SOIL SURVEY OF GREAT BRITAIN

SCOTLAND

The Soils of the Country round Elgin

(Sheet 95)

THE MACAULAY INSTITUTE FOR SOIL RESEARCH
CRAIGIEBUCKLER
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Soil Survey of Great Britain

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(Sheet 95)

by

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I. GENERAL DESCRIPTION OF THE AREA

Location and Extent

Most of the 132 square miles described in this memoir is a section of the coastal plain which follows the southern shore of the Moray Firth from Buckie to Inverness. It is sometimes referred to as the Laich of Moray but as this term has another, more restricted, application it will be more appropriate to use the description the Northern Lowlands of Morayshire. The 15 square miles of Banffshire included at the eastern end is of a different character both physically and geologically and will be treated separately. The southern boundary of the sheet is a line from the Hill of Stonyslacks in the east through Fochabers, Cranloch and Longmorn to Tarras in the south-west corner, a distance of 24 miles. In the north the area is bounded by some 30 miles of coastline from Portessie to Burghead Bay. The width of this coastal strip from north to south varies from 8 miles at Lossiemouth to 3 miles at the western end.

Despite its northern aspect and latitude corresponding to Northern Labrador, the region has long enjoyed and merited a reputation for productiveness and mildness of climate. Early geographers found it "the most pleasant and plentiful country in all Scotland" and later with the development of agriculture it became known as "the Granary". The bulk of the population of Moray is concentrated in the Lowland where practically all the land capable of improvement has been cultivated or planted with trees. The main centres of population are the market town of Elgin and the fishing ports of Lossiemouth and Buckie. Other settlements include Fochabers and the rural villages of Lhanbryd, Urquhart, Alves and Duffus inland, with Burghead, Hopeman, Garmouth and Portgordon on the coast.

The area is well provided with road and rail communications and adequately supplied with water and electricity although the latter supply has only recently been extended to some of the farms and others are still without it.

Physical Features

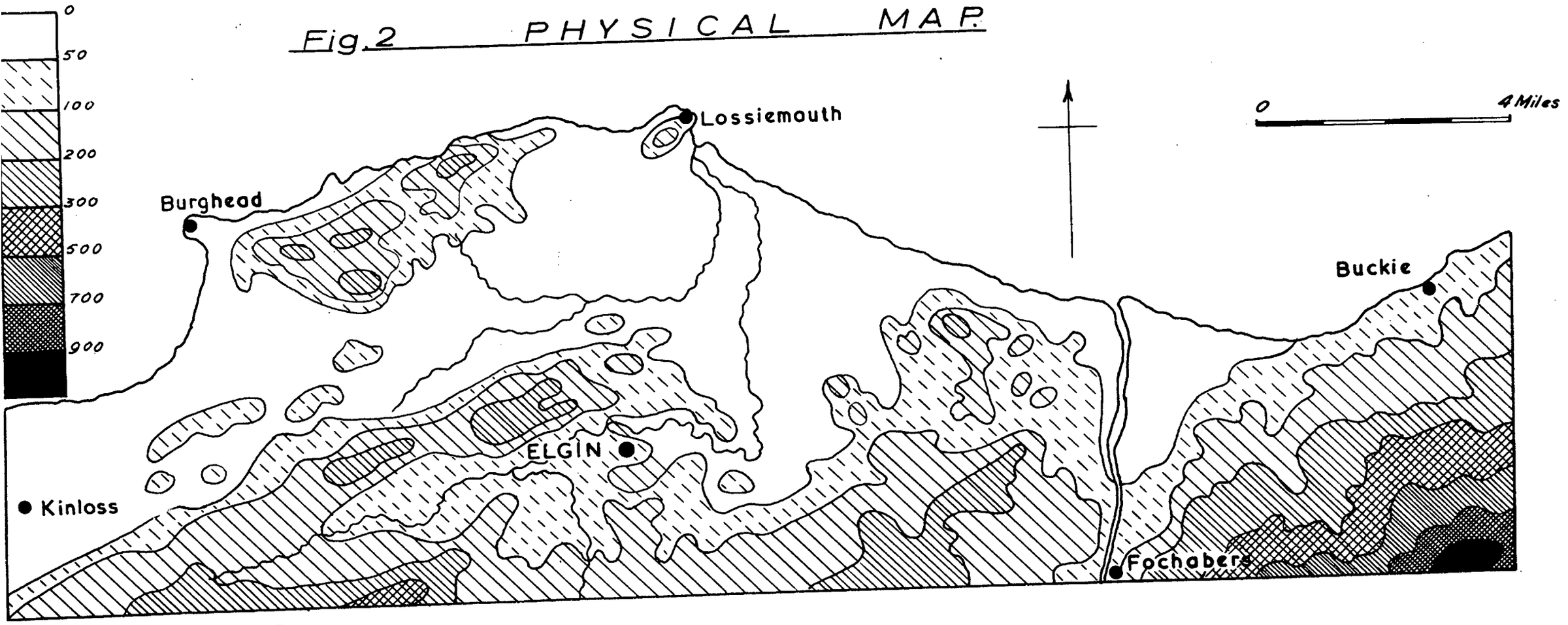
In the broad regional division of Scotland the area of Sheet 95 comes well within the Highlands, but the Moray coastal plain is distinctly lowland in character and quite out of place in such a description. The high sea-cliffs which form the coastline from Fraserburgh westwards end abruptly at

Portgordon and from there to the innermost point of the Moray Firth at Inverness the low shoreline is typically emergent with splendid examples of shingle bars and sand-dunes, land built by wave and wind action. It is interrupted only by the high and eroded Covesea-Burghead ridge and the Brander-burgh promontory. Inland, ample evidence may be seen of the stages of development, and of the processes by which the present topography has been moulded. Nearly two-thirds of the whole area of the map is less than 100 feet above sea-level, and more than two-fifths lower than 50 feet. Several fairly extensive flats occur at this lower level, on the raised beaches, river terraces and flood plains, and former lake beds. The more common topography consists of low mounds and ridges, with hollows between, eroded relics of the glacial and fluvio-glacial deposits which cover most of the Lowland plain, or more recent sand and shingle spreads.

The solid geology plays its customary role in determining the relief of the rest of the area. The highest ground occurs in the south-east where the ancient Dalradian rocks of Banffshire have resisted erosion. In less than 5 miles southward from the coast the altitude increases steadily to over 900 feet at the Hill of Stonyslacks where uncultivated moorland provides a sharp contrast to the woods and fields of the lower ground. West of the Spey, the gently undulating Old Red Sandstone plain is relieved by a series of ridges running roughly parallel to the coast. These again are formed of more resistant rocks. In the south, the well-wooded Monaughty ridge, which reaches to 700 feet at Heldon Hill, has a core of crystalline schists and gneisses. Hard Permo-Trias sandstones cap the Quarrywood ridge north across the Mosstowie valley from Monaughty. It extends from Spynie to beyond Alves at an average height of 250 feet, with the highest point, known as Cutties Hillock, just over 400 feet. The third ridge, also of Permo-Trias sandstone, follows the coast from Covesea to Burghead. The low ground between here and Quarrywood consists largely of the dried up bed of the formerly extensive Loch Spynie, and is the district properly referred to as the Laich of Moray.

The chief river of Morayshire is the Spey which, by the time it enters the area, is of considerable volume and very fast-flowing. It occupies a wide, braided channel in the last four miles of its course to the Firth at Kingston. Spates are of fairly frequent occurrence and during these, vast quantities of sand and shingle are carried down, providing abundant material for the building

Fig.2 PHYSICAL MAP



ALTITUDE IN FEET

of the storm beaches which are so prominent a feature to the west. The only other river of note is the Lossie which meanders northwards before turning sharply to the east around the town of Elgin. A few miles further on it swings north again to enter the sea at Lossiemouth. Numerous small streams also contribute to the drainage especially in the east of the area. The more important of these are the Buckie, Gollachy and Tynet Burns. In the low-lying western part a good deal of artificial drainage has been found necessary.

Lakes are few and of insignificant extent, only the now much reduced Loch Spynie, and Loch-na-Bo and Loch Oire near Lhanbryd meriting names.

The close interrelationship of topography, superficial geology and land utilisation results in the region falling naturally into a series of fairly distinct sub-divisions.

The first of these is the low coastal belt with its fringe of marram-grass covered sand-dunes. Blown sand covering, to a greater or less degree, old shingle ridges and storm beaches, limits the possible use of this area for agriculture but much of the former heathland has been fairly successfully planted with conifers. The name "Links" which is given to these coastal heaths is, in Scotland, practically synonymous with golf-course, and good examples of these sea-side courses have been constructed at Lossiemouth and Spey Bay with smaller ones at Burghead, Hopeman and Garmouth.

The high coast between Covesea and Burghead is very exposed and in places contaminated by blown sand. The top of the ridge resembles much of the Banffshire coast with its whin and heather moor but the till-covered south-facing slopes are mainly in cultivation.

Inland, the next important sub-division is the wide lowlying plain formed by the raised beaches and drained lake beds, extending from Kinloss in the west to beyond the River Lossie and including the river's wide flood-plain from Sheriffston to Inchbroom. This area is intensively cultivated and presents an almost continuous succession of arable fields interrupted only by occasional shelterbelts and small policy woodlands around a few of the larger properties. The broad flats of the raised beach at Kinloss, Lossiemouth and Leuchars have been taken over for the construction of airfields, the combination of level ground and almost fog-free climate making these sites ideal for the purpose. At the eastern end of this belt, around Buthill, Alves and Milton Brodie, a typically moundy spread of fluvio-glacial deposits with alluvial and poorly

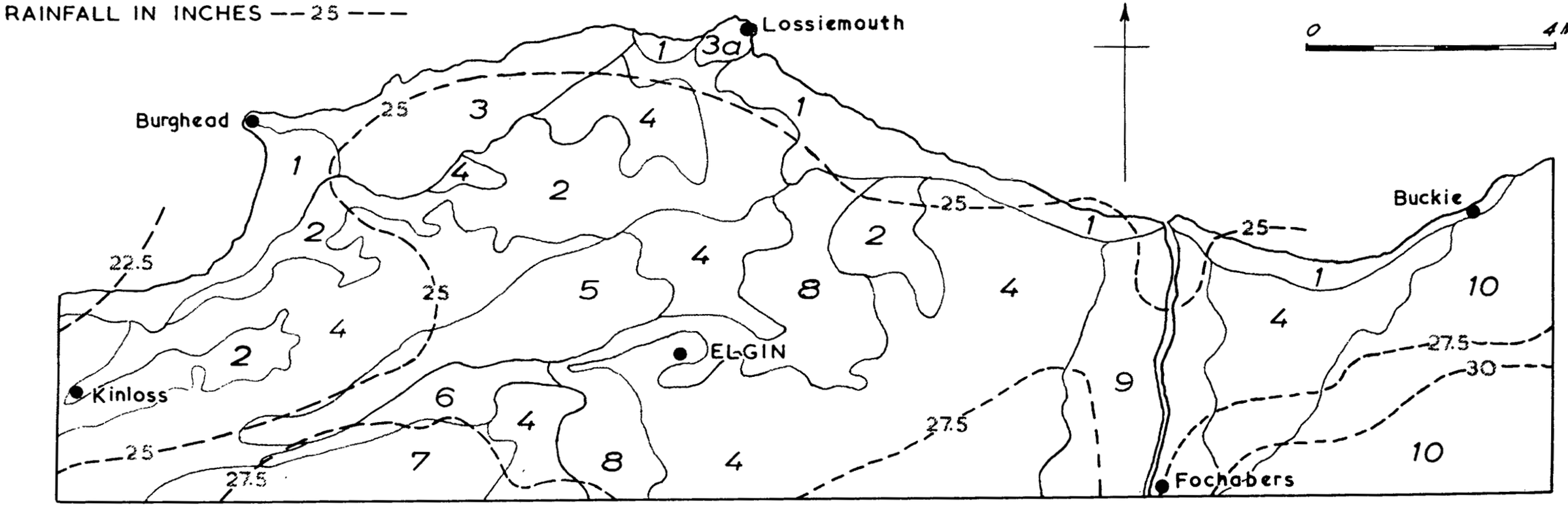
drained hollows, provides a variety of soils ranging from sand to peat. Most of the area is cultivated, with the larger farms situated where a capping of silty clay occurs on several of the low ridges. The thin stony soils of the old shingle bars at Spindlemuir are mainly relegated to small plantations of conifers, though attempts are being made to reclaim small sections.

The ridges of Quarrywood and Monaughty are similar in appearance, cultivated on the lower slopes and wooded higher up. This is especially true of Monaughty which is now a well established Commission forest. Quarrywood as its name implies has been the source of most of the once popular building stone known as "Elgin sandstone", and its slopes are pitted by numerous large quarries now unfortunately, with one exception, disused. This ridge is flanked by fluvio-glacial sand, with a wider development at the eastern end around Spynie where pine plantations are again a feature. At the eastern end of Monaughty a similar spread, this time dominantly of gravel, extends to the edge of the mile-wide alluvial flat which lies between the Black Burn and the River Lossie, south of Elgin. Between the two ridges the Mosstowie Valley from Aldroughty westwards to Burgie contains much good farmland but adequate drainage presents a serious problem in the low-lying central part.

The largest single landscape unit is a broad belt of fluvio-glacial and morainic sand and gravel deposits which extends from just east of the River Lossie to the coast at the Binn Hill and Garmouth, covering most of the parishes of St. Andrews-Lhanbryd and Urquhart. The topography varies from undulating to distinctly moundy with occasional well defined ridges. Gravelly moraine dumps with kettle-hole lochs are a prominent feature in the vicinity of Loch-na-Bo, at the northern end of the Blackhills marginal channel. A considerable part of this area is unsuitable for arable cultivation and much of it, formerly heather moor, has been given over to planted woodland, notably at Sleepieshill, Loch-na-Bo, and the Binn. Those parts which have been cultivated can, with careful management, prove quite productive.

Wide sand and gravel terraces, five of which can be easily distinguished, border the last few miles of the Spey from Fochabers to the sea. The comparatively level topography of this strip contrasts sharply with the irregular terrain on either side, but apart from this advantage, the soils are not greatly different and again areas of moorland and plantation are common. The

Fig. 3 MAP OF LAND FORM REGIONS with ANNUAL AVERAGE RAINFALL.



1. LOW COASTAL FRINGE
2. RAISED BEACHES & DRAINED LAKE BEDS
3. BURGHEAD-COVESEA RIDGE
3a. LOSSIEMOUTH HEADLAND
4. AREAS OF MOUNDY FLUVIO-GLACIAL DEPOSITS
5. QUARRYWOOD ALVES RIDGE
6. MOSSTOWIE BASIN
7. MONAUGHTY RIDGE
8. LOSSIE ALLUVIUM
9. SPEY TERRACES
10. BANFF FOOTHILLS

river runs in a braided channel with banks and islands of coarse shingle of little value for any purpose.

East of the Spey, and north of the main Fochabers-Buckie road, a continuation of the moundy morainic deposits similar to those at Loch-na-Bo extends beyond Auchenhalrig to the Tynet Burn with outwash sand spreading further east as far as Portgordon. In this area the policies of Gordon Castle include some excellent stands of conifers and much of the rest forms part of the Speymouth Commission Forest.

These water-laid deposits tail out against the lower slopes of the Banffshire hills, and in the south east corner of the sheet the rising ground has a thick cover of till. The fairly deeply incised channels of a series of streams, the Burns of Tynet, Cairnfield and Buckie, each ending in an alluvial flat at the change of slope, are a feature of the area. The range of land-use in relation to altitude and exposure is well illustrated here, the larger farms being succeeded by smaller holdings and plantations and finally by heather moor and in places hill peat.

Climate

In 1640 the historian Gordon of Straloch reported that "---- in salubrity of climate Moray is not inferior to any----The air is so temperate that, when all around is bound up in the rigour of winter, there are neither lasting snows nor such frosts as damage trees or fruit, proving the truth of that boast of the natives, that they have forty days more of fine weather in every year than the neighbouring districts----While harvest has scarcely begun in surrounding districts, there all is ripe and cut down and in comparison, winter is hardly felt." There would appear to have been a slight deterioration since those days, but there can be no doubt that the Northern Lowlands of Moray merit their reputation for mildness and dryness. The successful cultivation of wheat in the Laich and the existence of long-established orchards at Pluscarden and Gordon Castle bear witness to this and a further indication is the popularity of the area with summer holiday-makers and for residence by retired people.

The chief characteristic of the temperature figures is the comparatively low diurnal range. Over the year the average difference between day and night temperature is about 12°, varying between 40° and 52°F. For midwinter it is about 10°, varying from 33° to 43°F. Similarly, in the long days of the

northern summer the relative humidity shows considerably less diurnal change than at most places. The summer temperatures of the coastal region of the inner Moray Firth are slightly higher than those of Banff and Buchan, but the maximum temperature rarely reaches 80°F. Sunshine hours are likewise high, particularly in winter compared with other parts of Scotland.

Practically the whole of the area of the sheet has an average rainfall of less than 30 inches, the overall average being about 26 inches. The rainfall increases fairly uniformly from the coast inland with the 25 inch isohyet roughly following the inner margin of the sandy coastal strip except in the west where it swings inland to include much of the arable land in the parishes of Alves and Kinloss. The distribution of total rainfall is such that while some rain can be expected on slightly less than 200 days in the year, during the second six months the fall is rather more than one third greater than during the first six months. There are no records to show that the normal for any one month is ever less than 1½ inches. April nearly always has the absolute monthly minimum but there is no clear single maximum. Maxima occur in July or August and in October, with the summer maximum the chief one. In this respect it contrasts with nearly all the surrounding region. The bearing of this on the importance of Lowland Moray as a barley growing area is worthy of note as it has been suggested that the yield of barley in the eastern counties is greater when the rainfall is in excess of the average during July and August. Precipitation exceeds transpiration and evaporation over by far the greater part of Moray.

The area is notably free from fog, records showing that on more than 300 days in the year the visibility at midday exceeds 6½ miles, while occasions when the visibility is less than 1100 yards at 9 a.m. are, on average, fewer than five per year. Sea-mist very occasionally drifts inshore to affect the Brander-burgh and Covesea headlands.

Winds are from some part of the west quadrant for fully 200 days in the year. The rain-bearing winds from the west and south-west are föhn winds, which is the main reason for the mildness of the climate. It also accounts for the infrequency of snowfalls on the low ground (less than 30 days in the year) and for the reluctance of the snow to linger for long. Most gales are from the west or north-west, but occasional cold north and north-easterly winds bring stormy weather to the Moray coast. Towards the end of spring cold easterly winds sometimes do considerable damage to sprouting corn, young grass and fruit

Average Monthly Rainfall in Inches (1881-1915)

Table A

Station	Altitude above M.S.L.	Distance from coast	J.	F.	M.	A.	M.	J.	Ju.	A.	S.	O.	N.	D.	Year
Gordon Castle Fochabers	104 ft.	3½ m.	2.02	1.92	2.32	1.75	2.12	2.04	3.20	3.17	2.50	3.16	2.88	2.69	29.77
Blackhills	310 ft.	5½ m.	2.21	2.11	2.46	1.92	2.34	2.24	3.42	3.33	2.75	3.33	3.07	2.87	32.00
Kinloss (estimated as % age)	16 ft.	1½ m.	1.66	1.58	1.84	1.44	1.75	1.68	2.56	2.49	2.06	2.49	2.30	2.15	24.00

Monthly Distribution Rainfall in Wet Year (1954)

Table B

Station	Altitude above M.S.L.	Distance from coast	J.	F.	M.	A.	M.	J.	Ju.	A.	S.	O.	N.	D.	Total
Kinloss	16 ft.	1½ m.	1.29	0.89	0.94	0.92	4.21	2.10	2.98	1.59	1.78	5.21	1.88	3.76	27.55
Elgin	92 ft.	5 m.	1.68	0.86	1.34	0.73	4.79	2.43	2.47	2.09	1.54	4.82	2.06	3.77	28.58
Forres	155 ft.	3 m.	1.14	0.83	0.52	0.94	4.15	2.33	4.15	1.94	1.77	5.74	1.74	3.54	28.79
Fochabers	104 ft.	3½ m.	1.14	1.47	1.61	0.81	5.08	2.86	3.07	3.01	2.08	5.02	3.35	4.07	33.57

Monthly Distribution of Rainfall in Dry Year (1955)

Table C

Station	Altitude above M.S.L.	Distance from coast	J.	F.	M.	A.	M.	J.	Ju.	A.	S.	O.	N.	D.	Total
Kinloss	16 ft.	1½ m.	1.83	1.89	1.29	0.84	2.56	0.65	0.66	0.87	1.59	3.24	0.52	4.10	20.04
Elgin	92 ft.	5 m.	0.70	1.77	1.41	0.94	3.37	1.40	0.72	2.07	1.37	4.66	0.72	4.85	23.98
Forres	155 ft.	3 m	1.27	1.73	1.55	0.78	2.60	0.75	0.33	0.68	1.13	3.78	0.57	4.45	19.62
Fochabers	104 ft.	3½ m.	1.25	2.00	1.44	1.34	3.36	1.53	0.95	0.28	1.57	5.07	0.85	5.35	26.99

Average Monthly Rainfall in Inches (1881-1915)

Table A

Station	Altitude above M.S.L.	Distance from coast	J.	F.	M.	A.	M.	J.	Ju.	A.	S.	O.	N.	D.	Year
Gordon Castle Fochabers	104 ft.	3½ m.	2.02	1.92	2.32	1.75	2.12	2.04	3.20	3.17	2.50	3.16	2.88	2.69	29.77
Blackhills	310 ft.	5½ m.	2.21	2.11	2.46	1.92	2.34	2.24	3.42	3.33	2.75	3.33	3.07	2.87	32.00
Kinloss (estimated as % age)	16 ft.	1½ m.	1.66	1.58	1.84	1.44	1.75	1.68	2.56	2.49	2.06	2.49	2.30	2.15	24.00

Monthly Distribution Rainfall in Wet Year (1954)

Table B

Station	Altitude above M.S.L.	Distance from coast	J.	F.	M.	A.	M.	J.	Ju.	A.	S.	O.	N.	D.	Total
Kinloss	16 ft.	1½ m.	1.29	0.89	0.94	0.92	4.21	2.10	2.98	1.59	1.78	5.21	1.88	3.76	27.55
Elgin	92 ft.	5 m.	1.68	0.86	1.34	0.73	4.79	2.43	2.47	2.09	1.54	4.82	2.06	3.77	28.58
Forres	155 ft.	3 m.	1.14	0.83	0.52	0.94	4.15	2.33	4.15	1.94	1.77	5.74	1.74	3.54	28.79
Fochabers	104 ft.	3½ m.	1.14	1.47	1.61	0.81	5.08	2.86	3.07	3.01	2.08	5.02	3.35	4.07	33.57

Monthly Distribution of Rainfall in Dry Year (1955)

Table C

Station	Altitude above M.S.L.	Distance from coast	J.	F.	M.	A.	M.	J.	Ju.	A.	S.	O.	N.	D.	Total
Kinloss	16 ft.	1½ m.	1.83	1.89	1.29	0.84	2.56	0.65	0.66	0.87	1.59	3.24	0.52	4.10	20.04
Elgin	92 ft.	5 m.	0.70	1.77	1.41	0.94	3.37	1.40	0.72	2.07	1.37	4.66	0.72	4.85	23.98
Forres	155 ft.	3 m	1.27	1.73	1.55	0.78	2.60	0.75	0.33	0.68	1.13	3.78	0.57	4.45	19.62
Fochabers	104 ft.	3½ m.	1.25	2.00	1.44	1.34	3.36	1.53	0.95	0.28	1.57	5.07	0.85	5.35	26.99

Monthly Mean Temperatures (°F) at Gordon Castle, Fochabers (1906-1935) Table D

Temperature (°F)	J.	F.	M.	A.	M.	J.	Ju.	A.	S.	O.	N.	D.	Year
Maximum	43.9	44.9	47.0	51.0	57.3	62.0	65.1	64.1	60.4	54.3	47.1	43.9	53.4
Minimum	33.8	33.8	34.1	36.7	41.7	46.2	50.0	49.4	45.6	40.9	36.5	34.3	40.3
Mean	38.9	39.3	40.5	43.9	49.5	54.1	57.5	56.7	53.0	47.6	41.8	39.1	46.9

Sunshine Hours at Gordon Castle, Fochabers (1921-50) Table E

	J.	F.	M.	A.	M.	J.	Ju.	A.	S.	O.	N.	D.	Year
Sunshine (Hours)	45	71	111	134	173	171	145	143	115	92	53	34	1287

Daily Average - Sunshine Hours Table F

Station	Height in ft. above M.SL	Distance from coast	1947	1948	1949	1950	1951	1952	1953	1954	1955
Kinloss	16	1½ m.	-	-	-	-	-	3.55	3.73	3.47	4.22
Forres	155	3 m.	3.75	3.88	3.90	3.97	3.80	3.53	3.69	3.59	4.88
Lossiemouth		-	-	4.06	4.03	4.24	-	-	-	-	-
Fochabers	104	3½ m	3.85	3.90	3.83	3.89	3.70	3.24	3.40	3.43	4.16
Elgin	92	5 m.	-	-	-	-	-	-	3.86	3.82	4.33

Annual Rainfall (in inches) in Recent Years Table G

Station	Height in ft. above M.SL	Distance from coast	1947	1948	1949	1950	1951	1952	1953	1954	1955
Kinloss	16	1½ m.	-	-	-	-	-	20.89	24.17	27.55	20.04
Forres	155	3 m.	20.61	29.24	26.25	23.56	26.81	22.85	24.46	28.79	19.62
Lossiemouth		-	19.24	25.96	25.00	23.38	-	-	-	-	-
Fochabers	104	3½ m.	26.30	31.19	30.79	30.09	32.91	30.69	25.43	33.57	26.99
Elgin	92	5 m.	-	-	-	-	-	-	22.53	28.58	23.98

blossom. In the areas of sandy soils the dry April often leads to blowing of the topsoil and it is not unusual for turnips to have to be re-sown and roads to be cleared of drifts.

II. GEOLOGY

The solid geology of Sheet 95 is comparatively simple in that only a few formations are represented, but there is such an extensive development of superficial drift deposits that, despite frequent outcrops, the stratigraphical relationship of the rocks is not easily determined. There are practically no soils directly derived from the underlying rock, and consequently the drifts are the more important from the point of view of soil formation. Since, however, the superficial deposits have been derived to a very large extent from the local rocks and since no Geological Survey memoir has been published to accompany Sheet 95, some description is desirable. The succession (based on Read, 1948) is as follows:-

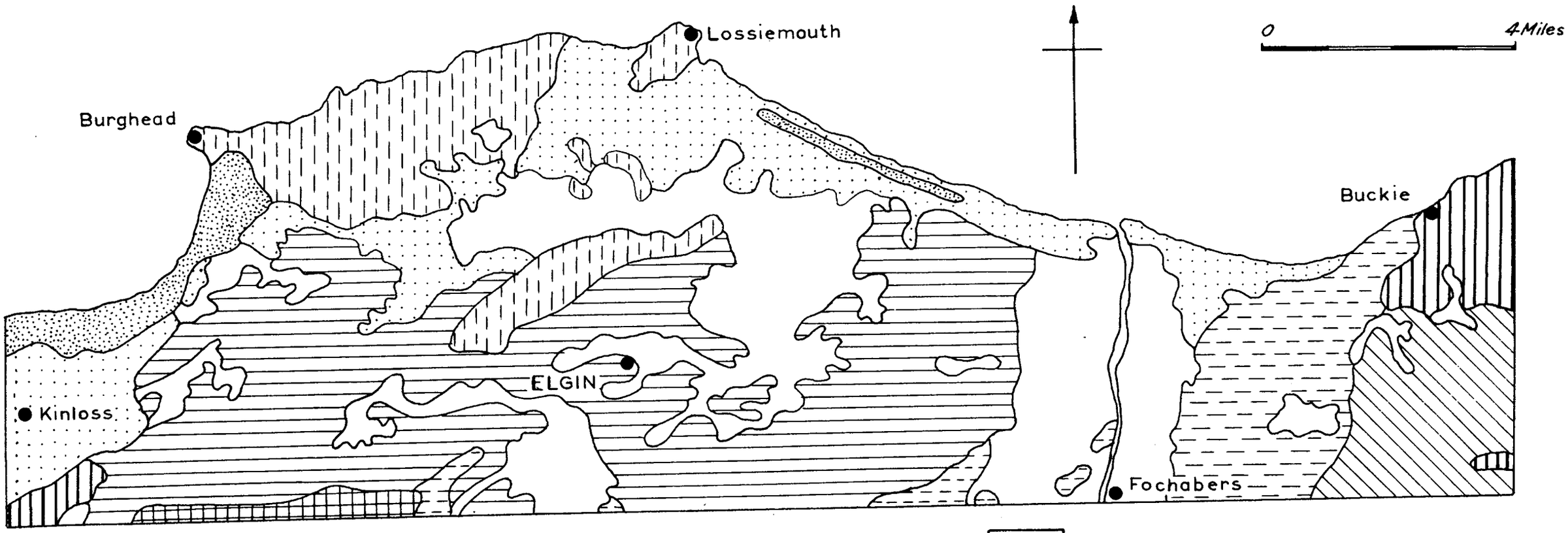
D.	Recent and Pleistocene	8. Blown sand, peat, river and lake alluvium.
		7. Raised beach deposits.
		6. Fluvio-glacial sand and gravel; morainic drift and till.
C.	Triassic and Permian	5. Cherty Rock of Stotfield, sandstones.
B.	Old Red Sandstone	4. Upper Division:- New Elgin "Cornstone", sandstones.
		3. Middle Division:- Shales and sandstones with thin limestone bands, conglomerates; one thin andesitic lava flow.
A.	Highland Schists	2. Dalradian:- Findlater Flags, West Sands Group, Cullen Quartzite.
		1. Moine Series (Central Highland Granulites):- quartzite, gneiss and mica-schist.

A. Highland Schists.

1. The oldest strata represented in the district are the very ancient and highly metamorphosed rocks of the Moine Series. They are for the most part concealed under later formations and outcrop only along the southern margin of the sheet, west of the River Lossie, where they form the northerly continuation of a more extensive development in Sheet 85. Around Tarras, south of Kinloss, there is a broad outcrop of feldspathic quartzite. Farther east, between Burgie House and the River Lossie, the rocks comprise quartzite and quartzose and micaceous schists (Hinxman and Grant Wilson, 1902, p.27).

2. Dalradian rocks occur in the eastern part of the sheet, east of a line running in a southerly direction from Buckie through Clochan. They appear

Fig. 1 GEOLOGICAL MAP



UPPER OLD RED SANDSTONE

MIDDLE OLD RED SANDSTONE

SCHISTS & FLAGSTONES

QUARTZITE

GNEISS WITH BANDS OF MICA-SCHIST

PERMO-TRIASSIC SANDSTONE

FRESH WATER ALLUVIUM

MARINE ALLUVIUM

BLOWN SAND

to be represented by the three lowest members of the Keith division (Read, 1923, p.14). These are, in ascending order:

a. Cullen Quartzite: This is a group of granulitic quartzites with subordinate garnetiferous mica-schists. The outcrop extends for between $1\frac{1}{2}$ and $2\frac{1}{4}$ miles south from the coast east of Buckie.

b. West Sands Group. This group of thinly flaggy garnetiferous mica-schists with thin quartzose and calcareous bands has been mapped as a narrow belt immediately south of the Cullen Quartzite in Sheet 96. In Sheet 95, however, it has not been separated from the succeeding group (c) to the south.

c. Findlater Flags. These rocks form the high ground in the south-east of the sheet. They are fine-grained micaceous flags, splitting easily along mica-covered partings, into slabs averaging one inch in thickness. Some of the more fissile varieties have been quarried for slate at Tarrymount. A belt of quartzite occurring within the flags forms the Hill of Stonyslacks.

B. Old Red Sandstone.

The Scottish Old Red Sandstone formation has been divided into three portions, Lower, Middle and Upper, each characterised by a particular fish fauna, but of these only the Middle and Upper are recognised in the Moray Firth area.

3. Middle Old Red Sandstone. A considerable development of these beds is found in a belt stretching westwards from the Buckie-Clochan line, round Fochabers and the Spey Valley to Cranloch. Two small patches also appear on the map at Dykeside and Miltonbrae. The succession begins with a basal conglomerate which rests unconformably on the Highland Schists and dips gently northwards. The conglomerate is fairly thick, Whiteash Hill being entirely composed of it, and is generally fine, of a red or purplish colour, with coarse bands and false-bedded sandy lenses. The pebbles vary in size from fine gravel up to fragments 3 inches in diameter. Pebbles of quartzite compose about two thirds of the constituents, together with several varieties of mica-schist and gneiss, and a few well-rounded pebbles of granite (Hinxman and Grant Wilson, 1902, p.58). The conglomerate is followed by beds of shale and red sandstone, the latter containing the well-known

fish-beds of Tynet and Dipple, with a few conglomerate bands and an occasional thin limestone band. These beds are well-exposed in the Tynet Burn and on the west bank of the Spey at Fochabers Bridge. Contemporaneous vulcanicity is represented only by a thin hornblende-andesite flow seen in the Gollachy Burn near Buckie (Read, 1948, p.63).

4. Upper Old Red Sandstone. This series occupies a broad belt extending from the Spey to beyond Nairn in the west, and is the formation most extensively developed in the area. The beds rest unconformably on various members of the Middle Old Red Sandstone or upon the Highland Schists. The strata consist almost entirely of sandstones, frequently coarse and pebbly, and in places feldspathic. Grey and yellow sandstones, fairly coarse, with seams and galls of clay, are exposed at Newton and Cloves. Fine-grained rocks which have provided the well-known building stone, the "Elgin sandstone", can be seen in several quarries on the Quarrywood ridge, notably those of Rosebrae and Leggat. In the Alves district the sandstones consist largely of granitic debris with conspicuous flakes of the red feldspar of the western granites. At New Elgin there is a broad outcrop of cherty calcareous rock - the New Elgin "Cornstone" - which, although containing a high proportion of feldspar, was at one time worked for lime.

C. Permian and Triassic.

North and north-west of Elgin there are extensive outcrops of sandstone containing remarkable reptilian faunas which show them to be of Permian and Triassic ages (Watson, 1909). The extent of the drift cover and the probability of considerable faulting make it impossible, however, to deduce the stratigraphical relationships between the various outcrops.

West of Elgin, a group of coarse sandstones, conspicuously false-bedded and often containing irregular bands of pebbles, occupies the top of Quarrywood Hill, an area of about $\frac{3}{4}$ of a square mile, where they are seen to rest unconformably on Upper Old Red Sandstone strata. The pebbles are of characteristically wind-cut shapes, the sand grains are well-rounded, and the whole deposit is fairly obviously of desert origin. Faunal evidence suggests that these beds represent the extreme top of the Permian or the boundary between the Permian and the Triassic. Sandstones of similar character, which may be of equivalent age, form the ridge between Covesea and Burghead and are well-exposed in the sea-cliffs.

Soft, fine-grained sandstones considered to be of Middle Triassic age extend southwards from the coast at Branderburgh to near Spynie and westwards for about 3 miles. At Branderburgh they appear to be succeeded by the "cherty rock of Stotfield" which is also exposed at Inverugie, Spynie and elsewhere. The Stotfield and Inverugie exposures are remarkable in having galena disseminated throughout the chert, often quite richly.

Mackie's (1897) study of the heavy residues of the Elgin sandstones shows that fluorite and barytes are usually present, sometimes in large amount. These two minerals form the cement of certain sandstones in the coastal Trias.

There are no other Mesozoic or Tertiary rocks within the area, although it seems probable from the evidence on the north side of the Moray Firth that there would have been a cover of these rocks at one time. Jurassic and Cretaceous erratic boulders are fairly common over most of the lower ground, and one huge transported block at Linksfield near Elgin was at one time actually quarried for lime.

D. Pleistocene and Recent.

6. The glaciation of North-east Scotland and the Moray Firth area is generally admitted to be complicated, and this is particularly true of the Lower Morayshire area where, at different periods, conflicting ice-streams coalesced and fluctuated. Bremner (1934) has quoted a great deal of evidence in support of three glaciations and his contention would appear to be fully justified. The findings of other investigators including Jamieson (1906) and Read (1923, p.186) are in agreement. An added difficulty in proving the sequence of events is the fact that the direction of movement of much of the third ice-sheet was the same as that of the first. However, an exposure of glacial drift deposits just south of Sheet 95, at Sandy Hill near Rothes, shows three successive tills, each with a distinct boulder content and separated by bedded silt, sand or gravel. The lowest till is red in colour and contains boulders which can be readily identified. These include Old Red, Permian and Triassic sandstones from the Elgin area, and fossiliferous Jurassic limestones from the north side of the Firth and perhaps also from the bed of the Firth. The second till is grey and contains very little Old Red Sandstone material. The boulders in it include diorite from Craigellachie to the south. The top till is again red in

colour and has the same rock content as the first with the exception of the Jurassic rocks. Other exposures of till in the neighbourhood and adjacent districts show similar successions.

The distribution of erratics over the area gives further indications of the different directions of ice-movement. Augen-gneiss and granites from Sutherland have been found between Burghead and Elgin and near Findrassie. Jurassic rocks are common around Elgin and have been found in till at Lhanbryd. One massive erratic block at Linksfield was believed to be in situ until it was discovered to overlie red till. Boulders of the Elgin and Reptiliferous sandstones have been carried to the east, south-east and south-south-east. Such distinctive rocks as the Netherley diorite and the Conerock quartzite have been dispersed both north and south-wards. Nairnshire granites have been carried eastwards to Lossiemouth and beyond across Banffshire into North Aberdeenshire.

The Old Red Sandstone and Permo-Triassic rocks have retained the striations imposed by the passage of rock-laden ice over them and fine examples of these striae are common on their many outcrops. Specially good examples at Inverugie and Quarrywood confirm two broad directions of ice-movement, one from the west and north-west and another from the south.

All these indications taken together with the evidence from other parts of the North-East and from places as far away as Caithness and Orkney, point fairly conclusively to three major ice-movements affecting the area. The first of these travelled from a centre situated to the north and west, south-eastwards across the Moray Firth and invaded the southern shore to a considerable extent, reaching well into Banffshire and Aberdeenshire. The meltwater from this ice on its retreat laid down a series of clays, sands and gravels which are particularly well-developed along the Banffshire coast. In the second period the main centre of accumulation was probably the Central Highlands and the Grampians, the ice moving northwards and apparently being deflected slightly westwards to pass on to the mainland in Caithness. The presence of ice from Scandinavia lying to the east may have been the cause of this deflection.

Since the greater part of the drift deposits left following the glaciation of an area will be removed by a subsequent ice-movement, and

the remainder almost always overlain by later deposits, the drifts of the third and last ice-flow are of most direct concern. This ice was less extensive than that of the first and second periods. A major stream from west of the Great Glen joined up with a stream from the Findhorn valley and ice moving south-eastwards from the north to form a wide lobe in the Moray Firth. The ice fanned out to cross the coast into Lower Moray but was restricted by pressure from ice moving down the Spey valley and off the Banffshire hills. The line of contact almost certainly fluctuated, but must have been south of the border of Sheet 95 at least once. The dominance of the Moray Firth ice is shown by the way in which the southern ice was prevented from reaching the coast. In the Moray Lowland many features related to the retreat of the ice can be seen. When the Spey glacier began to withdraw the Moray Firth ice passed up the valleys. An ice-dam near Orton caused the meltwater dammed up in the Rothes basin to spill over and form the conspicuous Mulben overflow channel, (Sheet 85). At a later stage the water probably escaped north-eastwards along the face of Whiteash Hill towards Tynet leaving a gravel terrace just south of the Fochabers-Portgordon road. Between Boghead near Gordon Castle and Auchenhalrig a moundy area known as the Beldornie Hillocks is dotted with small ponds and kettleholes and appears to be a terminal moraine marking a halt in the recession of the ice along the coastal plain. Similar moraine deposits occur farther west between Loch na Bo and the coast, and a very fine example of a marginal channel cuts across the hillside from the north end of the Glen of Rothes to Blackhills. More moraines can be seen at the junction of Glen Latterach and Glen Lossie just south of the sheet, marking a halt in the retreat of the ice up the latter valley, and it is clear that the Black Burn must have carried great quantities of meltwater. It appears probable too, that temporary lakes formed between the retreating ice and the land in the western part of the area where deposits of red silty clay are found in sites incompatible with the present topography. These silts are well seen near Alves and Coltfield. Great spreads of outwash sands and gravels cover wide areas of Sheet 95, blanketing the underlying till deposits in series of irregular mounds and ridges. These have been eroded and modified to some extent by wave action during

subsequent periods of submergence of parts of the coastal area. That there is an overall cover of till of varying thickness there is little doubt; only small areas on the ridge tops are free of drift and the till can frequently be seen underlying the sand, or outcropping on the tops of mounds from which the sand has been eroded. The dominant till is of local derivation, mainly from the sandstones of the Old Red with additional material from the older rocks north of Monaughty, and east of the Permo-Triassic outcrops. In the eastern part of the sheet, distinct tills from the Dalradian quartzites and schists, and from the Middle Old Red occupy limited areas. Till containing Jurassic and Cretaceous material was seen in an excavation near Lhanbryd, and one small patch of till composed mainly of black shale was noted at Shempston. Details of the glacial and outwash deposits will be given in the descriptions of the parent material of various soil associations.

7. At the end of the glacial period the sea stood at a level some 80 feet above the present sea-level, and many of the features seen today below this level are related to halt-stages in the emergence of the land (Ogilvie, 1923). Remnants of beaches at the 50-foot, 25-foot and 15-foot levels, sometimes extensive, can easily be traced in the Moray lowland. At the maximum submergence the Clarkly Hill -Covesea ridge and the Branderburgh headland would have stood out as islands lying off the mainland formed by the Quarrywood ridge and the higher ground south of Elgin round to the Binn Hill. Smaller islands at Spynie, Lesmurdie and Meft dotted the partly enclosed bay.

The subsequent history of the present area is apparently that of successive uplifts, though it should be borne in mind that in other areas to the south the presence of submerged forests between the 50-foot and 25-foot raised beaches affords evidence of oscillation. These uplifts gradually narrowed the strait and the remaining submerged part was increasingly cut off by the building of spits and shingle-bars as the waves and tides endeavoured to produce a regular shoreline. Well-marked cliff-margins at the 80-foot level can be seen at Findrassie, Alves, on the Coulard Hill at Lossiemouth and between Duffus and Hopeman.

On the first uplift the sea withdrew from the valleys and hollows south of Elgin, the islands at Spynie, Kirkhill and Meft became linked to the

mainland and the Coltfield ridge appeared. The shoreline, however, was even more involved since many of the low fluvio-glacial mounds and ridges were also exposed and most have undergone some modification. The only relics of wave-built land of this period are the low shingle-bars at Spindlemuir and south of Covesea lighthouse.

The next uplift closed the strait at Roseisle and exposed extensive beaches, in that area, around Kinloss and Westfield, and in the western part of the parish of Drainie. These beaches are not necessarily areas of deposition but more often eroded and planed-off fluvio-glacial sand spreads. This stage saw the greatest development of marine structures. The strait between Branderburgh and Covesea was closed by a succession of shingle-bars and the Binn Hill almost tied to the Branderburgh headland by a similar series of bars. These may have forced the river Lossie to find an outlet on the west side of Kinneddar, but the river did eventually break through at Inchbroom and the interrupted shingle-bars were then modified to form the immense spreads at Sunbank and Caysbriggs. A similar course of events was meantime taking place west of Burghead. The area of water being gradually enclosed was by now of the nature of a lagoon, and carse-type sediments were being deposited in parts of it. When the land again rose, more tracts of beach were exposed, the shore-line was comparatively smooth and was not greatly different from that of the present day. A fine section of the 25-foot beach cliff line backs part of the golf course at Stotfield and sea-caves at two levels can be seen at Covesea.

East of the Binn Hill the river Spey reached the sea through a typical estuarine delta, and with the lowering base-level, eroded its own deposits, some of them fluvio-glacial, and as it entrenched itself, formed the conspicuous series of terraces between Fochabers and the coast. The Links at Spey Bay are formed of shingle-bars and storm beaches comparable to those to the east.

The final uplift to the present level reduced the lagoon to a Loch Spynie of far greater extent than its present day counterpart. In the western area of the sheet there would have been numerous small lakes and swampy hollows. The outlet of the river Lossie was again deflected westwards to Branderburgh by the extension of a sandspit, and the sea continued

to add to the beach deposits between there and the Binn.

8. Later events include the development of a fringe of sand dunes on the seaward margins of the most recent raised beaches, the filling up of many of the small depressions by silting or peat formation or both, the spreading of alluvium by the river Lossie and its tributaries during periodic flooding and, in historical times, the reduction of the area under water by artificial drainage.

Analyses of Moray Rocks and Drift Deposits (W. Mackie, 1899)

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO_2	Total Calcium CaO	Calcium as Silicate	MgO	K_2O	Na_2O	Loss on Ignition CO_2	Loss on Ignition H_2O	Total
Lower Old Red Sandstone													
1. Red Crags. Fochabers	59.24	6.65	2.02	0.31	0.50	16.04	0.56	0.12	2.30	0.19	12.16	1.26	100.79
2. Matrix of conglomerate. Tynet.	51.65	8.81	3.15	-	1.04	18.41	1.68	0.33	1.28	0.27	13.15	2.40	100.49
Upper Old Red Sandstone													
3. Scaat Craig	49.74	1.33	1.89	0.57	0.86	24.52	1.70	0.20	1.05	0.37	17.93	1.73	100.19
4. Newton	85.56	10.76	0.52	0.23	Tr.	1.00	0.91	Tr.	1.57	0.12	0.07	0.43	100.26
5. Rosebrae	92.13	4.42	0.37	0.33	0.24	1.27	1.27	0.14	0.72	0.11	Nil.	0.42	100.15
6. Bishopmill	87.00	8.84	0.28	-	-	0.46	0.31	0.47	1.78	0.23	0.12	0.62	100.26
7. Cornstone. New Elgin.	19.75	0.79	0.53	0.21	0.67	42.39	-	1.08	0.82	0.12	33.74		100.10
Permo-Trias													
8. Cuttieshillock	93.01	3.86	0.63	-	-	0.32	0.17	0.28	1.57	0.22	0.12	0.65	10.54
9. Spynie	89.43	4.00	0.39	0.36	-	2.21	1.76	0.17	1.73	1.35	0.35	0.15	100.14
10. Findrassie	77.24	9.47	0.54	0.20	Tr.	5.42	2.06	0.22	1.05	0.39	2.64	2.39	99.56
11. Covesea	95.41	1.63	0.18	0.50	-	0.27	Nil.	0.03	0.75	Tr.	0.22	1.63	100.17
12. Cummingstown	93.69	1.21	1.11	0.15	-	1.14	0.80	0.16	0.98	0.26	Fl 0.21 Cl 0.03 CO_2 0.09	0.91	99.94

Drift Deposits	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO_2	CaO	MgO	K_2O	Na_2O	P_2O_5	Loss on ignition	Total
13. Till. Craigmoray, Elgin.	80.13	9.06	2.44	-	-	0.72	0.50	2.08	0.66	0.14	4.11	99.84
14. River terrace sand. New Elgin	90.74	5.16	1.14	0.08	Tr.	0.69	Tr.	1.19	0.26	-	1.30	100.56
15. River sand. Spey at Craigellachie.	83.40	9.42	1.96	-	Tr.	1.15	0.46	1.43	0.79	0.20	0.94	99.75
16. River sand. Lossie at Elgin.	90.27	4.01	1.95	-	0.16	0.33	0.04	1.73	0.78	0.11	0.44	99.82
17. Beach sand. Lossiemouth.	89.99	7.36	0.72	0.13	Tr.	0.46	Tr.	0.84	0.33	-	0.60	100.43
18. Blown sand. Culbin.	91.39	5.44	0.89	0.16	Tr.	Tr.	Tr.	1.19	0.70	-	0.65	100.42

III. SOILS

SOIL ASSOCIATIONS

Durnhill Association

Distribution. Soils of the Durnhill Association occur in two areas, (1) between the Buckie Burn and the eastern margin of the Sheet (1.86 square miles), a continuation of the extensive development of Scotstoun Moor Bauds of Cullen on Sheet 96; here the topography is gently undulating, between 100 and 150 feet, but rising to over 300 feet on the small prominence of Clean Hill; (2) on the Hill of Stonyslacks (958 feet) in the south east corner of the map, part of the ridge extending to Addie Hill (0.65 square miles).

Parent Material. The parent material of the Durnhill soils is a till derived from the quartzose rocks of the Cullen group of the Highland Schists. The main rock type is a fine-grained massive granulitic quartzite of white grey or pinkish colour often containing fine banding due to thin layers of dark heavy minerals. In zones of much folding, flakes of white mica are developed and the rock approaches a quartz-schist. The upper beds are more variable with many bands of dark garnetiferous mica-schist interbedded with fine-grained quartzite. The till, exposed in cliff-sections on the coast, is a compact, stony loamy sand of a pale whitish yellow colour often with a reddish cast which may be due to a slight addition of material from the Middle Old Red Sandstone to the west. The upper part of the till in the Buckie area has been modified to some extent by glacial meltwater and contains in many places rounded quartzites which give it the appearance of a coarse gravel. On the Hill of Stonyslacks the till is derived from a lens of quartzite contained in the schists. The till is generally thin and obviously not far removed from source, since it contains many angular fragments and is sometimes more of the nature of rock rubble than true till.

Soils. The soils of the Durnhill Association are amongst the most acid in the area. The parent material is light-textured and highly siliceous, and in the dominant freely-drained Durnhill series, this has aided the development of well-marked podzol profiles with prominent A_2 horizons. Soils under semi-natural vegetation occur on the Hill of Stonyslacks only. On the steeper slopes where the drainage is good the profile is that of a normal podzol, but as the slope decreases the less rapid run-off tends to allow

the accumulation of black raw humus and the soils are peaty podzols. This effect is often aided by the presence of a thin impervious iron pan in the profile. On the poorly drained sites on this Association the humus accumulation is generally sufficiently thick to be mapped as hill peat, but one small flush area at the head of a stream has been separated as the very poorly drained Balloch series of the Association. The soil is a peaty gley.

On the lower ground the Durnhill soils, although agriculturally they cannot be rated very highly, are almost invariably cultivated. This is probably due to the proximity of the well-populated strip along the coast creating a demand for farm produce, and the availability of shell sand, seaweed, fish offal and town refuse, together with the rather favourable climate, has helped to build up and maintain a reasonable fertility in a soil of low inherent value. The whole area has been mapped as freely drained, but in some flat or slightly depressed patches the presence of an iron pan, together with the almost universal indurated layer, tends to hold up water after rain and to give a misleading impression of poor drainage. Below the pan, however, the profile has all the characteristics of free drainage. The soils are always stony, and the hard, resistant quartzites cause considerable wear and tear on farm implements. The topsoils are a dark grey colour, having been formed by the ploughing together of the black mor humus and part of the almost white A_2 horizon which is always present and may exceed 18 inches in thickness.

Series.

Durnhill Series

The following profile is the nearest to a natural profile available on the lower ground. Taken from a gentle slope at an elevation of 275 feet on the Moor of Findochty just east of Sheet 95, it represents the uncultivated version of the common profile in the area. The vegetation consists of Calluna vulgaris - Trichophorum caespitosum heath with scattered Ulex europaeus and Salix spp. (cf. Analysis No. 1).

Profile Description

Horizon	Depth	
L	0 - 1 in.	Black, undecomposed litter.
A_1	1 - 9 in.	Black humus with bleached sand grains.

Profile Description (contd.)

Horizon	Depth	
A_2	9 - 13 in.	Grey-brown loamy sand; patchy humus staining; frequent bleached quartzite stones; slight accumulation of black humus and roots at base.
B_1	13 in.	Strong thin iron pan; no roots penetrate.
B_2	13 - 16 in.	Bright yellow-orange loamy sand; friable; iron staining decreasing downwards; sharp change to
B_3	16 - 27 in.	Yellow-brown sandy till; intensely indurated; many rounded and sub-angular stones; merging into
C	27 in. +	Light brown compact, very stony till.

On the higher ground, a typical profile developed on a moderate slope under mixed Calluna vulgaris and Erica cinerea with Deschampsia flexuosa and Empetrum nigrum.

Profile Description.

Horizon	Depth	
L	0 - $\frac{1}{2}$ in.	Dark brown undecomposed litter
F	$\frac{1}{2}$ - 4 in.	Very dark brown mor humus with many fine roots
H	4 - 7 in.	Black greasy humus, drying to small angular blocks with many reddish brown fine roots in shrinkage cracks; sharp change to
A_2	7 - 16 in.	Grey-brown stony loamy sand; weakly cloddy when moist; some vague organic staining; very few roots; clear change to
B_1	16 - 20 in.	Dark brown humus stained stony sand; moist; weakly cloddy; sharp change to
B_1	20 in.	Thin ($\frac{1}{8}$ in.) wavy iron pan, almost continuous; slight concentration of roots above; sharp change to
B_2	20 - 28 in.	Bright yellow-brown stony loamy sand; friable; firm; merging into
B_3	28 - 33 in.	Pale yellow-brown stony sand; indurated; merging with decreasing induration to
C	33 - 45 in.	Pale brown stony sand till; compact

The humose B_1 horizon is variable in thickness and may be absent. On flat or gently sloping sites, where the iron pan tends to be best developed the consequent impedence to the downward flow of water results in a thickening of the H layer of black humus and gleying occurs in the lower part of the A_2 layer above the pan. This gleyed layer (A_2g) develops a greenish tinge and is frequently of heavier texture than the upper part of the A_2 due to the accelerated weathering, particularly of the felspars.

Balloch Series

As indicated, the very poorly drained soil of this series occupies a few acres only, in a flush area at the head of the Addie Burn. The vegetation is mainly Juncus acutiflorus. The profile has a surface horizon of up to 12 inches of very dark brown to black peaty sandy loam with abundant roots and relatively few stones. This overlies, with a sharp boundary, 12 to 16 inches of light grey sandy loam with weak cloddy structure and frequent stones often partly decomposed. Some iron mottling occurs round the infrequent root channels. This A_2g horizon changes sharply to a strongly gleyed C horizon consisting of blue-grey to olive-grey stony loamy sand.

Strichen Association

Distribution. Soil series of the Strichen Association are confined to the eastern part of the sheet where they occupy an area of some 1.70 square miles. They form an extension westwards of the belt of Strichen soils developed on the lower slopes of the Hill of Maud and Addie Hill on Sheet 96. The topography is moderately to gently sloping with altitude ranging from 250 feet at Drybridge, to over 750 feet on the Hill of Menduff. The Letterfourie and Core Burns dissect the area with their deeply incised channels.

Parent Material. The parent material of the Strichen soils is a till derived mainly from Dalradian metamorphic quartzose rocks. In this area the dominant rock type is a grey fine grained micaceous flagstone which splits readily along mica-covered partings into slabs which average about 1 inch in thickness. The till also contains a moderate amount of quartz-schist, mica-schist and quartzite. It is pale yellow brown in colour and of loamy sand to sandy loam texture with a moderate content of 1 to 4 inch rock fragments. The till cover is rarely very thick and tends to thin out with increasing stoniness on the upper slopes. A feature of the till is a certain grittiness due to coarse quartz particles from the schists.

Soils. The freely drained, poorly drained and very poorly drained series are all represented but the configuration of the ground is such that the freely drained Strichen series is by far the most extensive. As in the adjacent Durnhill Association a few more level patches with less rapid run-off

contain soils with imperfect drainage but these are too small to indicate on a 1 inch map. The poorly drained Anniegathel series is found where the steeper slopes begin to level out and the wet condition of the soil is due more to seepage water than to impedence within the soil. The very poorly drained Hythie series is limited to a very small flush area at the head of the Addie Burn.

With the exception of narrow wooded strips bordering the streams practically all the ground up to about 600 feet has been cultivated. Attempts have been made to establish small crofts above this level but these have not been successful and most of them have now been abandoned.

Series.

Strichen Series

An uncultivated soil under a vegetation consisting dominantly of Calluna vulgaris with some Nardus stricta, at an altitude of 650 feet, has the following profile (Analysis No. 3).:-

Profile Description

Horizon	Depth	
L/F	0 - 3 in.	Black mor humus; fibrous; roots plentiful; indistinct change to
A_1-A_2	3 - 9 in.	Dark grey, mixed mineral and black organic matter in upper part sandy loam below; some bleached quartzite stones; sharp change into
B_1	9 in.	Irregular thin iron pan ($\frac{1}{8}$ in.); slight humus concentration above;
B_2	9 - 14 in.	Yellow-brown fine sandy loam; some dark brown humus and iron staining; sharp change into
B_3	14 - 21 in.	Pale yellow-brown loamy sand; stones frequent, mainly angular schists but some rounded quartzites; indurated - induration decreasing downwards; merging into
C	21 - 42 in.	Yellow-brown loamy sand till; massive; moderate stone content but stones increasing in size and number downwards.

The typical profile has a more sharply defined organic surface horizon with a well-marked 3 to 6 inch bleached A_2 horizon. The thin iron pan is not continuous and rarely very strongly developed, but the indurated B_3 horizon is characteristic.

The following profile description is of a corresponding cultivated soil from a three-year old pasture at approximately the same level, with a moderate slope and north west aspect. (Analysis No. 2.).

Profile Description

Horizon	Depth	
S	0 - 8 in.	Dark brown sandy loam; weak cloddy structure; a few traces of thin iron pan, probably relic; sharp change to
B_2	8 - 20 in.	Bright yellow-orange stained sandy loam with frequent fragments of micaceous flagstones and schists, often in a friable condition; grass roots to 18 inches; clear change to
B_3	20 - 28 in.	Pale yellow-brown loamy sand with many rock fragments up to 6 inches across, rock fresher than above; indurated; merging into
C	28 - 40 in.	Pale brown loamy sand till; very stony; compact.

In the cultivated areas the upper horizons of the podzol profiles have been mixed together to form the S horizon. In some cases these horizons have been so thin that part of the B_2 horizon has been incorporated in the plough layer with disruption of any iron pan that may have been present. On the higher ground the till is sometimes so shallow that an ordinary inspection pit exposes the underlying rock which is usually then much shattered and weathered.

Anniegathel Series

The profile of this poorly drained series of the Strichen Association a non-calcareous gley, is described from a site on the foot-slope of the field from which the previous description was taken.

Profile Description

Horizon	Depth	
S	0 - 8 in.	Dark grey-brown fine sandy loam; soft cloddy structure; friable to coarse crumb; moderate stone content; sharp change into
G_1	8 - 12 in.	Grey-brown fine sandy loam; soft cloddy structure; more compact than S horizon; some dark blotchy humus staining; frequent stones; sharp change into
G_2	12 - 18 in.	Yellowish grey stony fine sandy loam; strong coarse yellow-brown mottling; more compact than above; merging into
G_3	18 - 33 in.	Stony fine sandy loam, mottled grey and rusty-brown with grey predominating; compact; merging into
C-G	33 - 48 in.	As above, but texture coarsening to stony loamy fine sand.

This profile lacks the tendency to prismatic structure common to most poorly drained soils. This is attributable to the comparatively light texture, although the texture of the poorly drained series is, in general,

slightly heavier than that of the freely drained series.

Hythie Series

The very poorly drained Hythie series is of very minor extent on Sheet 95. The few acres at the head of the Addie Burn is little more than a Juncus flush area and although part of it had at one time been enclosed, it is much too wet for cultivation. The profile shows about 12 inches of peaty loam with abundant roots overlying strongly gleyed, compact, grey to bluish grey stony loamy sand with some iron mottling in the upper part.

Foudland Association

Distribution. Soils of the Foudland Association are found in the south-east of the area, in a belt running from north to south on the north-west facing slopes of the Banffshire hills. The slopes vary from gentle to moderate and are, in general, smooth. The elevation ranges from 200 feet at Arradoul to over 800 feet at Tarrymount on the southern edge of the sheet. A small outlying patch has been mapped in the vicinity of Oran. The total area of Foudland soils is 2.47 square miles.

Parent Material. There is no sharp line of demarcation between the till on which the Foudland soils are developed and the parent material of the neighbouring Strichen Association. The rock in each case is the Findlater Flag group of the Highland Schists but in the Foudland till the dominant type is a fine-grained argillaceous-schist which is often of a slaty nature, and the more quartzose schists are scarce or absent. A high fine sand content is a characteristic of the texture, and the rock fragments, which are abundant locally are nearly all flat and angular. At Tarrymount a highly fissile variety of the rock has been quarried at one time for both roofing and paving slabs and many of the field dykes in the district have been constructed of this quarried rock in the absence of the numerous erratic boulders so common in the adjacent Strichen and Durnhill areas. The quarry at Oran is in a hard calcareous mudstone which has provided a till of Foudland type. The till over the whole area is variable in thickness, 4 to 6 feet being common on the lower ground, but on the steeper slopes of the upper hillside it may be as little as 18 inches over shattered and weathered rock.

Soils. The freely drained Foudland Series occupies 90 per cent of the total area of the Association. The Fisherford and Shanquhar series, poorly

drained and very poorly drained respectively, have also been noted. Most of the better-drained land has been cultivated or improved with resultant destruction of the upper horizon of the podzol profile, but even in the semi-natural soil the finer texture and less siliceous parent material of this Association has meant less pronounced A_2 horizons than in the Strichen and Durnhill podzols.

Series.

Foudland Series

The following profile is described from an open plantation of old Scots pine on a north-west facing slope on the hillside near Tarrymount at an elevation of 650 feet. The ground vegetation is mainly Agrostis tenuis and Holcus lanatus with occasional Ulex europaeus. (Analysis No. 4).

Profile Description

Horizon	Depth	
S	0 - 11 in.	Very dark brown (10YR5/2) fine sandy loam; fine sub-angular blocky structure; stony - mainly angular fragments of flagstone; roots plentiful; sharp boundary
B_2	11 - 26 in.	Strong brown (7.5YR5/6) stony fine sandy loam; fine crumb structure; friable; uniform iron staining decreasing downwards; clear but irregular change to
C	26 - 46 in.	Brown (10YR4/3); composed of rock fragments due to weathering in situ, interstitial material loamy fine sand; roots penetrate to 40 in.

This is typical of the shallower till areas and the likelihood of rock close to the surface is probably the reason for the tree planting. The hill soils may well have been cultivated in the past but close to the above site a profile under dominant Calluna showed about 4 inches of black mor humus. The mellow friable B_2 horizon is characteristic of the Foudland series. A thin iron pan above the B_2 is not uncommon in the uncultivated profile and on the thicker till an indurated B_3 horizon may be encountered.

Fisherford Series

The poorly drained soils forming this series are limited to a few small areas of cultivated ground just south of Farnachty Wood. These sites are level or slightly depressed and in places have a thin layer of alluvial material on the surface. The soil is classed as a non-calcareous gley.

Profile Description

Horizon	Depth	
S	0 - 8 in.	Grey-brown fine sandy loam; weak cloddy to crumb structure; moderate content of slate fragments; sharp change into
G_1	8 - 12 in.	Brownish grey fine sandy loam; compact cloddy structure; occasional rusty mottles; merging into
G_2	12 - 28 in.	Pale grey-brown fine sandy loam; cloddy; much fine rusty brown mottling; moderate stone content of partly weathered slate; merging into
C-G	28 - 48 in.	Greyish yellow-brown loamy fine sand till; much brown, grey and yellow mottling; compact; more stony than above.

Shanquhar Series

Very poorly drained soils of the Foudland Association have been mapped in and around the area known as Bog Shalloch. It seems probable that a good deal of peat may have been cut here and the profile generally now has 10 to 12 inches of dark brown loamy peat overlying 2 to 4 inches of dark grey-brown humus stained sandy loam. This changes sharply to slightly bluish grey sandy loam with iron deposition around old root channels. The structure is weakly cloudy at the top of the horizon but becomes more massive with depth and the iron-staining decreases.

Elgin Association

Distribution. Soils of the Elgin Association are found throughout the surveyed area but occur mainly on the higher ground in the western part where the underlying boulder clay appears at the surface through the mantle of fluvio-glacial drift. They are best seen on the ridges of Monaughty, Quarrywood, Findrassie and Inverugie, and on isolated rises at Earnside and Grange Hill. They also occupy the rising ground south of Loch-na-Bo, and have been mapped in small areas east of the Spey at Ordiga, Broadley and Auchenhalrig. The total area of the Association is approximately 13.6 square miles.

Parent Material. The parent material on which the Elgin soils are developed is a sandy loam textured till derived mainly from sandstones of Upper Old Red Sandstone age. From the distribution and occurrence of exposures of this till it seems probable that it covers most of the ground from the western edge of the sheet to well east of the Spey underlying most of the

extensive fluvio-glacial sand and gravel deposits. The greatest thickness of till exposed is some 15 feet, but 4 to 6 feet is more common, and on the ridges it is not unusual for solid rock to be encountered within normal profile depth. The colour of the till is pale reddish brown which tends to darken and become redder locally, and always with depth. The sandy loam texture is notably consistent over the area although within the soil profile there is, as a rule, rather less clay in the upper horizons. In the vicinity of the Permo-Trias outcrops the till contains a higher proportion of material from these sandstones but, apart from a slight increase in the sand fraction (cf. Analyses Nos. 9, 12, 13.) this has little effect on the general nature of the till. Stones are common everywhere, mostly of sandstone. In the south of the sheet where the Old Red Sandstone approaches the Highland Schists, the proportion of erratics of acid metamorphic rocks is greatly increased.

Soils. The freely drained Elgin series is dominant and is nearly always cultivated where not wooded. The semi-natural profile is a well developed podzol in which an iron pan may be present. Humus podzols are fairly common, particularly in the imperfectly drained Rosebrae series which usually occurs on flatter sites where the impedence to drainage of an indurated layer is more effective. The poorly drained Monaughty Series is a non-calcareous gley and the very poorly drained Findrassie series a peaty gley, although the division here is not clear-cut. Small areas of very poor drainage may have a low-humic surface horizon from which peat has been removed, and similarly the drainage of some patches of peaty gley may be no worse than poor. Both these series are, however, of very small extent.

Series.

Elgin Series

Most of the soils of the Elgin Association occur on moderate slopes, and this together with the relatively low rainfall and coarse texture has resulted in the dominance of the freely drained Elgin series. Particularly the whole area occupied by this series has been cultivated or planted with trees, so that areas of semi-natural moorland or rough grazing are negligible. The following description is a typical profile in a 20 year old Scots pine plantation on a gentle slope at an elevation of 250 feet. (Analysis No. 5).

Profile Description

Horizon	Depth	
L/F	0 - 1 in.	Litter, mosses and pine needles, passing into a thin F-layer and incipient H-layer.
A_1	1 - 3 in.	Dark grey (10YR4/1) loamy sand; weakly cloddy; high organic matter; many roots; very moist; clear change into
A_2	3 - 8 in.	Light brown-grey (10YR6/2) loamy sand; weakly cloddy; stones common; organic matter in irregular streaks and blotches, concentrated around the few roots; moist; concentration of humus at base of horizon; sharp change to
B_2	8 - 20 in.	Strong brown (7.5YR5/6) merging downwards to reddish yellow (7.5YR6/8) loamy sand; weakly cloddy; friable; frequent stones; many roots; moist; merging colour change but boundary marked by incidence of induration.
B_3	20 - 30 in.	Reddish brown (2.5YR5/4) sandy loam; frequent stones; indurated with tendency to platy structure; no roots; moist; merging into
C	30 in. +	Reddish brown (2.5YR4/4) sandy loam; very compact; frequent rounded stones (quartzites and quartz-schists): no roots; moist.

This profile illustrates the increase in clay content and the reddening of the colour with depth. The high sand content of the upper horizons suggests in places the likelihood of some degree of water-sorting of the till surface and this almost certainly did occur in the Ordiga area east of the Spey. The bleached A_2 horizon is usually prominent due to the complete removal of the red colour. Tapering tongues of grey bleached material extending down through the B horizon following root channels are characteristic of the Elgin series. A thin iron pan may be present but is seldom extensive or continuous; more often a concentration of black humus is found at the base of the A_2 horizon followed by an inch or two of intense iron staining on the top of the B_2 horizon. The degree of induration varies from moderate to strong and is usually accompanied by the development of a platy structure. The non-arable soil is strongly acid and notably low in nutrients.

A corresponding cultivated profile from a smooth 5° slope at an elevation of 200 feet provided the following description. The vegetation was three-year old pasture. (Analysis No. 6).

Profile Description

Horizon	Depth	
S	0 - 16 in.	Dark brown (7.5YR3/2) sandy loam; weak sub-angular blocky; medium organic matter; stones common (quartzites and sandstones); roots frequent; earthworms common; moist; clear change to
B_2	16 - 20 in.	Yellowish red (5YR4/8) loamy sand; weak sub-angular blocky; friable; low organic matter; roots common; stones common; moist; no mottling; sharp change to
B_3	20 - 34 in.	Brown (7.5YR5/5) and light yellowish brown (10YR6/4) loamy sand; indurated; slightly platy; very low organic matter; stones common - rounded and sub-angular (1 to 4 inches); no roots; moist; merging with decreasing induration into
C	34 in. +	Reddish brown stony sandy loam till; compact; moist.

The fairly deep S horizon of this profile has been formed by the ploughing together of the A_1 and A_2 horizons and probably the upper part of the B_2 horizon. The effects of the processes of cultivation and the application of manure and artificial fertilizers may be seen in the greatly enhanced base status and higher figures for total and readily soluble phosphate.

Rosebrae Series

Soils of the imperfectly drained Rosebrae series occur in very small patches within the areas of the Elgin series, but have been mapped separately in three localities near Burgie, Asliesk and Linkwood. The less efficient drainage is due to poor run-off from nearly level sites, the addition of seepage water from slopes above, or to the impedence caused by a fairly strong indurated layer. The following profile is from a cultivated field of first-year pasture at an elevation of 320 feet, immediately below a wooded slope. (Analysis No. 7).

Profile Description

Horizon	Depth	
S	0 - 7 in.	Dark brown (7.5YR3/2) sandy loam; weakly cloddy to crumb structure; medium organic matter; stones plentiful; abundant grass and clover roots; frequent earthworms; moist; sharp change to
B_2	7 - 9 in.	Brown (7.5YR4/4) sandy loam; fine crumb structure; stones plentiful; roots common; moist; uniformly iron-stained; horizon of variable thickness probably due to incorporation of part in S horizon by ploughing; very sharp change to

Profile Description (contd.)

Horizon	Depth	
B_3(g)	9 - 20 in.	Yellowish brown (10YR5/4) coarse sandy loam; strongly indurated; very stony; no roots; blotchy appearance due to coarse mottling of varying intensity; merging into
C(g)	20 in. +	Brown (7.5YR5/4) and pale red (2.5YR6/2) stony loam; compact; colour patchy; some rusty staining; moist.

This profile has a higher than average stone content with a higher proportion of schists and quartzites. The absence of an A_2 horizon and the comparative thinness of the B_2 is the result of ploughing. More commonly, and especially on uncultivated sites a horizon of fairly intense humus concentration occurs just above the B_2 horizon.

Monaughty Series

With the exception of an area which is part of the westward extension of the Mosstowie valley, soils of the poorly drained Monaughty series are restricted to small pockets on level or slightly depressed sites. Such a site at 350 feet on the northern flank of the Monaughty ridge showed the profile described below. The area is uncultivated but planted with Norway spruce, Scots pine and European larch with a ground vegetation including Deschampsia flexuosa, Sphagnum sp., Polytrichum commune and Hylocomium splendens. (Analysis No. 8).

Profile Description

Horizon	Depth	
L	0 - 1 in.	Litter; moss and needles.
F	1 - 2 in.	Partly decomposed mor humus
H	2 - 2½in.	Black greasy humus
A_1	2½- 7½in.	Very dark brown (10YR2/2) humose loam; sub-angular blocky; high organic matter content; frequent stones; abundant roots; very moist; sharp change into
A_2g	7½- 12½in.	Grey-brown (10YR5/2) loamy sand; weak sub-angular blocky; low organic matter; indistinct humus staining; stones frequent; roots markedly less frequent than in above horizon; very moist; sharp change into
B_2g	12½- 16 in.	Light brown-grey (2.5Y6/2) sandy loam; coarse sub-angular blocky; stones frequent; roots scarce; very moist; many medium yellowish-red (5YR5/8) mottles; merging into

Profile Description (contd.)

Horizon	Depth	
B_3g	16 - 43 in.	Light brown-grey (2.5Y6/2) and reddish brown (5YR5/8) sandy loam, but with tongues and pockets of grey loamy sand; compact; stones frequent - all except quartzites much weathered; very moist; many rusty mottles as above; merging into
Cg	43 in. +	Reddish brown (5YR5/3) sandy loam; compact; no iron mottling but much grey gleying; wetter than above.

The stones throughout are of acid rock types, granite, quartz-schist, quartzite and sandstone. The increase in clay content of the gley horizons is almost certainly due to weathering of the rock fragments in the very moist conditions. The cultivated soil normally has a 9 inch S horizon of sandy loam, and is less moist as a result of tile draining. Otherwise the profile shows the same characteristics.

Findrassie Series

The very poorly drained peaty gley has been recorded on the map in two small areas only. The profile quoted (Analysis No. 9) is from a hollow on the flat top of the Quarrywood ridge with a vegetation of birch scrub and heather.

Profile Description

Horizon	Depth	
F	0 - 3 in.	Dark brown peaty humus
A_1-A_2g	3 - 5 in.	Very dark grey (10YR5/2) loamy sand; weakly cloddy; many roots;frequent stones; wet; much black humus staining at base; sharp change to
B_2g	5 - 11 in.	Dark reddish brown (5YR3/3) sand; weakly cloddy; strong brown to black humus staining especially around frequent root channels; many stones; very moist; merging into
B_3g	11 - 22 in.	Dark brown (7.5YR4/4) loamy sand; fairly compact with weak platy structure, compaction decreasing downwards; much humus staining; stones frequent; occasional roots; very moist; merging into
Cg	22 in. +	Light brown-grey (10YR6/2) loamy sand; stones frequent; slight humus staining along the occasional root channels; wet, with water seeping in at 34 in.

The influence of the Permo-Trias sandstones on the till in this locality is shown by the high sand content and the occurrence of "dreikanter" pebbles of quartzite. The profile gives the impression of being completely leached throughout but this may be due partly to the low iron content of the parent material.

Tynet Association

Distribution. With the exception of three small patches just west of the Spey Bridge at Fochabers all the soils of the Tynet Association lie east of the Spey. They occupy a wide strip across the northern face of Whiteash Hill and extend over the slopes above the village of Clochan to the undulating lower ground as far as Inchgower. Deep gullying, a common feature in areas of the comparatively soft Middle Old Red Sandstone rocks, is a characteristic of the Tynet topography. The total area of the Association is just under $4\frac{1}{2}$ square miles.

Parent Material. The parent material is a red till derived from sandstones and conglomerates of Middle Old Red Sandstone age. The texture of the till varies from sandy loam to loam and generally tends to become heavier with depth. It is always stony, the stones being small well-rounded pebbles, mainly of quartzite, quartz-schist and granite.

Soils. The prevalence of moderately steep slopes in the area and the fairly coarse texture of the till have resulted in the dominance of the freely drained series. This is a well-developed podzol with a prominent bleached A_2 horizon which contrasts markedly with the redness of the lower horizons. An iron pan may be present but is generally soft and discontinuous. Some degree of induration at about 18 inches is always found and is commonly quite intense. Much of the ground is uncultivated and parts have been ploughed and planted by the Forestry Commission. The upturned A_2 horizon material on drying out shows up almost white and presumably accounts for the appropriate name Whiteash Hill. The few insignificant imperfectly drained patches have been grouped with the freely drained. A poorly drained non-calcareous gley has been mapped in four small areas, where the wetness is due to poor run-off from level or depressed sites or to seepage from the slopes above.

Series.

Tynet Series

In semi-natural conditions this freely drained series occurs under dry heath with birch scrub. The following profile is from a north facing hillside with a 3° slope at a height of 300 feet, with present vegetation consisting of Calluna vulgaris, Erica cinerea, Deschampsia flexuosa, Betula spp. and the mosses Hylocomium splendens and Pseudoscleropodium purum.

The area would at one time have carried coniferous woodland, and is now being planted with Scots pine (Analysis No. 18).

Profile Description

Horizon	Depth	
L		Trace
F	0 - 3 in.	Fermenting raw humus; many fine roots.
H	3 - 3½in.	Very dark brown greasy humus; variable thickness but always present.
A_1	3½- 5 in.	Very dark grey (5YR3.5/1) humose sandy loam; weakly cloddy; high organic matter; numerous roots; moist; sharp but irregular change to
A_2	5 - 7 in.	Reddish grey (5YR5/2) sandy loam; weakly cloddy; medium to low organic matter; numerous roots; moist; some patchy humus staining; sharp but slightly irregular change to
B_1	7 - 7½in.	Layer of humus-iron concentration.
B_2	7½- 18 in.	Yellowish red and pale brown (5YR4/6 and 10YR6/3) sandy loam; medium subangular blocky structure; friable; numerous roots; moist; clear but irregular boundary marked by colour change and incidence of induration.
B_3	18 - 32 in.	Reddish brown (2.5YR4/5) loam with high coarse sand fraction; slightly platy; indurated; occasional large roots but roots generally limited by top of induration; clear change to
C	32 in. +	Dusky red (10R3/4) gritty loam; compact; breaking to medium subangular blocks; moist.

Small rounded pebbles of acid metamorphic rocks and granite are abundant throughout the profile, and a feature of the texture is a high proportion of sharp grit and coarse sand. The felspars in the granites tend to be completely altered. Subangular fragments of sandstone and fine conglomerate are also common.

The 3 to 6 inch raw humus layer is fairly uniform over the area. The ploughing done by the Forestry Commission rarely failed to reach to the A_2 horizon but more often penetrated to the B_2 horizon, thereby disrupting any iron pan that may have been present. The induration is not as intense as in the Durnhill and Strichen Association soils, but a tendency to platiness is usually well marked. Despite the existence of calcareous bands in the sandstones and in some places even cement and veins of calcite, the base status of the Tynet soils is very low. This, and a serious deficiency of phosphate does not, however, prevent their being made quite productive. Cultivation

commonly produces a 12 inch brown sandy loam top soil with good crumb structure. (cf. Analysis No. 19).

Whiteash Series

The poorly drained series is of very small extent and little importance. The wetness is usually due to poor run-off from level or depressed sites which often collect seepage water from slopes above. Another factor is the poor internal drainage on such sites due to impedence by the indurated layer. The profile consists of a 9 to 10 inch S horizon of sandy loam with a moderately high organic content, overlying 12 to 15 inches of fairly compact pale reddish grey sandy loam with much ochreous mottling. An indurated layer may be present or there may be a gradual merging with increasing compaction and decreasing mottling into the slightly gleyed red till.

Shempston Association

Distribution. Soils of this Association are limited to an area of some 15 acres capping a mound near the farm of Shempston about ¾ mile east of the village of Duffus.

Parent Material. The till which forms the parent material of the Shempston soil is derived from a dark grey shale. In view of the records of Jurassic till having been exposed in the area, the shale is probably of Jurassic age and has been brought from the bed of the Moray Firth to the north. A similar shale was seen as pebbles in the shingle of the 50 foot raised beach at Covesea and as erratics in the black clay which forms the parent material of the Whitehills Association found some 30 miles along the coast on Sheet 96. This clay is, however, of markedly higher base status than the Shempston till.

Series.

Shempston Series

The imperfectly drained Shempston series is the only one represented and has been classified as a brown forest soil of low base status with slight gleying in the B and C horizons. The area is partly arable and partly under trees. (Analysis No. 20).

Profile Description

The profile described below is from a small Scots pine plantation with some beech trees at an elevation of 90 feet near the crest of the mound. A grassy ground vegetation included Poa pratensis, Agrostis tenuis, Festuca sp. and the mosses Pseudoscleropodium purum and Rhytidiadelphus squarrosus. The annual rainfall of the area is approximately 25 inches.

Horizon	Depth	
L/F	0 - 3 in.	Brown (7.5YR4/4) humus-grass roots and moss litter; abundant tree roots; earthworms present; slightly moist; sharp change to
A_1	3 - 12 in.	Dark grey-brown (10YR4/3) loam; fine sub-angular blocky to crumb structure; medium organic matter; few stones; frequent roots; slightly moist; profuse fine rusty mottling; sharp change into
B_2g	12 - 23 in.	Brown (10YR4/3) and yellowish brown (10YR5/6) loam; medium sub-angular blocky; low organic matter; few stones; frequent roots; much earthworm activity; moist; much rusty mottling around weathering rock fragments; sharp change into

Profile Description (contd.)

Horizon	Depth	
B_3g	23 - 31 in.	Light olive brown (2.5Y5/4) fine sandy loam; compact, with angular fracture; no stones; frequent roots; moist; some distinct medium rusty mottling with more general diffuse fine mottling; sharp change into
Cg	36 - 56 in.	Dark brown (7.5YR3/2) clay; mainly composed of partly weathered shale fragments with yellow (2.5Y6/8) encrustation on cleavage planes.

The loam textured upper horizons have almost certainly had incorporated a fair amount of blown sand, in common with many other soils in the neighbourhood. The abundant angular shale fragments are the dominant feature of the till and their weathering products probably account for the high clay content (over 50 per cent) of the C horizon.

Boyndie Association

Distribution. The Boyndie Association is the most extensive and widespread, occupying some 47 square miles, or 35 per cent of the total area of the map. East of the Spey, Boyndie soils cover most of the ground below 250 feet between Fochabers and Buckie. West of the Spey, the biggest single area of the Association extends in a wide belt from the east bank of the river Lossie through the parishes of St. Andrews-Lhanbryd and Urquhart to the Binn Hill and Garmouth on the coast. More Boyndie soils occur at the eastern end of the Quarrywood ridge north of Bishopmill, on the flank of the Burghead-Covesea ridge particularly around Drainie, and, in the western part of the sheet, between the main Elgin to Forres road and the raised beaches. The topography may be gently undulating in places but is characteristically irregular and moundy with occasional well-defined ridges.

Parent Material. The parent material is stratified sand deposited by meltwater from the retreating ice at the end of the glacial period. It commonly shows well-marked current bedding and often contains lenses and layers of gravel and coarse sand. Inter-bedded thin bands of reddish silty fine sand and silty clay similar to the parent material of the Carden Association also occur, particularly in the western part of the area, although they have been noted as far east as Maverston. (See Analyses Nos. 28 and 31). Neither they nor the gravels make any great difference to the nature or

behaviour of the soils. The deposits vary in thickness from a few feet to over 50 feet in places; they are well-exposed in a sand quarry just east of Lesmurdie.

Soils. Four series have been mapped in the Association. The light-textured parent material and the prevalence of undulating to moundy topography have resulted in the freely drained Boyndie series being by far the most extensive. The profile under semi-natural conditions is a well-developed podzol with a prominent bleached A_2 horizon, but, as most of the Boyndie soils have been cultivated, this profile is seen now only in areas of very irregular topography which are unsuitable for agriculture and where the drainage tends to be excessive. A strongly cemented humus-iron B_2 horizon is a feature of the series.

The imperfectly drained Anniston series is found on the few comparatively level sites within the Association which have restricted external drainage. The profile is similar to that of the freely drained soil except for duller colours and weaker cementation in the B horizon and the appearance of diffuse ochreous mottling in the C horizon. Under cultivation Anniston soils tend to develop deep S horizons.

The poorly drained Dallachy series and very poorly drained Ballindarg series are of minor importance being limited to hollows and depressions where the water-table periodically approaches the surface. They have been classified as ground-water non-calcareous gley and peaty gley respectively.

Series.

Boyndie Series

Uncultivated soils under semi-natural vegetation are scarce in the Boyndie Association since most areas unsuitable for cultivation have been planted with trees. The following profile (Analysis No. 26) is from an old Scots pine plantation near Kinloss which has a sparse ground vegetation of Agrostis sp. and Hypnum cupressiforme. The annual rainfall of the district is less than 25 inches.

Profile Description

Horizon	Depth	
L	0 - ½ in.	Litter of pine needles and cones.
F	½ - 2½ in.	Very dark brown fibrous humus.
A_1	2½ - 3 in.	Irregular horizon of mixed humus and bleached quartz grains.

Profile Description (contd.)

Horizon	Depth	
A_2	3 - 8 in.	Dark greyish brown (10YR4/2) sand; very weak cloddy structure; low organic matter; a few small rounded pebbles; frequent tree roots; no worms; streaks of higher organic content along old root channels; slightly moist; sharp but irregular change to
B_1	8 - 12 in.	Dark reddish brown (5YR3/3) and yellowish brown (10YR5/4) sand; very weak cloddy structure; high organic matter - humus accumulation; abundant roots; slightly moist; variable humus staining; clear but irregular change to
B_2	12 - 32 in.	Strong brown (7.5YR5/6) and dark reddish brown (5YR3/4) sand; indurated (humus-iron pan); breaks into angular fragments; induration variable in intensity and decreasing downwards; no stones; very few roots; slightly moist; merging into
C	32 in. +	Light yellowish brown (10YR6/4) sand; single-grain; no stones; very few roots; slightly moist.

Under the free to excessive drainage conditions resulting from the very light texture it is unusual to find more than an inch or two of surface organic accumulation. The uncultivated soil is invariably heavily leached and as the very high sand fraction (over 90 per cent) is composed mainly of quartz, the resultant podzolic profile usually shows a prominent bleached A_2 horizon. The dark brown strongly iron-humus cemented B horizon (the "Moray pan") is a feature of the Boyndie series and together with the similar indurated horizon of the Corby series has a well-deserved notoriety among farmers. When soils of this series have been cultivated for a long time deep S horizons have been developed, 12 inches being common and 18 to 20 inches not infrequent. Much of the series has, however, been taken in from heathland in relatively recent times and the S horizon then consists of an 8 to 10 inches plough-layer usually low in organic matter. Newly ploughed fields often show bright yellow-brown patches where the plough has reached the B horizon, indicating a variation in topsoil depth which may be due in part to the tendency of the sand to blow in a dry spring.

Analyses Nos. 23, 24 and 26 demonstrate the improvement resulting from cultivation and the application of fertilizers, particularly in the figures for pH, exchangeable potassium and readily soluble phosphate. They also stress the need for regular applications of lime and the incorporation of more organic matter in the topsoil.

Anniston Series

Patches of the imperfectly drained Anniston series occur throughout the Boyndie series on footslopes and small flats which are not often of sufficient area to show on the one inch map. The example quoted is from a hollow in a moundy district, at an elevation of 150 feet. The field has long been cultivated and was carrying third year pasture at the time of sampling. (Analysis No. 25).

Profile Description

Horizon	Depth	
S	0 - 9 in.	Dark brown loamy sand; weak cloddy structure; low organic matter; a few small well-rounded pebbles; roots plentiful; earthworms scarce; moist; sharp change to
A_1	9 - 17 in.	Dark brown loamy sand with bleached quartz grains; moderate organic matter; occasional small pebbles; roots plentiful; earthworms scarce; slightly moist; merging into
B_1-B_2	17 - 25 in.	Dark reddish brown loamy sand; weakly compacted; much diffuse humus staining; roots common; slightly moist; merging into
B_2	25 - 40 in.	Yellowish brown sand; very weakly cloddy; some organic matter down root channels; slightly moist; merging into
B_3	40 - 44 in.	Light yellowish brown sand; compact but single-grain: occasional thin bands of iron deposition following bedding planes; moist; merging into
C	44 in. +	Light brown coarse sand; single-grain; moist.

The boundary at 9 inches marks the depth of ploughing, but the surface horizon differs little from the next and the organic content, though low, is considerably higher than in the S horizon of the corresponding freely drained soil. The dark humus-iron stained B horizon is much less cemented than in the Boyndie series and completely lacks the crisp, angular fracture.

Dallachy and Ballindarg Series

Soils of the Dallachy and Ballindarg series occur in narrow channels and other concave sites throughout the area of the Association; they are nowhere of any great extent. The poor drainage is the result of a high water-table sometimes caused by hold-up of the water by underlying till as in the vicinity of Muirton, but more often due to the lack of adequate outfall. In winter, following heavy rain or the melting of snow, the water-table may reach the surface and pools of standing water are often seen in areas of the Ballindarg series. Artificial drainage can improve the Dallachy soils

sufficiently to permit cultivation; the more poorly drained sites tend to be swampy, with some alluvial deposition and usually some development of a peaty surface layer.

A typical Ballindarg soil is described from the edge of a depression which is too wet to plough and supports only poor pasture with much Holcus and Ranunculus (Analysis No. 30).

Profile Description

Horizon	Depth	
S	0 - 11 in.	Very dark brown (10YR2/2) loamy sand; weak cloddy structure; high organic matter; roots plentiful; no stones; very moist; sharp change to
A	11 - 16 in.	Black (5YR2/1) amorphous loamy peat.
Bg	16 - 26 in.	Pale brown (10YR6/3) sand; structureless; a few thin horizontal lines of humus concentration; a few fine roots; wet; rusty mottling along old root channels; sharp change to
Cg	26 in. +	Very dark grey (5Y4/1) sand; massive; wet; some old decomposed roots.

The sand in the surface horizon is alluvial, probably down-wash from the adjacent slope. The Dallachy profile has no peat although it may have a highly organic S horizon, and the dark grey or blue-grey colour in the Cg horizon, denoting waterlogged conditions, may not be present within normal profile depth.

Corby Association

Distribution. Soils of the Corby Association are widely distributed throughout the area of the map. In the eastern part they occur on the broad upper terraces of the river Spey from Balnacoul Wood to the Hill of Garmouth, in the Gordon Castle policies and around Bogmuir and Dallachy, with smaller spreads above Farnachty and near Arradoul. They are also found extensively in the moundy area of gravel moraine east of Loch na Bo and at the eastern end of the Monaughty ridge around Miltonduff. At the western end of the sheet another wide area occupies the ground between the Wood of Alves, Morayscairn and Scotsburn. Smaller patches of Corby soils may be found anywhere within the areas of the Boyndie Association, usually on isolated gravel mounds. The total area of Corby Association soils is just over 7.5 square miles.

Parent Material. The Corby parent material is well-sorted, stratified gravel deposited by melt-water at the close of the glacial period. The stones are well-rounded, 1 to 3 inches in diameter, composed dominantly of quartzite, quartz-schist, gneiss and granite. Layers and seams of coarse sand are frequently interbedded. The spreads may occur as relatively flat upper terraces, well above the present river flood-plain, or as moundy morainic deposits. In the latter case the gravel may be less well sorted and the bedding less distinct.

Soils. The coarse texture of the parent material together with the moundy or undulating topography result in the dominance of the freely-drained Corby series. Much of it is uncultivated when the profile is that of a peaty podzol with a well-developed A_2 horizon. A thin iron pan does occur in places but more commonly a zone of humus-iron concentration marks the top of the B horizon. In this area the imperfectly drained Leys series is normally cultivated. It retains the main features of the freely drained series, but frequently a deep S horizon has been developed. The poorly drained Mulloch series and very poorly drained Mundurno series are limited to a few small depressions where the drainage is affected by the local water-table. They have been classed as non-calcareous gley and peaty gley respectively.

Series.

Corby Series

The semi-natural vegetation is Calluna heath with scattered conifers and occasional gorse and broom. The site of the following profile was near the top of a mound formerly carrying Scots pine but now under birch scrub and heather. The average annual rainfall is less than 30 inches (Analysis No.33).

Profile Description

Horizon	Depth	
A_1	0 - 2 in.	Variable; patchy; fibrous mor humus and mixed bleached sand and humus frequent. Calluna roots and some old pine roots; sharp change to
A_2	2 - 15 in.	Grey-brown (7.5YR5/2) bleached gravelly sand; slightly humus stained; many fine roots; sharp but wavy boundary with humus concentration at base.
B_1	15 - 16 in.	Dark reddish brown (5YR2/2) humus-iron pan; crisp fracture; clear change to
B_2	16 - 30 in.	Strong brown (7.5YR5/8) gravelly, coarse sand; strongly indurated; stones up to 6 in. diameter, well rounded; wavy boundary, parallel to base of A_2.

Profile Description (contd.)

Horizon	Depth	
B_3	30 - 36 in.	Strong brown (7.5YR5/6) as above with decreasing iron staining; sharp change to
	36 - 39 in.	Current-bedded coarse sand.
C	39 in. +	Yellowish brown (10YR5/4) gravel finer than above; loose; moist.

The main features of the freely drained profile are the induration of the B_2 horizon as well as the B_3, the sharp change in the C horizon to loose gravel, and the variation in thickness of the horizons. This variation is related to some extent to the topography, shallow profiles commonly occurring on the summits of mounds. The A_2 horizon frequently dips sharply possibly where a former tree root penetrated. The B_1 horizon may be quite strongly cemented and breaks into crisp, angular blocks. The B_2 tends to be of uniform thickness but varies in depth following the convolutions of the base of the A_2. The induration does not appear to impede the drainage.

The river terrace gravels have generally a smooth to gently undulating topography which encourages cultivation. Where a reasonable depth of S horizon has been developed the soil is quite good agriculturally although much depends on regular rainfall and absence of spells of drought.

The areas of moundy topography are better suited to forestry and considerable areas have been planted to Scots pine which is well adapted to the Corby soil.

Leys Series

The impedence in this series is usually due to poor external drainage from the site but this is frequently an advantage;at Garrowslack the impedence is caused by compact till underlying the gravel. Deep topsoils have been developed in many places although otherwise the profile is similar to that of the Corby series. The compaction of the B horizon is usually less intense, but the humus stained B_1 is commonly thicker. Slight iron mottling is present in the B_3 and C horizons.

Mulloch and Mundurno Series

The poorly and very poorly drained soils are scarce as would be expected with such a coarse-textured parent material. They are found in depressions or hollows among the mounds where the water-table is near the surface for much of the time. Artificial drainage and the removal of peat has produced

some of the Mulloch soils, as there is usually a very sharp change from free drainage to very poor drainage. Under natural conditions the peaty gley is the normal soil, and unless the drainage is maintained and the areas cultivated regularly they rapidly revert to a swampy state.

Carden Association

Distribution. Soils of this Association are found in the western part of the sheet at all levels up to 150 feet. They occur rather patchily on some of the higher mounds and low ridges, notably at Wester Alves, Hillhead and Carden with smaller areas near Burgie and Hempriggs, and at Kintrae, Rosehaugh and Kaim, occupying a total area of just over 2 square miles.

Parent Material. The parent material of the Carden Association is a lacustrine deposit of reddish silty clay, well-bedded, with occasional thin layers of coarser material. Its distribution suggests that it may have been more extensive at one time and subsequently been eroded, but the silt is more probably part of the late-glacial outwash deposits and represents a period of still-water deposition during a temporary halt in the westward retreat of the ice. It is nowhere very thick and has been seen directly overlying till (cf. Analysis No. 22) and interbedded with the sand of the Boyndie Association (cf. Analysis No. 28). Fine silt bands are not uncommon in the fluvio-glacial sand, particularly in the western half of the sheet, and they have been noted as far to the east as Troves and Maverston.

Series.

Carden Series

The undulating nature of the topography where the Carden soils occur provides reasonable slopes which, coupled with the low rainfall, result in the dominance of the imperfectly drained series, despite the fine texture of the parent material. Small patches of poor drainage do occur, but the imperfectly drained Carden Series is the only one shown on the one-inch map. It is described as a brown forest soil with slight gleying in the B and C horizons. All Carden soils are cultivated and provide excellent arable land.

Profile Description

The following profile is from a field of third year grass, at a height of 120 feet, near the top of a gentle slope. (Analysis No. 21).

Profile Description (contd.)

Horizon	Depth	
S	0 - 12 in.	Brown (7.5YR4/2) loam; medium angular blocky structure; friable to good crumb; medium organic matter; very few small rounded pebbles; frequent roots; moist; very sharp change to
B(g)	12 - 40 in.	Reddish brown (5YR5/3) and brown (10YR5/3) silty clay; coarse prismatic structure; frequent roots down worm tracks and structure cracks; moist; diffuse fine rusty mottling; slightly gleyed structure faces; merging into
C(g)	40 in. +	Reddish brown (5YR4/3) clay; more massive than above; moist; slight fine grey and ochreous mottling with some black staining along fine rootlet channels.

The surface horizon has a relatively high sand content probably due to the addition of blown sand from the west, although in some parts a thin superficial deposit of sand may have been incorporated by ploughing. Some variation in topsoil texture has been permitted in the mapping but the underlying material is notably uniform, with its lacustrine origin reflected in the high proportion of silt throughout the profile. A well-defined prismatic structure and diffuse, fine, grey and ochreous mottling are the outstanding features of the subsoil. High exchangeable calcium figures and almost complete base saturation distinguish the Carden soils from all the neighbouring soils except those of the comparable Duffus Association.

Duffus Association

Distribution. The soils of the Duffus Association are located around the margin of the "greater" Loch Spynie. They occur up to 50 feet above the central part of the basin which was finally drained less than 150 years ago, and have been traced to the farthest extent of the former loch at Bridgend, Kaim and Orchardfield. Typical areas may be seen at Rothills, Old Duffus and Kintrae. The total area occupied by the Association is just over 2 square miles, all of which lies between the 25 and 27.5 inch isohyets on the annual rainfall map.

Parent Material. A lacustrine silty clay forms the parent material of the Duffus soils. It represents the sediments in the extensive stretch of water which occupied the Laich of Moray prior to the post-glacial uplift. In the Later stages this water would have been of the nature of a lagoon and some of the deposits resemble the carse clays found in other parts of Scotland.

Typically the deposit contains 40-50 per cent clay with 30-40 per cent silt, though there is some slight variation and occasionally the silt exceeds the clay. Inevitably in such an area there is some interbedding of sand and silt with the clay, and in places a thin superficial layer of more recent alluvium. In addition, the blown sand which has contaminated much of the lowland of Moray, has had a considerable influence on certain areas of the Duffus soils, where it has now been incorporated in the topsoil by cultivation. The clay is always calcareous at slight depth and frequently throughout the profile.

Soils. The soils of the Duffus Association are recognised to be among the most productive in the area. The dominance of poor drainage is as much due to the almost level topography and low elevation as to the heavy texture. The timing of cultivation is important and although drying out is a danger to crops the rainfall is generally well enough distributed throughout the year to prevent serious trouble. This poorly drained soil has been mapped as a calcareous gley. An imperfectly drained soil occurs on the slightly higher ground surrounding the central low-lying area, and on several low rises. It tends to have a lighter-textured surface horizon and provides excellent arable land. It has been classified as a brown forest soil of high base status with gleyed B and C horizons.

Series.

Kintrae Series

The following profile is from a very gentle slope on one of the low undulations typical of the area. The altitude is only 30 feet above sea level and the drainage is nearer the wet end of the imperfect class. At the time of sampling the vegetation was second-year grass dominated by cocksfoot, rye-grass and white clover. (Analysis No. 35).

Profile Description

Horizon	Depth	
S	0 - 11 in.	Dark brown (7.5YR3/2) loam; medium sub-angular blocky structure; medium organic matter; very few small rounded stones; frequent roots; moist; no mottling; sharp change to
Bg	11 - 27 in.	Dark grey (10YR4/1) clay; strong, coarse prismatic structure - sharp angled prisms breaking to large angular blocks; abundant fine root channels giving porous appearance in cross section; some S horizon material down worm tracks and larger root channels.

Profile Description (contd.)

Horizon	Depth	
Bg	11 - 27 in.	a few small pebbles; frequent roots mainly in structure cracks; moist; profuse fine bluish-grey and rusty mottling, latter often concentrated round root channels; irregular boundary; merging into
Bg	27 - 42 in.	Dark grey-brown (10YR4/2) clay; prismatic structure less pronounced, and units more massive; numerous fine roots; moist; diffuse fine mottling with less blue grey; fine iron deposition round some of the root channels; some large, almost concretionary ochreous mottles; merging into
Cg	42 - 78 in.	Dark grey-brown (10YR4/1.5) clay; prismatic structure fades to massive; many fine former rootlet channels; no roots; diffuse grey mottling throughout; moist.

The loam surface horizon illustrates the effect of the addition of blown sand and its benefit to the soil for agriculture. This S horizon may in places be quite deep but elsewhere thins out so that the clay is at the surface, but commonly it is about 12 inches deep. The underlying sediments contain around 50 per cent clay, and have a strong prismatic structure, very well defined in the upper part but fading with depth. Diffuse fine grey and red-brown mottling is common throughout, giving a variegated appearance to cross sections of the structure units. Abundant fine pores attributed to former fine roots, persist to a depth of 42 inches.

The high base status of the Kintrae series is shown by the pH values which rise steadily down the profile to over 8.5 at 48 inches where the clay is distinctly calcareous. Other exchangeable bases also show high values, and while the total phosphate is fairly low, the readily soluble phosphate tends to be high, especially in the B horizon.

Duffus Series

The typical soil of this series is represented by a profile from an arable field at the low elevation of 11 feet in the central part of the basin. The vegetation was two year old grass with abundant white clover (Analysis No. 36).

Profile Description

Horizon	Depth	
S	0 - 9 in.	Very dark grey-brown (10YR3/2) clay; medium angular blocky structure; medium organic matter; very occasional small pebbles; frequent roots; slightly calcareous; moist; sharp change to

Profile Description (contd.)

Horizon	Depth	
Bg	9 - 39 in.	Brown (7.5YR4/2) clay; coarse prismatic structure; fairly porous; low organic matter; very occasional small pebbles; roots common to 21 ins. - below that mainly confined to earthworm tracks; no visible calcium carbonate but brisk effervescence with dilute hydrochloric acid; some diffuse ochreous mottling with formation of iron "drainpipes" around root channels below 22 in.; faces of structure units grey; some slight manganese staining on bedding planes of siltier bands; moist; clear change to
Cg	39 in. +	Dark grey to dark grey-brown (10YR4/1.5) clay with some silt bands and irregular silty masses; coarse prismatic structure; plastic; wet; pale ochreous coloration around "drainpipes"; calcareous.

The mechanical analysis shows some variation of the sand, silt and clay proportions of the different horizons. The surface horizon again has the highest proportion of sand although the figure is approximately half that of the corresponding Kintrae soil. The Bg horizon silt exceeds clay and reaches the high figure of 50 per cent. The structure of the topsoil is most pronounced; on drying out after cultivation it tends to break up into sharp angled cubes, and wide structure cracks are a common feature during a dry spell, even in well-established grassland. The strong prismatic structure persists well into the Cg horizon fading only when the water table level is approached. The presence of iron tubes around root channels below 22 inches indicates the lowering of this level effected by artificial drainage.

Chemically, the outstanding feature of the Duffus series is its alkalinity and the occurrence of calcium carbonate throughout the profile.

Immature Soils

Alluvium

Distribution. Soils on recent alluvium are widely distributed throughout the area of the map and account for more than one-fifth of the total area. The widest spreads are found on the lower terraces and present flood plains of the rivers Spey and Lossie, notably at Dipple, Dallachy, Manbeen, Barmuckity and Calcots: other extensive spreads occupy former lacustrine areas as in the central part of the Spynie basin, between Milton Brodie and Kinloss, and in the Mosstowie valley from Aldroughty to Alves. Smaller spreads occur along the courses of many of the smaller streams particularly where there is a change of slope as they reach the coastal plains. Good examples of this may be seen at Tynet, Cairnfield and Inchgower in the eastern part of the sheet. The topography is generally level or very gently undulating.

Parent Material. The parent material is the most recent of the water-sorted superficial deposits. Deposition may still take place in those parts of the river flood plains which are effected by periodic spates. Some of the lacustrine deposits may have been exposed only when artificial drainage by the construction of canals and ditches was effected. The sediments are extremely variable both vertically and laterally, all grades of texture from gravel to clay being encountered. Sand is the dominant grade size though much of it may be fine, and layers of silt and silty clay are often interbedded. In some areas bands of peat and, occasionally, of shell marl indicate the changes in conditions of sedimentation which have taken place in post-glacial times.

Soils. Alluvial soils normally tend to be so variable in composition and to show so little profile development that differentiation in the usual way is impossible. They are, however, of such an extent in this area that some attempt has been made to distinguish the variations on a basis of the texture of the upper part of the profile, and the hydrologic conditions. Four texture classes are recognised, gravel, sand, loam and clay, together with those soils having a highly organic surface horizon. The coarser textured soils can be quite freely drained, although impedence may sometimes be caused by bands of fine-textured material in the sequence. In the lacustrine areas the nature of the site is such that the external drainage is poor and the soils frequently are water-logged if not flooded during spells of heavy rainfall. The water table is rarely far below the surface on the lower river terraces and, of

course, is liable to considerable fluctuation.

Series. Eleven different categories have been separated on the basis of texture and drainage. Of these only the gravelly and sandy soils are reasonably well drained although much of the loam category has been mapped as imperfectly drained. The finer textured soils are always poorly drained, but areas of poor and very poor drainage occur in all grades except gravel which is rarely found in depressed sites although it may underlie some of the finer material. Soils with peaty surface layers are not extensive, being restricted to formerly ponded areas. Following artificial drainage they have usually been cultivated with the production of a highly organic peaty loam topsoil. It is impossible to give a generalised description of the alluvial profile, but the selection of individual profile descriptions given below will serve to illustrate the range of variation.

Sandy loam - Imperfectly drained.

This profile is from a field in second year pasture on the flood plain of the river Lossie at an elevation of 12 feet above sea-level. The sediments of the lower part of the profile may be estuarine (Analysis No. 39.).

Profile Description

Depth	
0 - 10 in.	Dark brown (10YR 4/3) sandy loam; cloddy; medium organic matter; no stones; roots frequent; many earthworms; sharp change to
10 - 15 in.	Dark grey-brown (10YR 4/4) loamy fine sand; weakly cloddy; no stones; roots frequent especially in worm tracks; frequent medium strong rusty mottles; sharp change to
15 - 35 in.	Light yellowish brown (10YR 5/2) interbedded fine sand and sand; single grain; low organic matter; strong rusty mottling; sharp change to
35 - 44 in.	Olive-grey (5YR 4/3) and dark grey-brown (10YR 4/2) alternating bands of sand and peaty silt; compact; no roots or stones; very moist; sharp change to
44 in. +	Pale brown (10YR 6/3) sand with plant remains in upper few inches; wet.

The upper deposits appear to be comparatively recent, and it seems likely that until the river was confined by banking the area would have been flooded fairly regularly. The alternations of fine and coarse layers, and the peaty bands suggests periods of stagnation and periodic flooding. The soil provides excellent arable land when the water table depth is controlled.

Sandy loam - Poorly drained.

The profile here is described from a site not far from the previous one, again from an arable field, but in a slight depression (Analysis No. 42.).

Profile Description

Depth	
0 - 10 in.	Dark brown (7.5YR 5/2) fine sandy loam; cloddy but friable to good crumb; medium organic matter; frequent roots; faint rusty mottling along root channels; slight greying of structure faces; clear change to
10 - 16 in.	Dark brown (10YR 4/3) silty fine sandy loam; much reddish brown rusty mottling, and grey gleying; no stones; abundant fine roots sharp change to
16 - 26 in.	Purplish brown sedge peat
26 in. +	Grey and grey-brown (2.5Y 5/0 - 5/2) coarse sand; a few pale rusty and humus stains; some concentrations of iron in tubes around root channels; massive; very moist.

The soil here is capable of producing good crops providing there is no prolonged period of heavy rainfall during the growing season.

Loam - Poorly drained.

This profile is from a flat field in first year pasture in the central part of the Spynie basin, at the low elevation of 10 feet above sea-level (Analysis No. 38.).

Profile Description

Depth	
0 - 10 in.	Very dark grey-brown (10YR 3/2) loam; cloddy, breaking to medium sub-angular blocky; medium organic matter; no stones; abundant roots; moist; occasional fine rusty mottles; slight greying of structure faces; sharp change to
10 - 12 in.	Light brown-grey (10YR 6/2) sand; weakly cloddy; low organic matter; no stones; frequent roots; moist; stony brown (5 YR 5/8) medium mottling; very sharp but irregular boundary
12 - 14 in.	Pinkish-white (5YR 8/2) irregular band of chalky marl; occasional roots; S horizon material in worm channels; occasional small intact snail shells; some fine yellow-brown mottling; moist; sharp change to
14 - 18 in.	Weak red (2.5YR 4/2) peaty marl; laminated; roots common; abundant shell fragments; moist; merging into
18 - 20 in.	Weak red (2.5YR 4/3) mainly clay; root channels with grey core and surrounding concentric zones of varying iron concentration; clear change to
20 - 34 in.	Weak red (2.5YR 4/2) sandy clay and sand interbedded; dark yellow-brown mottling more frequent in sandy layers; wet; merging into
34 in. +	Weak red (2.5YR 4/2) fine sand with prominent iron tubes.

The vegetable remains in the peat consisted mainly of Phragmites leaves. The snail shells which are commonly intact in the marl are about ½ inch diameter. Marl similar to this deposit occurs in several localities in the area of the sheet, notably at Gilston, Waterton and Wards of Alves. Such deposits were at one time excavated to provide agricultural lime but they are nowhere thick or extensive enough for large scale operations.

Clay loam - Poorly drained.

This soil represents the fine textured lacustrine alluvium and closely resembles the material on which the Duffus soils are developed. Its position in relation to the Duffus clay and to the other alluvium does, however, indicate its more recent deposition. The site is again practically level and at a very low elevation, in a field of young pasture, (Analysis No. 40.).

Profile Description

Depth	
0 - 9 in.	Grey-brown (7.5YR 3/3) clay loam; medium sub-angular blocky; small well-rounded pebbles very occasional roots plentiful; moist; sharp change to
9 - 23 in.	Reddish brown to dull brown clay with pockets and bands of clay loam; strong coarse prismatic structure; low organic matter; few roots concentrated on prism interfaces; slight yellow brown mottling; moist; merging into
23 in. +	As above with bands of silt more common; no mottling; very moist.

This soil is always cultivated, its high natural fertility producing good crops and permitting such crops as wheat and beans to be grown.

Peaty loam - Very poorly drained.

Very poorly drained soils such as this are found in depressions in the wider alluvial flats. The vegetation is long ley pasture with a good deal of Juncus effusus and Holcus lanatus present. (Analysis No. 41.).

Profile Description.

Depth	
0 - 12 in.	Very dark brown (10YR 2/2) peaty loam; weak cloddy structure; high organic matter; frequent roots; wet; sharp change to
12 - 14 in.	Dark reddish brown (5YR 2/2) amorphous peat; sharp change to
14 - 22 in.	Grey-brown (2.5Y 5/2) sand; structureless; brown humus staining and light brown iron mottling; several small rounded pebbles; wet; clear change to
22 in. +	Grey (2.5Y 5/0) sand; massive; some soft iron tubes around root channels and other rusty mottles; frequent fossil roots; wet; water at 25 inches.

This is typical of the cultivated peaty topped profile which would require to be better drained before it could be brought into the normal rotation.

Raised Beach Deposits.

Distribution. Soil series on this parent material have been mapped on certain sections of the extensive raised beaches where there has been little or no accretion by blown sand or alluvial deposition since their uplift. The areas are (1) north of Kinloss, (2) a narrow belt extending from Muirhead by Rosevalley to Roseisle, (3) between Drainie and the Stotfield Links, (4) on both sides of the main road from Spynie to Lossiemouth, (5) around Inchbroom and (6) north and west of Innes House, amounting in all to just over 6 square miles. The smooth, almost level topography of these areas has been taken advantage of for the construction of airfields at Kinloss, Lossiemouth and Milltown.

Parent Material. Mixed beach sediments, often of the nature of estuarine or lagoonal deposits, form the parent material of these soils. Although bands and lenses of fine gravel, silt and silty clay do occur, various grades of sand make up by far the greater part of the deposits. In a few localities thin layers of peat and dark grey humose silt may be found and several beds with marine shells were noted. Some parts of the beaches are eroded and planed off fluvio-glacial deposits and there the material is re-sorted rather than deposited sand. It is often difficult to make a distinction between raised beach deposits and alluvium, but in general the latter has a higher content of fine material and it can be related to a more recent source such as a flooding river or drained lake. It often happens that a varying thickness of recent alluvium is found to overlie deposits directly comparable to those of the raised beaches.

Soils. Apart from the development of an S horizon as a result of cultivation, the soils show little horizon differentiation other than that due to variations in texture, and they have therefore been placed in the immature category. Imperfectly drained and poorly drained series have been distinguished, however. Although the parent material is normally highly permeable the soils are rarely freely drained. This is due to a high water table and poor run-off from the areas despite artificial drainage by tile drains and deep open ditches. The average height above sea-level is less than 20 feet and it is difficult to get adequate gradients for the drains. The presence of silty bands tends to impede the free flow of water down the profile and in winter it is not uncommon to see standing water in some of the fields. Resort has had to be made to pumping in the worst parts of the airfields.

Series

Imperfectly drained.

The following profile is from a level field of two year old pasture at an elevation of 26 feet, in the narrow strait between Roseisle and Buthill (Analysis No. 43.).

Profile Description.

Depth	
0 - 8 in.	Dark brown (7.5YR 3/2) loamy sand; very weak cloddy structure; medium organic matter; no stones; frequent roots; no worms; moist; sharp change to
8 - 22 in.	Light yellow-brown (10YR 6/4) sand; very weakly cloddy; very low organic matter; no stones; few roots, limited to top few inches; moist; some distinct iron mottling (7.5YR 5/8) tending to vertical streaks; merging into
22 - 38 in.	Brown (10YR 5/3) and dark grey-brown (2.5Y 4/2) sand; slightly coherent; no stones or roots; wet; a few fine iron mottles near top of horizon; colour becomes darker with depth; very sharp change to
38 - 56 in.	Very dark brown (10YR 2/2) fen peat with fragments of birch wood.
56 in. +	Grey, wet sand.

The water-table stood at 33 inches when this profile was sampled (September). The thickness of the peat layer is unusual, although peat bands are not uncommon in these deposits. The almost complete absence of clay and silt, together with the low values of plant nutrients shown by analysis, suggests that this soil is of low agricultural value, but in other areas where a good topsoil has been built up, satisfactory yields can be obtained.

Poorly Drained.

The profile described below is from a level site just east of the Spynie-Lossiemouth road in a field of old pasture. The elevation is 13 feet above sea-level. (Analysis No. 44.).

Profile Description.

Depth	
0 - 9 in.	Grey-brown (2.5YR 5/2) loamy sand with high fine sand content; weakly cloddy; rather low organic matter; no stones; earthworms common; roots abundant; moist; sharp change to
9 - 20 in.	Light yellow-brown (10YR 6/4) sand; very weakly cloddy; moist; low organic matter and few roots except down frequent worm tracks; much fine ochreous mottling, increasing in lower part of horizon and tending to become redder and almost concretionary at base; clear change to

Profile Description (contd.)

Depth	
20 - 28 in.	Grey-brown (2.5Y 5/2) loamy fine sand; weakly cloddy; low organic matter; no stones; slightly moist; mottling limited to concentric deposition round old root channels forming "drainpipes" $\frac{1}{4}$-$\frac{1}{2}$ inch in diameter; clear change to
28 - 55 in.	Pale brown (10YR 6/3) sand; very weakly cloddy; no stones or roots; slightly wet; blotchy, bright ochreous mottling in top 10 inches decreasing in intensity and frequency downwards; fragments of peat throughout; sharp change to
55 in. +	Grey (7.5YR 5/0) wet sand.

Although the mechanical analysis shows a very high sand fraction throughout, there is some banding due to variation in the grade of the sand particles. The higher, but still low, values for exchangeable basis, pH and phosphate compared to the previous profile probably reflect longer and better agricultural management and fertilizer treatment.

Links

Distribution. Link soils have been mapped on the narrow strip of the lowest raised beach which follows the coastline from Buckie to Speymouth; on parts of the similar strip between Kingston and Lossiemouth and west of the Branderburgh headland to Covesea; on an area of higher ground east of Hopeman, and on the ½ mile wide belt bordering Burghead Bay. The total area is just under 8 square miles. The topography is, in general, level with sometimes low undulations and mounds (old dunes) and occasional low ridges. East of Lossiemouth storm beach ridges are a conspicuous feature.

Parent Material. The parent material is raised beach sand often with interbedded bands of shingle and almost always covered by a later addition of blown sand. A fringe of sand dunes frequently occurs along the seaward edge, but unless they have been stabilised by a closed vegetation cover, the dunes have been separated from the Links areas. Much of the higher ground west of Covesea lighthouse and to the east of Hopeman has at some time been inundated by blown sand and now has soils comparable to those of the low beaches.

Soils. The soils are very light textured and dominantly freely to excessively drained. The profile occasionally has the characteristics of a very weakly developed podzol but more commonly shows only a few inches of dark grey-brown loamy sand with a very weak blocky structure, over pale yellow-brown single-grain sand. Thin buried A horizons are common in the upper part of the profile.

Poorly drained soils have been mapped in three small depressed areas where the water table is near the surface.

Gorse scrub is a feature of the vegetation, particularly west of Lossiemouth. Elsewhere heath dominated by *Calluna* is the commonest type, with patches of acid grassland. Near the still active dunes *Ammophila* may be abundant. When mown and properly maintained the vegetation can be developed into a close sward ideally suited to the construction of golf courses, as at Stotfield and Spey Bay. Links soils have also proved to be adaptable to forestry and extensive plantations of Scots pine have been established by the Forestry Commission on the Innes Links and west of Roseisle.

Saltings.

A small area in the south-east corner of Findhorn Bay near Kinloss has been mapped as saltings. This is the term applied to land bordering estuaries which is not covered by ordinary tides, but which may be submerged periodically by high spring tides and is always influenced by a high salt or brackish water table. The material is dominantly raw sand, sometimes with a superficial layer of silty mud, particularly in the marshy patches. The halophytic vegetation includes Triglochin maritima, Cochlearia officinalis, Glaux maritima, Plantago maritima and Armeria maritima.

Skeletal Soils.

Storm Beach Shingle.

The post-glacial uplift of the land surface left an emergent coastline which lent itself readily to the formation of shingle bars and spits by coastal currents and wave-action. The rapidly-flowing river Spey brought down an ample supply of material for the purpose and the gap between the Binn Hill and the Branderburgh headland was almost completely closed. As the uplift continued a succession of shingle ridges was formed at the retreating strand-line on the exposed beach; particularly good examples of these may be seen south-east of Lossiemouth. Much of the shingle was subsequently covered by blown sand, but extensive spreads, consisting of little more than rounded cobbles of quartzite, quart-schist, granite and gneiss, remain at Sunbank, Caysbriggs and west of Kingston. It is these areas, amounting to 1.4 square miles, that have been mapped as storm beach shingle.

The shingle has been quarried for road metal and for the construction of airfield runways and sections show sand and coarse sand interbedded with it. Where there is a little interstitial sand in the top layers a sparse vegetation of gorse and heather has gained a hold despite the excessively free drainage, and several plantations of Scots pine have been established with moderate success presumably because tap roots can reach the water table. The resulting soil profile has 2 or 3 inches of raw humus, derived from pine needles and mosses, over a 6 inch A_1 horizon consisting of rounded pebbles with a little coarse sand and organic matter between them. Occasionally an incipient B horizon is evident but the profile is normally of the A-C type.

Dune Sand.

Most of the Links areas on the low coast have a fringe of sand dunes along their seaward edge. They are particularly well developed between the mouth of the river Lossie and the Binn Hill, and south of Burghead where they reach a height of over 50 feet and extend up to ½ a mile inland. Consisting entirely of raw blown sand, and being only partly stabilised by a thin vegetation cover, the dunes are always liable to erosion or modification by wind action, and blow-outs occur frequently. There is normally no soil

profile development though occasionally traces of a thin buried A horizon may be seen marking a temporary period of stability. The drainage is excessive.

The dominant species of the dune vegetation is Ammophila arenaria with, in places, Elymus arenarius important as a fixing agent. Some reasonably successful attempts have been made to establish plantations of Corsican pine on the dunes after thatching the more mobile areas with brushwood.

Sandstone.

The area of skeletal soils mapped on Quarrywood Hill has a thin cover of drift, sometimes of the nature of a very stony sandstone till, but more often consisting of little more than shattered sandstone debris in situ; outcrops of the rock are frequent. Where there is sufficient fine material among the rock fragments a sparse heath vegetation dominated by Calluna has provided a layer of mor humus which sometimes overlies a podzolic profile with a well-marked A_2 horizon but ill-developed B horizons. The typical A-C profile of skeletal soils is equally common. The area shown as poorly drained is a depression in the rock where seepage water collects. Here the profile contains a thin iron pan, which occurs sometimes within the solid rock. The A_2 horizon above it is invariably strongly gleyed.

The Forestry Commission has acquired most of the ridge top area for plantations of Scots pine, but some 15 acres are considered to be unplantable.

The narrow strip on the ridge from the Knock of Alves to Carden Hill is less rocky but outcrops of sandstone are again common and the solid rock is seldom far below the surface.

Organic Soils.

Basin Peat.

Small areas of basin peat occur wherever a depressed or ponded site has resulted in the accumulation of drainage water with subsequent water-logged conditions. They are commonest in the western quarter of the sheet with good examples at Miltonhill and Bruntland. Much of the peat is of a fen type and, when adequately drained, can be successfully cultivated, particularly where there has been some addition of blown sand to the surface layer.

Hill Peat.

Hill peat is restricted to the high ground in the south east corner of the map where it occupies about $\frac{1}{3}$ of a square mile on the slopes of the Hill of Stonyslacks. It is never very thick, $1\frac{1}{2}$ to 3 feet being usual, and it carries a vegetation dominated by Calluna vulgaris with Trichophorum caespitosum, Eriophorum vaginatum and Sphagnum spp. common. The profile under the hill peat normally has a prominent iron pan.

Mixed Bottom Land.

Soils in the narrower stream courses and drainage channels have been shown as mixed bottom land. Included are the colluvial soils on the sloping sides and the alluvial deposits in the bottom of the channel which are generally too complex and variable to be mapped separately.

IV. FORESTRY

The county of Moray is the most densely wooded of all the counties of Scotland with over 20 per cent of the land area under trees. The proportion is considerably less in the area of the map but although Lower Moray is primarily a region of arable farming a surprisingly large acreage is devoted to woodland. In addition to some extensive private plantations no fewer than four State Forests lie wholly or in part within the sheet. It may fairly be said that very little land is wasted: practically all but the most unpropitious soils, when not cultivated, have been planted.

Broad-leaved trees, beech, oak, sycamore, lime, elm and ash, can and do grow successfully on the better sites, but they are restricted mainly to policy woods away from the coast where their main purpose is decoration or wind-protection. Conifers are better adapted to the dominantly light-textured and freely-drained soils of the land available for planting and of these the native Scots pine is by far the most extensively used.

Of the Commission owned plantations, Lossie Forest is almost entirely a Scots pine project. This forest occupies nearly 2000 acres of the most recent raised beach between the mouth of the river Lossie and the Binn Hill, the area formerly known as Innes Links. Although much of this area consists of shingle ridges overlain by a variable amount of blown sand the trees are growing remarkably well. A narrow strip of Corsican pine has been planted on the dunes along the seaward edge and on the exposed face of the Binn Hill.

Roseisle Forest is situated on the belt of similar land stretching westward from Burghead. Scots pine is again the dominant species used, but in this case actual sand dunes are more extensive and in consequence a higher proportion of Corsican pine has been planted, sometimes after the dunes have been thatched with brushwood to stabilise the sand. The forest has been expanded from the links to take in several adjacent fields on other raised beach deposits. It now extends to just over 2000 acres.

At Monaughty Forest conditions are entirely different. The forest has been established on the ridge from Miltonduff to Burgie, including Heldon Hill. The elevation ranges from 200 to 700 feet, with some fairly steep slopes particularly on the south side. Soils are mainly those of the Elgin series with smaller patches of the Rosebrae and Monaughty series. The till thins out towards the crest of the ridge where, in places the soil is shallow and rocky. Species

include Douglas fir, Scots pine, Sitka and Norway spruce and a high proportion of European and Japanese larch. On the steeper south face hybrid larch, Douglas fir, Corsican pine, Lodgepole pine and Abies grandis are used. Small amounts of Thuja and Tsuga have also been planted. This forest suffered comparatively little damage during the great gale of 1953. All species flourish if selection for particular site has been correct. Monaughty Forest now includes some 400 acres on Quarrywood Hill and 235 acres at Burgie, making a total of well over 4000 acres.

Speymouth Forest is the largest of the four with some 3000 of its 12,000 odd acres within the area of the sheet. This acreage is made up of many small plantations scattered throughout the region between the Hill of Maud and the river Spey, together with those of Stynie, Castle Hill, Blackdam and Poundlers Wood west of the river. The woods which formed the policies of Gordon Castle are included and they contain some of the oldest and finest trees, notably at Ordiga where the soils are mostly of the Elgin association. Scots pine, again the dominant species, has been planted on the Tynet association soils of Whiteash Hill after ploughing, and at Dryburn, Auchenhalrig, Beldornie and Gowktree. At Broadley, Longhill and Spey Bay Links, Corsican pine has been favoured. West of the Spey the plantations, located on areas of the terrace gravels formerly in woodland, are almost entirely of Scots pine with small patches of Douglas fir. Other species include Sitka spruce at Ordiga and Scabbed Hill, Japanese larch at Castle Hill and birch at Redmoss. Hardwoods are limited to the vicinity of Gordon Castle and a few acres at Tulloch banks.

Most of the country residences and many of the farms have some trees around them, either for wind protection or ornament. Wind breaks in the form of strips or small block plantations of Scots pine are common everywhere, particularly in areas of the Boyndie association where blowing of topsoil can be a serious drawback to agriculture. The main bulk of private woodland is, however, controlled by the larger estates such as Seafield, Innes and Pitgaveny where hundreds of acres have been planted on lines similar to those of the Commission.

V. AGRICULTURE

The agricultural economy of the Northern Lowlands of Moray is based on mixed farming, that is, cash cropping and the production of livestock, with an emphasis on the fattening of cattle. The climate and variety of soil types are such that most crops can be grown successfully in some parts and although the productivity rating of the soils ranges from excellent in the case of the Carden and Kintrae series and some of the alluvium, to very poor for the worst of the Corby series, the region as a whole has a high reputation for efficient and successful farming.

The size of the farms varies considerably with the majority falling into either the 50 to 70 acre or 140 to 160 acre range. Small-holdings or crofts are not common, being found only in a few areas of poorer quality land, generally in groups. Isolated ones have tended to be absorbed in larger units. The post-war practice of the larger farms acquiring adjacent holdings to be worked as subsidiaries or to be incorporated in the main farms has resulted in the formation of several very large units exceeding 500 acres.

The steadings are, in general, substantially built, often so much so that they cannot easily be adapted and modernised. They are well-equipped although in many cases electricity has been provided only recently, and with the completion of the Glen Latterach dam the water supply is now more than adequate. Stone dykes, built of erratics cleared from the fields, which are such a feature of much of the north-east, are notably rare in Lower Moray. Except when readily quarried sandstone has been available, most field boundaries are marked by wire fences. The area is well supplied with good roads and contains the main railway line from Aberdeen to Inverness so that there are no problems of transport or distribution.

In an essentially rural region the supply of skilled labour has always been adequate while temporary labour is usually readily available when required. Contracting squads to handle such jobs as potato-lifting, carrot-pulling and hoeing have proved very useful in recent years. The farms are, of course, highly mechanised, with the towns of Elgin and Forres providing a good maintenance service for tractors and machinery.

A five- or six-shift cropping rotation is followed generally with respectively two or three shifts in grass, the former being more common on

have been effective for a number of years but when a storm wrecked the mill and machinery the project was abandoned.

In 1779 the loch was at its fullest, nearly 5 miles in length from Westfield to Oakenhead, and in the bay of Balornie and farther west, over a mile wide. It covered the lowland of Kintrae, the greater part of Crookmuir and Waterymains, the lower land of Salterhill, Balormie and Ardivot, part of Kinneddar and Oakenhead and the lower parts of Pitgaveny, Spynie, Myreside and Findrassie. Towards the eastern end between Kinneddar and Spynie a low island was at that time known as Fowl Inch on account of the large number of water-birds which frequented it. At the western end numerous small green islands or holmes were used for grazing, cattle being ferried to them in the summer. The total area under water probably exceeded 2500 acres. In that year a new drainage scheme on a larger scale was started. A new and bigger canal was dug along the line of the old one, to join the Lossie, but this time sluices were installed to exclude the tide. A smaller drain led some of the water through Kinneddar to the sea. The scheme was highly successful and despite opposition (and some litigation over lost amenities) some 1000 acres of land was exposed. Grant and Leslie's survey of 1798 puts the figure at 1152 acres, much of which, however, would still have had the appearance of swamp.

About 1800 the smaller Loch of Cotts was drained with good results, and the marshy ground about Inchbroom, Leuchars and Innes was greatly improved. Between 1808 and 1812, following advice from Telford who was then working on the construction of the Caledonian Canal, a major canal, 7 miles in length, was dug through the centre of Loch Spynie. With various side-drains the cost amounted to over £12,000 but this included legal expenses which were considerable owing to the numerous disputes over shares of costs and the partitioning of the reclaimed land. In 1821 a new road between Elgin and Lossiemouth was built, running over what had been one of the deepest parts of the loch.

In 1829 another catastrophe, well-known as the "Moray floods", overtook lowland Moray. An "unnatural" fall of rain in the hills to the south resulted in the Lossie rising to an unprecedented height. It broke through its banks, entered the loch by its old course and swept everything before

it, including the sluices. This let tidal water into the canal, and undid most of the good work not long completed. The landowners were thoroughly disheartened, the canal was neglected and silted up and much of the reclaimed land once again reverted to marsh. Farther west the spate on the river Findhorn also caused great destruction, flooding an area of 20 square miles around Forres.

By 1860 the silting up of the drains and the extended waters of the loch had become so serious that a deputation was sent by the proprietors to investigate other drainage schemes. On its recommendation the sluices were replaced and the canal and drains re-levelled with complete success. The loch nowadays extends to little over 100 acres with approximately the same area of marsh, but careful attention must be paid to the maintenance of the drains as there is constant danger of silting and of collapse of the sandy banks. Young suggested that there might be as much risk of the sea breaking in from the west between Burghead and Findhorn, and it is indeed true that coastal erosion is fairly active on that section. The village of Findhorn formerly stood a mile to the north-west of its present site, on a low plain which extended eastwards so that it was possible to walk in a straight line from there to Burghead, 5 miles distant. In 1701, the sea, as it had been threatening to do, overwhelmed the village and inundated much of the lowlying ground. It is estimated that during the 18th century some 4000 acres of land were submerged. The present coastline between Findhorn and Burghead is a wide curving beach, 9 miles long, where eroded banks of peat may still be seen at low tide.

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APPENDIX.

Analyses of Representative Soil Profiles

Horizon	Depth in.	% Loss on Ignition.	Mechanical Analysis			Exchangeable Cations m.e./100g.					% Saturation.	pH	% Carbon	% Nitrogen	mg./100g. Total P_2O_5	mg./100g. Read.Sol. P_2O_5
			% Sand Inter	% Silt Inter	% Clay	Ca	Mg	Na	K	H						
1. DURNHILL ASSOCIATION.			Durnhill Series.			Georgetown.					Sample Nos. 83132, 83134-5					
A_2	4-10	6.10	88.1	6.6	10.3	1.13	0.26	Nil	0.05	10.78	11.8	5.07	2.75	0.206	44	0.6
B_3	23-27	1.66	68.5	10.8	19.0	Nil	0.28	Nil	0.02	1.82	14.1	5.36			56	2.4
C	32-36	0.95	72.8	8.8	17.5	Nil	0.28	Nil	0.04	1.11	21.6	5.26			44	3.6
2. STRICHEN ASSOCIATION.			Strichen Series.			Rosebank.					Sample Nos. 83920-24					
S	3-6	11.90	59.5	16.3	18.3	5.96	0.40	0.02	0.11	13.16	33.0	5.66	2.06	0.248	165	1.1
B_2	10-16	3.80	62.1	18.6	15.6	0.51	0.16	Nil	0.08	6.24	10.7	5.60	0.85	0.051	100	0.8
B_3	22-28	2.60	79.6	8.3	8.9	0.05	0.10	Nil	0.04	1.52	11.1	5.82			75	2.8
C	32-36	2.84	81.0	9.3	6.9	0.05	0.20	Nil	0.04	1.92	13.2	5.84			77	2.1
C	40-44	2.99	75.2	11.9	9.9	0.05	0.08	Nil	0.04	2.63	6.1	5.83			92	2.8

3. STRICHEN ASSOCIATION. Strichen Series. Rosebank. Sample Nos. 83940-44

A_1-A_2	3-8	8.23	71.1	13.0	11.8	0.36	0.42	Nil	0.08	13.62	5.9	4.90	3.44	0.142	55	0.6
B_2	9-13	7.42	69.3	11.4	15.7	Nil	0.36	Nil	0.11	14.15	2.5	5.09	2.42	0.083	148	0.5
B_3	15-20	3.46	66.1	16.0	14.5	Nil.	0.10	Nil	0.04	2.71	4.9	5.20			75	0.9
C	23-28	3.03	73.1	11.1	12.8	Nil	0.06	Nil	0.04	1.67	5.6	5.21			81	1.2
C	42-46	2.61	80.6	5.5	11.3	Nil	0.12	Nil	0.04	2.12	7.0	5.15			76	1.5

4. FOUDLAND ASSOCIATION Foudland Series. Tarrymount Sample Nos. 98858-62

S	2-5	8.58	65.2	18.2	12.3	1.85	0.58	0.22	0.29	10.08	22.6	5.31	3.90	0.223	114	1.8
S	7-10	7.05	63.7	18.7	14.1	1.69	0.42	0.17	0.18	8.28	22.9	5.47	1.85	0.150	98	0.6
B_2	13-16	4.72	72.9	13.7	11.0	0.92	0.08	0.14	0.15	5.40	19.3	5.42			108	0.8
B_2	22-25	4.52	73.3	14.2	10.2	0.31	0.06	0.12	0.13	4.65	11.8	5.42			102	1.6
C	45-46	3.42	72.4	15.9	8.3	Nil	0.08	0.10	0.10	3.22	8.0	5.46			88	1.6

5. ELGIN ASSOCIATION. Elgin Series. Ordiga Wood No. 2. Sample Nos. 93676-79A

A_1	2-4	10.18	78.3	10.3	6.4	0.61	0.50	0.19	0.15	13.40	9.8	3.89	3.62	0.105	45	1.6
A_2	5-8	1.75	81.4	11.2	5.6	Nil	0.06	0.12	0.02	1.91	5.0	4.21	0.63	0.036	31	0.7
B_2	12-17	6.30	78.2	9.8	8.9	0.16	0.02	0.29	0.11	6.88	7.8	4.80			43	0.4
B_3	22-26	2.03	73.7	11.7	12.6	0.15	0.02	0.17	0.06	1.92	17.3	5.08			51	1.6
C	32-36	1.23	75.1	7.9	15.8	0.30	0.20	0.11	0.09	1.92	25.0	5.14			37	0.4

Horizon	Depth in.	% Loss on Ignition.	Mechanical Analysis			Exchangeable Cations m.e./100g.					% Saturation.	pH	% Carbon	% Nitrogen	mg./100g. Total P_2O_5	mg./100g. Read. Sol. P_2O_5
			% Sand Inter	% Silt Inter	% Clay	Ca	Mg	Na	K	H						
6. ELGIN ASSOCIATION						Elgin Series.			Rosebrae No. 1.			Sample Nos. 96482-86				
S	2-6	4.53	76.3	9.4	11.5	4.86	0.26	0.11	0.05	4.98	51.5	5.99	1.83	0.140	139	2.7
S	8-12	4.39	76.7	9.2	11.9	5.18	0.20	0.05	0.05	2.03	73.0	6.19	1.72	0.123	126	2.2
B_2	18-20	2.55	83.5	6.3	7.7	4.57	0.14	0.10	0.03	Nil	100.0	7.00			79	3.4
B_3	26-30	1.17	83.7	8.3	6.8	1.66	0.04	0.10	0.03	Nil	100.0	6.95			61	7.5
C	40-44	1.01	78.9	8.2	11.9	2.12	0.14	0.10	0.06	Nil	100.0	7.00			46	4.0
7. ELGIN ASSOCIATION.						Rosebrae Series.			Dykeside.			Sample Nos. 96466-70				
S	2-6	8.36	71.0	14.1	10.7	9.75	0.42	0.15	0.11	2.90	78.3	6.79	4.05	0.260	180	3.1
B_2	7-9	7.85	75.6	12.0	8.5	5.13	0.30	0.16	0.07	5.71	50.2	6.20	2.60	0.157	95	0.8
B_3(g)	13-17	1.26	76.1	10.6	12.1	0.60	0.04	0.08	0.04	2.02	27.4	6.10			70	9.9
C(g)	24-28	1.60	68.0	12.1	18.3	1.36	0.16	0.09	0.07	1.51	53.8	6.20			54	4.2
C(g)	43-47	1.40	65.2	12.0	21.4	1.21	1.04	0.11	0.13	Nil.	100.0	6.05			76	10.3

8. ELGIN ASSOCIATION. Monaughty Series. Monaughty No. 2. Sample Nos. 98834-39.

A_1	3-6	14.90	78.8	9.1	4.7	0.31	0.12	0.21	0.06	18.10	3.7	4.19	7.53	0.194	92	1.0
A_2g	8-11	1.60	74.0	14.7	9.7	0.60	0.02	0.09	0.04	2.11	26.2	5.26	0.56	0.057	40	1.0
Bg	12-15	1.25	73.0	12.3	13.5	0.60	0.30	0.13	0.07	0.35	76.0	5.35	0.11	0.023	55	11.7
Bg	18-21	1.77	66.4	11.1	20.7	1.82	0.58	0.18	0.15	0.35	89.6	5.88			45	3.2
Bg	28-31	1.48	67.7	12.2	18.6	2.13	0.94	0.18	0.18	0.71	82.9	5.89			65	2.7
Cg	43-48	1.31	74.1	10.5	14.1	1.96	0.70	0.14	0.10	0.21	93.3	6.18			110	20.4

9. ELGIN ASSOCIATION. Findrassie Series. Findrassie No. 2. Sample Nos. 93685-89.

A_1-A_2g	3-5	12.20	79.8	7.9	6.2	0.46	0.54	0.14	0.14	17.92	6.7	4.04	5.75	0.143	51	0.9
Bg	7-10	6.68	87.3	3.7	5.7	0.31	0.20	0.11	0.06	20.35	3.2	4.52	2.64	0.086	56	2.9
Bg	14-18	2.48	85.0	3.7	8.8	0.15	0.08	0.06	0.02	6.68	4.4	4.69			55	7.1
Cg	25-29	0.97	80.0	7.0	12.1	0.15	0.22	0.08	0.09	2.32	18.9	4.72			56	7.3
Cg	36-40	0.88	82.8	6.2	10.1	0.15	0.16	0.08	0.08	1.91	19.7	4.78			58	6.6

10. ELGIN ASSOCIATION. Elgin Series. Monaughty No. 1. Sample Nos. 98829-33

A_2	4-8	2.83	77.3	11.5	8.4	0.30	0.08	0.10	0.04	4.97	9.5	4.07	1.41	0.052	32	0.9
B_2	12-16	3.98	75.8	9.8	10.5	6.23	0.64	0.15	0.06	2.43	74.5	6.38	1.57	0.118	121	6.8
B_3	22-26	1.98	70.1	12.4	15.6	0.30	0.02	0.09	0.06	2.50	15.8	5.20			63	4.7
C	30-34	1.60	71.6	9.9	16.9	0.45	0.28	0.13	0.12	2.84	25.6	5.48			54	3.0
C	38-44	1.33	75.2	8.6	14.9	0.90	0.28	0.16	0.11	2.48	36.9	5.85			57	5.7

Horizon	Depth in.	% loss on Ignition.	Mechanical Analysis			Exchangeable Cations m.e./100g.					% Saturation	pH	% Carbon	% Nitrogen	mg./100g. Total P_2O_5	mg./100g. Read. Sol. P_2O_5
			% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H						
11. ELGIN ASSOCIATION.						Elgin Series.			Braehead.			Sample Nos. 93649-53.				
S	2-6	4.54	72.7	13.3	11.8	5.34	0.12	0.07	0.13	4.80	54.1	5.67	2.16	0.169	169	22.0
B_2	9-13	3.67	66.4	16.6	13.3	5.38	0.10	0.08	0.13	2.87	66.4	6.49	1.19	0.084	121	1.2
B_3	17-23	2.02	74.3	10.3	13.4	3.50	0.14	0.10	0.07	0.96	79.8	6.63			66	6.0
B_3/C	30-34	2.76	65.2	14.6	17.4	8.75	0.52	0.12	0.13	1.95	83.0	5.90			49	3.3
C	37-42	2.72	67.1	8.4	21.8	3.71	0.42	0.08	0.11	6.28	40.8	5.15			61	8.3
12. ELGIN ASSOCIATION.						Elgin Series.			Bishopmill No. 1.			Sample Nos. 93690-95				
F	0-2	96.00	N.D.	N.D.	N.D.	12.10	5.38	0.90	1.42	101.00	16.4	3.70	42.80	1.235	174	17.0
A_2	3-6	2.13	82.8	9.3	5.8	0.30	0.10	0.07	0.06	3.31	13.8	4.84	0.90	0.042	30	1.0
B_2	8-10	5.35	82.1	8.5	6.8	0.31	0.08	0.09	0.04	13.90	3.6	4.38	2.29	0.090	42	0.8
B_3	12-16	2.82	79.5	7.9	9.8	0.15	0.02	0.07	0.04	4.78	5.5	4.75			50	1.0
B_3/C	24-30	1.33	75.4	5.5	17.8	0.15	0.32	0.08	0.13	2.84	19.3	5.06			45	0.6
C	36-40	0.99	76.6	10.6	11.9	Nil.	0.24	0.07	0.08	2.33	14.3	5.06			51	0.9

13. ELGIN ASSOCIATION. Elgin Series. Findrassie No. 1. Sample Nos. 87288-92

A_2	4-6	2.18	88.9	0.7	8.3	0.30	0.44	0.09	0.03	1.68	33.8	4.44	0.79	0.056	25	1.2
B_2	7-10	4.80	90.1	0.2	7.4	0.15	0.34	0.13	0.03	8.06	7.5	4.68	2.27	0.076	47	4.2
B_3	13-18	2.16	82.1	6.2	9.6	0.15	0.14	0.09	Nil.	3.14	10.8	4.90			80	15.5
C	28-34	0.81	76.3	5.8	17.2	0.30	0.44	0.10	0.10	2.16	30.3	5.08			41	8.0
C	42-46	0.99	71.9	8.0	19.1	0.45	0.90	0.17	0.10	1.20	57.5	5.42			52	14.7

14. ELGIN ASSOCIATION. Elgin Series. Ordiga Wood No. 1. Sample Nos. 93670-75

A_1	1-3	40.80	N.D.	N.D.	N.D.	3.54	0.70	0.92	0.83	56.80	9.5	3.52	23.20	0.713	126	14.0
A_2	4-8	1.64	84.0	8.8	5.6	Nil.	0.06	0.08	0.02	2.81	5.4	4.13	0.58	0.042	29	0.7
B_2	12-16	2.06	89.5	2.9	5.6	Nil.	0.04	0.14	Nil.	2.83	6.0	4.96	0.12	0.027	63	1.4
B_3	23-26	1.70	88.6	6.1	3.6	Nil.	Nil.	0.08	Nil.	1.92	4.0	4.95			61	2.6
C	28-34	2.26	75.6	10.4	11.7	Nil.	0.04	0.11	0.02	1.92	8.1	4.95			57	2.7
C	38-44	2.20	67.9	12.2	17.7	Nil.	0.14	0.15	0.06	1.92	13.5	4.91			41	0.4

15. ELGIN ASSOCIATION. Elgin Series. Cloves. Sample Nos. 98869-75.

S	3-7	7.10	73.9	10.4	12.2	5.05	0.18	0.14	0.07	5.72	48.7	5.96	3.08	0.196	202	12.2
A	12-15	3.36	76.6	9.3	10.7	2.74	0.12	0.08	0.06	2.62	53.4	5.97	0.43	0.076	107	2.5
A	21-24	2.54	79.5	7.5	10.5	1.98	0.06	0.08	0.04	2.28	48.7	6.20	0.89	0.059	104	1.9
B_2	30-33	2.21	81.6	7.7	8.5	1.98	0.06	0.08	0.04	1.78	54.8	6.29			91	1.6
B_2	37-40	2.60	80.9	7.8	8.7	2.14	0.06	0.15	0.04	1.44	62.5	6.38			109	1.7
C	45-51	1.21	88.7	5.5	4.6	1.21	0.04	0.05	0.02	Nil.	100.0	6.50			58	2.0
C	54-58	1.13	91.1	3.4	4.4	1.36	0.08	0.08	0.02	Nil.	100.0	6.52			53	3.5

Horizon	Depth in.	% Loss on Ignition	Mechanical Analysis			Exchangeable Cations m.e./100g.					% Saturation	pH	% Carbon	% Nitrogen	mg./100g. Total P_2O_5	mg./100g. Read. Sol. P_2O_5
			% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H						
16. ELGIN ASSOCIATION.						Elgin Series			Ordiga Wood No. 3.		Sample Nos. 93680-84					
A_2	5-8	4.22	80.5	11.1	6.3	0.30	0.18	0.17	0.09	7.16	9.8	3.91	2.20	0.063	40	0.7
B_2	11-13	4.48	78.9	8.5	10.3	0.15	0.06	0.14	0.08	12.88	3.2	4.24	1.89	0.062	37	0.5
B_3	15-18	2.31	76.3	10.9	10.5	0.15	0.04	0.08	0.04	4.75	6.1	4.81			55	3.0
C	24-30	1.40	78.3	6.3	14.0	0.15	0.06	0.07	0.04	1.91	14.3	4.84			38	3.0
C	42-46	0.90	77.4	5.8	15.9	0.15	0.30	0.15	0.06	0.94	41.3	4.84			66	9.9
17. ELGIN ASSOCIATION.						Rosebrae Series.					Sample Nos. 101370-74.					
S	2-5	3.74	69.9	12.6	13.8	5.02	0.10	0.09	0.07	2.44	68.5	6.52	1.44	0.105	126	10.4
$B_2(g)$	8-11	1.66	70.9	10.8	16.6	2.58	0.14	0.07	0.09	2.02	58.8	6.37	0.22	0.022	63	10.7
$B_3(g)$	27-30	0.99	74.9	10.9	13.3	1.66	0.16	0.07	0.07	1.62	54.8	5.93			68	16.1
C	36-39	0.98	77.7	8.5	12.9	1.66	0.22	0.08	0.07	1.07	65.4	6.02			67	17.3
C	43-48	1.02	75.8	8.9	14.3	1.66	0.34	0.09	0.10	1.35	61.9	5.75			67	16.5

18. TYNET ASSOCIATION. Tynet Series. Wellheads. Sample Nos. 98822-28.

A_1	4-5	15.49	75.0	8.8	8.5	1.15	0.66	0.29	0.14	24.70	9.7	3.94	7.93	0.200	54	1.9
A_2	6-8	3.70	76.6	9.3	10.4	0.76	0.12	0.11	0.04	4.25	19.5	4.51	1.49	0.043	29	1.0
B_2	11-15	2.77	68.6	12.4	16.2	0.15	0.02	0.08	0.04	3.92	6.9	4.75	0.75	0.058	42	0.5
B_3	21-24	2.19	66.0	12.8	19.0	Nil.	0.04	0.06	0.06	2.50	6.0	5.06			39	0.7
B_3	27-30	1.81	68.8	10.5	18.9	0.15	0.10	0.07	0.04	2.49	12.6	5.05			37	0.6
C	34-37	2.62	66.2	13.7	17.5	0.15	0.12	0.07	0.06	2.84	12.3	5.04			43	0.5
C	44-48	2.29	67.7	12.1	16.9	Nil.	0.12	0.05	0.04	2.84	6.9	5.14			42	0.5

19. TYNET ASSOCIATION. Tynet Series. Chapelford. Sample Nos. 87279-83.

S	2-6	7.15	65.0	14.7	16.7	3.37	0.22	0.06	0.05	4.87	43.2	5.86	3.53	0.180	91	2.2
S	9-13	4.88	55.8	11.6	30.2	0.92	0.18	0.05	0.05	4.90	19.7	5.40	1.66	0.077	52	0.6
B_3	15-19	2.40	70.5	10.4	16.8	0.30	0.18	0.05	0.03	0.73	43.4	5.21			37	0.8
C	36-40	2.49	68.5	10.5	18.5	0.46	0.20	0.07	0.06	2.42	24.6	4.94			39	0.7

20. SHEMPSTON ASSOCIATION. Shempston Series. Shempston No. 3. Sample Nos. 98798-803.

A_1	4-8	7.28	56.8	10.4	29.2	10.87	1.60	0.67	0.64	5.15	72.8	6.16	2.16	0.152	305	18.6
B_2(g)	14-18	6.18	65.7	9.4	21.9	12.08	1.26	0.70	0.41	2.95	83.0	6.84	1.07	0.077	445	14.9
B_3(g)	25-29	3.92	67.5	8.5	20.1	6.33	1.08	0.45	0.25	3.62	69.2	5.56	0.39	0.041	198	1.8
C(g)	32-36	6.66	43.8	14.0	38.9	7.03	2.14	0.61	0.36	6.95	59.4	4.92			211	0.8
C(g)	40-44	10.85	26.2	16.4	52.0	6.47	2.90	0.60	0.39	12.23	45.9	4.76			595	2.5
C(g)	53-57	8.14	29.3	14.9	51.8	5.03	2.60	0.35	0.41	11.06	42.6	5.05			540	4.0

Horizon.	Depth in.	% Loss on Ignition.	Mechanical Analysis			Exchangeable Cations m.e./100g.					% Saturation.	pH	% Carbon	% Nitrogen	mg./100g. Total P_2O_5	mg./100g. Read. Sol. P_2O_5
			% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H						
21. CARDEN ASSOCIATION.						Carden Series.					Wester Alves.				Sample Nos. 101364-69.	
S	1-4	4.14	41.7	28.5	27.7	10.43	0.68	0.21	0.19	Nil.	100.0	7.45	1.24	0.108	151	5.9
S	8-11	5.00	51.0	22.6	23.9	10.50	0.62	0.17	0.17	1.84	86.2	6.72	1.56	0.121	169	11.5
B(g)	14-17	3.78	6.7	46.2	43.3	9.73	0.78	0.27	0.24	1.13	90.8	6.90	0.34	0.051	82	0.9
B(g)	19-22	3.68	7.4	44.5	44.4	10.50	0.84	0.32	0.29	Nil.	100.0	7.09			72	0.9
B(g)	26-30	3.40	4.1	45.8	46.7	9.60	1.42	0.32	0.29	Nil.	100.0	7.48			87	3.9
C(g)	40-46	2.84	15.7	42.1	39.4	8.35	3.14	0.25	0.37	Nil.	100.0	7.41			130	31.5
22. CARDEN ASSOCIATION.						Carden Series.					Rosehaugh				Sample Nos. 98892-95.	
S	3-7	6.30	43.4	23.5	30.0	9.55	0.94	0.17	0.32	4.35	71.6	6.26	2.08	0.171	163	5.3
B(g)	12-15	3.88	13.0	35.1	48.0	8.51	1.06	0.34	0.25	3.62	73.9	6.04	0.36	0.050	44	0.6
C(g)	17-20	3.78	23.7	31.3	41.2	6.95	0.84	0.34	0.23	3.62	69.8	6.10			51	0.6
D	34-38	0.93	82.2	6.2	10.7	1.86	0.08	0.11	0.04	1.42	59.6	6.28			41	4.1

23. BOYNDIE ASSOCIATION. Boyndie Series. Troves No. 1. Sample Nos. 87473-78.

A_2	4-10	1.52	91.2	0.3	7.0	0.15	0.06	0.05	0.05	1.81	14.6	4.84	0.75	0.050	13	0.8
B_1	15-18	4.54	85.4	2.6	9.8	0.31	0.16	0.11	0.12	11.48	6.1	5.08	1.95	0.095	26	0.8
B_2	20-24	3.83	89.9	0.9	5.3	1.39	0.06	0.06	0.05	10.08	13.4	5.29	1.21	0.071	34	0.7
B_3	28-32	1.08	91.8	1.1	6.0	0.30	0.02	0.05	0.03	0.96	29.4	6.22			62	7.9
C	36-40	0.60	94.7	0.5	4.2	Nil.	Nil.	0.03	0.03	0.47	11.3	6.53			50	0.6
C	45-50	0.84	94.4	0.9	3.9	Nil.	0.02	0.05	0.08	0.98	13.5	5.53			48	10.9

24. BOYNDIE ASSOCIATION. Boyndie Series. Troves No. 2. Sample Nos. 87467-72.

S	2-7	2.21	88.3	2.8	6.7	0.91	0.02	0.08	0.07	1.93	35.9	6.08	1.05	0.104	66	6.5
B_2	11-15	1.28	92.7	0.6	5.4	0.15	Nil.	0.05	0.07	1.44	29.5	5.92	0.46	0.046	35	3.4
B_3	20-24	0.99	93.6	1.6	3.8	Nil.	Nil.	0.06	0.07	0.46	22.1	5.70	0.33	0.037	29	2.2
C	32-38	0.73	93.3	2.7	3.3	Nil.	0.02	0.06	0.05	Nil.	100.0	5.85			35	3.6
C	54-60	0.55	94.0	1.1	4.4	0.75	0.06	0.05	0.05	Nil.	100.0	6.73			38	10.0

25. BOYNDIE ASSOCIATION. Anniston Series. Troves No. 3. Sample Nos. 87479-83.

S	2-6	3.72	83.3	3.6	9.5	1.68	0.02	0.07	0.07	6.79	21.4	5.24	1.83	0.155	82	7.1
A_1	10-14	4.68	84.6	3.5	9.5	3.38	0.12	0.08	0.03	6.73	34.8	5.61	2.17	0.145	50	1.4
B_1-B_2	18-22	1.35	88.3	1.4	9.0	1.06	0.06	0.06	0.02	1.76	40.6	6.08			45	4.0
B_2	30-34	1.07	91.7	1.0	6.2	0.91	0.02	0.06	0.02	1.40	41.9	6.25			98	17.5
C	45-50	0.78	94.0	0.4	4.8	0.30	0.04	0.03	0.02	Nil.	100.0	6.27			62	15.2

Horizon	Depth in.	% Loss on Ignition.	Mechanical Analysis			Exchangeable Cations m.e./100g.					% Saturation.	pH	% Carbon.	% Nitrogen.	mg./100g. Total P_2O_5	mg./100g. Read. Sol. P_2O_5
			% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H						
26. BOYNDIE ASSOCIATION.						Boyndie Series.			Muirhead.			Sample Nos. 98876-81.				
F	½-3	37.70	N.D.	N.D.	N.D.	11.60	3.58	3.00	1.44	39.00	33.4	4.48	18.78	0.737	119	6.2
A_2	3-7	5.45	85.5	7.1	4.7	0.61	0.32	0.51	0.10	8.60	15.2	4.36	1.75	0.125	53	1.1
B_1	8-11	8.97	89.4	3.5	2.7	0.31	0.32	0.86	0.11	13.13	10.8	4.43	3.34	0.143	82	0.9
B_2	15-19	1.31	95.0	3.6	Nil.	0.15	0.02	0.15	Nil.	2.86	10.1	4.95			92	2.0
B_2	24-28	0.92	95.0	1.9	2.2	0.30	0.02	0.10	Nil.	1.42	22.9	4.92			85	2.6
C	44-48	0.57	97.8	1.6	Nil.	0.30	0.04	0.12	Nil.	0.21	68.6	4.79			61	2.6
27. BOYNDIE ASSOCIATION.						Anniston Series.			Aldroughty Wood No. 1			Sample Nos. 93654-58.				
A_2	7-9	9.40	81.2	8.3	5.8	3.07	0.64	0.13	0.29	12.18	25.3	4.72	4.84	0.283	69	1.7
B_2	11-15	3.39	77.5	9.2	9.9	0.15	0.08	0.07	0.05	5.80	5.7	4.93	1.54	0.100	48	0.7
B_2	17-20	2.45	79.3	8.5	9.7	Nil.	0.06	0.04	0.03	3.34	3.8	4.94			46	0.6
C	23-27	1.04	88.7	4.7	5.6	Nil.	0.08	0.04	0.01	1.43	8.3	4.95			37	0.4
C	42-46	1.38	85.7	7.1	5.8	Nil.	0.06	0.04	Nil.	1.44	6.5	4.90			55	0.8

28. BOYNDIE ASSOCIATION. Boyndie Series. Mains of Cotts. Sample Nos. 93664-69.

A_1	3-6	2.19	87.7	4.5	5.6	0.61	0.08	0.06	0.06	2.42	24.3	5.38	0.63	0.065	93	9.5
A_2	8-12	2.65	83.0	8.7	5.7	1.06	0.18	0.09	0.11	2.44	37.2	5.63	0.79	0.076	90	2.1
B_2	15-18	2.95	80.2	11.2	5.7	0.46	0.08	0.14	0.11	2.45	24.4	5.38	0.85	0.068	104	1.8
B_3	20-23	2.53	48.4	41.4	7.7	0.15	0.06	0.44	0.02	1.42	32.0	5.19			76	7.8
	31-35	3.28	18.6	52.0	26.1	1.07	0.12	1.00	0.09	3.36	41.5	4.85			58	1.0
C	52-56	0.62	97.3	0.5	1.6	Nil.	Nil.	0.09	Nil.	0.47	16.1	5.16			61	6.3

29. BOYNDIE ASSOCIATION. Boyndie Series. Blackstob Wood. Sample Nos. 98790-97.

A_1	2-5	1.35	91.9	4.0	2.8	0.30	0.14	0.08	0.04	2.61	17.7	4.39	0.97	0.117	32	0.9
A_2	7-11	2.93	91.3	2.6	3.2	Nil.	0.06	0.08	Nil.	6.77	1.7	4.52	1.29	0.085	22	0.6
B_1	13-15	5.95	93.1	3.9	Nil.	Nil.	0.08	0.07	Nil.	14.65	1.0	4.76	2.45	0.077	33	0.5
B_2	18-22	3.06	93.7	3.2	Nil.	Nil.	0.04	0.04	Nil.	7.90	1.0	4.86			34	0.9
B_3	27-30	2.34	93.1	4.6	Nil.	Nil.	0.02	0.04	Nil.	5.36	1.1	4.91			35	1.0
C	39-42	0.75	95.9	3.4	Nil.	Nil.	0.02	0.04	Nil.	1.55	3.7	5.14			47	1.6
C	52-56	0.60	97.2	2.2	Nil.	Nil.	0.02	0.04	Nil.	0.93	6.1	5.29			40	1.6

30. BOYNDIE ASSOCIATION. Ballindarg Series. Wester Coxton. Sample Nos. 117318-21.

S	2-6	8.74	88.7	3.4	6.5	6.13	0.24	0.08	0.11	6.31	51.0	5.59	5.14	0.467	147	1.5
A_1g	12-16	26.70	65.9	1.8	5.6	17.70	0.91	0.20	0.16	27.66	40.7	5.29	19.70	1.188	147	1.0
B_g	18-22	0.66	97.0	2.3	Nil.	1.20	0.11	0.02	0.03	Nil.	100.0	5.59	0.17	0.037	29	0.8
C_g	30-35	0.95	96.3	2.7	Nil.	1.35	0.08	0.01	0.03	Nil.	100.0	4.11	0.42	0.038	48	2.7

Horizon	Depth in.	% Loss on Ignition.	Mechanical Analysis			Exchangeable Cations m.e./100g.					% Saturation	pH	% Carbon	% Nitrogen	mg./100g. Total P_2O_5	mg./100g. Read. Sol. P_2O_5
			% Sand Inter	% Silt Inter.	% Clay	Ca	Mg	Na	K	H						
31. BOYNDIE ASSOCIATION.						Boyndie Series.			Miltonhill.			Sample Nos. 98863-68.				
S	2-5	4.66	74.4	11.2	12.1	6.23	0.32	0.14	0.07	1.78	79.3	6.56	1.91	0.149	153	9.6
S	8-11	4.16	73.7	10.7	13.5	6.24	0.34	0.10	0.07	2.13	76.0	6.56	1.83	0.128	142	8.3
A_2	15-17	2.12	79.8	9.6	8.5	3.03	0.16	0.07	0.04	1.07	75.6	6.44	0.57	0.046	95	7.2
B_2	19-21	1.55	81.0	9.7	7.8	2.72	0.26	0.06	0.04	0.35	89.9	6.40			58	6.3
	24-28	3.65	28.9	30.7	36.8	7.98	1.40	0.25	0.20	1.22	88.8	6.25			44	0.6
C	36-42	1.41	82.9	9.1	6.6	2.72	0.30	0.13	0.06	Nil.	100.0	6.70			132	40.7
32. BOYNDIE ASSOCIATION.						Boyndie Series.			Burnside, Duffus.			Sample Nos. 98810-15.				
S	3-9	2.49	88.3	4.3	5.0	3.61	0.04	0.10	0.04	1.42	72.8	6.69	0.83	0.059	97	13.2
B	14-17	1.23	93.6	1.6	3.6	0.75	0.02	0.05	0.02	1.77	32.2	5.35	0.32	0.033	46	2.2
Buried Soil.	19-22	3.41	75.2	9.1	12.3	0.91	0.02	0.07	0.05	5.33	16.5	5.15	1.49	0.090	88	1.0
	25-28	4.39	68.9	14.1	14.8	1.21	0.04	0.08	0.04	6.40	17.6	5.25			107	1.0
	32-38	2.98	56.5	16.6	24.0	2.91	0.30	0.08	0.10	3.58	48.7	5.97			80	1.0
	42-48	2.76	48.0	16.0	33.2	4.62	1.52	0.19	0.24	1.09	85.8	6.03			65	0.6

33. CORBY ASSOCIATION — Corby Series. — Threapland Wood. — Sample Nos. 117322-26.

A_o-A_1	0-2	29.60	N.D.	N.D.	N.D.	13.06	3.68	0.47	0.82	25.52	41.4	5.50	18.45	0.950	231	19.3
A_2	4-8	2.60	87.2	8.1	2.1	..75	0.13	0.06	0.13	4.19	20.4	4.08	1.55	0.065	40	1.2
B_2	16-20	2.37	93.3	2.1	2.2	0.61	0.17	0.03	0.10	1.71	34.8	4.98	0.94	0.085	63	1.4
B_2	26-30	1.69	94.5	1.5	2.3	0.60	0.13	0.05	0.17	0.69	57.9	5.50	0.39	0.067	57	0.7
B_3	34-38	0.90	97.5	1.6	Nil.	0.60	0.13	0.02	0.05	Nil.	100.0	5.95	0.17	0.045	58	1.8

34. CORBY ASSOCIATION. — Corby Series. — Aldroughty Wood No. 2. — Sample Nos. 93659-63.

A_1-A_2	6-8	9.94	77.2	11.1	6.8	Nil.	0.34	0.14	0.17	13.50	4.6	3.93	5.45	0.192	50	1.0
A_2	9-11	3.41	82.5	7.2	6.9	Nil.	0.12	0.07	0.06	5.74	4.2	4.21	1.78	0.077	35	0.7
B_2	14-18	5.85	80.4	10.8	5.9	Nil.	0.10	0.13	0.13	15.00	2.3	4.61			59	0.6
B_2	22-26	3.29	84.6	5.4	6.7	Nil.	0.06	0.08	0.08	6.67	3.2	4.60			55	0.6
C	36-42	2.15	86.9	6.3	4.6	Nil.	0.06	0.08	0.04	4.25	4.1	4.65			46	0.8

35. DUFFUS ASSOCIATION. — Kintrae Series. — Orchardfield. — Sample Nos. 98845-51.

S	1-4	6.02	61.8	13.9	21.3	13.08	0.54	0.14	0.13	1.43	90.7	6.74	2.68	0.198	142	16.2
S	8-11	5.16	63.0	13.4	21.0	11.78	0.54	0.14	0.15	0.36	97.5	6.84	2.00	0.157	115	10.6
B(g)	15-18	4.79	17.1	28.7	51.8	13.00	0.54	0.22	0.34	Nil.	100.0	7.12	0.86	0.061	135	50.0
B(g)	23-26	5.29	9.4	34.5	53.8	13.14	1.48	0.25	0.42	Nil.	100.0	7.67			163	76.5
Bg	36-40	6.46	10.3	40.3	46.2	47.60	2.78	0.27	0.55	Nil.	100.0	8.46			150	17.7
Cg	48-54	6.52	14.6	34.5	47.6	55.00	3.48	0.27	0.61	Nil.	100.0	8.52			155	11.4

Horizon.	Depth in.	% Loss on Ignition	Mechanical Analysis			Exchangeable Cations m.e./100g.					% Saturation	pH	% Carbon.	% Nitrogen	mg./100g. Total P_2O_5	mg./100g. Read. Sol. P_2O_5
			% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H						
36. DUFFUS ASSOCIATION.						Duffus Series.					Old Duffus.			Sample Nos. 98804-09.		
S	3-6	6.55	32.6	26.0	38.2	18.82	1.62	0.25	0.52	Nil.	100.0	7.95	1.91	0.211	230	26.8
Bg	12-15	7.65	17.9	44.5	33.6	56.50	2.22	0.34	0.52	Nil.	100.0	8.56	0.95	0.050	141	10.5
Bg	20-23	6.90	10.2	50.0	36.0	56.40	3.26	0.45	0.50	Nil.	100.0	8.53	1.17	0.050	146	8.3
Bg	29-32	8.90	15.4	46.8	33.4	59.00	3.84	0.63	0.61	Nil.	100.0	8.60			143	8.2
Cg	41-44	6.15	17.8	32.5	46.7	51.10	4.68	0.78	0.80	Nil.	100.0	8.41			152	11.8
Cg	48-51	6.91	14.7	34.4	47.5	52.00	4.92	0.80	0.83	Nil.	100.0	8.27			151	10.8
37. ALLUVIUM.						Series:- Sandy loam, poorly drained.					Gilston No. 1.			Sample Nos. 96455-59.		
	2-6	6.88	65.0	15.2	16.4	10.45	0.58	0.32	0.11	2.80	80.4	6.32	3.07	0.244	190	4.2
	10-13	0.97	92.8	3.0	3.2	2.86	0.12	0.16	0.04	Nil.	100.0	7.37	0.52	0.032	71	8.9
	16-19	0.44	98.3	0.4	0.8	3.76	0.10	0.24	0.02	Nil.	100.0	8.43			82	13.9
	30-36	88.50	N.D.	N.D.	N.D.	50.30	51.60	43.30	1.65	28.40	80.8	5.77			83	2.2
	45-49	28.59	N.D.	N.D.	N.D.	137.00	12.38	14.45	0.57	Nil.	100.0	8.21			27	13.5

38. ALLUVIUM. Series:- Loam, poorly drained. Gilston No. 2. Sample Nos. 96460-65.

	2-4½	8.52	57.3	17.5	20.9	27.60	1.10	0.34	0.24	Nil.	100.0	7.98	4.53	0.312	206	4.2
	5½-8½	8.38	57.5	17.5	20.8	26.00	1.20	0.44	0.29	Nil.	100.0	7.90	3.48	0.294	181	3.7
	11-13	17.99	34.7	31.6	20.3	149.00	2.96	0.91	0.15	Nil.	100.0	8.42	2.73	0.220	21	1.8
	17-19	15.51	17.8	28.1	46.4	89.30	3.84	1.55	0.62	Nil.	100.0	8.10			74	0.9
	22-26	2.80	50.7	44.0	2.5	33.20	2.54	0.87	0.43	Nil.	100.0	7.94			117	11.8
	36-40	2.34	95.0	2.2	0.4	28.20	1.08	0.77	0.22	Nil.	100.0	8.17			128	3.6

39. ALLUVIUM. Series:- Sandy loam, imperfectly drained. Inchbroom. Sample Nos. 98816-21.

	3-6	3.60	74.1	11.4	10.9	4.10	0.14	0.17	0.07	2.86	61.0	6.00	0.86	0.119	146	5.0
	11-14	1.88	79.7	11.7	6.8	3.02	0.06	0.10	0.04	1.07	75.1	6.33	0.59	0.052	65	4.2
	18-22	0.43	96.4	1.0	2.2	0.90	0.02	0.07	0.02	Nil.	100.0	6.82	0.08	0.017	45	3.0
	27-31	0.93	89.8	6.9	2.4	2.11	0.08	0.10	0.04	0.35	86.9	6.54			146	8.8
	40-44	8.64	75.3	14.9	5.5	4.43	0.24	0.19	0.11	7.53	39.8	3.99			74	1.3
	48-54	0.45	97.0	2.2	0.4	0.90	Nil.	0.07	0.02	0.14	87.5	6.40			40	2.2

40. ALLUVIUM. Series:- Clay loam, poorly drained. Waterton. Sample Nos. 87284-87.

	2-8	4.60	40.1	24.6	33.0	19.90	1.26	0.18	0.45	Nil.	100.0	7.88	2.24	0.154	149	28.0
	12-16	4.10	39.0	26.0	33.0	54.50	1.06	0.30	0.44	Nil.	100.0	8.68	0.97	0.051	130	5.1
	26-30	4.72	3.8	52.1	41.8	126.80	3.48	0.51	0.57	Nil.	100.0	8.67			123	5.8
	42-46	4.02	44.0	22.5	29.5	77.80	2.96	0.48	0.59	Nil.	100.0	8.75			117	4.9

Horizon.	Depth in.	% Loss on Ignition.	Mechanical Analysis			Exchangeable Cations m.e./100g.					% Saturation	pH	% Carbon	% Nitrogen	mg./100g. Total P_2O_5	mg./100g. Read. Sol. P_2O_5
			% Sand Inter.	% Silt Inter.	% Clay	Ca	Mg	Na	K	H						
41. ALLUVIUM.			Series:- Peaty loam, very poorly drained. Wester Calcots No. 1.												Sample Nos. 117310-13	
	2-6	15.90	67.8	15.8	8.4	19.27	1.02	0.26	0.20	8.46	71.1	6.01	9.41	0.608	188	3.1
	9-12	15.80	67.8	13.3	11.0	16.69	0.76	0.24	0.21	12.00	59.8	5.67	9.48	0.564	158	1.6
	16-20	1.15	94.8	2.0	2.0	1.81	0.43	0.06	0.07	Nil.	100.0	5.29	0.37	0.034	54	1.8
	24-28	2.30	77.6	13.5	6.6	2.41	0.28	0.07	0.13	1.70	63.0	4.46	.86	0.067	81	14.1
42. ALLUVIUM.			Series:- Sandy loam, poorly drained. Wester Calcots No. 2.												Sample Nos. 117314-17.	
	2-6	9.22	53.0	26.4	16.0	13.53	0.28	0.14	0.34	1.49	90.5	6.71	4.48	0.380	173	2.9
	12-16	12.00	47.2	29.2	17.6	8.85	0.75	0.16	0.19	5.35	65.0	6.00	3.92	0.308	116	0.6
	18-24	79.30	N.D.	N.D.	N.D.	287.5	3.50	1.19	0.42	83.10	78.0	5.09	54.20	2.246	174	0.8
	26-32	1.04	96.8	2.2	Nil.	1.65	0.18	0.06	0.07	Nil.	100.0	4.58	0.47	0.053	51	5.2

43. RAISED BEACH DEPOSITS. Series:- Poorly drained. Westbank of Roseisle. Sample Nos. 98840-44

	2-6	3.18	89.3	2.9	4.6	2.57	0.04	0.08	0.18	2.49	53.6	5.75	1.25	0.111	95	7.1
	11-15	0.22	97.4	2.4	Nil.	0.60	0.02	0.04	0.04	Nil.	100.0	6.34	0.05	0.028	37	2.4
	20-25	0.29	99.7	Nil.	Nil.	0.60	Nil.	0.04	Nil.	Nil.	100.0	6.54			29	2.7
	29-34	0.80	96.6	2.6	Nil.	1.35	Nil.	0.06	0.02	2.30	38.4	3.76			33	1.5
	42-50	84.00	N.D.	N.D.	N.D.	114.30	7.38	1.31	0.51	25.75	82.9	6.24			137	1.5

44. RAISED BEACH DEPOSITS. Series:- Poorly drained. Muirton. Sample Nos. 98852-57.

	3-7	3.91	87.6	4.5	4.0	5.30	0.28	0.19	0.13	Nil.	100.0	6.91	1.46	0.113	125	17.6
	12-16	0.18	96.0	3.8	Nil.	1.20	0.02	0.07	0.07	Nil.	100.0	6.41	0.16	0.031	87	13.2
	22-25	1.84	83.9	8.1	6.2	3.33	0.16	0.16	0.09	0.28	93.1	6.10	0.61	0.059	93	3.0
	29-32	0.55	93.7	3.6	2.2	0.60	0.04	0.05	0.04	Nil.	100.0	5.44			44	3.0
	40-44	0.26	96.7	3.0	Nil.	0.90	0.06	0.06	0.04	Nil.	100.0	5.28			29	1.8
	55-61	0.70	93.3	4.0	2.0	0.75	0.14	0.04	0.04	0.98	49.8	5.34			40	3.2