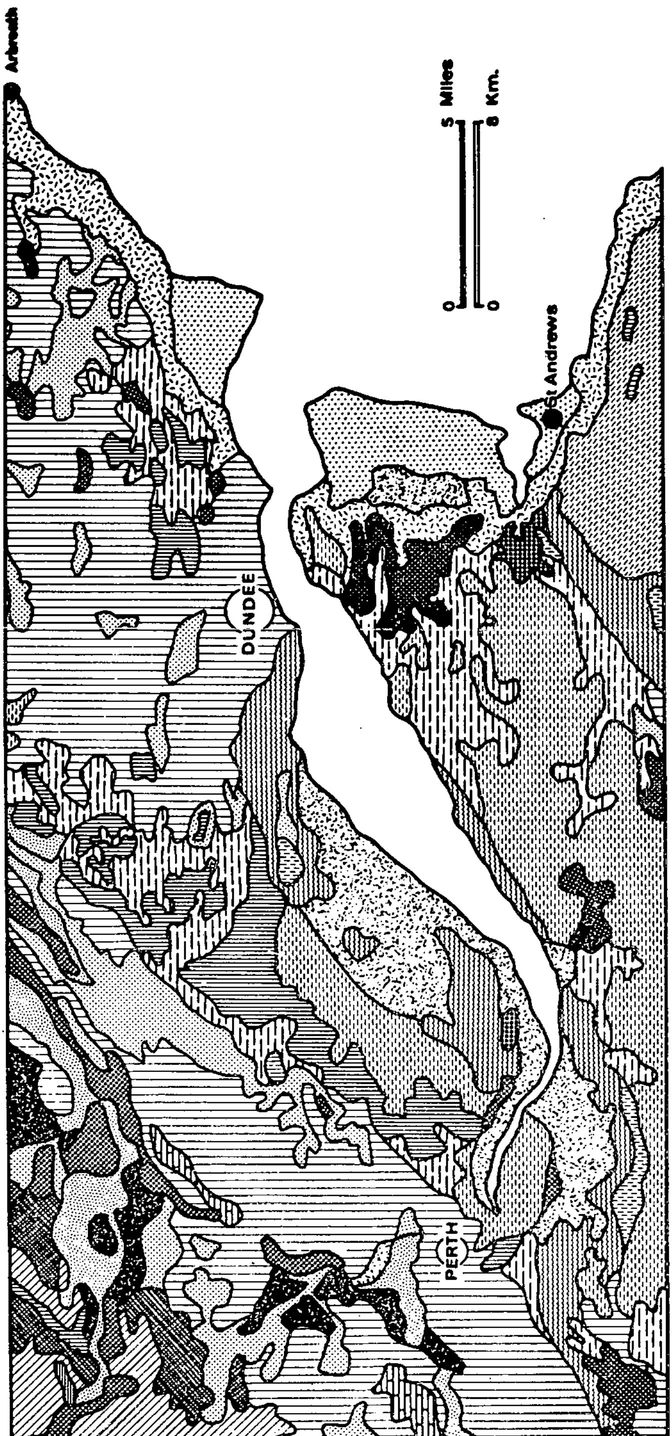
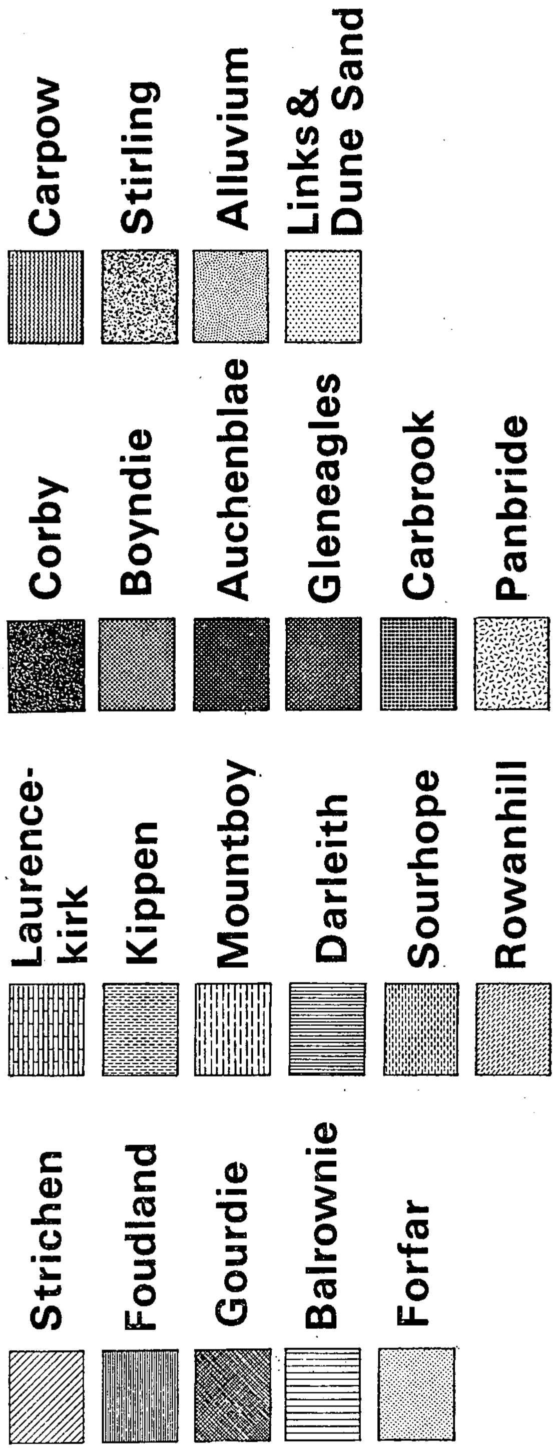


FIG. 9: Distribution of soil associations.


Strichen
Laurence-kirk
Corby
Carpow
Foudland
Kippen
Boyndie
Stirling
Gourdie
Mountboy
Auchenblae
Alluvium
Balrownie
Darleith
Gleneagles
Links & Dune Sand
Forfar
Sourhope
Carbrook
Rowanhill
Panbride

Key to Fig. 9.

normally red-brown, varies in texture from loam to sandy clay loam. In addition to boulders of Old Red Sandstone conglomerate from the immediate neighbourhood, the till contains many fragments of metamorphic rocks brought down from the north-west by Highland ice.

At one stage during the glacial period, Highland ice over-rode the Sidlaw Hills and descended to the sea, leaving proof of its path in the erratics of granite and other Highland rocks found on Lundie Hill and Craigowl Hill and scattered over the foothills between the Sidlaws and the sea. The Old Red Sandstone till which covers much of the Sidlaw foothills is similar in colour and in texture to that found in the Strathmore Lowland. On certain slopes of the Sidlaw Hills, and on some of the higher foothills, the sandstone till is generally coarser and of sandy loam to fine sandy loam texture, with colour variation from reddish brown to reddish grey. The soils developed from this till are grouped into the Balrownie Association, which also includes soils derived from decomposing sandstone rock. The latter soils occur in limited areas where there is an absence of till. It appears that throughout the area covered by the Balrownie Association, parts of the till deposits have been re-sorted by water action, probably towards the end of the Glacial Period. The upper part of the till has been noticeably altered in structure and in texture and is generally coarse and sandy. This re-sorted material is usually found in low-lying areas and adjacent to drainage channels, which supports the theory that it is derived from till modified by water action.

Where this re-sorted material is more than 24 inches deep, it has been considered as the parent material of a separate association, the Forfar Association. Modified till horizons are sometimes found in the soils of the Balrownie Association, but are seldom more than 18 inches deep.

Around Methven village, in Methven Wood and on Campsie Hill to the north of Perth, are small areas of till, derived mainly from Old Red Sandstone marls. This till forms the parent material of the Laurencekirk Association. Reddish brown to dark reddish brown in colour, the till varies in texture from sandy clay loam to sandy clay and contains many angular pieces of reddish brown mudstone in addition to a smaller proportion of sub-angular stones of Highland origin.

3. Till and associated drifts derived from Upper Old Red Sandstone sediments.

Till derived from these sediments covers a small area to the south of Bridge of Earn and extends eastwards to Abernethy as a narrow band bordering the Carse of Earn in this area. This till, which is also found in the Eden Valley to the East of Cupar, varies in colour from reddish brown to weak red and contains many angular pieces of sandstone and occasional sub-angular pieces of lava. Varying in texture from loam to clay loam, the till gives rise to soils of the Kippen Association.

4. Till and associated drifts derived from Old Red Sandstone igneous rocks.

The basic igneous rocks which form a large proportion of the Sidlaw lavas yield the parent material of the Darleith Association, already mapped in Ayrshire (Mitchell and Jarvis, 1956). On the hill-tops, the soil parent material reflects the nature of the underlying rock and is normally a brown sandy loam or fine sandy loam with a high content of angular lava fragments. The upper slopes, in most cases, are covered by a thin brown or yellowish brown loam till, mainly derived from basic igneous rocks. Similar till overlies the basic igneous intrusions of the Dundee district.

In the St. Andrews district in Fife, the Darleith Association is derived mainly from dark brown or dark reddish brown decomposed agglomerate which breaks down to a gritty sandy loam and is underlain by shattered agglomerate rock.

The intermediate lavas of which the Ochil Hills and part of the Sidlaw Hills are composed yield the parent materials of the Sourhope Association, already mapped in Roxburghshire and Berwickshire. (Muir, 1956; Ragg, 1960). The direction of ice-movement over the Ochil Hills has been deduced from the striae on ice-worn rock surfaces. Over the Western Ochils the ice moved in a general east to south-east direction, which became more easterly as the ice moved over the Eastern Ochils towards the coast. Much of the hill ground, particularly the middle slopes, is covered by till derived mainly from andesitic lavas. The till, normally of loam texture, varies in colour from brown to red-brown and in addition to a high proportion of angular lavas of local origin, contains a number of sub-angular pieces of sandstone together with occasional schists and other Highland rocks. The Association is also found on certain steep slopes where the till is absent or very thin and the soil parent material is composed mainly of soliflucted deposits derived from andesitic lavas. On lower slopes and in hollows the till is generally of finer texture.

In the vicinity of the Sidlaw and Ochil Hills and of igneous intrusions in the Old Red Sandstone areas, till and associated drifts derived from mixed lava and Old Red Sandstone sediments form the parent material of the Mountboy Association, previously mapped in Kincardineshire and north-east Angus. The till is similar in texture to that of the Balrownie Association, but contains a high proportion of lava which frequently imparts a brownish or purplish colour.

5. Till derived from Carboniferous sediments.

The East Fife Drift Plain and the lower slopes of the East Fife Uplands are overlain by till derived mainly from Carboniferous sediments. This till forms the parent material of the Rowanhill Association already mapped in Ayrshire (Mitchell and Jarvis, 1956). Two varieties of till occur, a sandy clay loam varying in colour from reddish brown to pinkish grey and normally containing pieces of red sandstone, and a greyish brown clay loam with pieces of Calciferous sandstone and occasionally small amounts of basic agglomerate from intrusions in the region.

6. Fluvioglacial deposits.

North and north-west of Perth fluvioglacial deposits of sands and gravels, generally yellow-brown in colour and derived mainly from rocks of Highland origin, are found along the valleys of the rivers Tay and Isla. Where possible, soils developed on fluvioglacial sand have been separated from those developed on fluvioglacial gravel, the former being correlated with the Boyndie Association and the latter with the Corby Association, both of which have been mapped previously in north-east Scotland. (Glentworth, 1954; Glentworth and Muir, 1963).

In the south-west around Dunning, and in certain areas of Fife, fluvioglacial sands and gravels derived from Old Red Sandstone sediments and lavas with some Highland schist rocks form the parent material of the Gleneagles Association. The deposits are generally brown to reddish-brown in colour.

In parts of East Fife, in particular along the valley of the Motray Water, red or red-brown fluvioglacial sands and gravels derived from Old Red Sandstone sediments give rise to soils of the Auchinblae Association, already mapped in north-east Scotland (Glentworth and Muir, 1963).

7. Raised Beach Deposits

Reference has been made in Chapter I to the coastal raised beaches of Angus and Fife. The sandy soils overlying the deposits of the 25-foot beach at Barry Links and at Tents Muir have been included in the group of soils mapped as Links in N.E. Scotland (Glentworth, 1954; Glentworth and Muir, 1963).

The late-Glacial coastal deposits, exposed chiefly between the 30-foot and 100-foot levels, are composed mainly of mixed sands and gravels and form the parent material of the Panbride Association. By using radiocarbon techniques an approximate estimate of the age of these deposits has been made. A sample from the base of a peat sequence resting on late-glacial sand between the 25 and 50-foot levels in St. Michael's Wood near Leuchars, has been dated 7995 B.C. (Scottish Radiocarbon Dates (1969)—Private Communication, J. I. Chisholm, Inst. of Geolog. Sciences).

Both the Carse of Gowrie and the Carse of Earn are raised plains composed of post-Glacial estuarine clays at an elevation below 50 feet. Greyish brown to brownish grey in colour, and with clay contents frequently over 40 per cent, these deposits form the parent material of the Stirling Association.

Along the Eden Valley west of St. Andrews, and in several areas of the Carse of Gowrie, deposits of red-brown late-Glacial estuarine silts and clays occur between the 75-foot and 125-foot contours. From these deposits, which can be correlated with similar deposits found in Stirlingshire, the Carbrook Association is derived.

8. Alluvium

The deposits on river flood-plains have been separated as recent alluvium. The texture is generally loamy sand or sand, but bands of fine sand or silt frequently occur.

River terraces, rising to 100 feet and over, represent older alluvium and the texture is generally very variable, ranging from sandy gravel to silty fine sand. Separation into different texture groups or into the Corby and Boyndie Associations has proved impracticable and the soils have been named the Carpow Association.

Chapter 4. The Soils

The system of soil classification used in this memoir is described in Appendix II, together with the more important field properties of each major soil group and sub-group. Table L lists the series found in the area arranged in their appropriate groups and sub-groups and the distribution of these groups is shown in Fig. 10.

TABLE L. Classification of Series

Major Soil Group	Sub-Group	Series
Brown Earths	Brown Forest Soils	Buchanyhill, Carpow, Darleith, Drumforber, Fourmerk Fungarth, Garvock, Greenside, Oldcake, Snaigow, Sourhope.
	Brown Forest Soils with Gleying	Balrownie, Bellshill, Caprington, Carey, Dunlop, Gourdie, Kippen, Laurencekirk, Luther, Macmerry, Mountboy, Winton.
Podzols	Iron Podzols	Aldbar, Allanhill, Auchenblae, Anniston, Boyndie, Corby, Forfar, Foudland, Gleneagles, Inchewan, Kellie, Kirkbuddo, Leys, Obney, Panbride, Rhynd, Strichen, Vinny.
Surface-water Gleys	Non-calcareous Gleys	Amlaird, Anniegathel, Atton, Barras, Cairnleith, Dallachy, Lour, Muirfoot, Mulloch, Rowanhill, Vigean.
	Gleyed Warp Soils	Cauldside, Harviestoun.
Ground-water Gleys	Gleyed Warp Soils	Carbrook, Fordel, Stirling.

Fifty-seven soil series have been distinguished in the surveyed area. The majority have already been mapped in other parts of the country and correlations have been made with soils from all three geographical regions of Scotland, the Highlands, the Central Lowlands and the Southern Uplands.

Table M shows the areas in square miles covered by the series and by other soil types viz. skeletal soils, alluvium, links, dunes, peat and mixed bottom land. The soil units which make up a soil association are arranged horizontally. Each association bears the name of one of its component series, usually that of the dominant series in the area where the association was first described. The names along the top of the table give the major soil group classification.

The percentage areas of drainage classes, of major soil sub-groups and of other soil categories have been calculated. Freely drained soils cover the greatest area, approximately 41 per cent of the total, with brown forest soils accounting for 23 and podzols for 18 per cent. Such soils, being naturally freely drained, require no artificial drainage. In the imperfectly drained category, where only occasional tile drains are required, brown forest soils cover 29·5 per cent, podzols 4·5 per cent and gleyed warp soils approximately 1 per cent. Poorly drained soils, which cover 7 per cent of the area, comprise gleyed warp soils (4·5 per cent) and non-calcareous gleys (2·5

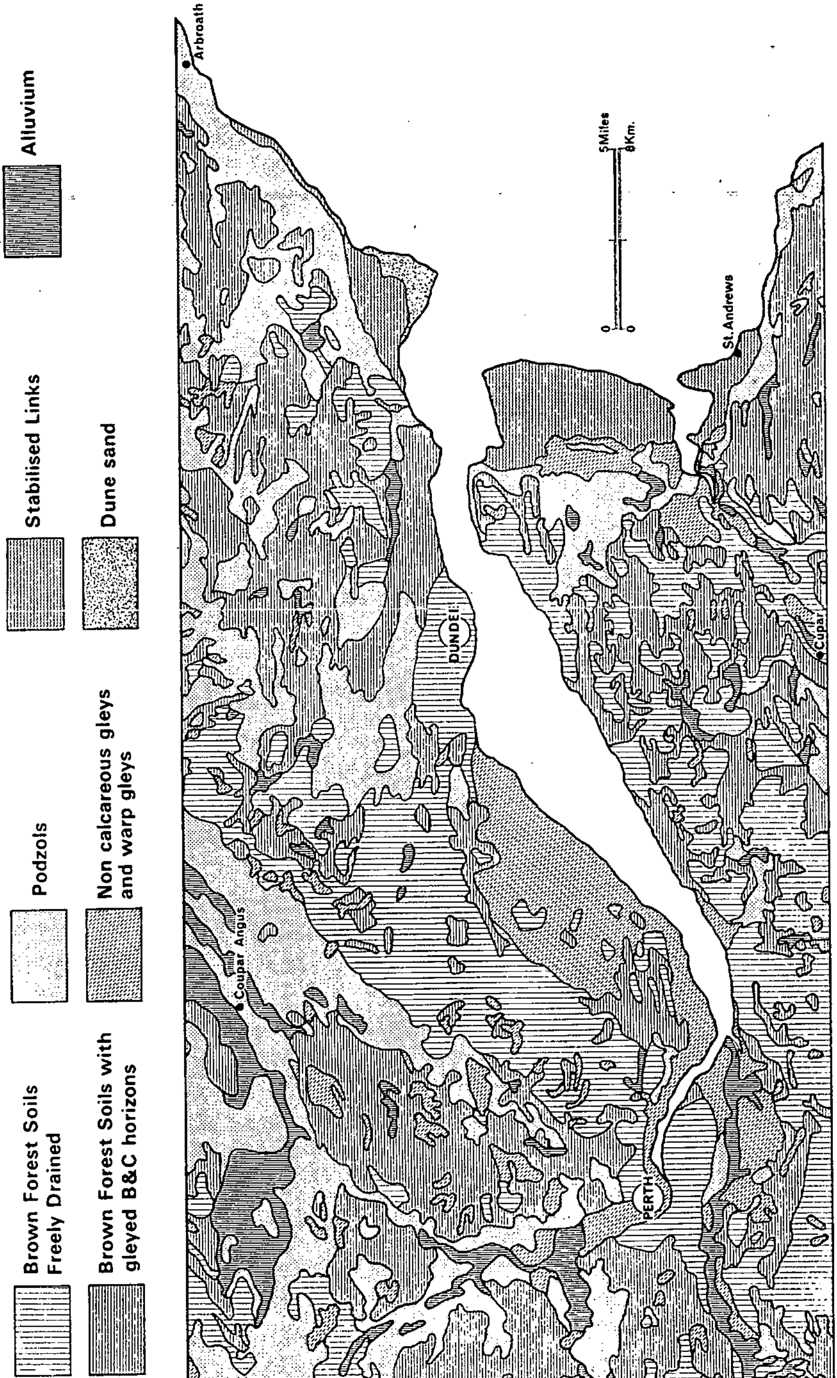


FIG. 10: Distribution of major soil sub-groups.

per cent). These require artificial drainage before they can be used successfully either for agriculture or forestry. Alluvium, including the small spreads of peat-alluvium complex and saltings, covers 8 per cent of the area, while Links and Dune Sand together account for 3 per cent. The remainder, amounting to approximately 6 per cent, consists of built-up and industrial areas, mixed bottom land and a small area of peat.

In this chapter the nineteen soil associations and their component series are described in some detail. Each profile description is taken from an actual pit and is numbered to correspond with entries on the table of analytical data appearing in Appendix III. Profiles have been selected which show morphological characteristics representative of what is considered the average or modal soil of a series, and details of local variations and phase differences are given in the text immediately after the descriptions.

Following most profile descriptions, a short note has been added on the analytical results. For the purposes of comparison, percentages of organic matter are graded low, moderate or high, as shown below:

Low	<8%
Moderate	8%–13%
High	13%–20%
Organic horizon	>20%

Values for total phosphorus and for acetic-soluble (or readily-soluble phosphorus, as shown in the tables in App. II), which are expressed as milligrams of P_2O_5 per 100 g. of soil, are also graded for comparison:

	Total P_2O_5	Acetic-soluble P_2O_5
Low	100	3
Moderate	100–300	3–10
High	>300	>10

Reference is made to exchangeable cations in the soil which play an important part in the mechanism of supplying nutrients to plants. A note on this subject and on the percentage base saturation is included in the chapter on analytical data (Chapter 6). Exchangeable cations are measured in milligram-equivalents per 100 g. of soil, and amounts for calcium, magnesium and potassium, three of the more important cations, are graded low, moderate and high, as is percentage base saturation:

	Ca	Mg.	K	% Base Saturation
Low	<3	<0·3	<0·1	<20%
Moderate	3–8	0·3–5	0·1–1	20–60%
High	>8	>5	>1	>60%

The land use capability grading of the soils is discussed in detail in Chapter 5, and it will suffice at this point to state that seven Capability Classes are recognized in which the limitations on use imposed by soil, site and climatic conditions become progressively greater from Class 1 to Class

TABLE M. Areas of Soil Categories (Square Miles).

ASSOCIATION	Brown Forest Soils				Podzols				Non-calcareous Gleys		Skeletal Soils	Total Area
	Series											
	Freely Drained		Imperfectly Drained		Freely Drained		Imperfectly Drained		Poorly Drained			
STRICHEN	Fungarth	0·4			Strichen	9·4	Obney	1·8	Anniegathel	0·8	0·3	12·7
FOUDLAND					Foudland	0·4					0·1	0·5
GOURDIE	Snaigow	4·4	Gourdie	4·2					Cairnleith	0·3		8·9
BALROWNIE	Buchanyhill	6·1	Balrownie	86·6	Aldbar	24·7			Lour	6·3	0·1	123·8
FORFAR					Vinny	17·3	Forfar	20·0	Vigean	2·4		39·7
LAURENCEKIRK	Oldcake	1·5	Laurencekirk	1·1					Muirfoot	0·1		2·8
	Drumforber	0·04	Luther	0·06								
KIPPEN	Fourmerk	0·1	Kippen	2·8								2·9
MOUNTBOY	Garvock	22·7	Mountboy	27·4					Barras	2·2		52·3
DARLEITH	Darleith	20·6	Dunlop	1·4					Amlaird	0·1	0·2	22·3
SOURHOPE	Sourhope	50·9	Bellshill	15·4					Atton	0·8	0·6	67·7
ROWANHILL	Greenside	0·8	Caprington	3·9	Allanhill	0·9			Rowanhill	0·3		
			Winton	9·1								16·0
			Macmerry	1·0								
CORBY					Corby	14·19	Leys	0·1	Mulloch	0·01		14·3
BOYNDIE					Boyndie	7·6	Anniston	1·0	Dallachy	0·1		12·7
					Inchewan	4·0						
AUCHENBLAE					Auchenblae	4·5	Kirkbuddo	0·3				4·8
GLENEAGLES					Gleneagles	4·5						4·5
CARPOW	Carpow	16·6	Carey	9·4								26·0
PANBRIDE					Panbride	12·8	Kellie	0·9				13·9
					Rhynd	0·2						
Total Areas		124·14		162·36		100·49		24·1		13·41	1·3	425·8

					Gleyed Warp Soils			
CARBROOK STIRLING					Harviestoun 3·2 Cauldside 1·8	Carbrook 0·4 Stirling 23·1 Fordel 2·9		3·6 27·8
Total Areas					5·0	26·4		31·4

ALLUVIUM—Undifferentiated	40·6	PEAT-ALLUVIUM-COMPLEX	1·2	MARINE—Saltings	1·7	43·5
LINKS (Freely drained)	16·1	LINKS (Poorly drained)	0·2	DUNE SAND	1·8	18·1
BASIN PEAT	0·6	MIXED BOTTOM LAND	4·4	BUILT UP AND INDUSTRIAL	26·2	31·2

Total Area 550·0

7. Soils in Class 1 have few or no limitations and, consequently, have no sub-classes, whereas soils in each of the others can have up to five sub-classes, depending on the limitations imposed. Classes 1 to 4 are all suitable for arable agriculture, limitations becoming increasingly severe from 2 to 4, Classes 5 and 6 are limited in use to permanent pasture or forestry and class 7 is unproductive land such as quarries, coal-bings, built-up areas, and upland areas above the tree-planting limit which are used for sport and recreation.

The soil associations, tabulated in the order in which they appear in Table M, are described below, commencing with soils derived from Highland Schist rocks and ending with those developed on terrace and raised beach deposits.

ASSOCIATIONS

The Strichen Association

The Strichen Association covers about 12 square miles, mainly in the north-west of the surveyed area. On the north side of the River Tay, it extends over the Grampian Foothills from Dunkeld eastwards to the Highland Boundary Fault; on the south side, it spreads from Birnam Hill eastwards over the Cairnleith Benchland to the Gelly Burn and southwards over the Logie-almond Bench as far as the Shochie Burn.

PARENT MATERIAL

The parent rocks are mainly micaceous schists and schistose grits of the Dalradian Series of Highland Schists. Shallow and stony till derived from these rocks covers most of the lower and middle slopes in the area. The colour is brown or light yellowish brown and the texture varies from fine sandy loam to loam and sometimes sandy clay loam. The stone content includes many angular and sub-angular schists, with other rounded or sub-rounded stones of Highland origin. On many of the upper slopes and hilltops decomposed schistose rocks form the soil parent material, and in some places thin skeletal soils have developed on rock rubble.

SOILS

Four series of the association have been distinguished in this area. Of these, Strichen and Fungarth are freely drained, Obney imperfectly drained and Anniegathel poorly drained.

STRICHEN SERIES

Strichen, a freely drained iron podzol, is the most extensive of the four series, covering rather more than half the association area. In addition to soils developed on till and occurring mainly on lower and middle hill slopes, the series includes soils developed directly on decomposed rock and found on upper slopes and on hill tops. Much of the lower ground is cultivated. Descriptions of both uncultivated and cultivated profiles are given below:

Profile Description

(No. 1 Cloven Stone).

SLOPE	3°.
ASPECT	south-west.
ALTITUDE	375 feet.
VEGETATION	old pine wood recently replanted; birch scrub with *Calluna vulgaris, Erica tetralix, Agrostis sp., Festuca sp., Hylocomium splendens, Pleurozium schreberi; Hypnum cupressiforme*
DRAINAGE CLASS	free.

Horizon	*Depth*	
L, F & H	2–0 in. (5 cm.–0)	Mixed pine and birch litter and partially decomposed litter with traces of well decomposed organic matter at base.
A_2	0–2 in. (0–5 cm.)	Grey-brown (10YR5/2) fine sandy loam; medium sub-angular blocky, breaking readily to fine crumb; low organic matter; few stones, mainly schists and other Highland rocks; many roots; dry. Sharp, smooth change into
B_2	2–14 in. (5–36 cm.)	Strong brown (7·5YR5/6) silty fine sandy loam; weak sub-angular blocky breaking readily to medium crumb; low organic matter—occasional accumulations in root channels; few stones, mainly angular pieces of schist with some sandstone; many roots; moist; no mottles. Sharp, even change into
B_2/B_3	14–20 in. (36–51 cm.)	Yellowish brown (10YR5/4–5/6) fine sandy loam; weak sub-angular blocky, breaking readily to medium crumb; occasional accumul-tions of organic matter down root channels; stones as above; roots frequent; moist; few faint strong brown (7·5YR5/6) mottles. Sharp, undulating change into
B_3	20–37 in. (51–94 cm.)	Brown to light yellowish brown (10YR5/3–6/4) fine sandy loam; indurated, breaking down under spade to platy structure and further, under moderate force, to medium angular blocky; many stones, mainly mica-schists; a few roots penetrate to 33 inches; moist; common faint yellowish brown (10YR5/6) mottles. Gradual change into
C	37–42 in. + (94–107 cm. +)	Yellowish brown (10YR5/6) gritty fine sandy loam; weak coarse angular blocky; low organic matter; many stones as above; moist with few faint mottles as above.

This profile shows the features of the typical freely drained Strichen podzol—the bleached A_2, the strong brown B_2 and the indurated B_3. Results of analysis show a higher percentage of U.S. silt than clay in all horizons. Exchangeable calcium is low, except in the L, F and H layer, while exchangeable magnesium is low below the B_2 horizon. Total phosphorus is moderate in all except the A_2 and B_2 horizons while acetic-soluble phosphorus is high in all except the B_2/B_3, where it is moderate, and the A_2 and B_2, where it is low. Percentage base saturation is low throughout and the pH ranges from 3·9 at the surface to 4·6 in the C horizon.

Profile Description

(No. 2 Upper Obney).

SLOPE	3°.
ASPECT	south-east.
ALTITUDE	525 feet.
VEGETATION	third year grass.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–9 in. (0–23 cm.)	Dark greyish brown (10YR4/2) loam; sub-angular blocky structure; moderate organic matter; frequent stones, mainly angular to sub-angular mica-schists; many fibrous grass roots; worms present; moist; no mottles. Sharp, smooth change into
B_2	9–15 in. (23–38 cm.)	Yellowish brown (10YR5/8) varying to strong brown (7·5YR5/8) silty fine sandy loam; weak small sub-angular blocky structure; low organic matter, occasional tongues of surface horizon material down root and worm channels; stones as above; many grass roots; worms present; moist; no mottles. Sharp, smooth change into
B_3	15–20 in. (38–51 cm.)	Pale brown (10YR6/3) fine sandy loam; weak angular blocky structure; low organic matter; many stones dominantly angular schists with some slates; grass roots frequent; moist; few distinct yellowish brown mottles. Gradual irregular change into
C	20–30 in. + (51–76 cm. +)	Yellowish brown (10YR5/6) sandy loam varying in texture to loamy sand with occasional pockets of finer material; weak platy structure, breaking readily to small angular blocky; very stony as above but with many larger stones; roots few; moist; few faint fine yellowish brown mottles.

Apart from the absence of A horizons, which have been destroyed by cultivation, this profile is similar in many ways to the previous one. The B_3 horizon is frequently indurated as in the uncultivated profile. Analytical results for exchangeable cations show that throughout the cultivated profile calcium is higher and magnesium lower than in the uncultivated profile. With cultivation, pH values tend to be higher, and percentage base saturation ranges from 76·7 in the S horizon to 26·8 in the C.

FUNGARTH SERIES

The Fungarth series occurs on the hill slopes immediately east of Dunkeld at altitudes between 300 and 500 feet. South of the River Tay it has been mapped between 700 and 1000 feet on the middle slopes of Birnam Hill. In these localities it is found under birch cover, or under mixed birch and oak, with a ground vegetation which frequently contains bracken. The drainage is free and the series is classed as a brown forest soil.

Profile Description

(No. 4. Birnam)

SLOPE	18°.
ASPECT	west.
ALTITUDE	475 feet.
VEGETATION	*Betula verrucosa, Pteridium aquilinum, Agrostis tenuis, A. canina, Teucrium scorodonia, Pseudoscleropodium purum*—now planted *Larix decidua.*
DRAINAGE CLASS	free.

Horizon	*Depth*	
A	0–6 in. (0–15 cm.)	Very dark brown (10YR2/2) loam; fine sub-angular blocky, breaking to fine crumb; friable; few stones; many roots; frequent bracken rhizomes; moist. Gradual change into
A/B	6–10 in. (15–25 cm.)	Brown (7·5YR4/4) fine sandy loam; fine to medium sub-angular blocky; few stones; frequent roots; tongues of A horizon material brought down by worms; moist. Clear change into
B_2	10–28 in. (25–70 cm.)	Yellowish red (5YR5/6) fine sandy loam; weak fine to medium sub-angular blocky; friable; roots frequent, few below 20 inches; moist. Gradual change into
C	28 in. + (70 cm. +)	Brown (7·5YR5/5) stony sandy loam/loamy sand.

Unlike profile No. 1, illustrating the Strichen series, the Birnam profile shows little evidence of leaching. Examination of analytical results shows that pH values are comparable and base saturation values very low in both profiles. A sharp contrast is noted in the data for the organic fractions. The podzolized Cloven Stone profile has high percentages of carbon and organic matter (36·6 and 61·9), while the Birnam soil has low values for both, indicating almost complete humification of organic residues and incorporation in the mineralized A horizon.

OBNEY SERIES

Covering a total area of about 1½ square miles, the Obney series is found mainly on Newtyle Hill and Letter Hill on the north side of the River Tay and on the Obney Hills on the south side of the river. Occurring on some lower or middle slopes adjacent to drainage channels or areas of poor drainage, the series is an imperfectly drained iron podzol with gleyed B and C horizons.

Profile Description

(No. 6. Letter Hill)

SLOPE	10°.
ASPECT	north.
ALTITUDE	575 feet.
VEGETATION	Old grass with *Agrostis tenuis, Anthoxanthum odoratum, Festuca rubra, Potentilla erecta, Rhytidiadelphus squarrosus, Pseudoscleropodium purum.*
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
A	1–10 in. (2·5–25 cm.)	Dark grey brown (10YR4/2) loam; weak sub-angular blocky; moderate organic matter; few stones, small to medium sub-rounded mainly of Highland origin up to 3 inches (8 cm.) in diameter; abundant fibrous grass roots; moist; faint fine ochreous mottles. Gradual change into
B_2(g)	10–18 in. (25–46 cm.)	Strong brown (7·5YR5/6) fine sandy loam; small sub-angular blocky; moderate organic matter; frequent small stones as above, mainly Highland schists, grits and quartzites with some slates; fibrous grass roots frequent; moist; frequent distinct rusty mottles. Sharp change into
B_3(g)	18–24 in. (46–61 cm.)	Yellowish brown (10YR6/4) fine sandy loam; indurated and breaking under strong pressure to angular blocky fragments; many small to medium angular and sub-rounded stones as above; no roots; slightly moist; frequent fine ochreous mottles. Gradual change into
C(g)	24 in. + (61 cm. +)	Yellowish brown (10YR5/4) fine sandy loam; massive; slightly plastic; stones as above; moist; mottles as above.

Although the Obney series resembles the Strichen series in many ways, there are notable differences. In the Obney profile, the B_2 horizon is normally less brightly coloured than in the Strichen profile. Mottling, which is absent or very faint in the freely drained series, is distinct in the B_2(g) and C(g) and, to a lesser extent, in the B_3(g) horizon of the imperfectly drained series.

ANNIEGATHEL SERIES

The Anniegathel series occurs on moderate to gentle slopes on parts of Letter Hill and Newtyle Hill. It is also found among the Obney Hills, mainly on low-lying areas or in hollows. The parent material is generally a till of fine sandy or silty loam texture, varying sometimes to sandy clay loam. The series is poorly drained and is classed as a non-calcareous gley.

Profile Description

(No. 9. Letter Hill)

SLOPE		9°.
ASPECT		north.
ALTITUDE		600 feet.
VEGETATION		Birch and willow scrub; *Juncus acutiflorus, Holcus mollis, Anthoxanthum odoratum, Agrostis canina var canina, Brachythecium rutabulum, Eurhynchium praelongum, Acrocladium cuspidatum.*
DRAINAGE CLASS		poor.
Horizon	*Depth*	
A	0–8 in. (0–20 cm.)	Very dark brown (10YR2/2) loam; massive; plastic; high organic matter; few stones; many grass, tree and *Juncus* roots; moist; few grey mottles towards bottom of horizon. Sharp change into
B_2g	8–14 in. (20–35 cm.)	Grey brown (10YR5/2) fine sandy loam; massive; firm; low organic matter; few stones towards bottom of horizon, mainly small angular pieces of schist; many roots as above; moist with grey brown gleying dominating the horizon colour and frequent large distinct brownish yellow (10YR6/6) mottles. Gradual change into
Cg	14–32 in. + (35–80 cm. +)	Light brownish grey (2·5Y6/2) fine sandy loam, varying to loam; angular blocky to prismatic; low organic matter; many stones, mainly of Highland origin with high proportion of angular and sub-angular schists; roots frequent, becoming few in lower half of horizon; moist; light brownish grey gleying dominates horizon with many large prominent yellowish brown (10YR5/6) mottles.

Throughout the areas of the Anniegathel series there are small areas of a poorly or very poorly drained soil, the Hythie series, which belongs to the sub-group of peaty gleys. In this district the areas of this series are too small to be mapped at the 1:25,000 scale.

Profile Description

(No. 10 Upper Obney).

SLOPE		3°.
ASPECT		east.
ALTITUDE		570 feet.
VEGETATION		*Calluna vulgaris, Juncus squarrosus, Trichophorum caespitosum, Molinia caerulea, Hypnum cupressiforme, Dicranum scoparium, Pleurozium schreberi.*
DRAINAGE CLASS		poor.
Horizon	*Depth*	
H	4–0 in. (10–0 cm.)	Dark reddish brown (5YR2/2) peaty humus; abundant roots; wet. Sharp change into
A_2g	0–4 in. (0–10 cm.)	Brown (7·5YR5/4) loam with greyish cast; medium to coarse platy; few stones; roots frequent with many dead cord roots; very moist. Clear change into
B_2g	4–12 in. (10–30 cm.)	Light yellowish brown (10YR6/3·5) fine sandy loam; fine to medium sub-angular blocky; friable; few stones; few live roots, frequent dead cord roots; moist; many strong brown (7·5YR5/6) mottles; Gradual change into
B_2g/C	12 in. + (30 cm. +)	Yellowish brown (10YR5/4) fine sandy loam; coarse sub-angular blocky tending to coarse prismatic; few stones; many distinct yellowish red (5YR5/6) mottles and grey structure faces on peds.

In this latter profile exchangeable cations have very low values, except in the H-horizon where calcium and magnesium are moderate and potassium high. Percentage base saturation is low throughout, and pH ranges from 3·9 at the surface to 5·3 in the B_2g/C. Total phosphorus is moderate in all horizons except the A_2g, where it is low; the acetic-soluble phosphorus is low in the H and A_2g and moderate elsewhere.

LAND USE CAPABILITY

The upper hill slopes on both sides of the Tay can support only permanent grass or trees and are placed in Class 6. Middle slopes are suitable for improved grass-land and fall into Class 5, while good Class 3 land is found from about 600 feet down to 300 feet.

The Foudland Association

Covering a total area of only 0·5 square mile, Foudland is the least extensive of the associations mapped in the district. The areas where it occurs follow the line of a slate band which crosses the Grampian Foothills a little to the south-east of Dunkeld. The largest area has been mapped north of the River Tay on the south-eastern slopes of Newtyle Hill; smaller areas are found on Letter Hill and, south of the river, on the Obney Hills.

PARENT MATERIAL

Most of the Foudland soils in this area are developed directly on slates or slaty schists where these rocks penetrate the schistose till covering much of the Grampian Foothills. The slates break down to give a parent material which is generally characterized by a moderately high silt content. Because of the narrowness of the slate band, till derived mainly from slates is found in only a few places; it is thin and generally olive brown.

SOILS

Only one series, Foudland, a freely drained iron podzol, has been mapped: it occurs over an altitude range from 300 to 700 feet. Several small patches of skeletal soil have been separated on hill-tops and in the vicinity of rock outcrops.

FOUDLAND SERIES

Profile Description

(No. 11. Letter Hill)

SLOPE	14°.
ASPECT	north.
ALTITUDE	700 feet.
VEGETATION	*Agrostis tenuis, Deschampsia flexuosa, Holcus lanatus, Potentilla erecta, Luzula multiflora.*
DRAINAGE CLASS	free.

Horizon	*Depth*	
A	0–9 in. (0–23 cm.)	Very dark greyish brown loam (10YR3/2); loose medium subangular blocky, breaking readily to fine crumb; moderate organic matter; frequent stones in lower half of horizon, mainly of Highland origin with a large proportion of angular slaty schists. Sharp change.

B	9–16 in. (23–41 cm.)	Strong brown (7·5YR5/8) silty loam; sub-angular blocky breaking readily to fine crumb; friable; stony, mainly angular pieces of slaty schist; roots plentiful; moist; no mottles. Gradual change into
C	16–22 in. (41–56 cm.)	Dark brown (7·5YR4/4) silty fine sandy loam; medium crumb structure, breaking readily to single grain; friable; low organic matter; very stony—pieces of shattered slate increasing in size with depth; roots frequent at top, few at bottom; moist; no mottles. Gradual change into
D	22 in. + (56 cm. +)	Shattered slaty schist.

With the exception of potassium which is moderate, all exchangeable bases have low values, and percentage base saturation is very low. There is little variation in pH down the profile, the range being 4·7 to 5·0. Total phosphorus is moderate throughout, but acetic-soluble phosphorus is low except in C.

The above profile is typical of parts of the association used for sheep grazing. The remainder of the area is afforested and the profile generally shows L, F and H layers, either well or partially defined, an A_2 layer in which bleached sand grains are prominent, and a brown or strong brown B_2 horizon.

LAND USE CAPABILITY

Although in some parts of Aberdeenshire the series provides good agricultural land, in the Grampian Foothills Region, mainly because of climatic, topographic and rooting zone limitations, it has been placed in Land Use Capability Class 6 as suitable only for permanent pasture or forestry.

The Gourdie Association

Covering a total of approximately 9 square miles, the Gourdie Association is contiguous to the Strichen Association and occurs in two main areas, one north of the River Tay on the eastern portion of the Grampian Foothills and the other south of the river on part of the Cairnleith Benchland to the west of Murthly. In the former area the relief is strongly undulating to hilly, with altitudes ranging from 200 to 650 feet; in the latter it is gently rolling, with elevations between 300 and 400 feet.

PARENT MATERIAL

For a few miles east of the Highland Boundary Fault till derived from Highland schists is mixed with sandstone from the Lower Old Red Sandstone deposits which underlie Strathmore and the eastern part of the Grampian Foothills region. The resulting till forms the parent material of the Gourdie Association; it may vary in colour from brown or light yellowish brown under freely drained conditions to dark greyish brown when poorly drained. The texture is loam, varying sometimes to fine sandy clay loam. Light colours and finer sandy textures are found more commonly in the areas nearest to the Highland Boundary Fault, while further east the sandstone influence becomes greater, the till colour being sometimes reddish brown. The association may be considered as transitional between the Strichen and Balrownie Associations (p. 51).

In addition to Highland schist and sandstone rock material, which are the main constituents, the till normally contains a proportion of igneous rocks. This is more noticeable in the soils occurring north of the River Tay where there are frequent igneous intrusions.

The Gourdie Association differs from the Strathfinella Association mapped in the vicinity of the Highland Boundary Fault in Angus and Kincardineshire in that, while both associations are developed on similar lithological parent materials, the parent material of the Strathfinella is coarser in texture and notably reddish brown in colour.

SOILS

Three soil series have been mapped. Snaigow is a freely drained brown forest soil and Gourdie an imperfectly drained brown forest soil, while Cairnleith is a non-calcareous gley.

SNAIGOW SERIES

Much of the Snaigow series, particulary in areas north of the Tay, occurs on hill slopes which are moderate to moderately steep. South of the river it is found mainly on gentle slopes, at lower altitudes. Most of the series is under arable cultivation. The remainder supports several small plantations of mixed coniferous and deciduous woodland under which soils with podzolic characteristics have developed. Because of the limited occurrence of these soils, no attempt has been made to separate a podzol series and all have been included in the Snaigow series. The first profile shown below is of this podzolic type.

Profile Description

(No. 12 East Cult)

SLOPE		12°.
ASPECT		north-east.
ALTITUDE		575 feet.
VEGETATION		Oak wood with *Holcus mollis*, *Anthoxanthum odoratum*, *Rubus idaeus*, *Pseudoscleropodium purum*, *Thuidium tamariscinum*.
DRAINAGE CLASS		free.
Horizon	*Depth*	
L & F	1–0 in. (2·5 cm–0)	Dark brown fibrous humus mixed with oak leaf litter; many roots. Sharp change into
A	0–2 in. (0–5 cm.)	Dark reddish brown (5YR2/2) humose loam; amorphous; firm; high organic matter; many bleached sand grains; many fibrous grass roots; moist; no mottles. Sharp change into
A/B	2–6 in. (5–15 cm.)	Brown (7·5YR4/4) fine sandy silt loam; medium sub-angular blocky, breaking readily to fine crumb and single grain; low organic matter; few small sub-rounded stones of Highland origin; many fibrous grass and woody *Rubus* roots; moist; no mottles. Sharp change into
$B_{2(1)}$	6–11 in. (15–28 cm.)	Strong brown (7·5YR5/6) fine sandy silt loam; medium sub-angular blocky, breaking readily to fine crumb; low organic matter; few small stones, as above; roots as above; moist; no mottles. Sharp change into
$B_{2(2)}$	11–19 in. (28–48 cm.)	Yellowish brown (10YR5/4) loam; coarse angular blocky with tendency to prismatic, breaking readily to fine crumb and single grain; low organic matter; stones as above; roots frequent but decreasing in number with depth; moist; no mottles. Sharp change into

B_3	19–33 in. (48–84 cm.)	Light yellowish brown (10YR6/4) fine sandy loam; indurated, breaking under strong pressure to angular blocky and further to fine crumb; low organic matter; many small angular pieces of mica-schist and slate with occasional fragments of sandstone and lava throughout; few roots; moist; few fine faint yellowish brown (10YR5/4) mottles. Gradual change into
C	33 in. + (84 cm. +)	Light yellowish brown (10YR6/4), brown (7·5YR4/2) and, in patches, reddish brown (5YR4/3) loam varying to fine sandy clay loam; massive; compact; firm; stones as above; few roots; moist; diffuse medium to coarse strong brown (7·5YR5/8) mottles.

This profile is typical of most of the woodland soils in the Snaigow series. Bleached sand grains are prominent in the A horizon, the colour in the B_2 is strong brown to yellowish brown, and induration is strong in the B_3, which is normally 12 inches thick or more.

Examination of the molecular ratios of the clay fraction for this profile shows a fall in the percentage of silica in the $B_{2(1)}$ horizon and a corresponding rise in the percentage of iron oxide and alumina, indicating accumulation of sesquioxides in this horizon. Below the B_2, the percentage of silica increases while the value for sesquioxides falls.

The profile described below was taken from a cultivated site.

Profile Description

(No. 13. Middle Gourdie)

SLOPE	7°.
ASPECT	south.
ALTITUDE	350 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–8 in. (0–20 cm.)	Dark brown (7·5YR3/2) loam; medium sub-angular blocky, breaking readily to fine crumb and single grain; low organic matter; few sub-angular quartzites and schists; frequent fibrous grass roots; worms present; moist; no mottles. Sharp change into
B_2	8–12 in. (20–30 cm.)	Brown (10YR4/3) loam varying to fine sandy loam; medium angular blocky, breaking readily to fine crumb and single grain; low organic matter; stones as above; roots as above; worms present; moist; no mottles. Sharp change into
B_3	12–24 in. (30–60 cm.)	Yellowish brown (10YR5/4) to brown (7·5YR5/4) fine sandy loam; strongly indurated, with tendency to platy structure, breaking under strong force to small angular fragments and single grain; low organic matter; many stones, mainly small sub-angular dark Highland rocks with some red sandstones; few roots, absent below 15 inches; no worms; moist; faint fine strong brown (7·5YR5/8) mottles throughout and grey clay accumulations round stones. Gradual change into
C	24–36 in. + (60–90 cm. +)	Brown (7·5YR5/4) sandy clay loam; massive; firm; frequent rounded and sub-angular stones of Old Red Sandstone and Highland origin; moist; mottles as above; grey faces on peds and grey skins around stones.

Except in the A horizons, the two profiles have many similarities. Mechanical analyses show comparable percentages of soil separates, with silt figures slightly higher in the cultivated profile and clay higher in the uncultivated one, particularly in the C horizon. A possible explanation is that the uncultivated soil, lying 2 miles farther to the west, probably contains a higher proportion of fine-textured material, derived largely from Highland schists, than the cultivated soil to which a coarser texture has been imparted by the breakdown of sandstones present in the till.

GOURDIE SERIES

The Gourdie series occurs mainly at altitudes below 300 feet on gently rolling slopes. The application of the association name to a series usually indicates a perceptible dominance over other series, but in this instance the total area of the Gourdie series is only slightly greater than that of the Snaigow series. With the exception of a few small areas of woodland, the series is all cultivated.

Profile Description

(No. 14. Middle Gourdie).

SLOPE		5°.
ASPECT		south.
ALTITUDE		240 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
S	0–18 in. (0–46 cm.)	Very dark grey brown (10YR3/2) loam, varying to dark brown (7·5YR3/2) with depth; coarse sub-angular blocky, breaking readily to coarse and medium crumb; firm; low organic matter; few stones but becoming stony with depth, mainly angular and sub-angular sandstones and schists; fibrous grass roots plentiful; worms present; moist; few faint fine ochreous mottles in lower half of horizon. Sharp change into
B_2(g)	18–23 in. (46–58 cm.)	Grey brown (10YR5/2) loam; amorphous, with slight tendency in parts to weak platy; low organic matter; few stones; grass roots frequent; moist; prominent ochreous mottles. Gradual change into
B_3(g)	23–27 in. (58–69 cm.)	Light brownish grey (2·5Y6/2) sandy loam; weak medium sub-angular blocky; loose; low organic matter; many stones mainly angular and sub-angular sandstones and schists with occasional lava; few roots; moist; many medium distinct yellowish brown (10YR5/8) mottles. Gradual change into
C(g)	27–40 in. + (69–102 cm. +)	Reddish brown (5YR5/3) loam varying to sandy clay loam; sub-angular blocky; firm; low organic matter; stones as above, but fewer and smaller with occasional pieces of decomposing red sandstone; few roots; moist; distinct yellowish brown (10YR5/6) mottles.

The thickness of the S horizon, which is greater than the normal value of 8 to 10 inches, suggests that the field has been deep-ploughed or, more probably, in view of its proximity to the farm steading, that it is a former in-field in which the soil was gradually built up over the years by composting. Results of mechanical analysis show an appreciable fall in the percentage of clay in the B_3(g) and C(g) horizons with a corresponding rise in the percentage of sand, due doubtless to the presence of decomposing sandstone.

While the Gourdie series resembles the Balrownie in many respects, there are notable differences. Compared with the above profiles, the Balrownie profile at Guildtown, No. 17, shows a higher percentage of clay in all horizons. Although the silt percentage is similar in both profiles, the ratio of silt to clay is much higher in the Gourdie profile than in the Balrownie. A comparison of exchangeable cations shows that in both series calcium values are generally moderate i.e. from 3 to 8 milligram-equivalents per 100 g of soil. Values for magnesium and potassium also tend to be moderate for both series, although magnesium is sometimes low in Gourdie.

CAIRNLEITH SERIES

The Cairnleith series, which is not extensive, occurs on low-lying ground about Cairnleith Moss, a former peat moss now cut-over. Although peaty-topped soils do occur occasionally throughout the series, they have not been separated and the series is classed as a non-calcareous gley.

Profile Description

(No. 16. Cairnleith)

SLOPE		level.
ASPECT		nil.
ALTITUDE		375 feet.
VEGETATION		Mixed birch and pine woodland with *Vaccinium myrtillus*, *Polytrichum* sp., *Sphagnum* sp.
DRAINAGE CLASS		poor.
Horizon	*Depth*	
L, F & H	1–0 in. (2·5 cm–0)	Mixed leaf and pine needle litter, fermenting humus and well decomposed organic matter; many fibrous plant and woody tree roots. Sharp change into
A_1g	0–6 in. (0–15 cm.)	Dark reddish brown (5YR3/2) fine sandy loam; amorphous; plastic; high organic matter; few stones; many plant roots, frequent tree roots; wet; prominent light brownish grey (10YR6/2) mottles. Sharp change into
A_2g	6–10 in. (15–25 cm.)	Very dark grey brown (10YR3/2) sandy loam; massive; slightly plastic; many stones—medium angular and sub-angular stones of Highland origin; frequent fibrous roots, few tree roots; wet; prominent fine light brownish grey (2·5Y6/2) mottles. Gradual change into
B_2g	10–17 in. (25–42·5 cm.)	Reddish brown (5YR4/3) fine sandy loam; massive; slightly plastic; low organic matter; stones as above; fibrous roots frequent becoming few at base of horizon; wet, water-table at 18 inches; prominent light brownish grey (2·5Y6/2) mottles. Gradual change into
Cg	17–24 in. + (42·5–60 cm. +)	Dark greyish brown (10YR4/2) loam varying to sandy clay loam; massive; plastic; low organic matter; stones as above with frequent large boulders; roots occasional; wet; prominent reddish brown (5YR5/4) mottles.

This profile has low pH values and very low base saturation throughout. With the high organic content in the A_1g horizon, it approaches a peaty gley. Most of the series is found under woodland or rough grazing.

LAND USE CAPABILITY

Below about 300 feet most of the Gourdie series and of the Snaigow series is good agricultural land falling into the 2S class. Above this level the soils, mainly Snaigow, are classed as 3S or 3SG. The poorly drained Cairnleith series is 6W.

The Balrownie Association

The Balrownie Association, covering 22·5 per cent of the total soil area, is the most extensive association in the district. It occurs in three main areas: (1) in Strathmore, the largest area; (2) in the Sidlaw Foothills Sub-region of Angus; and (3) on certain slopes of the Sidlaw Hills to the north and north-west of Dundee. A few small scattered areas have been mapped in other regions.

PARENT MATERIAL

The main parent material of the association is a till derived from Lower Old Red Sandstone sediments, containing both coarse massive sandstones and fine grained flaggy sandstones. The till, which is generally reddish brown in colour and often more than 6 feet in depth, varies in texture from loam to clay loam and has a moderate stone content of sandstones with occasional Highland schist erratics. Where the till has been derived mainly from flaggy sandstone, the texture is generally fine sandy loam or fine sandy clay loam and angular pieces of flaggy sandstone are common throughout. On upper slopes and on rising ground, particularly in the Sidlaw Hills, the till is stony and normally of sandy loam or loam texture; the colour varies from reddish brown to dark reddish brown. Freely drained soils are developed on this till, which is generally shallow and underlain by sandstone rock. Most of the lower ground is covered by tills of finer texture, sandy clay loam to clay loam, on which are developed imperfectly and poorly drained soils. In certain small areas where there is an absence of till, decomposing sandstone rock forms the soil parent material which is normally of loamy sand texture and varies in colour from reddish brown to weak red.

SOILS

Four series within three drainage classes have been mapped in this association. The dominant series, Balrownie, is imperfectly drained, and occurs mainly in Strathmore and in the Sidlaw Foothills. The poorly drained Lour series is found in the more low-lying parts of these regions. The freely drained Aldbar series covers much of the Sidlaw upper slopes and of the higher ground to the north and north-west of Dundee. The other freely drained series, Buchanyhill, occurs only occasionally throughout the association area and is of limited extent.

BALROWNIE SERIES

Balrownie, the dominant series, is an imperfectly drained brown forest soil with gleyed B and C horizons. It is developed on till which varies in texture from loam to clay loam, the higher clay contents being found mostly in the southern parts of Strathmore. The series occurs mainly on gently or moderately sloping ground. In Strathmore it has been mapped between Coupar Angus and Perth and to the west and north-west of the latter. In the Sidlaw Foothills Sub-region the series covers much of the rising ground behind the coastal raised beaches.

Profile Description

(No. 17. Guildtown)

SLOPE		3°.
ASPECT		north.
ALTITUDE		225 feet.
VEGETATION		first year grass.
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
S	0–1 in. (0–25 cm.)	Dark greyish brown (10YR4/2) loam; moderate medium sub-angular blocky; firm; moderate organic matter; few stones usually small sub-angular; many roots; moist; no mottles. Sharp change into
$B_2(g)$	10–22 in. (25–56 cm.)	Dark reddish grey to reddish brown (5YR4/2 to 4/3) sandy clay loam with occasional patches of coarser texture; sub-angular blocky; firm; low organic matter; few roots; many small sub-angular stones, with occasional large cobbles; moist; prominent fine yellowish red (5YR5/6) mottles. Gradual irregular change into
C(g)	22–50 in. + (56–127 cm. +)	Reddish brown (5YR4/3) clay loam; medium sub-angular to angular blocky; few roots; many sub-angular stones; moist; distinct fine mottles.

The thickness of the surface horizon varies from 9 to 12 inches and the texture is normally loam although it is sometimes sandy clay loam. The $B_{2(g)}$ horizon, of loam to sandy clay loam texture, has an angular to sub-angular blocky structure. It shows prominent yellowish red (5YR5/6) mottles and, frequently, light grey (5YR7/1) mottles. The texture of the C horizon is normally sandy clay loam or clay loam, although in some cases, where coarser material from decomposing sandstone is present, it is only loam.

In some areas and more frequently in northern Strathmore than further south, soils of the Balrownie series have been mapped which show evidence of water-sorting in the upper horizons of the profile. The depth of this water-sorted layer varies and may include part or all of the B horizon. Textures in the upper horizons of the sorted soils are coarser than in the corresponding horizons of the unsorted soils, and it appears that much of the clay and silt fraction has been removed, presumably by water action. In the B and C horizons of these soils manganese dioxide staining is not uncommon and small manganese/iron concretions are sometimes found.

Profile Description

(No. 18. Stewart Tower)

SLOPE		0° (top of low mound).
ASPECT		nil.
ALTITUDE		350 feet.
VEGETATION		third year grass.
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
S	0–11 in. (0–28 cm.)	Dark greyish brown (10YR4/2) loam; coarse sub-angular blocky breaking readily to medium crumb; firm; low organic matter; few stones mainly sub-angular mixed Highland and Old Red Sandstone; many grass roots; moist; no mottles. Smooth sharp change into
$B_2(g)$	11–15 in. (28–38 cm.)	Yellowish brown (10YR5/4) gritty loam; coarse angular blocky, breaking readily to medium crumb; friable; low organic matter; stones as above; roots frequent; moist; frequent distinct yellowish red (5YR4/8) mottles with faint light grey (5YR7/1) coatings on peds. Clear undulating change into

C(g)	15–40 in. + (38–102 cm. +)	Reddish brown (5YR4/3) sandy clay loam to clay loam; coarse angular blocky; firm; stones as above, occasionally weathered; few roots to 22 inches; moist; few faint ochreous mottles.

Examination of analytical results for the two profiles above shows that values for percentage clay are comparable, although in most cases slightly higher in the Guildtown profile than in the Stewart Tower. In the latter, the effect of water-sorting is clearly seen in the lower clay content of the B_2(g) horizon and, to a lesser extent, of the S horizon. Both profiles have moderate exchangeable calcium throughout, with the value in the Guildtown profile approaching high below 30 inches. Exchangeable magnesium is moderate in all the Guildtown horizons; the Stewart Tower profile has low values in the S and B_2(g) with moderate values in all other layers. In various cultivated Balrownie profiles examined, exchangeable calcium is generally moderate to high. Magnesium is generally moderate in the S horizon and throughout the profile, although there is frequently an increase from S to C. Potassium, in most cases, is moderate.

Percentage base saturation values for both profiles are comparable, being moderate in S and B horizons and high in C, although for the water-sorted B_2(g) layer of the Stewart Tower profile, which is of coarser texture, the value is much lower than in the other horizons, being only 25. Low or moderate to low saturation is a feature of most coarse-textured water-sorted horizons.

pH value in the Guildtown profile rises from 6·2 in the S to 6·8 in the C; in the Stewart Tower profile, there is a slight drop from 5·9 in the S to 5·6 in the C.

Values for total and acetic-soluble phosphorus follow the pattern observed in a number of cultivated Balrownie profiles. Total phosphorus, which is generally highest in the S and of moderate value, usually drops in the B horizons—sometimes to low levels—and rises again in the C. Acetic-soluble phosphorus is commonly moderate to high in the S, moderate in the B and high in the C.

In uncultivated areas, particularly under coniferous woodland, imperfectly drained podzols are developed on Balrownie till. On Sheet 39 (Stirling), lying to the south-west of the area surveyed, areas of uncultivated land are more extensive and an imperfectly drained podzol, Muirhead series, has been separated. In this area however the series is now of only limited extent, although at one time it was more widespread, much of the soil having been podzolic before cultivation; all imperfectly drained soils of the association have therefore been included in the Balrownie series. A typical profile from coniferous woodland is described.

Profile Description

(No. 20. Lamberkine Wood)

SLOPE	2°.
ASPECT	north.
ALTITUDE	360 feet.
VEGETATION	Coniferous woodland with *Deschampsia flexuosa, Erica cinerea, Calluna vulgaris, Hylocomium splendens, Pleurozium schreberi*
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
L, F, H	1–0 in. (3–0 cm.)	Dark brown litter and fermenting humus with trace of well decomposed humus at base. Sharp change to
A_1/A_2	0–2 in. (0–5 cm.)	Very dark greyish brown (10YR3/2) fine sandy loam; weak sub-angular blocky, breaking readily to medium crumb; high organic matter; stones absent; many fibrous grass and woody tree roots; no mottles. Sharp smooth change into
B_2(g)	2–10 in. (15–25 cm.)	Light yellowish brown (10YR6/4) to yellowish brown (10YR5/4) sandy loam; slightly compact sub-angular blocky, breaking under moderate pressure to fine crumb; low organic matter; frequent small rounded stones and larger angular pieces of decomposing sandstone; roots frequent; frequent prominent medium strong brown (7·5YR5/6) mottles. Clear irregular change into
C(g)	10–33 in. + (25–84 cm +)	Reddish brown (5YR4/3) sandy clay loam varying with depth to clay loam; strong coarse angular blocky to prismatic; few rounded stones and several large pieces of decomposing flaggy sandstone; few woody roots; few medium to fine faint yellowish brown (10YR5/8) mottles and light grey (2·5Y7/2) deposits on sides of root channels.

The profile frequently has an indurated B_3 horizon, and in such cases the B_2(g) is generally shallower, the depth not exceeding 3 or 4 inches. The degree of induration varies, but is not normally as strong as in the freely drained Aldbar series. With the exception of magnesium, which rises to 2·9 me/100 gms. in the C horizon, all exchangeable cations reach their highest values, which are moderate, in the organic surface horizon. Thereafter, calcium is low throughout, magnesium low in the B_2(g) and the upper C(g), and potassium low in the $B_{2(g)}$. Base saturation is low, except in the lower C(g) where it rises to 50, while the pH ranges from 4·1 to 5·2. Total phosphorus is moderate in the LFH and A_2 horizons and low elsewhere, while acetic soluble is high in the LFH only and low in other layers.

ALDBAR SERIES

Developed on sandstone till, normally of sandy loam or loam texture, the Aldbar series is a freely drained podzol. Occurring mainly on upper hill slopes and on rising ground, the series is most extensive in the Sidlaw Hills to the north and north-west of Dundee. The series has also been mapped on more level country in the Muirhead area to the west of Dundee and in several small isolated localities throughout Strathmore. The till on upper slopes is frequently shallow and the underlying sandstone rock occurs at within 3 feet of the surface.

Profile Description

(No. 22. Muirloch)

SLOPE	2°.
ASPECT	south-west.
ALTITUDE	575 feet.
VEGETATION	third year grass.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–8 in. (0–20 cm.)	Dark brown (7·5YR3/2) fine sandy loam; strong coarse sub-angular blocky, breaking readily to small sub-angular blocky and medium crumb; moderate organic matter; frequent stones, mainly sub-angular sandstone and lava; many fibrous grass roots; moist; no mottles. Sharp undulating change into

B_2	8–15 in. (20–38 cm.)	Brown (7·5YR5/4) fine sandy loam/sandy loam; strong coarse angular blocky, breaking readily to small angular blocky and further to fine crumb; firm; low organic matter; few small sub-angular stones and larger angular pieces of flaggy sandstone; many fibrous grass roots; moist; few faint strong brown (7·5YR5/6) mottles. Sharp irregular change into
B_3	15–30 in. (38–76 cm.)	Reddish brown (5YR5/3) sandy loam; slightly compacted at top, becoming indurated below 21 inches; firm; low organic matter; frequent stones, increasing with depth (mainly angular flaggy sandstones); few roots, becoming rare below 24 inches; slightly moist; no mottles. Gradual irregular change into
C	30–35 in. (76–89 cm.)	Reddish brown (5YR4/3) sandy loam/loam; strong coarse sub-angular blocky; firm; low organic matter; many stones, mainly sandstone, both massive and flaggy.
D	35 in. + (89 cm. +)	Shattered sandstone rock.

Because of the shallowness of the till, the textures throughout this profile tend to reflect the nature of the underlying rock, fine sandy textures indicating flaggy sandstone. In contrast to the Stewart Tower profile (No. 18) from the Balrownie series, which shows in the S horizon a ratio of 35·5 U.S. silt to 20 clay, the above profile shows the ratio silt to clay as 31·5 to 9. This ratio, which is approximately constant down the profile and only becomes noticeably lower in the C horizon, is an indication of the flaggy nature of the parent rock.

In some profiles, more frequently in those representing soils from lower altitudes, the texture of the till is generally finer and in some cases approaches that of the Balrownie series.

Profile Description

(No. 21. Greenford)

SLOPE	7°.
ASPECT	west.
ALTITUDE	760 feet.
VEGETATION	old pasture.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–8 in. (0–20 cm.)	Dark brown (7·5YR3/2) loam; weak small sub-angular blocky, breaking to small crumb; high organic matter; many grass roots; few stones in lower half of horizon; no mottles. Sharp change into
B_2	8–14 in. (20–36 cm.)	Brown (7·5YR4/4) loam; coarse sub-angular blocky, breaking to medium crumb; moderate organic matter; many stones; grass roots frequent; no mottles. Sharp change into
B_3	14–24 in. (36–60 cm.)	Dark reddish grey to reddish brown (5YR4/2–4/3) sandy loam; indurated, breaking down under moderate pressure to weak platy; low organic matter; many stones; roots few, becoming rare at bottom of horizon; few faint reddish yellow (7·5YR6/8) mottles. Gradual change into
C	24–30 in. + (60–76 cm.+)	Reddish brown (5YR5/3–4/3) loam to sandy clay loam; strong medium angular blocky; firm; low organic matter; many stones, with occasional flaggy sandstones towards bottom of horizon; frequent medium strong brown (7·5YR5/6) mottles.

Amounts of exchangeable cations tend to be lower in the Aldbar series than in the Balrownie, except, occasionally, in the S and A_1 horizons. pH is also lower, ranging in most cases from 4·5 to 5·5. Total phosphorus is frequently moderate or moderate to low throughout the profile, while readily soluble phosphorus is generally moderate in all horizons but is sometimes high in the L/F layers of uncultivated profiles and in the S horizons of cultivated soils.

BUCHANYHILL SERIES

The Buchanyhill series, which covers the smallest area of the association, is developed on decomposing sandstone rock. Soil depth is variable, depending on the depth to which the rock has been decomposed. The series, which is classed as a freely drained brown forest soil, has been mapped, mainly on cultivated ground, in a few small isolated areas throughout the Balrownie Association. Similar soils, derived also from sandstone rock, are found throughout the Aldbar series in small areas where there is an absence of till. These soils are podzols and, because of the difficulty of separation from podzols developed on thin till, they have been included in the Aldbar series. The upper horizons of the Buchanyhill series sometimes show evidence of water-sorting.

Profile Description

(No. 25. Blairbell)

SLOPE		5°.
ASPECT		west.
ALTITUDE		470 feet.
VEGETATION		third year grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–11 in. (0–28 cm.)	Dark reddish brown (5YR3/4) fine sandy loam; weak coarse subangular blocky, breaking readily to medium crumb; friable; moderate organic matter; few stones; many grass roots; no mottles. Sharp undulating change into
B_2	11–29 in. (28–74 cm.)	Weak red (2·5YR4/2) sandy loam to loamy sand; moderately indurated, breaking down to medium angular blocky; low organic matter; many stones; few roots; no mottles; Sharp irregular change into
C	29–55 in. + (74–140 cm. +)	Reddish brown (5YR4/3) loamy sand; weakly cemented and breaking readily to single grain, cementation dying out at 41 inches; occasional pieces of decomposing sandstone rock; no mottles.

LOUR SERIES

Covering approximately 5 per cent of the total area of the association, the Lour series occurs in scattered areas throughout Strathmore and, to a lesser extent, in the Sidlaw Foothills. Developed on till, generally more than 8 feet thick and of sandy clay loam to clay loam texture, the series is poorly drained and is found mainly on low lying ground and in hollows. It has been classed as a non-calcareous gley. Much of the series is uncultivated, part supporting coniferous woodland and part open moorland with *Juncus communis*, *Polytrichum* spp. and *Sphagnum* spp. common.

(No. 27. Westmuir)

SLOPE		level.
ASPECT		0.
ALTITUDE		475 feet.
VEGETATION		*Juncus communis, Calluna vulgaris, Polytrichum commune, Sphagnum* spp., *Erica tetralix, Nardus stricta*
DRAINAGE		poor.
Horizon	*Depth*	
L & F	3–2 in. (8–5 cm.)	Plant litter and partially decomposed rooty material.
H	2–0 in. (5–0 cm.)	Black (2·5YR2/0) well decomposed humus. Sharp irregular change to
A_2g	0–5 in. (0–13 cm.)	Dark greyish brown (10YR4/2) sandy loam to loamy sand; weak sub-angular blocky; low organic matter; many roots; frequent faint yellowish red (5YR5/6) mottles in lower half of horizon. Gradual (over 3 inches) irregular change into
B_2g	5–16 in. (13–41 cm.)	Weak red (2·5YR4/2) sandy clay loam; coarse sub-angular blocky to prismatic; plastic; low organic matter; few stones; few roots; many prominent yellowish red (5YR5/8) mottles and yellowish brown (10YR6/4) coatings round old root channels. Clear undulating change into
Cg	16–49 in. (41–124 cm.)	Dark reddish grey (5YR4/2) to dark reddish brown (5YR3/3) sandy clay loam/clay loam; massive; very firm; low organic matter; few stones, occasional boulders; roots few, becoming rare at 28 inches; few faint yellowish red (5YR5/8) mottles and light grey (10YR7/1) deposits on ped faces and round old root channels.

From 10·5 per cent in the A_2g horizon, the clay content in this profile rises to 27 in the B_2g and 30 in the Cg. Even higher clay contents are found in B and C horizons elsewhere in the Lour series and values are generally higher than in the imperfectly drained Balrownie series. Percentage base saturation also tends to be higher in the Lour series, particularly in the basal layers where it is often 100. Exchangeable calcium, in most cases, is moderate throughout, and, after dropping slightly in the sub-surface horizon, increases down the profile. Magnesium values are frequently higher than in Balrownie profiles, particularly in the C horizon where values are often high or moderate to high. Potassium values are generally moderate and are highest in the surface horizon. Total phosphorus tends to be moderate in most horizons, except in the uncultivated soils where values other than in the surface layer are frequently low. Acetic soluble phosphorus is frequently low or moderate to low in the surface, but increases down the profile, invariably reaching high values in basal layers.

LAND USE CAPABILITY

The greater part of the area covered by the Balrownie Association is Class 2 land. This includes most of the Balrownie series, certain areas of Aldbar series, and a few small patches of Lour series which, although classed as poorly drained, are yet sufficiently capable of improvement to warrant classification as 2W rather than 3W. Much of the Aldbar series is limited to Classes 3, 4 and 5 because of its occurrence at higher elevations but has nevertheless proved its worth on hill farms. Because of the moderate clay content of the parent material, soils of the Balrownie series have good moisture and nutrient-holding capacities but occasionally require tile drainage. They are thus valuable high quality soils and are largely responsible for the high agricultural reputation of Strathmore.

The Forfar Association

The Forfar Association, covering a total area of 40 square miles, is found throughout or contiguous to areas of the Balrownie Association to which it is closely related. Occurring extensively in Strathmore, it has been mapped around Coupar Angus in the Isla Flats, on parts of the Cairnleith–Balbeggie Benchlands and along foot-slopes of the Sidlaw Hills. In the eastern part of the district the association is found on lower slopes and in valleys among the Sidlaw Foothills. South of the River Tay it occurs in small areas bordering river terraces or spreads of alluvium; in many cases the areas are too small to be shown on the soil map and have been incorporated in the alluvium or the corresponding terrace soil.

PARENT MATERIAL

The parent material consists mainly of coarse-textured deposits derived from Lower Old Red Sandstone till which has been reworked and resorted by the action of water in post-glacial times. The deposits are generally reddish brown and vary in texture from sandy loam to loamy sand. They are moderately stony and, as the texture implies, the clay content is low. They are underlain at a depth of 2 feet or more by reddish brown till varying in texture from loam to sandy clay loam and identical with the till which forms the main parent material of the Balrownie Association. Thus the Forfar Association might be termed a water-sorted version of the Balrownie Association. It was first mapped in Angus on Sheet 57, and because the properties and land use capabilities resulting from its coarser texture differ from those of the Balrownie Association, it was considered important enough to warrant separation as an association.

Water-sorted horizons overlying the till are encountered frequently in Balrownie profiles, particularly in soils of the imperfectly drained Balrownie series, but in most cases are not more than 18 inches thick. Where Balrownie and Forfar Associations are contiguous and difficulty is experienced in delineating a boundary between the two, an arbitrary depth of 24 inches has been taken as the minimum thickness of the water-sorted layer in soils of the Forfar Association.

The association also includes soils, occurring mainly on lower hill slopes, which are derived from fine-textured colluvial material of Lower Old Red Sandstone origin.

Soils of the association are often found bordering alluvium in valley bottoms and in hollows; in such cases the horizons of the Forfar profiles frequently appear alluvial and the boundary between Alluvium and Forfar Association is a merging one.

SOILS

Three soil series of the association have been mapped in this district. Vinny is freely drained, Forfar imperfectly drained and Vigean poorly drained.

Many cultivated soils of both the Vinny series and the Forfar series have profiles with characteristics more akin to those of brown forest soils or acid brown earths. In the uncultivated state, however, soils of these series have good podzol profiles, and for this reason all have been classed as podzols.

VINNY SERIES

The Vinny series occurs mainly on rising ground or on low mounds and has been mapped most extensively in Strathmore, particularly in the Isla Flats and along the Sidlaw edge. Smaller areas are found throughout the Sidlaw Foothills. Although A horizons have been destroyed in the cultivated soil, a bright B_2 is present, and frequently an indurated B_3 also.

Profile Description

(No. 29. West Skichen)

SLOPE		2°.
ASPECT		south.
ALTITUDE		575 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–10 in. (0–25 cm.)	Very dark greyish brown (10YR3/2) loam; strong coarse sub-angular blocky; friable; moderate organic matter; frequent stones; many live fibrous grass roots; moist; no mottles. Sharp smooth change into
B_2	10–18 in. (25–46 cm.)	Reddish brown (5YR4/4) loamy sand; weak medium angular blocky, breaking very readily to fine crumb and single grain; loose; frequent stones; frequent live fibrous grass roots; moist; no mottles. Sharp smooth change into
B_3	18–26 in. (46–66 cm.)	Dark reddish grey (5YR4/2) sandy loam to loamy sand; indurated and breaking down under moderate pressure to medium sub-angular blocky; very firm; many angular and sub-angular stones with sandstones common; few roots; slightly moist; few faint fine ochreous mottles. Clear smooth change into
C	26–32 in. + (66—81 cm. +)	Reddish brown (5YR4/3) loam; strong coarse angular blocky structure; firm, slightly plastic when wet; stones as above; few roots; moist; few faint fine ochreous mottles.

The texture of the S horizon is frequently coarser than loam. The degree of induration of the B_3 varies, but the texture is always coarse and the stone content high. There is strong evidence of water-sorting, particularly in the upper horizons. Analysis shows that percentage base saturation is moderate in the S and B horizons, but rises to 66 in the lower B_3 and to 77 in the C. pH drops only slightly from 5·6 in the S to 5·3 in the C. Exchangeable calcium is moderate throughout, except in the B_2 and upper B_3 where values are low. Magnesium is low in the B_2 but moderate in all other layers. Total phosphorus is moderate throughout, while acetic soluble is moderate in the S and B_2 and high in other horizons.

In certain parts of Strathmore, particularly along the Sidlaw margin, the Vinny series is developed on colluvial deposits which have accumulated on lower hill slopes. These deposits are mainly of fine sandy loam texture.

Profile Description

(No. 30. Kirkton)

SLOPE	3°.
ASPECT	west.
ALTITUDE	250 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	free.
Horizon Depth	
S 0–13 in. (0–33 cm.)	Very dark greyish brown (10YR3/2) loam; moderate coarse angular blocky, breaking readily to coarse and medium crumb; friable; moderate organic matter; few stones; many live grass roots; worms present; moist; no mottles. Sharp smooth change into
S/B_2 13–26 in. (33–66 cm.)	Dark brown (7·5YR3/2) fine sandy loam; weak coarse angular blocky, breaking readily to medium and fine crumb; friable; moderate organic matter; frequent stones; frequent roots; worms present; moist; no mottles. Sharp even change into
C 26–32 in. (66–81 cm.)	Reddish brown (5YR4/4) loamy coarse sand; structureless; loose; low organic matter; many angular, sub-angular and sub-rounded stones of varying size, with several angular pieces of flaggy sandstone; few roots; slightly moist; no mottles.

The boundary between the S and B_2 horizons is frequently obscure, giving the appearance of a deep topsoil. Loam or fine sandy loam textures are a feature of both these horizons. With its free drainage, good structure and moderate to deep S horizon, this soil is an important agricultural one.

FORFAR SERIES

Classed as an imperfectly drained podzol, this series is found in parts of Strathmore and in certain valleys of the Sidlaw Foothills. On uncultivated ground, particularly under coniferous woodland, a podzol profile is well developed.

Profile Description

(No. 32. Wedderswell)

SLOPE	2°.
ASPECT	south.
ALTITUDE	525 feet.
VEGETATION	Coniferous woodland, 25–30 years old, with open canopy. *Calluna vulgaris, Erica cinerea, Erica tetralix, Deschampsia caespitosa,* Mosses.
DRAINAGE CLASS	imperfect.
Horizon Depth	
L, F & H 1–0 in. (2·5–0 cm.)	Mixed pine needle and *Calluna* litter, partially decomposed litter with trace of well decomposed organic matter at base; many fibrous plant roots and frequent woody tree and heather roots. Sharp change into
A_1/A_2 0–4 in. (0–10 cm.)	Very dark greyish brown (10YR3/2) loam; coarse sub-angular blocky structure; slightly cohesive; few stones; bleached sand grains common; moderate to low organic matter; many fibrous plant and frequent woody tree roots; moist; no mottles. Sharp change into
$B_2(g)$ 4–12 in. (10–30 cm.)	Brown (10YR5/3) varying to greyish brown (10YR5/2) loam; well developed coarse angular blocky; friable; low organic matter; roots as above; few stones; moist; frequent medium faint yellowish brown (10YR5/6) mottles. Sharp change into

C(g)	12–23 in. (30–58 cm.)	Reddish brown (5YR5/4) sandy loam; strong coarse angular blocky; firm; evidence of water-sorting; frequent stones, with many sandstones; low organic matter; live plant roots frequent, becoming few with depth; moist; many coarse distinct strong brown (7·5YR5/8) mottles. Gradual change into
C(g)	23–28 in. + (58–71 cm. +)	Reddish brown (5YR5/4) sandy clay loam; strong coarse angular blocky; firm; stones as above; roots few; moist; many coarse distinct strong brown (7·5YR5/6) mottles.

The H horizon is frequently more clearly defined and the depth can be up to 2 inches. In contrast to the B_2 of the Vinny series, the B_2(g) of the above profile is duller and shows mottling. Evidence of water-sorting is particularly noticeable in the upper Cg horizon which, however, still retains many of the structural features of a till. The underlying horizon is a sandstone till which shows no sign of water-sorting. The depth at which unsorted till occurs is usually below 23 inches.

On cultivated ground the A horizons are destroyed but the B_2 is still distinguishable.

Profile Description

(No. 33. Baldowrie Farm)

SLOPE	3°.
ASPECT	north-west.
ALTITUDE	225 feet.
VEGETATION	rotational grass.
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
S	0–16 in. (0–41 cm.)	Dark reddish grey (5YR4/2) varying to dark reddish brown (5YR4/3) sandy loam; sub-angular blocky; few small stones; many grass roots in upper 11 inches, frequent below; worms present; moist; no mottles. Clear irregular change into
B_2(g)	16–23 in. (41–58 cm.)	Brown (7·5YR5/4) fine sandy loam; weak sub-angular blocky; few small stones; grass roots few; worms present; vertical streamers of S horizon material penetrate; moist; diffuse pale grey and rusty mottles. Sharp change into
B_3(g)	23–29 in. (58–74 cm.)	Reddish yellow (7·5YR6/6) loamy sand; slightly compact weak sub-angular blocky; few stones; few roots; worms present; moist; mottles as above. Sharp change into
C(g)	29–31 in. (74–79 cm.)	Reddish brown (5YR5/3) loamy sand; massive; no stones; roots few; moist; few faint rusty mottles. Sharp change into
C(g)	31–39 in. (79–99 cm).	Reddish brown (5YR5/4) gritty loamy coarse sand; weak sub-angular. blocky, breaking readily to single grain. Sharp change into
C(g)	39 in. + (99 cm. +)	Weak red (2·5YR4/2) loam; compact.

There are few stones throughout this profile and many of the horizons are alluvial in appearance. The area of Forfar series from which the profile was taken is contiguous to a spread of alluvium occurring below the 25 feet contour.

Comparison of mechanical analyses for the above two profiles shows that the cultivated soil, because of its alluvial nature, has a higher percentage silt in the upper horizons than the uncultivated. In other layers of both profiles sand is generally high and clay low, except in the unsorted till horizon at the bottom of the profile where there is a rise in percentage clay. The cultivated soil, as would be expected, has a higher base saturation, ranging from 50·6 at the surface to 100 in the C. In the uncultivated soil the value drops from 12·6 in the LFH layer to 2·1 in the B_2(g), and then rises to 75 in the C(g), at the base of the profile. pH ranges from 5·8 to 6·6 in the cultivated soil and from 4·1 to 5·5 in the uncultivated.

An examination of the phosphorus figures shows that in the cultivated soil total phosphorus is moderate in all horizons except the middle and lower C, where it is low, while in the uncultivated soil total phosphorus is moderate only in the LFH and low elsewhere. Acetic soluble phosphorus is moderate in the S horizon of the cultivated soil and high in other horizons; in the uncultivated soil it is high only in the LFH and low in the A_1/A_2 and lower C(g).

VIGEAN SERIES

The Vigean series is poorly drained and is classed as a non-calcareous gley. It occurs in small scattered areas throughout Strathmore and in parts of the Sidlaw Foothills near the northern margin of the district. It is found in low-lying areas and in hollows, frequently bordering spreads of alluvium.

Profile Description

(No. 35. Bandirran)

SLOPE	level.
ASPECT	nil.
ALTITUDE	425 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	poor.

Horizon	*Depth*	
S	0–12 in. (0–31 cm.)	Dark brown (7·5YR4/2) loam; sub-angular blocky; few stones; many grass roots; worms present; moist; no mottles. Clear irregular change to
B_2g	12–17 in. (31–43 cm.)	Dark greyish brown (10YR4/2) fine sandy loam; sub-angular blocky; few small sub-angular stones, mainly sandstone; roots frequent; moist; many prominent grey and rusty mottles up to ½ inch diameter. Gradual change into
Cg	17–34 in. (43–86 cm.)	Reddish brown (5YR4/3) sandy loam to loamy sand with occasional lenses of finer material up to loam texture; loose sub-angular blocky; few small stones; many fine manganese dioxide concentrations following old root channels; few roots, but one or two penetrate to 28 inches; moist; many faint yellowish red (5YR4/8) and diffuse grey (5YR5/1) mottles. Gradual change into
Cg	34 in. + (86 cm. +)	Reddish brown (5YR4/3) sandy loam to loamy sand; massive; moist; mottles as above.

Among the exchangeable cations, calcium and magnesium both have a moderate value throughout, except in the B_2g where the value drops to low. Potassium is low in all horizons. Percentage base saturation is high in all layers other than the B_2(g), where it is moderate, and there is a corresponding slight fall in pH at this level. Values for both total and acetic soluble phosphorus are moderate throughout the profile, with the latter just reaching a high value in the C, between 28 and 32 inches.

LAND USE CAPABILITY

The greater part of the area covered by the Forfar Association is cultivated. The freely drained Vinny series and the imperfectly drained Forfar series are both agriculturally important soils. In the Vinny series, textures are generally slightly coarser than in the Forfar and the total depth of water-sorting greater. Vinny is normally accessible in all seasons, and the underlying fine-textured till, besides facilitating nutrient storage, is an insurance against drought in a dry season.

While most of the association area falls into Class 2, several small areas of the Forfar series in the Coastal Lowlands of Angus and a narrow strip of Vinny series on the Balbeggie Benchland between Newtyle and Kettins have been rated as Class 1 land. Soils of the poorly drained Vigean series belong to Class 3 or Class 4.

The Laurencekirk Association

The Laurencekirk Association, named after the village of Laurencekirk in Kincardineshire where it was first mapped, is one of the smaller associations, covering a total area of 2·8 square miles. It is confined to two areas, one to the west of Perth, around Methven village and in Methven Wood, and the other on the hill slopes overlooking the River Tay between Cargill and Campsie Hill.

PARENT MATERIAL

The main parent material is a till derived from marls or mudstones of Lower Old Red Sandstone age. The till varies in colour from reddish brown to weak red and in texture from sandy clay loam to clay loam. There is a moderate content of medium sub-angular and rounded stones, derived mainly from igneous and metamorphic rocks, and a proportion of angular pieces of soft red marl which increases with depth. The silt content is frequently over 30 per cent and this generally imparts a silty feel to the till, although the content may not be high enough to warrant classifying the soil as a silty clay loam. In several localities the till is absent, or very thin, and the soil parent material consists almost entirely of decomposed marl rock.

SOILS

Of the five series distinguished in the area, only two are of importance, the Oldcake and the Laurencekirk. The Oldcake series is freely drained and is slightly more extensive than the imperfectly drained Laurencekirk series which carries the association name because of its dominance in the Kincardineshire area where the association was established. The third series, Muirfoot, is of only limited occurrence, while the Luther and the Drumforber series are each represented by very small areas.

OLDCAKE SERIES

The freely-drained Oldcake series, has been classed as a brown forest soil. It usually occurs on moderate slopes and the most extensive area has been mapped on the slopes between Cargill and Campsie Hill. Smaller areas of the series have been mapped in the vicinity of Methven village. The parent material is generally a shallow till of sandy clay loam to clay loam texture underlain by soft marl rock.

Profile Description

(No 36. Gallowhill)

SLOPE	2°.
ASPECT	south-east.
ALTITUDE	450 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–11 in. (0–28 cm.)	Dark reddish brown (5YR3/4) silty clay loam; sub-angular blocky; firm; moderate organic matter; few stones, mainly sub-angular pieces of sandstone; many grass roots; moist; no mottles. Sharp smooth change into
B_2	11–32 in. (28–81 cm.)	Dark reddish brown (2·5YR3/4) varying with depth to reddish brown (2·5YR4/4) silty clay loam; sub-angular blocky; very firm; few stones, but many small pieces of decomposing marl which break down under strong pressure; a few roots penetrate to 28 inches; moist; no mottles. Diffuse irregular change to
C	32–50 in. (81–127 cm.)	Reddish brown (2·5YR4/4) clay loam; coarse sub-angular blocky; firm; many angular pieces of reddish brown marl, harder than in above horizon; roots absent; moist; no apparent mottles. Sharp smooth change into
D	50 in. + (127 cm. +)	Dark reddish brown to reddish brown (2·5YR3/4 to 4/4) decomposing marl rock with distinct platy structure.

In the above profile the colour of the parent material is reflected in the surface soil, and this occurs in all Oldcake profiles, the colour varying from dark reddish brown to reddish brown. The B_2 horizon here is very deep and almost certainly includes a B_3 horizon, as the colour variation indicates, although no boundary was discernible in the profile. B_3 horizons can frequently be distinguished in Oldcake profiles. They are often compact or slightly indurated and the texture is generally coarser.

Percentage base saturation is quite high at the surface—59·5—and except for a slight drop in the lower half of the B_2, increases with depth. pH shows little variation down the profile, apart from a drop in the B_2 corresponding to the drop in base saturation and a rise in the D horizon as the marl is reached. The slightly calcareous nature of the marl is indicated by the high values for exchangeable calcium in all horizons. Magnesium is moderate in the S and B_2 horizons and high in the C and D. Potassium is moderate throughout, with only minor variations in value and a slight rise in the D. Total phosphorus is moderate to low throughout while acetic soluble phosphorus is moderate in the S and B_2 horizons and high in the C and D.

DRUMFORBER SERIES

The Drumforber series is a residual series and has been mapped over a small area of Campsie Wood where marl till is absent and the soil is developed directly on marl rock.

Profile Description

(No. 37. Campsie Wood)

SLOPE		3°.
ASPECT		west.
ALTITUDE		250 feet.
VEGETATION		oak wood.
DRAINAGE CLASS		free.
Horizon	*Depth*	
L		Leaf litter.
A	0–1 in. (0–3 cm)	Dark reddish brown (5YR3/3) loam; moderate crumb; frequent small stones; many fibrous roots; dry; no mottles. Sharp smooth change into
B	1–9 in. (3–32 cm.)	Reddish brown (2·5YR4/4) loam varying to sandy clay loam; coarse sub-angular blocky; many angular fragments of reddish brown marl; many tree roots; worm holes; moist; no mottles. Clear smooth change into
C	9–20 in. (25–51 cm.)	Weak red (10R4/3) sandy clay loam; many stones, mainly angular pieces of marl; tree roots frequent; moist; no mottles. Clear smooth change into
D	20–46 in. + (51–116 cm.)	Reddish brown (2·5YR4/4) soft marl rock, breaking down readily to yield a clay loam to clay; a few roots penetrate to 34 inches; moist; no mottles.

In this profile the percentage base saturation is very low in the B horizon but rises down the profile to 80 in the D. pH ranges from 5 to 6·2. Exchangeable calcium is low in the upper horizons and only becomes high in the lower D layer. Magnesium, on the other hand, is moderate in other horizons and high in the D. Potassium is moderate throughout. Total phosphorus is low, except in the D horizon, while acetic soluble phosphorus is low in the B and the C and high in the lower D.

LAURENCEKIRK SERIES

The Laurencekirk series has been mapped in part of Methven Wood and over an area including Culdeesland Farm and Morrishill Wood on the outskirts of Methven. There is also a minor area at Methven Home Farm. Developed on till of sandy clay loam to clay loam texture, the series is imperfectly drained and has been classed as a brown forest soil with gleyed B and C horizons.

Profile Description

(No. 38. Morrishill Wood)

SLOPE		4°.
ASPECT		north east.
ALTITUDE		280 feet.
VEGETATION		Mixed ash and oak wood with *Deschampsia caespitosa*, *Viola riviniana*, *Holcus lanatus*
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
A	0–4 in. (0–10 cm.)	Dark reddish grey (5YR4/2) silty clay loam; fine sub-angular blocky; moderate organic matter; frequent stones, mainly small sub-angular sandstones and marls; many fibrous grass roots; worms present; moist; no mottles. Sharp smooth change into

B(g)	4–15 in. (10–38 cm.)	Reddish brown (5YR4/3) clay loam; moderate to strong fine angular blocky, with tendency to platy structure; low organic matter; stones as above, becoming more frequent in lower half of horizon; grass roots frequent; worms present; moist; faint fine ochreous mottles tending to be obscured by soil colour. Diffuse irregular change into
C(g)	15–30 in. (38–76 cm.)	Reddish brown (2·5YR4/4) clay loam/silty clay; massive breaking down to prismatic; firm; low organic matter; stones as above, with a proportion of rounded cobbles; few roots, becoming rare below 20 inches; moist; mottles as above; specks of black manganese oxide.

The U.S.D.A. silt content of the A horizon is notably high. The colour, dark reddish grey, is not as bright as in the A horizon of the freely drained series i.e. dark reddish brown to reddish brown. The B(g) horizon has a well developed angular blocky structure which has a tendency to break down to small platy. Mottles are present although they are usually fine and difficult to distinguish against the reddish brown soil colour. The C horizon is a glacial till of clay loam texture, varying frequently to silty clay or clay.

Below is the corresponding profile from a cultivated field adjoining Morrishill Wood.

Profile Description
(No. 39. Culdeesland)

SLOPE	2°.
ASPECT	north-east.
ALTITUDE	300 feet.
VEGETATION	third year grass.
DRAINAGE CLASS	imperfect.

Horizon Depth

S	0–9 in. (0–23 cm.)	Dark reddish grey (5YR4/2) silty clay loam; angular blocky; moderate organic matter; frequent stones; mainly small sub-angular from Highland and basic igneous rocks; many grass roots; worms present; moist; no mottles. Clear undulating change into
B(g)	9–20 in. (23–51 cm.)	Reddish brown (2·5YR4/4) clay loam; coarse angular blocky; firm; low organic matter; stones as above; roots frequent; worms present; moist; few faint fine strong brown (7·5YR5/8) mottles. Diffuse irregular change into
C(g)	20–40 in. + (51–102 cm. +)	Weak red (2·5YR4/2) clay loam varying to sandy clay; structure as above; many angular pieces of soft red marl; moist; few faint fine distinct mottles as above and prominent black manganese oxide staining.

Mechanical analyses for the above two profiles are comparable, although values of U.S. silt are slightly higher throughout the uncultivated soil. In the cultivated soil base saturation is high throughout, while in the uncultivated values are low in all horizons except the C. In the cultivated soil exchangeable calcium is high throughout, while magnesium and potassium are moderate; in the uncultivated calcium values are low in upper horizons and moderate in the C(g), while magnesium and potassium are moderate throughout. Total phosphorus is moderate in all horizons of the cultivated soil except the B(g) where it is low; in the uncultivated soil, values are low in all layers except the A and the upper B(g). Acetic soluble phosphorus is high in all horizons of the cultivated soil except the B(g) where it is moderate; in the uncultivated, it is low throughout except in the C between 22 and 26 inches where it is high.

LUTHER SERIES

The Luther series, an imperfectly drained brown forest soil, has been mapped in only one small area, near Methven at the western margin of the district. It is developed on water-sorted Old Red Sandstone till deposits overlying the marl till which forms the parent material of the Laurencekirk series. The Luther series resembles the Forfar series in many ways, and the water-sorted layer generally extends to a depth of over 24 inches. A generalized profile description shows:

Dark reddish grey (5YR4/2) silt loam, 12 inches
Water-sorted reddish brown (2·5YR4/3) sandy loam to loam, 15 inches
Weak red (2·5YR4/2) loam to sandy clay loam

MUIRFOOT SERIES

The Muirfoot series is a poorly drained non-calcareous gley which occurs only as small isolated patches in Methven Wood, Morrishill Wood, and Campsie Wood.

Profile Description

(No. 40. Methven Wood)

SLOPE		5°.
ASPECT		east.
ALTITUDE		275 feet.
VEGETATION		deciduous woodland—oak, willow, elm.
DRAINAGE CLASS		poor.
Horizon	*Depth*	
L		Litter from oak, willow and elm.
A	0–7 in. (0–18 cm.)	Dark brown (7·5YR4/2) clay loam; fine to medium sub-angular blocky; plastic; frequent roots; wet; worms very active. Clear change into
Bg	7–13 in. (18–33 cm.)	Reddish brown (5YR4/3) sandy clay loam; medium to coarse sub-angular blocky; tongues of A horizon material penetrate down; few tree roots; wet; clay skins on worm channels and fine pores; frequent fine rusty mottles. Gradual change into
Cg	13–21 in. (33–53 cm.)	Reddish brown (2·5YR4/4) clay loam; medium sub-angular blocky tending to massive structure; firm; many large boulders; moist; frequent fine distinct yellowish red (5YR5/6) mottles.

LAND USE CAPABILITY

The Laurencekirk Association, like the Balrownie, has a high reputation in Strathmore as valuable arable land. Although much less extensive here than in Kincardineshire, the Laurencekirk series holds its place among the highly productive agricultural soils of the district. The whole area covered by the association has been placed in Class 2, with the exception of a few small areas of the Muirfoot series which are classed as 3W.

The Kippen Association

The Kippen Association is not extensive, the total area amounting to 2·9 square miles. Occurring mainly on Sheet 48, with several small areas on Sheet 49, it covers a small area by Dron village to the south of Bridge of Earn and extends as a narrow strip between Aberargie and Abernethy. Small areas are also found in the Eden Valley to the east of Cupar and at the eastern end of the Carse of Gowrie near Longforgan.

PARENT MATERIAL

The major proportion of the association is developed on till derived from Upper Old Red Sandstone sediments. The till varies in colour from reddish brown to weak red and in texture from loam to clay loam. There is frequently a moderate to high stone content, mainly angular pieces of sandstone which break down readily. As a result, estimations from mechanical analyses of samples prepared by sieving generally give coarser textures than are found in the field. Decomposed sandstone rock forms the soil parent material over a small area of the association.

SOILS

Soils within two drainage classes have been mapped in this association. Kippen, an imperfectly drained series, accounts for almost the whole of the association, while Fourmerk, which is freely drained, is limited to a small area around West Dron Farm.

KIPPEN SERIES

Developed on reddish brown till of loam to clay loam texture, the Kippen series is imperfectly drained and is classed as a brown forest soil with gleyed B and C horizons. It is similar in many ways to the Balrownie series, but in the field the soils generally appear brighter reddish brown, although the Munsell colours are frequently the same or differ only by 1 in value or chroma.

Profile Description

(No. 41. West Dron)

SLOPE		4°.
ASPECT		south.
ALTITUDE		225 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
S	0–9 in. (0–23 cm.)	Dark reddish grey (5YR4/2) sandy clay loam; coarse sub-angular blocky, breaking to coarse crumb; moderate organic matter; frequent stones, mainly sub-angular pieces of sandstone; roots plentiful; no mottles. Sharp undulating change into
B(g)	9–23 in. (23–58 cm.)	Reddish brown (2·5YR4/4) sandy clay loam; strong sub-angular blocky; firm; stones as above but rather more numerous; roots frequent, becoming few below 16 inches; frequent coarse prominent strong brown (7·5YR5/8) mottles. Gradual change into
C(g)	23–40 in. + (58–102 cm. +)	Dark reddish brown (2·5YR3/4) sandy clay loam; sub-angular blocky; plastic; many stones, with a layer of large sandstone boulders between 30 and 40 inches; frequent prominent mottles as above.

The reddish hue of the S horizon is a feature common to many, but not all, Kippen profiles. The clay content of this horizon is frequently less than in the profile described above, and in many cases the texture may not be finer than loam. The B horizon, too, is often of coarser texture with a sub-angular blocky structure which is only weakly developed. The structure of the C horizon can vary from moderate sub-angular blocky to weak prismatic. In addition to the presence of prominent strong brown mottles throughout the horizon, grey faces are often found on peds and stones.

When the results of mechanical analysis for the above profile are compared with those of a typical Balrownie profile, Stewart Tower, No. 18, clay percentages are seen to be similar, except in the B(g) horizons. In the Kippen profile, clay reaches its highest value in the upper B(g); in the Balrownie, the value falls in the B(g) but rises again in the C. All horizons of the Kippen profile are completely base-saturated and pH ranges from 6·9 at the surface to 7·4 in the C(g). Exchangeable calcium is high in the S and upper B(g) horizons and moderate in other layers, while exchangeable magnesium is moderate throughout but increases down the profile. Potassium values are moderate and show little variation. In the Balrownie profile base-saturation is moderate in the S horizon, drops almost to low in the B(g) and rises to high in the C(g) while pH ranges from 5·9 to 5·6.

In the Kippen profile, total phosphorus is moderate in all horizons except the B(g) and upper C(g) where it is low; acetic soluble phosphorus is moderate in the S horizon, low in the upper B(g), and high elsewhere.

FOURMERK SERIES

The Fourmerk series is a freely drained brown forest soil. In the area where it was first mapped, on Sheet 39 (Stirling), it is developed on shallow till, with minor areas developed directly on the underlying sandstone rock. In the Perth/Dundee district it occurs as a very small area near West Dron farm where the till cover is absent.

Profile Description

(No. 42. West Dron)

SLOPE		5°.
ASPECT		north.
ALTITUDE		250 feet.
VEGETATION		third year grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–17 in. (0–43 cm.)	Dark reddish brown (5YR3/3) sandy loam, varying to reddish brown (5YR4/3) below about 12 inches; moist, friable; coarse sub-angular blocky; moderate organic matter; few stones; many grass roots; no mottles. Sharp undulating change to
B	17–31 in. (43–79 cm.)	Reddish brown (2·5YR4/4) loamy sand varying to sand; friable; weak sub-angular blocky, breaking readily to small crumb and single grain; low organic matter; few stones, occasional pieces of decomposing red sandstone; many roots at top, becoming few at bottom of horizon; no mottles. Gradual change to
C/D	31–35 in. (79–90 cm.)	Reddish brown (2·5YR4/4) to dark reddish brown (2·5YR3/4) decomposing sandstone, breaking down readily to coarse sand.

The S horizon is deeper here than normal, probably the result of deep ploughing. The variation in colour between 12 and 17 inches indicates the more usual depth of topsoil. Analyses show low values for exchangeable calcium in the B and C/D horizons, while magnesium and potassium are low in the B. Despite the coarse textures, percentage base saturation is high throughout the profile and reaches 100 in the C/D. Total phosphorus is low in the B and C/D horizons, while acetic soluble phosphorus is high, except in the lower S.

LAND USE CAPABILITY

All areas of the association mapped in the district form good agricultural land and have been placed in Class 2. In some parts of the country, shallowness and coarseness of texture limit the Fourmerk series to Class 3, and it is the depth of topsoil in this locality that is mainly responsible for the higher grading.

The Mountboy Association

The Mountboy Association, occupying a total area of 52 square miles, occurs among the Sidlaw and Ochil Hills and in the vicinity of igneous intrusions in the Old Red Sandstone regions. The two largest areas are found in the Sidlaw Hills, extending from Collace north-eastwards towards Newtyle near the northern margin of the district, and in the Eastern Ochils between Luthrie and Wormit. Smaller areas have been mapped in the Sidlaw Foothills behind Monifieth, on the rising ground above Cupar and in the Western Ochils, south of Newburgh and south of Forgandenny. The association is frequently found contiguous to areas of the Balrownie Association.

PARENT MATERIAL

The major components of the parent rocks are lavas and sandstones of Old Red Sandstone age, but igneous rocks from local intrusions are frequently among the constituents. A mixed till derived from these parent rocks covers much of the association area. The till varies in texture from sandy loam to sandy clay loam and in colour from reddish brown to weak red. Finer textures are normally found on level ground and on gentle slopes and coarser textures at higher elevations and on steeper slopes. While in many ways resembling the till of the Balrownie Association, the Mountboy till frequently has a purplish or brownish hue which is noticeable in the field but cannot be distinguished on the Munsell Colour Charts.

Over the remainder of the association area, the soil parent material consists of drift deposits of sandstone and lava. On some of the lower hilltops these deposits are made up of decomposed lava mixed with coarse textured sandstone drift.

SOILS

Three soil series have been mapped. Garvock is a freely drained brown forest soil, Mountboy an imperfectly drained brown forest soil and Barras a poorly drained non-calcareous gley.

GARVOCK SERIES

The Garvock series covers a total area of approximately 23 square miles, occurring mainly on hilly ground at altitudes between 400 and 1000 feet. The

PLATE 6
Gask Hill in the Sidlaws: Darleith Association.

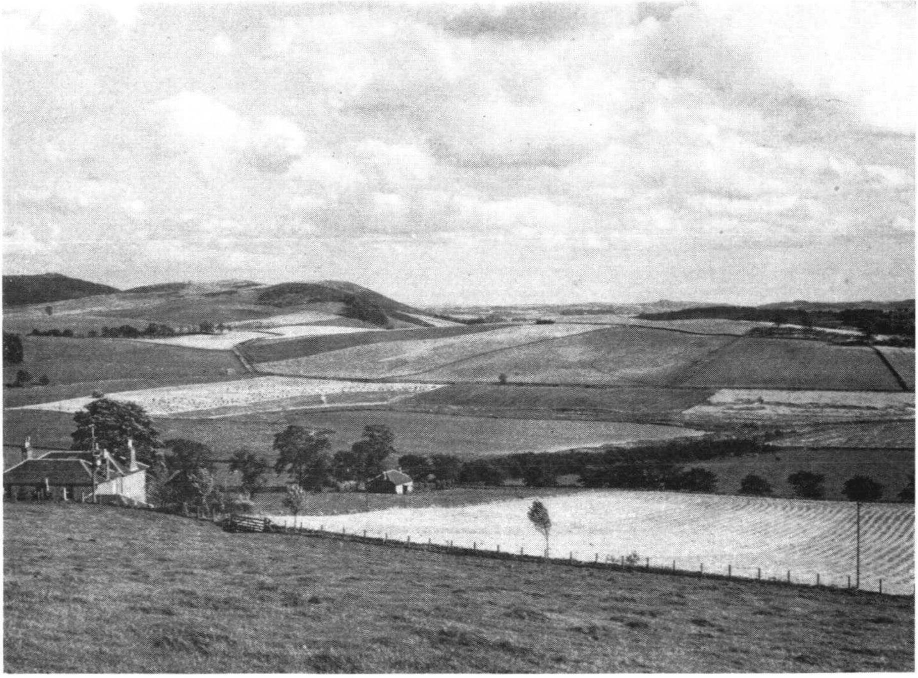


PLATE 7
A Farm in the Sidlaw Hills with Mountboy Association in the foreground and middle slopes, alluvium on the low ground and Darleith Association on the summit behind.

PLATE 8

The Carse of Gowrie and Invergowrie: mainly Stirling Association with Carpow Association bordering the village.

By courtesy of Aerofilms Ltd.

PLATE 9

Southern Margin of the Carse of Earn: Stirling Association with Sourhope Association on the Ochil Hills beyond.

largest areas mapped are in the Sidlaw Hills and in the Eastern Ochils. Many of the upper slopes support a *Calluna* heath vegetation under which is developed a profile similar to the one described below.

Profile Description

(No. 43. Ardgarth Hill)

SLOPE		8°.
ASPECT		north-west.
ALTITUDE		850 feet.
VEGETATION		*Calluna vulgaris, Erica cinerea, Deschampsia flexuosa, Trientalis europaea, Hypnum cupressiforme*
DRAINAGE CLASS		free.
Horizon	*Depth*	
L/F	1–0 in. (2·5–0 cm.)	Very dark brown (10YR2/2) litter and fibrous rooty material.
A_1	0–3 in. (2·5–7·5 cm.)	Dark reddish brown (5YR2/2) sandy loam; medium subangular blocky; friable, breaking readily to fine crumb; high organic matter; stones few; frequent bleached sand grains; many fibrous and woody plant roots; moist; no mottles. Clear undulating change into
B_2	3–20 in. (7·5–51 cm.)	Reddish brown (5YR4/4) sandy loam; medium angular blocky, breaking readily to small crumb and single grain; low organic matter; frequent stones, mainly rounded or sub-rounded pieces of lava and sandstone with a few Highland erratics; fibrous roots frequent becoming few towards base of horizon; moist; no mottles. Sharp change into
B_3	20–27 in. (51–69 cm.)	Reddish brown (5YR4/4) sandy loam; indurated; breaking under moderate to strong pressure to angular blocky and single grain; low organic matter; frequent stones mainly small angular pieces of lava and sandstone with occasional Highland erratics; few roots; moist; no mottles. Gradual change into
C	27 in. + (69 cm. +)	Reddish brown (5YR4/4) sandy loam; loose and friable breaking readily to single grain; many stones, mainly large angular pieces of basic lava; no roots; moist; no mottles.

Bleached sand grains are prominent in the A_1 horizon and there is an increase in clay content in the B_2. Except in the C horizon, where the value is moderate, percentage base saturation is low throughout, and pH ranges from 3·9 at the surface to 4·8 at 30 inches. While total phosphorus is moderate throughout, except in B_3 and C where values are low, acetic soluble phosphorus is moderate in B_3 and C and low in other horizons.

On some hills, generally on middle slopes under permanent or semi-permanent grass, profiles of the following type are developed.

Profile Description

(No. 44. Kinfauns farm)

SLOPE		15°.
ASPECT		south-east.
ALTITUDE		450 feet.
VEGETATION		old grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–19 in. (0–48 cm.)	Brown (7·5YR4/3) fine sandy loam; moderate coarse sub-angular blocky, breaking readily to medium crumb; many roots; frequent stones, mainly pieces of lava; moist; no mottles. Gradual change into

B_2	19–26 in. (48–66 cm.)	Reddish brown (5YR4/3) fine sandy loam; sub-angular blocky breaking to medium crumb; stones as above; many roots; moist; no mottles. Clear change into
B_3	26–30 in. (66–76 cm.)	Dark reddish brown (5YR3/4) fine sandy loam; sub-angular blocky, breaking to coarse crumb; stones as above but more numerous; frequent roots; moist; few diffuse rusty mottles. Clear change into
C	30 in. + (76 cm. +)	Dark reddish grey (5YR4/2) sandy clay loam; sub-angular blocky; firm; moist; faint yellowish red (5YR5/6) mottles.

In this profile, clay content in all horizons is higher than in profile No. 43. Percentage base saturation is low in the S and B_2 layers, but increases in the B_3 and reaches 100 in the C. Figures for total phosphorus are comparable with those of the other profile and are moderate throughout, except in the C horizon where the value is low. Acetic soluble phosphorus is low in all horizons. It is possible that this profile contains a smaller percentage of igneous material than the other and a correspondingly higher percentage of sandstone. This could explain the low figures for acetic soluble phosphorus, since results of an examination of the Mountboy Association as a whole indicate that the amount of phosphorus inherent in Old Red Sandstone rocks is higher in the lavas than in the sediments.

Silica-sesquioxide ratios in the clay fraction of the Kinfauns profile support the classification of the series as a brown forest soil. There is little or no differential eluviation of silica or sesquioxides throughout the profile and the silica-sesquioxide ratio remains constant at approximately 2, from the S horizon down to the B_3 (Table 9 Appendix IV); thereafter, it rises only slightly. In all the molecular ratios there is a slight drop in value in the B_2 horizon.

MOUNTBOY SERIES

The Mountboy series, covering a total area of 27 square miles, is found in the same regions as the Garvock series. Except in a few areas, e.g. on Ardgarth Hill at 1000 feet, the series occurs at altitudes below 600 feet.

The profile described below is from former woodland on lower slopes of the Sidlaw Hills.

Profile Description

(No. 47. Balthayock Wood)

SLOPE	2°.
ASPECT	north-north-west.
ALTITUDE	565 feet.
VEGETATION	*Calluna vulgaris, Pteridium aquilinum, Vaccinium myrtillus, Juncus squarrosus, Molinia* spp., *Polytrichum commune.*
DRAINAGE CLASS	imperfect.

Horizon Depth

L, F & H	1–0 in. (3–0 cm.)	Litter and partly decomposed humus with trace of well decomposed humus at base
A_1/A_2	0–3 in. (0–8 cm.)	Dark reddish brown (5YR3/2) organic fine sandy loam; weak coarse sub-angular blocky, breaking readily to medium crumb; high organic matter; many grass root; frequent stones, mainly sub-angular pieces of lava; moist; no mottles. Clear undulating change into

B_2	3–6 in. (8–15 cm)	Dark reddish brown (5YR3/3) gritty fine sandy loam; coarse sub-angular blocky; many roots; stones as above but more plentiful; moist; no mottles. Gradual change into
$B_3(g)$	6–17 in. (15–43 cm.)	Reddish grey to dark reddish grey (5YR5/2–4/2) sandy loam; angular blocky; moderately indurated; many stones, mainly lava but rounded and up to boulder size (>3″); roots few, becoming rare at 17 inches; moist; many coarse distinct yellowish red (5YR4/6) mottles and pinkish grey (7·5YR6/2) linings to old root channels. Clear undulating change into
C(g)	17–34 in. + (43–86 cm. +)	Reddish brown (5YR4/3) sandy clay loam; strong coarse angular blocky; firm; many stones, sub-angular pieces of lava up to boulder size in lower half of horizon; moist; mottles as above but fewer and pinkish grey linings less extensive.

The description which follows is of a profile from cultivated land below 200 feet.

Profile Description

(No. 46. Newton Farm)

SLOPE	3°.
ASPECT	south.
ALTITUDE	175 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
S	0–11 in. (0–28 cm.)	Dark reddish brown (5YR3/3) loam; coarse sub-angular blocky; frequent stones, mostly rounded hard schists and quartzites and small angular pieces of lava; many roots; worms present; moist; no mottles. Sharp change into
$B_2(g)$	11–16 in. (28–41 cm.)	Dark reddish grey (5YR4/2) sandy clay loam; sub-angular blocky; stones as above, some larger; roots frequent; worms present; moist; few fine yellowish red (5YR5/6) mottles and grey (5YR6/1) faces to peds. Sharp change into
$B_3(g)$	16–28 in. (41–71 cm.)	Reddish brown (5YR5/3) sandy clay loam; sub-angular blocky; firm; frequent stones, mainly hard and soft schists, sandstones and lavas, many being decomposed; roots few; moist; many diffuse grey and distinct yellowish red (5YR5/6) mottles. Gradual change into
C(g)	28 in. + (71 cm. +)	Reddish brown to light reddish brown (5YR5/4–6/4) loam; sub-angular blocky; stones as above with pieces of soft weathered lava, some with manganese staining along surfaces and cracks; moist; diffuse grey and patchy yellowish red (5YR5/6) mottles.

The Mountboy series resembles the Balrownie series in many ways; percentage soil separates in the above profile have values similar to those for a typical Balrownie profile, e.g. Guildtown (No. 17). The clay figures for Newton Farm, however, are slightly lower at the base of the $B_3(g)$ and in the C(g). The profile is fully base-saturated throughout and the pH is high, being over 7 in all horizons except the $B_2(g)$, where it is almost 7. Results are similar for most cultivated Mountboy profiles analysed. Cultivated profiles of the Balrownie series generally have moderate to high values for percentage base saturation, but these, together with the corresponding pH values, are generally lower than in profiles from the Mountboy series.

In the above profile total phosphorus is moderate in all horizons except the upper $B_3(g)$, where it is low, and acetic-soluble phosphorus is high, except in the $B_2(g)$ horizons where it is moderate. In most cultivated Mountboy profiles examined the trend is similar, minimum values occurring in the S or B_2(g) horizons. In cultivated Balrownie profiles values for available phosphorus are generally moderate to low, but are sometimes high in the C(g) horizon.

BARRAS SERIES

Small areas of the Barras series, a poorly drained non-calcareous gley, occur in low-lying localities throughout the Mountboy series, which it resembles to some extent. The Barras profile is of the type:

Dark greyish brown (10YR4/2) fine sandy loam to loam, 10–12 inches
Greyish brown to reddish grey (10YR5/2 to 5YR5/2) sandy loam to fine sandy loam, 12–18 inches
Grey to dark reddish grey (5YR5/1 to 5YR4/2) loam to sandy clay loam

LAND USE CAPABILITY

On level ground and on gentle slopes both the Garvock and Mountboy series provide Class 2 land. On steeper slopes, above 400 feet, the soils are limited, largely by topography, to Class 3. At higher elevations severe limitations are imposed both by topography and shallowness of soil and the land can be rated only as Class 4 or 5.

The Darleith Association

The Darleith Association, which covers an area of 22 square miles, is found mainly on hill ground. It has been mapped in three main areas: (1) in the Sidlaw Hills, where the soils occur over a large part of the range, mainly on summits and upper slopes, with smaller areas on some of the lower slopes and in intervening hollows; (2) in the Dundee district, where less extensive areas overlie the igneous intrusions; (3) in Fife, to the south of St. Andrews, where small isolated areas overlie the basic igneous masses intruded into the Carboniferous sediments.

PARENT MATERIAL

Drifts derived from basaltic lavas and various basic intrusive rocks form the parent materials of this association. On the Sidlaw Hills north of the River Tay the parent rocks are mainly basic lavas. The soils covering the hill tops are developed on decomposing rock, while on the slopes shallow tills, frequently overlain by alluvium, form the parent material. The products of decomposition vary according to the nature of the rock, but they are mostly brown or yellowish brown sandy loams containing a large proportion of subangular pieces of lava. The colour of the till is brown to reddish brown, or occasionally dark reddish grey. The texture, which is generally sandy loam or loam, tends to be finer on lower slopes and in hollows.

The basic-igneous intrusions of the Dundee district, among which dolerites and basalts are prominent, yield a brown stony parent material, generally of sandy loam or coarse sandy loam texture and frequently indurated. In East Fife the igneous intrusions, which include basalts, dolerites and agglomerates, produce, on weathering, a brown or yellow brown parent material of sandy loam or fine sandy loam texture.

SOILS

Two main series of the association, Darleith and Dunlop, are found in the area. Darleith, the dominant series, is a freely drained brown forest soil while Dunlop series is an imperfectly drained brown forest soil with gleyed B and C horizons. Small areas of a poorly drained non-calcareous gley, the Amlaird series, have also been mapped.

DARLEITH SERIES

Freely drained soils of the association extend over a large portion of the Sidlaw Range from Dalreichmoor above Balbeggie to Kinpurney Hill at the northern margin of Sheet 48. Here brown forest soils of the Darleith series are dominant, with smaller areas of an iron podzol. The podzol areas are too small to show on the 1 inch soil map, and have consequently been included in the Darleith series. The Darleith series is also found in the vicinity of the igneous intrusions of the Dundee region and of East Fife.

Soils vary throughout the Darleith series, from shallow residual on the flat to slightly undulating ground of hill-tops to deeper soils on the moderate to steep slopes of hillsides.

Profile Description

(No. 48. Laws)

SLOPE		10°.
ASPECT		north.
ALTITUDE		275 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–24 in. (0–61 cm.)	Very dark greyish brown (10YR3/2) silty loam; medium sub-angular blocky, breaking readily to small crumb; friable; moderate organic matter; many grass roots; frequent stones, mainly intermediate and basic lavas; no mottles. Sharp undulating change into
B_2	24–34 in. (61–86 cm.)	Brown (7·5YR4/4) fine sandy loam; coarse sub-angular blocky, breaking readily to large crumb; friable; low organic matter; roots frequent; frequent stones; no mottles. Sharp change into
B_3	34–39 in. (86–99 cm.)	Dark reddish grey (5YR4/2) loam; indurated; breaking down under moderate pressure to medium crumb; low organic matter; few roots; stones frequent becoming many at base of horizon, mainly sub-angular lavas; no mottles. Gradual change into
C	39 in. + (99 cm. +)	Brown (7·5YR4/4) sandy loam, varying to loam; fine sub-angular blocky; low organic matter; many stones, mainly large sub-angular pieces of lava; no mottles.

This profile has the deep S horizon typical of the series when it occurs on steep slopes; much of the S material is frequently colluvial. The thickness of the horizon is normally much less than it is here, and on the summits of hills it may be only a few inches. The sub-angular blocky structure breaking readily to good crumb is also characteristic of the series. Moderate to high

U.S.D.A. silt contents are normally found in all horizons, with the exception of the basal layers, and this is reflected in the soil textures which appear silty or fine sandy when examined in the field. Induration in the B_3 is normally, but not always, a feature. In deeper soils, as in this profile, the indurated layer is sometimes underlain by lava till, but in shallower profiles it rests directly on lava bed-rock.

Exchangeable calcium is high in all horizons except the B_2 and B_3, magnesium is moderate at all levels, and potassium is moderate in the S and low elsewhere. pH is 6·2 in the topsoil and varies little down the profile. Percentage base saturation is high, except in the B_2 and B_3 where values are moderate. Total phosphorus is high in the S and C horizons and moderate in B_2 and B_3, while acetic-soluble phosphorus is moderate in the S and C and nil in the B horizons.

On certain parts of the hill ground, mainly under woodland or heath, a freely drained iron podzol is developed.

Profile Description

(No. 49. Hollowdub.)

SLOPE		4°.
ASPECT		west.
ALTITUDE		550 feet.
VEGETATION		larch/pine woodland.
DRAINAGE CLASS		free.
Horizon	*Depth*	
L & F	3½–1½ in. (9–4 cm.)	Litter and partially decomposed humus.
H	1½–0 in. (4–0 cm.)	Very dark brown organic loam; weak sub-angular blocky, breaking readily to moderate crumb. Sharp change into
A_2	0–3½ in. (0–9 cm.)	Very dark greyish brown (10YR3/2) fine sandy loam; moderate medium crumb; tongues of organic matter penetrate down old root channels; frequent stones, small sub-angular lavas; many roots; no mottles. Sharp change into
B_2	3½–8½ in. (9–22 cm.)	Yellowish brown (10YR5/6) fine sandy loam; coarse sub-angular blocky, breaking readily to medium crumb; stones as above but larger and more numerous; many roots; no mottles. Gradual change into
C	8½–16½ in. (22–42 cm.)	Light yellowish brown (10YR6/4) fine sandy loam; weakly indurated; angular lavas less frequent than above, increasing in number with depth; frequent roots penetrating to bottom of horizon; no mottles. Sharp change into
D	16½ in. + (42 cm. +)	Lava rock.

The depth of the A_2 horizon is variable throughout the series, and frequently less than in this profile. In some cases the bleached layer is very shallow and the soils more nearly approach the brown podzolic profile. In contrast to the Laws profile, this profile has low exchangeable calcium in all horizons, while magnesium is moderate in A_2 and low elsewhere. Potassium is moderate throughout. Percentage base saturation is very low, with pH showing little variation in the range 4·6 to 4·7. Total phosphorus is moderate and acetic-soluble low.

The profile described below is from East Fife, and is developed on weathered agglomerate.

Profile Description

(No. 50. Easter Balrymonth Hill)

SLOPE	5°.
ASPECT	south-west.
ALTITUDE	340 feet.
VEGETATION	semi-permanent pasture.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–12 in. (0–31 cm.)	Very dark greyish brown (10YR3/2) loam; coarse angular blocky; friable; low organic matter; frequent stones, mainly basic igneous with some sandstone; many fibrous grass roots; moist; no mottles. Sharp undulating change into
B	12–25 in. (31–64 cm.)	Dark reddish brown (5YR3/4) to brown (7·5YR4/4) gritty loam; weak sub-angular blocky; low organic matter; frequent stones, angular fragments of basic igneous rock and of decomposed agglomerate; moist; no mottles. Sharp change into
C	25–35 in. (64–89 cm.)	Very dark brown (10YR2/2) rotting agglomerate rock, breaking down under strong pressure to a gritty fine sandy loam; few roots to 29″. Sharp change into
D	35 in. + (89 cm. +)	Shattered agglomerate rock.

As compared with the other two described, this profile has a much lower content of silt and a proportionately higher content of sand. Exchangeable calcium and magnesium are very high throughout, but potassium is moderate. Base saturation is high, and pH ranges from 5·1 in the S to 6·0 in the C. While total phosphorus is moderate in the S and C and high in the B, acetic-soluble phosphorus is high in all horizons.

DUNLOP SERIES

The Dunlop series is not extensive, and occurs in limited areas throughout the Darleith series. The parent material is a till of loam to sandy clay loam texture, and the series is found mainly on moderate to gently sloping ground. Imperfectly drained, it has been classed as a brown forest soil with gleyed B and C horizons.

Profile Description

(No. 52. Wellbank)

SLOPE	5°.
ASPECT	south-west.
ALTITUDE	555 feet.
VEGETATION	first year grass.
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
S	0–7 in. (0–18 cm.)	Dark brown (7·5YR3/2) loam; strong coarse angular blocky; friable; moderate organic matter; frequent stones, mainly sub-angular pieces of basic lava; many fibrous grass roots; moist. Clear irregular change to
$B_2(g)$	7–12 in. (18–30 cm.)	Brown to dark brown (10YR5/3–4/3) fine sandy silty loam, strong coarse angular blocky; firm; moderate to low organic matter; many stones, mainly pieces of basic igneous rock and occasional pieces of sandstone; frequent fibrous grass roots; few, fine, faint yellowish brown (10YR5/8) mottles. Clear irregular change into

B_3(g)	12–17 in. (30–43 cm.)	Light reddish brown (5YR6/3) fine sandy loam; strong coarse angular blocky; friable; low organic matter; stones as above; frequent fibrous grass roots; many coarse prominent strong brown (7·5YR5/8) mottles and light grey (10YR7/2) coatings on peds. Clear irregular change into
C(g)	17–30 in. (43–76 cm.)	Reddish brown (5YR4/3) loam to sandy clay loam with coarser texture in parts; strong coarse angular blocky; firm; low organic matter; many stones as above; fibrous grass roots frequent becoming few below 26 inches; frequent coarse distinct yellowish brown (10YR5/8) mottles with light grey (10YR7/2) coatings on peds.

The thickness of the S horizon in this series is variable, but is seldom more than 11 inches. An angular blocky structure in all horizons of the profile is characteristic. The texture of the B_2(g) horizon as determined in the field suggests a moderate to high content of fine sand and/or silt, although this may not be borne out by the results of the mechanical analysis. The colour of the B_3(g) is variable, but is frequently brown. This horizon is sometimes slightly indurated. The texture of the C(g) is sometimes finer than in the above profile and the colour is brown, varying in shade according to the nature of the parent rock. The structure can vary to weak prismatic. The stone content, which is composed of angular pieces of basic-igneous rock, is always high.

The values for exchangeable cations are comparable to those for the freely drained Laws profile (No. 48). Exchangeable calcium is high, as is percentage base saturation, while pH ranges from 6·2 in the S to 6·4 in the C(g) with a slight drop in the B_2(g).

AMLAIRD SERIES

The Amlaird series covers a total area of only 0·1 square mile. An average profile has a dark greyish brown surface horizon of loam or sandy clay loam texture overlying a strongly gleyed greyish brown Bg horizon of sandy clay loam texture which is underlain by a grey or reddish grey Cg horizon of clay loam to clay texture. As most of the areas where it occurs are low-lying and drainage cannot readily be improved, the series is generally uncultivated.

LAND USE CAPABILITY

On lower slopes of the Sidlaw Foothills, the Darleith series, together with small areas of the Dunlop series, forms good Class 2 land. At higher altitudes, on more uneven terrain, the soils fall into Classes 3 and 4, with Class 5 on the higher ground and on hill-tops.

The Sourhope Association

Covering a total area of approximately 68 square miles, the Sourhope Association occurs most extensively on the south side of the River Tay on the Ochil Hills of Fife and East Perthshire. An isolated area covers Moncrieffe Hill between the Tay and its tributary the Earn.

On the north side of the River Tay the association extends over the south-west portion of the Sidlaw Range between Kinnoull Hill and Abernyte.

PARENT MATERIAL

The parent material is derived from intermediate lavas of Lower Old Red Sandstone age and varies from a residual stony sandy loam at upper levels to a fine-textured till on lower ground and in hollows. On hill-tops and on upper slopes, decomposition of the underlying lava rock has yielded a parent material which is usually a brown or pale reddish brown sandy loam or fine sandy loam. On some summits and on scree slopes shallow skeletal soils have developed on rock rubble. Middle slopes and lower ground are covered by till derived mainly from intermediate lavas. This till is generally brown or reddish brown and varies from sandy loam or loam on the slopes to sandy clay loam in the hollows. It is usually gritty and, in addition to a high proportion of angular lavas of local origin, contains sub-angular pieces of sandstone and occasional schists and other Highland erratics.

SOILS

Three soil series have been mapped. Sourhope, a freely drained brown forest soil, covers most of the high ground throughout the association. On a few small areas of conifer woodland, and of moorland which was formerly under trees, freely drained podzols have developed. Because these areas are small and there is difficulty, in many cases, of determining the boundary between podzol and brown forest soil, these freely-drained soils have been mapped as brown forest soils. The Bellshill series, an imperfectly-drained brown forest soil occurs on some lower slopes, while the Atton series, a poorly-drained non-calcareous gley, is found mainly on low-lying ground and in hollows.

SOURHOPE SERIES

Sourhope, the dominant series, is developed either on shallow till or residual material derived mainly from intermediate lavas. Two profiles are described below. The first soil is developed on weathered andesitic lava rock at an altitude of 800 feet, the second on lava till at 375 feet.

Profile Description

(No. 53. Seven Gates)

SLOPE	10°.
ASPECT	north-east.
ALTITUDE	800 feet.
VEGETATION	Coniferous forest, mainly pine; *Agrostis tenuis, Gallium saxatile, Polytrichum commune, Rhytidiadelphus squarrosus*
DRAINAGE CLASS	free.

Horizon	*Depth*	
L, F & H	1–0 in. (2·5 cm.–0)	Very dark brown (10YR2/2) litter and fibrous material derived mainly from grass and pine debris; amorphous; thin layer of decomposed humus at base.
A	0–8 in. (0–20 cm.)	Dark brown (7·5YR3/2) loam; moderate coarse sub-angular blocky breaking readily to medium crumb; friable; high organic matter; occasional medium to small angular pieces of andesite; many fibrous grass and woody tree roots; moist; no mottles. Clear smooth change into

B	8–20 in. (20–51 cm.)	Brown (7·5YR4/4) silty loam; moderate medium to coarse angular blocky, breaking readily to medium crumb; friable; moderate organic matter; many angular fragments of andesite, particularly towards bottom of horizon; frequent grass roots; moist; no mottles. Clear smooth change into
C	20–88 in. (51–223 cm.)	Weathered andesite of fine sandy to silty fine sand texture, colour varying from olive at top with purple bands to pink/olive at base.
D	88 in. + (223 cm. +)	Andesite rock with frequent yellow phenocrysts of chlorite material

In this profile sand content is high throughout and clay low. Percentage of U.S.D.A. silt (50–2μ), which, except at the top of C, falls in the range 20 to 26, is lower than in most residual profiles of the series. Percentage base saturation is low down to the B horizon but thereafter is high in the C, ranging from 84·9 to 98·3. pH values range, correspondingly, from 4·5 in the surface horizon to 6·9 at the base of the C. This suggests the presence of calcium-rich material in the parent rock and this is substantiated by the figure for exchangeable calcium, which drops from 6·7 in the LFH layer to 1·1 in the B, thereafter rising to 30·4 in the C. The magnesium figures follow a similar pattern, being moderate in the LFH layer, low in the A and high in the C. Exchangeable potassium has a high value in the LFH horizon and thereafter is moderate to low. Total phosphorus is moderate in all horizons; acetic soluble is moderate in the LFH, low in A and B and high in the C.

Profile Description

(No. 54. Grange)

SLOPE	10°.
ASPECT	east.
ALTITUDE	375 feet.
VEGETATION	fourth year grass.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–15 in. (0–38 cm.)	Dark greyish brown (10YR4/2) loam; moderate sub-angular blocky; moderate organic matter; many small sub-angular lava stones; many grass roots; worms present; moist; no mottles. Clear undulating change into
B_2	15–25 in. (38–64 cm.)	Strong brown (7·5YR5/6) loam; moderate sub-angular blocky; low organic matter, occasional tongues of S horizon penetrating down root channels; sub-angular pieces of lava frequent, becoming larger and more numerous with depth; occasional pieces of flaggy sandstone; roots frequent becoming fewer with depth; worms present; moist; no mottles; Clear undulating change into
C	25–37 in. (64–94 cm.)	Reddish brown (5YR4/3) sandy clay loam; moderate sub-angular blocky; many stones, medium to large sub-angular lavas with some flaggy/sandstones; roots few, absent below 28 inches; moist; common distinct stong brown (7·5YR5/6) mottles.

While the field texture of the till is found normally to be loam or sandy clay loam, results of analyses indicate a coarser texture. The till is generally reddish brown of 5YR hue; shallower tills on upper slopes sometimes show a variation in value and chroma to dark reddish grey (4/2) or dark reddish brown (3/2). Below the B_2 there is sometimes a weakly indurated B_3 horizon merging into the C. The description which follows is of a podzol profile taken from a site on permanent pasture in the Sidlaw Hills. On Sheet 39 (Stirling),

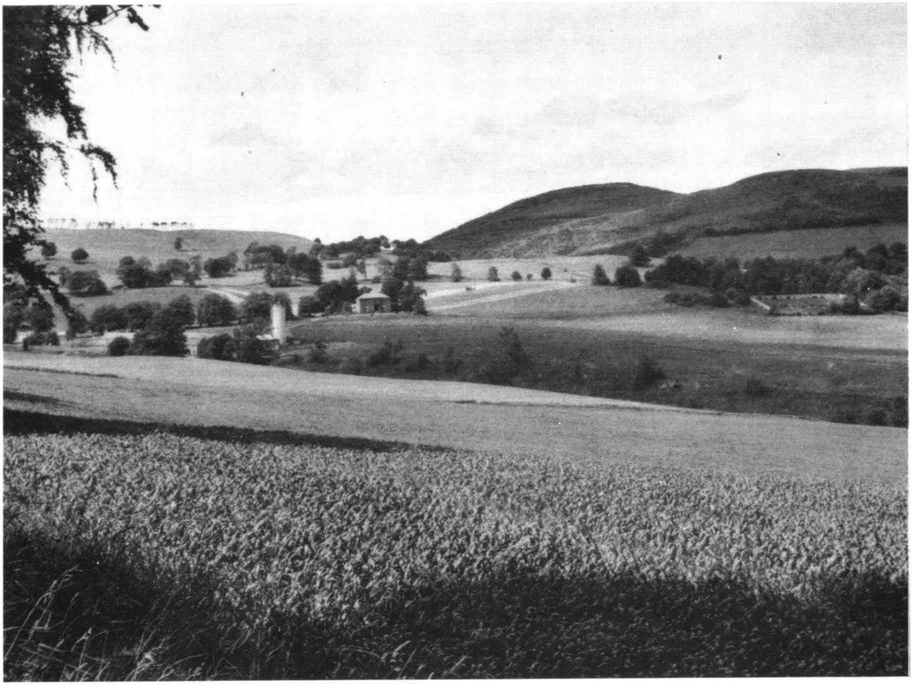


PLATE 10
Sidlaw Hills: Sourhope Association with cultivation on lower slopes, rough grazing on upper.

PLATE 11
Glenearn Hill in the western Ochils: Sourhope Association on the summit and upper slopes, Kippen and Mountboy Associations on cultivated lower slopes.

By courtesy of Aerofilms Ltd.

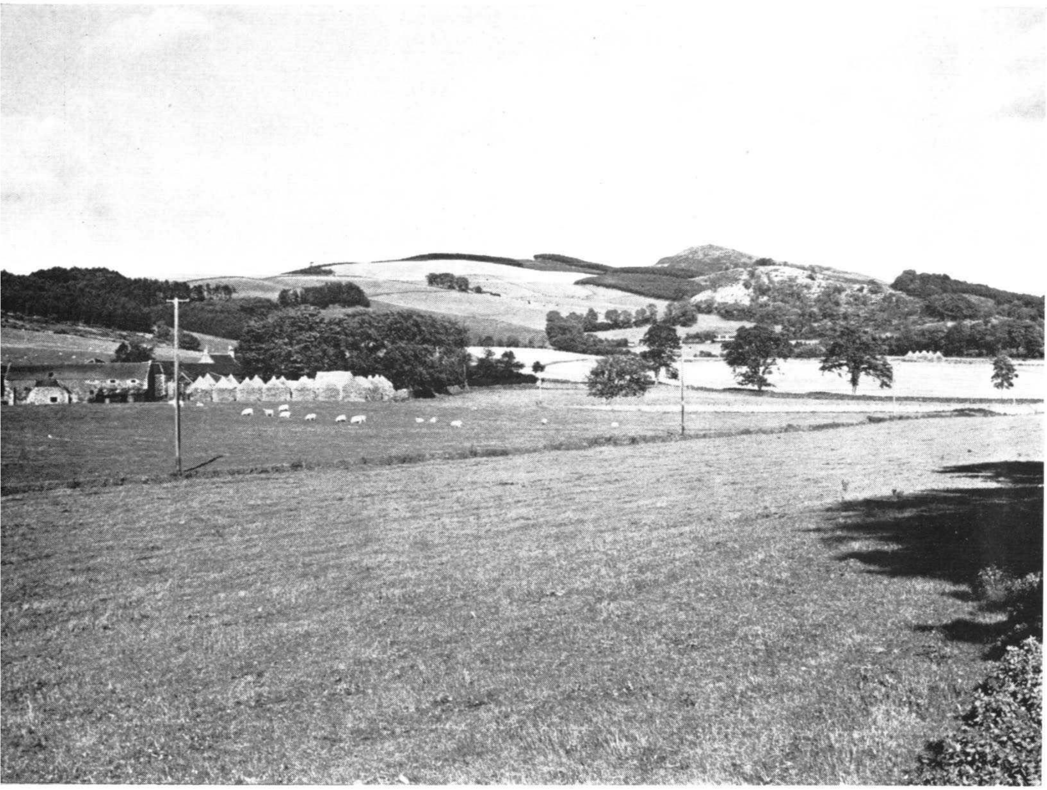


PLATE 12
Ayton Hill and Norman's Law in the eastern Ochils: Sourhope Association.

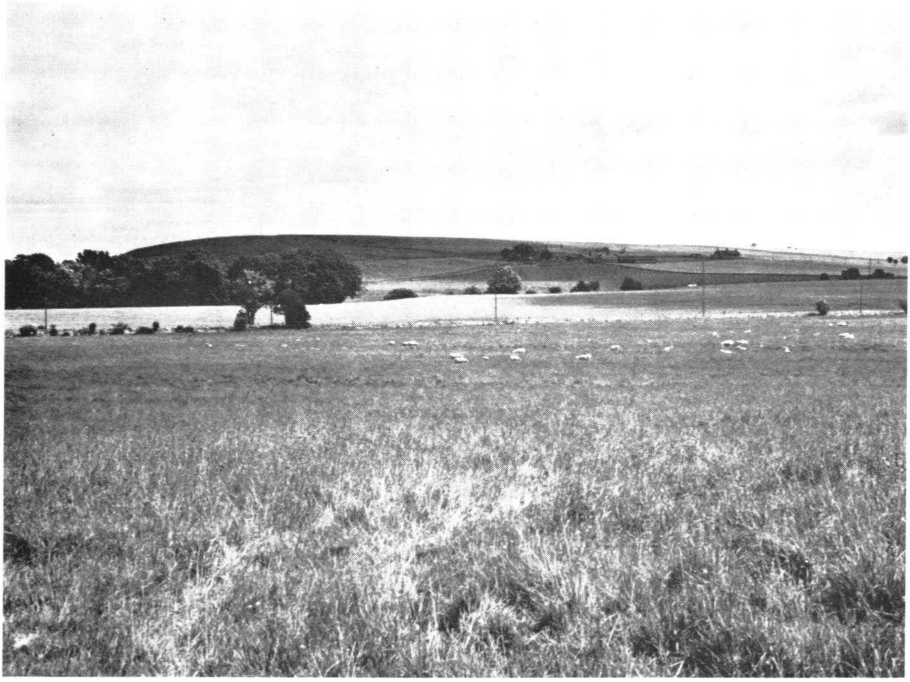


PLATE 13
Wester Balrymonth Hill in the east Fife uplands: Darleith Association on the hill with Rowanhill Association on the low ground.

to the south-west of this district, uncultivated areas of the Sourhope Association are more extensive and podzols have been separated as the Frandy series.

Profile Description

(No. 57. Balthayock Wood)

SLOPE		2°.
ASPECT		north-west.
ALTITUDE		650 feet.
VEGETATION		permanent pasture, formerly mixed forest.
DRAINAGE CLASS		free.
Horizon	*Depth*	
L & F	1–0 in. (2·5–0 cm.)	Litter and fermenting humus.
A_1/A_2	0–2 in. (0–5 cm.)	Very dark greyish brown (10YR3/2) sandy loam; weak medium crumb; high organic matter; no stones; many fibrous grass roots; moist. Sharp even change into
B_2	2–10 in. (5–2·5 cm.)	Brown (7·5YR4/4) gritty fine sandy loam; weak sub-angular blocky; moderate organic matter with occasional tongues down root channels; few stones, mainly small sub-angular pieces of lava; many roots; moist; no mottles. Gradual undulating change into
B_3	10–18 in. (25–46 cm.)	Brown (7·5YR4/4) silty fine sandy loam; moderate compact angular blocky; frequent roots, becoming few with depth; occasional small sub-angular to rounded pieces of lava; moist; no mottles. Clear undulating change to
C	18–24 in. (46–61 cm.)	Dark reddish grey (5YR4/2) gritty fine sandy loam; strongly indurated angular blocky; many medium angular pieces of lava; moist; no mottles. Sharp undulating change into
D	24 in. + (61 cm. +)	Lava rock.

Although absent in this profile, a well-defined H horizon of decomposed organic matter is frequently found below the L/F layer. The B_2 horizon described above is thicker than the average 4 to 6 inches for profiles of this series. The B_3 horizon is frequently strongly indurated, the induration continuing into the C horizon. In some cases, as on upper slopes where the parent material is shallow, the B_3 horizon is absent.

BELLSHILL SERIES

The Bellshill series is imperfectly drained and covers soils in the drainage category intermediate between the Sourhope and Atton series. It occurs mainly on gentle slopes or level ground, and often merges at upper levels into the freely drained Sourhope series and at lower levels into the poorly drained Atton series. The series is developed on till varying, normally, from loam to sandy clay loam, although the field texture may frequently appear silty or fine sandy. It has been classed as a brown forest soil with gleyed B and C horizons.

Profile Description

(No. 58. Grange of Elcho)

SLOPE	level.
ALTITUDE	125 feet.
ASPECT	nil.
VEGETATION	old grass pasture.
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
S	0–10 in. (0–25 cm.)	Dark greyish brown (10YR3/2) loam; moderate sub-angular blocky stiucture; friable; modeiate organic matter; many small stones, mainly sub-angular quartzites and angular lavas; many grass roots; moist. Sharp even change into
B(g)	10–18 in. (25–46 cm.)	Brown (7·5YR5/2) loam; strong sub-angular blocky; low organic matter with occasional tongues penetrating down root channels; roots frequent, becoming few in lower half of horizon; stones as above but larger and including some schists; moist; frequent faint strong brown (7·5YR5/6) mottles. Gradual irregular change into
C(g)	18–32 in. (46–81 cm.)	Dark reddish grey (5YR4/2) varying to reddish brown (5YR4/3) sandy clay loam; strong sub-angular blocky; low organic matter; stones as above with a few pieces of sandstone and a greater proportion of angular lavas; moist; frequent faint strong brown (7·5YR5/6) mottles.

With the exception of a high value for calcium in the S horizon and a low value for potassium in the C, all three exchangeable cations, calcium, magnesium and potassium, occur in moderate amounts. Base saturation is also moderate and pH ranges from 5·5 in the S to 6·6 in the C. Total phosphorus is high in the S and moderate elsewhere, with acetic-soluble high in all horizons.

ATTON SERIES

The Atton series occurs on lower hill slopes and in hollows between hills. The series is poorly drained and belongs to the sub-group of non-calcareous gleys. The texture of the till which forms the parent material is finer than in the better-drained series and generally varies from loam to sandy clay loam.

Profile Description

(No. 61. Foodie Farm)

SLOPE	gentle.
ASPECT	north.
ALTITUDE	200 feet.
VEGETATION	wheat stubble.
DRAINAGE CLASS	poor.

Horizon	*Depth*	
S	0–10 in. (0–25 cm.)	Dark reddish (5YR4/2) grey silty clay loam; strong angular blocky to prismatic; frequent small to medium angular pieces of lava; frequent fibrous roots; worms present; moist; few faint diffuse mottles and grey faces on peds. Sharp change into
B_2g	10–14 in. (25–36 cm.)	Reddish brown (5YR5/3) silty clay loam; angular blocky to prismatic; stones as above but larger; frequent roots; worms present; moist; frequent prominent grey (5YR6/1) and yellowish red (5YR5/8) mottles. Sharp change into
B_2g	14–25 in. (36–64 cm.)	Reddish brown (5YR5/3) varying to dark reddish brown (5YR3/4) stony silt loam; strong prismatic; many medium and large angular pieces of lava, high proportion completely rotted; roots few; worms present; moist; frequent distinct grey and yellowish red (5YR4/6) mottles and black manganese staining. Sharp change into
B_3g	25–33 in. (64–84 cm.)	Dark reddish brown (5YR3/2) gritty loam; moderate prismatic; many weathered stones, mostly lavas; few roots; worms present; moist; mottles as above but less distinct. Sharp change into
Cg	33–45 in. + (84–114 cm. +)	Dark reddish grey (5YR4/2) silt loam; coarse prismatic, tending to die out with depth; many stones, mainly lavas; few roots; worms present in upper half of horizon; moist; few yellowish red (5YR5/8) mottles, replaced below 45 in. by bluish grey colour of soft pieces of lava.

The thickness of the S horizon is sometimes slightly greater than in the above profile, but is seldom more than 12 or 13 inches. The lower section of B_2g as shown above is not normal for this horizon, the thickness of which is generally not more than 6 inches. The colour of the B_3g horizon, described in the field as a "pinkish brown", is darker than that of the B_2g. In the B_3g the prismatic structure is less well developed than in the B_2g, and grey and ochreous mottling is less prominent.

Notably different is the profile described below, which occurs at 550 feet on uncultivated ground some 12 or 13 miles to the west. The drainage approaches the very poorly drained category and the soil would have been mapped as a peaty gley had such a group been separated.

Profile Description

(No. 62. Ballomill)

SLOPE		gentle.
ASPECT		north-east.
ALTITUDE		550 feet.
VEGETATION		*Juncus acutiflorus, Holcus lanatus, Anthoxanthum odoratum, Agrostis tenuis, Ranunculus acris, Rumex acetosa, Lotus uliginosus, Agrostis canina, Carex* sp.
DRAINAGE CLASS		poor.
Horizon	*Depth*	
H_1	0–7 in. (0–18 cm.)	Very dark grey (10YR3/1) organic fine sandy loam; structureless; high organic matter; many fine fibrous roots; few stones; wet. Clear irregular change into
B_2g	7–15 in. (18–38 cm.)	Very dark grey (10YR3/1) gritty silt loam; coarse sub-angular blocky to prismatic; plastic; moderate organic matter; frequent stones, mainly small pieces of rotting lava; fibrous roots frequent; wet; many distinct yellowish brown mottles (10YR5/6). Diffuse irregular change into
Cg	15–24 in. (38–61 cm.)	Dark grey (10YR4/1) silt loam to silty clay loam; coarse sub-angular blocky to prismatic; highly plastic; frequent stones with several large sub-angular pieces of lava; a few roots penetrate to base of horizon; wet; frequent faint to distinct yellowish brown (10YR5/4) mottles. Sharp irregular change into
D	24 in. + (61 cm. +)	Decomposing lava rock.

In addition to indicating poorer drainage conditions, the dark grey colours in this profile suggest a variation in the composition of the lava rock from which the parent material is derived. Analysis shows the total phosphorus to be much higher than in the Foodie Farm profile and noticeably high for an uncultivated soil. The acetic-soluble phosphorus, on the other hand, is low in all horizons, except in the top of the Cg where it is moderate. In the Foodie Farm profile the value is high to very high; in addition it has 89 per cent base saturation in the S horizon and is completely saturated elsewhere, while pH ranges from 6·3 in the S to 8·1 in the C at 48 inches. Exchangeable calcium is high throughout the profile, magnesium is moderate, with one high value at the top of the Cg horizon, and potassium is moderate at all levels. In the uncultivated Ballomill soil, percentage base saturation is not high ranging from 20·4 to 49·3, while pH varies from 5·3 to 6·3. The suggestion that base saturation in the cultivated profile has been raised by the application of fertilizers would seem disproved, at least for the C horizons, by the fact that the freely drained uncultivated profile from Seven Gates (No. 53) also shows high base saturation in the C horizon, with correspondingly high exchangeable calcium and magnesium.

LAND USE CAPABILITY

As most of the association is on hill ground, only a limited area, generally below 400 feet, comes into Class 2. Above this level a considerable area is moderately good arable land and falls into Class 3, with occasional poorer areas in Class 4, while the upper slopes and summits of hills are mainly Class 5 land.

The Rowanhill Association

The Rowanhill Association, which covers a total area of 16 square miles, is confined to the East Fife Drift Plain and to lower and middle slopes of the East Fife Uplands.

PARENT MATERIAL

Till derived from Carboniferous sediments forms the parent material of the greater part of this association. Two variants of the till have been distinguished, differing mainly in colour. The more extensive of the two, a reddish brown to dark reddish grey clay loam, covers most of the northern part of the association area and extends from Kemback Hill eastwards by St. Andrews to the coast. The other variant, a grey or greyish brown clay loam/ sandy clay, covers the remainder of the area. Pieces of Carboniferous sandstone are common throughout both variants; in the first the sandstone is almost all reddish brown, while in the second it is mainly yellowish brown. Brown or dark brown shales are often found in the second till, and sometimes also amounts of basic agglomerate fragments from intrusions in the region.

The reddish brown till is normally shallow, and at about 4 feet it passes into grey or grey brown sandy clay loam or clay loam till. On the ground the boundaries between the two variants are usually difficult to determine, as the tills merge into one another, and soils developed on the reddish brown till are found almost side by side with those on the greyish brown till.

Throughout the association, generally in small areas adjacent to streams or drainage channels, the upper parts of the till have been resorted by water action. Because of the resulting alteration in texture and in structure, the soils developed on these deposits have not been placed in the same series as the unsorted material. Resorting, which has already been encountered in the Balrownie and Forfar Associations of Strathmore, was caused probably by melt-waters as the ice retreated.

In some areas the till cover is absent and soils have developed on the underlying sandstone rock, a pale yellow or yellowish brown Carboniferous sediment which weathers to a loamy sand or sand. Although differing considerably in texture and in structure from the dominant till soils of the association, these residual soils are nevertheless derived from one of the parent rocks, and have therefore been included in the association, as the Allanhill series.

SOILS

Six series of the association have been mapped in this region. Winton, Caprington and Macmerry belong to the major soil sub-group of brown forest soils with gleyed B and C horizons, Greenside is a freely-drained brown forest soil, Allanhill a freely-drained iron podzol, and Rowanhill series a poorly-drained non-calcareous gley. Rowanhill is the dominant series in Ayrshire, where the association was first named, but here in north-east Fife, the dominant series is Winton. On Sheets 33 and 34 (Haddington and Eyemouth) a Winton Association was mapped, with Winton the dominant series and Macmerry the corresponding water-sorted series, but as a result of correlation the Winton Association has now been discarded and Winton and Macmerry included as series in an enlarged Rowanhill Association.

WINTON SERIES

The Winton series is developed on a clay loam till, varying in colour from reddish brown to reddish grey. An imperfectly drained brown forest soil, the series occurs on gentle slopes of the East Fife Drift Plain, generally between the 125 and 350 foot contours, although it is found in places up to 500 feet on moderate slopes of the uplands.

Profile Description

(No. 63. Feddinch)

SLOPE	3°.
ASPECT	north-east.
ALTITUDE	300 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
S	0–7 in. (0–18 cm.)	Dark greyish brown (10YR4/2) loam; strong coarse angular blocky; firm; low organic matter; few stones; many fibrous grass roots; moist; few faint fine ochreous mottles in lower half of horizon. Gradual change into
$A_2(g)$	7–13 in. (18–33 cm.)	Dark greyish brown to greyish brown (10YR4/2–5/2) loam; moderate sub-angular blocky; loose; friable; moderate organic matter; few stones; many fibrous grass roots; moist; frequent distinct yellowish brown (10YR5/6) mottles. Sharp change into
$B_2(g)$	13–19 in. (33–48 cm.)	Reddish brown (5YR4/3) loam to sandy clay loam; medium angular blocky; firm; low organic matter; few stones; few fibrous grass roots; moist; frequent medium prominent yellowish red (5YR5/6) mottles and pinkish grey (7·5YR6/2) faces to peds. Gradual change into
$B_3(g)$	19–27 in. (48–68 cm.)	Reddish brown (5YR4/3) clay loam; structure as above; firm; low organic matter; few stones with occasional pieces of red sandstone; few roots; moist; mottles as above, but varying in parts from frequent to few and from prominent to distinct. Gradual change into
$C_1(g)$	27–48 in. (68–122 cm.)	Dark reddish grey (5YR4/2) clay loam; massive; firm; few stones, becoming stonier with depth; few roots; moist; frequent medium distinct yellowish red (5YR5/4) mottles and light grey (5YR7/1) faces to peds. Gradual change into
$C_2(g)$	48–66 in. (122–168 cm.)	Light grey (N7/0) with patches of brown (7·5YR4/2) sandy clay loam; medium angular blocky; firm; low organic matter; stony; moist; frequent coarse prominent yellowish red (5YR5/4) mottles, usually associated with decomposing stones. Sharp irregular change into

$C_2(g)$	66–72 in. + (168–183 cm. +)	Grey (N6/0) fine sandy clay loam; massive; firm; few stones; moist; few faint fine ochreous mottles.

In this profile a $C_1(g)$ horizon of dark reddish grey clay loam, the parent material of the soil, is underlain below 48 inches by a $C_2(g)$ of grey and brown sandy clay loam, similar to the parent material of the Caprington series.

When not destroyed by cultivation, the gleyed A_2 horizon is a typical feature of the Winton series and usually varies in colour from dark grey brown to grey brown, with strong brown or yellowish brown mottles. The reddish brown colour in the B(g) horizon of this profile is characteristic of the series, as is the dark reddish grey of the $C_1(g)$ although this horizon may be reddish brown. The clay content increases slightly down the profile, rising to 31 per cent; this is normal for most Winton profiles, values ranging from 27–32. As in most cultivated profiles of the series, exchangeable calcium and magnesium figures are moderate throughout, with the exception of the $B_3(g)$ and C(g) horizons where the values are high. Potassium is low in the S, $A_2(g)$ and $B_2(g)$ horizons and moderate in the others. pH rises gradually from 5·6 to 6·7 and percentage base saturation is high throughout, ranging from 66·8 to 97·3; both features are typical of the series. Except in the S and $A_2(g)$ horizons, and in the upper part of the $C_1(g)$ horizon, the acetic-soluble phosphorus is low, while the total phosphorus is low in all except the first two horizons.

CAPRINGTON SERIES

In this part of Fife the Caprington series is less extensive than the Winton, but farther south, where there is a higher proportion of shales in the parent rocks, Caprington becomes the dominant series. It occurs under the same conditions of relief and drainage as the Winton series, and differs from it mainly in colour, being greyish brown throughout and developed on a grey or greyish brown clay loam till.

Profile Description

(No. 64. Winthank)

SLOPE	2°.
ASPECT	south-east.
ALTITUDE	500 feet.
VEGETATION	semi-permanent grass.
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
S	0–11 in. (0–28 cm.)	Dark grey brown (10YR4/2) loam; sub-angular blocky, breaking readily to medium crumb; moderate organic matter; few stones, mainly sandstones; many roots; worms present; moist; no mottles. Sharp irregular change into
$B_2(g)$	11–14 in. (28–36 cm.)	Light reddish brown (5YR6/3) loam; sub-angular blocky, breaking readily to medium crumb; firm; organic matter low and only in root and worm channels; stones as above; grass roots frequent; moist; many distinct yellowish red (5YR5/6) and pinkish grey (7·5YR6/2) mottles. Gradual irregular change into
$B_3(g)$	14–24 in. (36–61 cm.)	Light brownish grey (10YR6/2) clay loam; coarse angular blocky; plastic when wet; many stones, sandstone dominating with occasional basic igneous rocks; few roots; worms present; moist; many medium to large prominent strong brown (10YR5/6) mottles. Gradual irregular change into

C(g)	24–50 in. + (61–127 cm. +)	Dark grey brown (10YR4/2) sandy clay loam to clay loam; coarse angular blocky; many stones, sandstone and basic igneous; roots few at top of horizon; moist; many distinct yellowish brown (10YR 5/6) mottles and grey (10YR6/1) faces to peds.

Although percentage clay in Caprington profiles is frequently greater than in Winton, the clay values in the above profile are slighly lower than in the Feddinch profile, the range being from 17·5 to 27·9. Exchangeable calcium is high in all horizons except the B_2(g), where it is moderate to high, exchangeable magnesium is high in all horizons except the S and B_2(g), and potassium is low in the B_2(g) and moderate elsewhere. Except in the S horizon, where the value is moderate, percentage base saturation is high throughout. Ranging from 5·1 to 5·8, pH in this profile is lower than normal for the series. Total phosphorus is moderate in all horizons except the B_2(g) and B_3(g), where it is low, while acetic-soluble phosphorus is moderate to high in the B_2(g) and C(g) and low elsewhere.

MACMERRY SERIES

Macmerry series is not extensive in this region and is confined mainly to low-lying areas bordering streams or drainage channels, often contiguous to spreads of recent alluvium.

Profile Description

(No. 66. Ballone)

SLOPE	level.
ASPECT	nil.
ALTITUDE	125 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
S	0–13 in. (0–33 cm.)	Dark grey brown (10YR4/2) loam; coarse sub-angular blocky breaking to fine sub-angular blocky; firm; low organic matter; frequent stones; many fibrous grass roots; moist; few faint fine ochreous mottles near bottom of horizon. Sharp even change into
B_2(g)	13–17 in. (33–43 cm.)	Brown to dark brown (7·5YR4/2) sandy loam; weak coarse sub-angular blocky; loose; friable; low organic matter; frequent stones; frequent grass roots; evidence of water-sorting; moist; few faint medium ochreous mottles. Gradual change into
B_3(g)	17–30 in. (43–76 cm.)	Reddish brown (5YR4/3–5/3) sandy loam, varying in parts to sandy clay loam; evidence of water-sorting; weak angular to sub-angular blocky; firm in parts; low organic matter; many stones, with occasional pieces of red sandstone; moist; frequent coarse strong brown (7·5YR5/8) mottles. Gradual change into
C(g)	30–35 in. (76–89 cm.)	Reddish brown (5YR4/3) sandy clay loam; coarse angular blocky structure; firm; low organic matter; stones as above; moist; frequent medium strong brown (7·5YR5/6) mottles.

Water sorting is a notable feature of both the B_2(g) and B_3(g) horizons of the above profile and clay contents are in most cases lower than would be found in a corresponding profile of the Winton series. Values for exchangeable calcium are moderate throughout, as are the magnesium values. Potassium is low in all horizons except the S. Percentage base saturation is high, and pH ranges from 5·9–6·9.

The Macmerry series is in many ways comparable to the Forfar series of the Forfar Association, but analyses show that it normally has a higher clay content in most horizons.

GREENSIDE SERIES

The Greenside series, covering a total area of approximately 1 square mile, is confined to the upper slopes of Knock Hill and Clatto Hill and to the rising ground about Greenside. The parent material is reddish brown to reddish grey till, usually of sandy loam or loam texture but varying occasionally to sandy clay loam. The drainage class is free, but the areas include profiles where drainage is free to slightly imperfect.

Profile Description

(No. 67. Upper Magask)

SLOPE		3°.
ASPECT		north.
ALTITUDE		400 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
S	0–9 in. (0–23 cm.)	Dark greyish brown (10YR4/2) sandy loam; well developed coarse sub-angular blocky, breaking readily to fine sub-angular blocky and medium crumb; friable; few stones, small sub-angular of mixed origin; moderate organic matter; many fibrous grass roots; no mottles. Sharp smooth change into
$B_3(g)$	9–18 in. (23–46 cm.)	Light brown (7·5YR6/4) sandy loam; indurated, breaking under moderate pressure to medium crumb and single grain; frequent stones, mainly angular and sub-angular pieces of sandstone and some lava; low organic matter; fibrous grass roots frequent, becoming few towards bottom of horizon; moist; many coarse distinct strong brown (7·5YR5/6) mottles and light grey (10YR7/2) faces to peds. Sharp irregular change into
C(g)	18–35 in. (46–89 cm.)	Dark reddish grey (5YR4/2) to reddish brown (5YR4/3) sandy clay loam; well developed coarse angular blocky; firm; stones as above but larger with pieces of Carboniferous sandstone frequent; low organic matter; few roots; worms present; moist; many fine distinct strong brown (7·5YR5/6) mottles and pinkish grey (7·5YR 6/2) faces to peds; some manganese staining.

An indurated B horizon is a feature of the series. While the profile described above has only an indurated $B_3(g)$, many others in the series have a loose friable B_2 and an indurated or strongly indurated B_3. Strong induration is usually associated with better drainage.

Percentage clay is not high in this profile, being only 21 in the S and under 20 in all other horizons. The presence of decomposing Carboniferous sandstone in the C(g) is responsible for a lower figure for percentage clay than might have been expected from the field texture of sandy clay loam. Exchangeable calcium is high in the S and C(g) horizons and moderate in the $B_3(g)$ while magnesium is moderate throughout. Potassium is moderate in all layers except the $B_3(g)$, where the value is low. Total phosphorus is moderate in all horizons, while acetic-soluble phosphorus is moderate in the B but high elsewhere. Percentage base saturation is high throughout; from 83 in the S horizon, the value drops to 73 in the B_3(g) but rises again to 94 in the C. pH remains constant at approximately 6·3 throughout the profile except in the lower C where it rises to 6·7.

ROWANHILL SERIES

Rowanhill is the least extensive of the series mapped in the association in this area. Developed on a till of clay loam texture, it is a poorly drained non-calcareous gley, occurring normally on low-lying ground and in hollows. Small areas are also found at higher altitudes throughout the imperfectly-drained Caprington series.

Profile Description

(No. 68. Winthank)

SLOPE		2°.
ASPECT		north-east.
ALTITUDE		475 feet.
VEGETATION		third year grass.
DRAINAGE CLASS		poor.
Horizon	*Depth*	
S	0–10 in. (0·25 cm.)	Very dark greyish brown (2·5Y3/2) sandy clay loam; medium/coarse angular blocky; firm; moderate organic matter; few stones; many grass roots; moist; few faint fine ochreous mottles at bottom of horizon. Sharp irregular change into
Bg	10–18 in. (25–46 cm.)	Greyish brown (2·5Y5/2) silty clay loam; coarse angular blocky tending to prismatic; low organic matter; stones few, becoming frequent towards base; roots frequent, becoming few; moist; few distinct medium to coarse strong brown (7·5YR5/8) mottles. Gradual change into
Cg	18–36 in. (46–91 cm.)	Dark grey (2·5Y4/0) clay loam to clay; massive breaking to coarse prismatic; low organic matter; few stones, with occasional pieces of decomposing Carboniferous sandstone; moist; frequent, medium to fine, strong brown (7·5YR5/8) mottles.

Typical of the Rowanhill series, this profile shows high clay contents throughout, the percentage varying from 25·6 at the surface to 37·7 in the Bg horizon. Exchangeable calcium is high in all horizons except the lower S where it is low; magnesium is moderate in all horizons except the lower Cg, where it is high; potassium is moderate throughout. All horizons are completely base saturated, and pH ranges from 7·1 to 7·5.

Throughout the area covered by the Rowanhill series, small patches of a poorly drained to very poorly drained soil are found in hollows, generally under semi-natural vegetation. The soil profile approaches the category of a peaty gley but, because of the difficulties of delineation on the map, these areas have not been separated from the Rowanhill series.

Profile Description

(No. 69. Prior Muir)

SLOPE	flat.
ASPECT	nil.
ALTITUDE	335 feet.
VEGETATION	Open scrub: *Betula pubescens*/*B.veruccosa* with *Polytrichum commune*, *Erica tetralix*, *Juncus* spp., *Agrostis tenuis*.
DRAINAGE CLASS	poor to very poor.

Horizon	*Depth*	
L & F	2–0 in. (5 cm.–0)	Black to dark reddish brown (5YR2/1–2/2) leaf litter and mixed fibrous material; many fibrous plant roots; few woody tree roots. Sharp even change into
A	0–7 in. (0–18 cm.)	Very dark brown (10YR2/2) loam; moist and firm; moderate coarse angular blocky, tending to prismatic; high organic matter; few stones; many fibrous roots, few woody tree roots; no mottles. Sharp irregular change into
Bg	7–14 in. (18–36 cm.)	Light grey to light brownish grey (10YR7/2–6/2) fine sandy clay loam; massive; wet and plastic; low organic matter; few stones; frequent fibrous plant roots, few woody tree roots; frequent medium to coarse prominent brownish yellow (10YR6/8) mottles. Gradual irregular change into
Cg	14–26 in. (33–66 cm)	Light grey (5Y7/2) clay; massive; wet and plastic; few pieces of decomposing Carboniferous sandstone and a few large boulders; few roots; many coarse prominent reddish yellow (7·5YR6/8) and strong brown (7·5YR5/8) mottles; water table at 26 inches.

ALLANHILL SERIES

Allanhill is not an extensive series, and, like the Greenside, covers an area of about 1 square mile. It is developed directly on Carboniferous sandstone at localities where the rock penetrates the till cover of the East Fife Drift Plain. The largest area is found on the north-west slopes of Kemback Hill. A small area lies about 1 mile south of St. Andrews, near Allanhill where the soil was first mapped. The series is classed as a podzol and podzol profiles are well developed in Kemback Wood; in the other areas the podzols are cultivated.

Profile Description

(No. 70. Kemback Wood)

SLOPE	5°.
ASPECT	north-west.
ALTITUDE	200 feet.
VEGETATION	Beech/oak woodland: *Dryopteris* sp., *Oxalis acetosella*, *Holcus mollis*, *Endymion nonscriptus*.
DRAINAGE CLASS	free.

Horizon	*Depth*	
L, F & H	1–0 in. (2·5 cm.–0)	Dark reddish brown (5YR2/2) mixed leaf and fern litter, becoming humose at bottom; many fibrous fern and woody tree roots; no stones; moist; no mottles; Sharp change into
A_1	1–2 in. (2·5–5 cm.)	Very dark brown (10YR2/2) fine sandy loam to loamy fine sand; loose fine crumb, breaking readily to single grain; high organic matter; many woody tree roots; moist; no mottles. Sharp change into
B_2	2–10 in. (5–25 cm.)	Dark yellowish brown (10YR3/4) fine sandy loam; loose medium sub-angular blocky, breaking readily to fine crumb and single grain; moderate to high organic matter; few stones, mainly sub-angular pieces of Carboniferous sandstone; many fibrous roots, few woody tree roots; moist; no mottles. Sharp change into
B_3	10–16 in. (25–41 cm.)	Yellowish brown (10YR5/6) loamy sand varying to loamy fine sand; loose coarse angular blocky, breaking readily to fine crumb and single grain; low organic matter; a few sub-angular pieces of sandstone; roots few; moist; no mottles. Sharp undulating change into
C	16–48 in. + (41–132 cm.)	Light yellowish brown to brownish yellow (10YR6/4–6/6) sand; single grain; low organic matter; few stones, mainly sub-angular pieces of sandstone; few roots becoming rare at 24 inches; moist; diffuse ochreous mottles. Sharp regular change into
D	48 in. + (132 cm. +)	Light yellowish brown decomposing sandstone.

The A_1 horizon is frequently replaced in uncultivated profiles of this series by a grey brown A_2 horizon, 2 to 3 inches thick with a low organic matter content and sand grains noticeably bleached. Except that the A horizons have been destroyed by ploughing, the cultivated profile is similar to the uncultivated.

Sand content is high throughout the profile and clay content low, except in the B_2 where it increases slightly. In both cultivated and uncultivated profiles, values of exchangeable calcium tend to be high in surface and low in sub-surface horizons; exchangeable magnesium is generally low in all horizons except the LFH and A_1, where it is moderate. Potassium is frequently moderate to high in the LFH layer and moderate to low elsewhere. Percentage base saturation is low throughout, while pH ranges from 3·7 to 4·4 in the uncultivated profile and from 5·2 to 5·9 in the cultivated. Values for total phosphorus and acetic-soluble phosphorus are low, except in the A horizons of the uncultivated soil where they are moderate.

LAND USE CAPABILITY

Over 80 per cent of the association area has been classed as 2S land. Areas of the Allanhill series occurring on lower ground fall into Class 3S because of the coarse texture of the soils and the general irregularity of the topography. On steep slopes, such as Kemback Hill, the series is limited to Class 5. Areas of the poorly drained Rowanhill series are classed as 3W or 4W, depending on the feasibility of drainage improvement. Several minor areas of the series occurring throughout larger spreads of the imperfectly drained Caprington series have been classed as 2W.

The Corby Association

The Corby Association occurs throughout Strathmore in small scattered areas which together total 14 square miles. It is found, generally at altitudes below 250 feet, mainly in the Isla Flats sub-region to the west and north-west of Coupar Angus and in the Tay and Earn Flats to the west and north of Perth.

PARENT MATERIAL

The parent material is gravel either fluvioglacial and morainic or part of former river terraces or raised beaches. The gravel varies both in size and in geological composition; in general, size variation ranges from ½ inch diameter to 2 inches, the larger sizes being found at lower depths. The rocks from which most of the gravel is derived are mainly acid igneous and acid metamorphic rocks, such as granites, quartzites, or Highland schists. According to the area in which the association occurs, the parent material may contain a proportion of gravel derived from other rocks. In the area around Stormont Loch, near the northern margin, the gravel is dominantly of Highland origin; in the area of Kinclaven, further to the south, Old Red Sandstone lavas are common; in the area of Loanleven, to the west of Perth, dolerites are notable. Mingled with gravels, there are always moderate to high proportions of sand, and the association almost invariably occurs contiguous to areas of the Boyndie Association.

SOILS

Because of the coarse texture of the parent material, the soils of the association are dominantly freely drained. Only a few small areas of imperfectly drained gravel soils have been mapped and one very small area of poorly drained.

CORBY SERIES

The Corby series is freely drained and belongs to the major soil sub-group of iron podzols. Podzolic characteristics are well developed in the uncultivated profile; in the cultivated one, although the A horizons have been destroyed, there is usually a bright illuvial B horizon and clear indications that the soil was formerly an iron podzol or a humus iron podzol. Descriptions follow of both uncultivated and cultivated profiles.

Profile Description (uncultivated)

(No. 71. Stormont)

SLOPE		2°.
ASPECT		north.
ALTITUDE		175 feet.
VEGETATION		Scots pine woodland, open canopy—*Calluna vulgaris, Vaccinium myrtillus, Deschampsia flexuosa, Pleurozium schreberi, Hylocomium splendens.*
DRAINAGE CLASS		free.
L & F	$3\frac{1}{2}$–0 in. (9 cm.–0)	Dark reddish brown (5YR3/2–3/3) mixed plant litter and partly decomposed organic matter; many fibrous plant and woody tree roots.
H		Trace of well decomposed dark reddish brown (5YR2/2) humus. Sharp change into
A_2	0–4 in. (0–10 cm.)	Dark grey (10YR4/1) fine sandy loam; loose fine crumb; friable; moderate to low organic matter; many stones, mainly rounded pebbles; many bleached sand grains; many fibrous plant roots and frequent woody tree roots; moist; no mottles. Sharp level change into
B_2	4–8 in. (10–20 cm.)	Brown (7·5YR5/4) coarse sandy loam; coarse sub-angular blocky; friable; moderate organic matter; stones few becoming many towards base of horizon—stones as above but larger and with a high proportion of Highland origin; plant and tree roots frequent; no mottles. Sharp undulating change into
C	8–28 in. + (20–71 cm. +)	Yellowish brown (10YR5/4) coarse sandy gravel; single grain; gravel varying in size from $\frac{1}{4}$ to 1 inch in diameter and derived mainly from Highland rocks; few large (3 inch diameter) sub-angular to rounded stones in lower half of horizon; roots frequent becoming few below 20 inches.

The H horizon is seldom well developed in uncultivated profiles of this series, although it can on occasion be as much as 2 inches thick. The A_2 frequently has a much lower content of organic matter than in the above profile and is then grey or greyish brown. Thin manganese dioxide pans are not uncommon below the A_2 horizon, and a thin iron pan has been recorded in one or two cases. An indurated or compacted B_3 horizon is sometimes present below the B_2.

With its coarse texture and generally low clay content, this profile has low base saturation and is strongly acid, pH ranging from 3·5 to 4·3. Exchangeable calcium is less than the lower limit in all horizons except the L/F, which has the high value of 9·6. Magnesium and potassium are also high in this horizon; thereafter, both are moderate in the A_2 and then fall to low. Total phosphorus is moderate in the LFH and B_2 and low in other horizons, while acetic-soluble is high in the LFH and low elsewhere.

Profile Description

(No. 73. Loanleven)

SLOPE		level.
ALTITUDE		100 feet.
ASPECT		nil.
VEGETATION		second year grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–10 in. (0–25 cm.)	Very dark greyish brown (10YR3/2) gritty loam; sub-angular blocky breaking readily to medium crumb; moderate organic matter; many stones, mainly sub-angular of medium size, with some small gravels; many fine fibrous living roots; moist, no mottles. Sharp undulating change into
B_2	10–18 in. (25–46 cm.)	Brown (7·5YR4/4) sandy loam; sub-angular blocky, breaking readily to fine crumb; low organic matter; roots as above; stones as above with larger proportion of gravel; dry; no mottles. Sharp smooth change into
B_3	18–22 in. (46–56 cm.)	Yellowish brown (10YR5/4) medium to fine sand; slightly compact; platy, breaking under moderate force to single grain; frequent gravel pebbles; few roots; moist; few faint rusty mottles. Clear undulating change into
C	22–36 in. + (56–91 cm. +)	Brown (10YR5/3) sandy gravel; gravel frequently up to 2·5 in. diam. and mostly quartzites; sand very heterogeneous and possibly containing some material derived from lava.

The B_3 is sometimes indurated or strongly indurated, but in such cases the texture of the horizon is much coarser and gravel content is higher.

In common with most cultivated soils, this profile has higher base status in all horizons than the uncultivated one. Percentage saturation is high in the S and B_3 and moderate in the B_2 and C, and there is a corresponding fall in pH in these horizons. Exchangeable calcium is moderate in the S and low elsewhere; magnesium is low in all horizons except the B_3, where it is moderate; potassium is low in the S and B_2 and less than the lower limit in the B_3 and C. While total phosphorus is high in the S and moderate in the other horizons, acetic-soluble phosphorus is moderate in the S and B_3 and low in the B_2 and C.

LEYS SERIES

The Leys series, which is an imperfectly drained podzol, is of only limited occurrence throughout the district. It is generally found in low-lying areas or in areas where finer-textured deposits underlying the gravelly parent material prevent free drainage.

The Leys series has a profile similar to that of the Corby series, with certain notable differences. In the Leys profile the B_2 horizon is normally greyish brown, and there are many prominent grey and ochreous mottles in the sand fraction. The colour in the B_3 is duller than in the Corby series, and induration, if present, is generally weak. Grey and ochreous mottles are frequent in this horizon, but are less prominent than in the B_2.

MULLOCH SERIES

The Mulloch series is a poorly drained non-calcareous gley, and covers only 0·01 of a square mile. It occurs in a hollow contiguous to areas of the imperfectly-drained Leys series, poorly drained Lour series and poorly to very poorly-drained peat. The B horizons show strong grey and ochreous mottling.

LAND USE CAPABILITY

The Corby series with its coarse texture and good drainage allows cultivation in almost all conditions, but has the disadvantage of poor moisture and nutrient-holding capacity. It is thus a hungry soil requiring liberal applications of fertilizers and dung. Stones and gravel, particularly the larger sizes, cause considerable wear to farm implements. Much of the series has a reasonable depth of topsoil and provides moderately good arable land of Class 3 quality. The shallower soils, developed under less favourable topographical conditions are limited to Class 4.

The Boyndie Association

The Boyndie Association covers a total area of 12·7 square miles, mainly in the west and north-west of the district. Around Meikleour village, near the junction of the River Tay and the tributary River Isla, the association extends over 2 to 3 square miles. In the Isla Flats sub-region north-east and south-west of Coupar Angus it stretches as a terrace bordering the alluvium of the River Isla from Bridge of Isla to the northern margin of the district. A small area has been mapped near Tibbermore, a few miles west of Perth, and several small patches occur throughout Strathmore. Most of the association is under cultivation.

PARENT MATERIAL

The parent material is a brown or yellowish brown sand, derived mainly from metamorphosed sediments such as schists, quartzites and grits of the Highland Schist series. The sand frequently contains a small proportion of gravel and is generally of fluvioglacial origin, although in some areas the deposits are remnants of former river terraces or raised beaches. The association normally occurs at altitudes above 125 feet, contiguous to areas of the Corby Association, which is developed on gravel mainly of Highland origin.

SOILS

Four series of the association have been mapped. Boyndie, a freely drained series derived from medium and coarse sand, covers the greatest area. Inchewan, also freely drained, is derived from fine sand and has an area approximately half that of the Boyndie series from which it is distinguished solely on the basis of texture. Anniston, with imperfect drainage, covers small areas throughout the Boyndie series, while Dallachy, which is poorly drained, is confined to a few small isolated patches.

BOYNDIE SERIES

The Boyndie series has been classed as an iron podzol. The greater part of the series is cultivated, the remainder being wooded. Two profiles are described, the first from a wooded area and the second from a cultivated field.

Profile Description

(No. 74. Meikleour)

SLOPE		5°.
ASPECT		north-west.
ALTITUDE		150 feet.
VEGETATION		woodland with *Holcus mollis* and *Anthoxanthum odoratum-Quercus robur, Fagus sylvatica, Holcus mollis, Oxalis acetosella, Viola riviniana.*
DRAINAGE CLASS		free.
Horizon	*Depth*	
L & F	1–0 in. (2·5–0 cm.)	Dark brown fibrous leaf litter. Sharp change into
A	0–2 in. (2·5–5 cm.)	Dark grey (10YR4/1) to very dark greyish brown (10YR3/2) fine sandy loam; weak sub-angular blocky; moderate organic matter; no stones; many fibrous grass roots; moist; no mottles; many bleached sand grains. Sharp undulating change into
B	2–23 in. (5–58·5 cm.)	Brown to dark brown (10YR4/3) loamy fine sand; weak sub-angular blocky; low organic matter; no stones; frequent fibrous grass roots, with a few large woody tree roots, becoming few towards base of horizon; moist; no mottles. Sharp undulating change into
C	23–46 in. (58·5–117 cm.)	Yellowish brown (10YR6/4) sand; weak angular blocky; friable; low organic matter; no stones; no roots; moist; few faint strong brown (7·5YR5/6) mottles near top of horizon and few distinct strong brown (7·5YR5/6) bands of iron accumulation lower down which become fainter with depth.

As a result of humus enrichment, the B is darker than is normal for the illuvial horizon of an iron podzol. In consequence, this profile approaches, more nearly the humus podzol first described by Frosterus in 1914 (Kubiena, 1953). The B as it is today in this profile is probably a relic of a much earlier A horizon, as it is noted that many of the trees in the area, particularly the famous Beech Hedge which bounds this part of the Meikleour Estate, were planted about the middle of the eighteenth century.

The following description is of a cultivated profile taken at the same altitude as the uncultivated Meikleour profile but from a site approximately 300 yards to the east.

Profile Description

(No. 75. Bridge Farm)

SLOPE		3°.
ASPECT		south.
ALTITUDE		150 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–16 in. (0–41 cm.)	Dark brown (10YR3/3) fine sandy loam; medium crumb; moderate organic matter; no stones; many fibrous grass roots; worms present; moderate organic matter; moist; no mottles. Clear irregular change into

B_2	16–21 in. (41–53 cm.)	Yellowish brown (10YR5/6) fine sand; single grain; frequent tongues of organic matter from above horizon; no stones; frequent grass roots; moist; no mottles. Gradual change into
B_3	21–31 in. (53–79 cm.)	Brownish yellow (10YR6/6) sand; single grain; non-cohesive in upper half but becoming compact in the lower; a few tongues of topsoil penetrate down old root channels; no stones; roots becoming fewer towards bottom of horizon; moist; few fine faint rusty mottles and an incipient iron pan. Sharp change into
C	31 in. + (79 cm. +)	Yellowish brown (10YR5/6) sand; single grain; a few roots penetrate to about 36 in.; moist; few distinct light brownish grey (10YR6/2) and yellowish brown (10YR5/8) mottles and traces of other incipient iron pans.

This profile also has certain similarities to a humus iron podzol. Although the presence of humus in the B_2 is not so marked as in the uncultivated profile described, the B_2 is slightly darker and has a higher organic content than the B_3, while traces of incipient iron pans are present in both the B_3 and the C horizons.

Throughout both profiles, percentage sand is high and percentage clay low. Percentage base saturation is low, except in the LF horizon of the uncultivated soil and in the S and C horizons of the cultivated. There is little variation in pH down either profile, the uncultivated ranging from 4·3 to 4·8 and the cultivated from 5·5 to 5·9. Total phosphorus is moderate in the surface horizons of the uncultivated and low in the other horizons, while acetic-soluble phosphorus is high in the LF, moderate in A and B, and high again in C. In the cultivated soil, total phosphorus is moderate throughout, while acetic-soluble is low in the S and B_2 but moderate in other horizons.

INCHEWAN SERIES

The Inchewan series is generally found contiguous to areas of the Boyndie series, and, as the series differ only in texture, the boundary between them is difficult to delineate on the map. The series occurs on upper terraces of the River Tay in the area near Dunkeld which gives its name to the series, around Murthly Castle, in the Cargill area and around Stormontfield. A few small areas lie on upper terraces of the River Isla. East of Perth the series occurs as a narrow band bordering the Carse of Gowrie near its south-western corner, and to the south a similar band stretches along the northern margin of the Carse of Earn below Moncrieffe Hill.

Profile Description

(No. 76. Warren Wood)

SLOPE	5° (Low mound).
ASPECT	south.
ALTITUDE	200 feet.
VEGETATION	pine wood, about 30 years. Open canopy. *Chamaenerion augustifolium, Rubus fruticosus.*
DRAINAGE CLASS	free.

Horizon	*Depth*	
L & F	2–0 in. (5–0 cm.)	Pine needle and plant litter with traces of fibrous humus; many roots. Sharp change into

A_2	0–3 in. (0–7·5 cm.)	Very dark greyish brown (10YR3/2) fine sandy loam; weak coarse sub-angular blocky, breaking readily to fine crumb and single grain; friable; low organic matter; few stones; many bleached sand grains; many fine fibrous plant roots; frequent thicker plant roots and few woody tree roots; moist; no mottles. Sharp smooth change into
B_2	3–11 in. (7·5–28 cm.)	Dark brown (10YR4/3) loamy fine sand; very weak coarse angular blocky, breaking readily to fine crumb and single grain; loose; low organic matter; no stones; frequent fibrous plant roots; few woody tree roots; moist; no mottles. Clear irregular change into
B_3	11–23 in. (28–58 cm.)	Dark yellowish brown (10YR4/4) loamy fine sand; slightly compact, breaking down readily to weak medium angular blocky and further to fine crumb; low organic matter; fibrous roots frequent; moist; no mottles. Sharp smooth change into
C	23–42 in. (58–107 cm.)	Yellowish brown (10YR5/4) fine sand; slightly compact, breaking readily to single grain; few roots; moist; no mottles.

DALLACHY SERIES

The Dallachy series occurs in several small low-lying areas, most of which are uncultivated. It is poorly drained and belongs to the major soil sub-group of non-calcareous gleys.

Profile Description

(No. 78. South Wood)

SLOPE	level.
ASPECT	south.
ALTITUDE	160 feet.
VEGETATION	Birch woodland, *Juncus effusus*, mixed grasses.
DRAINAGE CLASS	poor.

Horizon	*Depth*	
L, F & H	2–0 in. (5–0 cm.)	Litter, fermenting humus with traces of well decomposed organic matter
A_1	0–2½ in. (0–7 cm.)	Black (5Y2/1) organic sandy loam; weak fine crumb; slightly plastic; many fibrous roots; moist; no mottles. Sharp change into
B_2g	2½–7 in. (7–18 cm.)	Dark reddish brown (5YR3/2) sandy loam; moderate sub-angular blocky; slightly cohesive; moderate organic matter; roots frequent; moist; diffuse grey faces to peds in lower half of horizon. Sharp irregular change into
B_3g	7–20 in. (18–51 cm.)	Very dark greyish brown (10YR3/2) sand, varying with depth to dark greyish brown (10YR4/2); single grain non-cohesive; low organic matter; roots few, some penetrating to about 17 inches; wet; strongly gleyed. Gradual change into
Cg	20 in. + (51 cm. +)	Dark greyish brown (10YR4/2) coarse sand; single grain structure loose; moderate content of fine gravel; wet; permanent water table at 23 in.

The A horizon of this profile has a high organic content and ochreous mottling is absent in all horizons, features which suggest that the profile more nearly approaches the very poorly drained category of peaty gley. In the poorly-drained Dallachy series, the organic content of the A_1 horizon is generally slightly less than it is here, and ochreous mottling is distinct in the B and C horizons.

ANNISTON SERIES

Representing the drainage category intermediate between the freely drained Boyndie series and the poorly-drained Dallachy series, Anniston is classed as an imperfectly drained iron podzol. Of limited extent, it occurs mainly on gently sloping ground, frequently bordering areas of Dallachy series on the one side and areas of Boyndie series on the other.

Profile Description
(No. 79. Brunty)

SLOPE		5°.
ASPECT		north-west.
ALTITUDE		175 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
S	0–13 in. (0–33 cm.)	Dark greyish brown (10YR3/2) sandy loam; weak coarse sub-angular blocky; moderate organic matter; no stones; many fibrous grass roots; moist; no mottles. Sharp undulating change into
$B_2(g)$	13–25 in. (33–64 cm.)	Light yellowish brown (10YR6/4) sand; massive; low organic matter; few small stones; frequent fine fibrous grass roots; moist; frequent coarse faint yellowish brown (10YR5/8) mottles. Gradual irregular change into
C(g)	25–35 in. + (64–89 cm. +)	Pale brown (10YR6/3) sand, varying to brown (10YR5/3) at bottom of horizon; massive; low organic matter; no stones; roots few; moist; mottles as above.

Although similar in many ways to the cultivated Boyndie profile (No. 75), the Anniston series is distinguished by mottling in the B and C horizons and a paler colour in the C. A gleyed B_3 horizon is sometimes present.

Analytical data for the two profiles described are noticeably different. Exchangeable cations have higher values in the imperfectly drained profile, while percentage base saturation is high and pH ranges from 6·2 to 6·7. Both profiles have moderate total phosphorus, but acetic-soluble phosphorus is high throughout the imperfectly drained profile and moderate or low in the freely drained.

LAND USE CAPABILITY

Good drainage conditions and general ease of cultivation of the dominant Boyndie series, tend to be offset by its low retentive capacity for moisture and plant nutrients. As a result, the series is limited to Class 3, with the exception of certain areas where the organic content of the topsoil has been improved by liberal applications of farmyard manure or compost. The imperfectly drained Anniston series is normally Class 3 but some areas fall into Class 2.

The Auchenblae Association

The Auchenblae Association was first mapped in Kincardineshire where deposits of red sands and fine gravel cover a wide area around the village of Auchenblae. In the Tayside district, the association covers a total area of 4·8 square miles and occurs extensively in Strath Eden where it has been mapped in the valley of the Motray Water, the main tributary of the River Eden.

PARENT MATERIAL

The parent material is a fluvio glacial or morainic sand, frequently containing some gravel and a proportion of red marl. Gravel is most extensive in the vicinity of St. Fort Station, south-east of Wormit on the Tay estuary. These deposits of sand and gravel were laid down in post-glacial times during the decay of an ice lobe which advanced from Wormit southwards into the "100 foot sea" (Rice, 1961). While the sand, which varies in colour from reddish brown to yellowish red, is derived largely from Lower Old Red Sandstone sediments, the gravel pebbles are of mixed origin and include schists, granites, quartzites, lavas and sandstones.

SOILS

The Auchenblae series, a freely drained podzol, occupies the whole of the association area, with the exception of a few localities where small areas of the Kirkbuddo series, an imperfectly drained podzol, have been mapped.

AUCHENBLAE SERIES

The Auchenblae series occurs on mounds and terraces above 75 feet. Below this level, on the seaward side, it merges with the marine raised beach deposits of the Panbride Association.

Profile Description

(No. 80. Linkswood)

SLOPE	4°.
ASPECT	W.
ALTITUDE	130 feet.
VEGETATION	broad-leaved woodland. *Dryopteris dilatata, Rubus fruticosus, Holcus mollis, Lophocolea bidentata, Eurhyncium praelongum.*
DRAINAGE CLASS	free.

Horizon	*Depth*	
L	1½–½ in. (4–1 cm.)	Litter of pine needles and fern fronds.
F	½–0 in. (1–0 cm.	Dark brown fibrous humus; abundant rootlets. Sharp change into
A_1	0–1 in. (0–2·5 cm.)	Very dark grey (10YR3/1) sandy loam/loamy sand; very weak sub-angular breaking to single grain; moderate organic matter; many roots. Clear change into
A_1	1–6½ in. (2·5–16·5 cm.)	Dark brown (7·5YR3/2) gravelly loamy sand; weak sub-angular breaking to single grain; loose; roots frequent to many. Clear change into
B_2	6½–10 in. (16·5–25 cm.)	Dark reddish brown (5YR3/3), with reddish brown (5YR5/4) and reddish yellow (5YR6/6) blotches, gravelly coarse sand; loose; single grain; weakly cemented in patches. Clear change into
B_3	10–16 in. (25–41 cm.)	Reddish brown (5YR5/4) gravelly coarse sand; moderately to weakly cemented; massive; few roots. Gradual change into
C	16 in. + (41 cm. +)	Reddish brown (5YR5/4) gravelly coarse sand; loose; single grain. Earthworms present throughout.

This profile is typical of the uncultivated Auchenblae series, with high sand and low clay content throughout. Percentage base saturation is low in all upper horizons but rises somewhat in the C. Like that of similar uncultivated soils, pH is low, ranging from 3·7 in the A_1 to 5·5 in the C. While total phosphorus is low in the C horizon and moderate in all others, acetic-soluble phosphorus is moderate in the A and C horizons but low in B_2 and B_3.

All the soils have been included in the podzol group, although most of the series is cultivated and the upper podzolic horizons destroyed.

Profile Description

(No. 81. Newton Farm)

SLOPE		5°.
ASPECT		north.
ALTITUDE		125 feet.
VEGETATION		third/fourth year grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–9 in. (0–23 cm.)	Reddish brown (5YR4/3) sandy loam to loamy sand; loose weak crumb; few rounded gravel pebbles; many grass roots; worms present; moist; no mottles. Sharp irregular change into
B_2	9–17 in. (23–43 cm.)	Red (2·5YR4/6) fine sand to sand; weak angular blocky, breaking to single grain; stones few and small; grass roots frequent; worm channels seen; moist; few grey and rusty mottles. Sharp change into
B_3	17–23 in. (43–58 cm.)	Yellowish red (5YR4/6) sand; very weak angular blocky breaking to single grain; few small hard rounded gravel pebbles; grass roots frequent; moist; no mottles. Sharp change into
C	23 in. + (58 cm. +)	Yellowish red (5YR4/8) coarse sandy gravel; single grain structure; hard gravel pebbles of all sizes but dominantly 5 in. diameter or less, schists, granites quartzites, lavas, red sandstones; few roots to 40 inches; moist; no mottles.

While the values for mechanical analysis are very similar to those for the uncultivated profile, nutrient status, as would be expected for a cultivated soil, is different. Base saturation is high, except in the B_2 and B_3, and the pH is correspondingly high. Exchangeable calcium, magnesium and potassium are all moderate in the S horizon; thereafter all are low, except for moderate Mg and K in the middle C. Total phosphorus is moderate in the S and low in all other horizons. Acetic-soluble phosphorus is high in the surface and moderate elsewhere.

KIRKBUDDO SERIES

The imperfectly drained Kirkbuddo series is found in low-lying areas and in depressions between mounds where drainage is often slightly impeded by the presence of a fine-textured layer at the base of the profile. The series has a profile similar to that of the Auchenblae series but with mottling in the B horizon, and sometimes in the C.

Profile Description

(No. 82. Morendy)

SLOPE	level.
ASPECT	nil.
ALTITUDE	70 feet.
VEGETATION	broad-leaved woodland with planted pine. *Dryopteris dilatata, Rubus fruticosus, Holcus mollis, Thuidium tamariscinum.*
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
L & F	1–0 in.	Dark brown fibrous humus; abundant rootlets, mainly fern. Clear change into
A_1	0–3 in. (0–7·5 cm.)	Very dark brown (10YR2/2) humose sandy loam; weak fine to medium sub-angular blocky; friable; pale brown mineral grains; many roots. Clear change into
B_2(g)	3–9 in. (7·5–23 cm.)	Brown (7·5YR5/4) loamy sand; weak sub-angular blocky; breaking to single grain; roots few to frequent; frequent faint strong brown (7·5YR5/6) mottles. Clear change into
B_3(g)	9–17 in. (23–43 cm.)	Brownish yellow (10YR6/6) loamy fine sand; weak sub-angular blocky to massive; few roots; distinct strong brown (7·5YR5/6) mottles and patches of faint pale brown (10YR6/3) gleying. Sharp change into
C(g)	17 in. + (43 cm. +)	Pink (7·5YR7/4) sand; single grain; few roots; local areas of rusty iron enrichment.

Analytical data for this profile are similar to those for the freely drained uncultivated profile, except that exchangeable calcium and magnesium are both high in the L and F horizon. Calcium is very low in all horizons except the C, while magnesium is moderate down the profile. Total phosphorus is moderate in the L and F horizon and low elsewhere; acetic-soluble phosphorus is high in the L and F and moderate to low elsewhere.

LAND USE CAPABILITY

While the coarse texture and resultant free drainage of the Auchenblae series ensure that cultivation is possible at any time, the soil is liable to suffer from drought during a dry season. This can be obviated in some measure by liberal applications of farmyard manure, which also improve the nutrient-holding capacity of the soil. Some soils of the association fall into Class 3, others into Class 4.

The Gleneagles Association

The Gleneagles Association covers a total area of 4·5 square miles and occurs mainly in three localities—in the Earn Flats sub-region of Strathmore between Forteviot and Dunning, to the south-east of Newburgh around Lindores Loch, and by Letham village due west of Cupar on the northern margin of Stratheden. Several isolated patches occur in Strathmore, in the Coastal Lowlands of Angus and in the Sidlaw Foothills.

PARENT MATERIAL

The parent material consists of fluvioglacial and morainic sands and gravels, derived mainly from Old Red Sandstone sediments and lavas together with some Highland schists. As sandstones form the dominant component, the colour of the deposits, particularly the sand fraction, is normally reddish brown but does vary to brown, particularly where a higher proportion of lava or Highland rock is present. The sands and gravels generally occur as low ridges or mounds.

GLENEAGLES SERIES

The Gleneagles series, the only one found in this district, is a freely drained iron podzol. The first profile described below is uncultivated and the soil parent material is dominantly sand, while the second shows a cultivated soil developed on sandy gravel.

Profile Description

(No. 83. Dun Knock)

SLOPE	18°.
ASPECT	north-east.
ALTITUDE	260 feet.
VEGETATION	woodland with *Holcus mollis, Anthoxanthum odoratum— Quercus robur, Holcus mollis, Anthoxanthum odoratum, Agrostis tenuis, Poa pratensis, Festuca rubra, Pseudoscleropodium purum.*
DRAINAGE CLASS	free.

Horizon	*Depth*	
L & F	1–0 in. (2·5–0 cm.)	Dark reddish brown (7·5YR2/2) grass and oak leaf litter with trace of fermenting humus.
A_1/A_2	0–1 in. (0–2·5 cm.)	Very dark grey brown loamy (10YR3/2) fine sand; single grain; moderate organic matter; many small stones and gravel pebbles of mixed origin; many grass roots; dry; no mottles. Sharp change into
B	1–7 in. (2·5–18 cm.)	Brown (7·5YR5/4) fine sand; single grain; low organic matter; frequent sub-rounded stones and gravel pebbles; many grass roots; dry; no mottles. Gradual change into
C	7–40 in. (18–102 cm.)	Brown (7·5YR4/4) sand, becoming coarser with depth; single grain; low organic matter; few rounded pebbles; roots frequent becoming few about 36 inches; few tree roots; dry; no mottles.

The texture of the A and B horizons in this profile suggest that the major component of the parent material is a fine-grained sandstone, or that there is a considerable content of fine-grained schists. The sand content is high throughout, rising from 84 per cent in the A_1/A_2 horizon to 96 in the C. Percentage base saturation is very low, except in the surface horizons, and pH is less than 5 in all except the L/F layer.

Profile Description

(No. 84. Inchrye)

SLOPE	2°.
ASPECT	south-east.
ALTITUDE	225 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–12 in. (0–30 cm.)	Very dark brown (10YR2/2) sandy loam; well developed coarse sub-angular blocky; friable, breaking readily to coarse crumb; moderate organic matter; few stones, mainly sub-angular and rounded of mixed origin, number increasing with depth; many fibrous grass roots; moist; no mottles. Sharp even change into
B	12–18 in. (30–40 cm.)	Reddish brown (5YR4/3) sandy loam to coarse sandy loam; weakly developed coarse sub-angular blocky; friable breaking readily to medium crumb; low organic matter; a few tongues of S horizon penetrate down root channels; many stones, of mixed origin, number increasing with depth; several large sub-angular boulders and frequent pieces of lava and sandstone; fibrous grass roots frequent; moist; no mottles. Gradual irregular change into
C	18–36 in. (46–91 cm.)	Reddish brown (5YR4/3) coarse sandy gravel; single grain structure apart from a few strongly indurated portions; low organic matter; frequent large (3 in. diameter) angular and sub-angular lavas and sandstones; roots frequent in upper half of horizon, becoming few with depth; no mottles.

The reddish brown colour is marked in all except the surface horizon. The sand content is lower throughout than in the uncultivated profile and the clay content is higher. Percentage base saturation is quite high, 76 in the surface horizon rising to 79 at the base, while the pH throughout is practically constant at just over 6.

Most of the area covered by the Gleneagles series is under cultivation. As would be expected, the series resembles the Auchenblae in many ways. A comparison of analyses for the two uncultivated profiles described in this chapter shows that in the Gleneagles profile percentage base saturation is much higher in the surface horizons than in the Auchenblae. Figures for total phosphorus are comparable, but in some cases the acetic-soluble phosphorus is higher in the Gleneagles profile. Comparisons of values for the cultivated profiles, show that percentage base saturation is generally quite high in both series except in the B_2 and B_3 of the Auchenblae. Total and acetic-soluble phosphorus in most horizons are higher in the Gleneagles profile and the values are very high in the two surface horizons.

LAND USE CAPABILITY

While possessing the advantages of free drainage and accessibility at all seasons, the Gleneagles series has a low moisture-holding capacity and can suffer from drought in a dry season. These factors, combined as they often are, with the additional hazards of uneven topography and stoniness, limit the soils to Class 3 and, in many cases, to Class 4.

The Carpow Association

The Carpow Association, which is closely related to the fluvioglacial and raised beach soils described in this memoir, occurs in the Carse of Gowrie, in the valley of the River Earn, along the southern bank of the River Tay and in Strath Eden, while smaller areas are found in the upper valley of the Motray Water.

PARENT MATERIAL

The parent material consists mainly of river terrace deposits rising above flood-plain levels to 100 or 125 feet and representing older alluvium. In addition, it includes certain reddish brown deposits mapped geologically as raised beaches, and containing material derived from Old Red Sandstone sediments and lava with a considerable proportion of Highland metamorphics. Texture varies from sandy gravel to silty fine sand, but separation into different texture groups, or into series correlated with those of Corby, Boyndie, Auchenblae or Gleneagles Associations is impracticable.

SOILS

Two soil series have been distinguished. Carpow, a freely drained brown forest soil, is developed mainly on coarse sands and gravels, while Carey, an imperfectly drained brown forest soil, is derived mainly from deposits of finer texture such as fine sands and silts.

CARPOW SERIES

Occurring on level or gently sloping ground at altitudes between 50 and 125 feet, Carpow is the more extensive of the two series. The first profile described is from a site near the eastern edge of the Carse of Gowrie. The soil is of loam texture in the upper horizons, becomes gritty with depth, and passes into stony sandy gravel at 30 inches.

Profile Description

(No. 85. Mylnefield)

SLOPE		level.
ASPECT		nil.
ALTITUDE		100 feet.
VEGETATION		first year grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–13 in. (0·33 cm.)	Dark brown (7·5YR3/2) loam; coarse sub-angular blocky; friable; low organic matter; frequent stones, mainly sub-angular pebbles of Old Red Sandstone origin; many grass roots; moist; no mottles. Clear change into
B_2	13–24 in. (33–61 cm.)	Dark reddish brown (5YR3/3) loam; medium to coarse sub-angular blocky; friable; stones as above; roots frequent; moist; no mottles. Clear change into
B_3	24–30 in. (61–76 cm.)	Reddish brown (5YR4/4) gritty loam; medium sub-angular blocky; stones as above but larger and increasing in number towards bottom of horizon; roots penetrate to 30 inches; moist; no mottles. Sharp change into
C	30 in. + (76 cm.)	Reddish brown (5YR4/4) stony sandy gravel.

The second profile, developed on alluvial terrace sands in the Earn Flats sub-region of Strathmore, is of coarse texture throughout.

Profile Description

(No. 86. Drum of Garvock)

SLOPE		3°.
ASPECT		south.
ALTITUDE		125 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		free.
Horizon	*Depth*	
S	0–12 in. (0–30 cm.)	Dark brown (7·5YR3/2) sandy loam; well developed coarse to medium crumb; friable; moderate organic matter; few stones; many fibrous grass roots; moist; no mottles. Sharp undulating change into
B_2	12–20 in. (30–51 cm.)	Reddish brown (5YR4/4) to brown (7·5YR4/4) loamy sand to sand; loose; weakly developed sub-angular blocky, breaking readily to single grain; few tongues of organic matter down root channels; few sub-angular stones; many fibrous grass roots; moist; no mottles. Clear undulating change into
C	20–41 in. + (51–104 cm. +)	Brown (7·5YR5/4) and dark brown (7·5YR4/3) sand; slightly compact; breaking readily to single grain; low organic matter, but occasional tongues of S horizon down old root channels; few fibrous grass roots down to 27 inches; few stones, moist; no mottles but iron oxide accumulations occurring as faint, fine horizontal bands.

While both the above profiles are freely drained, the first has the finer texture, particularly in the S and B_2 horizons, which are all base-saturated and have high pH values. In the second profile, which is coarse-textured throughout, percentage base saturation is low in the S and B_2 horizons but increases in the C, reaching 100 at 30 inches.

The Mylnefield profile has high total and acetic-soluble phosphorus in all horizons. While these high analytical values are not typical of the Carpow series, they do serve to indicate the potential fertility of the finer-textured variants of the series when liberal applications of fertilizers are made. The Drum of Garvock profile, on the other hand, with only moderate total phosphorus in most horizons and high acetic-soluble only in the C, is more nearly representative of the series as a whole.

CAREY SERIES

The Carey series is much less extensive than the Carpow, and occurs on lower sites in the same localities. In most cases it is contiguous to the freely drained series.

Profile Description

(No. 87. Newbigging)

SLOPE		4°.
ASPECT		north-east.
ALTITUDE		50 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
S	0–8 in. (0·20 cm.)	Brown to dark brown (7·5YR4/2) fine sandy loam; medium subangular blocky, breaking down to medium crumb; loose, friable; low organic matter; few stones; many grass roots; moist; no mottles. Sharp smooth change into
B_2	8–12 in. (20–30 cm.)	Brown (7·5YR4/4) fine sandy loam; medium angular blocky, breaking down to medium and fine crumb; loose; friable; low organic matter; few stones; many grass roots; moist; no mottles. Gradual change into
B_3(g)	12–20 in. (30–51 cm.)	Reddish brown (5YR4/3) sandy loam varying to loam; medium angular blocky, breaking to coarse crumb; friable; low organic matter; few stones, becoming more stony at base of horizon; roots few; moist; frequent medium distinct strong brown (7·5YR5/8) mottles. Sharp smooth change into
C(g)	20–36 in. (51–91 cm.)	Brown (7·5YR5/2) silty loam varying to reddish brown (5YR5/3) in lower half of horizon; coarse angular blocky, tending to medium prismatic; few stones; few roots; moist; frequent distinct strong brown mottles.

Examination of the values for percentage soil separates in this profile shows the clay figures to be comparable with those of the freely-drained Mylnefield profile although much higher than those of Drum of Garvock. Percentage U.S.D.A. silt is quite high throughout and reaches 57 in the C horizon. Base saturation is high, ranging from 82 in the S to 100 in the C, and the corresponding pH values vary from 6·2 to 7·0. Total phosphorus is moderate, except for a slight drop in the B_3(g), while acetic-soluble phosphorus is high throughout.

LAND USE CAPABILITY

Although textures are variable and are frequently coarse, they are seldom sufficiently coarse to cause serious limitations, and soils of this association generally provide good quality Class 2 land, while a strip, mainly of Carey series, along the south bank of the Tay estuary has been graded as Class 1.

The Panbride Association

Covering a total area of about 13 square miles, the Panbride Association is confined to the Coastal Lowland sub-region of Angus and north-east Fife. It extends over the areas of raised beach lying between the 25 foot and 125 foot contours.

PARENT MATERIAL

The parent material consists of coastal raised beach deposits, composed mainly of sands and gravels, but containing occasional lenses of silt or silty clay. The thickness of the deposits is variable and can be several feet; in some areas, on the other hand, e.g. near the burgh boundary of Arbroath, Old Red Sandstone till underlies sands and gravels at about 30 inches. The parent material occurs above the level of the 25 foot or lowest raised beach, and includes deposits of both the 50 foot and 100 foot beaches of the Angus coast. The association extends no further west than Dundee in Angus, Tayport on the north coast of Fife, and Guardbridge at the head of the Eden estuary. Sands and gravels occurring further inland, and mapped by the Geological Survey as raised beach deposits, form the parent material of soils distinguished as series of the Carpow Association.

SOILS

Three soil series have been distingushed. Panbride, the dominant series, developed on coarse sand and gravel, is a freely-drained podzol. Rhynd, covering a very small area in Fife, is also a freely drained podzol and is developed mainly on fine sand. Kellie, derived from fine sands and silts, is an imperfectly drained podzol. While the imperfect drainage is usually caused by the fine texture of the deposits, it sometimes results from the presence of underlying till.

PANBRIDE SERIES

In Angus the Panbride series covers the coastal lowland from Arbroath to Dundee with the exception of two small areas, one on the outskirts of Arbroath and the other on the outskirts of Monifieth. In Fife a narrow coastal strip runs eastwards from Newport, while a little south of Tayport a more extensive spread borders the fluvioglacial sands and gravels of the Auchenblae Association and stretches as far as Leuchars. From there the series follows the line of the low raised beach which borders the estuary of the River Eden as far as St. Andrews. South-east of the town it follows the coastline as a narrow strip, widening beyond Buddo Ness and extending to the southern margin of the region.

PLATE 14

The Eden Estuary: Links soils on the southern tip of Tentsmuir and on Pilmour Links followed by Panbride Association further inland and Darleith on rising ground to the south-west.

By courtesy of Aerofilms Ltd.

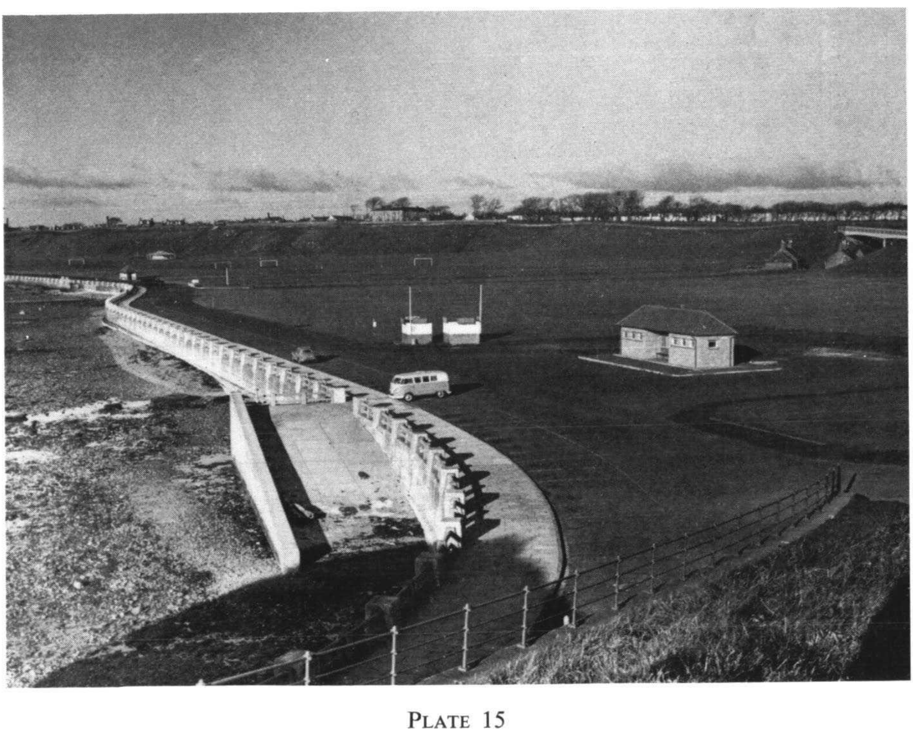


PLATE 15

Twenty five and fifty foot beach levels at Arbroath.

PLATE 16

The Rock and Spindle, a volcanic neck of agglomerate rising through Calciferous Sandstone two miles east of St. Andrews.

PLATE 17

Upper old Red Sandstone sediments resting unconformably on Lower Old Red Sandstone near Arbroath.

The first of the two descriptions which follow is for a profile developed on sandy gravel and the second for a profile on coarse sand.

Profile Description
(No. 89. Balcathie)

SLOPE	nil (top of low mound).
ASPECT	nil.
ALTITUDE	80 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–11 in. (0–28 cm.)	Dark brown (7·5YR3/2) loam; moderate coarse sub-angular blocky; friable, breaking readily to large and medium crumb; moderate organic matter; frequent sub-angular and rounded Highland schists with some lavas; many fibrous grass roots; moist; no mottles. Sharp smooth change into
B	11–14 in. (28–35·5 cm.)	Brown (7·5YR4/4) loamy coarse sand; loose, structureless; low organic matter; stones as above but more frequent, with occasional angular pieces of schist and some red sandstone; frequent fibrous grass roots; dry; no mottles. Gradual irregular change into
C	14 in. + (35·5 cm. +)	Brown (7·5YR4/4) to dark yellowish brown (10YR4/4) sandy gravel, rounded and sub-rounded with diameter varying from ½ inch to 2 inches; many large angular and sub-angular stones from Old Red Sandstone sediments and lavas and Highland schists; low organic matter; few fibrous roots; dry; no mottles.

The Panbride series has been classed as a podzol, and evidence of podzolization can be seen in the few remaining areas of uncultivated land. As a result of cultivation the above profile has lost most of its podzolic characteristics and now displays those of a brown forest soil. The S horizon is frequently thicker —up to 20 inches—and of coarser texture, while the B is sometimes compacted or moderately indurated.

Mechanical analysis for the above profile shows that, except in the S horizon, clay content is low throughout and sand content very high. Percentage base saturation is high throughout and drops only slightly from the S horizon to the C. Exchangeable calcium is high in the S and moderate in all other horizons while magnesium is moderate throughout. Potassium is low in the upper C and moderate elsewhere. pH values are high and vary little down the profile. Values for total phosphorus are moderate in all horizons, while acetic-soluble phosphorus is high in the S and upper C horizons but moderate in the B_2 and lower C.

Profile Description
(No. 90. Kincaple)

SLOPE	level.
ASPECT	nil.
ALTITUDE	60 feet.
VEGETATION	permanent pasture.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–26 in. (0–66 cm.)	Dark greyish brown (10YR4/2) fine sandy loam; medium angular blocky, breaking readily to fine crumb and single grain; low organic matter; few small angular and sub-angular stones, mainly sandstone and some lava; many grass roots; worms present; dry, becoming moist in lower half of horizon; no mottles. Sharp change into

B	26–38 in. (66–96·5 cm.)	Reddish brown (5YR4/4) loamy sand; weak sub-angular blocky, breaking readily to single grain; low organic matter; tongues of S horizon material carried down root channels; few stones; rounded masses of reddish brown (5YR4/3) till are present, varying in texture from loamy sand to sandy clay loam; many fibrous grass roots; moist; no mottles. Sharp undulating change into
C	38–46 in. + (96·5–117 cm. +)	Dark brown (10YR4/3) coarse sand; colour mainly due to humus staining; massive and slightly compact, breaking readily to single grain; few small rounded pebbles; few roots; moist; no mottles.

The deep S horizon, in this case over 20 inches thick, is typical of many profiles in the series. Values obtained by mechanical analysis are comparable to those for the first profile described, clay content being very low and sand content very high in all horizons except the S. Percentage base saturation is generally high and increases down the profile. Exchangeable calcium is moderate throughout, except for the high values in the S horizon at 11 inches and in the C at 42 inches, while magnesium is moderate in all horizons. Potassium is moderate in the S and upper B horizons and low otherwise. pH increases down the profile, varying from 5·7 in the S to 6·7 in the C. Total phosphorus is high, except in the B horizon, and acetic-soluble phosphorus is high throughout.

RHYND SERIES

The Rhynd series has been mapped only in Fife, where it covers an area of 0·2 square mile around Rhynd Farm, a little north of Leuchars. It is distinguished from the Panbride series on the basis of texture, being developed mainly on fine sand with occasional silt.

Profile Description

(No. 91. Rhynd)

SLOPE	2°.
ASPECT	south-east.
ALTITUDE	50 feet.
VEGETATION	sixth year grass.
DRAINAGE CLASS	free.

Horizon	*Depth*	
S	0–9 in. (0–23 cm.)	Dark greyish brown (10YR4/2) loam to fine sandy loam; strong coarse angular blocky, breaking under moderate pressure to medium angular blocky; slightly plastic when wet; moderate organic matter; few stones; many live grass roots; moist; no mottles. Sharp even change into
S_2	9–16 in. (23–41 cm.)	Dark brown (10YR4/3) fine sandy loam; moderate coarse angular blocky, breaking readily to medium sub-angular blocky and medium crumb; moderate organic matter; slightly plastic when wet; no stones; worms present; live grass roots; moist; no mottles. Clear smooth change into
B_2	16–22 in. (41–56 cm.)	Brown to dark brown (10YR4/3) loamy fine sand; weak coarse sub-angular blocky, breaking readily to medium crumb and single grain; loose; low organic matter; no stones; many live grass roots; moist; no mottles. Sharp irregular change into

$B_3(g)$	22–28 in. (41–56 cm.)	Light brownish grey (10YR6/2) loamy fine sand; structureless; loose; low organic matter; no stones; roots frequent; moist; frequent medium prominent reddish brown (5YR5/4) mottles. Sharp irregular change into
C(g)	28–38 in. + (71–96·5cm. +)	Yellowish brown (10YR5/6) fine sand; loose structureless; low organic matter; no stones; few roots; moist; many coarse strong brown (7·5YR5/6) mottles tending to mask horizon colour.

This profile has a moderately thick S horizon. Exchangeable calcium is high in the S, moderate in the B_2 and low in the B_3 and C; magnesium is moderate in the S and B_2 and low in the B_3 and C, while potassium is moderate to low in the S and low in all other horizons. In most profiles of the association, percentage base saturation is high, but here values are high only in the S and B_2, dropping to moderate in lower horizons. pH varies little and ranges from 6·2 in the S to 6·0 in the C, with a slight fall in the B_2 and B_3. Both total and acetic-soluble phosphorus show moderate values throughout.

KELLIE SERIES

The Kellie series, about 1 square mile in extent is found in four small areas near the towns of Arbroath, Monifieth, Tayport and St. Andrews. It occurs contiguous to more extensive areas of the Panbride series, and the profile described below was taken from an area of Kellie too small to separate from Panbride on the map.

Profile Description

(No. 92. Pitskelly)

SLOPE	2°.
ASPECT	south.
ALTITUDE	100 feet.
VEGETATION	old grass.
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
S	0–15 in. (0–38 cm.)	Dark brown (7·5YR3/2) sandy loam; moderate medium to coarse sub-angular blocky; friable; few stones; many fibrous grass roots; moist; no mottles. Sharp undulating change into
$B_2(g)$	15–27 in. (38–68·5 cm.)	Brown (7·5YR4/4) sand; weak coarse crumb; very friable; no stones; few fibrous grass roots; moist; frequent coarse prominent yellowish red (5YR4/8) mottles. Gradual smooth change into
$B_3(g)$	27–35 in. (68·5–89 cm.)	Brown (10YR5/4) sand; massive; loose; no stones; no roots; moist; many coarse distinct strong brown (7·5YR5/6) mottles. Smooth gradual change into
C(g)	35 in. + (89 cm. +)	Greyish brown (10YR5/2) to brown (10YR5/3) sand; loose; single-grain; few small sub-angular and rounded pieces of red sandstone and less frequent Highland rocks; no roots; moist; frequent coarse distinct strong brown (7·5YR5/6) mottles, decreasing with depth.

Soil separates for this profile are similar to those for the Panbride series, the clay percentage being very low and the sand very high in all horizons except the S. The imperfect drainage in this case is due to the presence of till at depth. The boundary between Panbride and Balrownie series in this area is 300 yards from the profile site, and the Old Red Sandstone till which forms the Balrownie parent material extends towards the coast to underlie the raised beach deposits. Percentage base saturation, 50 in the surface horizon, rises to 89 in the $B_2(g)$ and to 100 in the $B_3(g)$ and C(g), while pH rises down the profile from 6·2 to 6·6. Exchangeable calcium shows moderate values as does magnesium, except for a low value in the C(g), while potassium is moderate to low throughout. Total phosphorus is low in all horizons except the S and acetic-soluble phosphorus is moderate in the upper horizons and high in the $B_3(g)$ and C(g).

LAND USE CAPABILITY

Coarse sub-soil textures which tend to limit moisture and nutrient-holding capacity are off-set in many cases by deep or moderately deep topsoils, and much of the land covered by the Panbride Association falls into Class 2; as a result of their location and favourable aspect, some areas, e.g. a part of the Angus Coastal Fringe, are Class 1 land.

The Carbrook Association

Covering a total area of only 1·5 square miles, the Carbrook Association has been mapped in three areas—around Errol in the Carse of Gowrie, by Dron village in the Carse of Earn, and to the east of Cupar in the Eden Valley.

PARENT MATERIAL

The parent material consists of high raised beach deposits occurring at altitudes ranging from 75 to 125 feet, although in a few cases they are found at altitudes as low as 50 feet. Reddish brown in colour, these deposits vary in texture from clay loam to silty clay and, judging from their colour, have been derived to a large extent from Upper Old Red Sandstone sediments. Horizontal beds of fine sand are sometimes present among the silt.

About the middle of the nineteenth century it was realized that some of the clay deposits were suitable for the manufacture of bricks and tiles, and a factory was erected at Pitfour in the Carse of Gowrie. Its first contract was to supply the bricks for the foundations of the original railway bridge over the River Tay and it also supplied the bricks for the existing bridge.

SOILS

Although two soils series have been mapped only the imperfectly drained Harviestoun is of importance in this district. The poorly drained Carbrook series, which gives its name to the Association because of its dominance in the area in which it was originally mapped, occurs in only in a few small areas.

HARVIESTOUN SERIES

The Harviestoun series has been classed as an imperfectly drained gleyed warp soil. It is most extensive in the Carse of Gowrie area, where it has been mapped around Errol and Clashbenny. Here, the series occurs at altitudes from 50 to 100 feet above sea level and slopes down to the grey-brown estuarine clays of the low raised beach. In the Carse of Earn area, a narrow band occurs between the 75 and 125 feet contours; below this altitude it is succeeded by the coarser-textured deposits of the Carpow Association. These border the silts and clays of the Carse of Earn. In the Eden Valley area the series occurs between the 50 and 100 feet contours where it is contiguous to the Carpow Association.

The first profile described was taken in the Carse of Gowrie, from the vicinity of a pit supplying clay for the Errol Brick and Tile Works.

Profile Description

(No. 93. Gallowflat)

SLOPE		level.
ASPECT		nil.
ALTITUDE		65 feet.
VEGETATION		old grass.
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
S	0–12 in. (0–30 cm.)	Dark brown (7·5YR4/2) fine sandy clay loam; coarse angular blocky; slightly plastic when wet; moderate organic matter; few stones, mainly pieces of decomposing red sandstone; moist; few medium distinct yellowish brown (10YR5/4) mottles. Sharp smooth change into
B(g)	12–16 in. (30–41 cm.)	Reddish brown (5YR5/3) silty clay loam; well developed coarse angular blocky; plastic when wet; low organic matter; few stones; roots frequent, becoming rare; moist; frequent medium distinct strong brown (7·5YR5/6) mottles and pinkish grey (7·5YR6/2) coatings on ped faces. Gradual change into
C(g)	16–36 in. + (41–91 cm. +)	Reddish brown (5YR4/3) silty clay; strong coarse prismatic; plastic when wet; low organic matter; no stones; no roots; moist; few medium faint to distinct strong brown (7·5YR5/6) mottles and pinkish grey (7·5YR6/2) coatings on ped faces.

The second profile site is in the Eden Valley.

Profile Description

(No. 94. Seggiehill)

SLOPE		level.
ASPECT		nil.
ALTITUDE		75 feet.
VEGETATION		*Ulex europaeus*, *Rubus fruticosus*, *Agrostis* sp., *Crataegus monogyna*.
DRAINAGE CLASS		imperfect.
Horizon	*Depth*	
A	0–4 in. (0–10 cm.)	Light reddish brown (5YR6/3) silty clay loam; coarse crumb; moderate organic matter; few stones; many fibrous grass roots; dry; no mottles. Gradual change into
B(g)	4–10 in. (10–25 cm.)	Reddish brown (5YR5/3) silty clay loam to silty clay; small to medium angular blocky; very firm and breaking under strong pressure to small crumb; low organic matter; few stones; many woody and fibrous roots; worm channels; dry; few faint diffuse rusty mottles. Gradual change into
C(g)	10–59 in. (25–150 cm.)	Weak red (2·5YR4/2) silty clay; coarse angular blocky; hard and breaking under strong pressure to small angular blocky; low organic matter; few stones; small fibrous roots to 24 inches, large woody roots to 48 inches; worms present; moist; mottles as above; few distinct black patches of manganese dioxide, becoming frequent with depth. Gradual change into
C(g)	59 in. + (105 cm. +)	Reddish brown (2·5YR4/4) silty clay; compact well-developed coarse angular blocky structure with lamellar cleavage; firm; low organic matter; few stones; few tree roots penetrate; moist; no rusty mottles but grey coatings and black manganese dioxide deposits on ped faces.

In this series the colour of the parent material is frequently, although not always, reflected in the colour of the S horizon, which then appears reddish brown or dark reddish brown. Dry weather and lack of rain during the five weeks prior to the date of sampling were responsible for the lightness of the surface horizon colour in the second profile described as compared with the more common reddish brown. Percentage silt normally increases down the profile and frequently exceeds the corresponding clay figure. The presence of lenses of fine sand in certain profiles may partly explain the higher percentages of U.S.D.A. silt found in these. Grey or pinkish grey coatings on ped faces are normally a feature of the B(g) horizon. Faint to distinct ochreous or rusty mottles are present but are sometimes partly obscured by the colour of the horizon. The C(g) horizon has a coarse angular blocky or medium prismatic structure, frequently with platy cleavage. Ochreous mottling is often absent, but when present it is normally the same colour as in the B(g). Grey coatings are sometimes found on structure faces and black manganese dioxide deposits are common.

Percentage base saturation in the Harviestoun series is invariably high and increases with depth, frequently reaching 100, particularly in cultivated soils. In the first of the two profiles described here, values range from 63 in the surface horizon to 87 at 31 inches depth; in the second, they range from 64 at the surface to 100 at 62 inches. Exchangeable calcium is normally high throughout profiles of this series, and magnesium is moderate to high, with the high values occurring in the lower horizons. Potassium values are moderate throughout. Total phosphorus is moderate to low and acetic-soluble phosphorus normally high, particularly in surface horizons of cultivated soils. The value frequently drops to moderate or low in the B horizon rising again to high in the C.

CARBROOK SERIES

A poorly drained gleyed warp soil, this series occurs in only a few small areas. An average profile shows a dark grey brown clay loam or silty clay loam 9 or 10 inches thick overlying a reddish grey or dark reddish grey clay or silty clay.

LAND USE CAPABILITY

The fine texture of the soils of the Harviestoun series ensures that they never suffer from drought, but, like the soils of the Stirling series, they require careful treatment and times and methods of cultivation are all-important. Nevertheless, these soils can be highly productive and most of the land has been rated as Class 2. The poorly drained Carbrook series is usually found in low-lying areas where drainage cannot be improved and the land is not above Class 3.

The Stirling Association

First mapped in the Carse of Stirling, this group of soils was originally called the Carse Association. Because of ambiguity regarding the interpretation of the term "carse" when applied to different areas in Scotland, it was decided to change the association name to Stirling.

Covering a total of 27·8 square miles, soils of the association occur in two main areas, the Carse of Gowrie and the Carse of Earn, the former being the more extensive. Small areas have also been mapped in the Earn Valley west of Bridge of Earn and bordering the River Tay a little to the north of Perth. At Tents Muir in Fife, the association covers much of the low ground between the Forest and the rising ground of the coastal raised beach.

PARENT MATERIAL

The soils of the association are developed on estuarine low raised beach deposits laid down in Boreal times (8000–10,000 years ago) as a result of marine encroachment following a period of low sea-level. Occurring at elevations between 25 and 35 feet, these deposits consist largely of silty clay or clay silt and are frequently referred to as the "Carse clays", a term more commonly used in the Carse of Stirling. The deposits in the Carses of Gowrie and Earn frequently have clay contents over 40 per cent, and sometimes as high as 60 per cent. The silt is normally as high as the clay content, and occasionally higher. In general, the percentage clay is lower than in the Carse of Stirling where it can sometimes be as high as 70.

While the sand content of the Carse deposits is generally moderate to low (normally <30 per cent), a few small areas do occur where the percentage of sand is high and of clay low. Although these deposits differ markedly in texture and in structure from the "Carse clays", they occur at similar elevations and as parts of the same raised beaches. In consequence, the soils developed thereon have been separated as a series of the Stirling Association.

SOILS

The soils are classed as gleyed warp soils. Three series have been separated —Stirling and Fordel, both poorly drained, and Cauldside, imperfectly drained.

STIRLING SERIES

Covering nearly 90 per cent of the association area, the Stirling series is developed on clay or silty clay with a well developed coarse prismatic structure and a colour variation from grey to olive grey. The clay deposits over much of the Carse area are underlain at a depth of 10 feet or more by a layer of peat up to 3 feet thick resting on sands and gravels. From examination of pollen in peat samples taken from a site on the bank of the River Earn near Carey Farm, the age of the peat has been dated as Boreal (Durno, S.E.—private communication).

Profile Description

(No. 95. Brickhall)

SLOPE	level.
ASPECT	nil.
ALTITUDE	33 feet.
VEGETATION	third year grass.
DRAINAGE CLASS	poor.

Horizon	*Depth*	
S	0–8 in. (0–20 cm.)	Dark greyish brown (2·5Y4/2) silty clay loam; medium to coarse angular blocky; firm; low organic matter; few stones many grass roots; moist; few fine faint yellowish brown (10YR5/6) mottles. Sharp change into
B_2g	8–15 in. (20–38 cm.)	Light grey (2·5Y7/2) to light brownish grey (2·5Y6/2) silty clay; medium prismatic; firm; low organic matter; few stones; roots frequent; moist; many coarse prominent strong brown (7·5YR5/6) mottles. Gradual change into
Cg	15–50 in. (38–127 cm.)	Light brownish grey (2·5Y6/2) clay; coarse prismatic; very plastic; no stones; no roots; wet; many coarse prominent strong brown (7·5YR5/6) mottles and occasional iron oxide deposits in the form of "drain-pipes". Gradual change into
Cg	50–72 in. (127–183 cm)	Light olive grey (5Y6/2) clay; strong coarse prismatic; very plastic; wet; frequent medium distinct strong brown (7·5YR5/8) mottles and many well developed iron "drainpipes".

A typical example of the poorly-drained series, this profile shows clay contents throughout of between 30 and 40 per cent, with the exception of the upper part of the C horizon where the value rises to 62 per cent. The silt value is always equal to or higher than the clay, except in the C horizon mentioned above where it drops to 19 per cent. The well developed prismatic structure and the iron "drain-pipes" are conspicuous features of the C horizon.

While the pH increases with depth in most profiles of the Stirling series, the value in the profile described drops from 6·7 in the S horizon to 5·9 in the C horizon at 32 inches and to 4·2 at 66 inches. This is explained by the presence of an underlying peaty layer. The site of the profile is near the western edge of the Earn/Gowrie Carse area. Another profile, taken from a site near the eastern edge of the area, is described below.

Profile Description

(No. 96. Eastbank)

SLOPE	level.
ASPECT	nil.
ALTITUDE	35 feet.
VEGETATION	fifth year grass.
DRAINAGE CLASS	poor.

Horizon	*Depth*	
S	0–11 in. (0–28 cm.)	Dark greyish brown (2·5YR4/2) silty clay loam; strong very coarse angular blocky; firm; moderate organic matter; many live grass roots; no stones; worms present; moist; frequent faint mottles. Sharp change into
Bg	11–25 in. (28–64 cm.)	Greyish brown (2·5Y5/2) silty clay; moderate very coarse prismatic; plastic when wet; low organic matter; roots few; stoneless; moist; prominent yellowish brown (10YR5/6) mottles. Gradual change into
Cg	25–34 in. (64–86 cm.)	Light brownish grey (10YR6/2) silty clay; moderate coarse prismatic; plastic when wet; low organic matter; no roots; stoneless; moist; prominent yellowish brown mottles.

This profile is notable for the very low percentage of sand throughout and the high values of silt. With the exception of the surface horizon, where silt and clay percentages are equal, the percentage silt is twice, or more than twice, that of clay. In general, it has been found that throughout the Carse deposits of this area percentage clay reaches its highest value towards the west while percentage silt is highest in the east. Similar findings have been noted in the Carse of Stirling. pH in this profile rises from 6·5 in the surface horizon to 7·9 in the C horizon.

CAULDSIDE SERIES

The Cauldside series covers a very small portion of the association area and is developed on estuarine deposits, which contain less clay and have higher contents of fine sand and silt than the parent material of the Stirling series. With its coarser texture and more open structure, the Cauldside series is imperfectly drained. The profile described was taken from an area of woodland on the north bank of the River Tay.

Profile Description

(No. 100. Paddockmuir Wood)

SLOPE	level.
ASPECT	nil.
ALTITUDE	25 feet.
VEGETATION	broad-leaved woodland—*Acer pseudoplatanus, Ulmus glabra, Holcus lanatus, Eurynchium praelongum.*
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
L & F	½–0 in. (1·25 cm.–O)	Grass and oak leaves.
A_1	0–3 in. (0–8 cm.)	Very dark greyish brown (10YR2/2) loam; very weak sub-angular blocky, breaking readily to fine crumb; high organic matter; many roots; moist. Sharp uneven change into
B_2	3–10 in. (8–25 cm.)	Brown (10YR4/3) fine sandy silt loam; medium sub-angular blocky, breaking readily to medium crumb; friable; moderate organic matter; frequent roots. Clear change into
B_2(g)	10–24 in. (25–61 cm.)	Brown (10YR5/3) silty clay; coarse prismatic, breaking readily to angular blocky; roots frequent; material from above horizon carried down root channels and worm tracks; many diffuse yellowish brown (10YR5/6) mottles on ped faces and yellowish red (5YR4/8) mottles associated with root channels; moist. Sharp change (textural) into
B_3(g)	24–34 in. (61–86 cm.)	Light brownish grey (10YR6/3) loamy sand; massive, with occasional vertical cracks; roots frequent; many dark grey brown (10YR3/2) humus stains on ped faces; moist; many coarse and fine strong brown (7·5YR5/6) mottles, often in the form of "drain-pipes". Sharp change into
C(g)	34 in. + (86 cm. +)	Olive grey (5Y5/2) silt loam; coarse prismatic, breaking down to angular blocky; many fine yellowish red (5YR4/8) and strong brown (7·5YR5/8) mottles in old root channels.

FORDEL SERIES

The most extensive area of the Fordel series covers the low-lying ground between Tents Muir Forest and the coastal raised beaches further inland. Two small areas have been mapped in the Carse of Earn. The parent material of the series consists mainly of sands and silts, the clay content rarely exceeding 7 per cent, except in the S horizon. The areas in which the series occurs are so low-lying that, despite the coarse textures of the soil, there is little run-off and the drainage class is poor or imperfect to poor.

Profile Description

(No. 102. Craigie)

SLOPE		level.
ASPECT		nil.
ALTITUDE		30 feet.
VEGETATION		second year grass.
DRAINAGE CLASS		poor.
Horizon	*Depth*	
S	0–10 in. (0–15 cm.)	Dark greyish brown (10YR4/2) fine sandy silt loam; moderate coarse angular blocky, breaking to fine angular blocky; low organic matter; many fibrous grass roots; moist; frequent medium prominent yellowish red (5YR5/8) mottles. Sharp even change into
B_2g	10–21 in. (15–53 cm.)	Light brownish grey (2·5Y6/2) silty fine sandy loam; massive; low organic matter; few grass roots; moist; many medium prominent strong brown (7·5YR5/8) mottles. Gradual change into
Cg	21–43 in. + (53–109 cm. +)	Greyish brown (2·5Y5/2) silty fine sand; massive, breaking to weak medium angular blocky; low organic matter; few roots; moist; frequent medium distinct yellowish brown (10YR5/6) mottles and rusty "drain-pipes" frequent below 30 inches.

Percentage clay is highest, 12·7, in the S horizon; thereafter, it falls to 2·8 in the B horizon and rises again to 6·9 in the C. Sand content is highest, 81 per cent, and silt lowest, 16 per cent, in the upper part of the C horizon. pH remains constant at 6·3 down to the C horizon, and thereafter drops to 4·3 at 40 inches, an indication of the presence of peat below as in the Brickhall profile (No. 95).

In most profiles from the Stirling series examined, exchangeable calcium is high in all horizons and magnesium moderate. Exceptions are seen in the two profiles described here. In the Eastbank soil, calcium is low in the S horizon and high elsewhere, while magnesium is moderate in the S and high or moderate to high elsewhere. The Brickhall profile has high calcium down to 36 inches. Below this level values are moderate, decreasing to low at 57 inches. Magnesium values are moderate, but drop almost to low below 57 inches. Potassium in profiles of this series is generally moderate at all levels, but sometimes reaches high values in surface horizons of cultivated soils. Percentage base saturation is generally high throughout, exceptions being again found in the Eastbank profile, where the value in the S horizon is moderate, and in the Brickhall, where the value falls to low at 57 inches in the C.

In the Paddockmuir Wood profile, an uncultivated soil of Cauldside series, calcium is low throughout, magnesium moderate to low, except in the S horizon, potassium moderate and percentage base saturation low. Cultivated profiles of the series generally have higher values for exchangeable cations and higher base saturation.

In the Craigie profile, representing the Fordel series, calcium values are high in the S and B_2g and fall in the lower horizons. Magnesium and potassium have moderate values throughout, and percentage base saturation is high, falling to moderate in the lower Cg.

LAND USE CAPABILITY

Until draining was commenced, about 1735, much of the Carse of Gowrie was a waste of marsh and stagnant pools. Since reclamation the land has been cultivated, and over the years progress in cropping, fertilizer practice and farm management has been so well maintained that at the present time the area, together with the Carse of Earn, is one of the more important arable regions of Central Scotland. Because of its silty clay texture, the Stirling series becomes massive and sticky when wet, although it dries out to a good prismatic structure. Thus the soil requires careful treatment, and the method of cultivation and the times at which it is carried out are all-important for the preparation of a good tilth before sowing.

Despite these limitations, the soil of the Stirling series can be adapted to growing a wide range of crops, and for this reason much of the Carse of Gowrie and of the Carse of Earn has been rated as Class 2 land. Some areas, where the clay content is higher and the soils heavier, are good quality Class 3 land.

ALLUVIUM

Alluvium is common throughout the district. Both river and lacustrine alluvium are present, but no separation has been made on the soil map. River alluvium, which is by far the more extensive, is found along the banks of rivers and streams and also in former glacial overflow channels. Lacustrine alluvium is generally associated with ponds and with hollows representing, in many cases, the sites of post-glacial lakes. All the alluvium in the district has been deposited by fresh water, with the exception of several small areas along the estuary of the River Tay, which is tidal as far as Perth.

Alluvium occurs most extensively in the Isla Flats sub-region of Strathmore. Here, wide alluvial flats have been laid down both by the Isla and its parent river, the Tay. Further south alluvium borders the Tay between Stanley and Luncarty and extends up the valley of the Ordie Burn. Nearer Perth it is found in the valley of the River Almond and, to the south of the city, follows the course of the River Earn from the western margin of the district through the Earn Flats and the Carse of Earn to its junction with the River Tay. Smaller areas of alluvium have been mapped, bordering streams and drainage channels in Angus and in Fife.

PARENT MATERIAL

The parent material consists of water-sorted deposits laid down by rivers and streams since the close of the glacial period. Along river valleys the alluvium occurs on the lowest terraces, where, in some areas, alluvial material is still deposited in times of flood. The texture is commonly fine sandy loam varying to loamy sand or sand and the deposits are frequently underlain by gravel at depth. Stones are generally absent, but where they do occur, more commonly in the upper horizons, they frequently reflect the nature of the geological formations through which the river or its tributaries has passed. The texture of lacustrine deposits is normally finer and sometimes varies down the profile from silt loam to silty clay.

SOILS

The soils developed on river alluvium generally show little evidence of horizon differentiation. The drainage is commonly free to imperfect but sometimes varies to poor in the more low-lying areas adjacent to rivers and streams. Soils formed on lacustrine alluvium normally show some profile development and are invariably poorly drained.

Because of low level of differentiation in most alluvial profiles, it is generally difficult to distinguish between drainage categories, and for this reason drainage series have not been separated on the soil map. While some variation in texture is found among the alluvial soils in the district, many of the profiles have coarse loamy sand or sand textures which permit free movement of water throughout. In some cases, however, layers of fine-textured material, e.g. silts and clays, occurring at various depths, hold up water and render the soil drainage imperfect to poor.

Two profiles are described. The first, which is coarse-textured throughout and underlain by coarse sandy gravel, is freely drained.

Profile Description

(No. 103. Braecock)

SLOPE	level.
ASPECT	nil.
ALTITUDE	100 feet.
VEGETATION	barley stubble.
DRAINAGE CLASS	free.
Depth	
0–16 in. (0–41 cm.)	Dark greyish brown (10YR4/2) sandy loam to loamy sand; weak sub-angular blocky, breaking readily to fine crumb; low organic matter; few stones mainly of Highland origin; many grass roots; moist; no mottles. Sharp smooth change into
16–35 in. (41–89 cm.)	Dark yellowish brown (10YR4/4) loamy sand; very weak angular blocky breaking readily to weak crumb and further to single grain; low organic matter; no stones; roots frequent in upper half of horizon, a few penetrate almost to the bottom; moist; no mottles. Gradual irregular change into
35–65 in. (89–165 cm.)	Yellowish brown (10YR5/4) sand, varying in texture from fine to medium and becoming coarser with depth; no stones; a few dead roots; moist; no mottles. Sharp change into
65 in. + (165 cm. +)	Coarse sandy gravel.

The second profile is also coarse-textured, but because of the occurrence of a layer of clay loam texture at a depth of 3 feet the drainage is imperfect.

Profile Description

(No. 104. Baldowrie Farm)

SLOPE	level.
ASPECT	north-west.
ALTITUDE	200 feet.
VEGETATION	second year grass.
DRAINAGE CLASS	imperfect.
Depth	
0–10 in. (0–26 cm.)	Dark brown (7·5YR4/2) sandy loam; weak sub-angular blocky; few stones; many roots to 8 inches, frequent below; worms present; moist; no mottles. Sharp change into
10–13 in. (26–33 cm.)	Very pale brown (10YR7/4) disturbed horizon of loamy coarse sand intermingled with patches of sandy loam from horizon above; weak sub-angular blocky; no stones; few roots; worms present; moist; prominent grey and distinct rusty mottles. Sharp change into

13–25 in. (35–64 cm.)	Light brown (7·5YR6/4) loamy coarse sand; weak sub-angular blocky; no stones; few roots; worms present; moist; distinct grey and rusty mottles; vertical worm channels filled with dark brown surface horizon material. Sharp change into
25–37 in. (64–94 cm.)	Light brown (7·5YR6/4) coarse sand; very weak sub-angular blocky breaking readily to single grain; no stones; few roots penetrate; moist; grey and rusty mottles as above. Sharp irregular change into
37–48 in. (94–122 cm.)	Light brownish grey (2·5Y6/2) clay loam; massive; frequent small hard stones; no roots; no worms; moist; brownish yellow (10YR6/6) mottles, generally associated with small weathered stones. Sharp irregular change into
48 in. + (122 cm. +)	Light brownish grey (2·5Y6/2) coarse sand—pit flooded to top of this horizon.

LAND USE CAPABILITY

While certain alluvial areas are inaccessible because of location or poor drainage, in areas where limitations are less severe and cultivation is possible, alluvial soils are generally fertile and highly productive. Soils with free or imperfect drainage can readily be worked during most seasons of the year, and much of the alluvial land in the district is in Class 2. On the more low-lying sites there is frequent danger of flooding in a wet season, with resultant damage to crops, and consequently the soils fall into lower classes. The danger of flooding has been obviated to a large extent by the erection of embankments or levees such as those along parts of the River Tay.

Another hazard to which alluvium, particularly fine sandy material, is subject in certain areas is wind erosion. In the Tay Flats, especially in the parishes of Caputh and Lethendy, high winds in the early spring can remove the dry top soil and newly sown seed.

PEAT-ALLUVIUM COMPLEX

Several small areas occur where alluvial deposits have shallow peaty tops and where peaty layers are interspersed with alluvial bands. These are generally found throughout or adjacent to alluvium and have been separated as Peat-Alluvium Complex. They are invariably very poorly drained and of no use agriculturally.

SALTINGS

The saltings which border parts of the Tay Estuary are deposits of marine alluvium. They are flooded at least twice yearly by tidal waters, although in earlier times—within the past 70 years, according to one agricultural worker—flooding took place almost at every high tide. The saltings consist largely of very poorly drained phragmites swamp with a profile of the type shown below.

0–1 inch (0–2·5 cm.)	Brown silty peat.
1–12 inches (2·5–30 cm.)	Dark grey peaty silt with abundant roots, very blackened.
12 inches + (30 cm. +)	Grey amorphous peaty silt with large (½ inch) phragmites roots.

MIXED BOTTOM LAND

The term Mixed Bottom Land is applied to soils occurring in narrow streams and drainage channels and also occasionally on valley sides. The soils are mostly a mixture of alluvial deposits of varying age, origin, texture and drainage. Because of their heterogeneous composition, they cannot correctly be classed either as alluvium or as an association, and the smallness of the area they cover makes separation of drainage series on the one inch soil map impossible.

LINKS AND DUNES

Reference has been made in Chapter 1 to the 25 foot raised beach which constitutes the second sub-region of the Coastal Fringe. Wind-blown sand overlies the beach deposits and has been stabilized, except on an area of Barry Links where the sand has accumulated as dunes. Moundy and unstable, these dunes support little vegetation other than clumps of marram grass (*Ammophila arenaria*) and lyme grass (*Elymus arenarius*) which achieve partial fixation of the sand. The soils developed on stabilized wind-blown sand are classed as Links, a group of soils which are not given association status but are classed as immature.

On the north side of the River Tay a narrow strip of Links extends down the Angus coast from Wormiehills south-east of Arbroath to Carnoustie. Beyond this point it widens out to cover some 3 square miles of Barry Links, the remaining portion of which extends to the coast as sand dunes. In Fife the association covers Tents Muir and a strip alongside the River Eden from Guardbridge to St. Andrews where it widens out in the Pilmour Links.

The sand from which the Links soils are derived is largely quartzose. Although the dominant drainage class is free, there are frequent small areas of imperfect drainage. Drainage is poor to very poor in certain areas where good run-off is precluded by the absence of slope. Such drainage conditions are found on parts of Tents Muir where the water table is high. The Muir was originally open heather moorland, but has now been converted to close coniferous woodland by the Forestry Commission. Because of the complexity of the drainage pattern over the greater part of Tents Muir and the consequent difficulty in mapping at the 1 inch to 1 mile scale, the drainage over the whole area is shown as undifferentiated, except in a few small patches separated as very poorly drained. Since the completion of this survey a detailed soil map on the scale of 6 inches to 1 mile has been prepared for the woodland area by the Forestry Commission.

In some areas, particularly towards Tents Muir Point on the northern coast and in places along the eastern coast of the Tents Muir sub-region, deposits of shelly sand were noted in many profiles. These profiles have high base saturation and high pH, especially in the lower horizons, and resemble in many ways profiles of the Fraserburgh series, a soil developed on shelly wind-blown sand and first mapped on the north-east coast of Aberdeenshire. On Tents Muir, however, these calcareous soils occur too spasmodically to warrant separation.

In coniferous woodland, or under semi-natural vegetation, a podzolic profile is developed.

Profile Description
(No. 107. Fetters)

SLOPE	level.
ASPECT	nil.
ALTITUDE	25 feet.
VEGETATION	cleared pine wood, recently replanted; *Chamaenerion angustifolium, Deschampsia flexuosa, Rhytidiadelphus loreus and squarrosus, Hypnum cupressiforme*
DRAINAGE CLASS	free.

Horizon	*Depth*	
A	0–3·5 in. (0–9 cm.)	Very dark grey (10YR3/1) with pale brown (10YR6/3) to light yellowish brown (10YR6/4) sand grains; very friable; weakly developed medium crumb, breaking readily to single grain; moderate organic matter; many woody and fibrous roots; moist. Sharp undulating change into
B	3·5–10 in. (9–25 cm.)	Brown (7·5YR5/4) to light brown (7·5YR6/4) sand; loose; single-grain; low organic matter; frequent fibrous and woody roots; dry. Clear smooth change into
B(A)	10–18 in. (25–46 cm.)	Brown (7·5YR5/4) sand with light brown (7·5YR6/4) patches; very friable; single-grain; low organic matter, dark patches of A horizon material, probably remnants of a buried horizon; roots frequent; moist. Clear smooth change into
C	18–32 in. (46–81 cm.)	Yellowish brown (10YR5/4) sand; very friable; single grain; low organic matter; few roots; frequent fine distinct strong brown (7·5YR5/8) mottles. Clear smooth change into
C(A) (buried)	32–33 in. (81–84 cm.)	Very dark brown (10YR2/2) and brown (10YR5/3) sand; very friable; weakly developed small sub-angular blocky, breaking readily to single grain; moderate organic matter; roots frequent; moist; frequent fine distinct strong brown (7·5YR5/8) mottles. Sharp change into
C(B) (buried)	33–42 in. (84–107 cm.)	Light yellowish brown (10YR6/4) to pale brown (10YR6/3) sand; single-grain; moist; frequent medium faint yellowish brown (10YR 5/8) mottles.

As a result of the clearing and replanting in this area, the organic surface layers are missing from the above profile. Undisturbed profiles normally have L and F layers which together can be up to 2 inches thick and are sometimes underlain by a black well-decomposed humus horizon. A strongly bleached A_2 horizon is often present.

The Fetters profile is shallow and overlies traces of a buried profile. Traces of buried horizons are not uncommon in the Tents Muir region. Percentage sand is high throughout the profile and percentage clay low or negligible. Values for exchangeable cations are low throughout, except in the A horizon where magnesium and potassium are moderate. Base saturation is low except in the A and pH is low in all horizons. Values for total phosphorus are low and for acetic-soluble phosphorus moderate.

The description given below is of a shallow profile from the Angus coast.

Profile Description
(No. 108. Carnoustie Links)

SLOPE	level.
ASPECT	nil.
ALTITUDE	15 feet.
VEGETATION	*Elymus arenarius, Ammophila arenaria, Galium verum, Thymus drucei, Festuca ovina, Cerastium vulgatum, Hylocomium splendens.*
DRAINAGE CLASS	free.

Horizon	*Depth*	
L & F	2–0 in. (5 cm.–0)	Grass and moss litter.
A	0–4 in. (0–10 cm.)	Greyish brown (2·5Y5/2) sand; very weak coarse sub-angular blocky; loose; low organic matter; frequent roots; moist. Clear change into
C	4 in. + (10 cm. +)	Pale brown (10YR6/3) sand; compact; single grain; few roots in upper part of horizon; traces of organic matter carried down root channels; moist.

This is an immature profile with no B horizon. Although the profile description makes no mention of shells or shelly sand, exchangeable calcium is moderate in the L and F horizon and high in the C, while percentage base saturation ranges from 69 to 100 and pH from 6·1 to 7·8.

The description given below is of a typical profile from the imperfectly drained areas.

Profile Description

(No. 109. Fettersloch)

SLOPE	level.
ASPECT	nil.
ALTITUDE	25 feet.
VEGETATION	pine forest plantation. *Pteridium aquilinum, Erica tetralix, Deschampsia flexuosa, Polytrichum commune, Pleurozium schreberi.*
DRAINAGE CLASS	imperfect.

Horizon	*Depth*	
L & F	1–0 in. (2·5 cm.–0)	Pine needle litter and fibrous rooty material.
A_1	0–1 in. (0–2·5 cm.)	Very dark brown (10YR2/2) fine sandy loam; weak fine crumb, breaking readily to single grain; high organic matter; many fibrous grass and plant roots; many bleached sand grains; moist. Sharp change into
A_2(g)	1–8 in. (2·5–20 cm.)	Dark brown (7·5YR4/2) sand; massive; loose; low organic matter; many bleached sand grains; many fibrous grass roots; few woody tree roots; frequent fine faint strong brown (7·5YR5/8) mottles at base of horizon. Clear smooth change into
B_2(g)	8–15 in. (20–38 cm.)	Brown (7·5YR5/4) sand; dry and loose; structureless; grass roots frequent; woody tree roots few; frequent medium faint strong brown (7·5Y5/6) mottles. Clear smooth change into
C(g)	15–39 in. (38–99 cm.)	Light brown (7·5YR6/4) sand; dry and loose, structureless; few fibrous grass roots, few woody tree roots; many medium faint strong brown (7·5YR5/6) mottles, increasing in number below 20 inches.

This profile has more definite podzolic features than the other described above—L and F layers, narrow A layer with high organic matter and many bleached sand grains. Mottling in the A_2(g), B_2(g) and C(g) is a feature of the imperfectly drained Links. The results of mechanical analysis are very similar to those for the freely drained Fetters profile. Percentage base saturation and pH are of the same order throughout, except in the C horizon at 35 inches where the values rise to 5·2 and 5·4 respectively. Exchangeable cations have moderate values in the A_1 horizon but are low elsewhere. Total phosphorus is moderate in the A_1 and A_2(g) but low in other horizons, while acetic-soluble phosphorus is moderate at all levels down to the lower C(g) where the value is high.

The description given below is of a profile typical of the poorly drained areas.

Profile Description

No. 110. Fettersloch)

SLOPE	level.
ASPECT	nil.
ALTITUDE	25 feet.
VEGETATION	pine forest (30–40 years). *Erica tetralix, Festuca ovina, Juncus squarrosus, Polytrichum commune.*
DRAINAGE CLASS	imperfect to poor.

Horizon	*Depth*	
L/F	2–0 in. (5 cm.–0)	Dark brown (7·5YR3/2) mixed pine litter and fibrous humus.
A_2	0–4 in. (0–10 cm.)	Dark grey brown (10YR4/2) loamy sand to sand; loose, single-grain; many fibrous grass roots; moderate organic matter; moist; no mottles. Clear change into
A_2(g)	4–8 in. (10–20 cm.)	Dark brown (10YR4/3) sand; loose, single grain; low organic matter; many bleached sand grains; frequent fibrous grass, few woody tree roots; moist; few faint fine yellowish brown (10YR5/6) mottles. Sharp smooth change into
B_2(g)	8–14 in. (20–35·5 cm.)	Brown (10YR5/3) sand; loose, single-grain; few fibrous roots; low organic matter; moist; many coarse prominent strong brown (7·5YR5/8) mottles. Clear irregular change into
C(g)	14–26 in. (35·5–66 cm.)	Pale brown (10YR6/3) sand; structureless; roots rare; moist; frequent medium prominent strong brown mottles. Gradual smooth change into
C(g)	26 in. + (66 cm. +)	Pale brown (10YR6/3) to brown (10YR5/3) sand; structureless; few woody tree roots; few faint medium to fine yellowish brown (10YR5/4) mottles.

Percentage base saturation is quite low in the A and B horizons of this profile but rises to 97 in the C, while the pH ranges from 4·7 at the surface to 6·6 at 30 inches. Total phosphorus is low in all horizons except the L and F, and acetic-soluble phosphorus is moderate in the upper horizons and high in the C.

LAND USE CAPABILITY

Because of poor water and nutrient-holding capacity resulting from coarse texture, the Links soils have limitations ranging from moderately to extremely severe. While a few cultivated areas have been placed in Class 3, most of the association falls into lower classes. The greater part of Tents Muir, which is planted to conifers, is in Class 5. The eastern seaward edges of Tents Muir and Barry Links are not considered suitable even for permanent grass and have been placed in Class 7, being limited both by low moisture-holding capacity and by susceptibility to wind-erosion. The remainder of the association is used mainly for recreational purposes, in particular for golf courses, as at Arbroath, Carnoustie, Monifieth and St. Andrews.

PEAT

The total area of peatland in the district is less than 200 acres (90 ha) and individual deposits, most of which are afforested, are small and of little economic importance. The three main deposits, discussed below, have developed under the influence of ground water and are typically associated with poorly drained hollows where drainage is impeded and where anaerobic conditions conducive to the accumulation of organic residues prevail. Inchrye is still in the low-moor stage of development, i.e. the nature of the vegetation is strongly influenced by ground water characteristics. Methven Moss appears to have originated in a shallow basin and probably achieved raised moss status at an early stage of development. At Moonzie Moss, the peat has also accumulated to a level above the influence of ground water, but the vegetation has been greatly modified by human activity and is not typical of raised bog conditions.

1. Inchrye

The Inchrye deposit, some 50 acres (20 ha) in extent, is situated in a small valley, bounded to the east by extremely steep slopes. The peat, up to 2 m. deep, overlies a bed of coarse gravel and along the eastern boundary is covered by a layer of sand and gravel derived from the slopes above. All horizons consist of well decomposed black peat containing a high proportion of mineral matter. The surface vegetation is dominated by a rank growth of reed grass (*Phragmites communis*), often over 2 m. tall. Normally, the site is completely water-logged and only limited access is possible even in dry weather.

2. Moonzie

The bog at Moonzie also covers about 50 acres (20 ha) and is situated in a shallow valley with an outlet to the west. The maximum depth recorded was 2·5 m. and the peat is almost completely amorphous. The underlying mineral material is a silt loam containing shell fragments and a few plant remains, probably stems and roots of semi-aquatic or aquatic species. The surface vegetation consists mainly of grasses and miscellaneous weeds; *Juncus* is frequent to locally abundant. Pasture improvement has probably been attempted at some stage in the past and indeed some evidence of tile drainage was found near the surface.

3. Methven Moss

The greater and deeper part of this deposit is located to the west of the map and only about 10 acres (4 ha) are located in the area described. Depths are extremely variable, the maximum being 1·8 m., and the surface now supports a mature stand of Scots Pine. The peat is highly decomposed and contains few recognizable plant remains. Probably of *Sphagnum* origin, it has been greatly modified by drainage and planting.

Chapter 5. Land Use Capability

In order to present the results of soil surveys in a form which may be of practical use to advisers, farmers, planners and other land users, the Soil Survey of Scotland, in conjunction with the Soil Survey of England and Wales, has prepared a Land-use Capability Classification for the soils of Britain. This is a modification of the system drawn up in 1961 by Klingebiel and Montgomery and developed by the Soil Conservation Service of the United States Department of Agriculture. Land is graded according to adaptability for crop growth as determined by the severity of limitations; there are seven capability classes, land adaptable to cultivation and other uses being placed in classes 1–4 and land not generally suitable for cultivation and of only limited use for other purposes in classes 5–7. Thus Class 1 has no limitations and is highly adaptable, while in the remaining six classes limitations are increasingly severe and the land is progressively less adaptable.

ASSUMPTIONS AND EXPLANATIONS

1. The classification is primarily for agricultural purposes.
2. Land is assessed on its capability under a moderately high level of management and not necessarily on its present use.
3. Land suffering from limitations which can be removed or reduced at acceptable cost is graded on the severity of remaining limitations.
4. The capability classification of a soil can be changed by major reclamation projects (e.g. pump schemes) which permanently change the limitations in use. Minor changes e.g. mole drainage liable to regress in time, will not affect the classification.
5. Within capability classes soils may differ in management and fertilizer requirements and detailed cropping, and are only grouped because they have similar degrees of limitations affecting adaptability. The classification however is not necessarily a grouping of soils according to the most profitable use to be made of the land.
6. Within specific subclasses are soils which suffer from the same degree and kind of limitation but which may differ in management requirements; for example in sub-class 3w the wetness may result from slow infiltration or from the effects of rising ground-water—each of these conditions will require separate treatment.
7. The system is based on physical limitations which in general are more permanent and more difficult to rectify than chemical limitations; severely limiting chemical properties, however, may be regarded as a limitation.
8. Distance to markets, types of roads and farm structure do not influence grading, although these factors naturally affect decisions on land use.

9. The interpretations are based on current knowledge, and as new experience is acquired new interpretations will be made where necessary.
10. The system is not a classification of soil suitability for specific crops or land use, e.g. for potatoes or forestry. When soil maps are used for such purposes they may require different groupings of the soil mapping units to express the concept of land capability.

Land Use Capability Class Descriptions

Class 1. *Land with very minor or no physical limitations to use.*

Soils are usually well drained deep loams, sandy or silty loams, related humic variants, or peat, with good reserves of moisture or with suitable access to moisture for roots; they are either well supplied with plant nutrients or responsive to fertilizers. Sites are level or gently sloping and climate favourable. A wide range of crops can be grown and yields are good with moderate inputs of fertilizer.

Class 2. *Land with minor limitations that reduce the choice of crops and interfere with cultivations.*

Limitations are due to the effects of one or more of the following: (1) moderate or imperfect drainage; (2) less than ideal rooting depth; (3) slightly unfavourable soil structure and texture; (4) moderate slopes; (5) slight erosion; (6) slightly unfavourable climate.

A wide range of crops can be grown, though with some root crops there may be difficulties in harvesting.

Class 3. *Land with moderate limitations that restrict the choice of crops and/or require careful management.*

Limitations may result from the effects of one or more of the following: (1) imperfect or poor drainage; (2) restrictions in rooting depth; (3) unfavourable structure and texture; (4) strongly sloping ground; (5) slight erosion; (6) moderately unfavourable to moderately severe climate.

The limitations affect the timing of cultivations and the range of crops, which is restricted mainly to grass, cereal and forage crops. Whilst good yields are possible, limitations are more difficult to overcome than in Class 2.

Class 4. *Land with moderately severe limitations that restrict the choice of crops and/or require very careful management.*

Limitations are due to the effects of one or more of the following: (1) poor drainage, difficult to remedy; (2) occasional damaging floods; (3) shallow and/or very stony soils; (4) moderately steep gradient; (5) slight erosion; (6) moderately severe climate.

Climatic disadvantages combine with other limitations to restrict the choice and yield of crops and increase risks.

Class 5. *Land with severe limitations that restrict its use to pasture, forestry and recreation.*

Limitations, which cannot be overcome, are due to one or more of the following: (1) poor or very poor drainage; (2) frequent damaging floods; (3) steep slopes; (4) risk of severe erosion; (5) severe climate.

High rainfall, exposure, and a restricted growing season prohibit arable cropping, though mechanised pasture improvements are feasible. The land has a wide range of capability for forestry and recreation.

Class 6. *Land with very severe limitations that restrict its use to rough grazing, forestry and recreation.*

Limitations, which cannot be overcome, are due to the effects of one or more of the following: (1) very poor drainage; (2) liability to frequent damaging floods; (3) shallow soil; (4) stones or boulders; (5) very steep slopes; (6) risk of severe erosion; (7) very severe climate.

Limitations are sufficiently severe to prevent the use of machinery for pasture improvement. Very steep ground which has some sustained grazing value is included in this class. On level or gently sloping upland sites wetness is closely correlated with peat or humose flush soils.

Class 7. *Land with extremely severe limitations that cannot be overcome.*

Limitations are due to the effects of one or more of the following: (1) very poorly drained boggy soils; (2) extremely stony, rocky or boulder-strewn soils, bare rock, scree, or beach sand and gravels; (3) untreated waste tips; (4) very steep gradients; (5) severe erosion; (6) very severe climate.

Exposed situations, protracted snow cover and a short growing season preclude forestry, but a poor type of rough grazing is sometimes available for a few months.

Land Capability Subclasses

Capability subclasses are divisions within capability classes based on the nature of the limitation affecting land use; these are:

W—Wetness
S —Rooting zone limitations
*T —Slope and soil pattern limitations
E —Liability to erosion
C —Climatic limitations

Soil, site and climate are involved in complex interactions which affect land use, and the separation of dominant limiting factors is merely a necessary, if arbitrary, simplification.

WETNESS

Hydrologic conditions, which result from interaction of soil properties, relief and climate, influence both management and crops. Coarsely structured,

* On the Land Use Capability map covering Sheets 48 and 49 the Symbol T was used for slope and pattern limitations. In later publications the symbol G has been adopted.

fine textured, slowly permeable soils may delay cultivations in spring and autumn, and badly timed operations can cause compaction and puddling, with serious long term consequences. The lower temperatures associated with wet soils during spring can delay germination, and waterlogging restricts the depth of rooting and causes poor root development or, in very severe cases, asphyxiation. Poor aeration, together with low temperatures, is a cause of denitrification. Wetness in autumn can cause difficulty in harvesting and limit the range of crops. Wet land needs capital and maintenance expenditure on drainage.

Wetness can result from the following causes, each of which may require a different remedial measure.

(i) slowly permeable materials of fine texture
(ii) impermeable layers: indurated layers difficult to break or iron and other pans relatively easily broken
(iii) High ground-water table
(iv) flushing by springs
(v) flooding from streams and rivers
(vi) high rainfall and low temperature

ROOTING ZONE LIMITATIONS

These limitations can be (a) shallowness; (b) stoniness; (c) soil texture and structure; (d) inherent low fertility.

Shallowness: Shallow soils have detrimental effects on crops which are usually seen in a low available-water capacity, restricted rooting range and inadequate nutrient uptake. In some cases, however, the limiting effects depend on external factors such as rainfall. Shallow soils present problems of management and the use of certain farm implements may be impracticable where rock is near the surface.

Stoniness: Stones affect both plant growth and farm operations more or less severely, depending on their size and number. Small stones hinder cultivations and mechanized harvesting of root crops, whilst boulders that are too large and/or too numerous to move preclude cultivation. Stones also diminish available-water capacity and nutrient supply, depending on their volume, mineralogical composition and porosity and on the scale and frequency of soil moisture deficits. Flints and similar hard stones also intensify wear of implements, and mole drainage becomes impracticable in very stony soils.

Soil Texture and Structure: The "cappings" associated with weakly structured soils, usually silty or fine sandy loams, can hinder plant emergence, indirectly damage seedlings through frost heaving, and affect the timing of cultivations and quality of seedbeds through wetness. Fine-textured soils are usually coarsely structured, slowly permeable, and retain large quantities of moisture. Available-water capacity is broadly correlated with texture; in sands the amount of water at tensions available to plants is low, in clays it is medium and in silty and fine sandy loams high.

The effects of both structure and texture on crop performance vary with climate, and in particular with rainfall.

Soil Fertility: Naturally low fertility difficult to correct by management may be taken into account under this subclass heading, but specific fertility problems are better considered using more detailed maps at larger scale.

SLOPE AND SOIL PATTERN LIMITATIONS

Slope has a marked effect on mechanized farming. Sites with slopes of 0–7 degrees are not usually obstacles to farming operations, though on slopes between 3 and 7 degrees difficulties may be experienced with gapping machines or mechanized weeders, precision seeders and some root crop harvesters. Between 7 and 15 degrees the use of a combine harvester becomes very restricted; 10–12 degrees (Finkenzeller, 1957) is considered the limit at which it can be operated without loss by spillage from trays. Two way ploughing also reaches a limit about 11 degrees, though much depends on the configuration of the ground, e.g. a short slope of 15 degrees within a field with turning space at head and foot might well be tackled, whereas a field with uniform 15 degrees slope would call for one way ploughing only. Towards the 15 degrees limit loading difficulties with trailers may arise (loading on one side only) and loads can only be removed from the field directly downslope. Over about 11 degrees additional weights may be necessary on the front of the tractor to compensate for drag and consequent steering difficulties.

Slopes greater than 15 degrees are not suitable for normal rotations and remain in grass for long periods; cultivation costs can be high. Slopes greater than 20 degrees are difficult to plough and fertilize, and apart from this costs are high and normal rotations impossible. Between 20 and 25 degrees occasional tillage for pasture improvement is sometimes practised. Above 25 degrees some movement of soil starts and paths are formed across slope by animals (Ruhmann, 1957); mechanized operations are possible only with specialized machinery.

The slope gradient and the pattern or frequency of slopes both have a considerable influence on farming costs and crop performance. Where slopes or soil types of widely differing capability are combined in intricate small scale patterns the exploitation of good land is frequently limited by its proximity to bad land. In many areas depth and stoniness variations justify the recognition of a mosaic of soils ranging over at least two capability classes.

LIABILITY TO EROSION

Two major forms of erosion, by wind and by water, are recognized. Wind erosion, the main form found in this district, includes coastal sand dune movements and blowing of sandy or peaty light soils in exposed situations when the vegetative cover is breached either by natural causes or by cultivation. Young spring crops, e.g. sugar beet or turnips, can be so seriously affected, that reseeding is necessary.

The erosive effects of water include marine erosion and the formation of gullies or screes on steep slopes where overburning or overgrazing is practised. Sheet erosion can occur on quite gentle slopes after violent storms, and thick topsoils at lower field boundaries are further evidence of the gradual transfer of material downslope resulting from cultivation.

CLIMATIC LIMITATIONS

Knowledge of the relationships between weather and crop growth is incomplete, but it is already clear that differences in macroclimate influence land capability (Hogg, 1964), and this is reflected in the land use pattern.

To facilitate the recognition of climatic limits in capability classes 4 to 7, altitude and rainfall limits have been established. With increasing elevation, land suffers from a shorter growing season, heavier rainfall, lower insolation, and increased exposure, all factors which reduce productivity. The limits chosen, which include some introduced by the Study Group on Agricultural Land Classification, are designed to take account of (i) rainfall increase with altitude (the rate of increase, it should be noted, decreases from west to east), and (ii) temperature decrease with both altitude and latitude.

The limits are as follows:

(i) Land over 2000 feet, generally above the tree-line, and providing only poor rough grazing.
(ii) Land between 1000 and 2000 feet with more than 60 inches annual rainfall providing rough grazing; here pasture improvement is not usually feasible.
(iii) Land between 600 and 1000 feet with more than 50 inches annual rainfall, allowing pasture improvement but not suitable for arable crops.
(iv) Land between 400 and 600 feet with more than 40 inches annual rainfall (45 inches in Western Britain) mainly suitable for grass and limited arable cropping.

N.B.—On the Land Use Capability Map of the Perth/Arbroath/Dundee district, the symbol C does not appear. While it was recognized that there are climatic variations over the district both altitudinally and from east to west, it was not considered necessary to separate a climatic sub-class as land areas affected by the limitations of sub-class C are also affected to an equal or even greater extent by limitations of sub-classes S and T such as shallowness of soil and steepness of slope.

TABLE O. Approximate Percentage Areas of Capability Classes.

Class	Percentage Area
1	3
2	53
3	23
4	4
5	11
6	1
7	1
Built-up areas	4

LAND USE CAPABILITY OF THE SOILS

The Land Use Capability map for the district was prepared after consultation with Senior Advisory Officers from the Edinburgh and East of Scotland

College of Agriculture. A generalized version of the Land Use Capability map is shown in Fig. 11, while approximate percentages of the total area covered by the various capability classes are given in Table O. It can be seen that more than half the area is good agricultural land with 3 per cent in Class 1 and 53 per cent in Class 2. Adding 23 per cent in Class 3 and 4 per cent in Class 4 gives a total of 83 per cent of the area suitable for some form of arable agriculture. Class 5 land amounts to 11 per cent while Class 6 and Class 7 land each cover only 1 per cent. Built-up areas account for the remaining 4 per cent.

Class 1

The most extensive area of Class 1 land is a strip of the Angus Coastal Fringe extending from the outskirts of Arbroath to Carnoustie and stretching inland from the 30-foot contour approximately to the 175 foot. Apart from some small areas of the Forfar and Buchanyhill series, the Panbride series is dominant. Developed on coastal raised beach sands and gravels, the series is freely drained with a sandy loam or loam topsoil generally 12 to 18 inches deep. The land here is further favoured in having a good south-easterly aspect.

In the Isla Flats Sub-region of Strathmore, Class 1 land, consisting mainly of the freely drained Vinny series, stretches as a narrow band along the foot slopes of the Sidlaw Hills from Newtyle to the vicinity of Kettins 1½ miles south-east of Coupar Angus. Water-sorted till deposits form the parent material of these soils, which are freely drained and have sandy loam topsoils, frequently more than 12 inches deep. North-east of Coupar Angus, Class 1 land is also found on a sandy alluvial terrace of the River Isla.

Areas of Class 1 occur in the Carse of Gowrie where soils of the Carpow and Carey series, derived from upper terrace deposits of sands and gravels, have developed on the rising ground about Errol and Middlebank. South of the River Tay, in Fife, the Carey series forms a strip of Class 1 land bordering the estuary between Flisk Point and Ballinbreich.

All these Class 1 soils have the physical characteristics of good drainage, ease of cultivation, deep or moderately deep topsoils, and good productive capacity for a wide range of crops, and they are thus free from physical limitations or subject to only very minor ones.

Class 2

The greater part of the land up to an altitude of 400 feet, or, in some cases, 500 feet, falls into Class 2. In Strathmore the alluvial and fluvio-glacial deposits of the Tay and Earn Flats, together with the till soils, mainly of the Balrownie and Forfar Associations, on much of the Cairnleith–Balbeggie Benchland (in Fig. 4, Chapter 1) are subject chiefly to rooting zone limitations. The land has therefore been classed as 2S.

In Fife, Class 2 land covers much of the foothills of the Eastern Ochils, of Strath Eden and of the East Fife Drift Plain. Sourhope and Mountboy are the main associations on the Ochils and in Strath Eden, while the Rowanhill Association is dominant over the Drift Plain. It will be appreciated that included within the 2S sub-class are areas where the main limitation is slope

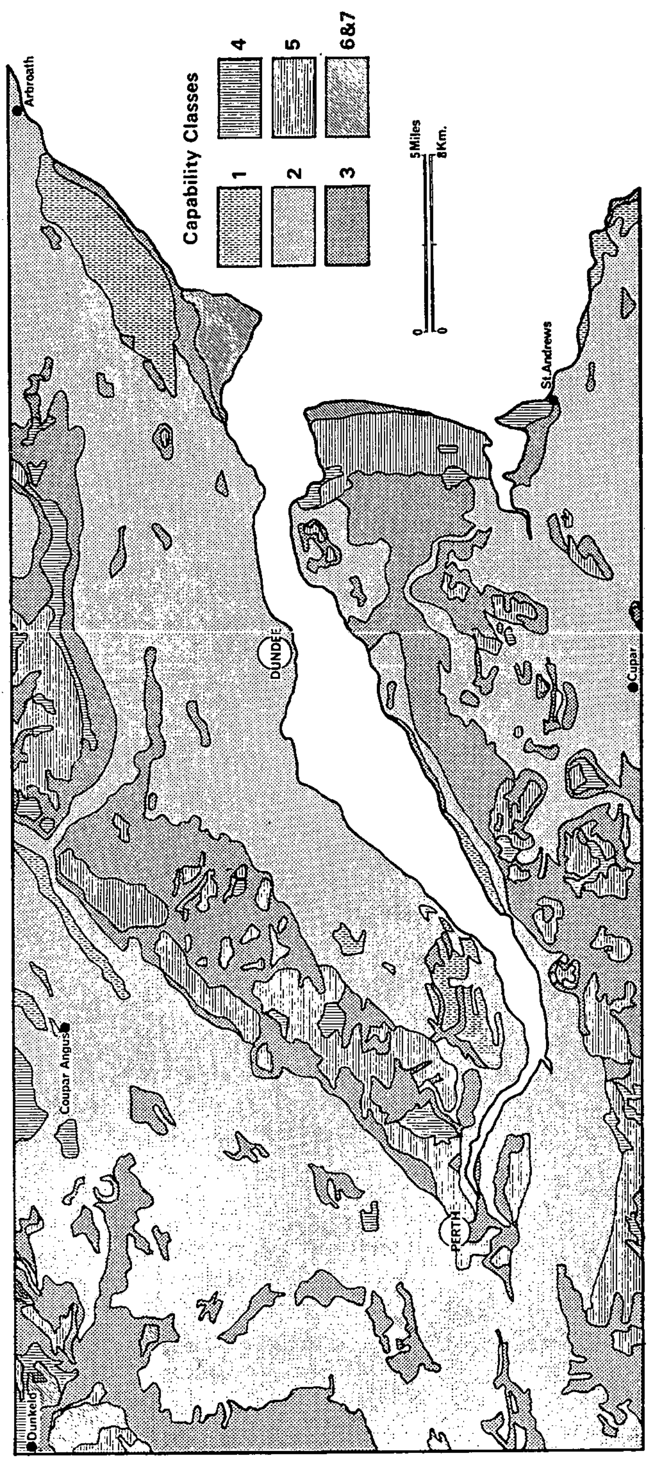


FIG. 11: Land use capability.

and soil pattern but which are too small to warrant separation as 2T. This is the situation in Fife where all the Class 2 land has been included in 2S. On the lower slopes of the Sidlaw Foothills and on the upper parts of the Angus Coastal Lowland, Balrownie and Forfar associations are dominant, with minor areas of Mountboy. Over most of this region slope and, to a lesser extent, pattern are the main limitations and the land has been classed as 2T.

Most of the Carse of Gowrie and the Carse of Earn has been rated as Class 2 land. Although they are "heavy soils" of the poorly drained Stirling series and require careful treatment, the soils are capable, under good management, of sustaining a high level of production for a relatively wide range of crops, although root crops can present difficulties. Drainage being the main limitation, the land has been classed as 2W.

Class 3

Covering an area slightly less than half that of Class 2, Class 3 land is most extensive on slopes of the Grampian Foothills, the Sidlaw Hills and the Ochil Hills at altitudes between about 500 feet and 700 feet. On these slopes, where the dominant series are Strichen, Aldbar, Darleith or Sourhope, both rooting and topographical limitations operate and the land is classed as 3ST. Included within the same sub-class is an area of land bordering the Motray Water in Fife and rising to a little over 100 feet. The topography is moundy and uneven and the soils, which belong to the Auchenblae and Panbride series, are sandy and, in some instances, gravelly. At lower altitudes, where poor drainage is the dominant limitation, soils are classed as 3W. This sub-class is not extensive and is confined mainly to areas of the Lour series and smaller areas of the Vigean and Barras series. Where rooting zone limitations are particularly effective, the sub-class is restricted to 3S. This occurs especially on gravelly soils such as the Corby series and, in some cases, the Gleneagles series, and on certain limited areas of Panbride series and of Links.

Class 4

Class 4 covers only 4 per cent of the total area. At altitudes above about 700 feet limitations are moderately severe and the capability sub-class is 4ST. Small areas are found on the south-east slopes of the Sidlaw Hills where, mainly because of the favourable aspect, the cultivation level extends to above 850 feet on soils of the Balrownie and Albar series. A small area of the sub-class is also found in the Grampian Foothills on soils of the Strichen and Snaigow series.

Certain areas below 700 feet are limited to Class 4ST because of rooting zone limitations or slope and soil pattern restrictions. Among these is the area north-east of Meikleour in the Isla Flats Sub-region of Strathmore where soils of the Corby series are developed on mounds of fluvio-glacial sand and gravel.

Class 5

Upper hill slopes, in most cases, cannot be rated higher than 5ST, as they are too steep and too elevated for arable cultivation although quite suitable for permanent pasture or forestry. This sub-class is quite extensive on upper slopes of the Sidlaw Hills, where both the Sourhope and the Darleith Associations are found, and of the Ochil Hills, where Sourhope is dominant. On the Grampian Foothills, the sub-class is limited to two small areas of the Darleith series. The greater part of Tents Muir in Fife, which consists of stabilized windblown sand, comes into the 5SE category as low moisture-holding capacity and susceptibility to erosion are the dominant limitations. Several small cultivated areas are rated as 4S.

Class 6

On the Grampian Foothills soils are frequently subject to very severe limitations such as steepness, stoniness, shallowness, and even at quite low altitudes the capability class may not be higher than 6ST. Throughout the district, a few small areas of poorly or very poorly drained land have been classed as 6W.

Class 7

Apart from several quarry areas and rock outcrops occurring throughout the district, Class 7 land is confined to the eastern seaward edges of Tents Muir and Barry Links. These are not considered suitable even for permanent grass, being limited both by low moisture-holding capacity and by susceptibility to wind erosion, and the area is therefore classed as 7SE. Inland from Barry Links, where the soil becomes more stabilized, the capability class improves to 6SE and, still further inland, to 3SE.

Chapter 6. Discussion of Analytical Data

Profiles representative of the various soil series mapped were described and sampled during the survey of the district and standard physical and chemical analyses have been carried out on each sample. Appendix III gives standard analytical data relating to the profiles described in Chapter 4. Certain profiles were also subjected to more detailed investigation by mineralogical, differential thermal, X-ray and spectrochemical methods. Percentages of silica and of the oxides of iron and aluminium in the clay fractions are given in Appendix IV, together with the corresponding molecular ratios. Appendix V gives percentages of minerals in the fine sand fractions and in the clay fractions.

STANDARD DATA

Loss on Ignition

The loss in weight of a soil sample resulting from ignition is due mainly to the removal of organic matter by oxidation to carbon dioxide, to the loss of carbon dioxide resulting from the decomposition of calcium carbonate and, to a lesser extent, to the loss of water from the clay fraction. In coarse-textured soils loss on ignition may be taken as an approximate estimate of organic matter content. The maintenance of a proper supply of organic matter in arable soils is of the greatest importance, not only because it affects the physical condition of the soil and supplies plant nutrients but also because it provides a source of energy to accelerate the biochemical processes.

Carbon and Nitrogen

Determinations of carbon and nitrogen were made on surface and upper horizons of profiles. A comparison of data shows that for semi-natural soils carbon is usually high and the C/N ratio around 10 or 12. This ratio can be used to indicate the degree of decomposition or humification of the residues which make up the soil organic matter. Thus, in the surface horizon of uncultivated soils where carbon contents and C/N ratios are high, organic residues are large and little humification has taken place. In cultivated soils, on the other hand, organic matter has been incorporated in the mineral horizons and is completely humified, so that surface horizons are relatively much richer in nitrogen and the C/N ratios are comparatively low.

Soil Separates

Soil separates were determined by mechanical analysis, using both the International Scheme and that adopted by the U.S. Department of Agriculture. The particle size limits are shown in Appendix I.

TABLE N. Textural Classes of Soil Series.

ASSOCIATION	TEXTURAL CLASS: COARSE-TEXTURED SOILS		MODERATELY COARSE TEXTURED SOILS		MEDIUM-TEXTURED SOILS		MODERATELY FINE-TEXTURED SOILS		FINE-TEXTURED SOILS
		Coarse to Mod. Coarse		Mod. Coarse to Medium		Medium to Mod. Fine		Mod. Fine to Fine	
STRICHEN				Strichen, Fungarth Obney, Anniegathel					
FOUDLAND					Foudland Snaigow				
GOURDIE			Cairnleith		Gourdie				
BALROWNIE		Buchanyhill		Albar		Lour Balrownie			
FORFAR			Vinny, Forfar Vigean						
LAURENCEKIRK							Laurencekirk Oldcake Drumforber		
KIPPEN			Fourmerk			Kippen			
MOUNTBOY				Garvock Mountboy					
DARLEITH					Darleith Dunlop				
SOURHOPE				Sourhope	Bellshill Atton				
ROWANHILL		Allanhill	Greenside	Macmerry		Caprington Winton		Rowanhill	
CORBY	Corby								
BOYNDIE	Boyndie Dallachy	Inchewan							
AUCHENBLAE	Anniston Auchenblae Kirkbuddo								
GLENEAGLES		Gleneagles							
CARPOW		Carpow		Carey					
PANBRIDE		Panbride Rhynd Kellie							
CARBROOK								Harviestoun	
STIRLING					Fordel	Cauldside		Stirling	
LINKS	Links								
Areas (to nearest sq. mile)	44	46	41	148	50	110	3	27	

These analyses provide a means of checking the validity of soil texture assessments made by hand in the field. As already stated in Chapter 4, the field texture of a sample frequently differs from the texture indicated when results of mechanical analysis are plotted on the triangular texture diagram. This discrepancy, in many cases, is due largely to the presence of organic matter in the field sample. There is a tendency, too, to overestimate in the field the clay content of some mineral soils, particularly in the presence of coarse sand. In table N the various soil series are arranged in textural classes as determined from the mechanical analysis of the B horizon plotted on the triangular diagram.

The area covered by each class is shown to the nearest square mile. At one end of the scale coarse-textured soils of the Corby, Boyndie and Auchenblae associations, together with Links soils, cover 44 square miles, while at the other end moderately fine to fine-textured soils of Rowanhill, Carbrook and Stirling Associations occupy 27 square miles. Soils of moderately coarse to medium texture cover the largest area, 148 square miles, with soils of medium to moderately fine texture in second place at 110 square miles. All the other textural classes are limited to much smaller areas. The smallest class—only 3 square miles—comprises moderately fine-textured soils of the Laurencekirk Association. With the exception of Links, soils in categories not classed as series have been excluded from the table.

Exchangeable Cations, Percentage Base Saturation and pH

Ion exchange can be considered the most important of all the soil processes. The exchange property resides almost entirely in the clay and organic fractions, which hold within their complex structure varying numbers of adsorbed cations, consisting of both hydrogen ions and metallic ions or bases. These adsorbed cations have characteristic exchange properties and can be replaced to a greater or lesser extent by other cations, e.g. by active hydrogen in nature or by metallic ions from applied chemical fertilizers.

The exchange capacity of a soil is a measure of the total exchangeable cations and depends on the nature and amount of both the mineral and organic portions. The unit used in expressing the magnitude of the exchange capacity is a milligram-equivalent (m.e.), which is expressed as "one milligram of hydrogen or the amount of any other ion that will combine with or displace it". The results are expressed as m.e./100g. of soil. Cations normally estimated are calcium, magnesium, sodium and potassium, and these, together with the exchangeable hydrogen which is determined separately, are taken as an approximate measure of the total exchange capacity. (The cation exchange capacity of the minor elements occurring in the soil is regarded, in this estimate, as negligible). As it is known that higher plants readily make use of at least some part of the exchangeable constituents of soils, the effect of ionic exchange on the availability of nutrients to higher plants can be readily understood.

Exchange capacity is not shown in the table of analysis in Appendix III, but percentage base saturation is listed. This is determined by expressing the total exchangeable bases, i.e. Ca, Mg, Na and K, as a percentage of the total exchangeable cations, which includes, in addition, exchangeable hydrogen. For comparison values of percentage base saturation are graded as follows:

Low	$<20\%$
Moderate	20–60%
High	$>60\%$

Base saturation varies with past liming and fertilizer practice and the majority of the cultivated soils have high values in the S horizon. In general, high values are associated with moderately fine to fine-textured soils, while the lowest values appear in certain profiles developed on Links sand. On the other hand, because of the presence of calcareous shelly sand, some Links profiles show high values or are completely saturated in lower horizons.

Lowest pH values, generally ranging from 4 to 5 but occasionally below 4, are found among the uncultivated soils, particularly those developed on sands and gravels or on material derived from Highland rocks. For the cultivated soils the range, on average, is from 5 to 6·5 or, occasionally, 7. Highest values are normally found in poorly drained fine-textured gley soils such as the Atton profile, No. 61, where the pH rises to 8·3 in the C horizon.

Total and Acetic-Soluble Phosphorus

Several of the cultivated soils, as might be expected, show high (>300 mg/100 g.) phosphorus in the surface horizons. Among the uncultivated soils, only the poorly drained Atton profile, No. 62, has high total phosphorus; in this case the value is high in all horizons. Because soil nutrients are changed to less-soluble forms by reaction with inorganic and organic components of the soil, phosphorus, together with other nutrients, can become less mobile and thus less available to plants. Therefore, while the figure for total phosphorus may give little indication of the amount of phosphorus available, the acetic-soluble phosphorus does give an approximate estimate. In profile No. 62, despite the high total phosphorus, the acetic-soluble is low in all horizons except the upper C where the value is still only moderate. In profile No. 61, which is cultivated and from the same series, total phosphorus is moderate and acetic-soluble high to very high in all horizons.

SILICA-SESQUIOXIDE RATIOS OF THE CLAY FRACTION

Determinations of silica, iron and aluminium were carried out on the clay fractions ($<1{\cdot}4\mu$) of certain typical profiles. The percentages of silica, iron oxide and aluminium oxide are given in Appendix IV, together with the molecular ratios SiO_2/R_2O_3, SiO_2/Fe_2O_3, SiO_2/Al_2O_3 and Al_2O_3/Fe_2O_3, ($R_2O_3 = Fe_2O_3 + Al_2O_3$). Silica sesquioxide ratios indicate the relative leaching and differential movement of iron and aluminium as compared with silica and thus allow comparison of soils from various major soil groups.

The most striking evidence of movement of iron oxides from the A horizon is seen in podzols. This is well illustrated in the Strichen profile, No. 1, (Appendix IV, Table 11), where percentage silica drops from 51 in the A_2 to 28 in the B_2 and iron oxide rises from 9·9 in the A_2 to 24 in the B_2. The results also show a slight increase in percentage Al_2O_3 from the A_2 to the B_2 and a greater accumulation in the B_2/B_3. A similar, but less striking movement of iron oxides is seen in the Foudland profile, No. 11 (Table 11). Results for other podzol profiles indicate a tendency to aluminium accumulation in the lower B_2 or the B_3 horizon. In the imperfectly drained podzols, for example No. 6, (Table 12), evidence of iron oxide translocation is less marked.

Percentages and ratios for freely drained brown forest soils in most cases do not vary appreciably down the profile and there is little evidence of leaching. Slight evidence of podzolization is shown in profiles No. 12 and No. 48 (Table 9) where percentage iron oxide increases in the B_2, with a corresponding fall in the SiO_2/Fe_2O_3 ratio.

In the imperfectly drained brown forest soils there is even less evidence of sesquioxide translocation, except in the Rowanhill profile, No. 65, and the Balrownie profile, No. 18, (Table 10) where percentage Fe_2O_3 increases slightly in the B_2(g) horizons.

Non-calcareous gleys, profiles No. 27 and No. 61, (Table 13) show movement of iron from the surface horizon, with accumulation in the B_2g.

MINERALOGY OF THE FINE SAND FRACTION

The 75–100μ size fraction was separated by sieving the fine sands of two layers, an upper and a lower one from profiles belonging to the principal soil series of the area. Each layer was then separated into a heavy and a light fraction by tetrabromoethane (S.G. 2·9) and the fractions analysed mineralogically with a polarizing microscope. The results of the analyses of these fractions are given on a frequency scale which emphasizes small differences in the proportions of minerals present in only small amounts. In the case of the light minerals only the lower layer of each profile was analysed. Results are shown in Table 14 in which the weights of the light minerals are given as percentages.

The percentage weight of light minerals is usually over 90 and this fraction is almost invariably dominated by quartz.

Excluding the iron oxides, which contain many grains of secondary minerals formed pedologically as well as primary rock minerals, the dominant heavy mineral in all the soils examined is garnet. This indicates that the till forming the parent material of most of the soils is derived from a mixture of rock types. The figures for augite, however, do show a considerable variation which can be related to the parent rocks. This apparent anomaly is explained by the high resistance to weathering of garnet so that it accumulates in sedimentary rocks, while the less resistant augite is restricted to basic rocks. Thus augite is a major component in the sands from the Darleith, Sourhope and Mountboy Associations. The zircon contents also show some variations being high in the Strichen and Forfar Associations and low in those on the igneous rocks. In general, the heavy minerals show a fairly uniform distribution over the area.

MINERALOGY OF THE CLAY FRACTIONS

The clay fractions ($<1{\cdot}4\mu$) of the predominant series in the area have been analysed mineralogically by X-ray powder diffraction and thermal methods.

Profiles from thirty series representing the major soil groups of twelve soil associations were selected and samples from all horizons examined. Apart from these of the Stirling Association, on estuarine silts and clays, all the soils are developed on glacial tills, derived from a variety of rock types. Almost half the tills are derived from intermediate and basic lavas, the rest being from sediments, mainly of Old Red Sandstone age. Many of the series have been established in other areas and comparision with the soils from these areas is made.

Since clays contain a mixture of minerals in varying proportions, accurate quantitative analysis is not possible on the semi-routine basis used, and the results in Table 15 are not expressed numerically. Nevertheless, the proportions of individual clay minerals can be correlated broadly with the parent materials. In general, the soils of this area do not contain a high proportion of amorphous constituents in the clay fractions.

Darleith series consists of brown forest soils with free drainage and their clay mineralogy is similar to that of the Darleith series of Sheet 22 (Kilmarnock). They have a low illite content and are predominantly vermiculitic with some kaolin and chlorite. The low illite content is typical of soils on basic igneous rocks which normally have a low potassium content. The Sourhope Association soils are represented by freely and imperfectly drained brown forest soils and by gleys. They are derived from tills formed from intermediate lavas of Lower Old Red Sandstone age. The freely drained soils are illitic, with some kaolin: montmorillonite occurs at the base of the profiles, as was noted in the Sourhope series mapped on Sheets 17 and 18 (Jedburgh and Morebattle). The imperfectly drained and gleyed Sourhope soils, represented by the Bellshill and Atton series, have a lower illite content. The Bellshill has a high kaolin content at the surface and the Atton high kaolin and chlorite. The clay mineralogy of the Atton series contrasts markedly with that of the same series on the Jedburgh and Morebattle sheets which is dominantly illitic with montmorillonite in the lower layers. Typical results for the Darleith and Sourhope Association soils are given in Table 15.

Two freely drained soils of the Mountboy Association developed on till derived from Old Red Sandstone lavas and sediments were examined. The clays from the surface horizons of these brown forest soils contain chlorite, illite and vermiculite while those from the C horizons contain montmorillonite and kaolin in addition to illite and chlorite.

The Balrownie Association, developed on till derived from Lower Old Red Sandstone sediments, is represented by imperfectly drained brown forest soils, freely drained iron podzols and non-calcareous gleys. The soil clay of the imperfectly drained profile of the Balrownie series is essentially vermiculitic, with a small amount of gibbsite confined to the A and B horizons which are developed from partially water-sorted colluvial material, as opposed to the basal horizon which is derived from flaggy till. A small amount of illite is present throughout the profile. The clay fractions of the freely drained iron podzol profiles contain illite and have a high kaolin content in the surface layers. The C horizon material has a moderate amount of chlorite and some montmorillonite. Gibbsite occurs in the B horizons of these profiles. In the non-calcareous gley profiles illite predominates in the clay from the surface horizons, but kaolin and chlorite are the dominant minerals in the lower horizons. Gibbsite and goethite were both identified in the Bg horizons.

The Forfar Association, on a water sorted or colluvial material overlying till derived from Lower Old Red Sandstone sediments, is represented by podzols of free and imperfect drainage and non-calcareous gleys. The clay of the freely drained soil is predominantly illite with some kaolin and chlorite, the latter increasing in the B and C horizons. Gibbsite was noted in the B_2 horizon. Imperfectly drained soils of the Forfar series are dominantly illitic, with some kaolin, vermiculite and chlorite. There is a significant increase in the chlorite content of the lower horizons. In the non-calcareous gley profiles chlorite is the dominant clay mineral in the surface horizons, whereas illite and montmorillonite are characteristic of the C horizons. Gibbsite occurs in the basal horizons.

The principal series of the Rowanhill Association is an imperfectly drained brown forest soil. The clay mineralogy changes little down the profile, with illite and kaolin predominating and some montmorillonite present. Gibbsite and goethite were identified in the B_2(g) horizon.

The Stirling Association is derived from estuarine silts and clays. The most extensive soil, a non-calcareous gley is essentially illitic, with some kaolin. Gibbsite occurs in the Bg and Cg horizons.

TRACE ELEMENTS

The parent materials and drainage conditions of the majority of soils in this area are such that serious deficiencies or excesses of trace elements are unlikely to be widespread. Most of the parent materials derived from sedimentary rocks have an appreciable argillaceous component and there are few acid igneous or other silica-rich parent materials that tend to give rise to soils very deficient in cobalt or copper. Serious excesses are equally unlikely, both because of the nature of the parent materials and the relative absence of very-poorly drained soils in which mobilization readily occurs. There are however a few soil types whose contents of trace elements may give rise to border-line conditions and, in some circumstances, slight deficiencies or excesses may arise, particularly as a number of the soils in the area have pH values above 7.

The soils of the extensive Balrownie Association all contain 20–30 p.p.m. total cobalt and 30–40 p.p.m. total copper in their lower horizons, but in several of the soils the contents fall to below 10 p.p.m., particularly of cobalt, in the upper horizons, which are considerably lighter in texture. A non-calcareous gley (27) does not demonstrate the mobilization of cobalt, nickel or other trace elements to the extent expected in lower horizons under impeded drainage conditions. This is presumably related to the mode of occurrence of the trace elements in the parent rocks of Lower Old Red Sandstone origin. While all the surface soils examined contain adequate amounts of extractable cobalt and copper, in the immediate sub-surface horizons the contents of both elements are on occasion sufficiently low to suggest that the possibility of cobalt deficiency in stock on soils of this association cannot be completely excluded and also that on the lighter soils marginal copper deficiency in cereals cannot be entirely ruled out. There appear to be adequate but nowhere excessive levels of molybdenum, while in one or two of the soils of this association a relatively high but not exceptional lead content of up to 300 p.p.m. in the surface soil is typical of that found in the upper organic horizon of many uncultivated soils.

The next most widespread association, Sourhope, derived from andesitic lavas, shows total trace element contents typical of such parent material, namely some 25 p.p.m. cobalt, 50 p.p.m. nickel and 35 p.p.m. copper. In this parent material, impeded drainage results in considerable mobilization of cobalt, nickel, copper and vanadium in the lower horizons of the two gleys examined, in marked contrast to the behaviour in the Balrownie Association. There is however no evidence of any element, particularly nickel or molybdenum, reaching a level toxic to plants or animals. In one gley (61) a horizon of manganese accumulation at about 30 inches has been observed, with a total content of 1 per cent, of which one-quarter is readily extractable. No trace element problems are however to be anticipated on the soils of this association.

A freely drained profile (48) of the Darleith Association, ascribed to more basic lavas, corresponds closely in trace element content to similar profiles of the Sourhope Association, and the total contents of indicator elements such as chromium and nickel do not suggest that a more basic rock is involved. The Mountboy association, which covers over 50 square miles, is developed on a parent material comprising a mixture of the sedimentary rocks and andesitic lavas of the Old Red Sandstone. The findings for the trace element contents of the two freely drained profiles analysed (44, 45) are in keeping with this origin, being intermediate between the Balrownie and Sourhope associations.

From the three profiles studied (31, 34, 35), the soils of the Forfar Association, derived from light-textured modified ORS till, are somewhat lower in cobalt and possibly copper than those of the lower horizons of the Balrownie Association, but no marked decrease towards the surface is noticeable and with extractable cobalt contents about 0·6 p.p.m. and copper around 3·0 p.p.m., they should be no more liable to deficiencies of these elements. Again, this parent material of sedimentary origin does not appear to contain trace elements readily mobilizable under conditions of impeded drainage.

One profile (96) of the Stirling Association represents the estuarine silty clays of the area. The trace element contents of this soil are quite normal, with the total contents of 25 p.p.m. cobalt, 15 p.p.m. copper, 40 p.p.m. nickel, 1 p.p.m. molybdenum and about 1000 p.p.m. manganese, giving extractable contents that are adequate, without any possibility of toxic excess of any trace elements arising in the poorly-drained gley soils.

A freely drained Carpow Association soil (85) on a stony sandy gravel does not exhibit the low contents that might be expected from such a parent material, and its clay content of 20 per cent in the upper horizons is in keeping with levels of around 15 p.p.m. cobalt, 30 p.p.m. copper and 40 p.p.m. nickel. The extractable cobalt (0·8 p.p.m.) and copper (10–15 p.p.m.) levels in the upper horizons are both high and no deficiency problems are normally to be expected on soils of this association similar to the one examined, although the high pH (7·1) of this soil will undoubtedly restrict the uptake of cobalt and manganese to some extent.

The one soil examined from the Rowanhill Association (65), developed on mixed carboniferous sediments, has total contents of about 20 p.p.m. cobalt, 50 p.p.m. nickel, 40 p.p.m. copper, 800 p.p.m. manganese and 1 p.p.m. molybdenum, but these levels vary somewhat from horizon to horizon and generally there is appreciably more than the figures quoted in the surface horizon, in which 150 p.p.m. lead, 30 p.p.m. tin and 10 p.p.m. beryllium are reported. There is however no reason to suppose that these levels are likely to cause problems. The acetic-acid-extractable cobalt at 2·2 p.p.m., nickel at 3·0 p.p.m. and zinc at 14 p.p.m. and EDTA extractable copper at 10·7 p.p.m. are all somewhat above the normal levels in Scottish soils but do not approach excessively high values. No trace element problems should arise on this association provided the content of argillaceous sediment does not fall far below the level in this profile.

The raised beach sands and gravels of the Panbride Association are represented by one profile (89) of the freely drained series. The sub-surface total contents of 10 p.p.m. cobalt, 15 p.p.m. copper, 40 p.p.m. nickel and less than 1 p.p.m. molybdenum in this example suggest the possibility of slight cobalt and copper deficiencies on some soils of this association, but in this instance the surface horizon is adequately supplied with these elements, the extractable levels being 0·7 p.p.m. cobalt and 3·6 p.p.m. copper, both well above the deficiency criteria, even at pH 6·8.

The fluvioglacial sands of the Boyndie Association (75, 77) show the lowest total contents of cobalt and copper of the soils examined, with levels of 6–10 p.p.m. in the lower horizons in both cases. Again, however, accumulation in the surface horizons is sufficient in the profiles examined to provide adequate levels of extractable cobalt (0·7 p.p.m.) and copper (2·5 p.p.m.) even at relatively low loss-on-ignition values around 6 per cent. The low level of extractable manganese might result in some deficiency at high pH values, but this is probably unlikely at pH 5·5, the level in the surface horizons of the soils examined. The coarser fluvioglacial gravels of the Corby Association exemplified by profile 73 appear to be somewhat higher in total trace elements, with 15 p.p.m. cobalt, 40 p.p.m. copper and 50 p.p.m. nickel and this is borne out by slightly higher contents of extractable cobalt and copper in the lower horizons compared with Boyndie. There is little significant difference in the surface horizons.

A small area of Highland Schists in the north-west corner of the map carries soils of the Strichen Association, largely uncultivated. These soils have some 15 p.p.m. cobalt, 25 p.p.m. copper, 30 p.p.m. nickel, 1000 p.p.m. manganese, 1 p.p.m. molybdenum and quite normal contents of the other trace elements, all within the ranges expected for soils of this origin and in line with similar soils elsewhere, although such metamorphic parent materials are likely to be somewhat more variable than those from igneous rock. Adequate levels of extractable cobalt and copper occur in the surface horizons, although this is of little diagnostic value as the soils examined were uncultivated. The soils of the Gourdie Association adjoining those of the Strichen Association contain some ORS sediments and lava mixed with the schists but are not appreciably different in trace element content, such lavas as are present presumably being andesitic rather than basaltic.

Two profiles of the Laurencekirk Association (37, 39) from Old Red Sandstone marls show the trace element contents typical of argillaceous rocks, with cobalt around 30 p.p.m., nickel 60 p.p.m. and copper 50 p.p.m.; no problems should arise in these soils. The total contents in soils of the Kippen Association are possibly slightly lower, but adequate extractable levels should be present. A similar comment can be made regarding the profile (11) of the Foudland Association derived from argillaceous schist.

No attempt has been made to assess the boron status of any of the soils: deficiency of boron is probably unlikely in any of the associations examined unless they are excessively limed, but could possibly occur on some of the sands and gravels of fluvioglacial origin (e.g. Corby and Boyndie Associations).

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.

Chapter 7. Vegetation

The Tay basin contains a wide variety of ecological habitats ranging from the extensive dunes of the coast to the high ground of the Grampian foothills, Sidlaws and Ochils, and the plant communities found in the area are correspondingly numerous. In general, the lowlands of Strathmore and Fife are agricultural, with blocks of private and Commission-planted trees scattered throughout. Grassland is fairly extensive on most of the uncultivated land and sheep graze the dunes that extend from St. Andrews to Arbroath. Strips of broad-leaved woodland are found in the dens and around the large country houses. Moorland is confined to the tops of the higher hills and to the few remaining areas of peat on the low ground.

Climatically, the lowlands north of the Tay are one of the warmest regions in Scotland and this, together with the fertile nature of the soils, is responsible for the remarkable quality and size of the trees in the area. Dunkeld is famed both for its European and Japanese larch and as one of the places where natural crossing produced the hybrid larch. The tallest Douglas fir in Scotland is found here, and at nearby Murthly is the largest Sitka spruce. The beech hedge at Meikleour, which is over 80 feet high, is a well-known landmark, and Rossie Priory is noted for its hardwoods, especially sycamore and ash.

South of the Tay is Tents Muir Forest, one of the first Commission plantings in Scotland. The dune slack beyond the trees is the most southerly station on the east coast of Baltic rush (*Juncus balticus*), and is also one of the few east coast stations of seaside centaury (*Centaurium littorale*).

The liverwort *Calypogeia neesiana* was recorded for the first time in the vice-county (85) on the remnant moss at Prior Muir, and a new vice-county record (88) for *Calypogeia sphagnicola* was made on Methven Moss where the liverwort was found along with the white beak-sedge (*Rhynchospora alba*) and the mosses *Sphagnum molle* and *S. tenellum.*

METHODS

The countryside of the Tay has a very long history of settlement by man and very little vegetation remains today that has not been disturbed either by agriculture or by silviculture. The account which follows describes the natural or semi-natural vegetation of such areas as have been relatively undisturbed by man or where a sufficient period of time has elapsed since disturbance for the vegetation to have attained some degree of stability. It does not attempt to show the extent of the various plant communities in the form of a map, but lists and describes those communities found in the area surveyed which have been differentiated according to information drawn from a much wider area of Scotland (Appendix VI). The weed communities of arable fields are not included, nor are the earlier stages of pasture after cultivation. Figure 12

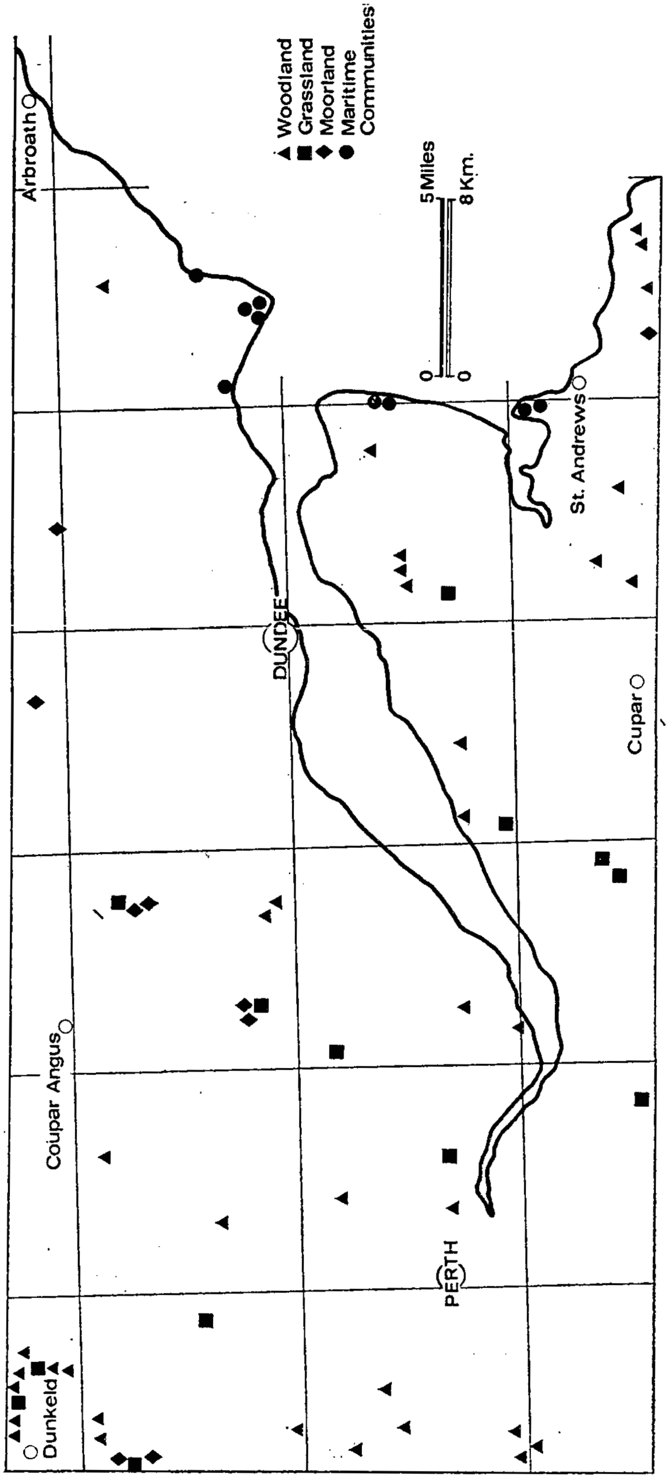


FIG. 12: Location of vegetation sites.

gives the location of vegetation sites examined. Many of the plant communities have already been described in detail in the vegetation chapters of earlier publications (Birse and Robertson, 1967, 1973; Robertson and Birse, in preparation), and in such cases only a brief description of the communities is given with a note of any changes resulting from the addition of more recent information. Communities not previously described are dealt with in full.

The methods of recording in the field and of analysing the data are based, with some minor modifications, on those of Poore (1955a and b).

Collection of Field Data

Homogeneous stands of natural and semi-natural vegetation are selected for investigation. Although the test of homogeneity is a subjective one and depends on the experience of the recorder or recorders, different recorders nevertheless usually arrive at approximately the same conclusion as to what is a uniform stand, and the method allows a relatively rapid survey to be carried out over large areas where more objective methods would be too time-consuming.

The vegetation described includes all communities on soils mapped by the soil survey but 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 conveniently be shown on a map of scale 1 inch equivalent to 1 mile.

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, 1955b).

The ratings for the scale are:

Cover about 100%	10
Cover >75%	9
Cover 50–75%	8
Cover 33–50%	7
Cover 25–33%	6
Abundant, cover about 20%	5
Abundant, cover about 5%	4
Scattered, cover small	3
Very scattered, cover small	2
Scarce, cover small	1
Isolated, cover small	X

The size of the original sample plot is then doubled to 2 square metres and any additional 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 area is doubled once more to 4 square metres and any species new to the original sample plot are recorded by the same procedure. As most of the species in the stand will now have been included, a further increase in the sample plot size is usually unnecessary, except possibly where there has been a considerable intake of new species in the 2 square metres to 4 square metres increase.

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 scrub 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 in Scotland many trees are planted and the canopy layer is thus artificial in composition. Although not forming part of the basic sampling unit, the tree and shrub layers are nevertheless very important constituents of woodland vegetation and are sampled in a circular area of radius 15 yards centred on the sampled 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 field and ground layer species, and in the text and tables are considered as separate species from the adult trees and shrubs.

Major sites characteristics are recorded for each sample area and include altitude, aspect and slope. The percentage cover of the different layers of the vegatation is noted, and also the height of the trees, shrubs and field layer.

A soil pit is dug and the profile exposed is described. The different horizons are sampled for laboratory analysis. The soil is then assigned to 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 for each stand are transferred to stiff cards for ease in grouping and regrouping into communities. Each card has a serial number and shows, in addition to the data described above, the date of collection and the locality and map reference. The serial number comprises the figures for the year of collection, omitting the century figures, followed by the number given to the stand in the 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 merely a convenient life-form grouping until such time as higher plant sociological units for Scotland are firmly established. One group of maritime communities and one of montane communities are also separated. Sub-division of groups is 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 similarly shown.

Five constancy classes for the presence of the species in the stands are defined as follows:

Presence in stands	Class
0–19%	I
20–39%	II
40–59%	III
60–79%	IV
80–100%	V

To ensure that the communities distinguished have a certain degree of homogeneity, an empirical test is applied to the floristic table constructed for each (McVean and Ratcliffe, 1962). For adequate homogeneity, the number of species in constancy class V (80–100 per cent) ought to exceed that of species in constancy class IV (60–79 per cent).

Within the communities a sub-division is made into facies, based on the presence or absence of certain species.

The total number of species is given for each stand, and also the total and average number of species per stand for each facies and community. In the case of the woodland communities, the total and average for the field and ground layers are given in brackets after the figures for the complete species list. Epiphytes on fallen branches are not included in these values and their totals are quoted separately.

New records are incorporated into the floristic tables as they are collected, and resulting change in presence values of species may alter the list of constant species and the designation of a facies of a community. In some communities this may even lead to division into two or more separate communities. Such "progressive approximation" (Poore, 1955b) will continue until adequate records of the range of a particular type of vegetation have been collected. This procedure also counteracts any tendency to base conclusions on data recorded from the restricted areas in which the communities were first established.

PLANT COMMUNITIES

WOODLAND COMMUNITIES

It is probable that at one time there was extensive forest cover of the area, dominated by deciduous trees such as oak, elm, alder and birch, but by the seventeenth century the pressures of felling, grazing and fuel gathering during the long history of settlement had resulted in an almost total depletion of the natural forest. Later woodlands, including most of those that exist today, were planted, for amenity and shelter round the many large country houses in the first instance but in more recent times as a commercial crop.

As a basis for drawing up the communities, the tree layer would have been unreliable, and so the species of the forest floor, including small shrubs and tree seedlings, have been used as the means of establishing and differentiating the separate woodland communities. This does not mean that the tree species are ignored; the canopy is both sampled and described along with the field and ground layers, although in a slightly different manner. In the account of every woodland not previously described in other memoirs, two sets of figures are quoted for the range, total and average numbers of species; the first represents the complete list of species, including the tree species, while the second applies to the field and ground species only.

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

(Base-rich Woodland)

This woodland community of base-rich soils has already been described in previous publications (Birse and Robertson, 1967, 1973; Robertson and Birse, in preparation). As a result of the inclusion of more recent quadrat data, however, *Cirriphyllum piliferum* becomes a class V constant and *Geum* *urbanum* is now no longer included in class IV. The two other constant species are *Eurhynchium striatum*, and *E. praelongum*; *Fraxinus excelsior* and *Mnium undulatum* remain in constancy class IV.

Stands were recorded from an altitudinal range of 20 to 675 feet. The community is found largely on alluvial terraces and on river banks where the river has cut through till, and the slopes vary correspondingly from 0 to 32 degrees. Aspect is determined by the course of drainage system and has no apparent influence on the occurrence of the community.

The soils are predominantly freely drained brown forest soils but range to poorly drained non-calcareous gleys. Two stands were recorded on brown calcareous soils. The pH of the surface horizon varies between 4·4 and 7·6, but the modal value is in the region of 5·3. Base saturation is generally over 50 per cent, and some of the soils are fully saturated with bases. The level of exchangeable calcium is usually high and the magnesium level medium.

Cirriphyllum piliferum is also a constant of the *Geum urbanum* facies and there are three additional class IV constants—*Acer pseudoplatanus*, *Fraxinus excelsior* seedlings and *Galium aparine*. Five stands were recorded in this area from Campsie Wood, Paddockmuir Wood, Greenhill, Flisk Point and Rossie Hill, on soils of the Drumforber, Stirling, Garvock, Carey and Darleith series respectively. *Geum urbanum* dominates the field layer in the Paddockmuir Wood stand but is absent from the quadrat recorded at Flisk Point. The Rossie Hill stand occurs on a brown calcareous soil with a very high exchangeable calcium value (60 m.e./100 g.) and a surface horizon pH of 7·6, due in part to the presence of old wall rubble and mortar on the site.

In the *Mercurialis perennis* facies, which is otherwise unaltered, *Dryopteris filix-mas* becomes a class IV constant. Quadrats were recorded from Dura Den, Boarhills and Rossie Hill. The broad-leaved woodlands at Dura Den and Boarhills are found on narrow alluvial terraces and mark the site of old mill lades which are an interesting feature of this part of Fife. One of the Boarhills stands is on an imperfectly drained soil of the Caprington series and the Rossie Hill quadrat on a Darleith brown forest soil.

Woodland with *Holcus mollis* and *Dryopteris dilatata*

As described in the vegetation chapters of the earlier memoirs, this lowland community is defined by the presence of three constant species—*Dryopteris dilatata, Holcus mollis,* and *Oxalis acetosella,* and two class IV constants—*Galium saxatile,* and *Eurhynchium praelongum.*

The community is found at altitudes ranging from near sea level to the present highest record height of 630 feet, and is usually on gentle slopes, although a few stands have been recorded on slopes of over 20 degrees. The soils are mainly low base status brown forest soils, freely or imperfectly drained. Three stands in one facies were recorded on poorly drained acid gleys. The surface pH varies from 3·7 to 4·6 and the modal value is approximately 4·1.

The community as a whole is much as described in earlier memoirs, but in the facies characterized by the constant presence of *Endymion non-scriptus*, *Eurhynchium praelongum* is no longer a constancy class IV species. One stand of this facies was recorded in Kemback Wood on a slope of 23 degrees. The tree canopy is mixed oak and the field layer is dominated by *Holcus mollis*. The soil is the most acid member of the community, with a surface pH of 3·7, and is most closely related to the Greenside series which has been mapped nearby.

The second facies with abundant *Lonicera periclymenum* was not found in the area, but four stands of the third facies common to coniferous plantations were recorded in Bishop's Wood, Dunmore, Morendy Wood and Tentsmuir Forest. Three of these stands occur in Scots pine plantations and the fourth, at Dunmore, is dominated by European larch. *Pseudoscleorpodium purum* is present in all four stands and dominates the ground layer of the Dunmore quadrat. The soils are all brown forest soils and those from Bishop's Wood, Morendy Wood and Tentsmuir Forest have gleyed B and C horizons and have been mapped as Winton series, Kirkbuddo series and Links respectively. The soil at Dunmore is freely drained and is a member of the Fungarth series.

Woodland with *Dryopteris* and *Rubus*

This community has already been described by Birse and Robertson (1973). The constant species are *Rubus fruticosus* agg., *Dryopteris dilatata*, *Chamaenerion angustifolium* and the moss *Eurhynchium praelongum*. Revision of the community on the basis of further quadrat data has resulted in the inclusion of *Oxalis acetosella* as a class IV constant along with *Rubus idaeus* and the tree *Pinus sylvestris*.

No stands have yet been recorded above 650 feet and the community is considered to be 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 are predominantly freely or imperfectly drained brown forest soils of low base status, but one stand was recorded on an acid gley and another on drained peat. The surface pH values range from 3·6 to 5·0 and there appear to be two distinct groups with modal values of 3·8 and 4·6.

This type of woodland is often found on old agricultural land, and three such stands were recorded from the area. The first two, from Links Wood and Black Wood, belong to the *Viola riviniana* facies and the soils have a surface pH of 3·8 and 4·6 respectively. The Links Wood soil has developed from a podzol of the Auchenblae series and the Black Wood soil is a member of the Balrownie series. There is little indication in the vegetation of this difference in acidity other than the occurrence of isolated ash and beech trees in the Black Wood stand. The third stand, from Morendy Wood, is a member of the *Mnium hornum* facies where the soil has been mapped as the Auchenblae series. All three stands occur in plantations of Scots pine in which sycamore is also present.

Woodland with *Holcus mollis* and *Anthoxanthum odoratum*

Detailed descriptions of this oakwood community can be found in the previous publications. The constant species are the grasses *Holcus mollis* and *Anthoxanthum odoratum*, the forbs *Galium saxatile* and *Oxalis acetosella*, and the mosses *Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus*.

There are also four constancy class IV species—*Pteridium aquilinum*, *Agrostis tenuis*, *Viola riviniana* and *Lophocolea bidentata*.

The addition of further stands to the community has increased the total number of species to 145 (123) and there are also fourteen epiphytes which are found only on fallen branches or on old tree stumps.

The community is mainly a lowland type, but one stand has been included from a birchwood at an altitude of 1350 feet. The habitat is one of moderately steep valley sides; most of the stands recorded are on slopes of more than 10 degrees, although some are on more level ground. The majority of the soils are freely drained brown forest soils of low base status, but there are two soils with imperfect drainage and two podzols. Surface pH ranges from 3·8 to 5·3.

The first, grassy facies differs from previous descriptions in that *Galium saxatile* is no longer a class V constant, dropping to constancy class IV. This facies is a common woodland type in the area and five stands were recorded, from East Cult, Meikleour, Dun Knock, Blairbell and Rossie Hill. The tree canopy is dominated by oak except in the stand on Rossie Hill which is located in a Scots pine plantation. The soils are all freely drained brown forest soils of low base status with a surface pH of 4·1 to 4·7 and are included in the Snaigow (East Cult), Gleneagles (Dun Knock) and Darleith (Blairbell and Rossie Hill) series. The oak and beech trees at Meikleour are part of a policies woodland planted in the mid-eighteenth century, and the low base status brown forest soil under them has been included in the Boyndie Association.

The second facies is now characterized by the constant presence of *Pteridium aquilinum*, together with *Holcus mollis*, *Galium saxatile*, *Oxalis acetosella* and *Lophocolea bidentata*. There are also large groups of class IV constants—*Betula pubescens*, *Anthoxanthum odoratum*, *Deschampsia flexuosa*, *Viola riviniana* and the mosses *Hylocomium splendens*, *Pseudoscleropodium purum*, *Rhytidiadelphus squarrosus*, *R. triquetrus* and *Thuidium tamariscinum*.

One stand was recorded in an oakwood at East Cult, Caputh. The field layer is dominated by *Melampyrum pratense* and there is abundant *Deschampsia flexuosa*. The soil is freely drained with a surface pH of 3·9, and belongs to the Snaigow series.

Woodland with *Anthoxanthum odoratum* and *Agrostis tenuis*

This rather variable community of birch and oakwood, which is briefly described in the vegetation chapters of earlier memoirs, is closely related to the woodland community with *Holcus mollis* and *Anthoxanthum odoratum*, but is distinguished from it by the constant presence of *Agrostis tenuis* and the absence of *H. mollis*. In addition to *Anthoxanthum* and *Agrostis tenuis*, *Deschampsia flexuosa*, *Oxalis acetosella*, *Luzula pilosa*, *Galium saxatile*, *Viola riviniana* and the bryophytes *Hylocomium splendens* and *Lophocolea bidentata* are class V constants; *Pteridium aquilinum*, *Agrostis canina*, *Hypericum pulchrum* and the mosses *Pleurozium schreberi*, *Pseudoscleropodium purum* and *Rhytidiadelphus triquetrus* are constancy class IV species.

Only seven stands have been included in this community so far and definition of its full range and composition must wait until further information is collected. The number of species per stand meantime varies between 20 and

38 (19 and 36), the average is 29 (27) and the total number of species is 90 (82). The lichens *Evernia prunastri*, *Parmelia physodes* and *Usnea* sp. occur as epiphytes on fallen branches.

The stands were recorded from an altitudinal range of 120 to 750 feet on flat terraces and moderate to steep valley slopes. The soils are freely drained brown forest soils, but there is a considerable range in the base saturation of their surface horizons from 8·4 to 92·1 per cent, and the surface pH varies correspondingly from 4·1 to 6·3. The level of exchangeable calcium present is low in all but the high base status soils and the exchangeable magnesium values are medium. One stand was recorded on dried-out basin peat with a surface pH of 3·8.

The canopy is usually that of birch or oak and its cover is relatively low, being less than 60 per cent in all but one instance. The field layer is dominated by grasses of which *Agrostis tenuis*, *Anthoxanthum odoratum* and *Deschampsia flexuosa* are the most consistently abundant species. *Agrostis canina* and *Festuca ovina* occur less frequently, but are abundant in individual stands. The forb *Oxalis acetosella* is dominant in one instance. Composition of the ground layer is very variable, and in any one stand the most abundant moss may be *Hylocomium splendens*, *Pseudoscleropodium purum*, *Rhytidiadelphus triquetrus* or *Thuidium tamariscinum*. The ground cover ranges from 20 to 98 per cent.

One stand of this community was noted in Birnam Wood under mixed birch scrub (*Betula pendula* and *B. pubescens*) on a soil of the Fungarth series.

In the Highlands, the *Betula* herb *nodum* (McVean and Ratcliffe, 1962) is the nearest counterpart to this community. It has five constants, *Anthoxanthum odoratum*, *Oxalis acetosella*, *Galium saxatile*, *Viola riviniana*, and *Hylocomium splendens*, in common with the *Anthoxanthum odoratum—Agrostis tenuis* woodland.

Outwith the Scottish border, the sessile oakwoods in Wales and Ireland as described by Tansley (1953) are very similar to this community.

Woodland with *Vaccinium myrtillus*

The community of mixed oak and birchwood dominated by *Vaccinium myrtillus* is very common on podzolic soils and has been described at length in the previous publications. Revision and the addition of five stands to the original data has slightly altered the presence values of a few species, however, and the constants are now *Vaccinium myrtillus*, *Deschampsia flexuosa*, *Hylocomium splendens* and *Pleurozium schreberi*, whilst *Luzula pilosa*, *Hypnum cupressiforme* (including the variety *ericetorum*) and *Lophocolea bidentata* are class IV constants.

The altitudinal range recorded is 130 to 1350 feet, but the community probably extends to the upper limit of tree growth. The habitat is one of uneven, often boulder terrain unsuitable for cultivation and the slopes vary from level ground to 20 degrees.

The soils are freely drained acid brown soils, iron podzols and humus iron podzols, although there are a few with impeded drainage. Profiles are generally shallow, terminating in bedrock or shattered boulders at depths ranging from 5 to 36 inches. The pH of the H or A horizons varies between

3·4 and 4·6 and the modal value is approximately 3·9. Base saturation is less than 30 per cent and the soils are usually low in exchangeable calcium and magnesium except when enriched by flush water.

Two facies have been separated on the presence or absence of *Oxalis acetosella*. The first, with constant *Oxalis*, is very similar to that already described in other memoirs except that *Betula pubescens*, *Calluna vulgaris* and the epiphyte *Parmelia physodes* are now constancy class IV species. One stand was recorded in a mixed oakwood at Etnie Brae where the trees have regenerated from stools and are now about 70 years old. The soil is a brown forest soil of low base status of the Fungarth series.

In the second, species-poor, facies *Hylocomium splendens* has become a class V constant in place of *Pleurozium schreberi* which drops to class IV. *Calluna* is no longer a constancy class IV species. Four stands were described in the area from Kinnoull Hill, Stenton, Blairbell and Birnam. The Kinnoull Hill quadrat lies in a very open scrub of oak, birch and mountain ash where the old trees have only recently been felled and the wood is in an early stage of regeneration. The soil is a low base status brown forest soil of the Sourhope series. The stands at Stenton and Blairbell both occur in mixed oakwood on shallow brown forest soils of the Darleith series, while the stand at Birnam is in a very young plantation of Scots pine and European larch on an iron podzol of the Strichen series.

Woodland with *Deschampsia flexuosa*

A community closely related to the *Vaccinium myrtillus* woodland has been distinguished by the absence of *V. myrtillus* and the constant presence of *Deschampsia flexuosa*, which is nearly always the most abundant species in the field layer. Occasionally it is found like *Vaccinium myrtillus* woodland in an oak and birchwood, but it occurs more commonly under dense stands of planted conifers. The mosses *Hylocomium splendens* and *Pleurozium schreberi* are class V constants in this community also and the constancy class IV species are *Pinus sylvestris*, *Luzula pilosa*, *Galium saxatile*, *Hypnum cupressiforme* var. *ericetorum* and the epiphytic lichen *Parmelia physodes*.

In the ten stands so far recorded, the number of species per stand ranges from 12 to 30 (11 to 28), the average is 21 (19) and there are 85 (76) species in the community. Six epiphytic liverworts and lichens occur on fallen branches, while two other species were recorded both as epiphytes and as members of the ground layer.

The recorded range in altitude is 200 to 780 feet and the stands occur on level ground or on slopes, generally north-facing, of up to 20 degrees. The soils are freely drained iron or humus iron podzols, but two low base status brown forest soils and one imperfectly drained podzol were also noted. The surface pH ranges from 3·5 to 4·4 and the base saturation does not exceed 16 per cent. Below the F and H horizons, the soils are low or deficient in exchangeable calcium and have low to medium levels of exchangeable magnesium and total phosphate. The carbon-nitrogen ratios are all greater than 18.

The tree canopy is usually *Pinus sylvestris*, although some stands are dominated by *Betula pubescens* or *Quercus robur*, and the cover is usually over 50 per cent.

The composition of the field layer is influenced by the density of the tree cover and the acid nature of the litter, and the stands are species-poor. *Deschampsia flexuosa* is often the only abundant species, with the class IV constants, *Luzula pilosa,* and *Galium saxatile*, occurring as scattered individuals. *Lonicera periclymenum* and *Pteridium aquilinum* have high cover values in two stands, and *Dryopteris dilatata*, *Festuca ovina*, *Oxalis acetosella* and *Trientalis europaea* are the only other important elements.

Hylocomium splendens and *Pleurozium schreberi* generally make up the greater part of the ground cover, which ranges from 40 to 90 per cent, but carpets of *Lophocolea bidentata* and *Rhytidiadelphus triquetrus* may dominate individual stands and there is often abundant *Pseudoscleropodium purum.* The epiphytic lichen *Parmelia physodes* is commonly found on fallen branches, but has low cover-abundance values.

Four stands of this woodland community have been recorded, at Dupplin Lake, Almondbank, Bonnytown and Greenhill. The woodland beside Dupplin Lake is a strip of very old pine and oak trees over 70 feet tall. Under their open canopy, the field layer is relatively rich in species and *Vaccinium mrytillus* is present. The soil is a freely drained brown forest soil of the Airntully series (Forfar) which has not been mapped in this area. The presence of *Vaccinium myrtillus* suggests that this stand is a transition between the *Deschampsia flexuosa* and *Vaccinium myrtillus* woodland communities. The Almondbank stand occurs in an old beechwood with an understory of oak, and the mosses *Dicranum majus*, *Mnium hornum* and *Polytrichum aurantiacum* are the abundant species of the ground layer. The soil is a freely drained brown forest soil of the Buchanyhill series. At Bonnytown, old birch woodland has been cleared and replanted with Scots pine and Sitka spruce. The soil here is an imperfectly drained podzol which has developed from a gleyed brown forest soil of the Caprington series. The Greenhill quadrat was recorded in a 25 year old Scots pine plantation in which *Deschampsia flexuosa* forms wide patches of pure stands with abundant *Hypnum cupressiforme* var. *ericetorum* in the ground layer. The soil is an iron podzol of the Frandy series (Sourhope), and, because of its limited extent, has not been mapped.

The *Deschampsia flexuosa* woodland contains a number of different elements which may eventually, when further information is collected, be separated as facies. Because of the variety of elements, comparison with communities recognized by other authors is not wholly significant, but in general the equivalents are the same as in the *Vaccinium myrtillus* woodland. The group of stands under pine correspond most closely to the triquetrosum facies of the Highland Pinetum Hylocomieto-Vaccinetum (McVean and Ratcliffe, 1962). Although they have only one constant, *Hylocomium splendens*, in common, the species lists of the two are very similar.

In England, the communities most like the *Deschampsia flexuosa* woodland are the heathy oakwoods of the Pennines and the oak-birch heath of Southern England.

Woodland with *Calluna vulgaris* and *Erica cinerea*

This community of pine plantations is very closely related to both the *Vaccinium myrtillus* and the *Deschampsia flexuosa* woodlands and only differs from the latter in having constant *Calluna vulgaris* and *Erica cinerea*, either of which may be dominant.

Only five stands have been described but, apart from a tendency to occur on south-facing rather than north-facing slopes, their habitat characteristics are identical to those of *Deschampsia flexuosa* woodland.

One stand was recorded in a Scots pine plantation at Spoutwells, Scone. The soil is an imperfectly drained podzol of the Muirhead series (Balrownie) which has not been mapped in the area.

Equivalent communities described by other authors are as quoted for the *Deschampsia flexuosa* woodland.

Woodland with *Deschampsia cespitosa*

A fern and herb-rich woodland community dominated by *Deschampsia cespitosa* has already been described in the earlier publications. The constant species are *Deschampsia cespitosa* and the bryophytes *Eurhynchium praelongum*, *Thuidium tamariscinum* and *Lophocolea bidentata*, while *Dryopteris dilatata*, *Oxalis acetosella* and *Viola riviniana* are constancy class IV species. The presence value of *Holcus lanatus* has been reduced by the addition of recent quadrat data and is no longer a class IV constant.

Fourteen stands have been recorded from an altitudinal range of 60 to 850 feet on gentle, north-facing slopes. The habitat is often one of shallow, wet depressions, influenced by high water tables or flushing, and the soils are imperfectly drained brown forest soils with gleyed B and C horizons or poorly drained non-calcareous gleys. The base saturation of the A horizon varies from less than 10 to 67·6 per cent and the pH range is from 3·8 to 5·6. The level of exchangeable calcium in the soils is low to medium and that of exchangeable magnesium is medium. The carbon-nitrogen ratios are all greater than 13 and the amount of total phosphorus present ranges from 49 to 160 m.e./100 g.

Two stands of the *Rytidiadelphus squarrosus* facies were found, in Morrishill Wood and at Dupplin Lake. The first is in a mixed wood of ash and birch where the undergrowth has been cleared and the ground planted with Norway spruce and beech. The soil is an imperfectly drained brown forest soil of the Laurencekirk series. The second stand, at Dupplin Lake, is dominated by alder and there is abundant *Oxalis acetosella* in the field layer. The soil is a moderate base status surface water gley ascribed to the Vigean series.

The second, fern-rich facies is one of mixed birch and alder woodland and six of the seven facies stands were recorded from the area. Three stands, at Letter Hill, Dhu Loch and Murrayfield, are dominated by alder and the soils are non-calcareous gleys with surface pH ranging from 3·9 to 5·2. The soils of the Letter Hill and Dhu Loch sites are water-modified variants of the Anniegathel series and the Murrayfield stand occurs on an acid gley of the Lour series. Birch dominates the stand in Bishop's Wood where the soil is a Rowanhill gley. Drier soils of the Balrownie series underlie the quadrats in Ancothie Wood and at Drumcairn and were probably cultivated in the past. The tree canopy in Ancothie Wood is oak and birch, whereas the Drumcairn stand is located in a 30-year old Scots pine plantation.

Woodland with *Juncus acutiflorus*

A very fragmentary flush community of wet woodland has been distinguished by the constant presence of dominant *Juncus acutiflorus*. In the four stands so far recorded, *Salix cinerea* ssp. *atrocinerea*, *Agrostis canina* ssp. *canina*, *Holcus lanatus*, *Epilobium palustre*, *Potentilla erecta* and the mosses *Brachythecium rutabulum*, *Eurhynchium praelongum* and *Rhytidiadelphus squarrosus* are always present.

The number of species per stand ranges from 21 to 30 (19 to 28), the average is 28 (25) and the total number of species in the community is 55 (50). *Parmelia physodes* and *P. sulcata* occur as epiphytes on fallen branches in one stand.

Three stands were found between 340 and 600 feet on moderate, north-facing slopes where the soils are poorly drained non-calcareous gleys with a surface pH ranging from 4·5 to 5·2. The fourth was recorded on a level basin peat with a surface pH of 5·5. Exchangeable calcium and magnesium values are high in all but the most acid of the gleys.

A shrub layer of *Salix cinerea* ssp. *atrocinerea* is a constant element of the canopy, but in individual stands *Alnus glutinosa*, *Betula pendula* and *B. pubescens* are more abundant.

Juncus acutiflorus dominates the field layer and its dense root system probably has a restricting effect on the abundance of other species. Although the stands are grass and herb-rich, *Agrostis canina* ssp. *canina* and *Anemone nemorosa* are the only other species with high cover values.

The three constant mosses, *Brachythecium rutabulum*, *Eurhynchium praelongum* and *Rytidiadelphus squarrosus*, form the bulk of the ground cover, which varies between 40 and 75 per cent. *Thuidium tamariscinum* dominates in one stand.

All thee stands on the non-calcareous gleys were recorded from the area around Letter Hill, near Dunkeld. The soils belong to the Anniegathel series, although the first is very poorly drained and has been water-modified.

Woodland with *Filipendula ulmaria* and *Angelica sylvestris*

A further group of stands found in wet scrub woodland has been tentatively separated as a community on the basis of the constant presence of *Filipendula ulmaria* and *Angelica sylvestris*. Other class V constants are *Epilobium palustre*, *Galium palustre* and the moss *Acrocladium cuspidatum*. There are also four class IV constants, *Poa trivialis*, *Ranunculus repens*, *Eurhynchium praelongum* and *Lophocolea bidentata*.

Five stands have been noted, with a range in species of 14 to 29 (14 to 27). The average number per stand is 22 (21) and there are 69 (66) species in all. The epiphytic lichens *Evernia prunastri*, *Parmelia physodes*, and *Usnea subfloridana* occur on fallen branches.

The stands recorded so far occur in an altitudinal range of 8 to 750 feet, and the habitat is one of wet, often peaty, hollows which receive drainage water rich in bases; one stand, however, was recorded on a flushed peat on a slope of 15 degrees. The soils are non-calcareous gleys or peats with medium to high levels of base saturation, exchangeable calcium and magnesium and the surface pH values range from 4·9 to 6·1.

The cover provided by the tree layer is somewhat variable. It is absent altogether in one stand and ranges from 10 to 75 per cent in the others. The canopy is of *Alnus glutinosa*, *Betula pubescens* or *Salix cinerea* ssp. *atrocinerea* and the trees seldom attain a height of more than 40 feet.

The field layer may be dominated by *Juncus acutiflorus*, *Caltha palustris*, *Filipendula ulmaria*, *Menyanthes trifoliata* or *Ranunculus repens* and its cover is often complete.

Acroladium cuspidatum is the most important element of the ground layer and dominates in two instances, but *Mnium undulatum*, *Climacium dendroides*, *Cratoneuron filicinum*, *Eurhynchium praelongum* or *Lophocolea bidentata*, though less constant, may be abundant in individual stands.

One stand was recorded in an alderwood at Methven on a non-calcareous gley of the Muirfoot series. *Ranunculus repens* dominates the field layer here, and there is abundant *Viola palustris*, *Galium palustre* and *Poa trivialis*. *Filipendula ulmaria* only occurs in the vicinity of the quadrat and *Angelica sylvestris* is absent altogether, but the remaining species are sufficiently similar to the rest of the community for the stand to be included. *Eurhynchium praelongum* is the most abundant moss in the ground layer.

The woodland communities of *Deschampsia cespitosa*, *Juncus acutiflorus* and *Filipendula ulmaria–Angelica sylvestris* are closely inter-related, but their field layers tend to be heterogeneous, due to irregular topography, range in base status and degree of drainage. They may be regarded as part of the alderwood of McVean and Ratcliffe (1962), although the drier stands of the *Deschampsia cespitosa* woodland correspond more closely to the mixed deciduous woodland described by these authors.

Comparison with communities further south reveals a resemblance to phases of the *Filipendula ulmaria* society of pedunculate oakwood in Cambridgeshire and the alderwoods of southern England (Tansley, 1953).

PASTURE COMMUNITIES

Agrostic-Festuca Basic Grassland

The basic grassland community is found on soils derived from base-rich parent material and this is reflected in the vegetation by the presence of a strong calcicolous or basiphilous element. The community is described in detail in the accounts of the vegetation of other areas. Slight changes in the presence values of some species caused by the inclusion of three additional lists have resulted in *Festuca rubra* becoming a class V constant and *Pseudoscleropodium purum* dropping to class IV. The twelve constant species are the grasses *Agrostis tenuis*, *Festuca ovina*, *F. rubra* 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 mosses *Hylocomium splendens* and *Rhytidiadelphus squarrosus*. There are nine class IV constants.

The stands were recorded at altitudes between 20 feet and 850 feet, and the habitat is generally one of steep, south-facing slopes. The soil profiles are often shallow and associated with outcrops of basic lava flows, and the soils themselves are all freely drained brown forest soils. With the exception of three low base status soils, all have base saturation values of over 50 per cent in their surface horizons and a range in pH of 5·2 to 6·7. One of the soils, a brown calcareous soil, has a high level of exchangeable calcium and three others, derived from ultrabasic rocks, have large amounts of exchangeable magnesium in their A horizons, but in the other soils the values for these elements are generally only medium.

Two stands were recorded in the area, from Lundie Craigs and Dunbog Hill. On Lundie Craigs, the basic grassland is growing on a creep soil of the Darleith series, while on Dunbog Hill the soil is a shallow low base status brown forest soil of the Sourhope series. Both stands are subjected to grazing by sheep.

Agrostis-Festuca Meadow Grassland

A community, usually of old ley pasture grazed by sheep and cattle, has been distinguished from the basic and acid *Agrostis–Festuca* grasslands by the presence of sown-out species. It has already been described by Birse and Robertson (1973), but revision has reduced the number of constant species to seven, these being the grasses *Agrostis tenuis*, *Cynosurus cristatus*, *Festuca rubra*, *Holcus lanatus* and *Poa pratensis* and the forbs *Cerastium holosteoides* and *Trifolium repens*. The grasses *Anthoxanthum odoratum* and *Poa trivalis*, the field woodrush, *Luzula campestris*, the forbs *Plantago lanceolata* and *Veronica chamaedrys* and the moss *Rhytidiadelphus squarrosus* are constancy class IV species.

So far, the community has been found at altitudes between 50 feet and 925 feet on gentle to moderate slopes up to 19 degrees. The soils are freely to imperfectly drained brown forest soils, with a range in pH between 5·0 and 6·1 in their A horizons. The level of base saturation in all but three of the surface samples is over 50 per cent, the exchangeable calcium values are high and the magnesium values medium.

Two facies have now been differentiated by the constant presence of *Lolium perenne* on the one hand and of *Potentilla erecta* on the other. The difference is largely one of age. The *Lolium perenne* facies represents a younger pasture in which a high proportion of the sown-out species is still an important element. Besides *Lolium*, *Dactylis glomerata* is also constant but with variable cover-abundance. *Poa trivalis* often dominates the field layer and *Phleum pratense*, although never very abundant, is a class IV constant. *Ranunculus bulbosus* can have high cover values in some stands and *Eurhynchium praelongum* is the most frequently found moss in the ground layer.

The *Potentilla* facies is comprised of stands from older pasture where some of the sown-out species have died out and those that remain have formed a stable community with the natural grasses. The community constants—with the exception of *Poa pratensis*—are also constant in the facies, together with *Anthoxanthum odoratum*, *Luzula campestris*, *Potentilla erecta* and *Rhytidiadelphus squarrosus*. *Dactylis glomerata*, *Phleum pratense*, *Ranunculus bulbosus* and *Eurhynchium praelongum* are usually absent.

Two stands were recorded from the area. In the first, on Letter Hill, there are traces of a woodland element in the presence of scattered plants of *Oxalis acetosella* and *Potentilla sterilis* and nearby birch trees. The soil is a rather acid brown forest soil with gleyed B and C horizons, a member of the

Baikes series (Strichen) which is of limited extent here and has not been mapped. The second stand, near The Binn Farm, Kinfauns was found in a clearing amongst gorse scrub. The soil is a freely drained brown forest soil of the Sourhope series.

Agrostis-Festuca Acid Grassland

This community has been described in detail in three earlier publications It is a semi-natural community of some economic importance because of its grazing value for sheep, and it forms a considerable part of the rough grazing on Scottish hills. There are eight constant species, namely the grasses *Agrostis tenuis*, *Anthoxanthum odoratum* and *Festuca ovina*, the field woodrush, *Luzula campestris*, the forbs *Galium saxatile* and *Potentilla erecta* and the mosses *Hylocomium splendens* and *Rhytidiadelphus squarrosus*. *Veronica officinalis*, *Pleurozium schreberi* and *Pseudoscleropodium purum* are class IV constants.

Stands were recorded from an altitudinal range of 6 to 1050 feet on moderate to moderately steep slopes, but occasionally the sites are gently or steeply sloping. The soils are freely or imperfectly drained brown forest soils, although some are more podzolized, and the level of base saturation in the surface horizon is usually less than 40 per cent. Surface pH ranges from 3·8 to 6·3, but values lie mostly between 4·2 and 5·3 and the modal pH is approximately 4·7.

As previously mentioned, there is some difficulty in separating the intergrading stands of this community into different facies, but for convenience of description four divisions have been made. The first is characterized by the presence of *Thymus drucei* and *Carex caryophyllea* which are exclusive to the facies. The eight community constants are also constant here, together with *Thymus drucei*, *Trifolium repens* and *Veronica officinalis*. *Carex caryophyllea*, *Achille millefolium*, *Campanula rotundifolia*, *Viola riviniana* and the mosses *Hypnum cupressiforme* var. *ericetorum*, *Pleurozium schreberi* and *Pseudoscleropodium purum* are constancy class IV species. The soils are of slightly better base status than those of the other facies, the stands are more species-rich, and the forb element contributes more to the cover of the field layer. This facies corresponds to the *Trifolium repens–Thymus drucei* facies of previous descriptions. One stand was recorded, on the lower slopes of the Obney Hills. Besides the dominant grassy element, *Pteridium aquilinum*, *Campanula rotundifolia*, *Carex caryophyllea*, *Galium saxatile* and the moss *Dicranum scoparium* are abundant species. The soil beneath the quadrat is a very stony imperfectly drained brown forest soil of the Baikes series (Strichen), but the dominant soil type around it is more podzolic and has been mapped as the Obney series.

The second facies is closely related to the *Agrostis–Festuca* meadow grassland, and probably occurs as a transition where old ley pasture has run out into acid grassland. The sites may also have been affected by former woodland. The facies is defined by the presence of *Holcus mollis* and *Poa pratensis*, but the species are only preferential to it and can occur in other facies as well. In addition to the constants of the community, *Holcus lanatus* and the moss *Pseudoscleropooium purum* are class V constants. The constancy class IV species are *Agrostis canina* ssp. *montana, Festuca rubra, Poa pratensis* and *Viola riviniana.*

Grasses again dominate the field layer and the most consistently abundant is *Agrostis tenuis*. The remaining species do not contribute greatly to the cover, with the exception of *Galium saxatile, Potentilla erecta* and, occasionally, *Luzula campestris* and *Pteridium aquilinum.*

The ground cover is almost entirely of *Hylocomium splendens, Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus.*

Two stands were recorded from Letter Hill on freely drained low base status brown forest soils derived from slaty schists. The soils are most closely akin to the Ettenbreck series (Foudland), but the general soil type is a shallow podzol which has been mapped as skeletal Strichen. The first quadrat is probably affected by former open woodland and contains abundant *Deschampsia flexuosa. Luzula pilosa* and *Trientalis europaea* are also present, and *Pleurozium schreberi* is the dominant moss of the ground layer. In the second quadrat, the presence of *Carex panicea* indicates slight flushing.

The third facies is defined by the presence of a heathy element. *Deschampsia flexuosa* and *Pleurozium schreberi* are constancy class V species in addition to those of the community, and *Vaccinium myrtillus, Dicranum scoparium, Hypnum cupressiforme* var. *ericetorum* and *Pseudoscleropodium purum* are class IV constants. The soils are all freely drained brown forest soils of low base status, but are generally more acid and podzolized than the soils of the other facies. This slight difference is being eradicated by the present surface treatment with lime and fertilizers.

Four stands were examined in the area. The first on West Hill near Abernyte was found on a soil of the Darleith series which has a surface pH of 6·3 and a base saturation of 83·3 per cent in its surface horizon due to the application of lime. The heavy grazing intensity is ousting the once abundant *Calluna* and species indicative of a better base status, such as *Galium verum* and *Veronica chamaedrys,* are present. Two stands, from Ballomill and Crumblie Hill, occur on the Sourhope series, and in each the ground layer is dominated by *Pleurozium schreberi.* The fourth stand was recorded at Dunmore on a soil of the Fungarth series which, because of its limited extent, has been included with the podzol of the Strichen series which surrounds it.

Two stands of dune pasture with *Carex arenaria* have been separated as a fourth facies, but both occur outwith the area.

Nardus Grassland

The *Nardus* grassland has been described before and is very similar to the *Agrostis–Festuca* acid grassland. It is, however, a community of more acid soils and can occur at much greater altitudes. The constant species are the grasses *Agrostis canina* ssp. *montana, Anthoxanthum odoratum, Festuca ovina,* and *Nardus stricta,* the forbs *Galium saxatile* and *Potentilla erecta* and the mosses *Pleurozium schreberi* and *Rhytidiadelphus squarrosus. Vaccinium myrtillus, Deschampsia flexuosa, Juncus squarrosus, Luzula multiflora* and *Hypnum cupressiforme* var. *ericetorum* are class IV constants.

Stands were recorded from an altitudinal range of 460 to 1750 feet on slopes of 0 to 30 degrees. There is a very wide range in soils from freely drained brown forest soils to poorly drained peaty gleys and hill peat, but all are acid and base deficient in the surface horizon. The surface pH varies between 3·8 and 5·6 and the modal value is approximately 4·2. Exchangeable calcium values in the A horizons tend to be low and magnesium values low to medium.

The first facies of the community, characterized by the constant presence of *Sieglingia decumbens*, is as described in earlier accounts but there has been a slight alteration in the composition of the second and third facies.

The second facies is defined by the constant presence of the differential species *Polytrichum commune*, and other constants include those of the community, together with *Deschampsia flexuosa*, *Luzula multiflora* and *Hypnum cupressiforme* var. *ericetorum*. The class IV species are *Vaccinium myrtillus*, *Juncus squarrosus* and *Plagiothecium undulatum*.

The habitat characteristics are broadly those of the community, but the soils are the most acid of the community and generally the least fertile. *Nardus stricta* is usually dominant and, with abundant *Deschampsia flexuosa* and *Festuca ovina*, provides the bulk of the field cover. *Vaccinium myrtillus*, *Juncus squarrosus* and *Galium saxatile* all have relatively high cover values in some stands. *Polytrichum commune*, *Pleurozium schreberi* and *Rhytidiadelphus squarrosus* are the most abundant mosses of the ground layer.

One stand of the *Polytrichum commune* facies was found at White Myre, Glen of Rait on an imperfectly drained brown forest soil of the Mountboy series. The field layer contains abundant *Galium saxatile*, and *Carex panicea* and *C. nigra* are present.

The third facies consists of the stands in which there is neither *Sieglingia decumbens* nor *Polytrichum commune*. It was not found in the area.

Vaccinium myrtillus Heath

Two stands of vegetation closely allied to the *Nardus* grassland but dominated by *Vaccinium myrtillus* have been isolated as a possible separate unit. Many more stands must be analysed before a statement as to its species content and habitat characteristics can have any real significance, but on the existing evidence this grassy heath appears to be a community on freely drained brown forest soils of low base status.

Scattered through the dominant *Vaccinium* are abundant *Deschampsia flexuosa* and *Festuca ovina* and, to a lesser extent, *Luzula multiflora*, *Galium saxatile* and *Potentilla erecta*. The ground layer, which does not provide more than 50 per cent cover, is made up of *Pleurozium schreberi*, *Hypnum cupressiforme* var. *ericetorum* and *Rhytidiadelphus squarrosus*.

Both stands recorded so far lie within the area and were located on Cairnie Hill near Lindores and Norman's Law. The vegetation is grazed by sheep in each case and the soils belong to the Sourhope series. Norman's Law is of interest as the site of a Mediaeval fort, and a soil sample taken at a depth of 10 inches down the profile had a total phosphorus value of 1598 mg./100 g.

Carex Wet Pasture

A wet flush community dominated by sedges was described in previous publications, but the heterogeneous nature of the vegetation and the restricted localities in which the stands were analysed allowed only a preliminary assessment of this community to be made. Further information has now been included, but it is still not possible to give a complete picture of the *Carex* pasture. The community is characterized by the constant presence of *Potentilla erecta*, *Carex panicea* and *Succisa pratensis*, while *Carex pulicaris*, *Nardus stricta* and the moss *Ctenidium molluscum* are class IV constants.

There are a total of 168 species present in the field and ground layers of the 16 stands and a further 6 species of trees and shrubs occur in some instances. The average number of species per stand is 34, ranging from 23 to 44.

Stands were recorded from an altitudinal range of between 50 and 1650 feet on gentle to moderate slopes. The soils are usually poorly to very poorly drained gleys with a highly organic A horizon, although one stand was found on peat and another on an imperfectly drained brown forest soil. The pH of the surface horizon varies between 4·3 and 7·2, with most of the values exceeding 5·0. The exchangeable calcium values are usually high, reaching 66 m.e./100 g. in one case, and the magnesium level medium to high. In one group of soils, the exchange complex is dominated by magnesium, calcium having only medium values.

The *Juncus acutiflorus* and *J. articulatus* facies do not differ markedly from previous descriptions and were not recorded here.

The stand dominated by *Salix repens*, which has been separated as a possible third facies, is located in Five Mile Wood near Stanley. *Carex panicea* and *C. nigra* are abundant and *C. ovalis* and *C. pulicaris* are also present. The mosses *Climacium dendroides* and *Acrocladium cuspidatum* dominate the ground layer. The soil is a non-calcareous gley of the Lour series and has a relatively low surface pH of 5·2.

Two other fragmentary facies have also been separated, the first containing *Juncus squarrosus* and the second *Schoenus nigricans*. Neither was found in the area.

MOORLAND COMMUNITIES

Dry *Calluna* Moor

The community of dry moorland dominated by *Calluna vulgaris* has been extensively described in three previous publications. A further 19 stands have since been analysed and as a result the community constants have been slightly altered. The constant species are now *Calluna vulgaris*, *Deschampsia flexuosa*, and the mosses *Dicranum scoparium* and *Hypnum cupressiforme* var. *ericetorum*, while *Erica cinera*, *Vaccinium myrtillus*, *Pleurozium schreberi* and *Pohlia nutans* are constancy class IV species.

A total of 65 stands has been used to describe the community and there is a wide range in species content from 6 to 47. The average number of species per stand is 19 and there are 150 species in all, excluding *Pinus sylvestris*, *Betula pendula*, and *B. pubescens* which occur in some instances.

The range in altitude recorded is 4 to 1840 feet which probably approaches the true limits of the dry heath. Slopes vary from level ground to over 30 degrees and there is no preference in aspect. The majority of the soils are freely drained iron podzols and imperfectly drained peaty podzols, but stands are also found on acid brown forest soils and, in one case, on a poorly drained peaty gley. The soils are all acid and the base saturation of the H or A horizon is usually less than 25 per cent. Surface pH ranges from 3·4 to 5·4, but the modal value is around 4·0. The level of exchangeable calcium is generally low and that of magnesium medium, but values are slightly higher where the heather has been recently burned or where the parent rock material is of a more basic nature.

The *Empetrum nigrum* sub-alpine facies was not found in the area, but one stand of the grassy *Nardus stricta* facies was recorded at Nether Handwick. Only *Vaccinium myrtillus* and, to a lesser extent, *Deschampsa flexuosa* are abundant under the canopy of the dominant *Calluna*, and *Nardus stricta* has a very low cover value. *Hypnum cupressiforme* dominates the ground layer. The soil is an imperfectly drained brown forest soil of the Muirhead series (Balrownie), which has not been mapped here, but it has probably developed from an imperfectly drained brown forest soil of the nearby Balrownie series. The vegetation is grazed by sheep and cattle.

The *Lathyrus montanus* facies, which is associated with freely drained soils of slightly better base status, is represented by a stand on Black Hill where the soil is a brown forest soil of the Garvock series. Scattered plants of *Lathyrus montanus*, *Lotus corniculatus* and *Campanula rotundifolia* are present, and again the vegetation is grazed by sheep and cattle.

The typical species-poor dry *Calluna* moor of the fourth facies is found on high ground in a number of localities near the Tay. Stands were recorded on Ardgarth Hill, Cairnie Hill, the Obney Hills, Lorns Hill and Black Hill. *Calluna*, *Vaccinium myrtillus* and *Deschampsia flexuosa* usually make up the bulk of the field layer, but *Erica cinerea* is also abundant in the quadrats from Ardgarth Hill, the Obney Hills and Black Hill.

The stand on Ardgarth Hill contains no *Vaccinium myrtillus* and the soil is a freely drained iron podzol of the Caplaw series (not mapped in this area) with the dominant type surrounding it—a brown forest soil of the Garvock series. On Cairnie Hill, the soil is a brown forest soil of the Sourhope series. The quadrat was recorded in a small patch of *Calluna* heath surrounded by open oakwood with a field layer of *Vaccinium myrtillus*. The two stands on Lorns Hill are rich in lichen species and the liverwort *Lophozia ventricosa* is most abundant in the ground layer of the first. Although the adjacent soils are brown forest soils of the Balrownie series and iron podzols of the Aldbar series, the soil beneath the quadrats is an imperfectly drained podzol of the Muirhead series (Balrownie), a series which has not been mapped here because of its limited extent. The stands on the Obney Hills and Black Hill are two of the highest recorded in the area, being at 1000 feet and 1050 feet respectively, and are remarkable for the presence of the boreal species *Vaccinium vitis-idaea*. The first is sited on an iron podzol of the Obney series and the second on a brown forest soil of the Darleith series.

Two additional facies have been separated on the basis of recent information. The first comprises five stands in which *Arctostaphylos uva-ursi* is a constant and *Listera cordata* is often present. The base saturation of the iron and peaty podzols on which it is found is over 20 per cent in the surface horizon and the exchangeable calcium values are medium to high. The second fragmentary facies is composed of two stands of a maritime heath characterized by the presence of *Carex arenaria*. Neither facies was found in the area.

Wet *Calluna* Moor

The wet *Calluna* moor of earlier memoirs has been only slightly altered by the inclusion of 11 extra lists. The community constants are *Calluna vulgaris*, *Erica tetralix*, *Trichophorum cespitosum*, and the mosses *Dicranum scoparium* and *Hypnum cupressiforme* var. *ericetorum*, and the only class IV constant is the moss *Pleurozium schreberi*.

Stands were recorded from an altitudinal range of 325 to 1150 feet, but the potential limits are restricted on the one hand by agriculture and on the other by the development of thick peat which carries a different moorland community. The topography is generally either flat or gently sloping, but some stands occur on slopes up to 15 degrees. The majority of the soils are imperfectly drained peaty podzols or poorly drained peaty gleys, though a number of the gleys have only a shallow raw humus horizon. They are slightly more acid than the soils of the dry *Calluna* moor, having a range in surface pH of between 3·6 and 4·7 and a modal value of 3·8. The level of base saturation in the H or A horizon is generally less than 20 per cent and the exchangeable calcium and magnesium values are low to medium.

The first facies is distinguished by the constant presence of *Sphagnum compactum* and *Cladonia impexa*, together with the community constants and *Juncus squarrosus*. The stands are also rich in liverworts and lichens, of which *Gymnocolea inflata* and *Cladonia floerkeana* are present as class IV constants. One stand was recorded from Prior Muir, near St. Andrews on an acid gley of the Rowanhill series. *Molinia caerulea* is abundant in the field layer and the vegetation is grazed by cattle.

As with the dry Calluna moor, a general or typical facies of wet moorland has now been recognized. Its constants are those of the community, together with *Pleurozium schreberi*. The stands are species-poor as compared with those of the first facies and the field cover is made up of *Calluna*, *Erica tetralix*, and *Trichophorum cespitosum*, although *Molinia caerulea* or *Juncus squarrosus* is abundant in some instances. The ground layer is usually made up of the constant mosses, but *Hylocomium splendens*, *Leucobryum glaucum* or *Sphagnum* spp. dominate in individual stands. Liverwort and lichen species are still numerous, but generally with low cover values. One stand was described at 1000 feet on Ardgarth Hill, near Lundie. *Nardus stricta* is a common element in the field layer and the moss *Polytrichum commune* is abundant. The general soil type of the site is an imperfectly drained brown forest soil of the Mountboy series, but the soil directly beneath the quadrat is more podozlized.

The third facies, which corresponds to the *Molinia caerulea* facies of previous descriptions, is characterized by the constant presence of *Erica cinerea*, *Festuca ovina*, *Molinia caerulea* and *Potentilla erecta*, in addition to the five community constants. It is richer in forbs than the first two facies but floristically poorer in leafy liverworts and lichens. This facies is represented in the area by one stand from Upper Obney at the foot of the Obney Hills.

Narthecium ossifragum and *Juncus squarrosus* are abundant and *Erica cinerea* and *Potentilla erecta* are absent, but the stand has been included here as it is most closely approximate to this vegetation type. The grassland element may be supressed by the heavy selective grazing of cattle. The soil beneath the stand has a shallow raw humus horizon and has been classed as a peaty gley, but the dominant soil is a poorly drained non-calcareous gley of the Anniegathel series.

Calluna—Eriophorum vaginatum—Trichophorum Moor

This community of peat moorland has been described in detail in all three previous publications. Its constant species are *Calluna vulgaris*, *Erica tetralix*, *Eriophorum vaginatum* and *Trichophorum cespitosum*; *Eriophorum angustifolium* and the mosses *Hypnum cupressiforme* var. *ericetorum* and *Pleurozium schreberi* are class IV constants.

The altitudinal range recorded is 50 to 1600 feet and the topography is one of level ground or gentle slopes. The community is usually found on blanket peat or raised moss, but a number of sites have only a shallow peat horizon and these soils are classed as peaty gleys. The surface pH ranges between 3·3 and 4·6 and there are two "peaks" at 3·8 and 4·2. The former is the modal pH of the more widespread acid peat, whereas the latter is due to the influence of flushing on some sites from nearby mineral soils and is often indicated by the presence of *Myrica gale*. The level of base saturation in the surface peat is usually less than 20 per cent, while the level of exchangeable calcium is low to medium and that of magnesium medium except in the flushed sites where the values are higher.

The four facies as previously described are largely unaltered by the addition of information from eleven recently inspected quadrats to the original data. The first three, as defined by the constant presence of firstly *Deschampsia flexuosa* and *Carex nigra*, secondly *Narthecium ossifragum* and lastly *Myrica gale*, are not represented in the area, but two stands of the dried-out peat and hummock facies were recorded on Methven Moss. This raised moss is just outwith the area in which the soils were mapped, but has been included here as an example of this type of moorland. The Moss is remarkable for the presence of *Rhynchospora alba* and *Calypogeia sphagnicola*.

MARITIME ZONE

The coast-line of Fife and Angus provides a wealth of maritime plant communities, many of which require intensive sampling before they can be firmly established. A large extent of Tents Muir has been planted with conifers and the vegetation is in a transitional stage to an acid type of woodland, but in the immediate vicinity of the shore there are numerous communities virtually unaltered by man.

Atriplex-Cakile Foreshore Community

Too few samples of this community have been collected to give the species presence ratings, but the characteristic plants are species of *Atriplex* and *Cakile maritima*.

The habitat is one of sand and shore-line debris which is liable to be moved by storms in winter. The raw unstable soils usually have adequate supplies of nutrients for plant growth and the species which establish themselves are generally annuals tolerant of high salt concentration. Seedlings of the dune grasses, *Ammophila arenaria*, *Elymus arenarius* and *Agropyron junceiforme* do establish themselves and can initiate the development of dune where there is sand accretion. On the other hand, they are subject to removal by winter storms and so the community is essentially a community of the annual species noted, together with *Salsola kali* and sometimes *Hokenya peploides.*

Agropyron junceiforme Foredune Community

Behind the foreshore the embryonic dunes are usually initiated by *Agropyron junceiforme.* This species is sometimes the only plant present, but *Honkenya peploides* and the species of the foreshore are often associated with it. Progression to the lower dunes is seen in the presence of *Ammophila* and *Elymus.*

The soil is raw sand, often with a high content of shell fragments, and the pH ranges from near neutral to 8·5.

Of the two stands recorded in Fife one contains only *Agropyron junceiforme* and in the other *Elymus arenarius* is the most abundant species.

Ammophila-Elymus Mobile Dune Community

The next stage in the succession is the fixation of the shore sand by the main dune-building plants, *Ammophila arenaria* and *Elymus arenarius.* This community is much richer in species than the foreshore or foredunes, with a total of 38 in 7 stands.

The constants are *Ammophila arenaria*, *Festuca rubra*—usually the variety *arenaria*, and *Senecio jacobaea.* Constancy class IV species are the grass *Poa pratensis* and the two composites *Hypochoeris radicata* and *Taraxacum officinale.*

The dunes are unstable and erosion of the sand by wind can occur in one part of the system at the same time as active building is taking place in another. The soils shows little profile development, with only a slight humus concentration associated with the root mat of *Festuca rubra* and other species near the soil surface. Frequently, old buried surfaces can be seen when a profile pit is dug.

The carbon:nitrogen ratio of the surface horizon is about 10 and shell fragments are common. Because of this the pH is usually 7 or higher, but occasionally, when the sand is almost entirely quartz, it drops to 6·3 or less.

The physiognomy of the community is dominated by marram grass, *Ammophila arenaria*, and less commonly by sea lyme-grass, *Elymus arenarius.* Between the tussocks of these species the bare sand is often colonized by orthotropic mosses, the commonest being *Bryum pendulum* which successfully survives periodic burial by sand and helps, where wind and erosion is not too severe, to bind the surface (Birse and Gimingham, 1955).

The other important elements in the vegetation are composites and *Poa pratensis.* The yellow flowers of *Senecio jacobaea* and *Hypochoeris radicata* are especially conspicuous.

***Ammophila-Festuca rubra* Fixed Dune Community**

With the fixation of the dunes more species are able to establish themselves and there is a gradual decrease in the vigour of *Ammophila.* This next stage of the succession, the *Ammophila–Festuca rubra* community, has five constant species, the grasses *Ammophila arenaria, Festuca rubra* and *Poa pratensis* and the two forbs *Cerastium holosteoides* and *Galium verum.* The constancy class IV species are *Carex arenaria, Lotus corniculatus, Senecio jacobaea* and the moss *Ceratodon purpureus.*

In eleven stands there is a total of 109 species with a range of 15 to 33. Even allowing for the larger number of stands, this is floristically a much richer community than that of the mobile dunes.

The dunes are now fairly stable, except for occasional destructive "blow-outs", and fresh deposition of sand is relatively slight compared with the earlier zones.

Profile development of the soil is still at an immature stage. The pH of the surface is, however, generally below 7·0, unless the sand had an initially high content of shell fragments. The carbon:nitrogen ratio is below 14, except in the lichen-rich facies at Tents Muir where it is over 20.

The field layer provides fairly high cover and the cover of the ground layer may be as high as 70 per cent (up to 80 per cent in the lichen-rich facies).

Ammophila is still often the dominant species, but the later stages of the succession have other species such as *Ononis repens* or *Festuca rubra* as the most abundant. The yellow flowered composites of the previous community are still present—although less abundant—and the most abundant and constant dicotyledonous herb is *Galium verum.*

The sand sedge, *Carex arenaria,* is now present and its shoots may be seen in regular procession along the length of individual rhizomes. *Poa pratensis* is constant and often abundant while other prevalent grasses are *Holcus lanatus, Koeleria cristata* and *Arrhenatherum elatius. Ononis repens* is characteristic of this community and in the ground layer *Brachythecium albicans* is the characteristic species.

Three facies have been provisionally distinguished—one with *Astraglus danicus* as a constant species, a second with abundant lichens and the third a general facies. The facies with *Astragalus danicus* is richer in species than the others and the grass *Koeleria cristata* is preferential to it.

Four stands of this facies have been recorded in the sand-dune systems at the mouth of the Tay Estuary. All four stands have *Koeleria cristata, Hypochoeris radicata* and *Plantago lanceolata,* and *Ononis repens* is abundant in two.

The second facies was recorded at Tents Muir and the two most abundant lichens here are *Cladonia pyxidata* and *C. scabriuscula.*

***Festuca-Agrostis* Dune Pasture Community**

Behind the high dunes with abundant *Ammophila* there is often an area of lower dunes with much fewer and less vigorous plants of that species. The community is dominated by grass species, of which *Festuca rubra, F. ovina* and *Agrostis tenuis* are constant and abundant.

In this *Festuca–Agrostis* grassland the constant species are the three grasses already noted, together with *Koeleria cristata,* the dwarf shrub *Thymus drucei,* the legumes *Astragalus danicus, Lotus corniculatus* and *Trifolium repens,* and *Galium verum, Plantago lanceolata* and *Senecio jacobaea.* There are also nine constancy class IV species—the grasses *Anthoxanthum odoratum* and *Poa pratensis,* the sand sedge *Carex arenaria,* the woodrush *Luzula campestris,* three forbs *Campanula rotundifolia, Cerastium holosteoides* and *Hieraceum pilosella* and the two mosses *Rhytidiadelphus squarrosus* and *R. triquetrus.*

The total number of species for seven stands is 81, with a range of 22 to 37 and an average of 31. As a whole the community is not floristically richer than the fixed dune community, but individual stands contain a larger number of species.

This is a community on which grazing pressure is usually heavy—at one time largely by rabbits, but nowadays, perhaps, more by sheep. If grazing prevents the development of scrub on the smaller dune systems, this may be the end stage of succession.

Deposition of sand is much less than in the first three dune communities and some horizon development may be seen in the soils. Where the shell content is high the pH is around 6·5 at the surface, but rises to over 7·0 with depth. The soils are classified as immature brown forest soils and brown calcareous soils.

The constancy classes V and IV species already quoted give the essential character of the vegetation. *Ammophila* is either absent or has a cover-abundance value never greater than 4. The community recorded is very similar to basic *Agrostis–Festuca* grassland and could be considered a maritime facies of it. Differences lie in the high constancy of *Carex arenaria, Astragalus danicus* and the moss *Climacium dendroides* in the maritime vegetation.

Six of the stands recorded can be placed in a *Koeleria cristata* facies on the more calcareous dunes, and evidently the vegetation of the more acid dunes has yet to be sampled.

Two stands of this community have been recorded on Barry Links. One is a level site approaching a dune slack in character, with abundant *Salix repens* and *Gentianella campestris,* but otherwise fitting readily into the *Koeleria cristata* facies of the dune pasture. The water table is fairly high at this site and fluctuates throughout the year. The second stand also fits into this facies, the only aberrant feature being the abundance of *Cladonia arbuscula.*

Juncus gerardii Dune Slack Community

In the dune slack there is often a community with abundant *Juncus gerardii.* It contains species such as *Festuca rubra, Glaux maritima* and *Plantago maritima* which occur in salt marsh dominated by this rush, but it is clearly differentiated from salt marsh by the abundance of *Parnassia palustris* and *Sagina nodosa.*

Only two stands of this community have been described and one, at Tents Muir in Fife, contains *Juncus balticus,* its most southern station on the east coast of Britain. The soil here is developed on quartz sand with shell fragments and there is clear evidence of a fluctuating ground water table.

RELATIONSHIP BETWEEN SOILS AND PLANT COMMUNITIES

There is a clear relationship between many of the plant communities and the major soil groups and their sub-divisions, although some communities occur over a wide range of soils and the controlling influence on their distribution is some other factor in their environment.

The following account details the plant communities found on the different sub-divisions of the major soil groups distinguished in the country round Perth, Arbroath and Dundee. 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 samples taken from the profiles under the vegetation. Sub-divisions of very limited extent and minor variants of sub-divisions are not mapped, and are not shown in the Classification of Series (Table L, p. 35), but they are included in this description because of the distinctive plant communities which grow on them, and are discussed under the sub-divisions to which they are most closely related.

The soil series on which the communities occur in this area are also given, in brackets, but as yet records have been insufficient to establish any clear relationship between series and community in all but a few cases. The series quoted for any particular stand may not correspond to that given for the locality on the soil map, but again this is due to the restricted area of the soil in question. A list of the localities visited, their plant communities and soil series is given in Table 32.

Brown Forest Soils

The brown forest soils are the most extensive group in the area surveyed and are most often found under the many remaining patches of broad-leaved woodland where the terrain is unsuitable for cultivation. Most of the grassland stands and a few of the dry *Calluna* moor have also been recorded on this soil type.

BROWN CALCAREOUS SOILS (BCS)

The brown calcareous soils are closely related to the high base status brown forest soils. There is usually 2 per cent or more free calcium carbonate present in the profile and the horizons are fully saturated with bases. In the soils so far recorded, the exchangeable calcium values range from 12 to 66 m.e./100 g. soil and the pH lies between 6·4 and 7·6. These calcareous soils have usually developed on shelly sand, but they can also occur on residual material where free calcium carbonate is present.

As might be expected from their origin, the soils usually carry maritime communities of links and dune pasture, but the base-rich woodland and *Agrostis–Festuca* basic grassland have also been noted on them. The *Geum urbanum* facies of the base-rich woodland was found on Rossie Hill (Darleith) where the soil contains a high proportion of lime-rich rubble.

BROWN FOREST SOILS OF MODERATE TO HIGH BASE STATUS (BFS)

These brown forest soils are defined as having a base saturation of 50 per cent or more in the A horizon, but generally the values recorded are well above this figure. The level of exchangeable calcium is nearly always high (>8 m.e./100 g. soil) and the pH ranges between 4·9 and 6·3, with most values occurring between 5·2 and 5·7. The soils are freely drained, apart from a few profiles in which the drainage is slightly impeded.

The modal communities of this soil type are the base-rich woodland and the *Agrostis–Festuca* basic and meadow grasslands, although other communities are found on it to a lesser extent. The *Geum urbanum* facies of the base-rich woodland was recorded at Greenhill (Garvock) and the *Mercurialis perennis* facies on the alluvial terraces at Boarhills and Dura Den. One stand of the *Agrostis–Festuca* basic grassland was noted on Lundie Craigs (Darleith) and an example of the *Agrostis–Festuca* meadow grassland on the Binn Farm (Sourhope).

BROWN FOREST SOILS OF LOW BASE STATUS (BP)

In this group of brown forest soils, the base saturation of the A horizon is always less than 50 per cent and is usually below 20 per cent. The soils are freely drained and the pH of their surface horizons ranges between 3·6 and 5·4, although most of the values are less than 5·0. The level of exchangeable calcium in the surface rarely exceeds 8 m.e./100 g. soil and is usually well below that figure.

A wide range of woodland communities is found on these brown forest soils, and the *Holcus mollis–Anthoxanthum odoratum* woodland (Boyndie, Darleith, Gleneagles, Snaigow) and the *Endymion non-scriptus* facies of the *Holcus mollis–Dryopteris dilatata* woodland (Fungarth, Greenside) are almost entirely confined to them. Other woodland communities recorded in this area on these soils are the base-rich woodland (Darleith, Drumforber), the *Dryopteris-Rubus* woodland, the *Anthoxanthum odoratum-Agrostis tenuis* woodland (Fungarth), the *Vaccinium myrtillus* woodland (Darleith, Fungarth, Sourhope) and the *Deschampsia flexuosa* woodland (Airntully, Buchanyhill).

Of the grassland communities, the *Agrostis–Festuca* acid grassland (Darleith, Fungarth, Sourhope) is most commonly found on this soil type. The stands of the *Vaccinium myrtillus* heath recorded from Cairnie Hill and Normans Law and the stand of the *Agrostis–Festuca* basic grassland on Dunbog Hill were found on soils of the Sourhope series.

The only moorland community found on these soils within the area was the dry *Calluna* moor, the stands concerned being those on Black Hill (Darleith, Garvock) and Cairnie Hill (Sourhope).

BROWN FOREST SOILS WITH GLEYED B AND C HORIZONS

The imperfectly drained brown forest soils have a very wide range of properties, and for descriptive purposes have been sub-divided into two groups on the basis of the level of base saturation in the surface horizon.

GLEYED BROWN FOREST SOILS OF MODERATE TO HIGH BASE STATUS (GBS)

The base saturation of the surface horizon is generally more than 40 per cent and the surface pH ranges between 5·1 and 7·2. The level of exchangeable calcium is moderate to high and that of exchangeable magnesium is usually moderate.

The community most commonly found on these soils is the base-rich woodland; two such stands in the area are those at Flisk Point (Carey) and Boarhills (Caprington). Less frequently occurring communities are the *Agrostis–Festuca* meadow grassland, as on Letter Hill (Baikies), the woodland with *Holcus mollis* and *Anthoxanthum odoratum*, and, as on Barry Links (Links), the *Festuca–Agrostis* dune pasture.

GLEYED BROWN FOREST SOILS OF LOW BASE STATUS (GBP)

In the second group of soils, the base saturation of the surface horizon is less than 40 per cent and the pH varies between 3·8 and 5·0. Exchangeable calcium values are usually low and those of exchangeable magnesium low to moderate.

The modal communities of these more acid soils are the woodland with *Dryopteris* and *Rubus* and the woodland with *Deschampsia cespitosa*; one stand of the former was recorded on these soils from Black Wood (Balrownie) and three of the latter from Morrishill Wood (Laurencekirk), Ancothie Wood (Balrownie) and Drumcairn (Balrownie). Occurring less frequently on these soils are the *Holcus mollis–Dryopteris dilatata* woodland, as recorded in Bishop's Wood (Winton), Morendy Wood (Kirkbuddo) and Tentsmuir Forest (Links), the *Agrostis–Festuca* acid grassland, as noted on the Obney Hills (Baikies), and the *Nardus* grassland, as seen at White Myre (Mountboy).

Podzols

The freely and imperfectly drained podzols of the area are not nearly as widespread as the brown forest soils, and in their uncultivated form are restricted to small areas on the hills, where they carry a moorland vegetation, and to patches of heathy woodland.

IRON PODZOLS (IP)

These acid soils have low base saturations of 30 per cent or less in the surface horizon, although the levels of exchangeable calcium and magnesium are usually moderate. Except on a few sites where drainage is slightly impeded, the soils are freely drained. The surface pH varies from 3·4 to 4·5, with a modal value of 3·9. Although a well-developed F or F/H horizon was present and was sampled for analysis, the above values apply only to the A horizon or, where present, the H horizon. The soils, however, are acid throughout the profile.

The modal plant communities of the iron podzols are heathy woodland and dry *Calluna* moor; the more acid grassy woodlands and acid grasslands also occur but to a lesser extent. Examples in the area are a stand of woodland with *Vaccinium myrtillus* recorded at Birnam (Strichen) and one of woodland with *Deschampsia flexuosa* recorded at Greenhill (Frandy). Dry *Calluna* moor was found on iron podzols on Ardgarth Hill (Caplaw) and on the Obney Hills (Obney).

IMPERFECTLY DRAINED PODZOLS (GP)

These imperfectly drained acid soils have a base saturation of less than 20 per cent and a range in pH from 3·7 to 4·5 in their A or H horizons. The modal pH is 4·0, and the levels of exchangeable calcium and magnesium present are low to moderate.

Imperfectly drained podzols are not often encountered and their extent is limited, so that relatively few stands of vegetation have been recorded on them. Nevertheless, their typical communities are much the same as those on the iron podzols—heathy woodland, acid grassland and *Calluna* moor. Woodland with *Deschampsia flexuosa* was recorded on these soils at Bonnytown and *Calluna–Erica cinerea* woodland at Spoutwells (Muirhead), while stands of the dry *Calluna* moor were noted at Nether Handwick and Lorns Hill (Muirhead), and one stand of the wet *Calluna* moor on Ardgarth Hill.

Non-Calcareous Gleys

The non-calcareous gleys are poorly drained, often flushed soils with a few tending towards very poor drainage. They are separated from the peaty gleys on the basis of the amount of organic matter in their surface horizons which is less than 25 per cent. Although these soils are very limited in extent, they carry a range of flush communities which are often species-rich. The non-calcareous gleys vary greatly in the properties of their A horizons and, as an aid to description, it has been found convenient to sub-divide them into two groups—those with a moderate to high base status and those with a low base status.

NON-CALCAREOUS GLEYS OF MODERATE TO HIGH BASE STATUS (BG)

The base saturation of the surface or A horizon of these gleys is always greater than 30 per cent and the pH ranges between 5·0 and 7·2, although most values are below 5·8. The level of exchangeable calcium in the surface horizon is moderate to high and that of exchangeable magnesium is moderate.

The plant communities most often encountered on these soils are the *Deschampsia cespitosa* woodland, the *Juncus acutiflorus* pasture and the wet *Carex* pasture, of which only the first was recorded in the area on this soil type. One stand was noted beside Dupplin Lake (Vigean) and another near Dhu Loch (Anniegathel). Several other flush communities of woodland, grassland and heath are occasionally found on these gley soils, and within the area base-rich woodland was recorded in Paddockmuir Wood on the Carse of Gowrie (Stirling), *Juncus acutiflorus* woodland on Letter Hill (Anniegathel) and *Filipendula ulmaria–Angelica sylvestris* woodland at Methven (Muirfoot).

NON-CALCAREOUS GLEYS OF LOW BASE STATUS (AG)

This group of acid gley soils has a base saturation of less than 30 per cent in the surface or A horizon and a range in pH of between 3·7 and 4·9. The level of exchangeable calcium is low and that of exchangeable magnesium is low to moderate.

Although *Deschampsia cespitosa* woodland is again the community which occurs most frequently on these gleys, vegetation found on them differs from that of the higher base status gleys in its greater number of more acid communities. *Holcus mollis–Dryopteris dilatata* woodland and wet *Calluna* moor have been recorded on them, and occasionally also *Dryopteris–Rubus* woodland, *Nardus* grassland, and a number of other moorland communities.

In this area, *Deschampsia cespitosa* woodland was found on these gleys on Letter Hill (Anniegathel), in Bishop's Wood (Rowanhill), and at Murrayfield (Lour), *Juncus acutiflorus* woodland was found on Letter Hill (Anniegathel), and wet *Calluna* moor on Prior Muir (Rowanhill).

Peaty Gleys

This second group of poorly or very poorly drained gley soils is separated from the non-calcareous gleys by the presence of an organic surface horizon, usually 2 inches or more in depth and containing 25 per cent or more organic matter. The group has been sub-divided into moderate to high base status peaty gleys or humic gleys and low base status peaty gleys.

PEATY GLEYS OF MODERATE TO HIGH BASE STATUS (Humic Gleys—HG)

The base saturation of the surface horizon is 30 per cent or more and the surface pH ranges from 4·9 to 6·0. The level of exchangeable calcium is high and that of exchangeable magnesium is moderate.

Three flush communities have so far been recorded on the humic gleys. The most commonly occurring of these is the wet *Carex* pasture, recorded in this area in Five Mile Wood (Lour); *Juncus acutiflorus* woodland and pasture occur only once, the woodland stand being that on Letter Hill.

PEATY GLEYS OF LOW BASE STATUS (PG)

The peaty gleys with a base saturation of less than 30 per cent in their surface horizons range in surface pH between 3·4 and 5·5, the modal value being 3·9. The level of exchangeable calcium is usually low and that of magnesium moderate.

The *Molinia* grassland community has its maximum occurrence on these soils, with the *Polytrichum commune* facies almost entirely confined to them. Of frequent occurrence are the wet *Calluna* moor, *Juncus acutiflorus* pasture and *Calluna–Eriophorum vaginatum–Trichophorum* bog, while several other communities with low base requirements have also been recorded.

Only one stand of vegetation was recorded on a peaty gley in this area—on wet *Calluna* moor at Upper Obney.

Peat—Raised Moss (RM)

The raised moss peat so far examined has a low level of base saturation in the surface horizon and a range in pH between 3·5 and 3·9. The level of exchangeable calcium is low to moderate and that of exchangeable magnesium is moderate.

The characteristic community of raised moss peat is the *Calluna–Eriophorum vaginatum–Trichophorum* bog; two such stands were recorded on Methven Moss.

Immature Soils (Dune Sand)

FORESHORE, FOREDUNES AND MOBILE DUNES

Profiles examined on these sites show little or no development of recognizable horizons. Drainage is usually excessive and very little organic matter is present in the surface. The soils are fully saturated with bases, with the exception of a few which, however, become fully saturated with depth. Surface pH ranges from 6·3 to 8·5. There is often a high proportion of shell fragments in the surface sand and consequently the level of exchangeable calcium is usually high, whereas exchangeable magnesium values are moderate.

Stands of foreshore and foredune vegetation and of the *Ammophila–Elymus* mobile dune community were recorded from Carnoustie, Barry Links, Tents Muir and Out Head.

FIXED DUNES AND DUNE PASTURE

Profile development on these soils of fixed dunes and dune pasture is still at an immature stage, but there is a recognizable A horizon. The percentage of organic matter in the surface horizon is higher than in the first group of dune soils, but does not usually exceed 7 per cent. The proportion of shell fragments present in the A horizon varies considerably and there is a correspondingly wide range in pH, from 4·5 to 7·8, and in the level of exchangeable calcium. The level of exchangeable magnesium is low to moderate. Drainage is again excessive, and the soils are classed as immature brown forest soils and brown calcareous soils.

The *Ammophila–Festuca rubra* fixed dune community was recorded from Carnoustie, Barry Links, Monfieth, Tents Muir and Out Head and the *Agrostis–Festuca* dune pasture from Barry Links.

DUNE SLACK

One stand of the *Juncus gerardii* dune slack community was recorded from Tents Muir, on a poorly drained raised beach soil.

Chapter 8. Agriculture

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Perhaps the most significant feature of agriculture in the area lying between the foothills of the Grampians and the Ochil Hills is the great variety of agricultural activities. Topographical features give rise to a range of soil types, each influencing to some extent the type of farming and the whole presenting a changing panorama of many interests. From the rich valleys of the Rivers Tay, Earn and Isla to the less fertile glens and hillsides of the Grampians, the Sidlaws and the Ochils can be found farms representative of many types of crop and stock production. It is this variety of conditions which makes the farming interesting to study and complicated to describe. Agriculture is the industry which is basic to the economy of the area and one which has progressed vigorously in many aspects of production.

Historical

The history of agriculture in the area has been one of changing fortunes. At the time when the New Statistical Accounts appeared, (1837–44), the agricultural revolution was well under way. Good times during the prolonged continental wars early in the nineteenth century and from the 1840's to the 1870's, stimulated progress and changed what had been a backward system of husbandry into a prosperous one of livestock and crop husbandry, worthy of the reputation the area now holds. A number of factors contributed to the changes which took place in the nineteenth century. The enclosure of land, the granting of long leases to give security of tenure and the expanding market for agricultural produce in the rapidly rising industrial area of Scotland, all helped to further the progress of farming in Scotland and not least in Angus, Fife and East Perthshire.

About 1820 it was realized that on many of the soils the potato was well suited to field culture. An export trade to London was started with a variety known as Perthshire Reds. Potato blight in 1845 put Perthshire Reds off the market, but new varieties appeared and, throughout the years, production of potatoes, particularly of seed potatoes, has been a main source of farm income. Another significant date in the history of the region was June 1808 when Hugh Watson of Keillor, Coupar Angus, went to Trinity Fair in Brechin and purchased ten of the best heifers and a bull. These, together with six cows and a bull given to him by his father, constituted the foundation herd of Aberdeen Angus cattle, a breed now of world wide renown wherever high quality beef cattle are produced. The year 1827 is important as the date when Patrick Bell, a divinity student from Auchterhouse, near Dundee, invented the reaper which, for twenty years, worked on his brother's farm at Inchmichael in the Carse of Gowrie. It was not until the 1850's that Bell's invention was accepted and recognized, but it is interesting to note that the cutting mechanism of the combine harvesters in use today operates on exactly the same principle as that designed by Bell.

The years between the 1840's and 1890's became known as the Golden Age in Agriculture. It was during this period that many of the fine farmhouses and steadings still in use today were built. A set rotation based on the famous "Norfolk four-course" was almost universally established on the arable farms and this, together with improved varieties of grasses, clovers, cereals and potatoes, constituted a system of crop husbandry which has remained basic ever since.

The area being naturally suited to livestock husbandry, it was inevitable that, during the Golden Years, great progress was made in the improvement of beef cattle; the demand for beef was keen and the finishing of beef cattle fitted admirably into the system of land use adopted on the majority of arable farms. Cereals, the extractive crop, provided straw for bedding in winter, turnips, the cleaning crop, provided the succulent winter food, and hay and oats provided the bulky feed. Grassland, the rejuvenating crop, provided grazing in the summer months. Potatoes formed the important cash crop and, as farmyard manure was considered essential for the maintenance of fertility, the more straw tramped into muck in the spacious cattle courts the better. The more muck, the better the crops, the better the crops, the more cattle could be kept. The more cattle, the more muck! This was the cycle in farming throughout and very effective it was as subsequent events proved.

It was not until much later that dairy farming became a feature in the area and, apart from some references to town dairies, there is little record of dairy farming in the nineteenth century. Arable farmers in the river valleys and on the coastal belt pinned their faith on the short ley, cash cropping grain and potatoes and the fattening of sheep and beef cattle.

The area of upland and hill land is quite extensive and, once the river estuaries and straths are left behind, the land in the glens and on the hillsides is less fertile and not so suitable for intensive cash cropping. Nevertheless, the uplands have made a great contribution over the years to farming in the area and, up to the present day, the system of farming on hill ground has been interlocked with that on the better arable farms. By the middle of last century, sheep had taken over on the hill farms, stocked mostly with that hardy breed of sheep, the Blackface, which contributed greatly to the supply of Greyfaced lambs for ewe stocks on farms in more kindly climatic situations. The hills, therefore, bred sheep for the arable farms and the lower uplands bred both cattle and sheep, a system which was economically logical and which has been intensified in recent years.

Before leaving the period of the revolution, one must make reference to improvements which took place in the second half of the nineteenth century and early this century, alongside developments in crop and animal husbandry. Reclamation of land proceeded apace and large tracts of moorland were converted into good growing land. The use of guano, bone meal and other so-called artificial fertilizers gave results which prompted a continuing expansion in their use, and by the end of the century considerable quantities of ground mineral phosphates and the then new superphosphate were being shipped to the harbours at Perth and Dundee and transported from there and from railway centres to farms throughout the area.

The carse lands, which are a feature of the area, were reclaimed by extensive drainage. Large open ditches or pows were dug and underground drains led into them. In the Carse of Gowrie, the first pows were not very successful, largely because the underground drains which led the water into them did not function properly. A vast amount of underground drainage was carried out between 1855 and 1875. Some of it was satisfactory and some not, but eventually drainage was sufficiently successful to turn what had once been a flooded morass into one of the most fertile farming areas in the country.

During the wave of prosperity up to the 1870's, proprietors were spending freely on buildings, tree planting, drainage and reclamation, and people were competing for tenancies. Many were convinced that the farmers' strength in the area lay in livestock and no-one more so than John Fraser of Invermay, who in 1862, as a boy of sixteen, left the farm of Peel, Tibbermore, to enter the land surveying office of McDonald of Perth. Two years later the firm started weekly stock sales, in a small way at first, and gradually demonstrated the advantage of weekly auction sales over the colourful but time-consuming method of droving cattle to the trysts and fairs. From these auctions were established in Perth the great Aberdeen-Angus and Shorthorn pedigree sales which attract buyers from all over the world.

The Twentieth Century

The last two decades of the nineteenth century and the early years of this century were not easy farming years. It was a period of "dumping" from abroad, and whilst this meant cheap imported food for both people and livestock, it hit at the very foundations of the farming pattern in the area. But the farmers were resourceful and resilient. Increased costs of production were met by using improved varieties of cereals and roots. From the production of ware potatoes, farmers turned to that of high class seed. Rotations were widened to allow longer and better leys enabling more livestock to be carried and giving greater overall fertility.

On the uplands, livestock remained the sheet anchor of the farming system and, although times were difficult and cash crop production unprofitable except on the better high-yielding land, the area continued to develop, with the help of scientific teaching which was put to good use. The great surge forward in the use of fertilizers came at the beginning of the present century. Between 1900 and the outbreak of the first world war in 1914, the use of phosphates and nitrogen trebled and the use of potassium doubled.

An outstanding feature during all the years of depression was that, with a few exceptions, farmers never dreamt of robbing their land. This stood them in good stead in the 1914–18 years when a prodigious effort was made by all concerned to produce food for a nation at war. Reserves of fertility, together with an all-out effort to grow direct food crops, resulted in a great contribution to the nation's food supply, and by the end of hostilities a large acreage was under the plough. Ruling prices made ploughing up and reclamation well worth while. War-time contingencies turned the thoughts of many farmers towards the tractor as a means of power, and by the time the war ended a number of these machines were at work. The comparatively large size of the farms made mechanization a possibility, and although progress in this field was halting at the outset, the tractor and all that it implies came more and more into prominence. Two factors mitigated against rapid advance in mechanisation at this early stage. The first was the lack of suitable tractor implements. Trailing horse implements were not suited to the new found power and many farmers came to the conclusion that a tractor and its fuel was an expensive way of pulling ordinary farm implements. Moreover, the early iron-wheeled tractors were unsatisfactory in many ways. The invention of the pneumatic tyre in the late 1920's, however, did much to improve performance and this, along with improvements to tractor implements, led to steady development until the outbreak of the second World War.

Perhaps a greater brake to progress was the depression into which agriculture fell in the 1920's and early 1930's. Prices collapsed and, in the area under review, as elsewhere, farmers found difficulty in making ends meet. Land went out of cultivation and back to grass. Extensive livestock farming, involving as little expense as possible, became general. Upland farmers could not afford the manures necessary to keep their land in good heart, and there was little encouragement to prevent the resultant deterioration. On the better farms there were difficulties too. The seed potato trade, spurred on by the inspection scheme initiated by the Department of Agriculture for Scotland in the 1920's, brought in much-needed revenue during the bad years, but even this line of production proved disastrous in the early 1930's when prices fell to such an extent that the crop was not worth marketing. Attempts were made to keep the industry from bankruptcy by various methods of support, prices, marketing boards, etc., but it was not until 1935–36 that conditions started to improve.

The Second World War

By the time war broke out in 1939, there was more vigour in the industry and farming was set for a second revolution just as exciting and profound as in any industry in the country. The experience gained during the first World War was valuable in getting the food production machine going at the beginning of the second. The Government vested powers in local Agricultural Executive Committees whose main function was to get essential food produced from the area under their jurisdiction as quickly as possible and in as large quantities as possible. Of prime importance was the production of fresh milk, potatoes, sugar beet and other direct food crops. Less emphasis was placed on the longer term beef and mutton production and, although the area maintained these traditional lines of production, there was a considerable swing towards dairying and cash cropping. The large cattle courts in the area were eminently suitable for conversion into courts for dairy cows, the only major addition being a milking parlour and dairy. This system became increasingly popular during the war years and, with modern variations, remains the fundamental dairying system in the area to the present day.

The ploughing up of grassland for cash cropping proceeded very rapidly during the war years. Notable increases in cereal, potato and sugar beet acreages were made at the expense of rotational grass and rough grazings and were indicative of the great need to produce direct food crops at the time. This increase in arable crops, labour consuming as they are, drove farmers more and more towards mechanization. The area with its big farms suited this development which continued rapidly during the post-war years.

For some years after the war, the cropping and stock pattern remained on the war-time basis but gradually, as overall food supplies increased under peace-time conditions, some relaxation in cropping requirements was possible, particularly on marginal and hill farms. In 1948 the tillage acreage was reduced and more emphasis was placed on livestock. This suited the large number of upland and hill farms in the area and more attention was paid to grass and grass products on these farms. A steady increase in the numbers of cattle in the area resulted from the following changes—direct reseeding to grassland, silage making, improved techniques in hay making, better understanding of fertiliser use and the extension of out-wintering of breeding beef cows on land much of which had formerly been Blackface sheep country. Farms which had turned to dairy farming during the war years continued to produce milk, quickly absorbing modern techniques of silage making, rationing, clean milk production, recording, etc., until today many dairy farms in the area are second to none in their particular branch of the farming industry.

Farm Buildings and General Improvements

The total land area involved has remained constant as have topographical features, but great changes have taken place in the way the land is farmed. On upland and marginal farms the emphasis is now definitely on livestock rearing which, in modern farming, depends for success on the proper management of grassland. Helped by considerable grants under marginal land and hill farming schemes, and now also under the winter keep scheme, great advances have been made. Drainage, fencing, roads and farm buildings have all been improved and better understanding of the full use of grassland has led to a big increase in stocking both in summer and in winter. The problem of winter keep has been tackled vigorously and whilst a lot of hay is still used, the system of conserving grass in the form of silage has spread and is now an integral part of farming on most farms where cattle are kept. Difficulty in finding adequate labour has resulted in mechanization and in both haymaking and silage-making modern equipment is used to great advantage. The labour problem has also led to attention being given to farm buildings which were outdated and inconvenient. The spanning of a whole steading under one roof is the trend now, and the storage of hay and silage as near the feeding point as possible greatly reduces labour requirements in winter.

On both upland and arable farms, the silo in many cases is accessible to the cattle, thus making self feeding possible. All this has boosted the numbers of store beef cattle off the hills and uplands. The great autumn and spring sales at Perth, Blairgowrie, Cupar and elsewhere, with large numbers of good quality store cattle and calves, bear out the big contribution now being made by what might be termed more difficult farming land.

Mechanization

On good arable farms there has been a rapid advance in mechanisation. The combine harvester, first used in the district during the war years, has rapidly taken over from the binder in the harvesting of cereal crops. For some years central grain drying plants dealt with most of the grain coming off combines, but the increase in acreage harvested by combine put a great pressure on drying plants and, further, created a glut of grain on the market at harvest time. Farmers therefore have installed their own drying and storage plants, costly in capital but essential in the light of the almost universal use of labour-saving combine harvesters in the area.

Cereal Crops

The balance of cereal crops now tends towards increasing acreages of barley and wheat as opposed to oats, with barley gaining ground more quickly. New varieties of early-ripening, short-strawed, heavy-yielding barleys, suitable for combining and in demand for stock feed, have ousted to a large extent the older distilling barleys which were less resistant to lodging. With the advent of indoor storage for potatoes, long straw for the covering of potato pits has become less essential and so for wheat, too, the short-strawed varieties have become popular. Yields of grain from 40 cwt. to the acre and upwards are now looked on as normal; and in a good year 50–60 cwt. of wheat per acre is not an uncommon yield.

Root Crops

Of all the arable crops in the district, virus-free potatoes are the most important. Apart from some spots on the sunny side of the Sidlaw Hills and in Strathmore where early potatoes are grown for the ware market, practically all the 22,000 acres devoted to the crop are used for the production of seed. The soil and climate are favourable and over the years growers have gained great experience in the handling of top quality seed, and in marketing not only to England but also to countries abroad. In the post-war years, the production of virus-tested stocks raised from individual clones was pioneered on a commercial scale in Perthshire, notably by the late Sir James Denbigh Roberts at Strathallan and the late John Marshall of Dalreoch, Dunning. Popular varieties are those in demand for the English market, e.g. Arran Pilot and Home Guard earlies, Majestic and King Edward late varieties. Storage for many years was in potato pits, but in the 1950's there was a great movement towards storage in big frost-free sheds and these are now the rule rather than the exception.

Sugar beet growing came to an end with the closure, some years ago, of the sugar beet factory at Cupar. While some beet growers have turned to the production of food crops for processing and some have increased their cereal acreage, others have put more emphasis on livestock production, particularly beef cattle.

Soft Fruit

Of the 7000 acres of raspberries grown in Scotland, over 6000 are grown in the counties of Perth, Angus and Fife. Between 12,000 and 15,000 tons of raspberries are produced annually, with a cash value of about a million and a half pounds. Commercial growing of raspberries originated in Blairgowrie, the pioneer being Mr. J. M. Hodge, a solicitor, who about 1890, persuaded a number of local farmers to cultivate them in fields. Blairgowrie has remained the centre of the industry ever since and, over the years, raspberry growing has proved profitable on the whole. Like the potato farmers, growers of raspberries have a vast experience behind them and, in spite of a spectacular increase in the acreage grown in the post war years, they have been able to market the crop successfully and economically.

Stock

Alongside cash cropping, the feeding of beef cattle and sheep for slaughter has continued in importance on arable farms. Straw from cereals is still tramped into farmyard manure by cattle. Although in the 1950's the economics of finishing beef cattle in courts were not attractive and led to the establishment of breeding herds of cows on many arable farms, the district still produces great quantities of high quality beef. The development of silage-making techniques led to a great reduction in the acreage of the more costly and more labour-consuming turnip crop. By 1958, the turnip acreage in Perthshire was down to fifteen thousand acres. In the same year, over five thousand acres of grass were made into silage.

Pigs and Poultry

Because post-war conditions demanded economic production, pig and poultry rearing, important farming features in the area throughout the years, have tended to develop from side-line, part-time units into large specialized units. Notable in this line of development is the increasing number of large units producing thousands of chickens at a time for the broiler trade. In recent years, the economics of both poultry and pig farming have been very erratic and this has further encouraged streamlining and specialization.

Labour Force

The labour force in the area remained fairly static between 1900 and 1939, but during the war and post-war years it has been reduced year by year. In Perthshire, for example, the labour force in 1920 was 5760; in 1938 it was 5250; but by 1961 it had fallen to 3750. In spite of the fall in available labour, production has risen by almost 60 per cent since 1939, a measure of the effect of mechanization on farming in the area and of the use of modern techniques in crop and stock production. During and after the war, lifting of the potato crop was carried out by casual labour, including school children released on special potato harvesting holidays. The release of school children for this purpose is no longer permitted and farmers are turning to the various new complete potato harvesters now on the market. Already a number have been working successfully on suitable types of land. These machines are now

PLATE 18
Raspberry picking.
By courtesy of A. D. S. Macpherson.

PLATE 19
Transplanting young spruce trees in Ledmore Nursery, Strathord section of Dunkeld Forest.
By courtesy of B. R. Feaver.

PLATE 20
The Meikleour Beech Hedge: Boyndie Association.

widely used and, in recent years, electronic equipment for the separation of stones has become a prominent feature of some models.

Farm Size

Alongside the post-war developments in techniques has come the tendency for farms to get bigger. In Fife, for example, there were over 300 fewer farms in 1960 than in 1875. Mechanization has made it possible to work larger units and economic pressure has prompted estate owners to unite farms to avoid high maintenance costs. Many farmers in the area now own their farms and they too, have, where possible, added nearby farms to their existing holdings, already of considerable size. It is an area in which the 100 acre arable farm is now looked on as a small unit and where opportunities arise to mechanize in a big way. Thus it is now the most highly mechanized area in the country with combines and farm grain driers the rule rather than the exception.

Chapter 9. Forestry

by J. L. F. Fergusson, B.A. (For.) Oxon
Forestry Commission (*Scotland*)

Within the surveyed area there is a total woodland acreage of some 25,000 acres in private ownership and 10,400 acres owned by the Forestry Commission. These woodlands are well scattered over the area, mainly in small to medium-sized blocks. There are a few large estates, such as Murthly (3300 acres), Scone (1500 acres), Lynedoch (over 1000 acres), Dupplin (2000 acres), Meikleour (900 acres), Panmure (1300) acres, and Rossie Priory (about 650 acres), but the majority of estates and owner-occupied farms have from 30 to 300 acres of woodland. Some of the estates have a long-established tradition of forest management and this is being continued under the Forestry Commission's Dedication or Approved Woodlands Schemes. A number of smaller plantations and shelter belts have also been established with the aid of planting grants.

There are five main Forestry Commission areas. Strathord section of Dunkeld Forest (1600 acres), in the Stanley district of Strathmore, comprises several plantations on Old Red Sandstone drift soils, mainly the imperfectly drained Balrownie series, with small areas of the poorly drained Lour series. Hallyburton section of Dunkeld Forest (2100 acres) comprises one block west of Burrelton on similar Old Red Sandstone soils and other blocks on part of the Sidlaw Hills south of Coupar Angus where the dominant soils are the freely drained Darleith and Garvock series and the imperfectly drained Mountboy series. Kinfauns section of Dunkeld Forest (1100 acres), near Perth, consists of plantations on Kinnoull and Moncrieffe Hills where the dominant soil is Sourhope series. Similar soil also occurs over Pitmedden section of Blairadarn Forest (1700 acres) at the east end of the Ochil Hills south of Abernethy. Tentsmuir Forest, (3700 acres) is established on stabilised windblown sand overlying the 25 ft raised beach between the Tay and Eden estuaries. Some of these areas were originally bare hill grazings of little value and some were old felled woodlands, but Tents Muir supported little except rabbits before planting commenced.

The annual rainfall varies from about 32 inches in the Dunkeld area to little more than 20 inches around St Andrews. This is one of the main reasons why Scots pine is the principal coniferous tree grown in the district. Tentsmuir Forest consists almost entirely of this species and the introduced Corsican pine. The flat terrain and sandy soil make for easy road access, and there is a considerable output of thinnings for pulpwood and other uses. Scots pine is also used on the dry, rocky sites in the Sidlaws and Ochils and on the acid drift soils derived from the Old Red Sandstone in Strathmore. Here it grows to a large size and good quality, as at Dupplin, Murthly, Scone and elsewhere, but most of the older stands have been felled. Norway spruce grows well on the poorly drained gley soils characterized by a rush vegetation. Sitka spruce, from Western North America has been used on the more acid gley soils in more recent years and on poorly drained sites on the hills where Norway spruce would suffer from exposure. The species puts on a large volume of timber quickly and is not easily destroyed by vermin and so it is much planted by private owners as well as by the Forestry Commission. It is more affected by late frost than Norway spruce and also requires a fairly high rainfall, so that it is not likely to be grown on a long rotation in the district.

The district is, in general, too low in elevation for the satisfactory growth of European larch in quantity, although trees of good quality do occur in many places, grown mixed with Scots pine or hardwoods. Japanese and hybrid larch have been used more recently on dry slopes as they grow quickly and do not suffer from the diseases to which European larch is prone. There are well-known plantations of hybrid larch on Birkhill Estate in North Fife, on soils of the Sourhope and Mountboy series. On the dry hill-tops and south-facing slopes where igneous rocks outcrop, Scots pine is more often used. Another pine which is sometimes planted on difficult sites is Pinus contorta from Western North America. Other conifers from that part of the world which have been planted in the district include Douglas fir, which grows very well on the fluvio-glacial gravel terraces in the Murthly district where there are some very large trees.

Apart from Scots pine, the conifers which are planted so much at the present time have all been introduced to this country from abroad within the last two or three hundred years. As the majority of plantations are of conifers, the woodlands bear little relation to what was the native forest in the past. Oak was an important constituent of it but practically all the oak woods or hedgerow trees which one sees in the district were planted, mainly one hundred or two hundred years ago. Oak grows well on the deeper soils of Strathmore and wherever the soil is of arable quality, but is not planted much today. Birch is a tree which was a common constituent of the old primeval forest and which still seeds itself in great quantity on acid soils, from heavy clay drifts to sands. Beech has been planted in the past around mansion houses and in shelter belts, and is still used today on the better soils and for amenity purposes. It is tolerant of a wide range of soils, except the wettest and most acid. The quality varies but there are some good stands of beech in Strathmore, for example at Hallyburton, and also on the more basic soils derived from the igneous lavas of the Sidlaws, as on Rossie Priory Estate, and of North Fife. Ash and sycamore, and to a lesser extent wych elm, are characteristic of these basic soils and regenerate freely on them. At Rossie Priory some of the finest sycamore in the country may be seen, together with excellent ash, oak and beech.

The planting of the soils in the lower Tay Valley is usually fairly easily accomplished, but the more acid and heavy tills of Strathmore are often wet and covered with a growth of heather or rushes. Here the modern technique of heavy ploughing helps drainage and suppresses the heather. On the drier sites, such as the Sidlaws and North Fife hills, trees are not easily established where there is a tough sward of grass which competes for moisture with the tree roots. Shallow ploughing can also be a help here. Gorse is often a bad weed which invades young plantations on such dry sites, while broom comes in on more acid sands and gravels. Willow-herb is a weed which can be expected on felled woodland sites on most soils in the district except the wetter, acid ones. On the poorer types of acid heath and peatland, it is common practice, after soil preparation by ploughing, to assist early growth by spreading about two ounces of ground mineral phosphate around each plant at the time of planting. The application of phosphates is also used sometimes to bring young trees such as spruce out of check.

Species referred to in the Text

Ash	*Fraxinus excelsior* L.
Beech	*Fagus sylvatica* L.
Birch	*Betula pendula* Roth. and *B. pubescens* Ehrh.
Contorta Pine	*Pinus contorta* Dougl. ex Loud.
Corsican Pine	*Pinus nigra* Arnold ssp. *laricio* (Poir.) Palibin
Douglas Fir	*Pseudotsuga menziesii* (Mirb.) Franco
European Larch	*Larix decidua* Mill
Hybrid Larch	*X Larix eurolepis* Henry
Japanese Larch	*Larix leptolepis* (Sieb. and Zucc.) Gord.
Norway Spruce	*Picea Abies* (L) Karst.
Durmast or Sessile Oak	*Quercus petraea* (Mattuschka) Liebl.
Common or Pedunculate Oak	*Q. robur* L.
Scots Pine	*Pinus sylvestris* L.
Sitka Spruce	*Picea sitchensis* (Bong.) Carr.
Sycamore	*Acer pseudoplatanus* L.
Wych Elm	*Ulmus glabra* Huds.

References

Balsillie, D. (1934). Petrography of the instrusive igneous rocks of south Angus. *Trans. Proc. Perthsh. Soc. nat. Sci.*, **9**, Pt. 4, 133.
Bibby, J. S. and Mackney D. (1969). Land Use Capability Classification. *Soil Surv. Gt. Brit. Tech. Monograph*, No. 1.
Birse, E. L. and Robertson, J. S. (1967). Vegetation. (In Ragg, J. M. and Futty, D. W.: The Soils of the country round Haddington and Eyemouth. *Mem. Soil Surv. Scot.* pp. 115–152).
Birse, E. L. and Roberston, J. S. (1971). Vegetation. (In Bown, C. J., The soils of Carrick and the country round Girvan. *Mem. Soil Surv. Scot.* pp. 132–180).
Birse, E. L. and Gimingham, C. H. (1955). Changes in the structure of bryophytic communities with the progress of succession on sand-dunes. *Trans. Brit. bryol. Soc.* Vol. 2, Pt 4.
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 mechanical analysis of soils. *Soil Sci.*, **23**, 343.
Bown, C. J. (1973). The soils of Carrick and the country round Girvan. (Sheets 7 and 8). *Mem. Soil Surv. Scot.* Edinburgh: H.M.S.O.
Bremner, A. (1937). The Glacial Epoch in north-east Scotland. *Deeside Fld.*, No. 8, 64.
Charlesworth, J. K. (1926). The readvance, marginal kame-moraine of the south of Scotland, and some later stages of retreat. *Trans. roy. Soc. Edinb.*, **55**, Pt. 1, No. 2.
Clapham, A. R., Tutin, T. G. and Warburg, E. F. (1962). Flora of the British Isles. 2nd ed. Cambridge: University Press.
Findlay, D. C. (1965). The soils of the Mendip district of Somerset. (Sheets 279 and 280). *Mem. Soil Surv. Engl. & Wales.* Harpenden: Rothamsted Experimental Station.
Finkenzeller, R. (1957). Combine harvesting on slopes. *Landtechnik*, 12 (1), 12.
FitzPatrick, E. A. (1956). An indurated soil horizon formed by permafrost. *J. Soil Sci.*, **7**, 248.
Geikie, A. (1900). The geology of central and western Fife and Kinross. *Mem. Geol. Surv. Scot.* Glasgow: H.M.S.O.
Geikie, A. (1902). The geology of eastern Fife. *Mem. Geol. Surv. Scot.* Glasgow: H.M.S.O.
Glentworth, R. (1944). Studies on the soils developed on basic igneous rocks in central Aberdeenshire. *Trans. roy. Soc. Edinb.*, **61**, Pt. 1, No. 5, 149.
Glentworth, R. and Dion, H. G. (1949). The association or hydrologic sequence in certain soils of the podzolic zone of north-east Scotland. *J. Soil Sci.*, **1**, 35.
Glentworth, R. (1954). The soils of the country round Banff, Huntly and Turriff. (Sheets 86 and 96). *Mem. Soil Surv. Scot.* Edinburgh: H.M.S.O.
Glentworth, R. and Muir, J. W. (1963). The soils of the country round Aberdeen, Inverurie and Fraserburgh. (Sheets 77, 76, 87/97). *Mem. Soil Surv. Scot.* Edinburgh: H.M.S.O.
Grant, R. (1960). The soils of the country round Elgin. (Sheet 95). *Mem. Soil Surv. Scot., Interim memoir.* Aberdeen: Macaulay Institute for Soil Research.

Harris, J. W. (1928a). The intrusive igneous rocks of the Dundee District. *Trans. Edinb. geol. Soc.*, **12**, 53.

Harris, J. W. (1928b). Notes on the extrusive rocks of the Dundee District. *Trans. Edinb. geol. Soc.*, **12**, 105.

Harry, W. T. (1956). The Old Red Sandstone lavas of the Western Sidlaw Hills, Perthshire. *Geol. Mag.*, **93**, 43.

Hodge, C. A. H. and Seale, R. S. (1966). The soils of the district around Cambridge. (Sheet 188). *Mem. Soil Surv. Engl. & Wales.* Harpenden: Soil Survey of England and Wales.

Hogg, W. H. (1964). Climatic factors and choice of site with special reference to horticulture. *Symp. Inst. Biol.*, No. 14, 141.

Hunter, J. G. (1950). An absorptiometric method for the determination of magnesium. *Analyst, Lond.*, **75**, 91.

Innes, D. E. (1939). The Geology of the Dundee District. Handbook prepared for the meeting of the British Association for the Advancement of Science, Dundee 1939.

James, P. W. (1965). A new check-list of British lichens. *Lichenologist*, **3**, 95.

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.

Kubiena, W. L. (1953). The Soils of Europe. London: Murby.

Land Utilisation Survey of Britain, (1944–46). Report. The Land of Britain. Pt. 12 (Perth), Pt. 27 (Angus) and Pt. 30 (Fife). Edited by L. Dudley Stamp. London: Geographical Publications.

Linton, D. L. (1951). The delimitation of morphological regions. pp. 199–217. London Essays in Geography. Edited by L. D. Stamp and S. W. Wooldridge. London: Longmans Green & Co.

MacGregor, M. and MacGregor, A. G. (1948). The midland valley of Scotland. 2nd ed. *Brit. reg. Geol.* Edinburgh: H.M.S.O.

Macnair, P. (1908). Geology and Scenery of the Grampians and the Valley of Strathmore. Vol. II. Glasgow: Maclehose.

Markham, R. (1942). A steam-distillation apparatus suitable for micro-Kjeldahl analysis. *Biochem. J.*, **36**, 790.

McVean, D. N. and Ratcliffe, D. A. (1962). Plant communities of the Scottish Highlands. *Monogr. Nature Conservancy*, No. 1. London: H.M.S.O.

Melville, L. (1939). The Fair Land of Gowrie. Coupar Angus: William Culross & Sons Ltd.

Meteorological Office (1938). Averages of humidity for the British Isles. M.O. 421. London: H.M.S.O.

Meteorological Office (1952). Climatological Atlas of the British Isles. M.O. 488. London: H.M.S.O.

Meteorological Office (1959). Averages of rainfall for Great Britain and Northern Ireland 1916–50. M.O. 635. London: H.M.S.O.

Meteorological Office (1963a). Averages of temperature for Great Britain and Northern Ireland 1931–60, in degrees Celsius. M.O. 735. London: H.M.S.O.

Meteorological Office (1963b). Averages of bright sunshine for Great Britain and Northern Ireland 1931–60. M.O. 743. London: H.M.S.O.

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. Scot.* Edinburgh: H.M.S.O.

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 soils, plants and related materials. *Tech. Commun. Commonw. Bur. Soil. Sci*, No. 44A.

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. Scot.* Edinburgh: H.M.S.O.

Muir, J. W., Morrison, R. I., Bown, C. J. and Logan, J. (1964). The mobilization of iron by aqueous extracts of plants. I. Composition of the amino-acid and organic-acid fractions of an aqueous extract of pine needles. *J. Soil Sci.*, **15**, 220.

Muir, J. W., Logan, J. and Bown, C. J. (1964). The mobilization of iron by aqueous extracts of plants. II. Capacities of the amino-acid and organic-acid fractions of a pine needle extract to maintain iron in solution. *J. Soil Sci.*, **15**, 226.

Munsell Color Company Inc. (1954). Soil Color Charts. Baltimore: Munsell Color Company Inc.

New Statistical Account of Scotland (1845). Vol. X. Perth. Edinburgh: Blackwood.

Parker, F. W. (1929). The determination of exchangeable hydrogen in soils. *J. Am. Soc. Agron.*, **21**, 1030.

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. II. Practical issues involved in an attempt to apply the Braun-Blanquet system. *J. Ecol.*, **43**, 245.

Ragg, J. M. (1960). The soils of the country round Kelso and Lauder. (Sheets 25 and 26.) *Mem. Soil Surv. Scot.* Edinburgh: H.M.S.O.

Ragg, J. M. and Futty, D. W. (1967). The soils of the country round Haddington and Eyemouth. (Sheets 33, 34 and part 41). *Mem. Soil Surv. Scot.* Edinburgh: H.M.S.O.

Read, H. H. and MacGregor, A. G. (1948). The Grampian Highlands. 2nd ed. *Brit. reg. Geol.* London: H.M.S.O.

Rice, R. J. (1959). The glacial deposits of the Lunan and Brothock valleys in south-eastern Angus. *Trans. Edinb. geol. Soc.*, **17**, Pt. 3, 241.

Rice, R. J. (1961). The glacial deposits of St. Fort in north-eastern Fife: a re-examination. *Trans. Edinb. geol. Soc.*, **18**, 113.

Robertson, G. (1950). The colorimetric determination of aluminium in silicate materials. *J. Sci. Fd Agric.*, **1**, 59.

Robertson, J. (1799). General View of the Agriculture in the County of Perth. Perth: Morison.

Robertson, J. S. and Birse, E. L. (in preparation). Vegetation. (In Romans, J. C. C. The soils of the Black Isle. *Bull. Soil Surv. Scot.*, No. 2).

Robinson, W. O. (1939). Method and procedure of soil analysis, used in the Division of Soil Chemistry and Physics. *Circ. U.S. Dep. Agric.*, No. 139. Washington: Government Printing Office.

Romans, J. C. C. (1962). The origin of the indurated B_3 horizon of podzolic soils in north-east Scotland. *J. Soil Sci.*, **13**, 141.

Ruhmann, H. (1957). Cultivation zones on gradients; practical limits of tractor work. *Landtechnik*, 12(9), 259.

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.

Simpson, J. B. (1933). The Late Glacial readvance moraines of the Highland Border west of the River Tay. *Trans. roy. Soc. Edinb.*, **57**, Pt. 3, No. 24, 633.

Sissons, J. B. (1963). The Perth readvance in central Scotland. Part I. *Scott. geogr. Mag.*, **79**, 151.
Smith, A. (1952). The Third Statistical Account of Scotland. Vol. 2. The County of Fife. Edinburgh: Oliver & Boyd.
Soil Survey of Great Britain (1960). Field Handbook.
Synge, F. M. (1956). The glaciation of north-east Scotland. *Scott. geogr. Mag.*, **72**, 129.
Tansley, A. G. (1953). The British Isles and their Vegetation. Cambridge: University Press.
Ure, A. M. (1954). The application of electronics to spectrochemistry. Thesis, University of Aberdeen.
U.S. Dept. Agric. (1951). Soil Survey Manual. U.S. Dept. Agric. Handbk. No. 18. 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.
Warburg, E. F. (1963). Census Catalogue of British Mosses. 3rd ed. *Brit. bryol. Soc.*

APPENDIX I

Methods and Definitions

The primary aim of a soil survey is to identify and describe soils and to record their distribution on a map. Soils are identified on the basis of their morphology in the field, that is by a comparative study of their appearance. The main features considered are colour, texture, structure, consistence, organic matter, stoniness, wetness, nature of the parent material and thickness of the various horizons or layers. These features are examined in soil profiles exposed in small inspection pits dug at frequent intervals. The primary unit of mapping is the soil series, defined as a group of soils with similar profiles and formed from similar parent materials. Each soil series is identified by a number of established profile features from which there is a permissible range of variation.

CARTOGRAPHIC METHODS

The soil series as well as being the primary mapping unit, is also the primary unit of classification. In order to relate them to their environment, and particularly to geology, soils are grouped into a larger unit, the soil association. A soil association comprises series developed on the same or similar parent material but showing a variation in profile morphology due, largely, to variations in hydrologic conditions.

In field mapping, the Soil Survey of Scotland uses Ordnance Survey maps with a scale of 1:25,000 (approx. 2½ inches to 1 mile). For publication, these maps are reduced to a scale of 1:63,360 (1 inch to 1 mile) and soil series are distinguished by the use of different colours. It will be appreciated that certain areas (less than approx. 5 acres) on the 2½ inch scale are too small to delineate on the 1 inch scale. Thus, on the published map, the area uniformly coloured and labelled as one series may contain a small area or areas (less than 5 acres in extent) of some other series.

FIELD MAPPING

During the survey of an area inspection pits are dug at intervals, normally to a depth of from 2 to 3 feet, but frequently to greater depths. The soil profile exposed is examined and a brief description recorded on the field map. The areas covered by different soil series are delineated on a map, the relationship between soil profile, topography and vegetation being used in determining the positions of boundaries.

When a series has been established in an area, a typical profile is exposed in a soil pit dug to a suitable depth, commonly up to 4 feet (1·2 m.). The profile is carefully described, using standard terms, and soil samples are taken from the various horizons or layers. The standard terms used in describing soil profiles and certain site characteristics are listed and defined later in this appendix. The samples are labelled and sent to the Macaulay Institute for Soil Research for routine physical and chemical examination. Further analyses by mineralogical, differential thermal, X-ray and spectrochemical methods are carried out on a selection of the profiles.

HORIZON NOMENCLATURE OF SOIL PROFILES

Typical soil horizons can be more readily compared and contrasted if a symbol is assigned to each one. L, F, H, A, S, B, C and D used in this memoir are those appearing in earlier memoirs of the Scottish Soil Survey, but the system of soil classification and the symbols employed to denote horizons are at present under review.

The L, F and H layers are subdivisions of the organic matter lying on the surface of the solum.

L—a superficial layer of relatively undecomposed plant litter, generally of the past year.

F—a superficial layer of partially decomposed litter with recognizable plant remains.

H—a superficial layer of decomposed organic matter with few or no recognizable plant remains.

The A horizon is the upper mineral part of the solum. It is the horizon of maximum biological activity and the horizon most subject to the direct influence of climate, plants and animals.

L, F, H and A horizons can be distinguished only in natural or semi-natural soils. With cultivation they become incorporated in the S layer which is the surface horizon of a cultivated soil.

The B horizon is the lower part of the solum lying between the A (or S) and C horizons. It is characterized either by a relatively high content of sesquioxides (oxides mainly of iron and aluminium) or clay or by a blocky to prismatic structure. It is frequently brightly coloured.

The C horizon is the parent material from which the soil has been developed.

The D horizon is either the rock from which the C horizon has been developed or a stratum of material not related to the C horizon.

The symbol for a horizon which has a slight to moderate amount of gleying, as shown by the presence of grey coatings on the peds of sub-surface horizons, is qualified by adding (g), e.g. B_2(g), C(g); when gleying is strong, g is used, e.g. B_2g, Cg.

HORIZON NOMENCLATURE OF THE MAJOR SOIL SUB-GROUPS

Brown Forest Soil

L	undecomposed plant litter.
F	partially decomposed plant litter.
H	trace of decomposed organic matter—may be absent.
A	brown colour with medium organic matter, 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 and closer to the colour of the parent material. May show some degree of induration.
C	the relatively unweathered parent material.

Brown Forest Soil with gleying.

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.

Iron Podzol

L	undecomposed plant litter.
F	partially decomposed litter.
H	decomposed organic matter—dark brown or black. (This layer is frequently absent or very thin).
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	less bright than B_2; shows some relative enrichment of free sesquioxides and may be indurated.
C	the relatively unweathered parent material.

Non-calcareous Gley

L	undecomposed plant litter.
F	partially decomposed litter.
H	trace of decomposed organic matter—often absent.
A_1	mixed mineral-organic layer. Some ochreous mottling associated with roots. Weak structure.
A_2g	pale-coloured mineral layer, low in organic matter. Ochreous mottling may be present. Weak structure.
Bg	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.

It is sometimes possible to sub-divide the Bg horizon into B_2g and B_3g layers.

STANDARD TERMS AND DEFINITIONS

Standard terms used in describing soil profiles are listed briefly here. They have been given in detail in earlier memoirs of the Soil Survey of Scotland.

Slope Classes

Slope classes employed in describing land form units or the relief at profile sites are those used by the U.S. Soil Survey (U.S.D.A. 1951).

Class	Limits	Single Slope Class	Class	Limits	Single Slope Class
Class A	*Limits* Lower 0°, Upper ½–1½°	Level	Class D	*Limits* Lower 6–9°, Upper 12–17°	Moderately steep
Class B	*Limits* Lower ½–1½°, Upper 3–4½°	Gentle	Class E	*Limits* Lower 12–17°, Upper 24–33°	Steep
Class C	*Limits* Lower 3–4½°, Upper 6–9°	Moderate	Class F	*Limits* Lower 24–33°, Upper 90°	Very Steep

Drainage Classes

In soil survey, drainage refers to the inherent drainage qualities of the soil as revealed by the morphology of the profile. In general, freely drained soils have bright, uniformly coloured B horizons, while poorly drained soils have dull mottled B horizons. Mottling, especially grey mottling, is regarded as evidence of gleying. Drainage classes, therefore, are distinguished purely on morphology.

The main characteristics to be considered in assessing drainage class are given below:

Drainage: Free

The B horizons are normally bright and uniformly coloured, although the class occasionally includes soils with B horizons which are slightly dull and show some mottling.

Drainage: Imperfect

The B(g) horizons are not quite so bright as those of the freely drained soil and have appreciable mottling.

Drainage: Poor and Very Poor

In both cases, the Bg horizons are dull and mottling is very evident.

The imperfectly drained soil is intermediate between the freely and poorly drained soils, but it is generally rather closer in character to the freely drained.

The poorly drained soils require tile drains before successful cultivation can be undertaken. In this district, very poorly drained soils cover areas too small to delineate on the map. In most cases, the soils are found in very low-lying localities, and because of this and of their mixed nature, they have been included in the category of Mixed Bottom Land.

The drainage class, excessive, characterized by horizons shallower than normal and B horizons of bright and uniform colour, is only rarely found in this district and has not been recorded on the map.

Colour

Soil colours are assessed by the Munsell Soil Colour Charts system, which is now used internationally.

Texture

Soil texture is the relative proportion of the various size groups of primary particles in a mass of soil; it refers, specifically, to the proportions of sand silt and clay in that part of a soil which passes through a 2 mm. sieve. The presence of particles larger than 2 mm. does not affect the texture of the soil directly, but it can be indicated by additional descriptive terms such as stony, pebbly etc.

A soil can be separated by mechanical analysis into sand, silt and clay fractions. Soil separates or particle size groups have been arbitrarily selected for each fraction and are listed below. Two schemes are shown, the International Scheme of Mechanical Analysis (by no means in universal use) and that used by the U.S. Department of Agriculture.

U.S.D.A.		International Scheme	
Name of Separate	Effective Diameter (range) μ	Fraction	Effective Diameter (range) μ
sand: very coarse sand	2000–1000	sand: coarse sand I	2000–200
sand: coarse sand	1000–500	sand: fine sand II	200–20
sand: medium sand	500–250		
sand: fine sand	250–100	silt III	20–2
sand: very fine sand	100–50		
silt	50–2	clay IV	< 2
clay	< 2		

The Soil Survey of Scotland now makes use of both schemes and two sets of results are quoted for each profile shown in Appendix III.

Textural Class Names

Textural class names for soil horizons are ascertained by plotting on a triangular diagram (Fig. 13) the percentages of sand, silt and clay separates. (The Soil Survey of Scotland groups all the sand separates under the general name sand). The section of the diagram into which the soil fits is ascertained and the soil given the appropriate name. The various textural class sections on the diagram have been established after years of experience, especially in the United States of America and, strictly speaking, the diagram should be used only in conjunction with the U.S.D.A. Scheme of Mechanical Analysis.

Soil textures shown in profile descriptions are those estimated by hand in the field when a small portion of moistened soil is worked between finger and thumb. Textures assessed using the triangular diagram frequently differ slightly from those estimated in the field. Discrepancies arise mainly because textural classes on the diagram take no account of organic matter and, in addition, because the sand fraction determined by mechanical analysis is sometimes slightly higher as a result of the grinding up of small pieces of rock during preparation of the sample.

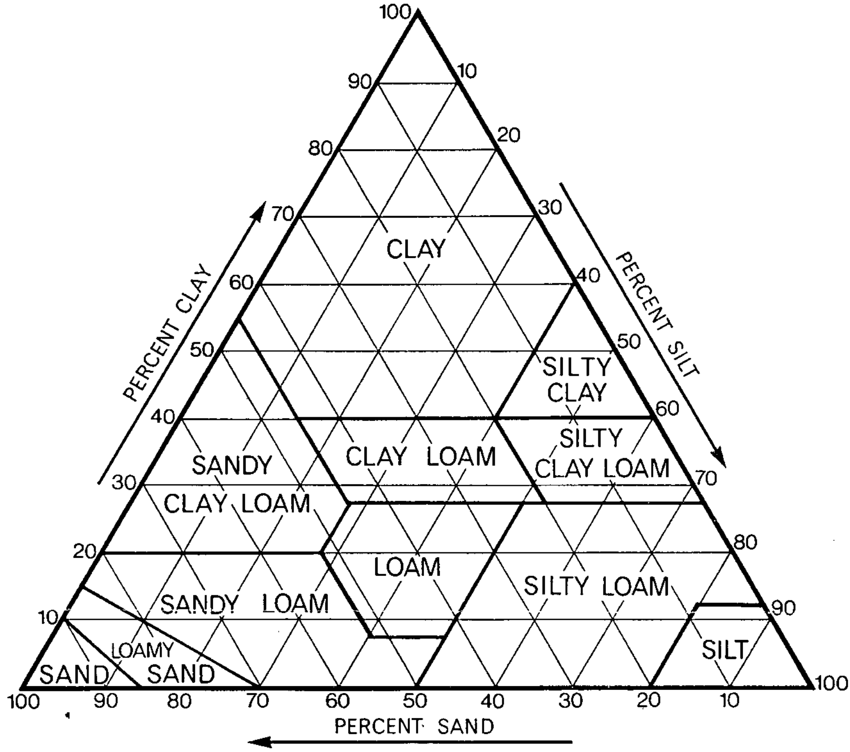

FIG. 13. Percentage of Clay ($<2\mu$), Silt (2–50μ) and Sand (50–2000μ) in the Basic Soil Textural Classes.

General Grouping of Soil Textural Classes

It is often convenient to distinguish broad groups of textural classes. Acceptable general terms are given for textural classes in three- and five-class groupings, and relationship to the twelve basic textural classes on the triangular diagram is indicated.

General terms		*Basic terms*
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

Structure

The primary particles of a soil are aggregated into compound units or peds with characteristic shapes and sizes, and in the field soil structure is described by recording for these units the grade, type and class.

Grade is the degree of distinctness and durability of the structure. The following terms are used in describing it.

Structureless—no observable peds, massive if coherent, single grain if non-coherent;
Weak —indistinct peds; when disturbed breaks mainly into structureless material;
Moderate —well-formed peds; when disturbed yields many unbroken units and a little structureless material;
Strong —well-formed peds; when disturbed yields unbroken units with very little structureless material.

Type of soil structure covers the shape and arrangement of peds and is defined as follows.

Platelike —with one dimension, the vertical, much less than the other two.
Prismlike —with two dimensions (horizontal) much less than the vertical
Sub-types { Prismatic (without rounded caps)
Columnar (with rounded caps).
Blocklike —with three dimensions of the same order of magnitude, enclosed by plane or curved surfaces that are casts or moulds formed by faces of adjacent peds.
Sub-types { Angular blocky (with relatively sharp angles)
Sub-angular blocky (with rounded faces).
Spheroidal —with three dimensions of the same order of magnitude enclosed by plane or curved surfaces which have slight or no accommodation to the faces of surrounding peds.
Sub-types { Granular (relatively non-porous).
Crumb (porous).

Class designates the size of the aggregates and five classes are recognized for each type—very fine, fine, medium, coarse, very coarse.

Consistence

Soil consistence is a quality of soil material which is expressed by the degree of cohesion or adhesion. It is measured by the resistance of a soil to deformation or rupture and varies with moisture content. Thus the consistence at any time should be considered in relation to the moisture level. The following terms are used.

Consistence when Wet

To evaluate, roll the 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 a mass that appears moist.

0. Loose —non-coherent.
1. Friable —soil material crushes under very gentle pressure but coheres when pressed together.
2. Firm —soil material crushes under 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 hands but only with difficulty between thumb and forefinger.
3. Very hard —can normally be broken in the hands, but only with difficulty.

In Scotland, soil horizons are usually either wet or moist.

Induration

Induration 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:

Weakly indurated —not usually detected when digging, but presence shown by stabbing a knife into the profile face. Soil breaks easily in the hand.

Moderately indurated —detected when digging. Soil breaks in the hand by using moderate pressure.

Strongly indurated —detected when digging, and in fact causes difficulty. Soil not readily broken in the hand.

The origin and occurrence of indurated layers in soils of north-east Scotland have been discussed by Glentworth (1944, 1949, 1954), FitzPatrick (1956) and Romans (1962). While FitzPatrick suggests that "the indurated layer is the fossilized permafrost layer", Romans maintains that the development of the layer is related to the development of the podzol profile and that its origin must be ascribed, therefore, to pedological rather than to periglacial processes.

Organic Matter

In profile descriptions, it is usual to estimate the amount of organic matter present in each horizon. A horizon containing more than 20 per cent organic matter is considered an organic horizon, and a horizon with less than 20 per cent a mineral horizon. The following terms are normally used to indicate amounts of organic matter.

High	13–20%
Moderate	8–13%
Low	<8 %

In addition to the amount, the structure and degree of humification are noted. As stated in the section on horizon nomenclature, organic horizons can often be sub-divided into L, F and H layers.

Three principal types of humus, mull, silicate moder and raw humus or mor, are found in the area. Mull is an intimate mixture of mineral and organic matter in the A horizon with constituent parts indistinguishable by means of a lens. Silicate moder has an appearance similar to mull but constituent organic and mineral parts can be identified by the use of a good lens. Raw humus or mor is usually found where there are well-developed L, F and H layers and there is no intimate mixing of organic and mineral parts.

Stoniness

An estimate is made of the percentage stones in a horizon and the stoniness expressed using the terms given below. It must be emphasized that this is only an approximate assessment.

Few	<5% by volume
Frequent	5–25% by volume
Many	>25% by volume

A brief description is normally given of the shapes and sizes of stones and, where possible, of their geological nature.

Roots

The quantity, size and nature of roots is estimated from a clean-cut area of profile surface 1 foot (30 cms.) square. Quantity is expressed as few (<10), frequent (10–100), many (>100); size ranges from fine (less than 1 mm. diameter) to very large (more than 30 mm. diameter); nature is termed woody, fibrous or fleshy.

Mottling

Mottling is described by colour and pattern. For colour the Munsell Color Charts are normally employed but a general term "ochreous" is sometimes used where there are differing shades of brown. Pattern is described in terms of:

Abundance
- few —mottles <2% of surface.
- frequent —mottles 2–20% of surface.
- many —mottles >20% of surface.

Size
- fine —<5 mm.
- medium —5–15 mm.
- coarse —>15 mm.

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 value, hue and chroma.

Horizon Boundaries

Boundaries between soil horizons differ in distinctness and regularity. The following terms based on the width of the boundary are used to describe distinctness.

- Sharp —<1 inch.
- Clear —1–2½ inches.
- Gradual —2½–5 inches.
- Diffuse —>5 inches.

APPENDIX II

System of Soil Classification

The system of classification used by the Soil Survey of Scotland and the Soil Survey of England and Wales is at present under review, but as the new and revised classification has yet to be established the system adopted here is similar to that used in previous memoirs, Muir (1956), Mitchell and Jarvis (1956), Grant (1960), Glentworth and Muir (1963), Ragg and Futty (1967).

In Scotland three main soil divisions are recognized—leached soils, gleys, and organic soils. Each division is made up of major soil groups which are in turn divided into sub-groups. Soil series with very similar profiles are assigned to the same major soil group and sub-group.

In Table L the series mapped in this district are listed in their appropriate division, major soil group and sub-group, for which the more important field properties are given below.

Division of Leached Soils

The process of leaching takes place under humid climatic conditions when the general movement of soil water is downwards and consequently there is a tendency for substances to be removed by solution from upper layers and redeposited at lower levels in the soil profile. Leached soils are characterized by a uniformly coloured B horizon, absence of free lime in the upper horizons and an acid reaction.

MAJOR SOIL GROUP: NORMAL BROWN EARTHS

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

Sub-group: Brown Forest Soils

Brown forest soils have a moderately acid reaction. There is a clear change from the A horizon to the B_2 but a sharp change from the B_2 to the B_3.

Sub-group: Brown Forest Soils with Gleying

Brown forest soils with gleying are of moderate base status and moderately acid reaction. The B and C horizons usually show slight gleying. The soils are generally formed on parent material of fine texture.

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

As this is the only podzol sub-group occurring in the district, it appears on the key accompanying the soil map under the unqualified heading "Podzols".

The iron podzol has a strongly bleached A_2 layer and a well-developed bright B_2. Sometimes there is a sharp change into a paler, indurated B_3 horizon.

Division of Gleys

Gleys are 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 and beneath it the horizons are grey with a greenish or bluish tinge and ochreous mottling. These are secondary colours which mask the colours inherited from the parent material.

MAJOR SOIL GROUP: SURFACE-WATER GLEYS

Surface-water gleys are soils which exhibit strongly gleyed surface horizons: the intensity of gleying diminishes with depth. The soil colour inherited from the parent material is more apparent in the B_3g and Cg horizons than in others.

Sub-group: Non-calcareous Gleys

Non-calcareous gleys have no free calcium in the upper mineral layers. The H layer is usually not more than 1 inch (3 cm.) thick and an A_2g horizon, often well defined, is present in the semi-natural soils.

MAJOR SOIL GROUP: GROUND-WATER GLEYS

Ground-water gleys are soils which have developed under the influence of a high ground-water table. The effect of gleying increases with depth and the colour inherited from the parent material is not apparent at depth.

Sub-group: Gleyed Warp Soils

Gleyed warp soils have profiles similar to those of the surface-water gleys, but with little trace of a well defined organic-rich layer. Grey colours become pronounced with depth as a result of water-logging from the permanent ground-water table.

Division of Organic Soils

Organic soils are formed under waterlogged conditions. They have more than 12 inches organic matter overlying the mineral soil.

MAJOR SOIL GROUP: BASIN PEAT

Basin peat develops initially under the influence of ground water in depressions or badly drained basins. The profile shows a definite vegetation sequence.

APPENDIX III

Standard Analytical Data

TABLE 1. SOILS DERIVED FROM HIGHLAND SCHISTS

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations m.e./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.								**Strichen Association**; Strichen Series. Cloven Stone, 161504–10											
L/F/H	2–0	62·30	*n.d.	n.d.	n.d.	n.d.	n.d.	8·32	2·27	0·22	1·00	87·90	11·8	3·86	36·60	1·836	183	13·0	Low Ca except in L/F/H.
A_2	0–2	21·50	49·1	29·0	67·9	10.2	5·8	1·87	0·85	0·08	0·19	33·54	8·2	3·72	12·60	0·818	73	1·6	Low Mg except in L/F/H, A_2 & B_2.
B_2	6–10	10·00	51·5	37·0	73·0	15·5	6·5	0·31	0·39	0·04	0·02	18·35	4·0	4·41	3·79	0·244	74	0·3	Low K except in L/F/H & A_2.
B_2/B_3	15–19	3·47	54·0	38·5	76·2	16·3	7·5	0·31	0·08	0·02	0·02	5·77	6·9	4·58			103	6·2	Low % saturation throughout.
B_3	22–26	2·00	53·6	38·7	74·6	17·7	7·7	†—	—	0·02	—	3·91	0·5	4·52			136	17·0	Low Total P_2O_5 in A_2 and B_2.
B_3	31–35	2·39	54·0	36·5	72·9	17·6	9·5	—	—	0·02	0·03	2·42	2·0	4·56			143	14·7	High readily soluble P_2O_5 in L/F/H, B_3 and C.
C	38–42	2·08	54·4	37·9	75·7	16·6	7·7	—	0·04	0·02	0·03	2·54	3·4	4·61			145	17·7	
2.								**Strichen Association**; Strichen Series. Upper Obney, 161511–15											
S	3–7	7·48	42·0	38·3	59·7	20·6	16·0	10·34	0·04	0·07	0·21	3·24	76·7	6·05	3·08	0·247	168	2·6	High Ca in S, low in B_3 and C.
B_2	11–14	6·47	52·3	35·0	70·7	16·6	9·5	4·76	0·22	0·07	0·06	6·66	43·4	5·89	1·82	0·152	107	1·2	Low Mg.
B_3	16–19	2·53	62·2	32·4	78·9	15·7	5·4	0·75	—	0·01	0·03	0·85	48·2	5·80			88	15·2	Low K except in S.
C	21–25	2·06	72·5	23·9	88·8	7·6	3·6	0·60	—	0·01	0·03	1·08	37·2	5·79			139	23·0	High % saturation in S, elsewhere moderate.
C	32–36	1·99	75·8	21·2	89·5	7·5	3·0	0·30	—	0·01	0·02	0·90	26·8	5·80			163	30·8	Low total P_2O_5 in B_3.
																			Readily soluble P_2O_5 low in S and B_2, high in B_3 and C.

3. **Strichen Association**; Strichen Series. Letter Hill, 171457–62

A	2–5	9·30	53·9	32·1	71·5	14·5	9·3	2·01	0·54	0·11	0·25	11·73	19·9	4·87	4·88	0·286	134	2·2	Low Ca throughout.
B_2	9–12	4·17	57·1	24·5	69·3	12·3	16·3	0·76	0·12	0·06	0·08	5·59	15·4	5·20	1·57	0·105	114	1·1	Low Mg and K except in A.
B_2	15–18	3·48	72·0	15·7	79·9	7·8	12·3	0·76	0·05	0·06	0·06	4·38	17·5	5·41	1·09	0·073	122	2·2	Low % saturation except in C.
B_3	20–23	1·55	61·9	26·0	75·2	12·7	12·1	—	0·07	0·05	0·06	1·47	11·9	5·52			151	26·8	High readily soluble P_2O_5 in B_3
C	26–30	1·54	54·7	30·8	70·8	14·7	14·5	0·76	0·20	0·06	0·11	1·34	45·7	5·80			119	16·5	and C.
C	38–41	1·84	58·8	28·5	73·0	14·3	12·7	0·76	0·28	0·06	0·09	1·42	45·6	5·90			129	24·8	

4. **Strichen Association**; Fungarth Series. Birnam, 171866–69

A	1–5	11·30	52·5	35·4	72·1	15·8	6·4	1·08	0·40	0·11	0·22	19·85	8·4	4·09	5·63	0·277	131	1·1	Low Ca.
A/B	6–10	6·94	47·4	31·3	63·7	15·0	17·8	—	0·08	0·07	0·03	11·75	1·5	4·59	2·88	0·189	84	0·6	Low Mg and K except in A.
B_2	10–14	5·67	49·3	30·1	65·7	13·7	17·8	0·31	0·08	0·05	—	9·39	4·5	4·79			82	0·6	Low % saturation.
C	20–24	3·24	69·9	22·2	81·9	10·2	7·9	—	0·01	0·04	—	5·28	0·9	4·89			117	6·0	Low total P_2O_5 except in A and C
																			Low readily soluble P_2O_5 except in C.

5. **Strichen Association**; Fungarth Series. Dunkeld Oakwood, 127502–08

A	0–1	31·65	n.d.	n.d.	n.d.	n.d.	n.d.	6·52	2·24	0·26	1·38	16·08	39·2	4·70	19·25	0·923	220	0·4	Low Ca & Mg except in surface
A	1–2·5	11·91	41·9	43·4	65·7	19·6	8·7	0·93	0·60	0·14	0·38	18·18	10·1	4·46	7·23	0·426	132	1·4	layer.
B_2	6–9	5·69	45·0	33·6	61·6	17·0	18·6	0·31	0·08	0·06	0·06	8·51	5·7	4·91	1·89	0·123	74	0·9	Low K except in A.
B_3	13–16	2·99	48·9	31·6	64·0	16·5	16·5	0·15	0·07	0·06	0·03	6·72	4·4	5·04			88	2·4	Low % saturation except in A
C	18–21	2·66	56·1	30·7	70·4	16·4	10·5	—	0·01	0·05	—	3·43	1·7	5·15			106	11·2	and C.
C	26–29	3·02	52·4	32·7	66·4	18·7	11·9	0·15	0·19	0·05	0·14	1·80	22·8	5·51			102	3·8	Low total P_2O_5 in B_2 and B_3.
C	37–41	1·95	61·1	27·2	73·8	14·5	9·7	—	0·03	0·04	0·06	1·39	8·6	5·48			130	15·9	Readily soluble P_2O_5, high in C, low elsewhere.

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 1: Soils derived from Highland Schists—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations m.e./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.								**Strichen Association; Obney Series.** Letter Hill, 171470–74											
A	1–4	9·55	45·2	37·1	64·6	17·7	12·9	3·69	0·67	0·13	0·16	7·02	39·85	5·08	4·45	0·275	143	1·6	Low Ca, Mg and K except in A.
A	6–9	8·28	40·3	41·5	61·7	20·1	14·1	4·58	0·67	0·10	0·13	5·65	49·2	5·11	3·28	0·225	133	1·4	Readily soluble P_2O_5 low in A, high in B_3(g) and C(g).
B_2(g)	13–16	4·50	50·1	34·4	69·4	15·1	13·2	1·83	0·25	0·06	0·08	5·44	29·0	5·35			149	4·8	
B_3(g)	18–20	2·64	56·6	30·9	70·1	16·7	12·5	0·76	0·16	0·04	0·06	2·55	28·6	5·51			123	11·7	
C(g)	26–30	2·04	56·0	31·4	69·0	18·4	12·6	0·75	0·12	0·04	0·06	1·57	38·2	5·54			144	26·3	
7.								**Strichen Association; Obney Series.** Upper Obney, 161516–20											
S	3–7	6·18	44·4	37·0	63·4	18·0	15·5	5·64	0·42	0·07	0·05	3·14	66·3	6·21	2·03	0·205	176	10·9	Low Ca except in S.
B_2(g)	10–13	2·41	64·2	28·0	79·3	12·9	7·8	0·76	0·07	0·03	0·03	1·59	35·9	5·87	0·76	0·063	113	16·0	Low Mg in B_2(g) and B_3(g).
B_3(g)	16–20	2·70	47·9	42·8	70·4	20·3	9·3	1·21	0·19	0·02	0·04	2·66	35·4	5·69			91	4·3	Low K throughout.
B_3(g)	28–32	2·49	54·8	37·5	74·5	17·8	7·7	2·42	0·55	0·07	0·03	0·04	98·7	5·99			160	35·1	High % saturation in S and lower B_3(g).
C(g)	40–44	1·95	54·8	38·2	75·5	17·5	7·0	1·81	0·50	—	0·03	1·02	49·6	5·93			162	44·2	High readily soluble P_2O_5 except in upper B_3(g).

8. **Strichen Association**; Obney Series. Whinnyhill, 161488–94

L & F	3–1	90·42	n.d.	n.d.	n.d.	n.d.	n.d.	4·43	3·72	0·89	1·48	113·99	8·4	3·99	54·81	1·319	239	6·1	Low Ca except in L, F, H and in lower C(g). Low Mg in A_2 and B_2(g). Low K except in L and F. % saturation low in upper horizons, high in B_3(g) and C(g). Total P_2O_5 low in A_2. Readily soluble P_2O_5 high in B_3(g) and C(g).
H	1–0	51·60	n.d.	n.d.	n.d.	n.d.	n.d.	5·75	2·41	0·44	—	65·64	11·6	3·99	29·91	1·304	226	5·5	
A_2	0–2	6·00	35·1	30·7	73·2	12·6	11·2	0·61	0·19	0·04	—	13·70	5·8	4·60	2·85	0·303	75	2·0	
B_2(g)	5–9	3·36	42·8	45·7	68·6	19·9	11·5	—	0·07	0·04	—	4·02	2·7	5·15			124	6·0	
B_3(g)	16–20	2·22	52·4	36·3	68·6	20·1	11·3	1·06	0·55	0·06	—	0·82	67·1	5·41			115	18·2	
C(g)	28–32	1·13	52·8	39·5	73·4	18·9	7·7	2·59	0·95	0·07	0·03	—	100	5·66			166	34·7	
C(g)	42–46	1·62	52·9	38·6	74·4	17·1	8·5	3·18	1·16	0·08	0·04	—	100	5·80			157	40·5	

9. **Strichen Association**; Anniegathel Series. Letter Hill, 171466–69

A	3–7	15·40	50·1	31·6	65·5	16·2	10·6	10·89	1·94	0·27	0·15	12·76	50·9	5·18	8·65	0·399	159	2·5	High Ca in A, low elsewhere. Low Mg in Cg. Low K except in A. Readily soluble P_2O_5 low in A, high elsewhere.
B_2g	10–13	4·20	46·6	37·7	64·6	19·7	13·6	2·81	0·59	0·13	0·02	4·86	42·2	5·13	1·52	0·108	101	15·3	
Cg	19–23	1·86	61·0	30·4	77·1	14·3	8·6	0·75	0·16	0·05	0·01	0·67	59·1	5·21			109	27·6	
Cg	28–32	1·93	64·0	25·8	77·0	12·8	10·2	0·75	0·23	0·05	0·01	0·81	56·2	5·29			115	28·8	

10. **Strichen Association**; Anniegathel Series. Upper Obney, 171870–73

H	4–0	89·00	n.d.	n.d.	n.d.	n.d.	n.d.	5·91	4·78	0·79	4·06	87·29	15·1	3·94	44·97	1·715	287	0·6	Low Ca, Mg and K except in H. Low percentage saturation throughout. Moderate total P_2O_5 in H, B_2g and B_2g/C, low in A_2g. Low readily soluble P_2O_5 in H and A_2g.
A_2g	0–4	5·42	53·9	38·5	78·2	14·2	4·9	—	0·10	0·07	0·01	12·38	1·4	3·91	2·63	0·149	40	1·1	
B_2g	6–10	3·11	53·1	38·6	75·3	16·4	8·3	—	0·02	0·04	—	5·28	1·1	4·82			112	8·9	
B_2g/C	13–16	2·36	51·4	39·1	71·2	19·3	9·5	0·30	0·12	0·05	—	3·10	13·2	5·30			119	7·5	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 1: Soils derived from Highland Schists—*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 m.e./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
11.								**Foudland Association**; Foudland Series. Letter Hill, 171463–5											
A	2–6	10·40	45·5	33·4	62·6	16·3	15·9	0·93	0·34	0·07	0·34	13·41	11·1	4·70	4·87	0·243	107	1·2	Low Ca throughout.
B	10–14	7·46	51·8	33·8	68·5	17·1	10·7	—	0·09	0·05	0·13	6·85	3·8	4·91	2·68	0·133	123	0·8	Low Mg except in A.
C	18–22	6·20	60·9	22·4	69·6	13·7	13·6	—	0·01	0·04	0·10	4·69	3·1	5·01			155	3·2	Low % saturation throughout. Low readily soluble P_2O_5 in A and B.
12.								**Gourdie Association**; Snaigow Series. East Cult, 171445–52											
L & F	1–0	55·00	n.d.	n.d.	n.d.	n.d.	n.d.	9·40	4·78	0·59	2·20	48·95	25·7	4·41	31·91	1·445	251	13·9	High Ca in L and F, low below A.
A	0–2	36·30	n.d.	n.d.	n.d.	n.d.	n.d.	3·14	1·31	0·37	0·63	41·59	11·6	4·09	18·16	0·883	230	3·9	Low Mg below A.
A/B	3–6	10·80	45·1	37·2	64·8	17·5	12·3	—	0·09	0·04	0·13	20·95	1·2	4·24	4·98	0·467	108	1·0	High K in L and F, low in upper B_2 and B_3.
$B_{2(1)}$	7–10	10·00	47·5	34·9	66·0	16·4	12·6	—	0·03	0·07	0·06	17·24	0·9	4·42			123	0·9	Low % saturation except in L and F.
$B_{2(2)}$	14–18	7·50	44·8	32·9	61·3	16·4	18·5	—	0·04	0·06	0·10	11·08	1·8	4·42			141	1·4	Low total P_2O_5 in C and lower B_3.
B_3	20–24	3·34	46·1	31·7	61·4	16·4	22·2	—	—	0·03	0·09	2·86	4·0	4·59			119	4·9	High readily soluble P_2O_5 in L and F, low elsewhere except in A and upper B_3.
B_3	28–32	2·80	45·3	32·2	59·5	18·0	22·5	—	0·04	0·05	0·13	3·46	6·0	4·55			94	1·4	
C	38–42	2·88	44·1	31·8	57·4	18·5	24·1	—	0·05	0·06	0·13	3·60	6·3	4·61			83	0·9	

13. **Gourdie Association**; Snaigow Series. Middle Gourdie, 171630–35

S	1–5	5·93	36·7	41·1	57·4	20·4	19·2	5·87	0·36	0·06	0·12	5·07	55·8	5·60	2·53	0·226	229	7·7	Low Mg in upper B_3.
B_2	9–12	4·29	45·8	35·7	64·5	17·0	16·4	5·83	0·32	0·06	0·05	3·56	63·7	5·81	1·80	0·166	183	8·2	Low K except in S.
B_3	15–17	2·37	57·7	32·4	72·8	17·3	9·9	3·05	0·16	0·05	—	2·36	58·0	5·80	1·02	0·095	150	18·4	High % saturation except in S
B_3	20–22	1·94	54·7	34·5	70·8	18·4	10·8	3·04	0·36	0·05	—	1·61	68·2	5·80			106	16·2	and upper B_3.
C	24–27	2·16	50·9	37·1	68·7	19·3	12·0	3·95	0·57	0·09	—	1·09	80·9	5·90			79	9·3	Low total P_2O_5 in upper C.
C	31–36	2·24	42·6	40·1	61·8	20·9	17·3	4·27	1·44	0·09	—	1·58	78·5	6·00			118	19·1	High readily soluble P_2O_5 in B_3
																			and lower C.

14. **Gourdie Association**; Gourdie Series. Middle Gourdie, 171636–41

S	3–7	5·56	46·6	33·5	63·9	16·2	17·1	8·43	0·62	0·07	0·07	2·88	76·1	6·21	2·11	0·189	212	14·9	High Ca in upper S.
S	12–16	6·23	47·0	33·9	63·5	17·4	16·0	6·61	0·52	0·07	—	4·05	64·0	5·97	1·55	0·140	185	11·7	Low K throughout.
B_2(g)	19–22	3·87	47·4	34·4	64·9	16·9	18·2	6·28	0·59	0·07	—	4·96	58·3	6·01	1·40	0·106	150	5·5	High % saturation except in
B_3(g)	24–26	1·51	63·7	28·1	30·8	11·0	8·2	5·79	0·76	0·07	—	2·27	74·5	6·19			118	43·5	B_2(g).
C(g)	28–32	1·93	61·6	31·5	78·0	15·1	6·9	6·55	0·92	0·07	—	1·83	80·5	6·45			122	40·4	High readily soluble P_2O_5
C(g)	36–40	1·54	59·0	33·1	76·8	15·3	7·9	5·32	1·03	0·06	—	2·07	75·6	6·59			169	66·7	except in upper B_2(g).

15. **Gourdie Association**; Gourdie Series. Mains of Fordie, 189068–72

S	2–6	6·76	45·8	30·7	60·0	16·5	20·1	4·32	0·11	0·05	0·40	4·65	51·2	5·69	3·37	0·221	267	4·2	Low Ca in B_2 and B_3(g).
B_2	9–13	5·43	42·9	35·4	60·8	17·5	19·0	2·71	0·07	0·04	0·26	5·24	37·0	5·32	2·15	0·224	222	1·3	Low Mg in S, B_2 and B_3(g).
B_3(g)	17–21	2·51	55·6	28·6	66·9	17·3	15·8	2·66	0·25	0·04	0·09	1·62	65·2	5·71			69	4·6	Low K in B_3(g).
C(g)	24–28	2·59	53·6	30·2	63·8	20·0	16·2	4·10	0·58	0·07	0·15	1·55	76·0	5·62			81	4·1	High % saturation in B_3(g) and
C(g)	31–35	2·64	43·7	37·8	57·8	23·7	18·5	4·11	0·70	0·07	0·15	0·89	85·0	5·67			78	1·8	C(g).
																			Low total P_2O_5 in B_3(g) and
																			C(g).
																			Low readily soluble P_2O_5 in B_2
																			and lower C(g).

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 1: Soils derived from Highland Schists—*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 m.e./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
16.																			**Gourdie Association**; Cairnleith Series. Cairnleith, 179219–23
A_1g	0–3	70·60	n.d.	n.d.	n.d.	n.d.	n.d.	1·70	2·49	0·57	1·02	91·08	6·0	3·81	40·71	1·241	198	3·6	Low Ca throughout.
A_2g	6–10	6·58	58·6	33·6	78·1	11·1	4·5	0·31	0·07	0·10	0·20	15·98	4·1	4·29	3·19	0·138	51	1·1	Low Mg except in A_1g.
B_2g	11–15	9.23	56·5	36·6	75·7	17·4	2·3	—	0·07	0·05	0·05	19·72	0·9	4·44			113	1·8	Low K in B_2g and Cg.
Cg	19–25	5·18	58·3	34·6	77·8	15·1	4·5	—	0·08	0·07	0·05	9·77	2·0	4·63			146	2·7	Low % saturation throughout.
Cg	29–33	3·61	59·5	33·8	79·0	14·3	6·7	—	0·05	0·05	0·08	6·77	2·6	4·80			193	3·8	Low total P_2O_5 in A_2g. Low readily soluble P_2O_5 except in A_1g and Cg.

TABLE 2. SOILS DERIVED FROM OLD RED SANDSTONE ROCKS

Horizon	Depth in.	% Loss on Ignition	% Sand U.S.D.A.	% Silt U.S.D.A.	% Sand Inter.	% Silt Inter.	% Clay	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
17.																			**Balrownie Association**; Balrownie Series. Guildtown, 151080–84
S	3–7	6·02	42·5	31·1	55·6	18·0	23·4	5·84	0·46	0·10	0·33	7·96	45·8	6·23	2·13	0·182	153	4·7	High % saturation in lower C(g).
B(g)	12–16	2·78	41·0	29·4	53·3	17·1	29·6	6·16	1·69	0·16	0·18	7·44	52·4	6·35	0·21	0·017	59	—	Low total P_2O_5 in B(g) and upper C(g).
C(g)	24–28	2·50	41·6	32·1	54·0	19·7	26·3	6·52	3·02	0·14	0·14	7·69	56·1	6·28			98	5·2	High readily soluble P_2O_5 in lower C(g), low otherwise.
	32–36	2·40	44·0	31·1	55·3	19·8	24·9	8·02	4·11	0·20	0·19	7·90	61·3	6·55			118	23·2	
	46–50	2·83	32·0	45·9	43·8	34·1	22·1	7·37	3·42	0·21	0·18	4·81	69·9	6·83			166	31·7	

18. **Balrownie Association;** Balrownie Series. Stewart Tower, 161499–503

S	3–7	6·46	41·3	35·5	58·5	18·3	20·0	7·67	0·21	0·04	0·26	7·04	53·7	5·90	2·84	0·274	190	3·5	Low Ca in $B_2(g)$.
$B_2(g)$	12–14	3·96	49·5	33·0	54·6	27·9	17·5	2·29	0·16	0·03	0·12	7·76	25·1	5·57	1·53	0·151	140	7·2	Low Mg in S and $B_2(g)$.
C(g)	20–24	2·63	45·2	32·6	60·9	16·9	22·2	4·12	1·13	0·07	0·10	2·72	66·6	5·13			88	1·5	High % saturation in C(g).
	30–34	2·66	47·3	30·2	60·1	17·4	22·5	5·68	4·16	0·12	0·13	2·94	77·4	5·35			128	14·3	Low total P_2O_5 in upper C(g).
	36–40	2·88	40·7	33·6	53·8	20·5	25·7	5·97	4·16	0·14	0·13	1·67	86·2	5·57			128	15·6	High readily soluble P_2O_5 in lower C(g).

19. **Balrownie Association;** Balrownie Series. Balcalk Farm, 128289–94

S	1–4	10·80	40·1	37·5	58·4	19·2	17·0	11·24	1·56	0·15	0·25	2·52	82·8	6·28	4·53	0·404	210	5·7	High Ca except in $B_2(g)$ and lower S.
S	9–12	6·12	37·7	34·8	53·5	19·0	24·4	6·97	1·14	0·10	0·11	2·79	74·8	6·16	2·12	0·207	143	3·6	Low K in $B_2(g)$.
$B_2(g)$	13–17	4·04	45·1	33·9	63·6	15·4	19·0	4·46	0·77	0·07	0·08	0·49	91·8	6·35	0·76	0·082	119	7·9	High % saturation throughout.
$B_3(g)$	23–27	3·98	41·1	25·2	50·0	16·3	29·7	9·68	4·25	0·15	0·16	—	100	6·50			50	2·0	Low total P_2O_5 in $B_3(g)$ and upper C(g).
C(g)	31–34	4·13	51·1	25·7	60·9	15·9	21·1	7·98	3·19	0·15	0·11	—	100	6·53			88	18·4	High readily soluble P_2O_5 in C(g), low in $B_3(g)$.
C(g)	40–44	2·63	56·0	27·9	65·4	18·5	13·5	9·18	3·58	0·10	0·14	—	100	6·55			145	48·1	

20. **Balrownie Association;** Balrownie Series. Lamberkine Wood, 142653–58

L/F/H	1–0	45·30	n.d.	n.d.	n.d.	n.d.	n.d.	6·01	2·80	0·31	1·00	65·42	13·4	4·11	24·70	1·018	186	21·1	Low Ca except in L/F/H.
A_1/A_2	0–2	15·80	52·4	37·0	76·4	13·0	2·7	0·63	0·41	0·08	0·34	29·97	4·6	4·51	9·16	0·371	103	1·3	Low Mg in $B_2(g)$ and upper C(g).
$B_2(g)$	3–7	6·22	55·5	23·4	69·3	9·6	18·0	0·15	0·02	0·04	0·04	13·11	2·0	4·72	2·23	0·083	67	1·1	Low K in $B_2(g)$.
C(g)	11–15	3·40	48·8	25·1	59·1	14·8	26·1	0·15	0·09	0·06	0·10	7·60	5·0	4·86			31	0·4	Low % saturation except in lower C(g).
	20–24	3·38	43·9	28·9	56·6	16·2	27·2	0·15	0·35	0·10	0·13	7·90	8·5	4·94			45	0·4	Low total P_2O_5 except in L/F/H and A_1/A_2.
	29–33	3·48	44·0	24·7	54·8	13·9	31·3	2·00	2·86	0·10	0·19	5·22	50·0	5·22			80	3·2	High readily soluble P_2O_5 in L/F/H otherwise low.

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 2: Soils derived from Old Red Sandstone Rocks—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations m.e./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							
21.			**Balrownie Association;** Aldbar Series. Greenford, 172353–58																
S	3–7	18·50	48·2	32·3	69·2	11·3	5·6	—	0·44	0·08	0·12	31·92	2·0	4·39	8·59	0·396	151	0·5	Low Ca except in lower C.
B_2	9–12	6·40	42·9	38·0	61·4	19·5	15·9	—	0·11	0·05	0·02	11·34	1·6	4·68	2·33	0·138	135	1·4	Low Mg in B_2 and upper B_3.
B_3	15–18	3·23	54·5	30·0	65·4	19·1	15·5	—	0·10	0·05	0·02	5·60	2·9	4·72	0·54	0·053	127	11·8	Low K except in A.
B_3	20–23	3·54	55·2	28·9	67·4	16·7	15·9	—	0·25	0·05	0·03	5·62	4·5	4·80			140	14·4	High % saturation in lower C,
C	26–30	3·09	55·0	29·1	65·4	18·7	15·9	2·29	1·78	0·08	0·09	5·13	45·3	5·00			115	16·9	low otherwise.
C	40–44	2·67	55·1	29·0	67·6	16·5	15·9	6·13	3·28	0·13	0·08	0·61	94·0	5·39			114	37·6	High readily soluble P_2O_5 in B_3 and C, low in A and B_2.
22.			**Balrownie Association;** Aldbar Series. Muirloch, 184082–86																
S	2–6	11·40	53·8	31·5	68·7	16·6	9·0	5·03	1·19	0·06	0·26	15·48	29·7	5·75	5·32	0·295	139	3·6	Low Ca in B_3 and C.
B_2	9–13	4·73	53·0	31·4	70·5	13·9	13·2	6·17	0·10	0·03	0·12	6·69	49·0	5·60	1·54	0·138	96	1·9	Low Mg except in S.
B_3	16–20	3·08	59·4	30·3	73·2	16·5	10·3	—	0·14	0·02	0·12	4·44	5·9	5·39			93	2·6	Low % saturation in B_3 and C.
B_3	24–28	2·71	66·0	24·6	79·6	11·0	9·4	—	0·02	0·02	0·12	4·32	3·6	5·19			144	5·9	Low total P_2O_5 except in S and
C	31–35	2·29	64·0	23·8	75·1	12·7	12·2	—	0·11	0·02	0·11	4·20	5·4	4·83			90	5·7	lower B_3. Low readily soluble P_2O_5 in B_2 and upper B_3.

23. **Balrownie Association**; Aldbar Series. Balcalk Farm, 128283–87

S	1–4	12·45	40·9	33·5	57·2	17·2	19·4	14·28	1·76	0·10	0·58	—	100	7·06	6·60	0·379	228	5·8	High Ca in upper S, low otherwise. Low Mg and K except in upper S. High % saturation in upper S, low otherwise. Low readily soluble P_2O_5 in lower S.
S	10–13	9·49	46·3	32·7	63·9	15·1	16·3	2·20	0·30	0·07	0·18	12·26	18·3	5·53	4·49	0·277	192	0·4	
B_2	18–21	4·47	51·8	33·1	68·4	16·5	12·9	0·31	0·05	0·05	0·08	3·79	11·4	5·02			138	3·8	
B_3	25–29	4·20	65·8	23·0	78·2	10·6	9·1	0·15	0·04	0·05	0·08	2·86	10·0	5·20			171	6·7	
C	38–42	3·55	45·7	38·0	61·0	22·7	12·7	0·31	0·07	0·05	0·08	2·58	16·5	5·11			145	9·4	

24. **Balrownie Association**; Aldbar Series. West Mid Lamberkine, 142620–25

S	3–7	6·85	43·6	30·4	58·6	15·4	22·6	13·42	0·24	0·08	0·14	—	100	7·90	2·64	0·147	253	11·3	High Ca in S. Low Mg in B_2 and B_3. Low K in B_2, B_3 and middle C. High % saturation except in C. Total P_2O_5 low except in S and B_2. Readily soluble P_2O_5 high in S, low in B_2.
B_2	10–12	4·08	53·4	26·4	65·6	14·2	18·2	5·07	0·09	0·06	0·08	—	100	7·46	1·12	0·091	175	2·5	
B_3	13–17	3·06	53·6	23·6	63·2	14·0	19·8	3·67	0·07	0·06	0·08	—	100	6·98	0·49	0·058	99	4·0	
C	20–24	2·98	43·0	26·5	54·2	15·3	27·5	3·86	0·64	0·04	0·11	5·38	46·4	5·30			69	3·8	
C	26–30	2·86	44·2	27·4	56·1	15·6	25·4	4·30	1·05	0·04	0·09	5·02	52·2	5·35			72	6·7	
C	31–35	2·74	49·8	24·9	63·2	11·5	22·6	4·94	1·48	0·05	0·11	4·45	59·6	5·35			91	7·8	

25. **Balrownie Association**; Buchanyhill Series. Blairbell, 161532–6

S	3–7	6·74	57·7	19·2	66·5	10·4	19·7	5·98	0·26	0·06	0·06	2·84	69·1	5·67	2·29	0·206	130	2·6	Low Ca in upper B. Low Mg in S and lower B. Low K except in lower C. High % saturation throughout. Low total P_2O_5 except in S. Low readily soluble P_2O_5 in S.
B	14–18	2·61	74·6	14·0	78·9	9·7	11·4	2·43	1·49	0·03	0·04	0·83	82·8	5·70	0·80	0·077	51	3·1	
B	24–28	2·79	83·8	10·1	86·8	7·1	6·1	3·50	0·24	0·02	0·05	0·70	84·5	5·54			37	4·5	
C	32–36	2·90	87·6	8·5	90·5	5·6	3·9	4·41	0·51	0·04	0·07	0·89	85·0	5·51			61	5·3	
C	42–46	2·22	88·4	7·2	91·7	3·9	4·4	4·74	1·07	0·05	0·13	0·87	87·3	5·75			43	4·9	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 2: Soils derived from Old Red Sandstone Rocks—*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 m.e./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
26.								**Balrownie Association**; Buchanyhill Series. Lintrose, 184624–8											
A	1–4	7·92	61·5	16·8	69·9	8·4	17·7	2·46	1·16	0·14	0·28	7·30	35·6	4·73	2·75	0·248	124	2·1	Low Ca throughout. Low Mg in B. Low K and % saturation in B and upper C. Low total P_2O_5 except in A. Low readily soluble P_2O_5 in A and B.
B	8–12	5·24	65·5	15·1	73·2	7·4	16·8	—	0·23	0·08	0·05	8·88	3·9	4·12	1·88	0·147	86	0·9	
C	16–20	2·59	75·9	11·4	80·4	6·9	12·7	—	0·43	0·08	0·06	4·48	11·3	4·52			37	3·2	
	24–28	2·29	83·3	8·1	86·5	4·9	8·6	0·61	1·13	0·09	0·10	3·18	37·8	4·92			42	3·9	
	30–34	2·14	81·3	9·3	85·3	5·3	9·4	1·52	1·35	0·11	0·10	3·77	45·0	5·23			34	8·1	
27.								**Balrownie Association**; Lour Series. Westmuir, 142659–64											
H	2–0	64·90	n.d.	n.d.	n.d.	n.d.	n.d.	3·40	2·29	0·50	0·93	76·08	8·6	5·05	37·90	0·992	285	0·7	Low Ca in A_2g and B_2g. Low Mg in A_2g, high in lower Cg. Low % saturation in H and A_2g, high in Cg. Low total P_2O_5 except in H. High readily soluble P_2O_5 in lower Cg, low otherwise.
A_2g	1–4	3·74	74·4	15·1	82·2	7·3	10·5	0·46	0·24	0·07	0·10	11·91	6·8	5·09	1·29	0·052	40	0·6	
B_2g	8–12	2·94	49·8	23·1	59·3	13·6	27·1	1·38	1·70	0·09	0·11	3·15	51·0	5·35	0·16	0·016	31	0·4	
Cg	17–21	2·98	50·4	19·6	55·5	14·5	30·0	3·85	4·50	0·15	0·18	0·83	91·3	5·99			45	0·4	
Cg	23–27	2·55	55·2	16·6	62·3	9·5	28·2	4·76	5·04	0·17	0·17	—	100	6·51			63	1·9	
Cg	32–36	2·40	50·3	20·3	58·7	12·1	29·2	5·53	5·80	0·17	0·15	—	100	6·60			46	26·6	

28. **Balrownie Association;** Lour Series. Campsie, 118040–44

S	3–7	6·67	38·3	32·2	52·7	17·8	26·2	7·68	1·04	0·08	0·23	5·79	60·8	5·82	2·31	0·244	195	4·8	High % saturation throughout.
B_2g	11–15	4·98	33·5	31·6	47·5	17·6	32·4	7·85	1·19	0·11	0·34	2·77	77·2	6·21	1·01	0·135	190	2·9	High readily soluble P_2O_5 in lower Cg, low in B_2g.
Cg	20–24	2·79	57·5	21·8	68·3	11·0	17·9	6·57	1·49	0·09	0·18	—	100	6·41			105	4·3	
Cg	27–31	2·93	55·8	24·7	69·1	11·4	16·6	7·68	2·21	0·10	0·18	—	100	6·81			138	12·3	
Cg	33–37	2·65	73·3	14·0	81·9	5·4	10·0	7·03	2·26	0·09	0·10	0·50	95·0	6·71			146	15·1	

29. **Forfar Association;** Vinny Series. West Skichen, 197139–43

S	2–6	7·37	56·0	19·6	63·7	11·9	20·7	7·51	0·75	0·10	0·11	7·00	54·8	5·65	3·56	0·232	188	9·4	Low Ca in B_2 and upper B_3.
B_2	12–16	3·62	79·9	8·9	84·0	4·8	11·2	2·44	0·20	0·04	0·07	5·69	32·6	5·61	1·06	0·097	218	8·4	Low Mg in B_2.
B_3	19–22	2·50	71·1	17·6	78·0	10·7	11·3	2·42	0·30	0·05	0·05	2·94	49·0	5·61			137	14·0	Low K except in S and C.
B_3	24–26	2·35	63·0	23·5	71·1	15·4	13·5	3·82	0·76	0·07	0·08	2·43	66·1	5·42			119	14·3	High % saturation in lower B_3 and C.
C	28–32	2·29	58·4	25·2	70·6	13·0	16·4	5·19	1·35	0·07	0·12	1·93	77·7	5·35			128	20·4	High readily soluble P_2O_5 except in S and B_2.

30. **Forfar Association;** Vinny Series. Kirkton, 203506–10

S	1–5	6·93	62·5	16·1	72·6	6·0	18·0	7·58	0·20	0·16	0·10	7·84	50·6	6·09	2·56	0·235	230	8·1	Low Ca in C and lower B_2.
S	8–12	7·50	61·1	17·5	70·1	8·5	17·6	7·28	0·46	0·09	0·09	7·65	50·9	6·10	2·56	0·246	215	7·9	Low Mg in upper S and upper B_2.
B_2	14–18	5·00	65·4	16·1	75·5	6·0	16·0	3·18	0·24	0·05	0·05	7·61	31·6	6·10			178	3·7	Low K except in C and upper S.
B_2	21–25	5·11	69·5	13·2	75·6	6·1	14·7	2·88	0·44	0·04	0·03	7·33	31·6	6·05			207	4·0	
C	28–32	3·36	82·5	7·6	86·1	4·0	9·9	1·51	0·51	0·04	0·23	4·59	33·1	6·01			124	4·6	

*n.d. Not determined.

†— Less than lower limit of determination.

TABLE 2: Soils derived from Old Red Sandstone Rocks—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations m.e./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							
31.								Forfar Association; Vinny Series. Auchtertyre Farm, 128300–04											
S	1–4	6·67	64·1	19·5	73·9	9·7	13·1	8·76	0·35	0·07	0·60	1·10	89·8	6·46	3·00	0·252	229	16·2	High Ca in S. Low Mg in B_2 and B_3 High % saturation throughout. Low total P_2O_5 in C and lower B_3. High readily soluble P_2O_5 except in B_3.
B_2	13–16	3·03	80·8	11·1	87·1	4·8	5·1	5·33	0·17	0·04	0·15	—	100	6·90	0·79	0·093	215	11·3	
B_3	22–26	1·96	79·9	13·0	86·2	6·7	5·1	3·79	0·15	0·07	0·14	—	100	6·95			103	4·9	
B_3	32–36	2·44	78·7	12·6	83·6	7·7	6·3	3·80	0·22	0·07	0·13	—	100	7·10			81	3·0	
C	47–51	1·96	73·9	15·0	82·2	6·7	9·1	4·41	0·39	0·07	0·10	—	100	6·90			72	10·8	
32.								Forfar Association; Forfar Series. Wedderswell, 197133–38											
L/F/H	1–0	82·20	n.d.	n.d.	n.d.	n.d.	n.d.	8·50	5.78	0·62	1·19	111·96	12·6	4·13	48·53	1·933	234	15·1	High Ca and K in L/F/H otherwise low except in lower C. High Mg in L/F/H, low in A_1/A_2 and B_2(g). High % saturation in C(g) otherwise low. Low total P_2O_5 except in L/F/H. High readily soluble P_2O_5 in L/F/H, low in A_1/A_2 and lower C(g).
A_1/A_2	1–4	11·58	68·9	17·7	79·2	7·4	7·6	1·23	0·14	0·08	0·10	16·94	8·4	4·19	5·23	0·258	46	2·3	
B_2(g)	7–11	2·05	75·2	13·7	82·5	6·4	11·1	—	0·05	0·04	0·02	5·05	2·1	4·80	0·86	0·056	84	5·9	
C(g)	13–17	1·85	67·9	21·0	79·2	9·7	11·1	1·97	1·62	0·07	0·08	2·51	59·8	5·12			50	4·9	
C(g)	19–23	1·93	71·0	18·7	81·3	8·4	10·3	2·43	1·92	0·07	0·08	2·37	65·5	5·29			71	9·3	
C(g)	24–28	2·62	56·6	24·1	63·6	17·1	19·3	4·77	0·98	0·11	0·11	1·94	75·5	5·50			72	2·6	

33. **Forfar Association;** Forfar Series. Baldowrie Farm, 128305–11

S	1–4	4·60	47·8	33·3	71·7	9·4	16·6	5·07	0·21	0·07	0·17	5·38	50·6	5·85	1·82	0·185	299	8·3	Low Ca in B_2(g), B_3(g) and upper C(g). Low Mg throughout except in middle and lower C(g). Low K throughout except in S and lower C(g). High % saturation throughout except in S. Low total P_2O_5 in middle and lower C(g). High readily soluble P_2O_5 except in S.
S	12–15	3·86	53·7	28·1	72·1	9·7	14·3	3·68	0·13	0·04	0·13	5·18	43·4	6·10	0·90	0·123	288	4·2	
B_2(g)	19–22	2·34	68·9	23·2	83·3	8·9	5·6	2·13	0·09	0·04	0·08	1·38	62·9	6·31	0·49	0·069	205	11·0	
B_3(g)	25–28	1·93	88·7	6·0	91·1	3·6	3·4	2·11	0·19	0·04	0·06	0·98	71·0	6·34			138	11·0	
C(g)	29–31	1·45	87·3	8·2	91·8	3·7	3·0	2·88	0·25	0·05	0·04	0·29	91·7	6·56			117	17·1	
C(g)	34–37	1·43	93·3	3·3	94·7	1·8	2·0	3·35	0·38	0·06	0·08	0·59	86·8	6·49			91	13·0	
C(g)	40–44	2·23	53·7	32·5	72·4	13·8	11·6	6·10	1·05	0·07	0·15	—	100	6·66			79	18·6	

34. **Forfar Association;** Forfar Series. Balass Farm, 130962–67

S	1–5	9·20	65·2	16·2	72·4	9·0	14·0	8·34	0·47	0·07	0·34	9·27	49·8	6·00	5·03	0·330	152	14·1	High Ca in S. Low Mg in upper B_2(g). High % saturation throughout except in S. Low total P_2O_5 except in S. High readily soluble P_2O_5 in S and lower C(g), low in B_3(g).
B_2(g)	11–14	2·55	65·4	19·2	75·0	9·7	12·8	3·34	0·14	0·04	0·17	1·26	74·5	6·81	0·45	0·042	76	4·3	
B_3(g)	19–22	1·59	73·7	15·2	80·6	8·3	9·5	4·10	0·34	0·06	0·17	0·86	84·4	6·46	0·19	0·022	70	5·9	
B_3(g)	22–26	2·38	54·4	24·1	67·0	11·5	19·1	5·48	0·62	0·09	0·14	1·48	81·1	6·43			61	1·4	
C(g)	26–30	2·03	53·5	20·8	63·9	10·4	23·7	7·65	1·25	0·12	0·19	1·75	84·1	6·50			68	7·1	
C(g)	36–40	2·42	60·2	17·4	70·0	7·6	20·0	7·20	1·53	0·13	0·18	—	100	6·55			86	14·6	

35. **Forfar Association;** Vigean Series. Bandirran, 118995–99

S	3–7	7·26	49·1	26·4	60·0	15·5	20·9	6·88	0·75	0·05	0·09	4·50	64·0	6·35	2·68	0·226	208	4·0	Low Ca and Mg in B_2g. Low K throughout. High % saturation except in B_2g.
B_2g	13–17	4·53	55·0	25·6	66·9	13·7	17·1	2·76	0·23	0·04	0·04	4·48	40·6	5·92	1·38	0·138	184	3·3	
Cg	19–23	2·60	65·4	22·5	79·3	8·6	9·5	3·50	0·35	0·04	0·04	0·79	83·3	6·12			108	5·9	
Cg	28–32	2·35	66·7	18·9	76·5	9·1	12·0	5·03	1·18	0·05	0·07	0·73	89·7	6·24			110	10·5	
Cg	36–40	2·76	60·1	20·2	68·7	11·6	16·9	5·81	2·46	0·05	0·09	0·96	89·9	6·40			208	9·3	

*n.d. Not determined.
†— Less than lower limit of determination.

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TABLE 2: Soils derived from Old Red Sandstone Rocks—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations m.e./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							
36.								**Laurencekirk Association**; Oldcake Series. Gallowhill 136297–302											
S	1–5	7·09	23·9	36·3	40·7	19·5	36·4	8·66	0·69	0·07	0·19	6·55	59·5	5·80	1·99	0·247	180	4·6	High Ca throughout.
S	7–10	6·59	22·2	37·6	38·8	21·0	36·9	8·27	0·69	0·07	0·23	6·34	59·4	5·90	1·87	0·256	171	4·5	High Mg in C and D.
B_2	14–18	5·29	40·6	29·6	54·2	16·0	27·2	11·80	1·09	0·09	0·19	2·97	81·6	5·97	0·41	0·099	87	3·8	High % saturation below S.
B_2	24–28	4·78	47·4	21·7	55·2	13·9	28·5	9·61	2·68	0·07	0·28	7·16	63·8	5·25			70	10·0	Low total P_2O_5 in B_2 and C.
C	38–42	4·39	51·2	23·4	63·0	11·6	23·2	9·11	6·68	0·09	0·26	3·29	83·1	5·83			72	12·9	High readily soluble P_2O_5 in
D	56–60	4·07	66·6	11·7	72·9	5·4	19·7	10·50	6·65	0·11	0·35	1·58	91·8	6·40			133	64·8	C and D.
37.								**Laurencekirk Association**; Drumforber Series. Campsie Wood, 118045–9											
B	3–7	7·98	36·1	27·9	47·0	17·0	32·0	0·47	0·61	0·07	0·20	13·00	8·2	5·00	2·35	0·166	75	1·2	High Ca in lower D.
C	12–16	4.96	47·8	23·0	58·1	12·7	26·7	1·72	3·72	0·09	0·32	6.60	47·0	5·60	0·43	0·051	55	1·9	High Mg in D.
D	22–26	4·83	40·0	27·6	48·6	19·0	30·0	4·07	5·50	0·14	0·25	6·49	60·5	5·79			68	6·7	High % saturation in D, low in B_2.
D	30–34	5.00	44·2	22·3	50·9	15·6	31·0	7·57	6·18	0·17	0·29	4·03	78·0	6·28			88	20·2	Low total P_2O_5 except lower D.
D	42–46	5·32	29·3	23·7	37·2	15·8	44·3	9·95	6·38	0·21	0·40	4·17	80·3	6·19			116	33·2	High readily soluble P_2O_5 in lower D, low in B_2 and C.

38. **Laurencekirk Association**; Laurencekirk Series. Morrishill Wood, 171562–67

A	1–3	10·50	22·9	40·3	40·9	22·3	31·5	2·39	1·18	0·13	0·56	14·70	22·5	4·60	4·97	0·347	150	1·0	Low Ca in A and B(g). Low % saturation in upper B(g), high in C(g). Low total P_2O_5 in lower B(g) and C(g). High readily soluble P_2O_5 in middle C(g), otherwise low.
B(g)	6–9	7·60	24·2	35·9	38·5	21·6	36·1	1·31	0·84	0·15	0·33	15·10	14·8	4·58	2·74	0·202	112	0·4	
B(g)	13–15	6·69	26·9	35·9	39·3	23·5	33·9	2·24	1·36	0·14	0·27	10·49	27·7	4·91	1·80	0·154	90	0·2	
C(g)	17–20	4·62	26·8	34·9	38·7	23·0	36·0	3·76	2·82	0·20	0·19	3·47	66·8	5·41			43	0·2	
	22–26	7·85	40·2	34·6	55·6	19·2	21·2	6·36	4·44	0·25	0·17	0·74	93·8	6·13			97	24·8	
	27–30	2·91	31·5	36·3	44·9	22·9	30·1	6·42	4·51	0·24	0·22	2·09	84·5	5·81			38	0·9	

39. **Laurencekirk Association**; Laurencekirk Series. Culdeesland, 161537–40

S	3–7	6·69	28·1	34·7	39·4	23·4	33·9	12·09	1·10	0·09	0·22	2·54	84·4	5·52	1·81	0·200	199	10·7	High Ca throughout. High % saturation throughout. Low total P_2O_5 in B(g). High readily soluble P_2O_5 except in B(g).
B(g)	14–18	4·22	31·3	32·7	40·9	23·0	33·9	11·48	1·25	0·14	0·24	—	100	6·68	1·41	0·120	52	3·4	
C(g)	26–30	3·63	38·0	32·1	48·6	21·5	29·9	11·54	2·29	0·11	0·31	2·84	83·4	6·40			137	87·1	
C(g)	36–40	3·30	35·9	33·3	46·8	22·8	30·8	11·48	3·47	0·11	0·28	0·91	94·4	6·75			170	100·1	

40. **Laurencekirk Association**; Muirfoot Series. Methven Wood, 171874–6

A	1–5	8·88	35·0	39·4	50·1	24·3	21·2	7·81	2·95	0·16	0·26	9·35	54·5	5·25	3·79	0·307	99	1·8	Low K in Bg and Cg. High % saturation in Cg. Low total P_2O_5. High readily soluble P_2O_5 in Cg, low in A.
Bg	8–11	3·73	42·4	34·4	56·5	20·3	23·2	5·04	2·04	0·15	0·08	4·78	60·5	5·59	1·02	0·107	71	3·0	
Cg	16–21	3·38	44·5	32·4	58·5	18·4	23·1	6·88	3·63	0·16	0·08	4·09	72·4	5·87			76	13·7	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 2: Soils derived from Old Red Sandstone Rocks—*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 m.e./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
41.								**Kippen Association**; Kippen Series. West Dron, 137633–38											
S	1–5	3·98	48·4	26·4	63·6	11·2	21·2	9·03	0·71	0·07	0·17	—	100	6·94	1·20	0·130	146·0	6·5	High Ca in S and upper B(g).
B(g)	10–14	2·74	50·0	20·7	58·2	12·5	26·6	8·19	2·38	0·07	0·20	—	100	6·68	0·27	0·038	43·0	0·7	High % saturation throughout.
B(g)	19–22	2·61	52·5	21·5	61·2	12·8	23·4	7·69	2·87	0·07	0·17	—	100	6·85	0·14	0·033	70·0	11·3	Low total P_2O_5 in B(g) and upper C(g).
C(g)	28–32	2·31	53·4	22·0	62·1	13·3	22·3	7·22	3·54	0·08	0·18	—	100	6·90			92·0	36·7	High readily soluble P_2O_5 in C(g), low in upper B(g).
C(g)	38–42	2·02	56·7	21·0	66·7	10·0	21·3	6·90	3·16	0·08	0·17	—	100	7·25			115·0	54·2	
C(g)	48–52	1·75	60·1	17·8	70·4	7·5	20·3	6·75	3·08	0·07	0·17	—	100	7·38			116·0	60·6	
42.								**Kippen Association**; Fourmerk Series. West Dron, 179949–52											
S	2–6	3·23	72·2	12·6	78·3	6·5	15·2	4·10	0·38	0·06	0·28	2·75	63·7	5·71	0·78	0·061	136	14·4	Low Ca in B and C/D
S	11–15	2·17	75·1	13·8	80·8	8·1	11·1	4·27	0·34	0·04	0·14	0·91	84·0	5·93	0·62	0·063	119	9·5	Low Mg and K in B.
B	22–26	0·87	89·7	7·3	91·7	5·3	3·0	1·96	0·23	0·02	0·09	1·08	68·0	5·99			53	19·3	High % saturation.
C/D	32–35	1·02	88·5	7·1	90·5	5·1	4·4	2·36	0·39	0·05	0·10	—	100	6·11			75	20·3	Low total P_2O_5 in B and C/D. High readily soluble P_2O_5 except in lower S.

43. **Mountboy Association;** Garvock Series. Ardgarth Hill, 171526–31

L & F	1–0	54·50	n.d.	n.d.	n.d.	n.d.	n.d.	3·91	2·29	0·26	0·63	55·17	11·4	3·91	30·84	1·297	187	1·1	Low Ca except in L and F. Low Mg and K except in L and F and A. Low % saturation except in C. Low total P_2O_5 in B_3 and C. Low readily soluble P_2O_5 except in B_3 and C.
A_1	1–3	20·50	56·2	24·5	74·2	6·5	3·9	—	0·36	0·15	0·10	34·67	1·7	4·11	9·33	0·485	135	1·1	
B_2	5–8	7·40	59·9	26·2	76·2	9·9	10·2	—	0·04	0·04	0·02	9·03	1·1	4·68	2·09	0·146	140	1·5	
B_2	14–17	5·58	64·8	24·3	80·8	8·3	8·1	—	0·08	0·04	0·02	5·62	2·4	4·71			136	2·6	
B_3	23–26	2·53	82·0	11·9	87·9	6·0	6·1	—	0·05	0·04	0·02	2·31	4·5	4·78			91	4·9	
C	29–32	2·69	77·7	14·2	84·8	7·1	8·1	0·76	0·04	0·03	0·02	1·71	33·2	4.81			98	8·1	

44. **Mountboy Association;** Garvock Series. Kinfauns Farm, 117601–07

S	3–7	10·90	45·5	33·1	61·9	16·7	15·9	2·52	0·79	0·08	0·19	12·95	21·6	5·33	4·65	0·390	204	1·7	Low Ca in S and B_2, high in middle C. High % saturation in C, low in B_2 and lower S. Low total P_2O_5 in C. Low readily soluble P_2O_5 throughout.
S	12–16	8·52	40·5	36·9	59·1	18·3	18·3	1·56	0·45	0·09	0·12	9·63	18·7	5·35	3·49	0·275	193	1·2	
B_2	21–25	7·93	39·7	37·4	55·5	21·6	18·9	1·56	0·36	0·10	0·23	9·38	19·3	5·40	2·84	0·213	177	0·9	
B_3	27–30	7·88	37·2	35·3	52·8	19·7	23·9	4·80	1·93	0·19	0·14	7·58	48·2	5·89			167	0·4	
C	36–40	3·69	46·1	32·6	61·4	17·3	17·6	7·22	4·31	0·19	0·14	2·77	81·0	6·79			67	0·4	
C	43–47	3·46	52·3	29·7	68·7	13·3	14·5	8·58	4·87	0·19	0·13	—	100	7·09			61	0·5	
C	51–55	3·09	56·9	29·0	72·2	13·7	11·0	7·20	3·19	0·16	0·13	—	100	7·05			57	3·0	

45. **Mountboy Association;** Garvock Series. Dron, 152064–67

S	3–7	10·30	37·2	39·6	56·0	20·8	18·0	1·56	0·56	0·08	0·05	7·61	22·8	6·54	3·90	0·349	369	—	Low Ca throughout. Low K in S. Low % saturation except in S. High total P_2O_5 in S. Low readily soluble P_2O_5 except B_3 and C.
B_2	11–15	6·96	49·9	33·8	66·5	17·2	12·8	0·47	0·16	0·06	0·16	9·82	8·0	6·14	1·91	0·151	235	—	
B_3	20–23	3·77	55·9	29·3	67·2	18·0	14·8	0·46	0·26	0·07	0·22	5·63	15·2	6·07			238	3·0	
C	29–33	3·77	49·0	31·1	63·5	16·6	19·9	0·47	0·31	0·11	0·32	6·87	15·0	5·84			197	4·5	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 2: Soils derived from Old Red Sandstone Rocks—*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 m.e./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
46.								**Mountboy Association**; Mountboy Series. Newton Farm, 130943–48											
S	1–5	6·21	39·0	36·3	54·7	20·6	21·6	16·39	1·35	0·18	0·32	—	100	7·60	2·31	0·206	261	34·4	High Ca throughout.
B_2(g)	12–16	3·92	37·7	35·6	52·9	20·4	22·8	9·45	2·75	2·23	0·10	—	100	6·93	0·92	0·099	105	6·2	High Mg below B_2(g).
B_3(g)	16–19	3·04	35·0	37·8	52·0	20·8	24·2	12·23	5·46	2·81	0·18	—	100	7·30	0·39	0·044	78	21·3	High % saturation.
B_3(g)	24–27	2·55	49·5	29·0	61·2	17·3	18·9	10·39	8·08	1·22	0·18	—	100	7·05			130	62·9	Low total P_2O_5 in upper B_3(g).
C(g)	32–36	2·02	52·5	32·2	70·6	15·1	12·3	8·34	6·87	0·47	0·15	—	100	7·60			112	44·7	High readily soluble P_2O_5
C(g)	42–46	2·23	49·2	30·4	62·6	17·0	18·2	9·77	9·70	0·28	0·23	—	100	7·53			161	102·7	except in B_2(g).
47.								**Mountboy Association**; Mountboy Series. Balthayock Wood, 142647–52											
L/F/H	1–0	60·10	n.d.	n.d.	n.d.	n.d.	n.d.	11·11	5·44	0·30	0·76	92·12	16·0	4·01	22·57	1·198	174	6·7	Low Ca except in L/F/H and
A_1/A_2	0–2	18·97	57·1	19·8	67·8	9·1	8·8	2·21	0·98	0·12	0·33	34·72	9·5	4·21	10·76	0·436	115	1·2	lower Cg.
B_2	3–5	17·25	55·4	22·7	68·1	10·0	9·0	0·32	0·19	0·07	0·14	40·67	1·7	4·59	8·08	0·366	156	1·0	High Mg in L/F/H, low in
B_3(g)	10–14	3·64	52·0	26·5	63·6	14·9	21·5	—	0·02	0·03	0·06	4·91	2·2	4·98			100	2·6	B_2 and B_3(g)
C(g)	19–23	2·83	52·4	26·1	61·8	16·7	21·5	1·53	1·49	0·09	0·11	4·12	43·9	5·21			94	2·4	Low % saturation except in
C(g)	30–34	2·89	52·7	22·7	67·0	8·4	24·6	3·33	2·85	0·11	0·17	3·56	64·5	5·85			125	5·4	lower C(g).
																			Low readily soluble
																			P_2O_5 except in L/F/H and
																			lower C(g).

TABLE 3. SOILS DERIVED FROM BASIC AND INTERMEDIATE IGNEOUS ROCKS

48. **Darleith Association**; Darleith Series. Laws, 152083–88

S	2–6	12·00	39·9	39·7	60·4	19·2	14·4	18·51	1·21	0·25	0·25	7·41	73·1	6·21	4·48	0·423	340	9·9	High Ca except in B_2 and B_3.
S	10–14	10·40	36·8	43·1	57·8	22·1	14·9	12·76	1·47	0·16	0·15	7·97	64·6	6·21	3·66	0·363	300	2·3	Low K except in upper S.
S	19–23	11·20	43·9	40·7	67·0	17·6	9·8	9·76	0·87	0·21	0·07	9·07	54·6	6·22	4·11	0·385	297	—	High % saturation in upper S and in C.
B_2	27–31	6·06	41·2	47·4	70·6	21·0	8·4	5·97	0·51	0·14	0·05	8·18	44·9	6·10			232	—	High total P_2O_5 in S and C.
B_3	35–38	4·41	53·3	35·8	71·2	17·9	8·7	7·00	0·81	0·15	0·05	6·73	54·3	6·17			210	—	Low readily soluble P_2O_5 except in upper S and C.
C	40–44	8·00	61·5	26·4	73·6	14·3	8·1	9·74	2·06	0·21	0·07	7·13	62·9	6·15			375	3·7	

49. **Darleith Association**; Darleith Series. Hollowdub, 118037–39

A_2	½–3½	22·40	38·4	40·7	63·1	16·0	4·1	1·28	0·83	0·34	0·39	37·90	7·0	4·59	11·38	0·498	198	1·4	Low Ca throughout.
B_2	4½–7½	12·07	35·5	52·0	68·8	18·7	6·5	0·16	0·21	0·16	0·40	0·40	4·6	4·72	4·27	0·287	249	1·1	Low Mg in B_2 and C.
C	10½–14½	7·93	42·9	48·8	72·6	19·1	4·4	—	0·13	0·13	0·38	0·38	4·9	4·67			176	1·7	Low % saturation throughout.
																			Low readily soluble P_2O_5 throughout.

50. **Darleith Association**; Darleith Series. Easter Balrymonth Hill, 160270–73

S	1–5	9·84	45·0	24·3	54·7	14·6	25·8	24·73	10·78	0·31	0·64	16·50	68·8	5·12	3·28	0·326	252	46·2	High Ca and Mg throughout.
S	7–11	7·64	57·8	18·8	65·2	11·4	19·6	31·95	14·45	0·66	0·25	12·87	78·6	5·65	1·94	0·193	278	54·4	High % saturation throughout.
B	16–20	7·34	61·1	23·7	75·8	9·0	11·5	36·30	21·57	0·95	0·17	11·62	83·5	6·09			384	57·6	High total P_2O_5 in B.
C	27–31	5·85	70·6	21·0	82·7	8·9	5·5	30·51	21·72	0·88	0·67	4·03	93·0	6·05			254	69·9	High readily soluble P_2O_5 throughout.

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 3: Soils derived from Basic and Intermediate Igneous Rocks—*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 m.e./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
51.						Darleith Association; Darleith Series. Lundie Craigs, 171532–37													
A	3–7	16·20	34·3	38·8	54·2	18·9	14·7	15·77	4·59	0·19	0·21	15·58	57·1	5·20	7·05	0·552	261	2·1	High Ca throughout.
A	14–17	11·00	41·9	33·7	56·6	19·0	18·9	15·30	1·86	0·23	0·06	9·49	64·8	5·73	4·17	0·399	240	2·1	High Mg below A.
B	20–23	8·91	53·4	32·5	71·8	14·1	9·6	18·09	6·83	0·28	0·07	6·43	79·7	5·81	2·48	0·219	209	3·2	Low K except in upper A.
B	28–31	6·30	57·1	33·6	78·0	12·7	6·1	23·01	8·07	0·39	0·04	4·39	87·8	6·10			113	5·3	High % saturation except in upper A.
C	33–36	5·82	59·4	31·4	77·9	12·9	6·3	29·97	9·09	0·46	0·05	2·98	93·0	6·39			98	4·6	Low total P_2O_5 in C.
C	42–45	5·05	60·9	34·6	79·8	15·7	2·0	29·92	7·79	0·46	0·06	1.93	95·2	6·28			86	10·4	High readily soluble P_2O_5 in lower C, low in A.
52.						Darleith Association; Dunlop Series. Wellbank, 184616–19													
S	1–5	8·69	39·6	34·1	57·0	16·7	22·0	12·82	0·92	0·12	0·16	4·26	76·7	6·21	2·72	0·268	270	14·3	High Ca throughout.
B_2(g)	8–12	5·10	46·6	29·9	62·8	13·7	20·9	9.29	1·06	0·11	0·07	3·62	74·4	5·72	1·44	0·138	106	5·1	Low K in B_2(g) and B_3(g).
B_3(g)	13–17	2·91	57·6	26·5	63·8	21·1	15·9	9·25	1·24	0·11	0·07	0·86	92·5	6·08			64	7·9	High % saturation throughout.
C	26–30	3·20	60·8	27·1	76·6	11·3	12·1	20·24	4·72	0·20	0·11	1·37	94·9	6·42			197	92·4	Low total P_2O_5 in B_3(g). High readily soluble P_2O_5 in S and C.

53. **Sourhope Association**; Sourhope Series. Seven Gates, 184593–600

L/F/H	1–0	65·90	n.d.	n.d.	n.d.	n.d.	n.d.	6·75	3·47	0·61	2·48	57·34	18·8	4·58	30·40	1·535	237	7·3	Low Ca in A and B, high in C.
A	3–7	16·40	62·1	20·6	74·2	8·5	5·0	—	0·29	0·21	0·15	26·00	2·4	4·27	7·86	0·740	149	1·6	Low Mg in A, high in C.
B	12–17	8·13	63·1	21·8	74·2	10·7	11·0	1·08	0·56	0·13	0·04	12·79	12·4	5·20	1·92	0·192	134	2·4	High K in LFH and in C
C	24–28	7·83	82·6	12·4	89·9	5·1	1·1	29·34	13·15	0·39	0·37	7·69	84·9	6·08			186	34·1	between 46 in. and 72 in.
C	32–36	6·68	69·9	25·9	85·2	10·6	0·9	30·48	13·37	0·40	0·10	4·54	90·7	6·39			231	69·1	High % saturation in C other-
C	46–52	6·58	73·3	22·5	87·5	8·3	0·9	30·24	13·38	0·36	0·07	2·77	94·1	6·57			282	85·4	wise low.
C	66–72	5·13	68·8	26·7	84·1	11·4	1·9	24·45	11·37	0·38	0·08	0·64	98·3	6·78			298	99·5	High acetic soluble P_2O_5 in C,
C	80–86	5·50	75·1	19·3	87·8	6·6	2·8	27·87	13·47	0·42	0·17	1·38	96·8	6·90			286	83·4	low in A and B.

54. **Sourhope Association**; Sourhope Series. Grange, 147762–66

S	1–3	8·70	28·2	45·6	51·4	22·5	21·8	6·49	0·94	0·11	0·23	14·42	35·0	5·52	2·75	0·200	290	11·0	Low K in B_2 and C.
S	9–13	8·34	36·8	37·4	53·6	20·6	21·6	6·45	0·98	0·10	0·11	12·96	37·1	5·79	2·42	0·211	241	5·7	High % saturation in lower C.
B_2	17–21	6·79	53·9	36·0	70·4	19·5	6·7	6·14	1·02	0·13	0·08	9·53	43·6	6·50			181	3·3	High readily soluble P_2O_5 in
C	26–30	4·06	51·8	31·3	63·8	19·3	14·9	6·44	1·27	0·17	0·04	8·42	48·5	6·61			111	5·9	upper S and lower C.
C	33–37	2·95	55·6	31·2	68·5	18·3	13·2	7·64	1·77	0·17	0·04	5·81	62·3	6·58			105	22·1	

55. **Sourhope Association**; Sourhope Series. Foodie Farm, 130972–76

S	1–5	10·45	37·0	44·3	59·7	21·6	13·5	9·37	0·74	0·07	0·46	8·72	55·0	5·70	4·46	0·385	81	17·1	High Ca throughout.
B_2	12–16	4·83	64·4	27·2	77·3	14·3	6·0	8·24	0·73	0·15	0·18	—	100	6·75	0·69	0·090	159	10·6	High Mg in C.
C	24–30	4·60	45·6	39·5	64·4	20·7	12·6	19·51	5·33	0·28	0·22	—	100	7·20			237	6·7	High % saturation except in S.
C	38–42	4·09	47·2	37·1	63·3	21·0	13·7	16·30	6·03	0·22	0·24	—	100	7·15			249	65·0	Low total P_2O_5 in S.
C	47–51	3·99	45·8	35·9	61·0	20·7	14·3	15·25	6·81	0·24	0·25	—	100	7·05			157	61·8	High readily soluble P_2O_5 except in upper C.

*n.d. Not determined.

†— Less than lower limit of determination.

TABLE 3: Soils derived from Basic and Intermediate Igneous Rocks—*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 m.e./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
56.								Sourhope Association; Sourhope Series. Binn Farm, 171580–3											
A_1	2–6	8·30	37·6	40·9	59·5	19·0	17·3	7·74	2·72	—	0·28	5·41	66·5	5·56	3·32	0·295	193	2·4	High Ca except in A_1.
B_2	9–12	4·31	45·7	37·6	69·7	13·6	14·5	8·68	2·99	0·22	0·15	1·54	88·7	6·01	2·07	0·190	129	3·7	High Mg in upper C.
C	15–20	1·96	53·5	37·0	72·9	17·6	9·5	9·84	6·14	0·20	0·07	0·76	95·5	6·40			84	6·7	Low K in C.
C	25–29	3·22	53·1	35·7	67·9	20·9	11·2	10·73	4·04	0·21	0·07	0·30	98·0	6·40			86	11·9	High % saturation throughout.
																			Low total P_2O_5 in C.
																			High readily soluble P_2O_5 in lower C.
57.								Sourhope Association; Sourhope Series. Balthayock Wood, 142642–6											
A_1/A_2	0–2	24·69	48·9	25·2	65·8	8·3	7·4	2·62	1·06	0·10	0·44	39·13	9·7	4·28	13·14	0·537	106	1·1	Low Ca throughout.
B_2	4–6	13·95	50·3	32·8	70·8	12·3	9·9	0·25	0·18	0·03	0·15	22·85	2·6	4·91	3·38	0·184	91	0·4	Low Mg except in A_1/A_2.
B_2	6–9	9·22	46·8	35·0	65·6	16·2	13·6	—	0·07	0·03	0·06	13·72	1·2	4·93			178	0·6	Low K in lower B_2, B_3 and C.
B_3	13–17	6·55	44·4	37·4	64·7	17·1	14·9	—	0·03	0·03	—	7·56	0·8	4·85			158	0·9	Low % saturation throughout.
C	19–23	5·07	49·3	32·6	66·5	15·4	15·6	—	0·03	0·03	—	4·98	1·2	4·89			162	2·1	Low total P_2O_5 in upper B_2.
																			Low readily soluble P_2O_5 throughout.

58. **Sourhope Association; Bellshill Series.** Grange of Elcho, 147767–70

S	2–6	7·80	31·1	44·9	51·8	24·4	20·1	9·66	1·86	0·12	0·28	11·60	50·7	5·50	2·43	0·202	305	19·8	High Ca in S.
B(g)	12–16	3·54	53·3	33·3	66·9	19·7	13·4	6·69	0·76	0·07	0·10	8·29	47·9	5·88	0·36	0·042	139	19·2	High total P_2O_5 in S.
C(g)	20–24	3·08	48·5	38·4	66·2	20·7	13·1	5·60	0·68	0·07	0·11	8·03	44·6	5·98			141	46·5	High readily soluble P_2O_5
C(g)	28–32	2·66	57·4	27·6	70·4	14·6	15·0	5·61	0·76	0·07	0·08	6·71	49·3	6·64			120	39·4	throughout.

59. **Sourhope Association; Bellshill Series.** Lindores, 184601–04.

S	2–6	8·13	52·4	28·2	63·7	16·9	15·3	16·22	4·29	0·24	0·22	6·63	76·0	5·54	2·61	0·254	212	35·7	High Ca throughout.
B(g)	12–16	4·70	61·2	26·2	71·7	15·7	10·2	20·71	3·66	0·40	0·16	2·01	92·5	6·17	0·96	0·088	148	55·6	High Mg in C.
C(g)	22–26	4·79	58·3	30·0	70·9	17·4	9·3	20·60	5·26	0·40	0·17	0·64	97·6	6·49			161	72·3	High % saturation throughout.
C(g)	32–36	3·43	65·6	27·1	75·9	16·8	7·3	18·10	6·47	0·30	0·14	0·10	99·6	6·52			194	72·2	High readily soluble P_2O_5 throughout.

60. **Sourhope Association; Bellshill Series.** Foodie Farm, 130977–82

S	1–4	6·37	34·4	39·4	51·6	22·2	23·0	15·09	2·12	0·13	0·20	2·58	86·8	6·10	1·93	0·187	179	15·0	High Ca throughout.
S	6–10	5·14	37·9	43·1	58·4	22·6	16·4	15·57	1·75	0·18	0·15	0·54	97·0	6·50	1·15	0·139	128	7·8	High Mg in C.
B_2(g)	12–16	4·15	50·4	37·6	69·4	18·6	9·9	12·53	1·44	0·17	0·14	—	100	7·01	0·69	0·085	128	8·4	High % saturation throughout.
B_3(g)	20–24	3·28	52·2	37·1	72·9	16·4	7·4	12·04	2·18	0·19	0·14	—	100	7·21			107	16·1	High readily soluble P_2O_5 in
C(g)	28–32	4·43	66·8	25·3	77·7	14·4	5·7	20·91	5·14	0·36	0·19	—	100	7·61			143	31·0	upper S, lower B_2 and C.
C(g)	36–40	4·89	56·3	50·8	68·9	18·2	10·5	20·48	6·23	0·38	0·22	—	100	7·41			209	125·4	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 3: Soils derived from Basic and Intermediate Igneous Rocks—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations m.e./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							
61.								**Sourhope Association;** Atton Series. Foodie Farm, 130983–88											
S	1–5	7·05	24·9	47·8	46·0	26·7	23·8	16·79	2·35	0·15	0·23	2·34	89·3	6·30	2·37	0·259	219	24·6	High Ca throughout.
B_2g	10–14	4·89	25·7	51·4	49·2	28·9	20·5	18·40	2·83	0·24	0·18	—	100	7·11	1·15	0·141	182	37·7	High Mg in upper Cg.
B_2g	17–21	3·19	44·7	41·8	65·2	21·3	10·3	13·92	2·64	0·21	0·13	—	100	7·46	0·31	0·042	202	72·8	High % saturation throughout.
B_3g	27–31	3·18	59·0	25·9	72·7	12·2	11·9	16·85	4·85	0·21	0·18	—	100	7·65			256	98·2	High readily soluble P_2O_5
Cg	35–39	3·22	43·4	37·0	61·3	19·1	16·4	16·20	5·51	0·21	0·23	—	100	8·25			246	127·1	throughout.
Cg	40–44	3·61	44·0	32·7	60·6	16·1	19·7	14·88	4·73	0·21	0·22	—	100	8·30			240	128·1	
Cg	45–49	2·94	46·8	32·1	61·9	17·0	18·2	14·12	4·65	0·21	0·23	—	100	8·10			236	122·0	
62.								**Sourhope Association;** Atton Series. Ballomill, 137754–7											
A	1–5	25·10	51·3	19·1	60·0	10·4	10·8	3·09	2·32	0·36	0·62	24·92	20·4	5·34	13·33	0·837	380	0·5	Low K below A.
Bg	8–12	11·55	42·7	31·5	57·6	16·6	20·0	4·60	0·82	0·18	0·04	14·80	27·6	5·88	4·94	0·347	354	1·4	High total P_2O_5 throughout.
Cg	16–19	11·41	37·4	34·6	52·3	19·7	22·3	5·73	1·18	0·18	0·04	12·70	36·0	6·37			483	5·7	Low readily soluble P_2O_5
Cg	20–24	9·28	45·6	31·0	58·6	18·0	18·8	7·23	1·59	0·25	0·07	9·39	49·3	6·35			372	2·9	except in upper Cg.

TABLE 4. SOILS DERIVED FROM CARBONIFEROUS SEDIMENTARY ROCKS

63. **Rowanhill Association:** Winton Series. Feddinch {189102–6, 189976–79}

S	1–5	5·53	54·2	19·4	63·8	10·1	23·3	7·02	0·54	0·11	0·08	3·85	66·8	5·59	1·81	0·168	150	4·7	High Ca in B_3(g) and lower C_1(g). High Mg in B_3(g) and C(g). Low K in S, A_2(g) and B_2(g). High % saturation throughout. Low total P_2O_5 except in S and A_2(g). Low acetic soluble P_2O_5 except in S, A_2(g) and lower C_1(g).
A_2(g)	7–11	5·09	55·9	18·4	65·8	8·5	23·2	6·76	0·62	0·06	0·04	3·43	68·6	5·78	1·83	0·139	132	3·1	
B_2(g)	14–18	4·17	58·0	16·6	64·4	10·2	23·3	6·77	1·71	0·10	0·06	1·48	85·4	6·11	0·82	0·081	41	0·3	
B_3(g)	21–25	4·53	47·9	18·2	55·7	10·4	31·6	9·31	5·07	0·11	0·32	1·04	93·4	6·37	0·86	0·074	46	0·2	
C_1(g)	31–35	4·03	50·2	20·0	57·7	12·5	27·8	7·97	6·73	0·15	0·12	0·77	95·1	6·22			79	1·4	
C_1(g)	41–45	4·39	52·1	18·5	60·2	10·4	27·2	8·41	7·66	0·15	0·18	0·46	97·3	6·08			92	4·7	
C_2(g)	49–53	5·08	49·8	21·4	60·4	10·8	26·3	6·36	5·25	0·12	0·18	0·79	93·8	6·03			80	0·5	
C_2(g)	58–62	5·26	48·1	2·31	57·9	13·3	26·2	7·01	5.70	0·22	0·20	0·74	94·7	6·68			83	1·3	
C_2(g)	67–71	6·58	31·1	36·3	48·3	19·1	29·3	5·66	4·79	0·13	0·18	1·10	90·7	6·58			77	2·0	

64. **Rowanhill Association;** Caprington Series. Winthank, 160274–79

S	3–7	9·47	46·7	26·7	59·1	14·3	21·9	8·37	1·46	0·15	0·17	8·68	53·9	5·28	3·36	0·230	170	2·6	High Ca except in B_2(g). High Mg except in S and B_2(g). High % saturation except in S. Low total P_2O_5 in B_2(g) and B_3(g). Low readily soluble P_2O_5 in B_3(g) high in middle C(g).
B_2(g)	11–13	4·21	53·1	27·3	64·3	16·1	17·5	7·64	2·24	0·16	0·08	3·89	72·2	5·20	0·92	0·095	91	4·1	
B_3(g)	17–21	4·98	42·9	27·2	53·8	16·3	27·4	8·49	5·70	0·20	0·15	4·17	77·7	5·12	0·54	0·055	63	—	
C(g)	32–35	4·51	51·3	27·8	62·7	16·4	18·6	9·60	7·47	0·20	0·10	2·77	86·3	5·66			111	9·9	
C(g)	40–44	5·10	48·8	24·0	59·1	13·7	24·6	11·64	7·55	0·25	0·17	2·71	87·9	5·72			105	10·6	
C(g)	47–50	4·72	40·9	28·8	51·6	18·1	27·9	12·07	8·34	0·73	0·17	3·16	87·1	5·76			123	9·1	

65. **Rowanhill Association;** Caprington Series. Longraw, 179902–06

S	2–6	10·25	58·6	22·7	68·6	12·7	13·6	19·42	2·34	0·27	0·25	2·30	90·6	6·75	4·67	0·329	234	10·1	High Ca in S and A_2(g). High Mg in lower C(g). Low K in A_2(g) and B_2(g). High % saturation throughout. Low total P_2O_5 below A_2(g). High readily soluble P_2O_5 in S, low in B_2(g) and upper C(g).
A_2(g)	8–12	6·82	55·3	21·9	68·5	8·7	19·4	14·22	2·14	0·19	0·09	—	100	6·29	2·72	0·224	142	9·4	
B_2(g)	15–20	3·94	55·0	22·0	65·6	11·4	23·0	5·79	1·71	0·08	0·07	—	100	6·45			26	0·2	
C(g)	25–29	3·98	45·1	27·7	58·1	14·7	27·2	6·73	3·74	0·10	0·10	—	100	6·57			31	0·5	
C(g)	37–41	3·93	43·5	30·9	55·7	18·7	25·6	7 66	9·68	0·11	0·15	—	100	6·55			57	3·5	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 4: Soils derived from Carboniferous Sedimentary Rocks—*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 m.e./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
66.								**Rowanhill Association**; Macmerry Series. Ballone, 188894–98											
S	1–5	4·36	44·6	28·8	51·8	21·6	24·4	7·60	0·46	0·08	0·16	1·45	85·1	5·92	1·61	0·165	144	16·1	Low K below S.
S	8–12	3·56	61·1	20·2	70·1	11·2	18·7	7·89	0·70	0·07	0·13	0·71	92·5	6·22	1·29	0·087	127	13·0	High % saturation throughout.
$B_2(g)$	17–20	2·80	60·2	17·6	69·4	8·4	22·2	7·89	0·66	0·08	0·09	—	100	6·50			88	8·3	Low total P_2O_5 below S.
$B_3(g)$	24–28	1·87	64·7	21·9	76·6	10·0	13·4	7·19	1·07	0·09	0·06	—	100	6·81			89	31·4	High readily soluble P_2O_5
C(g)	31–35	2·10	68·2	19·4	76·3	11·3	12·4	6·54	1·41	0·09	0·02	—	100	6·93			92	44·4	except in $B_2(g)$.
67.								**Rowanhill Association**; Greenside Series. Upper Magask, 191421–24											
S	1–5	6·63	55·3	20·2	65·6	11·9	21·2	14·01	1·19	0·14	0·14	3·08	83·4	6·29	3·64	0·206	200	11·6	High Ca in S and lower C(g).
$B_2(g)$	12–16	2·54	67·2	17·9	77·2	7·9	14·9	6·11	1·01	0·08	0·04	2·65	73·2	6·22	1·46	0·136	101	8·5	Low K in $B_2(g)$.
C(g)	24–28	2·41	63·8	16·4	70·8	9·4	19·8	7·93	0·41	0·11	0·12	0·50	94·5	6·31			103	25·9	High % saturation.
C(g)	31–35	2·25	62·8	18·2	72·8	8·2	19·0	8·84	2·96	0·12	0·14	0·81	93·7	6·77			115	43·9	High readily soluble P_2O_5 except in $B_2(g)$.

68. **Rowanhill Association;** Rowanhill Series. Winthank, 189048–52

S	1–5	8·99	43·6	26·3	56·1	13·8	25·6	20·73	2·01	0·10	0·19	—	100	7·10	3·19	0·253	188	14·9	High Ca except in lower S where value is low.
S	6–10	7·84	40·2	28·5	54·8	13·9	27·4	2·64	1·79	0·11	0·19	—	100	7·23	1·95	0·181	164	7·4	High Mg in lower Cg.
Bg	13–17	7·27	32·2	25·2	40·0	17·4	38·0	15·32	3·37	0·13	0·15	—	100	7·23			59	0·6	High % saturation throughout.
Cg	20–24	7·30	37·7	20·9	42·1	16·5	37·7	16·79	4·48	0·09	0·17	—	100	7·35			107	3·6	Low total P_2O_5 in Bg.
Cg	31–35	6·77	41·4	21·3	46·8	15·9	33·9	14·99	5·36	0·24	0·29	—	100	7·50			125	33·1	High readily soluble P_2O_5 in upper S and lower Cg; low in Bg.

69. **Rowanhill Association;** Rowanhill Series. Prior Muir, 184605–09

L & F	2–0	82·80	n.d.	n.d.	n.d.	n.d.	n.d.	7·02	4·69	1·83	1·77	94·56	13·9	3·86	41·21	1·912	234	3·4	Low Ca except in L and F.
A	2–6	17·40	54·4	25·5	64·9	15·0	6·9	2·03	3·32	0·23	0·13	30·74	15·4	4·09	9·17	0·400	96	1·0	High K in L and F, low in Bg.
Bg	9–13	3·74	61·5	16·3	68·8	9·0	22·2	0·61	1·01	0·13	0·09	4·62	28·5	4·79			24	0·8	High % saturation in lower Cg, otherwise low except in Bg.
Cg	16–20	3·68	56·5	17·1	64·6	9·0	26·4	—	0·37	0·19	0·16	4·49	13·8	5·08			19	0·3	Low total and readily soluble P_2O_5 except in L and F.
Cg	22–26	3·62	55·1	18·4	64·3	9·2	26·5	2·92	5·09	0·26	0·14	2·29	78·5	5·28			30	0·2	

70. **Rowanhill Association;** Allanhill Series. Kemback Wood No. 1, 171609–15

L/F/H	1–0	68·0	n.d.	n.d.	n.d.	n.d.	n.d.	16·73	4·18	0·50	1·51	67·96	25·2	3·72	39·05	1·734	157	20·9	High Ca in L/F/H and A_1, otherwise low.
A_1	0–2	17·79	61·8	21·4	73·2	10·0	3·5	8·57	0·99	0·21	0·26	18·75	53·5	3·71	10·18	0·909	141	6·0	Low Mg and K below A_1.
B_2	5–9	7·74	67·1	17·7	76·4	8·4	11·3	1·69	0·27	0·04	0·05	12·07	17·0	3·91	4·36	0·233	101	1·5	Low % saturation below A_1.
B_3	12–15	3·73	74·2	16·4	82·7	7·9	9·4	0·61	0·06	0·02	—	5·67	12·2	4·30			68	1·1	Low total P_2O_5 below B_2.
C	21–25	1·19	82·6	12·1	88·9	5·8	5·3	—	—	0·01	—	2·99	0·3	4·49			29	1·0	High readily soluble P_2O_5 in L/F/H, otherwise low except in A_1.
C	29–33	1·77	68·1	23·8	83·5	8·4	8·1	—	0·05	0·01	—	4·62	1·3	4·48			30	0·8	
C	35–39	2·14	73·8	17·9	83·9	7·8	8·3	—	—	0·02	—	4·22	0·5	4·41			44	0·7	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 5. SOILS DEVELOPED ON FLUVIOGLACIAL AND MORAINIC DEPOSITS

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations m.e./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							
71.								**Corby Association:** Corby Series. Stormont, 189112–17											
L/F/H	3–1	79·80	n.d.	n.d.	n.d.	n.d.	n.d.	9·64	6·75	1·87	1·53	103·90	16·0	3·50	46·77	1·401	100	11·7	High Ca in L/F/H, otherwise low. High Mg and K in L/F/H, low in B_2 and C. Low % saturation throughout. Low total P_2O_5 in A_2 and C. High acetic soluble P_2O_5 in L/F/H, otherwise low.
A_2	0–3	23·55	51·4	21·6	66·6	6·4	9·3	—	0·64	0·27	0·21	45·09	2·4	3·40	13·20	0·542	88	1·1	
B_2	4–7	16·40	56·1	20·2	68·7	7·6	11·4	—	0·15	0·11	0·08	31·23	1·1	3·79	7·23	0·386	119	0·8	
C	10–14	7·76	83·7	5·0	86·6	2·1	11·4	—	0·04	0·04	0·06	11·42	1·2	3·91			88	0·9	
C	18–22	5·24	84·0	5·2	87·8	1·4	8·2	—	0·04	0·04	0·04	7·39	1·6	3·82			72	0·9	
C	24–28	3·29	91·1	4·1	93·1	2·1	4·8	—	0·02	0·04	—	3·31	1·8	4·32			71	1·1	
72.								**Corby Association;** Corby Series. Cleaven, 136285–91											
A_1	0–1	7·38	41·5	41·1	75·6	10·7	13·7	0·16	0·16	0·06	0·16	5·89	8·4	5·20	2·62	0·229	94·0	0·4	Low Ca and Mg. throughout. Low K except in upper A_1. Low % saturation. Low total P_2O_5 in upper A_1, B_2 and upper C. Low readily soluble P_2O_5 throughout.
A_1	2–4	11·20	72·3	20·4	82·8	9·9	7·3	0·16	0·03	0·02	0·04	16·49	1·5	4·91	4·60	0·212	142·0	0·4	
A_1/B_2	6–9	7·08	76·4	17·8	84·6	9·6	5·8	—	—	0·02	0·04	7·44	0·8	4·89	2·63	0·147	107·0	0·4	
B_2	10–14	4·16	86·7	10·6	93·0	4·3	2·7	—	—	0·01	0·04	5·69	0·9	4·80	0·80	0·073	82·0	0·4	
C	18–22	1·94	95·2	3·6	96·6	2·2	1·2	—	—	—	0·02	1·81	1·1	4·80			82·0	1·0	
C	30–34	1·94	95·6	4·4	97·7	2·3	—	—	—	0·01	0·04	1·41	3·4	4·91			109·0	1·2	
C	40–44	1·19	96·5	3·5	97·5	2·5	—	—	—	0·01	0·04	1·55	3·1	5·04			112·0	3·2	

73. Corby Association; Corby Series. Loanleven, 142633–36

S	3–7	4·78	52·2	26·1	65·1	13·2	19·3	5·60	0·26	0·07	0·09	2·67	69·3	6·36	3·27	0·210	329	5·3	Low Ca except in S.
B_2	12–16	2·14	64·0	24·1	79·0	9·1	11·9	1·51	0·07	0·03	0·06	2·79	37·4	5·76	1·19	0·103	210	2·0	Low Mg except in B_3.
B_3	19–22	2·38	82·3	15·3	94·4	3·2	2·4	0·45	0·41	0·02	—	—	100	6·00			135	4·2	Low K throughout.
C	32–36	4·77	86·6	7·5	90·3	3·9	3·5	0·23	—	0·01	—	0·27	47·1	5·90			118	2·5	High % saturation except in B_2 and C.
																			High total P_2O_5 in S.
																			Low readily soluble P_2O_5 in B_2 and C.

74. Boyndie Association; Boyndie Series. Meikleour, 171538–44

L & F	1–0	29·80	n.d.	n.d.	n.d.	n.d.	n.d.	12·47	3·92	0·31	1·11	29·62	37·6	4·81	14·83	0·953	174	13·0	High Ca in L & F, otherwise low.
A	0–2	11·10	67·8	5·7	84·2	4·5	5·7	1·53	0·84	0·14	0·33	15·83	15·2	4·29	6·01	0·363	106	3·3	Low Mg and K below A.
B	6–10	5·40	67·9	7·9	83·1	7·3	7·9	—	0·04	0·03	0·02	4·21	2·1	4·51	2·09	0·151	83	3·3	Low % saturation except in L & F and lower C.
B	13–17	3·71	68·4	2·41	87·6	4·9	7·5	—	0·05	0·03	0·02	4·06	2·4	4·41			94	4·8	Low total P_2O_5 below A.
C	24–28	1·41	85·7	11·9	94·8	2·8	2·4	—	0·01	0·02	0·02	2·44	2·0	4·42			57	17·6	High readily soluble P_2O_5 in L & F and C.
C	38–42	1·39	78·5	20·1	94·6	4·2	1·4	—	0·01	0·03	0·02	1·25	4·6	4·61			88	23·8	
C	55–59	2·14	60·6	33·8	78·4	16·0	5·6	—	0·36	0·06	0·02	1.45	23·3	5·40			86	5·2	

75. Boyndie Association; Boyndie Series. Bridge Farm, 136273–78

S	1–5	5·71	53·6	31·4	76·7	11·2	12·1	1·69	0·04	0·03	0·22	4·35	31·3	5·55	2·58	0·219	227	3·0	Low Ca and Mg throughout.
S	9–13	5·88	53·4	34·1	78·7	11·7	9·6	0·82	0·03	0·03	0·09	3·91	19·9	5·53	1·89	0·173	165	0·9	Low K except in upper S.
B_2	16–20	3·22	75·9	8·0	88·7	5·2	6·1	0·46	0·02	0·02	0·08	4·17	12·2	5·80	0·84	0·055	142	2·4	Low % saturation in B_2, B_3 and lower S.
B_3	23–27	2·04	93·3	5·7	96·4	2·6	1·0	—	—	—	0·06	1·77	3·3	5·90			151	4·1	Low readily soluble P_2O_5 in lower S and B_2.
C	33–37	1·78	72·5	22·4	88·6	6·3	5·1	—	0·03	0·02	0·04	0·24	27·3	5·61			138	5·2	
C	46–50	1·51	81·3	15·7	89·3	7·7	3·0	0·30	0·05	0·02	0·04	0·37	52·6	5·79			122	4·8	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 5: Soils developed on Fluvioglacial and Morainic Deposits—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations m.e./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							
76.								**Boyndie Association**; Inchewan Series. Warren Wood, 204137–42											
L & F	2–0	49·70	n.d.	n.d.	n.d.	n.d.	n.d.	2·34	1·30	0·21	0·93	43·76	9·8	4·50	29·28	1·049	161	19·9	Low Ca except in A_2.
A_2	0–2	11·20	76·4	8·5	80·9	4·0	9·5	6·38	0·36	0·18	0·07	19·10	26·8	3·95	5·41	0·288	123	19·3	Low Mg except in L & F and A_2.
B_2	5–9	4·24	80·4	8·0	83·2	5·2	9·5	—	0·07	0·04	0·16	9·82	2·7	4·30	1·45	0·139	104	4·8	Low K except in L & F.
B_3	13–17	2·76	80·5	9·6	87·3	2·8	9·9	—	0·02	0·04	0·10	8·66	1·8	4·40			87	3·4	Low % saturation except in A_2.
C	26–30	2·51	80·3	11·9	88·2	4·0	7·8	—	—	0·04	0·06	5·85	1·7	4·41			55	0·6	Low total P_2O_5 in B_3 and C.
	38–42	2·32	86·1	6·2	90·1	2·2	7·7	—	—	0·04	0·09	5·37	2·4	4·50			40	1·1	High readily soluble P_2O_5 in L & F and A_2, low in C.
77.								**Boyndie Association**; Inchewan Series. Middle Inchewan, 213948–52											
S	2–6	6·12	59·3	24·8	72·5	11·6	12·8	1·37	0·70	—	0·63	6·17	30·4	5·42	1·75	0·145	193	5·6	Low Ca throughout.
B_2	11–15	4·38	62·4	23·4	73·3	12·5	12·0	—	0·18	—	0·31	4·29	10·3	4·89	1·28	0·130	164	1·4	Low Mg except in S and B_3.
B_2	20–24	3·96	59·0	29·3	74·3	14·0	11·7	—	0·05	—	0·20	2·46	9·2	5·05			115	0·9	Low K in B_3 and C.
B_3	29–33	2·24	78·2	15·3	86·5	7·0	6·5	—	0·34	—	0·06	1·55	20·5	5·11			80	2·0	Low % saturation in B_2.
C	36–40	1·84	87·7	8·9	92·0	4·6	3·4	—	0·25	—	0·06	0·26	54·4	4·80			69	5·8	Low total P_2O_5 in B_3 and C. Low readily soluble, P_2O_5 in B_2 and B_3.

78. **Boyndie Association; Dallachy Series.** South Wood, 136267–72

L/F/H	2–0	71·50	n.d.	n.d.	n.d.	n.d.	n.d.	24·90	6·39	0·32	1·85	56·57	32·7	4·69	30·40	1·461	301·0	16·3	High Ca in LFH and A_1, low in B_3g and Cg. High Mg and K in LFH, low in B_3g and Cg. High % saturation in Cg. High total P_2O_5 in LFH, low in B_3g and Cg. High readily soluble P_2O_5 in LFH, low in A_1, B_3g and upper Cg.
A_1	0–2	29·70	n.d.	n.d.	n.d.	n.d.	n.d.	13·84	3·09	0·15	0·47	32·05	35·4	5·01	10·88	0·540	167·0	1·9	
B_2g	3–6	7·71	77·2	12·1	83·3	6·0	6·9	3·98	0·71	0·07	0·13	9·43	34·1	5·60	4·01	0·201	150·0	3·5	
B_3g	8–11	2·38	87·8	9·8	93·6	4·0	2·4	1·21	0·19	0·02	0·06	1·89	43·9	5·92	0·82	0·053	81·0	2·8	
Cg	14–17	1·64	91·5	6·5	94·6	3·4	2·0	0·81	0·11	0·02	0·06	—	100	6·15			51·0	2·8	
Cg	20–24	1·43	91·4	6·0	94·4	3·0	1·2	0·45	0·13	0·02	0·08	—	100	6·30			81·0	5·2	

79. **Boyndie Association; Anniston Series.** Brunty, 179224–27

S	2–9	4·93	67·4	24·2	80·2	11·4	5·9	9·15	0·23	0·09	0·33	2·46	79·9	6·20	1·89	0·186	223	22·9	High Ca in S (probably due to liming), low in C. Low Mg throughout. Low K in upper C. High % saturation throughout. High readily soluble P_2O_5 throughout.
$B_2(g)$	20–24	1·28	84·7	15·3	94·8	5·2	—	7·55	0·11	0·05	0·29	—	100	6·30	0·32	0·026	131	19·8	
C(g)	26–30	1·02	84·3	15·7	96·8	3·2	—	1·66	0·13	0·05	0·05	—	100	6·22			114	34·0	
C(g)	31–35	1·39	82·7	17·3	94·6	5·4	—	1·66	0·23	0·11	0·11	—	100	6·70			125	30·0	

80. **Auchenblae Association; Auchenblae Series.** Linkswood 179939–43

A_1	½–1½	19·00	64·2	18·2	73·1	9·3	3·3	—	0·67	0·04	—	24·28	2·8	3·77	8·26	0·604	189	7·2	Low Ca throughout. Low Mg except in upper A_1 and C. Low K except in lower A_1. Low % saturation except in C. Low total P_2O_5 in C. Low readily soluble P_2O_5 in B_2 and B_3.
A_1	2–6	9·65	74·2	16·9	83·5	7·6	4·1	—	0·17	0·06	0·15	12·44	3·0	4·33	5·53	0·533	200	4·9	
B_2	8–10	2·77	93·7	4·1	95·6	2·2	2·2	—	0·10	0·05	0·07	3·09	6·6	4·82			102	0·8	
B_3	11–15	1·85	94·6	3·2	95·8	2·0	2·2	—	0·11	0·04	0·04	2·29	7·7	5·00			124	1·3	
C	19–23	1·28	96·6	1·2	97·4	0·4	2·2	—	0·31	0·04	0·07	1·41	23·0	5·55			80	4·1	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 5: Soils developed on Fluvioglacial and Morainic Deposits—*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 m.e./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
81.											**Auchenblae Association;** Auchenblae Series. Newton Farm, 130949–53								
S	1–5	2·73	84·8	10·7	90·4	5·1	1·8	3·33	0·52	0·05	0·17	1·39	74·4	6·55	1·12	0·085	123	56·8	Low Ca except in S. Low Mg and K in B_2 and B_3. High % saturation in S and C, low in B_2 and B_3. Low total P_2O_5 except in S. High readily soluble P_2O_5 in S.
B_2	11–15	1·17	84·1	14·3	95·0	3·4	0·4	0·91	0·15	0·04	0·05	9·15	11·2	5·98	0·26	0·028	48	6·9	
B_3	19–23	1·24	95·0	3·8	96·0	2·8	—	0·75	0·20	0·03	0·03	8·53	10·6	5·81	0·11	0·022	64	9·0	
C	35–39	1·38	94·2	3·0	94·8	2·4	1·4	1·67	0·55	0·04	0·17	1·30	65·2	6·12			55	5·7	
C	42–46	1·30	93·1	5·0	95·1	3·0	0·6	2·72	1·11	0·06	0·13	—	100	7·51			60	8·1	
82.											**Auchenblae Association;** Kirkbuddo Series. Morendy, 179915–19								
L & F	1–0	55·70	n.d.	n.d.	n.d.	n.d.	n.d.	13·64	6·71	1·31	1·31	65·66	25·9	4·45	30·37	1·495	191	23·1	High Ca in L & F, otherwise very low. High Mg in L & F, low in B_3(g). High K in L & F, low in Bg and Cg. Low % saturation except in L and F and C(g). Low total P_2O_5 except in L & F. High readily soluble P_2O_5 in L & F, low in Bg.
A_1	0–3	14·00	77·2	10·7	84·2	3·7	5·1	—	1·33	0·51	0·97	28·41	9·0	4·10	7·51	0·475	71	5·8	
B_2(g)	3–7	4·58	78·5	8·5	84·0	3·0	10·7	—	0·43	0·15	0·05	10·75	5·5	4·08			20	0·6	
B_3(g)	9–13	1·15	87·9	7·3	94·0	1·2	4·8	—	0·25	0·08	—	4·66	6·6	4·36			30	1·0	
C(g)	17–21	0·60	91·4	6·2	95·4	2·2	2·4	0·53	0·88	0·09	—	1·90	44·1	5·20			28	4·3	

83. **Gleneagles Association;** Gleneagles Series. Dun Knock, 171848–54

L & F	1–0	51·60	n.d.	n.d.	n.d.	n.d.	n.d.	14·40	3·63	0·37	2·11	13·02	61·2	5·20	27·68	1·142	271	25·9	High Ca in L & F, low below A. Low Mg below A. High K in L & F, low in B & C Low % saturation except L & F and A. Low total P_2O_5 except L & F and A. High readily soluble P_2O_5 in L & F and lower C.
A	0–1	10·90	79·6	10·4	84·5	5·5	4·5	3·36	0·90	0·12	0·18	5·55	45·1	4·71	4·68	0·274	134	7·2	
B	2–6	4·53	88·0	5·8	89·0	4·8	3·9	0·30	0·17	0·05	0·04	6·42	8·0	4·62	1·31	0·103	90	4·9	
C	10–14	2·08	95·4	3·5	96·4	2·5	1·1	0·30	0·11	0·04	0·02	2·99	13·6	4·80			62	7·0	
C	15–19	2·17	94·4	3·8	95·4	2·8	1·8	—	0·11	0·03	0·02	3·46	4·5	4·72			70	8·0	
C	26–30	2·08	95·4	4·4	96·2	3·6	0·2	0·30	0·04	0·02	—	2·59	12·2	4·71			53	6·4	
C	36–40	1·58	96·2	3·2	96·6	2·8	0·6	—	0·08	—	0·03	2·89	3·7	4·75			51	10·4	

84. **Gleneagles Association;** Gleneagles Series. Inchrye, 189118–22

S	1–4	9·67	54·9	18·4	60·1	13·2	21·9	17·29	2·28	0·13	1·30	5·37	76·6	6·01	4·20	0·351	583	88·4	High Ca in S and B. Low Mg in C. High K in S. High % saturation throughout. High total P_2O_5 in S. High readily soluble P_2O_5 except in upper C.
S	7–11	9·26	59·8	14·0	62·5	11·3	21·2	18·05	2·22	0·11	1·12	5·53	79·5	6·09	3·86	0·345	511	84·0	
B	13–17	5·55	66·6	13·4	71·8	8·2	17·2	9·76	1·11	0·08	0·60	3·91	74·7	6·04			250	11·9	
C	23–27	3·76	82·9	6·9	85·8	4·0	10·2	5·34	0·07	0·07	0·32	3·18	67·2	6·08			145	6·5	
C	32–36	3·15	83·2	8·8	89·0	3·0	8·0	5·67	0·07	0·07	0·43	1·88	79·2	6·15			124	10·3	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 6. SOILS DEVELOPED ON TERRACE AND RAISED BEACH DEPOSITS

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 m.e./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
85.								**Carpow Association;** Carpow Series. Mylnefield, 119969–73											
S	2–6	9·10	48·3	26·9	60·8	14·4	20·2	14·55	1·37	0·10	0·23	—	100	7·11	2·99	0·261	487	59·1	High Ca except in B_3 and C.
S	8–12	8·93	41·8	30·3	54·0	18·1	23·4	14·58	1·48	0·15	0·28	—	100	7·16	2·81	0·277	444	53·5	High % saturation in S and B_2.
B_2	16–20	5·40	47·2	25·5	58·1	14·6	24·6	9·87	1·51	0·16	0·15	—	100	7·20			641	12·0	High total and readily soluble
B_3	25–29	4·41	59·0	22·1	70·6	10·5	16·7	5·88	0·86	0·05	0·11	3·46	66·5	6·84			359	11·5	P_2O_5 throughout.
C	33–37	4·25	81·1	7·7	86·1	2·7	9·1	3·58	0·35	0·05	0·10	3·02	57·5	5·83			371	11·1	
86.								**Carpow Association;** Carpow Series. Drum of Garvock, 184068–72											
S	2–6	6·67	70·8	16·8	78·0	9·6	9·1	3·57	0·02	0·04	0·05	7·40	33·2	6·20	3·19	0·235	217	8·5	Low Ca except in S.
B	13–17	2·32	87·5	6·3	90·8	3·0	6·2	0·61	—	—	0·02	2·84	18·2	5·69	1·12	0·112	106	4·6	Low Mg and K throughout.
C	22–26	0·95	94·9	3·2	96·1	2·1	1·8	0·61	—	—	0·02	0·43	59·4	5·63			92	10·2	High % saturation in C, low
C	30–34	0·75	97·0	1·2	98·0	0·2	1·8	0·61	0·05	—	0·02	—	100	5·58			102	14·6	in B.
C	37–41	0·93	92·9	5·3	97·0	1·2	1·8	—	—	0·01	0·05	—	100	5·38			80	14·1	Low total P_2O_5 in C.
																			High readily soluble P_2O_5 in C.

87. **Carpow Association**; Carey Series. Newbigging, 189079–84

S	1–5	4·48	39·5	38·6	58·0	20·1	19·7	10·67	0·89	0·08	0·09	2·51	82·4	6·22	1·77	0·146	121	19·5	High Ca throughout. Low K except in lower C(g). High % saturation throughout. Low total P_2O_5 in B_3(g). High readily soluble P_2O_5 throughout.
B_2	8–12	3·22	40·8	38·6	62·1	17·3	20·6	9·67	0·81	0·07	0·04	1·89	84·9	6·66	1·14	0·121	133	13·5	
B_3(g)	14–18	2·89	49·6	29·8	64·9	14·5	20·6	10·68	1·53	0·08	0·09	1·42	89·7	6·71	0·79	0·074	84	17·1	
C(g)	20–24	2·54	49·0	29·2	61·8	16·4	21·8	10·68	2·19	0·08	0·09	1·43	90·1	6·82			103	58·8	
C(g)	26–30	3·37	23·7	57·8	51·9	29·6	18·5	10·68	3·28	0·10	0·09	0·73	95·1	6·99			160	64·7	
C(g)	31–35	4·32	14·5	41·7	22·2	33·7	41·6	11·78	4·45	0·17	0·28	—	100	7·08			146	62·8	

88. **Carpow Association**; Carey Series. Flisk Point, 181783–86

A	1–5	6·13	47·6	31·5	62·8	16·3	17·8	6·79	1·74	0·12	0·27	4·40	67·0	5·22	2·58	0·206	169	10·0	Low K in C(g). High % saturation throughout. High readily soluble P_2O_5 throughout.
B_2(g)	8–12	3·34	53·4	27·9	68·1	13·2	18·7	5·68	1·58	0·17	0·12	0·74	91·1	6·21	0·98	0·087	135	12·2	
B_3(g)	18–22	3·35	54·2	27·3	67·3	14·2	18·5	5·67	1·65	0·16	0·10	0·84	90·0	6·27			167	11·4	
C(g)	24–28	2·72	50·1	33·4	67·3	16·2	16·5	6·35	1·31	0·19	0·09	—	100	6·59			153	16·0	

89. **Panbride Association**; Panbride Series. Balcathie, 184064–67

S	2–6	6·51	54·8	23·3	65·0	13·1	18·6	14·08	0·49	0·11	0·18	1·69	89·8	6·82	3·25	0·282	271	13·0	High Ca in S. Low K in upper C. High % saturation throughout. High readily soluble P_2O_5 in S and upper C.
B	11–13	3·50	89·5	6·4	93·0	2·9	4·1	5·54	0·38	0·09	0·11	2·14	73·1	6·70	1·28	0·122	174	9·1	
C	18–23	2·59	93·9	3·8	95·9	1·8	7·3	6.29	0·32	0·10	0·09	1·10	86·1	6·61			160	11·7	
C	26–30	2·31	89·1	7·8	91·8	5·1	3·1	3·71	0·37	0·07	0·11	1·59	72·8	6·60			151	8·0	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 6. Soils Developed on Terrace and Raised Beach Deposits—*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 m.e./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
90.								**Panbride Association**; Panbride Series. Kincaple, 169298–303											
S	3–7	6·31	60·0	23·8	71·7	12·1	13·0	6·42	0·87	0·19	0·50	7·71	50·9	5·70	3·25	0·210	320	11·5	High loss on Ignition in C due to humus accumulation.
S	11–15	4·62	57·8	24·5	70·2	12·1	15·4	9·65	0·68	0·18	0·18	5·07	67·8	5·90	2·60	0·135	341	15·5	High Ca in C.
S	20–24	3·89	57·8	29·9	76·5	11·2	12·3	7·67	0·71	0·15	0·12	2·76	75·8	6·12	2·07	0·107	429	38·2	Low K in lower B and C.
B	27–31	1·96	81·9	13·4	89·1	6·2	4·6	4·41	0·37	0·07	0·13	0·41	92·4	6·48			296	35·9	High % saturation except in upper S.
B	34–38	1·48	93·1	4·3	94·1	3·3	2·6	3·94	0·30	0·05	—	—	100	6·65			186	32·5	High total P_2O_5 except in B.
C	42–46	11·51	78·0	11·7	82·8	7·0	4·5	14·48	1·26	0·15	0·05	1·42	91·8	6·70			368	34·7	High readily soluble P_2O_5 throughout.
91.								**Panbride Association**; Rhynd Series. Rhynd, 203166–70											
S_1	2–6	4·88	49·7	27·9	59·8	17·8	20·0	8·48	0·56	0·09	0·12	5·09	64·5	6·20	141	0·138	152	8·3	High Ca in S_1 and S_2, low in B_3 and C.
S_2	11–15	3·88	61·8	17·4	69·2	10·0	20·8	8·04	1·51	0·07	0·07	4·11	70·2	6·09	1·38	0·128	154	3·7	Low Mg in B_3 and C.
B_2	17–21	2·85	78·4	8·1	82·1	4·4	13·5	4·69	0·40	0·06	0·09	3·26	61·6	5·95			171	3·6	Low K below S_1.
B_3(g)	23–27	1·86	87·4	4·0	89·3	2·1	8·6	2·41	0·21	0·02	0·02	1·99	57·2	5·91			178	5·6	High % saturation except in B_3 and C.
C(g)	34–38	0·72	94·2	0·4	94·4	0·2	5·4	2·41	0·14	0·02	—	4·35	37·1	6·07			203	8·6	

92. **Panbride Association; Kellie Series.** Pitskelly, 184059–63

S	1–5	6·21	66·0	16·5	75·1	7·4	14·4	6·95	1·05	0·04	0·11	8·16	50·0	6·20	2·45	0·245	183	4·7	Low Mg in C. Low K in lower S and B_2(g). High % saturation, except in upper S. Low total P_2O_5 below S. High readily soluble P_2O_5 in B_3(g) and C(g).
S	8–12	3·87	76·8	10·8	81·7	5·9	12·4	6·25	0·34	0·03	0·05	3·90	63·1	6·41	1·64	0·142	127	3·9	
B_2(g)	16–21	2·54	89·8	7·2	93·7	3·1	3·0	6·24	0·72	0·07	0·09	0·82	89·7	6·61			88	7·2	
B_3(g)	28–34	1·11	94·9	3·0	96·9	1·0	2·1	6·89	0·57	0·04	0·11	—	100	6·68			76	13·0	
C(g)	43–50	1·56	95·8	2·4	97·6	0·6	1·8	6·52	0·26	0·06	0·10	—	100	6·61			55	10·4	

93. **Carbrook Association; Harviestoun Series.** Gallowflat, 190024–29

S	1–5	6·34	40·3	31·4	53·3	18·4	25·1	9·31	0·58	0·12	0·45	6·04	63·4	5·89	2·33	0·221	206	18·4	High Ca except in B(g). High Mg in C. High % saturation throughout. Low total P_2O_5 in B(g) and upper C(g). High readily soluble P_2O_5 in S and lower C(g).
S	7–11	6·04	39·2	29·8	49·4	19·6	28·0	8·82	0·60	0·08	0·25	5·23	65·1	5·97	2·22	0·178	195	16·5	
B(g)	13–17	4·99	21·2	36·6	27·6	30·2	39·7	7·05	1·83	0·12	0·18	2·76	76·9	6·19	1·12	0·105	57	0·7	
C(g)	21–25	5·04	11·5	41·9	17·0	36·4	44·1	9·80	6·70	0·24	0·25	2·64	86·6	6·34			62	0·4	
C(g)	26–30	4·87	9·0	46·8	18·1	37·7	41·8	9·59	7·58	0·31	0·27	2·80	86·4	6·30			89	5·4	
C(g)	31–35	4·84	9·9	45·9	17·1	38·7	41·8	9·38	8·25	0·36	0·27	2·72	87·0	6·53			116	29·5	

94. **Carbrook Association; Harviestoun Series.** Seggiehill, 169282–88

S	1–3	14·60	13·9	37·0	26·3	24·6	41·8	12·26	4·24	0·92	1·09	10·30	64·2	5·31	8·27	0·438	176	18·1	High Ca throughout. High Mg in C(g). High K in S. High % saturation throughout. Low total P_2O_5 in B(g). and upper C(g). High readily soluble P_2O_5 except in B(g) and upper C(g).
B(g)	4–7	7·35	11·9	37·4	25·8	23·5	47·0	10·32	4·21	0·81	0·48	6·07	72·3	5·79	3·06	0·176	98	6·7	
C(g)	11–16	6·26	4·3	45·9	20·6	29·6	46·7	9·78	8·83	0·76	0·37	6·32	75·7	5·70	2·41	0·115	75	1·1	
C(g)	24–29	5·46	3·8	48·4	17·3	34·9	45·1	12·68	6·51	0·71	0·37	3·32	85·9	6·00			114	37·1	
C(g)	35–40	4·28	6·0	57·7	22·7	41·0	34·2	13·13	7·56	0·67	0·36	0·70	96·9	6.80			170	71·5	
C(g)	48–53	4·17	1·1	60·5	18·0	43·6	36·3	13·07	7·96	0·80	0·30	0·93	96·0	6.80			216	88·0	
C(g)	62–67	4·09	8·8	63·7	22·8	49·7	25·5	12·83	5·83	0·64	0·31	—	100	7·25			190	100·8	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 6: Soils Developed on Terrace and Raised Beach Deposits—*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 m.e./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
95.								**Stirling Association**; Stirling Series. Brickhall, 189980–88											
S	1–5	10·20	13·5	49·8	23·9	39·4	31·6	23·35	1·39	0·16	0·32	3·94	86·5	6·70	3·17	0·311	172	5·7	High Ca down to 36 in.
B_2g	10–14	5·49	10·3	49·3	18·3	41·3	37·7	16·66	1·49	0·14	0·32	3·98	82·4	6·68	1·25	0·120	59	0·2	High % saturation down to
Cg	18–22	5·85	6·2	28·0	14·8	19·4	62·9	14·31	1·53	0·15	0·34	1·76	90·3	6·42	1·48	0·139	76	—	down to 42 in.
Cg	25–29	4·89	8·6	49·3	19·0	38·9	39·7	12·31	1·30	0·17	0·37	1·59	89·9	6·39	1·38	0·132	56	—	Low total P_2O_5 in B_2g and
Cg	32–36	5·76	9·7	46·6	19·0	37·3	40·8	10·82	1·27	0·14	0·35	2·58	83·0	5·94			100	0·2	upper Cg.
Cg	38–42	6·07	8·2	47·1	18·2	37·1	41·7	7·71	1·14	0·12	0·32	3·91	70·4	5·53			102	0·3	Low readily soluble P_2O_5 ex-
Cg	48–52	5·35	8·3	51·1	20·6	38·8	37·9	3·16	0·54	0·11	0·26	6·93	37·0	4·69			101	1·2	cept in S.
Cg	57–61	5·06	11·8	49·8	23·2	38·4	35·9	1·26	0·32	0·08	0·26	8·40	18·6	4·44			83	0·4	
Cg	66–71	4·89	9·9	54·3	27·3	36·9	33·4	0·80	0·34	0·08	0·26	13·81	9·9	4·19			116	0·6	
96.								**Stirling Association**; Stirling Series. Eastbank, 152068–72											
S	3–7	7·80	4·9	54·0	21·5	37·4	37·2	2·03	1·29	0·19	0·91	3·68	54·6	6·51	2·10	0·190	180	19·5	High Ca in Cg, low in S.
Bg	12–16	4·98	—	70·8	12·3	56·0	29·2	7·85	5·13	0·14	0·29	2·15	86·2	6·76	0·52	0·045	102	14·3	High Mg in upper Bg and
Bg	20–24	3·55	—	79·9	24·1	55·8	20·1	7·93	4·52	0·15	0·28	—	100	7·72			146	56·4	lower Cg.
Cg	28–32	3·11	—	78·2	24·6	53·6	21·8	9·00	4·98	0·16	0·28	—	100	7·86			159	50·9	High % saturation except
Cg	34–38	3·05	2·3	75·9	29·0	49·2	21·8	9·01	5·33	0·17	0·29	—	100	7·94			168	53·9	in S.
																			High readily soluble P_2O_5
																			throughout.

97. **Stirling Association**; Stirling Series. Wester Ballindean, 189096–101

S	1–5	7·56	27·2	37·9	39·2	25·9	31·1	20·28	2·58	0·15	0·51	4·37	84·3	5·60	2·60	0·240	247	32·8	High Ca throughout.
S	7–11	6·73	24·8	39·5	37·6	26·7	32·3	20·59	2·80	0·14	0·34	3·10	88·5	6·12	2·48	0·234	239	33·4	High Mg in lower Bg and in Cg.
Bg	13–17	6·31	12·5	46·7	23·1	36·1	37·6	22·34	4·67	0·19	0·34	3·45	88·9	6·42	2·05	0·197	116	29·0	High % saturation throughout.
Bg	19–23	5·81	3·7	54·9	13·2	45·4	38·5	17·96	5·04	0·20	0·44	4·21	84·9	6·43			82	30·9	Low total P_2O_5 in lower Bg and
Cg	24–28	6·29	3·5	49·6	13·0	40·1	43·8	16·36	5·53	0·20	0·41	2·38	90·4	6·49			96	23·8	upper Cg.
Cg	31–35	6·39	3·1	48·4	13·7	37·8	45·3	14·08	6·63	0·22	0·50	4·18	83·7	6·53			117	24·7	High readily soluble P_2O_5 throughout.

98. **Stirling Association**; Stirling Series. Cordon, 190030–34

S	1–5	8·51	18·2	48·0	33·4	32·8	29·5	23·32	1·39	0·12	1·20	1·72	93·8	6·72	2·78	0·274	253	42·3	High Ca throughout.
Bg	9–13	5·14	13·8	53·3	35·1	32·0	30·3	14·43	1·32	0·11	0·74	—	100	7·03	1·22	0·117	252	1·0	High K in S.
Cg	18–22	4·89	14·0	53·4	33·8	33·6	30·2	13·18	1·51	0·12	0·40	0·49	96·7	6·81			50	0·6	High % saturation throughout.
Cg	25–29	4·67	11·3	57·4	29·8	38·9	29·0	10·73	2·01	0·13	0·27	0·54	96·1	6·80			47	0·8	Low total P_2O_5 in Cg.
Cg	32–36	4·58	9·2	59·5	30·7	38·0	29·0	9·73	1·15	0·17	0·31	—	100	6·81			36	0·4	High readily soluble P_2O_5 in S, otherwise low.

99. **Stirling Association**; Stirling Series. Maggotland, 189058–62

S	1–5	7·54	13·1	51·5	29·8	34·8	31·6	15·25	4·94	0·16	0·26	1·84	94·3	6·01	2·24	0·223	141	23·2	High Ca throughout.
B_2g	10–14	5·24	19·0	54·7	23·5	40·2	33·7	14·76	3·13	0·15	0·28	1·87	90·7	6·44	1·31	0·097	59	8·1	High Mg in Cg.
B_3g	18–22	4·56	13·1	57·3	27·4	43·0	27·3	13·09	4·49	0·18	0·36	1·11	94·2	6·20			96	23·1	High % saturation throughout.
B_3g	25–29	3·42	10·2	66·8	37·6	39·4	23·0	10·30	4·47	0·16	0·16	0·62	96·1	6·61			100	51·7	Low total P_2O_5 in B_2g and B_3g.
Cg	32–36	3·29	16·3	60·3	38·8	37·8	23·4	8·86	5·84	0·15	0·38	0·84	94·8	6·12			121	54·1	High readily soluble P_2O_5 except in B_2g.

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 6: Soils Developed on Terrace and Raised Beach Deposits—*continued*

Horizon	Depth in.	% Loss on Ignition	Soil Separates					Exchangeable Cations m.e./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							
100.								Stirling Association; Cauldside Series. Paddockmuir Wood, 172341–47											
A_1	1–3	21·10	19·7	50·6	41·6	28·7	13·9	—	1·09	0·10	0·52	35·40	4·6	4·11	10·09	0·692	181	1·6	Low Ca except in B_2(g).
B_2	4–8	11·90	13·6	49·0	27·0	35·6	31·4	—	0·33	0·09	0·29	28·96	2·4	4·28	4·47	0·292	98	0·6	Low Mg in B_2(g) and in B_3(g).
B_2(g)	12–15	11·00	5·1	56·0	20·7	40·4	33·4	0·62	0·24	0·11	0·14	27·97	3·8	4·50	3·70	0·204	87	0·5	Low K in B_3(g).
B_2(g)	17–21	6·80	9·0	56·6	27·6	38·0	34·4	0·15	0·24	0·10	0·15	17·67	3·5	4·14			66	0·4	Low % saturation throughout.
B_3(g)	26–30	3·02	51·6	42·3	78·8	15·1	6·1	—	0·07	0·05	0·02	7.20	1·9	4·30			28	0·4	Low total P_2O_5 except in A_1.
C(g)	35–38	4·84	5·9	65·6	30·7	40·8	28·5	—	0·33	0·11	0·17	11·29	5·1	4·21			31	—	Low readily soluble P_2O_5
C(g)	42–46	6·36	7·7	68·3	32·3	43·7	24·0	—	0·40	0·11	0·15	10·37	6·0	4·02			42	0·4	throughout.
101.								Stirling Association; Cauldside Series. Wardheads, 179234–38											
S	2–6	6·27	14·8	59·7	42·3	32·2	21·3	10·77	1·18	0·10	0·21	4·68	72·4	6·11	2·50	0·175	138	11·3	High Ca in S and lower C(g).
B_2(g)	14–18	3·11	19·2	63·8	48·8	34·2	17·0	7·83	0·92	0·09	0·18	1·73	83·9	6·43	0·67	0·049	101	27·1	High % saturation throughout.
B_3(g)	24–28	2·68	19·8	67·7	56·0	31·5	12·5	7·53	1·80	0·11	0·23	0·06	99·4	6·41			127	51·8	High readily soluble P_2O_5
C(g)	31–35	1·59	37·7	56·2	76·0	17·9	6·1	6·08	1·17	0·08	0·15	0·05	99·3	6·81			142	71·8	throughout.
C(g)	40–44	2·48	45·2	53·0	84·1	14·1	1·8	23·63	1·90	0·11	0·15	—	100	7·59			117	34·5	
102.								Stirling Association; Fordel Series. Craigie, 179288–92											
S	2–6	4·06	24·4	60·9	58·9	26·4	12·7	11·67	1·79	0·14	0·18	1·57	89·8	6·32	1·42	0·102	140	9·0	High Ca in S and B_2g.
B_2g	12–16	2·24	36·9	60·3	76·5	20·7	2·8	8·35	1·84	0·15	0·15	0·64	94·2	6·36	0·83	0·067	111	33·4	High % saturation throughout.
Cg	21–26	1·64	41·0	56·2	81·1	16·1	2·8	6·06	1·92	0·14	0·15	0·20	97·6	6·31			114	39·2	High readily soluble P_2O_5
Cg	30–34	1·79	36·9	56·3	76·6	16·6	6·8	4·24	1·81	0·14	0·17	1·85	77·5	5·70			137	42·3	except in S and lower Cg.
Cg	37–43	2·71	35·5	57·6	76·6	16·5	6·9	1·67	0·90	0·11	0·11	5·97	31·8	4·31			134	8·5	

TABLE 7. ALLUVIUM

103. **Alluvium.** Braecock, 164838–43

S	2–6	4·06	75·7	15·2	85·6	5·3	7·1	1·83	0·03	0·20	0·03	4·65	31·0	5·73	1·72	0·172	186	15·8	Low Ca and Mg throughout. Low K in upper S. Low total P_2O_5 in lower B and in C. High readily soluble P_2O_5 except in C.
S	11–15	2·72	81·5	11·8	88·0	5·3	6·7	1·52	0·19	0·06	0·75	3·40	42·6	5·35	0·90	0·097	154	14·7	
B	20–24	1·92	89·7	5·7	91·6	3·8	4·6	0·60	0·11	0·03	0·32	2·23	25·4	5·43	0·67	0·072	107	13·0	
B	30–34	2·24	85·5	10·5	91·7	4·3	4·0	0·45	0·11	—	0·25	2·29	26·1	5·46			99	12·3	
C	42–46	2·29	81·1	15·1	90·9	5·3	3·8	0·45	0·12	0·04	0·16	2·77	21·8	5·30			86	9·2	
C	56–60	2·34	81·8	13·4	91·3	3·9	4·8	0·45	0·13	0·07	0·15	2·09	27·7	5·20			76	7·0	

104. **Alluvium.** Baldowrie Farm, 128312–17

S_1	1–4	4·85	71·0	16·0	77·7	9·3	10·6	9·46	0·19	0·06	0·11	—	100	7·35	1·95	0·147	153	14·3	High Ca in surface layer. Low Mg except in B_3(g). Low K except in S_1, and B_3(g). High % saturation throughout. Low total P_2O_5 except in S_1, and B_3(g). High readily soluble P_2O_5 throughout.
S_2	10–13	1·97	79·9	11·9	87·9	3·9	6·2	3·63	0·16	0·04	0·06	—	100	6·60	0·40	0·046	67	16·1	
B_2(g)	18–21	1·11	89·7	6·0	93·0	2·6	3·2	3·02	0·14	0·06	0·06	—	100	6·40	0·09	0·014	97	22·3	
B_3(g)	30–34	0·85	91·7	5·8	96·9	0·6	1·6	2·56	0·24	0·05	0·04	—	100	6·57			66	21·9	
B_3(g)	39–43	2·40	42·3	27·7	61·1	7·9	27·6	5·33	0·48	0·10	0·17	—	100	7·41			160	60·1	
C(g)	52–56	0·52	94·7	3·0	97·5	0·2	1·8	2·87	0·22	0·06	0·04	—	100	7·74			70	22·0	

105. **Alluvium.** Little Fardle, 136279–84

S	1–5	8·65	44·8	43·2	76·6	15·8	7·6	4·92	1·14	0·07	0·26	6·80	48·4	5·50	3·84	0·323	154·0	6·0	Low Ca, Mg and K except in S. High % saturation except in S. Total P_2O_5 low in lower B_2 and C. Readily soluble P_2O_5 high in B_2 and B_3, low in lower C.
B_2	9–13	1·69	80·1	16·5	93·4	3·2	3·4	1·51	0·27	0·03	0·11	0·77	71·4	5·91	0·43	0·036	117	12·3	
B_2	19–23	1·12	90·9	6·9	95·6	2·2	2·2	1·36	0·28	0·02	0·06		100	6·21	0·20	0·011	96	15·9	
B_3	30–34	1·11	96·4	3·0	97·3	1·6	0·6	1·20	0·25	0·02	0·04		100	6·30			110	11·0	
C	44–48	0·80	98·6	1·4	99·2	0·8	—	0·80	0·16	0·01	0·04		100	6·20			56	4·5	
C	56–60	0·84	97·8	2·2	98·6	1·4	—	0·80	0·12	0·01	0·04		100	6·27			52	—	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 7: Alluvium—*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 m.e./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
106.								**Alluvium.** Dura Den, 171626–29											
A	2–6	5·25	63·2	19·0	76·3	5·9	15·2	8·90	2·21	0·07	0·11	3·50	76·3	5·59	2·82	0·251	157	9·6	High Ca in A.
A	9–12	3·83	65·5	18·9	76·8	7·6	15·6	8·64	2·50	0·07	0·05	2·53	81·7	5·81	2·17	0·190	135	7·0	Low K except in upper A.
B	15–19	2·61	73·4	13·6	81·7	5·3	13·0	6·27	2·05	0·07	—	4·36	65·8	5·70			119	7·7	High % saturation throughout.
C	22–26	2·55	75·0	14·4	84·1	5·3	10·6	5·33	1·79	0·06	—	1·10	86·7	6·11			105	8·7	

TABLE 8. LINKS

107. **Links.** Fetters, 179283–87

A	1–3	8·98	92·9	6·1	94·7	4·3	1·0	1·38	0·57	0·08	0·15	5·92	26·9	4·08	4·91	0·165	83	5·2	Low Ca throughout.
B	5–9	1·59	95·4	4·6	97·8	2·2	—	0·30	0·07	0·05	0·03	5·01	8·2	4·44	0·69	0·063	82	6·7	Low Mg and K except in A.
B(A)	12–16	1·55	96·8	2·2	97·4	1·6	1·0	0·30	0·08	0·06	0·03	4·82	8·9	4·29			91	4·9	Low % saturation except in A.
C	26–30	0·77	98·2	1·8	98·4	1·6	—	—	0·01	0·10	0·03	1·62	8·0	4·49			78	5·0	Low total P_2O_5 throughout.
C(B)	36–42	0·81	95·6	4·4	97·2	2·8	—	—	0·05	0·07	0·03	2·30	6·1	4·47			37	1·6	Low readily soluble P_2O_5 in C(B).

108. **Links.** Carnoustie Links, 172337–40

L & F	2–0	6·94	90·1	3·0	92·1	3·0	1·4	6·35	1·83	0·10	0·12	3·65	69·7	6·09	3·74	0·247	112	11·4	High Ca in C (probably from shelly sand).
A	0–4	1·29	100	—	100	—	—	1·80	0·40	0·04	0·06	1·49	60·8	6·70	0·73	0·071	109	15·8	Low Mg in C.
C	8–12	1·13	100	—	100	—	—	10·36	0·23	0·07	0·02	—	100	7·17			78	4·4	Low K except in L & F.
C	22–26	1·17	100	—	100	—	—	10·40	0·23	0·08	0·02	—	100	7·82			67	2·8	High % saturation throughout.
																			Low total P_2O_5 in C.
																			High readily soluble P_2O_5 in L & F and A.

109. **Links.** Fettersloch, 179277–82

A_1	0–1	51·70	n.d.	n.d.	n.d.	n.d.	n.d.	7·18	2·34	0·53	0·18	30·89	24·9	4·56	28·98	0·791	204	6·7	Low Ca, Mg and K except in A_1
A_2(g)	3–7	2·48	92·9	3·5	93·9	2·5	3·6	—	0·12	0·08	0·05	5·51	4·3	4·31	1·37	0·131	116	3·4	Low % saturation except in A_1 and lower C(g).
B_2(g)	10–14	1·50	95·0	4·6	96·0	2·6	0·4	—	0·12	0·07	0·05	3·87	5·8	4·39	0·72	0·061	98	5·6	Low total P_2O_5 except in A_1 and A_2(g).
C(g)	19–23	0·93	95·6	4·0	97·0	2·6	0·4	—	0·09	0·07	0·05	2·39	8·1	4·41			80	5·5	High readily soluble P_2O_5 in lower C(g).
C(g)	27–31	0·65	97·4	2·6	98·2	1·8	—	—	0·09	0·06	0·05	1·54	11·5	4·53			80	7·6	
C(g)	35–39	0·55	98·6	1·4	99·0	1·0	—	0·75	0·29	0·08	0·05	1·08	52·0	5·44			81	12·1	

*n.d. Not determined.
†— Less than lower limit of determination.

TABLE 8: Links—*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 m.e./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
110.								Links. Fettersloch, 179270–76											
L & F	2–0	8·80	84·1	10·1	89·2	5·0	1·4	2·31	0·87	0·15	0·38	12·51	22·9	4·78	4·78	0·220	105	7·0	Low Ca throughout.
A_1	1–4	7·40	84·6	9·2	88·3	5·5	2·5	0·92	0·50	0·10	0·18	11·05	13·3	4·40	3·95	0·187	97	2·0	Low Mg in A_2(g) and B_2g.
A_2(g)	5–8	3·99	90·7	5·2	93·3	2·6	4·1	0·30	0·27	0·06	0·05	6·62	9·3	4·41	1·95	0·110	92	0·9	Low K below A_1
B_2(g)	9–12	0·56	96·8	3·2	97·4	2·6	—	—	0·16	0·06	—	1·45	13·2	4·82			60	4·4	High % saturation in C(g)
C(g)	16–21	0·50	97·8	2·2	98·6	1·4	—	0·75	0·37	0·08	0·05	0·06	95·4	6·52			61	9·6	otherwise low except in L & F.
C(g)	24–28	0·23	98·8	1·2	99·2	0·8	—	0·60	0·37	0·08	0·05	0·05	95·7	6·55			88	13·8	High readily soluble P_2O_5 in
C(g)	30–36	0·40	99·0	1·0	99·4	0·6	—	0·60	0·31	0·10	0·04	0·03	97·2	6·60			55	12·1	lower C(g).

APPENDIX IV

Silica-sesquioxide Ratios of the Clay Fractions

TABLE 9. 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
Strichen	Fungarth	5	A_1	51·96	10·20	22·05	3·09	13·52	4·00	3·38
			A_1	47·28	13·45	26·80	2·27	9·37	2·99	3·13
			B_2	44·98	13·50	30·40	1·95	8·80	2·51	3·51
			B_3	44·80	16·40	29·90	1·88	7·23	2·54	2·84
			C	42·52	17·15	29·40	1·79	6·61	2·45	2·70
			C	40·20	20·55	27·20	1·69	5·19	2·51	2·10
			C	41·16	18·95	28·30	1·73	5·76	2·46	2·34
Gourdie	Snaigow	12	A_1	42·90	15·70	38·40	1·51	7·32	1·90	3·85
			B_2	37·48	19·15	39·50	1·23	5·21	1·61	3·23
			B_2	40·24	13·45	32·50	1·67	7·99	2·10	3·80
			B_3	44·58	10·65	30·30	2·05	11·27	2·51	4·50
			B_3	44·94	12·75	29·10	2·06	9·74	2·62	3·72
			C	44·78	13·45	28·70	2·04	8·90	2·65	3·36
Darleith	Darleith	48	S	45·88	9·50	27·85	2·29	12·80	2·80	4·57
			S	46·12	15·05	28·30	2·07	8·18	2·76	2·96
			S	42·60	9·65	32·55	1·87	11·83	2·22	5·32
			B_2	41·04	15·05	32·90	1·83	8·35	2·43	3·48
			B_3	45·64	12·10	30·50	2·01	10·00	2·52	3·88
			C	46·24	11·10	27·75	2·26	11·01	2·84	3·89

TABLE 9—*continued*

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
Mountboy	Garvock	44	S	45·18	15·10	28·00	2·03	7·92	2·73	2·89
			S	45·10	15·65	28·15	2·01	7·65	2·72	2·82
			B_2	43·84	16·05	28·90	1·89	7·22	2·57	2·81
			B_3	45·40	14·85	28·10	2·05	8·12	2·74	2·97
			C	47·68	15·20	26·10	2·26	8·35	3·10	2·69
			C	47·66	14·45	23·95	2·44	8·81	3·37	2·61
			C	48·74	13·05	26·15	2·39	9·89	3·16	3·13
Sourhope	Sourhope	55	S	52·50	8·55	30·85	2·46	16·15	2·90	5·60
			B_2	48·68	9·70	32·95	2·12	13·30	2·41	5·29
			C	54·02	8·80	31·45	2·48	16·35	2·92	5·62
			C	55·08	8·65	28·45	2·76	17·00	3·29	5·17
			C	54·82	8·70	27·10	2·85	16·90	3·44	4·93
Laurencekirk	Drumforber	37	B_2	53·56	10·35	22·00	3·17	13·71	4·13	3·32
			C	53·84	10·75	22·50	3·11	13·37	4·05	3·30
			D	55·28	10·30	21·70	2·96	12·81	3·85	3·33
			D	55·84	10·15	20·80	3·47	14·52	4·55	3·19
			D	55·32	10·15	22·60	3·22	14·38	4·14	3·47

TABLE 10. BROWN FOREST SOILS, IMPERFECTLY 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
Gourdie	Gourdie	14	S	46·74	12·45	29·70	2·10	9·99	2·66	3·74
			S	47·40	10·80	26·10	2·44	11·60	3·08	3·77
			B_2(g)	50·42	7·40	30·80	2·41	18·25	2·76	6·57
			B_3(g)	47·76	13·75	26·90	2·27	9·25	3·01	3·07
			C(g)	49·68	11·60	27·55	2·41	11·31	3·06	3·70
			C(g)	48·06	11·85	26·30	2·41	10·81	3·10	3·49
Balrownie	Balrownie	18	S	48·64	8·85	26·90	2·54	14·70	3·06	4·81
			B_2(g)	45·54	11·50	33·30	1·92	10·54	2·34	4·50
			C(g)	47·90	14·45	27·50	2·22	8·86	2·96	2·97
			C(g)	48·68	12·90	28·00	2·28	10·01	2·95	3·40
			C(g)	48·82	13·50	25·80	2·41	9·58	3·22	2·98
Forfar	Forfar	34	S	45·22	13·00	29·90	2·01	9·28	2·57	3·62
			B_2(g)	48·04	10·65	27·80	2·35	11·93	2·93	4·07
			B_2(g)	49·58	11·40	27·95	2·39	11·62	3·01	3·86
			B_3(g)	51·40	11·25	26·25	2·61	12·21	3·31	3·69
			C(g)	51·58	11·25	24·10	2·79	12·26	3·62	3·39
			C(g)	51·48	10·85	26·00	2·65	12·60	3·36	3·75

TABLE 10—*continued*

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
Kippen	Kippen	41	S	50·56	11·75	26·05	2·56	11·40	3·31	3·43
			B_2(g)	52·90	10·50	24·90	2·84	13·35	3·61	3·70
			B_2(g)	53·54	10·70	25·90	2·78	13·30	3·52	3·79
			C(g)	53·48	10·70	24·50	2·91	13·30	3·72	3·59
			C(g)	53·26	10·90	23·50	2·98	13·10	3·86	3·38
			C(g)	52·86	9·50	24·15	2·99	14·71	3·75	3·94
Sourhope	Bellshill	60	S	52·66	10·60	30·10	2·42	13·10	2·98	4·51
			S	52·62	8·85	30·30	2·48	15·90	2·95	5·40
			B_2(g)	54·02	9·10	30·60	2·52	15·80	3·00	5·26
			B_2(g)	51·88	9·90	32·20	2·28	13·90	2·74	5·10
			C(g)	52·06	10·45	29·95	2·42	13·30	2·95	4·56
			D	53·34	8·85	30·40	2·52	16·15	2·98	5·42
Rowanhill	Caprington	65	S	46·70	10·80	30.40	2·12	11·41	2·61	4·38
			A_2(g)	46·96	12·95	30·70	2·05	9·56	2·61	3·68
			B_2(g)	46·28	14·40	32·30	1·90	8·59	2·46	3·52
			C(g)	52·98	9·80	28·20	2·62	14·50	3·20	4·53
			C(g)	51·98	9·75	30·70	2·39	14·20	2·88	4·94

TABLE 11. PODZOLS, 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
Balrownie	Aldbar	23	S	45·08	12·55	28·00	2·12	9·49	2·73	3·48
			S	44·44	15·15	28·50	1·97	7·78	3·64	2·95
			B_3	43·18	15·55	30·60	1·81	7·40	2·39	3·09
			B_3	43·72	14·85	28·50	1·95	7·82	2·60	3·01
			C	42·64	14·85	29·70	1·85	7·62	2·44	3·13
Foudland	Foudland	11	A_1	39·06	16·85	28·15	1·71	6·20	2·36	2·63
			B_2	32·62	21·90	29·25	1·28	3·98	1·88	2·11
			C	33·42	17·95	32·65	1·29	4·96	1·74	2·86
Strichen	Strichen	1	A_2	51·04	9·90	24·90	2·78	13·71	3·49	3·94
			B_2	28·02	24·00	27·30	0·91	3·12	1·28	2·44
			B_2/B_3	34·30	14·65	39·80	1·19	6·23	1·47	4·24
			B_3	38·98	14·60	32·60	1·58	7·16	2·04	3·52
			B_3	38·16	14·80	40·00	1·31	6·84	1·62	4·22
			C	38·68	15·20	38·30	1·38	6·79	1·73	3·93

TABLE 12. PODZOL, IMPERFECTLY 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
Strichen	Obney	6	A_1	49·90	10·00	28·95	2·40	13·20	2·93	4·52
			A_1	45·22	13·65	28·05	2·09	8·87	2·73	3·25
			B_2(g)	39·30	15·65	28·40	1·73	6·68	2·35	2·84
			B_3(g)	40·88	13·90	30·30	1·78	7·84	2·30	3·42
			C(g)	46·22	9·80	29·30	2·21	12·60	2·68	4·71

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
Balrownie	Lour	27	A_2g	54·20	5·60	29·65	2·78	25·80	3·11	8·32
			B_2g	48·48	15·05	27·35	2·24	8·60	3·20	2·68
			Cg	48·82	12·00	26·35	2·45	10·90	3·16	3·44
			Cg	49·98	12·45	24·25	2·64	10·70	3·50	3·06
			Cg	51·50	12·10	26·50	2·56	11·30	3·30	3·42
Sourhope	Atton	61	S	51·60	12·05	24·95	2·68	11·45	3·51	3·27
			B_2g	51·70	14·15	25·90	2·51	9·66	3·39	2·85
			B_2g	52·10	14·10	23·70	2·70	9·85	3·72	2·65
			B_3g	53·44	12·90	20·90	3·11	10·98	4·34	2·53
			Cg	53·14	14·45	20·00	3·09	9·82	4·51	2·18
			Cg	53·60	12·15	20·00	3·28	11·74	4·55	2·58
			Cg	53·86	12·15	21·40	3·13	11·79	4·27	2·76

APPENDIX V

Mineralogical Data

TABLE 14. PERCENTAGE OF MINERAL GROUPS AND MINERAL FREQUENCIES IN THE FINE SAND FRACTION (75–150μ)

Analysis of Light Fraction (S.G. < 2·95) — Analysis of Heavy Fraction (S.G. > 2·95)

Association	Series	Profile No.	Horizon	Weight % Light	Quartz	Plagioclase	Potash Feldspars	Micas	Apatite	Augite	Biotite	Epidote	Garnet	Hornblende	Hypersthene	Iron Oxides	Muscovite	Rutile	Sphene	Staurolite	Tourmaline	Zircon	Rock Particles	Weathered Material
Strichen	Fungarth	5	A	91·2					—	0	0	4	8	6	*	5	1	1	—	—	0	2	1	0
			C	92·5	10	1	1	2	2	0	3	4	7	6	—	6	3	0	—	—	0	1	3	2
	Strichen	3	A	86·3					—	0	1	3	8	5	—	5	1	1	—	0	2	2	1	1
			C	91·0	10	1	*	1	1	0	1	3	8	6	—	6	0	0	—	0	1	1	3	3
	Anniegathel	9	B_2g	98·5					2	1	1	3	7	5	—	5	0	*	—	—	1	3	5	5
			Cg	91·9	9	4	4	1	2	1	2	4	8	6	—	5	2	1	0	—	*	3	3	3
	Obney	6	A	91·6					—	0	2	4	8	6	—	5	2	1	—	—	2	2	2	2
			C(g)	92·7	10	2	1	2	2	0	1	3	8	6	—	5	1	0	—	*	0	2	2	3
Balrownie	Balrownie	19	S	—																				
			C(g)	94·6	10	2	1	2	2	5	2	3	6	6	—	7	0	1	—	—	2	2	4	3
		18	S	91·2					1	2	0	4	7	6	—	6	*	1	—	*	0	2	2	1
			C(g)	92·4	10	*	*	1	1	0	2	4	7	6	—	6	2	0	—	*	1	1	3	2
	Aldbar	23	S	92·0					0	4	—	3	7	5	—	7	*	1	—	—	0	1	1	2
			C	95·2	9	1	2	5	2	5	2	2	6	5	—	7	0	*	—	—	1	1	4	3
		24	S	94·6					*	5	*	3	6	4	0	7	—	*	—	—	0	2	3	1
			C	96·3	10	3	2	2	1	5	1	2	5	5	0	7	0	0	—	—	0	0	4	4
	Lour	27	A_2g	93·8					—	4	1	1	6	3	0	7	0	0	—	—	2	1	3	4
			Cg	83·5	10	1	5	—	1	2	*	2	7	2	—	8	*	*	—	—	0	2	2	2

TABLE 14—*continued*

Association	Series	Profile No.	Horizon	Weight % Light	Quartz	Plagioclase	Potash Feldspars	Micas	Apatite	Augite	Biotite	Epidote	Garnet	Hornblende	Hypersthene	Iron Oxides	Muscovite	Rutile	Sphene	Staurolite	Tourmaline	Zircon	Rock Particles	Weathered Material
Forfar	Vinny	31	S	87·2					1	2	—	4	8	5	—	0	—	0	—	—	—	2	2	—
			C	90·9	10	1	2	—	1	1	0	2	6	4	—	8	—	1	—	—	0	2	3	3
	Forfar	34	S	83·2					0	2	*	0	6	3	0	8	—	1	—	—	0	4	0	0
			C(g)	98·6	10	1	2	—	0	3	0	2	6	4	*	8	—	0	—	—	2	3	3	4
	Vigean	35	S	90·9					*	3	*	3	7	5	—	7	—	*	—	—	1	2	1	1
			Cg	87·6	9	2	4	2	2	2	0	3	6	6	0	7	0	1	—	*	0	2	3	2
Mountboy	Garvock	45	S	93·3					0	5	1	3	6	5	—	7	0	0	—	—	1	0	3	3
			C	92·4	10	3	3	1	0	6	*	1	6	4	—	7	*	0	—	0	0	1	3	3
		44	S	97·1					0	6	0	3	6	6	1	7	0	*	—	—	1	1	4	2
			C	96·5	9	6	1	2	0	4	0	3	6	5	1	8	0	0	—	—	0	2	4	4
Darleith	Darleith	48	S	97·1					0	5	—	3	6	5	—	8	—	0	—	—	1	*	4	3
			C	96·5	9	5	4	—	1	4	*	1	6	6	—	7	—	1	—	—	0	1	3	4
Sourhope	Sourhope	55	S	96·5					1	5	0	3	6	5	1	7	0	0	—	—	0	1	3	2
			C	97·8	9	6	4	1	*	4	—	1	6	4	1	8	—	0	—	—	0	2	3	1
	Bellshill	60	S						1	4	0	3	6	5	1	7	*	0	—	—	0	2	3	2
			C(g)	99·3	6	9	*	—	0	3	—	1	5	3	0	9	—	*	—	—	—	0	4	1
	Atton	61	S	98·1					0	6	0	1	6	5	0	7	*	0	—	—	0	0	3	4
			Cg	96·4	9	2	4	2	1	5	*	2	6	4	0	7	0	0	—	—	1	1	2	2
	Atton	62	Bg	94·5					0	6	*	1	6	4	2	7	—	0	—	—	0	2	2	3
			Cg	95·8	10	1	1	3	0	6	0	1	7	4	2	7	—	1	—	—	0	2	2	3
Rowanhill	Caprington	65	S	97·8					—	5	—	1	4	3	1	8	—	0	—	—	0	1	4	5
			C(g)	98·9	10	*	*	—	1	4	1	2	6	4	0	8	—	1	—	—	2	2	2	3

Footnote: Frequency scale used for analysis of light and heavy minerals:
10=90–100%, 9=70–90%, 8=50–70%, 7=30–50%, 6=15–30%, 5=7–15%, 4=4–7%, 3=2–4%, 2=1–2%, 1=½–1%, *=½%, 0=absent.

TABLE 15. PERCENTAGE OF MINERALS IN THE CLAY FRACTION (<1·4μ)

Association	Series	Profile	Horizon	Illite	Kaolin	Chlorite	Vermiculite	Montmorillonite	Iron Oxides	Gibbsite
Darleith	Darleith	Laws	S	—	++	+	+++	—	+	—
			B_2	+	++	++	+	—	+	—
			C	+	++	+++	—	—	+	—
Sourhope	Sourhope	Foodie Farm	S	+++	++	+	—	—	—	—
			B_2	++	++	+	—	—	—	—
			C	+	++	+	—	+++	+	—
	Bellshill	Foodie Farm	S	—	+++	+	—	++	—	—
			B_2(g)	+	++	+	—	+++	—	—
			C	++	+	—	—	+++	—	—
	Atton	Foodie Farm	S	+++	++	+	—	—	—	—
			B_2g	+++	+	—	—	++	—	—
			Cg	++	—	+	—	+++	—	—
Balrownie	Balrownie	Stewart Tower	S	+++	++	+	—	—	+	+
			B_2(g)	+++	++	+	—	—	+	+
			C(g)	+++	++	+	—	—	+	—
	Aldbar	Balcalk Farm	S	++	+++	+	+	—	+	—
			B_2	++	++	+	+	—	+	+
			C	++	+	+++	+	—	+	—
	Lour	Westmuir	A_2g	+++	++	+	—	—	—	—
			B_2g	+++	+	+	—	—	+	+

+++ Dominant ++ Frequent + Present — not detected

APPENDIX VI

Plant Lists

In Tables 16–30, stands of vegetation are grouped according to communities and facies.

The figures enclosed in square brackets—[00]—indicate that two or more species share the same cover value. Isolated species outside the sample plot but still considered as constituents of the facies or community are indicated by the symbol—(X)—. Figures with an asterisk indicate species which occur on twigs, tree trunks or boulders within the quadrats.

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. In some instances a species can occur in the ground layer of one stand and as an epiphyte in another, and in this case it is included both in the ground layer figures and in the epiphyte total.

The presence of individual species in each community and facies, compiled from all the quadrat information so far collected, is shown as a percentage of the number of stands and noted as a value of K. Values over 79 per cent are in heavier type and underlined to indicate the constant species (Class V). The Constancy Class IV species (i.e. present in 60–79 per cent of the stands) are indicated by the heavier type only.

The following abbreviations have been used for the sub-groups and variants of the major soil groups:

BCS	Brown Calcareous Soils
BFS	Brown Forest Soils of medium to high base status
BP	Brown Forest Soils of low base status
GBS	Brown Forest Soils of moderate to high base status with gleyed B and C horizons
GBP	Brown Forest Soils of low base status with gleyed B and C horizons
IP	Freely-drained Iron Podzols
GP	Imperfectly-drained Podzols
BG	Non-calcareous Gleys of moderate to high base status
AG	Non-calcareous Gleys of low base status
HG	Peaty Gleys of moderate to high base status (Humic Gleys)
PG	Peaty Gleys of low base status
RM	Raised Moss

Abbreviations used for soil series are explained in the Soil Map Key.

Those for drainage categories of the soils are as follows:

P	Freely drained
PPH	Imperfectly drained
PH	Poorly drained
HP	Very poorly drained

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

TABLE 16. WOODLAND WITH CIRRIPHYLLUM PILIFERUM, EURHYNCHIUM STRIATUM AND E. PRAELONGUM

		Geum urbanum facies						Mercurialis perennis facies					
Reference no.		62102	62140	63126	63130	63147	K—Presence within the facies	62117	63114	63132	63145	K—Presence within the facies	K—Presence within the community
Map reference		NO 131 336	NO 217 199	NO 344 226	NO 311 226	NO 270 313		NO 416 146	NO 569 138	NO 575 142	NO 275 309		
Altitude	ft.	230	25	550	25	350		75	100	075	35		
Aspect		N	NIL	W	NW	W		E	N	NIL	W		
Slope		6°	0°	8°	9°	1°		5°	23°	0°	6°		
Cover—trees, shrubs and climbers	%	70	90	85	75	70		90	85	90	50		
—field	%	75	70	60	90	65		80	95	85	80		
—ground	%	40	85	<1	30	75		70	30	65	60		
Height—trees, shrubs and climbers	ft.	60–70	60	60	10–80	30		60	40	45	50		
—field	ins.	4–40	25	17	15–27	6		13–14	16	15	14		
Plot Area	sq. m.	2	1	4	4	4		1	4	1	4		
Soil Sub-group		BP	BG	BFS	GBS	BCS		BFS	GBS	BFS	BP		
Soil Series		DF	SG	GA	CJ	DL		AL	CP	AL	DL		
Drainage		P	PH	P	PPH	P		P	PPH	P	P		
pH		5·0	5·4	5·2	5·2	7·6		5·6	6·0	5·0	4·9		
Acer platanoides		—	—	—	—	—	0	6	—	—	—	8	3
A. pseudoplatanus		—	5	—	7	1	67	7	—	6	8	54	58
Aesculus hippocastanum		—	—	—	1	—	7	—	—	—	—	0	3
Alnus glutinosa		—	—	—	—	—	13	—	—	—	—	8	13
Betula pendula		—	—	—	—	—	7	—	—	—	—	8	6
B. pubescens		—	—	—	—	—	27	—	—	—	—	31	29
Chamaecyparis lawsoniana		—	—	—	—	—	7	—	—	—	—	0	3
Fagus sylvatica		5	—	—	—	—	7	—	—	8	—	8	6
Fraxinus excelsior		—	3	4	6	8	73	—	4	—	—	54	68
Ilex aquifolium		—	—	—	1	—	13	—	—	1	—	8	10
Larix decidua		1	—	—	—	—	13	—	—	—	—	0	6
Picea abies		—	—	—	—	—	0	—	—	—	—	15	6
Pinusnigra		—	—	—	—	—	7	—	—	—	—	0	3
P. sylvestris		4	—	—	—	—	20	—	—	—	—	15	16
Pinus sp.		—	—	—	—	—	0	—	—	—	—	8	3
Populus nigra var. italica		—	—	—	—	—	0	X	—	—	—	8	3
Prunus avium		—	—	—	—	—	7	—	—	—	—	0	3
Pseudotsuga menziesii		—	—	—	—	—	0	—	—	—	—	8	3

Quercus petraea	—	—	—	—	—	7	—	—	—	—	8	10
Q. petraea/robur	—	5	—	1	—	27	—	—	—	—	0	16
Q. robur	8	—	—	—	—	13	—	—	—	—	31	19
Sequoia sp.	—	—	—	—	—	7	—	—	—	—	0	3
Sorbus aucuparia	—	—	—	—	—	7	—	—	—	—	0	3
Taxus baccata	—	—	—	—	—	7	—	—	—	—	8	6
Tilia x europaea	—	—	—	—	—	7	—	—	—	—	0	3
Ulmus glabra	—	8	8	6	—	53	—	9	3	—	38	48
Corylus avellana	—	—	—	—	—	13	—	—	—	—	38	32
Crataegus monogyna	—	—	—	—	—	7	—	—	—	—	8	6
Prunus spinosa	—	—	—	—	—	0	—	—	—	—	8	3
Salix caprea	—	—	—	—	—	7	—	—	—	—	0	3
Sambucus nigra	—	—	—	—	1	27	—	—	—	X	23	22
Syringa sp.	—	—	—	—	—	7	—	—	—	—	0	3
Lonicera periclymenum	—	—	—	—	—	7	—	—	—	—	0	3
Acer platanoides seedlings	—	—	—	—	—	0	2	—	—	—	8	3
A. pseudoplatanus seedlings	—	—	—	—	—	27	—	—	X	—	31	26
Corylus avellana seedlings	—	—	—	—	—	7	—	—	—	—	0	3
Crataegus monogyna seedlings	—	—	—	—	—	7	—	—	—	—	8	6
Fagus sylvatica seedlings	X	—	—	—	—	20	—	—	—	—	0	10
Fraxinus excelsior seedlings	(X)	—	2	(X)	2	**67**	—	—	X	1	38	48
Hedera helix	—	—	—	5	—	7	—	—	2	—	8	6
Ilex aquifolium seedlings	—	—	—	—	—	7	—	—	—	—	0	3
Lonicera periclymenum	5	—	—	(X)	—	27	—	—	—	—	0	13
Prunus spinosa seedlings	—	—	—	—	—	0	—	—	—	—	8	3
Rhododendron ponticum	(X)	—	—	—	—	7	—	—	—	—	0	3
Rubus fruticosus agg.	(X)	3	(X)	4	—	47	—	—	—	—	0	26
R. idaeus	5	—	—	—	—	7	(X)	—	—	—	31	16
Taxus baccata seedlings	—	—	(X)	—	—	7	—	—	—	—	0	3
Ulmus glabra seedlings	—	(X)	X	—	—	27	—	—	—	—	0	16
Athyrium filix-femina	(X)	3	—	—	—	27	—	—	—	—	23	32
Blechum spicant	—	—	—	—	—	7	—	—	—	—	0	6
Dryopteris borreri	—	—	—	(X)	—	7	—	—	—	—	8	10
D. carthusiana	—	—	—	—	—	7	—	—	—	—	0	3
D. dilatata	1	(X)	—	4	—	40	(X)	(X)	X	—	46	42
D. filix-mas	6	—	—	—	—	33	—	—	—	(X)	**62**	52
Pteridium aquilinum	—	—	—	—	—	13	—	—	—	—	15	13
Agrostis canina	—	(X)	—	—	—	7	—	—	—	—	0	3
A. tenius	—	—	—	—	—	13	—	—	—	—	0	6

TABLE 16—*continued*

	62102	62140	63126	63130	63147		62117	63114	63132	63145		
Agrostis sp.	—	—	—	—	—	7	—	—	—	—	0	3
Dactylis glomerata	—	—	—	—	—	13	—	—	—	—	0	6
Deschampsia cespitosa	1	(X)	—	—	—	13	—	—	—	—	0	6
Festuca gigantea	—	—	—	—	—	0	—	—	—	—	8	3
Poa pratensis	(X)	—	—	—	—	7	—	—	—	—	0	3
P. trivialis	—	X	2	—	4	53	—	(X)	—	—	8	29
Carex sp.	—	—	—	—	—	0	—	—	—	—	8	3
Luzula sylvatica	—	—	—	—	—	7	—	—	—	—	0	3
Adoxa moschatellina	—	—	—	—	—	7	—	—	—	—	0	3
Aegopodium podograria	—	—	—	—	—	7	—	—	—	—	0	3
Ajuga reptans	—	—	—	—	—	7	—	—	—	—	15	10
Allium ursinum	—	—	—	—	—	7	—	—	—	—	8	16
Anemone nemorosa	—	—	—	—	—	27	—	—	—	—	31	35
Angelica sylvestris	—	—	X	—	—	13	—	—	—	—	0	6
Cardamine sp.	—	—	—	—	—	0	3	—	—	—	8	3
Chamaenerion angustifolium	—	—	—	—	—	0	—	—	—	(X)	15	6
Chrysosplenium oppositifolium	—	—	—	—	—	7	—	—	—	—	8	6
Circaea lutetiana	5	—	—	7	—	40	—	—	—	—	8	29
Endymion non-scriptus	—	—	—	—	—	20	—	(X)	(X)	—	23	26
Epilobium montanum	—	1	X	—	X	20	(X)	—	—	4	23	19
E. obscurum	—	—	—	—	(X)	7	—	—	—	—	0	3
E. parviflorum	—	—	—	—	—	7	—	—	—	—	8	6
Epilobium sp.	—	—	—	—	—	13	—	—	—	—	8	10
Filipendula ulmaria	—	—	—	—	—	7	—	—	—	—	8	6
Fragaria vesca	3	—	2	—	3	33	—	—	—	—	15	23
Galium aparine	—	—	X	—	1	**60**	—	—	—	—	23	42
G. odoratum	—	—	—	7	—	20	—	—	—	—	0	10
Geranium robertianum	—	—	4	—	—	40	—	—	—	—	8	23
Geum urbanum	1	8	5	—	5	**87**	(X)	—	—	—	38	58
Glechoma hederacea	—	—	—	—	1	27	—	—	—	—	8	16
Lysimachia nemorum	—	—	—	—	—	13	—	—	—	—	15	13
Mercurialis perennis	—	—	—	—	—	13	9	9	8	9	**100**	55
Moehringia trinervia	—	—	—	3	—	7	—	—	—	1	23	13
Myosotis arvensis	—	—	—	—	(X)	13	—	—	—	—	0	6
Oxalis acetosella	6	—	—	—	—	47	—	—	—	—	15	35
Paris quadrifolia	—	—	—	—	—	7	—	—	—	—	0	3
Potentilla sterilis	—	—	—	—	—	7	—	—	—	—	8	6

Primula vulgaris	—	—	—	—	—	0	—	—	—	—	0	3
Ranunculus ficaria	—	—	—	—	—	7	—	—	—	—	8	6
R. repens	—	—	(X)	—	8	20	—	—	—	—	15	16
Rumex sanguineus	—	—	—	—	X	7	—	—	—	—	0	3
Sanicula europaea	—	—	7	—	—	20	—	—	—	—	0	10
Scrophularia nodosa	—	—	—	—	—	0	—	—	—	—	8	3
Silene dioica	—	—	—	—	—	20	—	3	7	—	15	16
Stachys sylvatica	—	—	—	—	—	13	—	—	—	—	0	6
Stellaria holostea	—	—	—	—	—	7	—	—	—	—	0	3
S. media	—	—	—	—	X	7	—	—	—	X	8	6
S. nemorum	—	—	—	—	—	7	—	—	—	—	0	3
Urtica dioica	—	—	(X)	4	(X)	47	1	—	—	—	46	45
Valeriana officinalis	—	—	—	—	—	0	—	—	—	—	0	3
Veronica chamaedrys	2	—	—	—	1	40	—	—	—	—	0	19
V. montana	—	—	—	—	—	27	—	—	—	—	0	13
V. serpyllifolia	—	—	—	—	(X)	7	—	—	—	—	0	3
Viola odorata	—	—	—	—	—	7	—	—	—	—	0	3
V. riviniana	4	—	4	—	—	47	—	—	—	—	15	32
Amblystegium serpens	—	—	—	—	—	0	—	1	—	—	8	3
Atrichum undulatum	1	—	—	2	—	33	—	—	—	1	31	29
Brachythecium plumosum	—	—	—	—	—	0	—	—	—	—	0	3
B. populeum	—	—	—	—	—	0	—	—	—	2	8	3
B. rutabulum	(X)	5	—	2	—	53	—	—	—	—	31	45
B. velutinum	—	—	1	—	—	7	—	—	—	—	0	3
Cirriphyllum piliferum	—	X	X	—	4	**80**	4	(X)	(X)	4	**85**	**81**
Ctenidium molluscum	—	—	—	—	—	0	—	—	—	—	0	3
Eurhynchium confertum	—	—	—	—	—	0	—	1	—	—	8	3
E. praelongum	4	3	X	5	7	**100**	7	6	6	3	**100**	**100**
E. striatum	5	X	(X)	4	2	**87**	5	—	X	7	**69**	**81**
E. swartzii	—	—	—	—	—	13	X	—	5	—	23	16
Fissidens bryoides	—	—	—	—	—	13	—	(X)	—	—	8	10
F. taxifolius	(X)	4	—	—	—	13	1	—	—	—	23	19
Fissidens spp.	—	—	—	—	—	0	—	—	—	—	8	6
Heterocladium heteropterum	—	—	—	—	—	0	—	—	—	—	0	3
Hypnum cupressiforme	—	—	—	—	—	13	—	—	—	—	15*	13
Isothecium myosuroides	—	—	—	—	—	0	—	—	—	1	23	10
Mnium hornum	—	—	—	4	—	7	—	—	4	—	15	16
M. punctatum	—	—	—	—	—	7	—	1	—	—	15	13
M. undulatum	—	9	—	1	4	**67**	4	X	6	(X)	**85**	**71**
Mnium sp.	X	—	—	—	—	7	—	—	—	—	0	3

TABLE 16—*continued*

	62102	62140	63126	63130	63147		62117	63114	63132	63145		
Omalia trichomanoides	—	—	—	—	—	7	—	—	—	—	0	6
Orthotrichum affine	—	—	—	—	—	7*	—	—	—	—	0	3*
Plagiothecium denticulatum	—	—	—	—	—	7	—	—	—	1	8	13
P. sylvaticum	—	—	—	—	—	0	—	2	—	—	8	3
Polytrichum aurantiacum	X	—	—	—	—	7	—	—	—	—	0	3
Pseudoscleropodium purum	—	—	—	—	—	7	—	—	—	—	0	3
Rhodobryum roseum	—	—	—	—	—	7	—	—	—	—	0	3
Rhytidiadelphus loreus	1	—	—	—	—	7	—	—	—	—	0	3
R. squarrosus	—	—	—	—	—	7	—	—	—	—	0	3
R. triquetrus	5	—	—	—	—	20	—	—	—	—	8	13
Thamnium alopecurum	—	—	—	—	—	7	—	—	—	—	0	6
Thuidium tamariscinum	4	—	—	—	5	20	1	—	—	X	54	52
Chiloscyphus polyanthos	—	—	—	—	—	7	—	—	—	—	0	3
Lophocolea bidentata	—	—	—	—	—	13	—	—	—	—	15	13
L. cuspidata	—	—	—	—	—	13	—	—	—	—	15	19
L. heterophylla	—	—	—	—	—	7	1	—	1	2	31	16
Metzgeria furcata	—	—	—	—	—	0	—	—	—	—	8*	3*
Pellia epiphylla	—	—	—	—	—	0	—	—	—	—	0	3
Plagiochila asplenioides	—	—	—	—	—	13	2	—	—	—	38	26
Radula complanata	—	—	—	—	—	0	—	—	—	—	8*	3*
Cetraria glauca	—	—	—	—	—	0	—	—	—	—	8*	3*
Evernia prunastri	—	—	—	—	—	7*	—	—	—	—	0	3*
Parmelia physodes	1*	—	2*	—	—	20*	—	—	—	—	15*	19*
P. sulcata	—	—	—	—	—	7*	—	—	—	—	0	3*
Number of species:												
trees, shrubs and climbers	4	4	2	6	3	27	3	2	4	2	21	33
field and ground	27	15	19	16	20	99	17	13	14	17	68	118
epiphytes	1	—	1	—	—	4	—	—	—	—	5	8
Average—total species	—	—	—	—	—	24	—	—	—	—	19	22
—field and ground	—	—	—	—	—	20	—	—	—	—	16	18
Number of stands	—	—	—	—	—	15	—	—	—	—	13	31

TABLE 17 WOODLAND WITH HOLCUS MOLLIS AND DRYOPTERIS DILATATA — WOODLAND WITH DRYOPTERIS AND RUBUS

		Endymion non-scriptus facies		General facies						Viola riviniana facies			Mnium hornum facies		
			K—Presence within the facies					K—Presence within the facies	K—Presence within the community			K—Presence within the facies		K—Presence within the facies	K—Presence within the community
Reference no.		62119		62115	62125	63105	63113			63107	63144		63106		
Map reference		NO		NO	NO	NO	NO			NO	NO		NO		
		424		458	066	428	477			416	555		425		
		161		152	417	248	261			247	379		248		
Altitude	ft.	175		310	575	70	25			130	275		70		
Aspect		NW		E	NW	NIL	SW			W	W		SE		
Slope		23°		3°	16°	0°	1°			4°	1°		2°		
Cover															
trees, shrubs and climbers	%	35		80	65	60	60			60	50		40		
field	%	90		60	60	85	90			95	98		100		
ground	%	1		15	90	10	25			6	1		30		
Height															
trees, shrubs and climbers	ft.	70		40	55	70	45			40	60		55		
field	ins.	15		3–30	10–14	36	30			30	25		36		
Plot Area	sq. m.	1		2	1	4	4			4	4		4		
Soil Sub-group		BP		GBP	BP	GBP	GBP			BP	GBP		BP		
Soil Series		GI		WN	FU	KB	LN				BL				
Drainage		P		PPH	P	PPH	PPH			P	PPH		P		
pH		3·7		4·1	4·0	4·1	4·0			3·8	4·6		3·7		
Acer pseudoplatanus		—	29	—	—	4	—	33	23	2	1	50	2	50	50
Alnus incana		—	0	—	—	—	—	0	0	—	—	0	—	17	6
Araucaria araucaria		—	14	—	—	—	—	0	4	—	—	0	—	0	0
Betula pendula		—	0	—	—	—	—	0	0	—	—	10	—	0	6
B. pendula/pubescens		—	0	—	—	—	—	0	8	—	—	0	—	0	0
B. pubescens		—	29	7	—	3	—	33	35	—	—	30	—	33	31
Castanea sativa		—	0	—	—	—	—	0	0	—	—	10	—	0	6
Fagus sylvatica		—	14	—	—	X	—	8	8	—	1	10	—	17	13
Fraxinus excelsior		—	0	—	—	—	—	0	0	—	1	40	—	17	31
Ilex aquifolium		—	0	—	—	—	—	0	0	—	—	0	—	17	6
Larix decidua		—	29	—	8	—	—	33	23	—	2	40	—	0	25
Larix sp.		—	0	—	—	—	—	0	0	—	—	10	—	0	6
Picea abies		—	0	—	—	—	—	8	4	—	—	10	—	33	19

TABLE 17—*continued*

	62119		62115	62125	63105	63113			63107	63144		63106		
P. sitchensis	—	0	—	—	—	—	8	4	—	—	10	—	0	6
Pinus sylvestris	—	14	7	—	5	8	58	38	8	7	**60**	7	**83**	**69**
Pseudotsuga menziesii	—	0	—	—	—	—	8	4	—	—	0	—	0	0
Quercus cerris	—	14	—	—	—	—	0	4	—	—	0	—	0	0
Q. petraea	—	0	—	—	—	—	0	8	—	—	0	—	0	0
Q. petraea/robur	6	43	—	—	—	—	8	23	—	—	0	—	17	6
Q. robur	—	43	—	—	—	—	8	19	—	—	0	—	0	0
Quercus sp.	—	0	—	—	6	—	8	4	—	—	0	—	0	0
Sorbus aucuparia	—	0	—	—	—	—	8	12	—	—	0	2	50	19
Ulmus glabra	—	14	—	—	—	—	0	4	—	—	10	—	17	13
Crataegus monogyna	—	0	—	—	X	—	8	4	—	—	0	—	0	0
Rosa sp.	—	0	—	—	—	—	0	0	—	1	10	—	0	6
Salix caprea	—	0	—	—	—	—	0	0	—	—	10	—	0	6
S. cinerea ssp. atrocinerea	—	0	—	—	—	—	0	0	—	—	10	—	17	13
Sambucus nigra	—	0	—	—	—	—	0	0	—	—	30	2	33	31
Sarothamnus scoparius	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Lonicera periclymenum	—	0	—	—	—	—	0	12	—	—	10	—	0	6
Acer pseudoplatanus seedlings	—	29	—	—	4	(X)	33	23	X	1	70	—	33	56
Betula pendula seedlings	—	14	—	—	—	—	0	4	—	—	0	—	0	0
B. pubescens seedlings	—	14	—	—	—	(X)	8	8	—	—	0	—	33	13
Corylus avellana seedlings	—	0	—	—	—	—	0	4	—	—	0	—	0	0
Crataegus monogyna seedlings	—	0	—	—	—	—	0	4	—	—	0	—	33	13
Fagus sylvatica seedlings	—	0	—	—	—	—	0	0	X	—	20	—	17	19
Fraxinus excelsior seedlings	—	0	—	—	—	—	0	4	—	—	10	—	33	19
Lonicera periclymenum	—	14	—	—	—	—	0	31	—	(X)	40	—	0	25
Quercus cerris seedlings	—	14	—	—	—	—	0	4	—	—	0	—	17	13
Q. petraea/robur seedlings	—	0	—	—	—	—	0	4	—	—	10	—	0	6
Rubus fruticosus agg.	—	29	—	—	4	1	50	50	6	6	**90**	4	**83**	**88**
R. idaeus	—	43	—	—	—	(X)	33	31	(X)	3	**90**	3	**33**	**69**
Sarothamnus scoparius	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Sorbus aucuparia seedlings	—	0	—	—	—	(X)	17	15	—	—	20	—	17	19
Ulmus glabra seedlings	—	0	—	—	—	—	0	0	—	—	0	—	17	6
Vaccinium myrtillus	—	0	—	—	—	—	0	4	—	—	0	—	0	0
Athyrium filix-femina	—	0	—	—	—	X	17	8	—	—	40	—	50	44
Blechnum spicant	—	14	—	—	—	—	0	15	—	—	10	—	0	6

Dryopteris borreri	—	0	—	—	—	—	17	8	—	—	30	—	17	25
D. carthusiana	—	0	—	—	—	—	0	4	—	—	0	—	17	6
D. dilatata	X	43	7	3	8	9	**100**	**81**	8	8	**100**	8	**100**	**100**
D. dilatata x filix-mas	—	0	—	—	—	—	0	0	—	—	10	—	0	6
D. filix-mas	—	14	—	—	—	—	25	23	—	1	**60**	—	33	50
Pteridium aquilinum	(X)	**71**	—	—	—	—	25	46	(X)	—	30	—	33	31
Agrostis canina	—	0	X	—	—	—	25	19	—	—	10	—	0	6
A. stolonifera	—	0	—	—	—	—	0	4	—	—	0	—	0	0
A. tenuis	—	29	X	(X)	—	2	42	31	—	(X)	40	—	0	25
Anthoxanthum odoratum	—	0	—	—	—	—	8	15	—	—	0	—	0	0
Arrhenatherum elatius	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Deschampsia cespitosa	—	0	X	—	—	—	17	8	—	—	20	—	0	13
D. flexuosa	—	14	—	(X)	—	—	25	38	—	—	0	—	0	0
Holcus lanatus	—	0	—	—	—	—	0	4	—	—	20	—	0	13
H. mollis	9	**100**	1	8	6	4	**83**	**92**	4	—	10	—	0	6
Poa annua	—	0	—	—	—	—	0	0	—	—	0	—	33	13
P. trivialis	—	14	(X)	—	—	—	8	8	—	X	40	1	50	44
Carex binervis	—	0	—	—	—	—	0	0	—	—	0	—	17	6
C. pilulifera	—	0	—	—	—	—	8	8	—	—	10	—	17	13
Juncus conglomeratus	—	0	—	—	—	—	0	0	—	—	20	—	0	13
J. effusus	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Luzula multiflora	—	14	—	—	—	—	0	4	—	—	10	—	0	6
L. pilosa	—	14	—	—	—	—	8	15	—	—	0	—	17	6
L. sylvatica	—	14	—	—	—	—	0	12	—	—	0	—	0	0
Ajuga reptans	—	0	—	—	—	—	0	12	—	—	0	—	0	0
Anemone nemorosa	—	0	—	—	—	—	0	15	—	—	0	—	17	6
Angelica sylvestris	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Cerastium holosteoides	—	0	—	—	—	—	0	0	—	—	0	—	17	6
Chamaenerion angustifolium	(X)	29	—	—	—	—	8	12	X	2	**80**	1	**83**	**81**
Conopodium majus	—	0	—	—	—	—	0	0	—	—	0	—	17	6
Corydalis claviculata	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Digitalis purpurea	(X)	29	—	—	—	—	17	15	—	—	20	(X)	17	19
Endymion non-scriptus	3	**100**	—	—	—	—	8	35	—	—	10	—	17	13
Epilobium parviflorum	—	0	—	—	—	—	0	0	—	—	0	—	17	6
Epilobium sp.	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Fragaria vesca	—	0	—	—	—	—	0	4	—	—	0	—	0	0
Galium aparine	—	0	—	—	—	—	0	4	—	—	20	—	33	25
G. saxatile	—	43	1	X	X	X	**67**	**62**	2	—	20	—	0	13
Geum urbanum	—	0	—	—	—	—	0	0	—	—	0	—	17	16

TABLE 17—*continued*

	62119		62115	62125	63105	63113			63107	63144		63106		
Lysimachia nemorum	—	0	—	—	—	—	0	4	—	—	0	—	0	0
Moehringia trinervia	—	14	—	—	2	—	17	12	1	—	20	3	33	25
Myosotis sylvatica	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Oxalis acetosella	6	**100**	5	4	—	—	**83**	**85**	—	—	**60**	—	**67**	**63**
Potentilla erecta	—	0	—	—	—	—	0	8	—	—	20	—	17	19
P. sterilis	—	0	—	—	—	—	0	4	—	—	0	—	17	6
Primula vulgaris	—	0	—	—	—	—	0	4	—	—	0	—	0	0
Rumex acetosa	—	14	—	—	—	—	0	8	—	—	0	—	0	0
R. obtusifolius	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Senecio sylvaticus	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Silene dioica	—	14	—	—	—	—	0	4	—	—	20	—	17	19
Stellaria holostea	—	29	—	—	—	—	0	15	—	—	0	—	0	0
S. media	—	0	—	—	—	X	8	4	—	X	20	—	33	25
Teucrium scorodonia	2	29	—	—	—	—	8	19	—	—	0	—	0	0
Urtica dioica	—	0	—	—	—	—	0	0	—	—	20	—	17	19
Veronica chamaedrys	—	14	—	—	—	—	0	4	—	—	20	—	17	19
V. officinalis	—	0	—	—	—	—	0	8	—	—	0	—	0	0
V. serpyllifolia	—	0	—	—	—	—	0	0	—	—	0	—	17	6
Viola riviniana	—	43	—	4	—	—	17	35	1	1	**80**	—	0	50
Atrichum undulatum	—	0	4	—	—	—	8	4	—	—	20	—	33	25
Brachythecium rutabulum	—	29	—	—	—	—	8	19	—	X	40	2	33	38
Campylopus flexuosus	—	0	—	—	—	—	0	4	—	—	0	—	17	6
Ceratodon purpureus	X	14	—	—	—	—	0	4	—	—	0	—	0	0
Cirriphyllum piliferum	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Dicranella heteromalla	—	0	—	—	—	—	0	0	—	—	0	—	17	6
Dicranella sp.	X	14	—	—	—	—	0	4	—	—	0	—	0	0
Dicranum majus	—	0	—	—	—	—	8	12	—	—	0	—	0	0
D. scoparium	—	0	—	—	—	—	17	12	—	—	0	—	0	0
Eurhynchium praelongum	X	57	3	—	3	4	**83**	**69**	3	2	**90**	5	**100**	**94**
E. striatum	—	0	—	—	—	—	0	0	—	X	10	—	17	13
Fissidens bryoides	—	0	—	—	—	—	0	0	—	—	10	—	0	6
F. taxifolius	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Fissidens sp.	—	0	—	—	—	—	0	0	—	—	10	—	0	6
Hylocomium splendens	—	14	—	5	—	(X)	17	12	—	—	0	—	0	0
Hypnum cupressiforme	X	57	—	—	—	—	25	38	—	—	0	—	**83**	31
Isopterygium elegans	X	14	—	—	—	—	0	4	—	—	0	—	0	0
Isothecium myosuroides	—	0	—	—	—	—	0	0	—	—	0	—	17	6

Isothecium myurum	—	0	—	—	—	—	0	0	—	—	0	—	17	6
Mnium hornum	—	0	2	—	1	—	42	23	—	—	0	(X)	**100**	38
M. longirostrum	—	14	—	—	—	—	0	4	—	—	10	—	0	6
M. undulatum	—	0	—	—	1	—	8	4	X	—	30	—	17	25
Plagiothecium denticulatum	—	0	—	2	—	X	25	15	—	—	10	—	50	25
P. undulatum	—	0	3	—	—	3	50	27	—	—	10	—	50	25
Pleurozium schreberi	—	0	—	—	—	—	0	4	—	—	0	—	0	0
Pohlia nutans	—	0	—	—	—	—	8	8	—	—	0	—	17	6
Polytrichum aurantiacum	—	0	—	—	—	(X)	33	15	—	—	0	—	17	6
P. commune	—	0	—	—	—	—	0	8	—	—	0	—	0	0
P. formosum	—	0	—	—	—	—	0	8	—	—	0	—	0	0
Pseudoscleropodium purum	—	43	1	8	X	5	50	50	3	—	30	3	17	25
Rhytidiadelphus loreus	—	0	—	—	—	—	8	4	—	—	0	—	0	0
R. squarrosus	—	29	—	4	1	—	42	31	2	—	10	—	17	13
R. triquetrus	—	29	—	—	—	—	0	12	—	—	20	—	0	13
Thuidium tamariscinum	—	14	(X)	—	4	—	58	38	—	—	30	—	0	19
Lophocolea bidentata	—	43	2	—	2	4	58	54	4	—	30	4	50	38
L. cuspidata	—	0	—	1	—	—	33	15	—	—	10	—	33	19
L. heterophylla	—	0	—	—	—	—	0	4*	—	X	20	—	33	25
Pellia epiphylla	—	0	—	—	—	—	0	0	—	—	20	—	0	13
Plagiochila asplenioides	—	14	—	—	—	—	0	8	—	—	0	—	0	0
Cetraria glauca	—	0	—	2*	—	—	25*	12*	—	—	10*	—	0	6*
Cladonia cornuta	—	0	—	—	—	—	0	4*	—	—	0	—	0	0
C. fimbriata	—	0	—	—	—	—	0	4	—	—	0	—	0	0
Evernia prunastri	—	29*	—	—	—	—	8*	15*	—	—	0	—	0	0
Parmelia physodes	—	14*	—	2*	—	—	50*	35*	—	—	20*	—	0	13*
P. sulcata	—	29*	—	—	—	—	0	8*	—	—	10*	—	0	6*
Parmelia spp.	—	0	—	—	—	—	0	8*	—	—	0	—	0	0
Usnea hirta	—	0	—	—	—	—	0	0	—	—	10*	—	0	6*
U. subfloridana	—	14*	—	—	—	—	8*	12*	—	—	0	—	0	0
Usnea sp.	—	0	—	X*	—	—	17*	8*	—	—	0	—	0	0
Number of species—														
trees, shrubs and climbers	1	10	2	1	6	1	13	19	2	6	18	4	13	22
field and ground	13	44	15	12	13	18	47	85	16	15	66	12	59	88
epiphytes	—	5	—	3	—	—	6	11	—	—	5	—	1	6
Average—total species	—	15	—	—	—	—	16	17	—	—	21	—	23	22
field and ground	—	13	—	—	—	—	14	15	—	—	17	—	19	18
Number of stands	—	7	—	—	—	—	12	26	—	—	10	—	6	16

TABLE 18

		WOODLAND WITH HOLCUS MOLLIS AND ANTHOXANTHUM ODORATUM									WOODLAND WITH ANTHOXANTHUM ODORATUM AND AGROSTIS TENUIS	
		Festuca rubra facies						Pteridium aquilinum facies				
							K—Presence within the facies		K—Presence within the facies	K—Presence within the community		K—Presence within the community
Reference no.		6289	62103	62110	62128	63146		6290			62131	
Map reference		NO 074 424	NO 161 387	NO 024 142	NO 023 204	NO 271 312		NO 074 424			NO 043 393	
Altitude	ft.	575	150	260	450	400		560			475	
Aspect		NE	NW	NE	SE	W		NE			W	
Slope		12°	5°	18°	7·5°	10°		12°			13°	
Cover—												
trees, shrubs and climbers	%	70	75	45	65	40		40			15	
field	%	75	85	90	75	95		90			85	
ground	%	80	5	40	1	20		30			20	
Height—												
trees, shrubs and climbers	ft.	50	80	60	60–70	50		60			3–4	
field	ins.	6–15	15	15–18	12	10–18		10–20			14–30	
Plot Area	sq. m.	1	2	1	1	4		2			4	
Soil Sub-group		BP	BP	BP	BP	BP		BP			BP	
Soil Series		SY		GE	DL	DL		SY			FU	
Drainage		P	P	P	P	P		P			P	
pH		4·1	4·3	4·7	4·6	4·6		3·9			4·1	
Betula pendula		—	—	—	—	—	0	X	38	19	5	43
B. pendula/pubescens		—	—	—	—	—	0	—	0	0	—	14
B. pubescens		3	—	—	—	—	29	3	69	48	2	43
B. pubescens ssp. odorata		—	—	—	—	—	0	—	8	4	—	14
Castanea sativa		—	—	—	—	—	7	—	0	4	—	0
Fagus sylvatica		—	7	—	—	—	14	—	23	19	—	0
Fraxinus excelsior		—	—	—	—	2	14	—	15	15	—	0
Larix decidua		—	X	—	1	—	29	—	0	15	—	0
L. eurolepis		—	—	—	—	—	0	—	8	4	—	0
Picea abies		—	—	—	—	1	7	—	0	4	—	0
Pinus sylvestris		—	—	—	—	7	7	—	8	7	—	14
Quercus petraea		—	—	—	—	—	14	—	8	11	—	29

Quercus petraea/robur	—	—	—	—	—	14	—	23	19	—	14
Q. robur	8	7	7	8	3	57	7	23	41	—	0
Sorbus aucuparia	—	—	—	—	—	0	—	23	11	—	0
Ulmus glabra	—	—	—	—	—	0	—	8	4	—	0
Corylus avellana	—	—	—	—	—	7	—	31	19	—	14
Crataegus monogyna	—	—	—	—	—	0	—	8	4	—	0
Fagus sylvatica	—	—	—	—	—	0	—	8	4	—	0
Juniperus communis	—	—	—	—	—	14	—	0	7	—	0
Salix caprea	—	—	—	—	—	0	—	8	4	—	0
Sarothamnus scoparius	—	—	(X)	—	—	14	—	0	7	—	0
Ulex europaeus	—	—	—	—	—	7	—	0	4	—	0
Lonicera periclymenum	—	—	—	—	—	0	—	8	4	—	0
Acer platanoides seedlings	(X)	—	—	—	—	7	—	0	4	—	0
A. pseudoplatanus seedlings	—	X	—	—	—	7	—	8	7	—	0
Betula pendula/pubescens seedlings	—	—	—	—	—	0	—	8	4	—	14
B. pubescens seedlings	—	—	—	—	—	0	X	23	11	—	14
Calluna vulgaris var. hirsuta	—	—	—	—	—	0	—	0	0	—	14
Crataegus monogyna seedlings	—	—	—	—	—	7	—	15	11	—	0
Fagus sylvatica seedlings	—	—	—	—	X	21	—	0	11	—	0
Fraxinus excelsior seedlings	X	X	—	X	1	50	—	15	33	—	29
Lonicera periclymenum	—	—	—	—	—	14	—	38	26	—	14
Picea abies seedlings	—	—	—	—	—	0	—	8	4	—	0
Prunas avium seedlings	—	—	—	—	—	7	—	0	4	—	0
Pseudotsuga menziesii seedlings	—	—	—	—	—	7	—	0	4	—	0
Quercus petraea/robur seedlings	—	(X)	—	—	—	21	—	31	26	—	0
Q. robur seedlings	—	—	—	—	—	0	—	0	0	—	14
Rosa sp.	—	—	—	—	—	0	—	0	0	—	14
Rubus fruticosus agg.	—	—	—	—	—	0	(X)	8	4	—	29
R. idaeus	3	—	—	—	(X)	21	—	0	11	3	43
Sorbus aucuparia seedlings	—	—	—	—	—	7	(X)	31	19	—	43
Ulmus glabra seedlings	—	(X)	—	—	—	7	—	0	4	—	0
Vaccinium myrtillus	—	—	—	—	—	7	3	15	11	—	14
V. vitis-idaea	—	—	—	—	—	7	—	0	4	—	0
Athyrium filix-femina	—	—	—	—	—	0	—	8	4	—	0
Blechnum spicant	—	—	—	—	—	7	—	23	15	—	29
Dryopteris borreri	—	—	—	—	—	0	—	15	7	—	0
D. dilatata	—	—	—	—	(X)	14	—	0	7	—	14
D. filix-mas	—	—	—	—	(X)	14	—	15	15	—	14

TABLE 18—*continued*

	6289	62103	62110	62128	63146		6290			62131	
Pteridium aquilinum	—	—	—	—	—	29	3	100	63	5	71
Thelypteris dryopteris	—	—	—	—	—	7	—	0	4	—	0
T. limbosperma	—	—	—	—	—	0	—	8	4	(X)	14
Agrostis canina	—	—	—	—	—	14	4	31	22	6	67
A. canina ssp. montana	—	—	—	—	—	0	—	8	4	—	14
A. tenuis	3	3	5	(X)	6	93	—	46	70	8	86
Anthoxanthum odoratum	5	4	6	5	7	100	3	77	89	X	100
Arrhenatherum elatius	—	—	—	—	—	7	—	0	4	—	14
Dactylis glomerata	—	—	—	—	—	7	—	0	4	—	0
Deschampsia flexuosa	4	—	—	2	—	36	6	77	56	3	100
Festuca ovina	—	—	—	—	—	21	(X)	15	19	—	29
F. rubra	6	4	5	3	3	86	—	0	44	—	0
Holcus lanatus	—	—	—	—	—	14	—	0	7	—	29
H. mollis	4	6	6	7	5	86	5	85	85	—	0
Molinia caerulea	—	—	—	—	—	0	—	8	4	—	0
Poa pratensis	4	2	5	(X)	3	93	—	0	48	—	0
P. trivialis	—	—	—	—	—	7	—	15	11	—	14
Carex flacca	—	—	—	—	—	7	—	0	4	—	0
C. pallescens	—	—	—	—	—	0	—	0	0	—	14
C. pilulifera	—	—	—	—	—	7	—	8	7	X	29
Carex spp.	—	—	—	—	—	7	—	15	11	—	14
Juncus effusus	—	—	—	—	—	0	—	8	4	—	0
Luzula campestris	1	—	—	—	—	21	—	0	4	—	0
L. multiflora	—	—	—	—	—	14	—	31	22	—	43
L. pilosa	—	—	—	—	—	21	—	38	30	X	86
L. sylvatica	—	—	—	—	—	14	—	8	11	—	0
Ajuga reptans	—	—	—	—	—	36	—	8	22	3	29
Anemone nemorosa	3	—	—	—	—	29	—	38	33	—	14
Campanula rotundifolia	—	—	—	—	X	7	—	0	4	1	29
Cardamine flexuosa	—	—	—	—	—	7	—	0	4	—	0
Cerastium holosteoides	1	—	—	—	—	21	—	23	22	—	14
Conopodium majus	—	—	(X)	—	—	14	—	8	11	—	0
Digitalis purpurea	—	—	—	—	—	0	—	15	7	—	0
Endymion non-scriptus	—	—	—	—	—	0	—	0	0	—	14

Fragaria vesca	—	—	—	—	X	7	—	0	4	—	14
Galium aparine	—	1	—	—	—	14	—	0	7	—	0
G. saxatile	5	—	3	1	5	**79**	3	**92**	**85**	1	**86**
Geum rivale	—	—	—	—	—	0	—	0	0	—	14
Goodyera repens	—	—	—	—	—	0	—	0	0	—	14
Hieraceum sp.	—	—	—	—	—	7	—	0	4	—	0
Hypericum pulchrum	—	—	—	—	—	21	—	31	26	(X)	**71**
Hypochoeris radicata	—	—	—	—	—	7	—	0	4	—	0
Lathyrus montanus	—	—	—	—	—	14	—	0	7	—	0
Lysimachia nemorum	—	—	—	—	—	0	—	8	4	—	14
Melampyrum pratense	—	—	—	—	—	14	8	8	11	—	14
Oxalis acetosella	5	6	—	6	6	**79**	4	**92**	**85**	(X)	**100**
Potentilla erecta	X	—	—	—	—	50	—	46	48	—	57
Primula vulgaris	—	—	—	—	—	7	—	0	4	—	14
Prunella vulgaris	—	—	—	—	—	0	—	0	0	—	14
Pyrola minor	—	—	—	—	—	0	(X)	8	4	—	29
Ranunculus repens	—	—	—	—	—	0	—	15	7	—	0
Rubus saxatilis	—	—	—	—	—	7	—	0	4	—	14
Rumex acetosa	—	—	(X)	—	—	29	—	8	19	—	0
R. acetosella	—	—	—	—	—	0	—	15	7	—	14
Senecio jacobaea	—	—	—	—	—	7	—	0	4	—	0
Stellaria holostea	—	—	—	—	—	36	—	31	33	—	0
Succisa pratensis	—	—	—	—	—	14	—	0	7	—	14
Taraxacum sp.	—	—	—	—	—	7	—	0	4	—	0
Teucrium scorodonia	—	—	—	—	(X)	14	—	23	19	5	29
Trientalis europaea	4	—	—	—	—	14	5	38	26	2	43
Trifolium repens	—	—	—	—	—	0	—	0	0	—	14
Veronica chamaedrys	(X)	—	3	(X)	1	**71**	—	38	56	—	51
V. officinalis	—	—	—	—	—	21	—	23	22	—	43
Viola riviniana	1	6	—	4	4	**79**	—	**77**	**78**	1	**86**
Acrocladium cuspidatum	—	—	—	—	—	0	—	8	4	—	0
Atrichum undulatum	—	—	—	—	—	7	—	31	19	—	0
Brachythecium rutabulum	—	—	—	—	—	7	—	0	4	X	14
Bryum sp.	—	—	—	—	—	7	—	0	4	—	0
Campylopus flexuosus	—	—	—	—	—	0	—	8*	4*	—	0
Ceratodon purpureus	—	—	—	—	—	7	—	0	4	—	0
Cirriphyllum piliferum	—	1	—	—	—	14	—	15	15	(X)	14
Dicranella heteromalla	—	—	—	—	—	7	—	23	15	—	0
Dicranum majus	—	—	—	—	—	7	1	38	22	—	57
D. scoparium	—	—	—	—	(X)	7	—	0	4	—	29
D. strictum	—	—	—	—	—	0	—	8*	4*	—	0

TABLE 18—*continued*

	6289	62103	62110	62128	63146		6290			62131	
Eurhynchium praelongum	1	—	4	—	—	50	—	31	41	—	0
E. striatum	—	—	—	—	—	0	—	8	4	—	0
Fissidens bryoides	—	—	—	—	—	0	—	8	4	—	0
F. taxifolius	—	—	—	—	—	0	—	0	0	—	14
Hylocomium splendens	4	—	—	—	—	43	1	**62**	52	—	**86**
Hypnum cupressiforme	—	1	—	2	—	43	—	38	41	—	0
var. ericetorum	—	—	2	—	(X)	14	—	8	11	—	0
Isothecium myosuroides	—	—	—	—	—	7	—	0	4	—	14
I. myurum	—	—	—	—	—	0	—	0	0	—	14
Mnium affine	—	—	—	—	—	7	—	0	4	—	0
M. hornum	—	—	—	—	—	0	1	46	22	—	0
M. longirostrum	—	—	—	—	—	7	—	0	4	—	0
M. undulatum	—	3	—	—	—	21	—	31	26	—	0
Orthotrichum sp.	—	—	—	—	—	0	—	8*	4*	—	0
Plagiothecium denticulatum	—	—	—	—	—	0	—	8	4	—	0
P. succulentum	—	—	—	—	X	7	—	0	4	—	0
P. undulatum	—	—	—	—	—	14	2	31	22	—	14
Pleurozium schreberi	—	—	—	—	X	14	—	15	15	—	**71**
Pohlia nutans	—	—	—	—	—	0	—	8	4	—	14
Polytrichum aurantiacum	—	—	—	—	(X)	7	—	31	19	—	14
P. formosum	—	—	—	—	—	7	5	8	7	—	0
Pseudoscleropodium purum	7	2	6	3	5	**86**	X	77	**81**	5	**71**
Ptilium crista-castrensis	—	—	—	—	—	7	—	0	4	—	0
Rhytidiadelphus loreus	—	—	—	—	—	0	—	23	11	—	43
R. squarrosus	4	3	4	—	—	**86**	1	**77**	**81**	2	14
R. triquetrus	—	—	—	—	—	36	—	**62**	48	—	**71**
Thuidium tamariscinum	6	—	—	—	1	36	4	**77**	56	—	43
Barbilophozia attenuata	—	—	—	—	—	0	—	8*	4*	—	0
Calypogeia fissa	—	—	—	—	—	0	—	0	0	—	14
Diplophyllum albicans	—	—	—	—	—	0	—	8	4	—	0
Frullania fragilifolia	—	—	—	—	—	0	—	8*	4*	—	0
F. tamarisci	—	—	—	—	—	0	—	0	0	—	14
Lophocolea bidentata	X	—	—	—	2	50	2	**85**	**67**	—	**86**
L. cuspidata	—	—	—	—	—	0	—	0	0	—	14
Nardia scalaris	—	—	—	—	—	0	—	8	4	—	0
Pellia sp.	—	—	—	—	—	0	—	8	4	—	0
Plagiochila asplenioides	—	—	—	—	—	7	—	23	15	—	14
var. major	—	—	—	—	—	7	—	0	4	—	14

Radula complanata	—	—	—	—	—	0	—	8	4	—	0
Tritomaria quinquedentata	—	—	—	—	—	0	—	0	0	—	14
Cetraria glauca	—	—	—	—	—	14*	—	0	7*	—	0
Cladonia digitata	—	—	—	—	—	0	—	8*	4*	—	0
C. fimbriata	—	—	—	—	—	7	—	0	4	—	0
C. squamosa	—	—	—	—	—	0	—	8*	4*	—	0
Cladonia spp.	—	—	—	—	—	0	—	0	0	—	29
Evernia prunastri	—	1*	—	1*	—	29*	—	23*	26*	—	14*
Parmelia physodes	X*	1*	—	2*	—	36*	X*	23*	30*	—	29*
P. *sulcata*	—	—	—	—	—	0	—	15*	7*	—	0
Parmelia spp.	—	—	—	—	—	0	—	15*	7*	—	0
Peltigera canina	—	—	—	—	—	0	—	8	4	—	0
Peltigera sp.	—	—	—	—	—	0	—	0	0	—	14
Usnea subfloridana	—	—	—	—	—	0	—	8*	4*	—	0
Usnea spp.	—	—	—	—	—	14*	—	8*	11*	—	14*
Number of species:											
trees, shrubs and climbers	2	3	2	2	4	14	3	17	23	2	8
field and ground	24	17	13	13	25	96	24	84	123	21	82
epiphytes	1	2	—	2	—	5	1	15	17	—	3
Average—total species	—	—	—	—	—	25	—	27	26	—	29
field and ground	—	—	—	—	—	23	—	24	23	—	27
Number of stands	—	—	—	—	—	14	—	13	27	—	7

TABLE 19. WOODLAND WITH VACCINIUM MYRTILLUS

		Oxalis acetosella facies		General facies					
Reference no.		6284	K—Presence within the facies	6283	62122	62127	62130	K—Presence within the facies	K—Presence within the community
Map reference		NO		NO	NO	NO	NO		
		034		135	067	023	035		
		436		230	407	204	392		
Altitude	ft.	500		625	500	450	900		
Aspect		S		N	NW	S	E		
Slope		12°		6°	11°	8°	16°		
Cover—									
trees and shrubs	%	25		5	50	45	—		
field	%	80		95	95	90	90		
ground	%	15		90	10	1	55		
Height—									
trees and shrubs	ft.	40		15–20	40	70	—		
field	ins.	10–14		7–14	6–16	9	8–11		
Plot Area	sq. m.	1		1	1	1	1		
Soil Sub-group		BP		BP	BP	BP	IP		
Soil Series		FU		SH	DL	DL	ST		
Drainage		P		P	P	P	P		
pH		3·7		3·8	3·9	4·5	3·9		
Acer pseudoplatanus		—	0	1	—	—	—	8	4
Betula pendula		—	27	3	—	3	—	58	41
B. pendula/pubescens		—	13	—	—	—	—	0	7
B. pubescens		—	**60**	—	1	—	—	42	52
Fagus sylvatica		—	20	—	—	—	—	8	15
Ilex aquifolium		—	7	—	—	—	—	0	4
Larix decidua		—	0	—	1	—	—	8	4
Picea sitchensis		—	0	—	—	—	—	8	4
Pinus sylvestris		—	13	—	—	—	—	17	15
Quercus petraea		—	13	—	—	—	—	17	15
Q. petraea/robur		6	33	2	7	7	—	25	30
Q. robur		—	20	—	—	—	—	0	11
Sorbus aucuparia		—	33	3	—	—	—	33	33
Fagus sylvatica		—	7	—	—	—	—	0	4
Juniperus communis		—	13	—	—	—	—	17	15
Abies sp. seedlings		—	0	—	—	—	—	8	4
Betula pendula/pubescens seedlings		—	0	—	—	—	—	8	4
B. pubescens seedlings		—	7	—	(X)	—	—	33	19
Calluna vulgaris		—	**60**	(X)	—	—	—	58	59
Erica cinerea		—	7	—	—	—	—	25	15
E. tetralix		—	0	—	—	—	—	8	4
Fagus sylvatica seedlings		—	20	—	—	(X)	—	8	15
Larix decidua seedlings		—	7	—	—	—	—	0	4
Lonicera periclymenum		—	13	—	—	—	—	0	7
Pseudotsuga menziesii seedlings		—	7	—	—	—	—	0	4
Quercus petraea/robur seedlings		2	33	—	—	—	—	8	22
Q. petraea seedlings		—	0	—	—	—	—	8	4
Sorbus aucuparia seedlings		X	53	—	(X)	—	—	42	48
Vaccinium myrtillus		8	**100**	9	9	9	8	**100**	**100**
V. vitis-idaea		—	7	—	—	—	—	25	15
Blechnum spicant		—	20	—	—	—	(X)	25	22
Dryopteris borreri		—	0	—	—	—	(X)	8	4
D. dilatata		—	13	—	—	—	—	17	15

	6284		6283	62122	62127	62130		
Pteridium aquilinum	—	40	—	—	—	—	0	22
Thelypteris dryopteris	—	7	—	—	—	—	0	4
Agrostis canina	—	33	—	—	(X)	—	8	22
A. canina ssp. montana	—	0	—	—	—	—	17	7
A. tenuis	—	7	—	—	X	—	17	11
Anthoxanthum odoratum	—	13	—	—	(X)	—	25	19
Deschampsia flexuosa	5	**100**	7	6	4	6	**92**	**96**
Festuca ovina	—	7	—	1	2	(X)	50	26
F. rubra	—	0	—	—	1	—	8	4
Holcus mollis	—	7	—	—	—	—	0	4
Molinia caerulea	—	7	—	—	—	—	0	4
Carex pilulifera	—	7	—	—	—	—	0	4
Carex sp.	—	0	—	—	2	—	8	4
Luzula multiflora	—	7	—	—	—	—	25	15
L. pilosa	2	**87**	—	—	—	X	50	**70**
L. sylvatica	—	13	—	—	—	—	0	7
Galium saxatile	2	53	—	1	—	—	33	44
Goodyera repens	—	7	—	—	—	—	8	7
Lathyrus montanus	—	0	—	—	3	—	8	4
Melampyrum pratense	—	7	—	6	—	—	25	15
Oxalis acetosella	3	**87**	—	—	—	—	0	48
Potentilla erecta	—	47	—	—	2	1	42	44
Succisa pratensis	—	7	—	—	—	—	0	4
Teucrium scorodonia	—	0	—	—	—	—	8	4
Trientalis europaea	(X)	33	—	—	—	1	25	30
Viola riviniana	—	0	—	—	(X)	—	8	4
Campylopus flexuosus	—	13	—	—	—	—	0	7
Dicranum majus	3	**67**	—	—	—	—	8	41
D. scoparium	—	**60**	3	—	—	—	58	59
Eurhynchium praelongum	—	7	—	—	—	—	0	4
Hylocomium splendens	—	**80**	6	4	X	5	**83**	**81**
Hypnum cupressiforme	4	47	—	—	—	—	25	37
var. ericetorum	—	27	2	X	1	—	58	41
Mnium hornum	X	20	—	—	—	—	0	11
Orthotrichum sp.	—	7*	—	—	—	—	0	4*
Plagiothecium undulatum	—	40	2	—	—	—	25	33
Pleurozium schreberi	2	**87**	8	2	—	7	**75**	**81**
Polytrichum aurantiacum	4	27	—	—	—	—	8	19
P. commune	—	13	—	—	—	—	0	7
P. formosum	—	27	—	—	—	—	0	15
Pseudoscleropodium purum	—	47	2	4	—	1	50	48
Ptilium crista-castrensis	—	7	—	—	—	—	0	4
Rhytidiadelphus loreus	1	53	—	—	—	—	17	37
R. squarrosus	—	20	(X)	2	—	4	50	33
R. triquetrus	—	47	—	—	—	—	50	48
Sphagnum girgensohnii	—	7	—	—	—	—	0	4
S. plumulosum	—	7	—	—	—	—	0	4
Thuidium tamariscinum	1	40	—	—	—	—	0	22
Ulota bruchii	—	7*	—	—	—	—	0	4*
Barbilophozia attenuata	—	7	—	—	—	—	0	4
Calypogeia fissa	—	7	—	—	—	—	0	4
Lophocolea bidentata	X	**67**	4	—	—	—	58	**63**
L. cuspidata	—	7	—	—	—	—	8	7
L. heterophylla	—	7*	—	—	—	—	0	4*
Plagiochila asplenioides	—	7	—	—	—	—	0	4
var. major	—	7	—	—	—	—	0	4

	6284		6283	62122	62127	62130		
Cetraria glauca	—	13*	—	1*	—	—	8*	11*
Cladonia cornuta	—	13	—	—	—	—	0	7
C. pyxidata	—	7	—	—	—	—	8	7
Cladonia spp.	—	0	—	—	—	—	17	7
Evernia prunastri	—	40*	—	—	—	—	25*	33*
Parmelia physodes	—	**60***	X*	2*	—	(X)*	58*	59*
P. saxatilis	—	7*	—	—	—	—	8*	7*
P. subaurifera	—	0	—	—	—	—	8*	4*
P. sulcata	—	20*	—	—	—	—	0	11*
Parmelia sp.	—	7*	—	—	—	—	0	4*
Peltigera sp.	—	7	—	—	—	—	0	4
Usnea subfloridana	—	7*	—	—	—	—	8*	7*
Usnea spp.	—	20*	—	—	—	—	0	11*
Number of species:—								
trees and shrubs	1	11	4	3	2	—	11	14
field and ground	16	63	11	11	15	12	49	75
epiphytes	—	13	1	2	—	1	7	14
Average—total species	—	20	—	—	—	—	17	19
—field and ground	—	18	—	—	—	—	14	16
Number of stands	—	15	—	—	—	—	12	27

TABLE 20		WOODLAND WITH DESCHAMPSIA FLEXUOSA					WOODLAND WITH CALLUNA VULGARIS AND ERICA CINEREA	
Reference no.		62126	62134	63121	63127	K—Presence within the community	62114	K—Presence within the community
Map reference		NO 027 198	NO 056 266	NO 548 134	NO 345 225		NO 140 279	
Altitude	ft.	420	200	250	575		325	
Aspect		N	NW	N	NW		SSE	
Slope		15°	10°	5°	13°		8°	
Cover—								
trees and shrubs	%	30	80	60	50		60	
field	%	40	12	70	95		75	
ground	%	85	60	60	40		75	
Height—								
trees and shrubs	ft.	70	30–70	15	25–30		60	
field	ins.	4–16	3	6–30	5–14		10–14	
Plot Area	sq. m.	4	1	4	4		1	
Soil Sub-group		BP	BP	GP	IP		GP	
Soil Series		AY	BU		FY		MR	
Drainage		P	P	PPH	P		PPH	
pH		4·4	3·8	3·7	3·5		4·0	
Abies sp.		X	—	—	—	10	—	0
Betula pendula		—	—	—	—	20	—	40
B. pubescens		—	—	7	—	50	—	0
Fagus sylvatica		—	6	—	—	10	—	0
Larix decidua		3	—	—	—	20	—	0
L. eurolepis		—	—	—	—	0	—	20
Picea abies		—	—	—	—	0	—	20
P. sitchensis		—	—	3	—	10	—	0
Pinus sylvestris		5	—	4	7	**60**	8	**80**
Quercus petraea/robur		5	—	—	—	10	—	20
Q. robur		—	7	—	—	20	—	20
Ilex aquifolium		—	—	—	—	0	—	20
Picea abies		—	—	—	—	0	—	20
Betula pendula seedlings		—	—	—	—	0	X	20
B. pubescens seedlings		—	(X)	—	—	20	—	0
Calluna vulgaris		(X)	—	—	X	50	5	**80**
Erica cinerea		—	—	—	—	10	8	**100**
Fagus sylvatica seedlings		—	—	—	—	10	—	0
Fraxinus excelsior seedlings		—	(X)	—	—	10	—	0
Ilex aquifolium seedlings		—	—	—	—	10	—	0
Lonicera periclymenum		—	—	6	—	20	—	0
Picea abies seedlings		—	(X)	—	—	20	—	0
Pseudotsuga menziesii seedlings		—	X	—	—	10	—	0
Quercus petraea seedlings		—	—	—	—	0	X	20
Q. robur seedlings		—	(X)	—	—	10	—	0
Sarothamnus scoparius		—	X	—	—	10	X	20
Sorbus aucuparia seedlings		—	(X)	—	—	40	—	0
Vaccinium myrtillus		2	—	—	—	30	—	0
Blechnum spicant		—	—	—	—	30	—	0
Dryopteris borreri		—	—	—	(X)	10	—	0
D. dilatata		—	—	5	3	40	—	0
D. filix-mas		—	—	—	(X)	10	—	0

	62126	62134	63121	63127	62114		
Lycopodium clavatum	2	(X)	—	—	20	—	0
Pteridium aquilinum	—	—	—	—	20	—	60
Agrostis canina	1	—	—	—	20	—	0
A. canina ssp. montana	—	—	—	—	20	X	20
Anthoxanthum odoratum	1	—	—	—	30	—	0
Deschampsia flexuosa	5	5	6	9	100	—	60
Festuca ovina	4	—	—	—	20	—	0
Poa pratensis	X	—	—	—	20	—	0
P. trivialis	—	—	—	—	10	—	0
Carex pilulifera	—	—	—	—	30	—	0
Carex spp.	X	X	—	—	20	—	0
Luzula multiflora	2	—	—	—	30	—	0
L. pilosa	1	X	—	—	60	—	40
L. sylvatica	—	—	—	—	10	—	0
Campanula rotundifolia	1	—	—	—	10	—	0
Cerastium holosteoides	—	—	—	—	10	—	0
Chamaenerion angustifolium	—	—	(X)	—	10	—	0
Galium saxatile	2	—	—	2	60	(X)	20
Goodyera repens	—	—	—	—	0	—	60
Hypericum pulchrum	X	—	—	—	10	—	0
Hypochoeris radicata	—	—	—	—	10	—	0
Melampyrum pratense	—	—	—	—	20	—	20
Oxalis acetosella	(X)	—	—	—	30	—	20
Potentilla erecta	—	—	—	—	20	—	0
Pyrola minor	—	—	—	—	10	—	0
Succisa pratensis	—	—	—	—	10	—	0
Trientalis europaea	—	—	—	—	40	—	40
Veronica chamaedrys	—	—	—	—	20	—	0
V. officinalis	—	—	—	—	10	—	0
Viola riviniana	X	—	—	—	10	—	0
Dicranella heteromalla	—	—	—	1	20	—	0
Dicranum majus	—	5	—	—	30	—	40
D. scoparium	3	1	2	—	50	—	40
Hylocomium splendens	4	3	4	—	80	6	100
Hypnum cupressiforme var. ericetorum	1	4	—	5	70	1	80
Isothecium myosuroides	—	X	—	—	10	—	0
Mnium hornum	—	5	—	—	20	—	0
Plagiothecium undulatum	—	—	—	2	40	—	0
Pleurozium schreberi	4	1	6	3	80	5	100
Polytrichum aurantiacum	1	5	—	—	40	(X)	20
P. formosum	—	—	X	—	20	—	0
Pseudoscleropodium purum	—	—	6	—	50	5	80
Rhytidiadelphus loreus	—	2	—	—	40	—	0
R. squarrosus	—	—	—	—	30	—	0
R. triquetrus	7	—	1	—	40	—	80
Thuidium tamariscinum	—	1	3	—	30	—	20
Ulota crispa	—	—	—	—	0	—	20*
Calypogeia fissa	—	—	—	—	0	—	20
C. muelleriana	—	—	—	—	10	—	0
Cephalozia bicuspidata	—	—	—	—	20	—	0
Diplophyllum albicans	—	(X)	—	—	10	—	0
Lepidozia reptans	—	1	—	—	20	—	0
Lophocolea bidentata	4	—	—	6	50	4	80
L. cuspidata	—	4	—	—	10	—	0

	62126	62134	63121	63127		62114	
Nowellia curvifolia	—	—	—	—	20*	—	0
Plagiochila asplenioides	—	3	—	—	20	—	0
Ptilidium ciliare	1	—	—	—	10	—	0
Cetraria glauca	—	X*	—	—	20*	—	0
Cladonia digitata	—	(X)	—	—	20	—	0
C. furcata	—	1	—	—	10	—	0
C. impexa	—	X	—	—	10	—	0
C. pityrea	—	—	—	—	20	—	0
Evernia prunastri	—	—	—	—	20*	—	20*
Parmelia physodes	1*	2*	X*	—	70*	2*	80*
P. sulcata	—	—	—	—	20*	—	0
Peltigera canina	—	—	—	—	10	—	0
Usnea subfloridana	—	—	—	—	20*	—	40*
Boletus sp.	X	—	—	—	10	—	0
Mirasmius androsaceus	—	—	—	—	0	—	20
Number of species:							
trees and shrubs	4	2	3	1	9	1	8
field and ground	25	28	11	11	76	13	26
epiphytes	1	2	1	—	8	1	4
Average—total species	—	—	—	—	21	—	15
—field and ground	—	—	—	—	19	—	13
Number of stands	—	—	—	—	10	—	5

TABLE 21. WOODLAND WITH DESCHAMPSIA CESPITOSA

		Rhytidiadelphus squarrosus facies			Athyrium filix-femina facies							
Reference no.		62109	62129	K—Presence within the facies	6285	6288	6291	62116	62138	63125	K—Presence within the facies	K—Presence within the community
Map reference		NO 037 256	NO 036 205		NO 049 433	NO 226 225	NO 066 427	NO 459 152	NO 037 304	NO 027 278		
Altitude	ft.	280	415		340	90	550	310	430	400		
Aspect		ENE	NIL		NW	NIL	N	NIL	W	W		
Slope		4°	0°		4°	0°	3°	0°	2°	4°		
Cover—												
trees and shrubs	%	35	85		80	85	75	80	75	30		
field	%	95	95		75	60	70	90	95	95		
ground	%	35	6		40	25	85	60	40	25		
Height—												
trees and shrubs	ft.	30–40	30–40		40–50	50	40	40	40	40		
field	ins.	18–50	15		15–38	11–25	16–45	9–40	15–36	24–60		
Plot Area	sq. m.	1	4		1	1	1	4	1	4		
Soil Sub-group		GBP	BG		AG	GBP	BG	AG	AG	GBP		
Soil Series		LK	VG		AE	BL	AE	RH	LR	BL		
Drainage		PPH	PH		PH	PPH	PH	PH	PH	PPH		
pH		4·6	5·0		4·5	4·1	5·2	4·2	3·9	3·8		
Alnus glutinosa		—	9	29	9	—	8	—	8	—	43	36
Betula pendula		5	—	29	—	—	—	9	1	—	29	29
B. pendula/pubescens		—	—	14	—	—	4	—	—	—	14	14
B. pubescens		—	3	14	2	7	—	9	3	1	**71**	43
Fraxinus excelsior		5	—	43	—	—	—	—	—	—	0	21
Picea abies		—	1	14	—	—	—	—	—	—	0	7
Pinus sylvestris		—	—	29	—	—	—	—	—	6	29	29
Prunus avium		—	—	14	—	—	—	—	—	—	0	7
Pseudotsuga menziesii		—	—	0	—	—	—	—	—	—	14	7
Quercus petraea		—	—	0	—	7	—	—	—	—	14	7
Q. petraea/robur		—	—	14	—	—	—	—	—	—	0	7
Q. robur		—	—	14	—	—	—	—	—	—	0	7
Sorbus aucuparia		—	—	29	—	—	—	—	—	—	0	14

Salix cinerea ssp. atrocinerea	—	—	14	3	—	—	—	—	—	14	14
Acer pseudoplatanus seedlings	—	—	0	—	X	—	—	—	—	14	7
Betula pendula/pubescens seedlings	—	—	0	X	—	(X)	—	—	—	29	14
B. pubescens seedlings	—	—	0	—	(X)	—	—	—	—	14	7
Fraxinus excelsior seedlings	(X)	—	57	X	—	—	—	—	—	14	36
Lonicera periclymenum	—	—	0	—	—	—	—	—	—	14	7
Quercus petraea seedlings	—	—	0	—	X	—	—	—	—	14	7
Q. robur seedlings	(X)	—	14	—	—	—	—	—	—	0	7
Rubus fruticosus agg.	(X)	—	57	—	—	—	—	(X)	—	29	43
R. idaeus	—	—	43	—	—	(X)	1	—	5	43	43
Athyrium filix-femina	—	—	29	(X)	X	2	5	(X)	X	**86**	57
Dryopteris borreri	—	—	14	—	—	(X)	—	—	—	29	21
D. carthusiana	—	—	0	—	—	—	4	(X)	(X)	43	21
D. dilatata	—	—	57	—	(X)	2	5	(X)	1	**86**	**71**
D. filix-mas	(X)	—	29	—	—	—	—	—	(X)	14	21
Pteridium aquilinum	—	—	14	—	—	—	—	—	—	0	7
Agrostis canina	1	—	29	—	X	—	—	—	—	14	21
A. canina ssp. canina	—	3	14	X	—	—	—	4	3	57	36
A. *tenuis*	—	—	43	2	2	—	—	—	1	57	50
Anthoxanthum odoratum	—	—	29	—	—	—	—	—	—	14	21
Arrhenatherum elatius	—	—	14	—	—	—	—	—	—	0	7
Deschampsia cespitosa	9	7	**100**	8	7	8	2	9	8	**100**	**100**
D. flexuosa	—	—	14	—	—	—	—	—	—	0	7
Festuca rubra	—	—	57	—	—	—	—	—	—	0	29
Holcus lanatus	2	—	57	—	4	—	1	4	1	57	57
H. mollis	—	5	29	(X)	—	—	6	—	3	43	36
Molinia caerulea	—	—	14	—	—	—	—	—	—	0	7
Poa trivialis	1	4	57	—	—	4	6	4	—	43	50
Carex flacca	—	—	14	—	—	—	—	—	—	0	7
Carex sp.	—	—	14	—	—	—	—	—	—	0	7
Juncus conglomeratus	—	1	14	3	—	—	—	—	—	14	14
J. effusus	—	—	14	(X)	—	—	—	—	4	29	21
Luzula multiflora	—	—	14	—	—	—	—	—	—	0	7
Ajuga reptans	—	5	29	2	—	—	—	—	—	14	21
Anemone nemorosa	—	—	14	—	—	—	—	—	—	0	7
Angelica sylvestris	—	—	14	—	—	—	—	—	—	0	7
Cardamine sp.	—	—	0	—	—	1	—	—	—	14	7
Cirsium palustre	—	(X)	43	—	—	—	X	—	(X)	29	36

TABLE 21—*continued*

	62109	62129		6285	6288	6291	62116	62138	63125		
Digitalis purpurea	—	—	14	—	—	—	—	—	1	14	14
Endymion non-scriptus	—	—	14	—	—	—	—	—	—	0	7
Epilobium montanum	—	—	14	—	—	—	—	—	—	0	7
Filipendula ulmaria	—	—	14	—	—	—	—	—	—	0	7
Fragaria vesca	—	—	14	—	—	(X)	—	—	—	29	21
Galium palustre	—	—	0	1	—	1	—	—	—	29	14
G. saxatile	—	—	14	—	—	—	—	—	—	0	7
Geranium robertianum	—	—	14	—	—	—	—	—	—	0	7
Heracleum sphondylium	—	—	14	—	—	—	—	—	—	0	7
Hypericum pulchrum	—	—	14	—	—	—	—	—	—	0	7
Moehringia trinervia	—	—	0	—	1	—	—	—	—	14	7
Oxalis acetosella	—	6	57	4	—	5	—	7	6	**71**	**64**
Plantago lanceolata	—	—	14	—	—	—	—	—	—	0	7
Potentilla erecta	—	X	**64**	—	—	—	—	—	—	14	43
Prunella vulgaris	—	—	0	—	—	—	(X)	—	—	14	7
Ranunculus acris	—	—	14	—	—	—	—	—	—	0	7
R. repens	X	1	43	X	—	—	—	—	—	14	29
Rumex acetosa	—	—	29	—	—	—	—	(X)	—	14	21
R. obtusifolius	—	—	0	—	—	—	(X)	—	—	14	7
Scrophularia nodosa	X	—	14	—	—	—	—	—	—	0	7
Senecio jacobaea	—	—	0	—	—	(X)	—	—	—	14	7
Stelleria alsine	—	—	0	—	—	—	X	—	—	14	7
Succisa pratensis	—	—	43	—	—	—	—	—	—	0	21
Taraxacum palustre	—	1	14	—	—	—	—	—	—	0	7
Taraxacum sp.	—	—	14	—	—	—	—	—	—	0	7
Trifolium medium	—	—	14	—	—	—	—	—	—	0	7
Urtica dioica	—	—	0	—	—	—	2	—	—	14	7
Veronica chamaedrys	3	(X)	**71**	—	—	1	—	—	—	14	43
V. officinalis	—	—	14	—	—	—	—	—	—	0	7
Vicia angustifolia	—	—	14	—	—	—	—	—	—	0	7
Viola palustris	—	(X)	14	4	—	—	—	5	—	29	21
V. riviniana	5	3	**100**	—	—	5	2	—	—	43	**71**
Atrichum undulatum	—	1	43	4	3	—	1	—	—	43	43
Brachythecium rutabulum	—	—	14	1	—	X	—	3	—	43	29
Cirriphyllum piliferum	—	—	14	—	—	—	—	—	—	0	7
Dicranella heteromalla	—	—	14	—	—	—	—	—	—	14	14
Dicranum scoparium	—	—	14	—	—	—	—	—	—	0	7

Eurhynchium praelongum	3	1	86	5	1	4	5	5	5	86	86
Eurhynchium sp.	—	—	0	—	—	—	—	—	—	14	7
Hylocomium splendens	—	—	14	—	—	—	—	—	—	0	7
Hypnum cupressiforme	—	—	14	—	—	—	—	—	—	14	14
Mnium hornum	—	—	0	—	—	—	4	—	—	14	7
M. undulatum	2	3	71	—	—	3	—	5	—	29	50
Plagiothecium denticulatum	—	—	0	—	—	—	—	(X)	1	29	14
P. sylvaticum	—	X	14	—	—	—	—	—	—	0	7
P. undulatum	—	—	14	—	—	—	—	—	—	14	14
Pohlia nutans	—	—	14	—	—	—	—	—	—	0	7
Polytrichum formosum	—	—	14	—	—	—	—	—	—	0	7
Pseudoscleropodium purum	—	1	71	—	X	—	—	—	—	29	50
Rhytidiadelphus loreus	—	—	0	—	—	—	—	—	—	14	7
R. squarrosus	4	2	86	—	—	—	—	—	—	0	43
R. triquetrus	—	X	43	—	—	—	—	—	—	14	29
Thuidium tamariscinum	5	X	86	2	5	8	7	4	—	86	86
Lepidozia reptans	—	—	0	—	—	—	—	—	—	14	7
Lophocolea bidentata	4	4	86	—	2	X	2	3	4	86	86
Pellia epiphylla	—	—	0	4	—	—	—	—	—	14	7
Pellia sp.	—	X	14	—	—	(X)	—	—	—	14	14
Cetraria glauca	1*	—	14*	—	—	—	—	—	—	0	7*
Cladonia sp.	—	—	0	—	—	—	—	—	—	14*	7*
Evernia prunastri	—	—	29*	—	—	—	—	—	—	0	14*
Parmelia physodes	—	—	14*	—	—	X*	X*	—	—	29*	21*
P. sulcata	—	—	14*	—	—	—	—	—	—	0	7*
Number of species:—											
trees and shrubs	2	3	12	3	2	2	2	3	2	8	14
field and ground	17	24	74	19	15	20	19	17	17	60	94
epiphytes	1	—	4	—	—	1	1	—	—	2	5
Average—total species	—	—	26	—	—	—	—	—	—	21	23
field and ground	—	—	23	—	—	—	—	—	—	18	21
Number of stands	—	—	7	—	—	—	—	—	—	7	14

TABLE 22		WOODLAND WITH JUNCUS ACUTIFLORUS				WET WOODLAND WITH FILIPENDULA ULMARIA AND ANGELICA SYLVESTRIS	
Reference no.		6286	6287	6295	K—Presence within the community	62135	K—Presence within the community
Map reference		NO 048 433	NO 051 433	NO 060 431		NO 055 266	
Altitude	ft.	340	425	600		250	
Aspect		NW	N	N		NIL	
Slope		8°	8°	9°		0°	
Cover—							
trees and shrubs	%	75	25	30		75	
field	%	70	90	80		95	
ground	%	50	75	40		50	
Height—							
trees and shrubs	ft.	40	40–50	20–25		40	
field	ins.	25	28	30		6–9	
Plot Area	sq. m.	1	8	2		2	
Soil Sub-group		HG	AG	BG		BG	
Soil Series			AE	AE		MV	
Drainage		HP	PH	PH		PH	
pH		4·9	4·5	5·2		5·3	
Alnus glutinosa		8	—	—	25	9	40
Betula pendula		—	5	—	25	—	0
B. pendula/pubescens		—	—	—	25	—	0
B. pubescens		4	—	4	50	—	40
Salix cinerea ssp. atrocinerea		3	4	5	**100**	—	40
Betula seedlings		X	—	X	50	—	0
Fraxinus excelsior seedlings		1	—	—	25	X	20
Athyrium filix-femina		2	—	—	25	—	0
Equisetum fluviatile		—	—	—	25	—	40
E. palustre		—	—	—	0	—	40
E. sylvaticum		—	—	—	0	—	20
Agrostis canina ssp. canina		5	7	4	**100**	—	20
A. stolonifera		—	—	—	0	—	20
A. tenuis		—	2	—	25	—	20
Agrostis spp.		—	—	—	0	—	40
Anthoxanthum odoratum		—	4	4	75	—	20
Festuca rubra		—	—	3	25	—	20
Holcus lanatus		1	4	1	**100**	—	40
H. mollis		—	2	4	50	—	20
Poa pratensis		—	—	—	0	—	20
P. trivialis		—	2	3	50	5	**60**
Carex diandra		—	—	—	0	—	20
C. echinata		1	—	—	25	—	0
C. flacca		—	—	3	25	—	0
C. nigra		—	—	—	0	—	40
C. pallescens		—	X	—	25	—	0
C. paniculata		—	—	—	0	—	20
Juncus acutiflorus		8	8	9	**100**	—	40
J. conglomeratus		(X)	X	1	75	(X)	20
J. effusus		—	X	—	25	—	0

	6286	6287	6295		62135	
Ajuga reptans	3	X	3	75	4	20
Anemone nemorosa	5	6	2	75	—	0
Angelica sylvestris	—	—	—	25	—	80
Caltha palustris	—	—	—	0	4	40
Cardamine pratensis	—	—	—	0	—	40
Cardamine sp.	—	—	1	25	1	20
Cerastium holosteoides	—	—	—	0	—	20
Chrysosplenium oppositifolium	—	—	—	0	—	20
Cirsium palustre	(X)	—	—	50	—	20
Corralorhiza trifida	—	—	—	0	—	20
Crepis paludosa	—	—	—	0	—	40
Dactylorchis fuchsii	—	—	—	0	—	20
Epilobium palustre	2	2	2	100	—	80
Filipendula ulmaria	—	—	—	0	(X)	100
Galium palustre	3	1	2	75	5	80
G. uliginosum	—	—	1	50	—	20
Geum rivale	—	—	—	0	—	20
Hydrocotyle vulgaris	—	—	—	0	—	20
Iris pseudacorus	—	—	—	0	—	20
Lychnis flos-cuculi	—	—	—	0	—	40
Lysimachia nemorum	(X)	X	—	50	4	20
Menyanthes trifoliata	—	—	—	0	—	20
Oxalis acetosella	—	1	2	50	3	20
Potentilla erecta	1	1	2	100	—	0
P. palustris	—	—	—	0	—	40
Prunella vulgaris	—	—	—	0	1	20
Pyrola minor	—	—	—	0	—	20
Ranunculus acris	—	—	X	25	—	0
R. repens	—	X	—	25	8	60
Rumex acetosa	—	—	—	25	—	40
Stellaria alsine	—	—	X	25	—	20
Trientalis europaea	X	X	—	50	—	0
Valeriana officinalis	—	—	—	25	—	40
Viola palustris	—	—	—	0	5	40
Acrocladium cordifolium	—	—	—	0	—	20
A. cuspidatum	3	—	4	50	1	80
Brachythecium rivulare	—	—	—	0	—	40
B. rutabulum	4	3	5	100	4	40
Cirriphyllum piliferum	—	—	—	0	2	20
Climacium dendroides	—	—	—	0	—	20
Cratoneuron filicinum	—	—	—	0	—	20
Eurhynchium praelongum	3	7	5	100	6	60
Hylocomium splendens	—	—	1	25	—	0
Mnium hornum	1	—	—	25	—	0
M. pseudopunctatum	—	—	—	0	—	20
M. punctatum	—	—	—	0	4	20
M. seligeri	—	—	—	0	—	20
M. undulatum	—	4	3	75	4	40
Polytrichum commune	—	2	—	25	—	0
Pseudoscleropodium purum	—	—	—	25	—	0
Rhytidiadelphus squarrosus	1	5	3	100	—	20
Sphagnum palustre	2	—	—	25	—	0
S. squarrosum	(X)	X	—	50	—	0
Thuidium tamariscinum	7	1	—	75	—	0
Chiloscyphus pallescens	—	—	—	0	3	40
C. polyanthos	1	—	—	25	—	0
Lophocolea bidentata	—	3	2	75	—	60
Pellia epiphylla	—	2	—	25	—	0
P. fabroniana	—	—	—	0	2	20
P. neesiana	4	—	1	50	—	0
Riccardia pinguis	—	—	—	0	—	20

	6286	6287	6295	62135		
Evernia prunastri	—	—	—	0	—	20*
Parmelia physodes	—	—	X*	25*	X*	40*
P. sulcata	—	—	1*	25*	—	0
Usnea subfloridana	—	—	—	0	—	20*
Number of species—						
trees and shrubs	3	2	2	5	1	3
field and ground	26	28	28	50	21	66
epiphytes	—	—	2	2	1	3
Average—						
total species	—	—	—	28	—	22
field and ground	—	—	—	25	—	21
Number of stands	—	—	—	4	—	5

TABLE 23		AGROSTIS-FESTUCA BASIC GRASSLAND			AGROSTIS-FESTUCA MEADOW GRASSLAND			
					Potentilla erecta facies			
Reference no.		62101	62105	K—Presence within the community	6296	62112	K—Presence in the facies	K—Presence within the community
Map reference		NO 276 376	NO 290 162		NO 059 432	NO 159 232		
Altitude	ft.	850	650		575	550		
Aspect		SE	NNE		N	SE		
Slope		21°	16°		10°	13°		
Cover—								
field	%	95	98		95	95		
ground	%	3	5		30	1		
Height—								
field	ins.	7–15	7–10		4–15	5		
Plot Area	sq. m.	1	1		2	2		
Soil Sub-group		BFS	BP		GBS	BFS		
Soil Series		DL	SH		BI	SH		
Drainage		P	P		PPH	P		
pH		5·2	5·1		5·1	5·6		
Calluna vulgaris		—	—	55	—	—	0	0
Crataegus monogyna seedlings		—	—	0	—	—	29	15
Erica cinerea		—	—	45	—	—	0	0
Helianthemum chamaecistus		4	—	55	—	—	0	0
Juniperus communis		—	—	9	—	—	0	0
Rosa rubiginosa		—	—	9	—	—	0	0
Thymus drucei		4	—	**82**	—	—	0	0
Ulex europaeus		—	—	0	—	(X)	14	8
Vaccinium myrtillus		—	—	9	—	—	0	0
Agrostis canina		2	—	27	—	—	0	8
A. tenuis		7	8	**91**	8	7	**100**	**92**
Alopecurus geniculatus		—	—	0	—	—	0	8
Anthoxanthum odoratum		—	2	**64**	5	3	**100**	**69**
Arrhenatherum elatius		—	—	9	—	—	0	8
Brachypodium sylvaticum		—	—	9	—	—	0	0
Briza media		—	—	9	—	—	0	0
Cynosurus cristatus		—	—	0	(X)	5	**100**	**85**
Dactylis glomerata		—	—	27	—	—	14	46
Deschampsia cespitosa		—	—	0	1	—	14	15
Festuca arundinacea		—	—	9	—	—	0	0
F. ovina		4	4	**91**	—	—	29	15
F. pratensis		—	—	0	—	—	14	8
F. rubra		6	4	**82**	5	6	**100**	**100**
Helictotrichon pratense		—	—	36	—	—	0	0
H. pubescens		—	—	9	—	—	0	0
Holcus lanatus		—	—	18	3	4	**100**	**92**
H. mollis		—	—	9	—	—	0	0
Koeleria cristata		5	5	**100**	—	—	0	0
Lolium perenne		—	—	0	—	—	0	46
Molinia caerulea		—	—	9	—	—	0	0
Nardus stricta		—	—	0	—	—	29	15
Phleum nodosum		—	—	0	—	—	14	8
P. pratense		—	—	0	—	—	0	31

	62101	62105		6296	62112		
Poa annua	—	—	0	—	—	14	15
P. pratensis	—	5	45	1	5	71	**85**
P. trivialis	—	—	0	—	—	57	**62**
Sieglingia decumbens	—	—	55	—	—	29	15
Trisetum flavescens	—	—	9	—	4	29	23
Carex binervis	—	—	0	1	—	14	8
C. caryophyllea	4	—	73	—	—	29	15
C. curta	—	—	0	—	—	14	8
C. flacca	—	—	0	1	—	29	15
C. nigra	—	—	0	—	—	14	8
C. ovalis	—	—	0	—	—	0	8
C. panicea	—	—	36	—	—	0	0
C. pilulifera	—	—	9	—	—	0	0
C. pulicaris	—	—	9	—	—	0	0
Carex spp.	—	—	0	—	—	14	15
Juncus acutiflorus	—	—	0	—	—	14	8
J. conglomeratus	—	—	0	1	—	14	8
J. squarrosus	—	—	0	—	—	14	8
Luzula campestris	3	1	**82**	2	—	**86**	69
L. multiflora	—	—	9	—	—	14	8
Achillea millefolium	(X)	3	**82**	—	—	29	31
A. ptarmica	—	—	0	—	—	29	15
Ajuga reptans	—	—	0	—	—	14	8
Alchemilla glabra	—	—	0	—	—	14	8
Astragalus danicus	—	—	18	—	—	0	0
Bellis perennis	—	—	0	—	—	14	15
Campanula rotundifolia	X	3	**100**	—	—	14	8
Carlina vulgaris	—	—	9	—	—	0	0
Centaurea nigra	—	—	0	—	—	14	15
Cerastium holosteoides	—	—	18	X	X	**100**	**92**
Chrysanthemum leucanthemum	—	—	0	—	—	14	8
Cirsium arvense	(X)	2	36	X	2	57	38
C. palustre	—	—	0	—	—	29	15
C. vulgare	—	—	9	—	—	14	15
Conopodium majus	—	—	18	—	—	29	23
Euphrasia nemorosa	—	—	18	—	—	0	0
Euphrasia spp.	—	—	27	—	—	0	0
Fragaria vesca	—	—	0	—	(X)	14	8
Galium saxatile	X	—	45	—	—	0	0
G. uliginosum	—	—	0	1	—	14	8
G. verum	5	5	**82**	—	—	29	31
Geranium molle	—	—	0	—	—	0	8
Geranium sp.	—	—	0	—	—	0	8
Heracleum sphondylium	—	—	0	—	—	14	15
Hieraceum pilosella	—	—	36	—	—	0	0
Hypericum pulchrum	—	—	27	—	—	0	0
Hypochoeris radicata	—	—	0	—	2	29	23
Lathyrus montanus	—	2	36	—	—	0	0
L. pratensis	—	—	9	—	—	29	23
Leontodon autumnalis	—	—	0	—	—	29	31
Linum catharticum	—	—	27	—	—	14	8
Lotus corniculatus	1	(X)	**100**	—	4	43	46
L. uliginosus	—	—	0	—	—	14	8
Oxalis acetosella	—	—	0	1	—	14	8
Oxytropis halleri	—	—	9	—	—	0	0
Pimpinella saxifraga	—	—	0	—	—	14	8
Plantago lanceolata	—	—	73	—	3	71	62
P. maritima	—	—	45	—	—	0	0
Polygala serpyllifolia	—	—	27	—	—	0	0
Polygala sp.	—	—	9	—	—	0	0

	62101	62105		6296	62112		
Potentilla erecta	X	(X)	**73**	4	1	**86**	46
P. sterilis	(X)	—	9	X	X	29	15
Prunella vulgaris	—	—	36	(X)	—	43	23
Ranunculus acris	—	—	0	—	—	43	31
R. bulbosus	—	—	18	—	(X)	14	31
R. repens	—	—	0	3	—	43	46
Rhinanthus sp.	—	—	0	—	—	14	8
Rumex acetosa	—	2	9	1	—	57	54
R. acetosella	—	—	0	—	X	14	8
R. conglomeratus	—	—	0	—	—	0	8
R. obtusifolius	—	—	0	—	—	0	8
Sagina procumbens	—	—	0	—	—	29	15
Senecio jacobaea	—	—	9	—	—	29	23
Silene maritima	—	—	9	—	—	0	0
Stellaria graminea	—	—	0	X	—	29	23
Succisa pratensis	—	(X)	45	—	—	14	8
Taraxacum officinale	—	—	0	—	—	14	15
Taraxacum sp.	—	—	9	—	—	0	0
Teucrium scorodonia	—	—	9	—	—	0	0
Trifolium dubium	—	—	0	—	—	0	8
T. pratense	—	—	0	—	—	14	8
T. repens	4	—	**73**	2	6	**100**	**100**
Urtica dioica	—	—	9	—	—	14	15
Veronica chamaedrys	1	4	36	3	4	**71**	**62**
V. officinalis	X	—	9	—	—	0	0
V. serpyllifolia	—	—	0	—	—	14	8
Veronica sp.	—	—	0	—	—	0	8
Vicia augustifolia	—	—	0	—	—	29	15
V. cracca	—	—	9	—	—	0	0
Viola riviniana	(X)	(X)	**73**	2	X	43	23
Acrocladium cuspidatum	—	—	18	—	—	43	31
Atrichum undulatum	—	—	9	X	—	14	8
Brachythecium rutabulum	—	—	0	—	—	29	38
Bryum capillare	—	—	9	—	—	0	0
Camptothecium lutescens	—	—	18	—	—	0	0
Ctenidium molluscum	—	—	0	—	—	14	8
Dicranum scoparium	2	—	**73**	—	—	0	0
Entodon orthocarpus	—	—	9	—	—	0	0
Eurhynchium praelongum	—	—	0	—	—	14	38
Fissidens adianthoides	—	—	9	—	—	0	0
F. taxifolius	—	—	0	—	—	14	8
Grimmia apocarpa	—	—	0	—	—	14	8
Hylocomium splendens	(X)	X	**82**	3	—	29	15
Hypnum cupressiforme var. ericetorum	—	—	27	—	—	0	0
Hypnum cupressiforme var. lacunosum	—	—	36	—	—	0	0
Mnium longirostrum	1	—	18	—	—	0	0
M. undulatum	—	—	27	—	—	29	23
Pleurozium schreberi	2	1	**73**	—	—	0	0
Pohlia nutans	—	—	9	—	—	0	0
Pseudoscleropodium purum	3	2	**73**	4	—	43	23
Rhodobryum roseum	1	—	9	—	—	0	0
Rhytidiadelphus squarrosus	3	4	**82**	6	2	**86**	**69**
R. triquetrus	—	—	27	—	—	0	0
Thuidium delicatulum	—	—	0	—	—	14	8
T. tamariscinum	—	—	45	—	—	14	8
Weissia sp.	—	—	9	—	—	0	0
Frullania tamarisci	—	—	18	—	—	0	0
Lophocolea bidentata	—	—	55	—	—	14	15
Plagiochila asplenioides	—	—	9	—	—	0	0

	62101	62105		6296	62112		
Cladonia fimbriata	—	—	9	—	—	0	0
C. tenuis	—	—	18	—	—	0	0
Cladonia spp.	—	—	18	—	—	0	0
Number of species	28	22	97	28	22	90	102
Average	—	—	33	—	—	29	25
Number of stands	—	—	11	—	—	7	13

TABLE 24 AGROSTIS-FESTUCA ACID GRASSLAND

		Thymus drucei–Carex caryophyllea facies		Holcus lanatus—Poa pratensis facies			Deschampsia flexuosa—Dicranum scoparium facies					
Reference no.		62137	K—Presence within the facies	6293	6294	K—Presence within the facies	6297	62108	62124	63103	K—Presence within the facies	K—Presence within the community
Map reference		NO 022 377		NO 055 429	NO 057 429		NO 228 317	NO 183 147	NO 066 419	NO 412 229		
Altitude	ft.	950		700	700		660	560	600	200		
Aspect		S		N	N		NW	N	S	N		
Slope		14°		14°	14°		13°	18°	14°	30°		
Cover—field	%	95		95	95		100	95	90	90		
—ground	%	50		50	30		20	80	40	75		
Height—field	ins.	4–17		4–14	4–12		3–6	3–6	3–10	3–10		
Plot area	sq. m.	1		1	1		2	1	2	4		
Soil Series		BI		ET	ET		DL	SH	FU	SH		
Soil Sub-group		GBP		BP	BP		BP	BP	BP	BP		
Drainage		PPH		P	P		P	P	P	P		
pH		4·7		4·7	4·9		6·3	4·7	4·7	4·3		
Calluna vulgaris		—	33	—	—	10	(X)	(X)	—	—	56	31
Crataegus monogyna seedlings		—	7	—	—	0	—	—	—	—	0	3
Empetrum nigrum		—	7	—	—	0	—	—	—	—	0	3
Erica cinera		—	7	—	—	0	—	—	—	—	11	6
Sarothamnus scoparius		—	0	—	—	0	—	—	—	X	11	3
Thymus drucei		—	**80**	—	—	0	—	—	—	—	0	33
Ulex europaeus		—	0	—	—	10	—	(X)	—	—	22	14
Vaccinium myrtillus		—	27	X	—	40	2	1	—	1	**67**	39
Blechnum spicant		—	0	—	—	10	—	—	—	—	0	3
Pteridium aquilinum		6	20	—	—	40	—	—	—	X	33	28
Agrostis canina ssp. montana		—	40	3	3	70	3	—	—	—	56	50
A. tenuis		7	**100**	5	6	**100**	3	4	6	5	**100**	**100**

TABLE 24—*continued*

	62137		6293	6294		6297	62108	62124	63103		
Anthoxanthum odoratum	—	**87**	5	5	**100**	4	3	6	4	**100**	**94**
Deschampsia cespitosa	—	13	—	—	10	—	—	—	—	0	8
D. flexuosa	—	20	6	6	50	4	6	3	7	**100**	47
Festuca ovina	(X)	**93**	—	—	**80**	7	8	5	5	**100**	**92**
F. rubra	7	53	5	3	**60**	—	2	5	—	44	50
Holcus lanatus	—	27	5	4	**90**	—	—	—	—	0	39
H. mollis	—	7	—	—	20	—	—	—	X	22	14
Koeleria cristata	—	0	—	—	0	—	—	—	1	11	3
Molinia caerulea	—	0	—	—	0	—	—	—	—	11	3
Nardus stricta	—	27	—	—	0	—	—	—	—	11	14
Poa pratensis	—	20	—	—	**60**	—	—	—	—	11	31
P. trivialis	—	0	—	—	10	—	—	—	—	0	3
Sieglingia decumbens	—	47	—	—	10	X	—	—	—	33	31
Carex arenaria	—	0	—	—	0	—	—	—	—	0	6
C. binervis	—	0	—	—	10	—	—	—	—	0	3
C. caryophyllea	5	**73**	—	—	0	—	—	—	—	0	31
C. flacca	—	0	—	—	10	—	—	—	—	0	3
C. panicea	—	0	—	3	20	—	—	—	—	0	6
C. pilulifera	5	33	—	—	30	4	3	—	—	55	36
Carex spp.	—	13	—	—	0	—	—	—	—	11	8
Juncus squarrosus	—	0	—	—	0	—	—	—	—	11	3
Luzula campestris	—	**87**	2	4	**80**	5	3	4	3	**89**	**86**
L. multiflora	—	7	4	—	30	—	—	—	—	0	11
L. pilosa	—	0	2	—	30	—	—	—	—	11	11
Achillea millefolium	—	**60**	—	4	40	—	—	—	—	11	42
Anemone nemorosa	—	0	—	—	0	—	—	—	—	22	6
Angelica sylvestris	—	0	—	—	10	—	—	—	—	0	3
Bellis perennis	—	7	—	—	10	—	—	—	—	0	6
Campanula rotundifolia	6	**67**	2	—	30	5	—	(X)	—	44	47
Cerastium holosteoides	—	33	X	1	50	3	—	X	—	33	39
Cirsium arvense	—	0	—	1	10	—	—	—	—	0	3
C. palustre	—	0	—	(X)	10	—	—	—	—	0	3
Conopodium majus	—	13	—	—	20	—	—	—	X	22	17
Endymion non-scriptus	—	0	—	—	0	—	—	—	—	11	3

Euphrasia nemorosa	—	0	—	—	10	—	—	—	—	0	3
Euphrasia spp.	—	13	—	—	0	—	—	—	—	0	6
Galium saxatile	7	**100**	2	—	**90**	1	5	4	6	**100**	**97**
G. verum	—	7	—	—	10	1	—	—	—	11	8
Hieraceum pilosella	—	7	—	—	0	—	—	—	—	11	8
Hypericum pulchrum	—	0	—	—	10	—	—	—	—	0	3
Hypochoeris radicata	—	0	—	—	10	—	—	—	—	0	6
Lathyrus montanus	—	13	—	—	10	4	(X)	—	3	44	19
L. pratensis	—	0	—	—	10	—	—	—	—	0	3
Lotus corniculatus	—	47	—	—	30	1	—	3	—	33	36
L. uliginosus	—	7	—	—	0	—	—	—	—	0	3
Oxalis acetosella	—	0	1	—	10	—	—	—	—	11	6
Plantago lanceolata	—	53	—	—	20	—	—	(X)	—	22	33
Polygala serpyllifolia	X	27	X	—	10	—	—	—	—	11	17
Potentilla erecta	3	**93**	5	4	**100**	3	6	4	3	**100**	**94**
P. sterilis	2	7	—	—	0	—	—	—	—	0	3
Prunella vulgaris	—	7	—	—	0	—	—	—	—	0	3
Ranunculus acris	—	13	—	—	10	—	—	—	—	0	8
R. bulbosus	—	13	—	—	0	—	—	—	—	0	6
R. repens	—	7	X	X	40	—	—	—	—	0	14
Rhinanthus sp.	—	7	—	—	0	—	—	—	—	0	3
Rumex acetosa	—	27	—	—	50	—	—	—	—	0	25
R. acetosella	—	0	—	—	10	—	—	2	—	11	8
Senecio jacobaea	—	7	—	—	20	—	—	—	—	0	8
Succisa pratensis	—	0	—	—	20	—	—	—	—	0	6
Taraxacum officinale	—	7	—	—	0	—	—	—	—	0	3
Trientalis europaea	—	0	X	—	20	—	—	—	—	0	6
Trifolium repens	—	**80**	—	3	40	(X)	—	5	—	33	53
Veronica chamaedrys	—	33	4	3	50	X	—	2	—	44	39
V. officinalis	4	**80**	1	(X)	50	X	1	3	—	44	**61**
V. serpyllifolia	—	0	—	—	10	—	—	—	—	0	3
Viola lutea	—	7	—	—	0	—	—	—	—	11	6
V. riviniana	3	**73**	2	2	**70**	2	—	—	—	33	58
Acrocladium cuspidatum	—	7	—	—	0	—	—	—	—	0	3
Atrichum undulatum	—	7	—	(X)	10	—	—	—	—	0	6
Campylopus flexuosus	—	7	—	—	0	—	—	—	—	0	3
Ceratodon purpureus	—	0	—	—	0	—	—	—	—	0	3
Dicranum scoparium	6	53	1	—	10	1	(X)	1	1	**67**	47
Eurhynchium praelongum	—	20	—	—	0	—	—	—	—	0	8
Eurhynchium sp.	—	0	—	—	0	—	—	X	—	11	3
Hylocomium splendens	—	**87**	4	5	**80**	2	4	4	2	**100**	**89**

TABLE 24—*continued*

	62137		6293	6294		6297	62108	62124	63103		
Hypnum cupressiforme var. ericetorum	3	73	(X)	1	30	1	1	—	1	**67**	56
Mnium longirostrum	—	13	—	—	0	1	—	—	—	11	8
M. rugicum	—	7	—	—	0	—	—	—	—	0	3
M. undulatum	—	7	—	—	10	—	—	—	—	0	6
Mnium sp.	—	7	—	—	0	—	—	—	—	0	3
Polytrichum alpinum	—	20	—	1	10	—	—	—	—	11	14
P. aurantiacum	—	7	—	—	0	—	—	—	X	11	6
P. commune	—	0	1	—	20	—	—	—	—	11	8
P. formosum	—	0	—	—	0	—	—	—	—	11	3
P. juniperinum	—	13	—	—	0	X	—	—	—	11	14
P. piliferum	—	7	—	—	0	—	—	—	—	11	6
Pleurozium schreberi	3	**73**	6	4	40	3	9	3	8	**89**	**69**
Pseudoscleropodium purum	—	**67**	5	4	**80**	—	2	4	2	67	**69**
Rhytidiadelphus squarrosus	4	**100**	3	2	**100**	4	4	5	4	**100**	**100**
R. triquetrus	—	27	—	—	30	—	—	—	—	11	25
Thuidium tamariscinum	—	20	—	—	20	—	—	—	—	11	17
Barbilophozia barbata	—	7	—	—	0	—	—	—	—	0	3
Lophocolea bidentata	2	40	1	—	30	—	2	—	—	33	33
Plagiochila asplenioides	—	0	—	X	10	—	—	—	—	0	3
Ptilidium ciliare	—	7	—	—	0	3	—	—	—	11	6
Cladonia fimbriata	—	0	—	—	0	—	—	—	—	0	3
C. pyxidata	—	0	—	—	0	—	—	—	—	0	3
C. scabriuscula	—	0	—	—	0	—	—	—	—	0	3
C. subulata	—	0	—	—	0	—	—	—	—	0	3
Peltigera canina	—	13	—	—	0	—	—	—	—	0	8
Peltigera sp.	—	7	—	—	0	—	—	—	—	0	6
Number of species	18	78	29	26	70	29	21	22	21	62	113
Average	—	25	—	—	24	—	—	—	—	22	24
Number of stands	—	15	—	—	10	—	—	—	—	9	36

TABLE 25		NARDUS GRASSLAND — Polytrichum commune facies			VACCINIUM MYRTILLUS HEATH		
			K—Presence within the facies	K—Presence within the community			Present within two stands
Reference no.		63151			62106	63129	
Map reference		NO 207 283			NO 283 155	NO 307 203	
Altitude	ft.	720			625	650	
Aspect		SW			NNE	SE	
Slope		2°			18°	9°	
Cover— field	%	95			95	98	
ground	%	40			30	50	
Height field	ins.	10			5–13	3–13	
Plot Area	sq. m.	4			1	4	
Soil Subgroup		GBP			BP	BP	
Soil Series		MY			SH	SH	
Drainage		PPH			P	P	
pH		4·5			4·3	4·2	
Calluna vulgaris		3	31	29	—	X	+
Empetrum nigrum		—	13	6	—	—	0
Erica cinerea		—	0	6	—	1	+
E. tetralix		—	0	6	—	—	0
Sarothamnus scoparius		—	0	0	(X)	—	+
Thymus drucei		—	0	3	—	—	0
Ulex europaeus		—	0	6	—	—	0
Vaccinium myrtillus		X	**63**	**74**	8	8	+
V. vitis-idaea		—	13	6	—	—	0
Pteridium aquilinum		—	0	3	—	—	0
Agrostis canina ssp. montana		3	**100**	**91**	1	—	+
A. tenuis		—	44	47	—	5	+
Anthoxanthum odoratum		3	**88**	**91**	—	3	+
Deschampsia cespitosa		—	6	3	—	—	0
D. flexuosa		2	**94**	79	5	6	+
Festuca ovina		5	**100**	**100**	5	7	+
F. rubra		—	0	9	—	—	0
F. vivipara		—	13	6	—	—	0
Holcus lanatus		—	6	6	—	—	0
Lolium perenne		—	0	3	—	—	0
Molinia caerulea		—	6	15	—	—	0
Nardus stricta		9	**100**	**100**	—	2	+
Poa pratensis		—	0	3	—	—	0
Sieglingia decumbens		—	6	29	—	—	0
Carex binervis		—	13	35	—	—	0
C. caryophyllea		—	0	12	—	—	0
C. panicea		2	31	38	—	—	0
C. pilulifera		—	31	53	—	—	0
C. nigra		3	31	24	—	—	0
Carex sp.		—	6	3	—	—	0
Eriophorum vaginatum		—	6	3	—	—	0
Juncus effusus		—	0	3	—	—	0
J. conglomeratus		(X)	6	3	—	—	0
J. squarrosus		X	**75**	**62**	—	—	0

	63151			62106	63129	
Luzula campestris	—	31	50	—	—	0
L. multiflora	4	**81**	**65**	3	3	+
L. pilosa	—	6	6	—	—	0
Luzula sp.	—	0	3	—	—	0
Trichophorum caespitosum	—	0	12	—	—	0
Achillea millefolium	—	0	6	—	—	0
A. ptarmica	—	0	3	—	—	0
Anemone nemorosa	—	0	6	—	—	0
Campanula rotundifolia	—	0	3	—	—	0
Cerastium holosteoides	—	0	6	—	—	0
Dactylorchis maculata ssp. ericetorum	—	0	3	—	—	0
Euphrasia sp.	—	0	3	—	—	0
Galium saxatile	6	**94**	**97**	3	4	+
Hieraceum pilosella	—	0	3	—	—	0
Hypochoeris radicata	—	0	3	—	—	0
Lathyrus montanus	—	0	3	—	—	0
Narthecium ossifragum	—	0	6	—	—	0
Oxalis acetosella	—	0	3	—	—	0
Plantago lanceolata	—	0	6	—	—	0
Polygala serpyllifolia	—	6	9	—	—	0
Potentilla erecta	2	**88**	**94**	4	5	+
Rumex acetosa	—	0	6	—	—	0
R. acetosella	—	0	3	—	—	0
Succisa pratensis	—	0	6	—	—	0
Trifolium repens	—	0	3	—	—	0
Veronica officinalis	—	0	6	—	—	0
Viola lutea	—	0	3	—	—	0
V. riviniana	—	0	3	(X)	—	+
Acrocladium stramineum	—	6	3	—	—	0
Aulacomnium palustre	X	6	3	—	—	0
Campylopus flexuosus	—	6	18	—	—	0
C. fragilis	—	6	3	—	—	0
C. piriformis	—	6	6	—	—	0
Ceratodon purpureus	—	0	6	—	—	0
Dicranella heteromalla	—	6	3	—	—	0
Dicranum scoparium	1	38	44	X	1	+
Dicranum sp.	—	0	0	1	—	+
Drepanocladus revolvens var. intermedius	—	6	3	—	—	0
Hylocomium splendens	4	31	53	4	—	+
Hypnum cupressiforme var. ericetorum	6	**81**	**76**	1	4	+
Leptodontium flexifolium	—	0	3	—	—	0
Leucobryum glaucum	—	0	3	—	—	0
Mnium hornum	—	25	18	—	—	0
Plagiothecium undulatum	—	**63**	38	—	—	0
Plagiothecium sp.	—	0	0	X	—	+
Pleurozium schreberi	4	**81**	**85**	4	6	+
Pohlia nutans	X	13	18	—	—	0
Polytrichum alpinum	—	0	15	—	—	0
P. aurantiacum	—	6	15	—	—	0
P. commune	1	**81**	41	—	—	0
P. juniperinum	—	6	9	—	1	+
P. piliferum	—	0	3	—	—	0
Pseudoscleropodium purum	—	31	29	3	—	+
Rhacomitrium lanuginosum	—	6	3	—	—	0
Rhytidiadelphus loreus	—	13	12	—	—	0
R. squarrosus	3	**81**	**85**	4	1	+
Sphagnum capillaceum	—	0	3	—	—	0
Thuidium tamariscinum	—	0	6	—	—	0

	63151			62106	63129	
Anastrepta orcadensis	—	0	3	—	—	0
Barbilophozia floerkei	—	0	3	—	—	0
Calypogeia fissa	1	13	9	—	—	0
C. muelleriana	—	13	9	—	—	0
Cephaloziella starkei	—	0	3	—	—	0
Diplophyllum albicans	—	0	6	—	—	0
Gymnocolea inflata	—	13	9	—	—	0
Lophocolea bidentata	3	56	56	3	—	+
Lophozia ventricosa	—	6	3	—	—	0
Ptilidium ciliare	—	13	18	—	3	+
Cladonia arbuscula	—	0	0	—	5	+
C. fimbriata	—	0	3	—	—	0
C. impexa	—	0	3	—	—	0
C. pyxidata	—	0	3	X	—	+
Cladonia spp.	—	6	3	—	—	0
Cornicularia aculeata	—	6	3	—	—	0
Parmelia physodes	—	0	0	—	1	+
Number of species	24	58	104	19	19	28
Average	—	19	21	—	—	19
Number of stands	—	16	34	—	—	2

TABLE 26. CAREX WET PASTURE

(Salix repens facies)

			K—Presence within the community
Reference no.		62123	
Map reference		NO 089 343	
Altitude	ft.	270	
Aspect		NE	
Slope		1°	
Cover—			
field	%	90	
ground	%	75	
Height—			
field	ins.	4–6	
Plot Area	sq. m.	1	
Soil Subgroup		HG	
Soil Series		LR	
Drainage		PH	
pH		5·2	
Betula pendula		—	6
B. pubescens		—	6
B. pubescens ssp. odorata		—	6
Pinus sylvestris		—	19
Juniperus communis		—	13
Rosa rubiginosa		—	6
Betula pubescens seedlings		—	19
Calluna vulgaris		—	50
Crataegus monogyna seedlings		—	6
Empetrum nigrum		—	13
Erica cinerea		—	13
E. tetralix		—	56
Pinus sylvestris seedlings		—	6
Salix aurita/(cinerea ssp. atrocinerea)		X	6
S. repens		7	19
Thymus drucei		—	6
Vaccinium myrtillus		—	6
Equisetum palustre		—	19
Selaginella selaginoides		—	56
Agrostis canina		4	31
A. stolonifera		—	25
A. tenuis		—	13
Anthoxanthum odoratum		1	56
Briza media		—	6
Cynosurus cristatus		—	6
Deschampsia cespitosa		—	6
Festuca ovina		—	56
F. rubra		2	50
Helictotrichon pratense		—	6
Holcus lanatus		1	31
Koeleria cristata		—	19
Molinia caerulea		—	56
Nardus stricta		2	63
Poa pratensis		—	13
Sieglingia decumbens		—	31
Carex capillaris		—	6
C. caryophyllea		—	6
C. curta		—	6

	62123	
Carex demissa	—	13
C. dioica	—	31
C. echinata	—	13
C. hostiana	—	44
C. flacca	—	38
C. lepidocarpa	—	13
C. nigra	6	31
C. ovalis	3	6
C. panicea	6	**88**
C. pilulifera	—	6
C. pulicaris	3	**75**
Carex sp.	—	6
Eleocharis quinqueflora	—	25
Eriophorum angustifolium	—	44
E. latifolium	—	19
Luzula campestris	—	13
L. multiflora	—	19
Luzula sp.	—	6
Juncus acutiflorus	—	31
J. articulatus	1	38
J. bulbosus	—	13
J. conglomeratus	(X)	19
J. squarrosus	—	13
Juncus sp.	—	6
Schoenus nigricans	—	19
Triglochin palustris	—	6
Achillea ptarmica	2	38
Ajuga reptans	—	6
Alchemilla xanthochlora	—	6
Anemone nemorosa	—	6
Bellis perennis	—	6
Campanula rotundifolia	—	6
Cerastium holosteoides	—	13
Cirsium palustre	—	6
Dactylorchis spp.	—	19
Drosera rotundifolia	—	13
Euphrasia micrantha	—	13
Euphrasia spp.	—	13
Filipendula ulmaria	—	13
Galium boreale	—	6
G. palustre	—	6
G. saxatile	3	19
G. uliginosum	1	6
Hydrocotyle vulgaris	—	13
Hypericum pulchrum	—	25
Leontodon autumnalis	—	25
Linum catharticum	—	19
Lotus corniculatus	—	13
Narthecium ossifragum	—	19
Oxalis acetosella	—	6
Parnassia palustris	—	31
Pedicularis palustris	—	31
P. sylvatica	—	13
Pinguicula vulgaris	—	44
Plantago lanceolata	—	25
Polygala serpyllifolia	—	25
P. vulgaris	—	6
Polygala sp.	—	6
Polygonum viviparum	—	6
Potentilla erecta	X	**100**
Prunella vulgaris	4	50
Pyrola minor	—	6

	62123	
Ranunculus acris	2	50
R. flammula	X	13
R. repens	—	6
Rumex acetosa	—	6
Sagina nodosa	—	6
S. procumbens	—	6
Saxifraga aizoides	—	6
Succisa pratensis	1	**81**
Taraxacum palustre	—	13
Trifolium repens	2	44
Veronica chamaedrys	—	6
V. officinalis	—	25
Viola riviniana	—	19
V. palustris	—	6
Acrocladium cuspidatum	6	56
Aulacomnium palustre	—	13
Brachythecium rivulare	—	13
Breutelia chrysocoma	—	6
Bryum pallens	—	6
B. pseudotriquetrum	—	25
Bryum sp.	—	6
Campylium stellatum	—	50
Ceratodon purpureus	—	6
Climacium dendroides	7	19
Cratoneuron filicinum	—	6
Ctenidium molluscum	—	**63**
Dicranella heteromalla	—	6
Dicranum bonjeanii	—	6
D. scoparium	—	13
Ditrichum flexicaule	—	6
Drepanocladus revolvens	—	25
var. intermedius	—	13
D. vernicosus	—	6
Drepanocladus sp.	—	6
Eurhynchium praelongum	—	19
E. striatum	—	6
Fissidens adianthoides	—	50
Hylocomium brevirostre	—	6
H. splendens	—	56
Hypnum cupressiforme		
var. ericetorum	—	31
Mnium hornum	—	25
M. undulatum	—	19
M. punctatum	—	13
Philonotis fontana	—	13
Plagiothecium undulatum	—	6
Pleurozium schreberi	—	38
Polytrichum commune	—	6
Pseudoscleropodium purum	—	38
Rhytidiadelphus squarrosus	1	44
R. triquetrus	X	31
Scorpidium scorpioides	—	6
Sphagnum contortum	—	6
S. girgensohnii	—	6
S. recurvum	—	6
S. subsecundum	—	6
S. plumulosum	—	6
Thuidium delicatulum	—	6
T. tamariscinum	—	50
Calypogeia fissa	—	44
C. muelleriana	—	6
Cephalozia bicuspidata		
var. lammersiana	—	6

	62123	
Cephalozia sp.	—	6
Lejeunea lamacerina	—	6
Lophocolea bidentata	—	44
Lophozia ventricosa	—	6
Pellia fabbroniana	—	13
Plagiochila asplenioides	—	6
Riccardia multifida	—	13
R. pinguis	—	19
Riccardia sp.	—	6
Scapania irrigua	—	6
Cladonia pyxidata	—	6
Peltigera canina	—	6
Nitella	—	6
Number of species	26	168
Average	—	34
Number of stands	1	16

TABLE 27 DRY CALLUNA MOOR

		Nardus stricta facies		Lathyrus montanus facies		General facies							
Reference no.		63133	K—Presence within the facies	6298	K—Presence within the facies	62100	62107	62136	63142	63143	63150	K—Presence within the facies	K—Presence within the community
Map reference		NO 367 413		NO 227 321		NO 274 373	NO 281 154	NO 025 381	NO 444 403	NO 443 404	NO 221 321		
Altitude	ft.	830		725		850	675	1000	625	625	1050		
Aspect		N		SE		NW	N	SE	NE	N	NE		
Slope		10°		16°		8°	7°	14°	9°	11°	17°		
Cover—field	%	90		90		95	95	95	95	90	90		
—ground	%	85		15		40	45	90	70	95	80		
Height—field	ins.	10		15		9	8–12	12–15	11	17	9		
Plot Area	sq. m.	4		1		1	1	2	4	4	4		
Soil Sub-group		GP		BP		IP	BP	IP	GP	GP	BP		
Soil Series		MR		GA		CQ	SH	OB	MR	MR	DL		
Drainage		PPH		P		P	P	P	PPH	PPH	P		
pH		4·1		4·5		4·1	3·7	3·8	3·8	3·9	4·1		
Age of Calluna years		8		—		6	—	14	7	12	—		
Betula pendula		—	0	—	0	—	—	—	—	—	—	3	2
B. pubescens		—	0	—	0	—	—	—	—	—	—	3	2
Pinus sylvestris		—	0	—	0	—	—	—	—	—	—	7	3
Arctostaphylos uva-ursi		—	0	—	57	—	—	—	—	—	—	0	17
Betula pubescens seedlings		—	0	—	14	—	—	—	—	—	—	3	3
Culluna vulgaris		9	**100**	9	**100**	8	9	9	10	9	9	**100**	**100**
Empetrum nigrum		—	7	—	29	—	—	—	—	—	—	7	20
Erica cinerea		1	50	—	**86**	7	—	6	—	—	5	53	**60**
E. tetralix		—	14	—	0	—	—	—	(X)	X	—	7	6
Genista anglica		—	0	—	43	—	—	—	—	—	—	0	9
Pinus sylvestris seedlings		—	0	—	29	—	—	—	X	—	—	3	5
Sarothamnus scoparius		X	7	—	0	—	—	—	—	—	—	0	2
Sorbus aucuparia seedlings		—	14	—	14	—	—	—	—	—	—	7	8
Ulex europaeus		—	0	—	0	—	—	—	—	—	—	0	2
Vaccinium myrtillus		6	**71**	4	**71**	—	6	6	5	6	2	**71**	**75**
V. vitis-idaea		—	0	—	57	—	—	4	—	—	X	13	28

Blechnum spicant	—	7	—	14	—	—	—	—	—	—	0	5
Lycopodium clavatum	—	0	—	0	—	—	—	—	—	—	3	3
L. selago	—	0	—	14	—	—	—	—	—	—	3	5
Pteridium aquilinum	—	7	—	0	—	—	—	—	—	—	0	2
Agrostis canina ssp. montana	1	**93**	—	**71**	X	—	1	—	—	—	17	46
A. tenuis	—	7	(X)	43	—	—	—	—	—	—	7	12
Anthoxanthum odoratum	—	0	—	14	—	—	—	—	—	—	3	6
Deschampsia flexuosa	4	**86**	(X)	**86**	3	5	5	(X)	3	4	**83**	**85**
Festuca ovina	(X)	**86**	—	**86**	—	—	X	—	—	—	20	45
F. rubra	—	0	—	0	—	—	—	—	—	—	0	2
Holcus mollis	—	0	—	14	—	—	—	—	—	—	0	2
Molinia caerulea	—	21	—	0	—	—	—	—	—	—	3	6
Nardus stricta	X	**86**	—	14	—	—	—	—	—	—	0	22
Sieglingia decumbens	(X)	29	—	0	—	—	—	—	—	—	0	6
Carex arenaria	—	0	—	0	—	—	—	—	—	—	0	3
C. binervis	(X)	21	—	0	—	—	—	—	—	—	17	15
C. nigra	—	0	—	0	—	—	—	—	—	—	17	11
C. panicea	2	14	—	14	—	—	—	—	—	—	0	11
C. pilulifera	X	21	—	57	2	—	—	—	—	X	20	26
Carex spp.	—	7	—	14	—	—	—	—	—	—	3	5
Luzula campestris	—	0	—	0	—	—	—	—	—	—	0	2
L. multiflora	1	36	—	57	—	—	—	—	—	1	10	23
L. pilosa	X	7	—	43	—	—	3	—	—	—	13	14
Luzula spp.	—	7	—	14	—	—	—	—	—	—	0	3
Juncus effusus	—	7	—	0	—	—	—	—	—	—	0	2
J. squarrosus	—	50	—	0	—	—	—	—	—	—	13	22
Trichophorum cespitosum	—	7	—	0	—	—	—	—	—	—	7	6
Anemone nemorosa	—	0	—	57	—	—	—	—	—	—	0	6
Antennaria dioica	—	0	—	29	—	—	—	—	—	—	3	6
Campanula rotundifolia	—	0	(X)	57	—	—	—	—	—	—	0	6
Euphrasia micrantha	—	0	—	29	—	—	—	—	—	—	0	5
Euphrasia sp.	—	0	—	0	—	—	—	—	—	—	0	2
Galium saxatile	—	29	(X)	**71**	1	—	X	—	—	—	17	22
Hypericum pulchrum	—	0	—	14	—	—	—	—	—	—	0	2
Hypochoeris radicata	—	0	—	14	—	—	—	—	—	—	0	2
Goodyera repens	—	0	—	0	—	—	—	—	—	—	0	2
Lathyrus montanus	—	0	1	**71**	—	—	—	—	—	—	0	8
Listera cordata	—	14	—	29	1	—	—	—	—	—	17	23
Lotus corniculatus	—	0	X	57	—	—	—	—	—	—	0	9

TABLE 27—*continued*

	63133		6298		62100	62107	62136	63142	63143	63150		
Pedicularis palustris	—	0	—	0	—	—	—	—	—	—	0	2
Polygala serpyllifolia	—	0	—	29	—	—	—	—	—	—	3	6
Potentilla erecta	2	**93**	(X)	**100**	—	(X)	1	X	—	X	33	57
Pyrola media	—	0	—	29	—	—	—	—	—	—	0	5
Trientalis europaea	3	7	—	57	—	—	1	—	—	—	3	12
Veronica officinalis	—	0	—	14	—	—	X	—	—	—	3	3
Viola canina	—	0	—	0	—	—	—	—	—	—	0	2
V. riviniana	—	0	—	57	—	—	—	—	—	—	0	6
Campylopus flexuosus	—	21	—	0	—	—	—	—	—	—	17	15
C. piriformis	—	0	—	0	—	—	—	—	—	—	7	3
Ceratodon purpureus	—	7	—	14	—	—	—	—	—	—	3	8
Dicranella heteromalla	—	0	—	0	—	—	—	—	—	—	7	3
Dicranum fuscescens	—	0	—	0	—	—	—	—	—	—	3	11
D. majus	—	7	—	0	—	—	—	—	—	—	0	2
D. scoparium	4	**79**	—	**71**	2	(X)	4	6	3	5	**87**	**86**
D. spurium	—	0	—	0	—	—	—	—	—	—	0	2
Hylocomium splendens	1	43	—	**71**	—	6	—	—	2	(X)	27	42
Hypnum cupressiforme var. ericetorum	8	**100**	4	**100**	6	3	9	2	8	8	**83**	**91**
Leptodontium flexifolium	—	7	—	0	—	—	—	—	—	—	7	5
Leucobryum glaucum	—	0	—	0	—	—	—	—	—	—	7	3
Mnium hornum	—	0	—	0	—	—	—	—	—	—	0	5
Plagiothecium undulatum	—	14	—	0	—	—	—	—	3	—	10	9
Pleurozium schreberi	3	**79**	2	**100**	1	4	3	—	7	5	50	**69**
Pohlia nutans	3	57	—	57	4	—	—	2	1	2	**67**	**66**
Polytrichum aurantiacum	—	14	—	0	—	—	—	—	—	—	0	3
P. commune	—	36	—	14	—	—	—	(X)	3	X	20	26
P. formosum	—	0	—	0	—	—	—	—	—	—	3	2
P. juniperinum	—	7	—	29	(X)	—	—	—	—	—	13	14
P. piliferum	—	0	—	43	—	—	—	—	—	—	3	9
Pseudoscleropodium purum	—	7	4	29	—	—	—	—	—	—	0	5
Rhacomitrium heterostichum	—	0	—	0	—	—	—	—	—	—	0	2
Rhytidiadelphus loreus	—	7	—	0	—	—	—	—	—	—	0	5
R. squarrosus	2	43	1	43	—	(X)	—	—	—	2	10	18
R. triquetrus	—	0	—	29	—	—	—	—	—	—	3	12

Barbilophozia barbata	—	0	—	14	—	—	—	—	—	—	0	2
B. floerkei	—	0	—	0	—	—	—	—	—	—	7	9
B. hatcheri	—	0	—	0	—	—	—	—	—	—	0	5
Calypogeia fissa	—	7	—	0	—	—	—	—	—	—	3	5
C. muelleriana	3	14	—	0	—	—	—	5	—	—	7	6
Cephalozia bicuspidata	—	0	—	0	—	—	—	—	—	X	7	3
C. media	—	0	—	0	—	—	—	—	—	—	3	2
Cephaloziella hampeana	—	0	—	0	—	—	—	—	—	—	3	3
C. starkei	—	7	—	14	—	—	—	—	—	—	7	9
Cephaloziella sp.	—	0	—	0	—	—	—	—	—	—	3	2
Diplophyllum albicans	—	0	—	0	—	—	—	—	—	1	7	6
Gymnocolea inflata	—	0	—	0	—	—	—	—	—	—	3	2
Gymnomitrion concinnatum	—	0	—	0	—	—	—	—	—	—	0	2
Lepidozia trichoclados	—	0	—	0	—	—	—	—	—	—	3	2
Lophocolea bidentata	—	57	—	29	—	—	1	—	2	—	17	25
Lophozia alpestris	—	0	—	0	—	—	—	—	—	—	0	2
L. bicrenata	—	0	—	0	—	—	—	—	—	—	7	5
L. incisa	—	0	—	0	—	—	—	—	—	—	3	2
L. porphyroleuca	—	0	—	0	—	—	—	—	—	—	7	6
L. ventricosa	—	7	—	0	—	—	—	5	—	—	3	3
Lophozia spp.	—	0	—	0	—	—	—	—	—	—	0	3
Marsupella emarginata	—	0	—	29	—	—	—	—	—	—	0	5
Ptilidium ciliare	—	0	—	14	—	—	—	—	—	—	0	6
Scapania compacta	—	0	—	0	—	—	—	—	—	—	0	2
S. gracilis	—	0	—	0	—	—	—	—	—	—	0	2
Sphenolobus minutus	—	0	—	0	—	—	—	—	—	—	0	3
Tritomaria exsectiformis	—	0	—	0	—	—	—	—	—	—	0	2
Alectoria nigricans	—	0	—	0	—	—	—	—	—	—	0	2
Cladonia arbuscula	—	7	—	0	—	—	—	—	—	—	13	12
C. carneola	—	7	—	0	—	—	—	—	—	—	0	2
C. cenotea	—	0	—	0	3	—	—	—	—	—	3	2
C. cervicornis	—	0	—	0	—	—	—	—	—		0	3
C. chlorophaea	—	0	—	0	—	—	—	—	—	—	0	2
C. coccifera	—	7	—	14	—	—	—	(X)	—	—	10	17
C. coniocraea	—	0	—	0	—	—	—	—	—	—	0	2
C. cornuta	—	7	—	14	—	—	—	2	—	—	3	12
C. deformis	—	7	—	0	X	—	—	3	X	—	10	9
C. digitata	—	0	—	0	—	—	—	—	1	—	10	5
C. fimbriata	—	7	—	14	—	—	—	—	—	—	7	8
C. floerkeana	—	14	—	29	3	—	—	3	—	—	27	28
C. furcata	—	7	—	0	—	—	—	—	—	—	7	12

TABLE 27—*continued*

	63133		6298		62100	62107	62136	63142	63143	63150		
Cladonia glauca	—	7	—	14	—	—	—	2	1	—	20	15
C. gracilis	—	7	—	0	—	—	—	—	—	—	10	12
C. impexa	—	21	—	71	3	—	—	X	1	—	37	48
C. macilenta	—	7	—	0	—	—	—	—	—	—	0	2
C. pityrea	—	0	—	0	—	—	—	—	—	—	3	2
C. pyxidata	—	7	—	29	1	—	—	4	X	—	23	28
C. rangiferina	—	7	—	0	—	—	—	—	—	—	0	2
C. rangiformis	—	0	—	14	—	—	—	—	—	—	0	5
C. squamosa	—	0	—	14	1	—	—	3	1	—	23	23
C. subulata	—	7	—	0	—	—	—	—	—	—	0	3
C. tenuis	—	7	—	0	—	—	—	—	—	—	0	2
C. uncialis	—	0	—	0	—	—	—	—	—	—	3	9
Cladonia spp.	—	7	1	43	4	—	—	—	(X)	—	33	32
Cornicularia aculeata	—	0	—	0	—	—	—	—	—	—	0	5
Evernia prunastri	—	0	—	0	—	—	—	—	—	—	0	2
Ichmadophila ericetorum	—	0	—	0	—	—	—	—	—	—	3	2
Ochrolechia frigida	—	0	—	0	—	—	—	—	—	—	0	2
Parmelia physodes	—	14	1	43	3	2	—	—	—	—	33	42
P. saxatilis	—	0	—	0	—	—	—	—	—	—	0	2
Peltigera canina	—	0	—	14	—	—	—	—	—	—	0	5
Peltigera spp.	—	0	—	29	—	—	—	—	—	—	0	6
Sphaerophorus globosus	—	0	—	0	—	—	—	—	—	—	0	2
Usnea glabrescens	—	0	—	0	—	—	—	—	—	—	0	2
Number of species	23	69	15	71	20	10	16	20	19	17	86	150
Average	—	18	—	28	—	—	—	—	—	—	14	19
Number of stands	—	14	—	7	—	—	—	—	—	—	30	65

TABLE 28

		WET CALLUNA MOOR							CALLUNA-ERIOPHORUM VAGINATUM-TRICHOPHORUM MOOR			
		Sphagnum compactum–Cladonia impexa facies	K—Presence within the facies	General facies	K—Presence within the facies	Molinia caerulea–Potentilla erecta facies	K—Presence within the facies	K—Presence within the community	Dried-out peat and hummock facies		K—Presence within the facies	K—Presence within the community
Reference no.		63120		6299		62132			63123	63124		
Map reference		NO 529 131		NO 275 371		NO 027 371			NO 013 237	NO 009 235		
Altitude	ft.	325		1000		570			120	125		
Aspect		NW		E		E			NIL	W		
Slope		1°		3°		3°			0°	1°		
Cover—field	%	60		98		75			50	70		
—ground	%	75		50		75			90	80		
Height—field	ins.	6		10		2–4			4–9	7		
Plot Area	sq. m.	4		1		1			4	4		
Soil Sub-group		AG		GP		PG			RM	RM		
Soil Series		RH		—		—			—	—		
Drainage		PH		PPH		PH			—	—		
pH		3·9		4·0		3·9			3·5	3·5		
Age of Calluna years		7		9		—			2	—		
Pinus sylvestris		—	8	—	7	—	0	5	—	—	0	3
Andromeda polifolia		—	0	—	0	—	0	0	—	—	0	2
Betula pubescens seedlings		—	0	—	0	—	0	0	—	X	17	5
Calluna vulgaris		6	100	9	100	6	100	100	5	5	100	95
Empetrum nigrum		—	17	—	27	—	9	18	—	—	17	31
Erica cinerea		—	8	(X)	7	—	18	11	—	—	0	0
E. tetralix		6	92	5	93	X	100	95	6	8	83	92
Genista anglica		—	0	—	0	—	9	3	—	—	0	0
Myrica gale		—	0	—	0	—	0	0	—	—	0	10
Pinus sylvestris seedlings		—	17	—	0	—	0	5	—	—	0	3
Sorbus aucuparia seedlings		—	0	—	0	—	9	3	—	—	0	0

TABLE 28—*continued*

	63120		6299		62132			63123	63124		
Vaccinium myrtillus	—	8	1	27	—	36	24	—	—	0	26
V. oxycoccus	—	0	—	0	—	0	0	—	—	0	25
V. vitis-idaea	—	8	—	7	—	0	5	—	—	0	0
Agrostis canina ssp. montana	—	0	—	0	—	36	11	—	—	0	2
A. tenuis	1	8	—	0	—	9	5	—	—	0	0
Anthoxanthum odoratum	—	0	—	0	(X)	36	11	—	—	0	2
Deschampsia flexuosa	—	0	1	33	—	55	29	—	—	0	39
Festuca ovina	—	0	—	27	(X)	82	34	—	—	0	7
F. rubra	—	0	—	7	—	0	3	—	—	0	0
Molinia caerulea	4	25	—	53	4	82	53	—	—	0	25
Nardus stricta	—	8	4	33	3	45	29	—	—	0	5
Poa annua	X	8	—	0	—	0	3	—	—	0	0
P. pratensis	—	0	—	7	—	0	3	—	—	0	2
P. trivialis	—	0	—	0	—	0	0	—	—	0	2
Carex binervis	—	25	—	0	—	9	11	—	—	0	0
C. curta	—	0	—	0	—	0	0	—	—	0	3
C. echinata	—	8	—	7	—	9	8	—	—	0	0
C. nigra	2	42	—	40	—	45	42	—	—	0	34
C. panicea	—	58	—	0	—	36	29	—	—	0	7
C. pauciflora	—	0	—	0	—	0	0	—	—	0	5
C. pilulifera	—	8	—	0	—	9	5	—	—	0	0
Carex spp.	—	0	—	7	—	9	5	—	—	0	8
Eriophorum angustifolium	—	42	—	7	—	36	36	—	—	50	72
E. vaginatum	—	8	—	0	—	9	5	5	3	100	92
Juncus acutiflorus	—	0	—	7	—	9	5	—	—	0	0
J. bulbosus	—	0	—	0	—	0	0	—	—	0	2
J. kochii	—	0	—	0	—	9	3	—	—	0	2
J. squarrosus	2	83	X	47	6	45	58	—	—	17	21
Luzula campestris	—	0	—	0	—	9	3	—	—	0	0
L. multiflora	—	8	—	0	—	27	11	—	—	0	8
L. pilosa	—	0	—	7	—	9	5	—	—	0	0
Luzula sp.	—	0	—	0	—	0	0	—	—	0	2
Rhynchospora alba	—	0	—	0	—	0	0	2	4	33	7
Trichophorum cespitosum	5	100	—	80	4	91	89	—	—	33	82
Dryopteris carthusiana	—	0	—	0	—	0	0	—	—	0	3
Dryopteris sp.	—	0	—	0	—	0	0	—	—	0	2

Cerastium holosteoides	—	0	—	0	—	9	3	—	—	0	2
Dactylorchis maculata ssp. ericetorum	—	17	—	0	—	18	11	—	—	0	2
Drosera intermedia	—	0	—	0	—	0	0	—	—	0	2
D. rotundifolia	—	17	—	0	—	0	5	1	3	50	48
Euphrasia sp.	—	0	—	0	—	9	3	—	—	0	0
Galium saxatile	—	0	—	0	—	9	3	—	—	0	7
Listera cordata	—	0	—	27	—	0	11	—	—	0	2
Menyanthes trifoliata	—	0	—	0	—	0	0	—	—	0	2
Narthecium ossifragum	—	8	—	20	5	18	16	—	—	17	57
Polygala serpyllifolia	—	8	—	0	—	9	5	—	—	0	2
Polygala sp.	—	0	—	0	—	0	0	—	—	0	2
Potentilla erecta	—	8	(X)	7	—	**82**	29	—	—	0	31
Rumex acetosella	—	0	—	0	—	9	3	—	—	0	0
Succisa pratensis	—	0	—	0	—	9	3	—	—	0	0
Veronica officinalis	—	0	—	0	—	9	3	—	—	0	0
Acrocladium cuspidatum	—	0	—	0	—	9	3	—	—	0	0
Aulacomnium palustre	—	17	—	20	—	9	16	—	—	33	44
Breutelia chrysocoma	—	0	—	0	—	9	3	—	—	0	0
Campylopus flexuosus	4	50	—	20	—	9	26	—	—	17	21
C. piriformis	—	0	—	7	—	9	5	—	—	17	11
Campylopus sp.	—	0	—	0	—	9	3	—	—	0	2
Ceratodon purpureus	—	0	—	0	—	18	8	—	—	0	2
Dicranum fuscescens	1	8	—	0	—	0	3	—	—	0	0
D. scoparium	3	**92**	4	**100**	4	**82**	**92**	—	—	50	52
Drepanocladus fluitans	—	0	—	0	—	0	0	—	—	0	2
D. uncinatus	—	0	—	0	—	9	3	—	—	0	0
Hylocomium splendens	—	25	—	20	—	36	26	—	—	17	7
Hypnum cupressiforme var. ericetorum	2	**92**	2	**100**	8	**91**	**95**	—	—	**67**	**69**
H. imponens	—	0	—	0	—	0	0	—	—	0	2
Leptodontium flexifolium	—	0	—	0	—	9	3	—	—	0	0
Leucobryum glaucum	—	8	X	20	1	18	16	—	—	0	7
Mnium hornum	—	0	X	7	—	17	11	—	—	0	3
Plagiothecium undulatum	—	17	—	53	—	18	32	—	—	17	36
Pleurozium schreberi	—	42	6	**93**	3	55	**66**	—	—	50	**62**
Pohlia nutans	6	50	—	20	—	55	39	2	—	50	36
Pohlia nutans	6	50	—	20	—	55	39	2	—	50	36
Polytrichum alpestre	—	0	—	7	—	0	3	1	—	33	34
P. commune	(X)	50	5	7	—	18	24	—	—	0	25
P. juniperinum	—	0	—	0	—	0	0	—	—	17	7
Rhacomitrium canescens	—	8	—	0	—	0	3	—	—	0	0
R. lanuginosum	—	42	—	0	—	9	8	—	—	17	8

TABLE 28—*continued*

	63120		6299		62132			63123	63124		
Rhytidiadelphus loreus	—	8	—	20	—	18	16	—	—	0	20
R. squarrosus	—	0	—	7	—	9	5	—	—	17	16
R. triquetrus	—	0	—	13	—	0	5	—	—	0	2
Sphagnum capillaceum	—	8	—	20	—	0	11	—	—	50	34
S. compactum	7	83	2	27	—	0	37	6	6	33	5
S. cuspidatum	—	17	—	7	—	0	8	2	—	17	26
S. magellanicum	—	0	—	0	—	0	0	5	—	33	30
S. molle	—	0	—	0	—	0	0	6	4	33	3
S. palustre	—	0	—	0	—	0	0	—	—	0	5
S. papillosum	—	8	—	0	—	0	3	—	—	0	44
S. plumulosum	—	17	—	20	—	18	18	—	—	0	28
S. recurvum	—	0	—	0	—	0	0	—	—	0	25
S. rubellum	—	8	—	20	—	0	11	—	—	0	15
S. subsecundum	—	0	—	0	—	0	0	—	—	0	2
var. auriculatum	—	8	—	0	—	0	3	—	—	0	0
var. inundatum	—	0	—	0	—	9	3	—	—	0	0
S. tenellum	—	42	—	0	—	0	13	5	7	33	25
Sphagnum spp.	—	0	—	0	X	9	3	—	—	0	8
Splachnum sphaericum	—	0	—	0	—	0	0	—	—	0	2
Barbilophozia attenuata	1	8	—	0	—	0	3	—	—	0	0
B. floerkei	—	17	—	13	—	0	11	—	—	0	5
Calypogeia fissa	—	17	—	7	—	27	16	—	—	17	16
C. muelleriana	—	0	3	40	—	0	16	—	—	0	51
C. neesiana	2	8	—	0	—	0	3	—	—	0	0
C. sphagnicola	—	0	—	0	—	0	0	2	3	50	5
Calypogeia spp.	—	17	—	0	—	0	5	—	—	0	7
Cephalozia bicuspidata	—	8	—	7	—	9	8	2	—	17	8
C. connivens	—	17	—	20	—	0	13	4	—	67	33
C. leucantha	—	0	—	0	—	0	0	—	—	0	2
C. media	2	17	—	0	—	0	5	—	—	0	2
Cephalozia spp.	—	8	—	7	—	0	5	—	4	17	7
Cephaloziella hampeana	—	0	—	13	—	0	5	—	—	0	2
C. starkei	—	0	—	0	—	9	3	—	—	0	0
Cephaloziella spp.	—	8	—	0	—	9	5	—	—	0	3
Diplophyllum albicans	—	42	—	7	—	0	16	—	—	17	10
Gymnocolea inflata	1	75	—	0	—	0	24	—	—	0	5

	Lepidozia reptans	—	0	—	0	—	0	0	—	—	0	2
X	L. setacea	—	8	—	7	—	0	5	—	1	17	8
	L. trichoclados	4	33	—	13	—	9	18	—	—	50	13
	Lepidozia spp.	—	0	—	0	—	0	0	1	—	17	3
	Lophocolea bidentata	—	0	—	20	3	27	16	—	—	0	7
	Lophozia incisa	—	0	—	0	—	0	0	—	—	0	2
	L. porphyroleuca	—	8	—	7	—	0	5	—	—	17	11
	L. ventricosa	—	33	—	33	—	9	26	—	—	17	26
	Lophozia spp.	—	0	—	0	—	0	0	—	—	0	7
	Mylia anomala	—	8	—	13	—	0	8	2	3	33	30
	M. taylori	—	0	—	0	—	0	0	—	—	0	5
	Mylia spp.	—	8	—	0	—	9	5	—	—	0	2
	Odontoschisma denudatum	—	0	—	0	—	0	0	—	—	0	2
	O. sphagni	—	0	—	13	—	0	5	1	—	**67**	39
	Pleurozia purpurea	—	0	—	0	—	0	0	—	—	0	2
	Ptilidium ciliare	—	0	—	13	—	9	8	—	—	0	11
	Riccardia latifrons	—	0	—	0	—	0	0	—	—	0	3
	R. multifida	—	0	—	0	—	0	0	—	—	0	2
	Riccardia sp.	—	0	—	0	—	0	0	—	—	0	2
	Scapania gracilis	—	0	—	0	—	0	0	—	—	0	2
	Sphenolobus minutus	—	33	—	7	—	0	13	—	—	0	5
	Tritomaria exsectiformis	—	0	—	7	—	0	3	—	—	0	0
	Cetraria glauca	—	0	—	0	—	0	0	—	—	0	3
	Cladonia arbuscula	—	25	—	13	2	18	18	—	—	0	8
	C. bellidiflora	—	0	—	7	—	0	3	—	—	0	0
	C. coccifera	—	33	—	7	—	0	13	—	—	0	2
	C. cornuta	—	0	—	0	—	0	0	—	—	0	2
	C. crispata	X	25	—	0	—	0	0	—	—	17	2
	C. deformis	1	17	—	0	—	0	8	—	—	17	2
	C. fimbriata	—	0	—	0	—	0	5	—	—	17	5
	C. floerkeana	X	**67**	—	7	—	0	0	—	—	0	2
	C. furcata	—	17	—	7	—	9	26	—	—	17	2
	C. glauca	—	0	—	7	—	0	8	—	X	17	3
	C. gracilis	—	8	—	7	—	0	3	—	—	17	5
	C. impexa	X	**<u>83</u>**	—	47	—	9	8	—	—	17	5
	C. macilenta	1	8	—	0	—	18	50	—	3	**67**	28
	C. pyxidata	—	33	—	33	—	0	3	—	—	0	0
	C. rangiferina	—	8	—	0	—	0	24	—	—	33	8
	C. scabriuscula	—	0	—	7	—	0	3	—	—	0	0
	C. squamosa	—	33	—	27	—	0	3	—	—	0	0
	C. uncialis	—	33	—	13	—	0	21	—	—	17	7
	Cladonia spp.	1	25	—	13	—	9	18	—	—	17	13

TABLE 28—*continued*

	63120		6299		62132			63123	63124		
Cornicularia aculeata	—	8	—	0	—	0	3	—	—	0	2
C. muricata	—	0	—	0	—	0	0	—	—	0	2
Parmelia physodes	—	33	—	47	—	0	29	—	1	17	11
Usnea hirta	—	0	—	7*	—	0	3*	—	—	0	0
Blue-green algae	—	0	—	0	—	0	0	—	—	0	2
Galera hypnorum	—	0	—	7	—	0	3	—	—	0	0
Mirasmius androsaceus	—	0	—	7	—	0	3	—	—	0	3
Number of species	26	83	16	78	16	78	128	18	16	56	136
Average	—	23	—	18	—	19	20	—	—	18	21
Number of stands	—	12	—	15	—	11	38	—	—	6	61

TABLE 29

	FORESHORE			FOREDUNES		
Reference no.	63115	63136	—	63108	63116	—
Map reference	NO	NO	—	NO	NO	—
	492	561	—	502	492	—
	194	333	—	257	194	—
Altitude ft.	2	2	—	2	3	—
Aspect	W	E	—	E	W	—
Slope	2°	9°	—	9°	3°	—
Cover— field %	35	1	—	25	35	—
Height— field ins.	9	9	—	8	20–45	—
Plot Area sq. m.	1	10×1	—	4	—	—
Drainage	—	—	—	—	—	—
pH	8·4	8.0	—	8·5	8·1	—
Agropyron junceiforme	—	—	—	6	4	—
Ammophila arenaria	—	X	—	—	—	—
Elymus arenarius	4	—	—	—	6	—
Atriplex glabriuscula	—	X	—	—	—	—
A. laciniata	4	—	—	—	3	—
Cakile maritima	6	X	—	—	(X)	—
Honkenya peploides	—	X	—	—	—	—
Salsola kali	—	X	—	—	—	—
Number of species	3	5	7	1	4	4
Number of stands	—	—	3	—	—	3

TABLE 30

		AMMOPHILA-ELYMUS MOBILE DUNE					AMMOPHILA-FESTUCA RUBRA FIXED DUNE							FESTUCA-AGROSTIS DUNE PASTURE				JUNCUS GERARDII DUNE SLACK	
							Astragalus danicus facies					Lichen-rich facies		Koeleria cristata facies					
						K—Presence within the community					K—Presence within the facies		K—Presence within the community			K—Presence within the facies	K—Presence within the community		Present within two stands
Reference no.		63110	63118	63135	63139		63119	63134	63137	63141		63111		63138	63140			63112	
Map reference		NO 501 256	NO 492 194	NO 560 335	NO 542 307		NO 493 193	NO 561 336	NO 542 309	NO 507 324		NO 501 256		NO 539 308	NO 541 310			NO 501 257	
Altitude	ft.	15	8	12	15		10	15	12	20		12		8	15			4	
Aspect		W	E	N	S		NE	SE	N	SW		W		NIL	SW			NIL	
Slope		4°	10°	14°	20°		7°	8°	4°	14°		9°		0°	14°			0°	
Cover —field	%	35	65	70	70		70	98	95	80		25		98	60			95	
—ground	%	15	1	15	—		20	35	1	8		80		50	80			20	
Height—field	ins.	22	36	30	30		24	15	15–31	13–23		18		4	7–18			21	
Plot Area	sq. m.	4	4	4	4		4	4	4	4		4		4	4			4	
Soil Sub-group														GBS					
Drainage		—	—	—	—		—	—	—	—		—		PPH	—			—	
pH		8·2	8·5	7·8	7·3		7·4	7·1	7·8	4·5		5·1		7·2	5·2			5·3	
Rosa rubiginosa		—	—	—	—	0	—	—	—	—	0	—	9	—	—	0	0	—	0
Salix cinerea ssp. atrocinerea		—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	1	+
S. repens		—	—	—	—	0	—	—	—	—	0	—	0	7	—	17	14	1	+
Thymus drucei		—	—	—	—	0	—	2	1	—	43	—	27	4	4	**100**	**86**	—	0
Equisetum palustre		—	—	—	—	0	—	—	—	—	14	—	9	—	—	0	0	—	0
Polypodium vulgare		—	—	—	—	0	—	—	—	—	0	1	9	—	—	0	0	—	0
Agropyron junceforme		1	—	—	—	29	—	—	—	—	0	1	9	—	—	0	0	—	0
A. repens		—	—	—	—	0	—	—	—	—	0	—	9	—	—	17	14	—	0
Agrostis stolonifera		(X)	—	—	—	14	—	—	—	—	0	—	0	—	—	0	0	4	+
A. tenuis		—	—	—	—	14	—	—	2	5	29	—	18	3	4	**83**	**86**	—	0
Aira praecox		—	—	—	—	14	—	—	—	—	0	—	9	—	—	17	14	—	0
Ammophila arenaria		6	—	8	8	**86**	—	2	5	4	**86**	5	**91**	—	4	50	57	—	0
Anthoxanthum odoratum		—	—	—	—	0	—	—	—	4	14	—	9	2	5	**83**	71	—	+

Arrhenatherum elatius	—	—	—	—	0	—	—	—	—	29	—	27	—	—	0	0	—	0
Bromus sp.	—	—	—	—	0	—	2	—	—	14	—	9	—	—	0	0	—	0
Dactylis glomerata	—	—	—	—	0	X	—	—	—	14	—	9	—	—	0	14	—	0
Elymus arenarius	4	6	3	1	57	6	4	—	—	29	—	18	—	—	0	0	—	0
Festuca ovina	—	—	—	—	0	—	—	—	5	29	—	18	5	5	**100**	**86**	—	0
F. rubra	—	—	—	—	29	5	7	—	2	**86**	—	**82**	3	—	**83**	**86**	7	+
F. rubra var. arenaria	—	6	4	4	57	—	—	6	—	14	3	18	—	—	0	0	—	0
Helictotrichon pubescens	—	—	—	—	0	—	—	—	—	0	—	0	—	—	50	43	—	0
Holcus lanatus	—	2	—	—	29	—	—	—	—	29	—	36	—	—	17	14	—	0
Koeleria cristata	—	2	—	—	14	3	4	3	1	57	—	36	3	3	**100**	**86**	—	0
Lolium perenne	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	14	—	0
Phleum arenarium	4	1	—	—	29	—	—	—	—	0	—	0	—	—	0	0	—	0
Poa pratensis	(X)	3	(X)	3	**71**	2	4	6	3	**100**	2	**100**	—	—	**67**	**71**	—	+
Carex arenaria	—	—	—	1	43	—	1	3	5	**86**	—	**64**	4	6	**67**	**71**	—	0
C. caryophyllea	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	—	0
C. flacca	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	—	+
C. hostiana	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	1	+
C. maritima	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	—	+
Carex spp.	—	—	—	—	0	—	—	—	—	14	—	9	2	—	33	29	—	0
Juncus balticus	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	(X)	+
J. gerardii	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	8	+
Luzula campestris	—	—	—	—	0	—	—	—	X	29	—	27	—	3	**67**	**71**	—	0
Achillea millefolium	—	2	—	1	29	3	4	—	4	43	—	27	X	—	50	57	—	0
Anthyllis vulneraria	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	—	0
Astragalus danicus	—	—	—	1	14	3	5	1	—	**86**	—	55	6	1	**100**	**86**	—	0
Bellis perennis	—	—	—	—	0	X	—	—	—	14	—	9	—	—	17	29	—	0
Campanula rotundifolia	—	—	—	—	14	5	—	—	3	43	—	27	2	X	**67**	**71**	—	0
Centaurium erythraea	—	—	—	—	0	—	—	—	—	0	1	9	—	—	0	0	1	+
C. littorale	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	3	+
Cerastium arvense	—	—	—	—	0	—	—	—	—	14	—	9	—	—	0	0	—	0
C. holosteoides	—	—	—	—	0	3	1	1	X	**86**	—	**82**	1	1	**83**	71	—	0
C. semidecandrum	—	—	—	—	0	—	—	—	—	0	—	18	—	—	17	14	—	0
Cerastium sp.	2	—	—	—	14	—	—	—	—	0	—	0	—	—	0	0	—	0
Chamaenerion angustifolium	(X)	—	—	—	14	—	—	—	—	0	2	18	—	—	0	0	—	0
Cirsium arvense	—	(X)	—	2	57	X	—	(X)	—	57	—	45	—	—	17	14	—	0
C. vulgare	—	—	—	—	0	—	—	X	—	14	—	9	—	—	0	0	—	0
Coeloglossum viride	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	—	0
Crepis capillaris	—	—	—	—	0	X	—	—	—	14	—	9	—	—	0	0	—	0
Cynoglossum officinale	—	—	—	—	0	—	—	—	—	14	—	9	—	—	0	0	—	0
Epilobium nerterioides	—	—	—	—	0	—	—	—	—	0	—	9	—	—	0	0	—	0

TABLE 30—*continued*

	63110	63118	63135	63139		63119	63134	63137	63141		63111		63138	63140			63112	
Erodium cicutarium	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	—	0
Euphrasia confusa/foulaensis	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	—	0
E. foulaensis	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	—	+
E. nemorosa	—	—	—	—	0	—	—	—	—	0	—	0	4	1	50	43	—	0
Filago minima	3	—	—	—	14	—	—	—	—	0	—	9	—	—	0	0	—	0
Galium saxatile	—	—	—	—	0	—	—	—	—	0	—	0	—	1	17	29	—	0
G. verum	—	—	X	(X)	43	2	4	3	3	**100**	—	**82**	5	6	**100**	**100**	—	0
Gentianella campestris	—	—	—	—	0	—	—	—	—	0	—	0	6	—	17	14	—	0
Geranium molle	—	—	—	—	0	—	—	—	—	0	—	9	—	—	17	14	—	0
Glaux maritima	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	5	+
Gnaphalium sp.	—	—	—	—	0	—	—	—	—	0	—	9	—	—	0	0	—	0
Heracleum sphondylium	—	—	—	—	0	—	—	—	—	14	—	9	—	—	0	0	—	0
Hieracium pilosella	X	—	1	—	29	5	—	1	—	43	3	36	6	3	**83**	**71**	—	0
Hieraclum sp.	—	—	—	—	0	—	—	—	4	14	3	18	—	—	0	0	—	0
Hypochoeris radicata	4	4	1	X	**71**	4	1	(X)	2	57	—	55	—	3	17	29	X	+
Leontodon autumnalis	—	—	—	—	0	—	3	—	—	29	—	18	—	—	33	43	—	0
Linum catharticum	—	—	—	—	0	—	—	—	—	0	—	0	3	—	50	43	—	+
Lotus corniculatus	—	(X)	—	—	29	(X)	2	—	4	**71**	2	**64**	3	—	**83**	**86**	—	+
Medicago lupulina	—	—	—	—	0	2	—	—	—	14	—	9	—	—	0	0	—	0
Myosotis arvensis	—	—	—	—	0	—	—	—	—	14	—	9	—	—	0	0	—	0
M. ramosissima	—	—	—	—	0	—	—	—	—	14	—	18	—	—	0	0	—	0
Myosotis sp.	—	—	—	—	0	—	—	—	—	14	—	9	—	—	0	0	—	0
Ononis repens	—	—	—	(X)	29	(X)	6	8	—	57	—	55	—	—	0	14	—	0
Parnassia palustris	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	6	+
Plantago lanceolata	—	—	—	—	0	2	3	1	1	**71**	—	55	4	2	**83**	**86**	—	0
P. maritima	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	1	+
Prunella vulgaris	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	—	+
Ranunculus bulbosus	—	—	—	—	0	—	—	—	—	0	—	0	—	—	50	57	—	0
Rhinanthus minor ssp. stenophyllus	—	—	—	—	0	2	3	—	—	29	—	27	—	—	0	0	3	+
Rumex acetosella	—	—	—	—	14	—	—	—	—	0	3	9	—	—	17	14	—	0
Sagina nodosa	—	—	—	—	0	—	—	—	—	0	X	9	—	—	0	0	3	+
Sedum acre	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	—	0
Senecio jacobaea	(X)	—	1	(X)	**86**	X	2	2	X	**71**	(X)	**73**	2	1	**83**	**86**	—	0
S. vulgaris	2	—	—	—	14	—	—	—	—	0	—	0	—	—	0	0	—	0
Sonchus asper	—	—	—	—	14	—	—	—	—	0	—	0	—	—	0	0	—	0
Sonchus sp.	—	—	—	—	0	—	—	—	—	0	—	18	—	—	0	0	—	0
Stellaria graminea	—	—	—	—	0	—	—	—	—	0	—	0	—	—	33	29	—	0

Taraxacum laevigatum	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	—	0
T. officinale	1	—	2	1	**71**	X	X	—	—	29	(X)	45	—	—	0	0	—	0
T. spectabile	—	2	—	—	14	—	X	1	—	29	X	27	—	—	0	0	—	0
Taraxacum spp.	—	—	—	—	0	—	—	—	—	14	—	18	X	—	17	14	—	+
Torilis japonica	—	—	—	—	0	—	1	—	—	14	—	9	—	—	0	0	—	0
Tragopogon pratensis	—	X	—	—	14	X	1	—	—	29	—	18	—	—	0	0	—	0
Trifolium arvense	—	—	—	—	0	3	—	—	—	14	—	9	—	—	17	14	—	0
T. campestre	—	—	—	—	0	1	—	—	—	14	—	9	—	—	17	14	—	0
T. repens	—	—	—	—	0	3	—	—	—	29	—	18	5	X	**100**	**100**	—	+
Urtica dioica	—	—	—	—	0	—	—	—	—	14	—	9	—	—	0	0	—	0
Veronica arvensis	—	—	—	—	0	—	—	—	—	0	—	0	—	—	33	29	—	0
V. chamaedrys	—	—	—	—	0	—	—	4	1	43	—	27	3	—	**67**	57	—	0
V. officinalis	—	—	—	—	0	—	—	—	—	0	—	0	—	X	33	29	—	0
Vicia hirsuta	—	—	—	—	0	—	2	—	—	14	—	9	—	—	0	0	—	0
V. lathyroides	—	—	(X)	—	14	X	—	—	—	14	—	9	—	—	0	0	—	0
V. stiva ssp. angustifolia	—	—	—	—	0	—	—	—	—	0	—	9	—	—	0	0	—	0
Viola canina	—	—	—	—	14	—	—	2	—	14	—	9	3	2	50	57	—	0
V. hirta	—	—	—	—	0	—	—	—	—	0	—	9	—	—	0	0	—	0
V. riviniana	—	—	—	—	0	—	—	—	—	0	(X)	9	—	—	0	0	—	0
Viola sp.	—	—	—	—	0	—	—	—	—	14	—	9	—	—	0	0	—	0
Acrocladium cuspidatum	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	—	+
Barbula fallax	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	—	+
Brachythecium albicans	—	—	2	—	14	5	2	—	X	57	—	55	—	—	17	14	—	0
B. rutabulum	—	—	—	—	0	2	—	1	—	43	—	45	—	—	0	0	—	0
Bryum inclinatum	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	5	+
B. pseudotriquetrum	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	—	+
B. pendulum	3	2	5	—	57	—	—	—	—	0	—	0	—	—	0	0	—	0
Bryum spp.	—	—	—	—	0	—	—	1	X	43	—	36	—	—	0	0	—	0
Campylium stellatum	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	—	+
Ceratodon purpureus	5	1	—	—	29	2	—	X	3	57	5	**73**	—	2	33	29	—	0
Climacium dendroides	—	—	—	—	0	—	—	—	—	29	—	18	4	—	**67**	57	—	+
Dicranum scoparium	—	—	—	—	0	—	—	—	1	29	3	36	—	7	33	29	—	0
Eurhynchium praelongum	—	—	—	—	0	1	1	—	—	29	—	27	—	—	0	0	—	0
Hylocomium splendens	—	—	—	—	0	—	—	—	1	43	—	27	—	—	50	43	—	+
Hypnum cupressiforme	—	—	—	—	0	1	—	—	—	14	1	18	—	—	17	14	—	0
H. cupressiforme	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
var. lacunosum	—	—	—	—	0	—	—	X	—	14	—	9	—	1	33	29	—	0
Mnium longirostrum	—	—	—	—	0	—	—	—	—	14	—	9	—	—	0	0	—	0
M. punctatum	—	—	—	—	0	—	—	—	—	0	—	9	—	—	0	0	—	0
M. undulatum	—	—	—	—	0	—	X	—	1	43	—	36	3	—	17	14	—	0
Pleurozium schreberi	—	—	—	—	0	—	—	—	—	0	—	0	X	6	33	29	—	0
Pohlia nutans	—	—	—	—	0	—	—	—	1	14	—	9	—	—	0	0	—	0

TABLE 30—*continued*

	63110	63118	63135	63139		63119	63134	63137	63141		63111		63138	63140			63112	
Polytrichum juniperinum	—	—	—	—	0	—	—	—	1	14	—	9	—	2	17	14	—	0
Pseudoscleropodium purum	—	—	—	—	0	—	—	—	3	57	—	55	4	—	33	29	—	0
Rhytidiadelphus squarrosus	—	—	—	—	0	X	7	—	—	43	—	27	7	—	83	71	—	+
R. triquetrus	—	—	—	—	0	—	1	—	—	14	—	9	3	—	83	71	—	+
Tortula ruraliformis	—	—	1	—	14	—	—	—	—	14	—	18	—	—	0	0	—	0
Cephaloziella starkei	—	—	—	—	0	—	—	—	—	0	—	9	—	—	0	0	—	0
Lophocolea bidentata	—	—	—	—	0	—	2	—	—	14	—	18	—	—	0	0	—	0
L. heterophylla	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	—	0
Lophozia ventricosa	—	—	—	—	0	—	—	—	—	0	—	9	—	—	0	0	—	0
Ptilidium ciliare	—	—	—	—	0	—	—	—	—	0	—	0	—	X	17	14	—	0
Riccardia sp.	—	—	—	—	0	—	—	—	—	0	—	0	—	—	0	0	4	+
Cladonia arbuscula	—	—	—	—	0	—	—	—	—	0	—	0	—	6	17	14	—	0
C. coccifera	—	—	—	—	0	—	—	—	—	0	1	9	—	—	0	0	—	0
C. cornuta	—	—	—	—	0	—	—	—	—	0	(X)	18	—	—	0	0	—	0
C. fimbriata	—	—	—	—	0	—	—	—	—	0	—	9	—	—	17	14	—	0
C. furcata	—	—	—	—	0	—	—	—	X	14	—	9	—	1	17	14	—	0
C. gracilis	—	—	—	—	0	—	—	—	—	0	—	0	—	—	17	14	—	0
C. impexa	—	—	—	—	0	—	—	—	—	0	X	9	—	—	0	0	—	0
C. pyxidata	—	—	—	—	0	—	—	—	—	0	7	18	—	—	17	14	—	0
C. rangiformis	—	—	—	—	0	—	—	—	—	0	—	0	—	—	33	29	—	0
C. scabriuscula	—	—	—	—	0	—	—	—	—	0	5	9	—	—	0	0	—	0
Cladonia spp.	—	—	—	—	0	—	—	—	3	14	—	9	—	(X)	17	14	—	0
Parmelia physodes	—	—	—	—	0	—	—	—	—	0	4	9	—	—	0	0	—	0
Peltigera canina	—	—	—	—	0	—	—	—	—	0	—	9	—	—	50	43	—	0
P. polydactyla	—	—	—	—	0	—	—	—	—	0	—	0	—	3	17	14	—	0
Peltigera sp.	—	—	—	—	0	—	—	—	—	0	—	9	—	—	0	0	—	0
Usnea subfloridana	—	—	—	—	0	—	—	—	—	0	X	9	—	—	0	0	—	0
Number of species	16	14	13	13	38	33	30	24	30	78	26	109	31	31	78	81	17	35
Average	—	—	—	—	12	—	—	—	—	26	—	24	—	—	33	31	—	21
Number of stands	—	—	—	—	7	—	—	—	—	7	—	11	—	—	6	7	—	2

APPENDIX VI (*cont.*)

Plant Communities and Major Soil Subgroups

In Table 31, two values for exchangeable calcium, exchangeable magnesium and total phosphate are given. The first is the uncorrected value and the second is the corrected. The specific gravity of organic soil material is less than that of mineral soil material and, in order to compare the levels of the different nutrients more realistically, a correction factor for the amount of organic matter present has been applied. This factor is $\frac{100}{x+100}$, where x is the percentage of organic matter.

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
W3	Woodland with *Holcus mollis* and *Dryopteris dilatata*
W3a	*Endymion non-scriptus* facies
W3c	Coniferous plantation facies
W4	Woodland with *Dryopteris* and *Rubus*
W4a	*Viola riviniana* facies
W4b	*Mnium hornum* facies
W5	Woodland with *Holcus mollis* and *Anthoxanthum odoratum*
W5a	*Festuca rubra* facies
W5b	*Pteridium aquilinum* facies
W6	Woodland with *Anthoxanthum odoratum* and *Agrostis tenuis*
W7	Woodland with *Vaccinium myrtillus*
W7a	*Oxalis acetosella* facies
W7b	General facies
W8	Woodland with *Deschampsia flexuosa*
W11	Woodland with *Calluna vulgaris* and *Erica cinerea*
W12	Woodland with *Deschampsia cespitosa*
W12a	*Rhytidiadelphus squarrosus* facies
W12b	*Athyrium filix-femina* facies
W13	Woodland with *Juncus acutiflorus*
W14	Woodland with *Filipendula ulmaria* and *Angelica sylvestris*
P1	*Agrostis-Festuca* basic grassland
P2	*Agrostis-Festuca* meadow grassland
P2b	*Potentilla erecta* facies
P3	*Agrostis-Festuca* acid grassland
P3a	*Thymus drucei-Carex caryophyllea* facies
P3b	*Holcus lanatus-Poa pratensis* facies
P3c	*Deschampsia flexuosa-Dicranum scoparium* facies
P4	*Nardus* grassland
P4b	*Polytrichum commune* facies
P5	*Vaccinium myrtillus* heath

P8	*Carex* wet pasture
P8d	*Salix repens* facies
M1	Dry *Calluna* moor
M1b	*Nardus stricta* facies
M1c	*Lathyrus montanus* facies
M1d	General facies
M2	Wet *Calluna* moor
M2a	*Sphagum compactum-Cladonia impexa* facies
M2b	General facies
M2c	*Molinia caerulea-Potentilla erecta* facies
M3	*Calluna-Eriophorum vaginatum-Trichophorum* moor
M3d	Dried-out peat and hummock facies
S1	Foreshore community
S2	Foredune community
S3	*Ammophila-Elymus* mobile dune community
S4	*Ammophila-Festuca rubra* fixed dune community
S4a	*Astragalus danicus* facies
S4b	Lichen-rich facies
S5	*Festuca-Agrostis* dune pasture
S5a	*Koeleria cristata* facies
S6	*Juncus gerardii* dune slack community

Abbreviations used for the subgroups and variants of the major soil groups appear in the introduction to tables 16–30.

TABLE 31—*continued*

Major Soil Subgroups	PODZOLS										NON-CALCAREOUS GLEYS									
Additional Subdivisions and Variants	IP				GP						BG					AG				
Soil Series	ST	FY	CQ	OB		MR	MR	MR	MR		SG	VG	AE	AE	MV	AE	RH	LR	AE	RH
Plant Community or Facies	W7b	W8	M1d	M1d	W8	W11	M1b	M1d	M1d	M2b	W1a	W12a	W12b	W13	W14	W12b	W12b	W12b	W13	M2a
Reference no.	62130	63127	62100	62136	63121	62114	63133	63142	63143	6299	62140	62129	6291	6295	62135	6285	62116	62138	6287	63120
Altitude—ft.	900	575	850	1000	250	325	830	625	625	1000	25	415	550	600	250	340	310	430	425	325
Aspect	E	NW	NW	SE	N	SSE	N	NE	N	E	NIL	NIL	N	N	NIL	NW	NIL	W	N	NW
Slope	16°	13°	8°	14°	5°	8°	10°	9°	11°	3°	0°	0°	3°	9°	0°	4°	0°	2°	8°	1°
Drainage	P	P	P	P	PPH	PPH	PPH	PPH	PPH	PPH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH
pH—surface horizon	3·9	3·5	4·1	3·8	3·7	4·0	4·1	3·8	3·9	4·0	5·4	5·0	5·2	5·2	5·3	4·5	4·2	3·9	4·5	3·9
Base Saturation—%																				
—surface horizon	9·6	8·5	1·7	9·2	5·9	14·1	20·2	18·3	6·1	4·3	64·7	42·6	59·7	50·9	48·5	26·8	1·3	10·6	15·5	23·8
—B horizon	1·6	1·5	1·1	3·3	1·7	1·6	1·2	1·4	3·4	0·9	54·4	91·4	66·5	42·2	79·6	—	56·0	15·4	19·7	62·6
—C horizon	—	—	33·2	—	3·3	49·3	—	4·3	1·5	69·1	24·1	73·8	100	59·1	—	87·7	96·4	75·7	—	46·9
Exchangeable Ca																				
m.e./100g.—surface	5·64	2·39	0·0	1·63	0·0	1·09	11·17	11·10	0·0	0·0	15·71	6·29	6·36	10·89	7·35	3·40	0·0	2·18	2·29	1·2
	3·78	1·74	0·0	1·04	0·0	0·94	5·92	6·11	0·0	0·0	14·30	5·79	5.98	9·47	6·84	3·06	0·0	1·87	2·08	1·1
Exchangeable Mg																				
m.e./100g.—surface	1·93	1·12	0·36	2·61	1·10	0·70	4·58	6·09	2·32	0·97	2·61	1·12	1·67	1·94	3·00	0·79	1·05	0·77	0·61	0·1
	1·29	0·82	0·31	1·67	0·87	0·60	2·43	3·35	1·35	0·80	2·38	1·03	1·57	1·69	2·79	0·71	0·99	0·66	0·56	0·1
Carbon: Nitrogen																				
ratio—surface	24·4	21·3	19.2	27·9	13·1	24·0	30·6	28·7	39·7	26·4	14·5	18·9	17·6	21·7	14·1	13·4	15·8	14·3	14·7	10·0
Total P_2O_5																				
mg./100g.—surface	232	173	135	266	118	105	265	287	397	151	110	116	108	159	145	130	113	179	114	43
	155	126	116	170	93	90	140	158	230	124	100	107	102	138	135	117	106	154	104	41

Major Soil Subgroups	PEATY GLEYS			PEAT		IMMATURE SOILS															
Additional Subdivisions and Variants	HG		PG	RM		DUNE SAND															
Soil Series		LR	—	—	—	—	—	—	—	—	—	—	—	—	LN	—	—	—	—	—
Plant Community or Facies	W13	P8d	M2c	M3d	M3d	S1	S1	S2	S2	S3	S3	S3	S3	S4a	S4a	S4a	S4a	S4b	S5a	S6
Reference no.	6286	62123	62132	63123	63124	63115	63136	63108	63116	63110	63118	63135	63139	63119	63134	63137	63141	63111	63140	63112
Altitude—ft.	340	270	570	120	125	2	2	2	3	15	8	12	15	10	15	12	20	12	15	4
Aspect	NW	NE	E	NIL	W	W	E	E	W	W	E	N	S	NE	SE	N	SW	W	SW	NIL
Slope	8°	1°	3°	0°	1°	2°	9°	9°	3°	4°	10°	14°	20°	7°	8°	4°	14°	9°	14°	0°
Drainage	HP	PH	PH	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
pH—surface horizon	4·9	5·2	3·9	3·5	3·5	8·4	8·0	8·5	8·1	8·2	8·5	7·8	7·3	7·4	7·1	7·8	4·5	5·1	5·2	5·3
Base Saturation—%																				
—surface horizon	50·7	54·2	15·1	19·0	10·6	100	100	100	100	100	100	100	100	100	100	100	25·3	38·7	81·7	75·2
—B horizon	45·2	69·5	1·1	17·6	17·1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—C horizon	61·2	89·3	13·2	13·2	13·2	100	—	—	—	100	100	100	100	100	100	100	100	100	100	100
Exchangeable Ca																				
m.e./100g.—surface	20·06	22·59	5·91	10·29	2·57	12·92	4·93	10·29	10·51	6·79	21·04	17·42	5·13	17·52	15·59	3·80	1·52	1·21	2·42	3·06
	14·84	17·85	3·30	5·66	1·52	12·92	4·93	10·29	10·51	6·79	20·83	17·42	5·08	17·17	14·65	3·80	1·46	1·16	2·32	2·78
Exchangeable Mg																				
m.e./100g.—surface	4·26	3·93	4·78	7·26	5·64	0·87	1·32	0·70	0·64	0·32	1·00	0·46	0·23	0·97	2·65	0·23	0·50	0·46	0·87	4·94
	3·15	3·10	2·68	3·99	3·33	0·87	1·32	0·70	0·64	0·32	0·99	0·46	0·23	0·95	2·49	0·23	0·48	0·44	0·84	4·50
Carbon: Nitrogen																				
ratio—surface	20·9	23·0	26·2	32·3	24·5	9·5	12·7	9·3	10·0	10·8	11·1	9·5	9·0	10·0	9·9	10·0	9·7	20·7	12·1	18·9
Total P_2O_5																				
mg./100g.—surface	220	199	287	123	115	69	120	51	98	60	53	147	97	69	125	104	93	102	85	121
	163	157	161	68	68	69	120	51	98	60	52	147	96	68	118	104	89	98	82	110

TABLE 31. STANDS OF PLANT COMMUNITIES AND FACIES WITH MAIN SITE CHARACTERISTICS

Major Soil Subgroups	BROWN FOREST SOILS																								
Additional Subdivisions and Variants	BCS	BFS														BP									
Soil Series	DL	GA	AL	AL	DL	SH	DF	DL	GI	FU			SY		GE	DL	DL	SY	FU	FU	SH	DL	DL	AY	BU
Plant Community or Facies	W1a	W1a	W1b	W1b	P1	P2b	W1a	W1b	W3a	W3c	W4a	W4b	W5a	W5a	W5a	W5a	W5a	W5b	W6	W7a	W7b	W7b	W7b	W8	W8
Reference no.	63147	63126	62117	63132	62101	62112	62102	63145	62119	62125	63107	63106	6289	62103	62110	62128	63146	6290	62131	6284	6283	62122	62127	62126	62134
Altitude—ft	350	550	75	75	850	550	230	350	175	575	130	70	575	150	260	450	400	560	475	500	625	500	450	420	200
Aspect	W.	W	E	NIL	SE	SE	N.	W.	NW.	NW.	W	SE	NE	NW	NE	SE	W	NE	W.	S.	N.	NW.	S.	N.	NW.
Slope	1°	8°	5°	0°	21°	13°	6°	6°	23°	16°	4°	2°	12°	5°	18°	7·5°	10°	12°	13°	12°	6°	11°	8°	15°	10°
Drainage	P	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—surface horizon	7·6	5·2	5·6	5·0	5·2	5·6	5·0	4·9	3·7	4·0	3·8	3·7	4·1	4·3	4·7	4·6	4·6	3·9	4·1	3·7	3·8	3·9	4·5	4·4	3·8
Base Saturation—%																									
—surface horizon	100	68·4	76·3	54·2	57·1	66·5	8·2	27·6	2·0	15·3	2·8	13·2	11·6	15·2	45·1	19·9	13·3	12·1	8·4	12·1	12·4	7·4	8·8	3·5	3·4
—B horizon	100	54·0	65·8	52·5	79·7	88·7	47·0	17·4	2·0	4·9	6·6	1·9	0·9	2·1	8·0	2·2	4·7	1·2	4·5	3·8	1·7	2·8	4·9	3·4	1·5
—C horizon	—	—	86·7	59·2	93·0	95·5	60·5	—	1·0	—	23·0	2·4	6·3	2·0	13·6	—	—	—	—	2·4	—	—	—	—	—
Exchangeable Ca																									
m.e./100g.—surface	65·95	11·74	8·9	9·26	15·77	7·74	0·47	6·25	0·0	5·65	0·0	4·88	3·14	1·53	3·36	3·44	3·19	3·98	1·08	4·01	6·43	0·0	1·09	0·32	0·0
	60·67	10·68	8·5	8·98	14·04	7·35	0·45	5·63	0·0	4·24	0·0	3·81	2·39	1·39	3·12	2·92	2·52	2·87	0·98	2·61	4·37	0·0	1·00	0·28	0·0
Exchangeable Mg																									
m.e./100g.—surface	1·25	2·10	2·21	2·08	4·59	2·72	0·61	1·73	0·36	2·15	0·67	2·10	1·31	0·84	0·90	1·63	2·09	1·86	0·40	2·70	2·73	2·63	0·40	0·25	1·06
	1·15	1·91	2·10	2·02	4·09	2·58	0·59	1·56	0·31	1·61	0·59	1·64	1·00	0·76	0·84	1·39	1·65	1·34	0·36	1·76	1·86	1·58	0·37	0·22	0·82
Carbon: Nitrogen																									
ratio—surface	11·3	10·5	11·2	10·6	12·8	11·3	14·1	11·5	20·5	17·4	13·7	20·5	20·6	16·6	17·1	17·8	15·8	22·7	20·3	19·1	35·0	20·4	16·1	18·0	23·2
Total P_2O_5																									
mg./100g.—surface	217	184	157	122	261	193	75	303	147	312	189	150	230	106	134	177	284	233	131	332	192	208	120	173	176
	200	167	149	118	232	183	72	273	126	234	166	117	175	96	125	150	224	168	119	216	131	125	110	152	136

Major Soil Subgroups	BROWN FOREST SOILS																								
Additional Subdivisions and Variants	BP												GBS				GBP								
Soil Series	SH	ET	ET	DL	SH	FU	SH	SH	SH	GA	SH	DL	CJ	CP	BI	LN	WN	KB	LN	BL	LK	BL	BL	BI	MY
Plant Community or Facies	P1	P3b	P3b	P3c	P3c	P3c	P3c	P5	P5	M1c	M1d	M1d	W1a	W1b	P2b	S5a	W3c	W3c	W3c	W4a	W12a	W12b	W12b	P3a	P4b
Reference no.	62105	6293	6294	6297	62108	62124	63103	62106	63129	6298	62107	63150	63130	63114	6296	63138	62115	63105	63113	63144	62109	6288	63125	62137	63151
Altitude—ft.	650	700	700	660	560	600	200	625	650	725	675	1050	25	100	575	8	310	70	25	275	280	90	400	950	720
Aspect	NNE	N	N	NW	N	S	N	NNE	SE	SE	N	NE	NW	N	N	NIL	E	NIL	SW	W	ENE	NIL	W	S	SW
Slope	16°	14°	14°	13°	18°	14°	30°	18°	9°	16°	7°	17°	9°	23°	10°	0°	3°	0°	1°	1°	4°	0°	4°	14°	2°
Drainage	P	P	P	P	P	P	P	P	P	P	P	P	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH
pH—surface horizon	5·1	4·7	4·9	6·3	4·7	4·7	4·3	4·3	4·2	4·5	3·7	4·1	5·2	6·0	5·1	7·2	4·1	4·1	4·0	4·6	4·6	4·1	3·8	4·7	4·3
Base Saturation—%																									
—surface horizon	25·7	11·1	19·9	83·3	23·3	17·4	18·6	2·5	3·6	4·3	11·8	8·8	67·0	96·7	39·9	100	5·4	9·0	10·5	29·8	22·5	12·3	5·6	20·5	2·4
—B horizon	—	3·8	15·4	13·2	79·5	0·4	28·8	5·0	7·2	5·8	1·2	0·7	91·1	100	29·0	100	9·6	5·5	3·8	35·3	14·8	15·2	21·5	77·0	1·1
—C horizon	—	3·1	45·7	—	—	12·2	—	17·2	—	—	—	—	100	100	38·2	100	31·7	44·1	51·3	75·6	66·8	71·7	100	—	41·9
Exchangeable Ca																									
m.e./100g.—surface	6·68	0·93	2·01	38·06	6·91	2·48	5·58	0·0	0·84	0·0	8·88	3·19	6·79	2·93	3·69	6·04	0·56	0·0	0·79	4·31	2·39	1·08	0·0	3·41	0·0
	5·41	0·86	1·85	30·07	4·70	2·28	4·30	0·0	0·71	0·0	4·80	2·68	6·52	2·67	3·43	5·92	0·49	0·0	0·77	4·05	2·20	0·99	0·0	3·03	0·0
Exchangeable Mg																									
m.e./100g.—surface	2·38	0·34	0·54	1·24	4·87	0·35	1·91	0·59	0·34	0·85	4·79	0·74	1·74	4·60	0·67	0·52	0·41	1·33	0·11	1·71	1·18	0·61	0·94	0·85	0·31
	1·93	0·31	0·50	0·98	3·31	0·32	1·47	0·48	0·29	0·72	2·59	0·62	1·67	4·19	0·62	0·51	0·36	1·18	0·11	1·61	1·09	0·56	0·82	0·76	0·28
Carbon: Nitrogen																									
ratio—surface	15·5	20·0	17·1	16·1	16·6	16·7	13·8	19·2	9·8	17·9	24·6	19·3	12·5	10·1	16·2	15·4	17·1	15·8	19·2	10·6	14·3	18·0	16·8	16·1	15·6
Total P_2O_5																									
mg./100g.—surface	307	107	134	528	368	347	402	181	1598	252	244	139	169	40	143	82	364	71	25	203	150	117	184	178	150
	249	98	123	417	250	319	310	147	1342	214	132	117	162	36	133	80	317	63	24	191	138	108	160	158	134

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[continued overleaf

TABLE 32. SITES EXAMINED, PLANT COMMUNITIES AND SOIL SERIES

Locality	Plant Community	Soil Series	Reference Number	Map Reference
A. *WOODLAND*				
Almondbank	W8	Buchanyhill	62134	NO 056266
Ancothie Wood	W12b	Balrownie	6288	NO 226225
Birnam Wood	W6	Fungarth	62131	NO 043393
	W7b	Strichen	62130	NO 035392
Bishop's Wood	W3c	Winton	62115	NO 458152
	W12b	Rowanhill	62116	NO 459152
Black Wood	W4a	Balrownie	63144	NO 555379
Blairbell	W5a	Darleith	62128	NO 023204
	W7b	Darleith	62127	NO 023204
Boarhills	W1b	Caprington	63114	NO 569138
	W1b	Alluvium	63132	NO 575142
Bonnytown	W8	—	63121	NO 548134
Campsie Wood	W1a	Drumforber	62102	NO 131336
Dhu Loch	W12b	Anniegathel	6291	NO 066427
Drumcairn	W12b	Balrownie	63125	NO 027278
Dun Knock	W5a	Gleneagles	62110	NO 024142
Dunmore	W3c	Fungarth	62125	NO 066417
Dupplin Lake	W8	Airntully	62126	NO 027198
	W12a	Vigean	62129	NO 036205
Dura Den	W1b	Alluvium	62117	NO 416146
East Cult	W5a	Snaigow	6289	NO 074424
	W5b	Snaigow	6290	NO 074424
Etnie Brae	W7a	Fungarth	6284	NO 034436
Flisk Point	W1a	Carey	63130	NO 311226
Greenhill	W1a	Garvock	63126	NO 344226
	W8	Frandy	63127	NO 345225
Kemback Wood	W3a	Greenside	62119	NO 424161
Kinnoull Hill	W7b	Sourhope	6283	NO 135230
Letter Hill	W12b	Anniegathel	6285	NO 049433
	W13	—	6286	NO 048433
	W13	Anniegathel	6287	NO 051433
	W13	Anniegathel	6295	NO 060431
Links Wood	W4a	—	63107	NO 416247
Meikleour	W5a	—	62103	NO 161387
Methven	W14	Muirfoot	62135	NO 055266
Morendy Wood	W3c	Kirkbuddo	63105	NO 428248
	W4b	—	63106	NO 425248
Morrishill Wood	W12a	Laurencekirk	62109	NO 037256
Murrayfield	W12b	Lour	62138	NO 037304
Paddockmuir Wood	W1a	Stirling	62140	NO 217199
Rossie Hill	W1a	Darleith	63147	NO 270313
	W1b	Darleith	63145	NO 275309
	W5a	Darleith	63146	NO 271312
Spoutwells	W11	Muirhead	62114	NO 140279
Stenton	W7b	Darleith	62122	NO 067407
Tentsmuir Forest	W3c	Links	63113	NO 477261
B. *GRASSLAND*				
Ballowmill	P3c	Sourhope	62108	NO 183147
Cairnie Hill	P5	Sourhope	62106	NO 283155
Crumblie Hill	P3c	Sourhope	63103	NO 412229
Dunbog Hill	P1	Sourhope	62105	NO 290162
Dunmore	P3c	Fungarth	62124	NO 066419
Five Mile Wood	P8c	Lour	62123	NO 089343
Letter Hill	P2b	Baikes	6296	NO 059432
	P3b	Ettenbreck	6293	NO 055429
	P3b	Ettenbreck	6294	NO 057429
Lundie Craigs	P1	Darleith	62101	NO 276376

TABLE 32—*continued*

Locality	Plant Community	Soil Series	Reference Number	Map Reference
B. *GRASSLAND—continued*				
Norman's Law	P5	Sourhope	63129	NO 307203
Obney Hills	P3a	Baikes	62137	NO 022377
The Binn Farm	P2b	Sourhope	62112	NO 159232
West Hill	P3c	Darleith	6297	NO 228317
White Myre	P4b	Mountboy	63151	NO 207283
C. *MOORLAND*				
Ardgarth Hill	M1d	Caplaw	62100	NO 274373
	M2b	—	6299	NO 275371
Black Hill	M1c	Garvock	6298	NO 227321
	M1d	Darleith	63150	NO 221321
Cairnie Hill	M1d	Sourhope	62107	NO 281154
Lorns Hill	M1d	Muirhead	63142	NO 444403
Methven Moss	M3d	Raised Moss	63123	NO 013237
	M3d	Raised Moss	63124	NO 009235
Nether Handwick	M1b	Muirhead	63133	NO 367413
Obney Hills	M1b	Obney	62136	NO 025381
Prior Muir	M2a	Rowanhill	63120	NO 529131
Upper Obney	M2c	—	62132	NO 027371
D. *MARITIME COMMUNITIES*				
Barry Links	S3	Immature soil	63139	NO 542307
	S4a	Immature soil	63137	NO 542309
	S5a	Links	63138	NO 539308
	S5a	Immature soil	63140	NO 541310
Carnoustie	S1	Immature soil	63136	NO 561333
	S3	Immature soil	63135	NO 560335
	S4a	Immature soil	63134	NO 561336
Monifieth	S4a	Immature soil	63141	NO 507324
Out Head	S1	Immature soil	63115	NO 492194
	S2	Immature soil	63118	NO 492194
	S4a	Immature soil	63119	NO 493193
Tentsmuir	S2	Immature soil	63108	NO 502257
	S3	Immature soil	63110	NO 501256
	S4b	Immature soil	63111	NO 501256
	S6	Immature soil	63112	NO 501257

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