SOILS OF Co. LAOIS

An Foras Talúntais
National Soil Survey of Ireland

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by

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An Foras Taluntais
(The Agricultural Institute)

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PREFACE

This publication. Soil Survey Bulletin No. 41, presents the findings of the soil survey of County Laois. It is one of a series of county soil surveys being carried out by the National Soil Survey of An Foras Taliintais (The Agricultural Institute) to provide basic information which can be used in optimum land-use planning. The field mapping was carried out at a scale of 1:10,560 (6 in = 1 mile; 9.5 cm = 1 km) but due to scale limitation all the detail mapped on the field sheets is not shown on the published soil map.

Dr. Michael Conry and Mr. Tim O'Shea were responsible for the systematic field work which commenced in 1969. Dr. S. Diamond gave invaluable assistance and advice on soil correlation and soil suitability and Dr. R. F. Hammond on peat classification. Dr. G. A. Fleming and Mr. P. Parle wrote the chapter on trace elements and Dr. J. Lee the chapter on grazing capacity.

The bulletin was compiled by Dr. M. J. Conry and was edited by Dr. C. J. O'Rourke. Typesetting and layout were carried out by Ms. Helen O'Donnell and Mr. John Dowling and the bulletin was printed by the Publications Department of An Foras Taliintais. Photographs were taken by Mr. C. Godson, Dr. C. J. O'Rourke (aerial photos) and Dr. M. J. Conry.

Maps were prepared by the Cartographic Section of the National Soil Survey at Johnstown Castle, Wexford. The various figures and plates were also prepared by the staff of this Section.

The analytical data were provided by the.laboratory staff of the Soil Survey Department (with assistance from the Soil Fertility and Chemistry Department) and the Plant Nutrition and Biochemistry Department, Johnstown Castle. Mr. P. Sills was responsible for trace element analyses.

Assistance also came from a number of outside sources. In compiling the information on soil suitability, ACOT (the farm advisory and training service) personnel gave very valuable assistance. The help, courtesy and interest of A. Sweeney, J. Burke, J. Challoner, O. Dillon, T. Everard, S. Farrell, T. Hennessy, J. Kennedy, F. Monahan, P. Morrin, W. Murphy, M. O'Connor, J. O'Keeffe. L. O'Loughlin and E. Prendergast throughout the preparation of this work is greatly appreciated. Climatic data were abstracted from a publication by Leech (1983). The chapter on solid geology and glacial geology was abstracted from Feehan (1983) with additional information contributed by Michael O'Meara and Robert Aldwell of the Geological Survey. We gratefully appreciate John Feehan's and his publisher's permission to reproduce tables, diagrams and photographs.

The colour maps were printed by the Ordnance Survey which was also the source of base maps for field mapping; the printed maps are based on the Ordnance Survey by permission of the Government.

Grateful acknowledgement is made to all those contributors mentioned here and to others who helped in various ways.

John Lee,
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An Foras Taliintais,
Johnstown Castle,
June 1986.

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*Out of print

An illustrated 12-page summary of this Soil Survey Bulletin (reprinted from J. Feehan's 'Laois-An Environmental History,' Ballykilcavan Press, 1983) is available from the Publications Department, An Foras Taluntais, 19 Sandymount Avenue, Dublin 4.

CHAPTER 1

GENERAL DESCRIPTION OF THE AREA

Location and Extent

County Laois (Fig. 1.1) is situated in the central midlands between 52° 47' and 53° 13' north latitude and 6° 56' and 7° 44' west longitude. It is the only county in Ireland surrounded by counties which themselves (Kilkenny, Tipperary, Offaly, Kildare and Carlow) do not touch the sea.

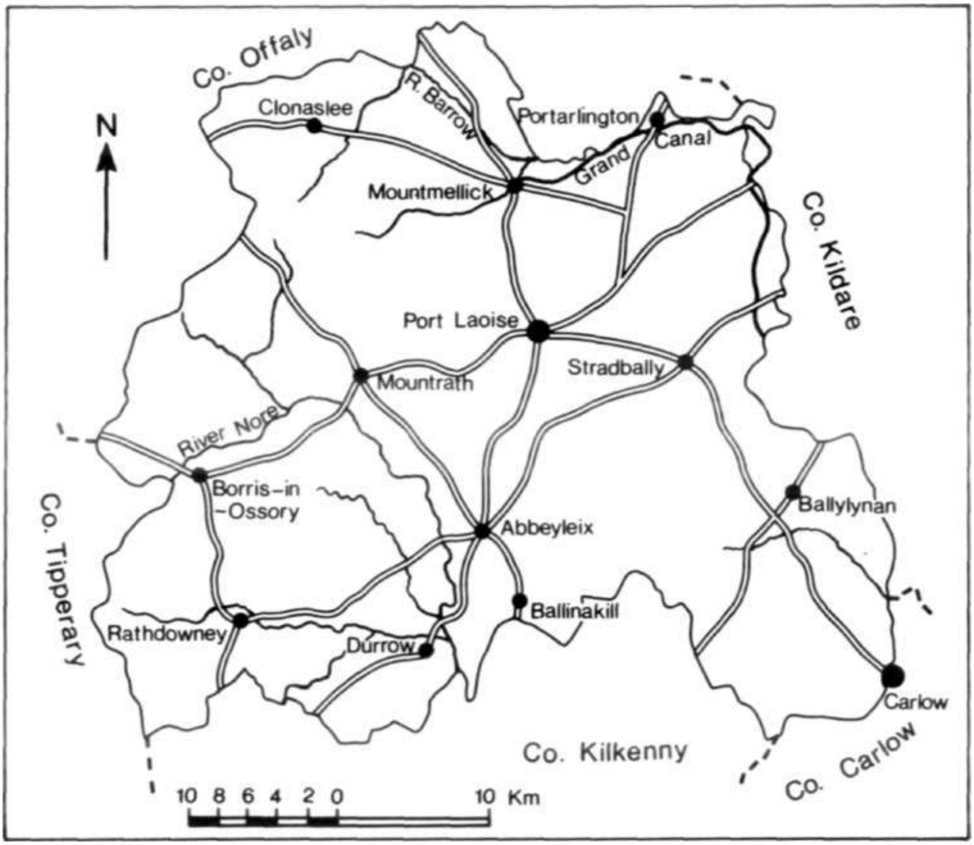

Fig. 1.1: Co. Laois.

The county occupies an area of 171,954 hectares (land and water) or roughly 1,719 km^2 (664 $miles^2$). Total land area is 171,738 hectares. The principal towns are Portlaoise, Mountmellick, Stradbally, Portarlington, Abbeyleix and Rathdowney.

Topographic Regions

Laois can be divided into three geomorphological regions, each of which is defined by several distinct and different characteristics (Fig. 1.2). At the north-western end of the county are the Slieve Bloom Mountains, an area characterised by moorland peats and related mountain soils and now partly afforested. This region rises sharply above the surrounding landscape to an elevation of 528 metres and is characterised by the rather smooth landscape of the Old Red Sandstone rock formation and deep incised

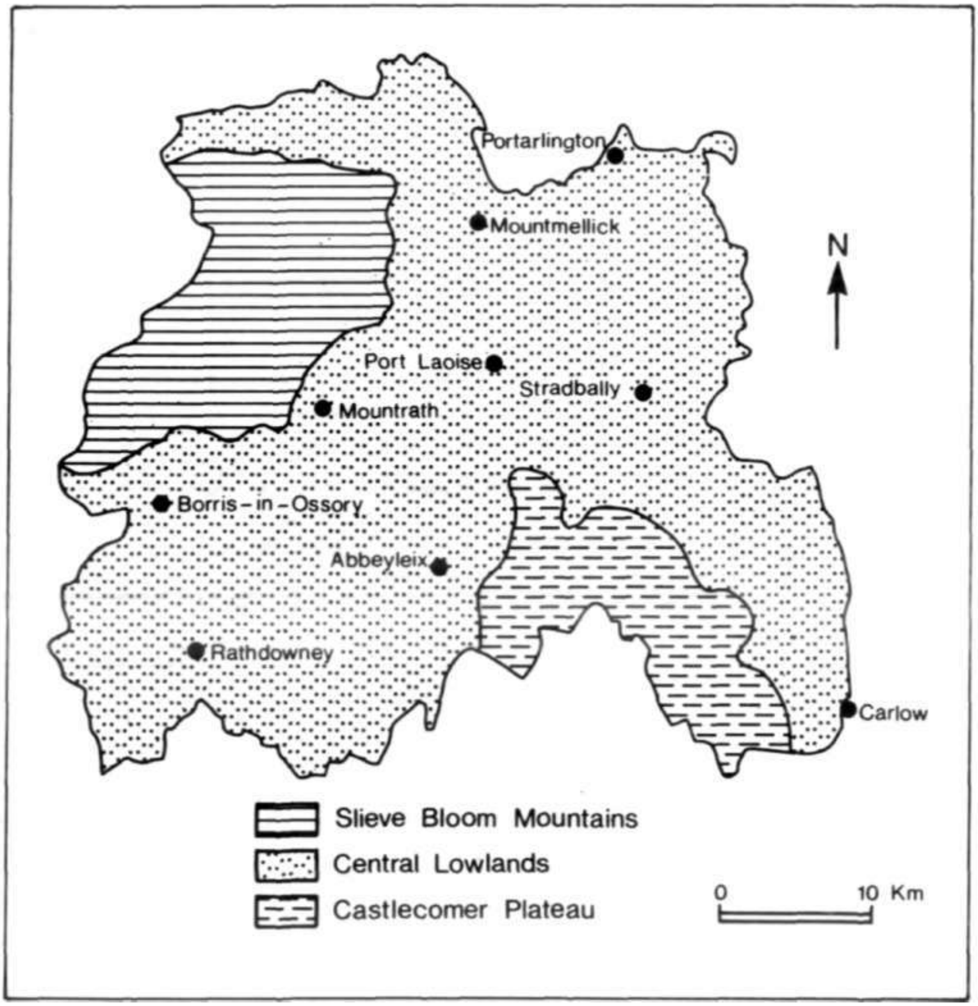

Fig. 1.2: Geomorphological regions of Co. Laois.

picturesque valleys where the underlying and sofier Silurian shales have been exposed to weathering processes.

At the opposite (south-east) end of the county, another area of high land, the Castlecomer Plateau, rises to an elevation of 330 m and is characterised for the most part by wet rush-infested soils. The Plateau is an undulating upland basin with a horseshoe-shaped high rim capped by tough sandstone. The soft underlying shales have been rapidly eroded to form a steep outer escarpment, particularly on the eastern side.

The greater part of the county, the Central Lowlands, lies between these two highland areas. It consists generally of much flatter land with better quality soils. The area lying to the south-east of Portlaoise consists of isolated hills and more continuous ridges of karst limestone (Feehan, 1983). Elsewhere, in this central part of Laois, hills, ridges, valleys, and large flats give the countryside a surprisingly diverse landscape.

River Systems

There are two major river systems in the county, the Barrow and the Nore (Fig. 1.3). The north-eastern half of the county is drained by the Barrow or its tributaries the

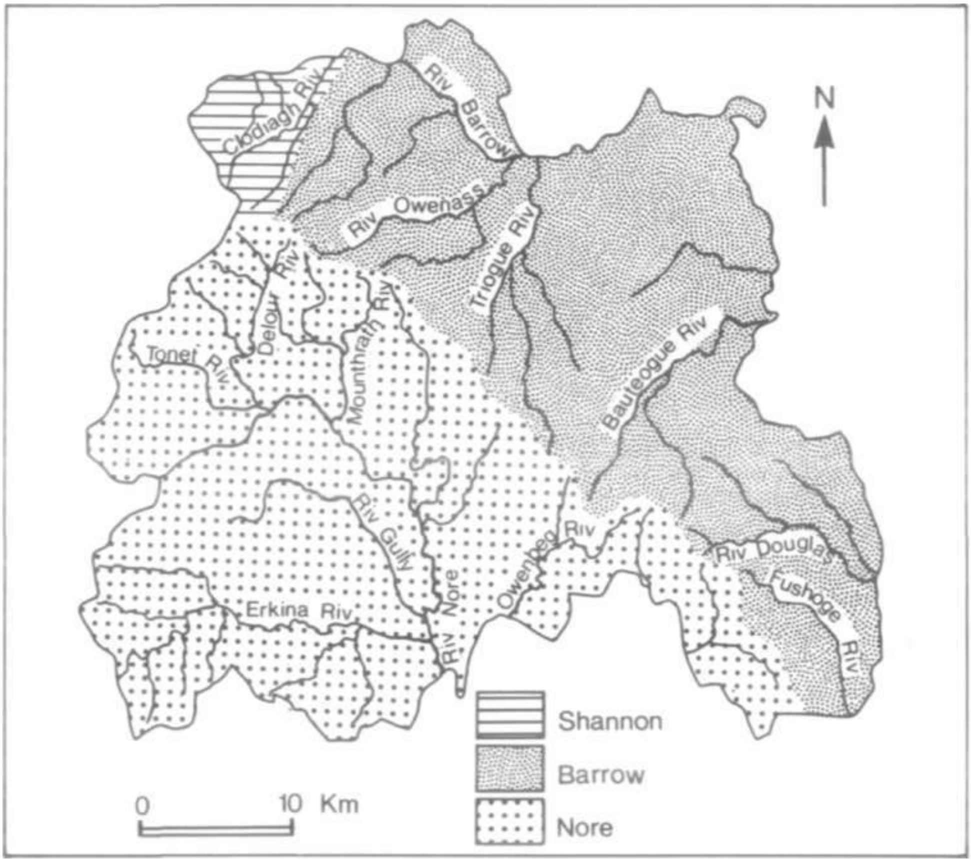

Fig. 1.3: River systems of Co. Laois.

Owenass, Triogue, Bauteogue, Douglas and Fushoge. The south-western half of the county is drained by the Nore and its tributaries the Tonet, Delour and Mountrath rivers, which drain the southern slopes of the Slieve Blooms, the Erkina which drains the southern lowlands and the Owenbeg which drains part of the Castlecomer Plateau.

A small portion of the extreme north-west of the county is drained by the Clodiagh which rises in Slieve Bloom and drains northwards into the Brosna and eventually into the Shannon.

The Climate of Laois*

Introduction

Ireland has a cool temperate climate with a strong oceanic influence. The Atlantic Ocean, warmed by the North Atlantic Drift, gives rise to marked differences between coastal and inland areas. Laois is an inland county where the effects of the sea are greatly reduced.

The Slieve Bloom mountains, rising to about 530 m above mean sea level in the north-west of the county, and the plateau in the south-east at 150 to 300 m above mean sea level have a further influence on the climate of the area, particularly on the temperature and rainfall distributions.

Rainfall

The general features of annual rainfall in Laois in relation to the country as a whole are shown by Fig. 1.4—Mean Annual Rainfall (including the water equivalent of snow, hail etc.) 1941—70. The detailed distribution in Laois is shown in Fig. 1.5 and monthly and annual averages for specified stations are given in Table 1.1. This shows that March, April and June are generally the driest months, in terms of rainfall amounts, and December and January the wettest months.

The county can be divided broadly into high, intermediate and low rainfall areas:

1. The Slieve Bloom mountains where mean annual rainfall exceeds 1200 mm and at one location, the Cut, reached 1639 mm in the 30-year period 1941—70.
2. The plateau area in the south-east, where the mean annual amounts are approximately 1000—1200 mm.
3. The rest of the county where the mean annual amounts are generally 800—1000 mm, but less than 800 mm in a narrow strip along the eastern border with Kildare. So, while Slieve Bloom has high rainfall, the extreme east of Laois is one of the driest parts of Ireland.

Rain days and wet days: In common with the rest of the country, rainfall in Laois in any given month varies widely from year to year. Annual or monthly rainfall values give an incomplete picture of the rainfall distribution over time. The rain may be confined to a small percentage of days, and if it occurs mainly as heavy rain the total duration will be short. At the other extreme, it may occur on a considerable percentage of days and

•This information is drawn solely from L. S. Leech's contribution to *Laois-An Environmental History* by John Feehan, 1983.

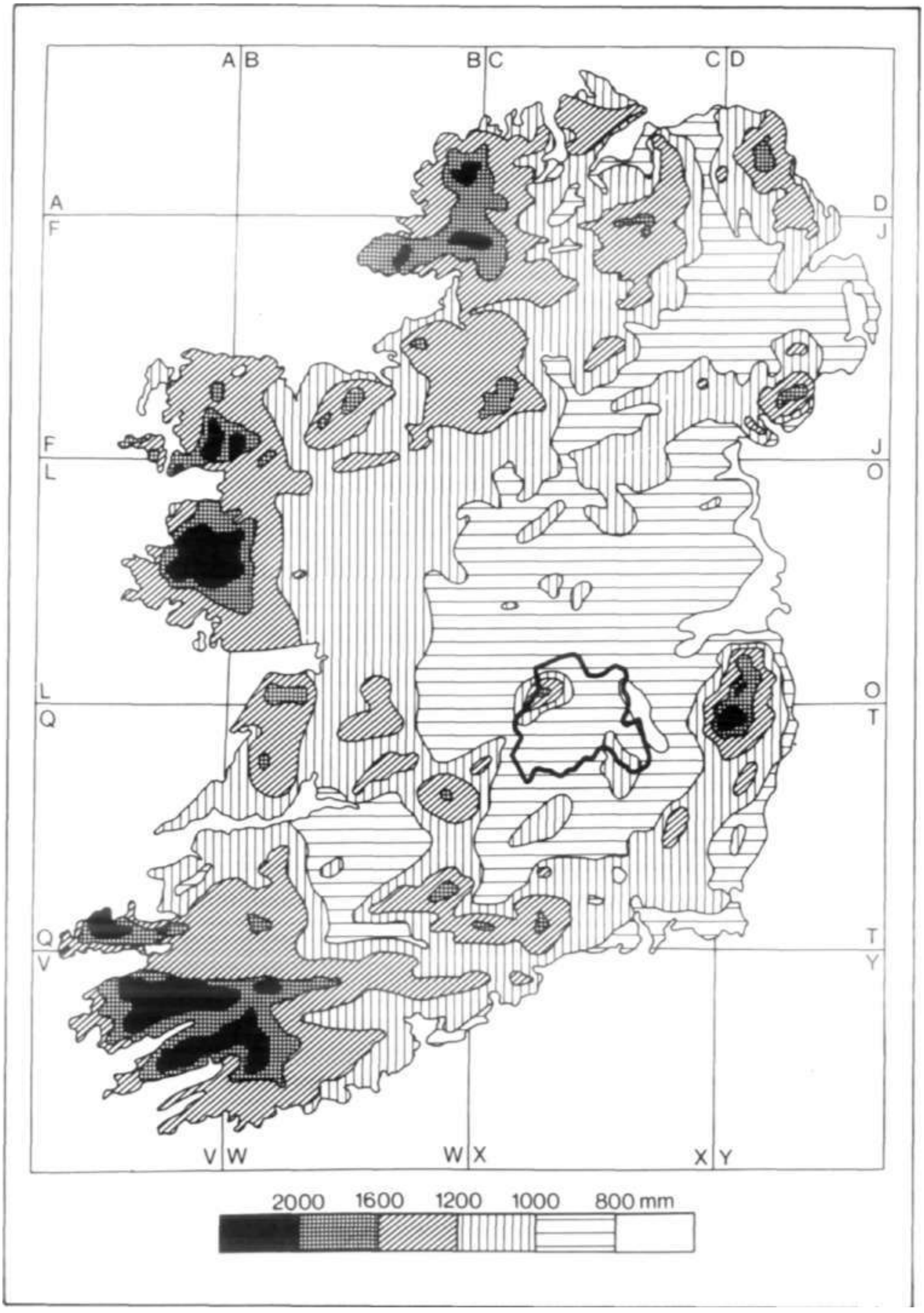

Fig. 1.4: Mean annual rainfall, Ireland, 1941-70. County Laois is outlined at lower-right centre.

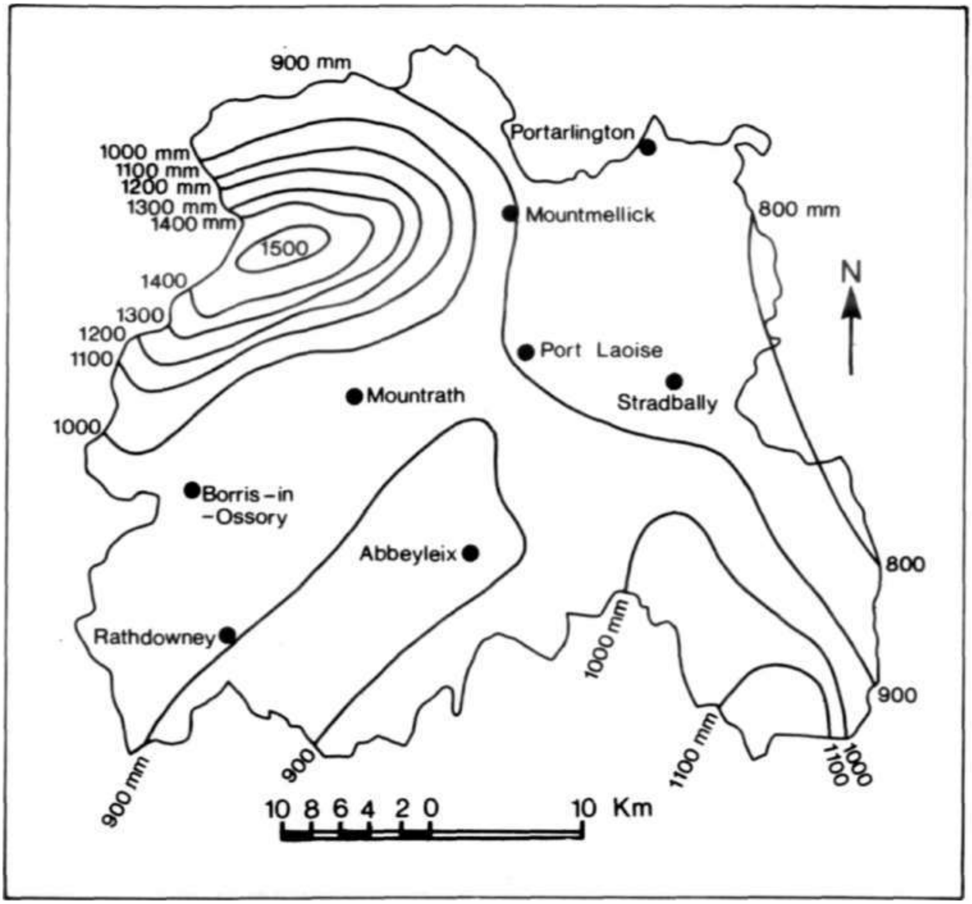

Fig. 1.5: Co. Laois, mean annual rainfall (mm), 1941-70.

mainly in falls of low intensity, resulting in much greater total duration. The rainfall in Ireland normally tends towards the latter type of distribution. Two simple indices for giving a limited description of rainfall distribution are:

a. rain-day—a day on which there is 0.2 mm or more of rainfall;

b. wet-day—a day on which there is 1.0 mm or more of rainfall.

The average annual number of rain-days and wet-days at relevant locations is given in Table 1.2.

Temperature

Table 1.3 gives the mean monthly temperatures and extremes for Mountmellick (1921—50), the only long-term series of temperature data available for a location within County Laois. The coldest months are January and February, with July and August the warmest.

The distribution of mean air temperature over Ireland in January and July is shown

TABLE 1.1: Monthly and annual averages of rainfall (mm) for specified stations in Co. Laois, 1941 - 70

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Abbeyleix (Blandsfort)	96	69	63	64	76	63	73	81	94	86	87	101	953
Abbeyleix Garda Station	92	63	55	56	68	55	68	82	91	81	79	94	884
Ballacolla Garda Station	90	60	54	57	62	53	64	84	8K	81	80	98	871
Ballinakill (Salesian Coll.)	96	65	61	60	75	61	71	88	97	83	84	99	940
Borris-in-Ossory Garda Station	100	66	64	64	71	59	71	87	97	88	87	106	960
Clonaslee Water WorKs	118	81	74	73	84	73	81	102	109	109	97	131	1,132
Durrow Garda Station	98	67	63	59	71	58	69	82	91	87	83	100	928
Mountmellick (Anngrove)	92	61	54	59	67	58	65	78	90	82	84	96	886
Portarlington Garda Station	78	53	5 2	52	63	60	70	80	85	73	74	89	829
Portlaoise ESB	86	60	53	52	64	54	65	73	86	79	74	93	839
Rathdowney Garda Station	96	61	60	57	66	55	66	79	86	83	81	99	889
Slieve Bloom Mtns. (Baunreagh Forest)	150	101	97	95	102	94	115	130	140	136	133	168	1,461
Slieve Bloom Mtns. (Nealstown)	99	69	66	69	85	75	92	103	104	100	88	108	1,058
Slieve Bloom Mtns. (The Cut)	170	113	113	107	112	111	123	149	165	148	151	177	1,639
Stradbally Garda Station	89	58	57	52	66	57	60	73	85	76	77	91	841
Wolfhill Garda Station	105	70	64	66	80	63	74	S6	106	88	90	105	997

Source: Leech (1983).

TABLE 1.2: Average annual rain-days and wet-days at Co. Laois locations

	Rain-days	Wet-days	Period
Abbeyleix	200	168	1941-70
Durrow	211	**154**	1947-69
Borris-in-Ossory	213	**164**	**1947-66**
Slieve Bloom Mountains (Nealstown)	**234**	178	1954-79
Birr	211	152	1941-70

Source: Leech (1983).

in Figure 1.6, thus allowing comparisons of winter and summer temperatures in Co. Laois with those of other parts of the country.

A comparison of data from inland (Birr, Kilkenny) and coastal (Rosslare) stations indicates that the mean monthly temperature in Co. Laois is 1 to 2°C lower than on the south-east coast from September to February, but from March to August there is little difference (Leech, 1983). However, this small difference in mean temperature conceals large differences in the associated daily maximum and minimum values. The inland locations, according to Leech (1983), have maxima 1 to 2°C higher than the coastal locations except in March, and minima 1 to **2°C** lower. During the succeeding months, September to February, the inland minima are still lower, at 2 to 3°C, than the coastal, and the inland maxima are also lower than the coastal, though to a lesser degree.

Elevation is an even more potent cause of variation in mean temperatures from place to place than is distance from the sea. A decrease of 1°C for every 150 m above mean sea level is usually assumed in Ireland. Thus in parts of the county which are over 300 m above sea level, the mean monthly temperatures may be as much as **2°C** lower than those of Mountmellick.

Sunshine

Sunshine records for Birr and Kilkenny can be taken as representative of neighbouring parts of Co. Laois which are less than 100 m above mean sea level, and can be compared with Rosslare data. May and June are the sunniest months and December and January the dullest (Leech, 1983). As is usual with inland counties of Ireland, Laois has, according to Leech, appreciably lower mean daily sunshine than most east-coast locations during most months of the year. The difference rises to about one and a half hours in June but is one-quarter of an hour or less during the winter months of December, January and February. A comparison of Birr and Kilkenny suggests that the period April to September is slightly less sunny in western parts of Laois than in eastern parts. It is uncertain whether general sunshine values in the plateau area of the south-east are lower than at say, Birr. However, investigations elsewhere indicate a reduction of about 20% mean annual sunshine totals compared with Birr, though for the Slieve Bloom area, at 300 m, the degree of reduction would probably differ appreciably throughout the year.

TABLE 1.3: Mean and extreme values of air temperature (°C)at Mountmellick, County Laois, 1921-50*

		Mean daily		Mean of Highest	Mean of Lowest	Absolute extreme			
	Mean	Max	Min	Max	Min	Max	Year	Min	Year
Jan.	4.9	7.9	1.9	**12.4**	-4.3	13.9	1944	-14.4	1945
Feb.	5.1	8.1	2.0	12.7	-3.2	15.0	1945	-6.7	1950
Mar.	6.4	10.3	2.4	15.6	-3.6	222	1946	-10.0	1928
Apr.	8.1	12.4	3.7	18.2	-1.6	23.9	1945	-4.4	1922
May	10.8	153	6.1	21.9	0.2	27.8	1922	- 2 2	1945
June	13.9	18.7	9.0	24.9	4.3	29.4	1921 1925 1950	1.7	1942
July	153	19.9	11.1	25.4	6.8	30.6	1921 1934	3.9	1942
Aug.	14.9	19.2	10.6	23.9	Si	27.8	1933	3.3	1946
Sept.	12.8	173	8.4	222	2.2	26.1	1929	-1.1	1921 1932
Oct.	9.8	13.6	6.0	18.9	-0.9	22.8	1926	-5.6	1931
Nov.	6.3	9.6	2.9	**14.6**	-3.8	18.9	1946	-6.7	1950
Dec.	5.2	8.0	2.4	122	-3.4	13.9	1931	-7.2	1925 1950
Year	9-5	13.4	5 6			30.6	1921 1934	-14.4	1945

*Some appreciable gaps occur in this record. These should not cause any material error in the monthly or annual means, but may have contained for one or two months more extreme values than those given in the table. (From Leech, 1983).

Frequency of Snow or Sleet, Hail, Thunderstorms and Fog

The mean annual number of occasions at Birr and Kilkenny of these weather elements is given in Table 1.4.

The average annual number of days with snowfall or sleetfall is about 16 at Birr and Kilkenny, and the frequency is perhaps double high up on the Slieve Bloom mountains.

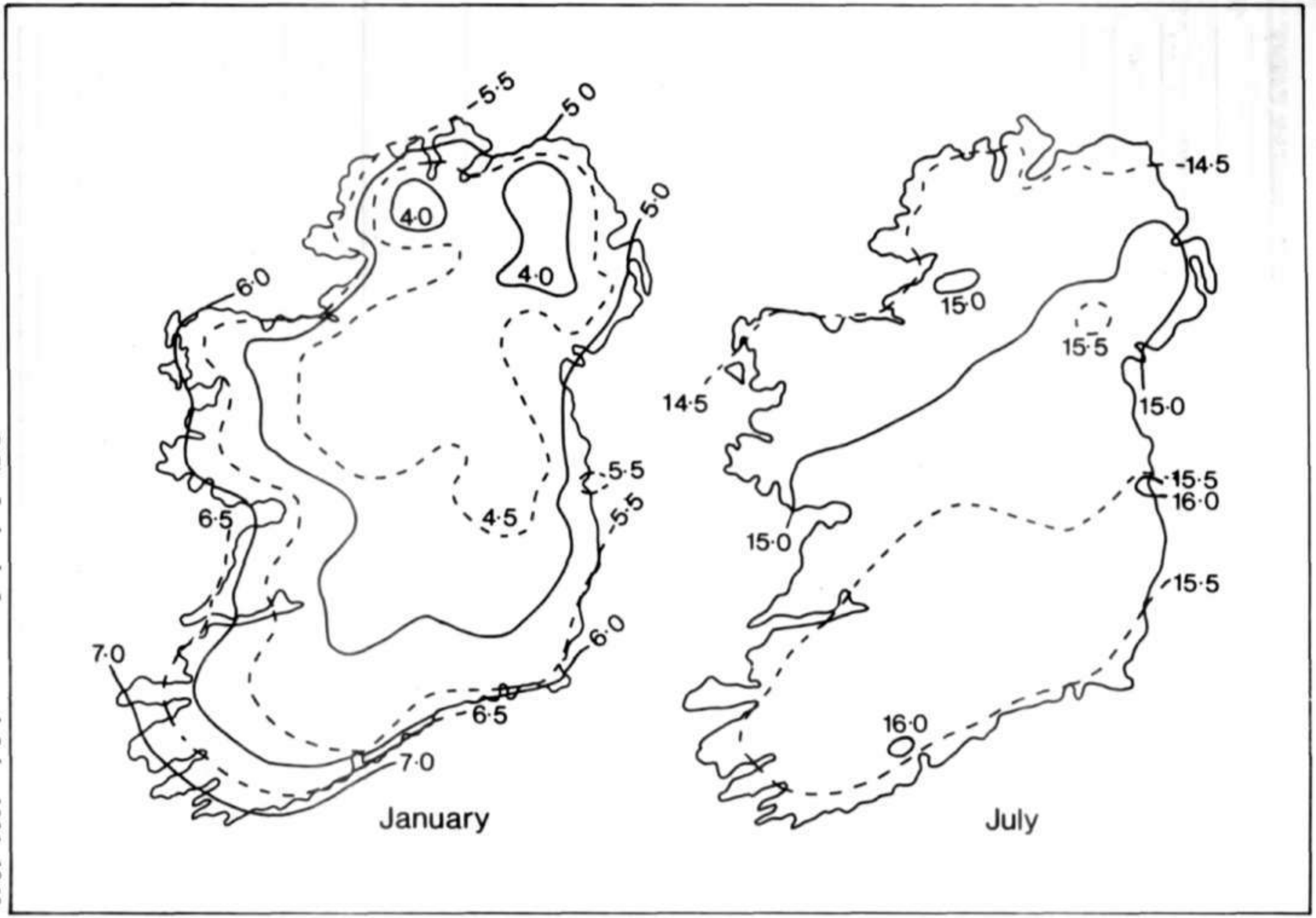

Fig. 1.6: Mean daily air temperature (°C), Ireland, January and July, 1931–1960. Reduced to mean sea level.

TABLE 1.4: Mean annual number of occasions* of various phenomena at Birr and Kilkenny 1958-77

Station	Fog	Snow or sleet	Hail	Thunderstorms
	Hours	Hours	Hours	Hours
Birr	202	64	12	10
Kilkenny	268	67	14	10

*In this context the occurrence, whether intermittently or continuously, at any time during the 60 minutes between two successive exact hours counts as one occasion.

The average number of days on which there is snow cover in Slieve Bloom, with or without any further snow the same day, is about 30.

Crop Growing Season

The duration of the growing season of crops is closely related to soil temperature, though the minimum temperature for growth varies with the crop. However, for grass which is the major crop in the country, the critical temperature for growth is taken to be 6°C.

The median length* of the grass-growing season in lowland parts of Laois is about 260 days per year based on Birr and Kilkenny values, whereas it is about 295 days at Rosslare, and as much as 330 days in many coastal areas of Cork and Kerry. Comparison of length of the Laois grass-growing season with those of the rest of the country is shown in Fig. 1.7. It is valid only for lowland sites, and a reduction of 15 to 20 days in the indicated values occurs for every 100 m increase in elevation.

Frost can cause considerable damage to young crops in spring and early summer, and to a lesser degree to crops in autumn. The median date for the last air frost in lowland Laois is 3 May, but there is still a 10% chance of it after about 29 May. The median date of the first autumn air frost is about 23 October, and there is a 10% chance of it being earlier than about 3 October. All these frost dates, which have been derived from Birr and Kilkenny values are liable to appreciable adjustment for any individual location, depending on its general susceptibility to frost as affected by local topography, slope of site and soil type, etc. The length of the frost-free season in the uplands is even more variable from place to place for the same reasons, while generally shorter than in the lowlands.

Generally, a reduction of about 3 weeks in the period free of air frost could be expected at 300 m elevation, but it would be very variable from year to year. The decrease in frost-free season with elevation is very much more pronounced at grass level (i.e. in regard to ground frost) than at the normal 1.2 m level used for measuring air temperatures.

* If the length of the grass-growing season at a place in each of, say, 15 years is D_1, D_2, D_3 … D_{15} in order of decreasing magnitude, then D_8 is the median length.

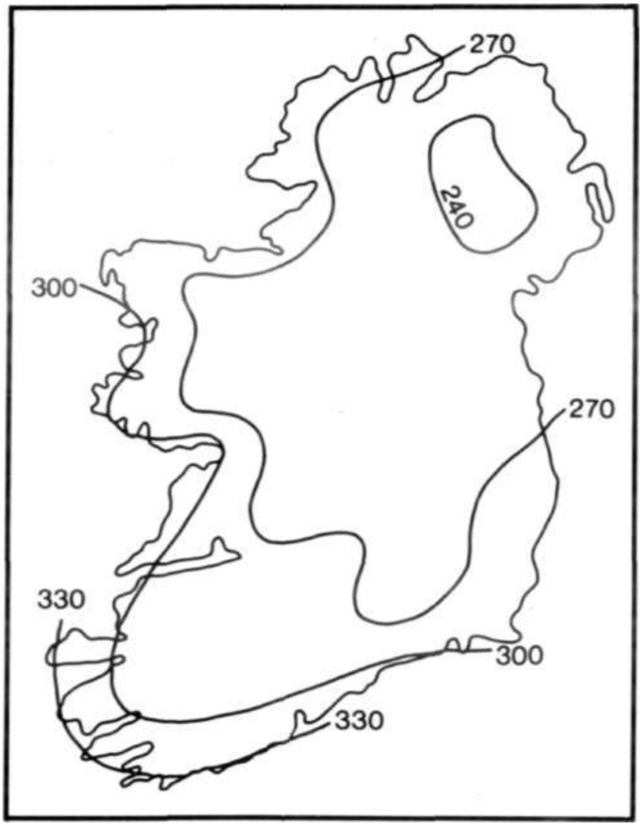

Fig. 1.7: Median length (days) of grass growing season (1954-68).

Another important factor is that during an invasion of the country by very cold air in spring or autumn, the normal reduction of air temperature with elevation may cause air frost to continue throughout the day in the mountains.

Summer soil moisture deficits

When rainfall is insufficient to balance water losses by evapotranspiration, the soil no longer holds maximum reserves of moisture; that is it falls below 'field capacity'. The extent to which soil moisture levels fall below field capacity is referred to as the soil moisture deficit. Throughout Ireland, during winter and early spring, rainfall exceeds evapotranspiration, and the soil moisture is normally at field capacity. From late spring to autumn, however, the rainfall is often insufficient to balance the water losses. When these losses result in soil moisture deficits of 50 mm or more, evapotranspiration from the grass or other crop (and ultimately yield) is reduced. Deficits of this magnitude or greater occur over an appreciable part of the June to September period in many years, especially in the counties of the midlands, east and south-east.

Although measurements of evapotranspiration are not routinely carried out in County Laois, cumulative soil moisture deficits at Oak Park, Co. Carlow(2 km from

TABLE 1.5: Cumulative soil moisture deficits (rnm) at the end of each of the months June to September inclusive, together with corresponding averages for these 4-month periods, at Oak Park Research Station, County Carlow for each of the 10 years 1971-80

Year	June	July	August	September	Average June-Sept
1971	40	47	19	25	33
1972	19	*19*	66	91	51
1973	S<	69	4^	0	50
1974	76	65	37	0	4-
1975	103	>9	92		71
1976	70	75	109	9	66
1977	5 2	83	24	31	4s
1978	54	S3	18	60	*4b*
1979	23	4K	27	28	32
1980	16	15	14	0	H

NOTES: Field capacity = 0. Low moisture deficits < 14 mm. Moderate deficits 15.29 mm. High deficits 30-49 mm. Near drought 50.74 mm. Drought conditions > 75 mm. (From Leech. 1983)

the east Laois border) at the end of each month. June to September, tor the 10-yea period 1971—80 are given in Table 1.5, indicating that deficits of 50 mm or more occui mainly in June and July, although the maximum of the decade occurred in August 1976. Field capacity is often regained before the end of September, but it is clear from the table that large deficits can also occur then in some years, reflecting a dr\ September on those occasions.

Some of the free-draining soils in Co. Laois (Elton, Knockbeg Series) are similar t< the Oak Park soils and would be expected to develop somewhat similar moisture deficits during the summer months. In parts of the south, centre and north-east of the county the predominant soils (Fontstown, Patrickswell and Stradbally) are well drained, shallower and lighter-textured with a lower moisture-holding capacity than the Oak Park soils and would, therefore, be expected to have slightly greater moisturt deficits and to be more liable to drought conditions. However, only a small part o: Laois has mean annual rainfall as low as that recorded at Oak Park. The light-texturec Baggotstown-Carlow limestone gravel soils would have still greater moisture deficit[1] and show some evidence of drought or near-drought conditions during most years

On the blanket peat soils of the Slieve Bloom mountains in the northwest of th< county, and to a lesser extent on the wet soils of the Castlecomer Plateau, high rainfal[1] and decreased sunshine further reduce the incidence of moisture deficits. In fact, ii very dry summers these areas will usually be free from the serious deficits that occur u the drier regions.

Upland climate

The effect of elevation in increasing mean annual rainfall is indicated clearl) in 1.4. Proportionately similar increases with elevation would occur in long-term mear monthlv rainfalls, and almost alwavs in the rainfall of individual months Referent has also been made to the effect of elevation in reducing the temperature and length of the growing season, the frost-free period and sunshine duration, in producing more days of snow cover, and in increasing the wind strengths. In Ireland the combined effect in these respects of an increase in elevation of even 200 to 300 m is, almost always, to produce an upland climate considerably less favourable to agriculture, especially to animal husbandry. This is particularly obvious both in the incidence and persistence of snow cover on the Castlecomer Plateau and the Slieve Bloom mountains. The main exception occurs in very warm, sunny and dry summers, when the reduction in sunshine duration is slight and, more importantly, moisture contents in most soils of the uplands are still adequate for crop growth.

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CHAPTER 2

THE GEOLOGY OF LAOIS

Solid Geology

Introduction

Laois may be divided into three geological regions, as follows:

1. Slieve Bloom Mountains—Silurian Shale and Old Red Sandstone
2. Central Lowlands—Lower Carboniferous
3. Castlecomer Plateau—Upper Carboniferous

Slieve Bloom Mountains

Silurian Shales: The oldest observable rocks in County Laois were laid down as sediments during the middle of the Silurian period. These Silurian shales, which are known locally as 'Shlig', form important rock formations in the Slieve Bloom area because they give rise to some of the most scenic valleys and because these shale-derived soils form some of the best soils in the Slieve Bloom area. The shales, also known geologically as greywacke, are exposed in deeply-incised valleys, mainly in the west central part of Slieve Bloom where the younger overlying Old Red Sandstone rocks have been worn away. These shales are generally grey to blue-grey in colour and on exposure break into small angular fragments. The shales consist of quartz, bits of siltstone and igneous rock and a variety of minerals, such as muscovite and calcite.

Old Red Sandstone: In the Slieve Bloom mountains the Silurian rocks are overlain by a group of rocks of the Old Red Sandstone series, which are of earliest Lower Carboniferous age. The Old Red Sandstone is known locally as grit or gritstone, often pronounced as 'greetstone'. It consists generally of a whitish or yellow coarse-grained sandstone composed of rounded quartz grains cemented by a quartz matrix, but it can also occur in various shades of brown or even purple and red. In places where the sandstones consist of coarse pebbles of quartz cemented by quartz, they are called Old Red Sandstone conglomerates and known locally as 'godstone'. Occasionally the Old Red Sandstone consists of a red siltstone, a uniformly fine-grained sediment which is always of a dark-red colour. Clonaslee stone, well known as a decorative building stone, belongs to the Old Red Sandstone series.

Central Lowlands

Lower Carboniferous Deposits: The total thickness of the Carboniferous deposits in

Laois is around 1,200 m. It has been divided into eight distinct formations in the west of the county (Table 2.1). The lowest deposits are the Lower Limestone Shales which occur in an outer circular ring at the base of the Slieve Bloom foothills (Fig. 2.1), and which consist in the main of black shales with thin beds of muddy and bioclastic limestones about 46 m thick. This is followed by the Castletown Limestone Formation, a succession of interbedded shales and bioclastic limestones which attain a thickness of about 260 m. This in turn is followed by the Knockahaw Oolite formation, about 92 m of medium-grey oolites with bands of bioclastic limestone. Overlying the Knockahaw oolites is the Strogue Limestone Formation, which is upwards of 130 m thick and consists of dark grey to black argillaceous limestones with thin bands of shale. The Strogue limestones are succeeded by an extensive development of reef limestones, 166-386 m thick in the western part of the county—this is dolomitised in the upper part i.e. part of the calcium carbonate in the rock has been converted to

TABLE 2.1: The stratigraphy of the Lower Carboniferous Limestone in Laois (After Feehan, 1983)

Series	Stage	Formation name	Main rock type	Approximate thickness (m)
	Brigantian Asbian Holkerian Arundian	Cullahill Crinoidal Limestone	Cherty bioclastic limestone	250
	Chadian	Aghmacait Peloidal Limestone	Fine grained bioclastic limestone	140
		Crosspatrick Cherty Limestone	Cherty bioclastic limestone	70
		Waulsortian Reef Limestone	Reef limestone and dolomitized reef limestone	166-386
	Couxceyan	Strogue Limestone	Argillaceous limestone and shales	131
		Knockahaw Oolitic Limestone	Oolitic limestone	92
		Castletown Limestone	Bioclastic limestone and shales	261
		Lower Limestone Shales	Shales	46

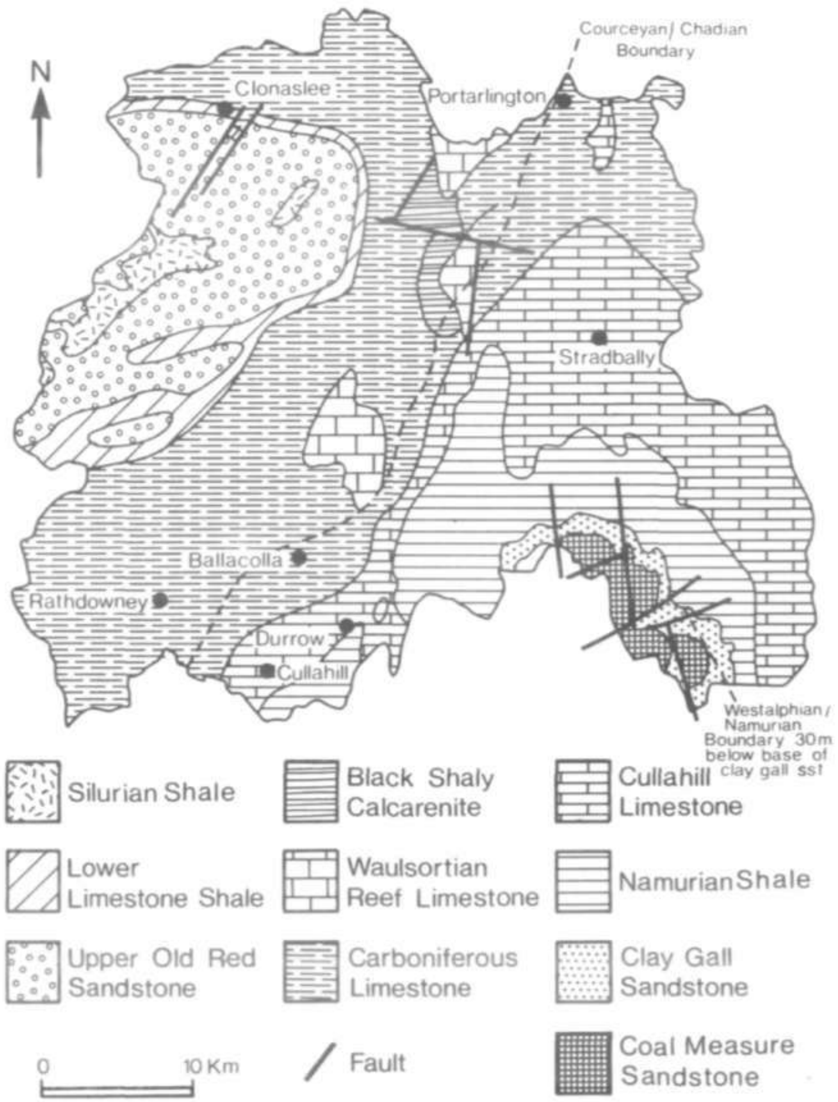

Fig. 2.1: Solid geology of County Laois. (After Feehan, 1983).

calcium magnesium carbonate, and weathers at the surface to a fine sand. The Crosspatrick Cherty Limestone Formation overlies the reef limestones, and comprises pale grey cherty bioclastic limestones of very variable thickness, which fill hollows in the surface of the reef. The Crosspatrick Formation is succeeded by the Aghmacart Peloidal Limestone Formation, a distinctive unit 140 m or so thick composed of fine-grained grey bioclastic limestones. The uppermost formation of Carboniferous

Limestone is the Cullahill Crinoidal Limestone Formation. This is very uniform, consisting of coarse-grained grey crinoidal limestone, with layers and nodules of chert, particularly in the upper part. It attains a thickness of about 250 m and yields the finest building limestones in the county. Although limestones dominate this succession, a variety of other rock types occur, representing a range of different environments. These include shales or mudrocks, and nodules or layers of hard and more resistant chert are frequent, particularly at certain levels near the top of the succession.

Some of the limestones here occur in massive blocks, which are often splendidly fossiliferous, and sometimes dolomitic. The locally-prominant ridge of hills that stretches from the southern tip of the county north-eastwards towards and on past Rathdowney is made of dolomite. Dolomite is somewhat more resistant to weathering than the limestones and other associated rocks.

The dolomite is followed in the succession by a sequence of rocks in which dark grey or black earthy limestone with partings of shale and chert nodules and layers predominate. This part of the sequence (formerly known as the calp limestone) is seen in a number of quarries in the general area of Ballacolla, and again near Cullahill. Two and a half km north-east of Durrow, and again around Stradbally, there are many quarries in the upper limestones, and the rock is seen in the splendid natural outcrops of Dunamase (Plate 4.2, Chapter 4) and the hills to the east and south.

Castlecomer Plateau

Upper Carboniferous Rocks: The deposition of the Upper Carboniferous layers of the Castlecomer Plateau was initiated by a sudden and steadily increasing uplift of the continents surrounding the clear-water sea in which the Lower Carboniferous Limestone was laid down. This uplift resulted in later accumulation of clay and sand deposits in the sea. These deposits of clay and sand form the Namurian rocks which are about 400 m thick in Co. Laois and include some 60 m of sandstone flags that were formerly exported for paving.

Similar sedimentation continued into the succeeding coal measures or Wesphalian, except that the sea was occasionally completely silted up so that luxuriant forests spread over them and were later buried to be compressed into coal seams. A violent compression of the earth's crust thrust up the Carboniferous rocks about 230 million years ago so that they have been repeatedly exposed to erosion since then. Only small remnants of the vast coal measures have survived in Ireland, the largest being the Castlecomer Plateau.

Some 300 m of coal measures with five seams of coal have survived in Co. Laois. The thickest and best seam has long been completely worked out and the remaining thin seams continue to be worked on a small scale. Two thick beds of fireclay separated by 7 m of shale also occur and these are exploited locally.

The Plateau is an upland basin with a horseshoe-shaped high rim capped by tough sandstones, while the soft underlying shales have been rapidly eroded to present a steep outer escarpment. Inside the rim the ground slopes gently down to the centre. A very tough coarse sandstone, 40—60 m thick, known as Clay Gall Sandstone, is a prominent feature and forms the highest part of the outer rim at Rossmore, 334 m above sea level.

Glacial Geology*

During the Quaternary Ice Age thick ice sheets spread across Ireland from vast snowfields that had accumulated in the north and west of the country on at least two occasions. The last of these, The Midlandian (Weichsel) Glaciation, has provided the soft superficial cover over the hard rocks in Co. Laois. The ice sheets rasped off boulders from the rocks that lay in their path and most of the boulders were ground to a rock flour by the moving ice. When the ice finally disappeared it left a mixture of rock flour and boulders known as till or boulder clay. This blanket of till varies in composition from place to place according to the nature and type of the original rock.

As the ice was melting a discontinuous blanket of sand and gravel outwash or glacial lake clays and silts was laid down subglacially or in ice-marginal lakes throughout the lowlands. The positions of the main subglacial rivers survived as sand and gravel eskers representing the casts of former ice tunnels (Plate 2.1).

Plate 2.1: The Timahoe Esker has been largely removed for sand and gravels.

Throughout Ireland two main glacial stages have been recognised—an earlier and more extensive Munsterian (Saale) Glaciation (Mitchell, 1976) and a lesser last or Midlandian (Weichsel) Glaciation. No recognisable deposits of Munsterian Age are known in Co. Laois. Initially the Midlandian ice flowed south across Laois, as indicated by the striae on the Castlecomer Plateau. Later, however, the ice stream was

*For detailed description of the glacial geology see *The Landscape ofSlieve Bloom* by John Feehan (1979) and *Laois-An Environmental History* by John Feehan (1983).

moving south-east, bringing midland limestone and even Galway granite right up and over Slieve Bloom. This same ice brought mostly limestone and some sandstones from Slieve Bloom over the highest parts of the Castlecomer Plateau. This mainly limestone till was progressively diluted by the local shales and sandstone as it crossed the Plateau. When the ice level eventually fell the outer rim emerged, cutting off the ice in the central basin, which then melted away, depositing till up to 40 m deep on the low ground. Where the original till survived it was dug as a source of lime, as at Gortahile ('field of lime').

Meantime the ice pressed against the northern slopes of the Plateau, sending narrow tongues down the valleys on both sides of it. The melt waters piled up high mounds of gravel as the margin of the ice fell back. When the ice lost its impetus, it shed its load of till and the tunnels under the ice, that carried the melt waters, were choked with gravel to give the winding esker ridges (Plate 2.1).

During the first phase of the Midlandian Glaciation all of the Slieve Bloom mountains were covered with ice. As the ice retreated it was no longer able to flow over the higher ground and was forced to flow around Slieve Bloom. Deposits of Midlandian age occur all over Slieve Bloom, but particularly on the north and north-west, where the ice abutted against the mountains. As the ice stood banked against the high ground of Ballybritt and Roscomroe, melt waters made their way through channels such as the Nealstown valley, depositing large tracts of outwash gravels, composed mainly of sandstone, shale and limestone, in the lower ground south of Glendine and Glenkitt.

The drift deposits on Slieve Bloom vary in composition and depth. Very often the drift in one locality consists of two or more different kinds representing several minor local ice advances. However, the drift is generally of local origin, dominated either by Old Red Sandstone or Silurian shale. Limestone material and even Galway granite erratics were carried onto the hills from the lowlands north of them. Much of the limestone has now been leached except in the deeper, more protected, valleys but the abundance of chert remaining testifies to a once high limestone content in the till deposits even on the southern side of Slieve Bloom.

The Postglacial Sequence

Once deglaciation was complete, further modification of the landscape virtually ceased (Feehan, 1983). At first, before the general spread of post-glacial vegetation, shelly marls were deposited on the floors of the lakes that were strewn throughout the lowlands after the ice sheet had melted away. Vegetation in the form of grasses and scrub spread throughout the lowlands. With the rapid rise of temperature that occurred about 10,000 years ago, marking the onset of the Littletonian Warm Stage (Mitchell, 1976), woodlands started to migrate into the lowlands, the first arrival being juniper *{Juniperus),* closely followed by willow *(Salix),* and then by birch *(Betula).* At the same time, fen peat formation commenced in swamps and hollows. By about 9,000 years BP (before present) the birch forest was displaced by hazel *(Corylus)* and pine *(Pinus).* But by 8,000 years BP oak *(Quercus),* elm *(Ulmus)* and alder *(Alnus)* had arrived.

Another significant change occurred about 7,000 years BP when a more temperate climate became established. Birch, hazel and alder spread at the expense of pine, and to some extent, of oak. *Sphagnum-peat*, with variable amounts of *Calluna* (heather) and *Eriophorum* (bog cotton) started about this time to extend across the fen peats that had formed around the edges of the lakes. This event marked the start of extensive raised bog growth coincident with the Climatic Optimum when summer temperatures reached their highest level since the last glaciation.

By about 4,000 years BP, as summer temperatures fell, a second change of conditions resulted in an accelerated growth *of Sphagnum-peat* (Mitchell, 1976). This rapid extension of peat growth continued until 1,600 years BP and even later. Due to the same climatic deterioration, blanket peat formation commenced in the upland areas of Co. Laois also around 4.000 BP.

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CHAPTER 3

SOIL SURVEY METHOD

Soil survey and classification require detailed descriptions of the various layers of soil which are exposed in any vertical section. The criteria used for differentiating between such layers and the reasons for their occurrence, together with the soil survey method, are summarised here.

The Soil Profile

The soil profile refers to a vertical section of the soil down to and including the geological parent material. The nature of the profile is important for many aspects of plant growth including root development, moisture storage and nutrient supply. The profile is, therefore, the basic unit of study in assessing the true character of a soil. It usually displays a succession of layers that may differ in properties* such as colour, texture, structure, consistence, porosity, chemical constitution, organic matter content and biological composition. These layers, known as soil horizons, occur approximately parallel to the land surface.

Soil Horizons: Most soil profiles include three main horizons that are usually identified by the letters A, B, C (Fig. 3.1). The combined A and B horizons constitute the so-called solum or true soil, while C refers to the parent material beneath. Certain soils lack a B horizon and are said to have AC profiles. In some soils also, organic layers (O horizons) overlie the mineral horizons.

Some soils may have a relatively uniform profile with A and C horizons while others are so complex that they possess not only A, B and C horizons but also several sub-horizons. Where horizons need to be sub-divided on the basis of significant differences, the sub-horizons are identified by the horizon designation plus a suffix number thus: A1, A2, A3, B1, B2, etc. The various horizons in a soil and their character reflect the processes of soil formation that have been operative and they present a picture of the true nature and salient characteristics of a soil which are important in its use and management.

The A Horizon: This horizon is the uppermost layer in mineral soils and corresponds closely with the so-called 'surface soil'. It is that part of the soil in which living matter,

*See Appendix I.

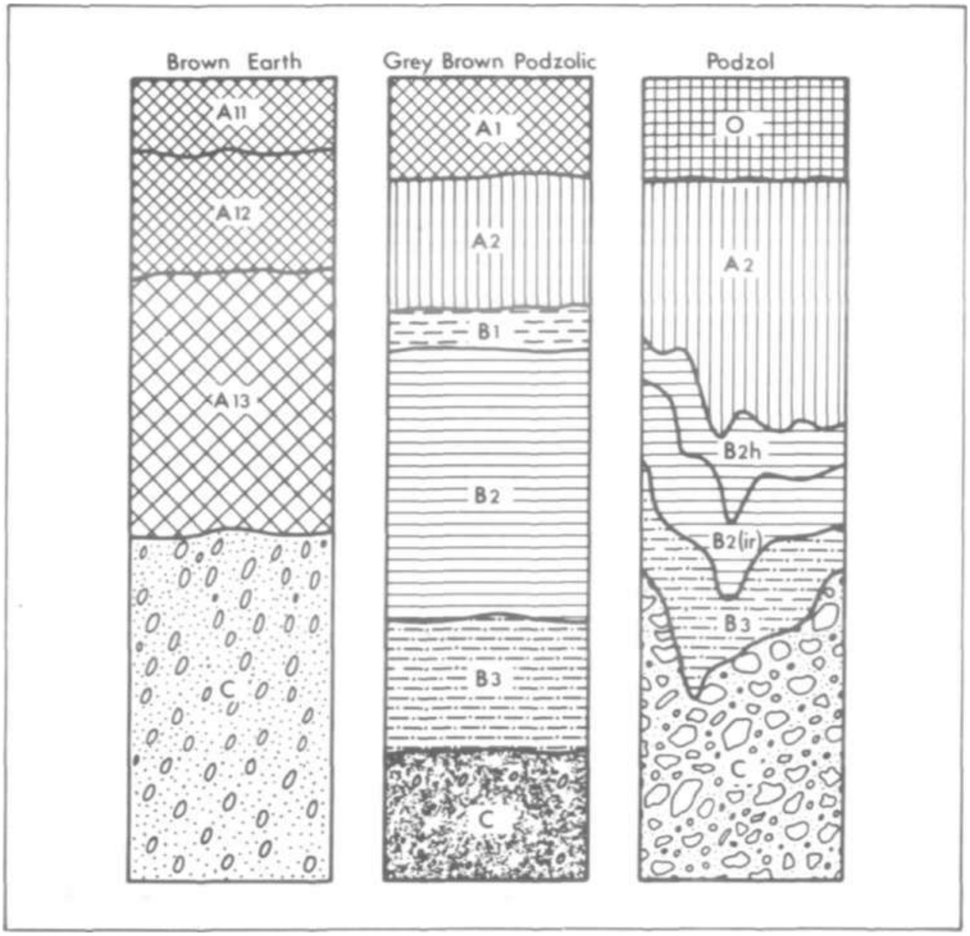


Fig. 3.1: Diagrammatic representation of hypothetical soil profiles showing horizon sequences.

e.g. plant roots, bacteria, fungi, earthworms, and small animals, is most abundant, and in which organic matter is usually most plentiful. Being closest to the surface, this horizon is the first to be reached by rainfall and is, therefore more leached than underlying horizons. The A horizons in most Irish soils have been depleted of soluble chemical substances and in certain cases, also, of some of their very fine clay particles. Where the soils have been strongly leached they may be depleted of iron and aluminium oxides and of other constituents. Two sub-divisions of the A horizon are commonly made, namely, Al and A2. Either the Al or the A2, or both, may be represented in a profile. The Al is a surface mineral horizon that usually incorporates a higher proportion of organic matter than do any of the underlying horizons. In cultivated soils this horizon corresponds to the plough layer and may be designated Ap. The A2 is a comparatively light-coloured horizon and frequently has a bleached appearance. The A2 always refers to the horizon which has undergone the greatest degree of leaching. This is reflected in the lighter colour, mostly the result of a partial removal of colouring constituents, principally iron. The A3 signifies a transition zone between the A and B horizon.

The B Horizon: This horizon lies immediately beneath the A and corresponds closely to the so-called 'sub-soil'. Lying between the A and C horizons, it possesses some of the properties of both. Living organisms are fewer than in the A but more abundant than in the C horizons. Compared with the A horizon, the B horizon is one of accumulation and usually has a relatively high content of iron and aluminium oxides, humus or clay that, in part at least, have been leached from the overlying horizons. Usually a more pronounced blocky or prismatic structure is found where this horizon is clay-enriched. Stronger colours are apparent in the B horizon, especially when the accumulation products are iron oxides or humus, or both.

Depending on the degree and pattern of accumulation of constituents within the B horizon, several divisions of the horizon e.g. Bl, B2, B3, may be warranted, B2 representing the zone of most intense accumulation. Besides, symbols such as B2t, B2ir and B2h are used to denote significant accumulations of clay, iron and humus, respectively. Bl and B3 denote transitional horizons from A to B and from B to C horizons, respectively. If the B horizon is without any appreciable accumulation of leached products but has distinctive colour or structure characteristics it is usually referred to as (B) horizon.

The C Horizon: This horizon refers to the geological material beneath the A and B horizons (solum). It consists of the upper part of the loose and partly decayed rock or other geological material, such as glacial drift, similar to that from which the soil has developed. It may have accumulated locally by the breakdown of the native rock or it may have been transported by ice, water or wind. The C horizon is less weathered, has less organic matter and is usually lighter in colour than overlying horizons.

The O Horizon: This horizon refers to a surface layer of raw or partly-decomposed organic matter more usually associated with very poorly drained or very degraded (podzolised) mineral soils. Where little or no decomposition has taken place the symbol Ol is used; 02 denotes more advanced decomposition. The organic matter content of O horizons is commonly several times greater than that of the underlying mineral horizons or of surface A horizons.

During the survey of any area, profiles typical of each soil are selected for special study. Fresh pits are opened for this purpose. The depth of pit varies according to soil depth but in Co. Laois is usually about one metre. Each profile is thoroughly examined and described and a record made of its salient characteristics.

A soil profile is described by first noting certain features of the soil's environment, followed by details of its general characteristics. The characteristics which apply to the site include relief, slope, aspect, elevation and vegetation. Drainage conditions and the pattern of horizon development within the profile are considered next and, finally, properties of the individual soil horizons such as texture, structure, consistence, colour, mottling, amounts of organic matter, stoniness, presence of hard-pans and root development are described (see Appendix I).

A bulk sample from each soil horizon is analysed physically and chemically at the Soils Laboratory, Johnstown Castle. The analytical data supplement many of the field observations and provide a more complete picture of the true soil character. The results of these analyses for representative profiles of each soil series are given in Appendix II.

The character of every soil can be attributed to the interaction of five major factors of soil formation: parent material, climate, living organisms, topography and time. These factors control the rate of weathering of rocks, the constitution and composition of the resultant soils and subsequent gains, losses and alterations within the profile. The relative influence of these factors is responsible for many of the differences in our soils. A sixth factor influencing many non-virgin soils is man's interference with the natural development processes and his modification of the soils for his own particular purposes.

None of the five factors of soil formation is universally uniform. There are many kinds of rocks, many types of climate, many combinations of living organisms, and great variation in topography and age of different land surfaces. As a result, there are innumerable combinations of the factors of soil formation giving rise to many different soils.

Although it is true that great variability exists, the distribution of soils is not so haphazard as might be expected. Each soil reflects the environment in which is has formed, occupies a definite geographic area and occurs in certain patterns with other soils. By recognising the main factors of soil formation and by distinguishing the reflected characteristics in the soils themselves, we can segregate geographic soil units. Thus similarities and differences among soils can be recognised and the various soils can be classified and their distribution mapped.

Soil Series: The primary category used in mapping is the Soil Series, which comprises soils with similar type and arrangement of horizons, and developed from similar parent material. The Soil Series is also a basic category in soil classification.

A major problem in mapping soils is the delineation of boundaries between different Series. Typical profiles of two different Soil Series may differ widely but, where the Series are contiguous, it is usual for them to merge, sometimes over a considerable distance. Consequently, a line on the map very often defines the merging zone between soils rather than a sharp change in the soil character.

A Series is named usually after the location in which the particular soils are best expressed or occur most widely.

Other Soil Units: Soils within a Series may be further sub-divided into soil types on the basis of surface textural differences. Different soil phases may also be mapped covering variations in features such as slope, drainage, or rockiness that are important in soil behaviour and land-use. Several such phases have been segregated in Co. Laois.

Method of Survey and Scale of Mapping

Following an initial familiarisation reconnaissance soil survey and a study of the geological history of Co. Laois, detailed soil surveys were carried out on the 6 inches to 1 mile (1:10,560) field sheets in representative areas of the county, to determine the soil types present and their exact distribution pattern. Fifty such areas, varying in size from 1 to 6 km^2, were surveyed. Some of these areas were chosen because they were of special interest.

As a result of these surveys, representative soil profile pits were examined, described and sampled throughout the county. With the knowledge compiled from these surveys, supplemented by laboratory analysis of the profiles examined, a soil legend for the county was drawn up. Mapping was then completed on a detailed reconnaissance scale using the 6-inch field sheets, which were reduced to a scale of 0.5 inch to 1 mile (1:126,720) for publication.

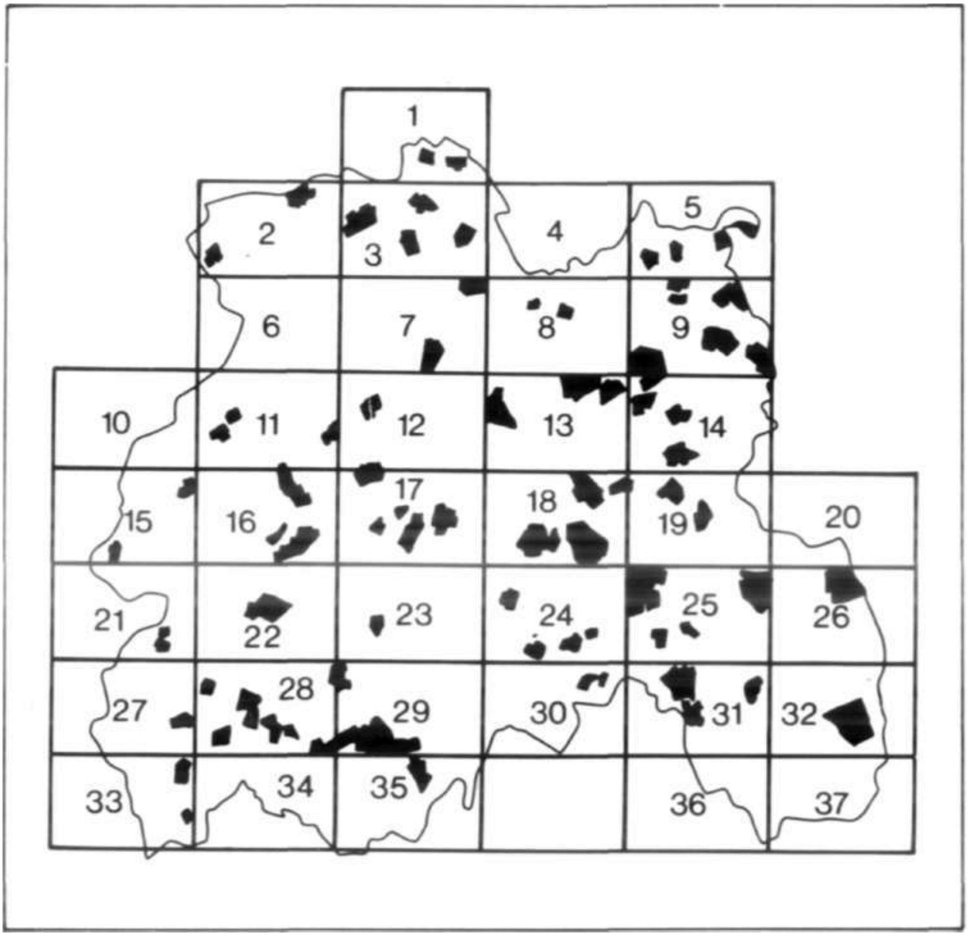


Fig. 3.2: Distribution of 77 areas in Co. Laois where detailed soil surveys were carried out. Each grid square (numbered 1-37) represents an Ordnance Survey 6" sheet.

Due to the scale of mapping, the published map does not accurately reflect the soil distribution pattern on a field-to-field basis except in those 77 areas where detailed surveys were carried out (Fig. 3.2). Furthermore, due to the reduction involved it has been found necessary to consolidate and, in some cases, delete some of the least-extensive soil separations shown in the larger scale. On a scale of 1:126,720 it is possible to show a minimum area of 10 hectares. This means that any uniformly-coloured area on the published map may include enclaves of less than 10 hectares. Where Soil Series are recognised but where their distribution pattern with contiguous Series is so intricate as to defy clear-cut delineation on the map, a soil complex is mapped. The component Series within the complex are named, and where possible, their relative proportions are given.

CHAPTER 4

THE SOILS AND THEIR USE-RANGE

Twenty four Soil Series have been mapped in Co. Laois. The different Series have been given geographic names based on the location in which particular soils are best exemplified or are most widely found. Frequently the Series name occurred in a previously-surveyed county e.g. Elton Series occurs in Elton in south-east Limerick and is named after the area where it was typically developed. Eight soil Complexes, and eighteen Phases, have also been recognised and described in Co. Laois, the Phases are included within the Series to which they are related.

As Laois falls into three well-defined geographic regions the soils are described on a regional basis as follows:

1. Central Lowland Soils
2. Castlecomer Plateau Soils
3. Slieve Bloom Soils

Within each region the soils are classified on a broad scale into Great Soil Groups, each of which consists of a collection of closely-related Soil Series. Each Great Soil Group consists of soils sharing one or more distinguishing features in common. A certain latitude in profile variation is permissable at this level of classification, but there is an overall similarity of quite a high order. The Great Soil Group is not confined to one particular geological parent material since soils are classified on the basis of profile characteristics.

CENTRAL LOWLAND SOILS

The Central Lowlands consist of a broad undulating lowland landscape between Slieve Bloom to the north-west and the Castlecomer Plateau to the south-east. The basic underlying rock formation is almost exclusively limestone. It is overlain by a mantle of glacial drift material which is composed mostly of limestone with variable proportions of shale and sandstone. On the higher parts of the landscape the dominant soils are Grey Brown Podzolics and Brown Earths, with gleys, regosols and peats in the wetter more low-lying areas.

Grey Brown Podzolic Soils

Fontstown Series

Soil Character: These soils have already been mapped extensively in the southern half of Co. Kildare. They cover an area of 12,991 hectares (7.56% of the county). They have been mapped throughout the whole of the central lowland portion of the county but they occur predominantly in the eastern part of Co. Laois adjoining the Kildare border. Although the elevation varies from less than 60 metres to 150 metres, the flattish to undulating nature of the topography is a distinctive feature of the area. Parent material consists of calcareous, non-tenaceous, compact stony till composed almost entirely of limestone. This material is known locally as 'corn gravel'. Small pockets of loose gravelly material are commonly observed in profile sections.

These moderately deep to shallow, well-drained soils, of sandy loam (to loam) texture have been classified as Grey Brown Podzolics. The profile normally shows a wide variation in depth; in extreme cases the profile varies from 20 to 115 cm but is generally 40—75 cm deep (Fig. 4.1). The profile normally consists of a brown to dark-brown Ap horizon with a moderately strong structure and friable consistence. This A horizon is generally 25 cm deep but varies from 18—30 cm; it usually contains 15—18% clay and 25—40% (average 35%) silt. The organic carbon content of the surface horizon depends to a large extent on the intensity of tillage; it ranges from 3—3.6% under grassland to 1.6—2.3% under tillage. In extreme cases where the soils have been very intensively tilled the organic carbon content can be a low as 1.2%.

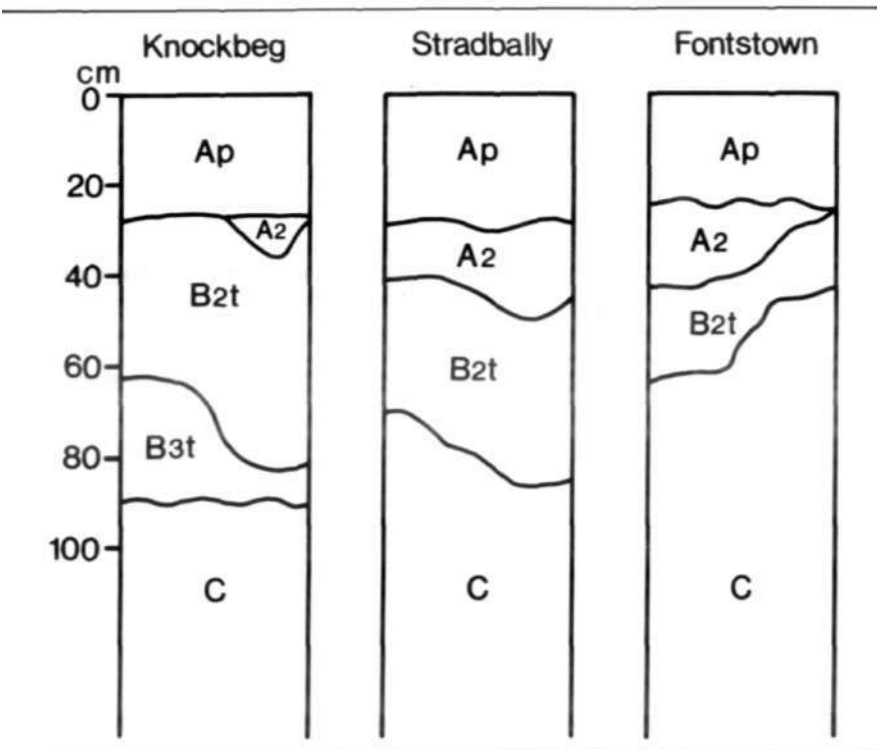


Fig. 4.1: Diagrammatic representation of the profile of three prominent Grey Brown Podzolic soils in the Central Lowlands of Co. Laois.

Beneath the Ap horizon a leached, sometimes indurated pale-brown A2 horizon overlies a brown to dark yellowish-brown B horizon which shows a strong textural increase with a clay content of 28—37%. This Bt horizon is normally rather thin and undulating; tonguing increases the thickness in places to as much as 40—60 cm. There is an abrupt transition from the textural B horizon to stony parent material. In the shallow parts of the profile the A2 and B horizons are absent and the Ap horizon rests directly on the parent material (Conry et al., 1970).

These soils generally have a very high base status with free carbonates occurring throughout the profile. These show their lowest concentration in the A2 and B horizons (Brickley, 1942). The free carbonates in the A horizon are probably due to the large-scale use of the underlying 'corn gravel' and burned lime as liming agents, particularly in the 19th century. However, some lime-deficient patches occur throughout this Series.

Soil Suitability: These soils have a wide use range. Together with the soils of the Stradbally, Patrickswell, Elton and Knockbeg Series they are the dominant tillage soils in the county. With their light to medium texture, good structure and friability they are easily tilled. Where properly fertilised, especially with potash, excellent yields of barley (including malting barley), wheat, sugar beet, swedes and other root crops can be obtained (Plate 4.1). Boron deficiency in swedes is a common problem. Peas, French beans, carrots and cabbage have been grown extensively for food processing.

Plate 4.1: Cereal growing on the Fontstown Series near Ballykilcavan with afforestation on the Dysart Hills Complex.

Raspberries and strawberries give good returns. Blackcurrants give good returns also, despite the fact that frost is a serious hazard and the soils are only considered moderately suitable for this fruit because they show a moisture deficit in dry periods.

Traditionally these soils were not supposed to require lime but in more recent years where lime-sensitive crops, such as swedes, sugar beet or peas are grown, irregular patches showing severe lime deficiency symptoms have been observed. As a direct result, toxic levels of manganese generally reduce yields considerably and often result in complete crop failures.

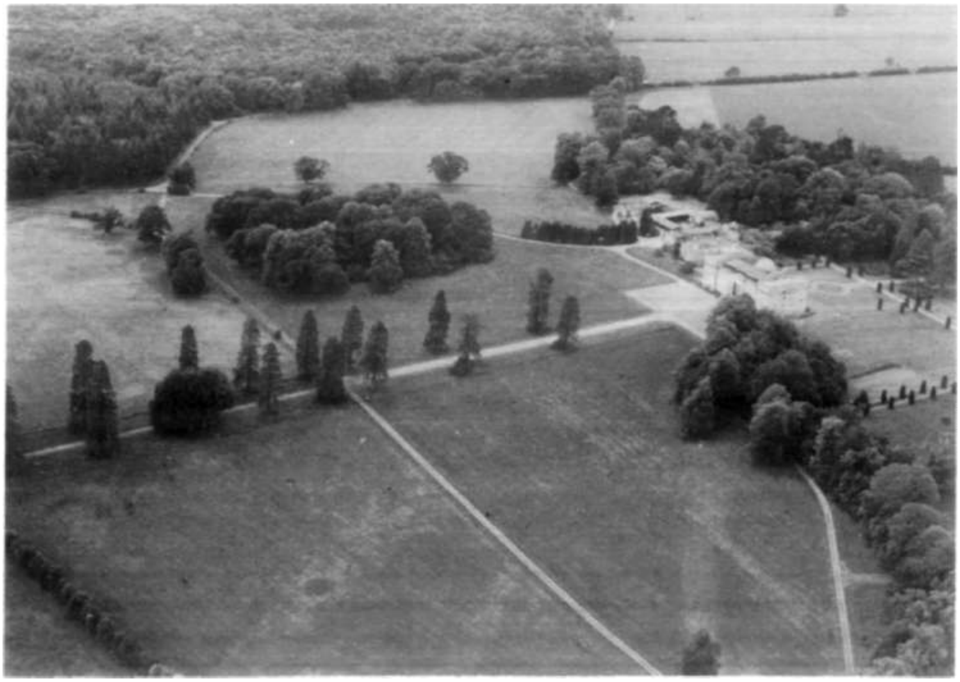


Plate 4.2: Emo Court (on Fontstown Series) near Portarlington showing redwood (Sequoiadendron) driveway.

These soils are highly suitable for grass production. With proper fertilising, and particular attention to potash and nitrogen, a very high output can be attained especially on new leys. Due to the relatively light texture of the soil, free drainage and shallow depth, a moisture deficit can severely limit production in dry seasons. Good visual responses to sulphur applications have been observed on these soils.

Profile descriptions and analyses are given in Appendix II.

Cullahill Series

Soil Character: The soils of this Series cover an area of 2,817 hectares (1.64% of the county) and occur mainly on the south-western border of the county near Cullahill village. The soils are very similar in profile characteristics to the Fontstown Series both in terms of arrangement and properties of the various horizons. A comparison of the modal profiles and analyses of the two series shows the great similarity between the soils. The Cullahill Series differs from the Fontstown Series in that it is derived from a more stony type of glacial till with a higher carbonate content. Consequently the soils tend to be stonier and shallower. Like the Fontstown Series, they are moderately deep to shallow but on the whole there is not the same variation in depth that is found in the Fontstown Series.

Although the topography on the whole tends to be undulating it is more hummocky than the landscape associated with the Fontstown Series.

Soil Suitability: The soils are very similar in land-use characteristics to the Fontstown Series. However, because of their slightly shallower profile and higher content of stones they are marginally more prone to drought than the Fontstown Series.

Profile descriptions and analyses are given in Appendix II.

Stradbally Series

The soils occur widely in the east central lowlands area around Stradbally. This is one of the important soils in Co. Laois not only because it covers 9,345 hectares (5.4% of the area) but also because it is one of the best soils in the county. The soils are derived from calcareous non-tenaceous glacial till of Midlandian Age. The till is composed predominantly of limestone with an admixture of sandstone and has a total neutralising value (TNV) of 27—38%. The topography is undulating, at an elevation of 60—200 metres. Most of the soils, however, occur between 60 and 120 metres.

These moderately deep, well-drained soils have a sandy loam surface texture and have been classified as Grey Brown Podzolic soils. The profile shows a fairly wide variation in depth; in extreme cases it varies from 50 to 110 cm but is generally 70—90 cm deep. (Fig. 4.1). The profile consists of a surface A horizon overlying a bleached A2 horizon and a textural B horizon above the largely unweathered mantle of till. The surface A horizon normally consists of a brown to dark-brown sandy loam Ap horizon with a moderately strong structure and friable consistence. It is generally 20 cm deep but varies from 20—40 cm; it usually contains 14—18% clay and 27—34% silt. The organic carbon content depends to a large extent on the intensity of tillage; it ranges from 1.5—2.0% under tillage to 2.7—4.0% under grassland. Beneath the Ap horizon a bleached, sometimes indurated pale-brown A2 overlies the darker-coloured textural B horizon. The clay content of the A2 can be as high or lower than the clay content of the surface A horizon but the clay content of the subsoil B horizon is always substantially higher than the horizon above. There is an abrupt transition from the textural B horizon to the strongly calcareous parent material.

These soils generally have a very high base status with free carbonates occurring throughout the profile. The free carbonates and high pH values in the surface horizons are probably due to the prolonged addition of liming agents including marl, burnt lime and ground limestone. pH values as low as 4.9 have been recorded on the soils on the Great Heath of Maryborough where modern agriculture has not been practiced for centuries.

The Stradbally Series is separated from the closely-related Fontstown Series because; (a) it is on average deeper with less extreme profile depth variations; (b) the A2 horizon, although well expressed, does not show the same intensity of clay minimum; (c) the B horizon is thicker and has a more friable consistence; and (d) the parent material has a substantially lower total neutralising value (TN V). The Elton and Knockbeg Series which are also derived from calcareous (predominantly limestone) till do not show the same distinct horizonation and are heavier throughout a profile which is also generally deeper than the Stradbally soils. They are separated from the Patrickswell Series in the west of the county because the latter is generally somewhat shallower, has a slightly higher silt content and lower coarse fraction.

In summary, the Stradbally soils can be described as moderately deep, well-drained, sandy loam, Grey Brown Podzolic soils derived from predominantly limestone till with a TNV within the range 27—38%.

Soil Suitability: These soils have a wide use range. With their light medium texture, good structure and friability they are easily tilled and are considered some of the best tillage soils not only in the county but also in the country. When properly fertilised, excellent yields of cereals, sugar beet, potatoes, swedes and other root and vegetable crops can be obtained. They are also highly suitable for grass production; with proper fertilising, high output can be obtained especially on new leys. Similar responses to sulphur applications have been observed. In intensive livestock systems there are some indications that sub-clinical symptoms of copper deficiency exist.

In short, these soils have the same wide use range as the Fontstown Series but their overall deeper soil profile gives them a greater resistance to drought and consequently higher yields in dry seasons.

Profile description and analyses are given in Appendix II.

Stradbally Rocky Phase

Soil Character: These soils occupy 1,725 hectares (1.00% of the county) and occur closely associated with the Stradbally Series and the Dysart Hills Complex, predominantly in the hilly areas around Stradbally. They are derived from shallow drift cover overlying limestone bedrock on rolling to hilly topography with slopes up to 17° at elevations of 100—200 metres. Outcropping rock occurs in some places. The soils are similar to the Stradbally Series but are generally shallower with an average depth of 50—60 cm.

In summary, these soils are shallower, more rocky and occur at slightly higher elevations than the Stradbally Series.

Soil Suitability: The use range of these soils is somewhat similar to the Stradbally Series. However, due to the steeper slopes and proximity of underlying rock in places, mechanised tillage operations are slower and more difficult. The soils are also more liable to drought due to their lower moisture-holding capacity. This, together with their slightly higher elevation, is responsible on average for lower yields not only of tillage crops but also in grass production.

Patrickswell Series

These soils occur widely in the west Central Lowlands area centred around Rathdowney. This Series, together with the Stradbally Series, forms some of the most important tillage soils in Co. Laois, not only because it covers 16,318 hectares (9.50% of the area) but also because it is one of the best soils in the county. These soils are derived from calcareous non-tenaceous glacial till of Midlandian Age. The till is composed predominantly of limestone with an admixture of sandstone and has a total neutralising value (TNV) of 27—38%. *The* topography is undulating with an elevation range of 60—200 metres. Most of the soils, however, occur between 60 to 120 metres.

Like the Stradbally soils these moderately deep, well-drained soils have a loam (to sandy loam) surface texture and have been classified as Grey Brown Podzolic soils. The profile shows a fairly wide variation in depth; in extreme cases it varies from 60—120 cm but it is generally 70—80 cm deep. The profile consists of a surface A horizon overlying a bleached A2 horizon and a textural B horizon over the largely unweathered mantle of till. The surface A horizon normally consists of a brown to dark-brown loam Ap horizon with a moderately strong structure and friable consistence. It is generally 20 cm deep but varies from 20 to 40 cm; it usually contains 16—18% clay and 30—35% silt. Like the Fontstown Series the organic carbon content depends to a large extent on the intensity of tillage; it ranges from 1.5—2.0% under tillage to 2.7—4.3% under grassland. The A2 horizon is less well defined than in the Stradbally Series. The clay content of the A2 can be as high or lower than the clay content of the surface A horizon but the clay content of the subsoil B horizon is always substantially higher than the horizon above. There is an abrupt transition from the textural B horizon to the strongly calcareous parent material.

Soil Suitability: These soils have the same wide use range as the Stradbally Series. With their medium texture, good structure and friability they are easily tilled. When properly fertilised, excellent yields of cereals, sugar beet, potatoes, swedes and other root and vegetable crops can be obtained. They are also highly suitable for grass production; with proper fertilisation high output can be obtained, epecially on new leys.

Intensively-grazed dairy cows on these soils show low levels of copper in blood samples and have responded to injected copper.

Profile descriptions and analyses are given in Appendix II.

Patrickswell Series-Rocky Phase

Soil Character: These soils occupy only 1,426 hectares (0.83% of the county) and occur closely associated with the Patrickswell Series mainly around the Clogh area in west central Laois. They are derived from shallow drift cover, overlying limestone bedrock, on rolling to hilly topography with slopes up to 14° at elevations of 100—200 metres. Outcropping rock occurs in some places.

These soils are very similar to the Patrickswell Series but they are shallower, more rocky and occur at slightly higher elevations.

Soil Suitability: The use range of these areas is somewhat similar to the Rocky Phase of the Stradbally Series. Due to the steeper slopes and proximity of underlying rock in places, mechanised tillage operations can be slower and more difficult than in the Patrickswell Series. The soils are also more liable to drought due to their lower moisture-holding capacity. This, together with their slightly higher elevation, is responsible on average for slightly lower yields, not only of tillage crops but also in grass production.

Elton Series

Soil Character: The Elton soils occur mainly in the west of the county, west of Rathdowney and around Borris-in-Ossory, where they occupy 2,376 hectares (1.38% of the county). They are found on gently undulating to rolling topography at elevations ranging from 100 to 200 metres but most of the soils occur around 125 metres. The soils are derived from limestone glacial till with a small admixture of shale and sandstone. The Elton soils are very similar to the Knockbeg and Ballinakill Series.

The Elton soils are deep and well drained with a heavyish loam texture. The profile has a dark-brown to brown relatively weak-structured loamy A11 horizon over a lighter-coloured A12. The topsoil contains 17—21 % clay with organic carbon levels of 1.8—4.2%. The subsoil A2 is generally weakly developed and the underlying B horizon normally shows little or no clay increase. Because only small portions of the B horizon show a significant increase in clay content the soils have been classified as minimal Grey Brown Podzolics. The soil profile varies from 65 to 125 cm but is generally about 85 cm deep. The moisture-holding capacity of the soil is high.

Soil Suitability: These soils have a wide use-range, being suitable for many farm and vegetable crops. A large proportion of the soils are under permanent pasture. Owing to their depth, free drainage, medium texture and good moisture-holding capacity, these are first-class grassland soils. When adequately limed, fertilised and managed, very high levels of production can be obtained. The grassland can be grazed over a long season but controlled grazing is necessary to prevent poaching and to achieve maximum utilisation.

Although these soils are more noted for grass production, they are also very good tillage soils. Cultivation and harvesting can be difficult in wet seasons, but nevertheless excellent yields of cereals and root crops, including potatoes and sugar beet, can be obtained.

Profile descriptions and analyses are given in Appendix II.

Knockbeg Series

Soil Character: This Series is derived from mixed glacial till of predominantly limestone composition with an admixture of sandstone and shale. It covers a total area of 4967 hectares (2.89% of the county) and occurs mainly on the low-lying south-eastern part of the county at elevations of 50—125 metres. Over a quarter of the Knockbeg Series has been mapped on the lower slopes of the Castlecomer Plateau between Portlaoise and Timahoe at elevations of 100—200 metres.

The soils of this Series are moderately deep to deep, well-drained, of loam (tending to clay loam) texture and have been classified <s Grey Brown Podzolics. The profile (Fig. 4.1) consists of a surface A horizon overlying well-defined subsoil textural B horizons with barely perceptible colour variations between horizons. The soil can vary in depth from 60 to 165 cm but it is normally 80 to 100 cm deep. The profile has a brown to dark-brown loamy surface A11 over a lighter-coloured subsurface A12 down to a depth of approximately 35 cm or a plough layer (Ap) which can be up to 27 cm in depth. Clay content of the A horizon varies from 19—25% with an organic carbon range of 2.9—4.2%, and 30—36% silt throughout the solum. The B horizon shows a sharp clay increase and distinct clay skins. It has a good structure but is fairly compact. In places a distinct A2 horizon can be observed above the B2 horizon especially when the soil profile is very dry. Roots are plentiful in the surface layers and penetrate freely to a considerable depth. Moisture-holding capacity of the soil is good.

The Knockbeg Series is separated from the closely-related Elton Series (see p. 36) on the basis that the latter does not have a well-expressed textural B horizon. It is also closely related to the Paulstown Series, previously mapped in Co. Carlow. The latter however is a considerably deeper soil and has an even higher clay content in the B horizon. It is also very similar to the Ballinakill Series (see p. 88).

In summary the Knockbeg Series can be described as a moderately deep to deep, medium to heavy textured, well-drained Grey Brown Podzolic without an observable A2 horizon but having a distinct well-expressed thick subsoil B2t horizon.

Soil Suitability: These soils have a wide use-range, being suitable for the production of a wide variety of farm, fruit and vegetable crops. Although tilling and harvesting can be difficult in wet seasons, good yields of cereals, potatoes, sugar beet, swedes and mangels are obtained. These soils are particularly good for wheat growing. Cereal harvesting can be delayed, however, especially on north-facing slopes at the higher elevations (125—200 m). They are rather heavy for carrots and asparagus. Blackcurrants give excellent yields and strawberries, notwithstanding the heavy-textured nature of the soils, grow very satisfactorily. Good yields of cabbage, peas and French beans are obtained.

Owing to their depth, free drainage, heavy texture and excellent moisture-holding capacity, these are first-class grassland soils. When adequately limed, fertilised and well managed, very high levels of production can be obtained. Controlled grazing is necessary, however, to prevent poaching and to attain maximum utilisation; stocking must be restricted when ground conditions are soft and surplus summer growth should be conserved for winter feed off the land.

In short, these soils can give excellent yields of a wide range of crops but their heavy texture slows up farm operations, particularly in unfavourable weather conditions.

Profile descriptions and analyses for two representative profiles are given in Appendix II.

Knockbeg Stony Phase

Soil Character: These soils occupy a narrow strip on the western side of the River Barrow near Graiguecullen; they occur on undulating topography at 45—60 m elevation. The Series occupies 898 hectares (0.52% of the county). The origin of the parent material is difficult to explain, but it was probably derived from a mixture of several glacial components; the calcareous limestone till of Midlandian (Weichsel) Age was influenced both by soliflucted material from the local Carboniferous shale, sandstone and flagstone formations and by a local concentration of chert. A distinctive feature of these soils is the high proportion of medium to large (5—10 cm) angular chert fragments in the soil, which are very obvious on the surface of tilled fields.

The soils of this Series are well drained, of stony loam tending to stony sandy clay loam texture and of high base status. The solum varies from 80—100 cm in depth. Colour is fairly uniform throughout the profile. The surface horizon, which varies in depth from 25—38 cm, has a moderate, fine and medium granular structure with a clay content of 18—22%. Organic carbon content depends on intensity of tillage and varies from 2—4% approximately. The subsoil Bt horizon is deep and well expressed. Roots penetrate freely down to the base of this horizon. Moisture-holding capacity of the soil is good.

Soil Suitability: These soils have a wide use range. They are good tillage soils, being well suited for a wide variety of farm, fruit and vegetable crops. High yields of cereals, potatoes, sugar beet and other root crops are obtained. Peas, French beans and carrots are also satisfactorily grown for processing. The soils respond well to fertilisers; liming is necessary only on a limited scale.

These soils are also highly suitable for grass production. With proper fertilisation and management, a very high output can be attained and, although there is a hazard of poaching under soft ground conditions, pastures can be grazed over a long season.

Profile description and analyses are given in Appendix **II.**

Podzol-Grey Brown Podzolic Soils

Graceswood Series

These dark-coloured light sandy soils occur in a limited area west of Abbeyleix-Durrow. They also occur in other isolated pockets which are often too small to show at the present scale of mapping. A total area of 2,359 hectares (1.37% of the county) has been mapped as this series.

The origin and genesis of these soils could be satisfactorily explained only after detailed and comprehensive pedological studies. The limited studies carried out on two soil profiles for this Report (Fig. 4.2) indicate at least two possible theories on their origin and development. One plausible theory is that the soil consists of a bisequal profile whose development is due to podzolisation following degradation of the Fontstown Series under a strongly podzolising type of vegetation which developed as a result of man's activity in prehistoric times (Mitchell, 1956). Modern agricultural practices, including deep cultivation and the addition of fertilisers and lime have now halted or possibly reversed the podzolising process. On the other hand, it is more likely that the soil is developed from a thin mantle of outwash sands (the origin of which is obscure) overlying Fontstown glacial till. Profile development in this light-textured

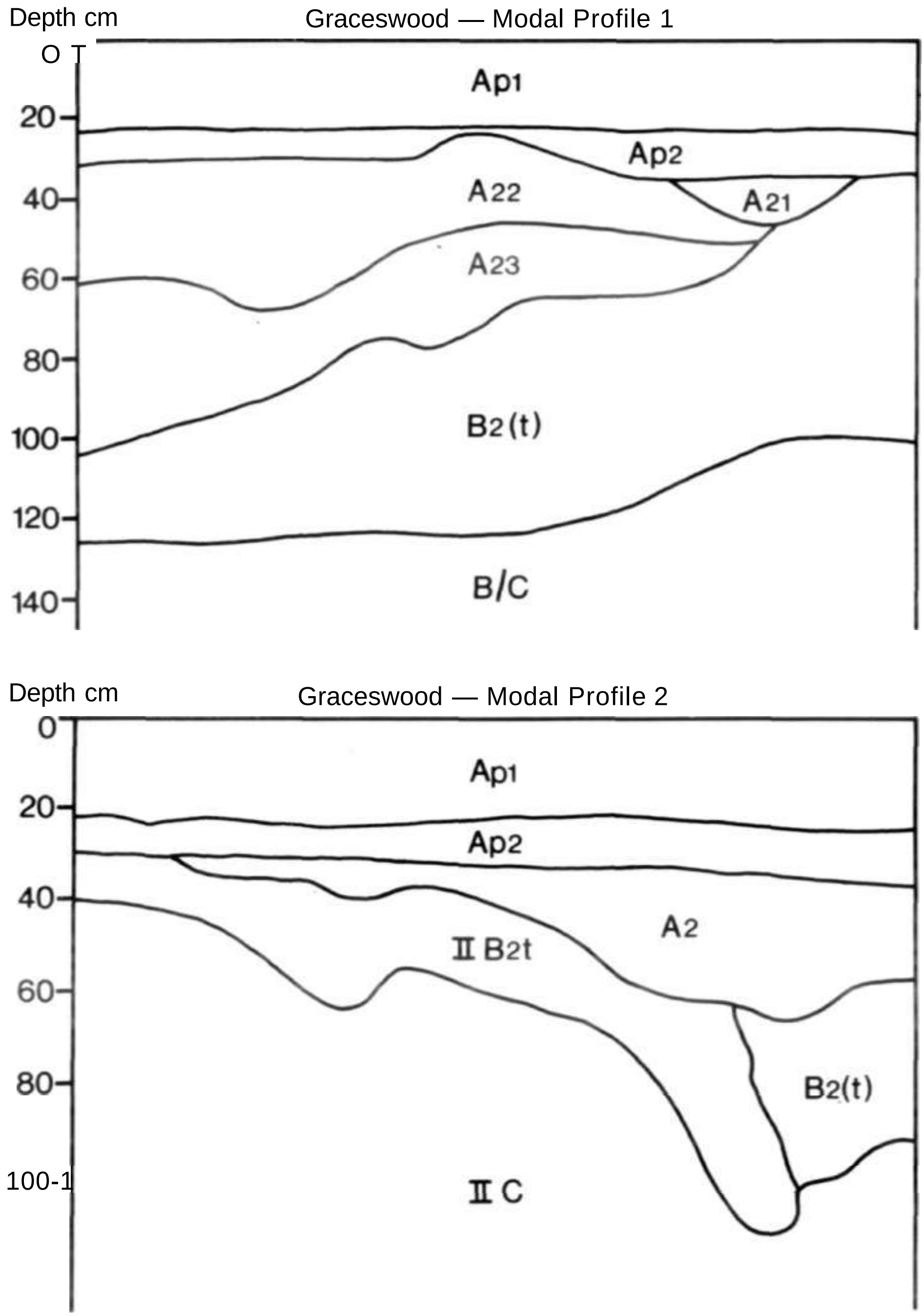


Fig. 4.2: Diagrammatical representation of two Modal Profiles in the Graceswood Soil Series (Podzol-Grey Brown Podzolic), Central Lowlands of Co. Laois.

material could have given rise to the development of a strongly podzolised soil with a low pH under a podzolising-type of vegetation cover. Subsequent addition of liming agents in the last few centuries could have raised pH levels and carbonate content. Where the layer of cover sand was particularly thin, bisequal intergrades (Modal Profile 2, Figure 4.2) with the Fontstown Series could have developed.

Soil Character: The salient and most obvious features of these soils are their dark colour and the light texture of the surface horizons. The soil profile consists of dark (greyish) brown, light sandy loam to loamy sand plough layers over coarser-textured strongly-leached subsoil A2 horizons generally containing less than 10% clay and less than 20% silt. These in turn are underlain by a heavier-textured dark-coloured B horizon which in turn overlies sandy material (Modal Profile 1, Fig. 4.2). The surface horizons have good structure and friable consistence but the underlying layers are slightly firmer. The addition of liming agents over the last few centuries has raised pH levels considerably and in some cases there are free carbonates in the surface horizons. The moisture holding capacity of the soil is low to moderate.

In places where the sandy surface material is thin, the bisequal nature of the profile is very evident (Modal Profile 2, Fig. 4.2) with the sandy surface and sub-surface horizons overlying HB2t and 11C horizons which are identical to those of the Fontstown Series.

In some places, notably near Mountrath, where hummocks of sandy material occur, sandy humus-iron podzols have been noted.

Soils similar to the Graceswood Soils have been mapped in Co. Offaly, notably around Cushina and Portarlington (Ryan and Walsh, 1966).

Soil Suitability: These soils have a fairly wide use range. With their light texture, good structure and friable consistence they are easily tilled even after periods of heavy rain. With adequate fertilising, high yields can be obtained from a wide range of farm, fruit and vegetable crops. However, due to their lighter texture and reduced moisture-holding capacity they are liable to drought in dry periods. Crops such as wheat and blackcurrants which do best in heavy moisture-retentive soils give poor returns especially in unfavourable seasons. Trace-element problems such as manganese and magnesium deficiency are liable to occur on a wide range of crops grown on these soils. Copper deficiency in barley has been observed. It is highly probable that copper deficiency could be a problem in grazing livestock.

These soils are highly suitable for grass production. With proper fertilising, high levels of production can be attained especially on new leys. Grass swards deteriorate very rapidly when neglected. Resistance to poaching is very good on these soils but, on the other hand, drought can limit production very severely in dry periods.

Profile descriptions and analyses are given in Appendix **II.**

Gleys

Mylerstown Series

Soil Character: This Series occupies 20,048 hectares (11.67% of the county) and occurs mainly in the central part of the county as part of the catenary sequence (Fig. 4.5) which includes the Allen, Ballyshear and Fontstown Series. The topography is flattish to undulating with the Mylerstown Series occupying the intermediate position between the edge of the bog and the more elevated better-drained soils. Like the Fontstown Series these soils are derived from stony calcareous glacial till composed almost exclusively of limestone.

The soil profile consists of a very dark greyish-brown, loamy surface horizon with a moderately strong to weak structure and friable consistence. This horizon overlies a mottled grey A2 horizon which in turn overlies the mottled yellowish-brown and grey textural B horizon (Fig. 4.3). The soils are usually calcareous within 20 cm of the

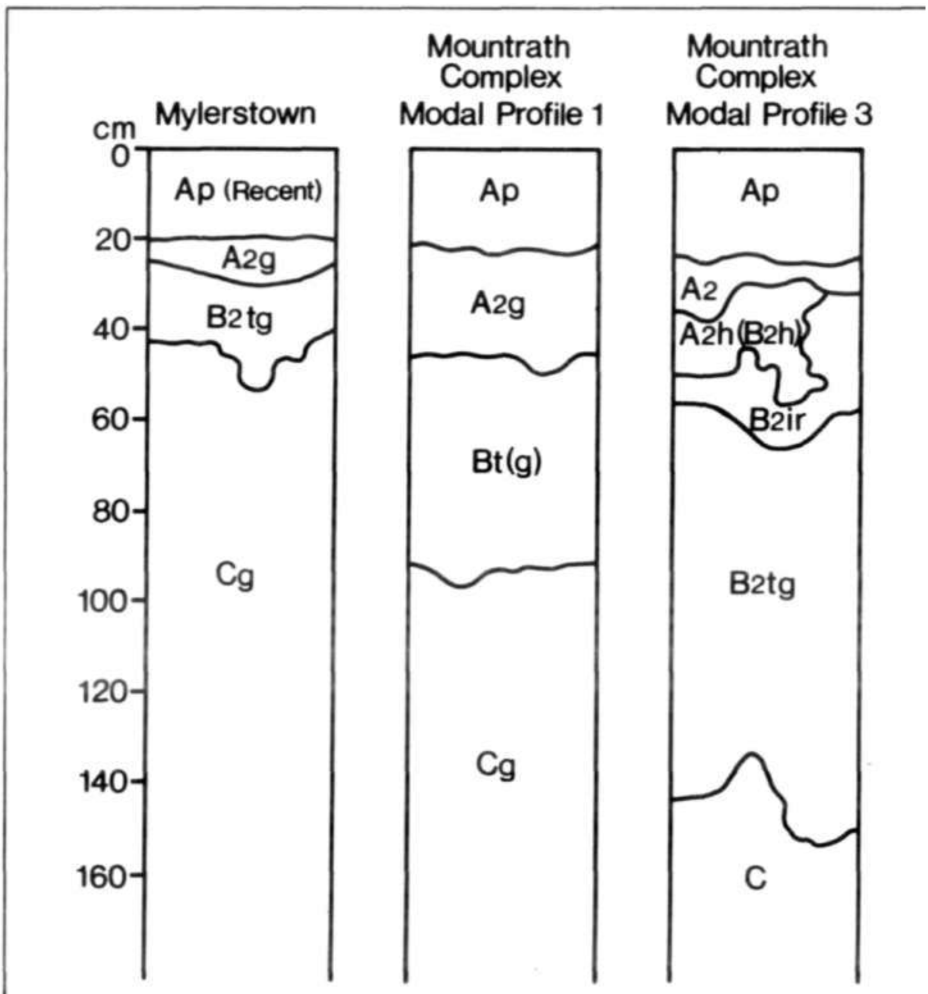


Fig. 4.3: Diagrammatic representation of Modal Profiles of Mylerstown Series (Gley) and Mountrath Complex, Central Lowlands of Co. Laois.

surface; in many cases the surface horizon is calcareous. The soil was formerly poorly drained as a direct result of the prevailing high water-table during the winter period. However, the vast majority of these soils have been improved by deepening the drainage system and installing field drains, thus lowering the water-table to such an extent that the soils are now free-draining. Like the Mylerstown Imperfectly Drained Phase they still retain their grey and mottled colours which are ample testimony of their former poor internal drainage properties. In some places where the arterial drainage has been neglected these soils have reverted to their original poorly-drained state. There are also considerable areas which still require artificial drainage.

Soil Suitability: These soils have a moderately wide use-range. Like the Mylerstown Imperfectly Drained Phase they can produce the same wide range of crops as the Fontstown Series but the 'risk hazard' is still greater. Although most of the soils are now free-draining, it is difficult to produce a good tilth in unfavourable seasons. Consequently, both sowing date and harvesting are often delayed, thus increasing the risk of obtaining poor quality, low-yielding crops. This is especially true for cereal production. The soils are best suited to grass production but here again some salient differences exist even after maximum improvement has been carried out; the grazing season must be curtailed in order to reduce the risk of poaching, particularly in spring and late autumn. For these reasons, although they can grow a wide range of crops these soils have a more limited use-potential than the Fontstown or even the Mylerstown Imperfectly Drained Phase. The portions of this series which have not been artificially drained have a limited use range at present.

Profile descriptions and analyses are given in Appendix II.

Mylerstown-Imperfectly Drained Phase

Soil Character: This imperfectly-drained podzolic Gley occupies an area of 2,060 hectares (1.2% of the county). It occurs on undulating to flatfish topography at a more lowlying position in the landscape than its well-drained counterpart the Fontstown Series, and at a slightly more elevated position than the poorly-drained Mylerstown Series.

The soil profile consists of a dark greyish-brown surface horizon with moderately good structure and consistence and is approximately 17.5—30 cm deep. This horizon overlies a thin, bleached and mottled A2 horizon which in turn overlies a thin, undulating strongly-mottled textural B horizon. The soil was formerly imperfectly drained as a direct result of high water-tables during the winter. Artificial drainage has improved the internal drainage properties to such an extent that the soils are now free-draining but they still retain the characteristics associated with impeded drainage, namely, gleying and mottling.

The artificial drainage was commenced centuries ago but it received a great impetus within the last 20 years under the Land Project Schemes. There are still fairly considerable areas which require artificial drainage.

Soil Suitability: These improved soils have a fairly wide use-range. As a result of improvement in drainage properties they have the same wide use-range as the well-drained Fontstown Series. However, some salient differences exist between the two soils. In favourable seasons this soil has few disadvantages when compared with the Fontstown soils, but in unfavourable seasons it is much more difficult to produce a desirable tilth so that spring-grown cereals are often delayed and as a direct consequence harvesting is also delayed. This increases the risk of obtaining both reduced crop yields and poorer quality. Similarly, there is also a greater risk of poaching by grazing stock in wet periods so that a greater proportion of the grass produced should be conserved for winter feeding off the land.

Profile descriptions and analyses are given in Appendix II.

Bally shear Series

Soil Character: This series occupies an area of approximately 898 hectares (0.52% of the county) and occurs as part of the catenary sequence (Fig. 4.5) which includes the Fontstown and Mylerstown Series. The topography is flattish to undulating with the Ballyshear Series occupying the lowest position in the landscape just on the edge of the cutover or non-cutover bogland areas. The soils are derived from the same calcareous glacial till as the Fontstown Series.

The soils are very poorly drained, of peaty clay loam surface texture and of high base status. The poor drainage is due to the presence of a high groundwater table. The profile consists of a weak-structured, strongly-mottled dark greyish-brown surface A horizon over-lying horizons which are grey and mottled. The A2 horizon contains some gravelly pockets. The sub-surface B horizon has a heavier texture, a mottled grey colour and poor structure; it is compact and sticky when wet and becomes hard on drying. This horizon merges gradually with the strongly gleyed, calcareous parent material. Pockets of coarse gravelly material occur frequently in the parent material.

Soil Suitability: These soils have a limited use-range. Due to poor drainage and other adverse physical conditions, they are generally unsuitable for tillage. Their optimum agricultural use is grass production.

Very little permanent improvement can be obtained without artificial drainage and reclamation. This is difficult in many cases without first improving the arterial drainage system. Where the arterial system is satisfactory, large areas have been drained and reclaimed in the last 20 years.

With liberal use of fertilisers, cereals and root crops can be grown but the yields can be disappointing, especially in unfavourable seasons. With fertilisation and a high standard of management, grassland gives good returns. For full utilisation of the grass, grazing must be of necessity be confined to the drier summer period to prevent poaching, rush *(Juncus)* infestation and general deterioration of the sward. Copper and manganese deficiency occur extensively on these soils. Copper deficiency in grazing animals is widely reported and there is substantial evidence that cobalt deficiency may be a problem, especially where intensive farming is practiced.

Profile descriptions and analyses are given in Appendix II.

Howardstown Series

Soil Character: This Series is the wet counterpart of the Elton and Knockbeg Series and is derived from the same drift material. It occupies a more lowlying position on the landscape and usually occurs in flattish depressional areas. It occupies an area of 3,176 hectares or 1.85% of the county.

The soil profile consists of a dark greyish brown, loam to clay loam surface horizon with a weak structure and fairly friable consistence. This horizon overlies the mottled yellowish-brown and grey textural B horizon. The subsoil horizon becomes hard and compact on drying. The soils are usually calcareous within 15 cm of the surface; in many cases the surface horizon is calcareous. The soil was formerly poorly drained as a direct result of the prevailing high water-table during the winter period. A high proportion has now been improved by deepening the arterial drainage system and installing field drains. They still retain their grey and mottled colours which are ample evidence of the former poor internal drainage properties. There are many areas which still require artificial drainage. In many places, however, it is difficult to obtain a sufficient outfall due to the lowlying nature of the area.

Soil Suitability: These soils have a limited use range. Due to poor drainage and other adverse physical conditions, they are generally unsuitable for tillage. Their optimum agricultural use is in grass production.

Very little permanent improvement can be obtained without artificial drainage and reclamation. This is difficult in many cases. Where the arterial system is satisfactory, large areas have been drained and reclaimed in the last 20 years.

With adequate fertilisers, cereal and root crops can be grown. The yields, however, are usually disappointing especially in unfavourable seasons. With fertilisation and a high standard of management, grassland gives good returns. For full utilisation of the grass, grazing must of necessity be confined to the drier summer period to prevent poaching, rush *(Juncus)* infestation and general deterioration of the sward.

Profile descriptions and analyses are given in Appendix II.

Clonaslee Series

This Soil Series which is also a component of the Baggotstown-Carlow Complex occupies 2,253 hectares or 1.3% of the county. It corresponds to the poorly-drained component of Athy Complex previously mapped in Carlow and Kildare. The soils are derived from the same calcareous limestone gravels and sands but as these gravels occur as outwash gravels on flattish lowlying topography the soils are almost exclusively poorly drained.

The dominant soil is a blackish, light textured, highly calcareous gley soil. The soil profile consists of a blackish to very dark greyish brown, coarse sandy loam, friable, calcareous surface horizon overlying strongly gleyed and mottled subsoil gravels and sands. The surface layer varies in depth from 20—40 cm but it can be up to 60-cm deep in places. In winter the water-table rises close to the surface of much of the soils, particularly those on the lowest parts of the topography. Those on slightly higher ground are largely outside the influence of water-table fluctuations.

All the pedological evidence suggests that these soils were influenced to a greater extent by higher ground water-table levels prior to improvements to the arterial drainage system which have been carried out over the last few centuries. It is postulated, therefore, that the dominant soil was a peaty gley (i.e. poorly drained component) but that arterial drainage improvements together with generations of cultivation have mixed the surface horizons to a considerable depth and lowered the overall organic matter levels very substantially. The soil has all the characteristics of a poorly-drained soil (i.e. blackish peaty surface and gleyed subsoil horizons) but the soil in fact now behaves as a free-draining soil at all times except where the water-table rises close to the surface in winter.

The soils of this area have a wide use-range. They are suitable for the production of a wide range of arable crops as well as being good grassland soils.

Profile descriptions and analyses are given in Appendix II.

Complexes

Baggotstown-Carlow Complex

The soils of this complex occupy only 4,770 hectares (2.8% of the county). They occur sporadically throughout the county but mainly at low elevations adjacent to the larger rivers. However, the most extensive area of these soils in the county occurs north of Slieve Bloom without any association with any river.

Their parent material consists of calcareous, fluvio-glacial coarse gravels and sands, of Midlandian Age, composed mainly of limestone with a small proportion of sandstone and other erratics. The topography is flattish to undulating but is commonly hummocky with sharp slope changes ranging from 0° to 12° and occasionally up to 25° as on the steep sides of the eskery gravels west of Clonaslee. These sharp changes in landscape features are mainly responsible for the variability of soils and the intricate pattern of distribution within the Complex. Because of the latter it was not feasible to segregate the different soil components on the scale *of* mapping employed. Consequently, the soils have been mapped as the Baggotstown-Carlow Complex. These soils have already been mapped in a number of other counties, notably Kildare and Carlow, as the Athy Complex.

Soil Character: Four major soils have been recognised within the Complex:
(1) *Carlow Series:* (Moderately deep component, Athy Complex, Soils of Co. Carlow). On the flattish to undulating topography and on the lower slopes of the hummocky hills and eskers, moderately deep soils have developed. These are naturally well drained, friable, gravelly sandy loams of high base status; they have been classified as Grey Brown Podzolics. This soil accounts for approximately 70% of the total area of the Complex.

The profile is characterised by a dark greyish-brown to dark-brown surface horizon which varies in depth from 15 to 35 cm and overlies a brown to yellowish-brown, leached A2 horizon. This in turn overlies an undulating, dark greyish-brown B horizon of distinct clay accumulation; clay skins are prominant on the ped surfaces. The surface horizon contains 10 to 15% clay and 6 to 12% organic matter; the B2t horizon has 20 to 30% clay. Diagnostic features of this soil are the high content of gravels throughout the profile, the distinct tonguing A2 horizon, the well-developed textural Bt horizon and the high pH and base status throughout the profile. Structure is moderately well developed. Roots are plentiful in the surface horizon and penetrate freely to the upper portion of the calcareous gravels. Moisture-holding capacity is moderately good, but in prolonged very dry periods a moisture deficit develops.

Profile description and analyses are given in Appendix II.

(2) *Baggotstown Series:* (Shallow Component Athy Complex. Soils of Co. Carlow). On the crests of the hummocks and higher areas of the eskers, the soils are very shallow, excessively drained, of stony or gravelly, coarse sandy loam texture, and of high base status. These have been classified as Brown Earths. They occupy about 20% of the Complex.

The profile is characterised by a dark-coloured A horizon which passes directly into the coarse-textured, calcareous parent material. The A horizon varies in depth from 15—30 cm, has a well developed crumb structure, is friable and contains abundant roots. Deep ploughing brings the gravel sub-soil to the surface in many cases. Moisture-holding capacity is poor and a moisture deficit develops in most years. Some of the eskery gravels, particularly west of Clonaslee, have a very high proportion of stony material. The eskers are unploughable as slopes are up to and even over 25°.

. Profile description and analyses are given in Appendix II.

(3) *Clonaslee Imperfectly-drained Phase:* (Imperfectly-drained Component, Athy Complex. Soils of Co. Carlow). On flattish, lowlying areas the soils are imperfectly drained, of sandy loam texture and of high base status; they have been classified as Brown Earths with gleying. Due to their lowlying position, a high water-table affects the lower portions of the profile for the greater part of the winter period causing gleying in this zone. The dark-greyish-brown, friable, calcareous A horizon varies in depth from 25 to 40 cm and contains approximately 15% clay and 8 to 10% organic matter. Although root development is largely confined to this horizon, these soils, except in very dry seasons, are not subject to drought due to the proximity of the water-table even in dry periods.

Profile description and analyses are given in Appendix II.

(4) *Clonaslee Series:* (Poorly-drained Component—Athy Complex. Soils of Co. Carlow). On the lowest portions of the topography where the water-table is permanently high, the soils are poorly drained, of sandy loam texture and of high base status; they are classified as Gleys. (See Clonaslee Series).

The profile is characterised by a very dark-brown to blackish calcareous surface horizon over an intensely gleyed calcareous parent material. Root development is confined to the surface horizon.

(5) *Banagher Series:* Small areas of organic soils similar to the Banagher Series occur throughout the Complex but mainly in the area north of Slieve Bloom.

Soil Suitability: These soils generally have a wide use-range. They are suited to the production of a wide range of farm, fruit and vegetable crops. Liming is necessary to a limited extent only on the moderately deep well-drained soils of the Complex. Good responses to fertiliser application are obtained. Potassium 'fixation' is high in the Baggotstown-Carlow Complex and applications of this element must be regular and generous for optimum crop growth. Farmyard manure, apart from being a nutrient source, also enhances the moisture-holding capacity of these light-textured soils.

The shallow component of the Complex is subject to drought almost every year, while the deeper well-drained component is prone to a moisture deficit only in very dry periods. Due to the intricate pattern of soil distribution, even within the same field, certain crops mature unevenly; peas arid cereals for instance mature 2 to 3 weeks earlier on the shallow excessively-drained soils of the Complex. This is a serious disadvantage to crops such as peas where maturity at harvesting is such a vital factor in processing.

The soils are generally suitable for tillage crops. Where they occur on slopes that are not too steep to cultivate, a wide range of tillage crops including cereals, potatoes, swedes, mangels, sugar beet and vegetable crops can be grown. They are particularly noted for malting barley production. Winter cereals give substantially better yields than spring cereals—spring wheat yields are generally uneconomic. Manganese deficiency is widely reported in tillage crops.

Grassland production on the Complex is very variable. Short-term leys can be very productive especially in "dropping years" i.e. good summer rainfall. But in dry seasons severe moisture deficits limit production very seriously, especially on the shallow components of the Complex. Responses to sulphur applications are widely observed on these light soils.

Dysart Hills Complex

These soils cover a small area of 951 hectares (0.55% of the county) and occur extensively on the chain of limestone hills which run in a NE—SW direction each side of Stradbally. The historic Rock of Dunamase (Plate 4.3) is one of the smallest but best known members of the western chain. Topography is hilly with elevations ranging from 120 to almost 260 metres. Slopes are generally within the 6—20° category but may be up to 25° in places with occasional almost vertical rock faces.

The soils within the Complex range from shallow Grey Brown Podzolics and shallow skeletal soils to bare outcropping rock (Fig. 4.4). The shallow Grey Brown Podzolics are derived from a thin drift cover which occurs in protected pockets on the hills and on the lower slopes of the hills. The profile consists of a sandy loam surface A horizon over a well-expressed textural B horizon overlying a thin layer of calcareous till or resting directly on bedrock. Natural vegetation consists of hazel *{Corylus avellina)* dominant scrub wood. In recent times sizeable areas of these soils have been planted with larch *(Larix)*, beech *(Fagus sylvatica)*, Scots pine *(Pinus sylvestris)*, Corsican pine *(Pinus nigra)* and Norway Spruce *(Picea abies)* and some areas have been reclaimed and reseeded.

The shallow skeletal soils consists of a loamy surface A horizon with a high organic matter content resting directly on limestone bedrock.

It is calculated that the Complex consists approximately of 35% shallow Grey Brown Podzolics, 40% skeletal soil and 25% outcropping rock.

Plate 4.3: The historical Rock of Dunamase is a prominent feature in the Dysart Hills Complex.

Soil Suitability: The use range of the Complex is very limited. The shallow skeletal areas which normally carry a scrubwood vegetation and the outcropping rock are unsuitable for any farming enterprise with the possible exception of rough grazing. Some of the shallow Grey Brown Podzolics which occur on the less steep slopes and local plateaus have been reclaimed and reseeded. Grassland output on these shallow soils is largely dependent on management and amount and distribution of rainfall during the growing season. These soils are unsuitable for tillage cropping.

Mountrath Complex

On the south-eastern fringe of Slieve Bloom there is a narrow belt of soils which are derived from calcareous glacial till composed predominantly of an admixture of limestone and sandstone. This Complex covers 7,429 hectares (4.33% of the county). Although the elevation ranges from 85 to 140 metres, the area as a whole is rather lowlying with flattish to gently undulating topography.

The high content of sandstone in the drift material reduces soil permeability very considerably, so that soils with poor internal drainage characteristics can, and do, occur even on favourable slopes. This, together with the lowlying flattish nature of the landscape, is responsible for the very high proportion of wet soils in the area. However, due to slight changes in the topography there is a wide range of wet soils varying from very poorly-drained peaty gleys and organic soils in the depressional areas to poorly-drained and imperfectly-drained soils on the more favourable convex slopes. The pattern of distribution is so intricate that the soils could only be mapped as a Complex.

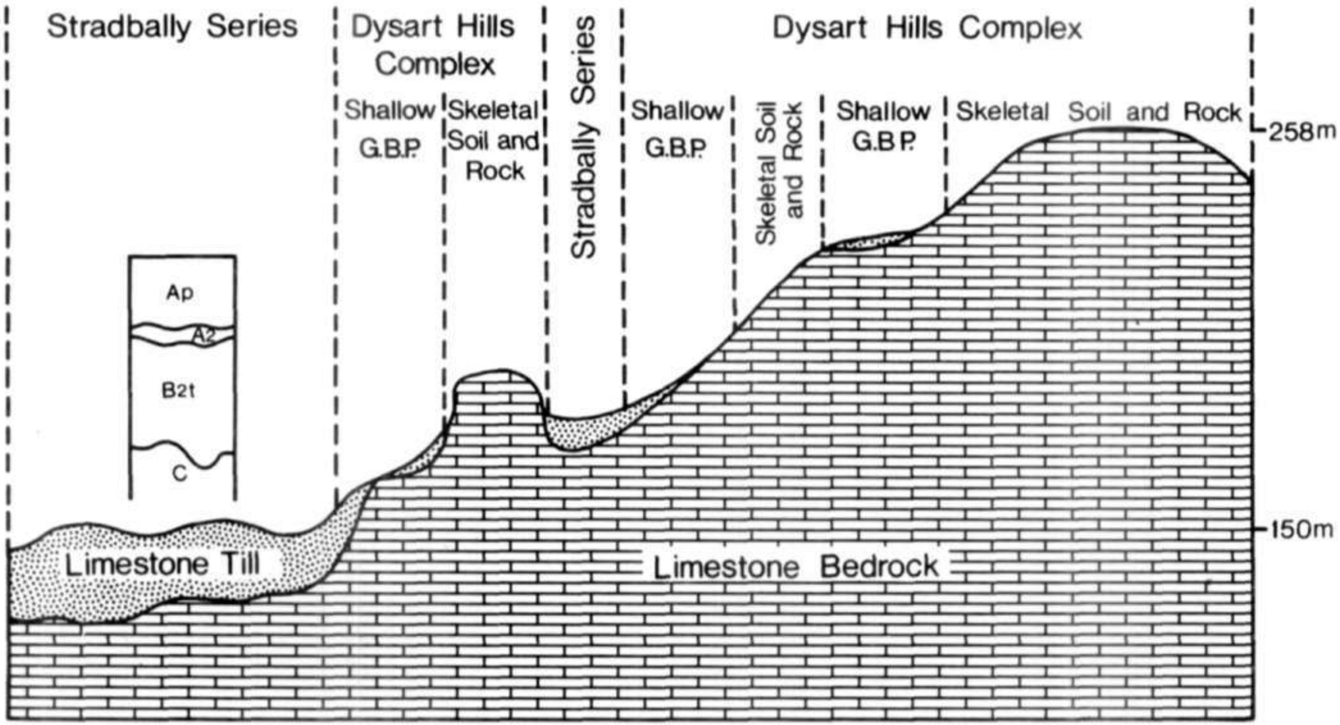


Fig. 4.4: Schematic relationship of geology and soils within the Dysart Hills Co. Laois.

Soil Character: The dominant soil in the Complex is a poorly-drained Gley soil. The profile consists of a dark-coloured sandy loam surface Ap horizon overlying a mottled grey coarser-textured A2 horizon which in turn overlies the heavier textured-gleyed textural B horizon (Modal Profile 1, Fig. 4.3). The subsoil B horizon grades into mottled parent material at a depth of about 1 metre. The soil is calcareous almost to the surface. Due to low soil permeability and the flatfish nature of the ground, the soils are wet for the greater part of the year. This, together with their relatively weak structure means that they are susceptible to poaching over a large part of the year.

Although they are now classified as poorly-drained soils there seems little doubt that at one time they were considerably wetter. The presence of a buried remnant of a surface peaty layer in Modal Profile 2 suggests, if not proves, that these poorly drained gleys were once very poorly drained peaty gleys. Generations of improvements to the overall arterial drainage system together with installation of field drains has improved the soil's drainage properties very substantially while cultivation has largely obliterated the peaty surface layer.

On the lower parts of the landscape, mainly in lowlying depressions, very poorly drained peaty gleys and organic soils occur. Some of the organic soils (Modal Profile 4) contain whitish layers of almost pure calcium carbonate, known commonly as "marl".

On the more favourable slopes poorly drained (to imperfectly drained) soils occur. In these positions it has been observed that most of the soils are in fact bisequal profiles (Modal Profile 3, Fig. 4.3). The heavier-textured poorly-drained gley soils have been degraded and podozolised—humus and iron podzol B horizons have developed in the degraded coarser surface horizon of the original poorly-drained gley. These soils are now outside the influence of the fluctuating water-table, but it is speculated that this particular soil development occurred under fluctuating water-table conditions at a time wlien the water-table was much higher than at present.

The subsoil horizons of this soil are very similar to the subsoil horizons of Modal Profile 1. The surface material now consists of coarse loamy sand to coarse sandy loam in which humus and iron have accumulated often as distinct and separate horizons. In some places, although the surface texture is very sandy, the humus and iron horizons are absent.

In summary, this Complex consists of soils with varying degrees of wetness on flatfish to gently undulating topography. The soils include poorly drained (sometimes degraded) gleys, very poorly drained peaty gleys and organic soils. The varying degrees of wetness are due to a combination of poor internal drainage properties (due to the sandstone content of the drift) together with the flatfish lowlying nature of the landscape. There is overwhelming evidence to show that most of the soils have been considerably altered and improved by generations of farming improvements, including improvements to the arterial drainage system.

Soil Suitability: On the whole the use range of this Complex is rather limited. Although many of the soils have been considerably improved, they are generally unsuitable for tillage cropping. Poor drainage and weak structure make tillage operations very difficult on all except the most favourable slopes in favourable seasons.

The soils are best suited to grassland and forestry. Although considerable

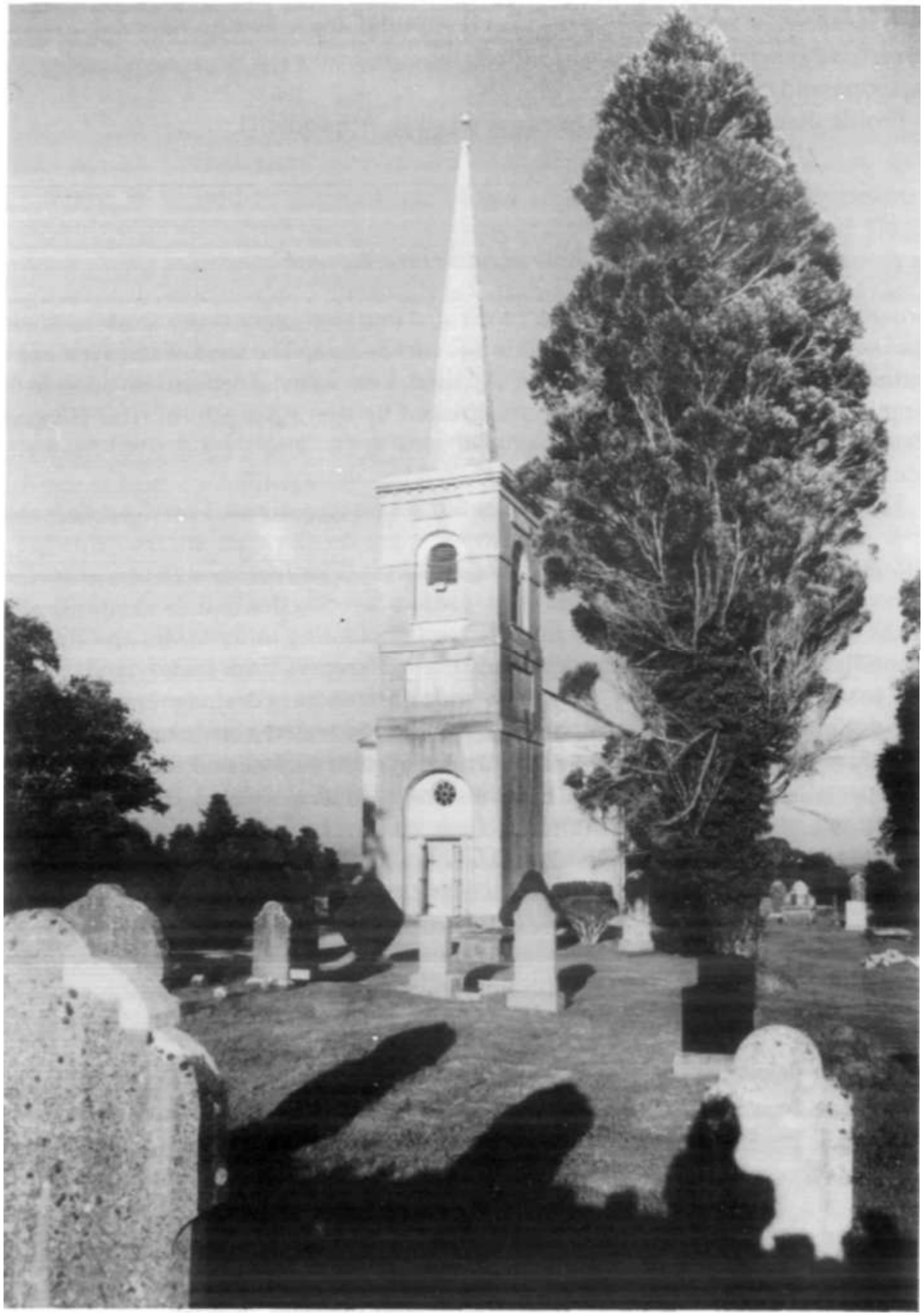


Plate 4.4: Coolbanagher Church, Emo, one of the few buildings in Ireland designed by Gandon.

improvements have been achieved there is still more room for improvement in the arterial drainage system without which some areas cannot be drained successfully. A high standard of grassland management is essential. Even then the grazing season can be seriously curtailed, epecially in difficult seasons, by the risk of severe poaching both in spring and autumn.

Profile descriptions and analyses are given in Appendix II.

Alluvial Soils Complex

Broadly speaking, alluvial soils can be divided into two major types, fresh-water and marine. The latter do not occur within the survey area. The fresh-water type can be furthe» sub-divided into lake and river alluvium. Lake alluvial deposits do occur in one large area (Pollagh Soils) but they are covered by varying depths of river alluvium. Hence, it can be said that all the alluvial soils in Co. Laois are derived from river alluvium. They occupy 6,848 hectares (3.99%) of the county.

The river alluvial soils were all deposited in fairly recent times. Therefore, they show tittle or no profile development. However, they do show an enormous range of differences in properties due to a number of factors. Firstly, although they show little or no profile development, they do show distinct layering due mainly to stratification of the deposited material and to the effects of fluctuating water-tables and flooding. Secondly, they show a great range of textural differences from loamy sands to silty clay loam and clays. Thirdly, they show wide differences in drainage categories from free-draining where the water-table is low and flood waters recede rapidly to poorly drained where the water-table is permanently near the surface and where flood water disappears very slowly. Fourthly, their composition is related to the geological formations in their catchment area.

At the scale of mapping employed in Co. Laois, it was not possible to segregate all the different alluvial soils. Consequently they are all mapped as miscellaneous river alluvial soils. Where it was possible to pick out fairly large areas which had distinctive characteristics either in terms of soil or land-use properties, these have been designated by subtype symbols or a combination of subtype symbols.

Subtype S

Almost all the alluvial soils in the county are derived from limestone with a small proportion derived from sandstone. For this reason the subtype L is not used to denote limestone-derived alluvium but the subtype S is used to denote river alluvium derived from sandstone material (River Alluvium—Profile 1). It occurs exclusively in the streams and rivers in the immediate vicinity of Slieve Bloom. The most notable area is associated with the Clodiagh River on the north side of Slieve Bloom near Clonaslee. It is a medium-textured free-draining alluvium. It is subject to periodic flooding. The soils are best suited to grassland but most of the area can be tilled also.

While most of this type of alluvium is associated with streams and rivers, fairly large tracts, particularly on the north side occur on sloping ground with slopes of 2—3° that are not associated with streams or rivers. It is postulated that these alluvial soils were deposited when the existing drainage channels could not cope with the high volumes of surface water coming off the higher ground during torrential rainstorms.

These are good grassland soils as well as being good tillage soils.

Subtype W

The subtype W is used to denote areas of wet alluvium where the water table is permanently high and where flooding is regular and often persistent in winter. They are found chiefly associated with the rivers Barrow and Nore. They are very similar to the Kilmannock Series mapped previously in Counties Wexford and Carlow. They are suitable only for summer grazing.

Subtype F

The subtype F denotes a wide range of alluvial deposits which are free draining but which are subject to a fluctuating water table. They are also sometimes subject to winter flooding. They are good to very good grassland soils and many areas are widely used for tillage cropping.

Profile description and analyses are given in Appendix II, (River Alluvium Profiles 2, 3, 4 and 5).

Subtype K

As a result of research work carried out at Johnstown Castle, Co. Wexford, it has been found that most of the alluvium derived from limestone in Co. Laois are potash-fixing soils. Tillage crops, notably cereals, grown on these soils give very poor yields unless high levels of potash are drilled with the seed. Alluvial areas where this is known to occur, or suspected of occurring because of soil type similarities, are denoted by the subtype symbol K—. The alluvial soils associated with the higher reaches of the Barrow for instance are not potash-fixing soils because they are derived from sandstone or a sandstone-limestone admixture (River Alluvium Profile 1, Appendix II).

Subtype Po

The distinctive broad flats of the middle reaches of the River Barrow stretching from north of Monasterevin to Athy are known locally as "The Pollaghs" and are denoted by the Subtype symbol Po. The topography is very flat with a fall of only about a metre in over 15 km. The water table is constantly at a high level even in summer while the flats are subject to regular and often persistent flooding in winter.

The soil profile consists of a shallow layer of non-calcareous river alluvium overlying calcareous lake deposits (River Alluvium—Profile 6). The river alluvium was laid down by recent flood water. It consists of a distinctive dark greyish brown clay layer with a good blocky structure. Clay content can be up to 60% with a total of

Plate 4.5: Thatched cottage near New Mills, Mountmellick.

almost 90 to 100% silt plus clay. It is usually about 12-cm deep but can be up to 25 cm close to the river banks. The underlying lake deposits are different both in colour and texture from the recently deposited river alluvium. The colour is distinctively grey with strong mottling in the upper part of the material above the level of the permanent water table.

The subsoil horizons also have a much higher proportion of silt than the topsoil. Silt content can be as high as 80% in places. Sometimes a thin layer of peat can be observed between the alluvium and the lake deposits.

These soils also occur in Co. Kildare where they have been mapped as part of the Finnery Complex (Conry *etal,* 1970) and in Limerick where they have been mapped as the Camogue Series (Finch and Ryan, 1966).

Soil Suitability: The use range of these soils is limited. Major limiting factors include regular flooding, high water-table, heavy texture and sometimes commonage and inaccessability. They are largely unsuitable for tillage crops except in drier areas close to the river bank. The flooding hazard effectively rules out winter cropping while the high water table is a major obstacle to getting in spring crops in time to obtain economic yields. Difficult harvesting conditions can also be a serious problem in wet seasons. Where tillage can be carried out, fertiliser placement is essential due to their extremely high potassium-fixing properties.

The Pollagh soils are best suited to summer grass production, but again there are serious limitations. At the present time they are used almost exclusively for rough summer grazing and meadowing. In the slightly higher and drier areas close to the river bank, the length of the grazing season can be quite good. But even 100 metres away from the bank the water table remains sufficiently high until late in the grazing season to effectively rule out early fertiliser (nitrogen) application and early grazing. Generally, grazing must be delayed until the end of May to avoid poaching. The usefulness of these lands even for grassland cannot be optimised unless the arterial drainage system is improved either by lowering the level of the river Barrow or installing pumps.

Other major obstacles to improvement in output include inacessability and commonage. Much of the Pollagh lands have poor access due to lack of roads while a sizeable proportion of the Pollagh soils are owned in common.

Profile descriptions and analyses are given in Appendix **II.**

Peats
(Histosols)

Peat formations are characteristic features of the county landscape and cover 15% of its land area. These landscape units range from fen and raised bog of the lowland plain to montane blanket bog on the higher hill and mountain masses of the Castlecomer Plateau and Slieve Bloom Mountains.

Many of these areas have been both extensively and intensively modified by man's activities down through the years. These activities include hand-cutting for domestic fuel, machine-cutting for commercial exploitation, draining, levelling and reseeding. These activities, together with the variation in the development of the bogs themselves, are responsible for substantial differences not only in the peat profiles but also in their land-use properties. These differences have in turn been used as mapping units.

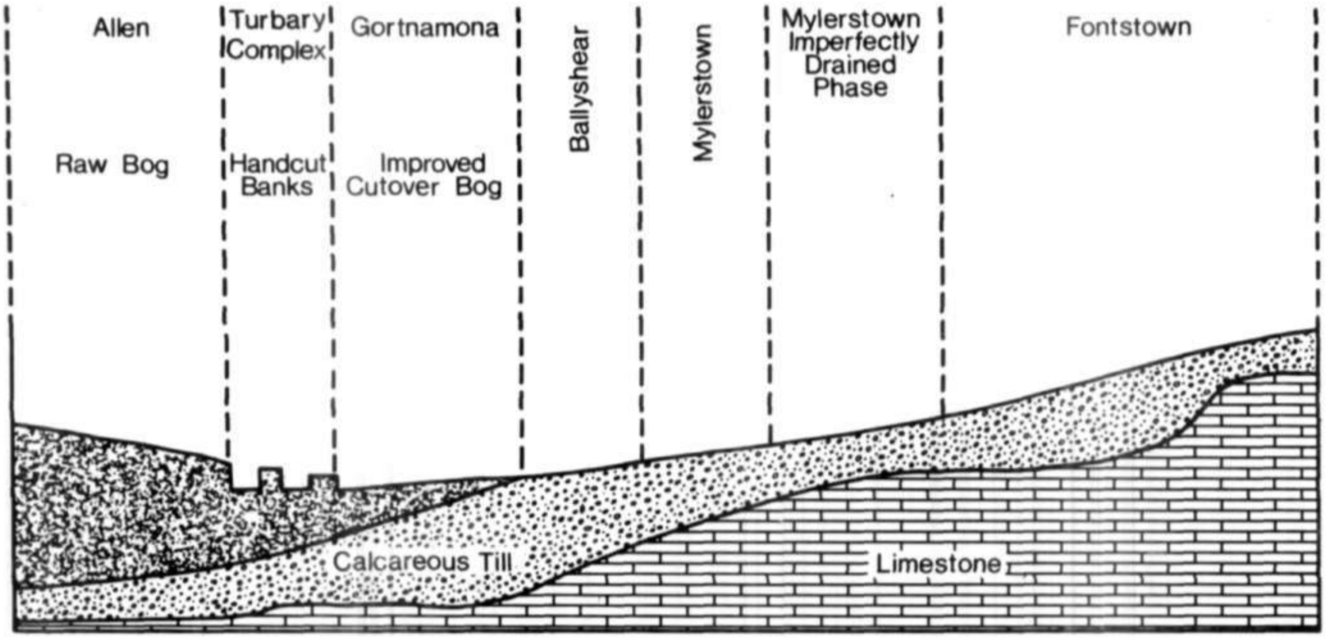
In the following, the salient features of these units and the histosols mapped within them are described.

Raised Bog

These landscape units in their undisturbed state are natural organic formations characteristic of the Central Plain of Ireland which have formed in depressed topography, on calcareous glacial drift (Fig. 4.5). Although formed in basin areas their mode of formation has resulted in a characteristic "raised" appearance, hence the term "raised bog" (Fig. 4.6).

Under suitable climatic conditions raised bog peat may be built up on top of fen peat. As the depth of fen peat increases, its living vegetation is less influenced by groundwater and more dependent on atmospheric precipitation as a source of moisture. This change in moisture supply results in the growth and development of a raised bog with its characteristic convex surface and acid plant remains (Hammond, 1979).

Fig. 4.5: Schematic representation of relationship between peats and some mineral soils in the Central Lowlands of Co. Laois.



A typical section shows a tri-partite layering with an upper tier 2—3 metres thick which is mainly comprised of poorly-humified Sphagnum moss. This overlies a tier of well-humified Sphagnum peat with variable amounts of *Calluna* (heather) and *Eriophorum* (Bog Cotton) remains. The basal layer is comprised of plant remains characteristic of fen conditions ranging from *Phragmites* reed swamp characteristic of the extremely base-rich environment associated with depressions in the bog floor to fen and woody fen of intemediate slopes and elevated situation of the bog floor.

Within this landscape unit the following mapping units have been delineated on definitions and profile descriptions as published (Hammond, 1979).

Allen Series

This Series mapped out on the uncut raised bog is undrained. It occupies 1,831 hectares (1.07%) of the county. It is extremely wet and strongly acid in reaction throughout. The upper 10—15 cm shows a natural surface decomposition reflecting summer water table levels. Below this the peat types vary between poorly-humified Sphagnum-dominated peats with intercalcation of well- to moderately-well humified peats dominated by Cyperaceous and *Calluna* plant remains. Throughout the profile there is a strong smell of sulphide reflecting the wet and reduced conditions.

Soil Suitability: Without drainage this Series is only suitable for conservation and when drained forestry and fuel production are the only practicable land-use options.

Profile descriptions and analyses are given in Appendix II.

Turbary Complex

Past turf-cutting practices by the local population have given rise to uneven micro-topography on the periphery of the raised bogs. Within this area larger peat blocks remain which, in many instances, show the full bog profile description above. Deep bog holes occur next to these peat blocks which are separated by variable extents of flat areas used for hand spreading of peat fuel.

In areas which have been levelled after cutting the micro-topography is flat and the soil profile consists of a layer of acid peat strippings ('top sod') of variable thickness (100—150 cm) over a basin peat (wood or fen plant remains). The drier surface is colonised by heather *(Calluna)* and bog cottons *(Eriophorum* spp.) with *Eriophorum angustifolium* and *Sphagnum* spp. in the wetter areas. This Complex occupies 6,883 hectares or 4.01% of the county.

Soil Suitability: In the post-cutting state such areas are restricted to afforestation. However, with land development, levelling, drainage, and fertiliser application these areas have a definite potential for agricultural production.

Profile descriptions and analyses are given in Appendix II.

Gortnamona Series

Where the Turbary Complex has been drained, levelled and reclaimed they are mapped as the Gortamona Series (Modal Profile 1). This series occupies 2,535 hectares (1.48%) of the county. The soil profile usually consists of a surface Oap horizon

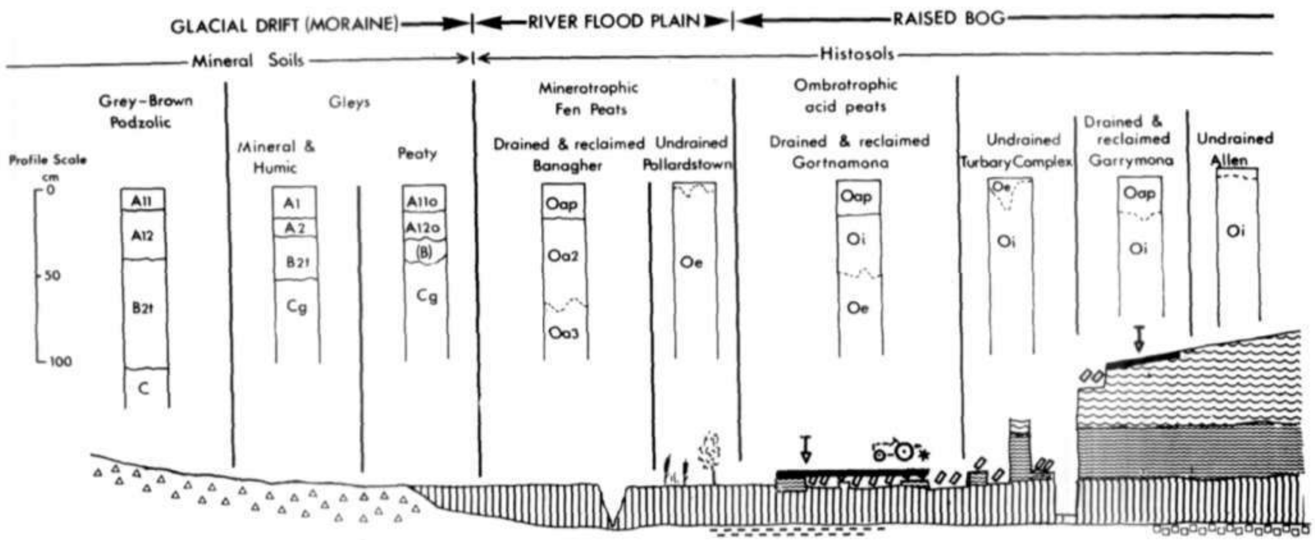


Fig. 4.6: Schematic cross-section of typical organic soils landscape in the Irish Midlands (from Hammond, 1979).

10—30 cm thick developed from a layer of acid peat strippings ('top sod') of variable thickness (100—250 cm) over basin peat (wood or fen plant remains). Depending on the age of reclamation some areas have been improved by applying mineral material such as calcareous gravels, to raise the pH and increase the fertility. In this case the surface soil is high in ash, black and well decomposed, with a ground cover of grasses (Modal Profile 2). Due to cost and availability lime has replaced the heavy applications of marling materials as practiced in the 19th century, resulting in an Oap of lower ash content and, depending on age, more recognisable plant remains.

Soil Suitability: These areas have a definite potential for afforestation, grassland, and in some instances, a range of crops such as cereals, carrots and celery. All three enterprises are practiced within the county on these areas. With suitable drainage and management the physical nature of such soils presents little or no problem; nutritional problems are also easily overcome. Frost is a hazard in lowlying areas.

Profile descriptions and analyses are given in Appendix II.

Banagher Series

This Series occupies 8,238 hectares (4.8%) of the county. It occurs not only as large individual broad flat expanses but as small pockets within many of the more extensively-mapped mineral soils. The plant community which forms the parent material of this Series is characteristically minerotrophic.

The soil profile shows a black, well-decomposed surface horizon of variable thickness (10—50 cm) with a relatively good structure where artificial drainage has been maintained. The presence of stones within this horizon indicates the addition of mineral matter which improved its fertility, raised the pH and reduced poaching damage. The sub-surface horizon is dark reddish-brown with recognisable wood and herbaceous plant remains in a humified matrix. In some places the presence of sulphides in the lower horizons indicates a permanent water table. These soils «re usually moderately deep (< 100 cm) (Profile 1) and in many cases they are substantially deeper (> 150 cm) (Profile 2). The underlying mineral substratum varies from shell marl to glacial drift materials.

Soil Suitability: The use range of these soils at present is very variable. Many of these organic soils show the effects of previous cultivation. In many instances the vegetation has reverted to a very poor condition (rushes and sedges) although field outlines are still discernible either by the presence of fence lines of "filled in" drains. Where the arterial drainage has been improved and good water outlets occur they are very amenable to improvements. With adequate manuring and reseeding, together with good management, very high levels of production can be obtained consistently, both under grassland and tillage crops and in particular under vegetable cropping.

Copper deficiency in cattle, sheep, cereals and other tillage crops is widespread on these soils, while manganese deficiency is widely reported in tillage crops particularly oats, barley and sugar beet.

However, where a suitable water outlet does not occur they are only suitable for rough summer grazing and forestry.

Profile descriptions and analyses are given in Appendix II.

Pollardstown Series

This Series occupies only 158 hectares (.09%) of the county. It is limited in extent since almost all the fen peat has been drained with only a few small areas constituting this Series left in their original condition.

Soil Suitability: In its present condition this soil is not suitable for agriculture but has potential for amenity and wildlife conservation.

Industrial Complex

Since the late 1930s, Bord na Mona (Irish Peat Development Authority) have developed throughout the Midlands large expanses of raised bog for the production of horticultural moss peat and peat fuel. Within County Laois, however, Bord na Mona have developed raised bogs for moss peat production only, the Coolnamona Group west and south of Portlaoise town. Moss peat, as described above, is produced from the upper tier. Thereafter the residual peat will be used for peat fuels. The flat to gently undulating organic soils landscape resulting from these operations will create new areas with large-scale land-use possibilities. This Complex occupies 1,320 hectares, or 0.77% of the county.

Land Suitability: The suitability of these areas is basically dependent on the depth and type of peat which remains after production has ceased and on the type of sub-peat mineral "soil". Various enterprises are being experimentally evaluated at the present time to assess their suitability for forestry production, grassland production and horticulture which includes vegetable crops and nursery stocks. In the overall evaluation of these areas the amenity aspect warrants special consideration. However, the selection of the particular land-use enterprise which should be followed will depend largely on soil type and future economic and social circumstances.

SLIEVE BLOOM SOILS

Like the Castlecomer Plateau in the south-east, the Slieve Bloom mountain range forms a distinct geographical unit in the north-west of the county in the Laois-Offaly border area.

Three important groups of soils have been recognised and mapped in Slieve Bloom, namely the shale-derived soils, the sandstone soils and the blanket peats. The last-mentioned, which occur at the top of the mountains, are independent of parent material because their origin is due to climate and is not related to the underlying geological material.

Shale Soils

Soils derived from shales form an important group of soils in the Slieve Bloom area, both because of their extent and because they are some of the best soils in the hill area. In Co. Laois they are found only in the southern slopes of the mountains.

The shale soils are found chiefly at elevations of 150—400 metres where deeply dissected valleys are a noted feature of the landscape. The soft shale rock offered less resistance to weathering than the surrounding coarse-grained sandstone, thereby giving rise in many cases to steep-sided valleys which are for the most part now densely wooded.

Most of the shale soils are derived from glacial drift deposits, composed mainly of Silurian shale with a small admixture of sandstone and some Galway granite and other erratics. In the more elevated areas and especially where the slopes are very steep, the drift mantle has been eroded away and the soils are derived therefore from the underlying shale bedrock.

Within this group the soils were separated and mapped on differences in profile development, subsequent modification and drainage differences giving three main divisions, Brown Earths, Podzols, and Gleys. The Brown Earths were further subdivided into slope categories which were considered important in terms of land use.

Brown Earths

Baunreagh Series
Soil Character: These soils cover an area of approximately 933 hectares (0.54% of the county) at elevations of 150—320 metres but mostly between approximately 200 and 300 metres. They occur on undulating to rolling topography on slopes of *4*—8°. These soils are derived mainly from glacial till composed of shale with a variable but small admixture of sandstone (Fig. 4.7).

These moderately deep, well-drained soils have a loam to clay loam texture, good structure, friable consistence, low base status and have been classified as Brown Earths. The soil profile consists of a brown to dark-brown friable loam to clay loam surface A horizon over a distinct yellowish-red to strong-brown subsoil B horizon whose characteristic colour is due to an accumulation of iron oxides and humus leached from the surface layer above. The accumulation, however, is not intense enough to warrant classification as Brown Podzolic soils. Where the sandstone content is relatively low the silt content ranges from 30 to 40% with around 27% clay in the surface A horizon (Fig. 4.8). Where there is a greater sandstone influence (Profile Analysis 2) both silt and clay content are noticeably lower. In the semi-natural state the soils are acid with pH values of 4.5 to 4.9 in the Al horizon, rising to 5.5 in the subsoil horizons. The free drainage, good structure, friable consistence and prolific root development down to the base of the B horizon are characteristic features of these soils. Moisture-holding capacity is moderately good but drought problems can be severe in dry seasons.

Some inclusions of a gravelly variant have been observed within this Series, but the areas are too small to map at the scale of mapping employed. They are usually very

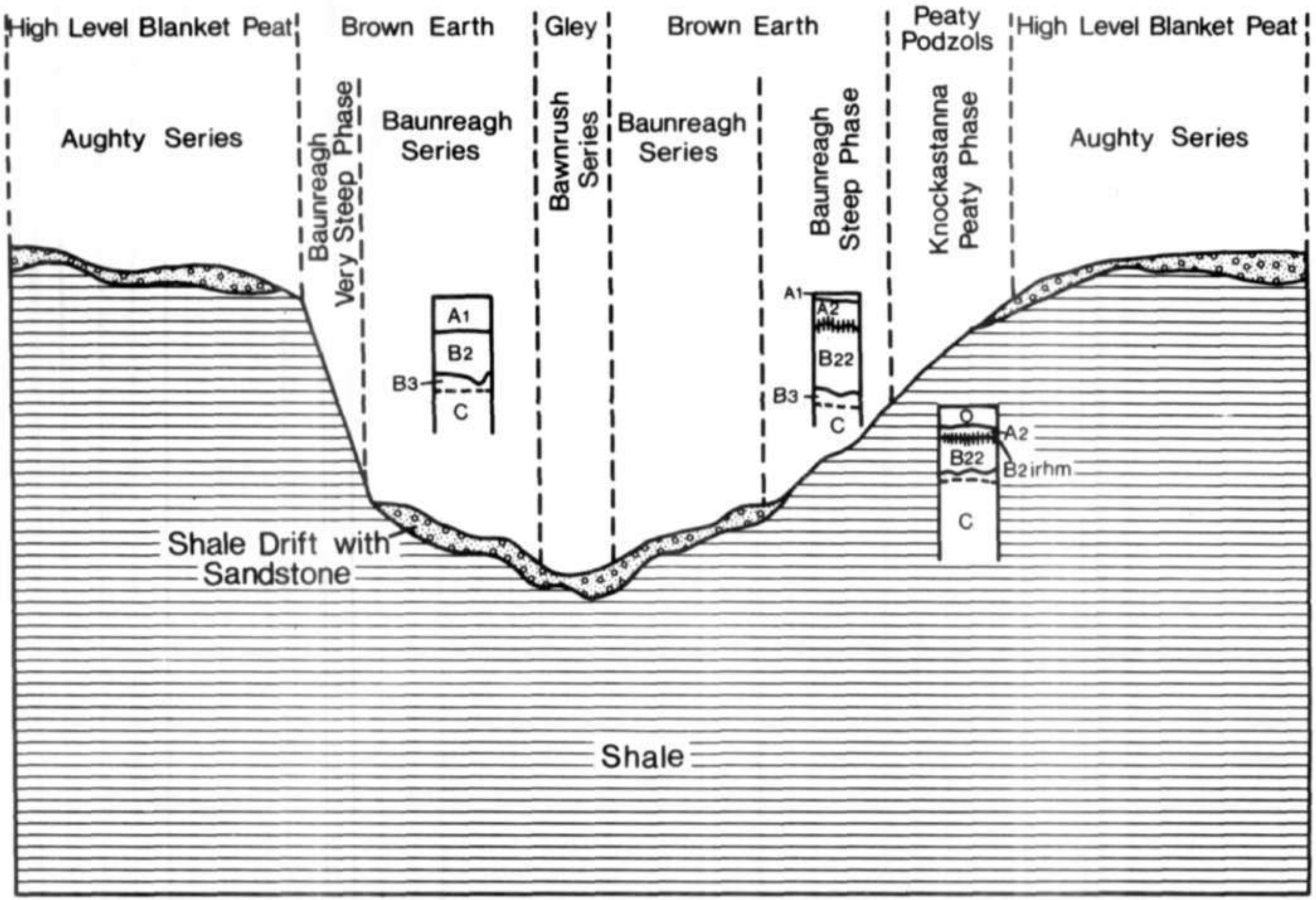


Fig. 4.7: Relationship between landscape features, geology and some shale soils on the Slieve Bloom mountains and foothills.

similar to the Baunreagh Series but are significantly coarser in texture with significantly lower clay and silt contents (Baunreagh Gravelly Variant, Modal Profile 2).

Soil Suitability: These soils have a fairly wide use range. With their good physical properties, cultivation presents no major problem. The soils are capable, therefore, of producing a fairly wide range of arable crops. However, good yields cannot be expected without frequent application of lime and fertilisers. Even with adequate use of fertilisers, climatic limitations place restrictions on tillage cropping. The high rainfall (1,000—1,400 mm per annum), high humidity and lower temperatures associated with the higher elevations at which these soils occur result in lower yields together with late and troublesome harvesting conditions for cereals. At present, tillage cropping is limited to the growing of barley, oats, swedes, mangels, potatoes, kale and rape.

These soils have a good potential for grass production, but unless adequately fertilised and managed the more valuable sown species are replaced by inferior indigenous grasses and weeds. Grass conservation, particularly hay-making, is troublesome especially in late summer as a result of the high humidity and frequent rains and mists. June is the most favourable month for hay making.

Profile descriptions and analyses are given in Appendix II.

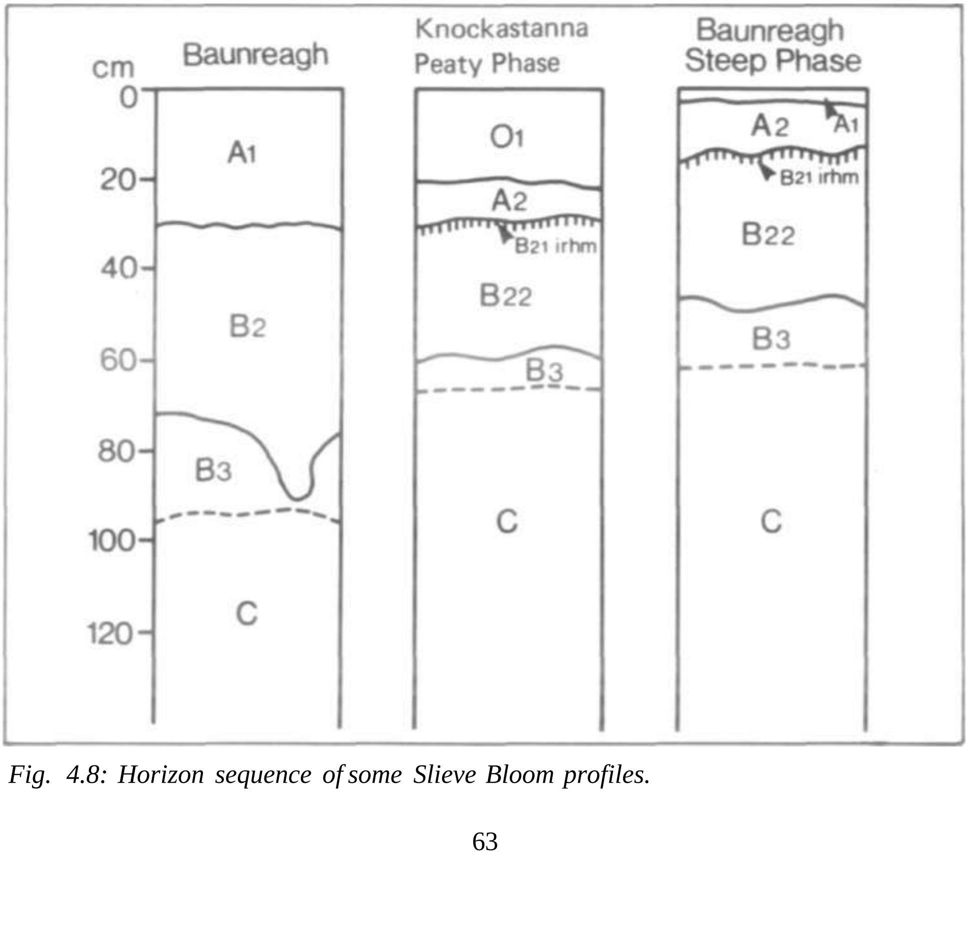


Fig. 4.8: Horizon sequence of some Slieve Bloom profiles.

Baunreagh Steep Phase

Soil Character: This Series occurs on higher portions of the landscape above the Baunreagh Series and on steeper slopes (18—32°) where the drift cover is minimal or absent, and the soils are derived mainly from disentegrating shale bedrock.

On the steeper slopes, where cultivation is difficult if not impossible, the soil profile is strongly podzolised. It shows a thin Al horizon overlying a bleached A2 and a thin almost continuous ironpan which rests directly on top of a well-developed friable yellowish-red podzol B horizon (Modal Profile 1). The characteristic colour of the B horizon is due to the accumulation of iron oxides and humus. It grades into disintegrating shale at a depth of approximately 60 cm. Soil pH rises from 4.1 on the surface to over 5 in the subsoil. Roots penetrate freely below the ironpan. Even relatively shallow cultivations could obliterate the surface horizons, including the ironpan. Where the soil has been cultivated in the past, it is very similar in profile characteristics to the Baunreagh Series. The only noticeable difference is the higher silt and clay content which is attributed to the stronger influence of shale in the parent material.

On very steep slopes the profile shows a thin peaty layer overlying a bleached A2 and a weakly-developed but continuous ironpan which in turn rests on the well-developed B horizon (Modal Profile 2). This phase covers only 599 hectares (0.35% of the county).

Soil Suitability: These soils have a limited use range. Arable cropping is extremely difficult. Consequently they are not now tilled. Grassland farming too is very difficult and many of these areas become infested with fern and gorse. The soils are therefore best suited to forestry (Plate 4.6). A large portion has been planted with trees in the last 30 years.

Profile descriptions and analyses are given in Appendix **II.**

Podzols

Knockastanna Peaty Phase

Soil Character: These soils cover only 423 hectares (0.25% of the county). They occur on fairly steep slopes (10—18°), between the Brown Podzolics of the valleys and the Blanket Peats above at elevations of approximately 275—375 metres (Fig. 4.7). The soils are normally derived from the underlying shale bedrock but in some places there is a significant admixture of sandstone-containing drift material. The high elevation, with attendant higher rainfall and lower temperatures, has contributed to the highly-leached nature of the soils and to the surface accumulation of raw humus.

These peaty Ironpan Podzols are characterised by a peaty surface horizon, a strongly leached A2 horizon, a thin continuous tonguing ironpan and a thick, strong-brown B22 horizon overlying the shattered shale bedrock (Conry, 1972)(Fig. 4.8). The surface peat varies in depth from 15 to 30 cm but where the slopes are steep (18—25°) the peaty surface layer is less than 5 cm deep and the ironpan is not so strongly developed. The few small areas of this kind, which occur chiefly at the head of the Gorteen River, are treated here as an inclusion with the above soils. The ironpan shows a highly significant free-iron accumulation and a humus enrichment while the underlying B22 horizon also shows a substantial increase in free-iron and humus. Root and water penetration are impeded by the ironpan; root development is confined to the horizons above the pan.

Where there is a significant admixture of sandstone in the parent material, the silt and clay contents are significantly lower (see Profile Analyses 2).

Somewhat similar soils have been mapped in Carlow and Wexford as the Black Rock mountain Series and in Annascaul, Co. Kerry as the Glanmore Series (Gardiner and Ryan, 1964; Conry and Ryan, 1967; Conry and O'Shea, 1971).

Soil Suitability: The soils of this series have a very limited use range. They are suited only to forestry or extensive grazing. Their nutrient status and lime content are very low and manganese, copper and cobalt levels are deficient. The application of lime and to a lesser extent fertilisers in these areas is difficult. For hill-grazing purposes, however, stock-carrying capacity can be improved considerably by the application of phosphatic fertilisers with some cobalt, and where feasible, by some overseeding.

Small areas of these soils have been reclaimed in the past. Details of profile and land use changes are given by Conry (1972). Where extensive areas of these soils occur on moderately steep slopes they are suitable for reclamation using modern methods of deep ploughing, levelling, rotavating, reseeding and fertilising. Although the land use range of these reclaimed soils has been improved by human activity, their inherent infertility is still reflected in the reclaimed soil. They are only capable of growing a limited range of arable crops such as potatoes, oats, cabbage, kale and root crops including swedes and mangels. Only when adequately limed and fertilised can reasonable yields of these crops be obtained. This is also true of grassland which degenerates quickly unless fertility levels are maintained.

Profile descriptions and analyses are given in Appendix II.

Gleys

Bawnrush Series

Soil Character: This soil occupies an area of 335 hectares (0.2% of the county). It is the wet component of the Baunreagh Series. It occurs on the lower parts of the landscape in depressional areas and in deeply dissected valleys close to streams and rivers (Fig. 4.7). Slopes are normally less than 8° but some areas can be almost flat, particularly when adjacent to streams and rivers. The poor internal drainage properties of the soils are due to excess seepage from higher ground.

The soil consists of a dark greyish-brown strongly-mottled surface layer over grey and mottled subsoil horizons. Soil structure is weak and root development is largely confined to the surface horizon. Alluvial soils occur in association with this soil, particularly where streams and rivers occur. The alluvial soils, like the gley soils, are medium to heavy textured and generally poorly drained. Although fertility levels are reasonably high, their physical limitations place severe restrictions on their use range.

Soil Suitability: These soils have a limited use range. They are unsuitable for arable cropping. They are best suited to grassland and forestry production. Optimum grass production cannot be obtained without artificial drainage. Even then the high elevation at which they occur and their susceptibility to poaching limits both grass production and utilisation. Where these soils have been planted with Sitka spruce (Plate 4.6) very high levels of production have been obtained.

Sandstone Soils

The sandstone soils are by far the most important group of soils in the Slieve Bloom region because they account for over 90% of the hill soils. They occur throughout the whole area, right from the south-western tip near Roscrea to the opposite end at Rosenallis.

Most of the sandstone soils are derived from glacial drift deposits which have been carried on to the hills by the various ice movements from the north and northwest. The presence of silicaceous chert indicates that the drift originally contained a proportion of more soluble limestone. However, almost all this limestone has been removed by post-glacial weathering and the parent material of the bulk of the sandstone soils, therefore, consists of till composed of coarse-grained sandstone and chert with some shale, Galway granite and other erratics. Calcareous till with a high proportion of sandstone and some limestone is found only in wet lowlying depressional areas at the foot of the hills where post-glacial weathering has not been intensive enough to remove

Plate 4.6: High-yielding Sitka Spruce on the Bawnrush Series in the Slieve Bloom Mountains.

all the limestone. On moderately steep and steep slopes, where post-glacial weathering has removed the drift deposits, the soils are derived from the underlying bedrock.

The sandstone rock itself is a highly silicaceous coarse-grained sandstone. Where the cleavage is good it breaks into flagstones, known as Clonaslee stone, which are widely used for ornamental building purposes. Throughout the sandstone there are some large and many smaller areas of coarse-grained conglomerate. This conglomerate is also highly silicaceous and hardwearing and therefore often occurs as prominent knobs on which the drift cover is thin or absent.

There is a wide range of profile development within the sandstone group including Brown Earths, Humus-iron Podzols, Ironpan Podzols, Reclaimed Podzols, Peaty Gleys and non-Peaty Gleys. These profile differences together with slope difference were the main criteria used in separating and mapping the various soils within the sandstone group.

Podzols

Conlawn Series

Soil Character: This soil occurs mainly on convex southern slopes with the largest single area occurring south of Conlawn Hill near Ballyfin. They cover an area of 352 hectares (0.21% of the county) between 170 and 300 metres elevation (Fig. 4.9).

These strongly-leached coarse sandy soils have been classified as Humus-iron Podzols. The profile consists of a shallow peaty layer (3—20 cm thick) overlying a whitish grey coarse sandy A2 horizon which in turn overlies a humus-iron B horizon in which iron and humus have accumulated from the upper leached horizons (Fig. 4.10). The B horizon is subdivided into an upper darker humus-rich B2h and a lower yellowish iron-rich B2ir. The soil carries a heavily-grazed dry acid vegetation dominated by heath (Dry facies of Wet Heath Type 4 Vegetation, Cotton, 1974). The peaty surface layer is rather thin in places, probably due to its continued removal as sod peat for domestic fuel. Within this soil rocky portions occur, especially where the underlying sandstone grades into a conglomerate.

A sizeable proportion (up to 25%) of peaty gleys and some ironpan podzols also occur within this mapping unit in a pattern which would not allow their separation at the level of mapping employed.

Soil Suitability: In the natural state the use range of these soils is limited to rough grazing. A small area which has been planted with spruce and pine is giving moderately good results. These podzols are ideally suitable for reclamation because they have only a shallow peaty layer and are free draining. A further advantage is that most of these soils occur almost exclusively on the warmer south-facing slopes. The occurrence of rocky patches is a disadvantage for reclamation but the fact that most of this reclaimable land occurs as commonage is a far greater obstacle to any improvement in the use range of these soils.

Profile descriptions and analyses are given in Appendix II.

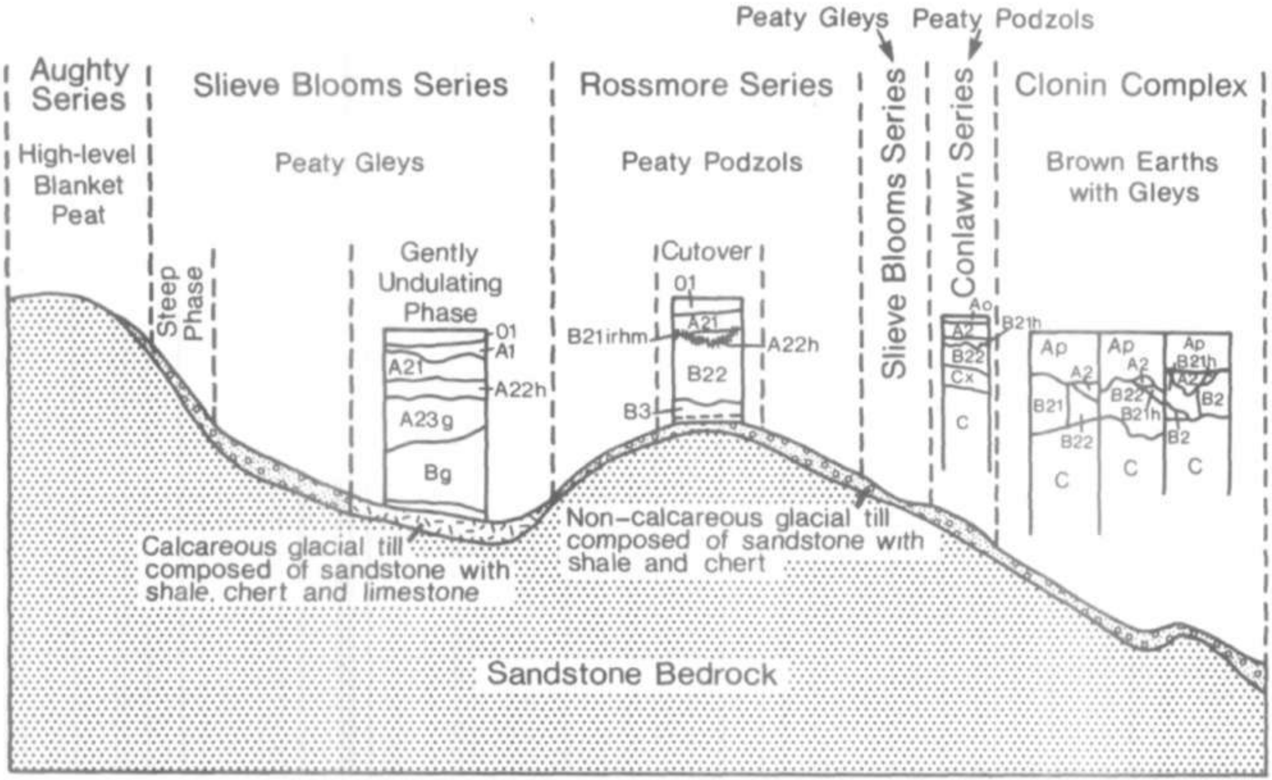


Fig. 4.9: Relationship between landscape features, geology and some sandstone the Slieve Bloom mountains and foothills.

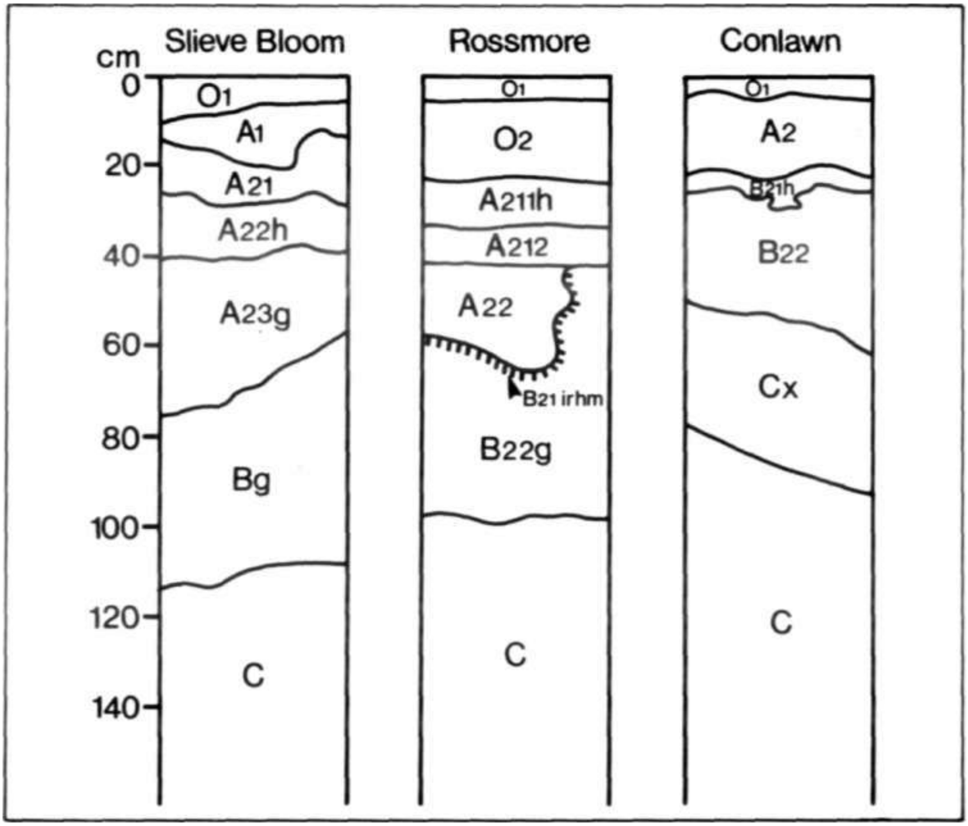


Fig. 4.10: Horizon sequence in some Slieve Bloom profiles.

Rossmore Series

Soil Character: The Rossmore Series occurs on rolling topography at elevations of 120—400 m where the higher rainfall and lower temperatures associated with these elevations are conducive to intensive leaching and the formation of surface peat. These soils occupy 669 hectares (0.39% of the county). The soils are derived from glacial till composed mainly of Old Red Sandstone with the admixture of chert and sometimes shale (Fig. 4.9). It is postulated that where the shale content is significant more poorly drained soils develop.

The dominant soil is a free-draining soil which is classified as a peaty ironpan podzol or Placorthod (USDA, 1975). The profile consists of a peaty surface horizon overlying a well-developed A2 horizon and a thin ironpan which in turn overlies the well-developed yellowish-red friable spodic B horizon in which there is a substantial accumulation of iron oxides and humus (Modal Profile Fig. 4.10). This B horizon grades through a B3 into parent material at a depth of 80—100 cm. Normally the lower part of the A2 horizon contains a dark accumulation of humus above the iron pan. Those soils have a relatively low clay and silt content. Occasionally where the texture is coarser these soils grade into the humus-iron podzols of the Conlawn Series. More often, however, they grade into Peaty Gleys which have almost continuous ironpans but do not have spodic B horizon (Modal Profile 2). Instead the B horizon is compact and strongly mottled. It is a peaty gley with ironpan (Placaquod). It is postulated that the slightly higher silt and clay content is responsible for the difference in profile development. It is further postulated that the higher silt and clay content is due to a higher proportion of shaly material in the glacial till cover. There is considerable evidence to suggest that the peaty surface was much thicker originally but that it has been largely removed as domestic fuel.

Soil Suitability: Up to 10 years ago or so these soils were only used for rough summer grazing for cattle. But since that time an increasing acreage have been planted, mainly with Sitka spruce and Contorta pine.

The Podzols are suitable for reclamation provided ploughing is deep enough to break the impervious ironpan. With deep ploughing, rotovation, levelling, seeding and the use of adequate lime and fertilisers and a good level of management these mountain soils could produce good grass. The grazing season, however, is relatively short at these elevations. In a few places outcropping or subsurface rock can be an obstacle to reclamation. The fact that most of these soils occur as commonage is a far more serious constraint on development than any physical limitations.

Profile description and analyses are given in Appendix II.

Plate 4.7: Integrated land use on the Slieve Bloom Mountains.

Slieve Bloom Series

Soil Character: The most important extensive group of soils on Slieve Bloom are the sandstone soils derived from predominantly sandstone drift material. Within these sandstone soils, the peaty gleys of the Slieve Bloom Series are by far the single most important and extensive soils mapped in the mountain part of the Slieve Bloom region. These peaty gleys on rolling topography (excluding peaty gleys which have been mapped as slope phases) cover a total of 3,661 hectares, accounting for 2.13% of the total area of the county (Fig. 4.9).

These peaty gleys occur on rolling topography at elevations ranging from 120 to as high as 450 metres in places. Slopes very from 5 to 16° but most of the slopes are between 5 and 10°.

Although they occur on moderate slopes they are predominantly wet due to the slow permeability of the compact subsoil material. The low permeability is due not to a high content of fine material in the soil but to the close packing of the finer material (silt and clay) between the coarser particles (Collins et al, 1977). Such an arrangement of soil particles reduces the amount of voids and air space to a minimum, thus reducing soil permeability also to a minimum. The slow permeability of the soil together with the cool wet climate at these elevations gives rise to the development of poorly-drained peaty gleys.

The soil profile consists of a peaty surface layer which overlies grey and mottled subsoil horizons. The lower part (A22) of the leached layer is compact and olive grey in colour, but the upper part (A21) of the leached layer is friable and dark-coloured due to humus accumulation. Sometimes the upper and lower parts of the A2 horizon are separated by a fairly distinct layer of humus-rich material (A2h). The grey and mottled subsoil Bg horizon grades into the compact sandstone parent material at a depth of about 1 metre (Fig. 4.10).

The peaty surface layer varies in depth from 5—35 cm but it is generally 15—25 cm deep. This variability in depth is due to intermittent and irregular sod removal. Sod removal for domestic fuel was witnessed in 1975. Where these soils have been mapped at higher elevations there is strong evidence that many of them originally carried a thick layer of peat which has now been removed for fuel.

The peat layer is normally wet and spongy with surface-water lodging in the local depressions except in dry periods. Irrespective of peat depth it carries a typical heavily-grazed wet-heath type vegetation dominated by heather *(Calluna vulgaris)*, heath rush *(Juncus squarrosus)*, deergrass *(Tricophorum caespitosus)*, and moss *(Sphagnum* spp.) with smaller amounts of bog cotton *(Eriophorum angustifolium)*, purple moor-grass *(Molinia caerulea)*, bog asphodel *(Narthecium ossifragum)* and *Erica tetralix* (Cotton, 1974).

Rocky areas occur frequently within this mapping unit, especially where the sandstone grades into quartzitic conglomerates.

Some small areas of very wet flush soils also occur within the Slieve Bloom Series, in flatfish areas and local depressions where seepage waters accumulate. The soil profile consists of a wet mucky peat which may be 30—70 cm deep over strongly-gleyed compact subsoil horizons derived from sandstone drift deposits. The mucky peat may be up to one metre deep in places. These soils carry a typical wet vegetation (Type 5a; Cotton, 1974) in which bog cottons are absent and rush species, both *Juncus effusus* and *J. acutiflorus*, are more prominent; *Sphagnum* mosses are common together with plants like *Potentilla erecta*, Sweet vernal and *Viola palustris*, which indicate higher levels of nutrients.

Soil Suitability: These soils have a limited use range. In the past they were used only for rough grazing for cattle in the summer from June to September. But in the last two decades an increasing acreage of these soils have been planted, principally with Sitka spruce and Cortorta pine.

There is an increasing interest in reclaiming these soils through a process of deep cultivation, rotovation, levelling, seeding, liming and manuring. However, as these soils usually occur above 200 metres the grazing season is rather short especially on north-facing slopes. Good management and constant attention to liming and fertilising is essential to maintain high levels of production. One of the main disadvantages of these reclaimed peaty gleys is that, even after reclamation using the best possible techniques, they are still inherently wet soils and are, therefore, easily poached by grazing stock.

Profile descriptions and analyses are given in Appendix II.

Slieve Bloom Series-Steep Phase

This soil is again similar to the peaty gleys of the Slieve Bloom Series but it occurs on steep slopes of 15—25° with most of the slopes between 18 and 22°. This phase covers an area of 423 ha (0.25% of the county). These soils are only suitable for rough summer grazing and forestry.

Slieve Bloom Series-Undulating Phase

These soils are very similar to the Slieve Bloom peaty gleys with which they are closely associated on the landscape and occupy 1,813 hectares (1.06% of the county). As they occur on flatfish slopes on lower portions of the topography they show some differences. Firstly, the peaty surface layer of the gently-undulating phase is wetter for a longer part of the year due to slower run-off on these flatfish slopes. Secondly, the well-developed characteristic humus concentration (A2h) in the A2 of the Slieve Bloom Series is mostly absent. Thirdly, the parent material of this soil is calcareous at depth. Otherwise the soils are very similar in profile characteristics.

In the semi-natural state they have the same use range as the Slieve Bloom Series. However, they are less suitable for reclamation because surface water is more difficult to dispose of on these flatter slopes. There is strong evidence that a considerable depth of peat has been removed for domestic fuel from some of these soils. Just as in the Slieve Bloom Series, the coarser-textured free-draining Conlawn Series and Rossmore Series also occur on better drained knolls within this Series.

Profile descriptions and analyses are given in Appendix II.

Slieve Bloom Series-Non-Peaty Phase

These poorly-drained non-peaty podzolised gleys occur at a wide range of elevations from 100—300 metres. They are usually found in local depressions but they can occur extensively on fairly good slopes where seepage water from the higher ground contributes to the poor drainage. These soils are derived from weathered glacial till material composed mainly of sandstone with some chert. At lower elevations, around the periphery of the mountains on flattish topography and local depressional areas, the original limestone content of the till has been largely preserved by its position in the landscape.

The profile consists of a dark greyish-brown sandy loamy surface horizon overlying a grey and mottled compact subsoil horizon. The mottling can be extensive in places. The outstanding feature of these soils is their low permeability. Despite the rather high content of coarse soil particles the soils are compact with low content of voids and air space. This is due again to the close packing arrangement of the soil constituents in which the finer material (silt and clay) fills the spaces between the coarser sand grains.

This Series occupies 4,190 hectares (2.4% of the county).

Soil Suitability: The use range of these soils is rather limited and depends to a large extent on whether they have been artificially drained. On the whole, they are inherently poor and difficult to manage. Even when artificially drained they are unsuitable for tillage cropping due to the poor physical properties and unfavourable climate at these elevations. Where a high standard of management is practised on

Plate 4.8: Monicknew amenity area near The Cut, Slieve Bloom Mountains.

areas which have been artificially drained they can, with adequate liming and fertilising, produce a fairly good sward of grass. At the other end of the spectrum where management is poor these soils become rush-infested and are generally unproductive. They are suitable for forestry, especially for planting with Sitka spruce.

Complexes

Clonin Complex

A large area of cultivated sandstone soils have been mapped around the Slieve Bloom foothills at elevations of 120—300 metres. This Complex occupies 4,471 hectares (2.6% of the county). They are derived mainly from sandstone glacial till containing a proportion of chert and some shale. In many places where the slopes are very steep the soils are derived from the underlying sandstone bedrock. The soils derived from the sandstone till are complex both in profile characteristics and distribution patterns. In fact the pattern is so complex that, in one profile pit, one, two or even three well-defined soil types can be recognised. These soil types include Brown Earths, Brown Podzolics, Reclaimed Podzols and Gleys. Observations indicate that the dominant soils in this area are free-draining soils which show various degrees of podzolisation. Generations of cultivation, together with the addition of liming agents and fertilisers tend to obliterate their podzolised nature and give a uniform appearance to the surface A horizon.

Despite this variability the soils have a number of common characteristics. Firstly, by virtue of their elevation they can all be classified as hill soils on rolling topography. Secondly, they are all derived from predominantly sandstone material. Thirdly, they have fairly uniform textural limits. They have relatively low silt and clay contents—silt varies from 13 to 26% but is generally 18—21%, while clay content is seldom above 17% and is normally 10—15%. Finally, they have fairly uniform dark greyish-brown sandy loam surface A horizons.

The dominant soil in the Complex grades from Brown Podzols to Podzols. They are moderately deep, friable, well-drained soils with a sandy loam texture and good structure; the soil profile consists of a dark greyish-brown A horizon overlying a brown to strong-brown or yellowish-brown subsoil B horizon (Fig. 4.11). But in most profile pits (Fig. 4.11) the presence of a leached A2 horizon and humus B2h horizons at least in part of the profile provides conclusive evidence of even more intense podzolisation. The evidence further indicates that most if not all of these soils have been reclaimed from mountain hill-land. The more intensely-podzolised portions ha^ve coarse textures (Modal Profile 3). A careful study of the relevant profiles (Modal Profiles 1, 2 and 3) and diagram (Fig. 4.11 provides clear evidence of the complexity of the situation.

Furthermore, throughout these soils sizeable proportions of soils occur in local depressions and on sloping ground which receive seepage from above. They range from Gleyed Brown Earths in the less-impeded areas to poorly-drained Gleys. They form an intricate pattern within the well-drained leached soils but ate not separated at the scale of mapping employed.

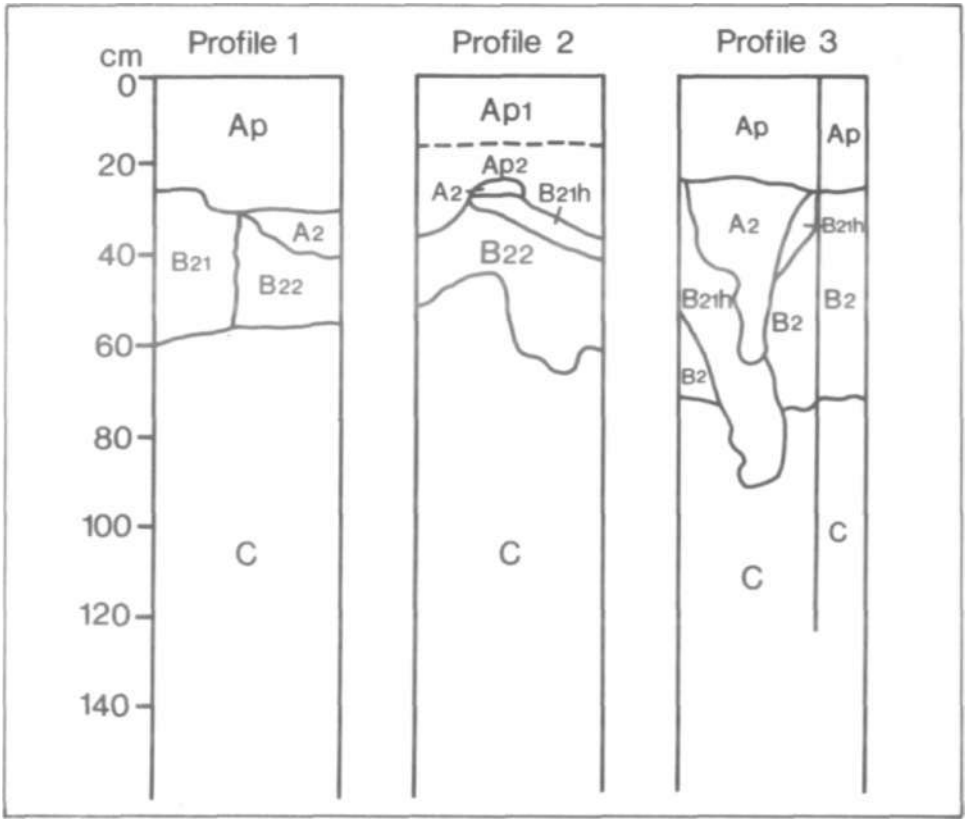


Fig. 4.11: Diagrammatic representation of horizonation complexity in the Clonin Complex.

In some places where the drift cover is thin or absent rock comes close to the surface and the soil consists of a shallow Brown Podzolic overlying shattered sandstone bedrock (Shallow Brown Podzolic—Profile Analyses 4).

Although a huge amount of stones, both large and small, have been removed from these areas over the years, many fields still contain a proportion of smallish or flat stones.

Soil Suitability: The Complex has a fairly wide use-range. They are easily cultivated due to their desirable texture, structure and consistence. The high stone content can be troublesome. They are capable of producing a variety of tillage crops including barley, oats, beet, swedes, mangels, kale, rape and potatoes. But because of their inherently low fertility, lime and fertilisers must be applied regularly. Even with adequate fertiliser use, climatic limitations impose restrictions on almost all tillage crops and particularly on cereal production.

The present level of grassland management is low due mainly to inadequate lime and fertiliser use and to poor management. Many pastures become infested with gorse (furze) when neglected. Even when fertiliser application is high and management is good, very high levels of production cannot be obtained due to climatic limitations. Hay making is troublesome due to high humidity and frequent summer rain and mist.

Profile descriptions and analyses are given in Appendix II.

Cardtown Complex

Soil Character: The soils of this gravelly Complex occupy 2,236 hectares (1.3% of the county). They occur mainly on the southern side of the Slieve Bloom mountains where the fluvio-glacial coarse gravels and sands were deposited by the melt waters of the retreating stages of the last ice movement. They are composed mainly of sandstone, limestone and shale with inclusions of Galway granite and other erratics. Elevation varies from under 150 to over 240 metres. The topography is undulating to hummocky with sharp slope changes ranging from 0—12° and occasionally up to 20°. These sharp changes in landscape features are mainly responsible for the variability of soils and the intricate pattern of distribution within the complex. Because of the latter it was not feasible to segregate the different soil components at the scale of mapping employed. Consequently, the soils have been mapped as a Complex.

Four major soils have been recognised within the Complex:

1. *Moderately deep component:* On the undulating topography and on the lower slopes of the hummocky hills and eskers, moderately deep soils have been developed. These are naturally well-drained, friable gravelly sandy loams. They have been classified as Podzols. This soil accounts for approximately 60% of the total areajof the Complex.

   The profile is characterised by a dark greyish-brown to dark-brown surface horizon 25—38 cm deep with remnants of a bleached A2 and humus B (B2h) overlying a well-expressed spodic yellowish-brown B2 horizon. In places the humus B does not occur and in other places the spodic B is poorly developed. Structure is moderately well developed and the soils are very friable. Roots are plentiful in the surface horizon and penetrate freely to the upper portion of the calcareous gravels. Moisture-holding capacity is moderately good, but in prolonged dry periods a moisture deficit develops.

2. *Shallow component:* On the crests of the hummocks and higher portions of the eskers the soils are very shallow, excessively drained, of stony or gravelly coarse sandy loam texture and medium base status. These have been classified as Brown Earths. They occupy about 30% of the Complex.

   The profile is characterised by a dark-coloured A horizon which passes directly into the coarse-textured, calcareous parent material. The A horizon varies in depth from 18—35 cm, has a friable consistence and a well-developed crumb structure with abundant roots. Moisture-holding capacity is poor and a moisture deficit develops in most years.

3. *Imperfectly-drained component:* On flatfish lowlying areas the soils are imperfectly drained, of sandy loam texture; they have been classified as Brown Earths with gleying. Due to their lowlying position, a high water-table affects the lower portions of the profile for the greater part of the winter period causing gleying in this zone. Although root development is largely confined to the upper A horizon,

these soils are not subjected to drought due to the proximity of the water-table even in dry periods. This component comprises about 5% of the Complex.

4. *Poorly-drained component:* On the lowest portions of the topography where the water-table is permanently high, the soils are poorly drained and often have a peaty surface horizon. They have been classified as Gleys.

Soil Suitability: Due to their excellent physical properties, these soils are very amenable to arable cropping. However, tillage crops are not grown to any great extent due mainly to the climatic limitations imposed by the high elevations (about 150 metres) at which these soils occur. The higher rainfall and lower temperatures are not conducive to cereal growing, especially wheat, but oats and barley can give good yields when properly limed and fertilised. Other tillage crops grown include potatoes, swedes, mangels, fodder beet and kale. Other factors militating against arable cropping in the area include small size of holding, small field size and the fact that store cattle production is the principal farm enterprise.

Well over 90% of the land is under grassland which has a strong presence of bracken and gorse, particularly at the higher elevations, suggesting that the standard of grassland production is quite low. As most of the soils are well drained and occur mainly on south-facing slopes, high levels of output could easily be achieved by standard improvement techniques including liming and fertilising, the introduction of new leys, weed control and good management.

Peats
(Histosols)

Blanket Bog

Blanket peats are described as Blanket Mire Soils by Hammond (1979). Two sub-types are described—a low-level Atlantic Sub-type which occurs along the western seaboard and the high-level Montane type which occurs at high elevations on the major mountain masses throughout the country. The latter type occurs extensively in Co. Laois on Slieve Bloom and to a smaller extent on the Castlecomer Plateau close to where the three counties of Carlo w, Laois and Kilkenny meet. In the Slieve Bloom area the high-level Sub-type occurs discontinuously at elevations greater than 210 metres but almost continuously at over 320 metres. On the Castlecomer Plateau they occur in depressional areas over 270 metres.

Blanket Peat covers a total area of 4,824 hectares (2.81% of the county).

Aughty Series

Soil Character: These soils in their natural state are acid, extremely wet and poorly drained. They carry a typical wet Upland Blanket Bog Type 5 vegetation (Cotton, 1974) dominated by *Sphagnum* spp., *Eriophorum vaginatum, Scirpus caespitosus, Calluna vulgaris* and *Narthecium ossifragum.*

Several mapping units have been recognised within these Blanket Peats. On flat to undulating topography on moderate slopes the depth of peat is consistently 1—2

Plate 4.9: Partially cutover peat on the Slieve Bloom Mountains with recent afforestation in left foreground.

metres. On steeper slopes of 5—8° there is a certain amount of peat slumping. The sub-type symbol Sm is used to denote these areas. They are conspicuous in the landscape by the higher concentration of dark-coloured *Calluna* which becomes dominant on the drier banks formed as a result of peat slip. Where the peat is shallower, 45—75 cm deep, it is denoted by the symbol Sh. The large areas which have been partially cutover for domestic fuel are denoted by the sub type symbol Cv. Hammond (1979) described these cutover areas as the man-modified Montane sub-type.

A profile description and analyses are given in Appendix II.

Soil Suitability: These soils have a very limited use range. In the past they have been used extensively as a source of domestic fuel. The high price of imported energy sources has resulted in renewed activity in this area in recent years (Plate 4.9). They have also been used to some extent as rough grazing for cattle. However, the quality of the rough grazing is extremely low—without access to areas of better-quality grazing, livestock will not survive on this type of grazing alone.

In the last 10 years or so the scarcity of better-quality land for planting has pushed forestry development onto these soils (Plate 4.9). The wisdom of planting them is very questionable both from the economic and aesthetic viewpoints and it would seem more appropriate to leave such areas as scenic, wildlife and environmental attractions.

A profile description and analyses are given in Appendix II.

The Castlecomer Plateau covers a sizeable tract in the south-eastern part of Laois. It forms a distinctive geographical area not only because of its elevation and its plateau-like features, but also because it consists mainly of wet rush-infested difficult land which is vastly different from the rich surrounding lowlands. The plateau-like feature is particularly well expressed when viewed from the east where the landscape rises sharply from 60 metres near Carlow to over 300 metres.

The wetness of the land is due to the dense tenaceous impermeable nature of the parent material deposited by the second-last (Munsterian) ice-sheet. This ice-sheet carried limestone from the surrounding northerly countryside, mixed it with the underlying shale flagstone and sandstone bedrock material, and gave rise to a dense tenaceous mantle of boulder clay overlying the bedrock formations. Where this material occurs it gave rise to wet gley soils. They are known as surface-water gleys because their wetness is due to the impermeable nature of the soil.

Plate 4.10: Rush-infested Gley soils on the Castlecomer Plateau.

The ice movement of the last glaciation (Midlandian) did not cover the plateau but during this ice age the mantle of boulder clay was eroded from the steeper slopes thus exposing the underlying shale, flagstone or sandstone bedrock formations. In these situations, well-drained Brown Earth soils have developed which stand out as ridges, islands or knolls of free-draining soils in a vast area of predominantly wet difficult soils (Fig. 4.12).

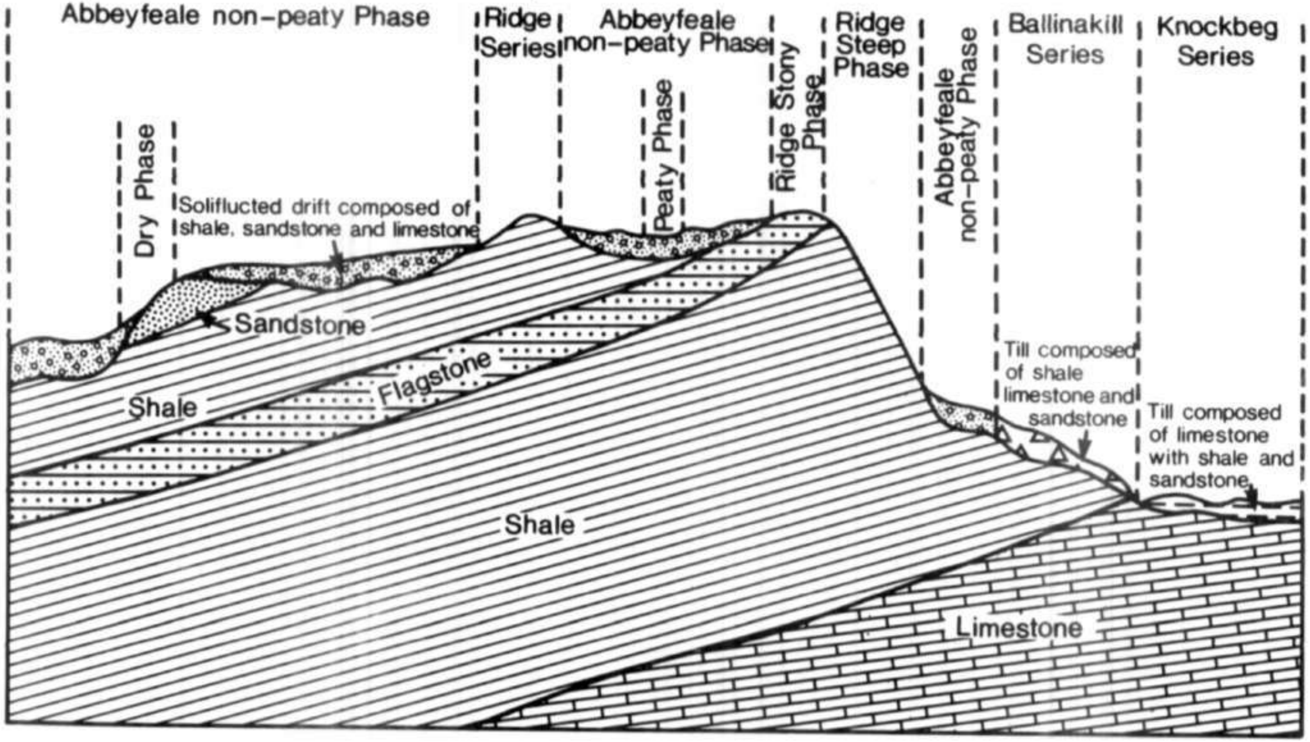


Fig. 4.12: Diagrammatic representation of soils in relation to landscape features and geology in the Castlecomer Plateau.

Ridge Series
Soil Character: These soils are situated on the top of the Castlecomer Plateau on undulating to rolling topography (Fig. 4.12). Slopes generally are less than 12° and elevations range between 200 and 300 metres. The drift cover deposited by the Munsterian ice movement on these topographic features has been eroded by the frost action of the last (Midlandian) glaciation. Consequently, the soils are derived mainly from the underlying carboniferous shales known locally as 'shlig' but have been influenced to a small extent by the soliflucted drift. This series occupies 1,936 ha (1.13% of the county):

The soils in this Series are moderately-deep, well-drained soils of low base status and are classified as Brown Earths. The profile is characterised by a dark-brown, friable, clay loam surface horizon overlying a yellowish-brown friable silt loamy B horizon.

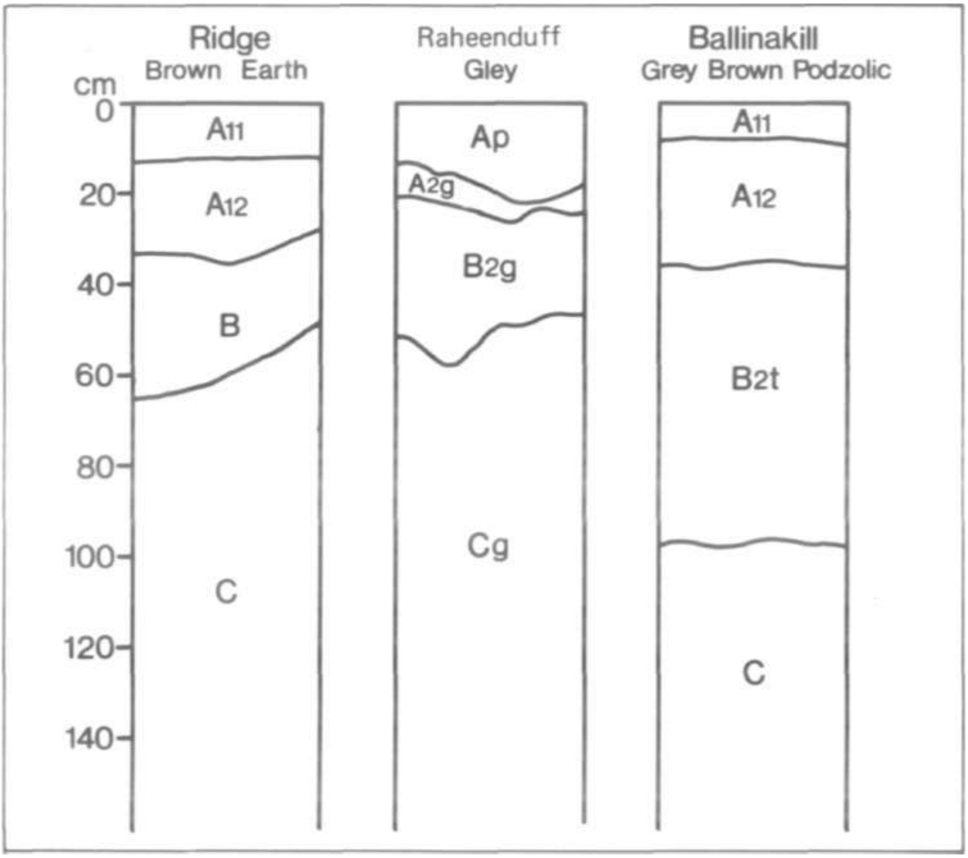


Fig. 4.13: Diagrammatic representation of the profdes of Ridge, Raheenduff and Ballinakill Series, Castlecomer Plateau.

The latter horizon merges with the olive-brown, shaly parent material at a depth of 50 to 65 cm (Fig. 4.13).

The A horizon, 25 to 35 cm deep, has a moderately strong granular structure and contains 26—34% clay and 40—45% silt. Places which have not been ploughed for generations have a stone-free surface A horizon which has been brought up by prolonged worm activity. Normally the organic carbon content is around 3—4% but it can be as high as 6% in these situations. Moisture-holding capacity of the soil is moderately good.

This soil has been mapped previously in Co. Carlow (Conry and Ryan, 1967) and is very similar to the Mountcollins Series in Co. Limerick.

Soil Suitability: These soils have a moderately wide use-range. Physically they are excellent soils but the high elevation, and its attendant colder and wetter climate, delays spring growth in most crops and causes late ripening, particularly of cereals. Winter barley is probably the most suitable cereal for these situations. Natural lime and nutrient status is low, and without liberal use of lime and fertilisers, especially phosphorus, yields are usually disappointing. The acreage of feeding barley is growing with the increased use of lime. Good yields of oats are obtained, as well as good crops of potatoes, swedes, mangels, kale and cabbage. Although the surface A horizons have a heavy texture with both a high clay and silt content, they are easily tilled due to their very good structure and friable consistence.

Grassland must be liberally fertilised and well managed if the potential of these soils for pasture and silage is to be realised. Even with good management, however, early grass production is difficult due to late warming-up of the soils in spring and the colder conditions generally.

Profile descriptions and analyses are given in Appendix II.

Ridge Steep Phase

Soil Character: This series occupies 440 ha (0.26% of the county), and occurs on the moderately steep slopes mainly on the escarpment of the Castlecomer Plateau. Although most slopes are under 30°, many are between 15 and 22°. The elevation varies from 120 to 300 metres O.D. Due to the steep slopes, glacial drift material is absent and the soils, therefore, are derived from the underlying carboniferous shale bedrock.

The soils are naturally well drained, of loam to clay loam texture and of low to medium base status. The profile consists of a brown to dark-brown surface A horizon over a yellowish-brown B horizon which merges gradually with the weathered shaly parent material at a depth of 45—60 cm. The surface horizon varies in depth from 20 to 30 cm, has a well-developed crumb structure, a clay content of 20—30%, with 40—50% silt and 8—12% organic matter. The B horizon, despite a distinct colour contrast, does not show a free-iron enrichment. Moisture-holding capacity is moderately good. Roots are abundant in the Ap horizon and penetrate freely down the profile.

These soils were mapped in Co. Carlow as the Keeloge Series (Conry and Ryan, 1967).

Soil Suitability: These soils have a moderately wide use-range. Due to their very good structure and friable consistence, a good tilth is easy to produce. However, steep slopes render ploughing, cultivation and other farm operations rather hazardous. Formerly, when mechanisation was largely confined to horse-drawn implements, the acreage of these soils under tillage was much greater. Good yields of oats, feeding barley, potatoes, swedes, mangels, kale and sugar beet can be obtained. Without regular use of lime and fertilisers, particularly phosphorus, good yields are difficult to attain.

This is equally true of grass production. New leys are highly productive, but without fertilising and good management the pastures degenerate quickly. On the steeper slopes where cultivation is difficult or impossible, the fields become overgrown with bracken, gorse (furze or whin) and brambles. In very dry periods the soils are liable to develop a moisture deficit.

Profile description and analyses are given in Appendix II.

Ridge Stony Phase

Soil Character: Like the Ridge Series these soils are situated on the top of the Castlecomer Plateau and Bealach Hills on undulating to rolling topography. Slopes generally are less than 12° and elevations between 120 and 300 metres. This soil has been mapped previously in Co. Carlow as the flaggy variant of the Ridge Series (Conry and Ryan, 1967).

The drift cover deposited by the Munsterian ice movement has been eroded, as in the case of the Ridge Series, by the frost action of the last (Midlandian) glaciation. Therefore the soils are derived mainly from the underlying carboniferous flagstone bedrock. These soils cover a small area of 915 hectares, or only 0.53% of the county.

The soils are moderately deep to shallow, well-drained of low base status and have been classified as Brown Podzolic soils. The profile consists of brown to dark-brown A horizons with strong blocky or crumb structure and friable consistence overlying a yellowish-brown to reddish-brown very friable B2 horizon enriched with iron oxides. The B horizon gives way abruptly to shattered flagstone at around 40—50 cm. The A horizon is 15—30 cm deep and contains over 30% clay, 35—40% silt and up to 7.5% organic carbon. Roots are plentiful in the surface horizon and penetrate freely down to broken bedrock.

Soil Suitability: These soils have a slightly more restricted use-range than the related Ridge Series. Although they resemble the latter in general land-use suitability, tillage operations are significantly more difficult due to the high concentration of flaggy stones. They are also more liable to drought as their moisture-holding capacity is lower than that of the Ridge Series.

Profile description and analyses are given in Appendix II.

Gleys

Abbeyfeale Non-Peaty Phase

Soil Character: These soils occur mainly on rolling topography (5—12° slopes) on the Castlecomer Plateau at elevations of 150 to 320 metres. They are derived from dense.

tenaceous, calcareous soliflucted glacial drift of Munsterial age. The drift is composed of a mixture of carboniferous shales, sandstone, flagstone and limestone (Fig. 4.12). The dense impermeable nature of the parent material and particularly the high silt content (40—45% on average) contribute largely to the poor structure, low permeability and poor natural drainage of these soils. They cover 11,319 ha (6.6% of the county) and have been previously mapped in Co. Carlow as the Castlecomer Series (Conry and Ryan, 1967).

These poorly-drained heavy-textured impermeable soils have been classified as surface-water Gleys. The profile consists of a dark greyish brown mottled clay loam surface horizon with weak structure and poor consistence. This horizon overlies grey and mottled plastic sub-surface layers with a weakly-expressed coarse prismatic structure when moist or wet, but which becomes more prominant on drying out. The surface layer has a high organic matter content with organic carbon contents of 4—5%. There is a very high percentage of fine material throughout the profile with on average 27—30% clay and 40—45% silt in the various horizons. Root development is largely restricted to the surface horizon. The sub-surface horizon, particularly the mottled Bg horizon, is known locally as 'yellow mud' and is mixed with 'culm' (the fine coal waste from the local mines) for use as domestic fuel.

Soil Suitability: These difficult soils have a limited use range. Owing to their adverse physical properties and poor climatic conditions associated with the high elevations, they are unsuitable for tillage cropping. They are best suited to grass production or forestry (Plate 4.11).

Plate 4.11: Castlecomer Plateau. Older forests on the Gleys in Rossmore with recent plantations on peat.

In their semi-natural state, production from these rush *(Juncus)-intested* pastures very low. The grazing season is or should be confined to the drier summer However, production levels can be increased very substantially through a planned programme of drainage, reseeding, liming and fertilising together with goou management practices. The whole programme of reclamation can be very expensive and can be ineffective unless management practices are of the highest calibr: Essentially, this means housing cattle during the winter months (November to March inclusive) and taking precautions to limit poaching to pastures during the often difficult months of April and October. In most years cattle will need to be housed < r removed to drier pastures during at least some or even the greater part of these months. Effectively the grazing season is about 6 months on average. Adequate leveis of fertilising particularly nitrogen, together with good management can reduce rush infestations to negligible proportions. Silage making can be particularly difficult and damaging to the sward in wet seasons. Even in normal years it is largely confined to a single cut. Only in favourable seasons can a second cut be obtained. There are strong indications that under intensive dairying systems, cows and even other livestock respond to copper injections.

The Abbeyfeale Non-Peaty Phase is suitable for forestry and in particular those species like Sitka spruce which can tolerate relatively impermeable wet soil conditions. Wind-throw can be a severe problem in exposed areas.

Profile descriptions and analyses are given in Appendix II.

Abbeyfeale Peaty Phase

Soil Character: This series occupies 229 ha (0.13% of the county). It is closely-associated on the landscape with the Abbeyfeale Non-Peaty Phase, occurring in depressional areas on the Castlecomer Plateau at elevations of 200—300 metres. The soils are derived from the same soliflucted drift material composed of carboniferous shales, sandstone, flagstone and limestone as the Abbeyfeale Non-Peaty Phase. It has been mapped in Co. Carlow as the Seskinrea Series.

These are very poorly drained soils with a peaty surface texture and low base status: they have been classified as peaty podzolic gleys. Over much of the area a deeper organic layer probably has been removed for domestic fuel, leaving a surface horizon 15 to 20 cm in depth. The sub-surface, leached, coarser-textured A2g horizon overlies a heavier-textured mottled Bg horizon. The latter in turn merges with the heavy-textured parent material at approximately 100 cm. Soil structure throughout the profile is very poor. Root development is largely confined to the surface horizon.

Soil Suitability: These rush/moss/sedge-dominated soils have a limited to very limited use-range. They are mainly used for rough summer grazing (Plate 4.12). With artificial drainage and with lime and fertilisers, grass production can be improved to a limited extent. To utilise the grass fully, management must be of a high standard and grazing must be confined to the summer period to curtail poaching.

Like the Abbeyfeale Non-Peaty Phase, a large proportion of these soils has oeen planted with Sitka and Norway spruce within the last 25 years. Present growth rate indicates that forestry may be a very good proposition on these soils.

Profile descriptions and analyses are given in Appendix II.

Plate 4.12: The Abbeyfeale Peaty Phase (Gley) on the Castlecomer Plateau has a limited use range.

Abbeyfeale Undulating Phase

Soil Character: The soil profile of the Undulating Phase is very similar to the Abbeyfeale Non-Peaty Phase. However, as it occurs on flatter topography (slopes of 1—4°) the soil is slightly wetter than the Non-Peaty Phase due to a slower rate of rainfall run-off. This wetter phase has a significantly higher organic carbon content (8—10%) in the surface horizon.

It covers an area of 1,127 hectares (0.66% of the county).

Soil Suitability: because they are slightly wetter with a lower bearing capacity these soils are more liable to poaching and are less suitable for silage cutting. However, it should be emphasised that this is only a matter of degree. With practically the same adverse physical and environmental limitations these soils have the same limited use-range.

Profile descriptions and analyses are given in Appendix II.

Raheenduff Series

Soil Character: These gley soils are derived from dense calcareous glacial till composed of an admixture of shale, limestone and sandstone. They occur on lowlying positions on the landscape—on flattish topography, depressional areas and lower slopes which receive excess water from higher ground. This soil covers an area of 3,531 ha (2.06% of the county).

The soil profile consists of shallow (15—20 cm) greyish brown mottled surface A horizons with a heavy loam to clay loam texture and weak structure (Fig. 4.13). The surface A horizons contain 25—30% clay with a high silt content of 32—40%. When reclaimed and intensively farmed the organic carbon content ranges from 5 to 8% but in the unreclaimed state the organic carbon content of the surface 5 cm Al 1 can be up to 12%. The subsurface A2 horizon is strongly gleyed and grades into an intensely-mottled heavy-textured subsoil B2 horizon which has a significantly higher clay content than the A2. Soil structure throughout the profile is weak and soil permeability is very low. Root development is largely confined to the surface horizon.

Soil Suitability: The use-range of these soils is limited. They are unsuitable for tillage cropping due to their adverse physical properties. They are best suited to grass production and forestry. With artificial drainage, liming, fertilising and reseeding they can be quite productive. However, like the Abbeyfeale Non-Peaty Phase, as poaching is a serious problem the grazing season is seriously curtailed and must be confined to the drier summer period. Silage-making operations can be very difficult and can cause a lot of damage in wet seasons.

Grassland output (especially early spring growth) is, however, curtailed by the less favourable climatic regime and soil physical properties, while utilisation is curtailed by their susceptibility to poaching.

Profile descriptions and analyses are given in Appendix II.

Raheenduff Imperfectly Drained Phase

Soil Character: These soils are closely associated in the landscape with the Raheenduff Series, all of which are derived from calcareous glacial till composed of a mixture of shale, limestone and sandstone. They form a catenary sequence with the well-drained Ballinakill Series and the poorly drained Raheenduff Series. This soil is in fact an imperfectly drained Grey Brown Podzolic. It occurs generally on gently undulating topography in an intermediate position between the other two Series and is intermediate both in soil properties and land use range between these two Series. This soil covers an area of 1,003 ha (0.58% of the county).

These deep heavy-textured imperfectly-drained soils have been classified as Grey Brown Podzolic soils (with gleying). The soil profile consists of a dark brown loam to clay loam surface A horizon overlying a thick heavier-textured clay loam subsoil B horizon which in turn grades into the parent material at a depth of 70—80 cm. The surface horizon has a weak structure and moderately good consistence while the subsoil B horizon is compact. Soil permeability is low. The resultant poor internal drainage gives rise to mottling thoughout the soil but particularly in the lower part of the profile.

Soil Suitability: These soils have a moderately wide use range. They are generally unsuitable for tillage, being less suitable than their well-drained counterparts the Ballinakill Series. Their heavy texture, weak structure and imperfect drainage together with their high elevation (generally above 150 metres) places severe restrictions on tillage operations particularly in wet seasons.

The soils are best suited to grass production. With adequate lime and fertilisers, particularly nitrogen, new leys can be productive.

Grey Brown Podzolics

Ballinakill Series

Soil Character: This Series occurs on rolling topography on the lower slopes of the Castlecomer Plateau and on the Bealach Hills at elevations of 120—240 metres (Fig. 4.12). This soil occupies 1,426 ha (0.83% of the county). The soils are strongly influenced by the underlying shale and sandstone bedrock of these areas. They are derived from calcareous glacial till material consisting of an admixture of shale, limestone and sandstone. The shale and sandstone are derived from the underlying bedrock while the limestone has been carried in from the Laois lowlands by the last (Midlandian) ice movement which pushed its way up the side of the Castlecomer Plateau and over some of the lower hills to the south of Durrow. The higher concentration of shale and sandstone, compared with the Knockbeg Series for instance, influences the soils significantly. Firstly, the parent material itself has a lower total neutralising value (10—22% TNV approximately). Secondly, the soils have a heavier texture with a slightly higher clay and higher silt content. The high silt content (35—40%) is a feature of all the soils which contain a significant proportion of carboniferous shales. Lastly, the soil profile tends to be deeper. Despite these differences it is difficult to separate these soils from the Knockbeg Series, especially when the latter occur on lower reaches of the Castlecomer Plateau.

These moderately deep to deep, heavy-textured, well-drained soils have been classified as Grey Brown Podzolic soils. The soil profile consists of medium to heavy textured A horizons over a heavier-textured well-expressed textural B horizon which in turn overlies the parent material from which the soil is developed (Fig. 4.13). Soil depth (i.e. A and B horizons) varies from 50 to 125 cm but is generally about 80—90 cm deep.

The soil consists of a dark brown surface A horizon with a high clay content (21—28%), high organic matter (8—22%) and a weak soil structure overlying the textural B horizon. The weak structure of the surface A horizon combined with the high clay and silt content means that tillage operations on these soils are difficult except in favourable weather. The B horizon contains up to 40% clay with 35—40% silt. It is fairly compact *in situ* but water penetrates freely (but slowly) due to its relatively good structure. Although the soil is free-draining, its permeability is relatively low. Moisture-holding capacity is high. In some places where the drift cover is shallow, the soil profile rests on soft rotten shale-derived material which has both a very high silt and clay content.

Soil Suitability: These soils have a wide use range. They are capable of producing a wide range of tillage crops as well as being good grassland soils. However, the higher elevations at which these soils occur, together with their heavy texture places considerable limitations on arable cropping and grassland production. Although they can grow the same range of tillage crops as their more lowlying counterparts, yields are considerably reduced due to the less favourable climatic regime at these elevations. This, coupled with the more difficult soil conditions such as heavy texture, weak structure and low soil permeability means that tillage operations are more difficult at the best of times and substantially so in unfavourable seasons. Spring wheat growing can be particularly hazardous due to late ripening, particularly when sown late. Winter cereals, on the other hand, provide a better opportunity of obtaining economic returns provided they are sown in early September before the soils become difficult to handle. It should be emphasised, however, that the potential of this Soil Series at the lower elevations is substantially better than at the higher elevations.

The soils are best suited to grass production. With adequate use of lime and fertilisers high levels of grass production can be obtained. Just as in the case of arable crops, the less favourable climatic regime and the less favourable physical properties of the soils place some limitations on optimising grassland output and utilisation. Again it can be expected that considerable differences exist at both ends of the elevation range. On the whole, grassland output, and expecially early spring growth, is curtailed by the less favourable climatic regime while utilisation is curtailed by their susceptibility to poaching at both ends of the grazing season. On the other hand, the high moisture-holding capacity of these soils is a considerable asset in dry seasons.

Profile descriptions and analyses are given in Appendix II.

Peats

Aughty Cutover Series: this is the only Series classified as peat which was mapped in the Castlecomer Plateau. It occupies 511 hectares (0.3% of the county). It is described above for the Slieve Bloom area.

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CLASSIFICATION OF THE SOILS ACCORDING TO NATURAL DRAINAGE CONDITIONS

The soils have been grouped (Table 64) into five drainage classes:

(a) Excessively drained
(b) Well drained
(c) Imperfectly drained
(d) Poorly drained
(e) Unclassified

All drainage classes refer to the natural drainage condition of the soil. Artificial drainage would upgrade the drainage condition of some of the soils in the lower categories. The soils in Class (a) are subject to moisture stress, particularly in dry seasons. The soils in Class (b) have good permeability and a low water table. Some of these soils have a moisture deficit limitation in dry seasons while others have trafficability problems in wet seasons.

Class (c) comprises:

(i) Soils of good permeability but with a seasonally high water table.
(ii) Surface water gleys with poor permeability.
(iii) Ground water gleys with a seasonally high water table.

All have trafficability problems in wet seasons. Some of the soils in this drainage Class have impervious subsoil horizons. In Class (d) soils, artificial drainage is a basic prerequisite to any form of sustained improvement and higher output. This applies to a lesser degree to Class (c) soils.

For each drainage Class the main factors conditioning the drainage regime of the soils are outlined. For example, in the case of the soils with defective drainage, contributing factors may be water table, or slow permeability, or both. Methods of artificial drainage to improve these soils must be adjusted to the factors responsible, if best results are to be obtained.

The extent of occurrence of each drainage Class is also given in Table 64. Some 43% of the soils of the county have free internal drainage, and approximately 57% have impeded drainage.

CHAPTER 5

SOIL SUITABILITY

Soil suitability classification is essentially a grouping of soils according to the potential use or uses to which they are most adaptable, and is based principally on the significance of the more permanent characteristics of the soil. A further step in the suitability classification consists of an assessment of the production potential of each soil, for the normal range of farm and forest crops, under defined management standards. This provides the essential link between the physical and economic aspects of the use of soil. However, for this purpose reliable quantitative data on the productive capacity of each soil are required; these can only be provided by detailed field experimentation and yield observations over a number of years on sample areas representative of the particular soil. So far, the only information of this nature available within County Laois is confined to forestry on certain Soil Series and to pasture production. These quantitative assessments are presented for grazing capacity but apart from these the system of soil suitability evaluation used is a qualitative, rather than a quantitative, appraisal of the potential of the different soils in the county.

Although the physical, chemical and biological properties of the soil merit foremost consideration in assessing soil suitability, environmental factors, such as elevation, aspect and local climate must be taken into account. For instance, local features such as exposure to strong winds and late spring frosts can limit forest tree growth, no matter how deep and fertile the soils may be. In general statements concerning soil suitability one must bear in mind, therefore, that environmental and other factors can influence the economics of production considerably and hence can modify the use-range to which the soils are otherwise ideally suited.

Furthermore, the concept of land quality has changed radically in recent years. With modern fertiliser technology, natural nutrient fertility problems in soils have become subordinate to physical ones such as defective natural drainage, heavy texture and poor structure which are more difficult and more costly to rectify. Besides, farm labour is no longer abundant, and its replacement by mechanisation has drastically altered the feasible cultural and management practices of many soils.

Suitability for Grassland and Cultivation

Suitability Classification: A widely-used system for the interpretation of soil survey data in land classification consists of assessing the capacity of each soil unit for permanent sustained production, and arranging the units according to the USDA system of Land Capability Classification (Klingebiel and Montgomery, 1961). This is a standard eight-class system to which classes I to IV are suited to cultivated crops, classes V to VII are suited to grazing and forestry and class VIII is suited only to wildlife.

The USDA system emphasises the adaptability of a soil for a range of uses and implies a hierarchy of use capacity Viz. cropping, grazing, forestry. In relation to land-use practice in Ireland this hierarchy is less relevant as the priority use of land is dairy livestock production which has a large grazing component. Since economic priorities change with time, value judgements based on economic criteria should be excluded as far as possible from a technical land classification.

The system recently adopted in Ireland (Finch et al., 1971) is to evaluate the degree of suitability of each soil unit for a set of uses, viz. cultivation and grassland, where all types of use have equal rank. This system could be extended to include suitability for forestry or urban development where appropriate. Choice of optimum use of a soil unit could be derived at any time from the suitability classification by assigning a weighting to each type of use based on the prevailing economic circumstances.

Soil suitability depends largely on the physical properties of the soil and the environment. These are rarely ideal and the limitations affect productivity and cultural practices. The degree of limitation is assessed from such factors as wetness (w), drought (d), liability to flooding (0, slope (s), rockiness (r), textural and structural properties affecting tilth and susceptibility to poaching (t). On the basis of these factors the soils are grouped into five classes designated A, B, C, D, E, for grassland and I, II, III, IV, V, for cultivation, denoting very suitable, suitable, moderately suitable, poorly suitable and unsuitable, respectively. Productivity is the dominant criterion in the ranking of suitability for grassland and the suitability classes A, B, C, C, D, and E parallel the grazing capacity classification. In the case of cultivation the ease of cultivation as well as productivity are taken into consideration.

Productivity is also the dominant criterion in the suitability ranking for arable cropping and closely parallels the suitability classes A, B, C, D, and E for grassland. Thus, while the Cullahill soils are as amenable for tillage operations as the Stradbally Series, they are downgraded to Class B1 for arable cropping because production levels are substantially lower than the Stradbally soils.

In the Table 5.1 legend the suitability classes are divided into sub-classes by principal limiting factor. Sub-classes are indicated by a subscript which indicates the type of limitation, for example; w = wetness, s = slope, etc. The degree of limitation increases from the higher to the lower categories.

Suitability Classes: Co. Laois

For grassland, 27.3% of the soils are placed in Class A (Table 5.1). Not only are they capable of high levels of production, but they have no major limitations. The Fontstown soils, would, however, show drought stress in very dry seasons. They are subdivided into Classes I and II for cultivation; 22.5% of the total Laois area is classified as Class I soils for tillage. Although a sizeable proportion of these Al soils occur in the western part of the county, there is a greater density of tillage cropping on the Stradbally and Fontstown soils in the east of the county (Plate 5.1). This may be

TABLE 5.1 : Co . Laois -Soil suitability for grassland and cultivation

Suitability Class: Grassland	Suitability Class: Cultivation	Sub Class limitations*	Area (hectares)	% Total land area	Mapping unit
A (27.3%)	i	d	38,654	22.507	Stradbally, Patrickswell, I'ontstown
	II	i	8.241	4.798	Elton, Knockbcg, Knockbeg Stony Phase
B (10.9%)	I	d	9.946	5.791	Cullahill, Graceswood, Baggotstown-Carlow Complex
	n	w	4,313	2.511	Clonaslee, Mylerstown Imperfectly Drained Phase
	III	r	3,151	1.835	Stradbally Rocky Phase, Patrickswell Rocky Phase
		e,1	1,426	0.830	Ballinakill
C(31.8%)	I	e	7,340	4.273	Baunreagh, Ridge, Clonin Complex
	II	s, e	3,151	1.834	Cardtown Complex, Ridge Stony Phase
	III	w	42,746	24.891	Mylerstown, Howardstown, Mountrath Complex, Lowland Peat-Industrial Complex, (iortnamona, Banagher**
		e,t,(w)	1,003	0.584	Raheenduff Imperfectly Drained Phase
	V	e, s	440	0.256	Ridge Steep Phase
D(12.6%)	IV		898	0.523	Ballyshear
		e, w	20,502	11.938	Abbeyfeale Non-Peaty Phase, Abbeyfeale Undulating Phase, Raheenduff, Bawnrush, Slievc Bloom Non-Peaty Phase
	V	c, w	229	0.133	Abbeyfeale Peaty Phase

TABLE 5.1: Co. Laois--soil suitability for grassland and cultivation *(Contd.)*

Suitability Class					
Grassland	Cultivation	Sub Class limitations*	Area (hectares)	% Total land area	Mapping unit
	V	r	951	0.554	Dysart Hills Complex
		s.e	599	0.349	Baunrcagh Steep Phase
E(13.2%)		w,e	7,341	4.275	Conlawn, Knockastanna Peaty Phase, Rossmore, Slieve Bloom, Slieve Bloom Steep Phase, Slieve Bloom Undulating Phase
		w	8,872	5.166	Lowland Peat (Allen, Turbary Complex), Pollardstown
		e,w	4,824	2.809	Upland Peat (Aughty Series and all Phases)
Variable 4%		t.w.f	6,848	3.987	Alluvial Complex
			(171,475)	(99.843)	

*d = drought; w = wetness; s = slope; r = rockiness; f = flooding; e = elevation; t =textural and structural properties affecting tilth and susceptibility to poaching.

**It is assumed that these peat soils have been drained and reclaimed.

Plate 5.1: Tillage farming is an important enterprise in eastern Co. Laois. Area shown is on the Fontstown Series near Vicarstown.

due to the slightly drier climate in this part of the county. Although high yields can be obtained on the Elton and Knockbeg soils, they are placed in Class II for cultivation because it is not easy to obtain a good tilth on these heavier-textured soils.

A further 10.9% of the county occurs in Class B for grassland. The Cullahill, Graceswood and Baggotstown-Carlow soils are downgraded because drought can be a severe problem in dry seasons, whereas excess moisture due to a high water table is the problem in Clonaslee and Mylerstown imperfectly-drained soils. The other soils in Class B have limitations associated with optimum utilisation of grassland ranging from rockiness to poaching problems. Table 5.2 shows that almost all Class A and B soils occur in the Central Lowlands area.

The Cullahill, Graceswood and Baggotstown-Carlow soils are easily tilled but production levels are considerably reduced due to lack of moisture except in 'dropping years'. For that reason they are classified overall as Bl soils for arable cropping. The Clonaslee and Mylerstown imperfectly-drained soils can give high yields of most arable crops but in wet seasons sowing and harvesting can present difficulties. While the remaining soils are classified as Class B soils for grassland they have some more severe limitations for arable cropping; the Rocky Phase of the Stradbally and Patrickswell Series are not amenable to tillage operations and are classified as Class III soils for cultivation. In favourable seasons the Ballinakill soils present few problems for arable cropping, but under the average weather conditions prevailing these heavy-textured elevated soils can present problems both in tillage operations and in obtaining consistently high yields.

The wet mineral soils and the organic soils of the Central Lowlands are classified as Class C for grassland (Table 5.2). These account for almost 25% of the total area of the county. The dry mineral soils of Castlecomer Plateau (Ridge soils) and the Slieve Bloom area (Baunreagh Series and the Clonin and Cardtown Complexes) are also classified as Class C soils for grassland because output is seriously limited by elevation and sometimes by steep slopes. These dry mineral soils are relatively easily tilled, but arable cropping is generally uneconomic due to climatic limitations imposed by elevation. The wet mineral soils of the lowlands, which comprise about 18% of the total area of the county, are poorly suited to arable cropping and are, therefore, classified as Class OIL It is indeed very debatable whether the organic soils (Banagher, Gortnamona and Industrial peat) should be classified as Class B or C soils for grassland. Some would argue that production levels can be as high as Class A grassland soils. However, they do present some problems in grassland utilisation. The Banagher and Gortnamona peats are ideally suited to certain vegetable crops but on the whole they present some difficulties both in cultivation operations and in obtaining consistently high yields. It would probably be more appropriate to classify both of these soils as Class Bill.

Class D soils for grassland account for 12.6% of the area of the county. Most of these soils occur on the Castlecomer Plateau (Table 5.2). These are subdivided into Class IV and V for cultivation. They are unsuitable for cultivation and poorly suited for grassland, mainly because of wetness. They also have the added disadvantage that

TABLE 5.2: Suitability of class percentages in the three geographic regions of Laois

Suitability Class				
Grassland	**Cultivation**	**Central Lowlands %**	**Castlecomer Plateau %**	**Slieve Bloom %**
A	**I**	**22.5**	**–**	
	II	**4.7**	**-**	**-**
B	**I**	**5.8**	**–**	**–**
	II	**2.5**	**-**	**-**
	III	**1.8**	**0.8**	
C	**I**	**–**	**1.1**	**3.2**
	11	**-**	**0.5**	**1.3**
	III	**24.8**	**0.6**	**-**
	V	**-**	**0.3**	**-**
D	**IV**	**0.5**	**9.4**	**2.6**
	V	**-**	**0.1**	**-**
E	**V**	**5.7**	**0.3**	**7.1**
Variable		**4.0**	**-**	**-**
Totals		**72.3**	**13.1**	**14.2**

almost all of these soils occur at higher elevations. Over 96% of all Class D soils occur on the Castlecomer Plateau or on the Slieve Bloom mountains.

A further 13.2% of the soils are classified as Class EV soils because they are unsuitable for grassland production or arable cropping due to extreme wetness and/or high elevation. The remaining 4% consists of alluvial soils which vary enormously in profile characteristics and in land use. Some of the free-draining alluvial soils are good for grassland as well as being good arable soils but the vast majority would fit into Class Bill with severe limitations for arable cropping.

References

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CHAPTER 6

QUANTITATIVE GRAZING CAPACITY OF SOILS

The objective of this part of the study is to determine the potential of County Laois and of different regions within it for livestock based on grass production and utilisation. Such quantitative measurements are possible only when the nature of the soil and climate is known and when pasture and animal production experimental data are available. The completion of the Soil Survey of the county has now made this possible. By comparing the potential targets thus identified with present livestock numbers, the possible improvements in livestock density can be ascertained.

Trend in Grazing Livestock Numbers

Grazing livestock numbers for each of the years 1958 to 1980 were obtained from the agricultural returns of the Central Statistics Office. Stock numbers were converted to standardised livestock units (LU) according to the method described by Attwood and Heavey (1964). The results are shown in Table 6.1. The number of livestock units increased by 65%, well above the national average increase of 43%, over the period 1958—80. Over the same period tillage declined by 19% in the county compared with a national decline of 24%. The decline in tillage is estimated to account for only 12% of the livestock expansion which must, therefore, be attributed largely to grassland intensification.

TABLE 6.1: Grazing livestock units (LU) in Co. Laois (1958-1980)

Year	No. of LU (000)	Year	No. of LU (000)
1958	101.7	1970	142.2
1959	109.8	1971	147.0
1960	113.8	1972	153.3
1961	114.8	1973	166.2
1962	115.2	1974	173.9
1963	117.7	1975	175.2
1964	125.3	1976	169.6
1965	133.9	1977	173.3
1966	141.7	1978	*
1967	144.7	1979	*
1968	137.3	1980	167.5
1969	139.3		

•Data not available for 1978 and 1979.

Current grazing livestock numbers

In 1980 there were 167,500 grazing livestock units in the county representing an average of 133 units per 100 hectares of land (54 LU/100 acres) devoted to grazing livestock. Stocking rate for District Electoral Divisions (DEDs) on the Castlecomer Plateau are generally in the 75—112 LU/100 ha range.

Average stocking rate in the Slieve Bloom area is about 112 LU/100 ha. Stocking rate in the Central Lowlands DEDs are mostly in excess of 125 LU/100 ha, reaching up to 175 LU/100 ha in some DEDs.

Table 6.2 compares stocking rate distribution in the county with the national position.

It is evident that Laois displays a more intensive stocking rate pattern than the national average.

Table 6.3 shows the composition of the grazing livestock population.

The proportion of other cattle (dry stock) is well above the national average whereas sheep, cows and heifers-in-calf are below average.

TABLE 6.2: Stocking rate distribution in Co. Laois compared with the Republic of Ireland (1980)

LU/100 ha	<50	50-100	100-150	> 150
	% Total area			
Laois	0	10	55	35
Ireland	8	23	47	22

TABLE 6.3: Composition of grazing livestock categories, Co. Laois and Republic of Ireland (1980)

	% of total LU			
	Cows and Heifers-in-calf	Other Cattle	Sheep	Horses
Laois	27	68	4	1
Ireland	30	59	9	2

Agricultural land-use allocation

Table 6.4 compares agricultural land-use allocation in the county with the national position.

Land under tillage is about double the national average, whereas land allocation to sheep is well below the national average. Land under cattle production is above average whereas land under dairying is below average. There is a pronounced tillage concentration on Soil Series such as Stradbally and Fontstown.

TABLE 6.4: Agricultural land-use allocation in Co. Laois and Republic of Ireland by percent agricultural area (1980)

	Total tillage	Tillage not devoted to livestock	Dairying	Other cattle	Sheep	Horses
Laois	18	12	24	60	3	1
Ireland	10	6	29	55	9	2

TABLE 6.5: Grazing capacity of soils of Central Lowlands, Co. Laois

			48 kg N/ha		230 kg N/ha	
Soil Series	Area (ha)	Grazing capacity	Capacity LU/100 ha	Gross grazing capacity (LU)	Capacity LU/100 ha	Gross grazing capacity (LU)
Fontstown	12.991	A 2	210	27,281	259	33,647
Cullahill	2,817	Hi	203	5,719	252	7,099
Stradbally	9,345	A_2	210	19,625	259	24,204
Stradbally Rocky Phase	1,725	Bl	198	3,416	247	4,261
Patrickswell	16,318	A2	215	35,084	264	43,080
Patrickswell Rocky Phase	1,426	B]	198	2,823	247	3,522
Elton	2,376	A_2	220	5,227	274	6,510
Knockbeg	4,967	A 2	220	10,927	274	13,610
Knockbeg Stony Phase	898	A_2	215	1,931	264	2,371
Graceswood	2,359	B2	195	4,600	245	5,780
Mylerstown	20,048	C]	180	36,086	222	44,507
Mylerstown Imperfectly Drained Phase	2,060	Bl	198	4,079	247	5,088
Ballyshear	898	Dl	158	1,419	207	1,859
Howardstown	3,176	Cl	173	5,494	212	6,733
Gonaslee	2,253	Bl	198	4,461	247	5,565
Allen	1,831	E				
Turbary Complex	6,883	E	-	-	-	-
Gortnamona	2,535	Cl	173	4,386	212	5,374
Banagher	8,238	Cl	173	14,252	212	17,465
Pollardstown	158	E	-	-	-	-
Industrial Complex	1,320	Cl	173	2,284	212	2,798
Baggotstown-Carlow Complex	4,770	Bl	205	9,779	254	12,116
Dysart Hills Complex	951	E	62	590	-	590
Mountrath Complex	7,429	Cl	173	12,852	212	15,749
Alluvium (Sandstone)		Bl	198^		247	
Alluvium (Winter Flood)	5,335	Bl	198 >	10,563	247	13.177
Alluvium (Potash Fixing)		Bl	198 J		247	
Alluvium (High water tables)	1413	E	124^1	1,876		1.876
Pollagh land		E	1 2 4 /			

Gross Grazing Capacity of Soils

The physical output data necessary for evaluation of the grazing capacity of the different soils in Laois were extrapolated from experimental sites to related areas defined by soil and climate. The grazing capacity estimates for the Soil Series and Complexes are set out in Tables 6.5—6.7 and are shown on the accompanying grazing capacity map. The estimates are based on nitrogenous fertiliser inputs of 48 kg and 230 kg/ha together with adequate phosphorus and potassium. The low N level (48 kg/N/ha) assumes that the clover contribution is optimised in the grazed areas. Artificial drainage of wet soils is also assumed. Pasture dry-matter production data from experimental sites in the Central Plain of Ireland provided the basis for the grazing capacity estimates for the well-drained Soil Series and Complexes. (In addition to the pasture data, animal production data from the An Foras Taliintais Research Centre at Grange, Co. Meath were also used, in addition to data from the An Foras Taliintais Research Farms at Ballinalack, Co. Westmeath and Ballintubber, Co. Roscommon).

Grassland productivity research indicates that pastures on well-drained soils in the south of Ireland have about a 5% advantage in annual dry-matter production over comparable pastures on soils such as the Patrickswell Series in Co. Laois. The southern part of the country has a climatic advantage for early growth, particularly of grass. This is reflected in the target date of grazing commencement which is early April in Co. Laois compared with early March in the south of the country.

The grazing capacity estimates for the Gley soils are based on the extrapolation of animal production data from the An Foras Taliintais Research Stations at Mullinahone, Herbertstown and Ballinamore, in addition to pasture output data from experimental sites in the Central Plain. The estimates for the Reclaimed Peats and

TABLE 6.6: Grazing capacity of soils of Castlecomer Plateau, Co. Laois

			48 kg N/ha		230 kg N/ha	
Soil Series	Area (ha)	Grazing capacity	Capacity LU/100 ha	Gross grazing capacity (EU)	Capacity LU/100 ha	Gross grazing capacity (LU)
Ridge	1,936	C]	173	3,349	212	4,104
Ridge Steep Phase	440	C2	163	717	188	827
Ridge Stony Phase	915	Cl	173	1,583	212	1,940
Abbeyfeale non-Peaty Phase	11,319	Dj	148	16,752	-	16,752
Abbeyfeale Peaty Phase	229	D:	136	311	-	311
Abbeyfeale Undulating Phase	1,127	Dl	148	1,668	-	1,668
Raheenduff	3,531	D]	148	5,226		5,226
Raheenduff Imperfectly Drained Phase	1,003	Cl	173	1,735	212	2,126
Ballinakill	1,426	Bj	203	2,895	252	3,594
Aughty Cutover	511	E	-	-	-	-

TABLE 6.7: Grazing capacity of soils of Slieve Bloom Mountains, Co. Laois

			48 kg N/ha		230 kg N/ha	
Soil Series	Area (ha)	Grazing capacity	Capacity LU/100 ha	Gross grazing capacity (LU)	Capacity LU/100 ha	Gross grazing capacity (LU)
Baunreagh	933	C]	173	1,614	212	1,978
Baunreagh Steep Phase	599	E	124	743	-	743
knockastanna Peaty Phase	423	E	49	207	-	207
Bawnrush	335	Dl	148	496	-	-
Conlawn	352	E	49	172	-	172
Rossmore	669	1	49	328	-	328
Slieve Bloom	3,661	E	49	1,794	-	1,794
Slieve Bloom Steep Phase	423	E	49	207	-	207
Slieve Bloom Undulating Phase	1,813	E	49	888	-	888
Slieve Bloom non-Peaty Phase	4,190	Dl	156	6,536	193	8,087
Clonin Complex	4,471	C]	173	7,735	212	9,479
Cardtown Complex	2,236	C]	185	4,137	227	5,076
Aughty	2,623	E	-	-	-	-
Aughty Slumping Phase	687	I.	-	-	-	-
Aughty Shallow Phase	71	E	-	-	-	-
Aughty Cutover	933	L	-	-	-	-

Industrial Complex are based on animal production data from the An Foras Taliintais Peatland Research Station at Lullymore, Co. Kildare.

The grazing potentials of soil Complexes are difficult to evaluate. The grazing capacity estimates are, of necessity, averages for the Complexes and may not be applicable to the entire area of a Complex because of possible geographic variation in the balance of components within a particular Complex. Similarly, because of

TABLE 6.8: Extent and definition of grazing capacity classes in Co .Laois

	LU/100 ha			
Grazing capacity class	48 kg N/ha	230 kg N/ha	Area (ha)	Percent total area
A2	210-222	264-276	46,895	27
Bl	197-210	252-264	21,812	13
B_2	185-197	227-252	2,359	1
C]	173-185	202-227	54,240	32
C2	160-173	188-202	440	0.3
Dl	148-160	-	21,400	12
D2	135-148	-	229	0.1
E	< 135	-	24,100	14

mapping limitation, the estimates for some Series, while applicable to the major extent of the Series, may not necessarily be applicable to its entire area.

Table 6.8 defines and shows the gross area of the grazing capacity classes in the county.

Tables 6.9, 6.10 and 6.11 give comparable data for the Central Lowlands, Slieve Bloom and Castlecomer Plateau.

In the Slieve Bloom region the Podzol Soil Series, Knockastanna Peaty Phase, Conlawn and Rossmore are classified in the absence of reclamation. With reclamation, Rossmore and Conlawn Series would be upgraded to Class C_2. Similarly the Slieve Bloom Series and Slieve Bloom Undulating Phase, which are Class E in absence of reclamation would be in Class D, assuming reclamation. The classification of Baunreagh Steep Phase is based on production under natural conditions.

TABLE 6.9: Extent of grazing capacity classes (Central Lowlands)

Class	Area (ha)	Percent total area
A_2	46,895	38
Bi	20,386	16
B2	2,359	2
Ci	42,746	34
Di	898	1
E	11,336	9

TABLE 6.10: Extent of grazing capacity classes (Slieve Bloom)

Class	Area (ha)	Percent total area
Ci	7,640	31
D_t	4,525	19
E	12,253	

TABLE 6.11: Extent of grazing capacity classes (Castlecomer Plateau)

Class	Area (ha)	Percent total area
Bi	1,426	7
Ci	3,854	17
C2	440	2
Di	15,977	71
D_2	229	1
E	511	2

Net Grazing Capacity-Comparison with 1980 livestock numbers
Table 6.12 shows the net grazing capacity of the county and Table 6.13 compares livestock numbers (1980) and possible stocking estimates.

Under a moderate level of grassland management (48 kg N/ha) livestock numbers could be expanded by 28%, whereas under intensive management an increase of 53% is technically possible.

TABLE 6.12: Net grazing capacity of Co. Laois land

	Area	Grazing capacity (LU)	
	ha	48 kg N/ha	230 kg N/ha
Central Lowlands	124,620	224,754	276,981
Slieve Bloom	24,418	24,361	28,959
Castlecomer Plateau	22,437	34,236	36,548
Total	171,475	283,351	342,488
Less			
Urban roads, fences etc.	13,761	22,568	27,109
Tillage crops not devoted to livestock (1980)	17,287	30,771	37,686
Forest (1982)	16,045	16,645	19,456
Net	124,382	213,367	258,237

TABLE 6.13: Livestock numbers (1980) and possible stocking estimates, Co. Laois

	Possible total (LU)	
Livestock numbers (1980) (LU)	48 kg N/ha	230 kg N/ha
167,500	213,367	258,237

The average grazing capacity of the Central Lowlands at 48 kg N/ha and 230 kg N/ha is 178 LU/100 ha and 218 LU/100 ha, respectively; the comparable figures for the Slieve Bloom are 103 LU/100 ha and 123 LU/100 ha, and for the Castlecomer Plateau 153 LU/100 ha and 163 LU/100 ha.

References

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CHAPTER 7

TRACE ELEMENTS*

A number of trace elements have been determined in the major Soil Series of Co. Laois—total levels of copper, zinc, boron, lead, tin, silver and gallium and extractable levels of copper, zinc, molybdenum, boron, manganese and cobalt. Total levels are of interest both geochemically and pedologically and extractable values are an aid in nutritional studies relating to both crops and animals. It will thus be convenient and logical to discuss the total and extractable values separately.

Total Contents

Geochemical factors

Total levels of trace elements in soils reflect the types of materials from which the soils were formed. Thus experience has shown that soils formed from such parent materials as granites, sandstones and quartzites are typically low in cobalt, copper, zinc and many other nutritionally-important trace elements whereas basalts, dolerites and shales give rise, on weathering, to soils which are richer in these elements. Soils formed from limestones may be quite variable in trace-element content. Where the limestones are pure they give rise to soils low in trace elements but where they are impure, e.g. the earthy or Calp limestones, the resultant soils are proportionately richer in trace element content. In other words most of the trace elements contained in limestone are contributed by the impurities. An interesting case is provided by the following Soil Series; Fontstown, Cullahill, Stradbally, Patrickswell and Knockbeg. These Central Lowland soils are composed primarily of calcareous glacial till but with increasing admixtures of sandstone and shale in the sequence as outlined. Increasing shale contents should be reflected in increased trace-element levels in the soils and if the data representing the five soils mentioned are examined (Tables 7.5—7.9 in that order) it is seen that in general, trace element levels do increase in the sequence Fontstown, Cullahill, Stradbally, Patrickswell and Knockbeg. It must be stressed, however, that with the low intensity of sampling inherent in the survey method, general trends only can be anticipated.

Even though only one peat soil was examined (Banagher, Table 7.14) extremely low levels of all trace elements are apparent. This can generally be expected with peats but in the case of some other trace elements such as molybdenum, high levels may be encountered. This will be referred to later.

In the Castlecomer Plateau soils the Ridge Series has higher trace element levels

•Compiled and written by G. A. Fleming and P. J. Parle.

compared with the Abbeyfeale non-Peaty soil (Tables 7.17 and 7.18). This is consistent with the higher content of shale in the parent material but equally it must be noted that the Abbeyfeale Undulating Phase (Table 7.19) has rather higher levels than might be expected. Obviously much more intensive sampling would be necessary to identify fully the effect of parent matter on general soil trace-element content.

The data for the surface horizons of the profiles (Tables 7.2—7.21) should be viewed against those of Table 7.1 which shows the normal ranges for a number of elements encountered in Irish surface soils.

TABLE 7.1: Normal ranges of some trace elements in Irish soils (total contents)

Element	Symbol	Ranges (mg/kg)	Element	Symbol	Ranges (mg/kg)
Arsenic	As	1 - 50	Lead	Pb	2 - 80
Boron	B	2 - 100	Manganese	Mn	20 - 3000
Cadmium	Cd	0.1 - 1	Mercury	Hg	0.03 - 0.8
Chlorine	CI	30 - 300	Molybdenum	Mo	0.2 - 3
Chromium	Cr	5 - 250	Nickel	Ni	0.5 - 100
Cobalt	Co	1 - 25	Selenium	Se	0.2 - 2
Copper	Cu	2 - 100	Silver	Ag	0.01 - 0.5
Fluorine	F	20 - 500	Tin	Sn	1 - 10
Gallium	Ga	5 - 50	Vanadium	V	20 - 250
Iodine	I	1 - 10	Zinc	Zn	10 - 200

TABLE 7.2: **Baunreagh Series - Brown Earth**

	Trace Elements -- total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
A	10	<50	96	35	6	.3	1?
B2	14	<50	68	20	3	.2	12
C	17	<50	5	20	4	-i	8
Al	30	121	68	24	6	1.0	14
B2	29	<50	77	24	4	.2	14
C	30	88	73	24	2	.2	12
11C	27	<50	82	15	6	.2	12
Al	13	<50	68	27	4	.2	16

Ranges in total contents (mg/kg) within series (data from 2 profiles)

	Cu	Zn	B	Pb	Sn	Ag	Ga
A	10-30	50-121	68-96	24-35	4-6	.2-1	13-16
B	14-29	<50-	68-77	20-24	3-4	.2-	12-14
C	17-30	50-88	5-82	15-24	2-4	.2—	8-12

A includes Al horizons (data from 3 horizons)

TABLE 7.3: Slieve Bloom Series - Gley

	Trace Elements -- total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
01	4	52	60	24	3	< .2	2
Al	4	<50	64	17	7	< .2	9
A21	6	<50	65	15	6	< .2	8
A22h	5	<50	43	18	3	< .2	8
A23g	9	<50	64	18	6	< .2	11
Bg	28	<50	115	14	4	< .2	14
C	26	<50	79	17	3	< .2	11
Ol	7	<50	64	45	6	< .2	4
02	6	<50	63	16	6	< .2	4
02	.7	<50	18	5	< 2	< .2	< 2
01	7	<50	64	45	6	< .2	4
Al	6	<50	58	19	5	.3	6
A2g	4	<50	^2	20	4	< .2	6
B2g	14	<50	90	25	3	.6	4
Cg	12	<50	90	16	3	< .2	5

With regard to Tables 7.2—7.21 different numbers of modal profiles were taken in different instances. Where more than one profile was sampled the range of the different trace elements found within the particular Soil Series is given under the main table. Study of these data reveals the variations which can occur.

Whereas the data in general conform with those recorded in Table 7.1 a few anomalous figures appear and therefore merit some comment. In the Clonin soil (Table 7.4), lead (Pb) levels are slightly high in two of the profiles whereas in one instance a figure of 702 mg/kg was found in an Ap layer. Such a figure is definitely anomalous and some form of contamination or possibly some lead mineralization is responsible.

In the Fontstown Series (Table 7.5) 220 mg/kg zinc was found in a B2 horizon. This is most probably due to a natural accumulation in such horizons.

A surface soil of one of the Patrickswell profiles (Table 7.8) contains over 400 mg/kg boron (B) and this is quite unusual. Such figures could be obtained from fields which had been freshly fertilised with a boronated compound or could be the result of adventitious "contamination" from a tourmaline-containing sandstone. Tourmaline in soils is quite resistant to weathering. It is frequently associated with sandstones which themselves are "residual materials". Some horizons in one of the Knockbeg profiles (Table 7.9) also show slightly elevated boron levels.

Some low levels of copper (Cu) occur in the Graceswood and Banagher soils (Tables **7.11** and 7.14). As the former contains glacial sand in the parent material and as the latter is a peat this is not surprising.

TABLE 7.4: Clonin Series - Complex

	Trace Elements - total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
Ap	15	<50	89	22	16	.2	9
B21	11	<50	74	17	<2	.2	3
C	33	<50	85	23	6	.2	8
Ap	12	<50	33	32	3	.2	4
A2	7	<50	47	14	<2	.2	4
B22	12	<50	65	17	3	.2	14
Apl	12	<50	72	22	7	.2	8
Ap2	25	<50	55	19	5	.2	10
A2	8	<50	54	12	5	.2	8
B2lh	11	<50	95	19	4	.2	16
B22	8	<50	69	16	4	.2	11
C	16	<50	84	14	2	.2	14
Ap	19	<50	80	82	6	.4	7
B2	17	H50	81	122	5	.2	12
C	32	<50	90	221	5	.2	13
A2	6	<50	48	45	4	.2	7
B21h	24	<50	84	157	3	.2	11
C	17	<50	72	122	5	.2	7
Ap	20	<50	81	24	6	.3	10
Ap	48	<50	69	702	7	.5	9
	Ranges in total contents (mg/kg) within the series						
A	12-48	<50.0	33-89	19-702	3-16	.2-.5	4-10
A2	6-8	<50.0	47-54	12-45	2-3	.2	4-8
B	8-24	<50.0	65-95	16-157	2-5	.2	3-16
C	16-33	<50.0	72-90	14-221	2-6	.2	7-14

A includes Ap, Apl and Ap2 horizons (data from 5 horizons)

There is a considerable variation both in the copper and zinc levels in the River Alluvium Complex (Table 7.16). Copper ranges from 9 to 149 mg/kg and zinc from less than 50 to 243 mg/kg. River alluvium would naturally tend to be variable, such variation being dictated by frequency and intensity of flooding.

Pedological Considerations

Trace-element distribution within soil profiles is a reflection of the various soil-forming processes which have interacted with the parent material to produce the soils as we know them today.

TABLE 7.5: Fontstown Series — Grey Brown Podzolic

	Trace Elements - total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
Ap	14	55	-9	22	6	.2	7
A 2	13	< 50	92	26	7	.2	8
B21	33	92	121	25	7	< .2	13
C	11	< 50	51	11	< 2	< .2	4
Ap	19	119	72	39	6	.5	7
A2	26	159	92	43	5	.3	8
B2	40	220	121	45	5	.5	12
C	20	< 50	39	17	< 2	.2	3
Ap	13	91	81	27	8	.3	7
A12	17	< 50	89	23	6	.3	8
A21	16	< 50	70	22	3	.3	6
C	12	< 50	19	12	< 2	.2	< 2
A11	17	88	86	47	8	.4	7
Ap	15	98	67	35	5	.4	7
Ap	27	87	107	37	7	1.0	10

Ranges in total contents (mg/kg) within the series

A	13-27	< 50-119	72-107	22-47	6 -8	.2-1	7-10
A 2	13-26	50-159	70-92	22-43	3 -6	.2-.3	6-8
B	33-40	92-220	121	25-45	5 -*1*	.2-.5	12-13
C	11-20	<50	19-51	**11-17**	<2	.2-2	< 2 - 4

A includes Ap, Al 1, A12 horizons (data from 6 horizons)

A2 includes A2 and A21 horizons

TABLE 7.6: Cullahill Series - Grey Brown Podzolic

	Trace Elements -- total contents (mg/kg)						
Horizon	Cu	Zn	B	Ph	Sn	Ag	Ga
AP	17	105	o9	38	5	.2	6
A 2	12	<50	64	29	3	.5	8
B2t	22	103	120	94	4	.2	16
C	7	<50	18	10	2	<.2	< 2

TABLE 7.7: Stradbally Series - Grey Brown Podzolic

	Trace Elements - total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
Ap	52	95	64	42	7	.3	7
A 2	20	< 50	62	23	< 2	.3	7
B2t	30	70	100	31	3	.3	11
C	21	< 50	46	21	< 2	< .2	5
AP	16	65	89	32	4	.5	7
A2	18	< 50	29	21	4	.2	7
B2t	16	< 50	79	29	4	.2	11
C	18	< 50	45	16	< 2	< .2	4
A11	12	66	98	25	10	< .2	7
A12	10	< 50	51	21	3	A	5
A2	18	< 50	60	24	< 2	.3	7
B2t	28	< 50	105	30	< 2	.4	10
C	26	< 50	57	18	< 2	.6	6
AP	22	58	73	3n	4	.5	7
AP	32	115	97	38	5	.5	s
AP	14	< 50	8(i	32	7	.3	7

Ranges in total contents (mg/kg) within series (data from 3 profiles)

	Cu	Zn	B	Pb	Sn	Ag	Ga
A	10-52	<50-115	51-98	21-42	3-9	< .2-.5	5-8
A 2	18-20	<50	29-62	21-24	<2-4	.2-.3	7
B	16-30	< 50-70	79-105	29-31	<2-4	.2-.4	10-11
C	18-26	<50	45-57	16-21	<2	< .2-.6	4-6

A includes Ap, A11, A12 horizon (data from 6 horizons)

Profile distribution of trace elements in young soils where little profile differentiation has taken place is relatively even. Any variations which may occur usually involve a decrease in content from the parent material upwards. During the various soil-forming processes different trace elements become redistributed in different ways; in a typical podzol many elements will concentrate along with clay and iron in the B horizon whereas others such as lead and silver tend to be retained by surface organic matter. In the soils of Co. Laois only two podzols occur, the Conlawn and Rossmore Series, and together they occupy only around 0.6% of the land area of the county. These soils were not analysed for trace element content. Viewing the Grey Brown Podzolic soils which were analysed, some accumulation of trace elements is apparent in B2 and B2t horizons, the most striking examples being copper, zinc, boron and gallium in the Fontstown and Cullahill Series (Tables 7.5 and 7.6).

TABLE 7.8: Patrickswell Series - Grey Brown Podzolic

	Trace Elements - total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
All	21	60	177	89	13	1.8	14
A12	30	<50	80	49	5	.5	7
A13	21	<50	62	28	4	.2	7
A2	26	<50	90	31	< 2	.4	9
B2t	3U	<50	94	33	2	.4	1U
C	21	<50	49	15	< 2	.8	2
Apl	21	81	79	36	4	< .2	7
Ap2	21	<50	78	32	5	.2	9
A2	11	<50	73	25	10	< .2	8
B2t	23	<50	83	32	< 2	< .2	12
C	27	<50	58	18	< 2	< 2	6
Al (Ap)	53	117	424	56	5	< .2	8
A2	18	<50	94	29	5	< .2	9
B2t	11	<50	56	15	< 2	< .2	7
C	17	<50	72	19	< 2	< .2	8
Apl	23	<50	68	31	6	.7	7
Ap	20	89	95	43	4	.7	10
All	17	70	119	19	3	1.1	9
	Ranges in total contents (mg/kg) within the series						
A	17-53	<50-117	62-424	19-89	3-13	< .2-1.8	8-14
A2	11-26	<50	73-94	25-31	<2-10	< .2-.4	8-9
B	11-30	< 50	56-94	15-33	<2	< .2-.4	7-12
C	17-27	< 50	49-72	15-19	< 2	< .2-.8	3-8

A includes Al, Ap, Apl, Ap2, All, A12, A13 horizons (data from 6 horizons)

The surface accumulation of lead vis-a-vis its association with the more organic horizons is apparent in a number of soils e.g. the Slieve Bloom, Fontstown, Stradbally, Patrickswell and Knockbeg Series (Tables 7.3, 7.5, 7.7, 7.8 and 7.9 respectively).

Available contents

Total levels of trace elements in soils are of limited use in predicting the availability of the elements to growing plants. Where total levels are either extremely low or unduly high, it can reasonably be assumed that risks of deficiencies or toxicities are present, but within these extremes total trace element values are of little use agronomically. It is necessary therefore that some index of trace element availability to the plant be

TABLE 7.9: Knockbeg Series - Grey Brown Podzolic

	Trace Elements -- total contents (mg/kg)						
Horizon	Oi	Zn	B	Pb	Sn	Ag	Ga
Ap	130	126	10?	46	5	.6	9
B21	4?	92	94	34	4	< .2	15
B3t	30	<50	58	23	< 2	< .2	8
C	25	<50	37	19	<2	< .2	7
All	22	72	59	47	6	.9	10
A12	24	<50	44	36	<2	< .2	12
Bl	*l2*	73	139	58	3	< *.2*	14
B2t	22	<50	130	34	< 2	< *.2*	14
B3	29	<50	173	32	3	< *.2*	17
C	16	<50	103	21	<2	< *.2*	9
All	22	104	93	37	4	.9	13
Apl	23	62	94	38	4	.4	9
All	36	112	76	36	4	.5	10

Ranges in total contents (mg/kg) within the series (data from 2 profiles)

A	22-130	<50-126	44-103	36-47	<2-6	< .2-.9	9-13
B	22-45	<50-92	58-173	23-38	<2-4	< *2*	8-17
C	16-25	<50	37-103	19-21	<2	< *.2*	7-9

A includes Ap, Ap2, Al 1, A12 horizons (data from 5 horizons)

TABLE 7.10: Knockbeg Series - Stony Phase

	Trace Elements -- total contents (mg/kg)						
Horizon	Cu	Zn	B	Ph	Sn	Ac	Ga
Ap	3u	103	76	4.,	8	< .2	9
A12	40	78	65	33	3	< .2	10
B21t	73	119	95	34	3	< .2	13
B22t	94	124	103	39	4	< .2	14
C	60	<50	68	25	< 2	< .2	8

known. Such indices have been achieved by extracting soil with relatively dilute acid or salt solutions, the premise being that these extractants simulate the behaviour of the growing plant in terms of nutrient uptake. Because the basic soil chemistry of trace elements may differ markedly, different solutions are required in the assessment of availability (Byrne, 1979). Even when this is done, different extracts should be calibrated against crop responses in the field and this may often vary for a given crop on different soils. In the absence, therefore, of a more intensive sampling scheme than

TABLE 7.11: Graceswood Series - Gley

	Trace Elements - total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
A22	6	58	80	18	9	< .2	7
A23	12	<50	81	15	3	< .2	*
B2(t)	16	<50	92	18	3	< .2	24
C	15	<50	74	15	3	< .2	10
Apl	30	<50	56	16	2	< .2	7
Ap2	11	<50	62	12	4	< .2	7
A21	9	<50	52	9	3	< .2	6
Apl	11	<50	91	22	12	< .2	8
Ap2	10	<50	54	12	< 2	< .2	7
A2	11	<50	77	21	7	< .2	7
HB2t	20	<50	73	20	2	< .2	9
B2(t)	18	<50	73	20	< 2	< .2	9
11C	10	<50	72	9	< 2	< .2	5

Ranges in total contents (mg/kg) within series (data from 2 profiles)

A	10-30	<50	54-91	12-22	<2-12	< 2	7 8
A:	6-12	<50-58	52-81	8-21	3-9	< .2	6 8
B	16-20	<50	73-92	18-24	<2-3	< .2	9-24
C	10-15	<50	72-74	9-15	<2-3	< .2	5-10

A includes Apl and Ap2 horizons
A2 includes A2 and A22 and A23 horizons

TABLE 7.12: Mylerstown Series - Gley

	Trace Elements -- total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
Ap	14	135	78	23	7	.2	8
A2g	24	88	72	23	2	.2	7
B2tg	21	94	8U	25	2	.2	12
Cg	17	50	98	21	2	.2	5
Al	11	50	61	24	6	.2	7

Ranges in total contents (mg/kg) within series

	11-14	50-135	61-78	23-24	6-7		7-8

A includes Al and Ap horizons (data from 2 horizons)

TABLE 7.13: Ballyshear Series - Gley

Horizon	Trace Elements - total contents (mg/kg)						
	Cu	**Zn**	B	Pb	Sn	Ag	Ga
Apl	**16**	151	69	36	6	.3	9
A12	**13**	**90**	70	31	2	< .2	10
A2g	**11**	**<50**	61	17	5	< .2	4
A2g	**10**	**<50**	64	28	4	< .2	9
Bg	**21**	**<50**	61	21	< 2	< .2	7
Btg	**: :**	**<50**	57	21	< 2	< .2	7
Cg	**13**	**<50**	30	11	< 2	< .2	3

TABLE 7.14: Banagher Series - Peat

Horizon	Trace Elements -- total contents (mg/kg)						
	Cu	Zn	B	Pb	Sn	Ag	Ga
6-22 cm **(A)**	**8**	<50	29	9	< 2	< .2	2
22-45 cm (B)	**8**	<50	21	**15**	v 2	< .2	< 2
> 45 cm (C)	**2**	<50	5	< 2	< 2	< .2	< 2

is possible in practical soil survey work, and accompanying calibration trials, trace element values cannot predict accurately the occurrence of a crop or animal disorder. They can, however, point the way and indicate likely problem areas. More intensive follow-up work will then be necessary to establish the extent and severity of different disorders. It is with the above in mind that the data of Tables 7.22, 7.23 and 7.24 and the accompanying comments should be viewed.

Copper

Cu values are reasonable for crop growth in Co. Laois but some very low values occur in the Baunreagh, Slieve Bloom and Graceswood Series.

Zinc

A wide range of values occurs and some quite low ones were encountered in the following Series; Baunreagh, Stradbally, Mylerstown, Mountrath, Graceswood and Raheenduff. Unusually high values occur in one soil of the Slieve Bloom Series and in the Banagher peat.

Molybdenum

For grassland, molybdenum and cobalt are important trace elements. Excess molybdenum in herbage induces a copper deficiency in ruminants and young cattle are especially at risk. High sulphur in the diet e.g. as a silage additive, frequently exacerbates this condition. Soil values in excess of 0.3 mg/kg Mo should always be

TABLE 7.15: Mountrath Series - Complex

	Trace Elements - total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	(,a
Ap	21	< 50	66	23	6	.2	7
A2g	12	< 50	66	14	4	< .2	S
Bt(g)	16	182	74	12	< 2	< .2	x
Cg	16	< 50	77	14	< 2	< .2	8
Apl	8	< 50	67	15	9	< .2	7
A12	6	< 50	58	11	3	< .2	7
A2g	7	< 50	62	11	4	.2	9
B21tg	13	< 50	101	24	5	< .2	12
B22tg (Clg)	13	< 50	66	12	< 2	< .2	8
Cg	16	~<50	71	14	< 2	< .2	9
Ap	14	< 50	49	16	8	.4	6
A2	5	< 50	60	8	5	< .2	7
A2h (B2h)	4	< 50	59	14	3	< .2	10
B2ir	9	< 50	52	20	< 2	< .2	8
B2tg	18	< 50	98	24	4	< .2	13
C	14	< 50	50	13	< 2	< .2	7
Al	16	< 50	4^	25	4	.5	6
A2g	7	< 50	52	18	2	< .2	9
Btg	12	< 50	61	17	< 2	< .2	S
C	12	< 50	70	16	< 2	< .2	9
Ap	10	< 50	43	15	4	.2	5

Ranges in total contents (nig/kg) within series (data from 4 profiles)

A	6-21	< 50	**43-67**	**11-25**	**3-9**	2-5	**5-7**
A 2	**4-12**	< 50	52-66	8-11	**2-5**	<.2	7-10
B	**9-18**	< 50-182	51-101	**12-24**	**2-5**	<.2	8-13
C	**14-16**	< 50	50-77	**13-16**	< 2	<.2	**7-9**

A includes Al, Ap, Apl and Al 2 horizons (data from 5 horizons)
A2 includes A2g and A2h horizons (data from 4 horizons)

viewed with some disquiet but many other factors e.g. the content of clover in the sward, the lime status of the soil and the amount of soil ingested by the grazing animal enter into the problem. In practice, herbage growing on soils having extractable Mo contents in excess of 0.3 mg/kg should be analysed both in spring and in autumn for Mo. If additions of lime are deemed necessary on these soils they should be carried out with caution and on no account should the soil be limed above a pH of 6.3—6.4.

The soils of Co. Laois which are potentially molybdeniferous are shown in Fig. 7.1 and include the following Series: Fontstown, Stradbally, Mylerstown, Ballyshear. Banagher. Mountrath, River Alluvium Complex, Patrickswell and

Fig. 7.1: Molybdeniferous soils of County Laois.

Knockbeg in the Central Lowlands, and the Ridge, Abbeyfeale, Raheenduff and Ballinakill Series in the Castlecomer Plateau soils. Tables 7.22—7.24 show that there is quite a variation in available Mo within any given Series. The molybdeniferous soils depicted in Fig. 7.1 are therefore probably an overestimate and are intended only to indicate general high-risk areas. In practice, farms within the shaded areas should be more thoroughly investigated to establish their molybdenum status.

Attention must be drawn to two further points. Firstly, in molybdeniferous areas poorly-drained soils are worst. Secondly, if arterial drainage is carried out, the spreading of spoil on felds adjacent to rivers may present a hazard, as such spoil from midland rivers frequently contains elevated levels of molybdenum.

Boron

All soils seem to be adequately supplied with boron but two very high levels (13 mg/kg) occur in one soil in the Slieve Bloom Series and in one in the River Alluvium Complex.

TABLE 7.16: River Alluvium - Complex

	Trace Elements - total contents (mg/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
Ap	20	75	77	22	4	A	11
A12	14	<50	94	20	< 2	< .2	15
Al?	8	<50	40	18	2	<2	6
A14	13	<50	76	21	< 2	< .2	11
0-30 cm Al	11	<50	82	16	3	< .2	9
30-50 cm	8	<50	52	21	<2	< .2	13
50-60 cm	12	<50	b9	26	3	< .2	16
60-85 cm	20	93	104	33	2	< .2	19
Al	35	89	70	44	4	.5	11
HBg	22	<50	50	23	< 2	< .2	7
HCg	31	61	72	31	< 2	< .2	8
All	28	116	130	44	4	.4	13
A12	28	h8	90	40	<2	< .2	18
11C	15	<50	51	21	<2	< .2	6
11C	14	<50	34	17	<2	< .2	4
Al	93	74	111	40	3	.6	11
HA2g	IS	<50	41	22	<2	< .2	5
HBgor HCg	16	<50	38	19	<2	< .2	4
All	35	181	120	35	6	6	17
A12	70	243	142	38	<2	< .2	21
A13	149	242	119	30	<2	< .2	16
11C	14	<50	30	12	<2	< .2	4

Ranges in total contents (mg/kg) within the series (data from 6 profiles)

A	11-93	<50-181	70-130	16-44	3-6	<.;.-.6	9-17
A:	8-70	<50-243	41-142	20-40	<2	< u	5-21
B	8-149	< 50-242	**40-119**	18-30	2-3	<.:	4-16
C	14-31	<50-93	30-104	12-33	<2	<u	4-19

A includes A, Ap and Al 1 horizons (data from 6 horizons)
A2 includes 11 A2g and A12 horizons (data from 4 horizons)
B includes HBg and A13 horizons (data from 3 horizons)

Manganese

Two forms of manganese were measured, easily-reducible (ER-Mn) and HCl-soluble Mn. The former is useful in predicting areas of possible Mn deficiency which would be important in cereal and possibly in sugar beet growing. The latter is useful for interpreting soil cobalt values.

TABLE 7.17: Ridge Series - Brown Earth

	Trace Elements - total contents (mg/kg)						
Horizon	**Cu**	**Zn**	**B**	**Pb**	**Sn**	**Ag**	**Cu**
All	**15**	**145**	**48**	**14**	**< 2**	**< .2**	**8**
A12	**50**	**153**	**133**	**47**	**6**	**< .2**	**35**
B	**7 3**	**187**	**118**	**42**	**5**	**1.1**	**33**
C	**68**	**121**	**103**	**38**	**4**	**.7**	**39**

TABLE 7.18: Abbeyfeale Series - Non Peaty Phase - Gley

	Trace Elements - total contents (mg/kg)						
Horizon	**Cu**	**Zn**	**B**	**Pb**	**Sn**	**Ag**	**Ca**
Ap	15	104	97	33	5	.2	15
A21	12	< 50	85	30	4	< .2	20
A22g	17	68	82	26	<2	< .2	19
Bg	47	< 50	138	31	2	< .2	20
Cg	26	80	121	28	2	< .2	22

TABLE 7.19: Abbeyfeale Series - Undulating Phase - Gley

	- Trace Elements -- total contents (mg/kg)						
Horizon	**Cu**	**Zn**	**B**	**Pb**	**Sn**	**Ag**	**Ca**
Al	**22**	**231**	101	**55**	**5**	**.5**	**15**
A2g	**29**	151	**102**	**35**	**7**	**< .2**	**26**
Bg	**64**	**103**	**142**	**39**	**6**	**< *2***	**29**
C	**70**	**125**	**128**	**44**	**5**	**< *.2***	**31**
All	**15**	**84**	8IJ	**32**	***b***	**.3**	**13**

Very low ER-Mn values occur in the Slieve Bloom gley soil whereas in the Central Lowlands the Mylerstown, Graceswood, and Mountrath soils have low levels. Mn deficiency in cereals has in fact been confirmed on the Mylerstown Series.

Cobalt

The soils of the Slieve Bloom Series are very low in cobalt, and soils in the Baunreagh and Clonin Series are also low. Where the HCl-soluble Mn is also low, the Co status of pastures on these soils is readily corrected by applying approximately 2 kg cobalt sulphate/ha and the improvement will probably be sustained for about three years. Where HCl-soluble Mn values are in excess of 400—500 mg/kg, however, extra cobalt

TABLE 7.20: Ballinakill Series - Gley Brown Podzolic

	Trace Elements - total contents (m;?/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
All	22	50	108	37	7	.3	12
A12	2^	72	^2	31	2	< .2	14
B21t	57	67	88	39	2	< .2	23
B22t	62	67	**102**	39	2	< .2	25
C	41	<50	69	29	<2	< .2	19
Ap	38	150	106	33	6	.4	12
Ap	14	146	**101**	29	6	.5	14
All	65	**115**	98	29	5	1	12
A	14-65	50-150	72-108	29-37	2-7	.2-1	12-14
B	57-62	67	88-102	39	2.1	< .2	23-25
C	41	<50	69	29	<2	< .2	19

A includes Ap, Al 1 and A12 horizons (data from 4 horizons)

TABLE 7.21: Raheenduff Series - Gley

	Trace Elements - total contents (m;g/kg)						
Horizon	Cu	Zn	B	Pb	Sn	Ag	Ga
Ap(All)	20	**101**	109	28	4	.3	11
A2g	12	95	115	21	6	.4	14
B2g	27	<50	104	38	< 2	.2	21
B2g	31	<50	109	37	<2	4	22
Cg	4 3	<50	88	29	<2	.2	17
Ap	27	136	**101**	2b	6	.2	14
Ap	20	133	**101**	28	6	4	22

Ranges ini total contents (ppm) with series (data from 1 profile)

Ap	20-27	**101-** 136	101-109	28	4-6	.2-4	11-22
A2g	12	95	115	21	6	.4	14
B	27-31	<50	104-109	37-38	<2	< .2-.4	21-22
C	43	<50	88	29	<2	< .2	17

Ap includes data from 3 horizons

will be necessary to correct Co-deficient pastures and where Mn values are greater than around 700 mg/kg, direct administration to the animal may very well be the best option. Cobalt deficiency is primarily a problem of sheep and more particularly the weaned lambi. In areas of extreme Co shortage, however, the possibility of cobalt deficiency in cattle should be considered.

TABLE 7.22: Slieve Bloom Mountains - Trace elements - extractable content in surface samples (mg/kg)

Soil Series	Great Soil Group	No. samples	Cu	Zn	Mo	Mn (Easily reducible)	B	Co	Mn (HC1-soluble)
Baunreagh	Brown Earth	3	0.8	2.5	.17	105	2.6	2.0	160
			2.0	2.2	.24	290	4.2	SO	700
			1.4	1.0	.07	130	3.9	6.0	415
	Ranges		0.8-2.0	1.0-2.5	.07-.24	105-290	2.6-4.2	2.0-8.0	160-700
	Means		1.4	1.9	.16	175	3.6	5.3	425
Slieve Bloom	Gley	3	1.1	32.0	.17	1	13.0	1.1	20
			0.5	3.2	.07	1	4.4	1.6	10
			0.5	3.4	.07	11	6.3	1.1	15
	Ranges		0.5-1.1	3.2-32.0	.07-.17	1-11	4.4-12.9	1.1-1.6	10-20
	Mean		0.7	12.9	.10	4.3	7.9	1.3	13.3
Clonin	Complex	5	2.6	0.7	.03	125	2.4	2.0	285
			5.9	1.5	.20	195	2.6	2.0	360
			4.3	0.9	.20	170	1.8	4 0	725
			3.2	0.7	.14	180	3.0	2.0	525
			10.1	0.8	.27	300	1.3	5.6	590
	Ranges		2.6-10.1	0.7-1.5	.03-.27	125-300	1.3-3.0	2.0-5.6	285-725
	Means		5.2	0.9	.17	194	2.2	3.1	497

TABLE 7.23: Central Lowlands -- Trace elements -- ex tractable content in surface samples (mg/kg)

Soil Series	Great SoU Group	No. samples	Cu	Zn	Mo	Mn (Easily reducible)	B	Co	Mn (HC1-solublc)
I'ontstown	Grey Brown Podzolie	6	4.5	4.;	.20	340	2.7	4 4	590
			3.6	2.6	.37	250	4.3	5.6	615
			3.5	3.9	.24	370	5.0	4.4	500
			4.9	3.2	.27	205	3.4	5.2	565
			4.3	2.8	.27	360	2.0	4.8	590
			4.6	1.7	.27	350	2.6	5.2	615
	Ranges		3.5-4.9	1.7-4.3	.20-.37	205-370	2.0-5.0	4.4-5.6	500-615
	Means		4.2	3.1	.27	313	3.3	4.9	579
CuIlahUl	Grey Brown Podzolie	1	3.8	5.2	.20	390	4.6	**6.0**	830
Stradbally	Grey Brown	6	4.7	3.8	.48	330	1.7	4.8	450
			2.5	1.5	.20	230	3.9	4.0	440
			1.1	4.5	.31	75	4.0	: 4	110
			3.2	0.9	.62	350	3.4	5.6	590
			4.7	3.6	.44	370	2.7	*52*	550
			3.3	1.8	.24	245	3.7	3.2	400
	Ranges		1.1-4.7	0.9-4.5	.20-.62	75-370	1.7 4,(i	2.4-5.6	110-590
	Means		3.3	2.7	.38	267	3.2	4.2	423

TABLE 7.23: Central Lowlands -- Trace elements -- ex tractable content in surface samples (mg/kg) *(continued)*

Soil Series	Great Soil Group	No. samples	Cu	Zn	Mo	Mn (Easily reducible)	B	Co	Mn (HC1-soluble)
Patrickswell	Grey Brown Podzolic	6	4.4	8.5	.34	340	3.8	4.8	565
			4.6	3.6	.31	340	2.6	4 4	600
			14.2	2.1	.27	230	2.0	4.8	350
			4.1	2.4	.17	310	2.9	3.6	425
			1.9	1.2	.41	200	3.1	6.0	590
			2.9	3.5	.24	185	3.5	5.6	415
	Ranges		1.9-14.2	1.2-8.5	.17-.41	185-340	2.0-3.8	3.6-6.0	350-600
	Means		5.4	3.6	.29	268	3.0	4.9	491
Knockbeg	Grey Brown Podzolic	5	4.4	3.4	.44	460	3.4	7.6	690
			3.8	3.5	.41	225	3.7	7.6	565
			3.6	2.3	.31	160	4.1	4 8	340
			5.7	7.7	.58	350	3.9	9.6	815
			2.4	1.5	.27	330	2.5	6.8	640
	Ranges		2.4-5.7	1.5-7.7	.27-.58	160-460	2.5-4.1	4.8-9.6	340-815
	Means		4.0	3.7	.40	305	3.5	7.3	610
Knockbeg Stony Phase	Grey Brown Podzolic	1	4.0	1.6	.58	310	3.7	5.6	390

TABLE 7.23: Central Lowlands -- Trace elements -- extractable content in surface samples (mg/kg) *(continued)*

Soil Series	Great Soil Group	No. samples	Cu	Zn	Mo	Mn (Easily reducible)	B	Co	Mn (IIC 1 - soluble)
Graceswood	Gley	2	0.6	0.3	.17	18	2.2	2.0	110
			3.2	3.2	.24	200	2.8	2.8	325
Mylerstown	Gley	2	2.9	2.0	.20	20	1.5	4(1	50
			1.9	1.4	.37	55	2.6	2.4	**185**
Bally shear	Gley	1	4.5	5.3	.62	65	2.3	5.6	150
Banagher	Peat	1	1.9	30.0	.31	300	5.8	3.2	1380
Mountrath	Complex	5	4.2	2.4	.27	130	2.4	2.8	260
			1.0	1.5	.10	80	2.2	11	135
			2.7	2.4	.31	165	3.8	2.0	400
			2.2	2.6	.37	150	3.9	4 0	440
			1.7	0.9	.14	26	2.3	0.8	50
	Ranges		1.0-4.2	0.9-2.6	**.10-.37**	26-165	2.2-3.9	**0.8-4.0**	50-440
	Means		2.4	2.0	.24	110	2.9	2.1	257
River Alluvium	Complex	6	7.0	6.0	.27	360	3.7	4 4	950
			2.1	2.6	.41	500	2.5	6.8	2840
			11.7	8.9	.27	300	5.9	6 8	575
			8.7	17.8	.24	185	6.5	6 4	400
			21.3	6.9	.20	75	13.0	-	-
			7.4	3.7	.52	500	3.9	10.4	1630
	Ranges		2.1-21.3	**2.6-17.8**	.20-.52	75-500	2.5-13.0	**4.4-10.4**	400-2840
	Means		9.7	7.7	.32	320	5.9	7.0	1279

TABLE 7.24: Castlecomer Plateau — Trace elements- extractable content in surface soils (mg/kg)

Soil Series	Great Soil Group	No. samples	Cu*	Zn	Mo	Mn (Easily reducible)	B	Co	Mn (HC1-soluble)
Ridge	Brown Earth	1	4.2	3.8	.96	350	3.4	10.8	930
Abbeyfeale- Non Peaty Phase	Gley	1	1.9	1.3	.27	130	4.0	9.2	400
Abbeyfeale- Undulating Phase	Gley	2	1.8	3.6	.37	125	6.5	10.0	350
			2.8	6.4	.55	280	2.1	5.6	390
Raheenduff	Gley	3	1.5	0.6	.07	27	4.4	5.2	135
			2.7	1.3	.62	280	4.5	N.4	700
			2.1	1.7	.24	70	4.1	7.2	150
	Ranges		1.5-2.7	0.6-1.7	.07-.62	27-280	4.1-4.5	5.2-8.4	135-700
	Means		2.1	1.2	.31	126	4.3	7.3	328
Ballinakill	Grey Brown Podzolic	4	5.0	6.7	.37	350	5.7	B.0	650
			8.5	3.5	.17	250	2.9	7.6	615
			5.8	1.7	.27	215	2.7	9.2	690
			3.9	3.2	.41	360	•4.7	8.4	590
	Ranges		3.9-8.5	1.7-6.7	.17-.41	215-360	2.7-5.7	7.6-9.2	590-690
	Means		5.8	3.8	.31	294	4.0	8.3	636

Interpretation of trace element data

As a guide to the interpretation of trace element analytical data Table 7.25 may be used. This table outlines the practical significance of the various trace-element data in the light of present experience.

TABLE 7.25: Interpretation of trace-element data (extractable contents)

Element	Content mg/kg	Practical agricultural significance
Copper	15	Risk of Cu deficiency in cereals if value is below this figure.
Zinc	l.U	Risk of Zn deficiency in cereals and possibly some horticultural crops if value is below this figure.
Molybdenum	.01	Risk of Mo deficiency in brassicas if value is below this figure.
	.30	Risk of Mo-induced Cu deficiency especially in young cattle if value exceeds this figure but other factors such as liming, sulphur content of feed and possibly level of soil intake (i.e. stocking rate) are important.
Manganese	40	Possibility of Mn deficiency in cereals and sugar beet if value is below this figure.
Boron		Risk of B deficiency in swedes and some horticultural crops-slight risk in sugar beet and oil seed rape if B content is below 1 mg/kg.
Cobalt		Risk of cobalt deficiency, especially in lambs, if Co content is below 5 mg/kg. For correction of cobalt-deficient pastures, application of cobalt sulphate works best when Mn figure is below 400. Direct Co supplementation of animals is probably best when Mn is 700 mg/kg or higher.

Summary of analytical data for available trace elements

While recognising that the variation in available trace-element content within any given Soil Series may be quite large, the mean data for the main soil subdivisions i.e. the Slieve Bloom, Central Lowlands and Castlecomer Plateau soils are presented in Table 7.26.

TABLE 7.26: Summary trace-element data for Co. Laois soils (extractable contents, mg/kg)

	Cu	Zn	Mo	B	Mn (ER)	Mn (Total)	Co
Slieve Bloom soils	2.9	4.4	.15	1.0	137	328	3.2
Central Lowland soils	4.5	4 J	*32*	3.6	248	542	4 8
Castlecomer Plateau soils	3.7	3.1	.39	4.1	222	509	8.1

The Slieve Bloom soils have generally lower mean trace element values than either the Central Lowlands or the Castlecomer Plateau soils, though in the case of zinc this is not so. This is due to one quite atypical value (32 mg/kg) in one of the Slieve Bloom soils. Disregarding this figure the mean value for Slieve Bloom soils would be 1.2 with a relatively small range in Zn content (0.7—3.4 mg/kg).

Reference

Byrne, E. 1979. Chemical Analysis of Agricultural Materials. An Foras Taliintais, Dublin. 194pp.

APPENDIX I

DEFINITION OF TERMS USED IN PROFILE DESCRIPTIONS* AND ANALYSES

Texture

Soil texture refers to the relative proportions of the various size particles in the mineral fraction of a soil. More especially, it refers to the relative proportions of clay, silt and sand in the mineral fraction less than 2 millimetres in diameter. Texture, which is one of the more important of the soils's physical characteristics, influences such factors as moisture retention, drainage and tilling properties of soils, their resistance to damage by stock and heavy machinery and earliness of crop growth.

Classes of texture are based on different combinations of sand, silt and clay; the proportions of these are determined by mechanical analyses in the laboratory. The basic textural classes, in order of increasing proportions of the finer separates, are sand, loamy sand, sandy loam, silt-loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay and clay. Definitions of the basic classes in terms of clay (less than 0.002 mm), silt (0.002 to 0.05 mm) and sand (0.05 to 2.0 mm diameter size) are presented in graphic form (Fig. 1).

Field Estimation of Soil Textural Class

The estimation of soil textural class is made in the field by feeling the moist soil between the fingers. The field estimation is checked in the laboratory. In arriving at an estimation in the field the following considerations are taken into account.

Sand: Sand is loose and single grained. The individual grains can readily be seen and felt. Pressed when moist, a weak cast may be formed which easily crumbles when touched.

Sandy Loam: A sandy loam contains much sand but has adequate silt and clay to make it somewhat coherent. If squeezed when moist, a cast can be formed that bears careful handling without breaking.

Loam: A loam has roughly equal proportions of sand, silt and clay. If squeezed when moist, a cast is formed which can be handled quite freely without breaking.

Silt Loam: A silt loam contains a moderate amount of sand, a relatively small amount of clay and more than half the particles of silt size. A cast can be formed which can be

*The terms and definitions used here are essentially those of the Soil Survey Manual, USDA Handbook No. 18, Washington, D C , 1951.

freely handled without breaking, but when moistened and squeezed between thumb and finger it does not 'ribbon' but gives a broken appearance.

Clay Loam: A clay loam contains more clay than a loam and usually breaks into clods or lumps that are hard when dry. In the moist state it is plastic and can be formed into a cast which can withstand considerable handling. When kneaded in the hand, it does not crumble readily, but tends to work into a heavy compact mass.

Clay: A clay has a preponderance of finer particles, contains more clay than a clay loam and usually forms hard lumps or clods when dry, but is quite plastic and sticky when wet. When pinched out between thumb and finger in the moist state it forms a long, flexible 'ribbon'.

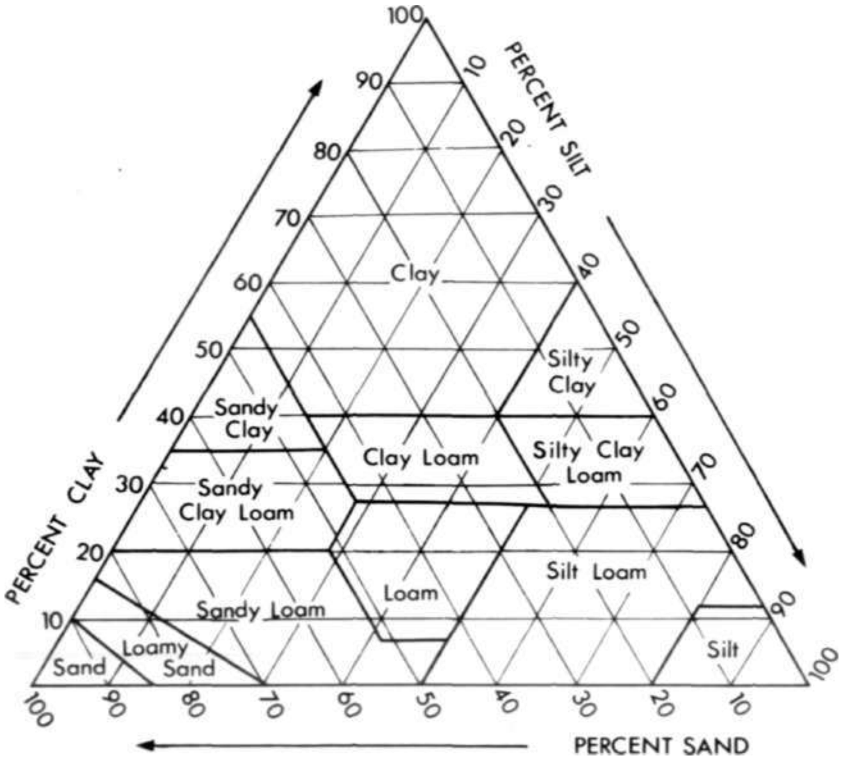

Fig. 1: Chart showing the percentages of clay (less than 0.002 mm) silt (0.002 to 0.05 mm) and sand (0.05 to 2.0 mm) in the basic soil texture classes (After Soil Survey Manual, USD A Handbook No. 18, Washington, D.C., 1951).

General Grouping of Soil Textural Classes

Often it is convenient to refer to texture in terms of broad groups of textural classes. Although the terms 'heavy' and 'light' have been used for a long time in referring to fine-and coarse-textured soils, respectively, the terms are confusing as they do not bear any relation to the weight of soil; the terms arose from the relative traction power required for ploughing. An outline of acceptable terms is as follows:

General terms		*Basic soil textural class*
Sandy Soils	Coarse-textured soils	Sands Loamy sands
	Moderately coarse-textured soils	Sandy loams
Loamy Soils	Medium-textured soils	Loams Silt loams Silts
	Moderately fine-textured soils	Clay loams Sandy clay loams Silty clay loams
Clayey Soils	Fine-textured soils	Sandy clays Clays

Structure

Soil structure refers to the aggregation of primary soil particles into compound particles, which are separated from adjoining aggregates by surfaces of weakness. An individual natural soil aggregate is called a ped.

The productivity of a soil and its response to management depend on its structure to a large extent. Soil structure influences pore space, aeration, drainage conditions, root development and ease of working. Soils with aggregates of spheroidal shape have a greater pore space between peds, are more permeable and are more desirable generally than soils that are massive or coarsely blocky.

Field descriptions of soil structure indicate the shape and arrangement *' . size and the distinctness and durability of the aggregates. Shape and arrangem .it of peds are designated as type of soil structure, size of peds, as class; and degree of distinctness, as grade.

Type

There are four primary types of structure:

(a) Platy—with particles arranged around a plane and faces generally horizontal.
(b) Prismlike—with particles arranged around a vertical line and bounded by relatively flat vertical surfaces
(c) Blocklike—with particles arranged around a point and bounded by relatively flat or curved surfaces that are not accommodated to the adjoining aggregates.

Each of the last three types has two subtypes

Under prismlike, the two subtypes are prismatic (without rounded upper ends) and columnar (with rounded ends). The two subtypes of blocklike are angular blocky (with sharp-angled faces) and sub-angular blocky (with rounded faces). Spheroidal is subdivided into granular (relatively non-porous) and crumb (very porous).

Class

Five size-classes are recognised in each type. The size limits of these vary for the four primary types given. A type description is generally qualified by one of the following class distinctions; very fine, fine, medium, coarse and very coarse.

Grade

Grade is the degree of aggregation or strength of the structure. In field practice, it is determined mainly by noting the durability of the aggregates and the relative proportions of aggregated and non-aggregated material when the aggregates are disturbed or gently crushed.

Terms for grade of structure are as follows:

0. *Structureless-No* observable aggregation. This condition is described as massive if coherent and single grain if noncoherent.
1. *Weak-Poor\y* formed indistinct peds which, when disturbed, break down into a mixture comprising some complete peds, many broken units and much non-aggregated material.
2. *Moderate-Many* well-formed, moderately durable peds that are not so apparent in the undisturbed soil. When disturbed, however, a mixture of many complete peds, some broken peds and a little non-aggregated material is evident.
3. 57rong-Structure characterised by peds that are well formed in undisturbed soil, and that survive displacement to the extent that when disturbed, soil material consists mainly of entire peds, with few broken peds and a little non-aggregated material.

The appropriate terms describing type, class and grade of structure are combined in that order to give the structural description, e.g., moderate, medium sub-angular blocky; weak, fine crumb.

Porosity

Porosity of a soil is conditioned by the shape, size and abundance of the various crevices, passages and other soil cavities which are included under the general name of soil pores. In this bulletin, porosity refers mainly to the voids between the soil structural units which is strictly the structural porosity. Soil porosity is influenced largely by type of structure; it is also influenced by rooting and by the activity of earthworms and other soil macro-organisms.

Porosity determines, to a large extent, the permeability rate in the soil and the air to water ratio prevailing and is thus of considerable importance with regard to soil aeration and drainage regime.

Consistence

Soil consistence is an expression of the degree and kind of cohesion and adhesion or the resistance to deformation and rupture that obtains in a soil. Interrelated with texture and structure, and strongly influenced by the moisture condition of the soil, this characteristic is most important in developing a good tilth under cultivation practices. On account of the strong influence of moisture regime, the evaluation of soil consistence is usually considered at three levels of soil moisture—wet, moist and dry.

Consistence When Wet

A. *Stickiness:* Stickiness expresses the extent of adhesion to other objects. To evaluate this feature in the field, soil material is pressed between thumb and finger and its degree of adhesion noted. Degrees of stickiness are expressed as follows:

0. Non-sticky: On release after pressure, practically no soil material adheres to thumb or finger.
1. Slightly sticky: After pressure, soil material adheres to thumb and finger but comes off one or the other rather clearly.
2. Sticky: After pressure, soil material adheres to both thumb and finger and tends to stretch somewhat and pull apart rather than pull free from either digit.
3. Very sticky: After pressure, soil material adheres strongly to both thumb and finger and is decidedly stretched when they are separated.

B. *Plasticity:* Plasticity is the ability to change shape continuously under applied stress and to retain the impressed shape on removal of the stress. To evaluate in the field, the soil material is rolled between thumb and finger to form a 'wire'.

0. Non-plastic: No wire formable.
1. Slightly plastic: Wire formable; soil mass easily deformed.
2. Plastic: Wire formable; moderate pressure required to deform soil mass.
3. Very plastic: Wire formable; much pressure required to deform soil mass.

Consistence When Moist

To evaluate in the field, an attempt is made to crush in the hand a mass of soil that appears moist.

0. Loose: Noncoherent.
1. Very friable: Soil material crushes under very gentle pressure but tends to cohere when pressed together.
2. Friable: Soil material crushes easily under gentle to moderate pressure between thumb and finger and tends to cohere when pressed together.
3. Firm: Soil material crushes under moderate pressure between thumb and finger but resistance is distinctly noticeable.
4. Very firm: Soil material crushes under strong pressure; barely crushable between thumb and finger.

Consistence When Dry

To evaluate, an air-dry mass of soil is broken in the hand.

0. Loose: Noncoherent.
1. Soft: Soil is fragile and breaks to powder or individual grains under very slight pressure.

2. Hard: Soil can be broken easily in the hands but it is barely breakable between thumb and finger.
3. Very hard: Can normally be broken in the hands but only with difficulty.

Cementation

Cementation of soil material refers to a brittle, hard consistence caused by various cementing substances. Different degrees of cementation occur.

1. Weakly cemented: Cemented mass is brittle but harder than that which can be shattered in the hand.
2. Strongly cemented: Cemented mass is brittle but harder than that which can be shattered in the hand; it is easily shattered by hammer.
3. Indurated: Very strongly cemented; brittle; does not soften when moistened and is so extremely hard that a sharp blow with a hammer is required for breakage.

General Analyses

pH

pH is a measure of soil acidity or alkalinity. A soil having a pH of 7.6 to 8.3 is moderately alkaline; pH 7.1 to 7.5, slightly alkaline; pH 7.0, neutral; pH 6.6 to 6.9, nearly neutral; ph 6.0 to 6.5, slightly acid; pH 5.3 to 5.9, moderately acid; pH 4.6 to 5.2, strongly acid; and pH below 4.5, very acid.

Total Neutralising Value (TNV)

This is an index of the level of carbonates present in a soil. These carbonates modify the solubility of other nutrients. Soils showing positive TNV values in the surface horizons contain adequate or excess neutralising materials and are not in need of liming.

Carbon and Nitrogen

The level of organic carbon indicates the amount of organic matter in a soil (C X 1.72 = organic matter). The content and nature of organic matter are of fundamental importance. Due to its high cation exchange capacity, organic matter acts as a reservoir for plant nutrients, which are gradually released to meet the requirements of the growing plant. At the same time, acid humus supplements the supply by influencing the extraction of nutrients from the mineral fraction of soils. Organic matter creates favourable physical conditions for crop growth; it promotes granulation of structure by reducing plasticity, influences cohesion and increases the water-holding capacity of the soil. Organic matter in the surface also influences the temperature of soils and, thus, seasonal growth.

Depending on organic carbon content, soils are classified as follows: over 30%, peats; 20 to 30%, peaty; 10 to 20%, slightly peaty; and those with 7 to 10% are usually referred to as 'organic'. In the case of the terms 'peaty', 'slightly peaty', and 'organic', the mineral textural class is included in the definition of the soil, e.g., peaty sandy loam; slightly peaty clay loam; organic loam. The surface horizon of mineral soils in Ireland normally contains 3 to 6% organic carbon.

Nitrogen, which is normally present in soils in relatively small amounts, is extremely important as a plant nutrient. It is easily leached from the soil and supplies need to be constantly replenished. The ratio or carbon to nitrogen (C/N ratio) indicates generally the degree of decomposition of organic matter; a ratio between 8 and 15 is considered satisfactory and indicates conditions favourable to microbial activity. Ratios higher than 15 are associated with a slower decomposition rate and with the accumulation of raw organic matter or, in more extreme cases, with peat development, and are indicative of unfavourable conditions for microbial activity.

Free Iron

A localised accumulation of free iron in a soil profile (Bir horizon), as is evident in brown-podzolic and podzol soils, indicates that leaching and podzolising processes have been operative. On the other hand, a uniform distribution of free iron throughout a profile as is the case in the Brown Earths, indicates that the soils have not been strongly leached.

Summary of Analytical Methods

Particle Size Analysis: Determined by the International Pipette method as described by Kilmer and Alexander (1949), using sodium hexametaphosphate as dispersing agent.

pH: Determined on 1/2 soil/water suspension using a glass electrode.

Total Neutralising Value: Determined on HC1 extract using phenolphthalein as indicator and titrating against NaOH. $CaC0_3$ was used as a 100% standard.

Organic Carbon: Estimated by the Walkley-Black dichromate oxidation method as described by Jackson (1958), modified for colorimetric estimation. Values were read off on a Spekker Absorptiometer using Orange Filter No. 607. A recovery factor of 1.1 was used.

Total Nitrogen: Estimated by a modification of the method of Piper (1950) by digesting soil with concentrated H_2S0_4 using selenium as a catalyst, distilling into boric acid and titrating with HC1.

Free Iron: Extracted with buffered sodium hydrosulphite (Mehra and Jackson, 1960). Fe determined colorimetrically using o-phenanthroline.

References

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Mehra, O. P. and Jackson, M. L. (1960). Iron oxide removal from soils and clays by a dithionitecitrate system buffered with sodium bicarbonate. Clays and Clay Minerals, 5: 317—327.

Piper, C. S. (1950). Soil and Plant Analysis, Interscience Publications Inc. New York.

APPENDIX II

PROFILE DESCRIPTIONS AND ANALYSES

Grid for Locating Soil profile Sites on 6-inch Ordnance Survey Sheets

The grid used by the national Soil Survey for soil profile location is not the National Grid as the latter is not shown on the 6-inch field sheets.

The National Soil Survey grid is formed by dividing the 6-inch field sheet into four rectangles which are lettered A, B, C and D. The sides of the rectangle are divided vertically by 36 and horizontally by 26. The vertical lines (ordinates) are each given a number and the horizontal lines (abscissae) a letter.

A grid reference consists of:
Six-Inch Sheet Number 3; Six-Inch Sheet Quarter B;
ORDINATE 13; ABSCISSA P;
3 B 13 P.

TABLE 1: Fontstown Series—Profile Analyse:5

Horizon	sand %	Fine sand %	Sill %	Clay %	pH	CEC mcq/100 g	TFB mcq/100 g	Base Saturation	C "A	N %	C/N	1 ree iron	TNV 9i
\p	29	H	25	15	r.4	21.8	17.61	81	2.2	2.1	10.5	1 1	2.9
A 2	21	JO	35	14	' 7	6.8	5.53	81	0.4	—	—	1.1	0.2
B2l	13	25	VI	2X	so	13.4	11.99	89	0.5	—	—	2.0	0.2
C	25	24	u	17	S4	7.8	83.2	Sat	0.4	—		0.4	47.2

FONTSTOWN SERIES MODAL PROFILE

Location:	Kyleballintallon, Ballacolla; 29/2 3—4
Topography:	Undulating
Slope:	3°
Elevation:	98 metres O.D.
Vegetation:	Tillage
Drainage:	Well drained (to excessively drained in places)
Parent Material:	Calcareous stony till, of Midlandian Age, composed mainly of limestone.
Great Soil Group:	Grey Brown Podzolic (Typic Hapludalf).

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—22/25	22—25	Sandy loam; dark greyish brown (10 YR 4/2); moderate fine to medium granular structure; moist friable; plentiful roots; abrupt wavy boundary to:—
A2	22—42	0—20	Loam; brown (7.5 YR 4/4); moderate fine granular structure; friable; sparse roots; highly porous; abrupt boundary to:—
B2t	25—42/62	15—20	Clay loam; brown to dark brown (10 YR 4/3); moderate medium to coarse subangular blocky structure; moist firm to plastic; plentiful roots; peds highly porous; abrupt boundary to:—
C	42+	—	Stony loam; greyish brown (10 YR 5/2); structureless; dry hard *in situ;* no roots; strongly calcareous.

TABLE 2: Cullahill Series—Profile Analyses

Horizon	(oarse s;iml %	Fine sand %	Sill 95		PH	(i·.(· meq/10()g	i m meq/100 g	Base Saturation	I	N ″/<	CVN	1 rec iron \	TNV °/t
Ap	22	27	31	20	7.6	24.6	23.33	95	3.0	0.31	9.7	2.1	0.2
A.[1]	19	37	29	15	7.X	8.2	8.25	Sal	0.6	—	-	2.0	0.3
B2l	20	2!	28	31	7.9	13.0	13.33	Sal	0.6	—	—	Ml	2.5
(	42	27	19	12	8.7	2.0	4.53	Sal	0.4	—		0.5	68.4

CULLAHILL SERIES — MODAL PROFILE

Location:	Scrub and Glenmaculla, Cullahill; 35/1 Y 3
Topography:	Hummocky—undulating
Slope:	4°
Elevation:	110 metres O.D.
Vegetation:	New ley
Drainage:	Well drained to excessively drained
Parent Material:	Calcareous, stony, compact till of Midlandian Age, composed mainly of limestone
Great Soil Group:	Grey Brown Podzolic (Typic Hapludalf)

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—20	20	Sandy loam to loam; dark brown (10 YR 3/2) moderate medium subangular blocky and fine crumb structure; moist friable; plentiful roots; calcareous; burnt lime present; abrupt smooth boundary to:—
A2	20—35/38	15—18	Sandy loam; brown (7.5 YR 4/4—5/4); many worm channels filled with Ap above; moderate fine granular structure; moist friable; plentiful roots; calcareous; clear wavy boundary to:—
B2t	35—50/56	15—20	Clay loam; brown to dark brown (7.5 YR 4/4); moderate medium subangular blocky structure; moist plastic; plentiful roots; calcareous; abrupt wavy boundary to:—
C	50+		Grey stony sandy loam; highly calcareous structureless compact glacial till; no roots.

TABLE 3: Stradbally Series—Profile Analyses

Horizon	s.iiki	line sand %	Sill ·.;	Clay	pH	CEC meq/IOO g	TEB meq/IOO g	Base Saturation %	<	N	C/N	Free iron ',	INV 9f
Ap	25	29	31	15	M	16.8	11.2	67	1.6	0.14	s.4	I.I	0.2
A :	22	33	32	13	'4	6.2	5.1	83	0.2	—	—	I 1	0.2
B2l	14	25	33	23	'4	10.6	9.8	92	0.3	—	—	1.8	1.2
C	22	19	37	22	8.0	7.4	8.6	Sat	0.1	—		1.2	38.0

STRADBALLY SERIES MODAL PROFILE

Location:	Knocknambraher. Stradbally; 14/3 Q 32
Topography:	Undulating
Slope:	2°
Elevation:	90 metres O.D.
Vegetation:	Tillage
Drainage:	Well drained
Parent Material:	Calcareous glacial till of Midlandian Age. composed mainly of limestone with some sandstone.
Great Soil Group:	Grey Brown Podzolic.

Horizon	*Depth (cm)*	*Thickness*	*Description*
Ap	0—27/30	27—30	Sandy loam; dark brown (10 YR 3/3); moderate medium subangular blocky and fine granular structure; moist friable; plentiful roots; clear smooth boundary to:—
A2	27—40/50	12—20	Sandy loam; yellowish brown to dark yellowish brown (10 YR 4/4—5/4); moderate medium subangular blocky structure; moist firm; sparse roots; clear wavy boundary to:—
B2t	40—68/85	25—35	Loam; dark yellowish brown (10 YR 5/4) and dark brown (10 YR 4/3); moderate medium subangular blocky structure; moist slightly plastic; sparse roots; worm channels prominent; clear wavy boundary to:—
C	68+		Loam, greyish brown (2.5 Y 5/2) structureless firm calcareous till.

TABLE 4: Patrickswell Series—Profile Analyses

Hon/.m	(oarsc s.liul	Fine sand	Silt tij		pH	< I (meq/lOOg	II li meq/100 g	Base Saturation °A	(	N	< N	1 ree nun	TNV
All	24	27	32	17	7.0	30.6	22.1	72	4.1	0.41	in 5	2.1	0.5
A12	26	25	)3	16	7.1	22.4	1).|	^	1.9	0.22	8.6	1.9	0
A 13	25	24	56	15	7.2	19.0	10.0	53	l.o	0.14	7 1	1.9	(i
(A2)	25	23	35	17	7.3	6.2	5.5	89	0.4	—		1."	()
B2t	24	22	31		7.8	ll). 6	7.9	75	0.3	—	-	2.4	4.3
C	29	26	29	16	8.5	2.8	6.1	Sal	0.2	—	-	I.I	29.2

PATRICKSWELL SERIES — MODAL PROFILE

Location:	Tinnell, Rosenallis 3/4 V 7
Topography:	Rolling
Slope:	2°
Elevation:	100 metres O.D.
Vegetation:	Grassland
Drainage:	Well drained
Parent Material:	Calcareous glacial till composed mainly of limestone with some shale and sandstone.
Great Soil Group:	Grey Brown Podzolic

Horizon	*Depth (cm)*	*Thickness (cm.*	*Description*
All	0—10	10	Loam; dark greyish brown (10 YR 4/2) almost stone free; moderate medium subangular blocky and fine crumb structure; dry friable; abundant roots; abrupt boundary to:—
A12	10—24	14	Similar to All but contains small cherty stones; abrupt boundary to:—
A13	24—52/55	28—31	Loam; brown to dark brown (10 YR 4/3) moderate fine granular or crumb structure; moist friable; plentiful roots; clear boundary to:—
(A2)	52—70	15—18	Loam; dark yellowish brown (10 YR 4/4); moderate medium and fine subangular blocky structure; moist friable; some roots; clear boundary to:—
B2t	70—85	15	Loam (to clay loam); brown to dark brown (10 YR 4/3) moderate medium subangular blocky structure; moist plastic; sparse roots; abrupt wavy boundary to:—
C	85+		Sandy loam; grey non-tenaceous calcareous glacial till.

TABLE 5:: Elton Series—Profile Analyses

Horizon	Coarse sand %	Fine sand %	Silt %	(lay %	pH	CEC meq/lOOg	TEB meq/100 g	Base Saturation %	C %	N	(VN	Free iron %	TNV
A1l	23	2}	33	21	5.5	15.5	10.0	65	3.1	0.34	9.0	1.8	
AI2	22	25	35	IK	**5.7**	10.6	7.0	66	1.3	0.15	8.4	1.9	—
B21	20	22	33	25	6.6	12.9	—	**Sat**	0.9	0.13	7.3	1 8	—
B2t	IK	20	J3	29	7.3	10.0	—	**Sat**	0.2	0.08	**2.4**	2.1	1 s

ELTON SERIES — MODAL PROFILE

Topography:	Gently undulating to rolling
Slope:	4°
Elevation:	120 metres O.D.
Vegetation:	Old Pasture
Drainage:	Well drained
Parent Material:	Glacial drift predominantly of limestone composition but with a small proportion of sandstone, shale and volcanics: of Midlandian Age.
Great Soil Group:	Grey Brown Podzolic (Minimal).

Horizon	*Depth (cm)*	*Thickness*	*Description*
All	0—20	20	Gravelly loam; brown to dark brown (7.5 YR 4/4); moderate, medium crumb structure; friable; abundant rooting; clear, smooth smooth boundary to:—
A12	20—38	18	Gravelly loam; brown to dark brown (7.5 YR 4/4); moderate, medium crumb structure; friable; plentiful rooting; gradual, smooth boundary to:—
B21	38—58	20	Gravelly loam; brown to dark brown (7.5 YR 4/4); weak, medium, subangular blocky structure; friable; plentiful rooting; clear, smooth boundary to:—
B2t	58—102	44	Gravelly clay loam; brown to dark brown (10 YR 4/3); weak, coarse, subangular blocky structure; clay coatings on some ped faces and along vertical cracks; wet sticky; few fine roots.

TABLE 6: Knockbeg Series—Profile Analysis (1)

Horizon	Cgarse sand %	Fine sand %	Salt %	Clay %	PH	CEC meq/100 g	TEB meq/100 q	Base saturation %	C %	N %	C/N	Free iron %	TNV %
Ap	24	19	34	23	7.0	19.4	9.4	4.8	2.3	0.18	12.7	1.9	
B2l	16	15	36	*M*	7.3	19.0	12.5	6.6	0.4	—	—	2.5	—
B3l	17	19	33	)1	8.0	9.8	10.1	Sat	0.2	—	—	1.5	32.4
C	27	15	31	27	8.1	10.2	11.5	Sal	0.2	—	—	1.4	38.9

KNOCKBEG SERIES — MODAL PROFILE (I)

Location:	Rathduff, Ballickmoyler 32/4 B 14
Topography:	Undulating
Slope:	1°
Elevation:	60 metres O.D.
Vegetation:	Tillage
Drainage:	Well drained
Parent Material:	Calcareous glacial till of Midlandian Age composed mainly of limestone with sandstone and shale.
Great Soil Group:	Grey Brown Podzolic (Typic Hapludalf).

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—27	27	Loam; brown to dark brown (10 YR 4/3); weak medium subangular blocky structure; moist friable; fair root supply; clear smooth boundary to:—
B2t	27—60/80	33—53	Clay loam; brown to dark brown (7.5 YR 4/4 nearest); moderate medium subangular blocky structure; moist plastic; moderate root supply; clear wavy boundary to:—
B3t	60—85/88	8—28	Clay loam; brown (7.5 YR 5/4 nearest); weak/ moderate medium subangular blocky structure; moist plastic; sparse roots; abrupt boundary to:—
C	85+		Loam to clay loam; yellowish brown (10 YR 5/4) calcareous structureless loamy till.

TABLE 7: Knockbeg Series—Profile Analyses (2)

Horizon	Coarse sand %	Fine sand %	Salt %	Clay %	pH	CEC meq/100 g	TEB meq/100 q	Base Saturation %	C%	N %	C/N	Free iron %	TNV %
A11	24	22	32	22	7.5	21.8	8.9	41	2.0	0.24	8.3	1.8	0.2
A12	21	21	33	23	6.3	16.8	8.7	52	1.1	0.14	7.S	1.9	—
B1	23	19	32	26	6.5	13.0	8.0	62	0.7	—	—	2.3	—
B21	17	19	33	31	6.5	15.6	8.8	57	0.5	—	—	2.^	—
B3	19	19	36	26	6.9	11.4	9.8	86	0,4	—	—	2.5	0.5
C	17	17	37	29	8.0	10.6	11.4	Sal	0.2	—	—	1 4	34.5

KNOCKBEG SERIES — MODAL PROFILE (2)

Location:	Killadooley, Donoughmore; 28/1 P 5
Topography:	Undulating
Slope:	1°
Elevation:	120 metres O.D.
Vegetation:	Pasture
Drainage:	Well drained
Parent Material:	Calcareous glacial till of Midlandian Age composed mainly of limestone with sandstone and shale.
Great Soil Group:	Grey Brown Podzolic (Typic Hapludalf)

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
All	0—15	15	Loam; dark greyish brown (10 YR 4/2); moderate medium subangular blocky; moist friable; abundant roots; gradual boundary to:—
A12	15—27/30	12—15	Similar to above horizon but colour is somewhat lighter (10 YR 4/3); pink artifacts of burnt soil present; worm holes prominent; gradual boundary to:—
Bl	27—37/43	10—13	Loam; brown to dark brown (10 YR 4/3); moderate medium to fine subangular blocky structure; moist friable to slightly plastic; gradual boundary to:—
B2t	37—55/60	15—18	Clay loam; brown to dark brown (10 YR 4/3) moderate medium subangular blocky structure; moist plastic; plentiful roots; worm channels prominent; clay skins obvious; clear wavy boundary to:—
B3t	55—75/83	20	Loam to clay loam; brown to dark brown (10 YR 4/2—4/3) with many prominent yellowish brown (10 YR 5/6) mottles; medium subangular blocky structure; moist plastic; roots present; abrupt wavy boundary to:—
C	75+		Clay loam; greyish brown (2.5 YR 5/2) structureless calcareous glacial till.

TABLE 8: Knockbeg Stony Phase--Profile Analyses

Horizon	Coarse sand %	Fine sand %	Silt 95	(lay %	PH	CEC meq/lOOg	TEB meq/100 g	Base Saturation %	C °/(	N "4	C/N	Free iron %	TNV 'V
Ap	26	21	34	19	6.7	26.6	10.9	41	2.0	0.21	9.5	2.1	
A12	28	20	31	21	7.1	11.0	7.8	71	0.7	—	—	1.9	—
B21t	28	17	28	27	7.3	11.0	8.7	79	0.5	—	—	2.9	—
B22t	*2h*	18	27	29	7.2	12.6	10.1	so	0.4	—	—	1.1	—
C	31	17	27	25	8.1	9.4	10.5	Sat	0.2	—	—	2.3	24.7

KNOCKBEG STONY PHASE — MODAL PROFILE

Location:	Ballyhide, Carlow; 37/2 P 9
Topography:	Gently undulating.
Slope:	0°
Elevation:	55 metres O.D.
Vegetation:	New pasture
Drainage:	Well drained
Parent Material:	Calcareous non-tenaceous glacial till composed of limestone, chert, sandstone, shale and flagstone.
Great Soil Group:	Grey Brown Podzolic (Hapludalf)

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—20	20	Stony loam; brown to dark brown (10 YR 4/3); moderate medium blocky and fine granular structure; dry firm; plentiful roots; clear smooth boundary to:—
A12	20—35/38	15—18	Stony loam; brown (10 YR 5/3); moderate medium blocky structure; dry firm; plentiful roots; clear wavy boundary to:—
B21t	35—50/55	15—20	Stony clay loam to loam; brown to dark brown (10 YR 4/3); moderate medium subangular blocky structure; moist firm to slightly plastic; sparse roots; clear boundary to:—
B22t	50—80/85	30—35	Slightly darker but otherwise similar to above; dark greyish brown to brown (10 YR 4/2—4/3); abrupt boundary to:—
C	80+		Stony sandy clay loam; calcareous structureless, greyish brown stony till.

TABLE 9: Graceswood Series (1)—Profile Analyses

Horizon	(oarsc sand %	Fine sand %	Silt 95	(lay	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C %	N	1 'N	1 ICC iron 95	TNV %
Apl	24	4?	20	9	6.8	19.0	12.8	67	2.7	0.17		1.2	1.2
Ap2	21	51	21	7	7.5	9.0	6.76	75	0.7	—		0.6	0.5
A21	21	54	20	5	7.8	6.8	2.8	47	0.3	—	-	0.1	—
A22	24	51	21	4	7.5	6.6	3.3	50	0,4	—		0.9	0 4
A23	[9	53	24	4	'.6	I S	2.2	80	0.5	—	-	1.2	ON
B2(t)	15	50	19	16	7.4	5.0	4.6	92	0.4	—		1.3	0.5
C	13	53	25	9	7.6	J.6	5.4	93	0.2	—		1.3	0.6

GRACESWOOD SERIES — MODAL PROFILE (1)

Location:	Kyleballintallon. Ballacolla; 29/M 35—36
Topography:	Undulating
Slope:	2—3°
Elevation:	97 metres O.D.
Vegetation:	Tillage
Drainage:	Well drained
Parent Material:	Sandy deposits overlying calcareous stony till of Midlandian Age, composed mostly of limestone.
Great Soil Group:	Podzolised Grey Brown Podzolic (Degraded Grey Brown Podzolic) or Sandy Podzol.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Apl	0—22	22	Light sandy loam; very dark greyish brown (10 YR 3/2); fine granular structure; moist very friable; plentiful roots; abrupt boundary to:—
Ap2	20—30/34	0—12	Light sandy loam (to loamy sand); dark greyish brown (10 YR 4/2) otherwise similar to Apl; abrupt wavy boundary to:—
A21	34—44	0—10	Occurs as more bleached pockets above A22. Loamy fine sand; light grey (10 YR 7/2) with many worm casts and holes filled with Ap2; fine granular structure; moist friable to slightly firm; some roots; abrupt wavy boundary to A22 below.
A22	30—42/64	0—34	Loamy fine sand; colour varies from homogenous dark yellowish brown (10 YR 4/4) to banded dark yellowish brown (10 YR 4/4) and brown (10 YR 5/3); moist friable to slightly firmer in darker bands; clear wavy boundary to:—
A23	42—62/103	0—50	Similar in colour and texture to A22 but horizon is hard and compact and appears to have many small black manganese mottles; no roots; clear boundary to:—
B2(t)	34—100/125	22—66	Sandy loam; reddish brown (5 YR 4/4); granular structure; moist friable to very friable; few manganese mottles; clear boundary to:—
C	100+		Sandy loam; brownish loamy sand; moist very friable; non-calcareous.

TABLE 10: Graceswood Series (2)—Profile Analyses

Horizon	Coarse sand %	Fine sand %	Siii 9J	Clay %	PH	CF.C meq/100 g	TEB meq/100 g	Base Saturation %	C%	N %	C/N	Free iron %	TNV 95
Apl	2X	46	17	9	7.2	18.4	10.7	58	1.6	0.18	8.9	0.8	
Ap2	29	45	18	8	7.2	9.4	6.3	67	0.6	—	—	0.6	—
A2	46	37	10	7	7.2	5.6	2.4	44	0.3	—	—	0.8	—
B2(t)	IX	36	28	18	7.')	8.0	8.!	Sat	0.3	—	—	1.5	4.0
IIB2t	16	38	25	21	7.7	7.2	8.(1	93	0.6	—	—	1.9	3.8
IIC	20	39	26	15	8.7	5.4	6.6	85	0.2	—		0.6	44.7

GRACESWOOD SERIES — MODAL PROFILE (2)

Location:	Graceswood, Abbeyleix; 29/2 T 17
Topography:	Undulating
Slope:	0°
Elevation:	90 metres O.D.
Vegetation:	Tillage
Drainage:	Well drained
Parent Material:	Sandy deposits overlying calcareous stony till, of Midlandian Age. composed mostly of limestone.
Great Soil Group:	Podzolised Grey Brown Podzolic (Degraded Grey Brown Podzolic).

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Apl	0—22/24	22—24	Light sandy loam (to loamy sand); dark brown (10 YR 3/3); moderate fine granular structure; moist very friable; plentiful roots; abrupt boundary to:—
Ap2	22—30/35	8—13	Light sandy loam (to loamy sand); brown (7.5 YR 4/2 nearest) with worm channels filled with Apl; moderate fine granular structure; moist very friable to slightly firm *in situ;* fair root supply; abrupt smooth boundary to:—
A2	30—62	0—28	Loamy sand; brown to dark yellowish brown (10 YR 4/4—7.5 YR 4/4) to brown (7.5 YR 4/4 nearest) in places; moist firm to friable; sparse roots; clear boundary to B2t and 1 lB2t.
B2(t)	40—80/95	0—35	Sandy loam to loam; reddish brown (5 YR 4/4); moderate granular structure; moist friable; sparse roots; abrupt wavy boundary to 11C.
HB2t	30—40/110	10—20	Sandy clay loam (to sandy loam); brown to dark brown (10 YR 4/3); moderate medium subangular blocky structure; moist plastic; sparse roots; abrupt tonguing boundary to:—
11C	40+		Sandy loam; calcareous limestone till, compact; no roots.

TABLE 11: Mylerstown Series--Profile Analyses

Horizon	Coarse sand %	line sand %	Sill %	(lay %	pH	CEC meq/100g	TEB meq/100 g	Base Saturation %	c%	N %	C/N	1 ICC iron	TNV <;
Ap	21	29	33	17	6.1	25.2	9.6	38	2.9	0.32	9.1	0.7	
A2g	22	.17	30	21	6.6	17.6	8.7	4')	1.9	0.23		1.5	—
B2tg	15	22	)8	25	7.5	13.6	11.3	83	0.9	—	—	2.6	0.6
Cg	13	20	41	26	8.4	9.0	9.4	Sal	(14	—	—	1.2	44.2

MYLERSTOWN SERIES — MODAL PROFILE

Location:	Newtownbert, Athy; 31/3 U 16
Topography:	Gently undulating to flattish
Slope:	1°
Elevation:	63 metres O.D.
Vegetation:	Tillage
Drainage:	Poorly drained
Parent Material:	Stony, compact, but non-tenaceous glacial till composed mainly of limestone.
Great Soil Group:	Gley.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap (recent)	0—20	20	Loam to sandy loam; dark greyish brown (10 YR 4/2) with many fine distinct dark reddish root mottles; weak to moderate medium sub-angular blocky structure; moist friable; abundant roots; abrupt boundary to:—
A2g	20—25/31	5—10	Loam; greyish brown (10 YR 4/2—4/3 nearest) with many fine distinct yellowish brown (10 YR 5/6) mottles; moderate to weak fine to medium subangular blocky structure; moist friable—hard when dry; plentiful roots; abrupt boundary to:—
B2tg	25—42/53	17—23	Loam (to clay loam); greyish brown (10 YR 5/2) with abundant distinct yellowish brown (10 YR 5/6) mottles—mottles almost dominant colour—and some black manganese flecks; weak medium subangular blocky structure; moist plastic; good root supply; abrupt tonguing boundary to:—
Cg	42+		Gritty stony loam; grey (5 Y 5/1—6/1) with many diffuse distinct light olive brown (2.5 Y 5/4) mottles; structureless; no roots; strongly calcareous.

TABLE 12: Mylerstown Imperfectly Drained Phase—Profile Analyses

Horizon	Coarse sand %	Fine sand %	Silt 95	Clay ·‹‹	pH	CEC meq/100 g	11 M meq/100 g	Base Saturation %	C %	N	C'/N	Free iron %	TNV <;
Al	19	22	44	15	6.5	18.9	5.7	30	**14**	0.3	11.3	0.77	
A 2	16	25	44	is	6.5	6.7	3 7	55	0.6	—		0.57	
B2t	9	20	46	25	7.5	12.4	11.8	95	0.5	—		1.74	
Cg	10	13	62	15	S.2	4.0	8.3	**Sal**	0.3	—		0.34	

MYLERSTOWN IMPERFECTLY DRAINED PHASE—MODAL PROFILE

Location:	Kilpatrick Farm. Lullymore, Co. Kildare 12/2 J 5
Topography:	Undulating
Slope:	0°
Elevation:	85 metres O.D.
Vegetation:	Permanent pasture
Drainage:	Imperfectly drained
Parent Material:	Stony, compact, but non-tenaceous glacial till composed mainly of limestone.
Great Soil Group:	(Podzolic) Gley.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Al	0—18	18	Loam; dark greyish brown (10 YR 4/2) with reddish brown (5 YR 4/4) root mottles; moderate medium angular blocky structure; moist friable; clear boundary to:—
A2	18—25/28	7—10	Loam; light brownish grey (2.4 Y 6/2) with many medium and fine strong brown (7.5 YR 5/6) mottles; moderate medium angular blocky structure; clear wavy boundary to:—
B2t	28—36/41	8—16	Loam to clay loam; yellowish brown (10 YR 5/4) with many distinct medium and fine strong brown (7.5 YR 5/4) mottles; weak angular blocky structure; clay skins distinct; abrupt tonguing boundary to:—
Cg	36+		Silt loam; light grey (10 YR 6/1) with many distinct yellowish brown (10 YR 5/6) mottles; structureless; moist hard *in situ;* no roots; calcareous.

TABLE 13: Ballyshear Series—-Profile Analysis58

Horizon	Coarse sand %	Fine sand %	S.lt %	Clay %	pH	CEC meq/100 g	TEB meq/100 B	Base Saturation %	C%	N %	C/N	Free iron %	TNV °A
Alp	12	20	36	32	6.6	44.8	21.9	4')	7.3	0.67	10.9	1.7	
A12	18	22	34	26	6.8	28.4	15.0	53	2.1	0.34	6.2	2.2	—
A2g	24	28	27	21	7.7	13.4	10.2	76	0.4	—	—	1.7	o 5
A2g	42	<X	13	7	8.1	6.6	4.0	60	0.1	—	—	0.9	3.4
Btg	7	10	42	41	8.3	10.2	10.7	Sal	O.7	—	—	1.7	41.6
Cg	22	31	33	14	8.2	2.8	5.2	Sal	0.2	—	—	0.5	47.3

BALLYSHEAR SERIES — MODAL PROFILE

Location:	Newtownbert, Athy; 31/3 T 16
Topography:	Flatfish
Slope:	0°
Elevation:	60 metres O.D.
Vegetation:	Tillage
Drainage:	Very poorly drained
Parent Material:	Similar to Fontstown Series
Great Soil Group:	Gley

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Alp	0—13/16	13—16	Peaty clay loam; dark brown (10 YR 2/3 nearest) to dark greyish brown (10 YR 3/2) with abundant fine dark-red root mottles; weak fine subangular blocky structure; moist friable; abundant roots (recently ploughed); abrupt smooth boundary to:—
A12	13—24/27	11	Loam; yellowish brown (10 YR 5/4) with abundant yellowish red (5 YR 4/6) mottles; moderate medium subangular blocky structure; moist friable to slightly plastic; some roots prominent; clear wavy boundary to:—
A2g	24—53/57	26—30	Sandy clay loam with some loamy sand pockets; grey (10 YR 5/1 nearest) with many distinct yellowish brown (10 YR 5/6 nearest) mottles; weak fine granular to weak subangular blocky structure; moist plastic (to friable in sandy pockets), clear wavy boundary to:—
Btg	53—80/120	30—70	Clay loam; mottled grey (10 YR 5/1) and olive brown (2.5 Y 4/4 nearest); weak medium prismatic structure; moist plastic; sparse roots; clear tonguing boundary to:—
Cg	80+		Sandy loam; grey (10 YR 5/1) till with some pale yellowish brown mottles; structureless; strongly calcareous.

TABLE 14: Howardstown Series—Profile Analyses

Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C %	N %	C/N	Free iron %	TNV %
A11g	12	13	33	42	5.8	29.8	22.7	76	8.6	0.81	10.6	1.8	—
A12g	10	14	33	43	6.0	18.8	16.8	X9	3.7	0.43	8.6	1.8	—
(A2)g	11	15	35	)9	6.X	11.8	—	Sat	0.9	0.14	6.4	1.2	0.0
B2tg	6	8	38	48	7.9	10.5	—	Sat	0.3	0.04	7.5	2.0	0.0
B3g	6	6	41	47	8.3	8.5	—	Sat	0.3	0.03	10.0	1.7	20.6

HOWARDSTOWN SERIES — MODAL PROFILE

Slope:	1°
Elevation:	100 metres O.D.
Vegetation:	Old pasture
Drainage:	Poorly drained
Parent Material:	Glacial drift predominantly of limestone composition with admixture of shale, sandstone and volcanics; of Midlandian Age.
Great Soil Group:	Gley

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Allg	0—15	15	Clay to clay loam, dark-brown (10 YR 3/3) with many, fine, faint, yellowish-red (5 YR 4/8) mottles; weak, fine crumb structure; friable; abundant, diffuse roots; gradual, smoth boundary to:—
A12g	15—25	10	Clay to clay loam; light-grey to grey (10 YR 6/1) with many fine, distinct, strong-brown (7.5 YR 5/6) mottles; moderately weak. medium subangular blocky structure; friable; plentiful, diffuse roots; gradual. smooth boundary to:—
(A2)g	25—45	20	Clay loam; light brownish-grey (10 YR 6/2) with many, fine, distinct reddish-yellow (7.5 YR 6/6) mottles; massive structure; wet, slightly plastic; few roots; gradual, smooth boundary to:—
B2tg	45—60	15	Clay; light brownish-grey (10 YR 6/2) with common,, medium, distinct, strong-brown (7.5 YR 5/6) mottles; massive structure; wet, plastic; few roots; diffuse, smooth boundary to:—
$B3_g$	60—100	40	Silty clay; strong-brown (7.5 YR 5/6) with common, medium, prominent, light-grey to grey (10 YR 6/1) mottles; massive structure; wet, plastic; very few roots.

TABLE 15: Baggotstown-Carlow Complex—Moderately Deep Component—Profile Analyses

Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C%	N %	C/N	Free iron %	TNV %
All	U	23	28	15	6.9	24.9	21.4	86	4.8	0.47	10.2	2.2	0.0
A12	u	24	27	15	7.5	16.0	15.7	98	1.5	0.20	7.5	1.5	0.0
A2	46	20	24	10	7.4	7.3	—	Sat	0 4	nd	—	I.I	0.0
B21	38	15	23	24	7.5	13.8	13.5	98	0.6	ml	—	1 X	0.0
B3	42	31	13	15	7.4	8.0	—	Sat	0.1	ml	—	0.9	0.4
C	IKl	nd	nd	nd	8.5	1.9		Sat	0.0	nd		0.4	51.4

BAGGOTSTOWN-CARLOW COMPLEX - MODERATELY DEEP COMPONENT
(Carlow Series)
MODAL PROFILE

Location:	Gravel Pit, near Manager's Residence. Agricultural Institute, Oak Park, Carlow.
Topography:	Undulating
Slope:	2—3°
Elevation:	61 metres O.D.
Vegetation:	Pasture
Drainage:	Well drained
Parent Material:	Calcareous, fluvio-glacial gravels, of Midlandian Age, composed mainly of limestone with a very small proportion of sandstone.
Great Soil Group:	Grey Brown Podzolic.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
All	0—9	9	Gravelly sandy loam; very dark greyish-brown (10 YR 3/2): moderate, fine and very fine granular structure; very friable; bleached quartz grains; non-calcareous; abundant roots; clear, smooth boundary to:—
A12	35—38	26—29	Gravelly sandy loam; dark-brown (10 YR 3/3); moderate, fine and medium granular structure; friable; bleached quartz grains; non-calcareous; plentiful roots; clear, smooth boundary to:—
A2	35—58/71	23—36	Coarse sandy loam (few gravels); brown to dark yellowish-brown (10 YR 4/3—4/4); weak, very fine granular structure; very friable; many worm channels lined with material from A12; plentiful roots; non-calcareous; abrupt wavy boundary to:—
B2t	58—69/89	11—31	Gritty sandy clay loam; dark greyish-brown to brown (10 YR 4/2—4/3); moderate, medium subangular blocky structure; wet, slightly plastic; plentiful roots; non-calcareous clear, smooth boundary to:—
B3	69—71/99	2—30	Gritty sandy loam; brown to dark-brown (10 YR 4/3); weak, fine granular structure; very friable; sparse roots; weakly calcareous; abrupt, tonguing boundary to:—
C	71+		Gravelly coarse sand; grey (5 Y 5/1); structureless; loose; no roots; strongly calcareous with bands of secondary calcium carbonate present.

TABLE 16: Baggotstown-Carlow Complex—Shallow Component—Profile Analyses

Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/lOO g	TEB meq/lOO g	Base Saturation %	C%	N%	C/N	Free iron %	TNV %
Ap	46	21	18	15	7.4	23.8		Sat	3.4	0.4		1.0	12.0
C	nd	nd	nd	nd	8.1	4.0	—	Sat	0.9	nd		0.4	40.1

BAGGOTSTOWN-CARLOW COMPLEX - SHALLOW COMPONENT

(Baggotstown Series)

MODAL PROFILE

Location:	Slate Sheds North, Agricultural Institute, Oak Park, Carlow
Topography:	Hummocky
Slope:	2°
Elevation:	61 metres O.D.
Vegetation:	Pasture
Drainage:	Excessively drained
Parent Material:	Calcareous, fluvio-glacial gravels, of Midlandian Age, composed mainly of limestone with very small proportions of sandstone.
Great Soil Group:	Brown Earth (of high base status).

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—28/36	28—36	Gravelly, coarse sandy loam; brown to dark brown (7.5 YR 4/2); moderate, fine crumb structure; very friable; abundant roots; calcareous; clear, wavy boundary to:—
C	28+		Gravelly coarse sand; light olive-grey (5 Y 6/2); structureless; loose; good root development in top 9 inches; calcareous—bands of secondary calcium carbonate present.

TABLE 17: Baggotstown-Carlow Complex—Imperfectly Drained Component—Profile Analysis

Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/100g	TEB meq/100 g	Base Saturation %	C %	N %	C/N	Free iron %	TNV %
Ap	39	27	19	15	7.8	25.8	23.7	92	4 1	0.33	12.4	0.6	4.3
Bg	55	20	15	10	7.9	6.0	nd	Sat	0.6	nd	—	0.2	7.0
Cg	69	13	9	9	8.4	1.8	nd	Sat	0.3	nd	—	0.3	55.1

BAGGOTSTOWN-CARLOW COMPLEX - IMPERFECTLY DRAINED COMPONENT
(Clonaslee Imperfectly Drained Phase)
MODAL PROFILE

Location:	Ninety-Eight Field, Agricultural Institute, Oak Park, Carlow.
Topography:	Flattish
Slope:	0°
Elevation:	58 metres O.D.
Vegetation:	Potatoes
Drainage:	Imperfectly drained
Parent Material:	Calcareous, fluvio-glacial gravels, of Midlandian Age, composed mainly of limestone with very small proportions of sandstone.
Great Soil Group:	Brown Earth with gleying (high base status).

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—25/32	25—32	Sandy loam; very dark greyish-brown (10 YR 3/2); moderate, fine granular structure; very friable; good root development; calcareous; clear, smooth boundary to:—
Bg	25—86	61	Gravelly sandy loam; dark-grey (5 Y 4/1); structureless; friable; sparse roots; calcareous; gradual, smooth boundary to:—
Cg	86+		Gravelly loamy sand; grey (5 Y 5/1); structureless; friable; no roots; calcareous.

TABLE 18: Clonaslee Series (Athy Complex—Poorly Drained Component)—Profile Analyses

Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C%	N	CYN	Free iron %	TNV %
A	57	17	15	11	7.7	26.8	—	Sat	4.5	0.37	12.2	0.4	12.5
Cg	36	43	11	10	8.4	2.6	—	Sat	0.3	nd		0.2	35.6

CLONASLEE SERIES
(Athy Complex—poorly drained component)
MODAL PROFILE

Location:	Bog Field, Agricultural Institute, Oak Park, Carlow
Topography:	Flat
Slope:	0°
Elevation:	60 metres O.D.
Vegetation:	Pasture
Drainage:	Poorly drained
Parent Material:	Calcareous, fluvio-glacial gravels, of Midlandian Age, composed mainly of limestone with small proportions of sandstone.
Great Soil Group:	Gley.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
A	0—33/43	33—43	Sandy loam; very dark brown (10 YR 2/2); weak, fine and medium granular structure; friable; plentiful roots; calcareous; abrupt, wavy boundary to:—
Cg	33+		Gravelly loamy sand; grey (5 Y 5/1); structureless; friable; no roots; calcareous.

TABLE 19: Mountrath Complex—Profile Analyses (1)

Horizon	Coarse sand	Fine sand	Silt		pH	CEC meq/lOOg	TEB meq/100 g	Base Saturation			CYN	Free iron %	TNV 91
Ap	40	20	23		6.3	31.4	18.8	60	3.8	0.32	1.9	0.9	
A2g	54	19	16	II	8.0	5.0	5.5	Sal	0.3			0.2	4.5
Bt(g)	34	22	28	16	8.3	6.7	6.8	Sat	0.2			0.1	15.3
Cg	31	24	29	16	8.5	4.0	6.6	Sal	0.2			0.9	21.8

MOUNTRATH COMPLEX MODAL PROFILE (1)

Location:	Iry, Ballyfin; 12/3 G 36
Topography:	Flattish
Slope:	0°
Elevation:	120 metres O.D.
Vegetation:	Pasture (badly poached)
Drainage:	Poorly drained (artifically improved)
Parent Material:	Calcareous glacial till composed of sandstone and limestone.
Great Soil Group:	Gley.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—20/23	20—23	Sandy loam; very dark greyish brown (10 YR 3/2) with many fine distinct root mottles; moderate medium subangular blocky and fine granular structure; moist—dry firm to friable; plentiful roots; non-calcareous; abrupt boundary to:—
A2g	20—45/50	25—30	Coarse sandy loam; grey (10 YR 5/1 and 5 Y 5/1) with many distinct brownish yellow (10 YR 6/6) mottles; moderate medium sub-angular blocky and fine granular structure; moist friable; good root supply; calcareous; gradual boundary to:—
Bt(g)	45—90/95	45—50	Sandy loam; brown (10 YR 5/3 nearest) with many faint grey and yellowish mottles; some manganese (pipe stem) concretions; moderate medium subangular blocky structure tending towards structureless; moist plastic; good root supply; calcareous; gradual boundary to:—
Cg	90+		Sandy loam; pinkish grey calcareous glacial till.

TABLE 20: Mountrath Complex—Profile Analyses (2)

Horizon	Coarse sand %	Fine sand %	Silt	Clay <Y<	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation 95	C%	N%	C/N	Free iron %	TNV
Ap1	58	26	25	11	(..(i	20.8	8.3	40	4.3	0.22	19.5	0.4	
A12	14	27	25	14	6.2	25.2	12.1	4S	6.0	0.21	**21.0**	0.4	—
A2g	38	25	27	10	6.4	6.8	4.2	62	0.7	—	-	0.5	—
B21tg	*u*	22	23	21	6.6	6.6	5.0	76	0.4	—	—	1.1	—
B22tg(Clg)	32	22	29	17	8.3	4.6	5.4	**Sal**	0.2	—	—	1.1	22.6
Cg	33	21	27	19	8.5	5.6	5.7	Sat	0.2	—	-	1.6	23.8

MOUNTRATH COMPLEX — MODAL PROFILE (2)

Location:	Esker. Mountmellick: 7/4 L 7
Topography:	Gently undulating
Slope:	0°
Elevation:	110 metres O.D.
Vegetation:	Pasture (heavily poached)
Drainage:	Poorly drained (artificially improved)
Parent Material:	Calcareous glacial till composed of sandstone and limestone.
Great Soil Group:	Glcy.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Apl	0—22/27	22—27	Sandy loam; very dark greyish brown (10 YR 4/2—3/2); moderate fine granular or crumb structure; moist/dry friable/firm; plentiful roots; abrupt boundary to A12 and A2g.
A12	22—27	0—5	Sandy loam; very dark grey (10 YR 3/1) (Remnant of original peaty surface layer); moderate medium subangular blocky structure; moist friable; plentiful roots; abrupt wavy boundary to:—
A2g	22—40/44	17—34	Sandy loam; light grey (10 YR 7/2) to light brownish grey (10 YR 6/2) with portions (worm-casts) of Apl; moderate fine granular structures; dry/moist firm *in situ;* some roots; non-calcareous; gradual boundary to:—
B21tg	40—80/85	40—45	Sandy clay loam; light grey to grey (5 Y 5/1—6/1) with very many prominent strong brown (7.5 YR 5/6) mottles; structureless tending towards subangular blocky; moist plastic; sparse roots; non-calcareous; clear wavy boundary to:—
B22tg or CIg	80—100	25—30	(Looks more like CIg); sandy loam; greyish brown (10 YR 5/2) with many distinct grey (5 Y 5/2) and brownish yellow (10 YR 6/6) mottles; structureless tending towards subangular blocky; moist plastic; little or no roots; calcareous; gradual boundary to:—
Cg	110+		Sandy loam; similar to above horizon but grey mottles poorly represented; structureless; calcareous glacial till.

TABLE 21: Mountrath Complex—Profile Analyses (3)

Horizon	Coarse sand %	line sand %	Silt 95	(lav	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C %	N	C7N	1 rec iron	TNV
Ap	39	26	26	')	6.3	23.X	16.1	67	3.2	0.25		0.7	
A2	46	26	23	5	6.8	5.8	3.0	52	(I 2	—		(i.I	—
A2h(B2h)	•44	25	24	7	6.8	12.2	7.8	64	0.7	—		0.2	—
B2ir	48	25	21		6.8	8.0	4.9	61	0.5	—		(I.S	—
B2tg	2[1]	23	32	IS	7.0	8.4	5.9	71	0.1	—		1.6	0.0
C	38	22	30	10	8.5	2.8	4.7	Sat	0.1			0.7	22.2

MOUNTRATH COMPLEX — MODAL PROFILE (3)

Location:	Rosskelton, Mountrath; 17/3 L 34
Topography:	Gently undulating
Slope:	0°
Elevation:	95 metres O.D.
Vegetation:	Tillage
Drainage:	Poorly drained (to imperfect) (Now improved)
Parent Material:	Calcareous glacial till composed of sandstone and limestone
Great Soil Group:	Bisequal podzolised gley. humus-iron podzol in degraded gley.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—23/25	23—25	Coarse sandy loam; very dark to dark greyish brown (10 YR 3/2—4/2); moderate fine granular structure: moist friable; plentiful roots; abrupt boundary to:—
A2	23—28/38	5—15	Coarse sandy loam to loamy coarse sand; light brownish grey (10 YR 6/2); moderate fine granular structure; moist/dry firm; sparse roots; clear wavy boundary to:—
A2h (B2h)	28—35/55	0—20	Coarse sandy loam; very dark brown (10 YR 2/2) with portions of greyish brown (10 YR 5/2); moderate fine granular structure; moist/dry firm; sparse roots; clear tonguing boundary to:—
B2ir	28—55/65	5—27	Coarse sandy loam to loamy coarse sand; yellowish brown with some greyish brown spots (10 YR 5/2); moderate fine granular structure; moist/dry firm to hard in places; no roots (hard at top of horizon); clear boundary to:—
B2tg	55—120/140	65—85	Loam to sandy loam; mottled yellowish brown (10 YR 5/6) and light grey (10 YR 7/2) with some black manganese flecks; moist plastic; non-calcareous; abrupt boundary to:—
C	120+		Sandy loam: light brownish grey (10 YR 6/2 nearest) calcareous till with many faint to distinct yellowish-brown mottles.

TABLE 22: Mountrath Complex—Profile Analyses (4)

Horizon	Coarse sand %	Fine sand %	**Silt** %	Clay	pH	**CEC** meq/100 g	TIB **meq/100 g**	Base Saturation %			C/N	iron	TNV
6—22	—	—	—	—	6.2	**112.4**	KI.8	67	27.6	1.6	17.3		—
22—40/45	—	—	—		**6.1**	179.2	116.9	65	22.6	1.6	14.1		—
40+	—	—	—	—	7.9	13.6	15.9	Sat	3.4	0.3	11.3		93.4

MOUNTRATH COMPLEX — MODAL PROFILE (4)

Location:	Rosskelton, Mountrath; 17/3 I 35
Topography:	Flat
Slope:	**0°**
Elevation:	90 metres O.D.
Vegetation:	Rough pasture
Drainage:	Poorly drained
Parent Material:	
Great Soil Group:	Peat (Histosol)

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
—	0—6	6	Organic; dark reddish brown fibrous root mat; clear smooth boundary to:—
—	6—22	16	Very dark brown (10 YR 2/2) well structured peat; clear smooth boundary to:—
_	22—40/45	18—23	Black (10 YR 2/1) well structured (prismatic) peat; abrupt wavy boundary to:—
—	40+	—	Whitish shell marl; highly calcareous.

TABLE 23: **River Alluvium—Profile 1 Analyses**

Horizon	Coarse sand %	Fine sand %	Sill	Clay	PH	CEC meq/100 g	TEB meq/100 g	Base Saturation	C %	N	C/N	Free iron	TNV
Ap	20	15	41	24	6.5	20.0	12.4	62	2.3	0.26	8.5	I.S	
AI2	24	II	43	22	6.8	16.2	9.2	57	0.9	—	-	1.8	—
A13	66	16	9	9	6.5	4.6	2.8	62	0.2	—		0.6	—
A14	24	29	25	22	5.9	13.0	7.1	55	1.0	0.12	8.3	2.0	—
A15	u	29	24	13	5.6	9.8	5.0	51	0.6	—	-	2.1	—
A16	14	•4')	24	1)	6.7	8.8	6.3	72	0.8	—		1.5	—

RIVER ALLUVIUM — MODAL PROFILE (1)

Location:	Rearymore, Clonaslee; 3/1 U 4
Topography:	Flattish
Slope:	**0°**
Elevation:	90 metres O.D.
Vegetation:	Tillage
Drainage:	Imperfectly drained
Parent Material:	River alluvium of mixed sandstone-limestone origin
Great Soil Group:	Regosol

Horizon	*Depth (cm)*	*Thickness (cm,*	*Description*
Ap	0—16	16	Loam; brown to dark brown (7.5 YR 4/2); moderate medium subangular blocky structure: moist friable to firm; plentiful roots; abrupt boundary to:—
A12	16—22/23	8—9	Loam; similar to above except colour is brown (7.5 YR 5/2); abrupt wavy boundary to:—
A13	22—32	10	Loamy coarse sand; brown to light brown (7.5 YR 5/2—6/4) with black manganese layer almost continuous throughout central portion of layer; structureless; moist friable but hard when cemented with manganese; sparse roots; abrupt boundary to:—
A14	32—50	18	Sandy clay loam; brown (7.5 YR 2/2) with many small black manganese mottles; moderate medium subangular block structure; moist friable; fair root supply; clear smooth boundary to:—
A15	50—82	32	Sandy loam; heterogenous colour consisting of brown (7.5 YR 2/2) with abundant black manganese concentrations (not concretions) and dark yellowish brown mottles; weak fine granular structure; moist friable; sparse roots; gradual boundary to:—
A16	82+		Sandy loam; pinkish grey (7.5 YR 6/2) with black manganese concretions and yellowish brown mottles; structureless; moist plastic; no roots; non-calcareous.

TABLE 24: River Alluvium—Profile 2 Analyses

Horizon	Coarse sand	Fine sand %	Silt %		pH	CEC mcq/100 g	TEB mcq/100 g	Base Saturation	C	N	CVN	Free iron	TNV '"<
0—30	20	36	18	26	7.3	29.4			2.6	0.30	8 7	3.8	0.1
30—50	1!	10	37	-4.1	7.1	37.4			2.8	0.4	7.0	10.6	0.1
50—60	8	17	38	37	7.5	29.4			1 4	0.19	7.4	8.8	0.1
60—85	8	II	36	4.1	7.2	32.0			1.6	0.16	10.0	13.6	0.1
85—105	8	16	u	J.1	7.:	34.4			1.6	0.17		10.X	().(
110—120	2	15	35	48	6.6	34.4			2 1	0.19	III	14.0	0.1
120—160	:	6	35	57	6.0	51.6			4.4	0.34	12.9	8.5	

RIVER ALLUVIUM — MODAL PROFILE (2)

Location:	Strahard. Mountmellick; 4/3 W 20
Topography:	Flat
Slope:	0°
Elevation:	73 metres O.D.
Vegetation:	Pasture
Dainage:	Imperfectly drained
Parent Material:	River alluvium derived from limestone
Great Soil Group:	Regosol.

Horizon	*Depth (cm)*	*Thickness*	*Description*
—	0—30	30	Sandy clay loam(?); dark brown (7.5 YR 3/2); moderate medium subangular block structure; moist friable; plentiful roots; clear smooth boundary to:—
	30—50	20	Clay loam; brown to dark brown (7.5 YR 4/2 nearest) with many black manganese concretions (small and medium); moderate medium subangular blocky structure; moist friable to slightly plastic; good root supply; clear smooth boundary to:—
	50_60	10	Clay loam; brown (10 YR 5/3) with abundant small yellowish brown (10 YR 5/8) mottles and few black (medium to large) manganese concretions; moderate medium subangular blocky structure; moist plastic; clear boundary to:—
	60—85	25	Clay to clay loam; yellowish brown (10 YR 5/4) with many yellowish brown (10 YR 5/8) mottles and abundant medium to large (0.5 cm) black manganese concretions; moderate medium subangular blocky structure; moist plastic; sparse roots; clear smooth boundary to:—
	85—105	30	Clay to clay loam; greyish brown (2.5 Y 5/2) with grey (10 YR 5/1) mottles and black manganese concretions; moist plastic; sparse roots; transitional through almost continuous black manganese (105—110) pan to:—
	110—120	10	Clay; greyish brown with abundant dark red mottling; almost structureless; moist plastic; no roots; clear boundary to:—
	120—160	40	Clay; dark grey (10 YR 4/1) with few yellowish brown (10 YR 5/6) mottles and black soft manganese flecks (0.5 cm); structureless tending towards prismatic.

ON

TABLE 25: River Alluvium—Profile 3 Analyses

Horizon	(oarse sand %	Fine sand %	Silt		PH	CEC meq/100 g	II B meq/100 g	Base Saturation	C	N	C/N	Free iron	TNV
All	8	14	35	4<	6.0	46.4	30.1	65	4.6	0.47		VI	
A12	2	9	36	53	6.3	32.8	27.2	S3	1.9	0.19	10.0	9.2	—
A13	8	4	4h	4:	6.5	85.2	67.6	79	15.0	1.0	15.0	1.5	(id
IIC	M	17	12	7	8.6	3.4	4.0	Sat	0.9	—		0.6	29.3

RIVER ALLUVIUM — MODAL PROFILE 3

Location:	Correel, Vicarstown; 14/4 B 15
Topography:	Flat
Slope:	0°
Elevation:	67 metres O.D.
Vegetation:	Tillage
Drainage:	Imperfect—free draining
Parent Material:	Alluvium derived mainly from limestone
Great Soil Group:	Regosol

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
All	0—28	28	Clay (to clay loam); dark brown (10 YR 3 moderate medium subangular block structure; moist friable; plentiful roots; clear boundary to:—
A12	28—58	30	Clay; yellowish brown (10 YR 5/6) with many distinct light brownish grey (2.5 Y 6/2) mottles and black manganese flecks; strong medium subangular blocky structure tending towards coarse prismatic; moist plastic; sparse roots; non-calcareous; abrupt smooth boundary to:—
A13	58—63		Blackish peaty silty clay; wood remains visible; abrupt smooth boundary to:—
UC	63+		Loamy sand; calcareous gravels.

TABLE 26: River Alluvium—Profile 4 Analyses

_ go	Horizon	sand %	**Fine sand** 95	Silt %		pH	(| (meq/100 g	TIB meq/100 g	Base Saturation		N	C//N	Free iron	**TNV**
	0—30	9	9	36	46	7.7	62.8	48.9	78	6.9	0.66	10.5	15.9	10.6
	30—75	3	7	40	50	7.5	64.0	48.1	75	5.7	0.62		21.9	13.4
	75+		—	—		6.8	137.6	**121.2**	**88**	25.6	**1.8**		**3.8**	—

RIVER ALLUVIUM — MODAL PROFILE (4)

Location:	Kilmartin, Borris-in-Ossory; 21/2 T 4
Topography:	Flat
Slope:	0°
Elevation:	107 metres O.D.
Vegetation:	Pasture
Drainage:	Free-draining
Parent Material:	River alluvium derived mainly from limestone
Great Soil Group:	Regosol

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
—	0—30	30	Clay; brown to dark brown (7.5 YR 4/2) with many prominent yellowish red (5 YR 5/8) flecks or mottles; strong medium subangular blocky structure; moist/dry friable; plentiful roots; gradual boundary through slightly darker layer to:—
	30—75	45	Clay to silty clay; speckled brown, dark greyish brown and yellowish red (5 YR 4/6); moderate medium subangular block structure tending towards coarse prismatic; moist plastic; sparse roots; abrupt boundary to:—
	75+		Black (10 YR 2/1) structureless woody peat.

TABLE 27: River Alluvium—Profile Analyses (5)

S

Horizon	Coarse sand %	Fine sand %	Sill 9!	Clay 91	pH	CEC meq/100 g	TFB meq/100 g	Base Saturation	C %	N	C/N	Free iron	TNV %
All	»7	43	14	6	7.7	18.4	12.8	69	1.6	0.13		1.0	6.9
A12	27	40	21		7.7	27.4	21.7	79	2.6	0.20	13.0	1.7	6.1
A13	13	50	25	12	7.6	27.0	22.1	SI	1.9	0.19	10.0	2.3	".9
A14	57	U	6	i	7.5	5.0	4.2	84	0 1		-	0.8	4.9

RIVER ALLUVIUM — MODAL PROFILE (5)

Location:	Coursewood, Durrow; 29/4 O-N 15
Topography:	Flat
Slope:	0°
Elevation:	80 metres O.D.
Vegetation:	Woodland
Drainage:	Free-draining
Parent Material:	River alluvium derived mainly from limestone
Great Soil Group:	Regosol

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
All	0—15/20	15—20	Loamy sand; brown (10 YR 5/3—4/3); moderate fine granular structure; dry very friable; plentiful roots; abrupt boundary to:—
A12	15—35/40	15—25	Sandy loam; dark brown (10 YR 3/3); weak medium subangular blocky structure; moist friable; gradual boundary through layer with sandy pockets (35—48 cm) to:—
A13	48—65/70	15—20	Sandy loam; similar to above but slightly heavier texture; abrupt boundary to:—
A14	65+	—	Coarse sand; pale brown with strong yellowish-red and black manganese mottles; structureless.

TABLE 28: Pollagh Soils—Profile Analyses (6)

Horizon	sand %	Fine sand %	Silt %	%	pH	CEC meq/100 g	n i l meq/100 g	Base Saturation %	C %	N	C/N	I ree iron	TNV %
AI	5	7	41	47	5.9	58.8	36.2	6.2	9.6	0.88	10.9	1.7	
HBg	2	3	65	30	8.4	9.4	10.4	Sat	0.4	—		2.1	36.3
HCg	2	6	42	50	8.5	15.2	15.7	Sat	0.5	—	-	2.0	40.2

RIVER ALLUVIUM — POLLAGH SOILS — MODAL PROFILE (6)

Location:	Courtwood, Ballybrittas; 9/4 W 35
Topography:	Flat
Slope:	0°
Elevation:	58 metres O.D.
Vegetation:	Old meadow
Drainage:	Poorly drained
Parent Material:	River alluvium over lake deposits oi limestone origin
Great Soil Group:	Regosol.

Horizon	*Depth (cm)*	*Thickness (ci*	*Description*
Al	0—12	12	Silty clay to clay; very dark greyish brown (10 YR 3/2) with many distinct root mottles; strong medium blocky structure; moist friable; abundant roots; non-calcareous; abrupt smooth boundary to:—
HBg	12—80	68	Silty clay loam; mottled grey (10 YR 5/1) and light olive brown (2.5 Y 5/4) with grey (10 YR 5/1) prism coatings; coarse prismatic structure; calcareous; clear boundary to:—
1 lCg	80+		Silty clay; olive grey (5Y 4/2) with dark grey (2.5 Y N 4) mottles; structureless; (generally waterlogged); no roots; calcareous.

fABLE 29: Allen Series—•Macrofossil Content

Horizon	Depth (cm)	*Sphagnum sp.*	*Calluna vulgaris*	*Eriophorum sp.*	*Cyperaceae* debris (ombro.)	*Non-Sphagnum* mosses	*Phragmites communis*	Fen rootlets	*C. geophilum*	Seeds	Mites	Charcoal	*Cyperaceae* debris (minero.)	Wood debris	Heterogeneous del •a	Amorphous mater a	Mineral matter	Recent roots
Oal	0-20	+++	+	++	+ +											+		+ +
Oal	20-60	t f	+++	+	++													··
Oa2	65-100	++		++	++++											+		
Oe2	85-100	+		++++	++++											+ +		
Oe3	100-110	++++		++	++											+		
Oa3	110-150	+ +	+++		f+				+			+				+++		

+ Present; + + Frequent;+++ Common;++++ Abundant.

TABLE 30: Allen Series—Profile Analyses

Horizon	Depth (cm)	Field Moisture (9i DM)	Ash (95 DM)	Db (g/ml)	S.P.I .(index	Rubbed Fibre	N c; DM 1	1 *K.* (a/Mg ratio	pH (H,0)
Oal	0—20	1011	3.80	ml	7	16	ml	nd	3.41
Oel	20--60	1387	1.76	nd	7	30	ml	ml	3.78
Oa2	65--85	2641	1.30	nd	7	14	ml	ml	3.90
Oe2	85-•100	1552	1.21	nd	7	*22*	ml	ml	4.01
Oe3	100-• 110	1266	0.87	ml	7	28	ml	nd	3.89
Oa3	110—150	1360	1.37	nd	7	\A	ml	ml	4.08

nd = not determined

ALLEN SERIES — MODAL PROFILE

Location:	Clonbrin Td. Co. Offaly. Grid Ref. N63 16.3
Classification:	USDA classification Sub-Group. Sapric Medihemist
Parent Material:	Ombrotrophic peat
Vegetation:	*Calluna vulgaris* (Heather) dried out sedge raised bog
Topography:	2° slope raised bog
Drainage:	Poor
Elevation:	ca. 64 metres O.D.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Oal	0—20	20	Peat; dark reddish brown (5 YR 3/2); cyperaceous *Sphagnum* origin; poorly humified vPI, clear boundary
Oel	20—60	40	Peat; dark reddish brown (5 YR 3/2) and dark grey (5 YR 4/1) colours; *Sphagnum/Calluna* origin; poorly humified residues slightly vPI; clear boundary
Oa2	65—85	20	Peat; dark reddish brown (5 YR 3/2) to very dark grey (5 YR 3/1); *Sphagnum* with cyperaceous remains poorly decomposed; clear smooth boundary to:—
Oe2	85—100	15	Peat; reddish brown (5 YR 4/4) and very dark grey (5 YR 3/1) colours; cyperaceous origin poorly humified vPI; clear boundary to:—
Oe3	100—110	10	Peat; dark reddish brown (5 YR 3/2); *Sphagnum* poorly humified vPI; clear boundary to:—
Oa3	110—150	40	Peat; dark reddish brown (5 YR 3/2); *Sphagnum* with cyperaceous debris; moderately well humified vPII.

TABLE 31: Turbary Complex—Macrofossil Content

Horizon	Depth (cm)	*hagnum sp.*	*lluna vulgaris*	*iophorum sp.*	*peraceae* debris (ombro.)	*n-Sphagnum* mosses	*ragmites comm* •3 B	n rootlets	*geophUum*		tes	ax coal	*peraceae* debris (minero.)	»od debris	terogeneous de •a	norphous mater	Mineral matter	cent roots
Oal	**0-10**	+		+	++											+++		++
Oel	**10-15**				++											+++		++
Oc2	**30-60**	++++		+	+											t		++
Oa2	**80-125**	++++		+	++													
Oc3	**125-150**	++++	+	++												+		

+ Present; ++ Frequent; +++ Common; ++++ Abundant.

TABLE 32: Turbary Complex—Profile Analyses

Horizon	**Depth** (cm)	**Field** Moisture (% DM)	**Ash** (% DM)	**Db** (g/ml)	**S.P.E.C** index	Rubbed 1 ibre	**N** (<•/, DM)	I \ Ca/Mg ratio	pH (H_20)
Oal	**0--10**	504	VI	0.185	2	9	**1.54**		3.69
Oel	**10--15**	5S2	2.7	**0.172**	6	28	1.38		$.62
Oe2	**30--60**	**1079**	1.7	0.092	7	28	1.10	0.9	3.SI
Oa2	**80-•125**	**1145**	2.4	**nd**	7	13	1.28	0.7	4.20
Oe3	**125-•150**	1062	6.0	nd	7	24	**1.22**	2.1	4.00

TURBARY COMPLEX — MODAL PROFILE

Location:	Ballyteige Nth. Td. Co. Kildare. Grid Ref. N75 25.3
Classification:	USDA Classification Sub-Group Hemic Medisaprist
Parent Material:	Ombrotrophic peat cyperaceous in origin.
Vegetation:	*Erica tetralix* (Cross-leaved Heath), *Eriophorum angustifolium* (Bog Cotton), *Calluna vulgaris* (Heather)
Topography:	
Drainage:	Very poor
Elevation:	ca. 80 metres O.D.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Oal	0—10	10	Peat; dark reddish brown (5 YR 2/2); well humified, surface decomposition, recent roots, clear boundary to:—
Oel	10—15		Peat; dark reddish brown (5 YR 3/2); moderately well decomposed vPII; cyperaceous origin; clear boundary to:—
Oe2	30—60	**30**	Peat; dark reddish brown (5 YR 3/3); poorly decomposed *Sphagnum* peat; vPII; clear boundary to:—
Oa2	80—125	45	Peat; dark reddish brown (5 YR 4/3) to dark reddish brown (5 YR 3/2) darkening rapidly on exposure to air. *Sphagnum* peat with cyperaceous remains fairly decomposed vPI; clear boundary to:—
Oe3	125—150	**25**	Peat; as above with *Calluna* remains.

TABLE 321: Gortnamona Series (1)--Macrofossil Content

Horizon	Depth (cm)	*Sphagnum sp*	*Calluna vulga·;*	*Eriophorum* iEL	*Cyperaceae* debris (ombro.)	*Non-Sphagnu m* mosses	*Phragmites cc mmunis*	Fen rootlets	*C geophilum*	Seeds	Mites	Charcoal	*Cyperaceae* d<;bris (minero.)	Wood debris	Heterogeneous debris	Amorphous nlaterial	Mineral matte	Recent roots
Oap	0-10	+														++		++++
Oe2	10-20	+	+		+++	+			+							++++		
Oil	20-85	++++				+												

+ Present; H I requcnt;+++Common;++++Abundant.

TABLE 34: Gortnamona Series (1)—Profile Analysis

Horizon	Depth (cm)	Field Moisture (95 DM)	Ash («•; DM)	Db (g/ml)	S.P.I < index	Rubbed Fibre	N (°/t DM)	1 x Ca/Mg ratio	pH ill O)
Oap	0—10	440	13.3	0.208	4	X	1.63		6.92
Oe2	10—20	614	3.4	0.148	6	26	0.94	6.7	4.15
Oil	20—85	860	2.3	0.081	7	44	0.68		3.59

GORTNAMONA SERIES — MODAL PROFILE (1)

Location:	BallinaTd. Co. Kildare. Grid. Ref. N71.2 41.5
Classification:	USDA Classification Sub-Group Typic Sphagnofibrist
Parent Material:	Ombrotrophic peat *Sphagnum* origin
Vegetation:	Permanent pasture
Topography:	Flat reclaimed cut-over raised bog
Drainage:	Moderate
Elevation:	75 metres O.D.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Oap	0—10	10	Peat; black to dark reddish brown (5 YR 2/1—2/2); few recognisable plant remains; moist to wet non-greasy, vPII; abundant fine roots; tendency to form surface mat; sharp smooth boundary to:—
Oe2	10—20	10	Peat; dark reddish brown (5 YR 2/2); hemic; *Sphagnum/Calluna* derived peat; slightly greasy in parts, vPII; drying crack with proliferation of recent fine roots; sharp boundary to:—
Oil	20—85	05	Peat; dark reddish brown (5 YR 3/3); fibric; *Sphagnum* peat; non-greasy, vPI; few fine roots in upper part of horizon; clear boundary to:—
Oi2	85—100	15	As for Oi 1 with *Eriophorum* remains.

TABLE 35: Gortnamona Series (2)— Macrofossil Content

Horizon	Depth (cm)	*Sphagnum sp.*	*Calluna vulgaris*	*Eriophorum sp.*	*Cyperaceae* debris (ombro.)	*Non-Sphagnum* mosses	*Phragmites communis*	Fen rootlets	*C. geophUum*	Seeds	Mites	Charcoal	*Cyperaceae* debris (minero.)	Wood debris	Heterogeneous debris	Amorphous material	Mineral matter	Recent roots
Oap	**0-30**													+		++++	+	
Oa2	**30-70**	++	++			**P**										+++		
Oa3	**70+**							+++		**Bi**			**H**	+	t +	f+		

+ Present; ++ Frequent; +++ Common;++++ Abundant. Bi = Birch; P = *Polytrichum.*

TABLE 36: Gortnamona Series (2)—Profile Analyses

Horizon	**Depth (cm)**	**Field** Moisture (*"A* **DM)**	Ash (95 DM)	Db (g/ml)	S.P.E.C. index	Rubbed Fibre	N (95 DM)	1 x Ca/Mg ratio	**pll** (HO)
Oap	**0—30**	**402.8**	**36.8**	**0.349**	**1**	**7**	**1.33**		6.47
Oa2	**30—70**	**741.7**	5.3	0.128	**5**	**9**	**0.80**		**4.83**
Oa3	**70+**	883.5	3 1	**0.112**	**6**	**10**	**1.31**		**4.97**

GORTNAMONA SERIES — MODAL PROFILE (2)

Location:	Lullymore Td. Co. Kildare Grid Ref. N 70 25
Classification:	USDA Classification Sub-Group Terric Medisaprist
Parent Material:	Minerotrophic peat
Vegetation:	Poor permanent pasture with herbs
Drainage:	Good
Topography:	Hand cut edge of raised bog
Elevation:	77 metres O.D.

Horizon	*Depth (cm)*	*Thickness (cm,*	*Description*
Oap	0—30	30	Black (5 YR 2/1); extremely well humified no recognisable plant remains; fine medium granular structure; abundant roots; presence added mineral matter; abundant roots; abrupt, smooth boundary to:—
Oa2	30—70	40	Dark reddish brown (5 YR 3/2); humified *Calluna-Sphagnum* (Cs) peat; few recent roots; layered structure; smooth clear boundary **to:—**
Oa3	70+		Dark reddish brown (5 YR 2/2); humified fen peat with woody remains.

TABLE 37: Banagher Series--Profile Analyses (1)

Horizon	Depth (cm)	Field Moisture (% DM)	Ash (% DM)	Db (g/ml)	S.P.E.C. index	Rubbed Fibre	N (% DM)	1 \ (a/Mg ratio	pH (II ())
Oap	0—40	380	25.7	0.415	1	14	1.02		6.11
Oa2	40—66	640	14.2	0.132	2	10	1.60		5.89

TABLE 38: Banagher Series--Profile Analyses (2)

Horizon	Depth (cm)	Field Moisture	Ash C; DM)	Db (g/ml)	S.P.E.C. index	Rubbed Fibre	N (', DM)	Ex. (a/Mg ratio	pH ill ())
Oap	0—20	)56	20.0	0.260	1	2	3.52		4.90
Oa2	20—50	MO	8.9	0.108	2	10	2.26	18.9	5.44
Oa3	50—70	987	7.1	0.101	h	7	2.42	17.8	5.20
Oa4	70—130	1105	7.4	0.086	^	8	2.32	14.2	5.49

BANAGHER SERIES — MODAL PROFILE (1)

Location:	Co. Meath.
Classification:	USDA Classification Sub-Group Terric Medisaprist
Parent Material:	Minerotrophic peat, fen origin
Vegetation:	Permanent pasture *Dactylisglomerata* (Cocks-foot) and *Filipendula ulmaria* (Meadow Sweet)
Topography:	Flat
Drainage:	Moderate
Elevation:	—

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Oap	0—40	40	Black (5 YR 2/1); sapric; well humified with no recognisable plant remains; fine crumb structure; heavily marled in the past; remains of limestone and shale
Oa2	40—66	26	Black (5 YR 2/1) with very dark brown patches (5 YR 3/4); sapric; cyperaceous peat with birch remains
	66—		Alluvium of interstratified silt and clay.

BANAGHER SERIES — MODAL PROFILE (2)

Location:	Derrycricket Td. Co. Offaly. Grid. Ref. N 54.25
Classification:	USDA Classification Sub-Group. Typic Medisaprist
Parent Material:	Minerotrophic peat of fen origin
Vegetation:	Poor permanent pasture
Topography:	Flat
Drainage:	Good to moderate
Elevation:	ca. 74 metres O.D.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Oap	0—20	20	Black (5 YR 2/1); sapnc; highly humified: mineral material; abundant roots; high biological activity; clear smooth boundary to:—
Oa2	20—50	30	Peat; dark reddish brown (5 YR 2/2); sapric; *in situ* layered structure; fine woody remains
Oa3	50—70	20	Peat; dark reddish brown (5 YR 2/2); transition from woody fen facies
Oa4	70—130	60	Peat; dark reddish brown (5 YR 3/3—2/2); fen peat; highly humified vPIII.

TABLE 39: Baunreagh Series—Profile Analyses (1)

Hori/on	Coarse sand %	Fine sand %	Silt %	Clay	pH	CEC meq/100 g	TEB mcq/100 g	Base Saturation %	c%	\	C/N	Free iron %	TNV
\1	IS	17	38	27	4.9	27.4	1.3	5	2.8	0.28	10.0	3.1	
B2	25	16	34	25	5.5	24.0	0.9	3	1.6	0.14	11.4	4 0	—
C	35	21	30	14	5.4	9.8	0.2	2	0.9	—	—	2.0	—

BAUNREAGH SERIES — MODAL PROFILE (1)

Location:	Baunreagh Wood; **11/1** E 34
Topography:	Rolling
Slope:	9°
Elevation:	230 metres O.D.
Vegetation:	Grassland with *Luzula.* brambles and bracken
Drainage:	**Well** drained
Parent Material:	Non-calcareous glacial till composed mainly of shale with some sandstone influence
Great Soil Group:	Brown Earths

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Al	0—28/30	28—30	Loam to clay loam; brown to dark brown (10 YR 4/3); moderate medium subangular blocky and fine crumb structure; moist friable abundant roots; clear boundary to:—
B2	28—70/90	42—60	Loam to clay loam; strong brown (7.5 YR 5/6); moderate fine crumb structure; moist very friable; plentiful roots; gradual tonguing boundary to:—
B3	70—90/95	0—20	Transitional horizon to:—
C	90+	—	Sandy loam; olive grey structureless glacial till; non-calcareous.

TABLE 40: Baunreagh Series—Profile Analyses (2)

Horizon	Coarsc sand %	Fine sand %	Silt %	Clay %	PH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C %	N	C/N	Free iron %	TNV %
•\l	31	19	28	2?	4.0	33.6	1.7	5	3.4	0.25	13.6	2.3	
B2	44	IK	21	I7	>4	21.4	1 4	6	1.0	0.09	11.1	3.1	—
C	51	25	16	8	5.6	16.2	0.6	3	0.4	—	—	1.2	—

TABLE 41: Baunreagh—Gravelly Variant—Profile Analyses

o

Horizon	Coarse sand %	Fine sand %	Silt 95	Clay	pH	CEC meq/100 *g*	II H meq/100 g	Base Saturation %	C %	N	C/N	1 KV iron	TNV '•;
Al	41	19	26	14	VI	25.8	1.9	8	2.9	0.2	14.5	?2	
B2	44	25	20	11	5.4	20.2	0.6	3	l.o	0.12	8.3	2.8	—
(	57	21	17	5	5.5	5.4	0.2	}	0.2	—	—	1.5	—
I1C	82	12	•4	2	5.5	2.2	0.2	II	0.2	—	—	l.l	—

BAUNREAGH GRAVELLY VARIANT — MODAL PROFILE

Location:	Glendine; 11/3 A 7
Topography:	Rolling
Slope:	12°
Elevation:	230 metres O.D.
Vegetation:	*Abies grandis* with ground vegetation of grass, heather and brambles
Drainage:	Well drained
Parent Material:	Gravelly till composed mainly of shale and sandstone
Great Soil Group:	Brown Earths

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Al	0—16/25	16—25	Sandy loam; brown (10 YR 4/3 nearest); moderate medium subangular blocky structure; moist friable; abundant roots; clear boundary to:—
B2	16—66	46—55	Sandy loam; strong brown (7.5 YR 5/6); moderate fine crumb structure; moist very friable; plentiful roots; gradual boundary to:—
B3	66—75/90	9—24	Transitional to:—
C	75—120	30—45	brownish (7.5 YR 5/4 nearest) compact gravelly till overlying:—
11C	120+	—	Pale brown rabbit sand.

TABLE 42: Baunreagh Steep Phase—Profile Analyses (1)

Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C%	N%	C/N	Free iron %	TNV 91
Al	12	12	45	'1	4.1	—	—	—	18.0	0.85	21.2	3.1	
A:	II	13	47	29	4.4	29.4	0.3	1	4.1	0.35	11.7	1.7	
B22	26	8	42	·4	S.4	25.2	0.7	3	4.3	0.26	16.5	5.8	
C	—	—	—	—	5.0	—	—	—	3.9	0.23	16.9	3.5	

BAUNREAGH STEEP PHASE — MODAL PROFILE (1)

Location:	Glendine; 11/1 W 2
Topography:	Hilly
Slope:	20°
Elevation:	230 metres O.D.
Vegetation:	Norway spruce with ground vegetation of grasses and some bracken and brambles.
Drainage:	Well drained
Parent Material:	Disintegrating shale with negligible drift influence
Great Soil Group:	Podzol (Uncultivated Brown Podzolic).

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Al	0—2/3	2--?	Organic clay loam; very dark brown (10 YR 2/2); moderate fine crumb structure; moist friable; abundant roots; clear boundary to:—
A:	2—10/15	8--12	Clay loam; greyish brown (10 YR 5/2) with sparse distinct yellowish brown (10 YR 5/8) mottles; moderate fine granular structure; moist friable; plentiful roots; abrupt wavy boundary to:—
B21irhm (ironpan)			Thin (2mm) dark red weak almost continuous ironpan; abrupt boundary to:—
B22	10—45/50	35	Shaly clay loam; yellowish red (5 YR 4/8 nearest) moderate fine crumb structure; moist very friable; plentiful roots; gradual boundary through transitional B3 to:—
	60+		Olive grey shaly debris.

TABLE 43: Baunreagh Very Steep Phase-—Profile Analyses (2)

Horizon	(oarse sand %	Fine sand %	Sill 95	(lay %	PH	CEC meq/100 g	II H meq/100 g	Base Saturation %	C %	N	(7N	Free iron %	TNV
01					4 7	57.6	2.9	5	27.6	1.3	21.2	4.6	—
\:	10	17	-r	26	4.8	24.6	0.5	2	3.6	0.3	12.0	2.3	—
B22	22	14	4(1	24	5.0	20.8	0.2	1	3.3	0.24	13.8	4.8	—
C	40	27	2K	5	5.2	5.8	0.1	2	0.2	—	—	1.6	—

BAUNREAGH VERY STEEP PHASE - MODAL PROFILE (2)

Location:	Bockagh, Monicknew; 11/2 A 10—11
Topography:	Hilly
Slope:	30°
Elevation:	275 metres O.D.
Vegetation:	Heather dominated with grasses and ferns
Drainage:	Well drained
Parent Material:	Disintegrating shale—drift cover absent
Great Soil Group:	Podzol.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ol	0—2	2	Partly decomposed plant remains; clear boundary to:—
A2	2—4/12	2—10	Loam to clay loam; greyish brown (10 YR 5/2); moderate fine granular structure; moist friable; plentiful roots; abrupt wavy boundary to:—
B21irhm	—	—	Thin (2mm) weakly developed ironpan
B22	4—50/60	40—50	Loam (to clay loam); strong brown (7.5 YR 5/6); moderate fine crumb structure; moist very friable; plentiful roots; gradual boundary through B3 to C
B3	50—70/80	20	transitional horizon to:—
C	70+	—	Disintegrating shale.

TABLE 44: Knockastanna Peaty Phase Series—Profile Analyses (1)

Horizon	Coarsc sand %	Fine sand %	Sill %	Clay	pH	CEC meq/lOOg	II B meq/lOOg	Base Saturation %	C	N	C/N	Free iron %	TNV %
01					4.6	83.2	1.7	2	27.0	1.18	22.9	.Ml	—
A2	13	26	41	20	4.2	35.8	0.2	I	4.6	0.25	18.4	0.5	—
B22	13	17	44	26	4.7	46.4	0.1	0	VI)	0.19	15.8	11.0	—
(	.17	44	14	5	4.9	6.2	0.1	l	0 4	—	—	2.6	—

KNOCKASTANNA PEATY PHASE SERIES — MODAL PROFILE

Location:	Baunreagh; 11/1 D—E 29—30
Topography:	Hilly
Slope:	12°
Elevation:	340 metres O.D.
Vegetation:	Wet heath
Drainage:	Imperfect
Parent Material:	Disintegrating shale
Great Soil Group:	(Peaty ironpan) Podzol

Horizon	Depth (cm)	*Thickness (cm)*	*Description*
02	0—2	2	Partly decomposed plant remains
01	2—20/22	18—20	Black well-decomposed plant remains; prismatic; abrupt boundary to:—
A:	20—27/28	5—i	Loam; grey (10 YR 5/1) heavily stained with blackish organic matter; weak fine granular structure; moist compact; root mat above pan; abrupt boundary to:—
B21irhm (ironpan)			Dark-red hard well-developed ironpan; abrupt wavy boundary to:—
B22	27—55	26—28	Loam to clay loam; yellowish-red (5 YR 5/8); moderate fine crumb structure; moist very friable; sparse roots; gradual boundary through transitional B3 to:—
	65+		Greyish brown broken shale bedrock.

TABLE 45: Knockastanna Peaty Phase Series—Profile Analyses (2)

Horizon	(oniso sand	Fine sand	Sill	Clay	pH	1 1 (meq/IOO g	II B meq/IOO g	b ise Saturation	I	N ',	C/N	Free iron 9i	TNV
01			—	·—	4.8	68.8	4.5	7	41.2	2.0		1.6	
A2	37	21	25	17	4.3	24.6	0.3	1	2.2	0.21	10.5	0.3	—
B22	31	22	26	21	4.7	23.8	0.4	-1	1.7	0.10	1.7	4.0	—
C	43	22	22	13	5.0	X.4	0.2	2	0.3	—	-		—

TABLE 46: Conlawn Series—Profile Analyses

Horizon	1 U.I ISC sand %	Fine sand %	Silt 95	(lay	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	<	\	C7N	1 rec iron	TNV
A!	52	30	17	1	4.3	37.6	5.8	15	11.0	0 5	22	0.2	
A2	51	27	21	1	4.4	5.8	0.4	6	0.6	—		0.2	—
B2Ih	41	23	36	li	4.5	31.4	0.7	2	1.8	o 1	14	0.9	—
B22	35	25	24	II	4.8	21.4	0.4	2	0.9	—	-	0.7	—
Cx	50	27	18	5	5.0	5.0	0.1	2	0.1	—	–	0.6	—
C	54	25	14	7	4.9	2.8	0.1	4	0.1			0.5	—

CONLAVVN SERIES — MODAL PROFILE

Location:	Conlawn Hill. Ballyfin: 12/1 Q 10
Topography:	Hilly
Slope:	12°
Elevation:	230 metres O.D.
Vegetation:	Dry facies of Wet Heath Type 4 vegetation (Cotton. 1974)
Drainage:	Well drained
Parent Material:	Coarse-textured Old Red Sandstone glacial till
Great Soil Group:	Humus-iron Podzol

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Al	0—3/4	3—4	Peaty coarse sand; very dark brown (10 YR 2/2) with abundant bleached sand grains; granular structure; moist-dry fibrous; clear boundary to:—
A2	3—18/24	15—20	Coarse sand; light brownish grey (10 YR 6/2): moderate fine granular structure; moist friable to slightly firm consistence: abundant roots: clear wavy boundary to:—
B21h	15—28	3—10	Coarse sand; dark reddish brown (5 YR 3/2—2/2); moderate fine crumb structure; moist friable; abundant roots; clear tonguing boundary to:—
B22	23—48/50	20—25	Sandy loam; brown to strong brown (7.5 YR 4/4—5/6) with few dark reddish brown (5 YR 3/2) streaks particularly at base of horizon; moderate fine crumb structure; moist friable; plentiful roots; clear boundary to:—
Cx	48—75/90	20—25	Loamv sand; pale brown (10 YR 6/3) with brown to dark brown (7.5 YR 6/4) streaks or bands; structureless; moist hard *in situ:* no roots; clear boundary to:—
C	75+		Loamy sand to sandy loam; reddish brown (5 YR 4/3) with pale brown (10 YR 6/3) portions; structureless massive; moist firm *in situ;* no roots; non-calcareous.

TABLE 47: Rossmore Series—Profile Analyses (1)

Horizon	< oarse sand	Fine sand %	Sill		pi I	CEC meq/100 g	11 1) meq/100 g	Base Saturation	1	N	(7N	Free m>n	TNV '•;
01			—	—	l.l	83.2	8.7	Id	22.0	0.84		0.6	
A2I	65	l')	13	3	4.3	8.4	0.7	8	1.4	0.08	17.5	0.1	—
A22h	61	17	15	7	4.4	14.4	0.6	4	1.6	0.12	13.3	0.5	—
B22	62	9	13	16	4.7	19.4	0.1	1	0.9	— •		3.5	—
C	SO	5	5	10	4 9	3.4	0.2	7	0.1			0.9	

ROSSMORE SERIES — MODAL PROFILE (1)

Location:	Ross, Clonaslee: 6/2 3 !4— :
Topography:	Hilly
Slope:	8°
Elevation:	220 metres O.D.
Vegetation:	Dry Phase of Wet Heatn r.pe 4 vegetation (Cotton, 1974)
Drainage:	Free-draining—impertec:
Parent Material:	Non-calcareous glaciai :nl imposed mainly of sandstone with a lot
Great Soil Group:	Peaty ironpan Podzoi i Placorthod).

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ol	0—10	10	Very dark brown (10 YR 2/2) partly decomposed plant remains: abrupt smooth boundary to:—
A21	10—15/25	5—15	Loamy coarse sand: jrevish brown (10 YR 5/2); weak fine granular structure; moist slightly firm: plentnu. ots: clear boundary to:—
A22h	15—28	0—5	This is the lower part ol the A2 which contains accumulated humus: loamy coarse sand to coarse sandy loam; dark reddish brown (5 YR 3/2); moderate fine crumb structure: moist friable; abrupt waw boundary to:—
B21irhm			Thin (2—4mm) aimost continuous dark reddish brown ironoan which is not strongly developed: abrupt boundary to:—
B22	15—60/65	40—50	Coarse sandy loam: mostly strong brown (7.5 YR 5/6) but dark yellowish brown (10 YR 4/4) in some lower portions; moderate fine crumb structure; moist friable: good root supply: gradual boundary tnrough B3.
B3	60—90	25—30	Transitional to:—
C	90+	—	Coarse loamy sand: very pale brown (10 YR 7/4) to light yellowish brown (10 YR 6/4); structureless; friable to firm; no roots; non-calcareous.

TABLE 48: Rossmore Series—-Profile Analyses

Horizon	Coarse sand %	line sand %	Silt %	Clay	pH	CEC meq/100 g	TEB meq/100 *t*	Base Saturation %		N	C/N	(ice iron	TNV
02	44	25	24	7	4.2	54.4	2.9	5	12.6	0.92	13.7	0.6	
A211h	45	27	IS	10	4.1	16.8	0.3	1	2.0	0.12	16.7	0.2	—
A212	44	25	19	IS	4.3	15.4	0.3	2	1.0	0.09	11.1	0.2	—
A 22	34	29	19	IS	4.6	10.6	0.3	2	0.4	—	—	0.9	—
B22g	38	32	15	15	4.8	5.4	0.3	5	0.2	—	--	1.9	—
C	37	34	13	16	5.0	4.6	0.4	S	0.1	—	—	1.5	—

ROSSMORE SERIES — MODAL PROFILE (2)

Location:	Garraunbaun. Camross; 15/2 L 4
Topography:	Rolling-Hilly
Slope:	6°
Elevation:	320 metres O.D.
Vegetation:	Wet Heath (Cotton. 1974)
Drainage:	Poorly drained
Parent Material:	Glacial till composed of sandstone with shale and chert
Great Soil Group:	Peaty Gley with ironpan (Placaauod)

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
01	0—5/6	5—6	Very dark brown partly decomposed plant remains; clear boundary to:—
02	5—22/23	17	Black peat/sandy loam: mostly decomposed plant remains; abrupt boundary to:—
A211h	22—30/32	8—10	Sandy loam; dark reddish brown (5 YR 3/2) due to organic accumulation: moderate fine granular structure: moist compact *in situ;* plentiful roots; gradual boundary to:—
A212	30—40/42	10	Sandy loam; brown to pale brown (10 YR 5/3—6/3) with black old root streaks: moderate fine granular structure; moist compact *in situ;* sparse roots; clear boundary to A22 and ironpan.
A22	40—55/68	0—28	Looks somewhat like B22g; sandy loam; reddish brown (5 YR 5/3) with many prominent reddish yellow mottles and blackish old root channels; weak fine granular; moist compact *in situ;* low permeability; sparse roots: abrupt boundary to:—
B21irhm	—	—	Thin (2—4mm) dark red non-continuous wavy ironpan; abrupt boundary to:—
B22g	40—93/95	35—55	Sandy loam; reddish brown (5 YR 5/3) with abundant prominent yellowish red mottles and prominent reddish root channels; weak fine granular structure: moist compact *in situ;* no fresh roots: gradual boundary to:—
C	93+		Sandy loam; reddish brown (5 YR 5/3) with many distinct yellowish mottles and black manganese flecks; structureless compact; no roots; non-calcareous.

TABLE 49: Slieve Bloom Series--Profile Analyses

Horizon	(oarse sand %	Fine sand %	Silt 9J	(lay 02	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C %	N %	C7N	lice iron %	TNV
Ol					4.0	83.2	7.2	l»	29.2	10	24.2	0.4	
Al	51	22	14	8	4.0	14.4	0.3	2	2.2	0.14	15.7	0.4	—
A21	4')	27	18	6	4.2	6.6	0.2	3	0.7	—	—	0.3	—
A22h	48	24	\b	12	4.2	21.8	0.2	1	1.4	0.08	17.5	0.2	—
A23g	42	26	19	13	4.7	7.8	0.1	1	0.4	—	—	0.3	—
Bg	36	25	17	22	4.^	8.8	0.1	4	0.1	—	—	1.2	—
C	52	22	14	12	4.9	M	0.1	14	0.2	—	—	0.5	—

SLIEVE BLOOM SERIES — MODAL PROFILE

Location:	Garragh Upper. Glendineoreean Wood: *b/2* L—K 2—3
Topography:	Hilly
Slope:	4°
Elevation:	335 metres O.D.
Vegetation:	Wet Heath (Cotton, 1974). Sod peat cutover
Drainage:	Poorly drained
Parent Material:	Glacial till composed mainiv of sandstone with chert, shale and other erratics.
Great Soil Group:	Peaty Gley

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ol	0—2/10	2—10	Very dark brown (10 YR 2/2) partly decomposed plant remains; abrupt boundary to:—
Al	2—10/20	3—15	Sandy loam; very dark greyish brown (10 YR 3/2) with many bleached sand grains; moderate to firm *in situ;* abundant roots; clear boundary to:—
A21	12—25/27	8—15	Loamy coarse sand to coarse sandy loam; greyish brown (10 YR 5/2); moderate fine granular structure; moist friable; plentiful roots; clear boundary to:—
A22h	27—36/40	8—13	Sandy loam; dark reddish brown (5 YR 3/2) grading into greyish brown (10 YR 5/2) with some black blotches; moderate fine granular structure; moist friable; clear boundary to:—
A23g	36—55/75	19—35	Sandy loam; pale brown (10 YR 6/3) with many distinct pinkish flecks: moderate fine granular structure tending towards massive: moist compact, few roots; clear boundary to:—
Bg	55—104/110	35—50	Sandy clay loam; speckled colour consisting mainly of reddish grey (5 YR 5/2) with pinkish grey (5 YR 6/2) on and between interfaces and prominent yellowish red (5 YR 4/6) mottles: weak medium subangular blocky structure; moist plastic to firm; sparse roots; clear boundary to:—
C	104+		Greyish brown (10 YR 5/2) with many prominent yellowish red mottles: structureless; non-calcareous; no roots.

TABLE 50: Slieve Bloom Undulating Phase—Profile Analyse;>

'Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C%	N	C/N	1 ICC iron 9,	TNV '•;
01	—	—	—	—	5.0	68.8	5.5	X	23.2	0.82	28.3	0."	
Al	37	24	26	13	4.3	31.4	1.2	•1	11.5	0.48	24.0	0.7	—
A2g	48	22	17	13	5.0	10.6	0.5	5	0.8	—	—	0.5	—
B2g	34	21	29	16	5.2	6.8	1.2 .	1H	0.3	—	—	1 4	—
Cg	•41	21	18	20	8.5	4.6	7.1	s.it.	0.1	—	—	1.2	4.0

SLIEVE BLOOM UNDULATING PHASE — MODAL PROFILE

Location:	Tinnahinch, Rosenallis; 6/2 B 28
Topography:	Flattish
Slope:	1—2°
Elevation:	Wet Heath (Cotton, 1974). "Scraw" peat removed.
Drainage:	Poorly to very poorly drained
Parent Material:	Glacial till composed mainly of sandstone with limestone, shale and other erratics.
Great Soil Group:	Peaty Gley

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ol	0—5	5	Very dark brown (10 YR 3/2) partly decomposed fibrous roots; abrupt boundary to:—
Al	5—18/20	13—15	Sandy loam; dark brown (10 YR 3/3); weak fine grannular structure; moist friable (the whole top layer is wet and sloppy in winter time); abundant roots; abrupt boundary to:—
A2g	18—40/45	20—25	Sandy loam; light brownish grey (10 YR 7/2); structureless; moist compact hard *in situ;* sparse roots; clear boundary to:—
B2g	40—100	55—60	Heavy sandy loam with some sandy pockets; mottled light grey to grey (5 Y R 6/1—7/1) and yellowish brown (10 YR 5/8); structureless massive (prismatic when dry); sparse roots; gradual boundary to:—
Cg	100+		Sandy loam to sandy clay loam; brownish with some blackish manganese mottles; structureless; moist compact and hard; no roots; calcareous at depth.

TABLE 51: Clonin Brown Podzolic—Podzol--Profile Analyses (1)

Horizon	sand %	Fine sand %	Silt %	Clay	pH	CEC mcq/100 g	1 IB meq/100 g	Base Saturation %	C	N	C/N	I ICC iron	l\\
\p	58	29	20	13	6.2	20.0	**11.5**	57	2.2	o 21	10 4	n o	—
B2I	29	JO	23	IS	6.0	27.4	7.5	27	3.4	0.28	12.1	.Ml	—
(	40	32	16	12	6.5	2.8	2.4	86	0.1	—		1 1	—
\p	36	29	22	13	6.2	**19.4**	10.9	56	2.2	0.20	1 1.0	0.9	—
A2	40	31	22	7	6.5	5.4	3.6	67	0.5	—	-	u l	—
B22	50	32	20	IS	6.1	32.8	11.0	M	14	0.18	II 1	2.3	—

CLONIN COMPLEX — RECLAIMED BROWN PODZOLIC — PODZOL
MODAL PROFILE (1)

Location:	Whitefield, Killinure: 11/4 D 4
Topography:	Gently rolling
Slope:	2
Elevation:	190 metres O.D.
Vegetation:	Pasture
Drainage:	Well drained
Parent Material:	Glacial till composed mainly of sandstone
Great Soil Group:	Brown Podzolic—Podzol

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—25/30	25—30	Sandy loam; dark greyish brown to dark brown (10 YR 4/2—3/3); moderate fine granular structure: moist friable; abundant roots; abrupt boundary to B21 and to:—
A2	30—40	0—10	Sandy loam to loamy sand: light grey (10 YR 7/2); weak fine granular structure; moist firm *in situ;* sparse roots: clear wavy boundary to B22.
B21	25—58	23—33	Sandy loam: eiiowish red (5 YR 4/8); moderate fine crumb structure; moist very friable; abundant roots: gradual boundary to C horizon.
B22	30—53	13—23	Similar to above horizon except colour is heterogenous being composed of dark reddish brown (5 YR 3/4—humus/iron B), dark brown (10 YR 3/3—humus B), and dark red (2.5 YR 3/6—like ironpan); clear wavy boundary to:—
C	53+		Reddish brown (5 YR 4/3) sandy loam; structureless: hard *in situ;* no roots.

TABLE 52: Clonin Brown Podzolic—Podzol—Profile Analyses (2)

Horizon	Coarse sand %	Fine sand %	**Silt** 9?	Clay %	pH	CEC meq/100 g	**TEB** meq/l(K) g	Base Saturation %	C %	N %	C/N	1 ICC iron	TNV %
Apl	.17	32	is	13	5.2	26.6	4.5	17	2.0	0.1S	11 1	1.5	
Ap2	41	31	17	11	5.9	15.6	5.2.	33	1.2	0.11	10.9	1.5	—
A2	45	31	IS	6	(..(i	7.4	3.1	41	0.4	—		0.7	—
B21h	35	32	16	17	5.5	27.4	S.2	30	1.4	0.11		2.9	—
B22	41	33	13	13	5.6	21.4	5.9	27	0.9	—		2.9	—
C	31	26	26	17	5.9	5.8	1.8	30	0.2	—		2.0	—

CLONIN COMPLEX — BROWN PODZOLIC — PODZOL
MODAL PROFILE (2)

Location:	Glencondra. Camross; 15/2 H—I 22/22
Topography:	Rolling
Slope:	4°
Elevation:	200 metres O.D.
Vegetation:	Tillage
Drainage:	Well drained
Parent Material:	Glacial till composed mainly of sandstone
Great Soil Group:	Brown Podzolic — Podzol

Horizon	*Depth (cm)*	*Thickness*	Description
Ap	0—23/35	23—35	Sandy loam; dark brown (Apl) to brown (Ap2) (10 YR 4/3—3/3); moderate fine granular structure; moist very friable; clear boundary to B22 and:—
A2	23—25	0—12	Sandy loam to loamy sand; pinkish grey (7.5 YR 6/2); fine granular structure; moist firm—hard *in situ;* abrupt boundary to:—
B21h	35—40	0—5	Usually found below A2; sandy loam; dark reddish brown (5 YR 3/2); moderate fine crumb structure; moist very friable; plentiful roots; traces of iron pan between B21 and B22; abrupt wavy boundary to:—
B22	26—40/66	15—32	Sandy loam; dark reddish brown (5 YR 3/2); moderate fine crumb structure; moist very friable; plentiful roots; this horizon contains patches similar to B21; gradual boundary to:—
C	40+		Reddish brown (5 YR 5/3); structureless compact sandstone till; no roots: non-calcareous.

TABLE 53: Clonin Brown Earth--Podzol-—Profile Analyses (3)

Horizon	sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/lOOg	TEB meq/100 g	Base Saturation %	C %	\N	C/N	1 ur iron	TNV
Ap	40	33	16	11	6.5	15.0	9.5	63	1.2	0.14	8.6	0.6	
B2	36	28	21	15	6.6	8.8	4.8	55	1.0	0.08	12.5	I 0	—
C	38	28	13	21	6.2	U	2.0	58	(i l	—	-	I.I	—
A2	4:	)4	18	6	6.7	2.8	2.0	12	0.1	—	-	(i 1	—
B21h	40	36	17	7	6.5	3.4	2.3	68	0.1	—	-	0.6	—
C	38	27	21	14	6.5	4.4	2.3	51	0.1	—		1.1	—

CLONIN COMPLEX — BROWN EARTH — PODZOL
MODAL PROFILE (3)

Location:	Clonin, Mountrath: 16/2 G 7—8
Topography:	Rolling
Slope:	4°
Elevation:	180 metres O.D.
Vegetation:	Pasture
Drainage:	Well drained
Parent Material:	Glacial till composed mainlv of sandstone
Great Soil Group:	Brown Earth — Podzol

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—22/24	22—24	Sandy loam; dark greyish brown to brown (10 YR 4/2—4/3); moderate fine granular structure; moist friable: abundant roots; clear wavy boundary to A2. B21h and to:—
B2	22—67/70	0—50	Sandy loam: strong brown (7.5 YR 5/6); moderate fine crumb structure; moist very friable; abundant roots: gradual boundary to C horizon.
A2	22—67	0—45	Sandy loam to loam sand: predominantly light grey (10 YR 7/2) with streaks of light yellowish brown (10 YR 6/4) and portions of worm casts (10 YR 4/3) from Ap above; moderate fine granular structure; moist firm *in situ;* sparse roots: clear irregular boundary to:—
B21h	22—90	0—40	Sandy loam to loamy sand: dark brown (10 YR 3/3) and brown to dark brown (10 YR 4/3); weak fine granular structure; moist very friable; fair root supply; clear wavy and tonguing boundary to B21 and C horizon.
C	67+		Sandy loam; reddish brown (5YR 4/3) with pale yellowish and few black manganese mottles in places: structureless; moist hard *in situ;* no roots.

TABLE 54: Clonin Sandstone Complex—Shallow Brown Podzolic—Profile Analyses (4)

Horizon	Coarse sand %	Fine sand %	Silt %	Clay	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	c%	N	C/N	Free iron	TNV
Ap	•42	30	16	12	6.0	24.2	7.7	32	1 9	0.19	10.0	0.9	—
B2	36	26	17	21	6.0	26.6	8.0	JO	1 6	0.1K	XS	1.7	—
C	—	—	—	—	—	—	—	—		—			—

CLONIN COMPLEX — SHALLOW BROWN PODZOLIC
MODAL PROFILE (4)

Location:	Deerpark, Muntrath; 11/4 L 28
Topography:	Rolling
Slope:	6°
Elevation:	165 metres O.D.
Vegetation:	Pasture
Drainage:	Excessively drained
Parent Material:	Sandstone bedrock
Great Soil Group:	Brown Podzolic

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—30	30	Stony sandy loam; brown (10 YR 5/3) to dark brown (10 YR 4/3); moderate fine granular structure; moist friable; stony; plentiful roots: clear smooth boundary to:—
B2	30—50	20	Flaggy sandy clay loam; yellowish red (5 YR 4/8) matrix between stones; moderate fine crumb structure; moist very friable; plentiful roots; abrupt boundary to:—
C	50+		Sandstone bedrock.

TABLE 55: Aughty Series--Peat-Profile Analyses

Horizon	Depth (cm)	Field Moisture C DM)	Ash (% DM)	Db (g/ml)	SPEC. index	Rubbed Fibre	N (% DM)	a/Mg ratio	pH (H,0)
Oal	0—25	556	*15*	0.109	7	6	1.78	nd	3.55
Oa2	25—80	554	IS	0.093	6	6	nd	nd	3.50
Oa3a	80—100	598	1.6	nil	7	6	nd	nd	3.80
Oa3b	100—150	•Ml	1.7	0.096	6	6	1.10	nd	3.62

AUGHTY SERIES —PEAT — MODAL PROFILE

Location:	Slieve Bloom Mountains. Gienletter TD N. 27.04
Classification:	USDA Classification Sub Group; Typic Borosaprist
Topography:	Hilly
Slope:	4°
Elevation:	396 metres O.D.
Vegetation:	*Eriophorum vaginatum* (Bog cotton), *Calluna vulgaris* (Heather!. *Erica tetralix* (Cross-leaved heath) & *\artheciumossifragum* (Bog asphodel) locally abundant.
Parent Material:	Ombrotrophic peat of cyperaceous origin
Great Soil Group:	

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Oal	0—25	25	Peat; black (5 YR 2/1); cyperaceous plant remains in well-humified matrix; pasty; on squeezing one third of peat mass passes through fingers; clear, smooth boundary to:—
Oa2	25—80	55	Peat; dark reddish brown (5 YR 3/2); many prominent long fine fibres in humified matrix; on squeezing little peat material passes through fingers:
Oa3	80—150	70	Peat; dark reddish brown (5 YR 3/2); fine fibres embedded in highly humified matrix; two thirds peat material passes through fingers on squeezing; abrupt, smooth boundary to:—
Alb	150—158	8	Loam; greyish brown to light brownish grey (10 YR 5/2—6/2); massive structure; wet sticky; fine fossil roots: clear boundary to:—
A2b	158+		Loam; light grey (10 YR 7/2); massive structure; fossil roots.

TABLE 56: Ridge Series—Profile Analyses

Horizon	Coarse sand %	Fine sand %	Sill %	Clay %	pH	(1 (meq/100 g	TEB meq/100 g	Base Saturation %	C %	N	C/N	Free iron %	TNV
A11	7	11	48	M	5.8	34.4	11.6	34	5.7	0.54	10.6	3.1	
A12	9	10	48	33	6.1	23.8	9.7	-41	2.3	0.18	I2.S	3.2	—
B	11	10	52	27	5.9	20.0	4.0	21)	0.8	—	-	3.5	—
C	13	7	56	24	5.8	10.6	6.7	63	0.2	—	—	2.3	—

RIDGE SERIES — MODAL PROFILE

Location:	Crissard. Wolfhill; 25/3 J—K 33
Topography:	Rolling
Slope:	2°
Elevation:	280 metres O.D.
Vegetation:	Pasture
Drainage:	Well-drained
Parent Material:	Weathered shale with influence ot chert and sandstone from soliflucted drift cover.
Great Soil Group:	Brown Earth (Dystrochrept)

Horizon	*Depth (cm)*	*Thickness (cm.*	*Description*
All	0—7	7	Silty clay loam to clay loam: brown (10 YR 5/3 dry); strong medium subangular blockv and fine crumb structure; dry friable: abundant roots; no stones: this horizon is due to worm activity over a long number of years: abrupt smooth boundary to:—
A12	7—27/34	20—27	Silty clay loam to clay loam; brown to dark brown (10 YR 4/3); strong medium subangular blockv structure; moist dry friable to slightly firm; many small stones present; plentiful roots; abrupt wavy boundary to:—
B	27—50/65	23—30	Silt loam to (clay) loam; dark yellowish brown (10 YR 4/4); moderate to strong medium to fine subangular blocky structure; moist friable; plentiful roots; some largish sandstone stones present; abrupt wavy boundary to:—
C	50+		Dark greyish brown weathered 'shlig' which is very compact *in situ* but breaks up into blocky fragments on digging; no roots; non-calcareous.

TABLE 57: Ridge Steep Phase—Profile Analyses

Horizon	Coarse sand %	Fine sand %	Silt %	(lay %	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	<	N 95	C/N	Free iron ',	TNV 95
Ap	10	22	45	23	5.5	35.2	11.4	32	(-.2	0.42	I4.K	1.8	—
(B)	35	15	36	14	5.4	17.2	3.9	44	1.6	0.12	13.3	1.9	—
C	41)	15	31	14	5.4	6.0	2.3	2S	0.1	nd	—	1.6	—

RIDGE STEEP PHASE — MODAL PROFILE

Location:	Bannagagole. Oldleisniin: 15/2 O 14
Topography:	Steeply sloping
Slope:	15°
Elevation:	280 metres O.D.
Drainage:	Well drained
Parent Material:	Carboniferous shale bedrock
Great Soil Group:	Brown Earth (of low to medium base status)

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—28/31	28—31	Loam; dark-brown i 10 YR 3/3); strong, medium crumb structure: triable: abundant roots; clear wavy boundary to:—
(B)	28–48/53	20–25	Shaly loam; yellowish-brown (10 YR 5/8); weak; fine granular structure; very friable; plentiful roots; clear, wavy boundary to:—
C	48+		Shaly sandy loam: light olive-grey (2.5 Y 5/4); structureless; firm *in situ;* no roots; non-calcareous.

TABLE 58: Ridge Stony Phase—Profile Analyses

Hori/on	Coarse sand %	Fine sand %	Sill %	Clay	PH	CEC meq/100 g	TEB meq/100 g	Base-Saturation %	C	N	C/N	1 ree ii mi	TNV
All	8	20	37	\5	5.5	37.4	11.3	30	7.5	0.56	13.4	2.9	
AI2	II	20	56	33	5.5	28.4	9.2	33	3.3	0.3	11.0	3.1	—
B2ir	II	22	34	13	5.8	21.4	5.5	2h	1.6	0.18	8.9	4.1	—
C	12	19	37	12	5.8	19.4	5.2	21	0.8	—	—	3.5	—

RIDGE STONY PHASE — MODAL PROFILE

Location:	Cullahill Mountain, Durrow; 35/3M—N6
Topography:	Hilly
Slope:	6°
Elevation:	265 metres O.D.
Vegetation:	Pasture with heather
Drainage:	Well drained
Parent Material:	Flagstone bedrock
Great Soil Group:	Brown Podzolic

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
All	0—8	8	Clay loam; brown (7.5 YR 4/2); moderate fine crumb structure; moist friable; abundant root mat; clear boundary to:—
A12	8—22	14	Clay loam; brown (7.5 YR 4/2); moderate medium subangular blocky structure; moist friable; plentiful roots; abrupt boundary to:—
B2ir	22—45/55	13—23	Stony clay loam; reddish-brown (5 YR 4/4); weak fine crumb structure; moist very friable but very stony; plentiful roots; clear wavy boundary to:—
C	45+		Olive brown very stony (flaggy) clay loam i.e. matrix of fine, friable material between broken flagstones.

TABLE 59: Abbeyfeale Non-Peaty Phase—Profile Analyses (1)

Horizon	Coarse sand	line sand	Silt %	Clay	pH	CEC meq/100 g	II B meq/100 g	Base Saturation %	C	N	C/N	1 ree iron	1\\
Ap	11	22	36	31	6.5	26.6	12.0	45	4.2	0.37	11.4	1.7	
A21	12	20	36	32 ,	5.7	16.1	5.3	33	2.0	0.21	9.5	1.6	—
A22g	12	19	42	27	5.5	12.0	3.8	32	0.7	—	-	2.2	—
Bg	II	20	42	27	5.9	13.4	7.6	57	0.6	—	—	i i	—
Cg	21	15	33	31	5.9	14.4	10.9	76	0.4	—	~	3.0	—

ABBEYFEALE NON-PEATY PHASE — MODAL PROFILE (1)

Location:	Fairymount, Crettyard; 31/3 B 33
Topography:	Rolling
Slope:	3°
Elevation:	215 metres O.D.
Vegetation:	New pasture
Drainage:	Poorly drained
Parent Material:	Dense, tenaceous. soliflucted drift of Munsterian age, composed of carboniferous shale, sandstone, flagstone and chert.
Great Soil Group:	Gley

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—18	18	Clay loam; greyish brown (10 YR 5/2) with many distinct yellowish red mottles; weak medium subangular block structure; moist friable-dry firm to hard; plentiful roots; clear boundary to:—
A21g	18—28	10	Clay loam; greyish brown (2.5 Y 5/2) with many distinct mottles; weak fine to medium subangular blocky structure breaking into large prisms on drying; moist plastic; firm to hard when dry; sparse roots; gradual boundary to:—
A22g	28—40	12	Olive grey (5 Y 5/2) with many distinct mottles; otherwise similar to A21g; gradual boundary to:—
Bg	40—70	30	Clay loam; speckled yellowish brown (10 YR 5/6) and olive grey (5 Y 5/2); structureless tending towards prismatic on drying; moist plastic; sparse roots; abrupt boundary to:—
Cg	70+		Gritty clay loam; blackish (manganese flecks), greyish brown variegated and grey (5 Y 5/1); structureless and non-calcareous.

TABLE 60: Abbeyfeale Undulating Phase--Profile Analyses (1)

Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/100 g	TEB meq/100 g	Base Saturatiori %	C %	N %	C/N	lice iron %	TNV %
01	nd	nd	nd	nd	4.6	71.0	9.6	14	23.6	1.0	23.6	1.6	
A2g	37	23	29	11'	5.3	4.7	0.6	13	0.4	nd	—	0.2	—
B2tg	14	18	41	27	5.4	8.2	2.6	32	0.3	nd	—	1.9	—
B/Cg	16	16	39	30	5.9	13.2	7.7	5K	0.2	nd	—	—	—

ABBEYFEALE UNDULATING PHASE - MODAL PROFILE

Location:	Baunreagh, Oldleighlin; 15/1 M 32
Topography:	Flattish to undulating
Slope:	2—3°
Elevation:	290 metres O.D.
Drainage:	Very poorly drained
Parent Material:	Dense, tenaceous, non-calcareous soliflucted drift composed of carboniferous shale, sandstone and flagstone
Great Soil Group:	Peaty Podzolised Gley

Horizon	*Depth (cm)*	*Thickness (cm,*	*Description*
Ol	0—12/15	12—15	Peaty clay loam; very dark-grey (10 YR 3/1); weak, fine subangular block structure; wet, plastic; many rush roots; abrupt, wavy boundary to:—
A2g	15—28	**13—16**	Coarse sandy loam; light-grey (10 YR 6/1) with many, coarse, prominent yellowish-brown (10 YR 5/8) mottles; weak, fine subangular blocky structure; wet, slightly plastic; sparse roots; gradual, smooth boundary to:—
B2tg	28—90/95	62—80	Stony clay loam to loam; grey (2.5 Y 6/1) with very **many,** coarse, prominent yellowish-brown and yellowish-red (10 YR 5/8 and 5 YR 4/8) mottles; structureless tending towards weak, coarse prismatic; wet, plastic; sparse roots; gradual smooth boundary to:—
B/Cg	90+		Stony gritty clay loam; grey (2.5 Y 6/0) with many, prominent yellowish-brown (10 YR 5/8) mottles; structureless; wet, plastic; no roots; non-calcareous.

TABLE 61: Abbeyfeale Undulating Phase--Profile Analyses (2)

Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C%	N %	C/N	Free iron %	TNV %
Al	10	10	41	(9	4.9	55.6	14.4	26	11.0	0.80	13.8	3.7	
(A2g)	9	18	44	:9	6.9	16.0	15.1	94	1.1	0.14	7.9	1.0	—
Bg	11	18	41	28	6.9	16.8	15.4	9:	0.5	—	—	5.6	—
C	11	15	44	JO	7.7	13.0	17.5	Sat.	0.5	—	—	2.0	1.8

ABBEYFEALE UNDULATING PHASE — MODAL PROFILE (2)

Location:	Rossmore Forest; 37/1 R 14—15
Topography:	Gently undulating plateau
Slope:	3°
Elevation:	320 metres O.D.
Vegetation:	Sitka spruce
Drainage:	Poorly drained
Parent Material:	Dense, tenaceous. soliflucted drift of Munsterian age, composed of carboniferous shale, sandstone, flagstone and limestone.
Great Soil Group:	Gley

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
02	0—2	2	Thin layer of pine needles.
Al	0—15	15	Clay loam; dark greyish brown (10 YR 4/2); moderate fine to medium granular structure; consistence friable when dry but sticky when wet; abundant roots; clear smooth boundary to:—
(A2g)	15—28/30	13—15	Clay loam; olive grey (5 Y 5/2) with many fine distinct yellowish brown (10 YR 5/6) mottles particularly around root channels; coarse prismatic structure; wet plastic; sparse roots; gradual boundary to:—
Bg	28—85	55	Clay loam; speckled grey (5 Y 5/1) and yellowish brown (10 YR 5/6); coarse prismatic structure; wet plastic; sparse roots; gradual boundary to:—
Cg	85+		Clay loam; grey (7.5 YR 5/10) with abundant distinct yellowish brown (10 YR 5/4) mottles; structureless weakly calcareous drift.

TABLE 62: Raheenduff Series—-Profile Analyses

Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C %	N %	C/N	Free iron %	TNV %
Ap(All)	18	18	38	26	6.6	49.2	31.1	63	10.2	0.85	12.0	1.2	
Ap(A2g)	19	20	31	30	6.3	31.4	18.8	60	5.0	0.46	10.9	1.0	—
A2g	19	18	32	31	6.5	21.8	12.0	5?	1.7	0.2	8.5	1.0	—
B2g	12	12	30	46	6.9	23.8	14.9	63	0.5	—	—	4.1	
B2g	12	10	41	*M*	7.0	16.8	14.0	83	0.4	—	—	3.6	0.2
Cg	11	13	47	29	8.1	13.4	14.1	Sat.	0.2	—	—	2.2	19.7

RAHEENDUFF SERIES — MODAL PROFILE

Location:	Boleybeg, Spink; 24/4 R 9
Topography:	Flattish
Slope:	
Elevation:	157 metres O.D.
Vegetation:	New ley
Drainage:	Poorly drained
Parent Material:	Calcareous glacial till composed of shale limestone and sandstone
Great Soil Group:	Gley.

Horizon	*Depth (cm)*	*Thickness (cm)*	*Description*
Ap	0—11/22	11—22	Recently ploughed admixture of very dark greyish brown (10 YR 3/2) A11 dark brown (10 Y 3/3) A12 horizon and greyish brown (2.5 Y 5/2) subsoil A2g horizon; loam to clay loam; weak fine and medium subangular blocky and crumb structure; moist plastic; plentiful roots; abrupt boundary to:—
A2g	11—20/26	2—10	Clay loam; greyish brown (2.5 Y 5/2) with few yellowish-red root mottles; coarse prismatic structure; moist plastic; hard when dry; gradual boundary to:—
B2tg	20—48/57	20—37	Clay loam to clay; speckled yellowish brown (10 YR 5/6) and grey (5 Y 5/1) with grey (5 Y 5/1) on outside of prisms; coarse prismatic structure; moist plastic—dry hard; sparse roots; non-calcareous; clear boundary to:—
Cg	48+		Gritty clay loam; same colour as B2g but individual colour areas are larger; structureless; no roots; calcareous.

TABLE 63: Ballinakill Series—-Profile Analys<:s

Horizon	Coarse sand %	Fine sand %	Silt %	Clay	pH	CEC meq/100 g	TEB meq/100 g	Base Saturation %	C%	N %	C/N	1 ree iron %	TNV ·.:
All	15	22	38	25	5.8	33.6	19.6	^S	8.3	0.71	11.7	1,4	—
A12	17	23	37	23	6.3	17.2	10.7	02	1.5	0.2	7.1	1.7	
B21t	13	14	35	38	(-.4	14.4	10.0	7<)	0.6	—	—	2.7	—
B22t	15	13	37	35	6.5	15.0	12.2	81	0.6	—	-	2.6	—
C	13	is	38	31	8.1	14.4	16.0	Sat.	0.6	—	—	2.2	13.1

BALLINAKILL SERIES — MODAL PROFILE

Location:	Tinwear, Durrow; 35/2 Q 15
Topography:	Rolling
Slope:	4—5°
Elevation:	170 metres O.D.
Vegetation:	Pasture
Drainage:	Well drained
Parent Material:	Calcareous glacial till composed of shale, limestone and sandstone
Great Soil Group:	Grey Brown Podzolic (Typic Hapludalf)

Horizon	*Depth (cm)*	*Thickness (cm,*	*Description*
All	0—8	8	Loam; dark brown (10 YR 3/3) with many dark red root mottles; moderate to weak fine crumb structure; moist slightly plastic; abundant roots; clear smooth boundary to:—
A12	8—35	27	Loam; brown to dark brown (10 YR 4/3); moderate fine and medium subangular blocky structure; moist friable; plentiful roots; clear boundary to:—
B2t	35—85	50	Clay loam; dark yellowish-brown to brown (10 YR 4/3—4/4); moderate medium sub-angular blocky structure; moist firm plastic; clay skins prominent; sparse roots; clear wavy boundary to:—
C	85+		Gritty clay loam; dark greyish brown (10 YR 4/2) structureless calcareous glacial till.

TABLE 64: Classification of Co. Laois Soil Series according to natural drainage

Natural Drainage Class	Conditioning Factors	Soil Series	Area (hectares)	% of County
(a) Excessively drained	Rapid internal drainage, moisture deficit in dry seasons.	Baggotstown-Carlow Complex (part of), Cardtown Complex (part of), Dysart Hills Complex (part of).	6,685	3.90
(b) Well drained	Good permeability, deep water-table, moisture deficit in dry seasons.	Cullahill, Fontstown, Graceswood, Dysart Hills Complex (part of), Baunreagh, Ridge, Clonin Complex, Ridge Steep Phase, Ridge Stony Phase, Baunreagh Steep Phase, Conlawn.	28,146	16.41
	Good permeability, deep water-table, good moisture-holding capacity.	Stradbally, Stradbally Rocky Phase, Patrickswell, Patrickswell Rocky Phase.	28,814	16.80
	Good permeability, deep water-table, good moisture-holding capacity, trafficability problem in wet seasons.	Elton, Knockbeg, Knockbeg Stony Phase, Ballinakill.	9,667	5.64
(c) Imperfectly drained	Good permeability, seasonal high water table, trafficability problem in wet seasons.	Banagher, Gortnamona, Baggotstown-Carlow Complex (part of), Cardtown Complex (part of), Clonaslee, Alluvial Complex (part of)	18,712	10.91
	Surface water gley; poor permeability and trafficability in wet seasons.	Rahcenduff Imperfectly Drained Phase	1,003	0.58
	Ground water gley, seasonally high water-table, trafficability problem in wet seasons.	Mylerstown Imperfectly Drained Phase	2,060	1.20
	Impervious subsoil horizon (ironpan)	lvn<>c'<astanna Peaty Phase, Rossmore	1,092	0.64

TABLE 64: Classification of Co. Laois Soil Series according to natural drainage *(condt.)*

Natural Drainage Class	Conditioning Factors	Soil Series	Area (hectares)	% of County
(d) Poorly drained	Ground water gleys, seasonal high ground water-table, trafficability problems in wet seasons.	Mylerstown, Howardstown, Mountrath Complex, Lowland Peat-Industrial Complex, Ballyshear, Alluvial Complex (part of), Bawnrush, Baggotstown-Carlow Complex (part of), Cardtown Complex (part of).	35,069	20.45
	Surface water gleys, slow permeability, trafficability problems in wet seasons.	Abbeyfeale Non-Peaty Phase, Abbeyfeale Undulating Phase, Raheenduff, Slieve Bloom Non-Peaty Phase, Abbeyfeale Peaty Phase, Slieve Bloom, Slieve Bloom Steep Phase, Slieve Bloom Undulating Phase.	26,293	15.33
	High water table, trafficability problems except in very dry periods.	Allen, Turbary Complex, Pollardstown.	8,872	5.17
	Trafficability problems except in very dry periods.	Aughty, Aughty Slumping Phase, Aughty Shallow Phase, Aughty Cutover.	4,824	2.81
(e) Unclassified	Rock outcrop	Dysart Hills Complex (part of)	238	0.14

SOIL SERIES INDEX

SOIL COMPLEXES INDEX