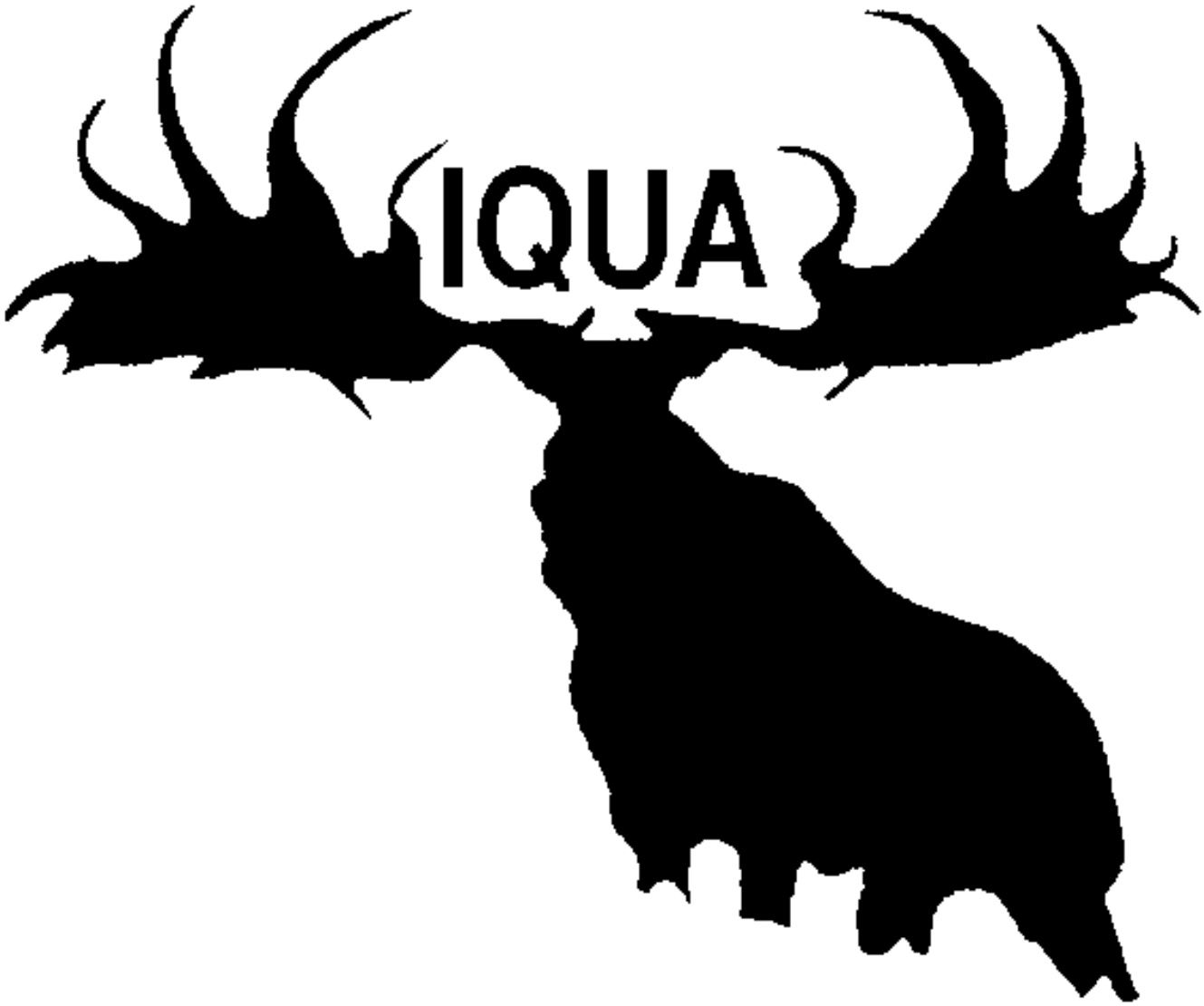

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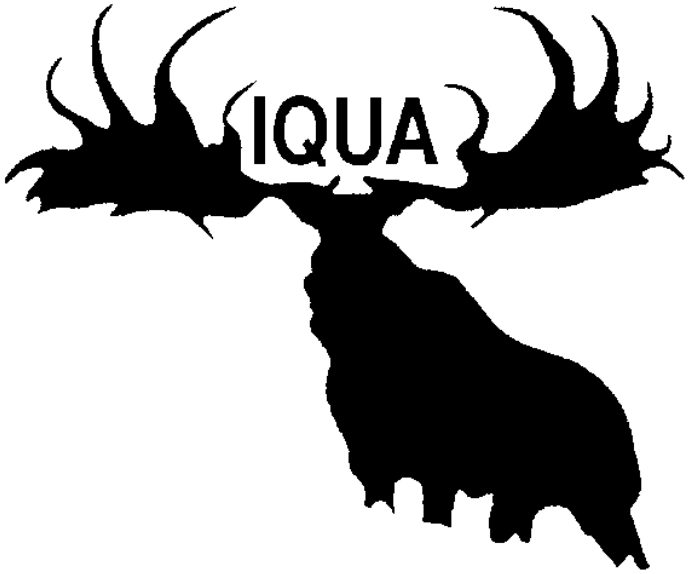
NORTH MEATH



Irish Quaternary Association

Field Guide No. 29

Tuaisceart Chontae na Mí

North Meath

2011

Edited by

Bettina Stefanini and Gayle McGlynn

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PREFACE

This field guide complements the annual field meeting of the Irish Quaternary Association (IQUA) held in North Meath, 2nd – 4th September 2011.

Meath has long been renowned for its geology and particularly its extraordinarily rich archaeology and history. Within this long-established heritage, the recent excavations along the M3 corridor have opened up a new window into human activity and its ties with Holocene landscape development. This and other new research have cast fresh light on some sites which were discovered a long time ago in this area. Even by selecting sites from the northern half of the county only, it is not possible to give more than a mere taste of the potential of the Quaternary geology, environmental history, archaeology and more recent history of this area within the framework of this guide. However, we hope the focus on recent research along with the longer known sites will prove as inspiring to you as it has to us and to the contributing authors.

The field sites are covered by sheet 42, sheet 35 and sheet 43 of the 1:50,000 OSI Discovery Series Maps.

Bettina Stefanini and Gayle McGlynn,

Dublin, August 2011

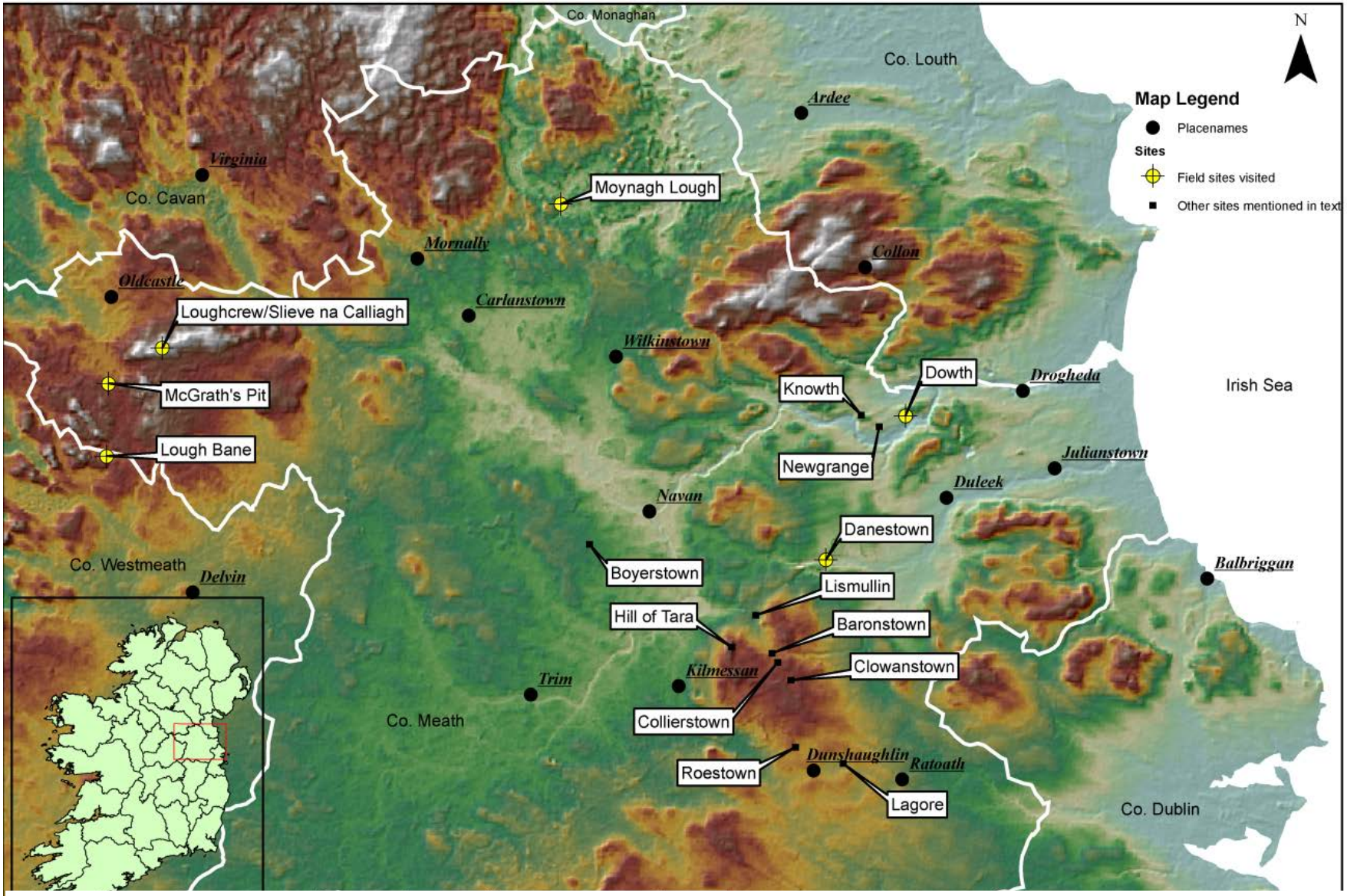


Figure 1 Topography and sites discussed in the text. Sites to be visited are marked by crosshair symbol.

INTRODUCTION

The Topography and Geology of Meath

Robert Meehan

Location

County Meath is located on the eastern margin of the Irish central lowlands. It stretches from the Irish Sea coast, between the Boyne and Delvin estuaries, as far inland as Lough Sheelin. Counties Louth, Monaghan and Cavan lie to the north, Westmeath to the west, Offaly and Kildare to the south, Dublin and the Irish Sea to the east. The county covers 905 square miles, and incorporates many different topographic regions.

Topography

Meath's landscape is generally low-lying and it is a region renowned for good soils and rich pastures. Though often low and undulating, the landscape is remarkably variable – generally a result of the variations in the underlying bedrock geology, but also having a profound Ice Age signature.

The plains of Meath largely correspond to areas underlain by limestone and cover approximately two-fifths of the county. They are found extending out southwest of a line drawn between Kells and Navan and beyond to Summerhill; and occupying the southeastern corner of the county, from the boundary with Kildare at Kilcock to the border with Dublin near Ashbourne (see map showing Topographic Units for this and other topographic units referred to in this section). The plains occur on thick glacial subsoils which are capped by deep, often well-drained topsoils. They are not as flat as is the common perception but are gently undulating with low-slope gradients of 2°–4°.

More than plains are seen in this landscape, however. The well-drained pattern is punctuated in places by wide boglands, and by narrow stream and river floodplains. These localities are pretty much flat and have either impermeable peat material below them, or are so close to watercourses that the real water table is just below the soil surface. The peat bogs may be as expansive as Ballivor Bog, covering over fifteen square kilometres in Meath alone, or may cover very small areas, such as Harristown Bog near Castlejordan (close to the county boundary with Offaly), which is just over twenty hectares in extent.

In contrast to the generally flat topography of the plains, surmounting them in places are high esker ridges and other associated hummocks and hills of sand and gravel. A network of thirteen individual esker ridges extends from just west of the Hill of Tara to the southwestern corner of the county, traversing the plains area.

The plains of Meath are bisected in the south of the county by the **shale ridges and valleys** of the Garadice-Summerhill-Drumree area, which stretch from the Royal Canal along the county boundary to Warrenstown, near Dunsany. The twenty or so ridges are remarkably similar in elevation, mostly between 125 and 139 m.

The ridges are cored by Namurian shale, which is usually quite close to the surface, smoothed by ice during the Ice Age into crag-and-tail features. The valleys are gently sloping but striking, the most impressive being those of the Moynalvey and Derrypatrick Rivers. The soils in this area are completely dominated by wet, poorly drained clays and clay loams, making agriculture difficult due to poaching of saturated ground during winter.

East of the plains, and close to north Dublin, the **Bellewstown Inlier** includes a number of high, east–west oriented ridges which are again cored by shale bedrock. Here the shales are of Silurian and Ordovician age, and are up to 159 m in elevation. A separate elevated area occurs adjacent to the **mid-Meath Hills** topographic unit, where high ridges around Tara, Skryne, Walterstown and Kilmessan extend almost as far as Dunshaughlin.

Moving northwards, the topography of the **Blackwater, Lower Boyne and Nanny River Valleys** includes low-lying terrain with river channels incised into wide tracts of sand and gravel terrace. Elevated portions of the landscape in these valley catchments comprise often isolated, relatively high, streamlined ridges of bedrock and glacial till, as crag-and-tails. Added together, these catchment areas cover a quarter of the county.

The Blackwater Valley stretches from Kilskeer and Carnaross in the west to Castletown, Wilkinstown and Kilberry in the east, and down as far as Navan where the Blackwater joins the Boyne. The sand and gravel flanking the Blackwater River in patches is particularly hummocky, and close to the Cavan county boundary, just south of Carnaross, spectacular kames and kettle holes can be seen. The sand and gravel is discontinuous however, and pockets of land consisting of deep glacial tills flank the river, for example around Kells and Headfort.

The Lower Boyne Valley stretches from the base of the Hill of Tara at Bellinter (where the river becomes incised into the landscape in a deep meltwater channel) as far as the sea at Mornington. The Boyne and the Nanny flow generally eastwards and there is some evidence to suggest that the Nanny was a former course of the Boyne during the end of the last Ice Age. The river catchments are separated by a high watershed at Realtoge-Redmountain-Donore, where high ridges of shale and limestone occur. Both the Boyne and the Nanny are flanked by flat-topped river terraces, which record the high, relict floodplain of the former meltwater rivers during deglaciation. Today, comparatively narrow alluvial plains flank both rivers, both of which are quite susceptible to flooding during heavy rainfall. The Slane-Rathkenny-Collon ridges are high crag-and-tail ridges cored by Silurian and Ordovician bedrocks. Some of these rocks are volcanic, others consist of sandstones, siltstones and greywackes, and around Slieve Beagh and Simpson’s Mountain they form some of the highest ground in the county. Belts of well-drained sands and gravels plug the larger valleys in the region and record fast-flowing meltwater rivers during the last deglaciation, including those at Stackallen, Castleparks and Rathkenny.

The drumlin belt dominates north Meath from Moynalty, Castletown and Lobinstown to the county boundaries of Cavan, Monaghan and Louth. The drumlins themselves are streamlined hills deposited by ice flowing from northwest to southeast during the last Ice Age. All of them are oriented along that direction, faithfully recording ice flow within the landscape grain. Each drumlin is up to a kilometre long, generally 200 to 600 m wide and as high as 30 m. On the shale in the northwest of the county they are much more rounded, larger and higher than on the limestone of the northeast.

The drumlin monotony is broken in places by high, bedrock ridges at places like Carrickspringan, Teevurcher and Barley Hill. These features have themselves been streamlined by the same ice that deposited the drumlins, with the ridges showing domed shapes and rounded upper flanks. Crag-and-tails stream from these ridges too, being particularly well expressed around Carrickleck and Meath Hill. The drumlin belt is also bisected between Nobber and Kingscourt by the Kingscourt Rift Valley, which is a deep suture in the landscape occupied by Whitewood and Newcastle Loughs, as well as wide bogs, small floodplains and some hummocks of sand and gravel.

Slieve na Calliagh and its surrounding ridges include the highest ground in the county, on the watershed between the Boyne/Blackwater and Inny catchments. The area includes Slieve na Calliagh itself as well as high ridges at Slieve Gullion, Knocklough, Ballinlough, Balnagon and Crossakeel. All are dominated by shallow glacial deposits and a good deal of bedrock close to the surface.

The kame and kettle topography of northwest Meath is one of the largest topographical regions in the county, but one of the least well known. This area extends from Kilskeer, around the Slieve na Calliagh ridges and along the Westmeath border, around by Oldcastle and as far as the Cavan border at Lough Sheelin. The area includes eskers, low hummocky ridges, discrete hummocks and hollows, with some wide, poorly drained flat areas. It contains many of the county's most impressive lakes, such as Lough Sheelin, Lough Bane, White Lough and Ben Loughs, as well as the highest density of wetland areas within the county.

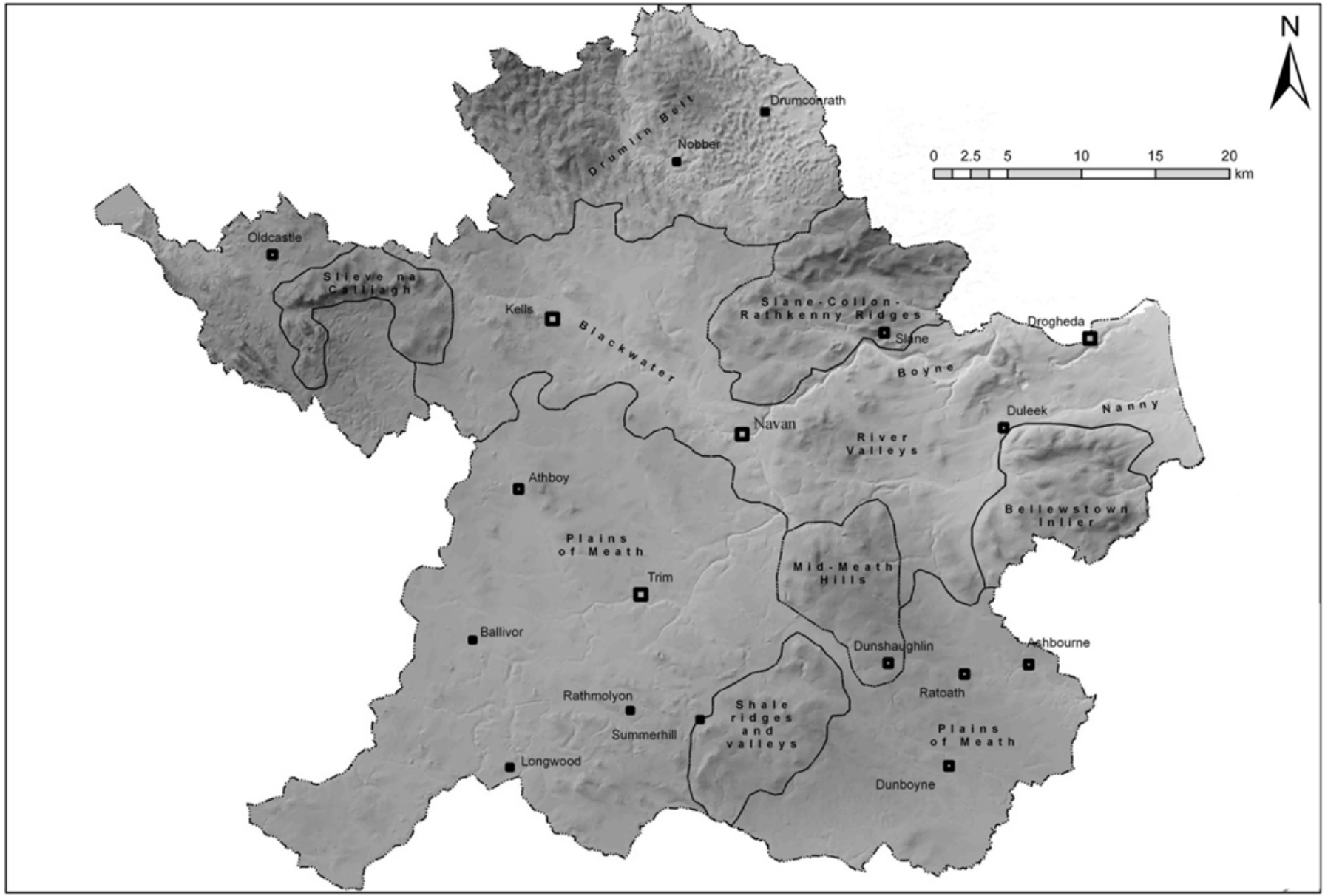


Figure 2 Topographic units in County Meath.

Bedrock Geology

Almost all of the bedrock geology of County Meath is of Palaeozoic age. The dominant rock types are Lower Palaeozoic (Ordovician and Silurian) formations and Upper Palaeozoic (Lower and Upper Carboniferous and Permo-Triassic) formations.

Lower Palaeozoic

Ordovician

Rocks of Ordovician age outcrop in two areas within the county, the largest area of which is to the north of Slane, extending as far as the county boundary around Collon. These rocks consist of a series of tuffs, lavas and shales, which are overlain by basic lavas with intercalated sediments. These are overlain by conglomerates which are in turn overlain by fossiliferous sandstones followed by shales (Brenchley et al., 1967). Associated with these rocks are the Deerpark Andesites and Tuffs (quarried extensively by Cement Roadstone PLC at Carrickdexter) which are of uncertain age but may be Lower Devonian (Vaughan, 1991).

Ordovician rocks are also present as part of the Bellewstown Lower Palaeozoic Inlier to the east of the county. The rocks are found in the Bellewstown/Carnes/Raholland area and in the Hodgestown/Naul/Fourknocks area. The northern area consists of mudrocks, siltstones, volcanics and limestones and some diorite intrusions. The southern area consists of red and green mudrocks, greywackes and andesitic volcanics, the latter being especially common around the county boundary. Finally, some diorite intrusions crop out along the base of the northern face of the Bellewstown ridge.

Silurian

Silurian rocks outcrop in three areas within the county. The largest area of Silurian rocks in County Meath lies in the northwest of the county. It includes the southeast–northwest trending ridges of the Slieve na Calliagh, Ballinlough and Kells areas and extends northwards to the county boundary west of a line between Headfort, Moynalty, Altmush and Kingscourt. The outcropping rocks consist of shale, siltstone, sandstone and greywacke. The faults along the boundary are quite complex and the exact boundary is in doubt in places, *e.g.* around Oristown. The rocks are much more resistant than the surrounding Lower Carboniferous rocks, hence the high escarpments of Slieve na Calliagh, Ballinlough, Screebog and Teevurcher.

An area of Silurian rocks surrounds those of Ordovician age (at Collon/Slane/ Grangegeeth) in the northeast of the county. This is bounded on the northern side by the southern limit of the Permo-Carboniferous Outlier at Kingscourt, which runs from Oristown to Newtown, approximately. Outcrops in the area are quite rare but are supplemented by borehole data. The rocks consist of Silurian greywackes and rare black mudrocks. This area of Silurian rocks forms the western fringe of the Louth Uplands.

The final area consists of the post-Ordovician rocks of the Bellewstown Inlier, forming the northern edge of the Balbriggan Massif. The rocks take the form of a series of ridges trending east–west. The outcropping rocks are shales, mudrocks and sandstones for the

most part. Some felsic to intermediate igneous intrusions are present, notably at Denhamstown. The Silurian rocks are intensely folded throughout the area.

Upper Palaeozoic

Lower Carboniferous

Rocks of Lower Carboniferous age are the most common in the county and consist mostly of limestone. They outcrop throughout the southern half of the county and also take up a sizeable proportion of the area east of the Kingscourt half-Graben. Basinal limestones of Holkerian to Brigantian age (Table 4) are the most common, consisting of dark, laminated argillaceous calcisiltites and calcareous shales. Purer shallow water limestones are present near Drogheda. Waulsortian limestone is also common, as is Courceyan argillaceous limestone. In the south of the county most of the limestone is overlain by Quaternary deposits up to 60 m thick.

Lower Carboniferous chert outcrops in the extreme west of the county on the high ridges around the shores of Lough Bane. Cherty outcrops are also present northwest of Drumconrath. The chert outcrops are all Holkerian to Brigantian in age.

Some Lower Carboniferous basaltic volcanic rocks outcrop in the extreme southwest of the county, northeast of Castlejordan in Park Townland. Their areal extent has been compiled from borehole data.

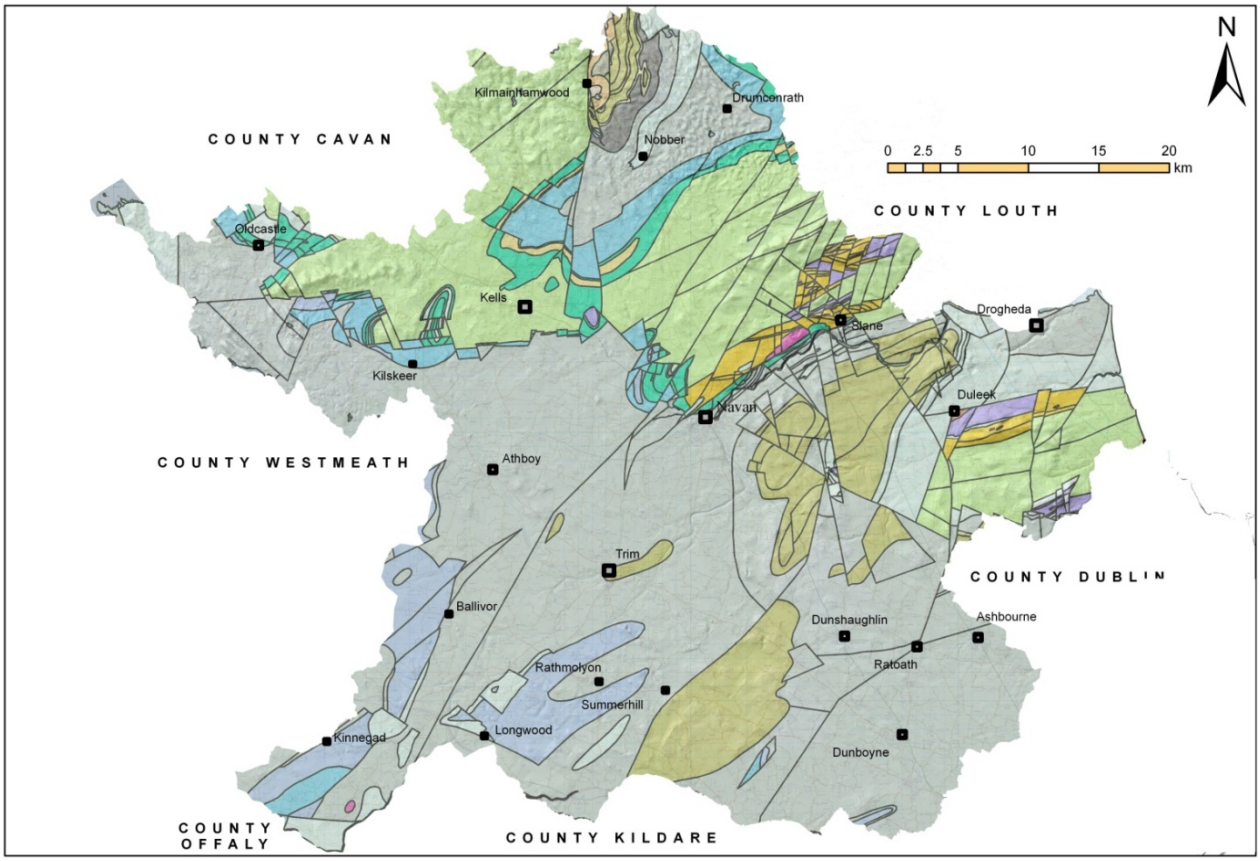
Upper Carboniferous (Namurian)

Upper Carboniferous rocks outcrop in small areas of a few square kilometres each in various parts of the county. They can be found in north Meath, east-central Meath and south Meath.

In north Meath the Upper Carboniferous rocks are found in a north-south strip to the east of the Triassic rocks and west of the Lower Carboniferous limestones, within the Kingscourt outlier. They consist of mudstones, shales, siltstones and sandstones, with occasional thin coal seams. The shales are generally black but the sandstones are grey in places but mostly bright orange/red and highly weathered. Most of the sandstones are underlain by shale which is of considerable thickness (at least 60 m).

In east central Meath, Upper Carboniferous shales and sandstones are present at four localities: between Walterstown and Donore; south of Yellow Furze; south of Rathfeigh; and between Skryne and Tara. These outcrops trend southwest–northeast, as do the outcrops in south Meath. The shale is again black, but little is known of the sandstone. The Upper Carboniferous rocks in east central Meath are generally overlain by Quaternary deposits of varying thicknesses.

In south Meath, Upper Carboniferous rocks outcrop northeast of Trim and in a broad zone between Killeen Castle and the county boundary (around Oldtown Townland). This latter area incorporates the Moynalvey, Culmullen and Garadice region. Again the rocks outcrop as black shales and grey sandstones. In places, pronounced shale escarpments occur, for example at Warrenstown, Culmullen and Mullagh



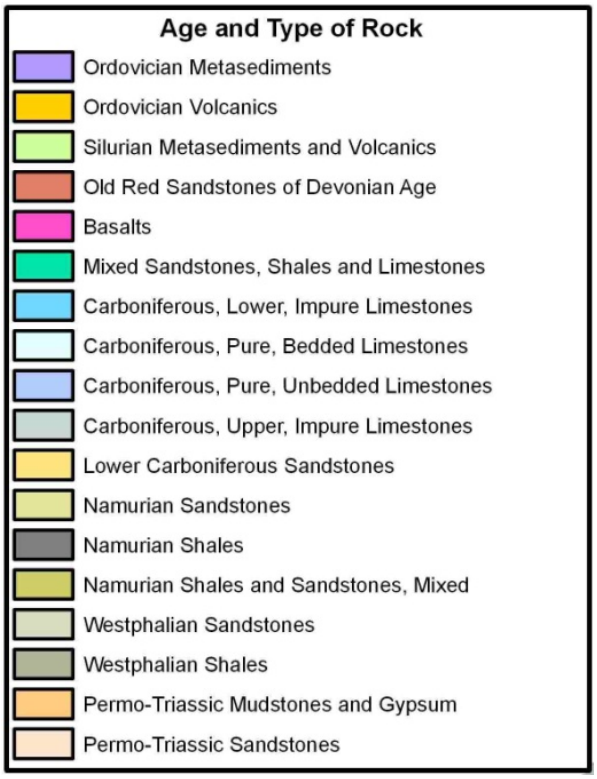


Figure 3 Bedrock geology of County Meath

Permo-Triassic

Most of the Kingscourt Outlier is composed of Carboniferous rocks but a narrow belt, covering *c.* 10 square kilometres of County Meath, consists of Permo-Triassic rocks. Natural outcrops are rare, but extensive drilling has supplied valuable information (Jackson, 1965). The rocks consist of reddish sandstones, which are underlain by gypsum deposits. This gypsum has been extensively quarried in recent years.

Description of Quaternary Geology

The glacial and glaciofluvial deposits in the Boyne Valley vary greatly across the area. The direct glacial deposits are very varied in their composition. Most of the sediments are dominated by limestone debris, but the sediments in many areas in the north and east of the valley are derived from Lower Palaeozoic rocks, mostly shales and sandstones. Generally, any Lower Palaeozoic dominated glacial deposits overlie Lower Palaeozoic bedrock. Many of the sediments contain high proportions of erratics, though, with basalt erratics from Carrickdexter present many kilometres south of Slane, granite from Crossdoney-Bellananagh in Cavan common in the subsoil around Oldcastle and Triassic sandstone erratics from Kingscourt present as far south as Nobber. Most of the erratics suggest a former ice movement of northwest to southeast which conforms with the orientation of drumlins and striae which occur in the area.

The dominant grain size in the tills is also a reflection of the underlying bedrock. In the extreme north of the county, much of the tills are clayey, resulting in relatively poor drainage (often reflected by the presence of rushes on slopes). This is due to the fact that much of the underlying bedrock in this area is of shale, and during glaciation these rocks were ground down to their constituent particles by the ice resulting in a clayey subsoil texture. In the central portion of the county the land is better drained generally. The tills here are more often silty to sandy, and usually quite stony, which results in better drainage. The stony nature of the tills reflects the resistance of the underlying (relatively hard, pure) limestone to crushing by the ice sheet during glaciation. Again, south of Bellewstown-Skryne-Summerhill, the tills are poorly drained, as the ‘Calp’ limestone bedrock there, with is an especially shaly limestone, have been ground down to a very clayey till.

The most striking glacial deposit near the coast is a clayey till which usually contains marine shell fragments and flints, as well as other erratics from the northern Irish Sea Basin. This till was laid down by the ice sheet which occupied the Irish Sea Basin while it moved onshore. In places the deposits contain erratics of Ailsa Craig Granite, which has been carried from a small island off the Scottish coast. The till is well exposed around Ben Head and as far south as Gormanston, where it is overlain by gravels (clearly seen in the cliff sections along the beach).

The precise relationship between the two ice sheets which affected the central and east Meath area is difficult to decipher. Erratics from the Irish Sea Basin have been found as far inland as Slane and shells occur in sands near Naul but we cannot tell exactly how far inland the Irish Sea Glacier reached. The ice from this sheet was moving east to west generally.

The inland ice had a source in the north of Ireland and moved generally northwest to southeast. During the onset of deglaciation as this ice thinned, topography had more of a control on the movement of the ice and, especially in the north of the area, deflected movement by a considerable amount. We do know that the entire area was covered by ice during glaciation, however, as erratic blocks are strewn across the crest of the Slieve na Calliagh ridge (the highest point in the area). The ridge itself is comprised of shale and greywacke rocks: the perched blocks on the ridge are of sandstone from the northwest.

After the ice sheets began to melt they separated and much of the meltwater escaped southwards to the sea. A wide river existed in the Gormanston/Ben Head area which is reflected in the vast amounts of gravels there today. These are clearly seen in Murphy's Pit just off the N1. Bedded sands and gravels here reflect deposition by meandering streams laden with sediment. Most of the stones in these pits are of limestone, but some erratics of flint occur.

At this point the Irish Sea ice ceased to have an effect on land and continued to retreat northwards up the Irish Sea Basin towards its source in Scotland. The inland ice sheet melted back across the countryside towards the centres of the ice dome in the Tyrone/Fermanagh area. Many of the moraines which straddle the Boyne Valley are oriented southwest to northeast and prove that the margin was oriented in this direction during retreat.

Meath was influenced by ice from two sources: the north central midlands and the Irish Sea Basin. The evidence for glaciation, and the exact pattern of glacial movement and deposition, is interpreted from geological and geomorphological evidence: basically the composition of the sediments and the stratigraphy (layering) of the glacial and meltwater deposits. The interpretation of the glacial history incorporates all of the known ice age geological record, but some features are more important than others.

Previous work on the Quaternary Geology of Meath

In and around Meath previous work has concentrated on the problems of the Irish Sea Till (Lamplugh et al*.,* 1903; Farrington, 1939; Colhoun and McCabe, 1973; McCabe, 1973; McCabe and Hoare, 1978), ice movement directions and regional stratigraphy (McCabe, 1971, 1972, 1973; McCabe and Hoare, 1978) and regional accounts of glaciation and deglaciation (Charlesworth, 1928, 1939, 1955, 1963, 1973; Synge, 1950, 1952, 1968, 1969, 1970; McCabe, 1971, 1985; Whittow, 1974; Finch, 1990).

Early work in the area

In the first study of glacial geology in Ireland, Maxwell Close (1867a, b) suggested that general ice flow direction over the study area was northwest to southeast, from looking at the orientation of drumlins (especially in Meath, Cavan and Longford). The early geological maps, compiled by field geologists from the Ordnance Survey and Geological Survey of Ireland (*e.g.* Hull and Leonard, 1871; Cruise, 1872; Leonard and Cruise, 1873) were primarily concerned with mapping bedrock geology. In conjunction with the mapping soil samples were collected with the intention of producing a soils map. This practice was terminated after eight years owing to time and economic constraints, although morphological and 'drift' observations continued to be recorded by the field geologists.

The detail of such recordings varies greatly depending on the individual geologist; in Meath the bedrock manuscript maps (Hull, 1871; Cruise, 1872; Leonard and Cruise, 1873) record peat and alluvial areas, as well as some ridges which were recorded at the time as 'eskars' (sic). The memoirs published with the maps summarize the Quaternary deposits of the area, which are subdivided into "the boulder clay, the limestone gravels and the eskar ridges…the pebbles in the latter being, as a rule, more rounded than those in the limestone gravels suggesting that the eskars were formed subsequently to the last gravels by the rearrangement of the latter by tides and currents" (Hull and Leonard, 1871). Gravel mounds at Lough Glore and on the northern slopes of Slieve na Calliagh, as well as erratic blocks of yellowish quartzose sandstone at Millbrook, were the only features specifically noted. In these notes the field geologists used the orientation of drumlins, alluvial flats, striae and roche moutonnées to infer former ice flow directions, agreeing with Close (1867a, b) on the northwest to southeast direction. National coverage at this level of mapping was completed by the GSI in 1890.

The 'Irish Sea Till'

On the lowlands of east central Ireland early workers such as Lamplugh et al. (1903) and Farrington (1939) identified two major till sheets: the older (Eastern General) of Irish Sea provenance related to an on-shore ice movement; and the younger (Midland General) associated with ice moving southwestwards from the north central midlands. Despite detailed stratigraphic mapping (McCabe, 1971; Hoare, 1972; McCabe and Hoare, 1978), little progress has been made on the origins of the tills, save the fact that they seem to represent the changing strengths of contemporaneous ice masses with inland and Irish Sea Basin sources. The palaeoclimatic and palaeoenvironmental significance of these two tills of differing source is still a matter of debate.

Charlesworth (1928) assumed that the last ice sheet in east central Ireland was composite in origin, consisting of an ice sheet in the Irish Sea Basin and one that came from the Irish Midlands. Farrington (1957) showed that the till deposits derived from the Irish Sea Basin always underlay till deposits derived from the Irish Midlands when observed in the same section, deducing that the Irish Sea ice was from his earlier, Eastern General Glaciation (Farrington, 1939, 1944, 1965). Synge and Stephens (1960) supported this view, while McCabe (1971) classified the deposits into members, formations and groups based on geologic-climatic (litho-stratigraphic) units. McCabe stated that the lithology of individual members varies geographically in response to changes in the underlying geology; that a member may be represented more than once in an exposure; and that two or more till members from the same or different formations may be seen at a single site. It was also recorded that sands and gravels sometimes intervene between the tills in some of the sections in the area (McCabe, 1971). Furthermore, members from one formation do not always show constant stratigraphic relationship to each other, even over relatively restricted distances. These facts are to be expected, as the ice sheet flow dynamics and resulting subglacial processes are so complex, but question somewhat the original validity of such a stratigraphic method on such complicated glacigenic sediments.

Glacigenic deposits in the Midlands.

The first important work to deal directly with the study area was that by Charlesworth (1928) which described the retreat of ice from the Southern Irish End Moraine across the Central Plain. Much of the analysis was morphological, with sedimentological data rarely taken into account. The Southern Irish End Moraine was regarded by Charlesworth as representing a standstill and a slow, continuous retreat within the moraine area itself, but with oscillations of some magnitude in places. The till and underlying gravels around Blessington were cited as examples of these oscillations.

The area free of moraines around east central Meath was mentioned in Charlesworth's paper, with the conclusion that the separation of the Irish Sea ice and the Irish ice took place in this area. (A conclusion which is arrived at without much evidence but seems logical to this day when it is considered that the area contains the boundary between the Irish Sea Till and till deposited by 'Irish' ice). The numerous moraines around Virginia, Kells, Navan and Trim, and as far southwest as Kinnegad and Mullingar, were considered to be the remains of a prolonged pause. The individual morainic features were not mapped separately and were grouped together in relatively broad 'bands', although their overall pattern within the area was noted and was used to infer the existence of three confluent lobes which had their origins in Donegal, Leitrim and Galway. From this it was concluded that the area covered by linear kames and other morainic ridges in this part of north central Ireland does not represent widespread stagnation, as was previously suggested, but demonstrates that the ice maintained its continuity in a slow, ordered retreat northwestwards, a theory supported by Warren and Ashley (1994). The origin of the ridges was somewhat in doubt, nonetheless, with some features known as eskers today having been termed moraines. An important observation was the fact that topography in part controlled ice flow during deglaciation, with Slieve na Calliagh quoted as one of the main obstructions in the area.

The Trim Esker had been mentioned by Sollas (1896) before Synge (1950) described in some detail the geomorphology and internal structure of all twelve eskers which feed into the Galtrim Moraine near Trim. Synge (1950) and Warren and Ashley (1994, 1995) interpret the Trim Esker as having been a subglacial tunnel feeding the Galtrim Moraine. The boulder gravel within the ridge was deposited in a tunnel and subsequently blanketed (in the southern part) with ice marginal outwash fans built into Glacial Lake Summerhill as the ice retreated to the north. The northern section of the ridge is simply a boulder tunnel-fill which was not covered with younger deposits. Within the Galtrim Moraine, minor deformation of the bedding and thin diamict deposits indicate an active ice margin. Other eskers and ice marginal ridges in the Irish Midlands were classified according to morphology, internal stratified sediments and, from these, the inferred sedimentary processes by Warren and Ashley (1994, 1995).

Glacial stratigraphy.

McCabe's (1971) PhD thesis deals in much detail with the glacial geomorphology of eastern counties Meath and Louth. In fact, only the eastern portion of County Meath is discussed. Following an introduction to the area, the second section of the thesis describes in detail the glacial stratigraphy of the till deposits and the pattern of glaciations,

which has been referred to above. The third section describes in excellent detail the nature and pattern of deglaciation, although sedimentological analysis of deglacial sediments was not carried out. The final section discusses the 'Drumlin Readvance Moraine' in the area. McCabe's (1972, 1973) papers were a summary of this work, concentrating on ice movements and glacial stratigraphy in the area. The studies attributed the readvance to a worsening in climate that led to an increased build-up of ice which caused the formation of drumlins north of this (following the "Drumlin Readvance" term having been coined by Synge in 1969).

McCabe and Hoare (1978) provided useful correlation between the complicated glacial and deglacial events as they were then envisaged along the eastern seaboard north of Wicklow. McCabe's (1985) geomorphological summary of Irish Quaternary studies proves useful, especially with the addition of more recent data (Synge and McCabe, 1979) on terraces and ice limits in the Boyne Valley. Within this paper it was stated that the terrace profiles flatten eastwards where their levels were controlled by various late-glacial sea levels in the Boyne Estuary, some terraces ending in delta tongues composed of large scale, multiple foreset gravel sequences, others being clearly related to late-glacial raised beaches.

Important work was carried out by McCabe (1983) for Tara Prospecting Ltd. and the resulting report details the Quaternary geology of the Kells/ Castletown/Kilberry area. It was concluded that two major phases of ice movement occurred towards the end of the last cold stage in the area; an earlier west to east ice flow over the Navan/Kilberry area and a later, northwest to southeast readvance following retreat to an unknown position north of Kells. This readvance was correlated with the 'Drumlin Readvance' and was thought to have formed the Clongill Moraine (McCabe, 1983) at Clongill, Wilkinstown, Irishford and Rathkenny. The ice waned from here and stabilised in the Maudlin's Bridge/Mabe's Bridge area, immediately north of Kells, forming the northeast–southwest trending gravel hummocks in the area. The area has become a type-site for Synge's Drumlin Readvance Moraine (1969), and has been termed the Kells Moraine, although the Clongill Moraine is thought by McCabe (1983) to be earlier than the Kells Moraine even though they are both from the same readvance. The esker at Dulane was thought (McCabe, 1983) to "feed into" the Kells Moraine during this stage. The Clongill Moraine is correlated with moraines at Mullens Cross and Castletown "where a large, topographically subdued gravel accumulation may be traced northeastwards towards Ardee" (McCabe, 1983, 5).

The 'Drumlin Readvance' theory

It was in his 1928 paper that Charlesworth suggested that "the moraine bounding the moraine-free area west of Drogheda and Dublin on the northwest is **probably** the product of a readvance" (Charlesworth, 1928, 341) mentioning its (somewhat discordant) relationship to the seemingly earlier moraine east of Athenry, and its probable correlation with the Northeast Ireland Moraine, as possible evidence for this. Since then various authors (specifically Charlesworth, 1939, 1955, 1973; McCabe, 1971, 1972, 1973, 1985, 1987, 1993; Synge, 1952, 1969; Synge and Stephens, 1960; Whittow, 1974; McCabe and Hoare, 1978) have used the idea of a 'Drumlin Readvance' (Synge, 1969) to explain the distribution of the drumlin features across the country, with the area of northern drumlins

bounded on the south by “the great kame and kettle morainic belt running from Kilkeel to Dundalk, Ardee and Kells” which “seems to mark a significant halt in the ice retreat” (Synge and Stephens, 1960, 127). By 1960, the feature was thought to represent a change from ordered retreat to wholesale stagnation of the ice cap (Synge and Stephens, 1960). This idea is at odds with Charlesworth (1928) and Warren and Ashley (1994) who advocated a more orderly retreat.

Charlesworth’s (1939) study on northeast Ireland includes some important observations. It was suggested by the author that the glaciofluvial gravels and drumlins are generally mutually exclusive in the region, and it was stated that the drumlins were formed before ice uncovered the country, as they “invariably lie beneath eskers and moraines in those few cases where they are found together” (p. 265). It was proposed that the drumlins were formed during the maximum of the last glaciation, as they are found up to 1000 feet ASL in the area. This suggestion was also put forward by Warren (1991).

In his 1939 paper Charlesworth again supports the idea of the ice having a linear front during retreat in this part of Ireland and states that it “did not pass into an immobile state at one and the same time over the entire area” (p. 276). He suggested, though, that where the ice was thin and debris-rich along its front it did disintegrate into an inactive state. The suggestion that the extensive sands and gravels in Tyrone, to the west of Lough Neagh, obscure drumlins which were formed earlier in the glacial period, deserves future research. The fact that many drumlins south of Lough Neagh, in County Armagh, and in the Lower Bann and Lower Lagan Valleys have had glaciofluvial sands and gravels plastered against their flanks, or rise above sheets of sands and gravels, hint that this may be a valid suggestion and may also relate to sands and gravels on the flanks of the drumlin belt.

Charlesworth’s short 1955 paper is the only work to deal specifically with the area of northern Meath and west Louth, in which the author attempts to “report the filling in of the small gap in the line of this readvance and the connecting up of the two loose ends, the one south of the Carlingford Mountains about Dundalk Bay, the other in the Central Plain about Lough Ramor, County Cavan” (p. 299) Glaciofluvial sands and gravels in County Louth (northwest of Ardee, east of Tallanstown and near Castlebellingham) are described as forming a strip of “billowy and moundy moraine” (p. 301), trending east–west just north of the Louth Hills. No genetic interpretation is suggested for these gravels, although those north of Drumconrath are described as having been formed lateral to the ice. The hummocky sands and gravels around Castletown and Nobber are described, although again are not studied sedimentologically (or even morphologically) in any detail. The area northwest of Nobber is ignored in terms of morainic deposits as it is somewhat taken for granted that drumlins and moraines are mutually exclusive (see also Charlesworth, 1939), although the author does suggest a more careful mapping at the six inch scale to check this. The sands and gravels around Castletown and Raffin, around Moynalty as far as Mullagh, northeast of Virginia, in the Blackwater Valley and along the eastern side of Lough Ramor, as well as those “about Oldcastle” (p. 302), are all described as “moraines”. Again, no genetic interpretation was attempted following a sedimentological analysis, and the fact that detailed mapping was not carried out meant that many hummocky areas presumed to be sands and gravels are in fact not, *e.g.* the area north and east of the Lough Ramor shore (which is composed of bedrock close to surface), the area northeast

of Virginia (till and bedrock) and much of the area south of Moynalty (till and other deposits).

Charlesworth (1955) also discusses the orientation of the Louth Uplands above the 90 m contour level (which is basically northeast–southwest) and uses the fact that this is at odds with both drumlin alignment and striae orientation on the lowlands to the north (these features are generally oriented northwest–southeast) and the fact these two regions are separated from each other by a line of sands and gravels, to advocate a difference in topography "within and without the gravels" which "clearly implies a readvance of the ice" and "taken in conjunction with the occurrence of these deposits between those of Navan and those of Carlingford demonstrates that the connecting line is of the Carlingford Readvance*"* (p. 302) This idea has many shortcomings, including the following:

1) The southwest–northeast trending topography of the Louth Hills is a result of structural geology and follows the Caledonide trend of all Siluro-Ordovician age bedrock ridges in northeast Ireland.
2) The ridges southeast of Ardee were last overtopped by ice moving northwest to southeast and not northeast to southwest, as demonstrated by striae at Slieve Beagh and Rathbran Beg (McCabe, 1971; Meehan, 1996).
3) During deglaciation it is likely that these high bedrock ridges in some way influenced ice flow on the lowland surrounding them with ice flow concentrated in the valleys, leaving a 'former east–west ice flow' imprint on the lowlands (manifested in the form of east–west trending streamlined features): this explains the form of the ground southeast of Ardee (see also McCabe, 1971).
4) The gravels to the northwest of the ridges along the Dee River are very restricted, are definitely not as laterally or vertically extensive as Charlesworth (1955) suggested and in fact seem to represent a number of short-lived standstills rather than one major halt.
5) Those gravels west of Ardee and around Castlebellingham are again associated with a number of short-lived standstills and, in any case, the latter are clearly from a stage following the readvance that is advocated, not contemporaneous with it (being 4 km north of the other moraines west of Ardee: see also McCabe, 1971).

Charlesworth (1973) described stages in the dissolution of the last ice sheet in Ireland and the Irish Sea region. The paper is a useful summary of previous work, but again is at odds with much of what was stated in previous papers by the same author. Following the retreat northwards of ice over the south Meath area and the deposition of the Galtrim Moraine, the next clear ice front is stated to be the Carlingford Readvance (ignoring the thirteen ice marginal positions suggested by McCabe, 1971, between these features). Confusion exists again (Charlesworth, 1973) regarding the 'Carlingford Readvance': the Carlingford Readvance Moraine is stated to be a different feature from (and several kilometres north of) the Dunleer Readvance Moraine (McCabe, 1971, 1972), but both were equated with the Drumlin Readvance of Synge (1969). This scenario gets even more confusing as the 'Carlingford Readvance' (which is also equivalent to the 'Dunany Readvance' after

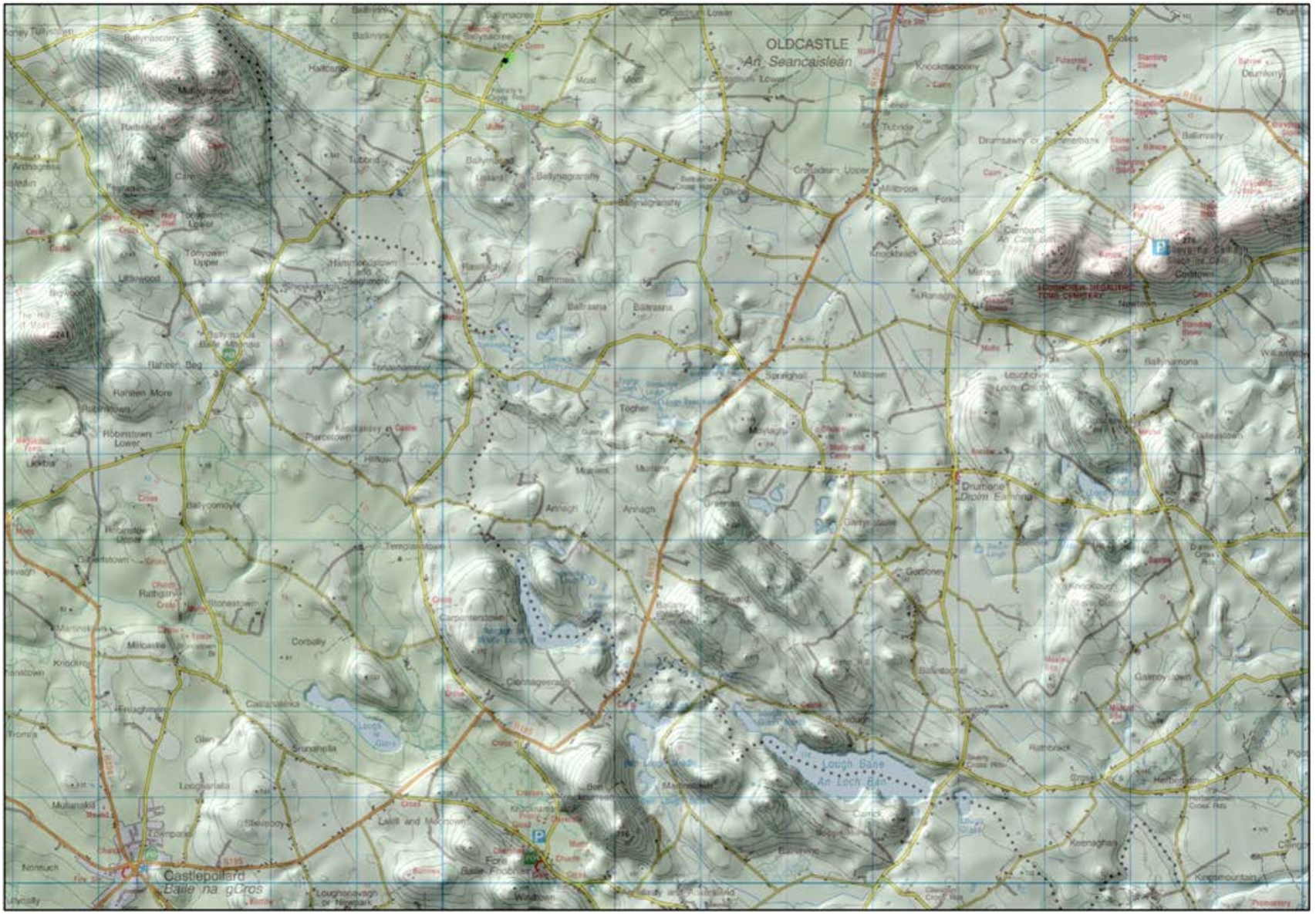


Figure 4 Topography of north-west County Meath

McCabe, 1985, although each is represented by a different, distinct feature) has been taken as the 'Drumlin Readvance' by various authors at times (*e.g.* Finch et al., 1983), without the consideration of the complexity of the associated sediments or the historic development of the theory regarding the feature. In other cases the broad "extensive) zones of outwash sands and gravels fronting the main drumlin forms" (McCabe, 1993, 26have been taken as being the readvance feature. (A fundamental question arises here regarding how extensive these outwash zones are and what exactly they consist of sedimentologically). The 'Carlingford Readvance Moraine' of Charlesworth (1973) is said to continue past Ardee and Drumconrath and continue by Trim (similar to the conclusion by Charlesworth, 1955: see above), but to the southwest the 'moraine' changes from the feature previously mapped as such (that north of the Bog of Allen) to the feature west of the Slieve Bloom Mountains and north of the Keeper Hills. This inconsistent morphological mapping, allied with the absence of sedimentological data, as well as the basic uncertainty of the position of the 'moraine' by those who support it, further leaves the validity of the Drumlin Readvance Moraine open to question.

The topography of northwest county Meath

Northwest County Meath is drained by the River Glore and its tributaries as well as tributaries of the Inny and Boyne Rivers, and has the highest density of lakes in the county, including Lough Glore (in Westmeath), Lough Bane, Lough Glass, Creeve Lough, White Lough, Lough Naneagh, and Ben Loughs. The land lies predominantly above 90 m ASL, with only areas in the extreme north and in the Lough Glore Valley lying below this elevation. The majority of the high hills, in the centre and west of the sheet area, correspond to areas of outcropping Derravaragh Chert or shelf limestones. (Only the Slieve na Calliagh Ridge is of earlier Lower Palaeozoic age).

Topographically, the area can be divided into two sections. A line of craggy ridges stretches northeast–southwest from Slieve na Calliagh to Fore, and from there northwest as far as Mullaghmeen Hill, forming a series of hills trending generally northwest–southeast (with the exception of Slieve na Calliagh, 278 m ASL, which runs west–southwest to east–northeast). These hills are bedrock cored crag and tail ridges, and generally rise to over 150 m ASL, with little or no Quaternary sediment cover on their summit slopes. The Hill of Maol (243 m ASL), Mullaghmeel Hill (262 m ASL) and the Ben of Fore (218 m ASL) are the most striking of these crag and tail hills. Slieve na Calliagh is comprised of a number of crag and tails, with the overall ridge showing a bedrock-influenced orientation and the constituent crag and tails also aligned northwest to southeast.

The remainder of the area is of a hummocky nature. This topography occurs either as hummocky ridges, quasi-linear ridges and hummocks interspersed with kettle holes, giving a kame and kettle topography, or as isolated mounds. Small peat bogs have formed in the larger of the kettle holes flanking the hummocky topography. Ridges, quasi-linear ridges and hummocky features form an extensive spread of gravels across the central portion of the area, from Murrens along the Westmeath border as far east as Belleek. On the northern side of these features, around Milltown, and to the east, in Belleek, flat basins (floored by sands and silts) flank the gravel hummocks. Flat areas also occur in the Drumsawry/ Knockmagoony area northwest of Slieve na Calliagh. Linear hummocky

ridges composed of diamictons are confined to the area south of Slieve na Calliagh and west of this ridge. These mounds trend southwest–northeast. They are subparallel to each other and may be up to 40 m high in places.

Hummocky topography also occurs between the craggy bedrock ridges in the south of the sheet area, around Fore, and between Castlepollard and the Hill of Maol. An extensive flat surrounds Lough Glore at the base of a northwest–southeast trending valley.

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Palaeoecological Research in County Meath

Rosemary Stewart

County Meath possesses some of the most prosperous farmlands in Ireland attesting to the well-drained rich soils and fertile pasturelands. The area has lower winter temperatures and more frosts than in western and coastal regions. Rainfall is almost the lowest in the country with an average of less than 150 rain days per year.

The reasons that make the landscape of Meath so attractive for agriculture in modern times must surely have influenced settlement in prehistory. The county has abundant, well-researched archaeological evidence of human presence and activity for much of the Holocene period.

The geographical situation of Meath suggests that it would have been one of the regions at the vanguard of movement and colonisation of people in the Mesolithic period. Neolithic and Bronze Age farmers would have appreciated the soils and moderate climate and these factors would have buffered the influence of unsettled periods of climate change and political disruption later in the Iron Age. The landscape changes made by the Anglo-Normans were particularly centred in the east of Ireland, as were those brought about by the influence of monastic orders with an emphasis on agriculture. In AD 1142 the Cistercians established an abbey at Mellifont.

The differences between the palaeoecology of eastern Ireland and the western regions suggest that there are good reasons to encourage further investigation in the area. Lakes provide a different focus of research from peat bogs, including diatom evidence. A number of the lake sites exhibit sedimentation extending back to late-glacial times, and a more calcareous aqueous environment allows bone to be preserved, including those of late-glacial fauna.

The different climate and soils in eastern areas may allow higher resolution and detail in the picture of human effects on the environment. The Elm decline was most marked in the fertile, eastern regions, and Tinsley and Grigson (1981) commented that in Ireland, Bronze Age clearance of lowland areas appears to have been quite spectacular. Large tracts of land in south and eastern Ireland were cultivated. Other factors that may mask the palaeoenvironment are less in evidence. At the close of the Neolithic, the deterioration of soils and growth of blanket peat had less effect in Meath (Edwards, 1985), and the Iron Age Lull was not so marked in the east as the west.

In historical times the hemp industry and leather tanning were important in Meath. The environmental effects of retting and the widespread felling of oak trees for tannin may be studied in the area.

However, in their assessment of the palaeoenvironmental research potential on the route of the M3, prepared for Meath County Council, Brooks and Farrell (2005) state that, despite an abundance of archaeological research evidencing substantial human-environment interaction in Meath for much of the Holocene period, palaeoenvironmental work from across the region has been relatively sparse.

One of the main reasons for this discrepancy is that there are less peat bogs and wetlands in Meath than in other parts of Ireland. However, the palaeoecological investigations of the lakes and fens that do occur alongside archaeological excavation in the area have produced excellent results. Brooks and Farrell cored sixteen sites along the planned route of the M3 to establish the potential of the county for further palaeoenvironmental investigation. In their report they list the main palaeoecological projects that have already been undertaken.

Sites in County Meath

Dunshaughlin: Frank Mitchell (1940) who lived in Meath, investigated this crannóg site. The lithostratigraphy and pollen of the infilled lake basin was recorded back to late-glacial times

Ratoath Bog: Frank Mitchell (1941) also investigated this smaller ancient lake basin near Dunshaughlin. The chronology dated back to the late Devensian and the bones of late-glacial animals including Giant Irish Deer and Reindeer were discovered.

Brú na Bóinne: The most intensively investigated area of Meath. Pollen and plant macrofossils have given a relatively detailed picture of the land use since the construction of the great passage tombs around 5200 BP. Gabriel Cooney (2000) brought all this data together to construct a hypothetical land use map of the Brú na Bóinne and surroundings during the Middle Neolithic .

Moynagh Lough: Palynological investigation close to the crannóg site were undertaken by Rosemary Stewart. Please see report in this volume.

Emlagh Bog: Karen Molloy (Newman et al., 2007) and her team undertook pollen, macrofossil and tephra analysis at Emlagh Bog including charcoal investigations at Raffin Fort. A detailed Holocene record and suite of radiocarbon dates were obtained.

Sites in the vicinity of County Meath

Scragh bog: Michael O'Connell (1980) investigated this site particularly to study the hydroseral establishment of fen communities. This included sedimentology, macrofossils and pollen dating back to late-glacial deposits.

Redbog, Essexford Lough and Whiterath Bog: Weir (1995) undertook palynological investigations at these three sites and constructed a picture of human interaction with the environment from the Bronze Age onwards. He found evidence of hemp and flax cultivation.

Lough Sheelin, Lough Kinale, Derragh Lough, Red Bog and Essexford Lough: Brown, O'Brien and Selby (Selby et al., 2005; Selby and Brown, 2007) have explored a number of sites on the borders of County Meath, including stratigraphy, geomorphological mapping, diatoms, plant macrofossils and palynological investigation.

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A brief introduction to County Meath archaeology and a selection of the results of the M3 Clonee North of Kells Motorway Scheme

Mary Deevy and Roisin Barton Murray

County Meath is often considered to be Ireland's Heritage Capital. Some of the most important archaeological and historical sites and monuments are located within the county, including the seat of the High Kings of Ireland at Tara. Virtually every important aspect of Irish history from prehistoric times through to recorded history is represented within the county. From the Neolithic tombs of Brú na Bóinne and Lough Crew, through the early medieval settlements at Lagore and Moynagh Lough, the medieval castle at Trim and monastic ruins at Mellifont and Bective through to the site of the Battle of the Boyne in 1690.

Probably the most famous site is Brú na Bóinne which is internationally renowned for the Neolithic passage tombs of Newgrange, Knowth and Dowth. These tombs include the largest collection of megalithic art in Europe. The tomb at Newgrange is the best known of all the Irish passage tombs with its passage way specifically aligned to catch the rays of sunlight at dawn on the winter solstice. The site at Knowth contains a passage tomb cemetery with a number of passage tombs surrounding the main tomb, which itself contains two tombs. Knowth also has the largest collection of art and excavations have shown that this site was in use for ritual and settlement purposes from the Neolithic through to the post-medieval period. Lesser known is the third massive passage tomb at Dowth which also has two tomb structures and decorated orthostats, although it has not been investigated by modern excavation. Apart from the tombs themselves, recent research (including geophysical and Lidar surveys) has shown that the wider area of Brú na Bóinne has been an important settlement and ritual centre for thousands of years.

Loughcrew (Slieve na Caillighe) is another important Irish passage tomb site, much less known than the tombs at Brú na Bóinne, but just as significant. Here there is a cemetery of approximately thirty passage tombs spread across a series of hills with the majority located on adjacent peaks, Carnbane East and West. The tombs vary in size and preservation. As at Knowth, there are large mounds partly surrounded by clusters of smaller mounds. Some of the tombs have wonderful megalithic art including Cairn L on Carnbane West and Cairn T on Carnbane East, the latter of which is a classic Irish passage tomb incorporating a cruciform passage and twenty-eight stones decorated with arcs, zigzags, concentric circles and flower-motifs. The entrance to the tomb in Cairn T is aligned with the rising sun at the equinoxes so that it illuminates some of the decorated stones.

The Hill of Tara in Meath is one of Ireland's most significant archaeological, historical and mythological sites. Over 30 archaeological monuments are visible on the low hill, but this number has been doubled by aerial and geophysical survey. Historically, Tara is the seat of the High Kings of Ireland and the majority of the upstanding sites on the hill are known by their medieval names. These include the largest monument *Rath na Rí* (the Fort of the Kings): an iron age oval enclosure (310 m by 210 m) with an internal rock-cut ditch which

surrounds a huge proportion of the summit of the hill. Deviations in the plan of the monument show that it intentionally enclosed earlier monuments including a small Neolithic passage tomb, the *Mound of the Hostages.* Limited excavations to date show that there was successive monument construction on the hill from 3000 BC to at least AD 400, and it is hypothosised that a number of monuments, including the Banqueting Hall and Teach Cormaic, were constructed between the fifth and eighth centuries.

Evidence of successive activity was also revealed in the valley below the Hill of Tara, and throughout the county of Meath, by archaeological research in advance of the M3 Clonee to North of Kells Motorway Scheme. One of the earliest sites and most astonishing discoveries was made in bogland on the edge of a former lake at Clowanstown. Four long conical alder woven baskets used as fish traps, probably much like lobster pots, were discarded around 5000 BC and became flattened and embedded in the peat forming at the edge of the lake (Figure 5).

Figure 5 Mesolithic (*c. BC 5000*) *fish trap from Clowanstown, Co. Meath. The basket was excavated and conserved intact in a block of the peat it was discovered embedded within, and is now on display in the National Museum of Ireland, Kildare Street.*

Such rare preservation (to date unique in a lake context in Ireland) might never have been discovered if the site had not been returned to again and again over the next 2000 years so that the peat which contained and preserved the baskets was eventually sealed beneath Neolithic burnt mounds. However, the baskets were not just revolutionary from a preservation point of view. Fitzgerald has pointed out that they were made by a technique classified as open twining which is more comparable to true weaving than previous finds of ‘coiled’ basketry in Ireland. The Clowanstown baskets, however, considerably predate the earliest extant finds of woven fabrics, indicating that experimentation with interlacing systems was occurring in Ireland much earlier than previously understood. The removal and conservation of these delicate artefacts was a ground-breaking achievement and major project in itself, and they are now on display in the National Museum of Ireland.

The most famous site found on the scheme was an extensive 80 m diameter wooden post-built ceremonial enclosure at Lismullin, dated to the early iron age. Unlike the monuments perched prominently on the Hill of Tara, this enclosure was deliberately situated in a discrete location at the base of the Gabhra Valley. Also unlike the monuments on the Hill, its construction did not require large-scale manpower to excavate deep soil or rock cut ditches, or to erect huge posts. In contrast, Lismullin consisted of a concentric double ring of widely spaced but numerous small wooden posts (of a similar size to modern fence posts), surrounding a much smaller (16 m diameter) central ring of closely spaced posts. A post-lined entrance avenue extended from the inner enclosure to a four-post structure located at a gap on the eastern side of the outer enclosure. However, far from being hidden, its positioning in a natural hollow surrounded by a ridge of higher ground provided an amphitheatre effect. The size of the surviving postholes suggests that the posts in the double ring would not have stood very high. The activities taking place within the enclosure would have been visible from a natural elevated viewing platform outside. The monument appears to have been carefully planned and constructed, and the results of a study of its morphology are presented elsewhere in this volume by Frank Prendergast.

Sometime near the end of the iron age in the townland of Collierstown (approximately 3 km south of Lismullin), a woman was buried lying on her back in a dug grave. A ring ditch was excavated around her, with the resulting soil used to create a low mound over her. Later, in the fifth and sixth centuries AD, her grave became the focus of an enclosed cemetery which was to eventually contain at least sixty individuals (Figure 6).

Figure 6 Aerial view of early medieval cemetery post excavation looking east, Collierstown, Co. Meath.

Burials were in simple pit graves or lined with stone or, to a lesser degree, wood. Initially only adults, probably of a certain social rank, were buried at Collierstown, but later additions of a juvenile and infants may suggest that it had become a familial plot. The majority of burials were not associated with grave goods and were oriented west–east in the Christian tradition. However, a small number of enigmatic artefacts were recovered from the site, including sherds of imported eastern Mediterranean amphorae and fine tableware of probable sixth century AD date. These ceramics were probably associated with the wine trade, which perhaps suggest that wine played a role in the mortuary rite. The rarity of these ceramics in Ireland confirms the high rank and status of the individuals buried. Other finds included an antler fish gorge (a predecessor to the fishhook) and a whalebone sword hilt (Figure 7).

Sword hilts were generally made of organic materials, and are rare finds in Ireland. The specialist report on the hilt cites a third century text by Solinus: ‘Those (of the Irish) who cultivate elegance adorn the hilts of their swords with the tusks of great sea-animals’. Riddler and Trzaska-Nartowski point out that while this sword hilt is not made from tusk it nonetheless stems from a ‘great sea-animal’. The cemetery fell out of use by the eighth century AD and was eventually forgotten until it was rediscovered in advance of the M3.

Figure 7 Bone artefacts from Collierstown cemetery: a whale bone sword hilt, a decorated plate from a composite comb and a fish gorge (*precursor of fish hook*).

The people buried at Collierstown would most likely have lived in a nearby ringfort in the same townland. A more unusual early medieval settlement option was a crannóg. Being lake settlements, the water-logged nature of these sites means that excavated examples can produce a wealth of organic material that does not survive on other contemporary settlement sites. At Moynagh Lough, crannóg organic preservation allowed for the dendrochronological dating of one of the timbers used in the construction of the crannóg, which showed that it had been felled in AD 625. Excavation has revealed a series of wooden round houses surrounded by post and plank palisades constructed throughout the seventh and eighth centuries AD. Skilled ornamental metalworking was one of the principal activities carried out.

Extensive metalworking was also a feature of one of the most important early medieval crannóg sites – the royal site of Lagore near Dunshaughlin. The site consists of piles of brushwood and peat 3 m thick and 41 m across at its greatest extent. The earliest phase of occupation at the site is represented by some Roman material, but with subsequent phases of occupation through the seventh, eighth, ninth and tenth centuries. The site produced a wealth of evidence for settlement activity including tonnes of animal bone, extensive metalworking, textile production, glass working, woodworking and an abundance of personal material including ornamental and ornamented objects. Another aspect of life at Lagore was shown through the collection of swords and spears recovered, showing that the inhabitants clearly felt the need to defend themselves. Lagore is referred to in the historic annals, including in AD 934 when it was destroyed by Olaf of Dublin.

Figure 8 Aerial view of early medieval settlement complex post excavation looking east, Roestown, Co. Meath.

On the other side of Dunshaughlin, at Roestown, archaeological work in advance of the M3 motorway discovered a contemporary settlement with a number of similarities to Lagore. The inhabitants were also wealthy with access to imported goods. A large D-shaped enclosure with external annexes and field systems was initially constructed in the mid-sixth century, and continuously occupied and modified (including by the addition of a souterrain) until the eleventh century (Figure 8).

As a dryland site, and having been completely levelled, Roestown could not compete with Lagore in terms of preservation of organic finds; nevertheless, a significant number of artefacts were recovered. These included iron knives, copper alloy and iron ringed pins, bone pins, glass and amber beads, lignite bracelets and bone combs. Of particular interest are the chronological and stylistic parallels between the metalworking assemblages of Lagore and Roestown. The patterns on bone motif pieces from both sites are so similar they must have been carried out by craftsmen from the same tradition, indicating that Roestown also had a key role in the production of specialised fine metalworking (Figure 9).

Figure 9 Bone motif pieces from Roestown early medieval settlement.

Nearby and also completely forgotten until discovered by geophysical survey in advance of the M3 motorway was another early medieval settlement at Baronstown (Figure 10).

This large and impressive ringfort was constructed in the sixth century and occupation lasted, albeit at a declining scale, possibly until the eleventh century. In similarity to the D-shaped enclosure at Roestown, various additional agricultural enclosures were added to the ringfort, and at its greatest extent the early medieval site measured 130 m north–south by 90 m. Waterlogged conditions within the ringfort's main ditch preserved various wooden artefacts, including yew cask and tub staves of various sizes, a turned alder bowl and a carved alder ladle or scoop with a D-shaped handle. These are high quality artefacts with parallels from the important early medieval sites – Lagore Crannóg, mentioned above, and Ballinderry Crannóg, County Offaly. Overall, however, the relatively limited range and number of artefacts, especially in comparison to Roestown, suggests that Baronstown was inhabited by farmers of average wealth.

Figure 10 Aerial view of early medieval settlement complex, Baronstown, Co. Meath.

After the Norman invasion in the twelfth century, the kingdom of Meath was granted to Hugh de Lacy, who constructed the castle at Trim, which remains one of the finest examples of medieval military architecture in Ireland. Less well-studied, because they do not survive above the ground, are the unfortified habitations of de Lacy's tenants. A rare glimpse of a rural medieval settlement was afforded by the discovery of a medieval farmstead at Boyerstown on the Navan-Athboy road as part of the M3 project. The site consisted of the partially surviving remains of two drystone-built houses and outhouses,

metalled stone surfaces, drainage ditches, an area of ridge and furrow and various pits and wells (Figure 11).

Artefacts from the houses and overlying topsoil were similar to what would be expected from an urban site, albeit without the organics. Finds included regionally made and imported medieval glazed and unglazed pottery, including jugs, drinking vessels and cooking pots, iron blades, barrel padlocks, keys, coins, decorated belt buckles, a finely worked thirteenth-century inscribed silver ring brooch and a silver crucifix pendant. The farm is interpreted as having been settled by an Anglo-Norman free tenant sometime during the early thirteenth century for a period of approximately 300 years.

Figure 11 Aerial view of commencement of excavations of a medieval settlement looking north, at Boyerstown, Co. Meath, on the Navan-Athboy road.

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The Lismullin Enclosure

Frank Prendergast

Introduction

The national monument at Lismullin, CountyMeath, was discovered by archaeologists in 2007 during developmental works for the M3 Motorway. Topsoil stripping and excavation revealed circular and linear arrays of post-hole sockets that delineated the existence of a large ceremonial enclosure (Figure 12). Radiocarbon dating indicates episodic construction and occupation of the site from *c.* 545—90 BC.

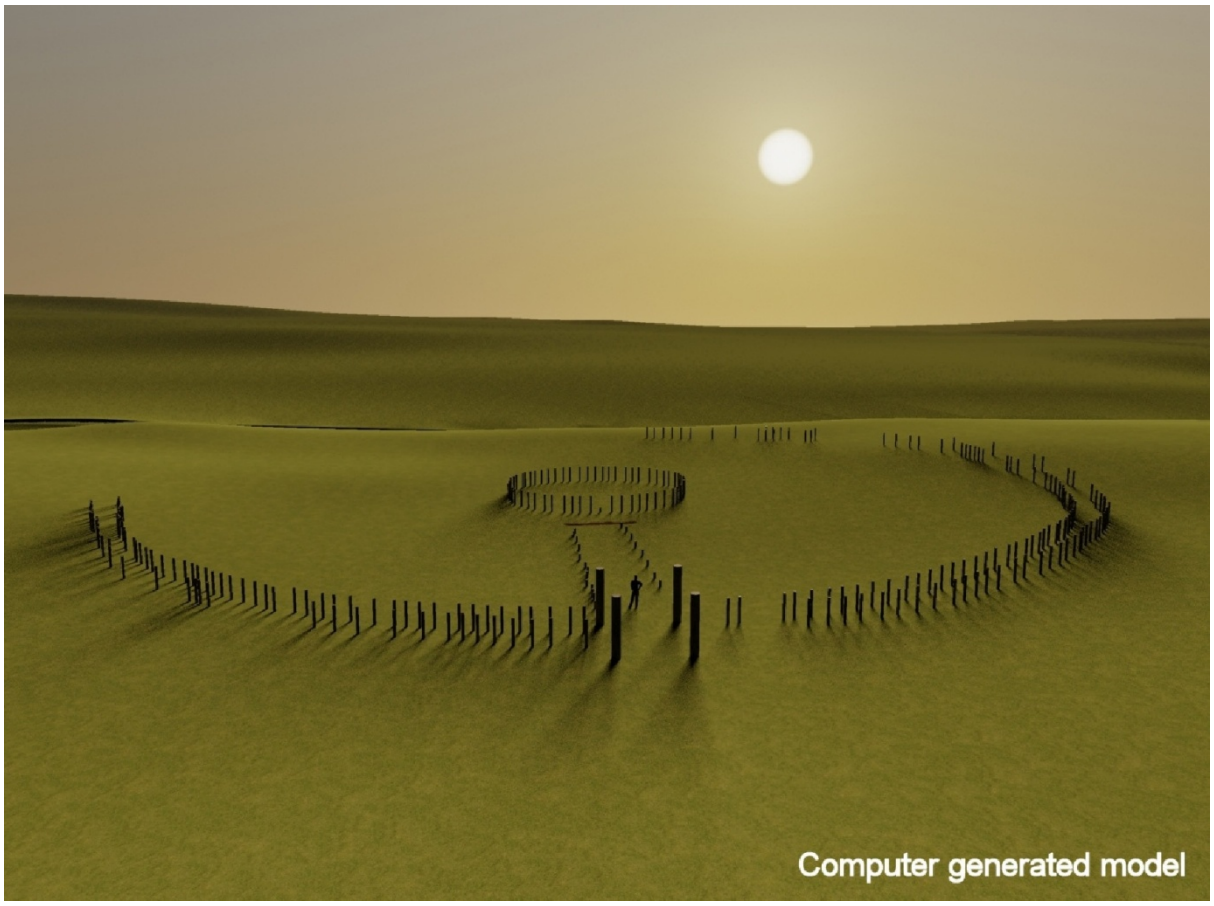

Figure 12 The post enclosure at Lismullin, Co. Meath (*source: CSA Ltd.). NGR* (*ITM*) *693 355 m, 761 584 m; Height c. 77 m; Geodetic ETRF89 N53˚ 35' 45", W06˚ 35' 23"; RMP ME032-062-*

Site description

The complex was composed of eight discretely built elements ‘a’ to ‘h’ (Figure 13):

a. Centre-post
b. Two inner arcs of post-holes
c. Inner enclosure (radius R = 8.0 m)
d. Outer enclosure (inner & outer rings)
e. Four-post entrance
f. Avenue
g. Transverse trench
h. Eight pairs of pits

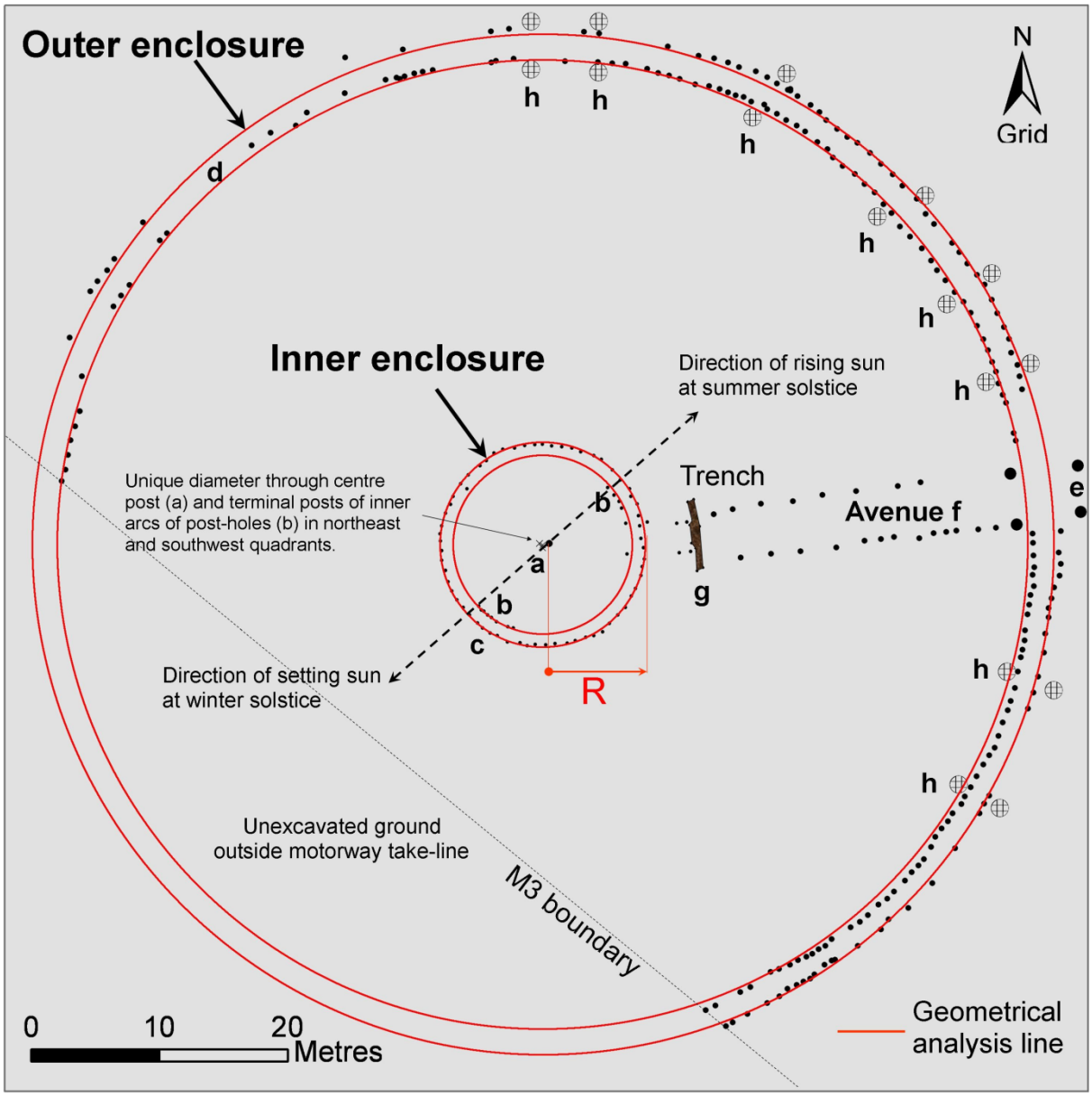

Figure 13 Plan showing structural elements ‘a’ to ‘h’ and the primary unit of measure R

Archaeological interpretation of the site's topographical setting and the excavation data suggest that the complex was designed for ceremonial use rather than for habitation or burial (O'Connell, 2009). Accordingly, this analysis and a technical report were commissioned by the excavation director and the National Roads Authority to investigate the likely use and function of the enclosure.

Research questions

Structure and morphology: Was the complex proportionally and symmetrically planned?

Structure and metrology: Was a unit of measure used?

Alignment and archaeoastronomy: Was the site aligned for ritual purposes on a seasonally prominent / culturally significant celestial body?

Findings

Computational analysis (least squares) indicates that elements 'b' to 'd' have a common centre ($\delta < \pm 0.3$ m, $p < 0.05$, 95%). These coincide (< 0.6 m) with the centre post-hole 'a'.

Statistical analysis (ANOVA) has discovered that a primary unit of measure R, based on the radius of 'c', was used to construct all other elements in proportion with each other.

Astronomical analysis of 'b' and 'f' has yielded evidence of alignment on the sun at the winter/summer solstice, and on the Pleiades star cluster, respectively (Figure 14).

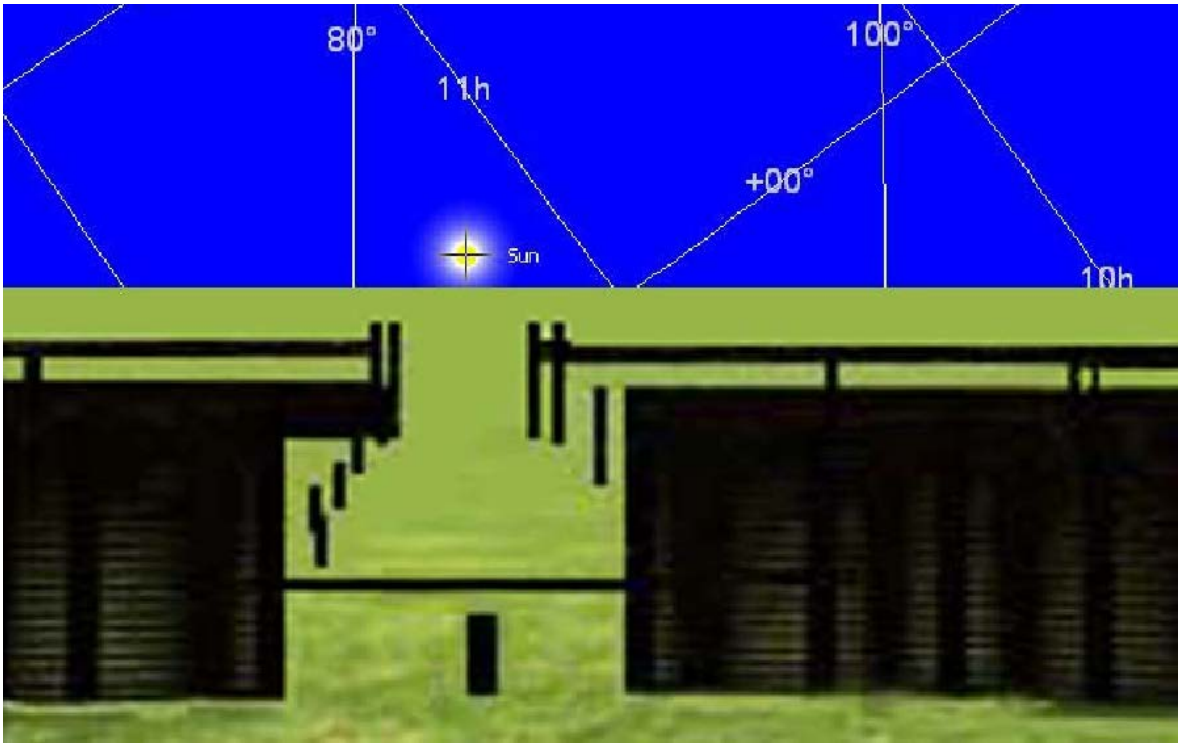

Figure 14 Sky view of sunrise from the enclosure centre, modelled for c. 500 BC

Conclusions

The complex was precisely constructed and aligned, and embodies proportionality, symmetry and astronomy. These attributes are consistent with a likely use of the site as a ceremonial and ritual enclosure with the audience segregated from celebrant(s). The timing of the astronomical events suggests a ritual use at winter/summer solstice and/or at the end of the autumn harvest.

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FIELD SITES

The Loughcrew Hills and Passage Tomb Complex

Frank Prendergast

Introduction

The Loughcrew Hills are a 5 km long by 1 km wide linear formation trending ENE—WSW and located 5 km southeast of the town of Oldcastle, County Meath. From the Ordnance Survey Ireland map of the area (Sheet 42 Discovery Series), six peaks can be discerned on its ridges. These range in altitude from 237 m AOD at the eastern end to the 254 m high summit of Carbane West at the other end of the range. Carbane East is the dominant peak with an altitude of 276 m AOD. Geologically, the main rock types of the formation are sandstone, greywacke and shale and are dated to the Silurian Period (440–410 million years ago). The environment then indicates that sand and mud were being deposited in a narrow ocean basin and at a time when mountain building was evident. The Loughcrew Hills lie at the south-west edge of this rock type and overlook a much more extensive formation of dark-grey argillaceous and cherty limestone associated with depositional processes occurring during the later Carboniferous Period (354–298 million years ago). Then, sand and mud was being deposited in a shallow warm tropical sea that was advancing over older and eroded Devonian Period mountains (410–354 million years ago) that date between the Silurian and Carboniferous Periods. Given the average elevation of *c.* 100 m AOD of the surrounding lowland, the pronounced height difference between the central plain below and the hill summits at Loughcrew provides the visitor located on the highest ground with a dramatic vantage. Furthermore, this creates a striking topographic feature that is visible from great distances.

The name ‘Loughcrew’ may be derived from the adjacent Creeve Lough, 3 km to the south of the megalithic tomb complex. More interestingly, the name ‘Carnbane’ is thought likely to derive from ‘*Carn Bán*’ or a heap of white stones. Given the presence of quartz found in association with some of the nearby megalithic passage tombs, such an explanation seems convincing. Local tradition also holds that the Irish name for the hills ‘*Slieve na Calliagh’* derives from the legend of the ‘Hag’ or witch, who reputedly dropped white stones onto the summits of Carnbane East and Carnbane West. Indeed, the most prominent kerbstone at Cairn T is known as the ‘Hags Chair’ and was, reputedly, the resting place of the witch during her cairn building endeavours.

Views from Loughcrew

A visit to Loughcrew normally commences at the visitor car-park on the western slopes of Carnbane East (Carnbane West is currently on privately owned lands). This leaves the climber with a steep vertical ascent of more than 70 m to reach to summit. The well marked trail quickly affords increasingly spectacular views over the central plain and once the summit is reached, the full panorama of the location is stunning. From clockwise in the south-west direction, five of the great midlands lakes can be seen (Figure 15). The surrounding counties of Dublin, Kildare, Westmeath, Longford, Cavan and Louth are all overlooked. In the distance, the Dublin Mountains are 70 km to the south, the River Shannon 50 km to the west, Slieve Gullion in County Armagh is 60 km to the north-east, while the Irish Sea coastline is 60 km to the east.

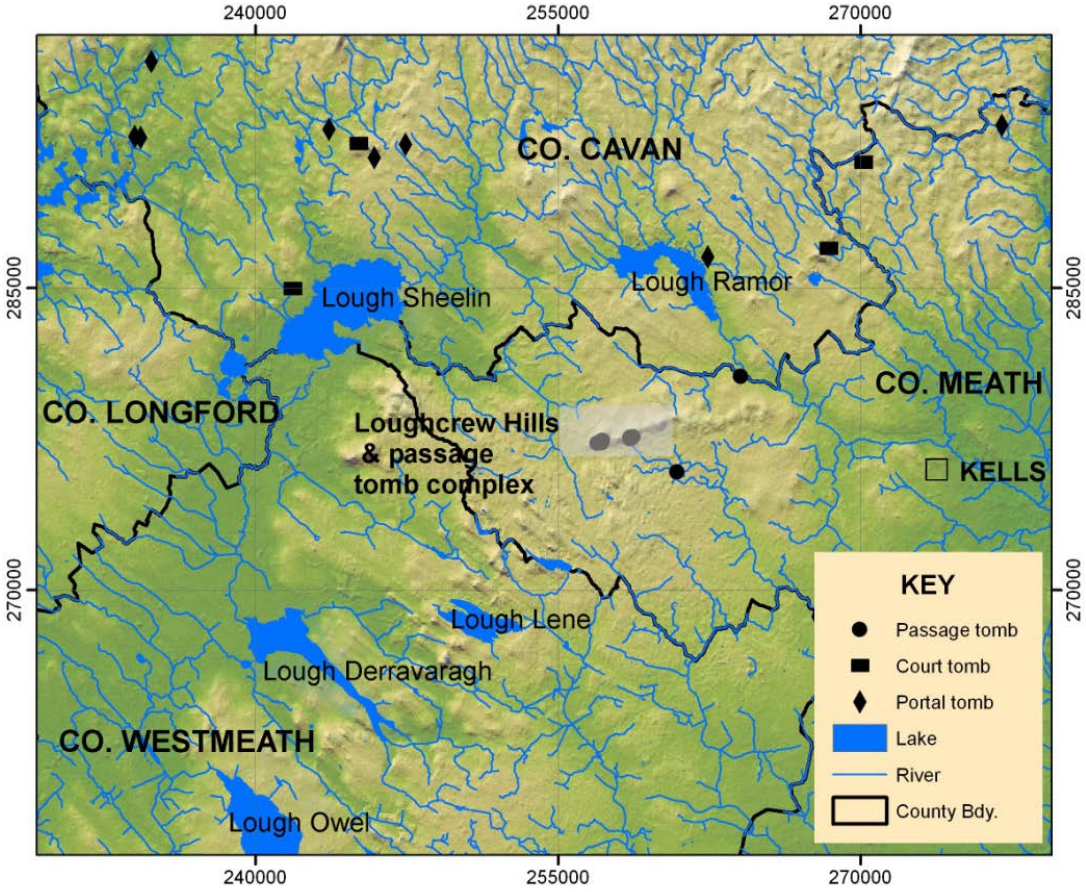

Figure 15 Regional setting of the Loughcrew Hills and passage tomb complex (*grid units are in metres on the Irish Grid)*

From the hilltops, several outlying passage tombs are just visible on the horizon. At a range of 65 km WNW, Sheemore Hill in County Leitrim with its three summit tombs can be seen on a clear day. The passage tomb at Banagher, County Cavan is 25 km distant in the NNW. To the north-east, the distinctive profile of Slieve Gullion in County Armagh and its crowning passage tomb are very evident, while to the south-east, the 'Mound of the Hostages' passage tomb on the Hill of Tara is visible at a distance of 40 km (although it is

now obscured by trees located close to the tomb). Contrary to some claims, the passage tombs situated on the summit of the Carrowkeel Mountains in County Sligo, 90 km WNW of Loughcrew cannot be seen.

Archaeological Landscape

The wider archaeology of this very special landscape is well described (*e.g.* Coffey, 1912, 1977; Cooney, 2000; Cooney, 2000; Mc Mann, 2005; Newman, 1995; Twohig, 1981) and officially recorded (http://webgis.archaeology.ie). Evidence of long-term occupation of the summits and slopes by a succession of cultural groups can be traced from the early Neolithic to the medieval period. Surviving sites and monument types include a cursus, standing stones, a stone circle, rock art, enclosures, barrows, religious houses, Norman mottes, Fuluacht fiadhs and a castle. However, it is the presence of a major passage tomb complex that gives the area a cultural status of national and international renown and which generates the greatest interest for the majority of visitors. The clusters of tombs, cairns and unclassified megalithic structures are recognised as one of the four such major sites on the island of Ireland – the others are located in the Boyne Valley, and at Carrowkeel and Carrowmore in County Sligo.

Passage tombs are widely distributed in Ireland with the majority lying along, or north of, an axis extending from County Sligo in the north-west to County Wicklow in the south-east (Figure 16). South of that line, their occurrence is more dispersed and numerically few. Nationally, there are 220 extant monuments of this class, comprised of 168 definite tombs and 52 possible tombs.

The distribution and archaeological classification of the megalithic monuments at Loughcrew are intricate. For clarification, these are tabulated and illustrated in Table 1 and Figure 17. The complex consists of 32 monuments distributed in five townlands *viz*. Newtown, Loughcrew, Corstown, Patrickstown and Thomastown. The national inventory classifies these (see Glossary) as definite passage tombs (15), a possible passage tomb (1), cairns (15) and an unclassified megalithic structure (1). The majority are clustered on the summits of Carnbane West (Newtown Td.) and on Carnbane East (Corstown Td.) while four sites are situated on the summit of Patrickstown Hill (Patrickstown Td.). Three kilometres to the south-east of Cairn T, an additional ruined tomb in Thomastown Td. is an outlier of the complex and is thus included here in the overall total.

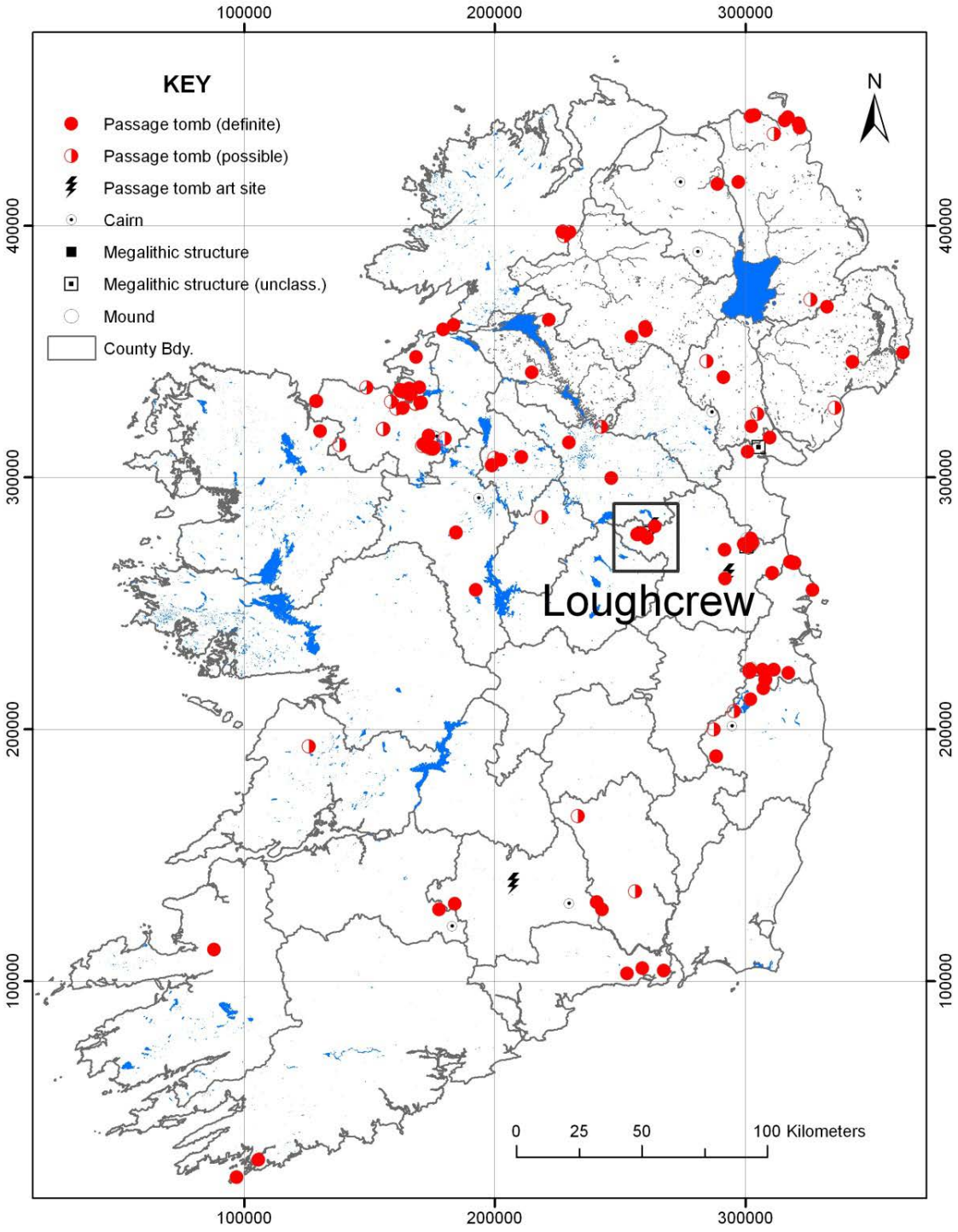

Figure 16 General map of Ireland showing the distribution of 220 passage tombs and other related sites (grid units are in metres on the Irish Grid)

Table 1 Loughcrew megalithic monuments by Townland

Townland	**Hill**	**Monument code** (Fig. 3)	**Monument class**
NEWTOWN	Carnbane West	B, F, H, I, J, K, L D, E, G, M, O	Definite passage tomb (7) Cairn (5)
LOUGHCREW	Carnbane West	A1, A2, A3, C	Cairn (4)
CORSTOWN	Carnbane East	R2, S, T, U, V, W N, P1, P2, Q, R1	Definite passage tomb (6) Cairn (5)
PATRICKSTOWN	Patrickstown	X1, X2 Y X3	Definite passage tomb (2) Cairn (1) Megalithic structure (1)
THOMASTOWN	-	ME015-111----	Possible passage tomb (1)

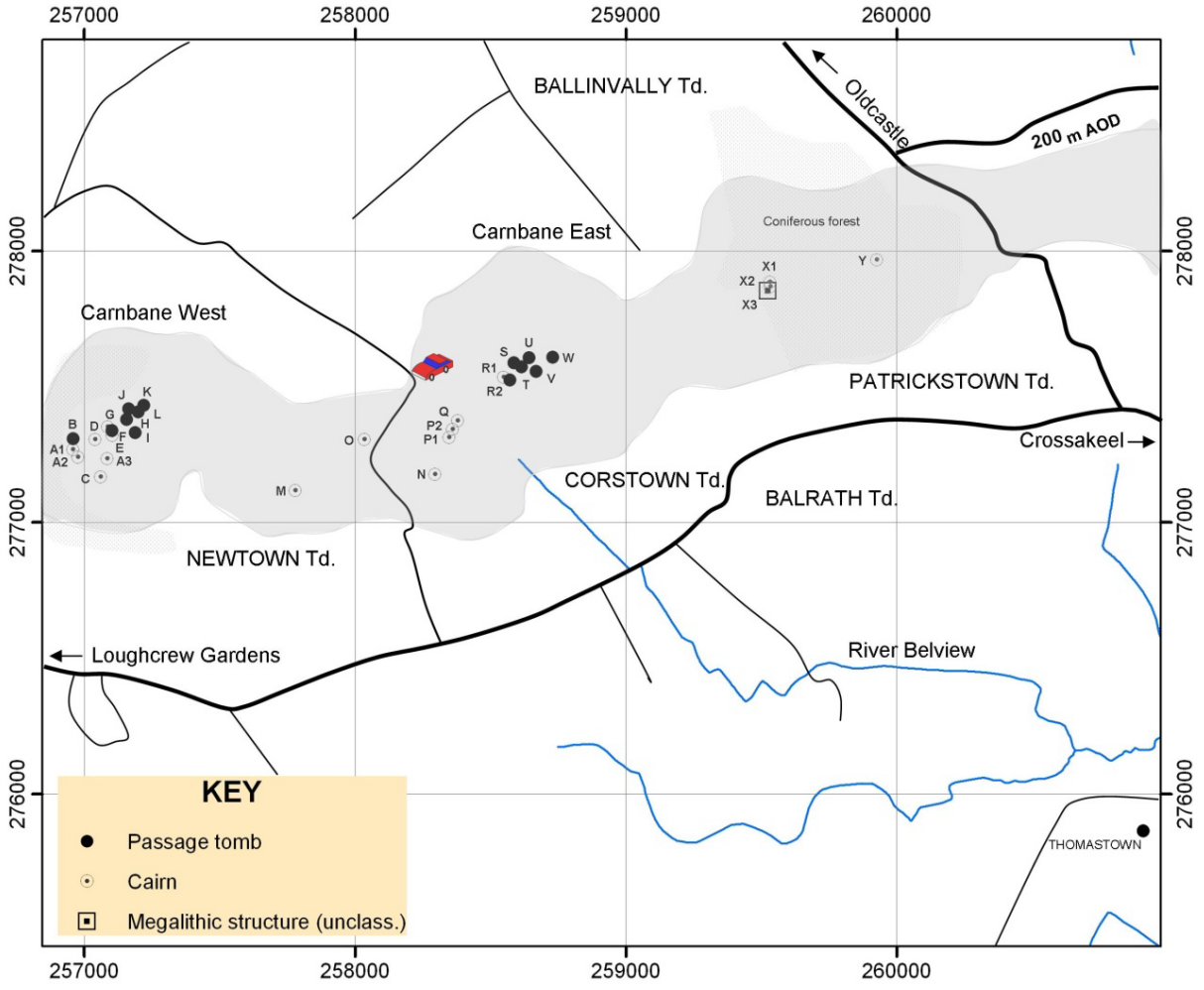

Figure 17 Plan of the Loughcrew Passage Tomb Complex (*grid units are in metres on the Irish Grid)*

To the north of Loughcrew, both court and portal tombs are encountered at lower elevations and do not encroach on the territory of the passage tombs (see Figure 15). Elsewhere, and where spatial mingling does occur between the three tomb traditions, the passage tombs always dominate the other tomb types in an elevational sense (Prendergast, 2011).

Chronologically, secure radiocarbon dates have been obtained for some of the Irish passage tombs using cremated bone ash (*e.g.* Bergh, 1995; O' Sullivan, 2005). These and other sources would suggest that the majority of such tombs were constructed within less than a thousand year period terminating in *c.* 2700—2600 BC and just before the Bronze Age.

Passage tomb morphology

Although much variation in style occurs, the typical tomb consists of a passage lined with upright stones (orthostats) leading to a central chamber. In some cases, there is no differentiation between the passage and chamber. Where differentiation is evident, the chamber ranges from a simple polygon to its most developed form – the cruciform type.

Here, three recesses are encountered, often with the right-hand one being the largest (Figure 18). Primarily, their function was funerary. For archaeological recording, every structural stone is annotated with a unique number, *i.e.* the passage sides (L and R), the chamber (C), and the kerb (K).

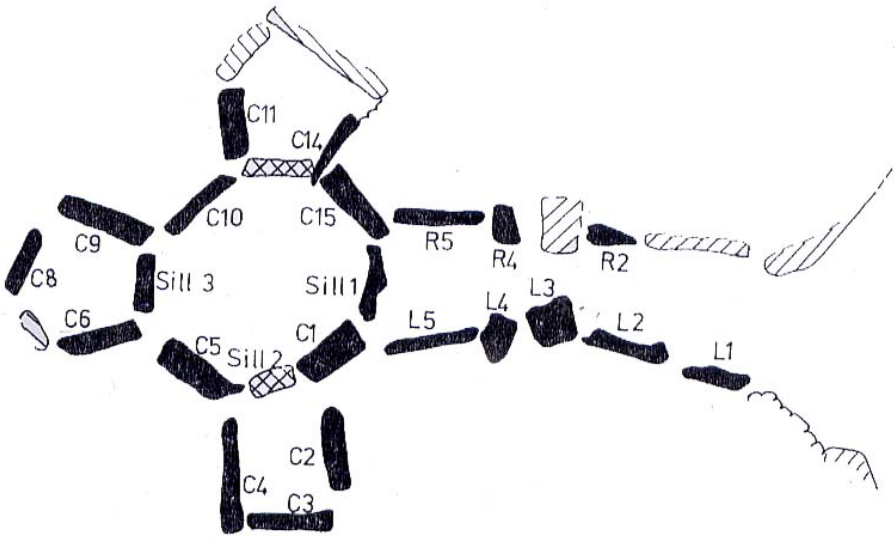

Figure 18 Plan of the cruciform burial chamber at Cairn T (*after Twohig, 1981, Fig. 232*) *.*

At Loughcrew, cruciform tombs occur at sites K, H, F and L on Carnbane West, sites T, R2, and U on Carnbane East, and site X1 on Patrickstown Hill, although there is some uncertainty regarding the classification of two of those (R2 and X1).

Externally, tombs were frequently delimited by a circular enclosing kerb of contiguous boulders. In many, the tomb was also covered by a large cairn of loose stones sometimes topped with a sod layer (Figure 19). Many of the cairns have been destroyed or damaged over the intervening millennia although in some, cairns may never have been constructed.

Cairn dimensions range from being diminutive to gigantic, with the largest (c. 90 m diameter and 10 m height) being found at Newgrange 1 and Knowth 1 in the nearby Boyne Valley, and on the summit of Knocknarea Mountain, County Sligo.

Figure 19 Cairn T on the summit of Carbane East (*elev. 276 m AOD*) *– entrance, kerb and covering cairn*

Passage tomb art

At Loughcrew, twelve tombs bear passage tomb ornament on the structural stones – internally and/or externally. The degree of preservation is dependent of aspect and geological hardness of the embellished stone. The catalogue of art found here forms a significant proportion of the total found nationally (Twohig, 1981). Interestingly, with the exception of two sites in County Sligo, all passage tomb art tends to occur on sites located towards the eastern part of their distribution. Arguably, the most spectacular and best preserved decoration at Loughcrew is encountered on stone C8 located in the end recess of Cairn T (Figure 20; and see Figure 18).

On this stone, the visitor will encounter a range of abstract and geometrically shaped motifs comprised of circles, circles and dots, grooved linear verticals, linear zigzags (in-phase), full-circle radials (open and enclosed), floral radials (full-circle), and U and nested U forms. Where megalithic art is applied to cover the whole of a stone surface, as with the assemblage on C8, this style has been described as ‘plastic’ meaning that the spatial relationship between the applied ornament and the ‘stone canvas’ is evidence of aesthetic intent by the Neolithic artist (O' Sullivan, 1993; 1997).

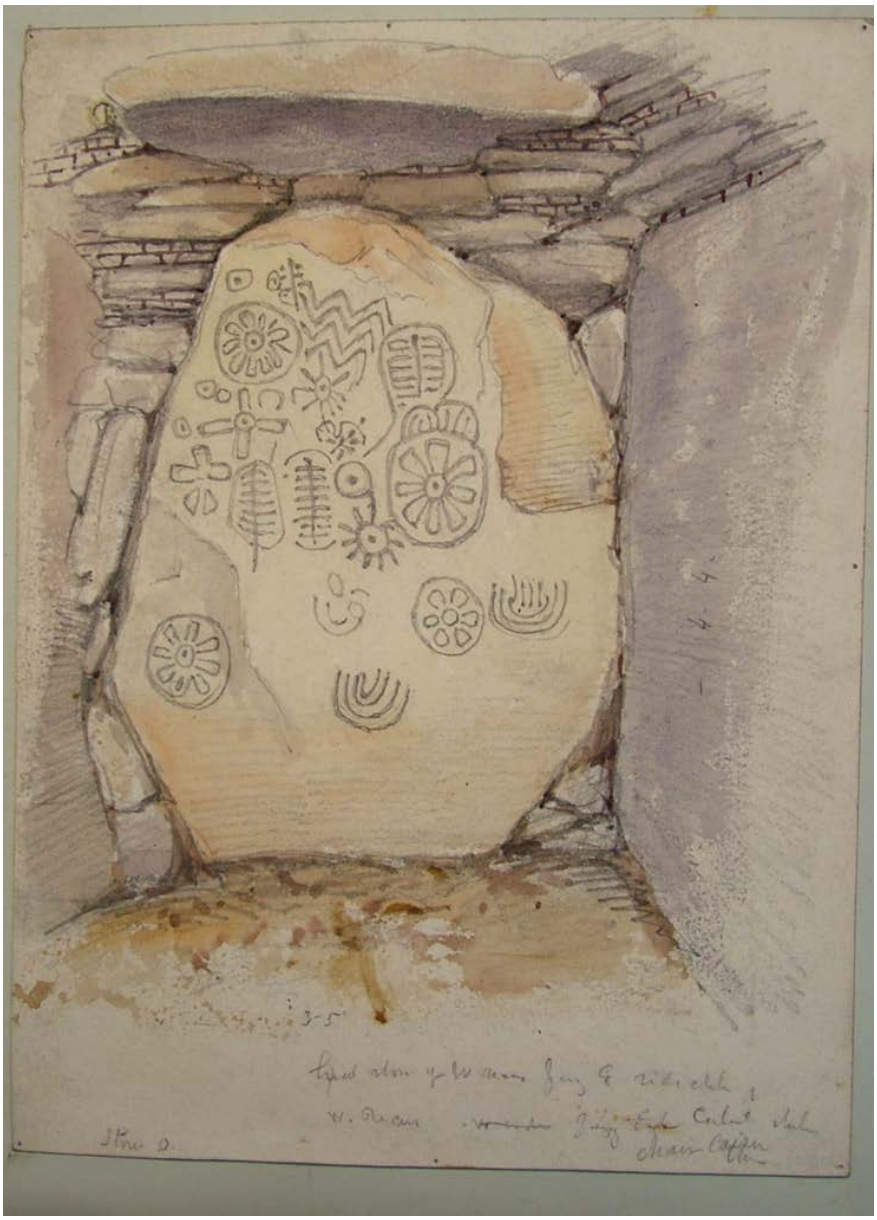

Figure 20 Watercolour of the decorated backstone C8 by George V. du Noyer (*by permission of the Royal Irish Academy Library; MS3D3*)

Passage tomb alignment and archaeoastronomy

Investigation of the orientation of the Loughcrew tombs by the writer indicates that of the 14 extant monuments with surviving passages, four are aligned towards other tombs within the complex (J → L, I → T, V → T, Thomastown → T). One of these, I → T, is illustrated in Figure 21.

In every case where the phenomenon of a directed view occurs, the target tomb is elevationally higher than the source. Nationally, this phenomenon is widespread and argued to be culturally significant (Prendergast, 2011).

Figure 21 Directed view from the chamber of Site I on Carbane West towards Cairn T on Carnbane East

Astronomical alignments at Loughcrew are few. Just three sites demonstrate potential evidence of tomb orientation consistent with an interest by the tomb builders in significant horizon events in the solar year. Biannually, and for a very short period in late March and September, the rising sun dramatically illuminates the decorated backstone C8 at Cairn T. The dates indicated by the calculated astronomical declination (*c.* -1°) could suggest deliberate orientation of that passage towards the rising sun at the period of the solar cycle when the astronomical declination of the sun is close to zero degrees. At these dates, the sun is midway between its apparent extreme positions on the horizon at the winter and summer solstices. This may have had ritual or ceremonial significance in the past.

On Patrickstown Hill, the putative axis of the ruined cruciform tomb X1 is aligned on the setting sun at the Winter Solstice – the indicated astronomical declination there is *c.* -24°. That discovery by the writer also resulted in megalithic art on one of the kerbstones being catalogued for the first time (Figure 22 and O' Sullivan et al., 2010).

Elsewhere, an additional alignment recently discovered by the writer links the outlying ruined tomb at Thomastown with Cairn T on the summit of Carnbane East. The spectacle of the sun setting behind the elevationally higher Cairn T at the period of the Summer Solstice in late June (astronomical declination *c.* +24°) provides evidence of the wider role and meaning of the passage tombs (Figure 23).

Figure 22 Megalithic art on kerbstone K1 at Site X1, Patrickstown Hill

Importantly, when these sites are visited at the indicated dates, the modern visitor can witness and experience similar spectacles to those observed by the builders of the passage tombs 5000 years ago.

Figure 23 Setting sun at summer solstice viewed from the alignment of Thomastown passage tomb to Cairn T on Carnbane East (image: Ken Williams)

GLOSSARY

Barrow A general term used to describe a circular mound of earth and stone used to cover a burial(s). Excavated examples have been dated to the Bronze and Iron Ages (*c.* 2400 BC–AD 400). Barrows are extremely common throughout Europe as a burial tradition. Apart from the round form, long, oval and rectangular/square types are known. The term originated in England. The equivalent term in Ireland was the tumulus – a term that is now obsolete.

Cairn The term cairn is derived from the Irish word 'carn' meaning a pile of stones. Thus, it is a round mound constructed primarily of stone but which cannot be classified as belonging to any megalithic tradition. Several variants are named in the table and these can date from any period of prehistory or later. Their siting tends to be in upland areas.

Court tomb A term introduced by R de Valera to describe long barrows containing, at their broader end, an unroofed forecourt area typically leading to the roofed and segmented burial gallery placed on the axis of the cairn. The covering cairn is retained by a kerb of upright stones or drystone-walling. The evidence suggests that the galleries were used for repeated burial, mostly cremations from *c.* 4000–3500 BC.

Megalithic structure A construction consisting of large stones of a megalithic character. Based on available evidence, these cannot be classified and can date from the prehistoric or later.

Megalithic tomb (unclassified) A term used to describe any tomb-like structure that cannot be classified as a court portal, passage or wedge tomb. These can date from the Neolithic to the Bronze Age (*c.* 4000 – *c.* 500 BC).

Megalithic tomb A general descriptive term that embraces all chambered tombs constructed with stones of megalithic proportion.

Mound An artificial platform, of earth or earth and stone, of unknown date and function which on present evidence cannot be classified as a monument of any type. Tumulus was the alternative term used in Ireland.

Passage tomb A class of megalithic tomb in which the burial chamber(s) is typically set within a round mound, delimited by a kerb of stones that are set contiguous or spaced. Much variation occurs in the number, form and shape of the chambers. Many were embellished with incised art on the structural stones. The predominant burial rite was cremation and they primarily date *c.* 3300–2900 BC. Regionally, some simpler tombs occur in Carrowmore, County Sligo and date to the Early Neolithic.

Portal tomb (dolmen) A single, short chamber formed by two tall portal-stones, two sidestones and a backstone. The chamber is typically covered by a large roofstone which slopes down from front to back. These were used to inter cremated burials in the Neolithic *c.* 3800–3200 BC. ‘Dolmen’ is a traditional French term for any kind of megalithic tomb but is now obsolete although it is still sometimes used to describe the simpler form of megalithic tomb.

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Slieve na Calliagh

Robert Meehan

Lower Palaeozoic rocks in northwest Meath are restricted to the Slieve na Calliagh ridge and the area immediately north and northeast of the feature. The rocks commonly crop out on the ridge crest and are siltstones and greywackes for the most part. The area of subcrop around the ridge crest covers almost two square kilometres.

The greywacke on the summit of Slieve na Calliagh shows that ice movement over the ridge was northwest–southeast by the presence of roche moutonnées (*e.g.* NGR 25790 27710) and other streamlined bedrock knolls, up to 7 m high (*e.g.* NGR 25730 27702).

Figure 24 Slieve na Calliagh erratic

Large red sandstone boulders, up to 2 m across, are strewn across the top of the Slieve na Callaigh ridge. Many of the clasts which make up the Loughcrew Passage Tombs are of a similar sandstone. These blocks are erratics of sandstone which have been carried to this elevation by ice, from their original bedrock source in Forkill townland to the northwest of the ridge. This again proves that ice movement in the area was northwest–southeast (there is no sandstone like this cropping out on the south side of the ridge). Erratics of Lower Palaeozoic greywacke rocks occur in some of the field in Phillipstown Townland, south of the Slieve na Calliagh ridge; these are not seen north of the feature.

South of Slieve na Calliagh well-defined ‘minor’ ribbed moraines occur. These features were formed transverse to ice flow and are usually no more than 5–8 m high, 100–200 m

wide and 500–750 m long. These features are therefore much smaller than the ‘major’ ribbed moraines further north in Cavan and Monaghan, which are usually 30–40 m high, 800–1200 m wide and 8–16 km long. The size of the features seems to be related to the fact that they occur on limestone bedrock, whereas the larger features further north are on shale, siltstone, sandstone and greywacke bedrock. Such rocks are poor aquifers with little fracture space within; this means that the subglacial meltwater released by friction during ice advance cannot escape as readily through these rocks as through well fractured limestone, such as occurs in the area south of Slieve na Calliagh. This in turn means that the ice is more ‘lubricated’ slowing to the north, whereas to the south of Slieve na Calliagh the ice is more ‘sticky’, and potentially relatively colder. This will mean more ‘freezing on’ of the ice, and potentially shorter and smaller features, whereas the more lubricated ice to the north slides more readily, and has the potential to mould sediment into larger forms.

Lough Bane

Robert Meehan

Lough Bane is situated within an area of high crags and well-streamlined tail features comprised of subglacial till sediment. These crag and tails characterise the landscape of westernmost County Meath and eastern County Westmeath, and extend from Slieve na Calliagh at the northeast to Mullingar in the southwest. The features therefore cover an area of 250 square kilometres, basically the 'Westmeath Lakeland' region. Drilling by the Geological Survey has shown that depths of up to 20 m of sediment occur immediately adjacent to bedrock outcrops.

Figure 25 Lough Bane

The crag and tails are up to 150 m high (Knockeyon, at Lough Derraghvarragh) and are usually 500–1000 m wide and up to 6 km long. At Lough Bane, the crags are 60–70 m high, with the tails 1–3 km long. The bedrock here is Derraghvarragh Chert, as it is in *c.* 60% of the crag and tail area. Chert is a hard material composed of microcrystalline quartz or opaline silica and usually occurs as nodules or beds in limestone.

Like Lough Lene, Lough Derravaragh, Lough Owel and many other smaller lakes in this area, Lough Bane was therefore gouged out of the broad ridges of limestone and chert by ice flowing southeastwards from the north midlands. These lakes are elongate and aligned northwest–southeast reflecting the flow of ice. In the area of Lough Bane the chert bands are several metres thick, resulting in high cliffs of really resistant material.

On its eastern side the lake is separated from the much smaller Lough Glass by a small gravel moraine feature, comprised of two small hummocks. This effectively 'dams' the lake

on its eastern flank. Try to imagine a large glacier filling the valley and depositing the moraine separating the two lakes.

Lough Bane is spring-fed (Quinlan, 2010) and there are no surface water inflows of over 10 l/s. There is one surface outflow at the southeastern end where the lake drains into the River Deel. This sometimes goes dry during extended dry periods of weather. Canalisation of surface channels in the general area has meant a reduction in the level of the lake, so that the current shoreline is up to 200 m away from that shown on the original six-inch maps.

Karst landforms occur in the general area of the Westmeath lakelands: swallow holes, dolines, turloughs, springs and karren. Of these, only karren is seen around Lough Bane. A swallow hole was shown at the southern shore of Lough Bane on the six inch map, but no evidence of this can now be seen. It is likely that as the lake level and extent has fallen, the swallow hole may have been filled in.

It has been suggested that the crags of the Westmeath Lakeland area were tower karst features prior to glaciation (Drew, 2002). Given the topography and hydrogeology of the area, there seems to be some merit in this argument.

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McGrath's Pit

Robert Meehan

McGrath's Pit is situated in Milltown Townland, 2 km east of the extensive 'Flood's' Gravel Pits at Murrens. This pit has been cut into a high, plateau-like hill which has a relatively steep western slope but a low gradient slope on the northeast side. A long, sinuous, steep sided ridge, 5 m high, feeds into the western slope and the landscape on this western and southwestern side is heavily kettled. The eastern slope is much more gradual and smooth, grading down into an area of sands and silts (with a small area of peat) on its northern side. This pit is currently operational and offers excellent exposure on each side, but only the eastern and southern faces were logged and sketched in detail in 1996. Structures of importance elsewhere in the pit were noted and incorporated into the following description.

Figure 26 McGrath's Pit

The pit is dominated by alternate layers of fine pebbles and sands, but a facies of cobble-gravels occurs both in the north and south faces in the pit (Figure 26).

The pit faces are up to 15 m high. A number of sand bed measurements and fabric analyses were carried out on sediments within the pit, as shown in Tables 2 and 3.

South Face

The south face trends 150°–330° and is between 15 m and 7 m in height. This face is cut into the southern end of the highest part of the feature and is dominated by

Sample Number	Bed type	Direction of dip (true)	Angle of dip
1	Medium sand, Sp	018°	31°
2	Coarse sand, Sp	019°	25°
3	Medium sand, Sp	070°	30°
4	Fine sand, Ss	041°	10°
5	Fine sand, Ss	062°	9°
6	Fine sand, Ss	038°	8°
7	Fine sand, Ss	043°	9°
8	Fine sand, Ss	043°	6°
9	Fine sand, Ss	055°	12°
10	Fine sand, Ss	060°	16°
11	Coarse sand, Sp	128°	11°

Table 2. Orientation and dip of sand beds from McGrath's Pit (*South Face).*

well sorted, planar crossbedded pebble-gravels and sands which dip at 6°–31°, to the northeast generally (see Table 3). The sand beds are often parallel laminated or trough crossbedded and the entire sequence seems to represent large scale foresets. Topsets are absent from the sequence but the uppermost beds are shallow-dipping (3°–4°) (Plate 4.22). The gravels are generally clast dominated but matrix supported. Cut and fill structures are very common and rip-up clasts are often present at sand/pebble-gravel boundaries. Within the finer sediments, some silt and clay lenses show soft sediment deformations (flames, convoluted laminations, load casts). Towards the western end of the face, the crossbedded sediments grade into massive, clast dominated, pebble and fine cobble-gravels in a coarse sand matrix, with the maximum clasts having b-axes of 0.3 m. These massive gravels have crude horizontal bedding close to the crossbedded sands and gravels, the latter draping the former in this area.

Midway through the section the crossbedded pebble sands and gravels overlie and drape a dome-shaped unit of massive cobbles and boulder-gravels in a silt/sand matrix (Figure 29).

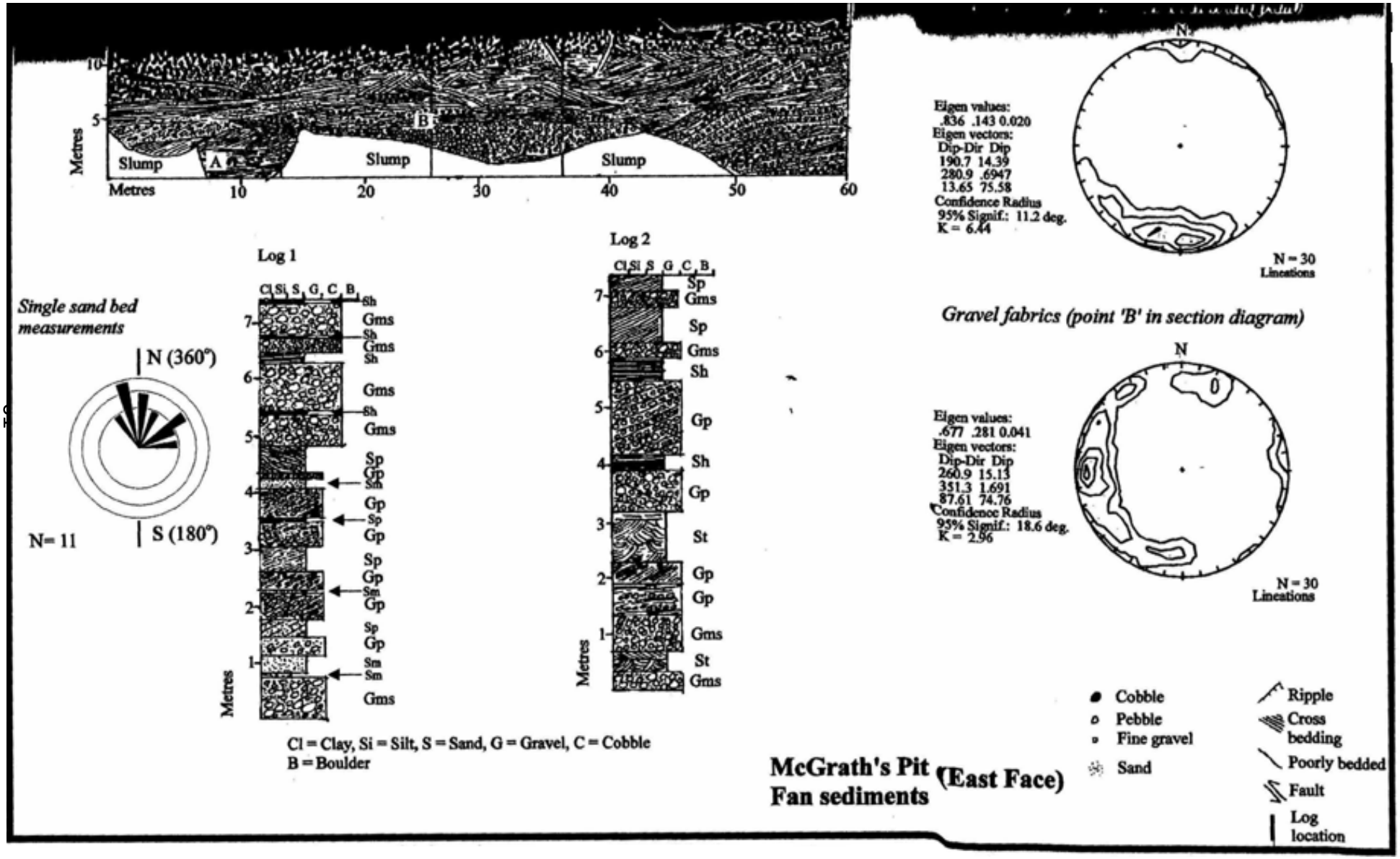

Figure 27 Cross section, bed measurements, fabric analyses and section logs of fan measurements exposed in McGrath's Pit (East Face)

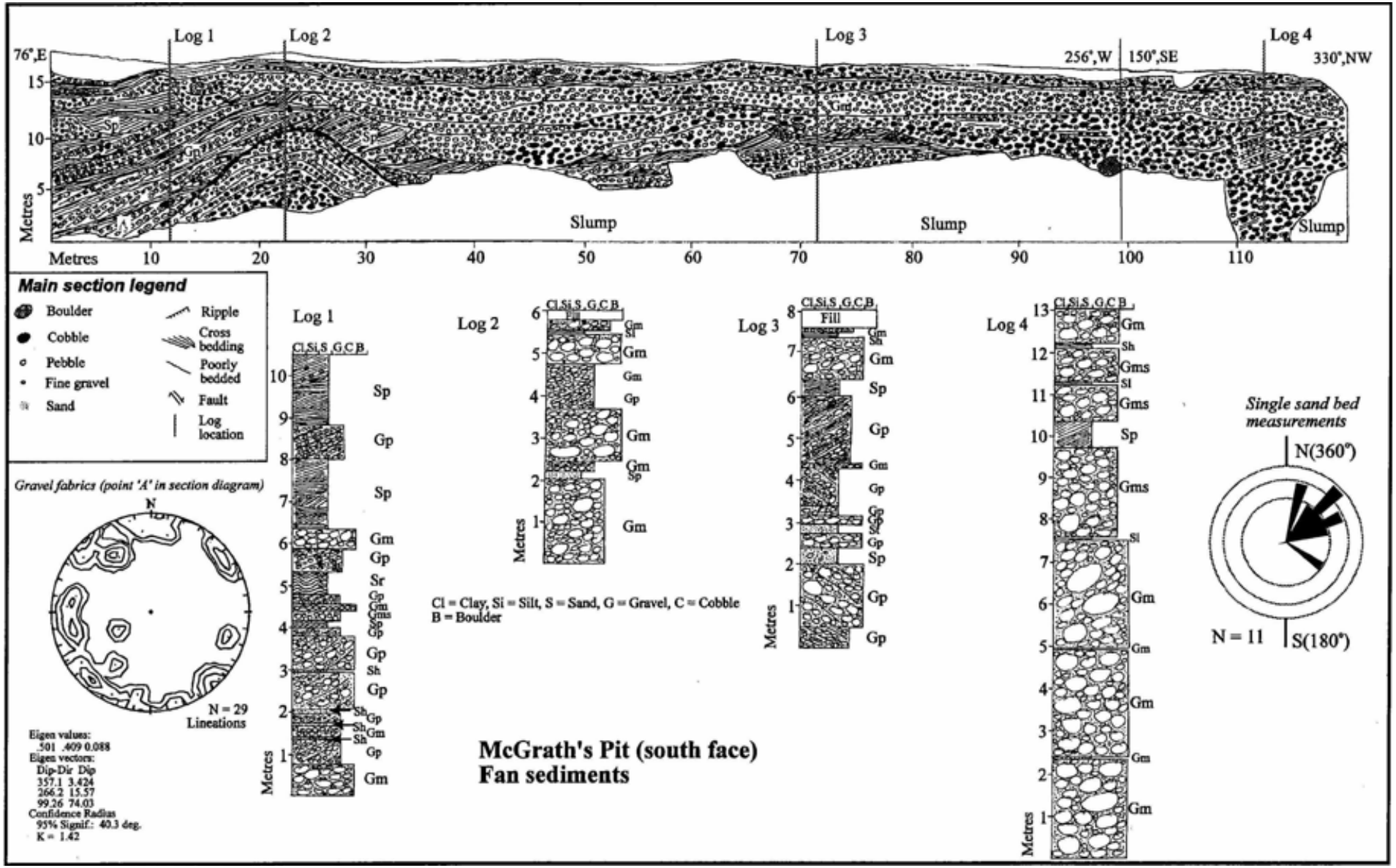

Figure 28 Cross section, bed measurements, fabric analyses and section logs of fan measurements exposed in McGrath's Pit (South Face)

Figure 29 Core of boulder and cobble gravels in McGrath's Pit (*south face).*

Clast fabrics taken from an imbricated pebble gravel unit indicate a direction of dip of maximum clustering (represented by the first eigenvector) dipping to the north (357°) at 3°.

Site location	**Direction of dip (true)**	**Angle of dip**	**Sediment type**
McGrath's Pit (east face)	191°	14°	Gravels
McGrath's Pit (east face)	261°	15°	Gravels
McGrath's Pit (south face)	357°	3°	Gravels

Table 3 Summarised results of fabric analyses carried out on sediments in McGrath's Pit.

East Face

The eastern face is dominated by finer sediments; sands and pebble to fine (pea-size) gravels dominate. The sediments are very well sorted and dominated by trough crossbedded units. Cut and fill structures are common. The sand units are internally planar or trough crossbedded. Some small scale collapse structures are present and avalanche bedding is commonly associated with the cut and fill structures. The beds dip at between 6° and 26°, generally towards the north and northeast (see Table 4). Gravel fabrics suggest flows from the south (191°) and west (261°) for 2 gravel beds measured (both dipping at 16°). The beds are part of a foreset sequence which dips into the face towards the flat area to the northeast and north.

Sample Number	Bed type	Direction of dip (true)	Angle of dip
1	Fine sand, Sl	340°	6°
2	Fine sand, Sl	327°	12°
3	Medium sand, Sp	058°	15°
4	Medium sand, Sp	052°	16°
5	Medium sand, Sp	080°	19°
6	Fine sand, Ss	009°	26°
7	Fine sand, Ss	066°	3°
8	Medium sand, Sp	348°	11°
9	Coarse sand, Sp	348°	14°
10	Medium sand, Sp	028°	6°

Table 4 Orientation and dip of sand beds from McGrath's Pit (*east face).*

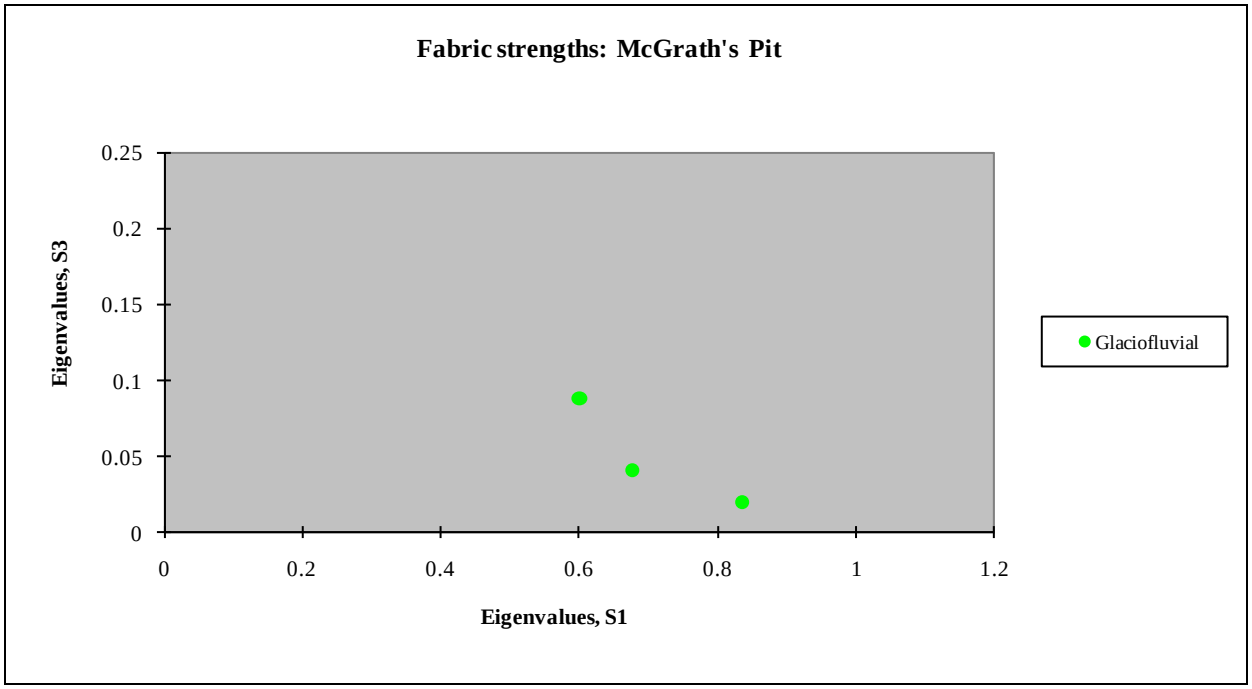

Figure 30 Fabric strengths of three samples taken from glaciofluvial sediments in McGrath's Pit. One sample has a very strong fabric strength represented by the high S_1 and low S_3; the other two samples have strong to moderately strong fabric strengths.

Further observations

In the northern face of the pit, a coarse cobble-gravel unit is present, consisting of a series of cobble and boulder beds. These gravels are mainly subrounded to subangular, although some quite angular clasts occur, and assume the characteristics of a gravelly diamicton in places. This coarse unit is overlain also by crossbedded pebble-gravels and sand which drape the underlying unit. Cut and fill structures are again common in these crossbeds.

A small, disused pit is located 50 m northeast of McGrath's Pit, at NGR 25525 27537. This is cut into the northern extreme of the gentle slope on the north side of the hillock that houses McGrath's Pit. North of here the landscape is gently undulates in 1 to 2 m swales down to the flat in the northern part of Milltown Townland. The faces in the pit are dominated by trough crossbedded and planar crossbedded sands interbedded with sand-supported, clast dominated pebble-gravels. These beds dip towards the flat area to the northeast, similar to those in McGrath's Pit. Silt and clay accounted for only 3.8% of Sample 93.2198 taken from these deposits. These gravels are often calcreted, especially where there is very little matrix. Petrographical analysis of Sample 93.2198 (GSI Reference Number), which was taken from a pebble-gravel bed in this pit, shows that limestone dominates at 89.5%. An erratic of granite from the Bellananagh area of County Cavan (28 km northwest of here) was found in the sample.

Interpretation of the pits around Drumone

Main esker ridge (*Pit at northeast of Murrens Townland and Main Floods Pit).*

The townland of Murrens, just west of McGrath's Pit, is dominated by coarse boulder gravels as exposed in several extensive gravel pits. The ridge to the northwest of this Murrens Gravel Complex, which is long, steep-sided and sinuous, and winds into the locality from County Westmeath, is flat-topped and straight crested, but grades into hummocky topography in Murrens Townland.

The entire hummocky gravel area can be taken as comprising a single morphological unit, as it comprises a fan-shaped area of boulder and cobble gravels, but the change in topography is interpreted to reflect a change in depositional environment. The winding ridge into is oriented northwest to southeast from Tonashammer Townland, County Westmeath to Murrens, then curves towards the east and then curves back northwest–southeast again at Murrens. The ridge itself is situated on relatively high ground on the drainage divide between the modern Boyne and Shannon Rivers (specifically, their tributaries of the Deel and Upper Inny respectively). The ridge is comprised of gravels which were deposited under a very high energy flow regime by glaciofluvial processes. The exposed sediments in pits in this ridge are composed of massive boulder gravels and do not reveal any sedimentary structures. The flow appears to have been northwest to southeast at this point, parallel with the ridge. Those sediments exposed in the same ridge in a second pit further southeast show large-scale crossbedded boulder units which are relatively shallow dipping, apparently from both west to east and east to west (which is parallel to the east–west orientation of the ridge in this pit). This section also exposes parallel-bedded, stacked units of fine gravels and sands.

The ridge is interpreted to be an ice channel fill feature deposited subaerially by glaciofluvial processes between separating ice lobes during deglaciation. The steep sides of the esker indicate deposition with lateral ice support (especially the western side). The channel into which the sediments were deposited is interpreted to have been walled by ice of a lobe to the north and by ice of a lobe to the west.

The steep ice contact faces on either side of the esker ridge (more strikingly the one to the west) suggests that the meltwater flow which deposited the coarse gravels in the Murrens Ridge was constrained laterally by the two ice lobes forcing drainage locally to move parallel to both ice margins. The channel is therefore interpreted to have acted as a conduit of sediment supply to the large lake which developed to the southeast (see below). Some of the sedimentary structures in the ridge in the second Murrens Pit, such as the extensive units of coarse gravel, the crossbeds dipping in opposite directions and the stacking of gravel units, suggest that the ridge began as a subglacial tunnel deposit (the combination of these structures would not be expected in open channel fills) which was laid down prior to the separation of the ice into the two lobes, and was thereafter covered with high energy regime fluvial sediments (see also Warren and Ashley, 1994). Structures such as these have been reported from subglacial tunnel-fill eskers elsewhere in Ireland (*e.g.* Ballyhaunis and Dunmore; Warren and Ashley, 1994) and suggest that the surrounding ice may have been active at the time of deposition of the ridge in order to maintain the geometry of the tunnel. The crossbeds are a product of bedform migration with, presumably, mainly traction transport (Brennand, 1992; Brennand and Shaw, 1996)

and the stacked, coarse units may record pulses within seasonal events (after Brennand and Sharpe, 1993).

Hummocks and hummocky quasi-linear/linear ridges* (*Flood's Pits in Murrens and pits in Ballintogher Townland)

The sediments in these pits are dominated by boulder and cobble gravels and crossbedded units of sands and pebble gravels. The size of clasts comprising the coarse gravels in the fan-shaped area generally decreases towards the southeast of the system (distal to the former ice margins) and the topography becomes more irregular, comprised more of hummocks than of linear or quasi-linear ridges. Throughout the area, the sediments are dominated by collapse faults and slump structures. Ice wedge casts and cryoturbations exposed in some parts of the pits imply periglacial conditions following deposition.

The sediments themselves are very coarse and the large-scale crossbedded units are indicative of very high flow regimes. Fan-type sediments in the more distal areas (nearer Dromone) suggest a lacustrine origin. There is no way of differentiating here between topsets, bottomsets and foresets but the inclined sand and fine gravel beds (which are especially common in the southeast of the feature in Floods southeastern pit) are interpreted as foreset beds. These inclined beds were formed by avalanche and clast flow over an inclined ice or underlying sediment surface. As the majority of the sediments are of the high energy flow regime (often in a small number of vertically stacked units), most of the coarse sediments are inferred as sheetflood and streamflood in origin. The foresets show a decreasing clast size distally from the apex of the fan-shaped area with cobbles more common in the southeast of the area, which is further to the southeast than the latter two pits. This suggests a continuity of sedimentation in the area of the coarse gravels (after Brennand and Sharpe, 1993). There is no distinct fining upwards in the sediments, so there is no evidence of a general decline in flow power with time. The faults and slump structures common in the sediments (as well as the deep kettle holes at the surface) are a result of the melting out of buried ice masses. The facies patterns within the pits are very irregular and it is difficult to predict the exact geometry of the units suggesting that the depositional environment was highly unstable. The predominance of faults and slump structures supports this view.

Similar sediments to those present at Murrens have been described from the Lanark area of Ontario, Canada, by Gorrell and Shaw (1991). The system at Lanark has a similar morphology to the Murrens area, comprising an esker, a suite of 'beads' radiating out from the esker and a series of fans which lie at the distal ends of the beads, several kilometres from the esker ridge. Sedimentologically, the system is also similar with coarse boulder gravels dominating the esker and finer sediments comprising the beads and fans. In the Canadian system, however, the esker is not as large (8 m high), and the 'bead' sediments generally fine upwards and form distinct, crested, distributary landforms to the esker. The 'fans' are found flanking the esker (these are absent at Murrens), accumulated at sites lateral to the principal esker-forming flow (also absent at Murrens) and distally to the esker. The most complex sedimentary sequences at Lanark were preserved in these fans, with active fans seen to overlap inactive ones in all areas. The gravels at Lanark were interpreted to have been deposited into a subglacial lake (close to and at the ice margin)

with ice beyond the grounding line decoupled from the bed. Subglacial rather than supraglacial deposition is advocated for the fans and beads due to the limited development of collapse structures in their sediment, their lateral position relative to the main tunnel and thrust faulting in their upper parts. The main and minor tunnels at Lanark (in which the 'beads' were deposited) were filled with water, with the exception of a narrow 'seal' where, at low flow, the minor tunnels became cut-off from the main conduit (Gorrell and Shaw, 1991). The shear structures in both bead and fan sediment indicate that the ice sheared the top of these landforms. These sediments therefore differ markedly to those at Murrens and the preponderance of collapse structures at Murrens, as well as the absence of fans lateral to the esker and evidence for thrust faulting within the sediments, suggests a supraglacial origin for the Murrens gravels.

From this the sediments comprising this hummocky gravel area are interpreted to be a supraglacial delta complex, deposited into a lake (Glacial Lake Murrens) which ponded on stagnating ice. The sediments are very coarse and probably intercalate both laterally and vertically with supraglacial stream deposits (it is very difficult generally to draw a clear boundary between glaciofluvial and glaciodeltaic deposits). The fact that the delta accumulated close to an open channel (associated with the esker ridge) supports the interpretation that the sediments are dominated by streamflood and sheetflood. The stagnating ice associated with the gravels resulted from the separation of the two ice lobes mentioned above. The northern lobe is interpreted to have had an (active) ice margin running along a line between Slieve na Calliagh and Loughs Naneagh, with the western ice lobe's margin running from Lough Dan (immediately west of Loughs Naneagh) and Ben Loughs. The area between these margins and the high ground to the east (specifically the Loughcrew Ridges, Slieve Gullion and the ridges around Lough Bane) contained the supraglacial lake, which lay on stagnant ice and dead ice blocks. The lake is interpreted to have been highly unstable owing to the irregular geometry of many of the sedimentary units (due to the ice beneath melting). The sediment was deposited into this lake from both ice lobes, but was specifically channelled subaerially along the Murrens Esker Ridge and a number of main subaerial channels radiating out from this. The fine sediments around the edges of the complex are interpreted as distal bottomsets or distal lake bottom sediments comprised of sands, silts and clays.

The lake is interpreted to have drained into the broad plain to the southeast of the high crags around Lough Bane *via* the meltwater channels at Cross Keys and Seafin Hill (the latter of which is part rock-cut). Both these channels are, however, below the inferred level of lake water (which is interpreted to have been between 130 m ASL and 150 m ASL, these being the lowest elevation of distal lake sediments in the area and the highest elevation of the Murrens Gravels respectively) by several metres. It is suggested, therefore, that the channels were allowing water to flow out of the lake during the entire history of the ponded feature. This would allow the rate of sediment supply to be maintained without a 'bursting' of the lake which would have formed a spectacular meltwater channel, possibly draining the lake in one event (the Cross Keys and Seafin Channels are by no means spectacular). Thus, the lake was in essence a 'river-lake' with meltwater constantly flowing in and out of the ponded area. By the time that the northern ice lobe had vacated the area between Loughs Naneagh and Slieve na Calliagh most of the lake water had drained through these channels and the majority of the area of the lake

had been infilled by supraglacial sediment. On the northern flanks of the system isolated kame features, often containing diamicton units, are common (*e.g*. the kame at NGR 25025 27673). These are interpreted as isolated supraglacial cavity infills. Small ponded areas remained around the margins of the complex following the draining of the main lake and the recession of ice away from Murrens (*e.g.* in the area around Loughs Naneagh).

The deposits at **McGrath's Pit** form a broad, almost flat-topped hill in a topographically complex area on the eastern margin of the Murrens Delta Complex. Low-angle, almost horizontal, planar bedding exposed at the top of the sedimentary sequence which overlies crossbedded units of pebble gravels and sands are interpreted as low-angle foresets, with steeper dipping foresets comprising the sediments beneath. Flow directions were to the east and northeast. These sediments were deposited as a subaqueous fan in an ice proximal lake environment of ponded and relatively still water. The fan may have been deposited within a few years, as only a small number of clay drapes were noted in the sedimentary sequence (after Smith and Ashley, 1985). Similar deposits in the area (the pits at Drumone and Greenan) are also composed of relatively fine sediments which suggest that a single body of water (or several smaller water bodies) characterised the area at the time of deposition. The water body into which the sediments at McGrath's Pit were deposited would have been smaller in extent than Glacial Lake Murrens (the pond was an earlier feature, with ice standing to the south and west of the fan) but as the ice withdrew the lake grew. It is envisaged that the channel at Cross Keys was blocked by ice at the time of deposition of the sediments at McGrath's Pit: were this not so then a sandur would have developed in the area. Furthermore, the absence of faults in the sediments at McGrath's Pit suggests that the deposits are not supraglacial in origin, but formed subaqueously at the ice margin. If faults were present then the deposits could be regarded as bottomsets of the supraglacial delta, as they occur distal to but on the flanks of the esker and quasi-linear ridges which comprise the delta. Faults are present at the westerly pit at Drumone: which suggests a supraglacial origin for the fan-type sediments at this location. Only to the west of McGrath's pit, therefore, are faults present in the waterlain sediments. The ice in the area therefore began to stagnate, resulting in the buried ice blocks, in the kettled area immediately west of McGrath's Pit.

The coarse cobble and boulder gravels underlying the finer sediments in McGrath's Pit are interpreted to be subglacial tunnel-fill sediments that accumulated in the area while the ice margin lay some distance to the south and east. They bear no relation to the overlying, finer foreset beds. McGrath's Pit is on the same interpreted line of suture (from the orientation of the ridge and the inferred pattern of separation of the two ice lobes) as the Murrens Esker Ridge so it is probable that the subglacial conduit associated with this ridge was active throughout deglaciation, initiated several kilometres upglacier from the ice margin (after Punkari, 1995) before the separation of the lobes associated with the Murrens Delta Complex. The coarse sediments in McGrath's Pit were probably deposited in this conduit and then overlain by the finer sediments when the ice margin retreated as far as this area.

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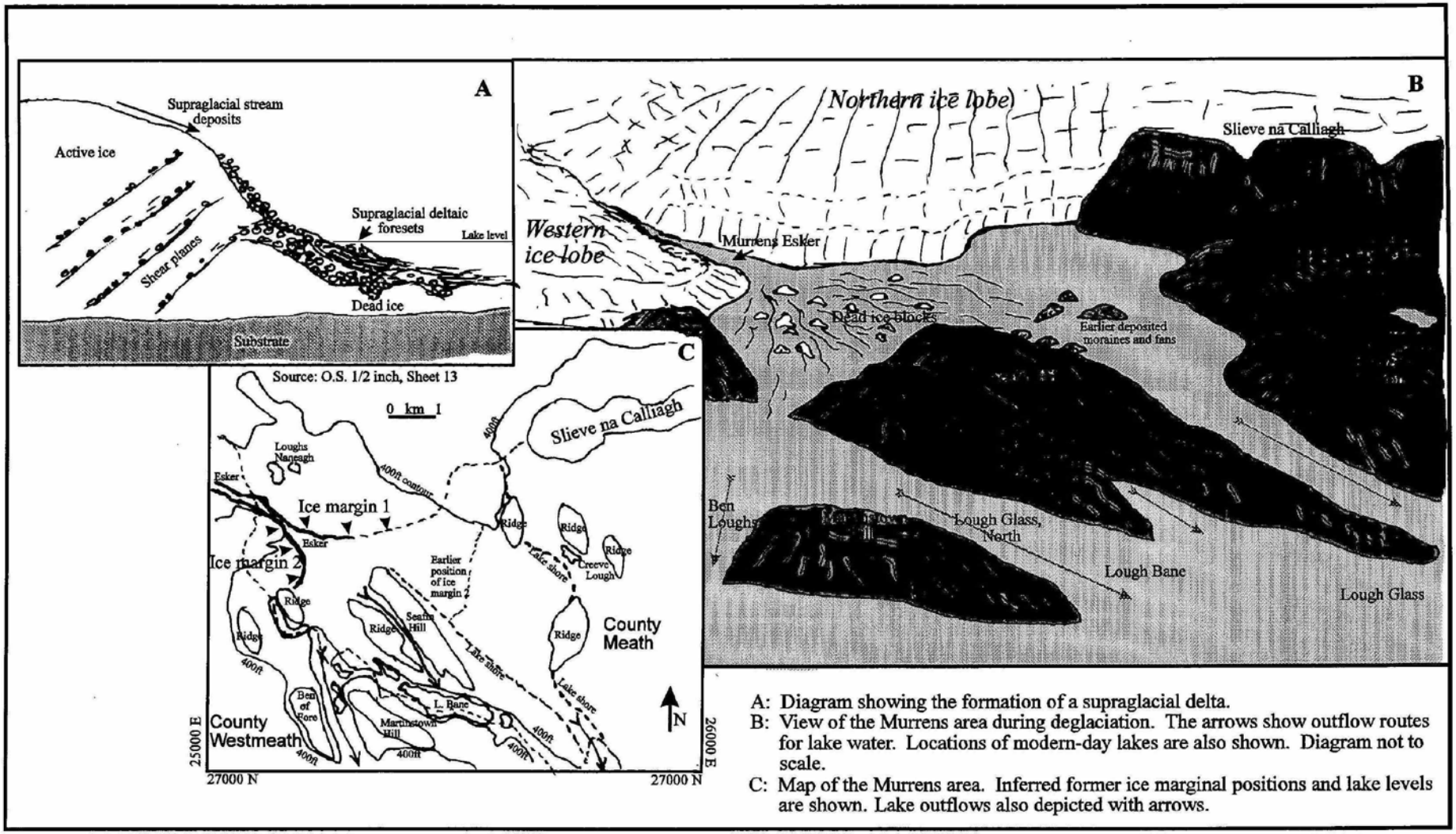


Figure 31 Various aspects of the formation of the Murrens Esker and of the associated supra glacial deltaic gravels.

Comparison and correlation of the archaeology and palaeoecology of Moynagh Lough, County Meath.

Rosemary Stewart

This project was submitted as an M.Sc. by research to Trinity College Dublin in January 1996.

The site

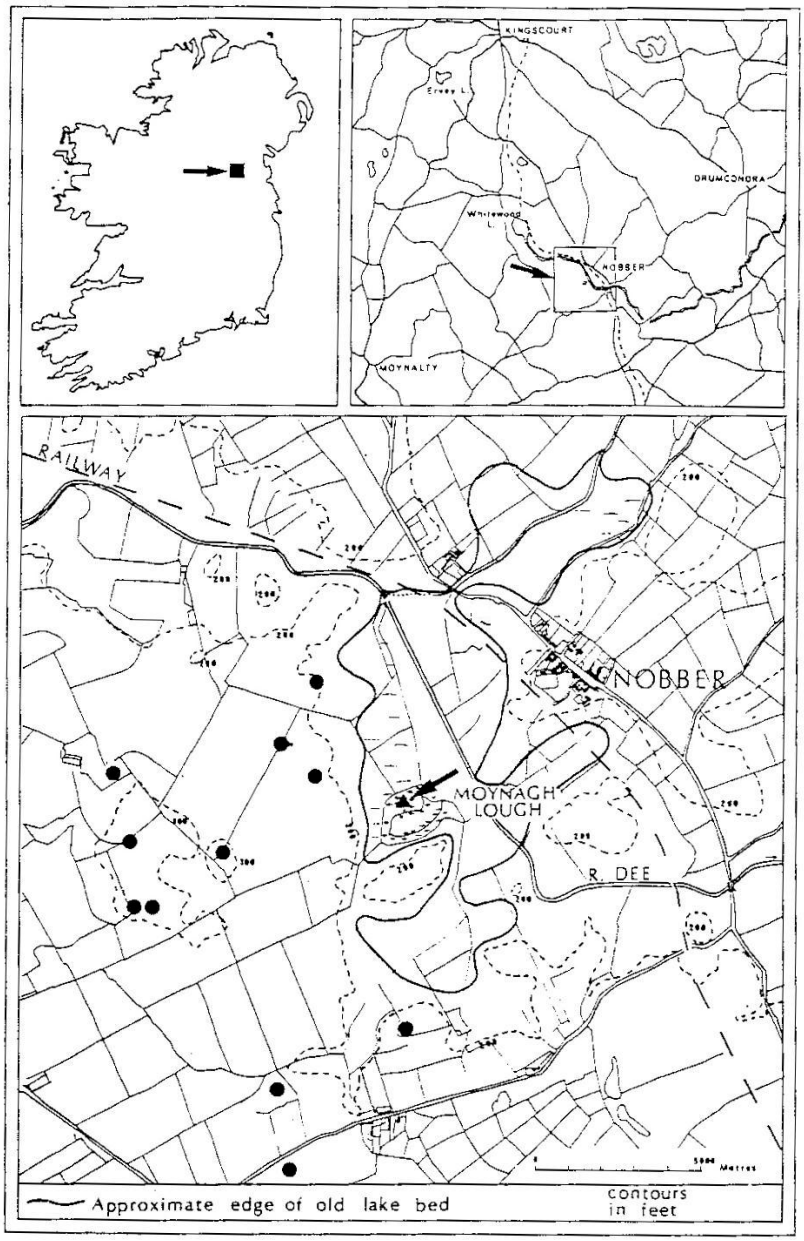


Figure 32 Moynagh Lough Grid reference: N820859 or 53°49'0" N 6°45'21" W black dots indicate raths from Bradley (*1991)*

Moynagh Lough is a small, deep lake, which was probably a kettlehole in early post-glacial times. The surviving lough is about 200 m long and 60 m across, and is situated towards the southern edge of an old lakebed that would originally have formed an expanse of the River Dee. Much of the old lakebed is still marked by fen. The word 'Moynagh' means 'boggy' (O'Drisceoil and Fennelly, pers. comm.)

Figure 33 View of Moynagh Lough site facing north

Discovery of the site

In 1886 a farmer, Owen Smith, discovered the archaeological site at Moynagh Lough. He found a mixture of objects including tools and a fragment of jet bracelet, which he sent to Colonel Wood-Martin. Wood-Martin was awarded a grant by the Royal Irish Academy to explore the newly discovered crannóg. A large hearth was uncovered, together with a range of objects of bone, iron and flint.

During land reclamation in 1977, when high ground forming the crannóg was being bulldozed into the surrounding fen, large quantities of animal bones were uncovered by the landowner, Frank Brady, who immediately stopped the work and informed Professor Eogan of University College, Dublin. Together with John Bradley, Professor Eogan conducted a five-week excavation in 1980. Excavations continued under the direction of John Bradley.

Palynological investigation

Moynagh Lough is undisturbed and deep allowing thirteen metres of soft sediment to be collected. At the base of the core were late-glacial clays. The core site was chosen at a distance of approximately 100 m from the crannóg excavations, far away enough to avoid any anthropogenic sediment disturbance but as close as possible to record contemporary vegetation.

Core ML1 was collected in November 1993 and ML2 in August 1995. The pollen record was taken from ML1.Four radiocarbon dates were obtained for Moynagh Lough; however, the two oldest dates, taken towards the base of the core, are too old. This may be due to the inwash of 'old' carbon from the Carboniferous limestone catchment (Edwards, 1982).

The date obtained from sample RC2 appears to be correct, as the archaeological and palynological chronologies support this. However, it does occur in the 'radiocarbon plateau' between *c.* 2800 and 2300 BP (Pearson et al., 1986). Because of the problems encountered with the radiocarbon dating, an age/depth curve was constructed using dates interpolated from the pollen evidence and the two radiocarbon dates from the upper part of the diagram that appear to be accurate.

Figure 34 Coring site and view towards north-east across the site

Archaeology and palaeoecology of Moynagh Lough

The Mesolithic Period

Pollen Zone ML1i-b Clearing made in local woodland, clay deposited on knolls – seasonal camps established

Pollen Zone ML1i-c *Alnus* rise and climax woodland established

Pollen Zone ML1ii-a Climax woodland and time of Late Mesolithic activity – flint knapping and hunting, with little vegetation disturbance.

The Early Mesolithic

At the base of the core ML1 sterile, grey/white glacial clay is unconformably overlain by lake sediment. The earliest post glacial period of open grassland and the *Corylus* rise are not represented in the palynological record. The lowest lake sediments were deposited when *Corylus* and *Betula* woodland had been established and *Quercus* and *Ulmus* pollen levels were rising, at an extrapolated date of about 8000 BP. Shortly after the expansion of *Quercus* and *Ulmus* pollen, another layer of glacial clay occurs on top of lake sediment, clearly out of sedimentological sequence. Immediately before, across and just after this clay layer arboreal pollen falls, and there is a rise in non-arboreal pollen including species considered as anthropogenic indicators. There is also charcoal present in very low quantities, which may be the result of domestic fires used by the Mesolithic people visiting

the site. On its own the evidence presented may not necessarily indicate human disturbance, but there is archaeological evidence, which corresponds to this layer of clay.

In the Mesolithic period, two knolls protruding above the lake surface were amalgamated by brashing with clay, pebbles and brushwood. A layer up to 20 cm deep of redeposited white lacustrine mud (Bradley, 1991) was found at the lowest levels of the archaeological excavation. It is likely that this is the same clay recorded in the pollen core.

In association with the palynological evidence, it is possible that the clay was placed on the knolls in earlier Mesolithic times. Bradley speculates that the purpose of this was to strengthen the knoll surface (pers. comm.). Archaeological excavations did not penetrate this level of clay but the palynological evidence indicates that possibly before 7000 BP humans cleared woodland, perhaps to facilitate hunting. This is an indication that Early Mesolithic, seasonal camps could have existed at Moynagh Lough. The anthropogenic indicators recorded at this level include *Urtica* and Chenopodiaceae, which are often found in association with human habitation. Bradley (1991) postulates that there may have been an Early Mesolithic presence along the River Dee and that Moynagh Lough was situated in an area of primary colonisation in Early Mesolithic times.

The Late Mesolithic

At Moynagh Lough elements of secondary woodland persisted after the initial disturbance, as indicated by the presence of Poaceae, Ranunculaceae, Caryophyllaceae and *Filipendula* pollen.

On top of the clay was an occupation layer containing Late Mesolithic stone artefacts. A radiocarbon date of 5270 ± 60 BP was obtained (Bradley, 1991). Brushwood strewn on this layer included twigs of *Corylus* and *Rubus fruticosus* and macrofossils of plants such as *Ranunculus* and *Carex* were recorded (Bradley, 1991). The presence of these plants indicates that secondary woodland was in existence around Moynagh Lough in Late Mesolithic times. Bradley (1991) suggests that this was possibly a base for hunting and flint knapping activities rather than a long-term habitation site.

This occupation at Moynagh Lough took place well within the overlap of the Mesolithic and Neolithic cultures. The Mesolithic level was sealed by a layer of brown lake sediment.

The Neolithic Period

Pollen Zone ML1ii-b First Elm decline and the development of pastoral farming, followed by a period of woodland regeneration.

Pollen Zone ML1ii-c Second Elm decline and a period of mixed farming.

The Early Neolithic

There is little archaeological evidence of Neolithic activity at Moynagh Lough. It would seem that rising lake levels had covered the knolls as the climate became wetter. Human presence is indicated by casual finds of Neolithic stone implements (Bradley, 1991). In the pollen record there is no evidence of farming before the first Elm decline at Moynagh Lough: all the first anthropogenic indicators recorded in the Neolithic level occur at exactly

the same horizon as the Elm decline. The Elm decline appears to have been rapid. With the establishment of farming there is a darkening of the sediment that becomes more intense across the Neolithic as charcoal levels rise.

After the first Elm decline there seems to have been a period of pastoral activity. The pollen evidence suggests that small fields existed in clearings in the woodland and that there was either some human habitation or the folding of animals, which supplied nutrient enrichment enabling the growth of *Sambucus nigra*. This period of farming activity lasted for probably less than one hundred years, after which the woodland regenerated over a period of about one hundred years, although never recovering to pre-Elm decline levels. This regeneration may represent the period in which the Neolithic 'standstill' occurred or the movement of the Neolithic settlers to fresh regions after a generation of land use near Moynagh Lough. However, charcoal levels remain high from the first Elm decline into the Bronze Age.

The Later Neolithic

The second Elm decline at about 4500 BP occurs in association with a slight drop in loss on ignition percentages indicating renewed human activity. Mixed farming seems to have taken place at this time together with further woodland clearance.

The Bronze Age

PAZ ML1iii-a The third Elm decline, further woodland clearance and mixed farming.

The Early Bronze Age

A third Elm decline occurred at Moynagh Lough at about 3700 BP, and farming activity greatly increased. Fabaceae pollen is first recorded at this level, indicating the cultivation of legumes. Woodland edge species became more prolific in the Bronze Age at Moynagh Lough. The landscape was dominated by extensive pasture and some arable fields. Some areas were still wooded but the pollen record shows that by the end of the Bronze Age almost half the woodland had been cleared from the surrounding countryside.

The site was used again for occupation in the Early Bronze Age. Archaeological evidence shows that the substrate was stabilised with stones and two habitation layers were found in association with a spread of artefacts. A radiocarbon date for this occupation layer of 3460 ± 35 BP was obtained (Bradley, 1991).

The Later Bronze Age

Bradley (1991) radiocarbon dated another Bronze Age occupation layer to 2650 ± 80 BP. The artefacts found at this level indicated that hunting took place together with habitation on the lake site. Fragments of exotic, imported amber and jet may indicate that wealthy people of high social status lived at the site.

Cereal cultivation is inferred by the discovery of at least a dozen quernstones. No cereal pollen was recorded in the palynological investigation at this level. Crops may have been brought some distance to Moynagh Lough for processing, which may explain the large number of querns but lack of cereal pollen.

A layer of lake mud 20 cm deep finally covered all the Bronze Age features and charcoal levels fell away, as the island site was no longer used.

The Iron Age

Pollen Zone ML1iii-b Farming continues but some scrub regeneration occurs and an increase in fallow land.

At about 2300 BP a period of scrub regeneration took place, lasting over three hundred years. Extensive farming continued but it appears that a proportion of land was left fallow and *Corylus* scrub extended into some areas. Charcoal levels were low at the beginning of this phase and then fell away completely as human activity diminished. Pastoral and arable farming was still an integral part of the landscape but it seems that marginal areas were left uncultivated, especially the wetter areas of damp meadows, where *Salix* might grow.

This Iron Age 'lull' occurs in many pollen diagrams in Ireland and Britain, beginning around 2300 BP and continuing for about 400 years, and frequently suggesting a general reduction but not absence of farming activities (Edwards, 1985). Farming continued across the Iron Age 'lull' around Moynagh Lough but at a lesser intensity.

There is no archaeological evidence of human activity at the Moynagh Lough site during the Iron Age. Evidence from other crannógs shows a similar pattern of desertion over the Iron Age.

The Early Christian Period

Pollen Zone ML1iv Intensive mixed farming including cereals.

Early in the first century AD there was an upsurge in human activity, resulting in an increase in charcoal to high levels, which persist across the period. Wet meadow and fen species increase in the Early Christian period, indicating increased waterlogging of the catchment area around Moynagh Lough.

At this level the pollen of plants that thrive in nutrient-enriched areas increased, indicating human habitation. Pasture and arable land appears to have surrounded Moynagh Lough, probably extending into areas unused even in the productive Bronze Age period. Cereals (including *Secale*) were grown, and the peak in *Artemisia* suggests more intensive cultivation of arable fields. Cereal production must have been increasingly important to the people living on the crannóg, as more than twenty quernstones were found there in the Early Christian layers (Bradley, pers. comm.). However, cereal pollen does not attain relatively high levels at Moynagh Lough until the medieval period. Early Irish literature suggests that cattle-rearing was an important activity in Early Christian times (Kinsella, 1969; Kelly 1997) and this seems to have been the case at Moynagh Lough. A majority of the faunal remains found at the crannóg site were cows' bones, implying that dairying was important. This corroborates the pollen evidence of widespread pasture.

Woodland was probably sparse in the vicinity of Moynagh Lough in Early Christian times but scrubby vegetation and hedgerows existed. Peat was redeposited on the crannóg and there is a rise in Ericaceae pollen across the levels associated with the Early Christian

habitation. Towards the end of the crannóg occupation there seems to have been a period of less intensive farming and a slight increase in scrub, as the crannóg was deserted. Just above the level where these changes take place a small peak of *Epilobium* may indicate that this plant was growing on the burnt remains of the crannóg. At the end of the Early Christian period, in early medieval times, the first *Cannabis* and *Linum* pollen are recorded.

There is an extensive archaeological record for the Early Christian period at Moynagh Lough when, sometime in the fourth century AD, the crannóg was built. This was a large, artificial island, up to 30 m across and enclosed by a palisade. The knolls would have provided shallow areas close to the deepest part of the lake. Four phases of habitation have been investigated. The dwelling on the crannóg would seem to be one of a prosperous family, making full use of the resources around Moynagh Lough (Bradley, 1991).

The earliest crannóg occupation level consisted of a large wattle house. Above this layer was evidence of another house and two metalwork areas. A furnace and numerous crucible sherds and moulds were uncovered. Quern stones were also manufactured on the site. The next habitation layer consisted of an oak palisade; two round houses and a metalworking area. The collection of clay mould fragments found at Moynagh Lough is the largest in Ireland (Bradley, 1994) and there is also evidence of jewellery-making, iron-working and glass-working. Brown (1994) obtained dendrochronological dates of AD 625 and AD 748 for two of the occupation levels on the crannog.

Artefacts found on the uppermost habitation layer of the crannóg indicate that it was in use until about AD 900 (Bradley, 1983). Crannóg use seems to have ended with the burning of the house. Bradley believes that it is likely to have been an accidental fire as there was prolific metalworking taking place on the crannóg.

The large number of raths in the immediate vicinity suggests that the area was densely settled. The names of these ringforts include, Lissanarwer, 'rath of the corn' and Lisnamuck, ‘rath of the pigs', (French, 1991) which attests to the agricultural nature of their use. Barry (1994) considers crannógs to be a variant of the ringfort and that the two types of habitation were linked to a similar economy.

Figure 35 The area of stones to the left of the photograph indicates the position of the Bronze Age habitation site

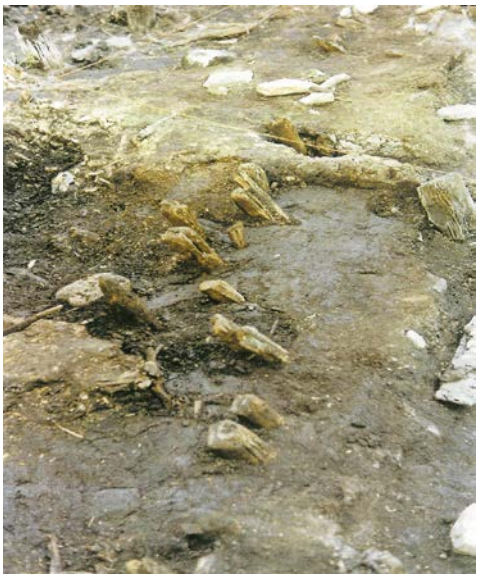


Figure 36 The remains of the Early Christian crannog palisade at Moynagh Lough

The Historical Period c. AD 900-1845

Pollen Zone ML1v. Some scrub regeneration followed by intensive arable farming and the removal of remaining woodland.

After the demise of the crannóg there was a short period of vegetation readjustment. Wetland species increased, probably around the edge of Moynagh Lough because there were fewer disturbances. There was some scrub invasion, which consisted mainly of *Crataegus* and *Prunus* and some fields were left fallow. This scrub regeneration lasted about fifty years.

Soon after this short period, arable cultivation increased greatly, with cereals, including *Secale*, being important crops. *Cannabis* and some *Linum* were retted in the area and herbaceous taxa levels decrease probably due to more efficient farming techniques. Over this period all woodland seems to have been removed and even the hedgerow species decline. The rise in intensive farming activity may be associated with the Anglo-Normans' interest in arable crops rather than the traditional Irish economy of primarily pasture. Although this zone spans changes in climate and times of famine and disease, the cultivation of crops continues with very little fluctuation.

The Brittas estate, in which Moynagh Lough lies, was initially passed down through the Anglo-Norman Cruise family. However, in Cromwell's time the Cruise family was dispossessed. The estate was passed to the Bligh family, who become the biggest landowner in County Meath (French, 1991). The local vegetation record at Moynagh Lough from this time reflects estate management rather than farming activity in the immediate vicinity.

Modern Day

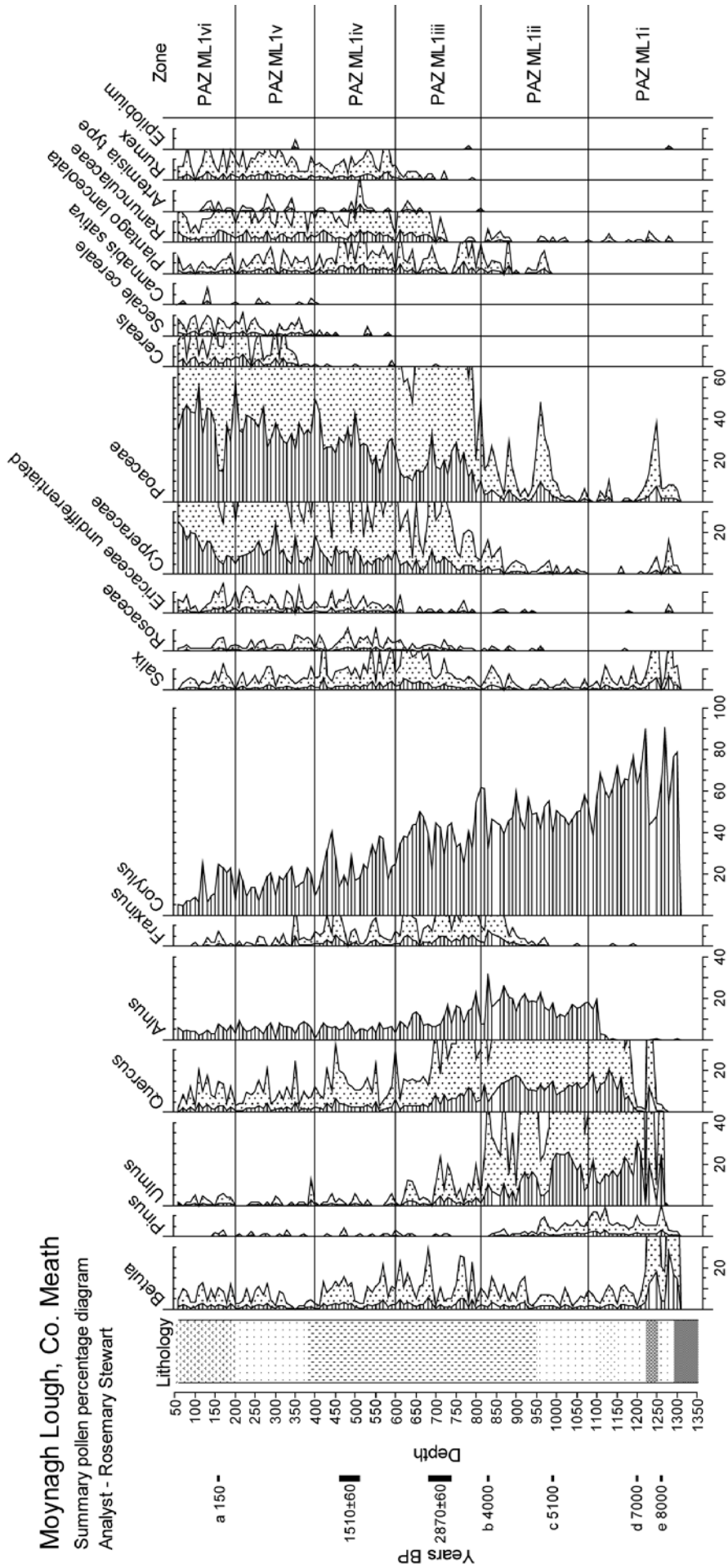
Pollen Zone ML1vi. Some scrub regeneration followed by less intensive farming. Lake drainage.

The Potato Famine of 1845–1851 brought to a halt the period of intensive arable farming accompanying the population expansion of the eighteenth and nineteenth centuries. The short period of scrub regeneration and fallow fields seen in the pollen record at Moynagh Lough probably marks this event. Shortly after, about 1850, the course of the River Dee was diverted away from Moynagh Lough and the lake was subsequently drained. Loss on ignition percentages fall to a very low level, probably as a result of sediment influx caused by disturbance as the river was diverted. This is followed by values that rise abruptly to their highest levels. Much of the lake became infilled with plant debris, reed swamp developed and sedimentation rates increased dramatically.

Over this period farming continued in the area, especially cereal production and pasture but the high pre-Famine levels were not reached again.

Although there is evidence of the planting of pine trees around Moynagh Lough in recent times, *Pinus* pollen was not recorded towards the top of the vegetation record. *Tilia vulgaris* trees were planted on the Brittas estate in the nineteenth century, but no modern *Tilia* pollen was recorded. Therefore it is thought that the upper one hundred years of sediment are missing from the core ML1.

Thomas Bligh, owner of the Brittas estate between 1695–1775, was a general in the British army. When he retired he planted lime trees at Brittas in the formation of his troops at the Battle of Cherbourg (French, 1991). These can still be seen from the site today.


Moynagh Lough, Co. Meath
Summary pollen percentage diagram
Analyst - Rosemary Stewart
Zone
PAZ ML1vi
PAZ ML1v
PAZ ML1iv
PAZ ML1iii
PAZ ML1ii
PAZ ML1i
Epilobium
Rumex
Artemisia type
Ranunculaceae
Plantago lanceolata
Cannabis sativa
Secale cereale
Cerealia
Poaceae
Cyperaceae
Ericaceae undifferentiated
Rosaceae
Salix
Corylus
Fraxinus
Alnus
Quercus
Ulmus
Pinus
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Lithology
Depth
Years BP
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1510±60
2870±60
b 4000
c 5100
d 7000
e 8000

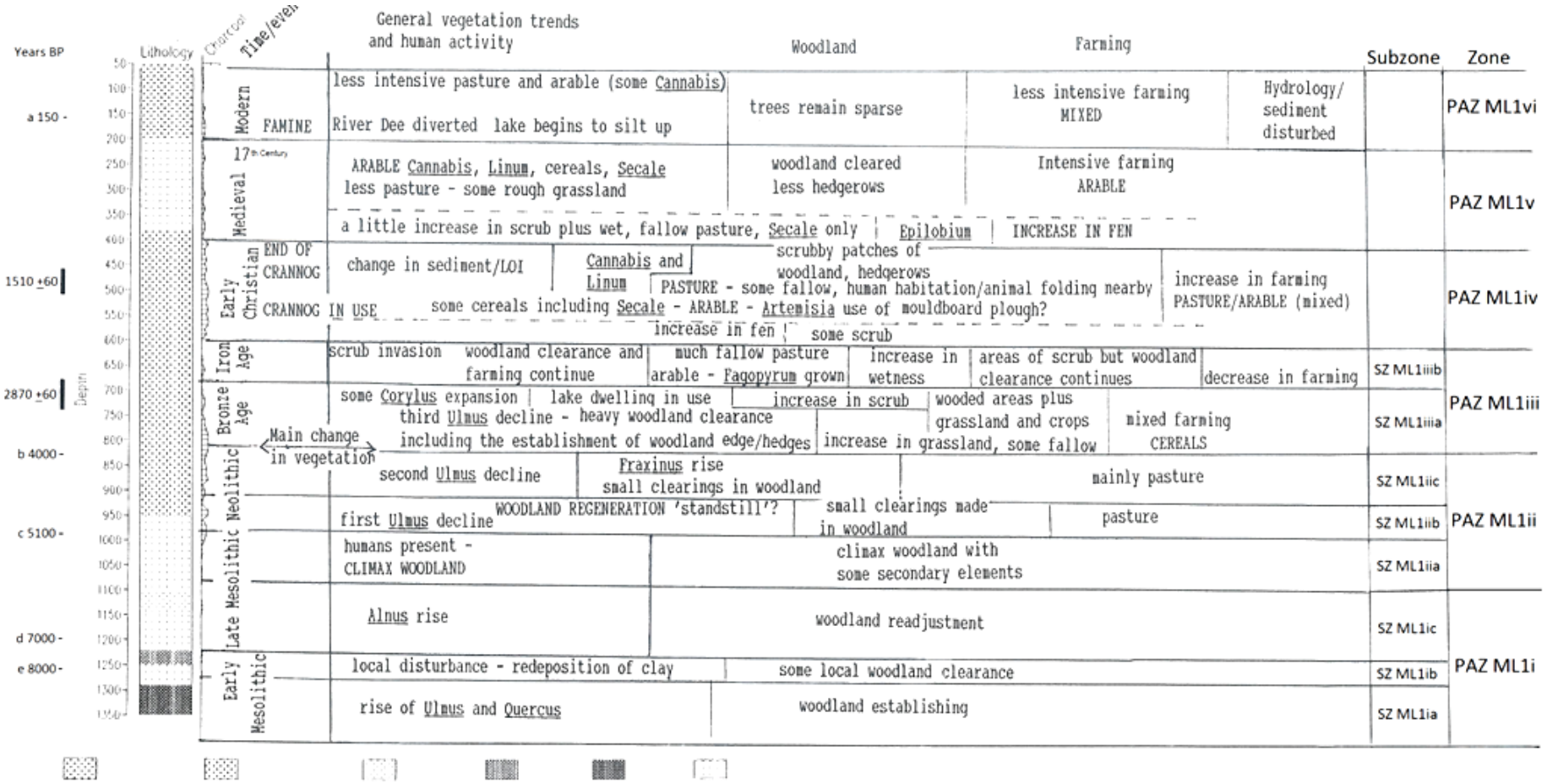

Figure 38 Diagramatic representation of the vegetation history and archaeology of Moynagh Lough

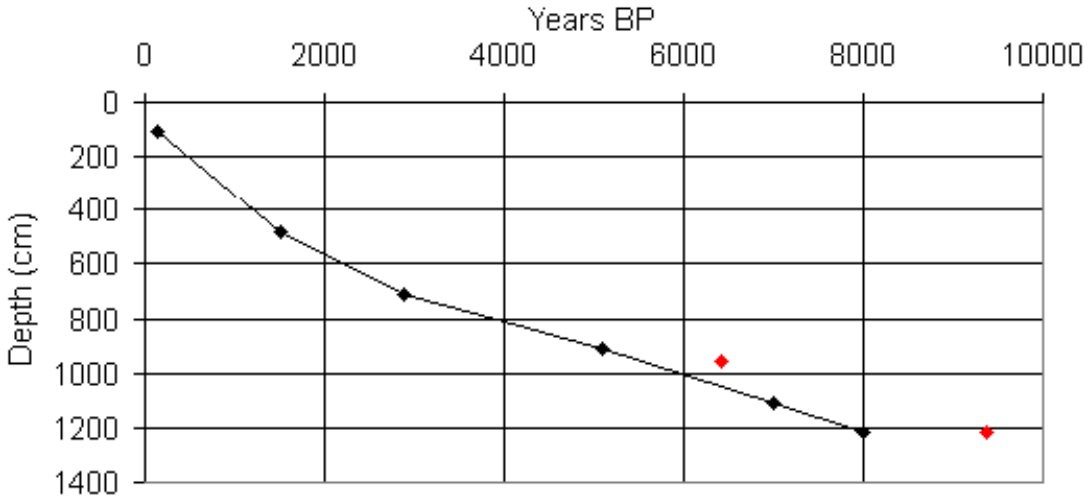

Figure 39 Age depth curve Moynagh Lough

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Medieval Settlement: the manor of Dowth

Mark Hennessy

Meath was one of the most intensively settled areas in the English colonisation of Ireland in the twelfth and thirteenth centuries, and there are many examples of medieval settlements from this period in the county preserved in both field and documentary evidence (Graham, 1975; Murphy, 2009). The manor of Dowth has extensive remains of medieval settlement (Stout, 2007), and is of particular interest for two main reasons. First, the survival of an *inquisition post mortem* for 1253 that gives us a glimpse of the internal organistion of the manor (TNA/PRO, C132/15, no.1, Dryburgh and Smith, 2007, No.15). An *inquisition post mortem* was an account of the holdings of a lord on his death carried out so that the crown could establish its interest in the estate: the detailed valuations of a lord's manors are known as manorial extents. The inquisition gave details of the demesne, or Lord's holdings, and also information about the value of tenants' holdings. The earliest known manorial extent for Ireland is for 1243 (Hennessy, 1996), so the extent for Dowth is one of the earliest Irish examples.

Dowth was held by Ralph de Picheford from Baldwin of Dowth. The 1253 extent reveals the importance of arable farming on the manor. The lord held 212 acres (approximately 530 statute acres) of arable and meadow valued at 12 pence an acre. This was a high valuation per acre for agricultural land and puts the Dowth demesne land in the highest category of arable land valuation in England in this period (Campbell, 2004, 351). The manor also contained two mills ("*duo molendini"*) valued at five marks (£3 6s 8d). This accounted for about 11% of the total value of the manor. This percentage exceeds the highest average for the proportional value of English manorial mills for a sample of English counties for the early fourteenth century (Ambler and Langdon, 1994, 21). The mills would have been used to grind the lord's demesne grain, but the tenants on the manor were also under a legal obligation to use and pay for the use of the lord's mills. The value of the arable and the significance of milling both show that an intensive cereal-producing agricultural system had been developed by the middle of the thirteenth century. This cereal-based economy was at least partly export oriented (Hennessy, 2004; Murphy, 2009).

This brings us to the second particular interest of the manor of Dowth as an example of medieval settlement in Ireland: the possible survival of the archaeological remains of medieval ploughing. Medieval open-field arable farming resulted in the generation of highly distinctive field remains (see Hall, 1982). Ploughing was carried out in long narrow strips (*selions*). When ploughing was carried out in a concentric pattern from the outside of the strip to its centre, over time soil was moved towards the centre of the strip. This resulted in creation of a pronounced ridge in the centre of the strip and furrows at the edges. The resultant field form is known as *ridge and furrow*. The turning of the plough at the end of an open field, or *furlong,* also resulted in the deposition of soil and the building up of a linear feature known as a *headland, headland ridge* or *furlong boundary*. When ploughing was not carried out in the same concentric pattern from year to year, furlong boundaries could be created without the development of ridge and furrow.

Despite the evidence of highly developed arable from manorial extents in the thirteenth century, very little *ridge and furrow* of medieval origin has been identified in Ireland, although there is clear evidence of flat ploughing and headland ridges at Oughterard and Castlewarden in County Kildare, (Hall et al., 1985). This makes the survival of cultivation ridges that appear to predate the modern field boundaries at Dowth (where we know there was extensive arable) of particular interest (Stout, 2003, 97). The cultivation ridges are found mostly to the west and north of the medieval church. They do not conform to the standard dimensions of classic English *ridge and furrow*: they are *c.* 2.5 m wide and between 0.3 and 0.5 m in height, but still could be of medieval date.

Figure 40 Church and Tower House at Dowth

A complicating factor on the manor of Dowth, also found on many Irish manors, is the presence of a significant Gaelic Irish element in the manorial population. Three of the nine Free Tenants on the manor were of Gaelic Irish origin: Gillegmudi Mac Regan, Gillecrist Mac Regan and Gillecrist Olnuthy. There was also a group of tenants called *Coterelli*

whose land and labour services were worth about 22% of the total value of the manor (£6 15s 6d) and were therefore a significant element of the manorial population. We are not given their names but it is very possible that a proportion of these *Coterelli* were of Gaelic Irish origin. It is possible that the persistence of a significant Gaelic Irish population following English colonisation resulted in the emergence of local ploughing practices that created distinctive field remains of medieval ploughing. We should not necessarily expect to find classic English forms in this colonial context.

Figure 41 Church and Tower House at Dowth with cultivation ridges in foreground

In the present-day landscape, Dowth contains other standard elements of a deserted manorial settlement in Ireland: a medieval parish church and a late medieval tower house (Stout, 2003, 98–100; Stout, 2007). The standing remains of the church are probably of late-fourteenth/fifteenth century date but the site was a church site from before the English colonisation. Parishes were often carved out in the late twelfth and thirteenth century along the territorial boundaries of the colonial manors: pre-colonial church sites were reconfigured as parish churches (Hennessy, 1985). The institutions of the manor and the parish strengthened each other and forged a strong territorial identification within the parish/manor community in the emerging colonial landscape.

The Tower House at Dowth is three-storey rectangular building. It was heavily remodelled in the nineteenth century. It is also possible that a motte castle was constructed at Dowth using the prehistoric passage tomb as a site, but no conclusive archaeological evidence remains.

The medieval settlement at Dowth is an example of a twelfth/thirteenth century *manorial centre* (Simms, 1988; Hennessy, 2004). Although manorial centres in Ireland did not usually become large nucleated settlements along the lines of English medieval villages, they were complex settlements with a number of distinct components, most of which can be identified at Dowth. First, a *fortification*, or the remains of a fortification. At Dowth the likelihood is that a motte castle was built on the site of the passage tomb from the period of colonisation in the 1170s. The late medieval tower house is in some ways the successor to this twelfth century castle. Second, the *seigneurial residence* or manor house. There are no remains of a twelfth/thirteenth century manor house at Dowth, but the late medieval tower house would have been built on its site in the fifteenth/sixteenth century. The 1253 extent records a garden. The seigneurial residence was also the site of the manor court which regulated the agricultural life of the manor and also exercised local jurisdiction over the manorial tenants. The manor court was the essential institutional heart of the manor. Third, the *seigneurial monopolies*: at Dowth the 1253 manorial extent tells us of two mills, a dovecote and a fishery. Fourth, a *nucleated settlement*. Although it is not possible to be certain, the likelihood is that the *coterelli* recorded in the manorial extent lived at the manorial centre. A geophysical survey has revealed traces of house platforms and paths which could be the remains of this *coterelli* settlement (Stout, 2007). Fifth, the parish church and graveyard. The manorial centre at Dowth was thus a strongpoint and seigneurial residence, an administrative and jurisdictional centre, a service centre, a nucleation of peasant farmers/manorial labourers and a parish centre. The manorial centre was surrounded by the demesne arable and meadow and further out by the holdings of the larger free tenants, such as Alan Proudfoot, who held approximately 240 acres (600 statute acres) in the adjacent townland of Proudfootstown.

Dowth is typical of manorial centre settlements in thirteenth-century Ireland. A number of factors led to decline in the fourteenth century: poor harvests and famine caused by cloudy wet summers from 1315 to the 1320s; the Bruce invasion (1315–1318) and the disturbance of the agricultural economy caused by war; the ending of England's war economy from 1314 onwards; and finally the spread of the Black Death in 1348/49. Settlements such as Dowth contracted, becoming mostly seigneurial service centres and parish centres.

Passage tomb

Dowth is of course better known for its Neolithic pasage tomb than for medieval settlement. Despite its comparable size, the passage tomb at Dowth is less well known than its neighbours at Newgrange and Knowth. The mound at Dowth contains two chambers and has extensive Neolithic art inscribed on the kerb stones and in its passages and chambers, although Stout describes this as "mere doodling compared to Newgrange and Knowth". The mound was also used for the construction of a souterrain in the Early Christian period.

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The ringwork castle at Danestown, County Meath

Emma Arbuthnot

The ringwork at Danestown, County Meath, consists of a sub-circular platform enclosed by two earthen banks and an intervening ditch. The earthworks seem to have been modelled out of a natural ridge and the enclosed platform stands up to 5 m in height above external ground level. The earthwork's siting is clearly defensive and it commands excellent views of the local area. The ruins of a medieval church within a graveyard are located approximately 50 m to the south-west of the site.

Figure 42 Ringwork castle at Danestown

Although the earthwork at Danestown has previously been classified as an early medieval ringfort (RMP ME032-007; Moore, 1987, 68), more recent research has shown that the earthwork represents an Anglo-Norman ringwork castle. Sweetman was the first to identify the earthwork at Danestown as a possible ringwork castle, based on its morphology and proximity to a known medieval church site (Sweetman, 2005, 394). The historical evidence also supports this classification as the documentary sources indicate that the ringwork castle and the adjoining medieval church formed the nucleus of an Anglo-Norman manorial centre.

The ringwork castle is a form of earthwork castle utilised by the Anglo-Normans, which generally consists of a raised circular or oval interior enclosed by one or more earthen banks. The identification of ringwork castles in Ireland is complicated by the presence of many thousands of early medieval ringforts, which can be morphologically similar to

ringwork castles, although the two site types differ greatly in terms of their original appearance and functions. Although the place of the ringwork castle in English and Welsh castellollogy is well-established, the study of ringwork castles in Ireland only commenced with the research of Twohig (1978, 7–9) and Barry (1983, 295–309; 1987, 50–53) in the late 1970s and 1980s. More recently, the research of O'Conor (1987–91, 3–12; 1992a; 1992b, 3–12; 1999,183–211) and Sweetman (1999, 4–16; 2005, 393–398) has led to the identification of more probable ringwork castle sites. Excavations carried out in the 1990s have shown several of the major Anglo-Norman stone castles in Ireland, including Trim Castle, Meath (Hayden, 2005), Kilkenny Castle (Murtagh, 1993, 1101–1117) and King John's Castle, Limerick (Wiggins, 2001, 13–44), were preceded by invasion period ringwork castles.

Due to the difficulties involved in differentiating between ringwork castles and ringforts on morphological grounds, it is necessary to take an interdisciplinary approach, taking both archaeological and historical evidence into account, in order to identify possible ringwork castles in an Irish context. As O'Conor (1992, i, 60) has pointed out, proximity to a known medieval church site located at a historically attested manorial centre is an important factor in identifying a possible ringwork castle. In the case of Danestown, the medieval church site and the ringwork castle are clearly associated. It is notable that the entrance to the ringwork castle is orientated directly towards the church, which lies approximately 50 m to the south-west. The close association between the two sites may indicate that the castle and church are contemporaneous and represent the core features of a planned manorial settlement on a green-field site. The siting of an earthwork in the landscape can also be important as ringwork castles tend to have defensive siting and are frequently located at high points in the landscape. This contrasts with the siting of early medieval ringforts, which are typically located halfway up slopes rather than in exposed hill-top locations (Stout, 1997, 106; Cody, 2005, 6). At Danestown, the ringwork castle appears to have been modelled out of a natural ridge. As a result, the interior of the ringwork is raised up to 5 m above external ground level and commands extensive views of the local area. The most compelling evidence in favour of classifying an earthwork site as a ringwork castle is often the historical evidence for the existence of a castle in a particular location.

The documentary evidence indicates that the ringwork castle at Danestown was associated with an Anglo-Norman manor, although there are no known direct references to a castle at Danestown. The place-name of Danestown seems to have evolved from 'de Aveni's town' over time and the historical sources show that the de Aveni family held the manor as vassals of the de Feipo lords of Skreen from the late twelfth century. The history of the de Aveni family of Danestown has been discussed by Hickey (1994, 106–7) in her study of the de Feipo lords of Skreen and their tenants, based on evidence from the charters contained in the *Chartularies of St Mary's Abbey, Dublin* (Gilbert, 1884). Although there do not appear to be any direct references to the ringwork castle at Danestown in the sources, the historical evidence suggests that both the manor and church were established in the late twelfth century and it seems likely that the ringwork castle was also constructed at this time.

As Hickey (1994, 106) has argued, it seems probable that the de Aveni family of Danestown were connected to the 'de Avene' lords of Afan in Glamorgan. The lords of Afan were of native Welsh rather than Norman descent and seem to have adopted the

surname ‘de Avene’ as they attempted to assimilate themselves into Anglo-Norman society (Davies, 2000, 424). Several members of the de Aveni family seem to have arrived in Ireland in the decade following the Anglo-Norman invasion of 1169, and the names of several members of the de Aveni family appear in the witness lists of charters issued by the de Feipo lords of Skreen (Gilbert, 1884, i, 91–92; Brooks, 1936, 184).

Two late twelfth-century charters mention a man called Robert de Aveni, who held lands within the de Feipo barony of Skreen. The first charter, issued *c.* 1185, records Bishop Eugenius of Clonard’s confirmation of Adam de Feipo’s grant of the ecclesiastical benefices of the churches in the barony of Skreen, including ‘the church of Robert de Aveni’, to St Mary’s Abbey, Dublin (Gilbert, 1884, i, 156–7). The second charter, issued by Thomas, archbishop of Armagh, also confirmed Adam de Feipo’s grant to St Mary’s Abbey, including the church on the lands of Robert de Aveni (Gilbert, 1884, i, 144–5). A single charter issued by Robert de Aveni himself has survived, recording his grant of lands in ‘Cruiceregan’ and ‘Rascunin’ to the Hospital of St John the Baptist in Dublin (Brooks, 1936, 172–3). Unfortunately, the location of these lands is unknown. Although the manor of Danestown is not specifically mentioned in any of these late twelfth-century charters, it is clearly implied that Robert de Aveni held lands of Adam de Feipo in the barony of Skreen. It seems reasonable to assume that these lands are represented by the civil parish of Danestown, and that the ringwork castle and church site at Danestown mark the site of Robert’s manorial centre.

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Danestown Meltwater Channels

Robert Meehan

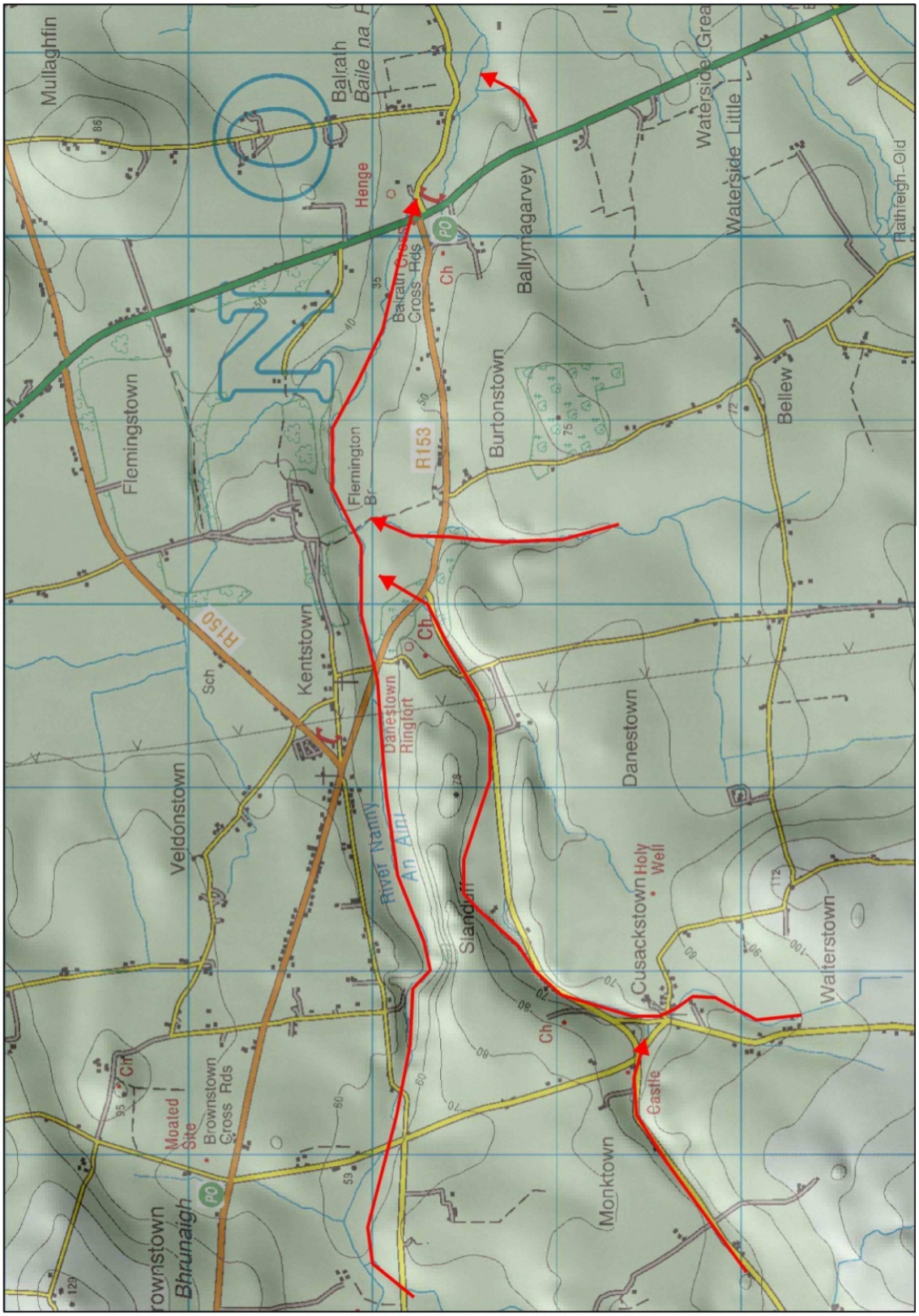

Figure 43 Meltwater channels in the Danestown-Kentstown area.

A number of well defined meltwater channels occur in the area around Danestown. These channels are up to 10 m deep and many are steep sided, currently hosting misfit streams. These channels are associated with the Nanny meltwater system, which was the precursor to the Boyne Meltwater system. The Nanny drained much of the central Meath area during early deglaciation.

Other Localities worth visiting

Other localities in County Meath worth visiting, which we do not have time for on the current trip, for fine glacial sites associated with our trip include:

Floods Gravel Pits, Murrens* (*NGR 251700 275250 and NGR 252500 274800)

Ardmulchan Gravel Pit* (*NGR 292200 271200)