Soil Survey Bulletin No. 23

Soils of County Clare

by

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(Report compiled by *T. F, Finch, E. Culleton* and S. *Diamond)*

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PREFACE

This publication, Soil Survey Bulletin No. 23, presents the findings of the Soil Survey of County Clare. It is one of a series of county soil surveys being carried out by the National Soil Survey of An Foras Taluntais (The Agricultural Institute) for the purpose of providing 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; 15 cm = 1.6 km) but the detail mapped on the field sheets is not shown on the published soil map at the scale of 1:126,720 (} in. 1 mile: 1.25 cm = 1.6 km) due to scale limitation. Copies of the field maps are available for consultation in the Soil Survey Office at Johnstown Castle, Wexford.

Mr. T. F. Finch was responsible for the operation of this survey; he commenced work in the county in 1965 and completed the field investigations in 1968. Technical assistance was provided from time to time by Mr. P. Feeney, Mr. T. O'Shea and Mr. T. Martin. Mr. S. Diamond gave assistance and advice in soil correlation, classification and land-use interpretation, and Mr. R. F. Hammond in peat classification. Mr. M. Bulfin contributed information on aspects of land-use in relation to forestry.

Various members of the staff of the National Soil Survey and of the Soils Division of An Foras Taluntais contributed to the bulletin: Mr. G. A. Fleming and Mr. P. Parle contributed the section on trace elements, Dr. P. V. Kiely the section on clay mineralogy, Dr. R. M. Jelley the section on soil physical properties and Mr. T. Gleeson the section on the potential of selected soils for pasture production. Dr. A. O'Sullivan provided the information on vegetation throughout Appendix II.

The analytical data in Appendix II were provided mainly by the laboratory staff of the Soil Survey Department (with assistance from the Soil Fertility and Chemistry Department) and of the Plant Nutrition and Biochemistry Department.

The colour maps and various figures and plates were prepared by Mr. J. Lynch and Mr. V. Staples of the Cartographic Section assisted by Miss O. Shudall.

Dr. T. Walsh, Director of An Foras Taluntais, gave the survey his enthusiastic support. Dr. P. Ryan, Deputy Director of An Foras Taluntais, encouraged and directed the work in his previous capacity as Head of the National Soil Survey. Mr. P. V. Geoghegan edited the bulletin, with assistance from Miss E. Bryan.

Assistance also came from a number of outside sources. Mr. J. Barry, Chief Agricultural Officer, contributed Chapter IV and in compiling the information on soil suitability, personnel in the local Agricultural and Horticultural Advisory Services gave valuable assistance. Information on forestry (Chapter III) was provided by the staff of the Forestry Division, Department of Lands, through Mr. O. V. Mooney, Head of the Branch. Staff of the Geological Survey provided the section on solid geology, and climatic records were provided by the Meteorological Service.

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

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

M. J. Gardiner,
Head, National Soil Survey of Ireland

An Foras Taluntais,
Johnstown Castle,
Wexford,
April, 1971.

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INTRODUCTION

County Clare (Fig. 1), situated on the west coast of Ireland between the great sea-inlets of Galway Bay and the estuary of the River Shannon, extends from 52° 34' to 53 8' north latitude and from 8° 17' to 9° 56' west longitude. The county covers 852,274 acres (344,729 hectares).

Annual rainfall within the county varies from over 1,500 millimetres in the elevated areas to less than 1,000 millimetres in some lowlands; temperatures on average range from minus 3° to plus 24° Celsius.

The principal elevated areas are the Burren. Slieve Bernaghs, Slieve Aughties and the Cratloe Hills. The 'Burren' is a unique feature of the county being composed of bare, bedded limestone and carrying a flora which combines species characteristic of sub-arctic and mediterranean regions.

The varied topography, climatic conditions and geological formations are largely responsible for the many different types of soil found in the county. In all, some 56 soil series and phases have been segregated and mapped. In common with the rest of the country, they are of comparatively recent origin being mainly derived from materials laid down during the last two glaciations.

The entire detail mapped on the field sheets at a scale of 6 inches to 1 mile(l: 10,560) could not be shown on the published soil map, due to scale limitation, but copies of the field maps are available for inspection in the Soil Survey Office at Johnstown Castle, Wexford. Place-names throughout the bulletin and on the maps are not. in all cases, in accord with local spelling, but it was thought preferable to adhere to the official place-name spelling used in the Ordnance Survey.

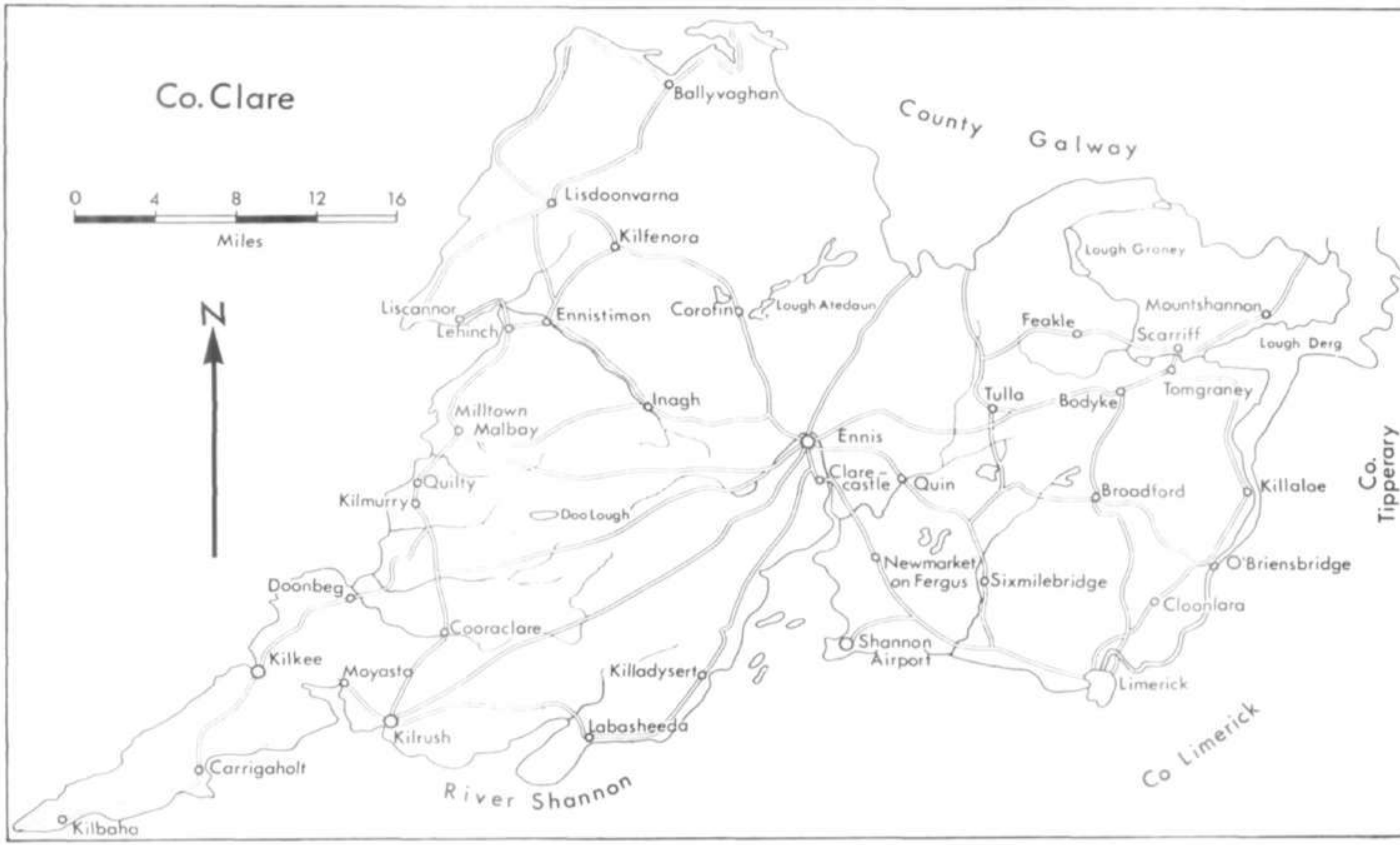


Fig. 1: County Clare—geographical location and principal towns, villages and roads

CHAPTER I

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 details of 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 in 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. The combined A and B horizons constitute the so-called solum or 'true soil' whilst 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 whilst 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: Al, A2. A3. Bl, B2. etc. The various horizons in a soil and their character reflect the process of soil formation that has 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. *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 besides. Two sub-divisions of the A horizon are commonly made, namely, Al and A2. Either the Al or both may be represented in a

* See Appendix I.

profile. The Al is a surface mineral horizon that usually contains a higher proportion of organic matter, incorporated with the mineral matter, than any of the underlying horizons. In cultivated soils this horizon corresponds to the plough la^v^er 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 horizons.

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 nore abundant than in the C horizons. Compared with the A horizon, the B honzon 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 overying 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, B21, B22, B3, max 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 characteristic 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 :he native rock or it may have been transported by ice, water or wind. The C horizon is ess 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 party decomposed organic matter more usually associated with very poorly drained or very degraded (podzolised) mineral soils. Where little or no decomposition has Uken 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. Clare is usually about 3 to 4 feet. Each profile is thoroighly examined and described and a record made of its salient characteristics.

A soil profile is described by first noting certain features of the soil'! environment, followed by details of its general characteristics. The characteristics whi;h apply to the site include relief, slope, aspect, altitude and vegetation. Drainage conditions and the pattern of horizon development within the profile are considered ne;t and, finally, properties of the individual soil horizons such as texture, structure, consstence, colour, mottling, amount of organic matter, stoniness, presence of hardpans and root development are described.

A bulk sample from each soil horizon is analysed physically and chemically at the Soil Laboratory. 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.**

Soil Mapping

The character of every soil can be attributed largely 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, great variation in topography and in age of different land surfaces. As a result, there are innumerable combinations of the factors of soil formation, giving 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 it 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.

Soil Variants

Variants are separate soil series that are too small in extent to be shown at certain scales of mapping. A soil which is recognised and defined as a variant in one survey area, however, may be designated as a separate series later in another area, depending on its extent.

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, depth or stoniness, that are important in soil behaviour and land-use. Several such phases have been segregated in County Clare.

Scale of Mapping

Field mapping is carried out on a scale of 6 inches to 1 mile (1:10,560) but this detail is reduced to a scale of \ inch to 1 mile (1:126,720) for publication. Since one 6-inch sheet covers an area of 24 square miles, to publish on this scale would necessitate, in the case of County Clare, at least 70 individual map sheets. Considerations such as the cost of colour printing, ease of handling and general use of the map, warrant reduction to the smaller scale.

This reduction, however, introduces certain difficulties. It has been found necessary to consolidate and, in some cases, delete some of the least extensive soil separations shown on the larger scale. On a scale of 1:126,720 it is possible to show a minimum area of 25 acres. This means that any uniformly coloured area on the published map may include enclaves of less than 25 acres. 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.

To accommodate those who are interested in more detail for special purposes, the field sheets (at a scale of 1:10,560) showing the entire field survey records are being retained for consultation at the National Soil Survey headquarters, Johnstown Castle, Wexford.

CHAPTER II

THE SOILS AND THEIR USE-RANGE

Great Soil Groups and Soil Series

Forty soil series have been recognised and mapped within County Clare; the series category has been defined in the previous chapter. The different series have been given geographic names based on the location in which the particular soils are best expressed or occur most widely. Four soil complexes, eleven variants and sixteen phases have also been recognised and described; the phases and variants are included within the series to which they are related in each case.

In mapping their distribution in any area, the soils can be classified on a broad scale, into major or great soil groups, each consisting of a collection of closely related soil series. Each great soil group then is comprised of soils having a number of important profile characteristics in common. A certain latitude in profile variation is allowable at this level of classification, but the degree of similarity is of quite a high order. A single great soil group may not be confined to a particular geological parent material, as the basic criteria for classifying the soils at this stage are the characteristics of the profile.

The description of the various soil series mapped in County Clare are arranged according to great soil groups in the following pages; soils derived from alluvial deposits and the complexes and variants are treated separately, however. Table 1 (page 47) shows the great soil groups, their respective series and the extent of the county occupied by each. The soils occurring as variants are classified into Great Soil Groups in Table 2 (page 48).

In Chapter V the main soil series in the county are grouped according to geological similarities in parent materials.

Brown Earth Group

The brown earths are relatively mature, well-drained, mineral soils possessing a rather uniform profile, with little differentiation into horizons. It follows, therefore, that these soils have not been too extensively leached or degraded, with the result that there are no obvious signs in the profile of removal and deposition of materials such as iron oxides, humus or clay. However, in many cases, some leaching has occurred, resulting in the translocation of soluble constituents, notably carbonates of calcium and magnesium.

Some brown earths are derived from parent materials poor in lime or other base-rich components and are, therefore, inherently acid; these are called acid brown earths or brown earths of low base status. Others have developed on more lime-rich parent materials, are less acid, or may even be alkaline and are distinguished as brown earths of high base status. An intermediate sub-group classified as brown earths of medium base status can also be distinguished. These and the brown earths of low base status, having pH values between 5.8 and 6.8 in the layers below cultivation, can develop also on lime-rich parent materials under conditions conducive to excessive depletion of bases.

Brown earths normally possess medium textures (sandy loam, loam, sandy clay loam), desirable structure and drainage characteristics and a high degree of friability. They are generally good arable soils. Although normally of rather low nutrient status in their natural state they respond well to manurial amendments. With good management, they can support high quality grassland and are also ideally suitable for a wide range of forest tree species.

*Baggotstown Series**

This series is of very limited extent occupying 0.07% (520 acres; 210 hectares) of the county. It occurs on fluvio-glacial limestone deposits. From Tulla south-westwards to Shannon Airport, however, a small percentage of sandstone and shale is found in the glacial drift from which this soil is derived (Appendix III). The topography is mainly morainic with occasional drumlins. Altitude is less than 500 feet (152 m).

The soils are shallow, usually less than 18 inches (46 cm) deep, and are excessively drained. Textures in the A and B horizons are generally gravelly sandy loam to loamy sand: roots are abundant, and pH values are high in the lower horizcns.

So/7 *Suitability^:* These soils have a wide use-range and are eminently suitable for tillage or grass production. Average rainfall in this area is high (1,125 mm) and only in a dry year will the soil show signs of drought. Hardwoods are the most suitable trees for planting on this soil.

Profile description and analyses—Appendix II, Table 1.

*Ballincurra Series**

This series occupies 0.17% (1,320 acres; 534 hectares) of the county. It occurs mostly as a member of Burren-Ballincurra Complex in which it is clcsely associated with the Burren Deeper Phase, Elton and Patrickswell Series; it occurs separately also at altitudes of less than 300 feet (91m) on rolling landscape with occasional steep slopes. Parent material is thin drift composed mostly of limestone with sandstone and shale as impurities. The drift has weathered into soil which now varies in depth from 6 to 18 inches (15 to 46 cm) over the limestone bedrock.

The soils are of loam, gravelly loam, and silt loam texture and are we 1 to excessively drained. The top soil is friable but the structure and consistence deteriorate in the B horizon. Roots are abundant and penetrate to the bedrock on which there is occasionally a thin coating of humic material. pH values become high in the bwer horizons.

Soil Suitability: This soil has a limited use-range. Its shallowness and frequent rock exposure preclude tillage except on a very small scale. Drainage may be excessive in places so that a moisture deficit may limit production in dry spells. Pasture can be grazed over a long season with little danger of poaching. The soil is not generally suited to forestry, except in the deeper phases where larch and Scots pine are the most suitable species.

Profile description and analysis—Appendix II, Table 2.

*Ballynalacken Series**

This series occupies 0.31 % (2,440 acres: 987 hectares) of the county and is derived from glacial drift of Silurian shale composition with a small admixture of Old Red

* See Appendix IV.

t In discussions of soil use-range in this bulletin, good management and adequate evels of fertilisers are assumed. Trace element levels are discussed in Chapter VI.

Sandstone (Appendix III). It is associated closely with the Ballylanders Series on the landscape but di.fers in the bouldery and stony nature of its parent material. Topography is varied but is mostly kame and kettle and drumlin with occasional steep slopes.

These soils have low pH values, are loam textured except in the C horizon and are fairly shallow, seldom exceeding 18 inches (46 cm) in depth. Drainage is good and roots penetrate throughout the soil.

Soil Suitability: These soils have a wide use-range, being suitable for tillage, pasture. and forestry. In Clare they are largely devoted to grassland but low levels of lime and nutrients limit production at present.

Profile description and analyses—Appendix II, Table 3.

Ballynalacken Grey Variant

This variant of the Ballynalacken Series covers only a small area within the county and is not shown on the 1:126,720 scale. In contrast to the normal brown colour of the series the soil is greyish-brown and light grey. These colours are generally associated with gleying and are unusual in such a free-draining soil. They are due to the low free iron content in this soil. This variant is found on the Silurian shales around both sides of Lough Graney and on the glacial drift derived from these shales. The topography is of gentle hillslopes, drift ridges and kames. Slopes range from 2 to 8 . and altitude from 200 to 900 feet (61 to 274 m). This soil, like the normal phase of the series, is a brown earth of low pH status. The soil suitability is similar to that of the series.

Profile description and analyses—Appendi; II, Table 4.

*Ballylanders Series**

This series covers 3.79% (29,4£0 acres; 11,931 hectares) of the county and is associated on the landscape with the Ballinalacken Series. In the more poorly-drained hollows and valley bottoms, however, it is found with the Puckane and Gortaclareen Series. The soils are derived from Silurian shale colluvium and from glacial drift with anadmiaureofOld Red Sandstone (Appendix III). The topography varies from gently rolling on the valley bottom to steeply rolling on the hillsides. Slopes range from 2 to 25 and altitude from sea-level to 900 feet (274 m) (Fig. 2).

The soils are loam in texture and are well drained. The topsoil is brown. 7 to 12 inches (18 to 30 cm) deep, over a yellowish-brown (B) horizon of variable thickness, but usually 4 to 9 inches (10 to 23 cm) and is friable throughout with abundant roots. pH values are low.

Soil Suitability: These soils have a wide use-range. They are very similar to the soils of the Clonroche Series in County We ford and, like them, they have no serious physical limitations. They are largely devoted to grassland but because of their desirable drainage, texture, structure and consistency they are also suited to a wide range of tillage crops.

These soils are excellent for grass production and a stocking density of one cow-equivalent per acre can be attained with good management. However, physical analysis (see Chapter VI) indicates that poaching might become a problem especially if stock have access to the land during wet periods. The moisture-holding capacity of the soils is high but in some of the more shallow situations a deficit may develop in dry seasons. The soil is suitable for most forest species.

Profile description and analyses—Appendix II. Table 5.

* See Appendix IV.

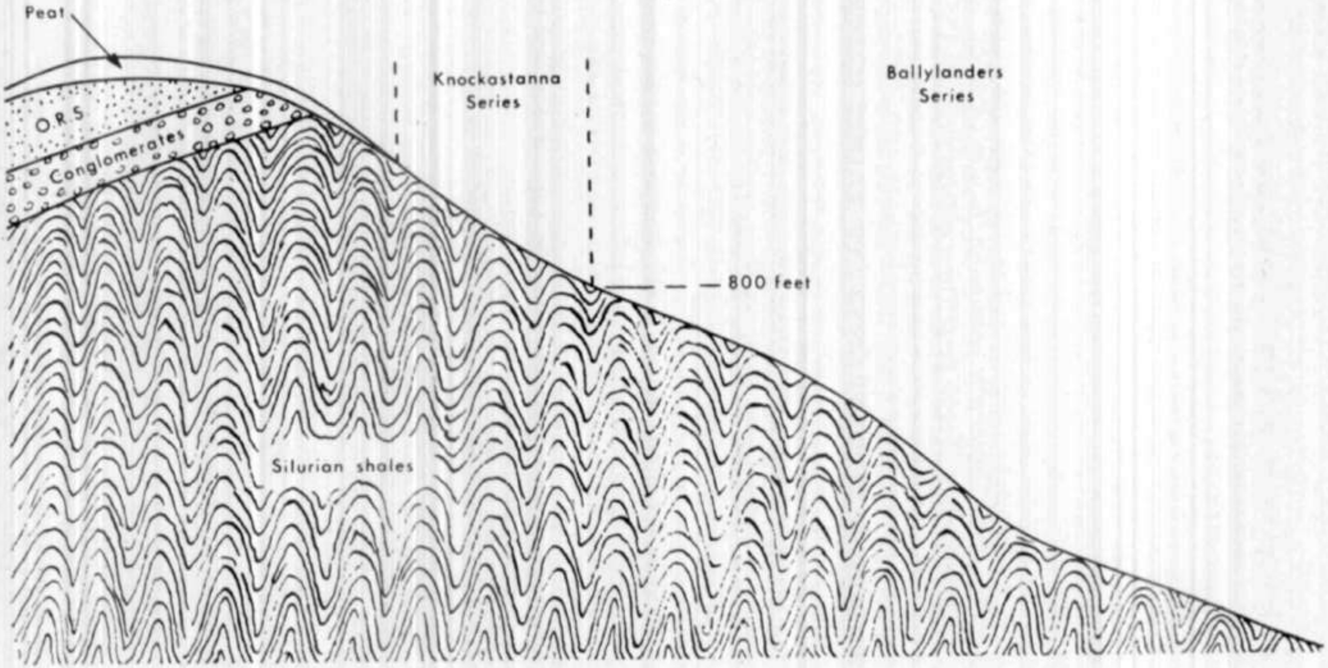
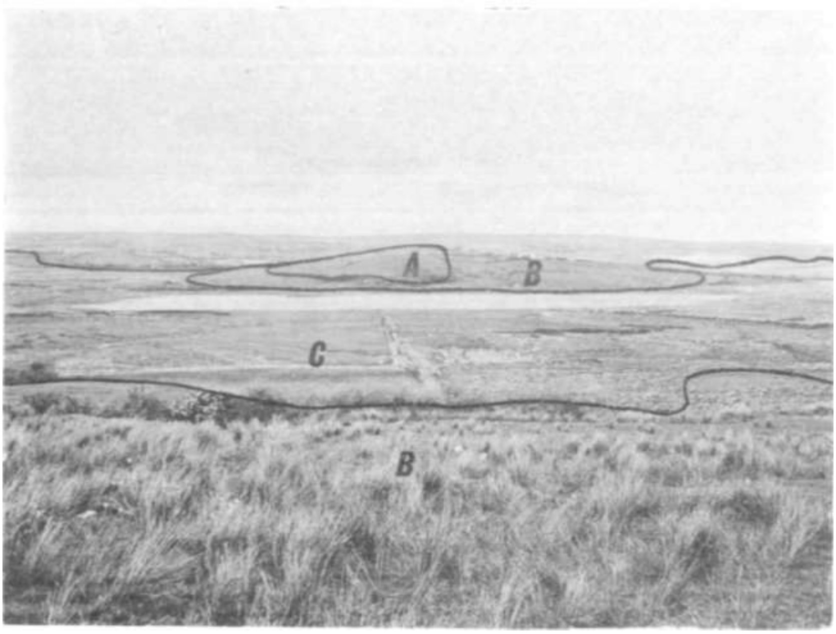


Fig. 2: Ballylanders Series in relation to landscape, geology and associated upslope soils



ri.te 1: Sporadic occurrence ofwell-drt ined Kilfergus soils (A) on drum/ins; B=Kilrush Scries; C=Bcncgher Series

Ballylanders Brown Podzolic Variant

This variant is frequently found within the Ballylanders Series. It occurs in similar situations and is the same as Ballylanders except for the presence of a very weakly-developed B2ir horizon and a more gravelly texture. The use-range is similar to that of the series.

Profile description and analysis—Appendix II. Table 6.

*Derk Series**

This series occupies only 0.03% (200 acres: 81 hectares) of the county and is associated with the Carrigogunnel and Elton Series. The parent material is glacial drift of felsitic ash with limestone and a small proportion of Old Red Sandstone. The altitude varies from 180 to 350 feet (55 to 107 m), and slopes from 2 to 10'.

The soil changes in texture from clay loam in the Al horizon to sandy loam in the C horizon (below 46 inches; 117 cm). The colour ranges from brown in the surface to yellowish-brown and strong brown in the sub-soil. pH values are high below the B horizon. Drainage is good and roots are abundant and diffuse.

Soil Suitability: These soils have a wide use-range. They are well suited to tillage and are capable of producing cereal, root, vegetable and fruit crops successfully.

They are also excellent for grass production and pastures can be utilised fully over a long grazing season due to the physical nature of the soils. A stocking rate of one cow-equivalent per acre is attainable with good management. The soils are also well suited to forestry.

Profile description and analyses—Appendix II, Table 7.

* See Appendix IV.

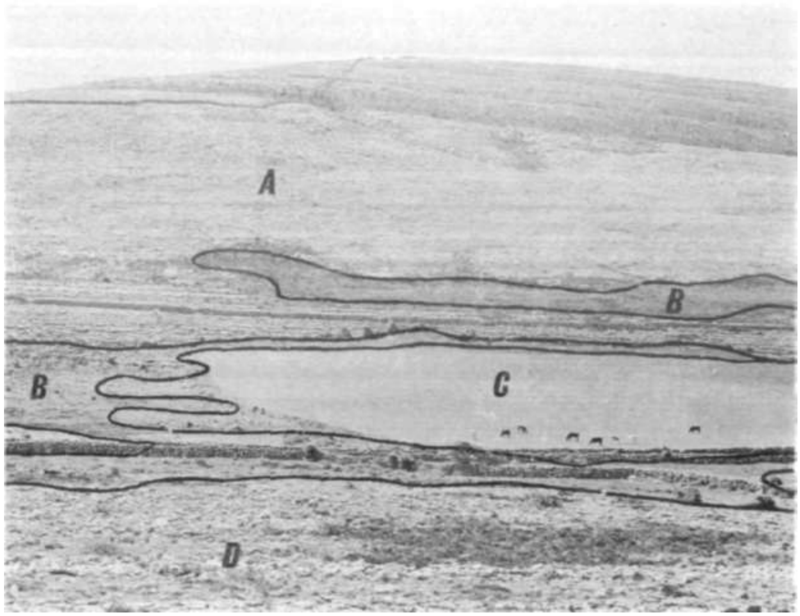


Plate 2: Soils of Kinvcrra Scri.s (C) *occurring wit I. in the Burren crca; Burren Series 75% rock (A), 25% (B) c ml SO^AD)*

*Kilfi. rgus Series**

This series covers 3.22% (25.030 acres: 10,150 hectares) of the county and occurs frequently in very small areas on the Upper Carboniferous shales and sandstones and the glacial drift derived from these rocks. It occurs over rolling kame and kettle, drumlin and steeper hillside topography with slopes ranging from 2 to 10 . The altitude is always less than £00 feet (183 m).

The soils are well drained with texture ranging from clay loam to shaly sandy loam: roots are abundant throughout the profile. pH values are low to medium.

Soil Suitability: These soils have a wide use-range and are suitable for tillage crops, pasture and forestry.

Profile description and analyses—Appendix II. Table 8.

Kinvarra Series

This series covers 1.78% (13.880 acres: 5,617 hectares) of the county and is found throughout the Burren and as far south as Ennis. It is derived from limestone till of Weichsel age which shows occasional erratics such as granite (Appendk III). It is associated with the Kilcolgan Series in the north and with the Patrickswell Series in the south. It occurs on both drumlin relief which is normally rolling with most slopes about 8 and also on glacial till with slopes of about 2 . The range in altitude is from sea level to around 1,100 feet (335 m).

These soils are well to excessively drained with surface te tures varying from gravelly clay loam to gravelly loam. They are usually 12 inches (30 cm) and seldom more than

| See Appendix IV.

15 inches (38 cm) deep. Roots are abundant throughout the profile and extend into the C horizon. pH values are high, except under heath vegetation, where they are noticeably lower.

So/7 *Suit ability:* The soils have a wide use-range; they are well suited to tillage crops and are also excellent for grassland. However, drought could reduce yields in dry seasons due to the rather low water retention. Hardwoods are the most suitable trees for planting on this soil.

Profile description and analyses—Appendix II. Table 9.

Kinvarra Series—Bouldery Phase

The soils of this phase are similar to those of the normal phase except for the presence of boulders which limit their use-range to grazing. The phase occupies 0.38% (2,960 acres; 1,198 hectares) of the county.

Kinvarra Podzol Variant

This variant occurs in Gleninagh in the Burren Hills and is found on the valley sides above cultivation limits and also around a shallow sink-hole at the northern end of the glen. The parent material is limestone glacial drift with some Galway granite (Appendix III). The topography varies from rolling on the hillside to gently rolling on the valley floor. The altitude is also variable ranging from about 700 feet (213 m) to nearly sea-level.

These well-drained soils are loam to clay loam in texture with good structure and consistence in the Al horizon. Structure and consistence deteriorate in the B horizon and at 19 inches (48 cm) become sub-angular blocky to massive and slightly sticky to plastic. A permeable ironpan occurs at 19 inches (48 cm) and a humus B horizon at 31 to 33 inches (79 to 84 cm*. pH values are low in the surface horizons.

Soil Suitability: These soils have a limited use-range and are mostly suited to grassland; they are moderately suited to forestry.

Profile description and analysis—Appendix II, Table 10.

Knocknaskeha Series

This series covers 0.14% (1.160 acres; 470 hectares) of the county and is found along the lowland limestone corridor from Whitegate through Scarrif. Tulla and Quin. It occurs mostly on drumlins but also in some areas of gentle relief and always below 400 feet (122 m). It is associated with the Patrickswell Series into which it frequently grades as the percentage of limestone increases (Appendix III). Where the limestone content decreases it is associated with the Puckane and Gortaclareen Series. The parent material is usually sandstone glacial drift with a high proportion of limestone and some shale but in some cases the proportion of limestone exceeds the sandstone (Appendix III).

The soils are well to excessively drained and are normally light-textured sandy loams to loams. pH values are variable depending on the proportion of limestone in the parent material. Roots are abundant throughout the profile.

Soil Suitability: These soils have a wide use-range. Around Whitegate and Mount Shannon, wheat, barley and roots, especially potatoes, are grown successfully. They are also suitable for grass production; poaching is not usual and an extended grazing season is possible. These soils are. very well suited to the normal range of forest species.

Profile description and analyses—Appendix II. Table II.

Tu/lig Series

This series covers 0.94% (7.280 acres; 2,946 hectares) of the county and is generally found west of a line from Milltown Malbay to Kilrush where it is associated with the Abbeyfeale and Kilrush soils. It occurs on ridges and hills of Upper Carboniferous shales and sandstones in the area not aTected by the Weichsel glaciation where the landscape, originally mature, has been subject to solifluction, leaving the hills bare of drift: the soil is formed from colluvium and weathered rock. In this county it always occurs below 500 feet (152 m).

The soil is moderately well drained with shaly clay loam texture. A slight clay increase occurs in the B horizon: the C hori/on may be slightly mottled. pH values are low to medium.

Soil Suitability: These soils have a moderate to wide use-range. Strong winds, weak structure and moderate drainage are limiting factors but because of the predominance of poorly-drained soils in the area they are commonly tilled, although more suited to grass production. In forestry only maritime conifers are suitable.

Profile description and analyses—Appendix II. Table 12.

Wcterpcrk Series

This series occupies over 0.05°„ (400 acres; 162 hectares) of the county. It is very similar to the Elton Series but is derived from drift of calcareous Carboniferous shales which occur in thick beds in the limestone. The soil occurs below 300 feet (91 m) in drumlin and kame and kettle morainic topography.

The soils are well drained and shaly loam in texture but with a weak structure. They are normally less than 3 feet (1 m) deep over shale. pH values are high.

Soil Suitability: Because of their weak structure these soils have a somewhat limited use-range and are only moderately suitable for tillage. They are excellent for pasture, however, except for the danger of poaching. Forestry should also be successful on these soils.

Profile description and analysis—Appendix II, Table 13.

Grey-Brown Podzclic Group

The development of these soils, like that of brown podzolics and podzols. is associated with a leaching process; in this case the principal constituent accumulated in the B horizon is the finely divided clay fraction. To be classified as a grey-brown podzolic, a soil must have a B horizon significantly higher in clay content than either the A or C horizons: it is then termed a textural B or Bt horizon. The occurrence of clay skins on the structural ped surfaces within the Bt horizon is a further characteristic. These soils usually have a proportion of limestone in the parent materials.

In general, the grey-brown podzolic soils possess a somewhat 'heavier' texture than the brown earth group: they are well to moderately well drained, possess a moderately well or well-developed structure and are usually moderately acid to neutral in reaction. The organic matter content in the surface is medium to high and the humus, like that of the brown earths and brown podzolic soils, is of the desirable mull-type.

Under Irish climatic conditions the 'lighter' textured members of the grey-brown podzolic group are good all-purpose soils comparable with the brown earths. When adequately manured and managed they are very productive under most agricultural enterprises. The 'heavier' textured members do not compare favourably with the brown earths in this regard but are suitable grassland soils, responding well to good manurial and management practices. The somewhat weak structure of these soils in County Clare limits their use-range especially for cultivated cropping. For the same reason, successful pasture farming demands a particularly high standard of grazing management. The grey-brown podzolic soils are not generally available for afforestation but should be highly productive for this purpose.

*Elton Series**

This series occupies 6.04% (47,040 acres: 19,037 hectares) of the county and predominates where the limestone drift contains a proportion of non-calcareous material such as sandstone, shale or volcanics (Appendix III). In almost pure limestone drift it occurs less frequently and develops only in certain situations such as drift-filled inter-drumlin hollows. It also occurs on kame and kettle topography and on ground and recessional moraines. The series is associated with the Patrickswell and Ballincurra Series in dry situations and with the Howardstown and Camoge Series and peat in poorly-drained areas. Topography varies from flat to rolling with slopes of up to 15 : altitude is less than 1,000 feet (305 m). The soil is classified as a minimal grey-brown podzolic since the clay increase in the Bt horizon seldom exceeds 2 to 3 %,

The soils are well drained and are generally gravelly loam in texture but may vary to sandy loam or sandy clay loam. The Al horizon is normally 8 to 18 inches (20 to 46 cm) deep and dark yellowish-brown in colour. An A2 or B2ir horizon sometimes overlies the B2t horizon which may be 10 to 20 inches (25 to 51 cm) thick. Coatings on some of the vertical structural cracks and occasional clay skins on the finer peds are evidence of clay movement down the profile. pH values are high despite the leaching. Roots are abundant; structure is weak.

Soil Suitability: These soils have a wide use-range. They have a very high potential for grass production and normally can be grazed over a long season. With good management a stocking rate of one cow-equivalent per acre is attainable. To exploit their true potential, however, management must be of a high order because of their somewhat weak surface structure. Despite good drainage, soil water-holding properties would dispose these soils to poaching and surface compaction if stocked during wet periods. High yields of cultivated crops including cereals, roots and vegetables can be obtained but lodging of cereals occurs frequently. Due to structure deterioration under tillage a short rotation is essential. Most forest species should be successful on these soils.

Profile description and analyses—Appendix II, Table 14.

Kilf\.nora Series

This series covers 0.52°$_0$ (4,040 acres; 1,635 hectares) of the county and occurs in the north-west near the boundary between the limestone and Carboniferous shales. The parent material is mixed drift derived from these rocks (Appendix III). Altitude ranges from 100 to 600 feet (30 to 183 m). Topography is chiefly drumlin but may consist of kame and kettle or it may be flat to very gently rolling.

The soils are moderately well drained with surface textures of gravelly clay to gravelly clay loam. A textural B horizon, 12 to 15 inches (30 to 38 cm) thick, and often gravelly, occurs at about 10 inches (25 cm). Soil depth is generally 2 to 3 feet (0.6 to I m). The C horizon is often slightly mottled. Roots are abundant in the surface but seldom penetrate below the Bt horizon. The structure is rather weak. pH values are medium to high.

Soil Suitability: These soils have a somewhat limited use-range. While suitable for tillage in a carefully controlled rotation, their prime use is in grassland, but poaching may be a problem owing to the weak structure and moderate drainage. Strong winds

* See Appendix IV.

Plate 3: Sheep grazing on the Kilftnora Series which has its most suitable use in grassland

from the Atlantic generally preclude forestry, but in sheltered situations a number of species can be grown.

Profile description and analyses—Appendix II. Table 15.

*Patrickswell Series**

This series occupies 2.27% (17,640 acres; 7,139 hectares) of the county and occurs over limestone glacial drift (Appendix III) along the north-south corridor from Crusheen to Shannon Airport and also sporadically in the Burren. It is associated on the landscape with the other series derived from limestone such as Kilcolgan. Howardstown, Baggotstown, Elton and Kinvarra. The topography is generally drumlin type and varies from flat to steeply rolling; the series also occurs on ground and recessional moraines. The altitude is less than 500 feet (152 m).

These soils are well drained, of loam texture, and of high pH status. Soil depth varies from 18 to 25 inches (46 to 64 cm) and structure is generally weak. The profile is characterised by an increase in clay content in the Bt horizon.

Soil Suitability: This soil has a wide use-range and is suitable for tillage or pasture but the structure, though more stable than that of the Elton, will deteriorate under cultivation. Available water-holding capacity is high and soil drainage is good.

* See Appendix IV.

Poaching damage is sometimes evident and there is a constant need to avoid topsoil compaction in intensive grazing management. Nevertheless, a stocking rate of one cow-equivalent per acre is attainable. These soils are also suitable for most forest species.

Profile description and analyses—Appendix II, Table 16.

Patrickswell Series—Bouldery Phase

This phase is similar to the series except for the presence of many boulders: it covers 0.48 °n (3.7(0 acres; 1,522 hectares) of the county.

Patrickswell Si lies—Lithic Phase

This phase is derived from shallow limestone drift and directly overlies limestone bedrock. It occupies 0.08% (640 acres: 259 hectares) of the county and is associated with soils of the Burren-Ballincurra Complex. It occurs at altitudes of less than 300 feet (91 m) on level to gently sloping topography. The soils are well drained.

Soil Suitability: In rock-free areas the potential use-range is similar to that of Patrickswell Series but where the roc'; outcrops it is similar to that of Ballincurra. despite the greater depth of soil between the outcrops. Excellent grass yields can be attained on these soils.

Profile description and analyses—Appendix II, Table 17.

Patrickswell Podzol Vcriant

This variant occurs frequently throughout the area south and south-west of the Slieve Aughties and also sporadically throughout drumlin swarms in the limestone lowland from Feakle to Crusheen: in most places it occupies less than 1 acre (0.4047 hectare). Its occurrence may be due to an increase of sandstone in the drift; in a stone count taken in one pit, sandstone content equalled that of weathered limestone (Appendix III). The elevation is between 100 to 400 feet (30 to 122 m) and the soil is associated with the Kinvarra, Kilcolgan, Patrickswell and Elton Series.

This shallow soil is strongly leached and of relatively low pH status in the surface; drainage is excessive. The soils have a dark-brown Al horizon above a grey A2 horizon which in turn overlies an ironpan and a B2ir horizon. Roots are mostly confined to the Al horizon.

Profile description and analyses—Appendix II, Table 18.

Brown Podzolic Group

The brown podzolics are a more intensely leached version of the brown earths and. as a result, the upper horizons are more depleted of bases and other constituents. A characteristic feature of these soils is a sub-surface horizon of strong red-brown or yellowish-brown colour due to enrichment, principally by iron oxides leached from the upper horizons. They are more degraded generally and of a more acid nature than the brown earths.

Although the brown podzolics are more leached and of lower natural nutrient status than the brown earths, they closely resemble each other in behaviour and productive capacity. On account of their desirable texture, structure, drainage and friability, the brown podzolics are considered highly suitable for cultivated cropping, except where they occur on steep slopes. Although lacking in natural nutrient and lime status, they respond well to manurial amendments. Highly productive short-term leys can be obtained within the crop rotation, when manuring and management are satisfactory. Like the brown earths, they are ideal forest soils, under Irish climatic conditions.

*Cooga Series**

This series occupies 1.26% (9,800 acres: 3,966 hectares) of the county. The parent material is mostly fluvio-glacial materials of Cld Red Sandstone, shale and limestone but occasionally may be glacial till. The soils occur on ground moraines, kame and kettle moraines and deltaic materials.

The texture is mostly sandy loam and the soils are excessively drained; colours are generally dark yellowish-brown. The profile is characterised by a B2ir horizon at approximately 16 inches (41 cm). Structure is fine crumb in the topsoil but changes to sub-angular blocky and below the B horizon becomes single grain. pH values are medium to low.

Soil Suitability: These soils have a somewhat limited use-range. Their chief limitations are lack of sufficient moisture due to excessive drainage and rather light texture; they are easily tilled but their weakly-developed structure and drought hazard limit their use for tillage. They can carry stock for a long grazing season, and with good management a high stocking rate is attainable. These soils are very suited to the normal range of forest species.

Profile description and analyses—Appendix II, Table 19.

Coogj Podzol Variant

This variant is derived from glacial melt-water material and occurs on the deltas formed by the ice sheets south of the Cratloe Hills. These deposits are composed of Old Red Sandstone with Silurian shale and occasionally limestone and granite also. The soil which is a podzol occurs in situations where it has been undisturbed for centuries. It is of little agricultural importance but it occurrence would indicate that the series itself, at least in parts, was formerly a podzol which constant cultivation has altered to a brown pod^olic soil.

Profile description and analysis—Appendix II. Table 20.

*Doonglara Series**

This series occupies 0.29% (2.2 0 acres; 907 hectares) of the county and is closely associated on the landscape with the Knockaceol and Seefin Series. It is found on the lower slopes of the Cratloe Hills in the south and of the Slieve Aughties in the north. Parent material consists of Old Red Sandstone bedrock or drift of Old Red Sandstone origin with some shale. Topography is mostly rolling.

These soils possess many of the profile features of a true podzol but the surface horizons in many instances have been modified by cultural practices. As a result, the original A horizons have been homogenised but the lower portion of the old leached A2 horizon is still obvious in some places; in the field they resemble the brown pod colics in many features and have been so classified. The A2 horizon is found mostly in the upper part of the altitude range. The soil is well to excessively drained and is characterised by an iron-enriched gravelly sandy loam to loam B horizon, 9 to 18 inches (23 to 46 cm) thick. Textures are gravelly sandy loam. Structure is fine crumb in the surface and becomes sub-angular blocky with depth. pH values are low but become higher in the subsoil.

Soil Suitability: These soils have a somewhat limited use-range. Except on the higher altitudes and steeper slopes, which in many instances limit the use-range, they can be devoted to tillage crops with considerable success. They are also capable of

* See Appendix IV.

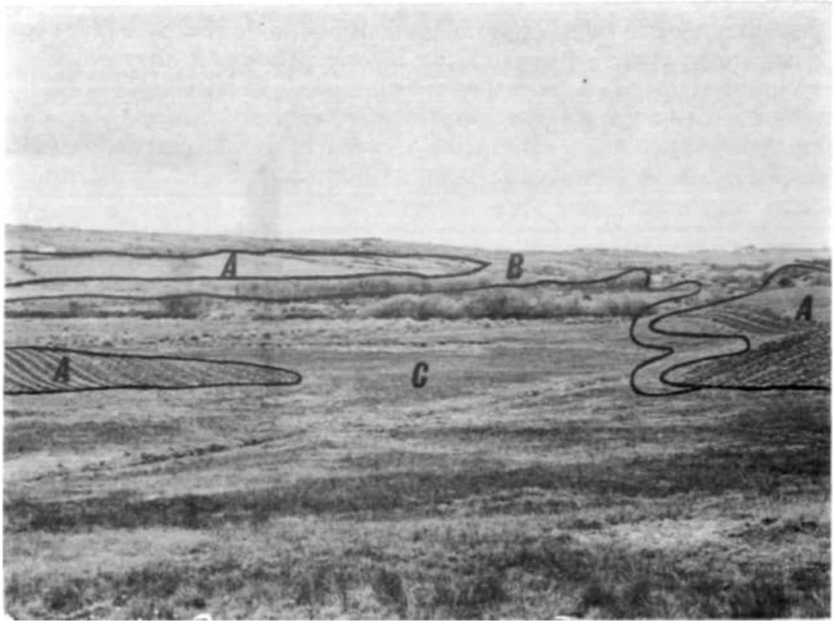


Plate 4: The well-drained Mountcollins soils (A)are suit ble for cultivation; B — Kilrush Series and C=peat

relatively high production under pasture, but at present many of the pastures are of very inferior quality and output is low. The soils can withstand quite intensive stocking without risk of poaching: this prolongs the grazing season and enhances pasture utilisation. These soils are very suitable for the normal range of forest species.

Profile description and analyses—Appendix II, Table 21.

*Mountcollins Series**

This series occupies 3.30% (25,680 acres; 10,393 hectares) of the county. The soil is well drained and is of considerable local importance due to its o:currence among peats and such poorly-drained soils as the Kilrush and Abbeyfeale Series.

It occurs in west Clare on rock, colluvium and glacial drift and on outwash materials of the Upper Carboniferous shales and sandstones. Most of the drift is of Weichsel age but a few areas are of Saale age. It occurs in kame and kettle topography especially along the terminal moraine of the Weichsel ice sheet, on some drumlins, and in the ice-scoured ridges of the Upper Carboniferous formations south of Killadysert. Altitude is below 600 feet (183 m).

Textures vary from shaly clay loam to shaly sandy loam. Below an AI horizon, 7 to 9 inches (18 to 23 cm) deep, the soils have an iron-enriched strong brown B horizon 3 to 6 inches (8 to 15 cm) thick. Structure is moderately strong and the root system is extensive throughout the profile. pH values are medium.

Soil Suitability: These soils have a wide use-range and are suitable for most tillage crops and for pasture. Vegetables, can be grown successfully where the elevation does not exceed about 500 feet (152 m): above this level rainfall and cloud cover are somewhat excessive.

* See Appendix IV.

For pasture production the Mountcollins soils have a decided advantage in certain respects over those of the Abbeyfeale and Kilrush Series since they provide growth earlier in spring and later in autumn and are less prone to poaching. A high stocking intensity is attainable but pastures, where neglected, tend to revert very rapidly to inferior swards and to become colonised by bracken and gorse. The soils are generally suited to forestry but windthrow from Atlantic gales is a problem in exposed situations.

Profile description and analyses—Appendix II. Table 22.

Mountcollins Lithosolic Variant

This lithosol occurs in many places over the Upper Carboniferous shales and sandstones but its extent is so limited that it has not been mapped. It occurs as a member of the Mountcollins-Kilrush Complex south-west of Killadysert and also on the various hills throughout the Upper Carboniferous formations. It is associated with Tullig in the west and with Kilfergus and Mountcollins Series on steeper topography in the east. Altitude varies from 100 to 2,000 feet (30 to 610 m). The soil is usually less than 12 inches (30 cm) deep and is liable to drought; its use-range is restricted to grazing.

Profile description and analyses—Appendix II, Table 23.

Podzol Group

These soils are more intensely leached than the brown podzolics. They display well-defined horizons of depletion and accumulation within the profile and are considered to be degraded soils. They either develop from parent materials of very low base reserve or under conditions which deplete the base reserves to a low level. The Old Red Sandstone hills, for instance, provide a situation in which both of these factors operate: with the acid nature of the geological parent materials, together with the high rainfall, considerable leaching of soil constituents, principally bases, iron and aluminium oxides and humus takes place. In more advanced deterioration the surface becomes very acid, the environment for decomposition by micro-organisms becomes unfavourable and a peat-like layer accumulates on the surface on which heath-type vegetation develops.

Podzols are generally poor soils with high lime and fertiliser requirements. In their unreclaimed state they usually have a cover of semi-natural vegetation. In lowland areas they have been successfully reclaimed for cultivated cropping and other purposes but unless management is good they revert easily. The more extreme forms, which occupy hill and mountain areas throughout the county, have not been ameliorated to any e tent. In most cases the nature of the terrain associated with these soils is such that mechanical reclamation and cultivation are not feasible. Here they are devoted mostly to rough gra7ing or forestry. Considerable improvement in stock-carrying capacity is possible by surface regeneration of the rough grazing through manuring and improved management.

Where an ironpan occurs within the profile it hinders root penetration (an important factor in forestry and in the agricultural use of these soils) and water percolation. For the latter reason, drainage in the surface horizon may be very poor—a further unfavourable feature of many of the podzols. These soils are usually very deficient in certain trace elements.

Podzols are the most widely available mineral soils for affoiestation in the country and are usually planted with pines *(Pinus* spp.). However, with deep ploughing and the application of phosphorus fertiliser in particular, they can support other species such as Sitka spruce *(Picea sitchensis)* with relative success.

*Knockaceoi Series**

This series occupies 0.26 ",, (2.000 acres; 809 hectares) of the county on the slopes of the Slieve Bernaghs, Slieve Aughties and Cratloe Hills, and is derived from colluvium. rock and glacial drift of Old Red Sandstone. It is closely associated with the Seefin and Doonglara Series and with peat (see Fig. 3), and less closely with the Puckane and Gortaclareen Series. In places, the soils have been transformed into the Doonglara Series by mi\ing of the A horizon during cultivation. The topography is hilly, almost mountainous in places, with frequent slopes too steep even for peat formation. In County Clare this soil occurs at around 500 feet (152 m).

The soils are well to excessively drained and ma> bhov\ the ejects of drought after a relatively short dry period. Textures are sandy loam to loamy sand; structure is weak crumb. A leached A2 horizon of variable depth overlies a B2ir horizon in the profile. The bedrock may consist of massive sandstone beds or of discrete sandstone boulders. pH values are low.

Soil Suitability: Due to their impoverished nature, the general elevations at which they occur, and the steep slopes, these soils have a very limited use-range. Application of lime and fertilisers is generally difficult due to the nature of the terrain. Consequently they are not normally suitable for tillage. Their best agricultural use is in pasture.

The swards are of extremely low quality but a significant increase in stock-carrying capacity could be achieved where liming and manuring are practicable. Spruce, larch and Scots pine are the most suitable forest species below 500 feet (152 m) and spruce and Contorta pine above this elevation.

Profile description and analyses—Appendix II. Table 24.

Knockaceol Series—Bouldery Phase

This phase occupies 0.17°,, (1,360 acres; 550 hectares) of the county. The soils are similar to those of the series in profile characteristics and use-range, differing only in the abundance of boulders present.

Knockcnattin Series

This series covers 0.10°o (760 acres; 308 hectares) of the county. It is derived from glacial drift of Old Red Sandstone composition (Appendix III) and is found on excessively-drained kames and es'ers of the last glaciation around Whitegate and Lough Atorick and also over exposures of Old Red Sandstone on Slieve Aughty. The series is associated with the Puckane and Gortaclareen Series and their peaty phases. The topography is generally rolling to steeply rolling and altitude ranges from 100 to 1.600 feet (30 to 488 m).

The soils are well to c cessively drained, gravelly clay loams to gravelly sandy loams with moderate structure in the surface. The leached, almost structureless A2 horizon, 2 to 6 inches (5 to 15 cm) thick, overlies an iron-enriched B horizon which is frequently streaked with humus and shows an increase in clay content. On occasions, the humus may be deposited above the Bir horizon. Roots are plentiful in the Al but die out in the A2 horizon. pH values are low to medium.

Soil Suitability: These soils have a limited use-range due partly to their occurrence in small isolated enclaves which are surrounded by poorly-drained soils and partly to high elevation and attendant climatic drawbacks. They are mostly suitable for extensive

* See Appendix IV.

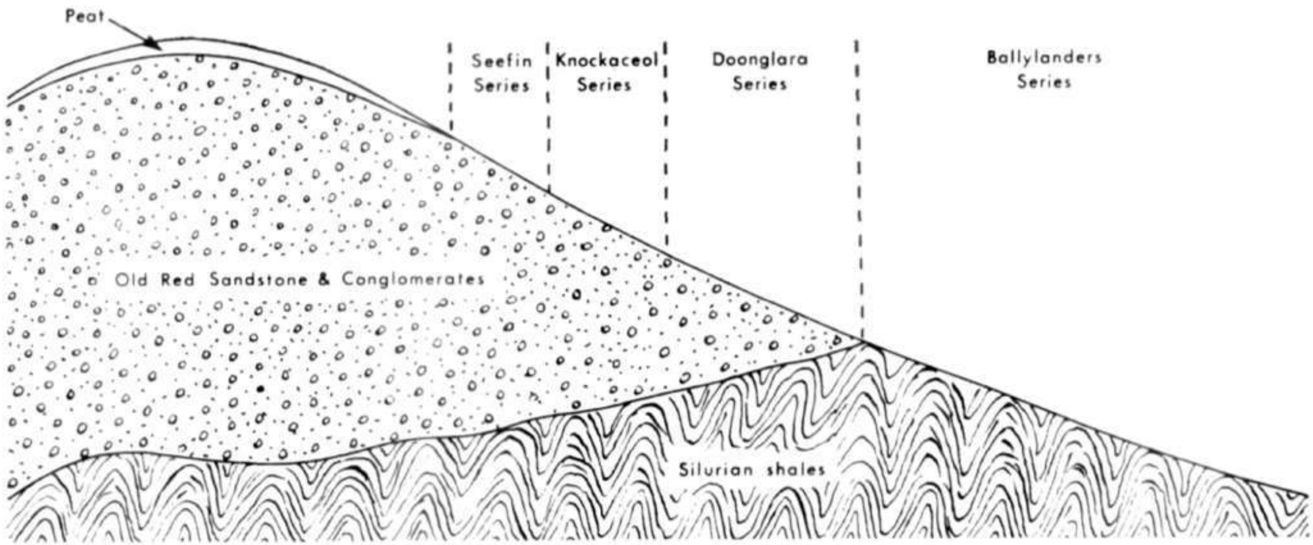


Fig. 3: Position of Knockaceol Series in relation to relief and elevation

grazing. In forestry, spruce, larch and Scots pine are the most suitable species below 500 feet (152 m) and spruce and Contorta pine above this elevation.

Profile description and analyses—Appendix II. Table 25.

Knockanattin Series—Peaty Phase

This phase occurs in small areas, mostly in the Slieve Aughties near Whitegate and has not been mapped separately. It has a surface horizon of peat of variable depth over the mineral soil but is otherwise similar to the series.

Soil Suitability: The use-range is limited to extensive grazing or forestr\.

Profile description and analysis—AppendU II. Table 26.

*Knockanimaha Series**

This series occupies 0.23% (1,800 acres; 729 hectares) of the county and occurs in close association with the Abbeyfeale Series throughout the west Clare hill region. It is found at the higher elevations on rolling relief and variable slopes (2 to 20) of the small scarp faces prevalent in this area. The soils are mainly derived from the Upper Carboniferous shale and grit bedrock and from colluvium derived from these rocks. In places sandstone influence gives rise to sandy textures.

The textures are generally gravelly or shaly loams or silt loams. The profile is characterised by a distinct A2 horizon usually overlying a thin ironpan and a di Tuse, iron-enriched horizon. Occasionally the ironpan is impermeable, resulting in impeded drainage and mottling of the overlying horizons and in root restriction. Where the soils have been cultivated, only parts of the ironpan remain and the profile is well drained throughout with roots penetrating freely. Localised pockets of the peaty phase have been noted on the gentle slopes but were not mapped at the scale employed. pH values are low.

Soil Suitability: These soils have a very limited use-range. Because of the acid parent material and the relatively cold, wet conditions prevailing at such altitudes, the soils have been leached and base depleted. The difficulty of applying lime and fertilisers adds to the problem of improving these soils. They are mainly suitable for extensive grazing and a considerable increase in stock-carrying capacity can be expected where manuring and some overseeding of the sward are practicable. Suitable forest species are limited to spruce, larch and Scots pine below 500 feet and to spruce and Contorta pine above this elevation.

Profile description and analyses—Appendix II. Table 27.

Knockanimpaha Humus B Variant

This variant occurs close to the west coast, from Quilty to Loop Head on hills subjected to sea spray from the Atlantic storms. This has probably intensified the downward movement of humates; hence the presence of a Bh horizon in the profile which is not found inland in the same series. The areas were too small to map.

Profile description and analyses—Appendix II, Table 28.

*Knockastanna Series**

This series covers 0.21 % (1,640 acres; 664 hectares) of the county. It occurs in the Slieve Bernaghs and Slieve Aughty mountains and is developed from Silurian shale bedrock, colluvium and glacial drift which also contains a small amount of Old Red

*See Appendix IV.

Sandstone. The topography is gently rolling to moderately steep and the soils are found above 700 feet (213 m). They are associated with the peaty phase of the series and with the Aughty Series. Slopes are mostly around 10 .

The soils are well drained and vary in the Al horizon from an organic shaly clay loam to loam: texture becomes coarse and shaly with depth. Below a brown Al horizon, 3 to 8 inches (8 to 20 cm) thick, there is a leached brownish-grey A2 horizon of the same thickness and below this a brown Bir horizon of variable thickness. Structure is generally weak crumb in the surface horizon; leaching is pronounced and pH values are low. Roots are mostly confined to the Al horizon.

Soil Suitability: These soils have an extremely limited use-range due to the steep topography and high rainfall. The ironpan restricts roots and, to some extent, water movement. Nutrient levels are very low and the difficulty of applying lime and manures adds to the problem of improvement. Arable cropping on these soils is just feasible and, where practised, tends to induce soil erosion.

The soils are mainly suitable for extensive grazing and with good management the stocking rate could be increased considerably. Spruce and Contorta pine are the most suitable forest species.

Profile description and analysis—Appendix II. Table 29.

Knockastanna Series—Peaty Phase

This phase is the most widespread component of the series, occupying 0.32 % (2,520 acres, 1,020 hectares) of the county. It occurs at higher altitudes than the non-peaty soil. It is generally above normal cultivation limits and is wetter owing to the

Plate 5: Normal landscape positions of Ballylanders (C) end Knockastanna Series (A) B=Shallow Rocky Ballylanders

higher rainfall. The presence of an ironpan causes gleying in the A2 horizon. The soil is imperfectly drained; textures below the surface layers of peat are clay loams to shaly loams. The ironpan generally occurs beneath the A2 horizon at about 20 inches (50 cm) depth. pH values are low.

Soil Suitability: The use-range is very limited and is confined to extensive grazing. Forest trees can be successfully established in the exposed upper reaches of the mountains but the growth rate is generally slow.

Profile description and analysis—Appendix II. Table 30.

*Seefin Scries**

This series occupies 0.04",, (280 acres; 113 hectares) of the county and occurs on Slieve Bernagh and the Slieve Aughties where the blanket peat of the higher elevations thins out giving a shallow surface peat or peaty horizon over podzolised mineral soils. It is associated with the Aughty Series and the peaty phases of the Puckane and Sellernaun Series. Elevation is between 500 and 1,000 feet (152 to 305 m) and the soil is derived from Old Red Sandstone bedrock and colluvium of almost pure sandstone composition. The land-form and topography occupied by this series consist principally of valley and mountain sides of fairly gentle slopes. (In this area where the depth of the peat layer exceeds 12 inches (30 cm), the soil has been classified as the Aughty Series (Blanket Bog) irrespective of the nature of the underlying mineral profile.)

The soil is coarse-textured with a peat or peaty sandy loam surface horizon and is moderately well drained; frequently the Al horizon is absent as in the modal profile described. An A2 horizon overlies an ironpan which is permeable in places but which generally prevents root penetration. An iron-enriched B horizon with a well-developed structure occurs below the ironpan. The C horizon overlies solid or shattered bedrock. The depths and thicknesses of these horizons are highly variable: pH values are low.

Soil Suit, bility: The use-range of these soils is very limited. High elevation, inaccessability. a peaty surface, together with the very low lime and nutrient status and in some cases ironpan development in the profile are the main limiting factors. They are not suitable for tillage: their best agricultural use is in grazing. Spruce is the most suitable forest species on these soils.

Profile description and analyses—Appendix II. Table 31.

Gley Group

Gleys are soils in which the ejects of drainage impedance dominate and which have developed under conditions of permanent or intermittent water-logging. The impeded condition may be caused by a high water-table, or by a 'perched' water-table due to the relatively impervious nature of the soils and their parent materials and, in some places, by both of these factors, together with excess run-oTfrom higher slopes. For these reasons, gley soils can occur both in depressions and on elevated sites.

Where the gley condition results from a high water-table the soils are referred to as ground-water gleys. Where it is due to the impermeable nature of the soils or of their parent material, or to run-olT from higher slopes, the soils are usually referred to as surface-water gleys.

*** See Appendix IV.**

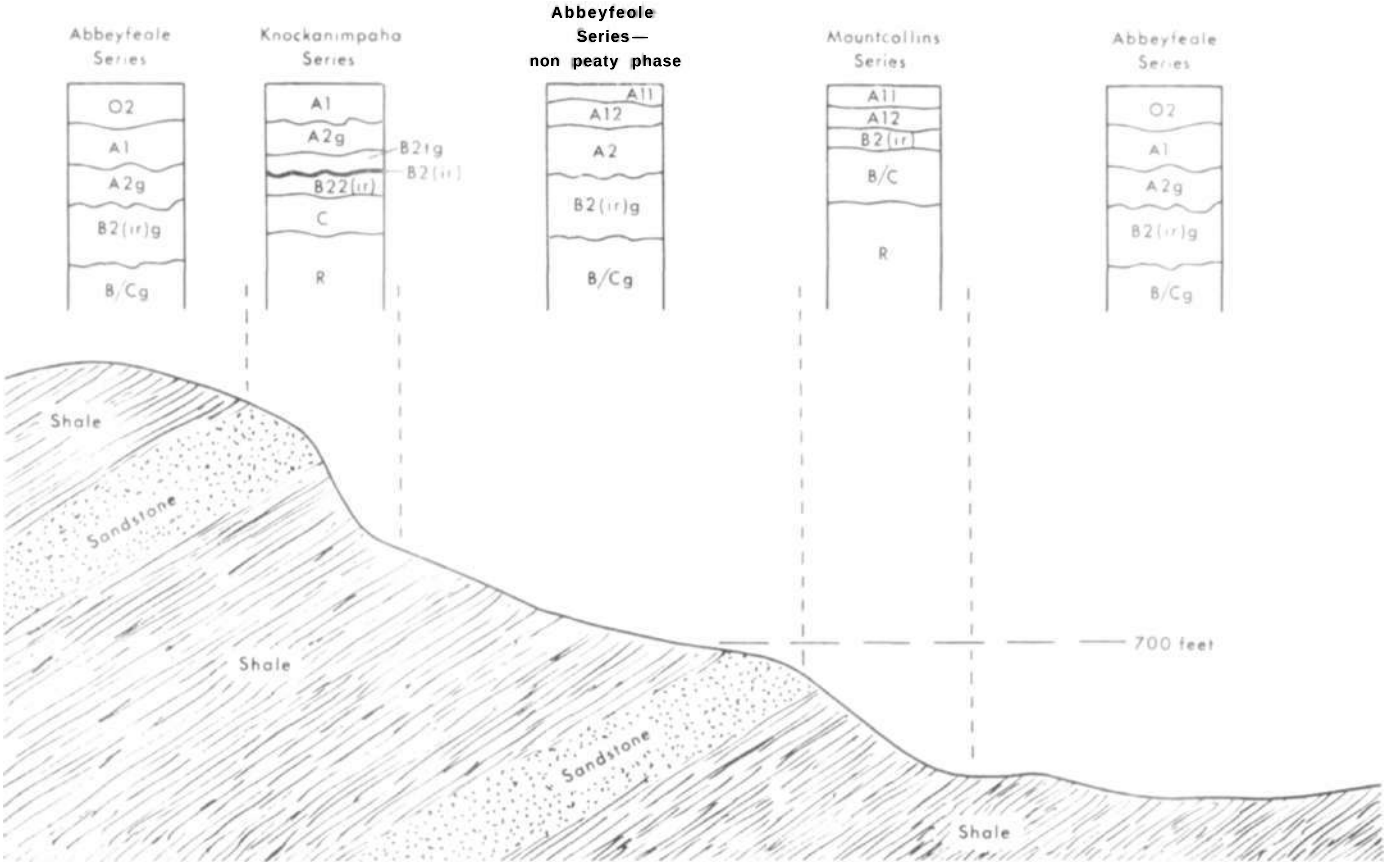


Fig. 4: Abbeyfeale and associated soils in relation to topography and geology (vertical s v/

The mineral horizons of gleys are usually grey (or bluish-grey, in more extreme cases) vt ith distinct ochreous mottling much in evidence. Relative to the podzolic soil groups, depletion of bases and other constituents is not so pronounced. Usually, however, rooting area is limited, aeration poor, rate of decomposition of organic matter slow and many other unfavourable features prevail.

Podzolised gleys are soils in which there is evidence of a soil formation process similar to that described for brown podzolics or podzols associated with gleying. Podzolic gleys refer to soils displaying evidence of grey-brown podzolic characteristics associated with gleying.

The majority of gley soils have weak structure, are not friable, and in the wet state tend to become very sticky. Due to their poor physical properties these soils, except in very favourable seasons, present difficulties in cultivation especially in the development of a desirable tilth. The poor drainage conditions retard growth in the spring. Even for pasture production this is a decided disadvantage. Besides poor drainage, the characteristic weak structure renders these soils susceptible to poaching damage by grazing stock, a factor which curtails the length of grazing season and the proportion of sward utilised. Despite their physical short-comings, however, the potential of these soils for pasture production is high in many cases, provided management and manuring are satisfactory.

Gleys are generally considered to be relatively productive forest soils. However, windthrow caused by poor root penetration is a common hazard. Many could have much greater yields if drained and manured.

Abbeyfeale Series

This series is found over the Upper Carboniferous shales and sandstones which include the Millstone Grit, Coal Measures and the Upper Avonian shales (Appendix III). It is associated on the landscape with the Kilrush, Tullig and Knockanimpaha Series principally in the Loop Head peninsula. Several phases of this series have been distinguished (Fig. 4).

Normal Phase (peaty)

This phase occurs extensively in County Limerick* but in Clare it occurs only in small isolated enclaves and has not been mapped. This soil is poorly drained, with a low base status and a surface accumulation of peaty material which varies from 0 to 9 inches (0 to 23 cm) in depth. The mineral profile has weak structure and sticky to plastic consistence throughout. The relatively high silt content of the lower horizons and their weak structure are mainly responsible for the poor drainage. Available water-holding capacity of these soils is very high. Although the effects of gleying predominate, podzolisation is also evident in the profile in the presence of a leached A2 and a depositional B horizon. Roots are well developed in the surface and are plentiful down to the A2 horizon.

Soil Suitability: The poor drainage and peaty surface limit the use-range of these soils to grass production. For forestry they are well suited to spruce.

Profile description and analysis—Appendix II, Table 32.

Abbey feale Series—N on-Peaty Phased

Where the peat cover has been removed from the soils they are classified as the non-

*See 'Soils of County Limerick' by T. F. Finch and P. Ryan, An Foras Taluntais.

|See Appendix IV.

peaty phase of the Series. In County Clare the non-peaty p'.iase oily was extensive enough to map. It occurs mostly in west Clare and covers 1.33% (10,320 acres: 4,177 hectares) of the county. The drift is mostly of Saale age but tie series may also be found on Weichsel-age drift. The land forms consist of long, smooth shale hills with a few areas of steeper slopes.

The soils are poorly drained; textures in the surface are loam but generally change to silty loam or silty clay loam with depth. pH values are medium :o low. Roots are mostly confined to the Al 1 and A12 horizons.

Soil Suitability: This soil has a limited use-range. The extensive occurrence of rushes in the pastures, even on slopes, reflects the slow permeability o'the soil. Because of the low micropore space and slow permeability, tile drainage could only produce a marginal improvement in drainage and aeration; mole drains are urlikely to last long due to the high silt and fine sand content of the subsoil.

The slow permeability of the sub-soil results in the topsoil remaining waterlogged for much of the year. This causes shallow rooting of the sward species and leads to the development of an organic surface horizon. This soil is very subject to poaching if grazed intensively in wet coadkions.

These soils are not suited to tillage. Spruce is the most suitable forest species.

Profile description and analyses—Appendix II. Table 33.

Abbeyfeale Series—Sandy Phase

This phase is influenced by wind-blown sands and occupies 0.09'„ (720 acres: 29! hectares) of the county. The soils are slightly podzolised and are underlain by the C horizon of the Abbeyfeale Series.

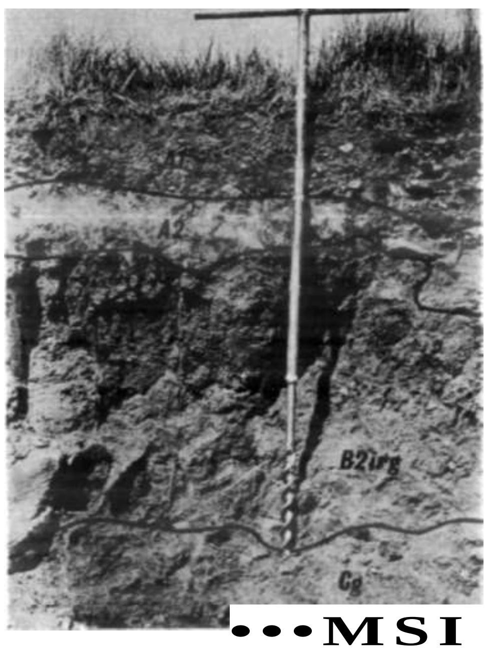


Plate 6: Profile of the Abbeyfeale non-Peaty Phase

Soil Suitability: These soils have a limited use-range. At present, they are used for grass production. The sandy nature of the soil ensures rapid surface drainage and early growth in spring but lack of shelter from the prevailing winds precludes more intensive agriculture or horticulture.

Profile description and analyses—Appendix II. Table 34.

Abbeyfeale Humus B Variant

This is distinguished from the series by the presence of a marked humic-stained B horizon in the profile which is apparently due to humus coatings on the ped faces. Analysis of a bulk sample, however, does not show an increase in carbon content in this horizon. This movement of organic matter may be due to sodium in the rainwater as the soil occurs along the coast from Quilty southwards.

The soil is similar to the Abbeyfeale Series in its physical characteristics and is limited to the same use-range as the non-Peaty Phase.

Profile description and analyses—Appendix II. Table 35.

Attyquin Series

This series occurs only as a member of the Attyquin-Howardstown Complex and has not been separately mapped. The soil was formed in lake basins which have now been drained; originally they carried a peat cover which was later partially removed for fuel. The parent material is dominantly limestone glacial drift but the soils also occur on fluvio-glacial materials; topography is flat.

The soils are poorly drained and textures are variable but mostly range from loam to gravelly sandy loam. The structure in the surface is moderate crumb which becomes sub-angular blocky to massive with depth. Roots are limited to the 02 and Al horizons. pH values are high.

Soil Suitability: These soils are subject to flooding and have an extremely limited use-range, being suitable only for summer grazing.

Profile description and analysis—Appendix II, Table 36.

*Gortaclareen Series**

This series occupies 5.08°„ (39,520 acres; 15,994 hectares) of the county. Parent material is mixed drift of Old Red Sandstone, Silurian shale and Carboniferous limestone composition (Appendix III). The relief is highly variable ranging from rolling to level. Altitude ranges from sea-level to 1,600 feet (488 m). The series is closely associated with the Puckane Peaty Phase and other soils derived from sandstone parent material. Frequently the pattern of occurrence of these soils is too intricate to map at the scale employed.

The texture is variable and ranges from gravelly clay loam to loam and gravelly sandy clay loam. The soils are poorly drained and mottled from 6 to 9 inches below the surface; the mottles rapidly become distinct to prominent with depth. The structure is weak, fine crumb grading towards massive in the B horizon. Roots are mostly confined to the Al horizon. pH values are medium.

Soil Suitability: These soils have a limited use-range. Though of somewhat 'lighter' texture and better drainage in the surface than most of the other gleys, their poor subsoil drainage and weak structure luriit their use to grassland. Physical analyses indicate that mole drainage should be successful on these soils but poaching would be a serious

***See Appendix IV.**

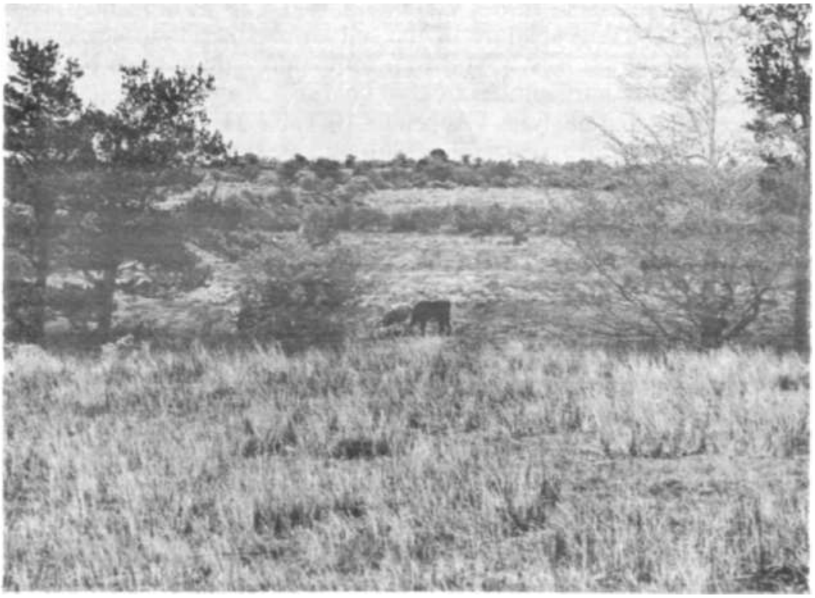


Plate 7: Lcnd-use on the Gortcclareen Series is restricted due to drainage problems

problem if pastures were grazed intensively. Rather surprisingly, available water-holding capacity is low and pasture production could be limited by drought in a dry season. Forestry has proved successful with trees such as Sitka and Norway spruce and a considerable acreage is now being planted in the Slieve Bernaghs and Slieve Aughties.

Profile description and analyses—Appendix II, Table 37.

*Howardstown Series**

This series is widespread over limestone, principally in the Gort-Ennis-Shannon Airport corridor and occupies 0.41 % (3,160 acres; 1,279 hectares) of the county. It is found in hollows between the drumlins and is derived from limestone drift and colluvium.

Textures vary from loams to gravelly loams on colluvium and from loams to clay loams on the drift; clay content increases in the Bt horizon. Drainage is poor and colours are grey in the sub-surface; roots are mostly confined to the A horizon. pH values are high.

Soil Suitability: These soils have a limited use-range and are suited only to grass or forestry. Because of their heavy retentive nature, poaching is a problem. Spruce is the most suitable species for forestry.

Profile dscription and analyses—Appendix II, Table 38.

Howardstown Humus B Variant

This variant has been found on a number of ridge tops in the Burren Hills and is of extremely limited extent. The parent material is mostly colluvium on limestone bed-rock with a little limestone glacial drift. The land form is mountainous but the soil

*See Appendix IV.

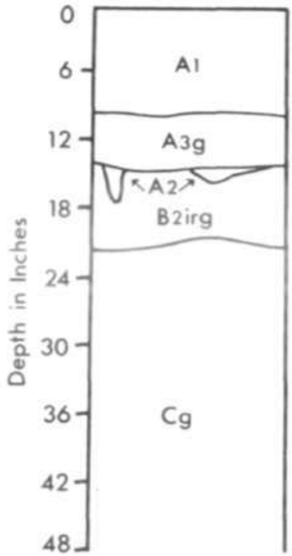


Fig. 5: Diagrammatic representation of profile from the man-made varicnt of Kilrush Series

occurs in hollows on the broad ridge tops at altitudes approaching 900 feet (274 m). The profile is characterised by an accumulation of humus just above the bedrock. Humus movement may have been accentuated by sodium from the rainwater.

Soil Suitability: The use-range of this variant is very similar to that of the series.

Profile description and analyses—Appendix II, Table 39.

*Kilrush Series**

This series covers 19.48",, (151,680 acres; 61,385 hectares) and is the most wide-spread soil in the county. It occurs over the Upper Carboniferous shales and sand-stones and till derived from these (Appendix III). It occurs principally in south-west Clare in the area affected by the last glaciation but may also occur on glacial deposits of Saale age. Areas of peat occur throughout its extent. Topography varies from rolling to flat and altitude from 1,000 feet (300 m) to sea-level.

These soils are poorly drained with a clay content of 40 to 60%. Because of their heavy texture and weak structure, permeability is slow; consistency is plastic and sticky below a friable Al horizon. pH values are medium.

Unlike the gleys of the Abbeyfeale Series, these soils show no evidence of podzolisa-tion by way of a leached A2 and depositional B horizon. It is mainly on account of these and related features that they have been distinguished from the Abbeyfeale Series.

Soil Suitability: These soils have a limited use-range and land-use is confined to grassland or to forestry. The present vegetation consists of poor rush and sedge-dominated swards. For forestry, spruce is the most suitable species in places sheltered from the full blast of the westerly winds.

Profile description and analyses—Appendix II, Table 40.

'See Appendix IV.

***Plate 8: Contrast** between good anil had grassland management **on the Puckane** Series*

Kilrush Man-Made Variant

This variant occurs in the Loop Head peninsula but segregation was not possible at the scale of mapping employed. It is generally similar to the Kilrush Series but is distinguished by the presence of remnants of the deeper tongues of an A2 horizon (Fig. 5). The silt content is also higher than in the series but the use-range is broadly similar.

Profile description and analysis—Appendix II, Table 41.

Puckane Series*

This series occupies 2.12°,, (16,480 acres; 6,669 hectares) of the county. The soils are closely associated on the landscape with those of the Gortaclareen Series and with many of the soils derived from sandstone and mixed sandstone-limestone drift. They are formed from deep till of both Saale and Weichsel age, the composition of which consists of Old Red Sandstone with variable amounts of Silurian shales and Carboniferous limestone (Appendix III). Where the proportion of limestone increases markedly, the alkaline phase of Puckane develops. The topography associated with the soil is variable and slopes of up to 10° may occur in places but it is frequently flat. It occurs on drumlins at less than 100 feet (30 m) elevation and extends up to 1,600 feet (488 m) on the Slieve Bernaghs.

These soils are poorly drained. Despite their sandy-loam texture, the weak structure causes marked gleying at 16 to 18 inches (41 to 46 cm) depth. The brown Al horizon, from 5 to 10 inches (13 to 25 cm) thick, overlies a leached A2 horizon approximately 6 inches (15 cm) thick, below which the soil grades towards a gleyed B horizon marked with red and brown mottles. pH values are generally low. Roots, while plentiful at the

•See Appendix IV.

surface, become scarce with depth and below 16 inches (41 cm) only the rush roots survive. These soils are very liable to have perched water-tables due to their poor structure. They are of variable depth ranging from 3 to 6 feet (1 to 2 m).

Soil Suitability: These soils have a limited use-range; their optimum agricultural use is in grass production or forestry. At present most pastures are dominated by poor grasses, rushes and weeds, but drainage, liming and manuring would greatly increase output. Spruce is the most suitable forest species.

Profile description and analyses—Appendix II, Table 42.

Puckane Series—Peaty Phase

This phase covers 0.28 % (2,200 acres; 890 hectares) of the county and occurs in association with the Puckane and Gortaclareen Series. Parent material is Old Red Sandstone drift, generally with some impurities. The soil is similar to the normal phase except for the cover of acid peat. In County Limerick, because of a somewhat lower content of organic matter in the surface, this soil was described as a slightly peaty phase.

Soil Suitability: The land-use is limited to extensive grazing or to forestry under spruce.

Profile description and analysis—Appendix II, Table 43.

Puckane Series—Alkaline Parent Material Phase

This phase occupies 0.48% (3,760 acres; 1,521 hectares) of the county. The soils are similar to the series except for the higher pH values in the lower horizons and the more calcareous nature of the parent drift (Appendix III). It occurs in several small areas intermingled with the series.

So/7 *Suitability:* Suitability is similar to that of the series.

Profile description and analyses—Appendix II, Table 44.

Sellernaun Series

This series covers only a small area and occupies 0.01 % (80 acres; 32 hectares) of the county. It occurs in association with the Puckane and Gortaclareen Series in enclaves generally less than one acre in extent. The altitude range is from 100 feet to 1,500 feet (30 to 457 m). Parent material is predominantly Old Red Sandstone drift with up to 20% Silurian shale impurities and with occasional fragments of limestone.

The soils, though coarse in texture, are poorly drained. Gleying commences at about 16 inches (41 cm) depth. Podzolisation is evident from the A2 horizon and an accumulation of humus in the B2hg horizon. pH values are low.

So/7 *Suitability:* The use-range of this soil is limited to extensive grazing or forestry. Where it occurs below 500 feet (152 m), spruce would be the most suitable forest species; above this altitude spruce and Contorta pine would be more successful.

Profile description and analyses—Appendix II, Table 45.

Sellernaun Peaty Variant

This variant occurs throughout the Slieve Aughties at varying altitudes. However, its occurrence is sporadic and nowhere of great extent. The topography is normally gently rolling to flattish. The profile is generally similar to that of the series except for the surface layer of peat.

Soil Suitability: These soils have a very limited use-range and are suitable only for forestry or extensive grazing.

Profile description and analysis—Appendix II, Table 46.

Sellernaun Alkaline Parent Material Variant

This variant is confined to the area between Feakle, Tulla, Broadford and Bodyke and has not been mapped on the half-inch scale. Higher pH values (due to the higher proportion of limestone in the parent material) and a slight accumulation of free iron below about 20 inches (50 cm) depth distinguish it from the normal phase.

So/7 *Suitability:* The use-range of this variant is also limited to forestry or extensive grazing.

Profile description and analyses—Appendix II, Table 47.

Rendzina Group

These are shallow soils usually not more than 20 inches (50 cm) deep, derived from parent material containing over 40 to 50% carbonates. The surface horizon is dark in colour with a moderately strong structure and neutral to alkaline reaction. A calcareous (B) horizon may be present. Drainage is always free to excessive.

Where they are sufficiently deep, rendzinas are suitable for tillage and pasture but in many places lack of soil depth precludes tillage. These soils are excellent for winter pasturage.

Burren Series

This series covers 9.6% (74,760 acres; 30,256 hectares) of the county and has been subdivided into rocky phases on the basis of less than 25%, less than 50% and less than 75% rock. Parent material is limestone rock. The topography may vary from flat to steep. Organic-matter content ranges from 20 to 40 %. Texture is clay loam and the

Plate 9: Typical view of the Burren Series

structure is a strong crumb; the soils are well to excessively drained, friable and of high pH status. Root development is excellent but the soil is never more than 9 inches (23 cm) deep.

Soil Suitability: The use-range of these soils is severely limited by their shallowness and by the amount of rock exposed. They are suited mostly to extensive grazing. Poaching is not a problem because of strong structure and good drainage: the soils therefore are very suitable for outwintering stock. They are not generally suited to forestry.

Profile description and analyses—Appendix II, Table 48.

*Burr en Series—Deeper Phase**

This phase occupies 0.05% (360 acres; 146 hectares) of the county and usually occurs intimately associated with the Ballincurra Series. Although deeper than the series its usual depth is less than 10 inches (25 cm). The relief, in general, is undulating and elevations vary from near sea-level to 500 feet (152 m) but occasionally the soils may occur on flat relief or on steep slopes.

The deeper phase and the rocky phases have been separated because of their different land-use potentials. In some places the deeper phase has been planted with Scots pine and larch and has sufficient soil depth for more intensive grazing and some hand cultivation. These deeper, excessively drained soils of organic, clay loam texture have high pH values. The profile is characterised by a dark-brown A horizon, with moderate crumb structure, overlying limestone rock which outcrops frequently. Roots are abundant.

Soil Suitability: These soils have a very limited use-range: due to shallow soil depth and frequent rock outcrops, tillage on a conventional i>asis is not practicable. The agricultural use of the soils is confined mainly to grazing. Over-wintering of stock is common. Forestry is not generally feasible.

Profile description and analysis—Appendix II, Table 49.

A note on the flora of the Burren

The Burren is a fine example of limestone karst scenery and has for long been 'a place of pilgrimage' for naturalists.

Pollen analyses have shown that there was a complete cover of pine, with subsidiary hazel and yew, on the Burren during the Boreal and Atlantic periods.[1] Today woodland is rare but patches of hazel are fairly widespread. There is evidence of human settlement in the area for at least 4,000 years.

The Burren is most colourful in May and June when *Gentian? verna, Dryas ottopetals* , *Geranium sanguineu.n. Saxifrcga hypnoicles. Fot.ntillu fruticosa* and *Helianth-*emum *canum* are flowering.

The numerous parallel fissures dissecting the soil-free limestone pavement harbour an abundant and diverse flora consisting mostly of fragmentary patches of limestone grassland (shallow crevices) or a woodland ground flora (deep crevices) or perhaps fen plants in crevices with ground-water influence. There are no special plants whose occurrence is confined to the limestone crevices, all of them occur as components of other vegetation in the vicinity.

*This soil was mapped in Co. Limerick as Rineanna Series..

'This note was contributed by Dr. A. M. O'Sullivan, An Foras Tallintais.

[1] Watts (unpubl.) quoted in Ivimey-Cook, R. B. and Proctor, M. C. F. (1966). The plant communities of the Burren, Co. Clare. *Proc. R. Ir. Acad.* 64B, 15:211-301.

Plate 10: Limestone** pavement within the Barren Series (75% **rock)

The Burren is best known for its phytogeographical diversity. It is possible to find such alpine plants as *Dryas, Gentiana* and *Euphrasia salisburgensis* commingling'with **southern species like *Neotinea intacta* and *Adianthum eapillus-veneris.***

Kilcolgan Series

This series is found over limestone glacial drift (Appendix III) throughout the Burren and occupies 1.85% (14,360 acres; 5,812 hectares) of the county. It occurs in association with the Kinvarra and Burren Series. Altitude varies from sea-!evel to 1,000 feet (305 m), and the soil is mostly found on drumlins but also occurs on areas of flatter drift; topography is rolling to gently rolling.

These soils are shallow and well drained. The textures vary between clay loam and gravelly sandy clay loam and the structure is moderately strong. Roots are abundant and pH values high.

Soil Suitability: These soils have a wide use-range and are well suited to tillage or grass production. With increased fertiliser-use their potential is very high despite their shallowness, but a slightly low water-holding capacity may lead to drought in very dry seasons. Due to the shallow soil and the relatively high pH] values, hardwoods are the most suitable forest species.

Profile description and analyses—Appendix II, Table 50.

Kilcolgan Series—Bouldery Phase

This phase is similar to the series except for the presence of many boulders. It occupies 0.96% (7,440 acres: 3,011 hectares) of the county.

Lithosol Group

This group consists of skeletal, stony soils (often of an organic nature) overlying, in most cases, solid or shattered bedrock. Generally, such areas have frequent rock outcrops. They are most often associated with podzols and climatic peats at the higher elevations. Their use-range is limited to rough grazing, or occasionally to forestry.

*Carrigogunnel Series**

This series occurs as small inclusions within the Derk Series and has not been mapped. The soils are derived from felsitic ash and are shallow, being generally less than 12 inches (30 cm) deep. Topography varies but is generally steep. Textures are gravelly sandy clay loam or sandy loam and drainage is excessive. Structure is moderately strong and roots are abundant. pH values are medium to high.

Soil Suitability: These soils have a very limited use-range because of their shallowness and are suited only to extensive grazing.

Profile description and analyses—Appendix II. Table 51.

*Slievereagh Series**

This series occupies only 0.01 % (80 acres; 32 hectares) of the county and occurs along the crests of the Old Red Sandstone ridges and also on rock outcrops on the hillsides.

The soil generally has a peaty surface layer overlying an A1 horizon with a sandy loam texture. Structure is very weak and drainage excessive; pH values are low.

Soil Suitability: The use-range of this soil is extremely limited and is confined to extensive grazing.

Profile description and analyses—Appendix II, Table 52.

Regosol Group

This group comprises mineral soils which are immature and show no distinct horizon development. The soils occur mostly in lowlying flat areas along river courses and at river estuaries, but they are also found on young deposits such as aeolian (windblown) sands. Depending on the source of the deposits such soils may vary in nutrient status and also in physical and drainage characteristics.

Seafield Series

This series occupies 0.16% (1,240 acres; 502 hectares) of the county, and consists of stabilised sand-dunes which occur on the north coast near Ballyvaughan and in other localities along the coast from Milltown Malbay to Kilkee.

The soil is excessively drained due to the sandy textures; free calcium carbonate occurs throughout the profile. The soil is grey in colour. Topography varies but usually consists of rolling sand-dunes; altitudes are below 50 feet (15 m).

Soil Suitability: These soils have a very limited use-range due to their texture, the prevalence of strong salt-laden winds and the high concentrations of free calcium carbonate even in surface horizons. They are suitable only for extensive grazing.

Profile description and analysis—Appendix II, Table 53.

•Occurs more extensively in Co. Limerick: see Appendix IV.

Alluvial Soils

These soils are derived from alluvial deposits which can be divided broadly into two major types, fresh-water and marine. The fresh-water type is sub-divided into lake and river alluvium. The material laid down by rivers is usually found in the vicinity of existing stream and river courses whilst lacustrine deposits occur in landscape depressions, originally the sites of glacial or post-glacial lakes. River and lake alluvium are usually related in their composition to the geological formations in their vicinity.

Most of these alluvial soils are very immature and show little or no profile development. They are differentiated on the basis of such factors as origin and composition of parent material, texture and drainage. The latter frequently vary even within individual series giving rise to phases which are too small in extent to map.

The use-range of these soils is generally limited.

*Ccmoge Series (river alluvium)**

This series is of limited extent and comprises 0.01 % (80 acres; 32 hectares) of the county. It is formed in interdrumlin flats from alluvium which is derived from limestone drift with some sandstone and shale.

Being of alluvial origin, soil texture varies from horizon to horizon and is generally coarser than in the same series in County Limerick. Gravel generally occurs at about 14 inches (36 cm) depth. The soil is poorly drained because of the high water-table, and structure is weak: pH values are high below the surface.

Soil Suitability: These soils have a very limited use-range. They are very poorly suited to tillage and only moderately to poorly suited to grassland. In forestry. Norway spruce should be most successful.

Profile description and analysis—Appendix II, Table 54.

*Feale Series (river alluvium)**

This series occurs in south-west Clare and along the Fergus valley from Kilfenora to Corofin and occupies 0.25"(1 (1.920 acres; 777 hectares) of the county. Parent material consists of Upper Carboniferous shales and sandstones with a small proportion of limestone.

Soil depth varies from 6 to 48 inches (15 to 122 cm). The soil has a high water-table and is poorly drained; textures are generally silty. Mottling occurs below about 4 to 10 inches (10 to 25 cm) and roots are confined to the surface horizons. Structure in the surface is weak sub-angular blocky and becomes massive in the C horizon.

Soil Suitability: Because of flooding this soil can be used only for grassland or perhaps forestry under Norway spruce.

Profile description and analyses—Appendix II, Table 55.

Glenomra Series (river alluvium)

This series covers 0.26% (2,000 acres; 809 hectares) of the county and occurs to the south of the Slieve Bernagh massif. The alluvial parent material is derived principally from Silurian shale with some Old Red Sandstone. These soils are confined to below 200 feet (60 m) and are subject to flooding.

The drainage is variable depending on proximity to the river; textures vary from gravelly sand to gravelly clay depending upon the proximity to the stream which laid

*See Appendix IV.

down the alluvium. The AI horizon, from 3 to 6 inches (8 to 15 cm) in depth, directly overlies the C horizon. Structure is weak to moderate crumb in the Al and becomes weak sub-angular blocky and sometimes structureless in the C horizon. Roots are well developed above the C2 horizon.

Soil Suitability: This series has a limited use-range due to the occasional floods and is suited only to grass production or forestry under Norway spruce.

Profile description and analysis—Appendix II, Table 56.

Kilgorey Series {river alluvium)

This series covers 0.06 $^{0}_{o}$ (440 acres: I 78 hectares) of the county and occupies many small areas throughout the drumlins south of the Slieve Aughties and Woodcock Hill. The alluvial parent material is chiefly derived from sandstone with local limestone and a little shale.

Drainage is poor due to the high water-table: textures are largely sand to sandy loam, but the profile is highly variable in texture. Below a dark-coloured Al horizon, 12 inches (30 cm) thick, the soil is stratified and the strata differ considerably in texture, pH values and free iron contents. On occasions a little mottling stands out in the predominantly grey soil.

Soil Suitability: This soil has a limited use-range. Flash flooding is a problem and grass production is the most suitable farming enterprise.

Profile description and analysis—Appendix II, Table 57.

Rathborney Series (river alluvium)

These soils are of limited extent and cover only 0.03 "t, (240 acres; 97 hectares) *of* the county. They are found principally in the Burren district and are associated on the landscape with the Kilcolgan. Kinvarra and Patrickswell soils. Parent material is alluvium derived from shales and sandstones laid down in places where the subterranean rivers in the limestone emerge in the valley bottoms or through the limestone at higher elevations. The topography is variable but this soil always occurs on an alluvial flat. The soils are poorly drained; texture varies but is usually silty clay, silty clay loam or silt loam; structure is fine crumb. The surface Al horizon is usually from 6 to 11 inches (15 to 28 cm) deep. The C horizons may be massive but are generally sub-angular blocky in structure and brown to light yellowish-brown in colour. Roots are abundant but. in some areas of temporary high water-table levels, they may be confined to the surface horizon. pH values are high.

Soil Suitability: This soil has a limited use-range, being suited only to grazing in the summer months or perhaps to forestry under Norway spruce.

Profile description and analyses—Appendix II. Table 58.

*Dromhanny Series (lake alluvium)**

This series covers 0.25% (1.920 acres: 777 hectares) of the county. It occurs mostly in the lower Fergus valley where the river forms a series of lakes. Deepening of the river has exposed extensive areas of lake alluvium from the vicinity of Crusheen to as far south as Ennis. The Drombanny Series is formed from this lake alluvium.

The soils are poorly drained and of clay, clay loam and silty clay texture: the percentage of silt increases proportionately with the content of the Upper Carboniferous shales and sandstones fh the parent material. Roots are well developed

* See Appendix IV.

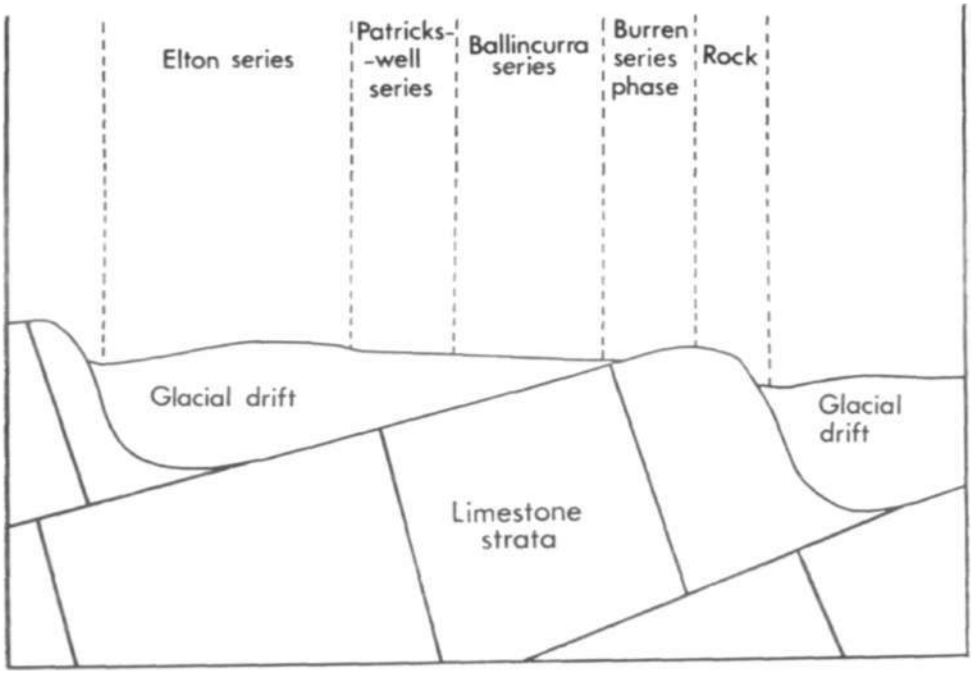


Fig. 6: Diagrammatic representation of the Burrcn-Ballincurra Complex in relation to landscape features c ml g. ology

above the water-table but do not extend below it. pH values are high. Organic carbon increases to 20°„ at about 14 inches (36 cm). The CI horizon shows an enrichment with calcium carbonate when it occurs below the lake level, and skeletons of fresh water snails are numerous in this horizon. The vegetation is normally poor grassland frequently infested with soft rush *(Juncus effusus).*

Soil Suitability: These soils have a very limited use-range and are suited only to grass production or perhaps to forestry under Norway spruce. Flooding is a major hazard.

Profile description and analyses—Appendix II. Table 59.

*Shannon Series (estuarine alluvium)**

This series occupies 1.89°„ (14.680 acres; 5,941 hectares) of the county. It occurs at or below spring-tide level but has been embanked and drained by a system of dykes and sluices so that the water-table is controlled. Only after heavy and prolonged rainfall is the water-table liable to rise into the soil. The parent material is estuarine alluvium containing some sea-shells.

The soils are very poorly drained and are classified as gleys. Textures are silt loam to silty clay loams. In some cases, as in the modal profile, there is an increase in clay content below the A horizon. The soils are friable in the Al horizon but become sticky

*** See Appendix IV.**

and plastic with depth. pH values are high.

Soil Suitability: These soils have a limited use-range and are suited mostly to grass production or forestry under Norway spruce.

Profile description and analyses—Appendix II. Table 60.

Complexes

Attyquin-Howardstown Complex

This complex covers some 0.43 % (3,320 acres; 1,344 hectares) of the county and is composed both of poorly drained (Howardstown and Attyquin Series) and well-drained soils (Kilcolgan and Kinvarra Series). The characteristics and use-range of these soils have already been discussed. The complex occurs to the north of Crusheen and extends eastwards as far as Tulla and westwards to the Burren Hills; in places, lakes with peat growing in them are prevalent; many of these have become filled-in or drained in the course of time and the peat on them cut for fuel.

Soil Suitability: The soils of this complex have a very limited use-range owing to the dominance of the poorly drained components. The only land-use possible is summer grazing or forestry under spruce.

Profile descriptions and analyses—Appendix II, Tables 9, 36, 38, 50.

*Burren-Ballincurra Complex**

This complex occupies 2.47% (19,240 acres; 7,786 hectares) of the county. It includes soils of the Elton, Patrickswell, Ballincurra Series and Burren Deeper Phase where these occur in a pattern on the landscape too intricate to be mapped on the scale used. The soils in the complex have already been described and discussed. Elton Series occurs in the deeper hollows, Ballincurra and Patrickswell Series on the shallower parts and Burren Deeper Phase on bedrock (Fig. 6). Limestone bedroc'; outcrops frequently in this area of extremely thin drift cover. These soils alternate extremely rapidly in places even over a distance of a few metres.

Soil Suitability: The use-range of these soils is extremely limited due to the frequent occurrence of the Burren Deeper Phase, and is mostly confined to extensive grazing.

Profile and descriptions and analyses—Appendix II, Tables 2. 14, 16, 48.

Mountcollins-Kilrush Complex

This complex covers 2.38% (18,560 acres; 7,511 hectares) of the county. It is composed of both well-drained and poorly-drained soils and occurs over the Upper Carboniferous shales and sandstones. The associated well-drained soils, in order of extent, are Mountcollins, Kilfergus, Knockanimpaha Series and Mountcollins Lithic Phase; the associated poorly-drained soils, also in order of extent, are Kilrush, Abbeyfeale and blanket peat. These proportions may vary slightly in certain areas; in the north between Lisdoonvarna and Lahinch, the lithic phase does not occur and peat is scarce; in the south just west of Killadysert both are prevalent.

Soil Suitability: The use-range of these individual components has been discussed under each series. In general, because of high rainfall, the steep and broken nature of the terrain, and the intricate soil pattern, grazing is the most suitable enterprise.

Profile descriptions and analyses—Appendix II, Tables 8, 22, 23, 27, 32, 40.

* These soils were mapped in Co. Limerick as the Rineanna Complex.

Puikonc-Slievereagh Complex

This complex covers 4.0)°,, (31,840 acres; 12,886 hectares) of the cov.nty. It is found over Old Red Sandstone both in the Slieve Aughties where it is widespread, and in the Cratloe Hills. The altitude range varies from 100 to 1.000 f;et (30 to 305 m) approximately. The well-drained members of thecomple; are Slievercigh, Knockaceol. Knockanattin and Doonglara Series; Puckane and Gortaclare?n Series and peat comprise the poorly-drained components (Fig. 7). The land-forms associated with this complex are normally drumlin but may be kame and kettle. The drr.mlins and kames are usually covered with the well-drained series.

Soil Suitability: The use-range of this complex is limited to e .tensive grazing, because of the difficulty of access, the poor drainage of some of the components, the presence of blanket peat and the frequent occurrence of stones.

Profile descriptions and analyses—Appendix II, Tables 21, 24. 25, 37, 42, 52.

Peat Soils

Peats are characterised by a high content of organic matter (o.er 30%) and by being at least 1 foot in depth. Two basically different types, basin and blanket peat, occur in the country.

Basin Pea is

Peat soils which have formed in lake basins, hollows, ri/er valleys or where the sub-soil is sufficiently impermeable to give a high water-table are termed Basin Peats. Two types, fen peats and raised bog peats, were recognised in County Clare.

Fen Peats: This peat type formed under the influence of base-rich ground-water and is composed mainly of the remains of reeds, sedges and other semi-aquatic or woody plants. Variations in concentration of the component plant remains depend on the topographic situation and nutrient content of the water supply. Peat soils of this type occur in river valleys and interdrumlin hollows. They have been mapped as one group but vary somewhat in botanical composition, nutrient status and soil reaction.

Banagher Series

This series, which occurs in river valleys and interdrumlin hollo.vs in association with soils derived from limestone and Carboniferous shale, occupies 2.5% (19,480 acres; 7,884 hectares^ of the county. It was formed under the influence of a base-rich ground-water supply and the component plant remains are characteristic of minero-trophic growth conditions. Because of periodic flushing, an acid peat layer was not formed on the surface.

The profile has an organic surface horizon with well-de eloped structure and abundant roots. Mineral materials present in some places indicate that 'marling' was carried out to improve fertility. Structure disimproves with depth; roots decrease rapidly in the sub-surface horizon and the permanent water-table occurs at 28 inches (70 cm) below the surface.

Soil Suitability: These soils have a moderately wide use-range. Frost hazards and low base status are the main problems.

Profile description and analysis—Appendix II, Table 61.

Raised Bog Peat: 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

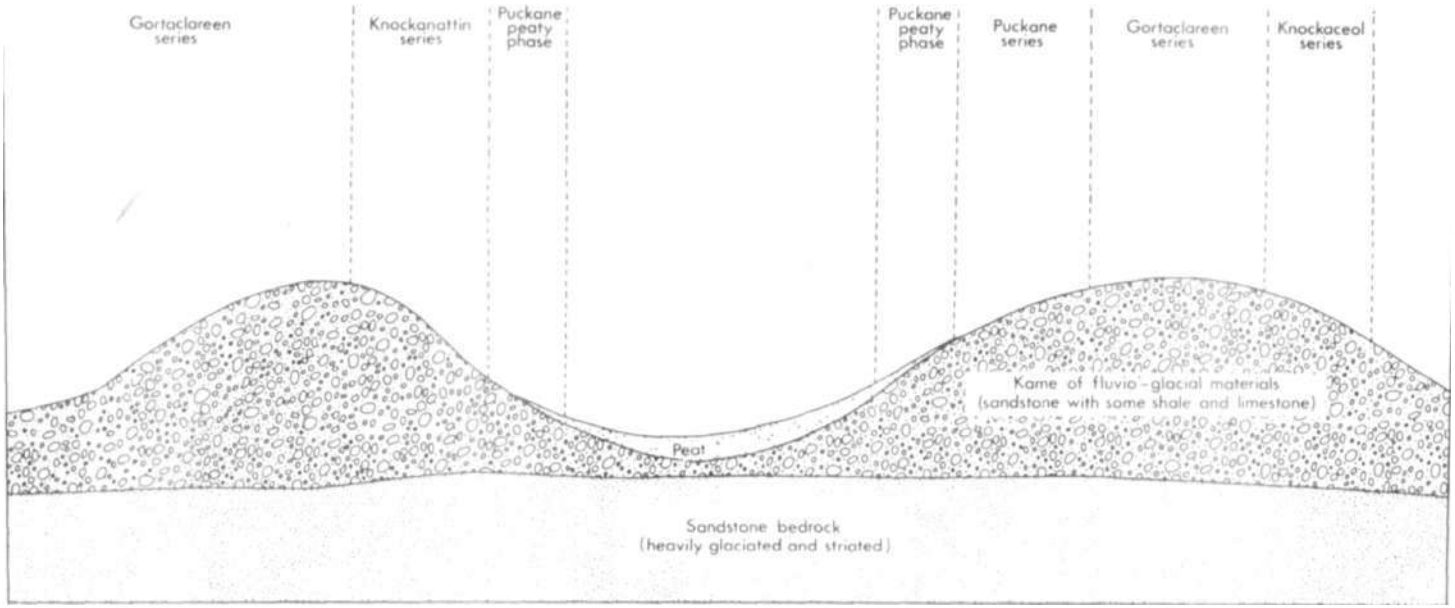


Fig. 7: Diagrammatic repre en tat ion of soil teries in relation to landscape features and % obey

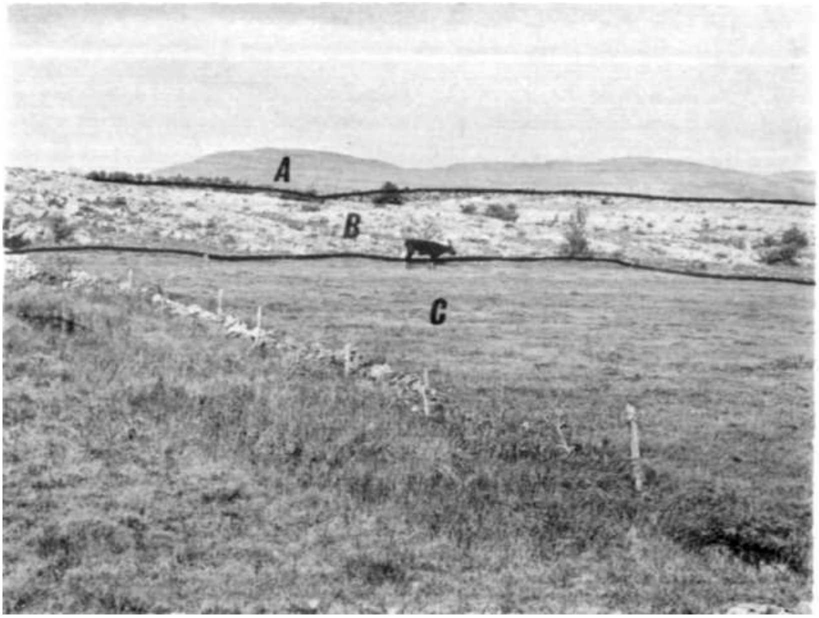


Plate 11: Banagher Series (C) within the Burr en area;
Burren Series 75% rock (A) and 50% (B)

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.

The profile usually consists of a basal layer of fen, woody fen or wood-fen peat overlain by a layer of acid ombrogenous peat characterised mainly by its high content of *Sphagnum* mosses, variable quantities of bog cotton (*Eriophorum* spp.) and ericaceous remains *(Cclluni).* In their natural state in County Clare they vary from about 10 to 32 feet (3 to 10 m) in depth and are typically acid in reaction.

Extensive areas of raised bog in County Clare have been cut-over. Usually 6 to 10 feet (2 to 3 m) of peat have been removed. The vegetation of most of these cut-over peat areas is dominated by acid-tolerant plants such as *Calluna vulgaris. Erica tetralix* and *Eriophorum* spp.

Allen Series

This series occurs in association with the Elton and Patrickswell Series in the east and with the Kilrush Series and Abbeyfeale non-Peaty Phase in the west. It occupies 0.77% (5,960 acres; 2,412 hectares) of the county. In an undisturbed state, peat depth may exceed 15 feet (5 m). The basal peat layer, which is generally highly humified and locally termed 'black peat', consists of remains of plants which grew under the influence of base-rich ground waters. This layer is overlain by a variable thickness of acid peat mostly composed of *Sphcgnum* moss remains with cyperaceous and ericaceous plant remains.

The profile is comprised of alternating layers of variably humified *Sphagnum* mosses. Fibre contents vary over short vertical distances from less than 35 % for *Sphagnum cuspidatum* peat to over 75%, for poorly-humified *Sphjgnum.* Little development of profile has taken plac^ and the soil is typical of an initial raw peat soil. The profile is wet throughout (85 to 91 % water) and, in the undrained state, the water-table is very close to the surface. At the outer edges of the raised bog, where localised drainage has been carried out to facilitate manual turf-cutting, the profile may be somewhat drier.

Soil Suitability: In their natural state, no physical 'ripening', *i.e.*, loss of water and aeration of profile, has taken place and the soils are unsuited to any type of agricultural enterprise. However, with drainage, liming and fertilising, grass production and forestry are feasible.

Profile descriptions and analyses—Appendix II. Tables 62 and 63.

Allen Series—Reclaimed Cut-over Phase

In many areas within the county, peat has been removed extensively. Where such areas have been reclaimed and used for grass production and, in some instances, for arable farming, they have been mapped as the reclaimed cut-over phase; they occupy 1.38% (10,760 acres; 0 5 5 hectares) of the county. The horizon sequence of reclaimed peats depends on the depths of peat previously removed. The well-decomposed organic surface horizon (less than 15 $°_0$ recognisable plant remains) exhibits moderately strong structure and a well-developed root system. Sand grains from sea-sand additions which were used to ameliorate strongly acid soil conditions are present. The sub-surface horizons are structureless and roots decrease rapidly with depth.

The permanent water-table occurs between 28 and 35 inches (70 to 90 cm) below the surface.

Soil Suitability: These soils have a moderately wide use-range. Frost-sensitive crops should not be planted too early because of the danger of late spring frosts. In most cases the reserves of plant nutrients are low.

Profile description and analysis—Appendix II. Table 64.

Piute 12: Cut-over peat sown to pasture with raised-hog in the background

Blanket Peat

Blanket peat accumulates under conditions of high rainfall and humidity. Such conditions prevail over much of the western part of the county and blanket peat is widespread in this region. This type also occurs extensively in the upper regions of Slieve Bernagh and Slieve Aughty due to high altitudes and associated adverse climatic conditions.

The climatic peat profile varies from 4 to 8 feet (1 to 2 m) in depth and is usually characterised by a basal layer of pine overlain by a more highly humified peat layer than that occurring in the basin peats. The degree of humification decreases towards the surface. The dominant plant remains include bog cotton *(Eriopkorum* spp.). purple moor grass *(Molin'u (ocrul?o),* black bog rush *(Si.ko.nus nigricans)* and bog asphodel *(North* (ium ossifrc gum).* In some instances variations may occur in botanical composition and nutrient status due to topographic and edaphic factors, particulaily in the basal layer where the humified peat with pine *in &itu* may be replaced in localised depressions by a peat composed mainly of reed remains.

Large areas of blanket peat have been cut-over and reclaimed, particularly in the west of the county.

Aughty Series

This series, which occurs predominantly in the more-elevated areas, occupies 8.4% (65,360 acres; 26,451 hectares) of the county. The depth varies from 16 inches (40 cm) to greater than 80 inches (2.0 m). The profile is raw in nature with no evidence of soil amelioration. The peat is relatively homogeneous throughout and is composed predominantly of cyperaceous plant remains with some *Sphcgnum* spp. embedded in a greasy humified matrix.

PI. te 13: Cut-over peat of the Aughty Scries is more suitable for cultivation the n the surrounding Kilrush Series

Soil Suitability: These soils have a very limited use-range and are only suited to grazing. Improved grass swards can be established by drainage, manuring and surface seeding.

Profile description and analysis—Appendix II. Table 65.

Aughty Series—Cut-over Phase

This phase, which occurs in association with the gleys of the Old Red Sandstone and also with those of the Carboniferous shales, occupies 6.47°„ (50,3(0 acres; 20,381 hectares) of the county. The peat has been removed to a considerable depth and the soil is relatively shallow. The surface and sub-surface horizons are very well decomposed and few of the component plants are recognisable. Structure is moderately well developed and roots are found to 18 inches (43 cm) depth. 'Marling' materials are present in the surface horizon. The peat, which is highly humified with depth, overlies a strongly gleyed, non-calcareous silty-clay sub-soil.

Soil Suitability: With drainage and manuring this soil has a high potential for grass production.

Profile description and analysis—Appendix II, Table 66.

TABLE 1: Classification of main Soil Series in County Clare into Great Soil Groups and the relative extent of each group

Great Soil Groups	Series	Percent of total area*
Brown Earths	Baggotstown, Ballynalacken, Ballincurra, Ballylanders, Derk, Kilfergus, Kinvarra, Knocknaskeha, Tullig, Waterpark	10.88
Grey Brown Podzolics	Elton, Kilfenora, Patrickswell	9.39
Brown Podzolics	Cooga, Doonglara, Mountcollins	4.85
Podzols	Knockaceol. Knockanattin, Knockanimpaha, Knockastanna, Seefin	133
Gleys	Abbeyfeale, Camoge, Drombanny, Feale, Glenomra, Gortaclareen, Howardstown, Kilrush, Puckane. Sellernaun. Shannon	31.94
Rendzinas	Burren, Kilcolgan	12.46
Lithosols	Slievereagh	0.01
Regosols	Kilgorey, Rathborney, Seafield	0.25
Peats	Allen, Aughty, Banagher	19.52
Complexes		9.37

^

•Refers to total area of County Clare minus major water and principal urban areas

TABLE 2: Classification into Great Soil Groups of soils occurring as variants in County Clare

Variant	Great Soil Grojp
Knockanimpaha—Humus B Variant	Podzol
Kinvarra—Podzol Variant	Podzol
Cooga—Podzol Variant	Podzol
Patrickswell—Podzol Variant	Podzol
Abbeyfeale—Humus B Variant	Gley
Howardstown—Humus B Variant	Gley
Kilrush—Man-made Variant	Gley
Ballylanders—Brown Podzolic Variant	Brown Podzolic
Mountcollins—Lithosolic Variant	Lithosol
Sellernaun—Alkaline Parent Material Variant	Gley
Sellernaun—Peaty Variant	Gley
Ballynalacken-Grey Variant	Brown Earth

CHAPTER III

SOIL SUITABILITY AND DRAINAGE

From the soil map it has been calculated that within the county (Table 3) 24% of the soils are good to very good for tillage, 8% are moderate and 38 °„ are poor to very poor.

Some 28% of the soils are good to very good for grassland, 7% are moderate and 35 % are poor to very poor.

Of the remainder. 20% are peats and 9%* are variable in their suitability for tillage or for grassland.

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 soils. 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 the county is confined to forestry on certain soil series and to pasture production on some series which occur in both Limerick and Clare. Therefore, the present system of soil suitability evaluation and classification is largely a qualitative, rather than a quantitative, appraisal of the potentialities of the di^erent 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, local climate, distance from the sea and factors such as accessibility, proximity to markets and consumer demands must also be ta' en 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 considerably the economics of production 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, an abundant farm labour supply no longer obtains, and its replacement by mechanisation has drastically altered the feasible cultural and management practices on many soils.

*These are the soils which, because they occur in an intricate pattern, cannot be separated into individual soil series at the present mapping s;ale, and were therefore grouped into soil complexes.

TABLE 3: Soil suitability for tillage

Suitability Class	Series	Limitations	Area		Percent of county
			Acres	Hectares	
1 Very good	Derk, Knocknaskeha, Patrickswell	No serious limitations	19,000	7,690	2.44
	Ballynalacken, Ballylanders, Doonglara, Kilfergus, Mountcollins	Some steep slopes	84,920	34,368	10.91
	Baggotstown, Cooga	Liable to drought	10,320	4,176	1.33
	Kilcolgan, Kinvarra	Shallow soil over calcareous till	28,240	11,429	3.63
2 Good	Elton, Waterpark	Weak structure	47,440	19,199	6.09
	Patrickswell Lithic Phase	Somewhat shallow soil over bedrock	640	259	0.08
3 Moderate	Ballincurra	Shallow soil over bedrock, liable to drought	1,320	534	0.17
	Kilfenora	Weak structure, moderate drainage	4,040	1,635	0.52
	Knockaceol	Weak structure, some steep slopes, low base status	2,000	809	0.26
	Knockanattin	High altitude, weak structure, some steep slopes, low base status	760	308	0.10
	Knockastanna	Exposure to Atlantic winds, weak structure, some steep slopes, low base status	1,640	664	0.21
	Gortaclareen, Howardstown	Poor drainage, weak structure, heavy texture	42,680	17,273	5.49
	Tullig	Exposure to Atlantic winds	7,280	2,946	0.94
4 Poor	Abbeyfeale non-Peaty Phase, Kilrush, Shannon	Poor drainage, weak structure, heavy texture	176,680	71,503	22.70

TABLE 3 (Continued)

	Camoge	Heavy texture, weak structure, liable to flooding	80	32	0.01
	Puckanc and Phases, Sellernaun	Poor drainage, weak structure	**22,520**	**9,112**	2.89
	Kilgorey	Liable to flooding, weak structure	**440**	**178**	0.06
	Abbeyfeale Sandy Phase	Exposure to Atlantic winds	**720**	**291**	0.09
	Drombanny	Heavy texture, weak structure, liable to flooding	**1,920**	777	**0.25**
	Kilcolgan, Kinvarra and Patrickswell Bouldcry Phases	Many boulders	14,160	5.731	1.82
	Knockaceol Bouldery Phw	Many boulders, some steep slopes, weak structure, low base status	1,360	550	0.17
	Knockanimpaha	High altitude, some steep slopes, weak structure, low base status	1,800	729	0.23
	Burren, Burren Deeper Phase, Slievereagh	Very shallow soil over bedrock, liable to drought	75,200	30,434	9.66
	Seafield	Alkalinity, exposure to Atlantic winds, trace element problems	1,240	502	**0.16**
	Knockastanna Peaty Phase. Sccfin	Exposure to Atlantic winds, weak structure, ironpan, some steep slopes, low base status, peaty surface	2,800	1.133	0.36
Variable	Attyquin-Howardstown, Burren-Ballinacurra, Mountcollins-Kilrush, Puckane-Slievereagh		72,960	29,527	9.37
Unclassified	Allen and Cut-over Phase, Aughty and Cut-over Phase, Banagher, l-cale, Glenomra, Rathborney		219,200	88,902	20.06

Suitability and Major Limitations of the Soils

The general suitability of the soils of County Clare for tillage, grassland and forestry together with their major limitations are summarised in Tables 3. 5 and 7. A number of soil series is included in each suitability class. Even with optimum manurial and management practices, certain differences in overall productive capacity persist between the soils included in each class, as a result of inherent differences between series. Nevertheless, the soils in any one class have sufficient important characteristics in common in their use and productive potential to warrant their inclusion in the same suitability class.

In drawing up the suitability classification, only the normal or dominant phase of each soil has been considered. For instance, some of the series may contain small inclusions of soils that are too shallow, too roc';y or that occur on slopes too steep for successful cultivation or management. Separate consideration of such exceptions within series is beyond the scope of this account. Besides, in any system of classification involving multiple variables, it is not possible to accommodate fully all exceptions without impairing the purpose of the classification. It must be accepted also that certain series placed in one general suitability class may be borderline to a neighbouring class.

The present suitability classification is based largely on a scale of values confined to the relative quality of the soils within the county. Therefore, some of the suitability classes established for the Clare soils may lose or gain status by reference to a national scale of suitability values.

Production Potential of Pastures on Certain Soil Series*

An experiment designed to determine the actual and potential pasture production from si *I* soil series, and the factors limiting production to its present level, was begun in 1963 and continued through 1964 and 1965. These experimental plots were in County Limerick but on soil series common to Limbicc and Clare. As climatic conditions are also sufkieutly similar th? e;p;rimeital results are applicable to County Clare.

The potential production from the indigenous sward was determined by applying high rates of nitrogen (2 cwt calcium ammonium nitrate per acre at each cutting), phosporus (8 cwt superphosphate per acre per annumK and potassium (4 cwt muriate of potash per acre per annum). Lime was applied at the rate indicated by soil analyses to all plots including the control.

All plots were grazed, but yields were measured five times from early May to late September by cutting under protective cages. The yield data provided information on the following:

i) The present production for each soil
ii) The potential production for each soil
iii) The response to fertilisers
iv) Soil factors limiting production

Data for 19(3 only are given in Table 4, but the results for 1964 and 1965 were similar. In the unfertilised state, the highest yields were on the Elton, Derk, Patrickswell and Ballylanders Series in that order: yield of grass on Elton was about double that on Howardstown and Puckane. On the fertilised plots the yield di Terence

*This section was contributed by Mr. T. Gleeson, An Foras Taliintais

TABLE 4: Grass yields and fertiliser responses for six Soil Series (1963)

Series	Yields (cwt DM per acre)[1] Complete fertiliser (NPK) Total	1st cut	5th cut	2nd, 3rd, 4th cuts	Control[2] total	Responses (cwt DM per acre)[1] Response to nitrogen	Response to phosphorus	Response to potassium	Total response to fertiliser' (NPK)
Puckane	80.0	3.6	10.8	65.6	26.2	48.4	21.5	12.6	53.8
Ballylanders	97.5	11.9	12.0	73.7	44.4	43.5	9.7	5.3	55.0
Derk	103.7	13.6	9.8	80.3	50.8	38.4	20.0	9.3	52.8
Howardstown	81.3	4.8	6.8	69.6	28.7	37.9	32.8	9.7	52.6
Elton	104.4	15.8	12.5	76.1	58.3	42.7	10.4	6.6	46.1
Patrickswell	100.3	18.2	10.3	71.9	47.0	38.9	14.0	9.9	53.3
SE	±2.4	±0.5	±0.5	14	±2.4	±4.2	•4.2	5.2	±4.6
F-test	***		***	***	***	NS		NS	NS

[1] The maximum yields obtained are approximately 100 cwt of dry matter per acre, thus all yields in the table may read as percentages of the potential yield.

[1] Lime was applied to all plots including 'Control*.

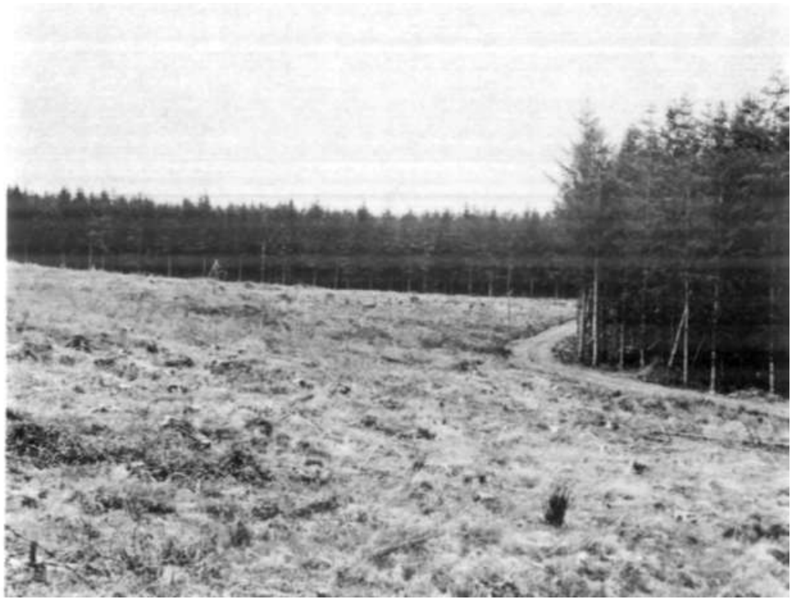
[3] The responses of N, P and K were calculated as follows: response to N Treatment NPK- Treatment PK; to P NPK-NK: and to K NPK-NP.

TABLE 5: Soil suitability for grassland,

Suitability Class	Series	Main limitations	Area: Acres	Area: Hectares	Percent of county
A Very good	Ballylanders, Ballynalacken, Derk, Doonglara, Kilfergtis, Knocknaskcha, Mountcollins, Patrickswell	No serious limitations	103,920	42,058	13.35
	Baggotstown, Cooga, Kilcolgan. Kinvarra Patrickswell Lithic Phase	Shallow soils	39,200	15,864	**5.04**
	Elton, Kilfenora, Waterpark	Weak structure	**51,480**	**20,834**	6.61
B Good	Ballincurra	Liable to drought	1,320	534	**0.17**
	Knockaceol, Knockanattin, Knock-astanna	Some steep slopes, weak structure, low base status	4,400	1,781	0.57
	Tullig	Moderate drainage, weak structure	7,280	2,946	**0.94**
	Kilcolgan, Kinvarra and Patrickswell Bouldery Phases	Many boulders	14,160	5,731	1.82
C Moderate	Gortaclareen, Howardstown	Poor drainage, weak structure	42,6X0	**17,273**	5.44
	Shannon	Weak structure, heavy texture, high water-table	**14,680**	5,941	**1.89**
	Camoge, Kilgorey	Liable to flooding	**520**	**210**	0.07
D Poor	Abbeyfeale non-Peaty Phase, Kilrush	Poor drainage, weak structure, heavy texture	**162,000**	65,562	20.,SI
	Puckane and Phases, Sellernaun	Poor drainage, weak structure	**22,520**	'Ml 2	**2.89**
	Abbeyfeale Sandy Phase-	Exposure to Atlantic winds	**720**	241	0.09

TABLE 5 (Continued)

E Very Poor	Knockastanna Peaty Phase, Seefin	Peaty surface, iron-pan, some steep slopes, weak structure, low base status	2,800	1.132	0.36
	Knockaceol Bouldery Phase	Many boulders, some steep slopes, weak structure, low base status	1,360	550	0.17
	Knockanimpaha	High altitude, weak structure, some steep slopes, low base status	1,800	729	0.23
	Sea field	Alkalinity, trace element problems, exposure to Atlantic winds	1,240	502	0.16
	Burren, Burren Deeper Phase, Slievereagh	Very shallow soil over bedrock, liable to drought	75,200	30,434	9.66
	Drombanny	Weak structure, liable to flooding	1,920	777	0.25
Variable	Attyquin-Howardstown, Burren-Ballincurra, Mountcollins-Kihush, Puckane-Slievereagh	Variable	72,960	29,527	9.37
Unclassified	Allen and Cut-over Phase. Aughty and Cut-over Phase, Banagher, Feale, Glenomra, Rathborney		219,200	88.902	20.06



PLte 14: A stand of Sitka spruce on the poorly-drained Puckane Series

persisted; drainage was the main influencing soil factor. The four well-drained soils —Elton, Derk, Ballylanders and Pat rick swell—have a production potential of approximately 100 cwt of dry matter per acre per annum, whereas the poorly drained Howardstown and Puckane Series have a potential of approximately 80 cwt. The yield difference, as might be expected, was most significant in the first and fifth cuts, *i.e.*, in spring and late autumn.

The total increase in yield due to fertilisers did not differ significantly between soil series in 1963, but in 1964 the response per acre was 10 cwt greater on the Howardstown and Puckane Series. The responses to fertiliser represent a two- to three-fold increase in production (Table 4).

Nitrogen gave the greatest increase in yield, over 40°((of the maximum yield in certain cases. Response to phosphorus was best on the gley soils, which, according to soil analysis, had the lowest phosphorus. The response to potassium was less spectacular than that to phosphorus or nitrogen on all soil series.

These results show that the different soil series do not differ widely in their potential to produce grass. The greatest difference was little more than 20% and even this difference in the case of the Puckane and Howardstown soils may be reduced by artificial drainage. However, in terms of relative management requirements in order to utilise the production fully, the difference in the economic sense would be greater than that indicated by the production data.

Forest Productivity Investigations on Selected Soil Series*

In forestry, site productivity is classified by yield classes. For each species, yield classes are determined from a top (total) height versus age relationship. Consequently

*This section was prepared by Research Officers of the Forestry Division (Research Branch), Department of Lands

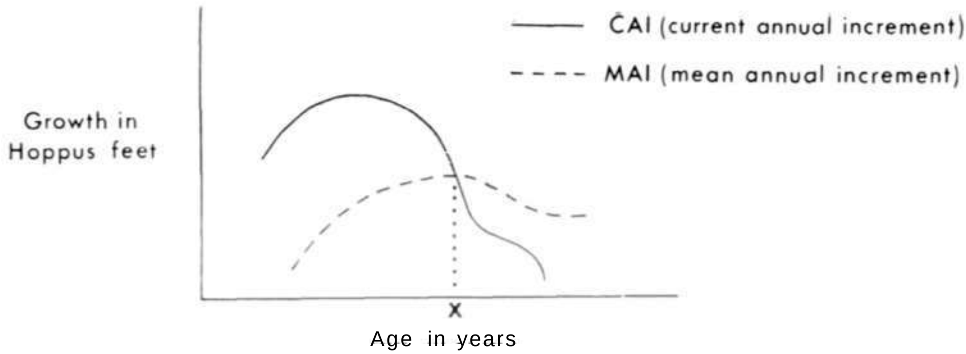


Fig. 8: *MAI (mean annual increment) and CAI (current annual increment) graphed against age and growth*

they will be influenced not only by soil conditions but also by other factors, such as, elevation, aspect and exposure, which are within the site, and provenance or origins of the seed used, which is independent of the site. Due to these factors, on any one soil series a number of yield classes will be found for a given tree species. Therefore, in preparing the tables, the yield classes for the various species were weighted by area and the weighted average yield class is shown against the species and soil series.

When a stand is rated as having a yield class of (say) 200 it means that the potential maximum mean annual volume increment is 200 Hoppus feet* per acre. The rotation age at which this production will be achieved will be different for each yield class within one species and also for the same yield class but in a different species. Figure 8 shows the relationship of mean annual increment (MAI) and of current annual increment (CAI) to age. The point at which the two graphs cross indicates both the maximum MAI and the age at which it will be achieved for the particular stand. For the stand of Figure 8 the maximum MAI which can be achieved is 200 Hoppus feet per acre and this will be reached when the crop is 69 years old.

When sustained yield management is practised, the rotation age for this stand would be 69 years and the potential maximum production would be 200 Hoppus feet per acre per annum.

Yield classes cover intervals of 20 Hoppus feet. The advantage of yield class rating as a measure of site productivity is that ratings for all species are comparable.

It should be noted that the Forestry Division's tables for Contorta pine show larger productivity gaps between the yield classes since they are converted from quality-class tables.

The maximum yield classes of the conifers discussed in Table 6 are as follows:

Sitka spruce—	280 (24.9 cubic metres/ha) and will be reached when it is standing 46 years.
Norway spruce—	240 (21.4 cubic metres/ha) and will be reached when it is standing 67 years.
Scots pine—	160 (14.2 cubic metres/ha) and will be reached when it is standing 41 years.
Contorta pine—	160 (14.2 cubic metres/ha) and will be reached when it is standing about 56 years.

* The Hoppus foot is the unit normally used in measuring the cubic content of round timber in this country. One Hoppus foot-T.273 cubic feet (true measure)

Japanese larch— 160 (14.2 cubic metres/ha) and will be reached when it is standing 41 years.

European larch— 140 (12.5 cubic metres/ha) and will be reached when it is standing 48 years.

TABLE 6: Yield class assessment for forestry (standing crops 1968) on selected soil series

Species	Ballylanders and Knockastanna		Puckane and Gortaclareen		Kilrush	
	H/feet/ac*	M^3/'ha**	H/feet/ac	M^3/ha	H feet/ac	M^3/ha
Sitka spruce	220	19.6	180	16.0	200	17.8
Norway spruce	200	17.8	200	17.8	200	17.8
Scots pine	140	12.5	120	10.7	80	7.1
Contorta pine	None planted		110	9.8	None planted	
Japanese larch	120	10.7	140	12.5	None planted	
European larch	80	7.1	120	10.7	None planted	

Species	Kilfergus		Slievereagh		Peat	
	H/feet/ac	M^3/ha	H/feet/ac	M^3/ha	H feet/ac	M^3/ha
Sitka spruce	220	19.6	200	17.8	180	16.0
Norway spruce	None planted		180	16.0	160	14.3
Scots pine	None planted		120	10.7	100	8.9
Contorta pine	None planted		None pianted		80	7.1
Japanese larch	None planted		None planted		80	7.1
European larch	None planted		None planted		None planted	

*Hoppus feet per acre
**Cubic metres per hectare

The figures given in Table 6 were taken from the data collected during the 1968 inventory of State woodlands. The yield classes for the various stands were weighted by area and the weighted average yield class is shown against species and soil series. The results have been rounded to the nearest whole yield class. Where mixtures occurred in stands, the area of the stand was divided and allocated to the two main species by their respective canopy percentages.

Classification of Soils According to Natural Drainage

Table 8 shows that 39% of the soils of the county have free internal drainage; 32% of the soils are impeded and require artificial drainage; and the remaining 29% comprise the soils of variable and unclassified drainage (mostly peats).

TABLE 7: Soil suitability for forestry

Great Soil Group	Series	Suitable species below 500 feet O.D.	Suitable species above 500 feet O.D	**11 ions**
Brown Earths	Baggotstown	Some hardwoods		Shallow soil, high pH
	Ballynalacken	All species*	Spruce and Contorta pine	Occasional steep slopes
	Ballincurra (where deeper)	Larch and Scots pine		Shallow soil on limestone bedrock
	Ballylanders	All species	Spruce and Contorta pine	Occasional steep slopes
	Derk	All sp.		
	Kilfergus	All species		Exposure near coast
	Kinvarra	Some hardwoods		Shallow soil, high pH
	Knocknaskeha	All species		
	Tullig	Maritime conifers		Exposure to Atlantic winds when near the coast
	Waterpark	All species		
Grey Brown Podzolics	Elton	All species		
	Kilfenora	All species		Exposure to Atlantic winds when near the coast
	Patrickswell	All species		
	Patrickswell Lithic Phase	All species		nine bedrock at 30 inches (75 cm)
Brown Podzolics	Cooga	All species		Drought hazard
	Doonglara	All species		
	Mountcollins	All species		Exposure to Atlantic winds when near the coast
Gleys	Puckane Alkaline Parent Material Phase	Spruce		Poor drainage, an A2 horizon
	Puckane Peaty Phase	Spruce and Contorta pine	Spruce	Poor drainage, peaty surface, an A2 horizon, low pH
	Sellernaun	Spruce	Spruce and Contorta pine	Poor drainage, an A2 horizon, low pH

TABLE 7 (Continued)

Rendzinas	Burren			Shallow soil with high pH over limestone bedrock
	Burren Deeper Phase			Shal low soil with high pH over limestone bedrock
	Kilcolgan	Some hardwoods		Shallow soil, high pH
Lithosols	Carrigogunnel			Shallow soil over bedrock
	Slievereagh			Shallow soil over bedrock
Regosols	Seafield			High pH, exposure to Atlantic winds
Alluvial Soils	Camoge	Norway spruce**		i)anger of flash floods, periodic high water-table, frost hazard
	Drombanny	Norway spruce		Danger of flash floods, periodic high water-table, frost hazard
	Feale	Norway spruce		Danger of flash floods, periodic high water-table frost hazard
	Glenomra	Norway spruce		Danger of flash floods, periodic high water-table, frost hazard
Podzols	Knockaceol	Spruce, larch and Scots pine	Spruce and Contorta pine	Steep slopes, an A2 horizon, low pH
	Knockanattin	Spruce, larch and Scots pine	Spruce and Contorta pine	Steep slopes, an A2 horizon, low pH
	Knockanattin Peaty Phase		Spruce and Contorta pine	Steep slopes, an A2 horizon, low pH, peaty surface
	Knockanimpaha	Spruce, larch and Scots pine	Spruce and Contorta pine	Steep slopes, an A2 horizon, low pH
	Knockastanna		Spruce and Contorta pine	Steep slopes, an A2 horizon, low pH
	Knockastanna Peaty Phase		Spruce and Contorta pine	Steep slopes, an A2 horizon, peaty surface, pan formation

TABLE 7 (Continued)

	Seefin		Spruce	Steep slopes, an A2 horizon, peaty surface, pan formation
Gleys	Abbey fcale	Spruce and Contorta pine	Spruce	Peaty surface, poor drainage, exposure to Atlantic winds in west
	Abbeyfeale non-Peaty Phase	Spruce	Spruce	Poor drainage, exposure to Atlantic winds in west
	Abbeyfeale Sandy Phase	Maritime conifers		Very exposed to Atlantic winds
	Attyquin			High water-table
	Gortaclareen	Spruce	Spruce	Poor drainage, low pH
	Howardstown	Spruce	Spruce	Poor drainage
	Kilrush	Spruce	Spruce	Poor drainage, exposure to Atlantic winds in west
	Puckane	Spruce	Spruce and Contorta pine	Poor drainage, an A2 horizon, low pH
	Kilgorey	Norway spruce		Poor drainage, low pH, danger of flash floods
	Rathborney	Norway spruce		Poor drainage, low pH, danger of flash floods
	Shannon	Norway spruce		Poor drainage, high pH
Peats	Banaghcr	Unclassified		
	Allen			
	Aughty			

•All species normally suitable
••Norway spruce recommended due to frost hazard

TABLE 8: Classification of the soils according to natural drainage

Natural drainage class	Conditioning Factors	Soils	Percent of total area
Excessively drained	Rapid internal drainage	Baggotstown, Cooga, Seafield	1.49
	Rapid run-off and permeability, temporary water-table on bedrock	Burren, Burren Deeper Phase, Slievereagh	9.66
Well drained	Moderate permeability, deep water-table	Ballincurra, Ballylanders, Ballynalacken, Derk, Doonglara, Elton, Kilcolgan and Bouldery Phase, Kilfergus, Kinvarra and Bouldery Phase, Knockaceol and Bouldery Phase, Knockanattin, Knocknaskeha, Knockastanna, Mountcollins, Patrickswell, and Lithic and Bouldery Phases, Waterpark	25.88
Moderately well drained	Heavy texture, deep water-table, peaty surface, iron-pan	Tullig, Kilfenora, Knockanimpaha, Seefin	1.73
Imperfectly drained	Peaty surface, iron-pan	Knockastanna Peaty Phase	0.32
Poorly drained	Slow permeability, deep water-table	Abbeyfeale non-Peaty Phase and Sandy Phase, Gortaclareen, Howardstown, Kilrush, Puckane and Alkaline Parent Material Phase and Peaty Phase, Sellernaun	29.28
	Variable permeability, seasonal high water-table	Feale, Glenomra, Kilgorey, Rathborney	0.60
	Very slow permeability, seasonal high water-table	Camoge	0.01
	Slow permeability, permanent high water-table	Drombanny	0.25
Very poorly drained	Slow permeability, permanent high water-table	Shannon	1.89
Variable		Attyquin-Howardstown Complex, Burren-Ballincurra Complex, Mountcollins-Kilrush Complex, Puckane-Slievereagh Complex	9.37
Unclassified		Allen and Cut-over Phase, Aughty and Cut-over Phase, Banagher	19.52

CHAPTER IV*

AGRICULTURAL PATTERN IN THE COUNTY

County Clare has some 14.000 agricultural holdings whose owners depend mainly on milk and store cattle production for their income. Much of the land in the county is of a heavy-textured soil type which does not readily lend itself to tillage and is best suited to grass. There are, however, limited areas where arable farming is very successful. In these districts, wheat, malting barley, feeding barley, oats and root crops are grown, but the acreage under these crops has been declining steadily during the past few years. In 1969 the total area of corn, root and green crops was 12,500 acres (5,062 hectares) while in the same year the area under hay and pasture was 550,200 acres (222,831 hectares).

There were 276,600 cattle in the county in 1969 and of these 82,000 were dairy cows. The sale of store cattle has always been a very important facet of agriculture in Clare, and in recent years there has been a change in the pattern of this enterprise. The numbers of 3-year-old cattle offered for sale have been declining while the numbers of younger animals in the 1^- to 24-year-old category have been increasing rapidly. In 1969 there were 7,900 three-year-old cattle compared with 101,300 animals aged between 1 and 3 years. The majority of store cattle are now sold through the Co-operative Marts at Ennis, Ennistymon, ScarifT and Kilrush, while the numbers on offer at local fairs are dwindling rapidly.

Dairying

The average herd size in Clare is between six and seven cows. In recent years the number of Friesians has increased considerably but the Shorthorn is still the predominant breed. The Dairy Disposal Company Ltd. operates an artificial insemination service in the county and approximately 50,000 cows were inseminated in 1969.

Clare differs to some extent from the other Munster counties in that it has only two co-operative creameries. The bulk of the milk is handled by the Dairy Disposal Company which has central creameries at ScarifT, Kilrush and Ennistymon and 35 branch creameries throughout the county.

The heavy retentive soils of Clare need a very high level of management, because of the ease with which they are poached in wet weather. Not only does poaching lead to a general deterioration of the sward but the rapid spread of rushes is also encouraged. There is not enough attention paid to the provision of adequate winter feed or to the yarding of cattle during the winter and early spring months when poaching of pastures is most likely to occur.

*This Chapter was prepared by Mr. J. Barry, B.Agr.Sc, Chief Agricultural Officer, Clare County Committee of Agriculture

Winter Feed

Hay has always been the traditional winter feed for cows. In the past, this has often been of indifferent quality but in recent years there has been a welcome improvement in the quality as a result of the increased use of lime and fertilisers and improved methods of hay-making.

Up to about 1963 the amount of silage made in the county contributed very little to winter feeding of cattle, only about 6,500 tons being made in that yeai. Since then there has been a spectacular increase each year; in 1970 the amount rose to 92,360 tons. This is a most welcome change because climatic conditions and soil type in the county make the saving of good hay a difficult and laborious job.

Sheep

Sheep farming in Clare is largely confined to the dry limestone soils of the Ballyvaughan, Corofin, Ennis and Tulla districts. In 1969 there was a total of 51,700 sheep in the county, the predominant breed being the Galway. Traditionally, lambs were kept for sale during autumn and winter and this system, for obvious reasons, often led to low returns from the enterprise. In more recent times there has been more attention paid by an increasing number of flock owners to early lamb production. Some of the more progressive breeders have obtained a nett output of £30 per acre from their flocks by use of adequate fertilisers and a proper system of management. Sheep are too often treated as scavengers to clean up pastures and to keep weeds in check. They are allowed to roam over all the farm in winter and eat out the earliest and best grasses. This system not only leads to low income from the flock but also seriously interferes with the amount of spring grazing available for other livestock. However, with the increased use of nitrogen for early grass more and more farmers have realised that this is not as serious a problem as was previously thought and they now look upon the flock as one of the more important farm enterprises.

Horses

Clare has a high reputation for the breeding of horses, especially hunters. The quality of the Irish Draught mare in the county compares very favourably with the best in the country. Although mechanisation has increased, there is still room on the small farm for a working horse. In 1969 there were 9,600 horses in the county and of these 8,700 were working horses, broken and unbroken.

Pigs

In a county where dairying is one of the more important farm enterprises, one would expect that pig-keeping would also be of major importance, but unfortunately this is not the case. There were only 17,900 pigs in the county in 1969 and of these 1,400 were sows.

A recent development in the industry has been the establishment of a Pig Fattening Co-Operative Society at Ennistymon. This has been in operation for about 4 years and is capable of finishing about 2,500 pigs per annum. Shareholders in this society have a guaranteed market for their bonhams throughout the year and this seems to be the answer to the complaint, often made by farmers, that fluctuation in the price of bonhams was one of the factors which kept so many out of pig production.

Other Enterprises

Horticulture and poultry-keeping are practised only to a limited extent. In the Newmarket-on-Fergus and Sixmilebridge areas a total of 127 acres (51 hectares) of vegetable crops were grown for canning in 1969, the principal crops being peas, carrots and some beetroot. A vegetable co-operative society was formed in Ballyvaughan late in 1967 and began operations in 1968. To date the co-operative has been able to market successfully all the vegetables grown by the members and it would appear that there is room for the expansion of this undertaking. In addition, limited acreages of vegetables are grown in the vicinity of the holiday resorts of Kilkee and Lahinch but this production is of a seasonal nature, catering only for the tourist trade.

Poultry numbers have declined during the past few years and there are now very few large flocks in the county. This trend is typical of the rest of the country as poultry production is largely confined to large-scale units and specialised production.

Future Trends

Within the past few years there has been a very marked increase in the use of lime and fertilisers, especially on grassland, and perhaps this welcome development gives some indication of future trends in agriculture in the county. The production of livestock and livestock products will continue to be the foundation of the industry. Already the more progressive farmers have adjusted their management systems to make full use of the increased production from their grassland.

The provision of an adequate supply of good quality winter feed has always been a problem in many parts of the county, especially on heavy, retentive soils. The marked increase in the making of silage from surplus summer grass over the past couple of years seems to be the answer to this problem and a greater increase in the making of silage in the future is very likely.

Congestion and limited farm size has been a factor which militated against agricultural development in the past. This is a problem which does not lend itself to a rapid solution but, under the schemes operated by the Department of Lands, numbers of farmers migrate each year to other parts of the country and their farms are available for re-distribution to those who remain. An extension of this activity would eventually lead to greater farm size and better income for the farmer.

CHAPTER V

SOILS, TOPOGRAPHY, CLIMATE AND GEOLOGY

The distribution pattern of the soil in any area is due to the interaction of several factors. Each soil reflects the environment in which it was formed, occupies a definite geographic area and occurs in certain patterns with other soils. In County Clare the most important factors influencing soil formation are topography, climate and geological parent material. The relationship between these factors and the soil pattern is briefly outlined in this chapter.

Topography

Topography includes elevation, degree of slope and general shape of the landscape. These have been mostly determined by the geological structure and its subsequent modification by ice movement. Soil formation is affected by topography; elevation, for example, with its attendant climatic and vegetational changes, strongly influences the soil development pattern. Brown podzolics, podzols, lithosols and peats are usually found at the higher elevations.

The use-range of soils is very often limited by topographic features such as steep slopes, rockiness or exposure at high elevations.

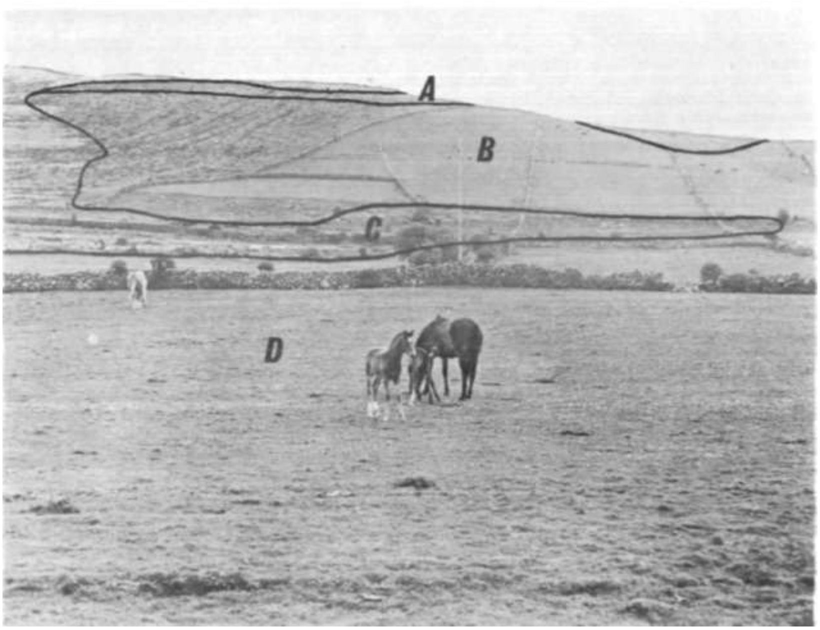


Plate 15: Soil distribution pattern in relation to topography (Carron. Burren Region) A =Kinvarra Podzol Variant; B=Kinvarra Series: C = Burren Series: and D = Patrick swell Series

County Clare may be divided into eight topographic units (Fig. 9) as follows:

1) Burren hills
2) Burren lowlands
3) Limestone lowlands coated with drift
4) Loop Head peninsula
5) Recently glaciated shale lands,
6) Sandstone-shale uplands
7) Sandstone-shale lowlands around Clonlara.
8) Alluvial flats of the Fergus and Shannon estuaries.

1) The Burren hills situated in the north-west of the county frequently rise to 1,000 feet (305 m) and consist of almost horizontal strata of bare limestone with some soil in the valleys and dolines. The hillsides are normally steep and frequently show vertical edges of limestone strata with flat areas of limestone pavement between them; at higher elevations these expand into gently stepped plateau-like areas of limestone pavement.

Soils associated with this topographic unit are the Burren Series. Burren Deeper Phase, Kinvarra and Kilcolgan Series. The latter two occur on the drumlins in the valleys. Small areas of the Patrickswell, Elton and Baggotstown Series are also found in the valleys.

2) The Burren lowlands are similar to the Burren hills and are composed of horizontally-bedded bare limestone pavement which lies mostly below 200 feet (61 m). This region extends east and south of the Burren hills and fades out north of Ennis. In the west the topography is almost similar to the adjoining hill region except for some drumlins scattered over the limestone. Towards the east and south the inter-drumlin areas are largely covered with peat and lakes; where the drumlins are in close proximity the limestone pavement may not be exposed. The drumlins frequently increase in numbers towards the east and are all aligned towards the south-west.

Associated with this topographic area are the Kinvarra, Kilcolgan and, in the hollows in the limestone terrain, small areas of the Howardstown Series. Some of the hollows in the south and east are occupied by the Banagher Series. The Burren Series occurs especially in grykes and occasionally as a soil-coating on the limestone.

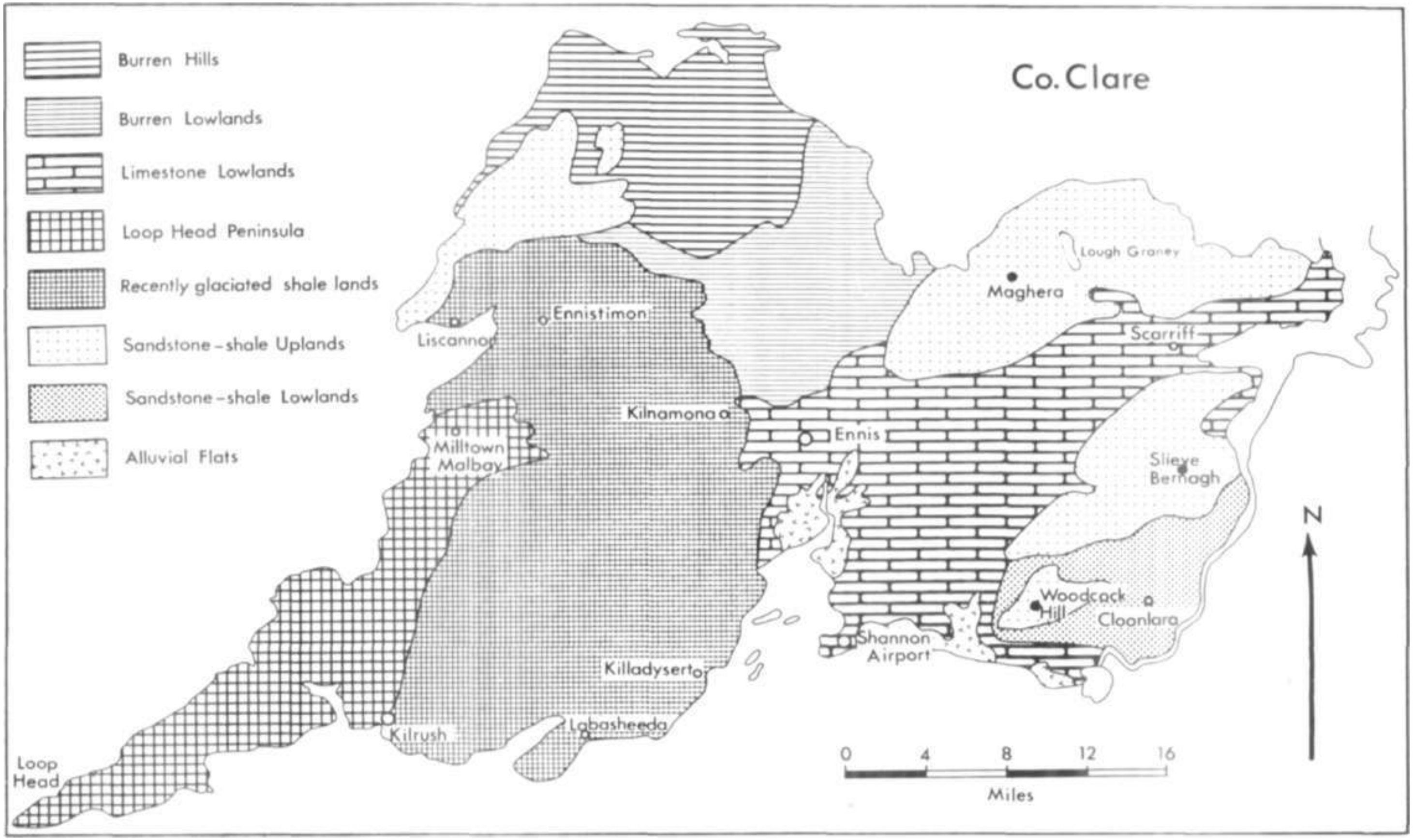
3) The Limestone lowlands extend from Shannon Airport through Ennis to Scariff and are coated with glacial drift. Here the limestone is no longer horizontal. Drumlins cover almost the entire area and in places the soils reflect the presence of some Old Red Sandstone in the drift.

In this area, the Elton and Patrickswell Series occur on drumlins and on a few interdrumlin flats. Ballincurra, Burren Deeper Phase and the complex of these two occur in the well-drained interdrumlin flats and in drumlin-free areas. Some of the poorly-drained Howardstown Series as well as the Banagher and Allen Series also occur in these interdrumlin areas.

On the outer edge of the lowland corridor between Slieve Bernagh and Slieve Aughty, some drumlins composed mainly of Old Red Sandstone are covered with the poorly-drained Puckane and Gortaclareen Series.

4) The Loop Head peninsula lies west of a line from Kilrush to Miltown Malbay and consists of gently undulating topography with long soliflucted slopes. Altitude seldom exceeds 100 feet (30 m).

Poorly-drained soils such as Abbeyfeale, Abbeyfeale non-Peaty Phase, Kilrush and Tullig predominate in this area; the podzolised variants of Knockanimpaha and Abbeyfeale occur along the coast. The Allen and Aughty Series are also found within this area.



Fig, 9: County Clare—general topographic features

5) The Upper Carboniferous shale area covered by the last glaciation consists of some hills surrounded by large areas of blanket bog interspersed with Kilrush and Abbeyfeale non-Peaty Phase. There are many rock exposures and fairly steep slopes, especially in the area between Killadysert and Labasheeda where the folding is parallel to the ice movement. The ice here over-deepened the valleys in the soft shales and left prominent ridges of sandstone between. This area is covered by Mountcollins-Kilrush Complex.

A drumlin-covered landscape, forming a sub-division of this glaciated shale area, stretches from Liscannor Bay to the Fergus estuary in an arc extending to Ennistymon and Kilnamona. At the north and south ends, the interdrumlin areas are poorly-drained, the central portion is occupied by peat and lakes. The drumlins are covered with the Kilrush, Kilfergus and Mountcollins Series, on occasions all three may be found on one drumlin.

6) The sandstone-shale uplands consist of the Slieve Aughties, Slieve Bernaghs (Slieve Bernagh 1,748 feet, 503 m; Maghera 1,314, 400 m) and the Cratloe Hills (Woodcock Hill 1,010 feet, 308 m). Many hills in the area rise to about 1,000 feet (305 m).

This area consists of massifs of Devonian Old Red Sandstone with poor acid soils and peat. In places the Old Red Sandstone has been eroded and the underlying Silurian shales exposed, *e.g.,* Lough Graney valley in the Slieve Aughties. The Aughty Series occupies the more elevated areas in this region while Puckane and Gortaclareen are found over deep mixed drift of predominantly sandstone origin at lower elevations. Ballylanders and Ballynalacken Series occur in the area of Silurian shales, especially around Lough Graney and on the eastern and southern slopes of the Slieve Bernaghs.

7) The sandstone-shale lowlands occur around Clonlara and the Cratloe Hills and are covered by the Gortaclareen and Puckane Series where the sandstone predominates and by the Cooga Series where the soils are derived mostly from the shales. Drumlins, mostly aligned north-south, are scattered over the area; the crests of these are covered by the Cooga Series and the sides and interdrumlin areas by the Gortaclareen Series.

8) The alluvial flats bordering the Rivers Shannon and Fergus are below spring-tide level and are embanked. Drumlins also occur in this area and are covered by the Elton and Gortaclareen Series.

Climate

Even on a uniform geological parent material soil development may vary widely due to environmental factors: one of the more active agents is climate and it is now recognised that our post-glacial climate showed distinct variations over time. The main element of our climate influencing soil development is the rainfall-evaporation regime. With the ratio balanced well in favour of rainfall, most of our soils tend to be leached to varying degrees, being strongly podzolised in more extreme cases. Apart from leaching, the humid climate is also partially responsible for the extensive areas of wet gley soils and for much of the peat formation in the country.

Rainfall

The county may be divided broadly into high and low rainfall areas (Fig. 10; Table 9). The high rainfall is associated with areas of high elevation, *e.g.,* the Burren, Slieve Bernaghs, Slieve Aughties and Cratloe Hills, and low rainfall with areas of low elevation, *e.g.,* Loop Head peninsula, Shannon Airport and the area east and north of Ennis.

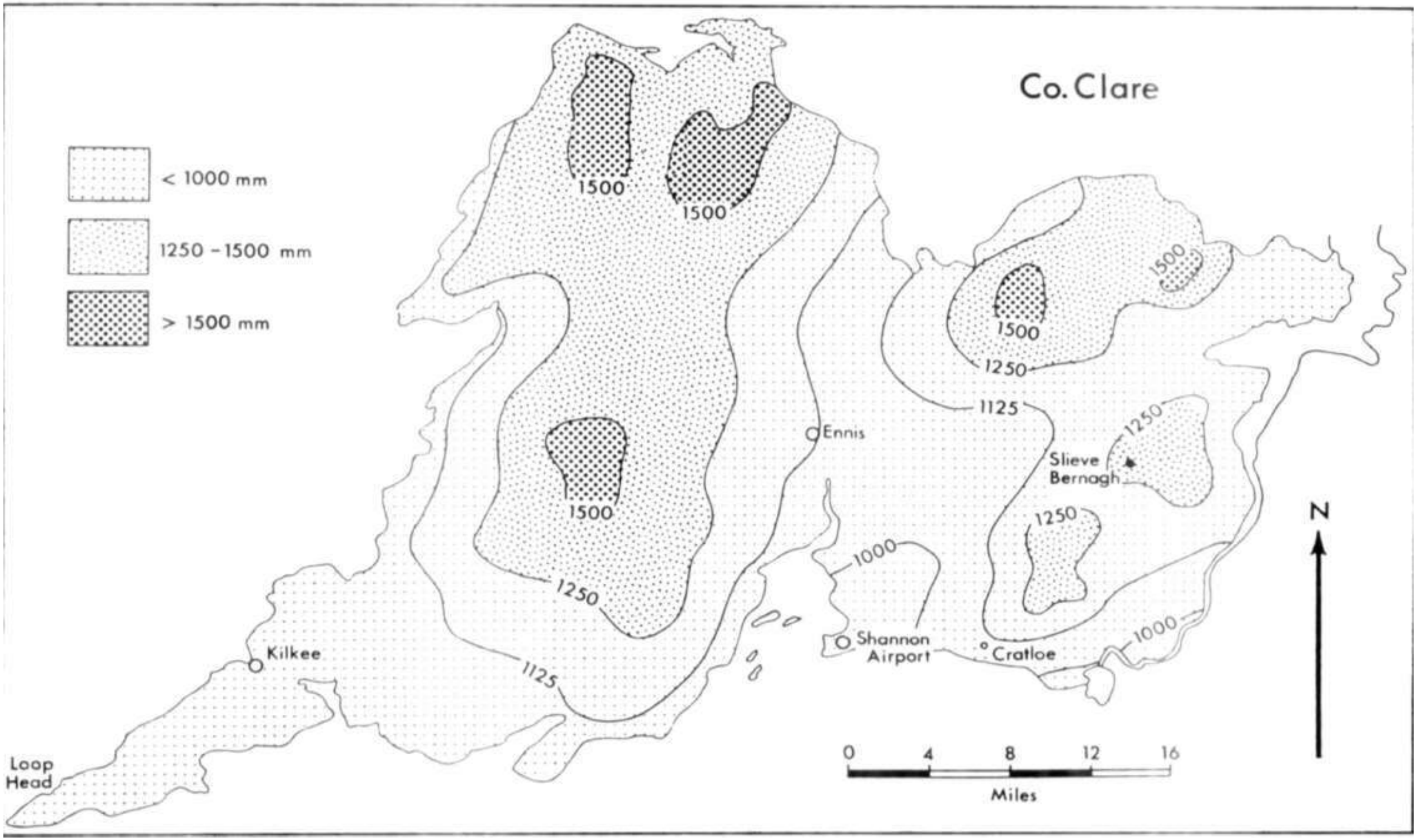


Fig. 10: Rainfall distribution on an average annual basis

TABLE 9: Average monthly and annual rainfall (mm) for high and low rainfall areas (1950-64)

Rainfall Area	Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
High	Carron	132.6	98.9	92.4	90.6	81.0	99.7	127.3	141.6	163.6	151.0	154.6	187.2	1520.4
High	Lissycasey	125.8	85.0	91.6	73.3	76.7	84.6	120.1	128.9	141.7	131.0	129.2	172.5	1360.4
Low	Kilkee	105.4	71.8	77.0	60.9	58.7	65.6	89.1	96.7	110.9	106.3	112.4	133.6	1090.4
Low	Shannon Aiirport	86.4	59.2	58.6	54.7	58.2	60.8	73.5	89.6	97.0	86.9	83.9	112.2	920.2

Minimum rainfall occurs in April and May and maximum in December with a secondary maximum in August. Within the average figures quoted (Table 9), there is a possible wide divergence. At Inagh, for example, the total rainfall varied from 1,848.4 mm in 1960 to 1.390.1 mm in 1952. During the same period rainfall during March varied from 28.2 to 175.8 mm and in December from 113.0 to 359.7 mm.

Temperature

Climatic data other than rainfall are available only for Shannon Airport. Average monthly air temperature figures are given in Table 10.

TABLE 10: Average monthly maximum and minimum air temperature (C), Shannon Airport (1939-42 and 1946-57)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Maximum	12	13	16	18	22	25	24	24	21	18	14	13
Minimum	- 7	- 6	- 3	- 2	0.5	3	6	5	3	2	- 3	- 4

January on average is the coldest month and June the warmest.

Sunshine

The mean daily duration of sunshine (hours) at Shannon Airport is shown in Table 11.

TABLE 11: Average daily mean of bright sunshine (hours), Shannon Airport (1931-60)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.70	2.55	3.45	5.12	6.39	6.05	4.65	4.97	3.91	2.88	2.05	1.41

Relative Humidity

Relative humidity figures for Shannon Airport are high ranging from 69 to 92%.

Frost

The average frost-free period at Shannon Airport is short, July and August being the only months completely frost-free (Table 12).

TABLE 12: Average number of days with ground-frost, Shannon Airport (1948-57)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
9.9	11.7	8.9	6.9	2.8	0.6	0.0	0.0	0.2	3.4	6.5	7.1

The average dates of first and last occurrence of ground frost are October 24 and May 4 respectively.

Wind Velocity

The average wind velocity at Shannon Airport is 10.5 knots per hour. Maximum velocity (Table 13) occurs between October and February.

TABLE 13: Absolute maxima of wind velocity (1951-64), knots per hour

1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
78	60	57	65	64	69	74	57	71	67	93	79	63	48

The influence of climate on soil formation is evidenced by the widespread occurrence of blanket peat in the county and by the intensive leaching and podzolisation of many of the soils, even at relatively low elevations.

Geology

Soil parent material may be either solid rock which has weathered or some superficial deposit such as glacial drift or alluvium which has been derived from weathered rocks and transported. Variation in the composition of different rocks is reflected in the diverse range of soils derived from them. For example, quartzite is highly resistant to weathering and, during its slow weathering process, little clay is formed and release of mineral nutrients is poor. Besides being inherently poor, soils on such materials degrade easily as the leaching process outpaces the rate of weathering. Fortunately most rocks are mixtures of many minerals, few of which can withstand weathering as well as quartz. Glacial drift, the most common parent material of Irish soils, varies considerably in constitution and in geological composition and gives rise to many different soils.

*Solid Geology**

The rocks of County Clare were formed in the Palaeozoic Era, and are predominantly of Carboniferous age except in the east where the Ordovician, Silurian and Devonian

•This section was prepared by staff of the Geological Survey

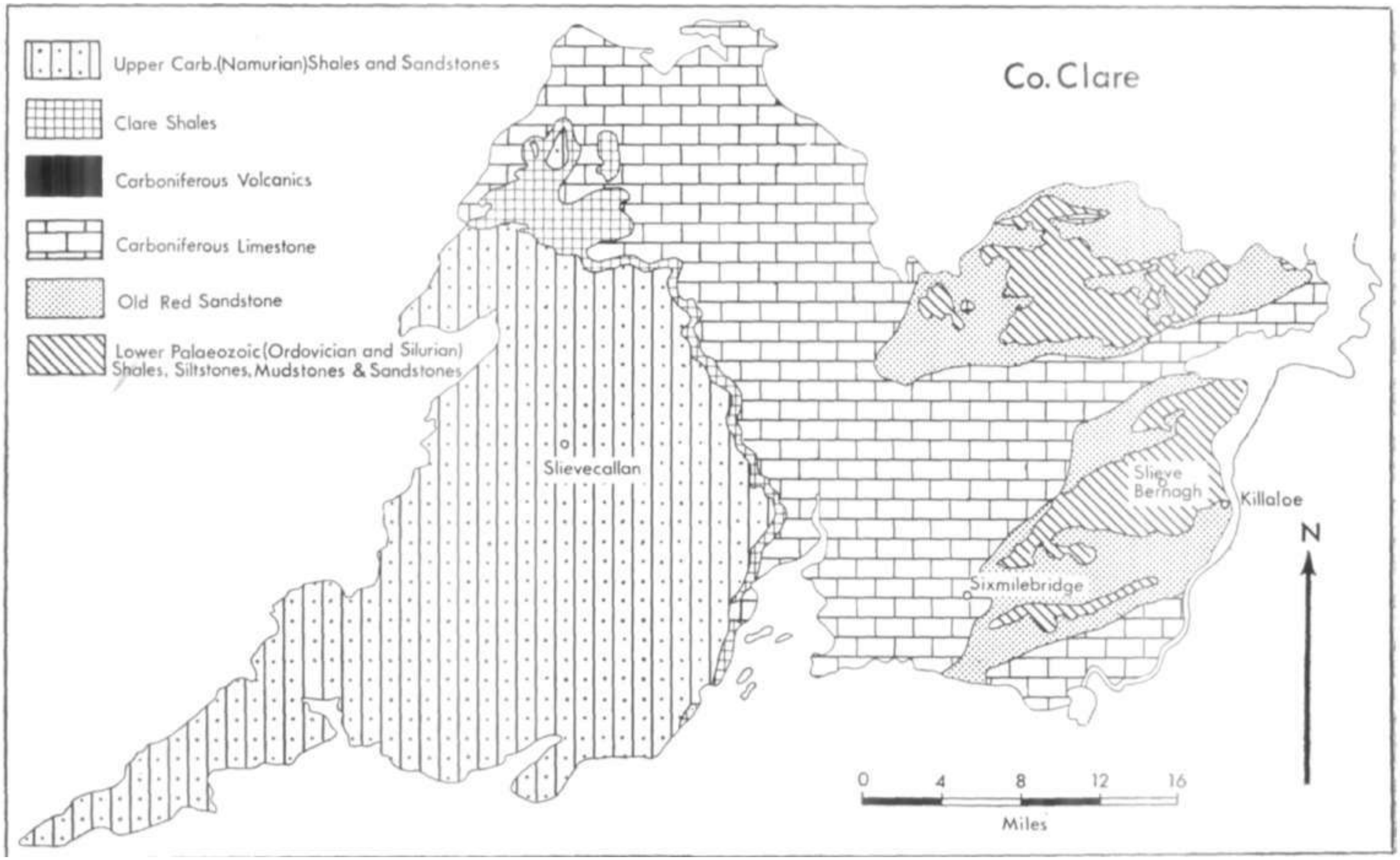


Fig. 11: Distribution of solid geological formations

Systems occur in the Slieve Aughty and Slieve Bernagh mountains and in the Cratloe Hills. The present distribution of rock types is a result of folding during the Armorican Orogeny which forced the beds into a series of east-north-east to west-south-west trending folds.

Large anticlines, crossed by east-west faults, form the Slieve Aughty and Slieve Bernagh mountains. The cover of Old Red Sandstone has been eroded from the central parts of the anticlines, exposing the Ordovician and Silurian. Between the two mountain areas is the East Clare Syncline, occupied by Lower Carboniferous limestones. These limestones extend in a broad strip northwards to the Burren. The intensity of folding decreases to the north-west, and in the northernmost part of the county the beds are nearly flat-lying. The west and south-west part of the region are underlain hy gently folded Upper Carboniferous shales and sandstones.

Figure 11 shows the distribution and extent of the major rock units, a brief description of which follows.

Lower Palaeozoics (Ordovician and Silurian Systems,

The Lower Palaeozoic rocks of the three inliers were laid down in a broad marine basin. The deposition of fine mudstones was frequently interrupted by influxes of coarser mateiial carried into the basin by currents made dense with suspended sediment. These influxes were responsible for the siltstone bands, sandstones, grits, conglomerates and slumped horizons which occur within the mudstones. Severe folding about an east-north-east axis took place during the Caledonian Orogeny resulting in steep dips and the local development of a strong cleavage. Some minor vulcanicity occurred during lower Palaeozoic times in the Slieve Aughty mountains.

Rocks of Ordovician age have been described from both the south west and north of the Slieve Bernagh inlier. The intervening rocks of the inlier are of Silurian age and are similar to those of the Cratloe Hills to the south. The ages of the Lower Palaeozoic rocks of the Slieve Aughties are not known for certain at present.

Old Red Sandstone (Upper Devonian)

During the Caledonian Orogeny, folding and uplift of the lower Palaeozoic rocks occurred, and a long period of erosion of the resulting mountains took place. By upper Devonian times the landscape had become relatively mature, and conglomerates and red sandstone were laid down in valleys cut in the lower Palaeozoics. The land then started to sink slowly, and the hills and valleys were covered by vast spreads of red sandstones and siltstones laid down in river channels and in the intervening alluvial flats.

Carboniferous System

a) *Lower Carboniferous Shales:* The pale-grey sandstones, dark silts and calcareous shales which make up this division of the Lower Carboniferous were deposited near the shore of a sea which spread northwards as the land continued to sink.

b) *Lower Carboniferous Limestone:* The limestones which make up the rest of the Lower Carboniferous were deposited in a shallow sea into which very little material was carried by rivers. They have not been subdivided in Figure 11 as they give rise to somewhat similar soil types. The succession is broadly the same as that in County Limerick, and is as follows:

Lower Limestone: Dark blue-grey, sometimes muddy, well-bedded limestones with shaly partings.

Plate 16: Kinvarra and Kilcolgan Scries being worked for sand and gravel

Waulsortian 'Reef Limestone: Pale-grey, unbedded, very fine-grained limestone on which is developed a characteristic hummocky topography.

Upper Limestone: Well-bedded grey limestone with occasional cherty horizons and dolomites.

Lower Carboniferous volcanics occur in two places in the county, one a few miles from Tulla, and the other one mile north of Limerick.

c) *Upper Carboniferous Shales and Sandstones:* This group of rocks includes **the** units referred to as the Upper Avonian shales and sandstones, the Millstone Grit and the Coal Measures on the old Geological Survey maps. Recent work has shown these subdivisions to be invalid; these rocks belong to the middle Carboniferous or Namurian stage.

The lowest beds, shown as the Clare Shales on Figure 1 l,are slightly carbonaceous and locally have a high content of selenium, molybdenum and phosphorus. Overlying the Clare shales is a sequence of shales and sandstones.

Glacial Geology

As the majority of the soils of Ireland have been derived from glacial 'drifts' laid down by an ice sheet or glacier or by the waters from melting ice, a consideration of the main events of the latest period of the geological record—The Great Ice Age—is appropriate here. The period embraces the last million years of the earth's history. In Ireland, however, little is known about the earlier part of this period (Charlesworth, 1928).

Elster Glaciation

From buried lake deposits exposed during the sinking of a well at Baggotstown some two miles east of Bruff in County Limerick it was learned that a temperate climate prevailed prior to the onset of the greatest of the major glaciations, the equivalent of the Saale glaciation of Northern Europe. The pollen and other plant remains found in the lake deposits indicate that a forest cover consisting mainly of pine, birch and oak existed during this climatic phase. Cooler climatic conditions both preceded and followed this phase; the vegetation was mainly scrub, and oak trees were absent. The presence of similar lake deposits at Kildromin near Herbertstown in County Limerick, at Boleyneendorrish near Gort in County Galway and at Kilbeg in County Waterford shows that such a climatic and vegetative sequence must have been quite general. As the lowest part of the Baggotstown deposit reflects the prevalence of a vegetative cover of willow, scrub and grassland—as prevails today in the far north of Europe—glacial conditions cannot have been long past (Farrington, 1936). Direct evidence of this early glaciation—the Elster of northern Europe—is poor, however, as only with difficulty would its deposits have survived later erosion by both ice and river action.

Saale Glaciation

Evidence of the next two glaciations is much clearer. The older of these, the Saale, was the largest of the Irish glaciations. Reaching its maximum about 200,000 years ago, it covered practically every part of Ireland. Only the higher hills in the west and south-west were not ice covered (Farrington, 1952). In County Clare the general ice-flow at this time appears to have been from east to west (Fig. 12): this is indicated by the direction of striations on the bedrock beneath the tills of this glaciation between Kilrush and Loop Head.

At this time the ice-shed or axis of the ice sheet lay well to the west, extending north-east from Connemara. There was probably a southern extension to the Burren in County Clare because a few boulders of Galway granite are found there. During the retreat of the Saale ice and of the later Weichsel glaciation, solifluction of the Saale deposits of west Clare occurred giving rise to long, gentle slopes.

Between the Saale glaciation and the last or Weichsel glaciation a long interglacial period ensued. Evidence of the warmer conditions prevailing during the interglacial has been found in buried or 'relict' soils in a number of places. A red clay unlike any soil formed under our more recent climatic conditions, has been found in the limestone grykes north of Lisdoonvarna. During the subsequent Weichsel glaciation the ice in this area was only about 400 feet (122 m) thick at a maximum. Erosion was not very active and the soil from the interglacial period was partly preserved within the grykes. This red clay is similar to the 'terra rossas' formed in the warm Mediterranean climate. Similar clay has been found in County Wexford (Gardiner & Ryan, 1962).

Weichsel Glaciation

This glaciation, which attained its maximum extent about 21,000 B.C., left its imprint firmly on the county and on a large portion of the country. Two phases have been distinguished, the first reached farthest south in this region and was called the Ballylanders advance (Synge, 1965). The second, the Fedamore re-advance, formed the end-moraine in County Clare. The islands of Scattery and Hog in the Shannon Estuary are part of this moraine which continues northwards from Kilrush through Cooraclare and Creegh to the east side of Slievecallan and thence through Milltown Malbay to Quilty.

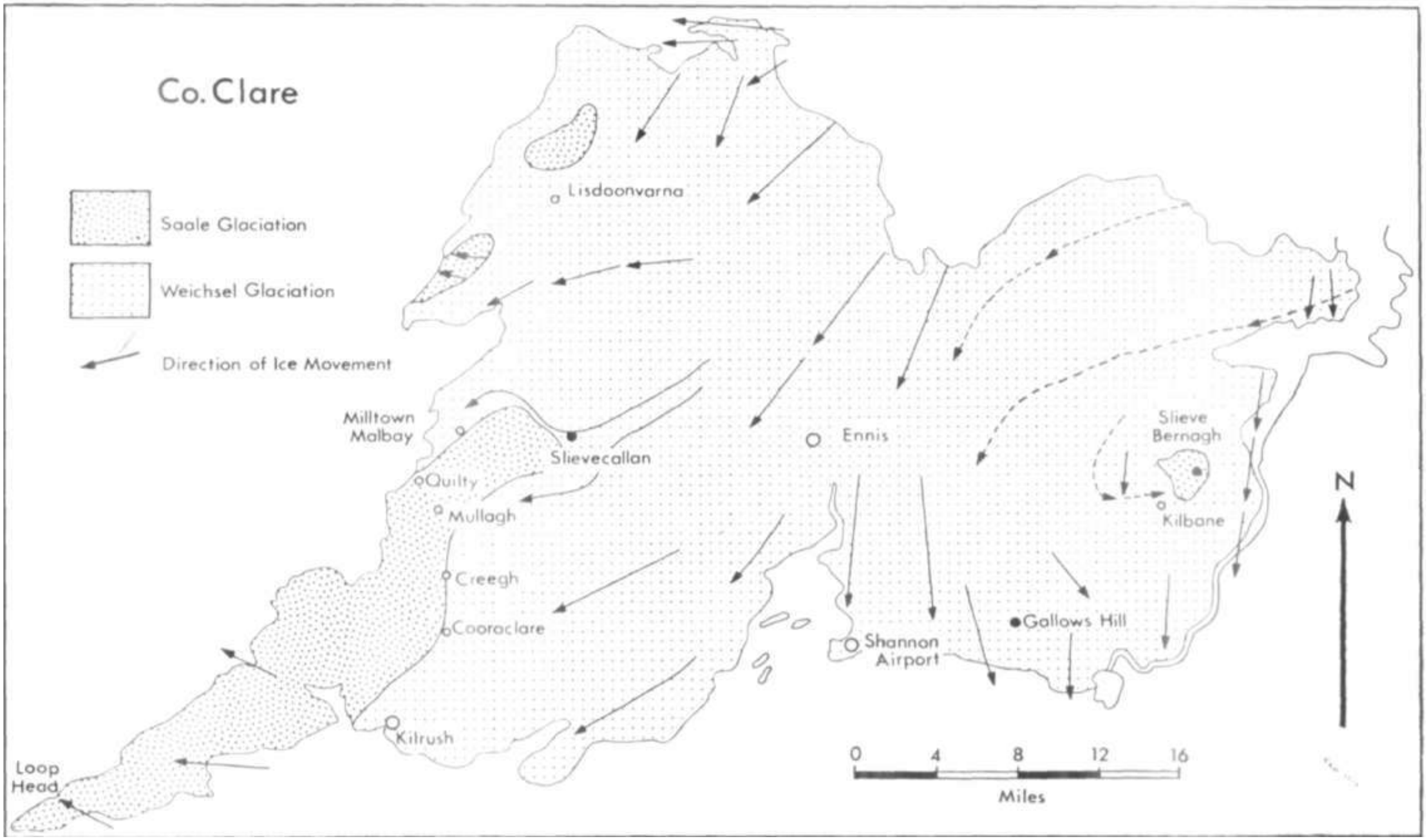


Fig. 12: Glacial pattern in County Clare

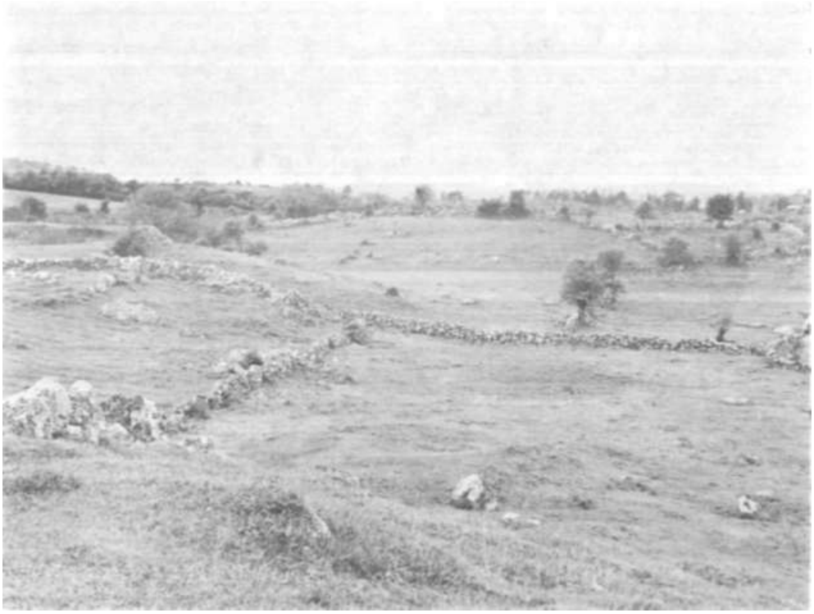


Plate 17: Kinvarra and Kilcolgan Series (Rocky Phase) on typical kame and kettle topography

The re-advancing ice sheets picked up and re-worked the till, leaving it in the form of drumlin swarms. These are widespread in the lowland corridors from Gort through Ennis to Shannon Airport and between Slieve Bernagh and Slieve Aughty. They are particularly well developed over the shales and sandstones of the Upper Carboniferous which appear to have eroded easily under the ice.

There are a number of belts of kame and kettle moraine within the county; one forms the terminal moraine from Kilrush to near Mullagh; a second is the terminal and recessional moraines south-west of Slieve Bernagh which extend from Kilbane to near Broadford where it joins another belt running north-east from Gallows Hills along the flanks of the Slieve Bernaghs. A third belt lies in the north-east around Whitegate.

TABLE 14: Main glacial events in County Clare and their association with the general glacial pattern in the country

Ireland	Clare
Post-glacial	Alluvium
Weichsel glaciation	Fedamorejice re-advance
	Bally landers ice advance
Last interglacial	
Saale glaciation	Glaciation of Loop Head
Great interglacial	Gortian interglacial
Elster glaciation	

The only esker in the county runs from the Slieve Aughties eastwards towards Lough Derg through Knockannattin. Two 'boulder trains' on either side of Ennis run southwards giving very free-draining but bouldery soils.

A summary of the main events of the glacial period in the county and their relation to glacial events in Ireland in general is provided in Table 14.

Soils and the Glacial Pattern

Generally the glacial drifts bear a close relationship in composition to the rocks over which they lie. Nevertheless, when ice crosses a major geological boundary there is a 'carry-over' of material from one formation to the other which becomes progressively more dilute with distance from the boundary.

The geological materials from which the soils of the county have been derived are of very mixed origin and constitution. The glacial history of the area has played a major part in creating this situation which, to a considerable extent, accounts for the complexity of the soil pattern prevailing.

The general relationship of the soils to the geological materials within the county is shown in Table 15.

Post-glacial

For some time after the ice had disappeared, the landscape carried open grassland cover with perhaps some scattered scrub. After the last phase of cool conditions (8,800-8,300 B.C.), the climate rapidly improved, birch scrub began to be replaced by pine forests and the silting of the lakes became more extensive. By about 5,500 B.C. oak woods were displacing the pine forest.

As the sea-level rose, the forests near the coasts were inundated and estuarine muds were deposited along the River Shannon. Today large tracts of these deposits are above sea-level owing to a subsequent slight rise in the land surface and to some reclamation, supplemented by a slight fall in sea-level. A change to wetter climatic conditions about 3,000 B.C. is reflected in a great extension of the peat bogs and a decline in the forest cover. This decline was accelerated with the advent of the Neolithic farmers about the same time; destruction of the forests commenced then and continued up to the present, the original wooded landscape gradually giving away to more open countryside.

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TABLE 17: Essential trace elements

Plant Nutrition	Animal Nutrition
Manganese	Cobalt
Copper	Copper
Iron	Manganese
Zinc	Iron
Molybdenum	Zinc
Boron	Molybdenum
Cobalt*	Iodine
Selenium*	Selenium
	Chromium

•Special circumstances or for particular plant species

Copper deficiency in cereals is quite common on organic soils and peats, and is accentuated by high levels of nitrogen. Symptoms show as a white tipping of the leaves at the grass-corn stage while later on ears fail to fill. The term 'blind-ear' is commonly used to describe copper deficiency in cereals. Vegetable crops grown on peat may also suffer from copper deficiency. Carrots, lettuce and onions are particularly sensitive to copper shortage.

Iron deficiency also occurs in plants and in Ireland it may be observed in grasses grown on peat. The symptoms are revealed as a 'chlorosis* or yellowing of the leaves especially between the veins. Timothy is particularly suceptible while Yorkshire fog is relatively resistant. Iron chlorosis may also affect fruit trees and is especially aggravated by lime.

Manganese deficiency symptoms are well displayed by such crops as oats and peas. In the case of oats a condition known as grey speck affects the leaves which, under severe shortage, may decay to the point of breaking off. In peas, a darkening of the centre of the pea results when manganese is limiting, and the condition is known as marsh spot.

Shortage of molybdenum is particularly noticeable in crops of the brassica family and in cauliflowers the condition is known as whiptail. Here the leaves are stunted and tend to curl inwards leaving the mid-rib exposed.

Zinc deficiency in such crops as maize is well known on a world scale and in Ireland it has occurred in onions and beans grown on peat. Flax is particularly sensitive to zinc deficiency and attention to the soil zinc status in flax-growing areas is obviously of importance.

Injury to plants can also arise when trace elements are absorbed in excessive amounts but, under Irish conditions, deficiency problems far outweigh those of toxicity

In the field of animal nutrition, nine trace elements are currently regarded as essential. Of these, cobalt is possibly the most important under Irish conditions and deficiencies in sheep and cattle have been widely recognised. Peats, and soils formed from granite, sandstone or quartzite, are particularly low in cobalt but deficiency may also occur on some limestone soils. Cobalt deficiency causes pining in animals: lambs and young cattle are particularly susceptible.

Copper deficiency in animals is frequently associated with an excess of molybdenum in the herbage and may give rise to severe scouring. Young cattle are particularly affected and if the animals are grazing exposed pastures the additional stress imposed by wind, rain and cold appears to worsen the condition considerably. Uncomplicated copper deficiency is also known while the occurrence of swayback in lambs is associated with copper deficiency; timely copper supplementation can prevent the condition.

Iron and zinc deficiencies are especially important in the nutrition of pigs while manganese deficiency in farm stock is usually confined to poultry.

Iodine deficiency gives rise to goitre while selenium deficiency precipitates a condition known as white muscle disease. Selenium deficiency is, as yet. unrecognised in Ireland but it is a problem in such countries as New Zealand, Turkey and the United States.

Chromium is the most recent addition to the list of essential elements but the extent of its importance must await further research.

Toxicities of trace elements can also cause problems in animal nutrition. Copper toxicity can arise in a number of ways and frequently results from accidental or unwitting overdosage with copper-containing mineral supplements. It is now recognised as a definite hazard where animals are maintained indoors for long periods. Ruminants appear to be more susceptible than monogastric animals of which only pigs present a problem under practical farm conditions.

Selenium toxicity results from the ingestion of herbage high in this element and the condition, which results in hoof deformation and loss of hair from the mane and tail, is known in Ireland, but only on a very limited scale.

In connection with trace element disorders in both plants and animals it must be stressed that while simple deficiencies and toxicities do occur, disorders are more commonly brought about by a combination of circumstances involving interactions and imbalances between elements. In plant nutrition, for instance, manganese and boron deficiencies may be induced by overliming while in animal nutrition an excess of molybdenum in the feed can result in a depletion of copper levels in both liver and blood.

Factors influencing trace element levels in soils

The levels of trace elements in soils are predominantly a reflection of the nature of the parent material but additions from other sources such as fertilisers, fungicides and general farm wastes can also contribute. Farmland close to large conurbations is undoubtedly affected by atmospheric fallout, *e.g.,* the addition of boron from soot. Lead concentrations are known to be greater in soils near busy highways and result from anti-knock degradation products in the exhaust gasses of motor vehicles. Trace element levels are quite frequently enhanced in soils adjacent to mining operations, and alluvial flats downstream from mines are particularly vulnerable. In the overall picture, however, the soil parent material remains the main source of supply. Soils derived from shale, limestone and basic igneous rocks are generally more plentifully supplied with trace elements than are soils formed from such materials as granite, quartzite and sandstone.

Trace element availability

From the practical agricultural standpoint it is not the total quantity of a particular trace element that is of importance but rather its availability to the growing plant. Many factors affect this availability, such as liming, soil moisture status, and organic matter content.

Liming reduces the availability of most agriculturally important trace elements but increases that of molybdenum and selenium. Reduction in availability is particularly noticeable in the case of manganese and boron, but copper, cobalt and zinc are also affected. The increase in available molybdenum following liming may be quite dramatic. From the animal health point of view the attendant increase in clover with its higher molybdenum levels often presents a very real problem.

Impeded drainage can increase the availability of many trace elements; with increased soil moisture and consequent reduction in soil air the formation of more easily assimilable forms of the elements is favoured.

The role of organic matter in trace element availability is well illustrated in the case of copper. This element is bound very effectively by soil organic matter and thereby rendered unavailable to plants. Organic-rich soils are often associated with deficiencies of copper and manganese, and addition of these elements then becomes necessary for greater production.

It is worthy of note that trace element deficiencies fall under three headings, 'inherited*, 'developed' or 'acquired*, and 'induced*. Inherited deficiencies arise when the soil is inherently low in a particular trace element, an example being cobalt in granite or sandy soils. Developed deficiencies arise from depletion through the podzolisation process whereby leaching of nutrients from the upper horizons results in residual levels below those required for normal plant growth or animal health. Induced deficiencies arise from man's interference with the soil by such practices as liming, drainage and irrigation.

Interpretation of data

The trace element data relating to the various soils in County Clare are given in Appendix II and to assist in their interpretation the following comments are relevant.

The trace element figures fall under two headings (a) total contents and (b) extractable contents (see Analytical Methods, page 87). The total contents have been determined spectrographically and they provide a general picture of the trace element status of the different soils. They are also useful in following such soil-forming processes as podzolisation, and surface accumulation by organic matter. The concentration of trace elements in the B horizons following podzolisation and the surface accumulation of such elements as lead are particularly noteworthy in this respect.

For the major soil series occurring in the county, *i.e.,* Ballylanders. Kinvarra, Knockaceol, Elton. Patrickswell, Abbeyfeale, Gortaclareen. Kilrush and Kilcolgan. the total trace element contents have been determined in each soil horizon while the ranges within the series have also been tabulated from analysis of several profiles within the particular series. In studying the latter figures, the horizons have been grouped simply into A, B and C. While trace element figures were produced for subdivided horizons, *e.g.,* All and A12, mean values were calculated and recorded under one heading—in this example under 'A Horizon*. For the more limited soil series, surface horizons only were analysed.

The extractable trace elements have been determined on surface horizons only and they provide a guide to the availability of some nutritionally important trace elements to plants, and indirectly to grazing stock. The soil values below which deficiencies might be expected are as follows: for copper and zinc 1.0 ppm. molybdenum 0.01 ppm. manganese 40 ppm and cobalt 5.0 ppm. It must be stressed, however, that these figures can only be regarded as broad guidelines. More precise information for different soils can only be achieved after calibration experiments linking extractable levels with plant uptake have been carried out. Nevertheless the figures can be used to draw attention to likely anomalous areas and to indicate where corrective measures are advisable.

Trace Elements in Great Soil Groups

In the following paragraphs the significance of the trace element data is discussed for the soils arranged under great soil group headings.

Brown Earths: From the available data, the following conclusions may be drawn. The Ballincurra soil is relatively low in extractable manganese and, if limed, could give rise to managnese deficiency in susceptible crops. The manganese figures for all other Brown Earth soils are in the normal range.

The cobalt figures are in the normal range for all soils except Baggotstown. Ballylanders, Knocknaskeha and Tullig. In the Ballylanders and Knocknaskeha Series the position is considered potentially more serious as the pH values in these soils are such that application of lime would normally be recommended. This would reduce cobalt availability.

No further anomalous trace element figures appear in the Brown Earths, but it is interesting to note the relatively high values for cobalt, nickel, chromium and zinc in the Derk Series. This is held to be a direct reflection of the parent material, which is primarily basic igneous, and inherently high in these elements.

Grey Brown Podzolics: In general, this group of soils is adequately supplied with trace elements but an exception occurs in the case of Patrickswell where the cobalt level was low in some of the profiles examined. In the Kilfenora soil, the extractable contents of both copper and molybdenum were higher than normal. The copper figures give no cause for concern but the molybdenum values are such that molybdenosis in grazing stock may present a problem particularly under intensification. The elevated copper and molybdenum figures are attributed to the presence of Clare shale (q.v.) in the parent material. Clare shale can also give rise to elevated selenium levels in soils but the amounts in this soil are not considered large enough to cause selenosis in animals.

Brown Podzolics: The cobalt content of this group of soils is rather low and, as the pH values indicate a requirement for lime, the possibility of cobalt deficiency in stock must be kept in mind. All other essential trace elements appear adequate.

Podzols: Of the profiles examined, cobalt is low in Knockaceol, Knockanattin. Knockanimpaha and Seefin, and the effect of podzolisation is well shown in the Knockaceol Series where all horizons were analysed. Here the depletion in the A2 and the accumulation in the B2 horizon is clearly evident. The inherently low cobalt values are a reflection of the Old Red Sandstone influence, and the podzolisation process has aggravated the situation.

Extractable manganese is very low in the Seefin profile and deficiency problems could well arise in a susceptible farm crop such as oats. From the point of view of animal production, manganese deficiency is not considered to be a likely limiting factor. Extractable copper figures in both the Seefin and Knockanimpaha soils are marginal and, under a more intensive management system, copper deficiency might cause problems in clover establishment and maintenance.

Gleys: The most striking characteristic of this group of soils is their almost uniformly low cobalt status. Only in the alkaline parent material phase of the Puckane Series and in the modal profile from Howardstown do the cobalt figures suggest a reasonable soil reserve and even here the levels are by no means high. Low cobalt could normally be expected on those soils formed from Old Red Sandstone drift but to find the shale soils so consistently low is rather surprising.

The manganese figures are likewise low but not as consistently so as those for cobalt. The Abbeyfeale and Howardstown modal profiles have adequate amounts and so has the alkaline parent material phase of the Sellernaun Series. In marked contrast, the humus B variant of Howardstown and the modal Sellernaun are extremely low in extractable manganese. The alkaline parent material phase of the Puckane soil is unique in having a high extractable manganese content, but manganese toxicity in crops is not considered to be a danger at the prevailing pH.

The boron figures do not indicate any anomalies and the molybdenum levels, with one exception, are in the normal range. This exception occurs in the Kilrush soil where the extractable contents are in excess of 2 ppm. This is confirmed by the 'total' figures where the Al 1 horizon contains 4 ppm and the parent material <0 ppm. The parent material consists of Upper Carboniferous shales and sandstones and the elevated molybdenum level would suggest inclusion of the very bituminous Clare shale here. Some beds in the Clare shales (q.v.) are notable for their high contents of phosphorus and of many trace elements including molybdenum.

Rendzinas: The rendzinas examined for trace element content were the deeper phase of the Burren Series and modal profile of the Kilcolgan. The Burren soil is adequately supplied with trace elements but some profiles from the Kilcolgan Series did reveal some low cobalt levels.

The manganese levels shown for both rendzina soils may appear high but calcareous soils often contain considerable amounts of manganese as this element possesses characteristics that permit its ready entry into the constituent minerals of limestone and dolomites. It is of interest to note that of all the soils examined only that from the Burren contained cadmium (10 ppm).

Lithosols: The two lithosols examined were the modal profiles from the Carrigogunnel and Slievereagh Series and they present a most interesting contrast. Being formed directly from bedrock, parent material is obviously a very significant, if not the dominant, pedogenic factor in determining their trace element levels but, in the Slievereagh soil, organic matter must exercise a considerable influence. The parent material of the Carrigogunnel soil contains an admixture of basic igneous material and this is reflected in the relatively high levels of such trace elements as zinc, nickel, cobalt and chromium. The Old Red Sandstone parent material of the Slievereagh soil is characteristically poor in these elements and this poverty is certainly evident in the soil, despite the high organic matter which can be assumed to have effected some concentration of trace elements.

In practice, the Carrigogunnel soil would be regarded as adequately supplied with trace elements but deficiencies of cobalt, manganese and possibly copper could be expected on the Slievereagh soil. The extractable copper figures indicate that copper reserves are reasonable but the high organic matter content may exert a strong influence in making this copper unavailable to plants and thus to the grazing animal.

Alluvial Soils: Four alluvial soils, Shannon, Rathborney, Feale and Drombanny Series, were examined for trace element content. Trace element levels appear adequate in all cases with the exception of cobalt in the Rathborney Series where the level is marginal. Any trace element problems on these soils are likely to result from an excess of trace elements, particularly selenium and molybdenum. Levels of molybdenum in the Feale and Rathborney soils are high and while the Shannon and Drombanny profiles have not shown anything unusual in this regard, similar soils in County Limerick have.

From a geological point of view the elevated levels of molybdenum and selenium are interesting and are held to be a direct reflection of the presence of Clare shale in the parent material. The Clare shales are black marine deposits which rest on top of the Carboniferous limestone and are known to contain strata with unusually high levels of several trace elements including selenium and molybdenum. They are also a source of phosphate and were mined for this material during World War II. The northern boundary of these shales lies in the region of Lisdoonvarna and the beds may be traced southwards through or near Kilfenora, Corrofin, Kilnamona. Killadysart, Foynes, Shanagolden, Ardagh and Ballagh to Dromcollogher.

Toxic levels of both selenium and molybdenum have been reported from the Drombanny Series in County Limerick where animals have been affected. The conditions leading to an excess of these elements in the soil involve organic matter accumulation and this is well shown in Table 18.

TABLE 18: Selenium and organic carbon levels in Drombanny Series

Horizon	Organic C(%)	Selenium (ppm)
All	6.3	12
A12	10.0	10
02b	20.0	21
Clca	1.7	9

Discussion of these soils and the selenium levels in crops grown on them may be found in The Soils of Co. Limerick' (National Soil Survey Bulletin No. 16) and the reader is referred to this work for further information. It may be stated, however, that while the area of seleniferous soils in County Limerick is not large, problems are associated with them. Attention must be drawn to these soils from the public health point of view, as excessive intakes of selenium have been associated with a higher than normal incidence of dental caries though it must be pointed out that slightly elevated intakes of molybdenum are held to be beneficial in this regard.

Analytical Methods

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Clay Mineralogy of Selected Soil Profiles*

Soil may be divided into fractions of different particle sizes, *viz.,* sand, 2mm to 50u; silt, 50 to 2u; and clay,<2u. Clay is the finest size fraction of soils; it accumulates as a weathering product of primary minerals during soil formation and is in many ways the most important fraction of soils.

The properties of soil clays are determined by the structure, composition and physical attributes of the clay minerals present. The clay fraction of soils commonly contains quartz and feldspar, but the more active components are the layer silicates, *e.g.,* mica, vermiculite, montmorillonite, kaolinite, and chlorite. The term 'clay mineral* is often interpreted to mean finely divided layer silicates.

As most chemical reactions in soils are surface reactions, clays, because of their high surface area and charged surface sites, play a dominant role in such soil properties as cation exchange, ion release, and ion fixation in soils. Soil potassium relationships are largely determined by clay mineralogy. Micas contain approximately 9 % potassium which they release for plant uptake at varying rates depending on the amount of edge surface exposed, the type of mica present and the potassium content of the soil solution. Fixation of potassium by vermiculite with a high charge density occurs to some degree in soils. Kaolinite, allophane, and ferruginous chlorite react with phosphate from fertilisers to form variscite and strengite which are relatively insoluble and result in phosphorus fixation.

Clay mineralogy also influences the physical properties of soils. A predominance of uncharged clay minerals such as quartz and kaolinite results in a compact structureless soil. Expanding clay minerals swell by adsorbtion of water between their layers; the ingress of water is determined by specific surface and structure with interactions with the exchangeable cations present. Montmorillonite and vermiculite are the principal expanding minerals. The shrinkage cracks often seen in soils on drying are an example of clay expansion and contraction at different moisture levels. 'Quick clays' can change from rigid to fluid with a change in the exchangeable cations often resulting in landslides on slopes or poaching in the case of soils.

The type of clay minerals present and the changes in clay mineralogy with depth are a measure of the extent to which weathering has occurred during soil formation.

Analytical methods

Soil samples from the principal soil series of County Clare were fractionated by repeated sedimentation after removal of carbonate with pH 5 NaOAc-HOAc buffer solution, organic matter removal with H_2O_2, and free iron oxide removal with dithionite-citrate-bicarbonate solution (Jackson, 1956). Two clay size fractions, 2-0.2(4 and <0.2u, were studied by x-ray diffraction; selective dissolution analyses for quartz, feldspar, and mica(Kiely & Jackson, 1965), kaolinite and amorphous material (Hashimoto & Jackson, 1960); CEC methods for montmorillonite and vermiculite (Alexiades & Jackson, 1966); and integral thermal loss for chlorite. The fine silt fraction, 5-2u, was studied for some of the soils.

•This section was prepared by Dr. P. V. Kiely, Mr. T. Roche and Mr. M. Hayes, An Foras Taliintais

TABLE 19: Mineralogy ("..) ol the coarse clay fractions (2-0.2ii) of the principal soils of Co. c lare

Series	Horizon and depth (in.)	Coarse clay(%)	Qtz.	Feld.	Mica	Kaol.	Vermic.	Mont.	Chi	Vermic. —Chi. Intergradc	Amor.
Ballincurra	AI 0-5J	15	32	4	32	3	6	0	8	12	3
	Bl 5J 10.1	12	31	2	35	3	6	2	7	10	2
	(B) 10J-17	12	25	2	39	2	6	0	10	15	2
Ballylanders	All 0-31	15	16	1	46	2	12	0	2	12	3
	A12 31-71	16	15	1	46	3	9	0	2	15	3
	Bl 7A 16	8	13	1	53	3	3	6	5	12	3
Kinvarra	Al 0-31	21	62	13	4	2	4	0	5	8	2
	<HI 3.1 8	14	45	9	9	5	6	0	5	10	4
Elton	All 0-5	8	24	12	21	6	4	0	8	20	5
	A12 5-17	8	27	15	25	6	4	0	5	15	4
	A2 17-25	6	23	13	29	6	2	0	5	18	4
Patrickswell	All 0-4	II	44	2	25	7	4	0	0	10	4
	A124 15	12	31	5	27	7	10	0	2	12	6
	Bl 15 20	16	28	5	27	7	4	0	8	14	7
	B2t 20-25	7	21	4	37	7	8	0	8	10	5
Abbeyfeale	All 0-4	12	13	2	36	3	7	0	1	20	5
	AI24 11	14	12	2	42	5	3	0	8	20	3
	A2 11-19	25	9		44	5	3	0	II	24	3
	B2irg 19-25	20	10		48	5	8	5	10	5	2
	B22irg 25-33	18	9		50	5	8	3	8	5	2
	C| 33-42	19	9		50	5	10	5	8	5	2
Gortaclareen	All 0-31	20	23		58	3	5	0	3	0	4
	AI2 34-71	15	J2		61	3	4	0	2	0	3
	Big 71-16	19	14	0	73	3	3	0	2	0	3
	(B)g 16 31	17	24		69	4	2	0	0	0	2
	Cg31 43	18	20		68	3	2	0	0	0	4
Kilrush	All 0-51	31	17	2	37	3	15	0	4	15	3
	A12g 51-101	36	15		40	3	15	0	5	15	2
	(B)g 101-14	42	17		41	2	5	6	5	15	2
Kilcolgan	All 0-5	10	16	3	34	7	5	0	10	20	3
	AI2 5-9	10	16	2	26	8	6	8	10	20	4

Qtz.= quart/; Feld, feldspar; Kaol. kaolinite; Vermic. • vermiculite; Mont.^ montmorillonite; Chi. = chlorite; Amor. - amorphous material.

Results and discussion

The results for the clay fractions are presented in Tables 19 and 20 and for the fine silt fraction in Table 21. From the results, the soils can be grouped into two main groups: i) shale and sandstone-derived soils, and ii) limestone drift-derived soils.

The shale and sandstone-derived soils (Gortaclareen, Ballylanders, Abbeyfeale and Kilrush) have very high mica contents ranging from 73 to 36 % in the clay fractions. They contain moderate amounts of quartz, vermiculite and chlorite and generally only trace quantities of other minerals. Mica content is slightly higher in the fine clay fractions than in the corresponding coarse clay fractions. The soils may be considered to be in an early to intermediate stage of weathering.

Limestone-derived soils contain less mica (4 to 49 %) and more quartz than do non-limestone-derived soils. There is evidence of non-limestone drift influence in most of the soils derived from limestone drift.

Ballincurra Series: The Ballincurra soil, formed from predominantly limestone drift, has a high mica content and a moderate level of quartz and vermiculite-chlorite-intergrade. Quartz increases and mica decreases towards the surface, indicating increased weathering near the surface. Increased weathering of mica to vermiculite near the surface is also evident. The high mica content and moderate clay content indicate a moderate potassium-supplying power. Compared with limestone-derived soils in general, the soil is high in mica and low in quartz.

Ballylanders Series: The Ballylanders soil, formed from Silurian shale, has a very high (50 %) mica content and a moderate to low content of quartz, vermiculite, chlorite, and vermiculite-chlorite-intergrade in the clay fraction. An increase in quartz and a decrease in mica with a corresponding increase in vermiculite indicates an increase in weathering towards the surface. The vermiculite is more chloritic (inter-layered) with depth, suggesting that it is formed in part by weathering of chlorite. Appreciable collapse of vermiculite on potassium saturation only occurs in the surface horizon. The increase in montmorillonite in the Bl horizon may be due to translocation or it may be derived from the parent rock. The soil should have a high potassium-supplying power as indicated by its high mica content.

Kinvarra Series: The Kinvarra soil, formed predominantly from limestone, has a very tow mica content, and a moderate level of vermiculite. indicating a high potassium requirement. It has a high quartz content particularly in the surface horizon. A high vermiculite-chlorite-intergrade content occurs particularly in the fine clay fraction. The appreciable feldspar content in the surface horizon which decreases with depth suggests an admixture of igneous material in the limestone drift parent material. The chlorite and kaolinite contents indicate phosphorus-fixing properties.

Elton Series: This series, formed from predominantly limestone drift with some granite, has a high feldspar content in the fine silt and coarse clay fractions, indicating some igneous rock content in the soil parent material. The clay fraction contains moderate levels of mica, vermiculite-chlorite-intergrade and quartz. Mica content is much higher in the fine clay than in the coarse clay fractions. Lower levels of montmorillonite. vermiculite, and kaolinite obtain. The content of amorphous material in the fine clay fraction is unusually high for Irish soil clays. The soil should have low to moderate potassium-supplying power and appreciable phosphorus-fixing properties.

Patrickswell Series: A high quartz and mica content and moderate amounts of vermiculite, chlorite, vermiculite-chlorite-intergrade and kaolinite occur in this soil which is formed from predominantly limestone drift. A higher than average content of amorphous material and kaolinite suggests a high phosphorus-fixing capacity. The surface horizon has very poor crystallinity as indicated by x-ray diffraction intensity.

TABLE 20: Mineralogy (%) of the fine clay fractions (<0.2^) of the principal soils of Co. Clare

Series	Horizon and depth (in.)	Fine clay (%)	Mica	Kaol.	Vermic.	Mont.	Chi.	Vermic. —Chi. Intergrade	Amor.
Ballincurra	Al 0-54	7	49	2	15	0	8	20	5
	Bl 54-104	7	48	4	9	0	12	20	5
	(B) 10i 17	7	49	3	10	0	12	15	6
Ballylanders	All 0-34	6	56	3	15	5	8	5	5
	A12 34-74	6	56	3	10	5	11	10	6
	Bl 74 16	4	58	5	2	12	10	10	3
Kinvarra	Al 0-34	7	28	4	10	5	10	30	II
	(B) 34-8	3	28	6	9	5	12	30	II
Elton	All 0-5	5	36	8	6	9	5	20	12
	A12 5-17	7	36	9	9	10	5	20	12
	A2 17-25	7	40	7	10	9	5	15	16
Patrickswell	All 0-4	8	45	17	10	5	X	5	9
	A12 4-15	7	30	12	7	5	10	20	14
	Bl 15-20	4	29	4	15	12	10	25	4
	B2 20-25	14	38	10	12	5	7	15	12
Abbeyfeale	All 0-4	6	38	5	8	0	8	30	5
	A124-11	7	43	8	5	0	8	30	3
	A2 11-19	8	47	9	5	0	8	30	3
	B2irg 19-25	8	51	5	4	14	10	10	6
	B22irg 25-33	6	52	5	4	14	10	10	6
	Cg 33^42	6	52	6	6	10	10	10	6
Gortaclareen	All 0-34	4	64	7	12	8	2	0	4
	A12 34-74	8	64	7	12	10	0	0	4
	Big 74-16	10	73	6	10	6	0	0	4
	(B)g 16-31	10	71	6	8	6	2	0	5
	Cg 31-43	8	73	10	4	4	2	0	6
Kilrush	All 0-54	16	39	6	17	0	8	20	4
	Al2g 54-101	16	40	4	16	0	8	25	4
	(B)g 104-14	16	42	4	8	0	10	30	4
Kilcolgan	All 0-5	11	39	9	8	10	6	25	8
	A12 5-9	9	40	6	12	12	6	20	9

TABLE 21: Mineralogy (%) of the fine silt fractions (5-2u) of the principal soils of Co. Clare

Series	Horizon and depth (in.)	Fine silt (%)	Qtz.	Feld.	Mica	Kaol.	Verm ic.	Chi.	Vermic. —Chi. Intergrade	Amor.
Bailment i .1	A10-54	5	63	7	14	1	3	10	0	1
	Bl 54-104	6	67	8	13	0	2	9	0	1
	(B) 104-17	5	57	7	19	1	4	11	0	1
Ballylanders	All 0-3J	7	51	3	25	0	2	2	8	3
	A12 34-7J	7	52	4	26	0	1	0	8	3
	Bl 74-16	5	44	4	34	1	1	6	10	2
Kinvarra	Al 0-3 J	2	75	11	4	0	2	0	0	1
	(B) 34-8	4	60	**10**	5	3	4	8	2	2
Elton	All 0-5	5	60	21	9	1	0	4	0	2
	A12 5-17	5	60	21	9	0	0	6	0	2
	A2 17-24	3	50	21	14	J	0	12	0	2
Abbeyfeale	All 0-4	6	45	4	22	0	2	15	3	3
	A12 4-U	6	50	5	25	1	1	10	2	2
	A2 11-19	8	47	5	28	2	0	12	2	I
	B2ir 19-25	9	32	5	34	2	1	24	0	1
	B22irg 25-33	11	37	5	32	2	3	18	0	2
	Cg 33-42	11	31	4	36	2	2	22	0	1
Kilrush	**All** 0-54	14	64	4	17	0	2	6	2	2
	A12 54-104	16	64	4	18	I	1	4	5	1
	(B)g 11)4-14	**14**	**03**	**4**	18	t	t	**4**	**5**	**1**
Kilcolgan	A10 0-5	3	66	9	13	1	0	**6**	4	1
	A12 5-9	5	67	14	8	1	0	2	4	1

The parent material appears to have been variable with depth. A moderate to high potassium-supplying power is indicated.

Abbeyfeale Series: This soil, formed from mixed drift of Upper Carboniferous shale and sandstone, has a very high mica content and a high vermiculite-chlorite-intergrade content. Mica increases and vermiculite-chlorite decreases with depth. A change in parent material at 19 inches (48 cm) is indicated by the much higher quartz content above this depth and the higher chlorite content below it in the fine silt fractions. The much higher content of vermiculite-chlorite-intergrade in the clay fractions of the upper horizons relative to the lower horizons supports this. The soil should have a very high potassium-supplying power as indicated by the high mica and clay contents.

Gortaclareen Series: This soil, formed from sandstone and shale drift, has an extremely high (60 to 70%) mica content in its clay fractions. It also contains moderate amounts of quartz, vermiculite, kaolinite and montmorillonite. The soil should have a very high potassium-releasing power as indicated by the high mica content in the clay fractions and the high clay content in the soil. Phosphorus-fixation properties are indicated by the kaolinite, chlorite, and amorphous material contents. Weathering of mica to vermiculite is evident in the upper horizons.

Kilrush Series: This soil, formed from drift of predominantly Upper Carboniferous shale composition, is marked by a high mica content (40%) in both clay fractions, a very high clay content, and an appreciable content of vermiculite in the Al 1 and A12g horizons. The high potassium-supplying power indicated by the high mica and clay contents is offset to some extent by the vermiculite content. Mica decreases and vermiculite increases towards the surface, probably resulting from increased weathering of mica to vermiculite. The slight increase in montmorillonite in the (B) g horizon may have been due to translocation from the upper horizons. The origin of the vermiculite-chlorite-intergrade is uncertain but it appears to be a product of chlorite weathering as it increases with depth.

Kikolgan Scries: This soil, formed predominantly from limestone, has a high content of mica and vermiculite-chlorite-intergrade and moderate contents of quartz, vermiculite, chlorite, montmorillonite and kaolinite. The feldspar content in the fine silt fractions suggests an igneous influence in the parent material. Also the mica content is higher than that generally found in limestone-derived soils and may have resulted from a mica-schist or other igneous rock admixture in the parent material. Levels of kaolinite and amorphous material suggest appreciable phosphorus-fixing properties.

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Physical Measurements*

Laboratory tests were carried out on soils from five series in Coanty Clare. Data are also included (Tables 22 to 24) for two other soils, Elton and Abbeyfeale Series, which were sampled in County Limerick, but are also widespread in County Clare.

Values measured in the laboratory included bulk density, with and without corrections for gravel and stone content, and water retention and air-filled pore volume at saturation and at moisture tensions of pF 1.30, 1.78, 2.15 and some higher tensions. These values are all for soil in the undisturbed state, but water retention at pF 4.2 was measured using sieved soil to estimate wilting-point moisture conten:. The value most commonly referred to in the following notes is the macropore space. This is taken as the percentage of soil volume which is occupied by air-filled pores at pF 1.78 and approximates to the volume of air in the soil at 'field capacity'.

Ballylanders Series: Map Location: 52 SE, C 16/17.

This soil has an excellent structure below 6 inches (15 cm) depth end will not show any drainage, aeration or root penetration problems. Water-holding capacity is high and crops should show good drought-tolerance except where the soil is shallow over rock or stony drift.

The surface soil is rich in organic matter and has a low density (0.(6 g/cm^3); there is also a slightly compacted zone at 2 to 4 inches (5 to 10 cm) depti. These features indicate that, like the Elton and Patrickswell Series, poaching could become a problem if stock have access to the land during wet periods.

Kinvarra Series: Map Location: 17 NE, Y 21.

Macropore space exceeds 12°,, from the surface down to 22 inches (56 cm) depth indicating that drainage and aeration problems will not occur on this soil- Bulk density figures are very high below 16 inches (40 cm) depth, but this is because the soil texture becomes gravelly rather than because of compact structure. Water retaining properties of the soil are rather low. particularly below 16 inches (40 cm) depth and drought could reduce yields in a dry season.

The macropore space at 2 to 4 inches (5 to 10 cm) depth is higher than in any of the other six profiles, indicating that poaching and compaction should not be a serious problem on this soil.

Elton S.ries: Map Location: R 64, 46 (Co. Limerick)

Bulk densities are low and there is no indication of compaction in the subsoil, at least as deep as 24 inches (60 cm). Macropore space exceeds 15% between 12 and 24 inches (30 and 60 cm) indicating that the soil is freely drained. A slight degree of compaction is apparent between 2 and 4 inches (5 and 10 cm), jtst below the soil surface. This indicates treading damage to topsoil structure by grazing stock in wet conditions. Despite good drainage, soil water-holding properties would dispose this soil to poaching and surface compaction if stocked during wet periods.

Available water capacity is high and drought problems are. therefore, minimal on Elton soils provided they are neither shallow nor excessively stony.

* This section was prepared by Dr. M. Jelley. An Foras Taliintais.

TABLE 22: Macropore volume* in some representative profiles

Depth		Soil Series						
inches	cm	**Bally-landers**	**Kin-varra**	Elton	Patricks-well	Abbey-feale	Gorta-clareen	**Kil-colgan**
0-2	0-5	13.7	**17.9**	15.7	14.3	14.0	**11.8**	**14.3**
2-A	5-10	8.6	12.3	8.1	8.1	8.7	6.3	9.7
4-6	10-15	9.6	12.6	9.3	8.9	5.8	9.6	13.4
6-8	15-20	14.3	12.6	11.8	9.0	2.2	9.0	**14.1**
8-12	20-30	14.3	14.5	13.2	11.1	3.8	nd	13.3
12-16	30-^tt)	nd**	15.4	15.8	12.3	2.9	6.5	14.0
16-20	40-50	21.2	15.6	15.4	11.3	3.9	4.6	nd
20-24	50-60	nd	13.2	17.1	13.2	2.7	4.5	nd
24-28	60-70	nd	nd	nd	23.1	2.0	4.3	nd

•Values represent the percentage volume of the soil occupied by large pores. The measurement is also known as the 'non-capillary porosity' or 'air capacity' of the soil. Values below 5 indicate severe compaction associated with drainage and aeration problems. Values from 5 to 7 also indicate compaction. With values from 7 to 11, drainage and aeration problems are unlikely to occur. Above 11 the soil is classed as porous and above 18 as very porous.

**Not determined.

TABLE 23: Bulk densities of representative profiles; data are given as g per cm^3 after correcting for stones larger than 2 mm

Depth		Soil Series						
inches	cm	Bally-landers	Kin-varra	Elton	Patricks-well	Abbey-feale	Gorta-clareen	**Kil-colgan**
0-2	0-5	0.66	0.81	0.73	0.81	0.46	0.74	0.87
1-4	5-10	0.92	1.06	1.07	1.10	0.68	**111**	1.15
4-6	10-15	1.07	1.09	1.15	1.22	0.88	1.31	**1.13**
6-8	15-20	1.04	1.15	1.21	1.31	1.37	1.45	**1.15**
8-12	20-30	1.22	1.28	1.24	1.37	1.26	nd	1.34
12-16	30-40	nd	1.33	1.41	1.29	1.40	1.63	1.51
16-20	40-50	1.15	1.69	1.48	1.40	1.58	1.68	nd
20-24	50-60	nd	1.83	1.38	**1.12**	1.43	1.65	nd
24-28	60-70	nd	nd	nd	1.05	1.54	1.70	nd

Patrickswell Series: Map Location: 2 SE, Q 27

The physical properties of this soil are almost similar to those of the Elton profile, although the Patrickswell subsoil below 17 inches (43 cm) is richer in clay. Bulk density is slightly high at 17 to 22 inches (43 to 56 cm) depth, but is remarkably low at 24 to 28 inches (60 to 70 cm) depth. This extremely porous horizon could be formed where limestone is being dissolved leaving loose residual material behind. Available water capacity is high and soil drainage is good, but there is evidence of current poaching damage and of a constant need to avoid topsoil compaction in intensive grazing management.

TABLE 24: Available water capacity of selected soils: data represent centimeters of available water held between pF 1.78 and pF 4.2 for horizons to a depth of 20 inches (50 cm)

Depth		Soil Series						
inches	cm	Bally-landers	Kin-varra	Elton	Patricks-well	Abbey-feale	Gorta-clareen	Kil-colgan
0-2	0-5	2.0	1.4	2.1	2.0	2.5	2.1	1.5
2-4	5-10	1.7	1.4	1.7	1.7	1.8	1.7	1.3
4-6	10-15	1.3	1.2	1.6	1.5	2.0	1.2	1.2
6-8	15-20	1.3	1.2	1.4	1.2	1.6	0.8	1.2
8-12	20-30	2.6	2.2	2.7	2.0	3.1	1.5	2.0
12-16	30-40	2.6	2.1	2.1	2.4	2.6	1.2	1.3
16-20	40-50	2.6	1.2	2.1	1.7	2.5	0.8	1.2
	Total	14.1	10.7	13.7	12.5	16.1	9.3	9.7

Abbeyfeale Series (non-Peaty Phase): Map Location: R 16, 28 (Co. Limerick)

The macropore space in this soil is below 4% except in the top 6 inches (15 cm) of the profile. This very compact structure results in low permeability to water, bad soil aeration and probably in mechanical impedance to root penetration. Because of the low macropore space and low permeability, tile drainage could only produce a marginal improvement in drainage and aeration. Furthermore, because the subsoil is generally rich in silt and fine sand, mole drains are unlikely to last long in this soil.

The low permeability of the subsoil results in the topsoil remaining waterlogged for much of the year. This causes shallow rooting of the sward species and leads to the development of a low density organic surface soil which is extremely likely to poach if fertilised and grazed intensively in wet conditions. As there is, as yet, no economic method of ameliorating the compact subsoil structure, reclamation measures for this soil should not go beyond improvements in surface drainage, fertilising to increase sward production and cutting or grazing only when the land is dry enough to withstand traffic or treading damage. Available water capacity of this soil is very high and grass production would not be reduced in a dry season.

Gortaclareen Series: Map Location: 52 NW, Q 33

Below 10 inches (25 cm) depth the subsoil exhibits a uniformly high density and low macropore space. This compact subsoil restricts root penetration, aeration and water movement. Tile drainage would not be an economic investment on such land, but where the soil does not contain many large rocks, mole drainage could have a beneficial effect. There is a greater depth (10 inches: 25 cm) of porous topsoil than in the Abbeyfeale profile and sufficient subsoil clay for the stability of mole drains to be high.

Although poaching would be a very serious problem in intensive use of pastures, the surface soil is likely to be firmer than in the Abbeyfeale Series, but weaker than in the well-drained Elton soils. Rather surprisingly, the wet Gortaclareen soil does not have a high available water capacity and pasture production could be limited by drought in a dry season.

Kilcolgan Series: Map Location: 17 NE, I 15/16

There are close similarities between the physical properties of the Kilcolgan and Kinvarra profiles. Both soils are adequately porous and are slightly low in available water storage for drought resistance and both show progressively coarser texture with depth. Bulk density in the subsoil below 14 inches (35 cm) depth is high. With good management poaching is not likely to be a serious problem on either soil.

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 specifically, it refers to the relative proportions of clay, silt and sand in the mineral fraction less than 2 millimeters in diameter. Texture, which is one of the more important of the soil'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. 13).

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.

5/7/ *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 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.

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

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'.

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 Silty 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, the size and the distinctness and durability of the aggregates. Shape and arrangement 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

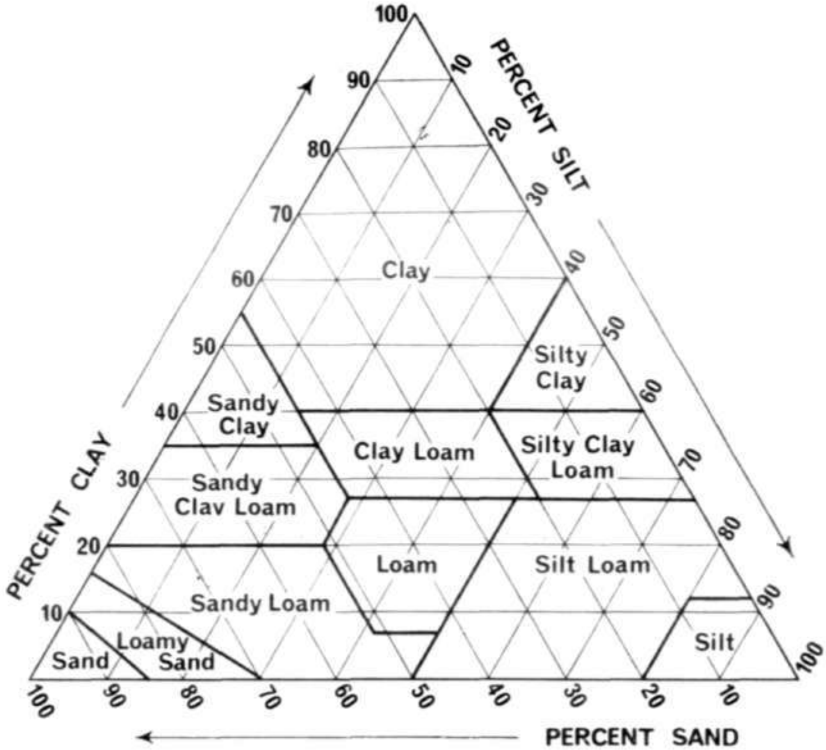

Figure 13: Chart showing the percentage of clay (less than 0.002 *mm), silt* (0.002 *to* 0.05 *mm) and sand* (0.05 *to* 2.0 *mm) in the basic soil texture classes (After Soil Survey Manual. L.S.D.A. Handbook No. 18, Washington, D.C., 1951)*

flat or curved surfaces giving a general block-like appearance. The ped surfaces here are accommodated by adjoining aggregates,

d) Spheroidal—with particles arranged around a point and bounded by curved or very irregular 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*—Poorly 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. *Strong*—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 hard but brittle and 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.

Cation Exchange Capacity

The cation exchange capacity, in its simplest terms, is an index of the capacity of a particular soil to adsorb and release cations such as hydrogen, calcium, magnesium, sodium and potassium. It is an indication of the ability of the soil to supply important nutrients to the growing plant, and of the crop response that can be expected to added nutrients in manurial amendments. The exchange capacity is governed chiefly by the organic matter and clay contents of the soil. Soils with high organic matter content usually have a high cation exchange capacity (25 to 40 meq/100 g of soil). The cation exchange capacity of a soil low in. or devoid of, organic matter is generally less than 12 meq/lOOg; here it is conditioned chiefly by the clay fraction.

Light sandy soils containing little organic matter or clay usually have a very low cation exchange capacity and, consequently, a low potential for retaining applied plant nutrients; hence the necessity for relatively frequent fertiliser dressings on these soils. Heavier textured soils, on the other hand, usually have a high cation exchange capacity and are capable of adsorbing and retaining larger quantities of applied nutrients especially calcium and potassium; the nutrients are slowly released to meet the needs of growing plants. On such soils, therefore, fertiliser and lime applications can be larger and less frequent.

Percentage Base Saturation end pH

The base saturation of the exchange complex of a soil is obtained by determining the total exchangeable bases (plant nutrients such as calcium, potassium, sodium, magnesium) and expressing the figure obtained as a percentage of the cation exchange capacity. As such it is an index of the base status of the soil.

The natural base status of a soil is inherited from the parent material but may be modified subsequently by weathering, leaching and other influences including cultural practices. Where the parent material is base-rich and leaching has not been excessive, the rate of release of bases by weathering is sufficient to offset losses through leaching, cropping and other outlets and to provide for a high base status profile. However, where rainfall is heavy and evapotranspiration low, or where the coarse nature of the soil permits excessive leaching, or where large amounts of bases are removed by intensive cropping, the base content of a soil may be considerably depleted. Low base status may also be an inherent characteristic of soils related to the acid nature of the parent material.

The base status of acid soils can be improved by liming, the amount necessary being determined by (a) the ability of the soil to adsorb bases—the cation exchange capacity—(b) the prevailing base status and (c) the desired base status. Certain fertilisers also supplement the base status of the soil. Many of the soils in County Clare are derived from base-rich parent materials, *e.g.*, limestone-rich glacial drift, but due to leaching the bases have been removed in many cases and especially from the upper horizons. Others are inherently acid. Application of lime would be a prerequisite to increased crop production on these soils.

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.

It is not intended that the pH and base saturation analyses given for each modal profile (Appendix II) be used as a basis for lime recommendations. For accurate recommendations random soil sampling and analyses are required. However, certain general conclusions can be drawn from the analyses provided, which reveal the variation in base status with soil depth and between different soils.

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 (Cx 1.72=organic matter). The content and nature of organic matter are of fundamental importance. Due to its high cation exchange capacity, organic matter is an ideal 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 of carbon to nitrogen (ON 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.

Cation Exchange Capacity: Determined by the method of Mehlich (1948). Soil was leached with buffered $BaCl_2$ to displace exchangeable cations, Ba displaced by $CaCl_2$, and K_2Cr0_4 was used in the colorimetric estimation.

Total Exchangeable Bases: Extracted by method of Mehlich (1948). Ca, Na and K estimated flamephotometrically, Mg by titan yellow method.

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

Total Neutralising Vu/u:: Determined on a HC1 extract using phenolphthalein as indicator and titrating against NaOH. $CaC0_3$ was used as a 100°/ standard.

Org ni • Cc.rbon: 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 Crange Filter No. 607. A recovery factor of 1.1 was used.

Tot/1 N.t.og n: Estimated by a modification of the method of Piper (1950) by digesting soil with conc. H_2S0_4 using selenium as a catalyst, distilling into boric acid and titrating with HC1.

Free ion: Extracted with buffered sodium hydrosulphite (Mehra and Jackson, I960). Fe determined colorimetrically using o-phenanthroline.

R f. rences

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APPENDIX II

PROFILE DESCRIPTIONS AND ANALYSES OF MODAL PROFILES

Baggotstown Scries

Location:	Clare, 43 NEM 12
Topography:	Gently rolling ground moraine beside ice-scoured lake
Slope:	2-3°
Altitude:	118 feet (36 m) O.D.
Drainage:	Excessive
Parent Material:	Fluvio-glacial material of Weichsel age and of limestone composition with a little-sandstone, shale and granite
Great Soil Group:	Brown Earth

Horizon	*Depth* (inches)	(cm)	*Description***
AI	0-10	0-26	Sandy loam; very dark greyish-brown (10 YR 3/2); moderate, fine crumb structure; friable; root mat in top 4 inches; clear, smooth boundary:
(B)	10-19	26-48	Sandy loam; dark yellowish-brown (10 YR 4/4); weak, line sub-angular blocky structure; friable; plentiful roots; clear, irregular boundary:
C	19-27	48-69	Gravelly sandy loam; very pale brown (10 YR 7/4); single-grain structure; friable; few roots; calcareous

Vegetation: *Centaureo-Cynosuretum,* typical Sub-ass. Old meadow with dense, grass dominant sward composed mainly of *Agrostls tenuis* (bentgrass) with lesser amounts of *Arrhenatherum elatius* (tall oat-grass), *Dactylis glomerata* (cocksfoot), *Festuca rubra* (red fescue), *Pkmtago lanceolata* (plantain) and *Trifoliumpratense* (red clover).

•National Soil Survey grid reference

•The procedure mostly followed is that described in the *Soil Survey Manual* (U.S. Dept. Agric. Handbook No. 18, Washington D.C. 1951). Colour designations are according to the Munsell colour notation. Colour, structure and consistence are measured on the moist soil unless otherwise stated

TABLE 1: Baggotstown Series

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	pH	Cation Exchange: CEC mcq/lOOg	TEB meq/lOOg	Base sat. %	Organic Fraction: C %	N %	C/N	Free iron %	TNV %
Al	27	34	29	10	6.1	19.0	14.86	78	2.3	0.25	9.2	0.8	
(B)	26	40	23	II	6.8	9.6	8.33	87	0.9	nd		0.7	
C	27	41	26	6	8.3	4.0		Sat.	0.2	nd		0.4	21.1

Coarse Sand 2.0-0.2 mm; Fine Sand 0.2-0.05 mm; Silt 0.05-0.002 mm; Clay 0.002 mm diameter size; CEC Cation Exchange Capacity; TEB Total Exchangeable Bases; C/N Ratio Carbon/Nitrogen Ratio; TNV Total Neutralising Value; nd not determined

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	2	10	2	2	35	10	35	25	3	30	750	250

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	7.0	5.1	0.22	218	2.7

Sn-Tin
Pb = Lcad
Ga = Gallium
Mo Molybdenum
V = Vanadium

Cu Copper
Zn Zinc
Ni Nickel
Co Cobalt
Cr Chromium

Ti = Titanium
Mn Manganese
B Boron
Se Selenium
ppm parts per million
< = less than

Ballincurra Series

1 oca t ion:	Clare, 52 SW, K15
Topography:	Rolling
Slope:	6
Altitude:	45 feet (14 m) O.D.
Drainage:	Well to excessively drained
Parent Material:	limestone glacial drift of Weiehsel age with some Old Red Sandstone and shale
Great Soil Group:	Brown Earth of high base status

*Horizon*f	*Depth* (inches)	(cm)	*Description*
Al	0-5 £	0-14	Loam to silt loam; brown (10 YR 5/3); moderate, line crumb structure; dry friable; root mat; clear, smooth boundary:
Bl	5H0A	14-27	Loam; yellowish-brown (10 YR 5/4); weak, fine crumb structure; friable when moist and dry; abundant roots; gradual, smooth boundary:
(B)	I0.J-17	27^3	Gravelly loam to silt loam; yellowish-brown (10 YR 5/6); weak, fine sub-angular blocky structure; moist, slightly plastic; plentiful roots; abrupt,irregular boundary:
R	Below 17	43	Limestone bedrock

Vegetation: *Centaureo-Cynosuretum*, Sub-ass. of *Galium verum*. Old, heavily grazed pasture dominated by *Agrostls tenuis*(bentgrass) and with *Anthoxanthum odoratum* (sweet vernal grass), *Cynosurus cristatus* (crested dog's tail) and *Festuca rubra* (red fescue) conspicuous. There are many indicators of acidity (surface) and low nutrient status present such as *Succisa pratcusis* (devil's bit). *SieglUlgla decumbent* (heath-grass) and *Rhytidiadclpluis squarrosus* (moss).

TABLE 2: Ballincurra Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coa isc- sand %	Fine sand %	Silt %	*I* lay **%**		CEC nicq/IOOg	TEB meq/IOOg	Base sat. ",,	**c%**	N ",,	C/N		
Al	14	9	51	26	5.8	27. ⊳	K.30	30	5.8	0.52	11.2	1.6	
Bl	19	13	45	23	6.2	15.4	8.70	56	1.5	0.17	8.8	1.5	-
(B)	18	18	50	14	6.9	12.2	10.50	86	I.I	0.13	8.5	1.7	

Trace **Elements**—i;xtractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co	B
A	2.5	•3.9	0.29	55	5.6	0.90

Ballynalackcn Series

Location:	Clare, 29 SE, M5
Topography:	Rolling, site is on side of kame
Slope:	3
Altitude:	135 feet (41 m) O.D.
Drainage:	Well drained
Parent Material	Silurian shale drift with some Old Red Sandstone, of Wcichsel age
Great Soil Group	Brown Earth

Horizon	*Dc-pth* (inches)	(cm)	*Description*
Al	0-9J	0-24	Gravelly, shaly loam; dark yellowish-brown (10 YR 4/4); moderate, fine crumb structure; wet, slightly sticky and moist friable; abundant roots; clear, smooth boundary:
(B)	9J-I4}	24-37	Shaly sandy loam; strong brown (7.5 YR 5/6); weak, line sub-angular blocky structure; moist friable and slightly sticky; plentiful roots; clear, smooth boundary:
C	I4J-23	37-59	Gravelly loamy sand; yellowish-brown (10 YR 5/8); weak, fine sub-angular blocky to single grain structure; moist friable and slightly sticky; few roots; abrupt, irregular boundary:
R	Below 23	59	Silurian shale boulders

Vegetation: Old pasture dominated by *Cynosurus crtstatus* (crested dog's tail), *Holcuslanatus* (Yorkshire fog) and *Anthoxanthum odoratum* (sweet vernal grass).

TABLE 3: Ballynalacken Series

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Sill ",	Clay ",,		CEC mcq/IOOg	TEB meq/IOOg	Base sat. %	c%	N ",,	C/N		
Al	30	21	31	18	5.4	20.8	5.28	25	3.4	0.37	9.2	1.4	
(B)	34	32	25	9	5.5	15.4	4.15	27	0.8	nd		1.2	-
(	38	37	19	<>	5.8	5.4	1.4	26	0.6	nd		0.8	

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	< 2	25	3	I	25	10	40	20	8	20	500	200

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	2.5	4.3	0.22	185	7.9

Ballynalackcn—Grey Variant

Location:	Clare, 20 NW, Dl I
Topography:	Rolling kame and kettle
Slope:	6
Altitude:	250 feet (76 m) O.D.
Drainage:	Well drained
Parent Material:	Silurian shale drift with some Old Red Sandstone-
Great Soil Group:	Brown Earth

Horizon	D,?pth (inches)	(cm)	*Description*
All	0-5	0-13	Shaly loam; dark greyish-brown (10 YR 4/2) with small, fine, obvious mottles of yellowish-red (5 YR 5/8); moderate, medium crumb structure; moist friable and slightly sticky; abundant roots; clear, smooth boundary:
AI2	5-12	13-30	Shaly loam; greyish-brown (10 YR 5/2); moderate, line crumb structure; friable: plentiful roots; clear, smooth boundary:
(B)	12-29	30-74	Shaly sandy loam; light grey (10 YR 7/2); massive structure; firm; few roots:
R	Below 29	74	Shale bedrock

Vegetation: Not classified.

TABLE 4: Ballynalacken—Grey Variant

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	pH	Cation Exchange: CEC meq/IOOg	TEB meq/IOOg	Base sat. %	Organic Fraction: C %	N %	C/N	Free iron %	TNV %
All	19	25	34	22	4.7	25.6	8.05	31	5.6	0.59	9.5	0.6	—
A12	27	23	32	18	5.2	16.0	3.47	22	2.2	0.20	11.0	0.7	—
(B)	27	28	30	15	5.7	15.0	2.96	20	0.4	nd	—	0.3	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	2	8	6	I	60	10	45	25	8	35	650	200

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
\	3.3	4.3	0.14	127	8.0

Ballylanders Series

location:	**Clare, 52 SE, C17/I8**
Topography:	Hillslope above a gently rolling valley floor
Slope:	S
Altitude:	700 feet (213 m) O.D.
Drainage:	Well drained
Parent Material:	Silurian shale drift with a little Old Red Sandstone, of Weichsel age
Great Soil Group:	Brown Earth

Hoi ton	*Depth* (inches)	(cm)	*Description*
All	0-3.1	0-9	Loam; brown (7.5 YR 5/4); moderate, fine crumb structure; friable; root mat; clear, smooth boundary:
AI2	3*-7J	9 19	Loam; brown to dark brown (7.5 YR 4/4); moderate, medium sub-angular blocky structure breaking into moderate, fine crumb; friable; clear, smooth boundary:
B1	/\-\b	19-41	Shaly loam; strong brown (7.5 YR 5/6); moderate, line sub-angular blocky structure breaking into moderate, line crumb; friable; diffuse roots; abrupt, broken boundary:
(B)	16-25	41-64	Shaly loam; dark yellowish-brown (10 YR 4/4); friable; few roots; structure and texture obscured by the shale fragments; abrupt, irregular boundary:
R	Below 25	64	Silurian shale

Vegetation: *Agrostis tennis* (bentgrass) and *Holcus lanatus* (Yorkshire fog) are the dominant species.

TABLE 5: Ballylanders Series

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Sill %	Clay %	pH	Cation Exchange: CEC meq/lOOg	TEB meq/lOOg	Base sat. %	Organic Fraction: C%	N %	C/N	Free iron %	TNV %
All	22	13	40	25	4.8	26.4	3.90	15	5.4	0.41	13.2	2.6	—
AI2	26	13	37	24	5.0	20.8	2.30	II	2.8	0.23	12.2	2.7	~
BI	28	20	33	19	5.3	16.0	2.00	13	1.3	0.13	10.0	1.9	-
(B)	35	14	29	22	5.2	19.0	2.55	13	1.4	0.14	10.0	2.2	—

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
All	<2	12	5	<1	45	10	25	30	4	25	860	300
AI2	<2	4	7	<I	35	8	25	3	4	30	1.500	350
BI	<2	<2	3	<I	25	10	25	3	3	25	800	250
Ranges in total contents (ppm) within series (data from two profiles)												
A	2	2-12	4-7	<1	30-45	8-10	25	3-30	3-4	25-45	800-1,500	200-350
B	2	2 2	3-7	<1	25-60	10-15	25	3-8	3-10		800-1,000	250-500
C	2	2	5	<l	60	25	25	10	14	65	1,000	600

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
	2.1	2.4	0.22	227	

liallylanders—Brown Pocizolic Variant

Location:	Clare, 52 SE, L3
Topography:	Shelf on hillside of moderate steepness (10°)
Slope:	3-4°
Altitude:	650 feet (198m)O.D.
Drainage:	Well drained
Parent Material:	Silurian shale drift with eolluvium of Old Red Sandstone
Great Soil Group:	Brown Podzolic

Horizon	*Depth* (inches)	(cm)	*Description*
Al	0-7	**0-18**	Gravelly, shaly loam; yellowish-brown (10 YR 5/6); moderate, fine crumb structure; friable; abundant roots; clear, smooth boundary:
B2ir	7-18	**18-^6**	Gravelly, shaly sandy loam; strong brown (7.5 YR 5/8); moderate, fine sub-angular blocky structure; friable; plentiful roots; no boundary apparent:
B22	I8-26J	**46-67**	Gravelly, shaly sandy loam; strong brown (7.5 YR 5/8); as above but with fewer roots; clear, irregular boundary:
B3	26A-36	**67-91**	Shaly sandy loam; brown (7.5 YR 5/4); moderate, fine sub-angular blocky structure: friable; few roots; dill use, smooth boundary:
C	Below 36	**91**	Glacial drift of Silurian shale with Old Red Sandstone pebbles

Vegetation: Not classified.

TABLE 6: Ballylanders— Brown Podzolic Variant

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fractioi			Free iron %	TNV /o
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/IOOg	Base sat. %	c%	N %	C/N		
Al	26	20	37	17	5.5	16.4	8.10	49	3.2	0.30	10.7	1.0	–
B2ir	43	18	25	14	5.7	16.3	5.40	33	I.I	0.12	9.2	2.5	-
B22	49	18	25	8	5.5	11.0	3.20	29	0.9	nd	-	1.5	-
B3	45	17	31	7	5.5	7.8	2.60	33	0.4	nd	-	1.0	-
C	-	-	-	-	-	-	-	-	-	-	-	-	-

Derk Series

Location:	Clare, 43 NW, I 14
Topography:	On glacial drift tail to a hill of volcanic ash in drumlin topography
Slope:	4 at base of 8 slope
Altitude:	198 feet (60 m) O.D.
Drainage:	Well drained
Parent Material:	Drift of felsitic ash with some limestone, of Wcichscl age
Great Soil Group	**Brown Earth**

Horizon	*Depth* (inches)	(cm)	*Description*
Al	**0-5**	**0-13**	Clay loam; brown (10 YR 5/3); moderate, fine crumb structure; friable; abundant roots; clear, wavy boundary:
A3	**5-16**	**13 41**	Gravelly clay loam; yellowish-brown (10 YR 5/6); weak, coarse breaking into weak, fine sub-angular blocky structure; moist plastic; plentiful roots; gradual, smooth boundary:
(B)	**16-28**	**41-71**	Gravelly clay loam; strong brown (7.5 YR 5/6); weak, coarse sub-angular blocky structure; moist plastic; plentiful roots; clear, smooth boundary:
B3	**28-46**	**71-117**	Clay loam; strong brown (7.5 YR 5/6); massive structure; wet plastic; many roots; calcareous; clear, smooth boundary:
C	**46 53**	**117-135**	Sandy loam; strong brown (7.5 YR 5/8); massive structure; wet sticky; few roots; calcareous

Vegetation: The dominant species are *Trifolium repens* (white clover), *Lolium perenne* (perennial ryegrass), *Holcus lunutus* (Yorkshire fog) and *Agrostls tenuis* (bentgrass). Other species present indicate low soil fertility. These include *Hypochaeris radicata* (cat's ear), *Luzulu campestris* (field woodrush) and *Senecio jacobea* (ragwort). Creeping thistle *(Cirsium arvense)* is common in some pastures.

TABLE 7: Derk Series

Horizon	Particle size analysis of mineral fraction: ('oarse sand %	Fine sand %	silt %	Clay %	pH	Cation Exchange: CEC meq/IOOg	TEB meq/lOOg	Base sat. %	Organic Fraction: C%	N %	C/N	Free iron "„	TNV V
Al	18	18	29	35	6.2	41.8	31.69	76	4.6	0.57	8.1	4.0	
A3	17	17	30	36	6.5	27.8	21.21	76	1.6	0.25	6.4	4.0	
(B)	16	18	39	27	6.9	16.0	12.39	77	0.7	nd		4.1	
B3	19	21	33	27	7.8	15.4		Sat.	0.7	nd		3.8	4.2
C	36	17	28	19	7.9	10.2		Sat.	0.6	nd		4.1	4.3

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn	Se
A	<2	3	10	2	40	40	90	90	35	85	4,500	1,000	1.8

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	
	11.5	4.3	1.25	349	0.90

Kilfcrgus Series

Location:	Clare. 30NE, ZI7
Topography:	Rolling landscape (subdued kame and kettle of end moraine, kettle holes filled with peat)
Slope:	*2*
Altitude:	130 feet (40m) O.D.
Drainage:	Well drained
Parent Material:	Derived from shales and sandstones from the Upper Carboniferous, of Weichsel age
Great Soil Group:	Brown Earth of medium base status

Horizon ;	D,•*pth*		*Description*
	(inches)	(cm)	
All	0-3	0-8	Organic clay loam to silty clay loam; dark greyish-brown (10 YR 4/2); moderate, fine crumb structure; moist friable and slightly plastic; mot mat; clear, smooth boundary:
AI2	3-8	8-20	Clay loam; brown to dark brown (10 YR 4/3); weak, tine crumb structure; moist, slightly plastic and slightly friable; plentiful roots; gradual, smooth boundary:
(B)	8-12	20-30	Shaly clay loam; dark yellowish-brown (10 YR 4/4); weak, fine sub-angular blocky structure; moist slightly plastic; many roots; clear, smooth boundary:
C	12-20	30-51	Shale and sandstone gravel

Vegetation: *Centaureo-Cynosuretn/n,* typical Sub-ass. Old, poor quality meadow. Weedy sward dominated by *Agrostis tenuis* (bcntgiass) and *Anthoxanthum odorutum* (sweet vernal grass). *Centaurea nigra* (knapweed) and *Dactyiorchis spp.* (orchids) are very common.

TABLE 8: Kilfergus Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse •and %	Fine sand %	Silt %	Clay %		CEC meq/IOOg	II H meq/IOOg	Base sat. %	c%	N %	C/N		
All	10	10	4ft	34	5.1	36.8	9.90	27	8.6	0.69	12.5	2.6	–
A12	13	II	44	32	5.2	27.4	8.70	32	5.9	0.42	14.0	2.5	-
(B)	14	II	42	33	5.6	24.5	8.40	34	3.5	0.30	11.7	2.6	-
C	49	4	44	3	5.9	18.0	6.90	38	2.2	0.15	14.7	2.2	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn	Se
A	2	10	10	l	60	18	40	8	6	45	1,200	650	0.7

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co	B
	4.4	5.2	0.72	290		1.5

Kinvarra Scries

Location:	Clare, 2 SW, UIO
Topography:	Footslopes of Burren Hills, slopes of 8' predominate
Slope:	8
Altitude:	98 feet (30 m) O.D.
Drainage:	Well drained
Parent Material:	Drift of limestone origin with some granite, of Weichsel age
Great Soil Group:	Brown Earth of high base status

Hoi; \zon	*Depth* (inches)	(cm)	*Description*
Al	0-3 *k*	0-9	Organic, gravelly loam; dark yellowish-brown (10 YR 3/4); moderate, fine crumb structure; friable; abundant roots; calcareous; gradual, smooth boundary:
(B)	3 J-8	9-20	Gravelly sandy loam; reddish-brown (5 YR 5/4); weak, line sub-angular blocky structure; moist plastic; plentiful roots; calcareous; clear, irregular boundary:
C	8-17i	20-44	Gravelly clay loam; white; with streaks of light brownish-grey (10 YR 8/2 and 6/2); massive structure; moist plastic; few roots

Vegetation: *Centaureo-Cynosuretum*, Sub-ass. of *Galium verum.* Poor, species-rich old meadow. The dominant species arc *Anthoxanthum odoratum* (sweet vernal grass[1]. *Trlfolium proteose* (red clover), *Festuca rubra* (red fescue) and *Plantago lanceolate* (plantain). Many colourful herbs present, notably *Primula verts* (cowslip) and *DactylorchU fuchsl* (orchid).

TABLE 9: Kinvarra Series

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	PH	Cation Exchange: CEC meq/lOOg	TEB meq/lOOg	Base sat. %	Organic Fraction: C%	N %	C/N	Free iron %	TNV %
A l	21	26	34	19	7.4	42.2	33.6	80	8.9	0.68	13.1	0.9	13.0
(B)	25	28	35	12	7.8	19.2	17.3	90	3.9	0.25	15.6	0.5	37.7
C	17	21	34	28	8.3	3.5	6.9	Sat.				0.1	91.5

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
Al	< 2	2	< l	< 1	10	7	30	18	5	**12**	530	850
(B)	2	10	1	1	20	12	30	18	3	25	700	650
C	2	< l	< 1	1	20	< 2	25	5	< 1	3	150	SO
Ranges in total contents (ppm) within series (data from six profiles)												
A	<2-2	<2-15	1-8	1-2	10-75	5-50	25-65	5-60	5-12	12 40	200-1,800	220-1,300
B	2-3	10-20	1-4	1-2	20-70	12^0	30-85	18-70	3-15	25-45	650-1,500	170-1,500
C	2	<1-8	<l-2	<l	20-75	2-20	25	5-60	<2-4	3 35	150-1,000	90-200

Extractable contents (ppm)

Modal profile

Horizon	Cu	Zn	Mo	Mn	Co
	1.8	5.2	0.22	325	4.2

Ranges within series (four profiles)

Horizon	Cu	Zn	Mo	Mn	Co
A	1.8-36.0	5.0-7.4	0.13-0.44	242-325	4.2-9.4

Kinvarra—Poihol Variant

Location:	Clare, 2 SW, N/O 18/19
Topography:	Steep slope on valleyside above old water channel
Slope:	8
Altitude:	575 feet (175 m) O.D.
Drainage:	Well drained
Parent Material:	Drift of Weichsel age composed of limestone with some granite
Great Soil Group:	Podzol

Horizon	*Depth* (inches)	(cm)	*Description*
Al	0-8	0-20	Organic clay loam; dark grey (10 YR 4/1); moderate, line crumb structure; friable; root mat; clear, irregular boundary:
A2	8-19	20-48	Loam; greyish-brown (10 YR 5/2); weak, coarse angular blocky structure tending towards prismatic; friable: plentiful roots; abrupt, irregular boundary:
B2lir	19	48	Ironpan:
B22ir	19-24	48-61	Loam to clay loam; yellowish-brown (10 YR 5/6); weak, line sub-angular blocky structure; moist, slightly sticky; few roots; clear, irregular boundary:
B23ir	24-31	61-79	Gravelly clay loam; yellowish-brown (10 YR 5/8); massive structure; moist plastic; few roots; abrupt, smooth boundary:
B2h	31-33	79-84	Clay loam; very dark greyish-brown (10 YR 3/2); weak, fine crumb structure; moist sticky; few roots; calcareous; abrupt, smooth boundary:
C	Below 33	84	Stony, gravelly sandy loam; light grey (10 YR 7/1); massive structure; moist friable; no roots

Vegetation: Noi classified.

TABLE 10: Kinvarra—Podzol Variant

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Orgainic Fracl			Free iron %	TNV /o
	Coarse Mind %	Fine sand %	Silt %	i %		Cl C meq/IOOg	11 B meq/IOOg	Base sat. %	C %	N %	C/N		
Al	11	22	39	28	7.3	15.0	15.9	Sat.	1.0	0.16	6.3	2.7	2.0
A2	11	21	43	25	6.0	14.0	6.12	44	0.6	0.12	5.0	2.8	-
B22ir	II	21	41	27	5.3	21.4	2.96	14	1.4	0.17	8.2	3.7	-
B23ir	12	22	42	24	5.1	19.6	2.59	13	2.6	0.24	10.8	2.2	-
B2h	10	23	39	28	5.0	29.6	4.22	14	7.0	0.55	12.7	2.0	-
C	-	-	-	-	-	-	-	-	-	-	-	-	-

Knocknaskeha Series

Location:	Clare, 43 NE, 112
Topography:	Flat to nearly flat sheet of glacial drift in drumlin topography beside lake
Slope:	1°
Altitude:	115 feet (35 m) O.D.
Drainage:	Well drained
Parent Material:	Mixed drift of limestone-sandstone composition, of Wcichsel age
Great Soil Group:	Brown Earth

Horizon	*Depth*		*Description*
	(inches)	(cm)	
All	0-5	0-13	Sandy loam; dark yellowish-brown (10 YR 3/4); weak, fine crumb structure; friable; root mat; gradual, smooth -boundary:
AI2	5-8J	13-22	Sandy loam; brown to dark brown (10 YR 4/3); weak, medium sub-angular blocky breaking into weak, tine crumb structure; friable; plentiful roots; gradual, smooth boundary:
(B)	8 H 3	22-33	Sandy loam; brown (10 YR 5/3); weak, medium sub-angular blocky structure; moist friable to loose; many roots; gradual, smooth boundary:
B3	13-161	33-42	Sandy loam; dark yellowish-brown (10 YR 4/4); weak, medium and fine sub-angular blocky structure; moist loose; many roots; gradual, irregular boundary:
C	16.1-35	42-89	Sandy loam; light yellowish-brown (10 YR 6/4); massive when moist, single grain when dry; moist loose; few roots

ion: *Centaureo-Cynosuretum*, Sub-ass. of *Galium verum*. Old meadow. Stemmy, species-rich sward dominated b> *ivstuca rubra* (red fescue), *Anthoxanthum odoratum* (sweet vernal grass), *Aurostis tenuis* (bentgrass), *Trifotium spp.* (clovers) and *Plantago lanceo/ata* (plantain).

TABLE 11: Knocknaskeha Series

Horizon	Particle size analysis of mineral fraction					Catiion Exchange			Organic Fraction				
	Coarse sand "„	Fine sand %	Sill	Clay %	PH	CEC meq/IOOg	TEB meq/IOOg	Base sat. %	c%	N %	(N	Free iron %	TNV /o
AII	34	36	22	8	5.6	15.4	4.77	31	2.4	0.26	9.2	0.6	–
AI2	31	37	23	9	5.7	12.2	4.80	39	1.4	0.13	10.8	0.6	-
(B)	30	40	22		6.0	8.6	4.7,	55	1.1	G.G9	12.2	0.7	-
B3	28	38	26	8	6.1	10.2	4.18	41	0.9	nd	-	0.6	-
C	29	40	23	8	6.9	6.8	3.64	54	0.8	nd		0.6	—

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	<2	7	1	1	20	20	60	8	2	30	S50	170

Extractable contents (ppm)

Mori/on	Cu	Zn	Mo	Mn
	8.8	3.3	0.22	156

Tullig Scries

Location: Clare, 65 NE, 6/M 5
Topography: Lower slopes of hillside subjected to solifluction
Slope: 4
Altitude: 280 feet (85 m) O.D.
Drainage: Moderately well drained
Parent Material: Colluvium derived from shales and sandstones of the Upper Carboniferous
Great Soil Group: Brown Earth with gleying

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-4	0-10	Shaly clay loam; brown to dark brown (10 YR 4/3); weak, fine crumb structure; friable; root mat; clear boundary:
A12	4 91	10-24	Shaly clay loam; brown to dark brown (10 YR 4/3); weak, medium sub-angular blocky structure tending towards prismatic; friable; plentiful roots; clear, smooth boundary:
(B)	9J-13i	24-34	Shaly clay loam; brown todark brown (10 YR 4/3) on outside ped faces, when broken they are yellowish-brown (10 YR 5/8); weak, medium sub-angular blocky structure which breaks into weak, fine sub-angular blocky; friable; plentiful roots; clear, smooth boundary:
B3g	13.1 IS	34-46	Shaly clay loam; light brownish-grey (10 YR 6/2) with faint, fine, few mottles of brownish-yellow; weak, medium sub-angular blocky structure breaking into weak, fine angular blocky; dry loose and moist friable; few roots; clear, smooth boundary:
Cg	18-26	46-66	Shaly loam; greyish-brown (10 YR 5/2) with common, medium, faint mottles of strong brown (7.5 YR 5/8); massive structure breaking into weak, fine sub-angular blocky; dry loose and moist friable; very few roots

Vegetation: *Centuureo-Cynosuretum,* typical Sub-ass. Old, moderate quality pasture in which *Agrosiis tenuis* (bcntgrass), *Cynosurus crislatus* (crested dog's tail). *Festucci rubra* (red fescue) and *Trifolium spp.* (clovers) are abundant. *Senecio jacobeu* (ragwort) a very conspicuous weed in late summer.

TABLE 12: Tullig Series

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	pH	Cation Exchange: CEC meq/ICOg	TEB meq/IOOg	Base sat. %	Organic Fraction: c%	N ",,	C/N	Free iron %	TNV %
All	7	22	43	28	6.6	51.2	28.1	56	6.0	0.57	10.5	2.5	–
AI2	7	22	43	28	5.3	23.4	5.8	25	2.3	0.28	8.2	2.7	-
(B)	6	15	45	32	5.4	22.8	7.3	32	1.6	0.21	7.6	4.1	-
B3g	10	13	47	30	5.5	20.8	7.6	37	1.0	0.17	5.9	3.6	-
Cg	21	14	41	24	5.8	15.4	5.8	44	0.6	nd	—	2.1	—

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn	Se
A	< 2	7	7	1	35	12	25	6	3	45	500	160	0.7

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co	B
	6.7	2.1	0.47	97	2.2	1.40

Waterpark Series

Location:	Clare, 2IASW, xn
Topography:	A small shale hill in drumlin topography
Slope:	6°
Altitude:	180 feet (55 m) O.D.
Drainage:	Well drained
Parent Material:	Drift of Weichscl age, composed of calcareous Carboniferous shale and limestone over calcareous shale rock
Great Soil Group:	Brown Earth of high base status

Horizon	*Depth* (inches)	(cm)	*Description*
Ap	0-4J	0-11	Loam; greyish-brown (10 YR 5/2); weak, line crumb structure; friable; root mat: smooth boundary:
Al	4.J-8	II 20	Loam; brown (10 YR 5 3); very weak, fine crumb structure; friable; plentiful roots; clear, wavy boundary:
(B)	8-15	20-38	Shaly loam; pale brown-(10 YR 6/2) with dark grey (2.5 N 4/-) shale fragments; weak, fine sub-angular blocky structure; moist, plastic; plentiful roots; clear, irregular boundary:
CI	15-23	38-58	Shaly loamy sand; light yellowish-brown (10 YR 6 4); weak, fine angular blocky structure; friable; some roots; clear, irregular boundary:
C2	23-35	58-89	Shaly sandy loam; very pale brown (10 YR 7/3): single grain structure; moist friable to loose; abrupt, irregular boundary:
R	Below 35	89	Shale bedrock

Vegetation: *Centaureo-Cynoswretum* typical Sub-ass. Old, moderate quality meadow dominated by *Agrostis tenuis* (bentgrass). *Dai tylisghmerata* (cocksfoot) and *Holcus lanatus* (Yorkshire fog). The low fertility of the site is shown by the abundance of *Centauiea nigra* (knapweed), *Plantago lanveolaia* (plantain) and *Lotus vornicuhilus* (bird's-foot trefoil).

TABLE 13: Waterpark Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/100g	II B meq/100g	Base sat. %	C %	N %	C/N		
Ap	21	20	37	22	6.3	22.8	19.4	84	3.0	0.31	9.7	1.8	—
A1	23	20	35	22	6.7	21.8	20.1	92	2.2	0.22	10.0	1.8	-
(B)	27	23	33	17	7.2	14.6	-	Sat.	0.8	nd	-	2.3	0.0
C1	38	41	14	7	7.5	8.0	-	Sat.	0.4	nd	-	0.9	0.0
C2	30	40	22	8	7.8	9.6	—	Sat.	0.7	nd	—	1.3	0.0

Elton St ris

I ocation:	Clare, 2 SE, R27
Topography:	Gently rolling. Site is near base of drumlin
Slope:	3
Altitude:	65 feet (20 m) O.D.
Drainage:	Well drained
Parent Material:	Limestone drift of Weichsel age with some granite
Great Soil Group:	Minimal Grey Brown Podzolic

Horizon	*Depth*		*Description*
	(inches)	(cm)	
All	0-5	0-12	Gravelly loam; dark yellowish-brown (10 YR 4/4); moderate, line crumb structure: friable; root mat poorly developed; clear, smooth boundary:
AI2	5-17	**12^3**	Gravelly loam; dark yellowish-brown (10 YR 4/4); moderate, fine crumb structure: friable; few roots; clear, smooth boundary:
A2	17-25	43-64	Gravelly sandy loam; yellowish-brown (10 YR 5/4): massive structure; firm; few roots: clear, smooth boundary:
B2l	25-34	64 86	Gravelly silt loam; light yellowish-brown (10 YR (>4); weak, fine sub-angular to angular blocky structure; moist plastic; few roots: calcareous; clear, smooth boundary:
(	34-48	86-122	Gravelly loam; white (10 YR 8/2) with streaks of light yellowish-brown (10 YR 6/4) from above; massive structure; friable; no roots; calcareous

ition: *Centaureo-Cynosuretum*, Sub-ass of *Galium verum*. Old, heavily grazed pasture dominated by *Agrostis tenuis* (bentgrass), *Cynosurus cristatus* (crested dog's tail), *Lolium persnne* (perennial ryegrass). *Poa irivialis* (rough-stalked meadow-grass) and *Trlfollum repens* (white clover). Weeds such as *Cirsium anense* (creeping thistle), *Hypochaeris radlcata* (cat's ear) and *Ranunculus hulhosus* (bulbous buttercup) are common.

TABLE 14: Elton Series

Horizon	Particle size analysis of mineral fraction					Cation Exchange			Organic Fraction				
	Coarse sand %	Fine sand %	**Silt** %	**Clay** %	pH	CEC meq/lOOg	**TEB** meq/IOOg	Base sat. %	C%	N %	**C/N**	Free iron %	**TNV** %
All	14	30	34	**22**	6.0	23.4	nd		3.1	0.37	8.4	1.1	
AI2	18	28	33	**21**	6.0	**14.6**	nd		1.5	0.18	8.3	1.2	
A2	10	43	30	17	6.2	8.0	nd		0.7	0.11	6.4	1.2	
B2t	2	21	51	26	7.3	10.8	nd		0.5	0.08	6.3	1.4	3.5
C	9	37	38	16	7.8	5.0	nd		0.4	0.C4	10.0	0.3	54.6

Trace elements—total contents (ppm)

Horizon	Sn	Pb	Ga	**Mo**	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
All	6	18	**15**	**3**	100	**20**	**80**	50	10	50	2.0C0	850
A12	2	8	5	**1**	35	8	40	40	5	20	1,000	250
A2	2	15	5	I	35	8	35	40	7	35	1,500	300
B2t	2	5	8	l	70	18	35	35	10	30	1,500	200
C	2	2	1	l	5	3	25	15	2	12	650	100
Ranges in total contents (ppm) within series (data from six profiles)												
A	2 6	4-20	3-15	1-3	35-100	5-50	25 100	10-50	4-10	20-50	650-2.COO	2CC-1,200
A2	2	15	**4-8**	• 1-2	20-40	8-15	25-35	20-40	3-8	15-75	1,000 |,5C0	2CO-3CO
B	2 5	2-30	1 20	1-2	25-100	10-25	25 120	25-75	3-15	10-60	700-3,5CO	120-1,500
C	2	2-12	I 3	1-2	5-60	3-15	25	15-60	2-10	12-45	650-1,800	100-200

Extractable contents (ppm)

Modal Profile

Horizon	Cu	Zn	**Mo**	Mn	Co
A	**2.5**	**3.8**	**0.07**	**198**	**4.9**

Ranges within series (six profiles)

Horizon	Cu	**Zn**	Mo	Mn	Co
A	**2.5-12.7**	**3.3-14.9**	**0.07-0.42**	**159-375**	1-8

KUftflora Scries

Location:	Clare, 16 NW, FI4
Topography:	Drumlin topography with rolling slopes
Slope:	**3**
Altitude:	190 feet (58 m) O.D.
Drainage:	Moderately well drained
Parent Material:	Weichsel drift derived from limestone and Upper Carboniferous shales
Great Soil Group:	Minimal Grey Brown Podzolic

Horizon	*Depth* (inches)	(cm)	*Description*
All	**0-6**	**0-15**	Gravelly clay; very dark greyish-brown (10 YR 3/2) with few, fine, faint mottles of yellowish-brown (10 YR 5/8); weak, fine crumb structure; friable; abundant rooting; gradual, smooth boundary:
AI2	**6-10**	**15-25**	Gravelly clay; dark greyish-brown (10 YR 4/2); calcareous; otherwise as above:
B2t	**10-25**	**25-64**	Gravelly clay; dark yellowish-brown (10 YR 4/4); weak, medium sub-angular blocky structure; friable; plentiful roots; calcareous; clear, irregular boundary:
CI	**25-35**	**64-89**	Gravelly clay loam; pale brown (10 YR 6/3); single grain to massive structure; moist, slightly plastic; few roots; calcareous; gradual, smooth boundary:
C2	**35-39**	**89-99**	Gravelly clay loam; very pale brown (10 YR 7/4); massive structure; moist plastic; no roots; calcareous

Vegetation: *Ceiiiaureo-Cyno.suretum,* typical Sub-ass. Old pasture. Moderate quality, heavily grazed, sward dominated by *Cynosurus cristatus* (crested dog's tail) and with *Loiium pereime* (perennial ryegrass) and *Trifolium repctts* (white clover) conspicuous.

TABLE 15: Kilfenora Series

Horizon	Particle size analysis of mineral fraction					Cation Exchange			Organic Fraction				
	Coarse-sand %	Fine sand %	Silt ",,	Clay %	PH	CEC meq/lOOg	TEB meq/lOOg	Base sat. ",,	C %	N ",,	C/N	Free iron %	TNV
All	II	13	32	42	6.6	43.6	nd		4.6	0.53	8.7	3.7	
AI2	12	14	31	43	7.1	32.0	nd		2.4	0.31	7.7	3.7	4.7
B2t	7	12	32	49	7.3	22.8	nd		1.2	0.15	8.0	3.6	18.2
CI	9	17	35	39	7.5	6.2	nd		0.5	0.05	10.0	1.0	75.4
C2	13	17	32	38	7.7	6.2	nd		0.5	0.05	10.0	0.9	76.2

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Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	2	12	B	2	105	40	70	45	15	40	700	1.000

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
	20.6	9.5	1.04	338	15

Patrickswell Series

Location:	Clare, 2 SE, Q27
Topography:	Gently rolling, subdued drumlin
Slope:	2
Altitude:	70 feet (21 m) O.D.
Drainage:	Well drained
Parent Material:	Drift of Weichsel age composed of limestone with a small proportion of granite
Great Soil Group:	Grey Brown Podzolic

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-4	0-10	Loam; brown to dark brown (10 YR 4/3); moderate, fine crumb structure; friable; root mat; clear boundary:
AI2	4-15	10-38	Loam; dark yellowish-brown (10 YR 4/4); weak, line crumb structure; friable: abundant roots; clear, irregular boundary:
Bl	15-20	38-51	Loam; yellowish-brown (10 YR 5/4) to light yellowish-brown (10 YR 6/4); weak, medium angular blocky structure; slightly firm, slightly friable; plentiful roots; clear, smooth boundary:
B2t	20-25	51-64	Clay loam; yellowish-brown (10 YR 5/4); weak, medium sub-angular blocky structure; slightly friable; many roots; clear, smooth boundary:
C	25-30	64-76	Stony, gravelly loam; light grey (10 YR 7/1); massive structure; friable; no roots; calcareous

Vegetation: *Centaurco-Cynosuretum,* Sub-ass. of *Galium verum.* Poor, old meadow with a short, stemmy sward composed mainly of *Festuca rubra* (red fescue), *Agrostis tenuis* (bentgrass) and *Anthoxanthum ocloratum* (sweet vernal grass). Abundant herbs are *Plantago lanccolata* (plantain). *Ranunculus bulhosus* (bulbous buttercup) and *Dactylorchis majalis,* spp. *occiclcntalis,* this latter being confined to the south western counties.

TABLE 16: Patrickswell Series

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt "„	Clay %	PH	Cation Exchange: CEC meq/IOOg	TEB meq/lOOg	Base sat. %	Organic Fraction: C%	N %	C/N	Free iron %	TNV %
All	15	29	36	20	6.3	19.6	nd	–	3.6	0.35	10.3	1.6	–
AI2	15	28	35	22	6.3	14.2	nd	-	1.2	0.18	6.7	1.5	-
Bl	7	26	42	25	6.7	12.8	nd	-	0.7	0.10	7.0	1.8	-
B2t	8	23	41	28	6.8	15.0	nd	-	0.5	0.10	5.0	2.3	-
C	19	25	31	25	7.8	11.2	nd	—	0.3	0.04	7.5	0.3	84.3

Trace Elements—total contents (ppm)

Horizon	**Sn**	**Pb**	**Ga**	**Mo**	**V**	**Cu**	**Zn**	**Ni**	**Co**	**Cr**	**Ti**	**Mn**
All	**<2**	**4**	**3**	**nd**	**25**	**7**	**35**	**20**	**6**	**20**	**600**	**350**
A12	**2**	**15**	**5**	**2**	**80**	**10**	**80**	**40**	**8**	**35**	**1,200**	**300**
Bl	**<2**	**15**	**5**	**1**	**50**	**7**	**65**	**35**	**6**	**25**	**750**	**200**
B2t	**<2**	**4**	**1**	**1**	**20**	**5**	**• 25**	**18**	**3**	**20**	**450**	**150**
C	**<2**	**<2**	**1**	**!**	**50**	**2**	**<25**	**2**	**<1**	**10**	**250**	**75**

Ranges in total contents (ppm) within series (data from five profiles)

	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	**<2-4**	**2-30**	**1-8**	**<l-2**	**10-80**	**7-35**	**35-170**	**6-100**	**2-12**	**6-40**	**350-1,800**	**200-3,000**
B	**: **	**4-18**	**1-20**	**1 2**	**20-100**	**5-18**	**25-80**	**18-85**	**3-15**	**20-40**	**450-1,200**	**150- 500**
C	**2 3**	**<2-20**	**<l-4**	**< 1-2**	**5-50**	**2-50**	**<25-250**	**2-75**	**<1-15**	**10-80**	**250-1,800**	**75- 220**

Extractable contents (ppm)

Modal profile

Horizon	**Cu**	**Zn**	**Mo**	**Mn**	**Co**
A	**1.9**	**2.6**	**0.14**	**235**	**5.6**

Ranges within series (five profiles)

Horizon	**Cu**	**Zn**	**Mo**	**Mn**	**Co**
A	**1.3-8.2**	**2.6-9.1**	**0.04-0.25**	**91-485**	**2-12**

Patrickswell Series—Lithic Phase

Location:	Clare, 33 NW, F22
Topography:	Stepped hillside above drumlin-filled valley
Slope:	1J
Altitude:	152 feet (46 m) O.D.
Drainage:	Well drained
Parent Material:	Drift of Weichsel age composed of Carboniferous limestone, with some sandstone and shale
Great Soil Group:	Minimal Grey Brown Podzolic

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-4	0-10	Clay loam; strong brown (7.5 YR 5/8) and grey (10 YR 5/1), common, fine and distinct mottles; weak, fine crumb to weak, fine sub-angular blocky structure; moist friable to moist, slightly plastic; root mat; gradual, smooth boundary:
AI2	4-9	10-23	Gravelly clay loam; brown to dark brown (10 YR 4/3); weak, fine to medium sub-angular blocky structure; friable; abundant roots; gradual, smooth boundary:
Bl	9-17	23-43	Gravelly clay loam; dark yellowish-brown (10 YR 4/4); weak, medium to fine sub-angular blocky structure; friable; plentiful roots; gradual, smooth boundary:
B2t	17-25	**43-64**	Stony clay loam; brown to dark brown (7.5 YR 4/4); weak, medium sub-angular blocky structure; moist plastic; many roots; clay skins apparent on the peds; abrupt, irregular boundary:
IIR	Below 25	64	Limestone bedrock

Vegetation: Not classified.

TABLE 17: Patrickswell Series—Lithic Phase

	Particle size analysis of mineral fraction					Cation Exchange			Organic Fraction				
Horizon	Coarse sand %	Fine sand %	Silt %	• %	pH	CEC meq/lOOg	TEB meq/lOOg	Base sat. %	c%	N %	C/N	Free iron %	TNV %
All	II	17	42	30	5.6	31.0	nd	–	4.2	0.51	8.2	2.3	–
A12	13	17	41	29	5.0	24.6	nd	-	2.7	0.36	7.5	2.6	-
Bl	12	16	40	32	5.1	25.6	nd	-	1.3	0.25	5.2	3.2	-
B2t	8	14	43	35	5.4	20.8	nd	-	I.I	0.16	6.9	3.6	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn	Se
A	2	16	8	3	55	20	90	25	12	35	1,200	900	0.8

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	4.75	3.3	2.3	420	9

Patrick swell—Podzol Variant

Location:	Clare, 35 SE, M34
Topography:	Drumlin
Slope:	15"
Altitude:	140 feet (43 m) O.D.
Drainage:	Well drained
Parent Material:	Limestone drift of Weichsel age with a high proportion of sandstone
Great Soil Group:	Podzol

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Horizon r	*Depth* (inches)	(cm)	*Description*
All	f>4	0-10	Sandy loam; dark brown (10 YR 3/3); weak, fine crumb structure; friable; plentiful roots; gradual, smooth boundary:
A12	4-11	10-28	Sandy loam; dark brown (10 YR 3/3); single grain structure; friable; many roots; clear, smooth boundary:
A2	11-15	28-38	Sandy loam; light grey and white (10 YR 7/2 and 8/2); single grain structure which is indurated; firm; few roots; abrupt, smooth boundary:
Bl	15 19	38-48	Sandy loam; pale brown (10 YR 6/3); massive structure; firm; no roots; clear, irregular boundary:
B2ir	19-23	48-58	Sandy loam; yellow (10 YR 7/6); weak, very fine crumb structure; moist plastic; no roots; clear, regular boundary:
CI	23-39	58-99	Sandy loam; grey or red-brown with speckles through it; massive structure; moist plastic and slightly friable; no roots; gradual, smooth boundary:
C2	39-53	99-135	Sandy loam; brown (7.5 YR 5/4); massive structure; friable; no roots

Vegetation. *Centaureo-Cynosuretum,* Sub-ass. *of Juncus effusus*. Old meadow showing very poor growth. Species-rich sward dominated by *Festuca rubra* (red fescue) and with lesser amounts of *Anthoxanthum odoratum* (sweet vernal grass), *Plantaga Umceolata* (plantain) and *Sieglingia decumbens* (heath-grass). Rich moss growth, mainly *Rhytidiadelphussquamous.*

TABLE 18: Patrickswell—Podzol Variant

Horizon	Particle size analysis of mineral fi				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse M nd %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/IOOg	Base sat. %	C%	N %	C/N		
All	38	31	25	6	5.5	30.1	nd		4.6	**0.34**	**13.5**	**0.4**	
A12	39	31	24	6	5.4	11.4	nd		1.5	0.12	12.5	0.4	
A2	43	29	24	4	5.9	4.8	nd		0.4	nd		0.3	-
Bl	42	27	25	6	6.1	6.9	nd		0.4	nd		0.9	
B2ir	36	31	25	8	6.1	9.1	nd		0.4	nd		1.2	
CI	39	26	23	12	6.3	4.8	nd		0.3	nd		0.8	
C2	38	27	21	14	6.3	5.0	nd		0.3	nd		0.7	

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	**Mo**	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	<2	5	I	**i**	6	2	<25	8	2	[illegible]	**MX)**	60

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	1.25	**3.0**	**0.11**	55	**1.3**

Cooga Series

Location:	Clare, 62NE, T13
Topography:	Gently rolling morainic topography with alluvial flats interspersed
Slope:	2-3°
Altitude:	10 feet (3 m) O.D.
Drainage:	Excessive
Parent Material:	Fluvio-glacial materials derived from Old Red Sandstone with some shales and limestone, of Weichscl age
Great Soil Group:	Brown Podzolic

Horizon	*Depth* (inches)	(cm)	*Description*
Al	0-3*	0-8	Sandy loam; greyish-brown (10 YR5/2)andyellowish-brown (10 YR 5/4); moderate, fine crumb structure; dry friable; root mat; clear boundary:
A3	3i—11	8-28	Sandy loam; yellowish-brown (10 YR 5/4); weak, fine sub-angular blocky structure towards crumb structure; dry friable; abundant roots; clear, wavy boundary:
Bl	11-16*	28^2	Sandy loam; brown (10 YR 5/3); weak, fine sub-angular blocky structure to single grain; loose; plentiful roots; clear, smooth boundary:
B2ir	16J-23	42-58	Sandy loam; yellowish-brown (10 YR 5/8); weak, very fine sub-angular blocky structure; friable; few roots; clear, smooth boundary:
C	23-41	58-104	Sandy loam; dark yellowish-brown (10 YR 4/4); single grain structure; friable; few roots; clear, smooth boundary

Vegetation: *Centaureo-Cynosuretum*, typical Sub-ass. Old heavily grazed pasture dominated by *Trifolium repens* (white clover), *Cynosurus cristatus* (crested dog's tail), *Lolium perenne* (perennial ryegrass) and *Agrostis tenuis* (bentgrass). *Cirsium arvense* (creeping thistle) and *Senecio jueobea* (ragwort) are conspicuous weeds.

TABLE 19: Cooga Series

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	c%	N %	C/N		
Al	31	30	25	14	5.8	19.1	nd		4.7	0.33	14.2	0.9	—
A3	30	31	27	12	6.0	11.6	nd		1.6	0.16	10.0	1.0	-
Bl	34	30	26	10	5.7	5.6	nd		0.6	nd	-	0.9	-
B2ir	32	31	27	10	5.8	8.2	nd		0.7	nd	-	1.6	-
C	32	31	25	12	5.8	6.9	nd		0.2	nd	-	0.5	—

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Oa	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	3	15	3	2	65	8	30	8	4	30	1,100	450

Extractable contents (ppm)

Hori/on	Cu	Zn	Mo	Mn	Co
A	2.9	2.5	0.27	239	3.0

Cooga—Podzol Variant

Location:	Clare, 62 NW
Topography:	Flat top to glacial melt water delta
Slope:	0°
Altitude:	100feet(30m)O.D.
Drainage:	Excessive
Parent Material:	Fluvio-glacial material of Old Red Sandstone and Silurian shale with a little limestone, of Weichsel age
Great Soil Group:	Podzol

Horizon	*Depth* (inches)	(cm)	*Description*
Al	0-4	0-10	Gravelly sandy loam; dark greyish-brown (10 YR 4 2); very weak, fine crumb structure; dry friable; root mat; clear, smooth boundary:
A3	4-11	10-28	Gravelly sandy loam; brown to dark brown (7.5 YR 4/2); single grain structure; dry firm; abundant roots; clear, smooth boundary:
Bl	11-17	28^3	Gravelly sandy loam; pinkish-grey (5 YR 6/2); single grain structure; dry loose; few roots; clear, irregular boundary:
B2ir	17-27	43-69	Gravelly sandy loam; strong brown (7.5 YR 5/8); single grain structure; dry loose; no roots; clear, irregular boundary:
C	Below 27	69	Gravelly sand; strong brown (7.5 YR 5/6); single grain; dry loose; no roots

Vegetation: Not classified.

TABLE 20: Cooga—Podzol Variant

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Sill ",,	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	c%	N %	C/N		
Al	39	30	18	13	5.3	19.4	nd		3.0	0.24	12.5	0.7	—
A3	43	26	18	13	5.3	15.6	nd		2.2	0.15	14.7	0.8	-
Bl	48	26	17	9	5.4	10.2	nd		1.2	0.06	20.0	0.9	-
B2ir	67	13	X	12	5.8	12.2	nd		1.0	0.04	25.0	1.9	-
C	78	16	2	4	5.8	3.8	nd		0.9	nd	—	0.5	—

Doonglara Series

Location:	Clare, 53 SW, W9
Topography:	Kame and kettle hole topography, which is not very marked
Slope:	3
Altitude:	285 feet (87 m) O.D.
Drainage:	Well drained
Parent Material:	Weichsel drift of Old Red Sandstone with some Silurian shale
Great Soil Group:	Brown Podzolic (man-made)

Horizon	*Depth* (inches)	(cm)	*Description*
Apl	0-4	0-10	Gravelly sandy loam; dark brown (10 YR 3/3); weak, line crumb structure; friable; mat of roots; clear boundary:
Ap2	4-1U	10-29	Gravelly sandy loam; dark brown (10 YR 3/3); weak, line sub-angular blocky structure; friable; slightly coherent; plentiful roots; gradual, smooth boundary:
I* "In	IIJ 15	29-38	Gravelly sandy loam; light brown (7.5 YR 6/4); weak, fine sub-angular blocky structure (almost single grain); friable; many roots; abrupt, smooth boundary:
B22ir	15-29	38-74	Gravelly sandy loam; reddish-yellow (7.5 YR 6/8); weak, fine crumb structure (almost single grain); friable; many roots; clear, smooth boundary:
C	29^2	74-107	Gravelly sandy loam; yellowish-brown (10 YR 5/8); single grain with a tendency towards medium, crumb structure; friable; few roots

Vegetation: Not classified.

TABLE 21: Doonglara Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	C%	N %	C/N		
Apl	33	30	20	17	4.9	22.8	nd		4.2	0.38	II.1	1.0	
Ap2	33	31	25	11	5.6	17.8	nd		2.5	0.21	11.9	1.0	
B21ir	35	30	26	9	6.3	8.6	nd		0.4	0.03	8.0	2.1	
B22ir	41	31	17	II	6.3	5.6	nd		0.4	0.05	8.0	1.5	-
C	33	40	22	5	6.6	3.6	nd		0.2	0.03	6.6	0.6	

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	2	35	4	2	35	10	45	12	6	25	750	1,700

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	4.0	4.8	0.34	410	5.0

Mountcollins Series

Location:	Clare, 30 NE, 036
Topography:	Gently rolling landscape (subdued kame and kettle-hole topography)
Slope:	4°
Altitude:	230 feet (30 m) O.D.
Drainage:	Well drained
Parent Material:	Drift of Weichsel age composed mostly of Upper Carboniferous sandstone with some shale
Great Soil Group:	Brown Podzolic

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-4	0-10	Organic loam; very dark greyish-brown (10 YR 3/2); moderate, fine crumb structure; friable; root mat; clear boundary:
A12	**4 8J**	**10-22**	Loam; dark yellowish-brown (10 YR 3/4); moderate, fine crumb structure; plentiful roots; clear, smooth boundary:
B2lir	sa-13A	22-34	Shaly, gravelly sandy loam; strong brown (7.5 YR 5/6); weak, fine sub-angular blocky structure; friable, plentiful roots; clear, smooth boundary:
B22ir	I3J-18	**34-46**	Shaly, gravelly sandy loam; dark yellowish-brown (10 YR 3/4); weak, fine sub-angular blocky structure; friable; few roots; clear, smooth boundary:
C	18-27	46-69	Shale gravel, with a texture of sandy loam

Vegetation: *Centaureo-Cynosuretum*, Sub-ass. of *Galium verum*. Heavily grazed, old pasture dominated by *Cynosurus eristatus* (crested dog's tail) and *Trifolium repens* (white clover). The continuous close grazing is further indicated by the abundance of *Bellis perennis* (daisy) and *Plantago lanceolata* (plantain).

TABLE 22: Mountcollins Series

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/IOOg	II B meq/lOOg	Base sat. %	c%	N %	C/N		
All	20	29	34	17	5.5	49.8	nd	–	9.2	0.83	11.1	2.6	–
A!2	19	32	35	14	6.4	33.7	nd	-	3.2	0.32	10.0	2.1	-
B2lir	30	23	41	6	6.4	31.0	nd	-	3.2	0.19	16.8	4.9	-
B22ir	32	21	41	6	6.4	40.2	nd	-	3.5	0.19	18.4	3.9	-
C	19	24	42	4	6.4	8.0	nd		0.4	nd		0.9	—

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	2	5	4	1	45	4	25	5	3	25	520	130

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co	
A	3.3	5.3	0.33	93	1.0	1.1

Mountcollins—Lithosolic Variant

Location:	Clare, 65 NE, L5
Topography:	Gentle hill top in hilly area
Slope:	3°
Altitude:	320 feet (98 m) O.D.
Drainage:	Excessive
Parent Material:	Upper Carboniferous shales and sandstones
Great Soil Group:	Lithosol

Horizon	*Depth*		*Description*
	(inches)	(cm)	
All	0-4	0-10	Organic, shaly loam; very dark greyish-brown (10 YR 3 2); moderate, fine crumb structure; friable; root mat; clear, smooth boundary:
A12	4-9	10-23	Shaly loam; very dark greyish-brown (10 YR 3/2) as in the All horizon but with dark red (2.5 YR 3/6) root channels; abrupt, irregular boundary:
R	Below 9	23	Upper Carboniferous shales

Vegetation: *Nanlo-dalion* community. Old pasture in exposed situation. Poor sward dominated by *Agrostis tenuis* (bentgrass). Small amounts *of Lotus corniculatus* (bird's-foot trefoil), *Plantago lanceolata* (plantain), *Poa pratensis* (smooth-stalked meadow-grass) and *Sieglingia ilecumbens* (heath-grass).

TABLE 23: Mountcollins—Lithosolic Variant

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Frat.			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	C%	N %	C/N		
All	5	30	44	21	5.4	33.6	nd		8.6	0.68	12.6	1.1	-
A12	10	30	40	20	5.7	28.4	nd		5.2	0.43	9.8	1.4	

Trace Elements—extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
	2.8	4.8	0.36	50	3.0

Knockaceol Series

location:	Limerick, 57, SE, M20
Topography:	A hillside of moderate slope
Slope:	3°
Altitude:	590 feet (180 m) O.D.
Drainage:	Well drained
Parent Material:	Colluvium derived from Old Red Sandstone and conglomerate
Great Soil Group:	Podzol

to

Horizon	*Depth* (inches)	(cm)	*Description*
Al	**0-4**	**0-10**	Sandy loam; dark-brown (10 YR4/3); weak, fine crumb structure; friable; abundant. diffuse rooting; gradual, wavy boundary:
A2	**4-9**	**10-23**	Sandy loam; brown to dark-brown (7.5 YR 4/3); massive structure; friable; few. vertical roots; clear, irregular boundary:
B2ir	**9-17**	**23^3**	Sandy loam to loam; yellowish-red (5 YR 5/6); weak, fine crumb structure; friable; diffuse roots; clear, irregular boundary:
B/C	**17-21**	**43-53**	Gravelly sandy loam to loam; yellowish-brown (5 YR 4/4); weak, medium crumb structure; friable; few roots; abrupt, smooth boundary:
R	**Below 21**	**53**	Old Red Sandstone bedrock

Vegetation: Old pasture dominated by *Agrostis tenuis* (bentgrass) and *Cynosurus cristutus* (crested dog's tail).

TABLE 24: Knockaceol Series

Horizon	Particle size analysiis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	pH	Cation Exchange: CEC meq/lOOg	TEB meq/IOOg	Base sat. %	Organic Fraction: C%	N "„	C/N	Free iron %	TNV V
Al	45	21	22	12	6.1	20.6	12.7	61	9.0	0.59	15.3	1.1	—
A2	43	23	23	11	6.1	12.4	7.8	63	1.7	0.12	14.2	1.3	-
B2ir	33	23	32	12	5.1	8.2	3.0	37	I.I	0.08	13.8	3.1	-
B/C	30	25	32	13	5.3	7.1	2.4	35	0.6	0.05	12.0	1.3	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	Cu	Ni	Co	Cr	Mn
Al	< 2	< 2	2	< 1	4	< 1	< 1	< 1	90
A2	< 2	< 2	2	< 1	3	< 1	1	1	70
B2ir	< 2	15	4	< 1	2	6	6	7	300
B/C	< 2	3	6	< 1	2	25	10	15	500
Ranges in total contents (ppm) within series (data from two profiles)									
A	< 2	< 2	2-3	< 1	4-5	< l ^ t	< l - 4	< 1-12	90-150
A2	< 2	< 2	2-3	< 1	2-3	5-6	< l - 2	1 15	30-70
B	2 3	<2-15	4-8	1-2	2-5	6-15	4-6	7-30	180-300
C	< 2	3-8	2-6	< 1	2-5	25-30	6-10	15-30	150-500

Knockanattin Series

Location:	Clare, 21A SW, J18
Topography:	Gently rolling morainic kame and kettle topography
Slope:	3
Altitude:	200 feet (61 m) O.D.
Drainage:	Well drained
Parent Material:	Old Red Sandstone drift, of Weichsel age
Great Soil Group:	Podzol

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-4	0-10	Gravelly loam; dark greyish-brown (10 YR 4/2); moderate, medium to fine crumb structure; moist friable to moist firm; root mat; gradual, smooth boundary:
A12	4-8	10-20	Sandy loam to loam, with some gravel; brown to dark brown (10 YR 4/3); weak, fine crumb structure with weak, fine sub-angular blocky structure also; friable; plentiful roots; clear, irregular boundary:
A2	8-10	20-25	Loam; light grey (10 YR 7/2); massive to single grain structure; friable, almost loose; few roots; abrupt, wavy boundary:
B2ir	10-16	25-41	Clay loam, with gravel; brown to dark brown (7.5 YR 4/2) with mottles of strong brown (7.5 YR 5/6); massive structure; firm; no roots; gradual, wavy boundary:
B2irh	16-27J	41-70	Clay loam; brown to dark brown (7.5 YR 4/4); medium sub-angular blocky to weak, fine crumb structure; friable; no roots; gradual, smooth boundary:
C	27.1-35	70-89	Gravelly loam, with large stones; yellowish-brown (10 YR 5/6); weak, medium sub-angular blocky structure; moist plastic; no roots

Vegetation: Not classified.

TABLE 25: Knockanattin Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/IOOg	TEB meq/IOOg	Base sat. %	C%	N %	C/N		
All	23	26	35	16	5.5	20.4	nd	–	4.1	0.41	10.0	1.0	–
A12	27	24	34	15	5.5	20.0	nd	-	1.7	0.25	6.8	0.9	–
A2	25	25	40	10	5.7	8.0	nd	-	0.5	nd	-	0.6	–
B2ir	13	16	42	29	5.8	17.2	nd	-	**0.6**	nd	-	3.4	–
B2irh	13	13	45	29	5.8	17.8	nd	-	1.0	nd	-	4.5	–
C	20	22	42	16	5.8	**11.6**	nd	~	0.6	nd	—	1.9	=

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	2	20	5	1	30	6	25	6	4	30	**650**	140

Extractable contents (ppm)

Horizon	**Cu**	**Zn**	**Mo**	**Mn**	**Co**
A	**4.0**	**3.9**	**0.43**	**90**	**3.4**

Knockanattin Series—Peaty Phase

Location:	Clare, 21 SE, S3
Topography:	Near top of steep slope in rolling topography
Slope:	15
Altitude:	340 feet (140m)O.D.
Drainage:	Moderately well drained
Parent Material:	Mixed drift of Old Red Sandstone and Silurian shale, of Weichsel age
Great Soil Group:	Peaty, Humus Podzol

Horizon	*Depth* (inches)	(cm)	*Description*
Ol	17|-71	**44-19**	Peat; black; strong, moderate sub-angular blocky structure; peaty consistency; plentiful roots; clear, smooth boundary:
0 2	7H>	**19-0**	Peat; black; strong, coarse sub-angular blocky structure; peaty consistency; plentiful roots; clear, irregular boundary:
A2	**0-3**	**0-8**	Gravelly loamy sand; dark grey to very dark grey (10 YR 4/1 to 3/1); massive structure; friable; few roots; gradual, smooth boundary:
B21h	3 -51	**8-14**	Gravelly sandy loam; black and very dark greyish-brown (10 YR 2/1 to 3/2); massive structure; moist, slightly sticky to moist loose; few roots; abrupt, wavy boundary:
B22ir	51	**14**	A thin discontinuous ironpan:
B23ir	5\	**14-24**	Gravelly sandy loam; dark yellowish-brown (10 YR 4/4); weak, medium sub-angular blocky structure; friable; many, diffuse roots; gradual, irregular boundary:
B3	94-16	**24^1**	Gravelly sandy loam; dark brown to brown (7.5 YR 3 2 to 4/4); weak, medium to fine sub-angular blocky structure; friable; many roots; humus staining apparent; gradual, irregular boundary:
C	16-26J	41-67	Gravelly loamy sand; yellowish-red (5 YR 5/6); weak, medium irregular blocky structure; friable; no roots

Vegetation: Not classified.

TABLE 26: Knockanattin Series—Peaty Phase

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Cta) ",,	pH	Cation Exchange: CEC meq/lOOg	TEB meq/lOOg	Base sat. %	Organic Fraction: C%	N %	C/N	Free iron %	TNV %
()l	nd	nd	nd	nd	3.7	126.4	nd	—	36.0	1.27	28.3	0.1	—
02	nd	nd	nd	nd	3.7	93.6	nd	-	24.0	1.00	24.0	0.1	-
A2	41	36	19	4	4.2	9.0	nd	-	1.7	0.07	24.3	0.1	-
B2Ih	38	29	20	13	4.3	26.0	nd	-	2.5	0.08	31.2	0.2	-
B23ir	35	31	18	16	4.4	23.4	nd	-	1.4	0.06	23.3	2.7	-
B3	46	29	14	II	4.6	16.6	nd	-	1.0	0.04	25.0	I.I	-
C	45	33	14	8	4.8	8.4	nd	—	0.7	nd	—	0.6	—

Knockanimpaha Series

Location:	Clare, 31 NE, W 19
Topography:	Steep valleyside
Slope:	23°
Altitude:	698 feet (213 m) O.D.
Drainage:	Moderately well drained
Parent Material:	Upper Carboniferous shales
Great Soil Group:	Podzol

Horizc m	*Depth* (inches)	(cm)	*Description*
02	1.1-0	4-0	Slightly peaty silt loam; fine, crumb structure; friable, slightly sticky; gradual, smooth boundary:
Al	0-24.	0-6	Organic silt loam; dark brown (10 YR 3/3); weak, fine crumb structure; moist plastic; gradual, smooth boundary:
A2	2f44	6-11	Silt loam; very pale brown (10 YR 7/4); weak, fine sub-angular blocky; moist plastic; abrupt, irregular boundary:
B21ir	4i	11	A thin ironpan:
B22ir	4J-10J	11-27	Silt loam to silty clay loam; strong brown (7.5 YR 5/8); weak, fine crumb structure; moist plastic; gradual, smooth boundary:
C	10i-12£	27-32	Shaly loam; yellowish-brown (10 YR 5/6); weak, fine crumb structure; moist plastic; gradual, irregular boundary to shale

Vegetation: Old pasture dominated by *Agrostis tenuis* (bentgrass) and *Festuca rubra* (red fescue)

TABLE 27: Knockanimpaha Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	C%	N %	C/N		
0 2	3	10	61	26	4.8	52.8	nd	–	13.8	0.75	IS.4	0.8	–
Al	1	II	65	23	4.7	41.2	nd	-	7.8	0.75	10.4	0.5	-
A2	0	II	65	24	4.8	32.0	nd	-	4.0	0.40	10.0	0.6	–
B22ir	1	10	62	27	4.8	44.4	nd	-	3.2	0.25	12.8	4.5	-
C	42	8	40	10	5.1	21.8	nd	-	1.2	0.23	5.2	2.6	—

Trace Elements—extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	1.3	3.5	0.13	8	0.7

Knockanimpaha—Humus B Variant

Location:	Clare, 65 NE, J 1
Topography:	Rolling hill top above west coast
Slope:	3-4°
Altitude:	400 feet (122m)O.D.
Drainage:	Moderately well drained
Parent Material:	Sandstone and shales of the Upper Carboniferous
Great Soil Group:	Humus Podzol

Horizon	*Depth* (inches)	(cm)	*Description*
Ol	4J-0	11-0	Peaty; black; weak, medium angular blocky structure; friable; abundant living and dead roots; clear, irregular boundary:
A2	0-7 J	0-19	Sandy loam; light brownish-grey (10 YR 6/2); massive structure; moist loose; few roots; clear boundary:
B2lh	7i-10	19-26	Sandy loam; black, with streaks of both light brownish-grey (10 YR 6/2) and yellowish-red (5 YR 5/8); massive, breaking to platey; friable; many roots; clear, wavy boundary:
B22ir	10-131	26-35	Sandy loam; yellowish-red (5 YR 5/8); medium, weak blocky towards single grain structure; friable; abrupt, clear boundary:
R	Below 13 J	35	Sandstone and shale of Upper Carboniferous

Vegetation: Partly reclaimed *Nardo-Callunetea* community. Mixed sward composed mainly of *Nardus stricta* (mat-grass), *Festuca rubra* (red fescue), *Calluna vulgaris* (heather) and *Juurus squarrosux* (henth rush) The presence of *Pkmtago maritime* (r>ca plantain) is indicative of tli«- >- iposcd coastal situation.

TABLE 28: Knockanimpaha—Humus B Variant

	Particle size analysis of mineral fraction					Cation Exchange			Organic Fraction				
Hori/on	Coarse sand %	Fine sand %	Sill ",,	**Clay** %	**pH**	CEC meq/IOOg	**TEB** meq/IOOg	Base **sat.** %	**C%**	N%	C/N	**Free** iron %	TNV **%**
Ol	nd	nd	**nd**	mi	**4.8**	74.8	nd	–	23.2	**1.26**	**18.4**	0.2	–
A2	19	36	**32**	13	4.7	15.4	nd	-	2.1	0.14	15.0	0.3	-
B21h	17	58	**19**	6	4.8	22.8	nd	-	2.3	0.13	16.1	0.2	-
B22ir	25	51	**16**	8	5.1	15.4	nd	—	0.7	nd		4.3	—

Trace Elements—extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co	
Ol	J.3	50	0.07	45	2.0	2.1

Knockastanna Series

Location:	Clare, 52 SE, A 24
Topography:	Near top of 15° slope
Slope:	10°
Altitude:	710 feet (216 m) O.D.
Drainage:	Well drained
Parent Material:	Silurian shale drift with some Old Red Sandstone of Wcichsel age
Great Soil Group:	Podzol

Horizon	*Depth* (inches)	(cm)	*Description*
Al	0-3	0-8	Organic silty clay loam; brown (10 YR 5/3); moderate, fine crumb structure; moist plastic; abundant roots; gradual, smooth boundary:
A2	3-8	8-20	Clay loam to silt loam; light brownish-grey (10 YR 6/2) with small, frequent mottles of strong brown (7.5 YR 5/8); weak, fine sub-angular blocky structure; moist, slightly plastic; few roots:
B21ir	8-10J	20-27	Shaly clay loam; strong brown (7.5 YR 5/8) with small mottles of light brownish-grey (10 YR 6/2); weak, fine sub-angular blocky structure; moist, slightly plastic; very few roots; gradual, smooth boundary:
B22ir	I0J-18	27-46	Shaly loam; strong brown (7.5 YR 5/8); moderate, fine sub-angular blocky structure; moist plastic; very few roots; clear, smooth boundary:
C	18-28	46-71	Shaly sandy loam; brown to dark brown (7.5 YR 4/4); moderate, fine sub-angular blocky structure; friable; no roots

Vegetation: Not classified.

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TABLE 29: Knockastanna Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/100g	TEB meq/100g	Base sat. %	C%	N %	C/N		
A1	11	9	52	28	4.8	32.0	nd		9.6	0.51	18.8	2.7	–
A2	12	9	52	27	5.0	21.8	nd		3.2	0.31	10.3	3.3	-
B21ir	12	9	49	30	4.9	15.1	nd		2.0	0.20	10.0	3.7	-
B22ir	30	17	31	22	5.1	14.6	nd		1.7	0.14	12.1	3.6	-
C	48	22	24	6	5.0	6.7	nd		0.6	nd	-	1.7	-

Knockastanna Series—Peaty Phase

Location:	Clare, 52 SE, J 12
Topography:	Ciently rolling crest of ridge
Slope:	2-4°
Altitude:	860 feet (262 m) O.D.
Drainage:	Imperfectly drained
Parent Material:	Silurian shale drift, with admixture of Old Red Sandstone, of Weichsel age
Great Soil Group:	Peaty Podzol

Horizon	*Depth* (inches)	(cm)	*Description*
02	8-0	20-0	Peat; well humified:
A!	0-3	0-8	Clay loam; dark grey to dark greyish-brown (10 YR 4/1) to (10 YR 4/2); weak, coarse sub-angular blocky structure, almost massive; moist plastic; abundant roots; gradual, broken boundary:
A2g	3-8	8-20	Shaly loam; dark greyish-brown (10 YR 4/2) with many coarse, distinct mottles of yellowish-brown (10 YR 5/8); weak, medium angular blocky structure; moist, slightly plastic and slightly sticky; few roots; abrupt, smooth boundary:
B21ir	8	20	Ironpan:
B22ir	8-19	20-48	Shaly loam; strong brown (7.5 YR 5/8); weak, fine sub-angular blocky structure; moist plastic; plentiful roots; gradual, smooth boundary:
	19-22	48-56	Shaly sandy loam; brown to dark brown (10 YR 4/3); single grain structure; friable; few roots

Vegetation: Not classified.

TABLE 30: Knockastanna Series—Peaty Phase

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV /o
	Coarse sand %	Fine sand %	**Silt %**	l kv %		CEC meq/IOOg	**II** H meq/IOOg	Base **sat.** %	**c%**	N %	C/N		
0 2	nd	nd	nd	nd	4.3	**111.2**	**nd**	–	30.2	1.22	**24.8**	1.2	–
Al	14	13	45	28	4.3	58.2	nd	-	4.4	0.23	19.1	3.6	_
A2g	25	13	36	26	4.5	**31.0**	**nd**	-	2.8	0.17	16.5	3.6	-
B22ir	26	16	40	18	4.6	21.8	nd	-	1.6	0.14	11.4	3.8	-
C	58	17	17	8	4.8	13.4	nd	_	0.6	nd	_	3.7	_

See/in Series-

Location:	*Clare*, 52 SE, LI8
Topography:	Hilly topography near summit of mountain
Slope:	10
Altitude:	950 feet (290 m) O.D.
Drainage:	Excessively drained below the peat
Parent Material:	Old Red Sandstone and conglomerate
Great Soil Group:	Peaty Podzol

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Horizon	*Depth* (inches)	(cm)	*Description*
02	10-0	25-0	Peat; black; massive; moist friable; plentiful roots; clear, smooth boundary:
A2	0-4	0-10	Gravelly sandy loam; grey (10 YR 5/1); massive structure; firm breaking into friable; plentiful roots; abrupt, wavy boundary:
B21ir	4	10	Ironpan
B22ir	4-7	10-18	Gravelly sandy loam; yellowish-red (5 YR 5/8); weak, line sub-angular blocky structure; friable; few roots; gradual, smooth boundary:
B3	7-12	18-30	Gravelly sandy loam; reddish-yellow (7.5 YR 6/6); weak, fine sub-angular blocky structure; moist, slightly plastic; few roots; abrupt, irregular boundary:
R	Below 12	30	Old Red Sandstone bedrock

Vegetation: Semi-natural heath communities dominated by *Callu vulgaris* (heather), *Molinia caerulea* (purple moor-grass), *Nonius stricta* (mat-grass) and *Scirpus caespitusus* (deer-grass).

TABLE 31: Seefin Series

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV /o
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	c%	N %	C/N		
02	57	3	38	2	4.1	130.0	nd	—	41.0	0.99	41.4	0.1	—
A2	47	20	24	9	4.1	24.4	nd	-	3.2	0.12	26.7	0.1	-
B22ir	35	25	25	15	4.3	29.3	nd	-	1.7	0.10	17.0	3.6	-
B3	32	28	32	X	4.5	16.8	nd	-	1.2	0.08	15.0	1.6	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
02	2	3	8	1	60	3	25	10	2	60	800	65

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
02	1.25	3.8	0.13	5	1.3

Abbeyfeale Scries

Location:	Clare, 65 NW, Y 25
Topography:	'Fertile' hollow in a cutover bog
Slope:	I
Altitude:	124 feet (38 m) O.D.
Drainage:	Poorly drained
Parent Material:	Soliflucted drift of Saale age and of Upper Carboniferous shale and sandstone composition, covered by peat
Great Soil Group:	Peaty, Podzolised Gley

Horizon	*Depth* (inches)	(cm)	*Description*
oi	16-7	41-18	Peaty clay loam; very dark greyish-brown (10 YR 3/2); moderate, fine sub-angular blocky; dry firm; abundant roots; gravel and finer materials added by man; clear, smooth boundary:
()2	7-0	18-0	Peaty clay loam to loam; black; moderate, coarse columnar and moderate, fine sub-angular blocky structure; moist to dry friable; plentiful roots; gradual, smooth boundary:
A2	0 6	0-15	Loam; light grey to grey (2.5 YR 6/1); weak, coarse sub-angular blocky structure; firm; few roots; gradual, smooth boundary:
B2lirg	6-17	15^3	Gravelly loam; grey with reddish-yellow (10 YR 5 I and 5 <•>) in few, small, faint mottles; massive structure; moist plastic; very few roots; gradual, smooth boundary:
B22irg	17-23	43-58	Gravelly silty clay loam; strong brown (7.5 YR 5/8) with grey (2.5 YN 5/-) in many, small prominent mottles; massive structure; moist plastic; no roots; gradual, smooth boundary:
	23-30	58-76	Gravelly silty clay loam; blue-grey (2.5 YR 5,'-); massive structure; moist plastic; no roots

Vegetation: *Senecioni-Juncetum* acutiflori. Old, hca\ ily grazed and manured pasture. Good, dense sward dominated by *Lolium perenne* (perennial ryegrass) and *Trifolium repens* (white clover). Indicator-species of impeded drainage which are present include *Senecio aquaticus* (marsh ragwort), *Lytlirnnr saiicaria* (purple loosestrife) and *Juncus effusus* (soft rush).

TABLE 32: Abbeyfeale Series

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse-sand %	Fine sand %	Sill "	**Clay** %		**CEC** meq/lOOg	**TEB** meq/IOOg	Base sat. %	c%	N %	C/N		
Ol	10	24	**35**	**31**	**6.0**	80.8	nd	–	23.6	1.04	22.7	**1.9**	–
0 2	6	15	42	37	5.6	61.4	nd	-	21.6	0.74	29.2	**0.7**	-
A2	8	27	47	18	5.5	19.0	nd	-	1.6	0.06	26.7	0.5	_
B21irg	II	20	48	21	5.3	9.2	nd	-	I.I	0.06	18.3	**1.5**	_
B22irg	7	10	55	28	5.2	10.2	nd	-	1.0	0.07	14.3	**1.4**	-
C	9	II	51	29	5.5	9.6	nd	_	1.1	0.07	15.7	1.3	_

Abbeyfeale Series—non-Peaty Phase

Location:	Clare, 65 NE, F 18
Topography:	Very gentle soliflucted landscape
Slope:	2-3°
Altitude:	130feet(40m)O.D.
Drainage:	Poorly drained
Parent Material:	Soliflucted drift derived from Upper Carboniferous shales and sandstone with Old Red Sandstone, Galway granite and limestone as occasional impurities, of Saale age
Great Soil Group:	Podzolised Gley

Horizon	*Depth* (inches)	(cm)	*Description*
A11	0-4	0-10	Organic loam; dark brown (10 YR 3/3); weak, medium sub-angular blocky structure breaking occasionally into weak, fine to very fine crumb; friable; conspicuous root mat; clear boundary:
A12	4-11	10-28	Loam; dark grey (10 YR 4/1); weak, fine crumb; friable; plentiful roots; clear wavy boundary:
A2	11-19	28-48	Clay loam; light grey (10 YR 7/2); massive with signs of prismatic structure; moist plastic; clear, wavy boundary:
B21irg	19-25	48-64	Clay loam; light grey (10 YR 7/2) with common, medium, distinct mottles of brownish-yellow (10 YR 6/8); prismlike structure; moist plastic; few roots; clear, wavy boundary:
B22irg	25-33	64-84	Shaly gravelly silty clay loam to silt loam; light grey to grey (2.5 YN 6/-) with common, medium, distinct mottles of brownish-yellow (10 YR 6/8) and yellowish-brown (10 YR 5/6); massive structure; moist plastic; only soft rush roots present; smooth, irregular boundary:
Cg	33-42	84-107	Shaly, gravelly silt loam; grey to light grey (2.5 YN 6) with common, coarse, prominant mottles of yellowish-brown (10 YR 5/4); massive; moist plastic; only soft rush roots present

Vegetation: The vegetation closely resembles that of the series.

TABLE 33: Abbeyfeale Series—non-Peaty Phase

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Sill "	Clay %	pH	Cation Exchange: CEC meq/lOOg	TEB meq/lOOg	Base sat. Jy0	Organic Fraction: C%	N %	C/N	Free -n %	TNV %
All	5	26	46	23	5.6	37.0	ad		8.3	0.67	12.4	0.8	–
A12	6	23	45	26	5.9	21.4	nd		3.6	0.28	12.9	1.2	-
A2	3	17	44	36	6.2	14.0	nd		1.7	0.16	10.6	0.4	–
B21irg	6	16	44	34	6.6	8.6	nd		0.7	nd	–	2.9	-
B22irg	7	13	53	27	6.6	10.8	nd		0.8	nd	-	2.4	-
Cg	8	15	52	25	6.9	11.2	nd		0.6	nd	—	0.6	-

Irate Moments total contents (ppm i

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
All	<2	3	8	<1	50	5	<25	5	3	35	2,000	75
A12	2	4	8	1	40	4	25	15	4	50	1,800	70
A2	3	8	10	I	100	8	25	20	10	50	1,000	35
B21irg	<2	5	8	1	75	10	25	20	10	60	1,500	200
B22irg	2	10	15	<1	50	20	30	15	10	50	1,000	170
Cg	<2	2	4	1	50	10	<25	10	5	50	500	75
Ranges in total contents (ppm) with series (data from five profiles^1												
Surface	<2-2	3-12	5-8	<1-1	25-175	4-20	< 25-45	2-15	<l-8	30-75	850-2,000	75-500
A2	<2-2	4-8	5-12	<1-1	40-100	8-18	-25-35	5-35	<2-10	30-50	1,000-1,800	35-250
B	<2	3-15	5-15	<l-2	25-100	8-25	<25-180	15-35	<2-10	25-60	1,000-1,600	40-1,500
C	:	2-10	4-5	<1-1	50	10	<25-30	10-20	5-20	40-50	500-1,000	75-200

Extractable contents (ppm)

Series	Horizon	Modal Profile: Cu	Zn	Mo	Mn	Co	Ranges extractable: Cu	Zn	Mo	Mn	Co
Abbeyfeale	A	4.0	6.7	0.25	60	2.4	2.5^.0	4.8-6.7	0.25-0.43	59-144	0.3-8.0

Abbeyfeale Series—Sandy Phase

Location:	Clare, 30 NE, A18
Topography:	Flat area between two gently rolling rises
Slope:	1°
Altitude:	50 feet (15 m) O.I).
Drainage:	Well drained to 21 inches and then poorly drained
Parent Material:	Wind-blown sand derived from comminuted shells and Upper Carboniferous shales and sandstones
Great Soil Group:	Regosol

Horizon	*Depth* (inches)	(cm)	*Description*
All	**0-4**	**0-10**	Loamy sand; very dark greyish-brown (10 YR 3/2); weak, line crumb structure; moist plastic; root mat; clear boundary:
A12	4-8½	**10-22**	Sandy loam; very dark greyish-brown (10 YR 3/2); very weak, line crumb structure; moist, slightly plastic and friable; plentiful roots; clear, smooth boundary:
CI	8½-15¼	**22-39**	Sandy loam; light grey (10 YR 7/1); single grain with a tendency towards very weak, coarse prismlike structure; moist loose; few roots; clear, smooth boundary:
C2	15¼-21¼	**39-54**	Sand; grey to light grey (10 YR 5/1); single grain structure; moist loose; few roots; clear, smooth boundary:
IIC3g	21¼- 34½	**54-88**	Silt loam; light grey (2.5 YN 7/-) and yellowish-brown (10 YR 5/6) in many, line, distinct mottles; weak, coarse prismlike structure; moist plastic; no roots apparent; gradual, smooth boundary:
HC4g	34½-40½	**88-103**	Loam; grey to light grey (2.5 YN 6/-) and strong brown in few, fine distinct mottles; massive with weak, line sub-angular blocky structure; moist, slightly plastic; no roots; gradual, smooth boundary:
IIC5g	Below **40½**	**103**	Loam; blue; massive structure; wet plastic; no roots

Vegetation: *Jiinco-Molinietum.* Old pasture on cliff overlooking Atlantic ocean. Poor, mixed sward dominated by *Agrostis stolonifera* (creeping bentgrass) and *Poa trivialis* (rough-stalked meadow-grass). Small amounts of *Junius acuti/lorus* (jointed rush), several sedges and *Cirsium dissection* (bog thistle).

TABLE 34: Abbeyfeale Series—Sandy Phase

Horizon	Particle size analysisi of mineral fraction					Cation Exchange			Organic Fraction				
	Coarse sand %	Fine sand %	Sill	Clay %	pH	CEC meq/IOOg	II H meq/lOOg	Base sat. %	iC%		C/N	Free iron %	TNV /o
All	57	25	12	6	6.0	22.9	nd		5.4	0.50	10.8	0.2	1
A12	23	51	19	7	6.2	11.6	nd		0.4	0.03	13.3	0.1	1
CI	83	13	3	1	6.3	2.1	nd		0.4	nd		0.0	1
C2	81	13	5	1	6.5	3.2	nd		0.3	nd		0.1	1
II C3g	2	31	52	15	5.8	7.1	nd		0.3	nd		0.9	1
11 C4g	19	18	48	15	5.1	7.5	nd		0.5	nd		0.9	1
II C5g	22	18	45	15	4.8	10.3	nd		0.5	nd		0.9	1

1 race Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	(u	Ti	Mn
A	2	10	2	1	40	8	<25	15	2	25	750	50

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co	B
A	).60	3.50	0.08	27	0.70	0.90

Abbeyfeale—Humus B Variant

Location:	Clare, 1 NW, S37
Topography:	Very gentle slopes
Slope:	2°
Altitude:	180 feet (55 m) O.D.
Drainage:	Poorly drained
Parent Material:	Solifiucted drift of Upper Carboniferous sandstone and shale composition; Saale i
Great Soil Group:	Podzolised Gley

fforizotn	*Depth* (inches)	(cm)	*Description*
All	0-3	0-8	Organic sandy loam; very dark greyish-brown (10 YR 3/2); weak, fine crumb structure; friable; root mat; clear boundary:
AI2	3-7	8-18	Sandy loam; very dark greyish-brown (10 YR 3/2); moderate, fine crumb structure; moist friable and slightly plastic; plentiful roots; clear, wavy boundary:
A21	7-11	18-28	Sandy loam; greyish-brown (10 YR 5/2) with few, fine, faint streaks of dark greyish-brown (10 YR 4/2); weak, fine angular blocky structure; moist, slightly plastic; few roots; clear, irregular boundary:
A22	11-15	28-38	Sandy loam; brown (10 YR 5/3); massive, with prismlike structure forming when drier; friable; few roots; clear, irregular boundary:
B21irhg;	15-23	38-58	Sandy loam to loam; grey (10 YR 6/1) with many, medium, distinct mottles of yellowish-brown (10 YR 5/8); massive when wet and prismatic when dry, peds outlined by humus; moist plastic; rush roots only; clear, irregular boundary:
B22hg	23-29	58-74	Shaly sandy loam; grey (10 YR 6/1) with many, medium, distinct mottles of yellowish-brown (10 YR 5/8); massive, with peds of prismlikc structure outlined by humus; moist plastic; no roots; abrupt boundary:
	Below 29	74	Millstone Grit

Vegetation: *Centaureo-Cynosuretum,* Sub-ass. *of Juncus effusus.* Old pasture in exposed, treeless area. Mixed sward of which the principal components are *Agrostis spp.* (bentgrasses), *Cynosurus cristatus* (crested dog's tail), *Juncus spp.* (rushes) and *Trifolium repens* (white clover).

TABLE 35: Abbeyfeale—Humus B Variant

Horizon	('article size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	c%	N %	C/N		
A1l	28	30	29	13	5.3	29.6	nd		8.0	0.48	16.7	0.3	
A12	29	25	30	16	5.0	39.0	nd		7.0	0.76	9.2	0.3	
A2I	31	29	30	10	4.8	17.8	nd		1.6	0.15	10.7	0.2	
A22	35	27	28	"0	4.9	11.2	nd		0.7	nd		0.3	
B2lirhg	28	22	32	18	4.9	10.8	nd		0.6	nd		2.5	-
B22hg	36	21	29	14	4.8	6.8	nd		0.5	nd		1.0	

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	< 2	3	2	I	35	10	< 25	4	1	25	820	50

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	6.75	5.50	0.27	40	0.30

Attyquin Series

Location: Clare, I8SE, G5
Topography: Limestone lands which arc in general flat but may be hummocky
Slope: 1½°
Altitude: 120 feet (37 m) O.D.
Drainage: Poorly drained
Parent Material: Drift of Weichsel age consisting of limestone with some sandstone and granite over limestone pavement

Great Soil Group: Peaty Gley

Horizon	*Depth* (inches)	(cm)	*Description*
02	5-0	13 0	Slightly peaty loam; moderate, fine to coarse crumb structure; friable; abundant roots; calcareous; clear smooth boundary:
Al	0-4	0-10	Sandy loam; dark brown (10 YR 3/3); massive structure breaking into weak, fine crumb; wet plastic; abundant roots; calcareous; clear, irregular boundary:
Bg	4-7	10 IS	Sandy loam; greyish-brown (10 YR 5/2) and light brownish-grey, (10 YR 6/2) in common, fine, faint mottles; weak, fine sub-angular blocky to massive structure; friable; few roots; calcareous; clear, irregular boundary:
Cg	7-12	18-30	Loam; light grey (10 YR 7/1) and yellow (10 YR 7/8) in common, medium, distinct mottles; single grain structure; friable; few roots; calcareous

Vegetation: Not classified.

TABLE 36: Attyquin Series

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraci			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/IOOg	Base sat.%	c%	N %	C/N		
02	19	19	38	**24**	7.9	**78.4**	nd	–	**12.4**	**1.20**	**10.3**	1.8	2.9
Al	33	23	30	14	7.2	44.4	nd	-	7.0	0.78	9.0	1.4	3.2
Bg	35	24	27	14	7.7	9.6	nd	-	0.5	nd	-	1.0	21.7
Cg	24	24	31	21	8.7	3.2	nd	-	0.1	nd	-	0.4	68.8

Gortaclareen Scries

Location:	Clare, 52 NW, Q33
Topography:	Gently rolling, morainic topography
Slope:	5°
Altitude:	165 feet (65 m) O.D.
Drainage:	Poorly drained
Parent Material:	Drift composed of sandstone, shale and limestone, of Weichsel age
Greal Soil Group:	Gley

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-3*	0-9	Loam; dark greyish-brown (10 YR 4/2) with strong brown (7.5 YR 5/8) root traces; weak, fine crumb structure; friable; root mat; clear boundary:
A12	3*-7*	9-19	Loam; greyish-brown (10 YR 5/2) with strong brown (7.5 YR 5/8) around the roots; weak, fine sub-angular blocky structure; friable; abundant roots; gradual boundary:
Big	7.1-16	19-41	Clay loam; light brownish-grey (10 YR 6/2) with common, fine, faint mottles of strong brown (7.5 YR 5/8); weak, fine sub-angular blocky structure; moist plastic; plentiful roots; clear, smooth boundary:
(B)g	16-31	41-79	Clay loam; light grey (2.5 YN 7/-) with many, coarse and distinct mottles of yellowish-brown (10 YR 5/8); grading towards massive structure: moist plastic; few roots; gradual boundary:
Cg	31-43	79-109	Gravelly clay loam; many, medium, distinct mottles of ieddish-yellow (7.5 YR 7/8) on light grey (2.5 YN 7/-) background; massive structure: wet plastic; no roots

Vegetation: *Centaureo-Cynosuretum*, Sub-ass. of *Juncus ejfusus*. Meadow reseeded a few years ago and now reverted. Poorish sward dominated by *Ho/cus lanatus* (Yorkshire fog), *Anthoxanthum oihrutum* (sweet vernal grass), *Poa trivialis* (rough-stalked meadow-grass) and *Juncus effusus* (soft rush).

TABLE 37: Gortaclareen Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Sill ".	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	c%	N %	C/N		
All	29	20	29	22	5.7	25.6	nd		5.9	0.54	10.9	1.3	–
A12	31	16	30	23	5.6	17.0	nd		2.6	0.26	10.0	2.6	-
Big	20	14	37	29	6.4	8.5	nd		0.4	nd	-	2.7	-
(B)g	19	15	35	31	6.4	7.8	nd		0.2	nd	-	2.3	-
Cg	21	15	32	32	6.6	8.7	nd		0.3	nd	-	2.3	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo		Cu	Zn	Ni	Co	Cr	Ti	Mn
All	<2	20	5	1	50	8	25	15	2	50	2,000	75
A12	<2	8	3	<1	20	4	25	5	<1	15	650	100
Big	2	15	7	<1	35	12	25	12	4	35	1,500	70
(B)g	2	18	7	1	30	15	35	30	5	35	850	150
Cg	2	20	5	1	50	8	<25	15	5	35	1,000	150
	Ranges in total contents (ppm) within series (data from four profiles)											
A	<2	8-20	2-8	<l-2	20-70	2-20	25-50	3-25	<2-10	15-50	600-2,000	90-500
B	2 2	15-50	5-10	<l-2	25-75	3-20	25-50	10-40	2-12	25-35	750-1,800	25-2,000
C	<2-2	20	4-10	1 1	35-60	8-10	25-30	10-15	4-5	20-35	1,000	70-250

Extractable contents (ppm)

Modal profile						Ranges within series (four profiles)					
Horizon	Cu	Zn	Mo	Mn	Co	Horizon	Cu	Zn	Mo	Mn	Co
A	1.9	3.8	0.09	*2H*	2.0	\	1 .'0-11.0	1.30-7.3	0.04-0.51	28-280	0.70-3.40

Howards town Scries

Location:	Clare, 52 NW, **M14**
Topography:	Flat glacial melt water channel 200-300 yards wide, the ides are fairly steep
Slope:	0
Altitude:	70 feet (21 m) O.D.
Drainage:	Poorly drained
Parent **Material:**	Colluvium of limestone composition, with some Old Red Sandstone and shale
Great Soil Group:	Gley

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-3	0-8	Slightly peaty clay loam; dark yellowish-brown (10 YR 3/4); weak, line crumb structure; moist plastic; root mat; clear, smooth bound.u
A12g		8-17	Clay loam; dark greyish-brown (10 YR 4 2) with feu. fine, faint mottles of brown to dark brown (7.5 YR 4/4); weak, fine crumb structure; moist plastic; plentiful roots; gradual, smooth boundary:
B2tg	6j 19	17-48	Silty clay loam; greyish-brown (10 YR 5/2) and yellowish-brown (10 YR 5/6) in few, line, faint mottles; weak, fine sub-angular blocky structure; moist friable: few roots; clear, smooth boundary:
B3g	19-26A	48-67	Clay loam; grey (10 YR 5/1) with brownish-yellow (10 YR 6/6) in fine, few, distinct mottles; prismatic structure; moist plastic; few roots; gradual, smooth boundary:
Alb	26.1 36	67 91	Loam; grey to light grey (10 YR 6/1); massive structure; moist sticky and slightly plastic; few roots

Vegetation: *Centaureo-Cynosuretum,* Sub-ass. *of J uncus effusus.* Old meadow with no distinctly dominant species. Mixed sward composed mainly of ***Antlioxuntiium*** *odoratum* (ssvect veco&l gvubb), *DuctylU glomerate* v>ock's> foot), *Festuca rubra* Cced fescue), *Holcux Uuudu** **(.Yorkshire** fog), *Plantago lunceolata* (plantain) and ***Trifottum*** *repots* (white clover).

TABLE 38: Howardstown Series

Horizon	Particle size analysis of mineral fraction				PH	Cat ion Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Sill '	Clay %		CEC nicq'IOOg	TEB meq/IOOg	Base nt %	C%	N %	C/N		
All	14	14	43	29	6.5	56.8	nd	–	11.3	1.00	11.3	1.1	—
AI2g	8	15	47	30	6.8	41.8	nd	-	5.7	0.59	9.7	1.5	-
B2tg	7	11	49	33	6.9	40.6	nd	-	4.8	0.51	9.4	2.1	-
B3g	27	15	30	28	6.9	28.4	nd	-	3.0	0.28	10.7	0.3	-
Alb	26	21	30	23	6.7	58.0	nd	~	9.1	0.66	13.8	0.1	

Trace Elements—extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co	B
A	9.9	3.9	0.09	59	3.8	1.1

Howardstown—Humus B Variant

Location:	Clare, 2 SW, V14
Topography:	Slight hollow in undulating broad ridge top
Slope:	2°
Altitude:	892 feet (272 m) O.D.
Drainage:	Poorly drained
Parent Material:	Limestone bedrock and limestone glacial drift, of Wcichscl age
Great Soil Group:	Peaty Gley

Horizon	*Depth* (inches)	(cm)	*Description*
02	7-0	18-0	Peat; black (2.5 YR 2/2); moderate, fine crumb structure; moist, slightly sticky; abundant roots; gradual, wavy boundary:
AI	0-4	0-10	Organic silty clay; very dark grey (10 YR 4/1); massive structure with humus-stained vertical cracks; prismatic structure when dry; wet sticky; some roots; gradual, smooth boundary:
(B)g	4-11	10-28	Silty clay loam; light grey (10 YR 7/2) with many, fine distinct mottles of strong brown (7.5 YR 5/8) and greyish-brown (10 YR 5/2); massive structure tending towards prismatic humus on down ped surfaces; wet sticky; no roots; abrupt, irregular boundary:
B2h	Below 11	28	Silty clay loam with humic material; very dark grey (10 YR 4/1); massive structure; wet sticky; no roots; abrupt, irregular boundary:
R	Below 11	28	Limestone bedrock

Vegetation: Not classified.

TABLE 39: Howardstown—Humus B Variant

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Silt %	**Clay** %		CEC meq/100g	TEB meq/100g	Base sat. %	C%	N %	C/N		
O2	nd	nd	nd	**nd**	4.7	nd	–	–	Peat	nd	–	0.2	–
A1	0	1	50	**49**	5.8	39.0	nd	-	8.3	0.55	15.1	0.8	-
(B)g	1	6	54	39	6.8	16.0	nd	-	1.2	0.19	6.3	1.3	-
B2h	2	12	51	35	6.9	nd	—	—	3.1	nd	-	0.3	—

Trace Elements—extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co	B
O2	6.0	5.8	0.29		1.3	1.6

Kilrush Scries

Location:	Clare, 16 NW, G14
Topography:	Drumlin topography, site is on drumlin side
Slope:	9°
Altitude:	210 feet (64m)O.D.
Drainage:	Poorly drained
Parent Material:	Drift of Weichsel age of Upper Carboniferous shale composition over the Clare shales
Great Soil Group:	Gley

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-5 J	0-14	Shaly, gravelly clay; grey to light grey (10 YR 6/1); weak, fine crumb changing to weak, fine sub-angular blocky structure with depth; friable; mat of roots to 4J inches; gradual, smooth boundary:
AI2g	5J-10A	14-27	Shaly, gravelly clay; grey to light grey (10 YR 6/1) with many faint, fine reddish-yellow (7.5 YR 6/8) mottles; prismatic structure breaking down into weak, fine angular blocky; friable; plentiful roots; clear, smooth boundary:
(B)g	I0i-I4	27-36	Shaly, gravelly clay; very dark grey (10 YR 3/1) and reddish-yellow (7.5 YR 7/8) in many, fine, faint mottles; prismatic structure; moist, slightly sticky; plentiful roots; clear, smooth boundary:
R	Below 14	36	Weathered shale, with few roots

Vegetation: *Centaureo-Cynosuretutn,* Sub-ass. *of Juncus effusus-* Old pasture in exposed situation. Sward dominated by *Holcus lanatus* (Yorkshire fog). *J uncus effusus* (soft rush), *Agrostis stolonifera* (creeping bentgrass) and *Lolium perenne* (perennial ryegrass). The principal herbaceous weed is *Ranunculus repens* (creeping buttercup).

TABLE 40: Kilrush Series

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	pH	Cation Exchange: CEC meq/IOOg	TEB meq/IOOg	Base sat. %	Organic Fraction: C %	N %	C/N	Free iron %	TNV %
All	**2**	**3**	**40**	**55**	6.3	47.2	nd		6.0	0.77	7.8	3.7	
AI2g	**2**	**2**	**32**	64	6.1	34.4	nd		3.1	0.38	8.2	4.2	
(B)g	**4**	**3**	**31**	62	6.1	27.2	nd		1.9	**0.21**	9.0	4.3	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
All	**< 2**	**12**	**20**	4	**135**	**15**	30	6	2	30	1.500	60
A12g	**< 2**	**4**	10	**2.5**	45	10	25	4	< 1	**25**	900	35
(B)g	**< 2**	**20**	18	40	200	45	50	10	2	60	1.000	**150**
Ranges in total contents (ppm) with series (data from six profiles)												
Surface	2 4	2-12	3-20	1-4	30-135	5-20	25-100	5-30	2-8	30-60	880-1,800	30-850
B	<2-2	<2-20	1-20	140	20-200	3^5	<25-50	4-35	<1-15	5-70	600-1,800	35-700
C	< 2	5	10	I	35	20	40	25	6	70	1,200	200

Extractable contents (ppm)

Modal profile

Horizon	Cu	Zn	Mo	Mn	Co
A	8.8	5.0	2.44	35	2.0

Ranges within series (six profiles)

Horizon	Cu	Zn	Mo	Mn	Co
A	1.8-8.8	1.3-5.0	0.22-2.44	35-345	2-7.5

Kit rush— Man-made Vavian t

Location:	Clare, 65 NE, Lll
Topography:	Soliflucted landscape of gentle slopes 3
Altitude:	145 feet (44 m) O.D.
Drainage:	Poorly drained
Parent Material:	Soliflucted drift composed of Upper Carboniferous shales and sandstones; Saale age
Great Soil Group:	Gley

Horizon i	*Depth*f		*Description*
	(inches)	(cm)	
All	0-4	0-10	Loam; dark greyish-brown (10 YR 4/2); weak, medium sub-angular blocky structure with weak, fine crumb; dry firm; root mat; clear, smooth boundary:
A12	4-6*	10-17	Loam; dark greyish-brown (10 YR 4/2); weak, fine sub-angular blocky structure; dry firm; plentiful roots; clear, smooth boundary:
AI3	6J-9A	17-24	Clay loam; greyish-brown (10 YR 5/2) with yellowish-brown (10 YR 5/8); root traces; massive when wet, but prismatic when dry breaking into weak, fine granular structure; moist plastic; plentiful roots; gradual, smooth boundary:
B and Ag	94-14	24-36	Loam; brown (10 YR 5/3) and yellowish-brown (10 YR 5/8); massive when wet and prismatic when dry; moist plastic; few roots; gradual, smooth boundary with lenses and tongues of clay loam; grey to light grey (10 YR6/1); massive structure; moist firm:
B2irg	14-21i	36-55	Clay loam; grey to light grey (2.5 YN 6/-) and brownish-yellow (10 YR 6/8) in common, medium, distinct mottles; massive when uet and prismatic when dry; moist plastic; few roots; gradual, smooth boundary:
	21 M l	55-104	Shaly loam; grey to light grey (2.5 YN 6/-) with 2 inch wide vertical streaks of dark yellowish-brown (10 YR 4/4); massive; moist, slightly plastic; very few roots

Vegetation: Not classified.

TABLE 41: Kilrush—Man-made Variant

	Particle size analysis of mineral fraction					Cation Exchange			Organic Fraction				
Horizon	Coarse sand %	Fine sand %	Sill	Clay %	pH	CEC meq/IOOg	TEB meq/IOOg	Base sat. %	C %	N %	C/N	Free iron %	TNV %
All	5	21	47	27	5.2	42.8	nd		8.4	0.92	9.1	1.0	–
A12	6	19	48	27	5.2	26.0	nd		3.4	0.33	10.3	1.9	-
A13	4	18	46	32	5.4	20.8	nd		2.4	0.26	9.2	1.3	-
B & Ag	4	17	44	35	5.5	17.2	nd		2.0	0.22	9.1	1.2	-
B2irg	7	19	47	27	5.9	9.6	nd		0.6	nd	-	2.4	-
C	II	21	42	26	6.0	8.0	nd		0.4	nd	-	0.7	-

I'uck one Series

I ocation:	Clare, 43 NE, X24
Topography:	Rolling, with drumlins interspersed
Slope:	3
Altitude:	185 feet (56 m) O.D.
Drainage:	Poorly drained
Parent Material:	Mixed drift *o\'* Weichsel age, consisting of Old Red Sandstone, Silurian shale and Carboniferous limestone
Great Soil Group:	Podzoliscd Gley

Horizon	*Depth* (inches)	(cm)	*Description*
Al	**0-5**	**0-13**	Gravelly sandy loam; brown (10 YR 5/3); weak, line crumb structure; wet plastic; root mat; clear, smooth boundary:
A2I	5-12J	**1 I \2**	Gravelly sandy loam: very pale brown (10 YR 8/3) with few, line, faint mottles; massive structure moist firm and slightly plastic: few roots, clear, smooth boundary:
A22	**12J-16**	**32-41**	Gravelly sandy loam: light brownish-grey (10 YR 6 2); massive structure which breaks to weak, line crumb; friable; plentiful roots; clear, irregular boundary:
B21irg	**16-21**	**41-53**	Sandy loam; light grey (10 YR 7/2), brownish-yellow (10 YR 6 6) and white (10 YR 8/1) in many, medium, distinct mottles; massive structure; moist plastic, few roots, mostly rush; clear, irregular boundary:
B22irg	**21-374**	**53-95**	Sandy loam; light reddish-brown (5 YR 6/3) and reddish-yellow (7.5 YR 7/6) in many, medium, distinct mottles; massive structure; moist plastic; only rush roots present; clear, irregular boundary:
Cg	**37J-47J**	**95-12**	Sandy loam; light reddish-brown (5 YR 6/3), strong brown (7.5 YR 5/6) and white (10 YR 8/1) in many, medium, prominent mottles: massive structure; wet sticky; only rush roots present

Vegetation: *Junco-AfoHnietian,* typical Sub-ass. Rough grazing for cattle bordering river. Poor sward dominated by *Agrostls tenuis* (bentgrass), *Festuca rubra* (red fescue) and *Holcus tinnitus* (Yorkshire log). Rush and sedge species common. Dense moss carpet, mainly composed of *Rhytuliiutelphus squarrosus* and *Hylocomium splendens.*

TABLE 42: Puckane Series

Hon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Sill	(lay %	PH	Cation Exchange: CEC meq/lOOg	TEB meq/lOOg	Base sat. %	Organic Fraction: C%	N %	C/N	I tee iron %	TNV %
Al	33	27	24	16	7.4	25.0	nd	–	4.9	0.38	12.9	O.:	-
A2I	34	25	24	17	6.0	11.2	nd	-	0.7	nd	-	0.3	-
A22	40	30	21	9	5.4	10.2	nd	-	0.6	nd	-	0.6	-
B2lirg	33	28	25	14	5.2	7.4	nd	-	0.4	nd		1.5	-
B22irg	29	28	25	18	5.3	8.0	nd	-	0.1	nd	-	1.7	-
Cg	32	26	2x	14	5.3	5.6	nd	-	0.1	nd	—	1.4	~

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	< i	Ti	Mn
A	< 2	8	4	1	50	10	25	25	4	35	I.I 00	110

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co	
A	1.3	2.3	0.04	24	0.3	0.6

Series—Peaty Phase

Location:	Clare, 21 SE
Topography:	Gently rolling morainic hillslopes, with steep, deep gullies
Slope:	3°
Altitude:	350 feet (107 m) O.D.
Drainage:	Poorly drained
Parent Material:	Predominantly Old Red Sandstone mixed drift, with about 20% Silurian shales and some limestone
Great Soil Group:	Peaty, Podzolised Gley

Horizon	*Depth* (inches)	(cm)	*Description*
02	9-0	23-0	Peat; black; coarse, strong crumb breaking into fine, strong crumb; friable; plentiful roots; clear, smooth boundary:
AI	0-2	0-5	Loamy sand; dark brown (7.5 YR 3/2); coarse, weak crumb breaking into fine, weak crumb; friable; few roots; gradual, smooth boundary:
A2	2-9	5-23	Loamy sand; pinkish-grey (2.5 YR 7/2) with humic staining in streaks down structured cracks; massive structure breaking into crumb-like fragments; moist, slightly sticky and friable; clear, smooth boundary:
B2ng	9-17	23-43	Gravelly sandy loam; ycllowish-rcd (5 YR 4/8) and light reddish-brown (5 YR 6/3) in common, coarse, faint mottles; massive structure breaking into weak, fine sub-angular blocky; moist sticky, almost friable; no roots; gradual, smooth boundary:
B3g	17-34	43-86	Gravelly sandy loam; reddish-brown (5 YR 5/3) and yellowish-red (5 YR 4/8) in common, medium, distinct mottles; single grain structure; friable:
Cg	Below 34	86	Gravelly sandy loam; light reddish-brown (5 YR 6/3). strong brown (7.5 YR 5/6) and white (10 YR 8/1) in many, medium, prominent mottles: massive structure; wet sticky; only rush roots present

Vegetation: Not classified.

TABLE 43: Puckane Series—Peaty Phase

	Particle size analysis of mineral fraction					Cation Exchange			Organic Fraction				
Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/lOOg	TEB meq/IOOg	Base sat. %	*C %*		C/N	Free iron %	TNV %
0 2	nd	nd	nd	nd	4.0	124.0	nd		31.2	1.22	25.6	nd	
Al	34	43	20	3	4.3	14.0	nd		2.4	0.11	21.8	0.2	
A2	38	40	20	2	4.3	3.2	nd		0.6	0.04	15.0	0.1	
B2irg	34	40	21	5	4.8	8.0	nd		0.5	0.04	12.5	0.9	
B3g	35	37	20	8	4.9	4.4	nd		0.2	0.03	6.7	0.7	
Cg	-	-											

Puckane Series—Alkaline Parent Material Phase

Location:	Clare, 52 NE, G 7
Topography:	Kame and kettle moraines. Rolling topography, site is in a hollow in this topography
Slope:	0° at site with 5-10° on slopes
Altitude:	390feet(119m)O.D.
Drainage:	Poorly drained
Parent Material:	Drift of Weichsel age and of sandstone, shale and limestone composition
Great Soil Group:	Podzolised Gley

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-3 \	0-9	Sandy loam; very dark greyish-brown (10 YR 3/2); weak, fine crumb to single grain structure; friable; root mat; clear boundary:
A12	*n-9*	9-24	Sandy loam; dark greyish-brown (10 YR 4/2); single grain structure; friable; abundant roots; calcareous; diffuse, smooth boundary:
A2I	9 H 5	24-38	Sandy loam; dark greyish-brown (10 YR 4/2) and light grey (10 YR 7/2); single grain structure; friable; plentiful roots; calcareous; diffuse smooth boundary:
A22	15-19	38-48	Sandy loam; light grey (10 YR 7/2) single grain structure; friable; many roots; calcareous; clear, irregular boundary:
B2irg	19-29	48-74	Sandy loam; brown to dark brown (10 YR 4/3) with many, fine, faint, reddish-brown mottles; massive structure; moist plastic; few roots; calcareous; clear, irregular boundary:
(	Below 29	74	Boulders and rocks, with a little mottled soil between them

Vegetation: *Centaureo-Cynosuretum*, Sub-ass. *of Juncus effusus*. Poor, old meadow. Low quality sward dominated by *Holcus lanutus* (Yorkshire fog), *Festuca rubra* (red fescue), *Antho.xanthum odoratum* (sweet vernal grass), *Juncus effusus* (soft rush) and *Centaurea nigra* (knapweed).

TABLE 44: Puckane Series—Alkaline Parent Material Phase

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	Sill	Clay %		CEC meq/IOOg	TEB meq/IOOg	Base sat. %	C%	N %	C/N		
AII	51	20	17	12	6.3	21.5	nd		4.2	0.30	14.0	0.4	—
A12	55	17	17	II	7.8	12.4	nd		1.8	0.16	11.3	0.3	4.0
A2I	58	15	19	8	8.0	8.2	nd		0.9	nd	-	0.1	2.7
A22	42	30	20	8	8.1	4.5	nd		0.5	nd	-	0.0	0.7
B2irg	36	23	21	20	7.5	13.2	nd		1.4	nd	-	0.9	0.9

Trace Elements—extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
	11.0	14.6	0.22	450	5.4

Sellernaun Series

i <nation:	Clare, 43 NE, E 14
Topography:	Gentle hollow in very gentle kamc and kettle terrain
Slope:	2-3°
Altitude:	160 feet (49 m) O.D.
Drainage:	Poorly drained
Parent Material:	Drift of Old Red Sandstone with occasional limestone
Greal Soil Group:	Podzolised Gley

Horizon	*Depth* (inches)	(cm)	*Description*
AI	0-11	0-28	Sandy loam; very dark greyish-brown (10 YR 3/2); weak, medium sub-angular blocky structure with a tendency to weak, fine crumb; moist slightly plastic; root mat to 3A inches plentiful below; clear, irregular boundary:
A2	11-16	28-41	Loamy sand; light grey (10 YR 7/2) with traces of yellow (10 YR 7/6) and very dark greyish-brown (10 YR 3/2); single grain structure; moist firm, shattering to single-grain; few roots; clear, irregular boundary:
B2hg	16-32	41-81	Loamy sand; light brownish-grey (10 YR 6/2) with very dark grey (10 YR 3/1) in streaks and globules; moist, single grain with a grouping into weak, fine crumb structure; moist firm and moist loose; plentiful roots; clear, irregular boundary:
CIg	32-42.1	81-108	Sandy loam; pale brown (10 YR 6/3) with common, medium, faint mottles of grey; single grain structure; moist sticky; few roots; clear, irregular boundary:
C2g	42J-48-J	108-123	Sandy loam; pinkish-grey (10 YR 6/2) with rusty mottles; massive structure; moist sticky; no roots

Vegetation: Not classified.

TABLE 45: Sellernaun Series

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse Mild %	Fine sand %	Sill ,,	Clay %		CEC meq/IOOg	TEB meq/IOOg	Base sat. /o	c%	N %	C/N		
A1	35	36	24	5	5.6	19.0	nd		3.2	0.25	12.8	0.2	–
A2	35	39	23	3	5.5	3.8	nd		0.7	0.04	17.5	0.1	-
B2hg	37	38	20	5	5.5	17.8	nd		1.2	0.06	20.0	0.2	-
C1g	36	37	22	5	5.5	8.0	nd		0.7	nd	-	0.2	-
C2g	37	31	25	7	5.3	3.2	nd		0.8	nd	~	0.6	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	(i	Ti	Mn
A	2	10	< 2	6	30	30	25	15	3	18	^0	35

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
	1.5	3.3	0.14		1.0

Sella f—*Peaty Variant*

I ocation:	Clare, 21 SE, T 4
Topography:	Gently rolling above steep gulley
Slope:	2°
Altitude:	320 feet (98 m) O.D.
Drainage:	Poorly drained
Parent Material:	Drift, principally of Old Red Sandstone, with up to 20°,, Silurian shales, of Wcichsel age
Great Soil Group:	Peaty, Podzolised Gley

Horizon	*Depth*		*Description*
	(inches)	(cm)	
02	11-0	28-0	Peat; black (2.5 YN 2/-); moderate, coarse sub-angular blocky structure; peaty consistency; plentiful roots, dead and alive; diffuse, smooth boundary:
All	0-3	0-8	Sand; black (7.5 YN 2/-); massive structure; peaty consistency; plentiful roots:
A12	3-9	8-23	Gravelly loamy sand; very dark greyish-brown (2.5 Y 4/2) and dark brown (10 YR 3/3), humic staining; massive structure; moist, slightly hard; few roots; gradual, smooth boundary:
A2	9-15	23-38	Gravelly sandy loam; light grey with humic stains (10 YR 7 2); massive structure; moist, slightly sticky; plentiful roots; diffuse, smooth boundary:
B2hg	15-22	38-56	Gravelly sandy loam; light grey (10 YR 7/2) and yellowish-red (10 YR 5/8) with common, medium, distinct humus mottles (10 YR 3/2); weak, coarse sub-angular blocky structure; moist, slightly friable and slightly sticky; very few roots: clear, smooth boundary:
Cg	22-33	56-84	Gravelly sandy loam; reddish-brown (5 YR 4/4), reddish-yellow (5 YR 7/8) and light grey (10 YR 7/2); common, medium, distinct mottles; weak coarse sub-angular blocky to massive structure; firm; very few roots

Vegetation: Not classified.

TABLE 46: Sellernaun—Peaty Variant

	Particle size analysis of mineral fraction					Cation Exchange			Organic Fraction				
Horizon	Coarse sand %	**Fine sand** %	Silt "„	Cla>	PH	**CEC** meq/lOOg	**TEB** meq/lOOg	Hasc **sat.** %	**c %**	N %	C/N	1 ICC iron %	TNV /o
<>:	**nd**	**nd**	nd	nd	4.0	nd	–	–	Peat	nd		0.1	–
A11	**46**	43	9	2	4.3	19.6	nd	-	3.8	0.14	27.1	0.1	-
AI2	**40**	37	19	4	4.2	10.8	nd	-	1.3	0.04	32.5	0.1	-
A2	33	32	22	13	4.5	13.2	nd	-	1.3	0.04	32.5	0.2	-
B2hg	**32**	**31**	23	14	4.9	8.4	nd	-	0.8	nd	-	0.5	-
Cg	**28**	**31**	22	19	5.0	3.8	nd	-	0.5	nd	-	0.4	-

Sellernaun—Alkaline Parent Material Variant

Location:	Clare, 35 SE, H 35
Topography:	Gently rolling with occasional drumlin kame; the site is gently sloping
Slope:	2-3°
Altitude:	70 feet (21 m) O.D.
Drainage:	Poorly drained
Parent Material:	Drift of Old Red Sandstone, limestone and Silurian shale, *of* Weichsel age
Great Soil Group:	Podzolised Gley

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-10	0-25	Sandy loam; very dark grey (10 YR 3/1); weak, line crumb structure with a tendency towards granular; friable; plentiful roots; calcareous; diffuse, smooth boundary:
A12	10-18	25-46	Sandy loam; dark grey (10 YR 4/1); weak, medium sub-angular blocky structure; few roots; calcareous; clear, irregular boundary:
A2	18-24	46-61	Sandy loam; greyish-brown (10 YR 5/2); weak, medium sub-angular blocky structure; friable; some roots; calcareous; gradual, wavy boundary:
B21h	24-26	61-66	Sandy loam; very dark grey (10 YR 3/1) and dark grey (10 YR 4/1) in blotches; weak, medium sub-angular to fine sub-angular blocky structure; moist friable to moist loose; few roots; calcareous; clear, distinct boundary:
B22irg	Below 26	66	Sandy loam; light yellowish-brown (10 YR 6/4) and rusty brown in common, medium, distinct mottles; weak, fine angular blocky structure; friable; no roots; calcareous

Vegetation: Not classified.

TABLE 47: Sellernaun—Alkaline Parent Material Variant

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Orgainic Fracti			Free iron %	TNV %
	Coarse nd %	Fine sand %	Sill ,,	Clay %		CEC meq/lOOg	TEB meq/IOOg	Base sat. %	C°/,,	N %	C/N		
A11	41	32	19	8	7.1	23.4	nd	—	3.2	0.29	11.0	0.5	0.2
A12	34	39	22	5	7.7	12.8	nd	-	1.6	0.12	13.3	0.4	2.7
A2	34	35	24	7	7.7	5.6	nd	-	0.9	0.05	18.0	0.1	0.5
B2lh	42	31	20	7	7.7	9.2	nd		1.1	0.05	22.0	0.2	0.2
B22irg	34	30	24	12	7.7	6.8	nd	-	0.7	nd	—	0.8	0.2

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
A	<2	10	2	1	15	5	<25	8	3	5	450	95

Extractable contents (ppm)

HoiI'lMl	Cu	Zn	Mo	Mn	Co
	2.5	4.1	0.15	70	2.0

Burren Series

Location:	Clare, 17 NW, 5 21/22
Topography:	Slight slope in level area
Slope:	3°
Altitude:	147 feet (45 m) O.D.
Drainage:	Excessive
Parent Material:	Carboniferous limestone bedrock
Great Soil Group:	Rendzina

Horizon	*Depth* (inches)	(cm)	*Description*
A	0-3J	0-9	Slightly peaty clay loam to loam; very dark brown (10 YR 2/2); strong, fine crumb structure; friable; abundant roots; calcareous; abrupt, irregular boundary:
R	Below 31	9	Carboniferous limestone bedrock

Vegetation: Not classified.

TABLE 48: Burren Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction				
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/IOOg	Base sat. %	C %	N %	C/N	i ree iron %	TNV %
A	9	16	48	27	7.1	61.4	nd		11.2	0.76	14.7	3.4	1.0

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	(t	Ti	Mn
A	5	20	6	1	125	20	loo	40	8	130	S00	3,500

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	4.75	14.6	0.07	740	7.0

Burr en Series—Deeper Phase

Location:	Clare, 61 NW, S I
Topography:	Level with the bedrock protruding frequently through the son
Slope:	1°
Altitude:	10 feet (3 m)O.D.
Parent Material:	Limestone bedrock with some drift
Great Soil Group:	Rendzina

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-3	0-8	Slightly peaty clay loam; dark brown (10 YR 3/3); moderate, line crumb structure; moist, slightly plastic; abundant roots, forming a root mat; clear, smooth boundary:
A12	3-7	8-18	Organic clay loam; brown to dark brown (10 YR 4/3); moderate, fine to medium crumb structure; friable; plentiful roots; abrupt, smooth boundary:
R	Below 7		Limestone bedrock

Vegetation: Not classified.

TABLE 49: Burren Series—Deeper Phase

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	pH	Cation Exchange: CEC meq/100g	TEB meq/100g	Base sat. %	Organic Fraction: C %	N %	C/N	Free iron %	TNV %
A11	12	12	45	31	6.0	59.2	nd		12.8	1.25	10.2	2.3	-
A12	15	15	41	29	6.5	52.4	nd		10.0	1.05	9.5	2.2	

Kilcolgan Series

I ocation:	Clare, 2 SW, U 18
Topography:	Drumlin
Slope:	5-8°
Altitude:	620 feet (189 m) O.D.
Drainage:	Well drained
Parent Material:	Drift of limestone origin, of Weichsel age
Great Soil Group:	Rend/ina

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-5	0-13	Clay loam, with some gravel; dark brown (10 YR 3/3); moderate, coarse crumb structure; friable; root mat; calcareous; gradual, smooth boundary:
A12	5-9	13-23	Clay loam, with some gravel; dark yellowish-brown (10 YR 3/4); moderate, coarse and fine crumb structure; friable; plentiful, diffuse roots; calcareous; abrupt, smooth boundary:
C	9-15	23-38	Gravelly clay loam; light grey (10 YR 7/1); massive structure; very few roots; calcareous

Vegetation: Not classified.

TABLE 50: Kilcolgan Series

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt ",,	(lay %	pH	Cation Exchange: CEC meq/lOOg	TEB meq/IOOg	Base sat. %	Organic Fractii in: C %	N %	C/N	Free iron %	TNV %
All	13	22	37	2X	6.9	31.0	nd		4.1	0.50	8.2	2.5	2.5
AI2	13	23	34	30	7.5	20.8	nd		2.0	0.27	7.4	2.3	19.8
C	10	19	38	33	7.8	6.2	nd		0.5	nd	—	0.6	80.6

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn
All	2	20	10	3	100	20	so	60	6	60	1,000	1.300
AI2	<2	15	7	2	70	18	35	40	10	40	1,200	800
C	<1	<2	<1	<1	25	2	25	10	1	15	450	85
Ranges in total contents (ppm) within series (data from four profiles)												
Surface	<2-2	4-35	<1-10	<l-3	20-100	<2-25	35-120	5-60	1-10	10-60	700-1,200	170-1,300
C	<2	<2-3	<1	<1	25-50	2-12	<25-130	7-10	1	7-15	250-600	85-170

Extractable contents (ppm)

Modal profiles

Horizon	Cu	Zn	Mo	Mn	Co	B
A	2.9	1.9	0.14	235	5.0	

Ranges within series (four profiles)

Horizon	Cu	Zn	Mo	Mn	Co
A	1.8-9.5	1.9-12.5	0.14 0.25	200-288	4.2-7.0

Carrigogunnel Series

Location:	Clare, 43 NW, H 15
Topography:	Small ridge-top on volcanic hill in drumlin
Slope:	1-3° above 8° slope
Altitude:	270 feet (82 m) O.D.
Drainage:	Excessive
Parent Material:	Felsitic ash
Great Soil Group:	Lithosol

Horizon	*Depth*		*Description*
	(inches)	(cm)	
Al	0-8	0-20	Gravelly sandy clay loam; brown to dark brown (7.5 YR 4/2); moderate, fine crumb structure; friable; abundant roots; abrupt, irregular boundary:
R	Below 8	20	Felsitic ash

Vegetation: Not classified.

TABLE 51: Carrigogunnel Series

Horizon	Particle size analysis of mineral fraction: Coarse sand %	Fine sand %	Silt %	Clay %	pH	Cavion Exchange: CEC mcq/lOOg	TEB meq/lOOg	Base sat. %	Organic Fraction: C %	N %	C/N	Free iron %	TNV %
Al	**43**	**14**	**22**	**21**	**6.7**	29.0	**nd**		**4.5**	**0.42**	10.7	3.9	-

Trace Elements—total contents (ppm)

Horizon	**Sn**	**Pb**	**Ga**	**Mo**	**V**	**Cu**	**Zn**	**Ni**	Co	Cr	Ti	Mn	**Se**
A	**3**	**8**	**15**	**2**	**150**	**40**	**140**	160	**40**	2(H)	6,500	2.000	**0.3**

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	6.75	2.5	0.75	260	40

Slievereagh Series

Location:	Clare, 56 SE, J 16
Topography:	Gentle slopes of mountain crest with numerous outcrops of Old Red Sandstone projecting through the drift
Slope:	5° above a 9° slope
Altitude:	950 feet (290 m) O.D.
Drainage:	Excessive
Parent Material:	Old Red Sandstone bedrock
Great Soil Group:	Lithosol

Horizon	*Depth* (inches)	(cm)	*Description*
02	lOJ-O	27-0	Partially decomposed peat, with a clear, smooth boundary:
AI	0-5.J	0-14	Sandy loam; light yellowish-brown (10 YR 6/4) with numerous small, faint mottles of black and reddish-brown; very weak, medium angular-blocky structure breaking down through crumb to single grain; fiiable; few roots; abrupt, irregular boundary:
	54	14	Old Red Sandstone bedrock

Vegetation: Not classified.

TABLE 52: Slievereagh Series

Horizon	Particle size analysis of mineral fraction					Cation Exchange			Organic Fracti< n				
	Coarse sand %	Fine sand %	Silt %	Clay %	PH	CEC meq/IOOg	TEB meq/lOOg	Base sat. %	C %	N %	C/N	I ice iron %	TNV %
02	nd	nd	ncl	ncl	5.3	128.0	nd		32.7	1.18	27.7	0.X	
Al	34	18	33	15	4.1	34.0	nd		2.9	0.12	24.2	0.8	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	(1	Ti	Mn
A	2	3	4	<1	85	5	<25	5	2	50	l.(XK)	15

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	4.75	2.9	0.14	I	2.0

Sea field Series

non:	Clare, 2 SE
Topography:	Rolling in subdued wind-blown sandhills
Slope:	5°
Altitude:	20 feet (6 m) O.D.
Drainage:	Excessive
Parent Material:	Wind-blown sands of comminuted shells and Uppei Carboniferous shales
Great Soil Group:	Regosol

Horizon	*Depth*		*Description*
	(inches)	**(cm)**	
Al	**0-6**	**0-15**	Sand; dark grey (10 YR 4/1); single grain structure; friable; many roots; calcareous; clear, smooth boundary:
CI	**6-11**	**15-28**	Sand; grey (10 YR 5/1); single grain structure; friable feu roots; calcareous; clear smooth boundary:
C2	**11-14**	**28-36**	Sand; greyish-brown (10 YR 5/2); single grain structure; friable; few roots; calcareous; clear, smooth boundary:
Ab	**14-23**	**36-58**	Sand; very dark grey (10 YR 3/1); single grain structure; friable; few roots; calcareous; clear, smooth boundary:
Cb	**23-36**	**58-91**	Sand; dark greyish-brown (10 YR 4/2); single grain structure; friable; few roots; calcareous

Vegetation: Not classified.

TABLE 53: Seafield Series

	Particle size analysis of mineral fraction					Cation Exchange			Organic Fraction				
Horizon	Coarse sand %	Fine sand %	Silt %	Clay %	pH	CEC meq/lOOg	TEB meq/lOOg	Base sat. %	C %	N %	C/N	Free iron %	TNV %
Al	58	39	2		8.2	4.4	nd	–	0.8	0.09	8.9	0.2	31.2
CI	63	34	2		8.3	3.6	nd	-	0.5	0.05	10.0	0.2	34.0
C2	73	25	1		8.3	3.0	bd	-	0.6	0.05	12.0	0.2	56.6
Ab	65	31	3		8.1	8.4	nd	-	I.I	0.09	12.2	0.2	33.4
Cb	68	30	1		8.6	nd	–	–	0.3	0.03	10.0	0.3	31.9

Camoge Series

Location:	Clare, 52 NW, F 25
Topography:	Alluvial flat between drumlins
Slope:	I
Altitude:	98 feet (30 m) O.D.
Drainage:	Poorly drained
Parent Material:	Alluvium derived from limestone drift with some sandstone and shale
Cireat Soil Group:	Gley

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-3	0-8	Organic sandy loam: veiy dark brown (10 YR 2/2); weak, fine crumb structure: friable; plentiful roots; clear, smooth boundary:
A12	3-6	8-15	Sandy loam: very dark greyish-brown (10 YR 3/2); weak, fine sub-angular blocky structure; friable; many roots; calcareous; clear, irregular boundary:
Clg	6-14	IS *M*	Gravelly sandy loam; grey to light grey (10 YR 6/1); single grain structure with weak, fine sub-angular blocky peds; wet friable; few roots; calcareous; gradual, irregular boundary:
C2g	14-20	36-51	Gravelly sandy loam; limestone gravel of varied colours, the finer fraction is grey to light grey (10 YR 6/1); single grain: wet loose; calcareous

Vegetation: Old grassland in which the following species are most conspicuous: *f'estuca pratenis* (meadow fescue), *Poa trivia/is* (rough-stalked meadow-grass), *Carex hirtu* (hairy sedge), *Juncus in/lcxus* (glaucous rush) and *Ranunculus repens* (creeping buttercup).

TABLE 54: Camoge Series

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV /o
	Coarse sand %	Fine sand %	Sill ,	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	c %	N	C/N		
All	26	26	31	17	6.7	59.4	nd	–	9.6	0.89	I0.S	O.ft	–
AI2	33	24	30	13	7.3	41.8	nd	-	5.0	0.57	8.8	0.6	14.4
Clg	46	20	23	II	8.2	13.4	nd	-	0.8	0.15	5.3	0.2	35.0
C2g	62	12	16	10	8.3	5.4	nd	-	0.2	0.04	5.0	0.2	40.8

Feale Series

Location:	Clare, 17 SW, X 4
Topography:	Alluvial flat by river with rolling valley sides
Slope:	0
Altitude:	70 feet (21 m) O.D.
Drainage:	Poorly drained
Parent Material:	Alluvium derived from Upper Carboniferous shales and sandstones with some limestone
Great Soil Group:	Gley

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-5	0 i -	Organic silty clay; greyish-brown (10 YR 5/2) with red-brown root traces; weak, fine sub-angular blocky structure; moist plastic; root mat; calcareous; clear, wavy boundai \:
A12	5-10}	13-27	Silty clay; grey (10 YR 6/1) and brownish-yellow (10 YR 6/6) in few, fine, faint mottles; weak, fine sub-angular blocky structure; moist plastic: plentiful roots; clear, wavy boundary:
Clg	10}-22	27-56	Gravelly silty clay loam; grey to light grey (2.5 YN 6/-) and reddish-yellow (7.5 YR 6/6) in fine, common, distinct mottles; massive structure breaking into weak, medium sub-angular blocky structure; wet sticky and wet plastic; very few roots; structural faces show clay skins; diffuse boundary:
C2g	22-34	56 86	Gravelly clay loam; grey to light grey (2.5 YN 6/-) with strong brown (7.5 YR 5/6) in fine, common, distinct mottles; massive structure; wet sticky; no roots; clear, wavy boundary:
C3g	34-50	86-127	Silty clay loam; grey to light grey (2.5 YN 6/-); massive structure; wet plastic; no roots

Vegetation: Dry-Phase: *Lolio-Cynosuretum,* moist variant. Elevated, rushfree part of a big swampy area. Heavily grazed, old pasture, probably used as dry-lying by cattle. High quality sward dominated by *Lolium perenne* (perennial ryegrass) and *Trifolium repeiu* (white clover). Commonly present are *Bellis perennis* (daisy), *Plantugo lanceolate* (plantain). *Ranunculus repens* (creeping buttercup) and broad-leaved dock *(Rumex obtusifolius).* Wet Phase: *Senecioni-Juncctum mutiflovi,* swampy variant. Rough grazing for cattle. Stemmy, rush dominant *(Juncus effusus)* vegetation with dense moss carpet *(Acrocladium cuspidatum).*

TABLE 55: Feale Series

Horizon	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraen			I ree iron %	TNV %
	Coarse sand %	Fine sand %	Sill	Clay %		CEC meq/lOOg	TEB meq/IOOg	Base sat. %	c%	N %	C/N		
All	2	8	45	45	7.3	39.0	nd	—	7.2	0.71	10.1	1.8	14.9
A12	2	6	49	43	6.4	27.2	nd	-	3.4	0.38	8.9	3.4	-
Clg	8	8	46	38	6.3	22.8	nd	-	1.0	0.16	6.3	4.6	-
C2g	7	14	46		6.4	21.8	nd	-	0.9	0.15		4.8	-
C3g	1	7	54	IX	6.1	22.4	nd	-	2.0	0.20	10.0	1.5	-

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn	Se
A	2	40	10	2	70	35	250	35	20	35	^(M)	1.3(H)	1.2

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	23	85	1.00	350	1.8

Glenomra Series

Location:	Clare, 45 SW, S 22
Topography:	Flat area on bank of Shannon
Slope:	0-1°
Altitude:	110 feet (34 m) O.D.
Drainage:	Poorly drained
Parent Material:	Alluvium derived principally from Silurian shales with some Old Red Sandstone
Great Soil Group:	Gley

Horizon	*Depth*		*Description*
	(inches)	(cm)	
All	0-4	0-10	Gravelly loam; dark greyish-brown (10 YR 4/2); modcate. fine sub-angular blocky structure; moist friable to moist plastic; root mat; abrupt, smooth boundary:
A12	4-9 £	10-24	Gravelly loam; yellowish-brown (10 YR 5/4); weak, coarse sub-angular blocky which breaks to moderate, fine sub-angular blocky structure; friable; many roots; abrupt, smooth boundary:
Clg	9J-I6	24-41	Sandy gravel with lenses of clay; very pale brown (10 YR 7 3); single grain structure; wet, sticky and friable; some roots present; abrupt, smooth boundary:
C2g	16-26	41-66	Silty clay loam; very pale brown (10 YR 7/3) and brownish-yellow (10 YR 6/8) in common, fine and distinct mottles; massive structure with traces of prismatic cracks; moist plastic; very few roots; clear, smooth boundary:
C3g	26-35	66-89	Silt loam; very pale brown (10 YR 7/3) and brownish-yellow (10 YR 6/8) in few, fine, faint mottles; massive structure; moist plastic; very few roots; clear, smooth boundary:
C4g	35-45	89-114	Gravelly silt loam to loam; light grey (10 YR 7/1); massive structure; wet sticky; no roots

Vegetation: *J unco-Molina-turn.* Sub-ass. of *Trijolium repens.* Alluvial area used as rough grazing for cattle. Poor, mixed sward in which *Agrostls stoloni/era* (creeping bentgrass), *Anthoxanthum odoratum* (sweet vernal grass), *Cynosurus crista)us* (crested dog's tail), *Holcus lanatus* (Yorkshire fog) and *J uncus spp.* (rushes) are abundant.

TABLE 56: Glenomra Series

Hori/on	Particle size analysis of mineral fraction				PH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse land %	Fine sand %	Silt %	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	c %	N	C/N		
All	21	14	42	23	6.3	28.4	nd		4.5	0.50	9.0	1.8	—
Al2	29	14	37	20	6.2	19.0	nd		2.1	0.16	13.1	1.3	-
Clg	57	14	18	II	6.0	12.8	nd		0.8	nd	-	1.0	-
C2g	2	2	63	33	5.8	12.8	nd		1.0	0.12	8.3	I.I	-
C3g	4	17	56	23	5.8	12.8	nd		1.0	0.12	8.3	0.5	-
C4g	II	20	50	19	6.1	11.6	nd		I.I	0.12	9.2	0.4	-

Kilgorey *Scries*

Location:	**Clare, 35 SE, L 30**
Topography:	**River flat**
Slope:	1°
Altitude:	**98 feet (30 m) O.D.**
Drainage**:**	**Poorly drained**
Parent Material:	**Alluvium derived from Old Red Sandstone-limestone with some Silurian shale**
Great Soil Group:	**Regosol**

Horizon	***Depth*** (inches)	(cm)	***Description***
All	**0-3**	**0-8**	**Sandy loam; dark greyish-brown (10 YR 4/2); weak,** very **tine crumb structure; moist slightly plastic;** root mat; diffuse, **smooth boundary:**
A12	**3-12**	**8-30**	**Sandy loam; datk greyish-brown (10 YR 4/2); weak,** very line crumb structure; **moist, slightly** plastic; plentiful roots; clear, smooth boundary:
CI	**12-17**	**30-43**	**Sand; light grey (10 YR 7/1); single grain** structure; moist, very **friable; few roots; clear, smooth boundary:**
C2	**17-27**	**43-69**	**Sand; grey and yellow (10 YR 5/1 and 7/6) in common, fine, distinct mottles; single grain** structure; moist, very **friable and slightly loose; abundant roots; clear smooth boundary:**
C3	**27^0**	**69-102**	**Sand; light grey (10 YR 7/2); single grain structure;** moist, very **friable; few roots;** dill use, **smooth boundary:**
C4g	**40-50**	**102-127**	**Sand; light grey (10 YR 7/2) with occasional** prominent red **mottles; single grain structure; very friable; no roots; calcareous**

Vegetation: ***CetUaureo-Cynosuretum,*** **Sub-ass. of** *Galium verum.* **Poor,** species rich **sward with many small herbs typical of dry, limestone land such av** ***Medicago luputtna*** **(black medick).** *Lmum catharticum* **(wild flax) and** ***Daucus*** *carom* (wild carrot). **The main sward constituents** are *Cynosurus* ***cristatus*** (crested dog's **tail),** *Atrtho.xaiuhum* ***odoratum*** (sweet vernal grass) **and** *Hypochoeris radicafu* **(cat's ear).**

TABLE 57: Kilgorey Swies

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Organic Fraction			Free iron %	TNV %
	Coarse sand %	Fine sand %	**Silt** %	Clay %		CEC meq/lOOg	TEB meq/lOOg	Base sat. %	C%	N %	C/N		
All	29	32	26	13	5.7	25.6	nd	–	3.8	0.28	**13.6**	1.3	–
A12	33	34	22	11	5.8	16.1	nd	-	2.4	0.21	**11.4**	1.1	-
CI	52	41	4	3	6.2	6.2	nd	_	0.4	nd	-	0.1	-
C2	48	45	4	3	6.6	6.4	nd	_	0.4	nd	-	0.4	-
C3	37	60	1	2	7.1	3.6	nd	_	0.1	nd	-	0.2	0.1
C4g	23	72	4	1	7.5	3.0	nd	_	0.1	nd	_	0.1	14.8

Rathborney Series

l ocation:	Clare, 2 SE, X 14
Topography:	River flat in gently rolling landscape
Slope:	0°
Altitude:	45 feet (14 m) O.l).
Drainage:	Poorly drained
Parent Material:	Alluvium derived from shales of Upper Carboniferous and Carboniferous limestone
Great Soil Group:	Regosol

Horizon	*Depth* (inches)	(cm)	*Description*
All	0 51	**0-14**	Organic silty clay; dark greyish-brown (10 YR 4 2); moderate, fine crumb structure; moist, slightly plastic; root mat; calcareous; clear boundary:
A12	5H0J	**14-27**	Silty clay; brown to dark brown (10 YR 4/3); moderate, fine crumb structure; moist, slightly plastic; plentiful roots; gradual, smooth boundary:
Cll	**I0J-15**	**27 38**	Silty clay; brown (10 YR 5/3); weak, fine crumb to sub-angular blocky structure; moist plastic; gradual smooth boundary:
C12	**15-32**	**38 81**	Silty clay to silty clay loam; brown (10 YR 5/3); weak, fine sub-angular blocky structure; moist pkisiic; many roots; gradual, irregular boundary:
C13	**32-42**	**HI** 107	Stony clay with lenses of fine, gravelly sandy clay loam; light yellowish-biown (10 YR 6/4); weak, fine sub-angular blocky structure; moist sticky; few roots; calcareous

Vegetation: *Centaureo-Cynosuretum,* Sub-ass. of *Galium verum.* Poor, species-rich, old pasture. Common and abundant species are *Lotus eornieulatus* (bird's-foot trefoil), *PhtltOgO lanceolata* (plantain), *Cyiio.uirus eristatus* (crested dog's tail) and *Koeleria gracilis* (en sled hair grass).

TABLE 58: Rathborney Series

Horizon	Particle size analysis of minera I fi actum				pH	Cation Exchange			Organic Fraction				
	Coarse sand %	Fine sand %	sin -.	Clay %		CEC meq/IOOg	1 1 11 meq/lOOg	Base sat. %	c%	N ",,	C/N	i ree iron %	TNV /o
A11	4	**10**	43	43	7.2	52.8	nd		8.3	0.93	8.9	2.3	4.0
A12	4	10	43	43	7.4	**39.0**	nd		4.4	0.62	7.1	2.7	0.0
Cll	2	12	45	41	7.4	32.0	nd		2.0	0.31	6.5	2.6	0.0
C12	2	10	48	40	7.3	21.4	nd		1.3	0.18	7.2	2.1	0.0
CI3	9	15	34	42	7.6	20.8	nd		I.I	0.19	5.8	2.0	11.8

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	(.;,	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn	Se
A	<2	**10**	3	4	**120**	**18**	50	**20**	5	35		**180**	**2.1**

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mri	Co
A	5.75	5.0	1.22	120	3.5

Drombanny Series

Location:	Clare, 33 NE,J 34
Topography:	Alluvial flat in area of limestone hillocks
Slope:	0U
Altitude:	38feet(12m)O.D.
Drainage:	Poorly drained
Parent Material:	Alluvium derived from limestone drift with some Upper Carboniferous shales and sandstones
Great Soil Group:	Gley

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-10	0-25	Organic clay; very dark greyish-brown (10 YR 3/2); moderate, fine crumb structure; wet plastic; root mat to 6 inches with abundant roots below; clear, irregular boundary:
A12	I0-I4A	25-37	Organic clay; very dark brown (10 YR 2/2); massive structure; wet plastic; plentiful roots; clear, irregular boundary:
02b	14i-19A	37-50	Slightly peaty silty clay; black; strong, coarse angular blocky structure; wet plastic: many living and dead roots; abrupt, smooth boundary:
Clca	19J-29	50-74	Clay loam; very pale brown (10 YR 8/3); massive structure; wet sticky; no roots; calcareous; clear ,smooth boundary:
C2	29-34	74-86	Sandy loam; grey (2.5 YN 5/-); single grain structure; wet plastic and moist friable; no roots; calcareous

Vegetation: Not classified.

TABLE 59: Drombanny Series

Horizon	Particle size analysis of mineral fraction					Cation Exchange			Organic Fraction				
	Coarse sand %	**Fine sand** %	**Silt** %	C lay %	**pH**	CEC meq/lOOg	TEB meq/lOOg	Base sat. %	c%	N %	C/N	Free iron %	TNV %
All	0	2	**40**	**58**	**6.9**	nd	—	—	6.3	0.58	10.9	0.8	-
AI2	5	II		45	6.8	nd		-	10.0	1.8	6.0	1.4	-
02b	2	2	46	50	6.9	nd	-	-	20.0	1.5	13.3	1.4	-
Clca	nd	nd	**nd**	nd	8.4	6.8	nd		1.7	0.10	17.0	0.1	88.8
C2	1	66	30	3	7.9	2.6	nd		0.3	nd		0.7	28.5

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	< i	Ti	Mn
A	2	6	5	<1	30	50	40	20	15	**30**	500	130

Extractable contents (ppm)

Horizon	**Cu**	Zn	**Mo**	**Mn**	Co
	40	**5.5**	0.22	**55**	12

Shannon Scries

Location:	Clare, 61 NW, L 20
Topography:	Estuarine flat formerly tidal
Slope:	0
Altitude:	0 feet O.D.
Drainage:	Very poorly drained
Parent Material:	Estuarine alluvium of Shannon and Fergus rivers
Great Soil Group:	Gley

Horizon	*Depth* (inches)	(cm)	*Description*
All	0-4	0-10	Silt loam; daik greyish-brown (10 YR 4/2); weak, line crumb structure; dry friable: root mat; calcareous; clear boundary:
AI2	4-9 J	10-24	Sill loam; dark grcyish-b.own (10 YR 4/2); weak, fine sub-angular blocky structure; dry friable; many roots; calcareous; clear, smooth boundary:
CIg	91-17	24-43	Silty clay loam; grey (10 YR 5/1) and yellowish-brown (10 YR 5/8) in common, fine, faint mottles; massive breaking into weak, line sub-angular blocky structure; moist plastic; few roots; calcareous; clear smooth boundary:
C2g	17-29	43-74	Silty clay loam; grey (2.5 YN 5/-) and yellowish-brown (10 YR 5/8) in common, line, faint mottles; weak, coarse prismatic structure; moist plastic; very few roots; clay can be seen on ped faces which are pin-holed, manganese and organic matter are also apparent on faces of peds; calcareous; gradual, smooth boundary:
C3g	29-33	74-84	Silty clay loam; grey (2.5 YN 5/-), yellowish-brown (10 YR 5/8) and strong brown (7.5 YR 5/8) in common, fine, faint mottles; weak, coarse prism-like structure; wet plastic; no roots; the ped faces are coated as in the C2g horizon; calcareous; gradual, smooth boundary:
C4g	33-41	84-104	Silt loam; grey (2.5 YN 5/-) with strong brown (7.5 YR 5/8) in common, fine distinct mottles; massive structure; no roots; calcareous

Vegetation: *Centaureo-Cynosuretum,* Sub-ass. of *Juncus effusus.* Old pasture. Flat, slightly rushy field with a mixed sward composed mainly of *Cynosurus crislatus* (crested dog's tail), *Alopecurus pratensis* (foxtail) *Lolium perenne* (perennial ryegrass) and *Trifolium repens* (white clovei).

TABLE 60: Shannon Series

Horizon	Particle size analysis of mineral fraction				pH	Cation Exchange			Orgaiflic Fnu i				
	Coarse sand %	Fine sand %	Silt %	Clay %		CEC meq/IOOg	TEB meq/IOOg	Base sat. %	C%	N %	C/N	I ree iron %	TNV %
All	5	7	66	22	7.4	28.4	nd	_	5.5	0.5	11.0	1.3	6.1
AI2	3	7	70	20	7.9	20.8	nd	-	3.1	0.33	9.4	1.3	9.3
Clg	2	3	67	28	8.3	14.0	nd	-	0.8	nd	-	1.0	12.2
C2g	3	2	66	29	8.2	16.0	nd	-	0.7	nd	-	1.3	6.4
C3g	1	2	69	28	8.0	14.2	nd	-	0.7	nd	-	0.7	1.2
C4g	l	2	75	22	8.0	8.7	nd	—	0.5	nd		0.3	18.8

Trace Elements—total contents (ppm)

Horizon	Sn	Pb	Ga	Mo	V	Cu	Zn	Ni	Co	Cr	Ti	Mn	Se
A	3	15	8	1	60	8	50	15	9	40	1,000	500	0.5

Extractable contents (ppm)

Horizon	Cu	Zn	Mo	Mn	Co
A	2.9	4.4	0.25	245	8.2

Banagher Series

1 iKation:	Clare, 36 SW, P 4
Topography:	Flat in drumlin topography
Slope:	0°
Altitude:	90 feet (27 m) O.D.
Drainage:	Imperfect; water-table 27 inches (70 cm), Jan 7, 1970
Parent Material:	Wood-fen peat
Great Soil Group:	Organic soil; Histosol (7th Approximation) Typic Medi-hemist, euic

Depth (inches)	(cm)	*Description*
0-6	0-15	Very well-decomposed organic material with less than 15 ",, identifiable plant remains, mineral grains visible; very dark brown (10 YR 2/2); many earthworms; very fine to medium, sub-angular blocky structure; abundant roots; diffuse, smooth boundary:
6-12	15-30	Very well-decomposed organic materials with few recognisable plant remains, *Carex* stem or leaf; black (5 YR 2/1); fine to medium, moderate sub-angular blocky Structure; plentiful, recent roots; earthworms; gradual, smooth boundary:
12-28	30-70	Humified peat matrix with fine woody fragments (bark and line twigs); dark reddish-brown (5 YR 2/2); approximately one-third of the peat material exudes between the fingers; very few recent roots; water content increases at 18 inches (45 cm) level; abrupt, smooth boundary:
28	70	Humified peat matrix with woody debris and fen plant remains (sedges and *Phragmites):* reddish-brown (5 YR 4/4) to dark reddish-brown (5 YR 3/4) darkening rapidly on exposure to the air; approximately one-third *of* the peat material exudes between the fingers; permanent water level and associated strong smell of sulphides

TABLE 61: Banagher Series

Depth in cm	Moisture %	pH in H_2Q	Ash %	Bulk Density g/cc	Fibre %
0-15	58.4-68. I	6.5	46.8 62.1	0.53	13.2
15-30	76.1-77.7	6.4	39.2-42.9		
30-70	86.5-90.5	5.8	9.2-10.8	0.11	49.2-51.7
70	88.0-88.7	5.5	14.2-17.7	0.10	42.3-60.0

Allen Series

Location:	Clare, 56NE, 0 32
Topography:	Gentle slope of raised bog
Slope:	2
Altitude:	70 feet (21 m) O.D.
Drainage:	Poor
Parent Material:	Ombrogenous, oligotrophic peat
Great Soil Group:	Organic soil, Histosol (7th Approximation) Typic Medihemist, dysic

Depth (inches)	(cm)	*Description*
0-11	0-27	Matrix humified *Sphagnum* peat with *Erlophorum* fibres; dark reddish-brown (5 YR 3/2); approximately half *of* the peat material exudes between the fingers; clear, smooth boundary
II 15	27-38	Well-humified peat matrix with cyperaceous fibres possibly *Erlphorum vaglnatum* or *Trichoplwnim caespitosum* origin; dark reddish-brown (5 YR 2/1 2/2); approximately half of the peat material exudes between the fingers; abrupt, smooth boundary:
15-39	38-99	Highly humified peat matrix with many fibres of cyperaceous origin (as in previous horizon); dark reddish-brown (5 YR 2/1-2/2); approximately two-thirds of the peat material exudes between the fingers; many woody twigs of *Myricagale'*, clear, smooth boundary:
39-45	99-115	Layered peat with Birch wood remains (twigs and hark); *Menyantkes trijoliahi* seeds and vegetative remains; yellowish-red (5 YR 4 6) on immediate exposure, rapidly darkening to dark reddish-brown (5 YR 3/2): very little peat material exudes between the fingers; clear, smooth boundary:
Below 45	115	Humified older *Sphagnum* peat; approximately half of the peat material exudes between the fingers

TABLE 62: Allen Series

Depth in cm	Moisture %	pH in H_2O	**Ash %**	**Bulk Density g/cc**	**Fibre %**
0-27	85.8-88.4	4.4	4.0	0.19	41.8-48.1
27-38	88.2-88.7	4.3	1.9-2.2	0.14	62.1
38-99	90.4-91.6	4.6	2.3-2.4	0.08	51.1-60.0
99-115	88.9-89.6	5.3	2.5	0.11	63.7
115-145	90.7-91.7	5.5	3.9		

Allen Series

Location:	Clare, 35 SE, W 4
Topography:	Gentle slope in interdrumlin area
Slope:	2°
Altitude:	110 feet (34 m) O.D.
Drainage:	Poor
Parent Material:	Ombrogenous, oligotrophic peat
Great Soil Group:	Organic soil; Histosol (7th Approximation) Fibric Medihcmist, dysic

Depth (inches)	(cm)	*Description*
0-12	0-31	Very poorly humified fresh *Sphagnum;* dark reddish-brown (2.5 YR 3/4); fibric, no material escapes between the fingers, only slightly turbid water; abrupt, broken boundary:
12-20	31-51	Humified *Sphagnum* matrix with *Erlophorum* fibres and fine ericaceous twigs; dark reddish-brown (5 YR 2 1 2/2); approximately one-third of the peat material exudes between the fingers; abrupt, broken boundary:
20-24	51-60	Fresh *Sphagnum* with ericaceous remains; dark reddish-brown (5 YR 3/4); small amount of peat material exudes between fingers with turbid water; gradual, smooth boundary:
24-28	60-70	As for 12-20 inches
28-37	70-95	As for 20-24 inches with a small amount of peat material exuding between the fingers; abrupt, smooth boundary:
37^14	95-112	Greasy textured *Sphagnum aupidatum* peat; dark reddish-brown (5 YR 3/2); with cyperaceous remains and *Vacclnlum* stems; approximately two-thirds of peat material exudes between the fingers; abrupt, smooth boundary:
Below 44	112	Humified *Sphagnum* peat with variable quantities of cyperaceous remains; dark reddish-brown (5 YR 2/2); two-thirds of peat material exudes between the fingers

TABLE 63: Allen Series

Depth in cm	Moisture	pH in H_20	Ash %	Bulk Density g/cc	Fibre %
0-31	90.9-92.1	4.1	3.0-3.2	0.055	75.4-82.4
51-60	90.0-90.3	4.7	1.2-2.8	0.094	63.0-68.0
70-95	88.2-92.3	4.8	1.8-5.1	0.091	46.0-68.0
95-112	89.0-91.4	4.9	1.4-2.8	0.100	26.0-34.0

Allen Series—Reclaimed Cut-over Phase

Location:	Clare, 56 NE, P 34
Topography:	Flat
Slope:	0°
Altitude:	50 feet (15 m) O.D.
Drainage:	Poor
Parent Material:	Ombrogenous, oligotrophy peat
Great Soil Group:	Organic soil; Histosol (7th Approximation) Typic Medihemist, dysic

Depth (inches)	(cm)	*Description*
0-6	0-15	Decomposed organic material with I5",, recognisable plant materials, sand grains visible; very dark brown (10 YR 2/2); sapric; several earthworms; moderate, fine and medium crumb to granular structure; many recent roots; clear, smooth boundary:
6-13	15-34	Humified older *Sphagnum* peat with *Ca/luna* remains; dark reddish-brown (5 YR 2/2-3/2); structureless; very few roots; clear, smooth boundary:
13-47	34-120	Moderately humified wood-fen peat composed of *Menyanthcs iri/oliata,* sedges, non-sphagnum mosses and wood remains; wood concentration present at 37 inches (94 cm); dark reddish-brown (5 YR 3/4); structureless

TABLE 64: Allen Series>—Reclaimed Cut-over Phase

Depth in cm	Moisture	pH in H,0	Ash %	Bulk Density g/cc	Fibre %
0 15	71.5-79.2	5.6	29.2-34.0	0.28	18.6-25.1
15-34	85.9-97.3	4.8	3.9-5.9	0.13	50.0-57.7
34-120	89.4-89.8	4.3	2.3-8.6	0.11	69.3-73.1

Aughty Series

Location:	Clare, 36 NE, S 35
Topography:	Gentle mountain side
Slope:	4°
Altitude:	950 feet (290 m) O.D.
Drainage:	Poor
Parent Material:	Oligotrophic peat
Great Soil Group:	Organic soil; Histosol (7th Approximation) Typic Mcdihemist, dysic

Depth (inches)	(cm)	*Description*
0-17	0-43	Humified peat matrix with cyperaceous plant fibres; dark ioddish-brown (5 YR.J2/2): approximately two-thirds of the peat material exudes between the fingers; diffuse, smooth boundary:
17-63	43-160	Well humified, greasy peat matrix with cyperaceous plant fibres; dark reddish-brown (5 YR 3/4) rapidly darkening to dark reddish-brown (5 YR 3/2-2/2); approximately two-thirds of the peat material exudes between the fingers; smooth boundary:
Below 63	160	Non-calcareous mineral sub-stratum

TABLE 65: Aughty Series

Depth in cm	Moisture %	pH in H_aO	Ash %	Bulk Density g/cc	Fibre %
0-43	87.6-89.3	4.2	2.7	0.039	
43-160	90.9-91.2	4.2	1.7-2.6	0.089	40.0-51.2

Aughty Scries—Cut-over Phase

Location: Clare, 47 NE, P 8
Topography: Flat
Slope: **1°**
Altitude: 88 feet (27 m) O.D.
Drainage: Poor
Parent Material: Peat
it Soil Group: Organic soil; Histosol (7th Approximation) Terric Medisaprist, euic

Depth (inches)	Depth (cm)	Description
0-6	**0-15**	Well decomposed peat with less than 15",, identifiable plant remains, sand and fine gravels clearly visible; black (5 YR 2/1); greasy texture; very fine to medium, moderate sub-angular blocky structure; abundant recent roots; earthworms; diffuse boundary:
6-17	**15-43**	Well decomposed peat with some plant remains recognisable; black (5 YR 2/1); greasy textuie; medium prismatic elements breaking to very fine to medium, moderate sub-angular blocky structure; plentiful roots; clear, smooth boundary:
17-28	43-70	Highly humified peat matrix with a few fossil plant roots; very dark greyish-brown (10 YR 3/2) on exposure, darkening to very dark brown (10 YR 2/2); very greasy texture, two-thirds or more of the peat material exudes between the fingers; structure-less; abrupt, smooth boundary:
Ik-low 28	70	Blue-grey silty clay; non-calcareous

TABLE 66: Aughty Series—Cut-over Phase

Depth in cm	Moisture	pH in H,0	Ash %	Bulk Density g/cc	Fibre %
0-15	58.3-67.7	6.0	45.2^18.7	0.45	18.8^10.5
15-43	58.8-68.7	6.3	41.8^*9.2	0.74	23.0-25.3
43-70	63.9-64.4	5.8	III -15.1	-	-

APPENDIX III

Stone counts on some soils of Co. Clare
(samples from modal profiles)

Size fraction 1 inch to ¼ inch (2.5 to 0.6 cm) diameter

Series	Type of rock	Age of rock	% of total stone count
Baggotstown	Limestone	Carbonifcous	48.5
	Sandstone	ORS	20.7
	Quartz/Chert	9	9.0
	Shale	Silurian	5.7
	Concreted Till	Recent	16.1
Ballylanders	Shale	Silurian	74.3
	Sandstone	ORS	22.9
	Quartz	7	2.7
Kinvarra	Limestone	Carboniferous	97.0
	Shale	Carboniferous	2.0
	Granite	Post Carboniferous	1.0
Kinvarra Podzol Variant	Limestone	Carboniferous	91.0
	Calcareous shale	Carboniferous	4.2
	Sandstone	Carboniferous	1.6
	Chert with granite pebbles	Carboniferous	2.9
Knocknaskeha i) alkaline (associated with Patrickswell Series)	Limestone	Carboniferous	74.0
	Sandstone	ORS	14.2
	Shale	Silurian	7.2
	Quartz/Chert	9	4.6
Knocknaskeha ii) acid (associated with Puckane Series)	Sandstone	ORS	41.5
	Limestone	Carboniferous	30.8
	Shale	Silurian	21.6
	Quartz/Chert	7	6.0
Doonglara	Sandstone	ORS	50.2
	Shale	Silurian and ORS	50.0
Knockaceol	Sandstone	ORS	97.7
	Shale	Silurian	18.3
	Quartz/Chert	7	1.0
Knockanattin	Sandstone	ORS	80.1
	Shale	Silurian	17.2
	Quartz/Chert	9	1.5
	Calcareous Shale	ORS	1.2
Elton	Limestone	Carboniferous	85.0
	Sandstone	ORS	8.2
	Quartz/Chert	7	3.4
	Shale	Carboniferous	2.9
Patrickswell	Limestone	Carboniferous	84.0
	Sandstone	ORS	8.0
	Shale	Carboniferous	5.0
	Chert	7	2.0
Patrickswell Podzol Variant	Limestone	Carboniferous	38.6
	Sandstone	ORS	32.3
	Shale	Silurian	22.3
	Chert	7	6.8

APPENDIX III (continued)

Kilfenora i)	Limestone	Carboniferous	88.2
	Shale	Upper Carboniferous	8.4
	Sandstone	Upper Carboniferous	2.3
	Chert	9	1.1
ii)	Limestone	Carboniferous	50.9
	Shale	Upper Carboniferous	39.1
	Chert	7	10.0
Abbeyfeale non-Peaty Phase	Shale	Upper Carboniferous	71.3
	Sandstone	Upper Carboniferous	24.4
	Quartz/Chert	7	3.8
	Limestone	Carboniferous	0.5
Gortaclareen	Sandstone	ORS	58.7
	Shale	Silurian	20.3
	Quartz, Chert	9	21.0
Kilrush	Shale	Upper Carboniferous	97.1
	Quartz/Chert	9	2.1
	Limestone	Carboniferous	0.8
Puckane	Sandstone	ORS	76.0
	Shale	Silurian	15.0
	Limestone	Carboniferous	3.0
	Quartz/Chet	7	5.0
Puckane—Alkaline Parent Material Phase	Sandstone	ORS	57.7
	Limestone	Carboniferous	23.0
	Shale	Silurian	9.7
	Calcareous Shale	Carboniferous	0.5
	Chert	7	10.9
Kilcolgan	Lin estone	Carboniferous	92.0
	Granite	Post Carboniferous	4.4
	Quartz/Chert	7	3.6

APPENDIX IV

SOIL SERIES COMMON TO COUNTIES LIMERICK AND CLARE

Brown Earths: Baggotstown, Ballincurra, Ballynalacken, Ballylanders, Derk, Kilfergus.
Grey Brown Podzolics: Elton, Patrickswell.
Brown Podzolics: Cooga, Doonglara, Mountcollins.
Podzols: Knockaceol, Knockanimpaha, Knockastanna, Seefin.
Gleys: Abbeyfeale, Gortaclareen, Howardstown, Kilrush, Puckane.
Rendzinas: Burren Deeper Phase (as Rineanna in Limerick).
Lithosols: Carrigogunnel, Slievereagh.
Alluvial Soils: Camoge, Feale, Drombanny, Shannon.
Complexes: Burren-Ballincurra Complex.

APPENDIX V

Classification* of soils according to American System: 7th Approximation**

Order	Sub-Order	Great Group	Sub-Group	Series
Entisol	Aquent	Haplaquent	Typic Haplaquent	Camoge, Drombanny, Feale, Glenomra, Kilgorey, Rathborney, Shannon
	Psamment	Quartzipsamment	Typic Quartzipsamment	Seafield
	Orthent	Udorthent	Lithic Udorthent	Slieveragh
Inceptisol	Aquept	Haplaquept	Typic Haplaquept	Abbeyfeale non-Peaty Phase, Gortaclareen, Kilrush, Puckane
		Humaquept	Typic Humaquept	Attyquin, Sellernaun
			Histic Humaquept	Puckane Peaty Phase
	Ochrept	Eutrochrept	Rendollic Eutrochrept	Baggotstown, Kinvarra
			Lithic Eutrochrept	Ballincurra
			Dystric Eutrochrept	Derk, Waterpark
		Dystrochrept	Typic Dystrochrept	Ballylanders, Ballynalacken, Kilfergus, Knocknaskeha
			Aquic Dystrochrept	Tullig
	Umbrept	Haplumbrept	Psammaquentic Haplumbrept	Abbeyfeale Sandy Phase
Alfisol	Aqualf	Ochraqualf	Typic Ochraqualf	Howardstown
	Udalf	Hapludalf	Typic Hapludalf	Elton, Kilfenora, Patrickswell
Mollisol	Rendoll		Lithic Rendoll	Burren
			Typic Rendoll	Kilcolgan
Spodosal	Aquod	Placaquod		Knockanattin Peaty Phase, Knockanimpaha, Knockastanna, Seefin
	Orthod	Haplorthod	Entic Haplorthod	Cooga, Doonglara, Knockanattin
			Typic Haplorthod	Mountcollins, Knockaceol

*This classification is based on the soil profile descriptions and analyses included in the report

**Soil Classification—A comprehensive system, 7th Approximation. Supplement March 1967. Soil Survey Staff, Soil Conservation Service, USDA, Washington D.C. 20250.

SOIL SURVEY (COUNTY) BULLETINS
PUBLISHED BY THE NATIONAL SOIL SURVEY

Soils of West Cork, April l963*.
Soils of Co. Wexford, May 1964.
Soils of Co. Limerick, March 1966.
Soils of Co. Car low, August 1967.
Soils of West Donegal, January 1969#.
Soils of Co. Kildare, December 1970.

*Part of the Report on the Resource Survey of West Cork.
#Part of the Report on the Resource Survey of West Donegal.

SOILS INDEX

NATIONAL SOIL SURVEY OF IRELAND

SOIL MAP OF Co. CLARE

(To accompany Soil Survey Bulletin No. 23)

GREAT SOIL GROUP	SERIES etc.	ACRES / Hectares	Per cent of total area
GREY BROWN PODZOLICS	59[1] Elton	47040 / 19037	6·04
	134 Kilfenora	4040 / 1635	0·52
	60 Patrickswell	17640 / 7139	2·27
	60A Patrickswell Lithic Phase	640 / 259	0·08
	60B Patrickswell Bouldery Phase	3760 / 1522	0·48
BROWN EARTHS	42 Baggotstown	520 / 210	0·07
	43 Ballincurra	1320 / 534	0·17
	45 Ballylanders	29480 / 11931	3·79
	49 Ballynalacken	2440 / 987	0·31
	44 Derk	200 / 81	0·03
	51 Kilfergus	25080 / 10150	3·22
	135 Kinvarra	13880 / 5617	1·78
	135A Kinvarra Bouldery Phase	2960 / 1198	0·38
	136 Knocknaskeha	1160 / 470	0·14
	137 Tullig	7280 / 2946	0·94
	138 Waterpark	400 / 162	0·05

[1] Numbers out of sequence refer to soils already mapped in other counties

GREAT SOIL GROUP	SERIES etc.	ACRES / Hectares	Per cent of total area
BROWN PODZOLICS	54 Coaga	9800 / 3966	1·26
	56 Doonglara	2240 / 907	0·29
	55 Mountcollins	25680 / 10393	3·30
PODZOLS	77 Knockaceol	2000 / 809	0·26
	77A Knockaceol Bouldery Phase	1360 / 550	0·17
	78 Knockanimpaha	1800 / 729	0·23
	139 Knockanattin	760 / 308	0·10
	79 Knockastanna	1640 / 664	0·21
	79A Knockastanna Peaty Phase	2520 / 1020	0·32
	80 Seefin	280 / 113	0·04
RENDZINAS	140 Burren	200 / 81	0·03
	140x Burren* Rocky Phase	22040 / 8920	2·83
	140y Burren very** Rocky Phase	34040 / 13776	4·37
	140z Burren extremely Rocky Phase***	18480 / 7479	2·37
	140A Burren Deeper Phase	360 / 146	0·05
	141 Kilcolgan	14360 / 5812	1·85
	141A Kilcolgan Bouldery Phase	7440 / 3011	0·96
LITHOSOL	85 Slievereagh	80 / 32	0·01

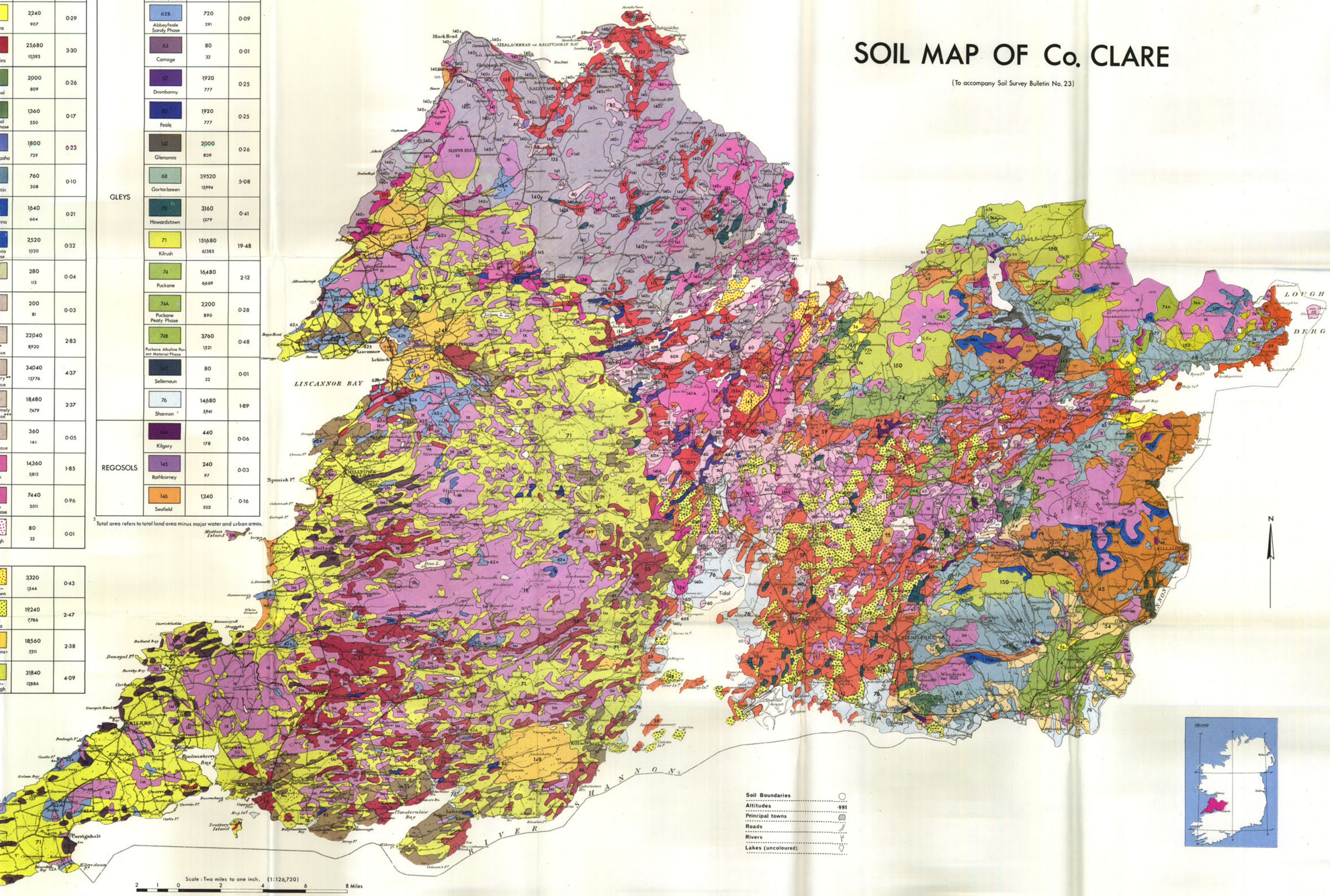
*25%, **50%, ***75% rock

GREAT SOIL GROUP	SERIES etc.	ACRES / Hectares	Per cent of total area[2]
GLEYS	62A Abbeyfeale Non-Peaty Phase	10320 / 4177	1·33
	62B Abbeyfeale Sandy Phase	720 / 291	0·09
	63 Camoge	80 / 32	0·01
	67 Drombanny	1920 / 777	0·25
	83 Feale	1920 / 777	0·25
	142 Glenamra	2000 / 809	0·26
	68 Gortaclareen	39520 / 15994	5·08
	70 Howardstown	3160 / 1279	0·41
	71 Kilrush	151680 / 61385	19·48
	74 Puckane	16480 / 6669	2·12
	74A Puckane Peaty Phase	2200 / 890	0·28
	74B Puckane Alkaline Parent Material Phase	3760 / 1521	0·48
	143 Sellernaun	80 / 32	0·01
	76 Shannon	14680 / 5941	1·89
REGOSOLS	144 Kilgory	440 / 178	0·06
	145 Rathborney	240 / 97	0·03
	146 Seafield	1240 / 502	0·16

[2] Total area refers to total land area minus major water and urban areas.

GREAT SOIL GROUP	SERIES etc.	ACRES / Hectares	Per cent of total area
PEATS	1K Aughty	65360 / 26451	8·40
	1M Aughty Cutover	50360 / 20381	6·47
	1B Allen	5960 / 2412	0·77
	1G Allen Cutover	10760 / 4355	1·38
	1H Banagher	19480 / 7884	2·50
COMPLEXES	147 Attyquin–Howardstown	3320 / 1344	0·43
	148 Burren–Ballincurra	19240 / 7786	2·47
	149 Mountcollins–Kilrush	18560 / 7511	2·38
	150 Puckane–Slievereagh	31840 / 12886	4·09

Soil surveyed by T. F. Finch



Scale: Two miles to one inch. (1:126,720)

2 1 0 2 4 6 8 Miles

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Based on the Ordnance Survey by permission of the Government

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Cartography: V. Staples, J. Lynch

Soil Suitability Map of Co. Clare

(To accompany Soil Survey Bulletin No. 23)

Suitability Class		Sub Class		Area		
Tillage*	Grassland**		Type of Limitation	Acres	Hectares	Percent of total area[1]
1	A	a	No serious limitations	19,000	7,690	2·44
		b	Occasional steep slopes	84,920	34,368	10·91
		c	Light texture	10,320	4,176	1·33
2	A	d	Shallow soil over calcareous till	28,240	11,429	3·63
		e	Somewhat shallow soil over bedrock	640	259	0·08
		f	Weak structure	47,440	19,199	6·09
3	A	g	Weak structure, moderate drainage	4,040	1,635	0·52
3	B	h	Shallow soil over bedrock, liable to drought	1,320	534	0·17
		j	Some steep slopes, weak structure, low base status	4,400	1,781	0·57
		k	Moderate drainage, weak structure, severe wind exposure.	7,280	2,946	0·94
3	C	m	Poor drainage, weak structure, heavy texture	42,680	17,273	5·49
4	C	n	Weak structure, liable to floods	520	210	0·07
		o	Weak structure, heavy texture, poor drainage	14,680	5,941	1·89
4	D	p	Poor drainage, weak structure	184,520	74,674	23·70
		q	Very light texture	720	291	0·09
5	B	r	Many boulders	14,160	5,731	1·82
5	E	s	Heavy texture, weak structure, liable to floods	1,920	777	0·25
		t	Many boulders, weak structure, some steep slopes, low base status	1,360	550	0·17
		u	Weak structure, high altitudes, some steep slopes	1,800	729	0·23
		w	Very shallow soil over bedrock, liable to drought	75,200	30,434	9·66
		x	Alkalinity, trace element problems, light texture	1,240	502	0·16
		y	Weak structure, some steep slopes, low base status, peaty surface.	2,800	1,133	0·36
[2]Variable		v		72,960	29,527	9·37
Unclassified (Mostly Peat)		z		156,080	63,166	20·06

* Tillage 1=Very Good 2=Good 3=Moderate 4=Poor 5=Very Poor

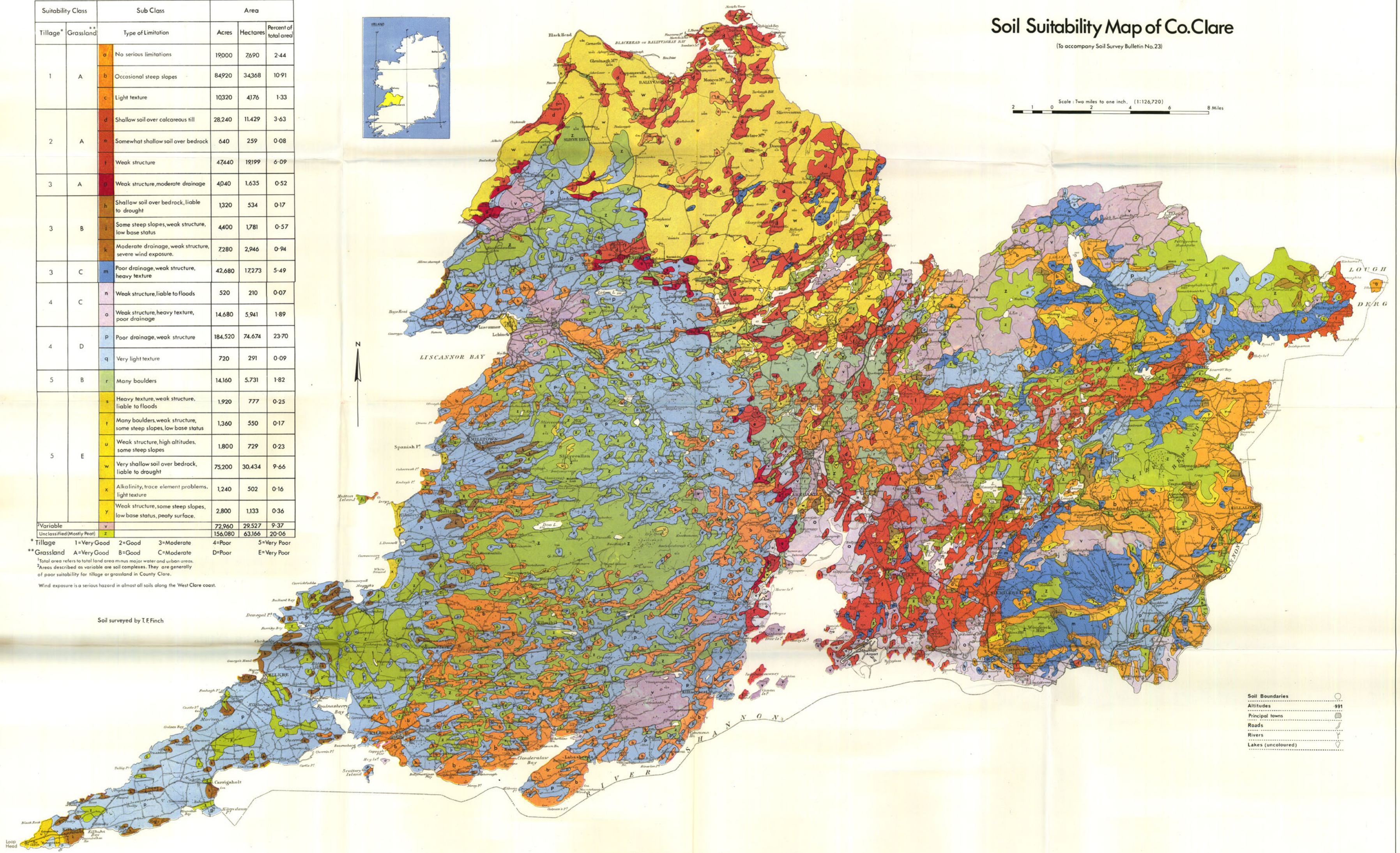
** Grassland A=Very Good B=Good C=Moderate D=Poor E=Very Poor

[1]Total area refers to total land area minus major water and urban areas.

[2]Areas described as variable are soil complexes. They are generally of poor suitability for tillage or grassland in County Clare.

Wind exposure is a serious hazard in almost all soils along the West Clare coast.

Soil surveyed by T. F. Finch



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