Port Láirge agus Corcaigh Thoir

Waterford and East Cork

Treoir Allamuigh Uimhir 12

Field Guide No. 12

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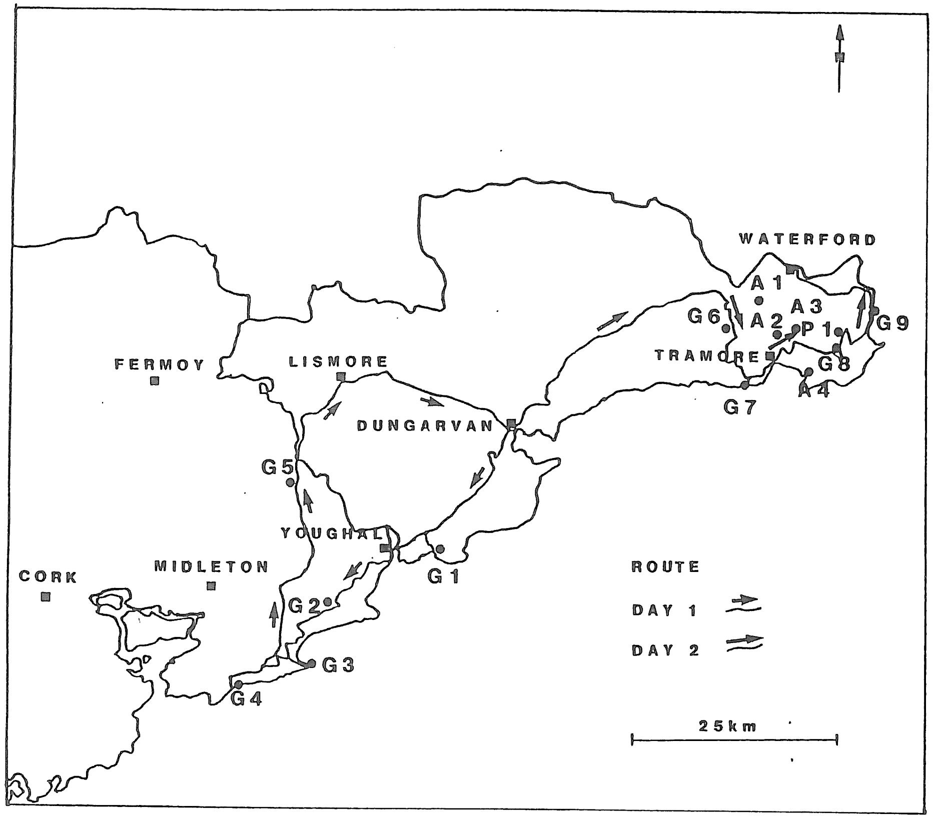

Frontispiece. Map of Waterford and east Cork showing excursion route and field stops (Archaeology: A1-A4; Geology: G1-G9; Palaeoecology: P1)

PORT LÁIRGE AGUS CORCAIGH THOIR

WATERFORD AND EAST CORK

á eagrú ag/edited by

I.M. Quinn agus/and W.P. Warren

Treoir Allamuigh Uimhir 12

Field Guide Number 12

Cumann Staidéar Ré Cheathartha na hÉireann

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CONTRIBUTORS

Maeve Boland (MB)	Geological Survey of Ireland Beggars Bush Haddington Road Dublin 4
Robert J. Devoy (RJD)	Department of Geography University College Cork.
Sean Diamond (SD)	Teagasc Johnstown Castle Wexford
Michael Moore (MM)	Archaeological Survey Office of Public Works Earl Court Adelaide Road Dublin 2
Irene M. Quinn (IMQ)	22 Laurleen Stillorgan Co. Dublin
William A. Watts (WAW)	Trinity College Dublin
William P. Warren (WPW)	Geological Survey of Ireland Beggars Bush Haddington Road Dublin 4

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1.1 Bedrock Geology

The bedrock geology of Counties Waterford and Cork covers the time span from Ordovician, through Silurian, to Devonian and Carboniferous (Figure 1). The alternation of marine and terrestrial conditions through to the Devonian was accompanied by tectonic activity and, in eastern County Waterford, by both prolonged and intermittent volcanism.

The base of the sequence is marked by Ordovician shales and tuffs which are intercalated with and intruded by rocks associated with submarine volcanicity (Stillman *et al.*, 1973). The distinctive rocky knolls of southeastern County Waterford represent volcanic vents formed around this time. The northeast-southwest orientation of the fault boundaries follows Caledonian structural trends.

These rocks are succeeded to the north by alternating shales and tuffs which crop out in the northeastern part of County Waterford. The incidence of the volcanic component declines to the north. Relief is characterised by the Rathgormuck Plateau (90-120 m OD) with deeply incised valleys which follow Caledonian structural trends. The Clodiagh River valley is an example.

Besides younging to the north, the succession also youngs to the west with the faulted transition to Devonian conglomerates and

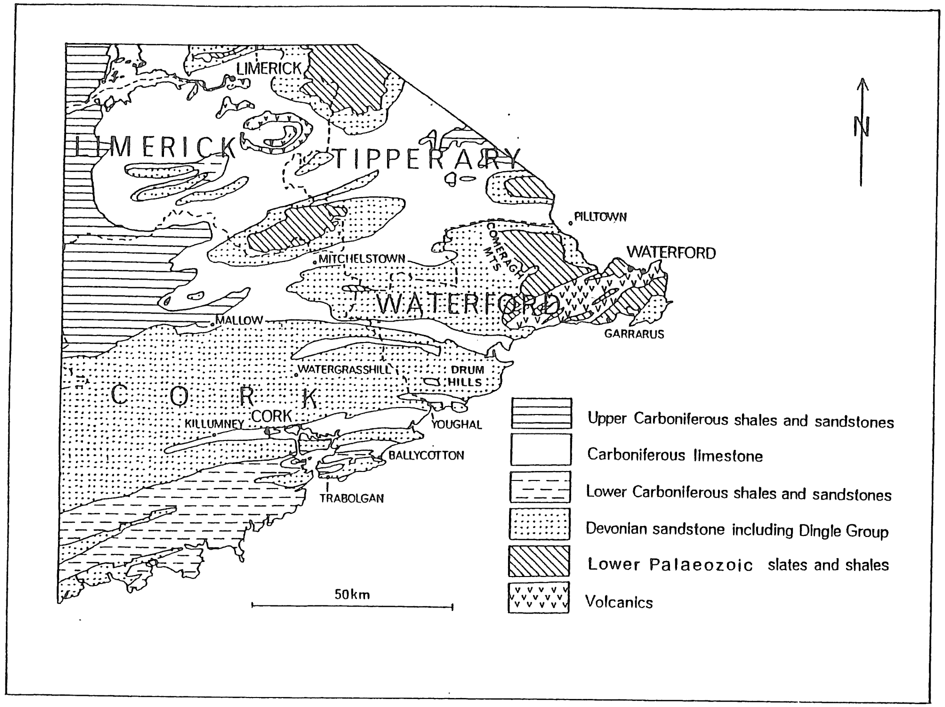

Figure 1 Outline bedrock geology of Waterford and east Cork. (Based on Geological Survey maps).

sandstones in the upland areas with Carboniferous shales and limestones in the synclinal valleys of western County Waterford and eastern County Cork. The east-west pattern of structure and relief reflect the younger Hercynian orogeny.

Because of the repetition of alternating outcrops of east-west aligned Upper Palaeozoic and northeast-southwest aligned Lower Palaeozoic rocks along a north-south profile i.e. the path of the dominant ice movements, the potential of any of the rock types referred to above for use in phenoclast petrological analyses or as indicator erratics in Quaternary sediments is limited (Figure 2).

1.2 Quaternary Geology

Counties Waterford and Cork are mantled by a shallow sequence of Quaternary sediments (Figure 3). Greater thicknesses of sediment are encountered only in valley locations, depressions and in the lee of the 'pre-glacial' rock cliff at the coast. Overall ridge and valley topography predominates in County Cork and western County Waterford and, as might be expected in glaciated terrain of this nature, the Quaternary sediments tend to be thinly spread on the ridges and thicker in the valley bottoms. In general exposure is poor inland but the Quaternary sediments are very well exposed along the coastline.

Wright and Muff (1904) were the first to establish the Quaternary succession on the south coast. They recorded the raised beach as being overlain by a lower (main) head, till of Irish Sea basin

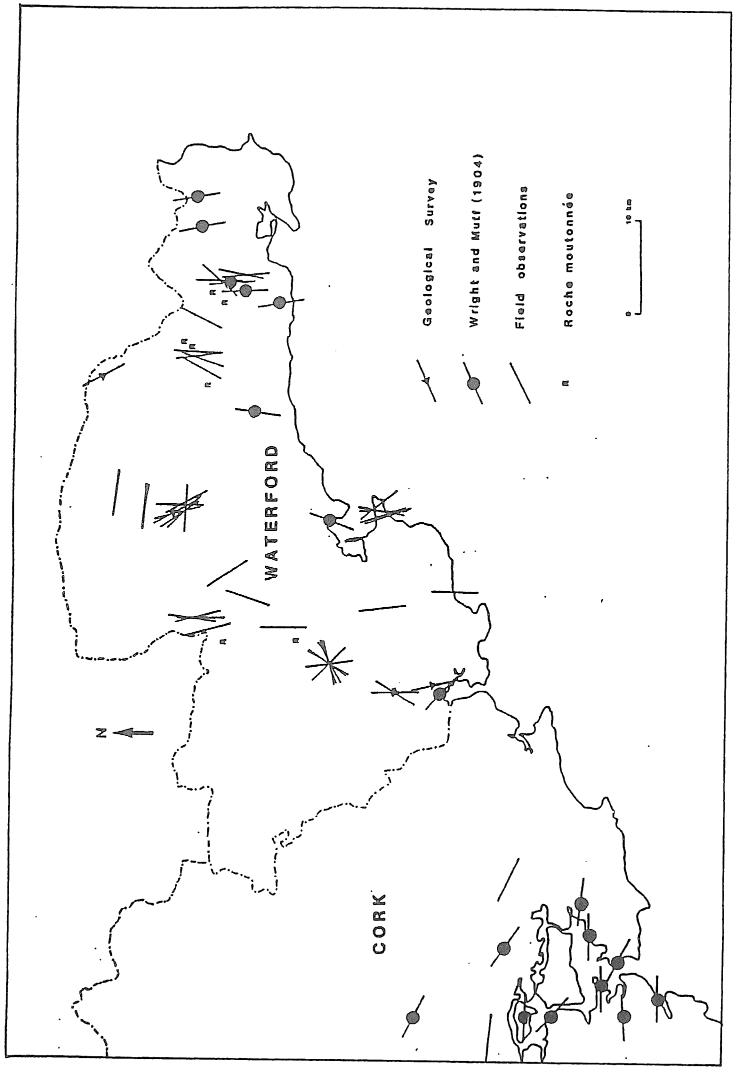

Figure 2 Ice movement indicators in Waterford and east Cork

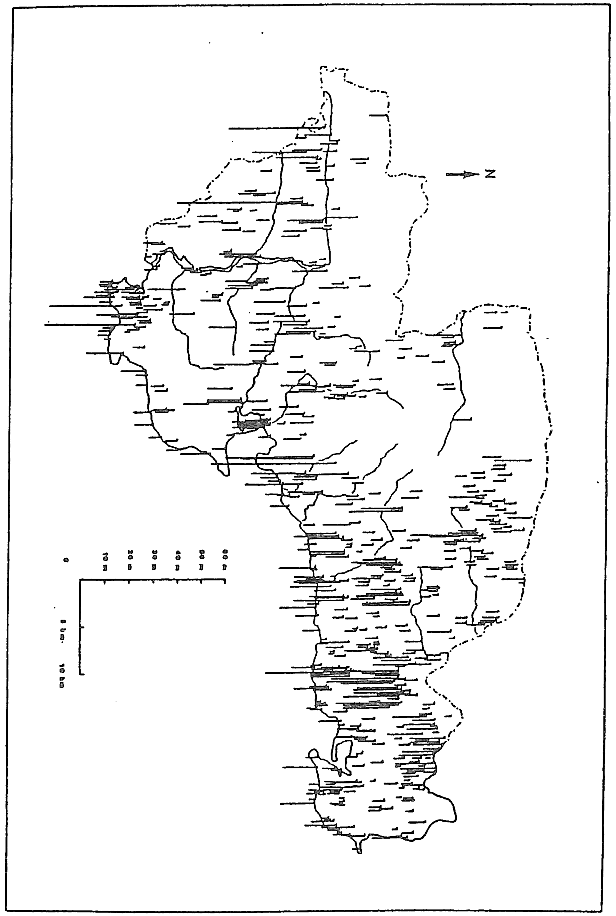

Figure 3 Depth of unconsolidated sediments in County Waterford

provenance, till of inland origin and an upper head. The succession was interpreted as representing an interglacial or preglacial beach associated with higher sea levels than at present, followed by the onset of cold conditions, a single glaciation and its retreat. This framework with minor alterations has persisted since. Along the Cork coast the upper till is associated with ice that spread eastwards from the Kerry/Cork mountains while in County Waterford the upper till is associated with a southerly moving ice sheet. The stratigraphic units have been formally named as follows (Warren, 1985):

Upper till of Kerry/Cork provenance	Garryvoe Formation
Upper till of midland provenance	Bannow Formation
Shelly till with Irish Sea basin erratics	Ballycroneen Formation
Lower head	Fenit Formation
Raised beach	Courtmacsherry Formation

At Kilbeg in east Waterford interglacial organic muds and peat, underlying till (probably Bannow Formation) were interpreted as of penultimate interglacial age (Watts, 1959). Organic deposits at Newtown were seen as more enigmatic. The age of the Kilbeg deposit is controversial as it is regarded by some as last interglacial in age (Warren, 1985 and below) and others as penultimate interglacial (Watts, 1985 and below).

Courtmacsherry Formation (Raised Beach)

The lowest unit in the sequence at the coast is a parahorizontally-bedded clast-supported gravel which rests on a

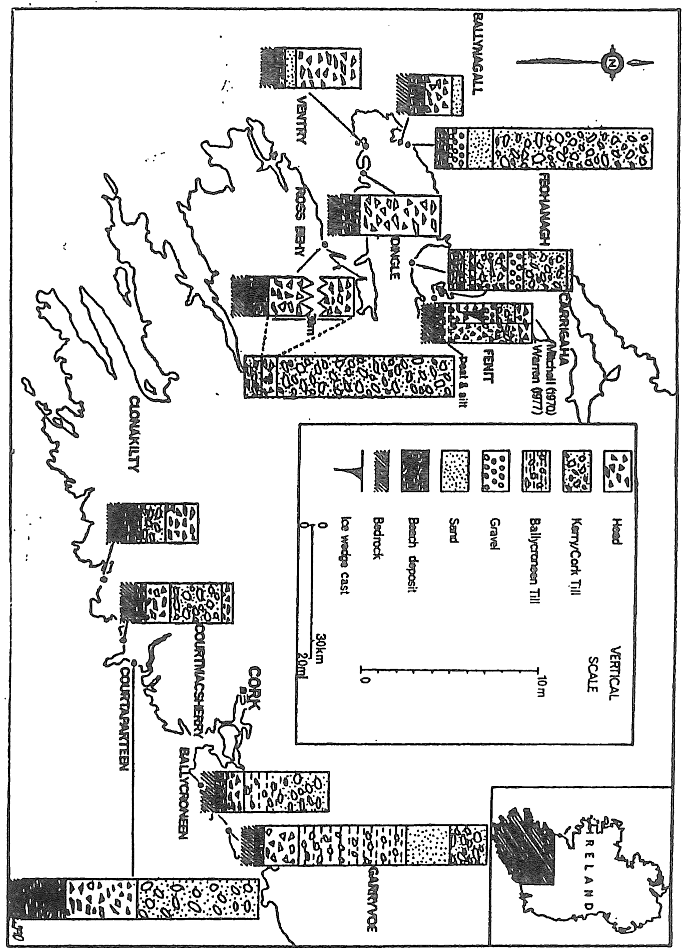

Figure 4 Quaternary lithostratigraphic columns for southwest Ireland

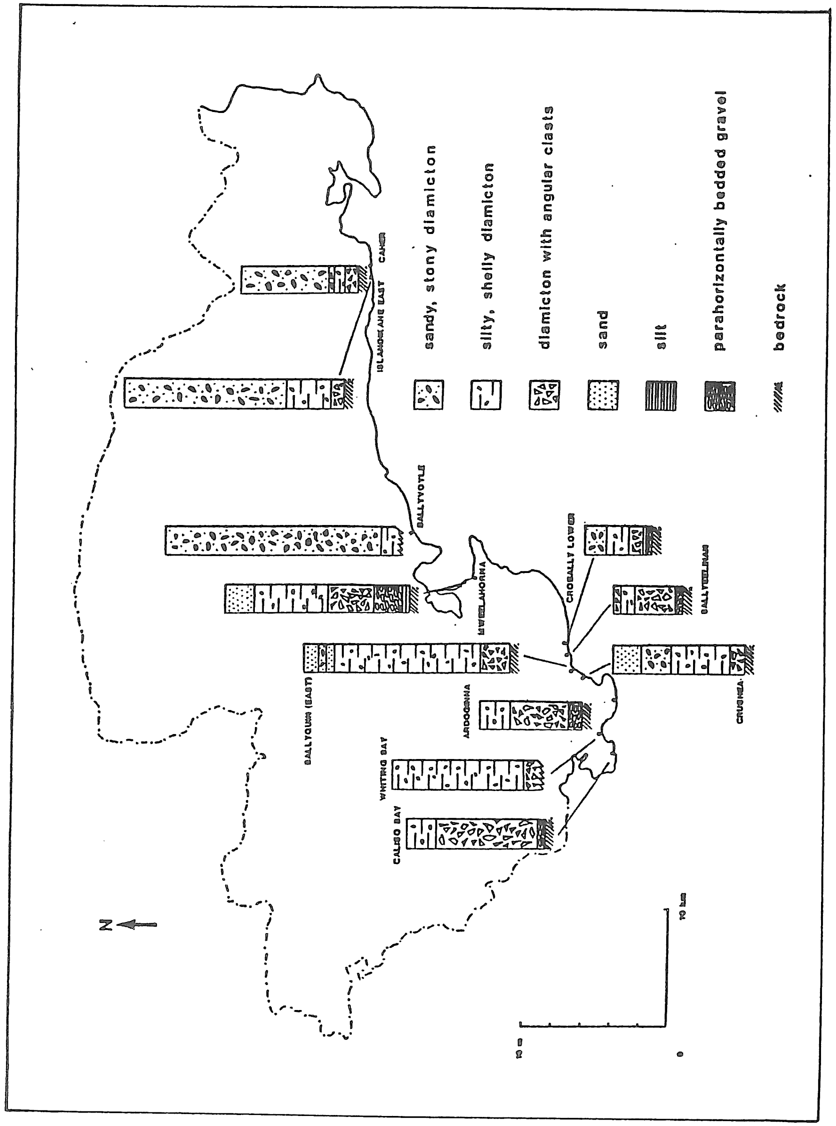

Figure 4(ctd) Quaternary lithostratigraphic columns for outcrops of silty diamicton in Waterford

wave-cut platform at approximately 3-5 m O.D. and is interpreted as a raised beach. The unit is up to 3.6 m thick and is in places overlain by a sandy facies. No faunal content has been observed within it although erratics of Irish Sea basin provenance have been recorded. This unit crops out extensively along the coasts of both County Waterford and County Cork. In all but a single case it is found to rest directly on the raised shore platform. The gravel is generally overlain by a diamicton interpreted as a head/gelifluncted unit. The beach and head deposits usually display a sharp horizontal contact. The raised beach gravels are directly overlain by till in a number of localities but these are rare occurrences. The interpretation of this unit as a raised beach is based on sedimentological and structural characteristics, unique coastal location, lateral continuity and uniform stratigraphic relationships. It was referred to by Wright and Muff (1904) as a preglacial raised beach but only in the sense that it predated all glacial deposits exposed on the south coast. The raised beach has generally been regarded as an interglacial deposit, traditionally assigned to the penultimate interglacial (Mitchell *et al.*, 1973). More recently, it has been termed the Courtmacsherry Formation and regarded as an isochronous marker horizon attributed to the last interglacial in Ireland (Warren, 1979; Warren, 1985).

Other Interglacial Units

Buried organic deposits at Kilbeg and Newtown have been analysed by Watts (1959). The former contains typical "Gortian" interglacial flora (see contribution by Watts to this guide), while the interglacial/interstadial? basal polleniferous silts at Newtown have been dated to "greater than 38,000 (Birm 89)" (Mitchell, 1970). Both deposits were correlated with each other and with the raised beach and were earlier considered to be of penultimate interglacial age (Mitchell *et al.*, 1973) but more recent workers suggest that a last interglacial age is more consistent with the stratigraphic evidence (Warren, 1979; Warren 1985; Quinn, 1987).

Fenit Formation (Head)

Two major types of head are distinguished within the head encountered in the area:

1. A clast-supported diamicton. Clasts are generally angular and local in origin. Their long axes are oriented subparallel to each other down the maximum topographic slope at very low angles (less than 5^{o}). This type commonly rests directly on the raised shore platform and is visible at the base of the Newtown sequence. It is often cryoturbated and occasionally contains ice wedge casts. The sediment is crudely bedded with individual beds being approximately equal to the thickness of the larger contained clasts. Occasionally there is evidence of intensified erosion where a finer bed may be separated from a coarser bed by a sharp bevelled contact. The head is usually found overlying the raised beach and is separated from it by a sharp, and locally, laterally continuous horizontal contact. Occasionally rounded clasts, including erratics of eastern and northern provenance, are contained in the basal layers. The

sediment is usually overlain by diamicton from which it is separated by a sharp contact. In one or two cases where the 'pre-glacial' rock cliff is intersected by the present coastline a continuous sequence of head is exposed above the raised beach unit.
2. Sediments composed of angular clasts as above, but supported in a clayey to sandy matrix.

These sediments have been interpreted since Wright and Muff (1904) described them, as the products of gelifluction processes characteristic of periglacial conditions in an intensifying cold climate. The erratics are generally considered to have been derived from the underlying beach or from an earlier glaciation. Synge suggested a penecontemporaneous glacial origin associated with initial high sea levels at the beginning of the succeeding glaciation (Synge, 1970).

Ballycroneen Formation (Irish Sea or Ballycroneen Till)

The Ballycroneen Formation has its type site on the coast at Ballycroneen Bay, County Cork (Wright and Muff, 1904; p. 256). The till of Irish Sea basin origin is recognised by its relatively stone-free, chocolate brown, calcareous silty matrix and by its characteristic suite of flint, fragments of shell and Irish Sea basin-derived erratic lithologies (Figure 4). The contained clasts display a marked fabric and are glacially faceted and striated. It crops out along the coasts of Waterford and Cork almost as far as Roches Point.

At Ballycroneen the shelly diamicton overlies, with a very sharp horizontal contact, the lower head at the western end of the bay.

In the centre of the bay the underlying head is seen to have been reworked into the basal layers of the shelly diamicton. There are indications of an east to west ice movement associated with this reworking. At Ballycotton it can be seen that the shelly diamicton was itself reworked by ice from the west which deposited the overlying westerly derived till - the Garryvoe Formation.

Outcrops of this unit are sparse in eastern County Waterford where thicknesses rarely exceed one metre. At Garrarus and sections in western County Waterford, the base of the outcrop is seen to rest on the lower head which in turn rests on the raised beach. The upper contact between the till of Irish Sea basin provenance and the overlying unit is sharp and laterally continuous for approximately two metres at Ballyvoyle.

The outcrops of till of Irish Sea basin provenance from Dungarvan westward provide a striking contrast to those in the eastern half of the county: they are generally measured in thicknesses of tens of metres and they occupy the predominant share of the stratigraphic column. These sediments extend westward almost continuously from Ballyeelinnane to Whiting Bay and beyond.

A blue-green basal laminated facies is seen at the base of the Ballycroneen Formation on the south side of Dungarvan Bay and the western end of Whiting Bay. The base of this facies is exposed at Whiting Bay. It is separated from the underlying head by a sharp, horizontal and laterally continuous contact. The laminations are extremely kneaded and contorted. This facies is in turn separated

by a sharp contact from the overlying massive silty diamictic facies which is observable throughout the coastal sections in this area. The basal facies is interpreted as a sub-marginal melt out facies deposited in a shallow water column. This phase was succeeded by lodgement at the base of a temperate ice sheet advancing from the southeast as represented by the massive shelly diamicton at the centre of Whiting Bay.

In western County Waterford the silty, stone-free diamicton is capped by a stony diamicton which has been interpreted as till of inland origin by Wright and Muff (1904).

The Ballycroneen Formation has been traditionally attributed with a penultimate glacial age (Mitchell *et al.*, 1973) although this interpretation has been disputed by subsequent workers in the field (see above) and is regarded here as last glaciation (Fenitian) in age.

Bannow Formation (Ballyvoyle Till Member)

The Ballyvoyle Till at its type site is a stony diamicton, with a sandy loamy texture and a predominance of volcanic clasts (61%), mostly local in origin. Thirty five per cent of the contained clasts are sandstones, 3% are chert and 1% are shale. The diamicton also contains very occasional flint and shell fragments. Some of the finer-grained sandstones are striated and many of the clasts are glacially faceted. With the exception of very occasional sandy lenses, no internal structures were observed within the diamicton. This facies of the Ballyvoyle Member is traceable in an easterly direction to the Waterford estuary. The limestone and granite erratic content increases in this direction. The same facies is found at the surface inland when traced in a northerly direction as far as the Rathgormuck plateau where the shale and chert content become increasingly more important.

On the western side of the Comeraghs, the diamicton which crops out at the surface also contains increasingly more chert and limestone erratics as one approaches the Suir valley. The rubbly diamicton which overlies the till of Irish Sea basin provenance at the coast in western County Waterford may represent either deposition by ice of inland origin or a local facies deposited by ice advancing northwestward across the coastline.

The sedimentation style of the structureless diamictons which crop out at the surface in County Waterford is characteristic of lodgement at the base of a temperate-based ice sheet of northern provenance.

Evidence of deglaciation appears to be largely restricted to isolated marginal terraced kame deposits of gravels to the west and north of the Comeragh Mountains and in the Suir valley.

Garryvoe Formation (Till of Kerry/Cork Provenance)

The Garryvoe Formation has a red/brown matrix and is characterised by phenoclasts of Devonian sandstone and shale, and Carboniferous limestone, shale and chert (Warren, 1985). To the west of Cork Harbour and in eastern County Cork outcrops of this till are of western provenance. It extends as far as Youghal

Harbour and overlies the Ballycroneen Formation (Wright and Muff, 1904; Farrington, 1954). It seems clear that the Garryvoe Formation relates specifically to the Fenitian Stage.

The Upper Head

This unit, first recorded by Wright and Muff (1904), although in east Cork where it rarely exceeds 1.5 m in thickness, was not observed in any of the sections logged in County Waterford although the upper 1.5 m of sections in diamicton was commonly cryoturbated.

Conclusion

The original observations of Wright and Muff (1904) are validated and extended inland.

As already concluded by Stevens (1959), the Mothel Till in northern County Waterford, interpreted by Watts (1959) as the product of a slightly more recent ice advance than that responsible for the deposition of the Ballyvoyle Till, is merely a relatively limestone/chert-rich facies associated with carry over of Carboniferous limestone erratics on to Devonian and Silurian strata.

The two major ice sheets which affected the area appear to have been broadly contemporaneous and somewhat mutually exclusive (Figure 5) as suggested by Watts (1959). Ice advancing out of the Irish Sea basin seems to have reached the coast before the ice of inland origin. It seems likely that the Kerry/Cork ice sheet was contemporaneous with the ice of northern provenance with which it merged as it crossed the coast around Youghal.

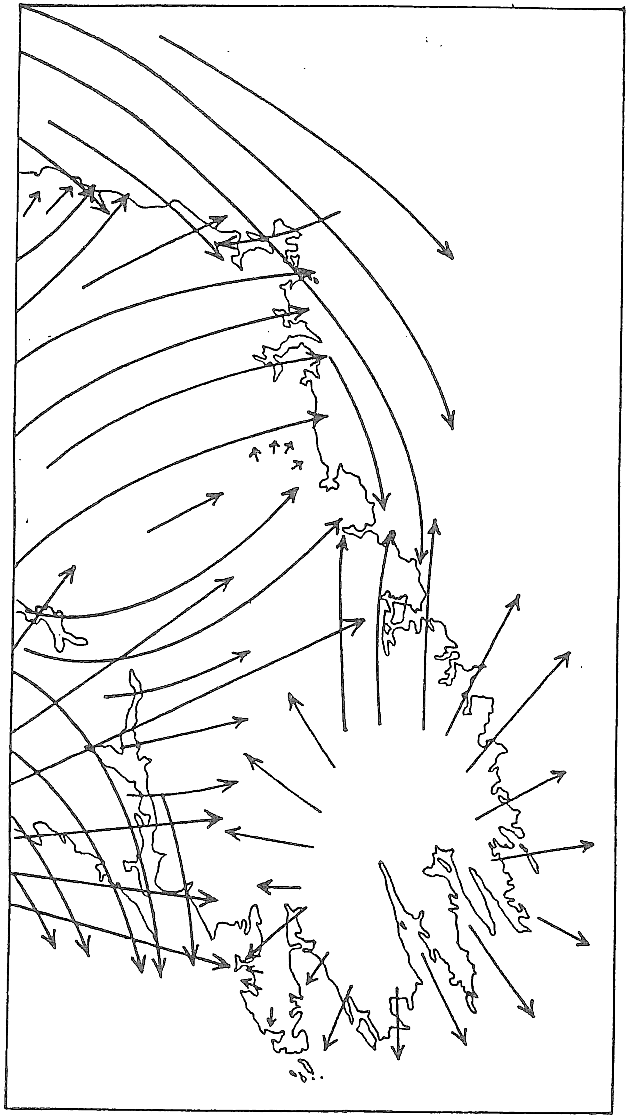

Figure 5 Directions of ice movement in southern Ireland

The entire Quaternary sequence in the east Cork/Waterford area is regarded as the product of a single glacial event which is assigned to the most recent glaciation in the absence of any convincing stratigraphic evidence to suggest otherwise (Figure 6). (IMQ and WPW).

1.3 Soils

The Kill series represents the free draining component of the volcanic region which extends from the Waterford/Dungarvan road to the south coast. This region comprises the largest area of volcanic soils in southern Ireland. The parent material is a thin matrix-supported diamicton containing acid volcanic clasts (andesite/ rhyolite) with an admixture of shale derived from the local Bala beds. There is very little carry over of shales from the north, so that the soil boundary practically coincides with the bedrock boundary. Rock outcrops commonly occur, especially in the eastern part of the region. The Kill series occupies two-thirds of the volcanic region; it is classified as a brown earth (Typic Dystrochrept). Weakly developed podzolic horizons occur sporadically. The lower slopes are occupied by poorly drained soils (Tramore series) which show fragipan features in places.

The Cloghernagh series occurs in the Woodstown/Tramore/Dunmore East region where it overlies shale and sandstone bedrock. It is derived from deep till composed predominantly of shale with some sandstone and/or volcanics. It occupies about two thirds of the landscape and may occur on the crests of slopes. Drainage is

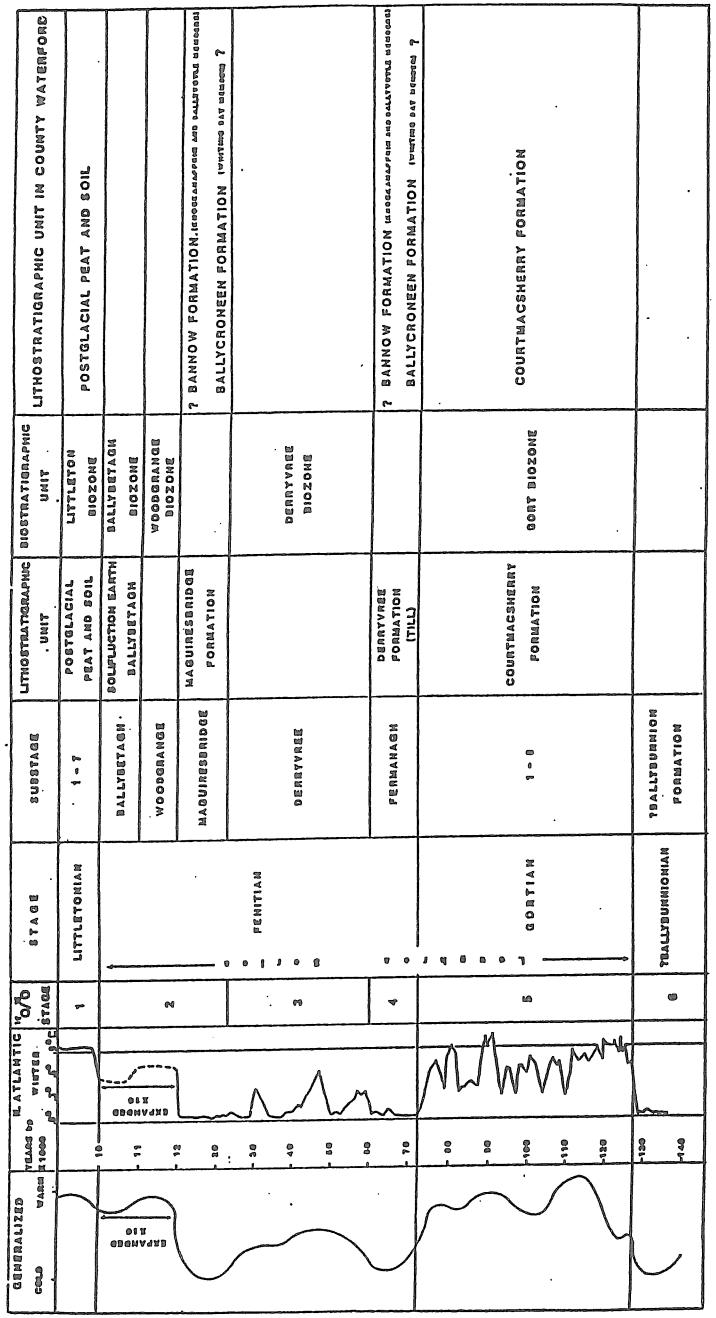

Figure 6 Lithostratigraphic framework

poor; the soil is classified as a gley (Typic Haplaquept). Permeability is slow: 5 cm per day and seepage contributes to the poor drainage on the lower slopes. It is similar in many respects to the Rathangan Series which is extensive in south Wexford on the Bannow Formation. The texture of the parent material is clay loam (33% clay); whereas the Ballycroneen Formation is typically a clay (45%). It appears that the soils of southeast Waterford are unrelated to the Ballycroneen Formation. (SD)

2. Palaeoecology of Quaternary Botanical Sites in East County Waterford

The deposits at Kilbeg and Newtown are described in detail by Watts (1959). Kilbeg is a buried interglacial deposit with no surface expression. It was probably a small swamp-surrounded pond of lake. The flora is typically 'Gortian' and very rich in species. *Eriocaulon septangulare* has been found in the Gortian at this site only. The species occurs in western Ireland and very locally in western Scotland today. The rest of the range is in North America. The find is of great biogeographical interest, for it proves the plant to be a long-term resident of Europe, not a Holocene immigrant. *Azolla*, which also occurs, is known only from deposits of penultimate or older interglacial age in continental Europe. Its range today is also American. It is not known from the Eemian or last interglacial in continental Europe. The same is true of northwest continental Europe for *Abies* (fir)-dominated floras such as that at Kilbeg. This makes it, on botanical grounds, difficult to assign an Eemian age to Kilbeg. It should be older, but the dating of interglacial deposits is subject to controversy. The controversy would be solved by finding an interglacial deposit of different botanical character on the surface of the Waterford till, covered only by periglacial materials. This would then be clearly of Eemian age and the till of Saalian age. Despite intensive searching no such deposit has been found in enclosed silt-filled basins in Wexford and Waterford which have revealed sparse glacial floras only (studied and recorded by Craig, 1978).

The exposure of the Newtown peats is variable depending on slumping of the cliffs above. The peats contain an uninformative pine-dominated flora which could appropriately belong to the end of an interglacial period or in a major interstadial. It is datable only by lithostratigraphy or directly by a radiometric method.

Belle Lake, studied by Craig (1978) shows the climatic diversity of the late-glacial period. The late-glacial ends with the cold Younger Dryas period, but the earlier warmer period itself falls clearly into two portions, and early warm productive juniper-dominated flora and a later colder grass-dominated flora. These contrasts of flora, climate and productivity are still better illustrated by the outstanding site of Coolteen in south Wexford, also studied by Craig. The radiocarbon dates for late-glacial boundaries from Belle Lake and Coolteen have been substantiated by more recent accelerator mass-spectrometer dates from Ballybetagh, County Dublin. (WAW)

Although palaeobotanists appear to have great difficulty in squaring the Irish interglacial deposits with the lithostratigraphy much of their difficulty arises from the fact that the biostratigraphy evolved in the context of an unsatisfactory morphostratigraphic approach to the lithostratigraphy. However a good working stratigraphy can be drawn up in which the Kilbeg and other Gortian deposits are placed in the last interglacial (Warren, 1979; Warren, 1985).

The appearance or nonappearance of specific taxa, such as *Azolla* cannot be regarded as indicative of any particular interglacial as simultaneous extinction throughout Europe cannot be assumed, witness the occurrence of *Eriocaulon septangulare* in Ireland and parts of western Scotland and its absence in the rest of Europe. As stated elsewhere (Warren, 1979) any correlation of the Gortian with the Holsteinian must rest on the proportion of *Abies* pollen. But this too is an unsatisfactory basis for correlation as *Abies* concentrations in the Gortian deposits are not nearly as high as those in the Holsteinian on the continent and as Watts (1959) points out "the resemblances between the English *(Hoxnian)* deposits and Kilbeg and Gort are less striking than the differences". The original dating of the Kilbeg deposit to a penultimate interglacial rested on the recognition of the so-called Ardcavan interglacial as last interglacial. When the Ardcavan deposits were finally recognised as postglacial the stratigraphic basis for a penultimate interglacial age for Kilbeg was removed and the safest stratigraphic view must be that it is last interglacial until this hypothesis can be falsified. (WPW)

3. Archaeology

Introduction

Waterford is the smallest county in Munster. The variety of its landscapes - sea-shore, estuary, marshland, upland and the mountains of Knockmealdown and the Comeraghs - presents a totality of landscapes within a relatively small area which early settlers might have exploited for sustenance. The study of this settlement area however, is not far advanced since the nature of all its archaeological monuments has not yet been systematically recorded. The Archaeological Survey of Ireland is at present engaged in a programme of preliminary survey of County Waterford. It has traditionally been recognised that Waterford has had a long history of settlement, at least since Neolithic times, and an outline of it can be given.

Palaeolithic

The possibility that Palaeolithic settlers were present in southern Ireland cannot be ruled out. However, to date no positive evidence of such occupation has yet been found. The human remains at Kilgreany cave, originally thought to have been associated with late-glacial animals (Tratman, 1928), are now thought to be more probably associated with a hearth containing oak, ash and hazel charcoal indicative of a temperate climate (Movius, 1935).

Mesolithic

There is a large body of archaeological material indicative of mesolithic society in Ireland. This consists almost entirely of stray flints from the Bann valley dating to the immediate post-glacial period. No context could be attributed to this material until Woodman's (1985) excavations at Mount Sandel, County Derry led to the secure C14 dating of the small finely-worked flint microliths of the earlier Mesolithic to 8370 +/- 200 BP.

The excavations in Lough Boora, County Offaly in 1977 (Ryan, 1980) extended the area over which Mesolithic material has been recovered. It also raised the possibility that the whole of Ireland might have been colonised during the Mesolithic.

Since the early 1980s, Woodman has been co-ordinating a survey programme to investigate the early settlement of southern Ireland. He has been rewarded with the discovery of shell middens at Ferriter's Cove, County Kerry. Here an industry, based largely on a local greenstone with some flint and chert, is associated with midden material lacking pottery or evidence of domestic animals and is likely to date to the later Mesolithic (Woodman *et al.*, 1984; Excavations, 1986).

In co-operation with Prof. Peter Woodman the Bally Lough Project was set up in 1983 under the principal direction of Dr. Marek Zvelebil to pursue similar aims of locating Mesolithic and early Neolithic settlement in east County Waterford (Zvelebil *et al.*, 1983). This area was chosen, among other reasons, because it provides the variety of environments from sea-shore to marshland to better-drained uplands, which early settlers might have needed to exploit at different seasons.

Their method has involved thorough field-walking during the ploughing season and has been rewarded with the recovery of tens of thousands of artifacts, much of it the debitage of stone-working. Areas of particular concentration have been identified and some of these excavated, including a site at Monvoy. The site has proven to be a rhyolite quarry and indeed may be the source of much of the rhyolite artifacts in the locality (Excavations, 1986). The vast majority of artifacts recovered are rhyolite since available flint is of a poor quality. Rhyolite has a crystalline structure not as fine as that of flint, which nevertheless fractures in a predictable fashion, and serviceable tools can be fashioned from it (Zvelebil and Green, 1985).

This discovery of a locally-available, easily-worked flint substitute opens up the whole of Ireland to early settlement studies. Although the Bally Lough material is still being examined and no firm pronouncements can be made, some artifacts can be described as Bann flakes, typical artifacts of the later Mesolithic in Ireland. The important result of the Bally Lough Project has been to establish beyond doubt that early settlement in Mesolithic/Neolithic times did take place in eastern Waterford.

Neolithic

The implications of this for the later prehistory of Waterford and Munster have not yet been fully comprehended since the relationship between the stone tool assemblage and the megalithic tombs has not been elucidated. Unlike the Mesolithic, the funery monuments of the Neolithic have since then been very visible on the Irish landscape. From its inception prehistoric archaeology has devoted a lot of attention to the megaliths. Most of the megalithic tombs of the Neolithic - court tombs, portal tombs and passage tombs - are located in the northern part of Ireland, north of a line from Galway to Dublin. Waterford is one area which is an exception and is in many ways enigmatic.

At Ballynamona Lower, near Dungarvan, is a court tomb (Powell, 1938), isolated by about 100 miles from its nearest companion, excepting the tomb at Farnoge, County Kilkenny. It has been regarded as a late tomb (Herity and Eogan, 1977) closely related to the remarkable series of portal tombs which stretch up from County Waterford through the Barrow valley to Wicklow. It may have been built at a time when portal tombs were being differentiated from court tombs in the north of Ireland and the practice of building portal tombs had already spread to the Irish Sea province with examples being built in Wales.

More recently, O'Kelly (1989) makes the following points: that the classification of tombs according to their morphology is a convenience of archaeologists; that the rigidities imposed by archaeological classifications cannot have existed to the same extent in the Neolithic and that the unifying theme of burial in megalithic structures is a more powerful one than the peculiarities of classification. Therefore a greater degree of contemporaneity and the mutual exchange of influences can be envisaged.

While communal burial in megalithic structures was the dominant

rite throughout the Neolithic, evidence is increasingly coming to light on the practice of single inhumation, often under a large barrow or cairn, at an early period in the Neolithic (O'Kelly, 1989). This practice is particularly noted in the southeast and there is no reason why examples, as yet unidentified, might not exist in Waterford.

The occupation of Waterford during the Neolithic has left the county with a fine assemblage of megalithic tombs. There are ten portal tombs, the finest of which is probably Knockeen (Site A1) and there are up to five examples of passage tombs. These have been described as entrance or undifferentiated tombs, because the passage widens slightly from the entrance inwards. They have been compared with a group of similar tombs in Cornwall and the Scilly Isles (Powell, 1941a) and have been isolated as the Tramore-Scilly group, based on the form of the passage. Passage tombs come in a variety of forms and undifferentiated tombs are present among the satellites at Knowth (Eogan, 1986) so this form is not peculiar to the Tramore - Scilly group. Two of the Waterford passage tombs have been excavated: Harristown by Hawkes (1941) and Carriglong (Site A2) by Powell (1941b) but neither produced evidence of a construction date. Harristown, however, produced ample evidence of Bronze Age burial where evidence of cremation in cists and pits was recovered.

Early Bronze Age

The inception of the Bronze Age in Ireland is dated to the earlier second millenium B.C. It was preceded by a copper-using phase marked in the archaeological record by Beaker pottery. This distinctively decorated product is recovered in Ireland almost exclusively from excavations of earlier megalithic structures. Although the megalithic tradition did not disappear from Ireland with the exploitation of the new material - there is evidence of Beaker ware in association with some wedge tombs - the new material did have a disruptive effect on the old agrarian lifestyle and the old traditions of communal burial.

The emphasis moved to single burial, most often cremated in cists or pits with decorative pottery called Food Vessels and later with Cinery Urns, both derived ultimately from Beaker ware. Cists and pits often occur singly but sometimes they are found in cemeteries. Even the cairns of older megalithic monuments were used, as was the case at Harristown (Waddell, 1970). To date at least seven cists have been recognised in County Waterford (Waddell, 1970). This is an average number, since cists are common throughout the country, although there is a marked decline in their numbers in areas where wedge tombs proliferate, one indication of some degree of contemporaneity of these monuments.

The search for copper, the main constituent of bronze, brought Munster finally to the forefront of developments in Ireland since there is extensive but small scale copper mineralisation on the peninsulas of Cork and Kerry. The distinctive monuments of the Bronze Age, the stone circles, whether composed of five stones or a greater number, boulder burials, standing stones and stone alignments are concentrated in the Cork/Kerry area. These monuments are recorded, though relatively rarely, elsewhere in

Munster and there are also concentrations in the north of Ireland (O'Nuallain, 1975). There are copper ores in the Bunmahon area of Waterford, but so far no early evidence of their exploitation has been forthcoming.

Through the comprehensive fieldwork of Sean O'Nuallain and the Megalithic Survey in counties Cork and Kerry precise figures on the occurrence of these monuments are available, but about Waterford, at the moment, we must be less dogmatic. Our own work for the Archaeological Survey of Ireland over the next year will involve a preliminary examination of all the known and possible antiquities in the county and the numbers of monuments dating to the Bronze Age can be expected to increase. This work is particularly overdue in the Bronze Age when one considers the large numbers of wedge tombs (79) and stone circles (88) known in Cork/Kerry, the two reinterpreted wedge tombs in Waterford (see A2 and O'Nuallain and Walsh, 1986) and the apparent absence of identified stone circles from Waterford. Undoubtedly more await discovery. In regard to standing stones, it is sufficient to say that they are being discovered almost daily.

With the beginning of the Bronze Age the nature of the archaeological record changes dramatically, reflecting equally dramatic changes in the society which produced it. The burial rite changed to single interment in the less visible cists and pits. New ritual sites in the form of stone circles were built. Although Waterford may be lacking these sites, at Castletown (Site A3) there is a large earthwork enclosure of the henge type to which stone circles are related (Condit and Gibbons, 1988). Artifacts became more versatile; their functions more specialised and their types manifold. Hoards of objects, either ritually deposited or deposited with a view to recovery, became common. This would have been an unthinkable practice in the Neolithic when the raw materials were so readily available. With the specialisation of tools came specialised trades, notably smiths and perhaps merchants. Gold came to be used for highly decorated products beginning with the lunulae and continuing with the gorgets of the Late Bronze Age and the torques of the Early Iron Age, to take but one example of neck ornament.

Late Bronze Age

The later Bronze Age is perhaps the darkest era in Ireland's prehistory. Little is known about settlement sites and burial practices. These must have been of the most transient nature, leaving little trace in the archaeological record. An indicator of the middle and late Bronze Age people can be found in the fulachta fiadha, the neglected and most numerous monument of prehistoric Ireland. Since O'Kelly's excavation and experiments at Ballyvourney (O'Kelly, 1954) interest in these monuments has lapsed somewhat but has revived recently with the increased emphasis on archaeological fieldwork. About 2000 of them are known from County Cork through the work of the Cork Archaeological Survey, based at UCC. Recent work on C14 samples from about 30 sites shows that they belong firmly to the Late Bronze Age, more particularly to the lower part of it. The exploration of fulachta fiadha has been one of the most exciting

developments in Irish archaeology in recent years and it is an area where the field worker can play an important role since most of them are unmapped.

They are frequently located in wet, though not necessarily low-lying, areas since ground water is an integral feature of these cooking sites. The headwaters of a stream is another likely location; a location close to the sea shore (Site A4) is unusual but not unknown. A fulacht fiadh consists of a trough into which pre-heated stones were added to boil the water. The used stone was accumulated to one side forming a low oval or kidney-shaped stony mound which is all that is generally visible today. With modern farming methods many of them are ploughed out but can be readily identified during the ploughing season as spreads of blackened soil and fire-cracked stones. We have identified about 20 fulachta fiadha, usually ploughed out, in eastern Waterford, this Spring. The fulachta fiadha are dated largely to the Late Bronze Age. They may be connected to the deterioration of climatic conditions from circa 1200 B.C. on.

Another element indicative of changing social conditions was the development of hill forts or hilltop settlements. A hillfort may exist at Garranbaun near Dungarvan (Condit and Gibbons, 1987). While hillforts are the type site of the Early Iron age in Ireland, there is evidence from excavated sites like Rathgall, County Wicklow (Raftery, 1976), that their origin lies in the Late Bronze Age.

Conclusion

The eastern part of County Waterford has been settled from very early times. We must await the full results of the Bally Lough Project to determine exactly how long but certainly from the Neolithic. This community was at some time part of the great megalithic tradition of western Europe but we do not yet know whether it was a totally isolated one, the only Neolithic community in southern Ireland apart from the non-megalithic one at Lough Gur, County Limerick, or whether other non-megalithic groups occupied surrounding areas.

Until the preliminary survey of the archaeological monuments is completed we can say little about the extent of Bronze Age settlement but judging from the number of sites known from Cork and Kerry it is quite likely that settlement was more extensive in County Waterford during the Bronze Age than we have evidence to believe it to be. (MM)

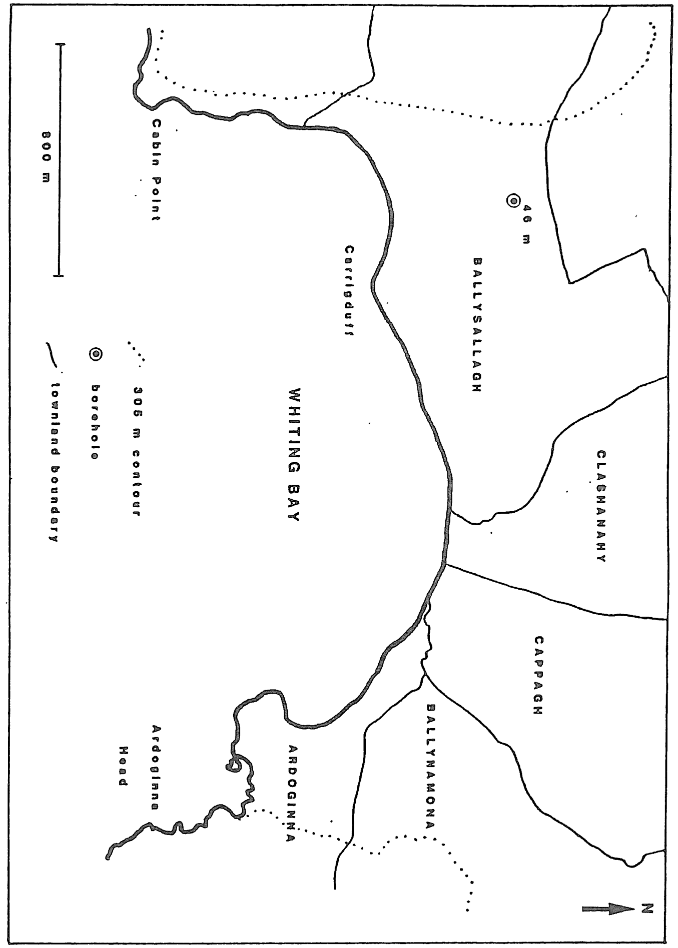

Figure G1.1 Townland locations in Whiting Bay

GEOLOGY

G1 Whiting Bay (IMQ)

The silty diamicton which is exposed in the cliff at the centre of the bay thins to the east and west. The type site for the Whiting Bay Member is located in the townland of Ballysallagh at the back of Whiting Bay X143775 (Figure G1.1). The unit is a massive silty, relatively stone-free diamicton up to seven metres thick. It contains striated erratic clasts of northern provenance, flint erratics and shell fragments (1-5 mm in diameter). The stone content is less than 10% of bulk weight. The petrography of the phenoclasts is composed of sandstone, volcanic, limestone and chert in descending order of frequency. Up to 80% of the contained clasts may be erratic in origin. Their diameter is between 2-5 cm. The base of the unit is defined by the erosional contact with the underlying head unit.

The unit is totally absent from the sections at Ardoginna Head and Cabin Point. At these points the sections are composed of head resting on raised beach and the Devonian raised shore platform. The head unit varies in thickness from four metres on the west side to between one and three metres at the back of the western and eastern embayments respectively where it crops out beneath up to seven metres of calcareous, shell and flint-bearing silty diamicton.

The silty diamicton was regarded as having been deposited by ice advancing out of the Irish Sea basin. It is overlain by an upper

stony diamictic facies up to five metres thick. This facies was considered by Wright and Muff (1904) to be "probably deposited by the inland ice coming from the north".

A number of contrasts may be seen in the unconsolidated sediments between the western and eastern sides of Whiting Bay where the succession is as follows:

1. The calcareous, silty diamicton rests on a bevelled platform of cryoturbated head at the western end of the Bay. The basal layers of the diamicton are a distinctive blue-green in colour. They are stone free except for very occasional drop stones; contain minute shell fragments (less than 1-2 mm in diameter) and are laminated and bedded. In places these beds/laminations are extremely kneaded and contorted. At the eastern end of the bay however, the head is folded into the base of the overlying diamicton which is massive and contains rare stones. In both cases the contact between the two units appears to be faulted due to glacial syntectonisation.

2. The basal diamictic facies is overlain in the eastern embayment by current bedded sands and gravels indicating deposition by palaeocurrents from the east and southeast. This sandy facies, together with the underlying silty diamicton has been subsequently glacially tectonised from the southeast. The sediments become noticeably more contorted in this direction. Folded and pushed sediments are particularly evident along the north/south coastal segment on the east side of the bay, where the line of exposure cuts transversely across the strike of the

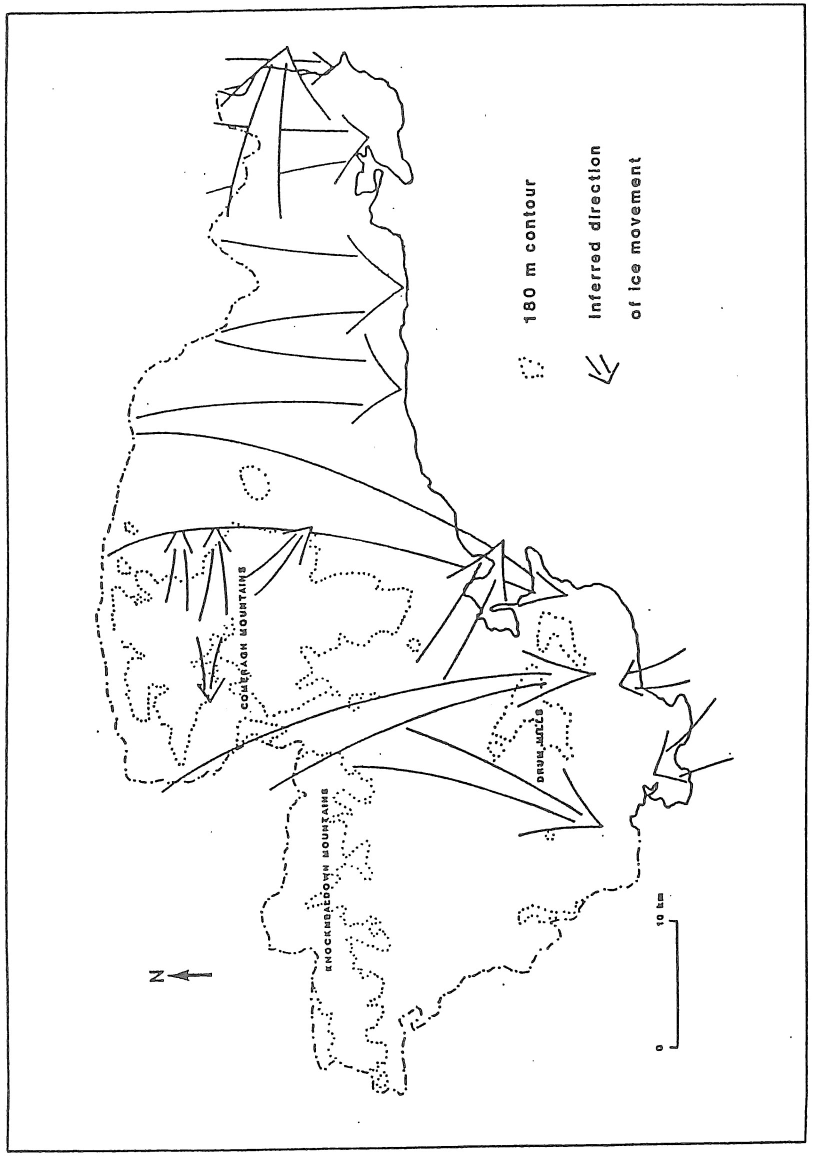

Figure G1.2 Ice movements in County Waterford

fold axes which are oriented 24°/204°. A degree of contortion is also visible in the massive silty diamicton on the west side of the buttress at Carrigduff where the line of exposure lies somewhat obliquely against the strike of the glacially tectonised sediments.

3. The gravelly/sandy unit is in turn overlain locally by a sequence of silty diamictic beds which appear to have been deposited syntectonically to form one-metre thick wedge-shaped beds which rest on the northern limbs of the anticlinal structures, particularly on the eastern side of the bay. In some cases the silty diamicton is partly interdigitated with the sand and gravel units. In other cases this facies rests on the preserved surfaces of the underlying sands and gravel units. Rare complex drop stones are visible in this facies. The evidence suggests a basal meltout origin.

4. This facies grades up into a massive unit with a northwesterly/southeasterly fabric and a predominant phenoclastic petrography of Carboniferous limestone (Figure G1.2). This unit occupies the bulk of the stratigraphic column throughout the bay.

5. The entire sequence is truncated by an erosion surface. East of Cappagh the succession is capped by a stony matrix-supported diamicton up to 2 m thick in which the sandstone group forms the predominant lithology. This unit may be interpreted as a local facies associated with ice from offshore or alternatively, as suggested by Wright and Muff (1904), with ice of inland origin.

To the west of Cappagh, the uppermost silty diamicton is capped in places by approximately one metre of alternating blown sands and thin organic horizons.

Interpretation

The basal silty, stone-free laminated and stratified diamicton is interpeted as the product of submarginal meltout into locally ponded shallow water trapped between the advancing ice sheet and the 'pre-glacial' rock cliff. This phase was followed by deposition of current-bedded and graded sands and gravels which were subsequently folded and reverse-faulted. They are interpreted as being of subglacial origin. The tectonisation is associated with syndepositional meltout and and was followed by subglacial lodgement in a prograding sequence associated with ice advancing northwestward out of the Irish Sea basin.

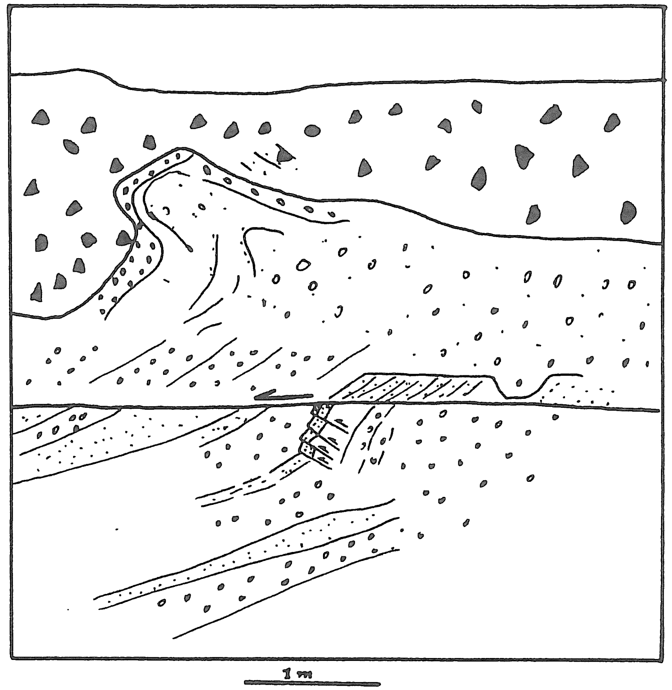

Figure G2 Glaciotectonic structures near Ballymacoda

G2 Ballymacoda (WPW)

A small gravel pit 2 km west of Ballymacoda shows clear evidence of glaciotectonic disturbance. The south working face of the pit shows 4-5 m of coarse gravel and sand dipping gently to the east. The sand/gravel is overlain by a diamicton with angular local clasts which exhibits strong fissility in places. The diamicton is 2-3 m thick. The gravels are faulted and folded with both reverse and normal faults. The reverse faults indicate thrusting from a westerly direction. The gravels are upfolded in a gentle overfold on to the diamicton at the western end of the face and appear more strongly overfolded and sheared into the diamicton east of this. These features also indicate pressure from the west.

At the eastern end of the pit, protruding through the floor a shelly diamicton bed up to 0.5 m thick dips steeply to the southwest. Associated gravel, sand and silt is very contorted. The diamicton and associated gravels seem to have been sheared and folded up into overlying gravels which were removed during gravel extraction leaving the uneconomical finer material behind. This situation illustrates considerable deformation of shelly deposits in association with ice pushing from the west. Striae at Knockadoon Head (Wright and Muff, 1904) underlying till of the Garryvoe Formation indicate a northwest-southeast direction and confirm the interpretation of the glaciotectonic features at Ballymacoda.

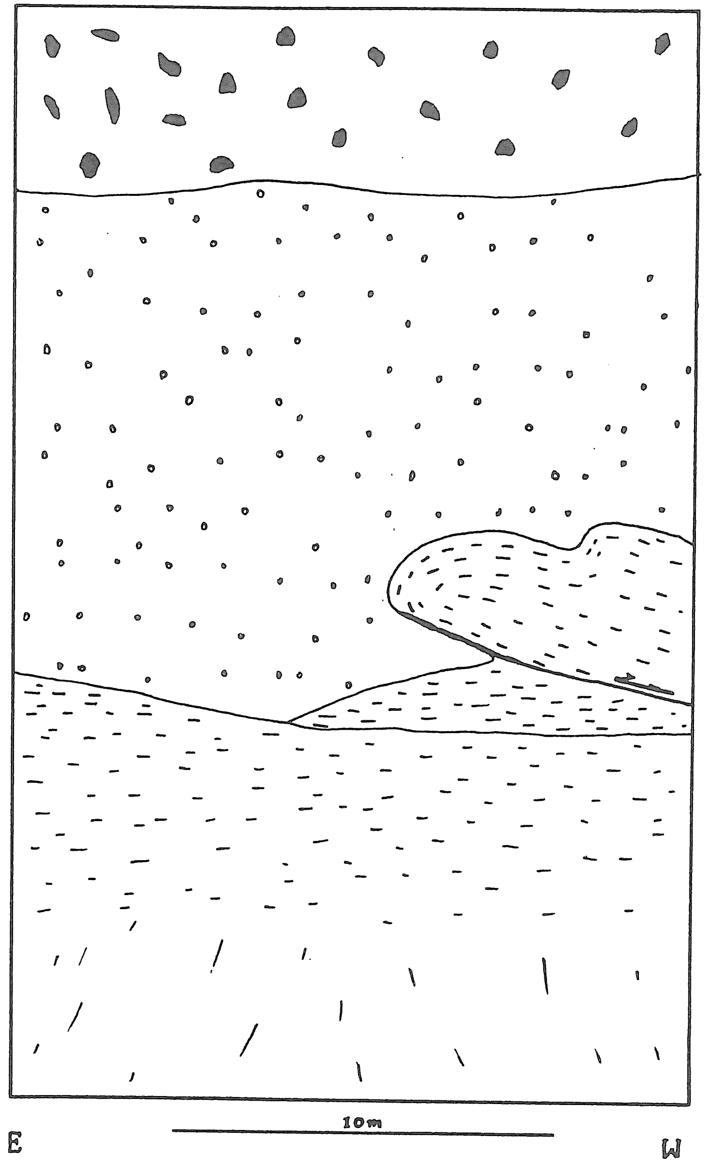

Figure G3.1 Overfolded head at Ballycotton

G3 Ballycotton (WPW)

Immediately southeast of the village of Ballycotton there is a good exposure in the Courtmacsherry Formation (raised beach). It can be clearly seen to be a marine deposit resting on a wavewashed platform and overlain by a terrestrial slope deposit, the Fenit (head) Formation.

Northeast of the village in a section, now rapidly becoming vegetated due to a coastal protection scheme, shelly till of the Ballycroneen Formation overlies, with a sharp contact, the head deposit. A fold was seen at one point along the contact in which the underlying head is overfolded onto the overlying shelly till (Figure G3.1). The fold axis dips to the northwest indicating probable ice movement from that direction. The shelly till is in turn overlain by a till of local onshore provenance (Garryvoe Formation) which is associated with ice from the northwest and was probably deposited by the ice which deformed the two underlying formations.

The type site of the Garryvoe Formation occurs within Ballycotton Bay. The integrity of the Garryvoe Formation is not clear at this site and it will be better seen at Ballycroneen. However as Farrington (1959) referred to sands resting on an eroded till surface at this site as indicating a significant lapse of time between the deposition of the shelly till (Ballycroneen Formation) and the locally derived till (Garryvoe Formation) the following is of note. In so far as can be seen at this poorly exposed site the undulating contact between the shelly till and

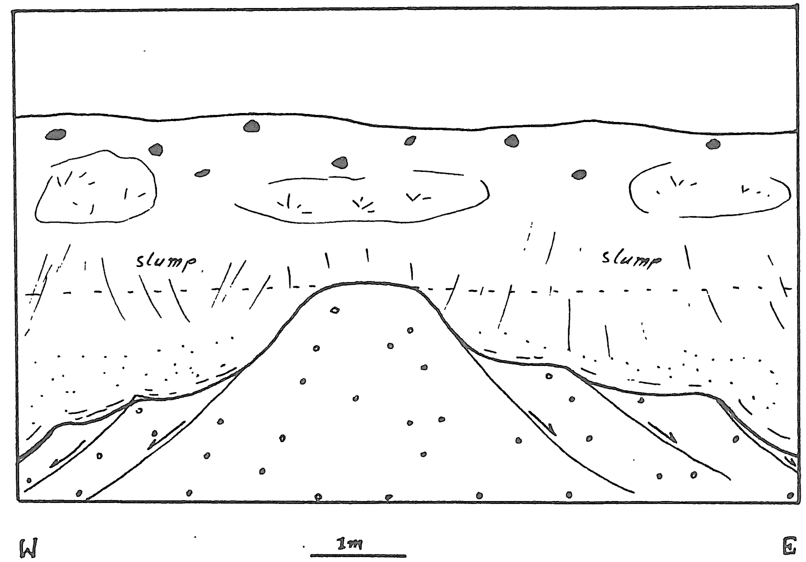

Figure G3.2 Collapse features in Ballycotton Bay the sand is in part at least only apparent. As illustrated in Figure G3.2 below the cliff is scalloped by modern marine action and the buttresses so formed collapse laterally along listric normal faults producing a complex apparently undulating surface in the till. The till surface can often on cleaning the section be seen to extend *in situ* at a higher level behind slumped debris.

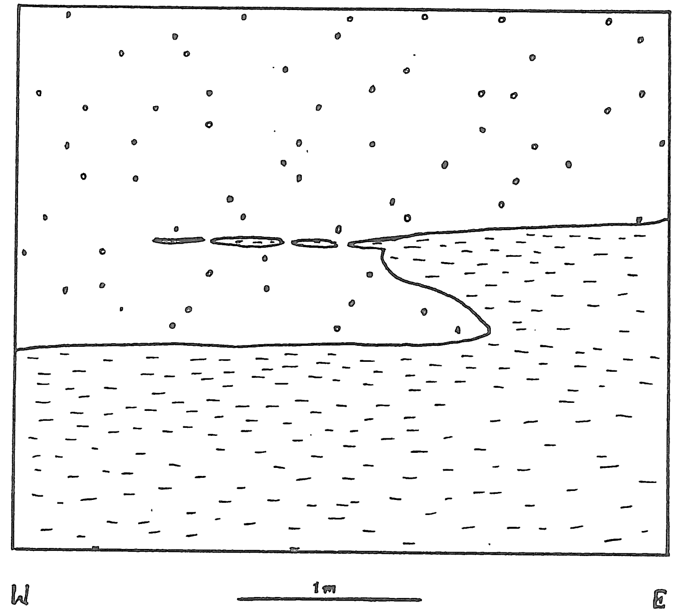

Figure G4 Sheared and dragged head at Ballycroneen

G4 Ballycroneen (WPW)

This is the type site of the Ballycroneen Formation, a shelly diamicton with a clay/silt matrix and an erratic suite of eastern and Irish Sea basin provenance. At the western end of Ballycroneen Bay the shelly diamicton is up to 6-7 m thick and rests with a very sharp contact on coarse head of the Fenit Formation. The underlying head is frequently contorted, with tabular clasts upended (vertical a/b plane) and with open interstitial spaces. This suggests a basal till deposition rather than subaqueous deposition. Frequently the erected clasts occur in a pod 0.3 - 0.5 m in diameter which is entirely clast supported with very open interstices. The shelly diamicton is very compact and appears structureless. It is overlain by a red/brown diamicton with occasional sand and gravel lenses. The contact between the diamictons is not always clear but it is sharp where seen.

The sharp contact between the shelly diamicton and the head is maintained towards the centre of the bay but in places in the centre of the bay thin packages of head material are incorporated into the base of shelly till. That this is a function of shearing and dragging (glacial deposition) is clear from the geometry of the units (Figure G4).

Along the length of the bay it can be seen that the shelly till/head contact undulates gently with three high points and three troughs illustrating as was recognised by Wright and Muff (1904) that the head is composed of a series of fans.

The upper red/brown diamicton is composed largely of local rock and appears to represent an ice sheet that extended from the Kerry/Cork mountains to the west (see sites G2 and G3).

Along this section flints are very plentiful in the shelly till, volcanic clasts are very common and occasional granite is seen.

At the eastern end of the bay the sequence is seen resting on bedrock. The Courtmacsherry Formation (raised beach) is preserved in sheltered localities where it is overlain by head and shelly till. Elsewhere the shelly till rests on a thin head which is little more than shattered bedrock. This is overturned and can be traced southwestwards away from the centre of the bay. This overturning seems to be due to glacial action.

G5 Sandyhill (WPW)

Sandyhill lies slightly below and to the north of the summit of an east-west trending ridge which acts as an interfluve between the River Bride to the north and the Lee and Womanagh to the south. Kame and delta gravels occur scattered along this ridge the most extensive deposit being that at Watergrasshill.

At Sandyhill the gravels are composed dominantly of Devonian sandstone with persistent Carboniferous chert. At the working face topset and foreset delta gravels are exposed. The foresets dip to the south and suggest a small ice damned lake between an ice sheet to the north and the ridge top to the south. The rest of the gravels are generally poorly exposed but the bedding seems chaotic in places.

These gravels and others both on the ridge top and in the upper reaches of the valleys on the southern side of the ridge seem to relate to the deglaciation of the area when down-wasting ice ponded water in the upper reaches of the valleys into which it fed deltaic deposits. It is likely that ponded water collected between stagnating blocks of ice in the major valleys. Such ponds may have drowned the ridge tops and allowed glaciolacustrine deposits to form.

G6 Ballyclough North (SD)

See outline description of the soils (pp 17 - 19)

Series:	Kill
Location:	Waterford. Ballyclough N S551053
Classification:	Typic Dystrochrept (Brown Earth)
Parent Material:	Till. Acid volcanic
Drainage:	Well
Topography:	Undulating
Slope:	2^{o}
Altitude:	65 m
Land-use:	Permanent pasture

Horizon	Depth (cm)	Description
A11	0-10	Brown (10 YR 4/3); loam; common medium and small stones; weak to moderate medium granular; friable; semi-deformable; moderately plastic (wet); abundant very fine diffuse roots.
A12	10-20	Brown (10 YR 4/3); loam; common medium and small stone; weak to moderate medium granular; friable semi-deformable; moderately plastic (wet); many very fine roots; clear wavy boundary.
A13	20-30	Brown (10 YR 4/3); loam; common medium and small stones; weak to moderate fine subangular blocky; friable semi-deformable; moderately plastic (wet); many very fine diffuse roots.
A14	30-40	Brown (10 YR 4/3); loam; common small to large stones; weak to moderate fine subangular blocky; friable, semi-deformable; moderately plastic (wet); many very fine diffuse roots; clear wavy boundary.
B2 ir	40-50	Strong brown (7.5 YR 5.5/6); loam; many small to large stones; weak, coarse breaking to fine sub-angular blocky; friable semi-deformable; moderately plastic (wet); abundant very fine pores; common very fine diffuse roots; clear broken boundary.
C1	50-75	Pale brown (10 YR 6/2) and yellowish brown (10 R 5/4); loam; many small to large stones; massive; very firm, brittle; moderately plastic (wet); many very fine pores; few very fine vertical roots.

C2	75-100+	Pale brown (10 YR 6/3) and yellowish brown (10 R 5/4); silt loam; abundant small to large stones; massive; very firm, brittle; moderately plastic (wet); many very fine pores; few very fine vertical roots to 100 cm

Kill Series - Analytical Data

Depth (cm)	0-10	10-20	20-30	30-40	40-50	50-75	75-100
Coarse sand % 200-2000 mic	21	20	19	20	15	27	23
Fine sand % 200-50 mic	14	13	13	13	11	15	14
Silt % 50-2 mic	43	46	47	46	55	42	50
Clay % 2 mic	22	21	21	21	19	16	13
T.N.V. %	0.6						
Exch. Cations meq/100g:							
Ca	14.1	14.1	11.7	9.8	8	2.6	1.9
Mg	0.41	0.34	0.27	0.27	0.2	0.14	0.14
K	0.36	0.14	0.1	0.1	0.04	0.03	0.03
Na	0.39	0.08	0.09	0.1	0.12	0.1	0.06
(T.E.B.)	15.26	14.66	12.16	10.27	8.36	2.87	2.13
Cation Exch. Cap. meq/100g	27.6	25.1	22	17.4	18	7.8	4.6
Base Saturat. %	55	58	55	59	46	37	46
pH	7.1	6.8	6.7	6.5	6.8	6.5	6.4
C%	2.9	2.5	2	1.6	1.3	0.4	0.3
N%	0.28	0.26	0.22	0.18	0.12	0.03	0.02
C/N	10.4	9.6	9.1	8.8	10.8		
Free Fe_2O_3	1.1	0.8	1.3	1.1	1.8	1	0.9

Kill Series - Analytical Data

Depth (cm)	0-10	10-20	20-30	30-40	40-50	50-75	75-100
Horizon	A11	A12	A13	A14	B2ir	C1	C2
Dp	2.46	2.45	2.5	2.53	2.57	2.64	2.65
S20	4.25	4.25	5.02	4.81	7.01	4.19	2.9
S60	7.25	8.25	12.28	14.7	15.03	6.86	4.68
S141	9.81	11.33	16.48	19.04	19.7	8.8	5.9
Pv20	54.83	54.5	49.41	51.78	52.72	37.63	32.48
Pv60	52.11	51.19	42.31	41.96	44.97	35.03	30.87
Pv141	49.56	48.11	38.1	37.63	40.26	33.09	29.65
PwpF 4.2	13.31	13.43	10.08	9.03	7.75	5.75	5
PvpF 4.2	15.71	17.46	12.4	10.93	8.99	9.6	9.1
St/100	52.14	47.44	50.73	52.15	54.85	36.78	31.74
Pv 0	59.12	58.74	54.43	56.58	59.74	41.82	35.38
Db at Sat	1.18	1.29	1.23	1.21	1.16	1.67	1.81
Db at 60 cms	1.18	1.3	1.23	1.21	1.16	1.67	1.82
A.W.C. %	36.4	33.73	29.91	31.03	35.98	25.43	21.77
A.W.C. (cm)	3.64	3.37	2.99	3.1	3.6	6.36	5.44
Σ A.W.C.	3.64	7.01	10	13.1	16.7	23.06	28.5

G7 Garrarus (IMQ and MB)

Bedrock Geology

Part of the Ordovician sequence is exposed at Garrarus Strand. West of the entrance to the strand nodular fossiliferous limestones of the Tramore Limestone Formation (Llandeilo) are overlain by black shales. This sequence marks a pause in volcanic activity after a major episode of basic volcanism and before a period of acid volcanism. Numerous intrusions of lava into unconsolidated sediment can be seen along the cliff face. Some galena and sphalerite (lead and zinc) mineralisation is seen near the stream. The headland west of the stream is a massive andesite (intermediate) body. east of the entrance to the cove a bedded sequence of coarse volcaniclastic sediments is cut by several andesite intrusions. (MB)

Quaternary Geology

The following is a generalised record of observations made at different points along the section exposed at Garrarus Strand:

3.14 m calcareous till containing striated ORS, conglomerates, limestones, shales and volcanic clasts. The sequence thins to east and west.

1 m head (angular volcanic clasts of local origin). resting on rock platform

Patches of shelly raised beach cemented to the sides of buttresses in the raised shore platform are recorded at five

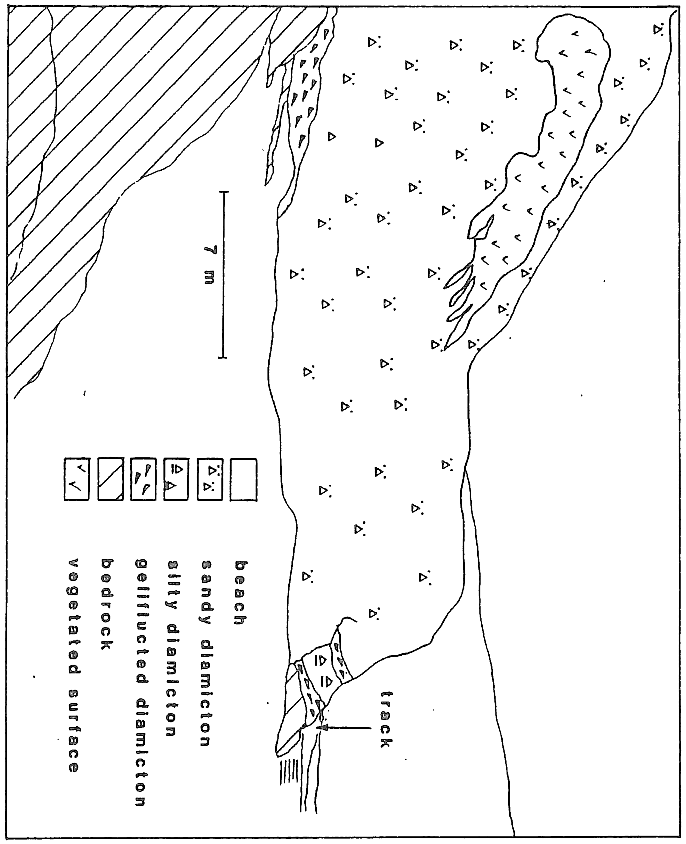

Figure G7 Sketch of section at Garrarus (Caher) sites in this locality at approximately 2 m OD. This deposit is thought to be of relatively recent age i.e. Post-Glacial age because of its organic content, restricted outcrop and isolated location outside the Quaternary stratigraphic column.

Immediately to the west of the slipway, in the townland of Caher (X547984), the following sequence may be observed (Figure G7):

5. 1.5 m gelifluted diamicton
4. 3.5 m stony diamicton
3. 0.3 m head, separated by a sharp planar contact from the units above and below
2. 0.7 m calcareous shelly, silty diamicton, separated by sharp planar contact from the underlying unit
1. 1.0 m head resting on rock platform

A sample taken for textural analysis from the wedge of lower, relatively stone-free silty diamicton shows that 58% of the matrix below 37.5 mm in diameter is composed of silt sized particles (2- 50 microns), 14% is composed of sand and the remainder (28%) gravel; The petrography of the phenoclasts in the lower diamicton is dominated by the volcanic content (98%), with very small amounts of chert (1.5%) and sandstone (0.5%). The matrix of the sediment is therefore erratic in origin; while the contained clasts are of extremely local origin. The sediment has a fabric with the modal values of the 'a' axes being oriented northeast/southwest ($40^{o}/220^{o}$) and dipping to the southwest. The upper diamicton contains 8% clay, 54% silt, 15% sand and 23%

gravel. The petrography of the phenoclasts is predominantly volcanic (86%), sandstone (7%), chert (3%), limestone (3%) and shale (1%). The fabric is similar to that of the underlying unit.

Interpretation

It is most probable that the fabric of the lower sediment has been reoriented by glacial tectonic processes (c.f. Warren, 1987). Although no shear planes are evident throughout the exposed sequence, this is hardly surprising owing to the sandy nature of the matrix. Many of the bases of the larger elongated clasts do however appear to be arranged parallel to each other in the basal layers of the section when traced in a northerly direction. Such a pattern would be consistent with shearing and reorientation of clasts in the substrate below the ice/till interface. Thus both the silty diamicton and the overlying head unit were probably sheared into their present stratigraphic position.

The stratigraphic significance of the discontinuous upper head lens and the underlying wedge of silty diamicton is therefore restricted to order of sedimentation i.e. the deposition of the silty sediment antedated that of the overlying diamicton. However the head unit was probably picked up from the surface of the lower head unit at the base of the icesheet some distance to the north and rafted or sheared into its present position over the silty diamicton to produce a multiple head and diamicton sequence.

There is no evidence to suggest that the two diamictic sediments were deposited in separate glacial events separated by a phase of gelifluction as hitherto suggested (Mitchell *et al.*, 1973). The entire sequence overlying the lower head unit is therefore interpreted as initial invasion of the area by ice of Irish Sea basin origin. This was followed by an advance of ice of northern inland origin with deposition by basal meltout and shearing being followed by subglacial lodgement. (IMQ)

G8 Leperstown (SD)

Series:	Cloghernagh
Location:	Waterford. Leperstown S660017
Classification:	Typic Haplaquept (Gley)
Parent Material:	Shale till, few sandstones
Drainage:	Poor
Topography:	Gently sloping
Slope:	3^o
Altitude:	45 m
Land-use:	Old pasture

Horizon	Depth (cm)	Description
A11	0-10	Greyish brown (10 YR 5/2); loam; few small stones; weak fine granular becoming medium with depth; friable slightly firm in places; plastic (wet); abundant very fine diffuse roots.
A12	10-20	Brown (10 YR 5/3); loam; few small stones; weak to moderate medium granular; friable semi-deformable; moderately plastic (wet); abundant very fine roots; clear wavy boundary.
Bg	20-40	Light grey (10 YR 7/2) with abundant yellowish brown (10 YR 5/8) coarse mottles; clay loam; common small stones; weak coarse and very coarse subangular blocky; firm; semi-deformable; moderately plastic (wet); common very fine pores; common vertical very fine roots; clear wavy boundary.
C11	40-67	Grey (2.5 Y 6/0) with many strong brown (7.5 YR 5/6) coarse mottles and common coarse black manganese mottles; clay loam; common small stones; massive; moderately strong; brittle; moderately plastic (wet); few very fine pores; few very fine roots; grey (2.5 Y 6/0) tongues occur at 1 m intervals with many coarse strong brown (7.5 YR 5/6) mottles; very weak coarse prismatic structure; firm; gradual wavy boundary.
C12	67-100	Grey (2.5 Y 6/0) with abundant coarse strong brown (7.5 YR 5/6) mottles; clay loam; common small and medium stones; massive; firm; semi-deformable; very plastic (wet); few very fine pores; very few vertical roots; diffuse boundary; grey tongues 1 cm wide occur at 25 cm intervals.
C21	100-150	Brown (10 YR 5/3) with common medium grey (2.5 Y 6/0) mottles and tongues; massive; firm; few pores; no roots; many small stones.

C22	150-180	Brown (10 YR 5/3) with common (5%) medium grey (2.5 Y 6/0) mottles and at 50 cm intervals grey (2.5 Y 6/0) tongues, 1 cm wide with yellowish brown (10 YR 5/6) rim 0.5 cm wide; clay loam; many small shaley stones; few large grey sandstone; massive; firm; very plastic (wet); few fine pores; no roots.

Cloghernagh Series - Analytical Data

Depth (cm)	0-10	10-20	20-40	40-67	67-100	100-150	150-180
Horizon	A11	A12	(B)g	C11	C12	C21	C22
Coarse sand % 200-2000 mic	28	34	21	19	20	19	19
Fine sand % 200-50 mic	12	11	11	11	9	10	10
Silt % 50-2 mic	34	32	37	40	41	38	38
Clay % 2 mic	26	23	31	30	30	33	33
T.N.V. %		1	0.2	0.3	0.5	0.3	0.7
Exch. Cations meq/100g: Ca	16.9	14.8	7.5	9.1	9	6.3	6.3
Mg	0.9	0.3	0.1	0.4	1.6	2.2	2.14
K	0.13	0.06	0.04	0.05	0.06	0.06	0.06
Na	0.28	0.12	0.12	0.18	0.12	0.12	0.14
(T.E.B.)	18.21	15.28	7.76	9.75	10.88	8.68	8.6
Cation Exch. Cap. meq/100g	27	25.2	15	11.6	11	10.1	9
Base Saturat. %	67	61	52	84	99	86	96
pH	6.5	7.3	7.9	7.8	8	8	7.9
C%	4.7	2.4	0.4	0.3	0.2	0.2	0.3
N%	0.4	0.24					
C/N	11.8	10					
Free Fe_2O_3	2.2	2	4.2	2.4	3.8	3	3.7

Cloghernagh Series - Analytical Data

Depth (cm)	0-10	10-20	20-40	40-67	67-100	100-150	150-180
Horizon	A11	A12	(B)g	C11	C12	C21	C22
Dp	2.38	2.49	2.63	2.66	2.67	2.68	2.68
S20	5.95	1.21	1.11	1.4	1.61	2.21	1.5
S60	9.77	3.57	4.46	4.21	4.34	4.35	4.67
S141	13.36	6.46	6	5.15	5.55	5.45	5.84
Pv20	56.82	51.07	45.73	36.76	36.63	35.49	40.18
Pv60	54.78	48.9	42.65	34	32.18	33.75	37.74
Pv141	51.18	46.02	41.11	33.06	30.98	32.65	36.57
PwpF 4.2	15.22	11.47	12.21	10.77	11.08	10.56	10.78
PvpF 4.2	12.33	14.34	18.68	19.49	20.05	19.54	19.19
St/100	66.82	49.93	42.03	32.22	32.74	31.93	34.72
Pv 0	62.77	52.27	46.84	38.16	38.24	37.7	41.67
Db at Sat	0.79	1.24	1.52	1.8	1.8	1.82	1.75
Db at 60 cms	0.81	1.25	1.53	1.81	1.81	1.85	1.78
A.W.C. %	42.45	34.56	23.97	14.51	12.13	14.21	18.55
A.W.C. (cm)	4.24	3.46	4.8	3.92	4	7.1	5.56
Σ A.W.C.	4.24	7.7	12.5	16.4	20.4	27.5	33.06

Key to Soil Physical Analyses

Dp	Particle density
Db	Bulk density
S20	% soil volume drained under suction of 20 cms
S60	% soil volume drained under suction of 60 cms
S141	% soil volume drained under suction of 141 cms
Pv20	% water content by volume at 20 cms
Pv60	% water content by volume at 60 cms
Pv141	% water content by volume at 141 cms
PV 0	% water content by volume at saturation
St/100	Total airspace
PwpF 4.2	Water content by weight at 15 .bar
PvpF 4.2	Water content by volume at 15 .bar
A.W.C.	Available water capacity
ΣA.W.C.	Sum of available water capacity to specified depth

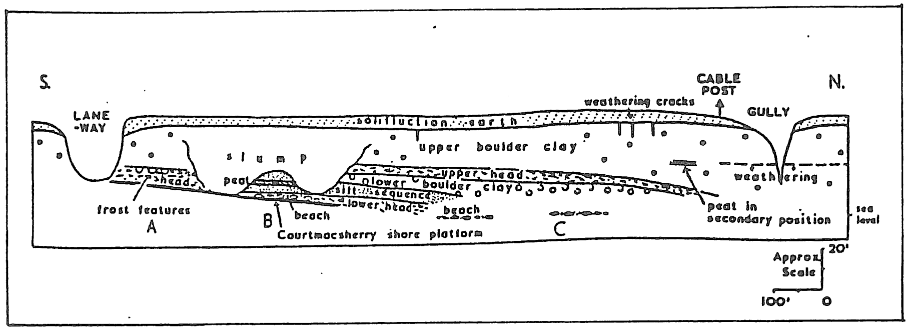

Figure G9 Sketch of Newtown section after Mitchell (1962)

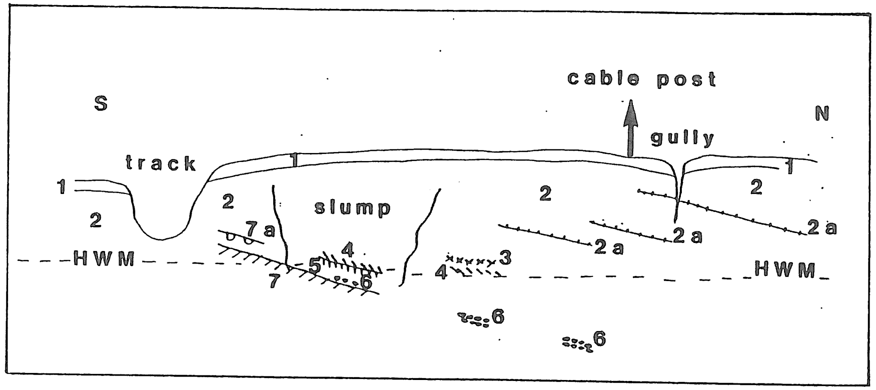

Figure G9(ctd) Sketch of Newtown section after Mitchell (1989)

1 Frost-disturbed till.
2 Till with occasional large limestone blocks; fabric indicates movement from northwest (Stevens, 1959).
2a Thrust planes indicated by leaching.
3 Head.
4 Upper silt.
5 Peat (older than 38,000 years, Birm. 89) and lower silt.
6 Beach gravels with numerous erratics.
7 Shore-platform of rock.
7a Frost disturbances in top layers of rock.

G9 Newtown S703081 (IMQ)

The following sequence has been observed in the cliffs to the south of the Cable Post although they currently present a fairly slumped and vegetated profile (Figure G9):

6. 1-2 m cryoturbated diamicton
5. Diamicton with WNW/ESE orientation of fabric
4. Diamicton with NNW/SSE orientation of fabric. This unit contains more clasts towards the base. The clasts are arranged with their long axes subparallel to each other to produce a pseudostratified appearance reminiscent of the basal layers of the upper diamictic unit at Garrarus.
3. Diamicton with angular clasts (head) which dips to the north and appears to grade laterally into the head unit which underlies the upper diamicton on the north side of the Cable Post.
2. Lower diamicton with WNW/ESE orientation of clasts, and a balanced modal dip indicative of sedimentation by glacial as opposed to gelifluction processes. This unit is wedge-shaped and pinches out to the north. The base of this unit was not seen. However, at approximately the same stratigraphic position to the north and south the following units were observed:
1. 1-2 m cryoturbated diamicton containing angular clasts (head) and occasional erratics of northern provenance resting on the raised shore rock platform.

Cemented and indurated beach gravels are found on the foreshore although they have not been recorded as actually underlying the sequence at Newtown. Likewise, the contact between the silts and organic material and the overlying sequence has not been observed or recorded as it has been obscured by slumped diamicton.

Petrologically there appears to be some contrast between the upper and lower diamictons in the Newtown sequence. The upper diamicton contains higher proportions of extra-local petrologies, namely, volcanic and sandstone lithologies. Texturally, also there is a marked contrast between the two diamictic units: the matrix of the lower diamicton is loamy sand (i.e. it appears to represent a 'washed' or eluviated aspect similar to that of gravels); whereas that of the upper facies is loamy in character.

Occasional silty lenses up to five centimeters in thickness and containing derived organic matter cropout in the upper diamicton approximately 4 m above the base of the unit. They extend along a north/south axis for approximately 1-2 m and do not appear to extend into the cliff face for any considerable distance. Parallel laminations within the lenses are not significantly disturbed and lateral and vertical junctions between the lenses and neighbouring sediments appear to be gradational.

Further north where the upper diamicton comes directly in contact with the underlying diamicton containing angular clasts (head), the contact between the two units is marked by a distinct and laterally continuous, parting composed of a fine sandy unit approximately 5 mm in thickness, over 30 m in length and 0.6 m O.D.

Interpretation

The lower diamicton is regarded as a basal lodgement till because of its massive character, erratic content and defined fabric. No sedimentological variations were observed within the unit. However it is possible that its original structural characteristics were removed by overriding ice.

The head unit which separates the lower and upper diamictons appears to have been drawn out in a southerly direction. It may be regarded as a glacially reworked unit through basal entrainment from a position further upglacier and subsequent redeposition as a partially rafted unit some distance downglacier. This thin intervening head unit probably acted as a plane of decollement as the fabric in the underlying unit appears to have retained a strong east/west orientation quite at odds with the north/south trend in the lower layers of the upper diamicton.

The lower, "stratified", stony layers of the upper diamicton probably represent meltout along shear planes at the warm-based front of an ice mass of inland origin (Boulton and Paul, 1976). This facies grades up into the overlying massive diamicton characteristic of lodgement till (Dreimanis and Lundquist, 1984).

The entire sequence above the lower head and cryoturbated platform at Newtown is therefore referrable to a single glacial event. Unfortunately the entire sequence at Newtown is nowhere

observed to directly overlie the raised beach. However the probability is that the sequence does in fact post-date the formation of the raised beach. However if the lower head unit is substituted as a local stratigraphic marker horizon, then the lithostratigraphic sequence which lies above it may be correlated with other outcrops of the Ballyvoyle Member throughout County Waterford.

P1. Belle Lake (RJD)

Sediments at Belle Lake and Coolteen were studied by Dr. Alan Craig in the late 1970s (Craig, 1978), and the contained pollen record examined. This led to regional vegetation-environmental reconstructions. The lakes showed a thick sequence of sediments with a particularly detailed late-glacial environmental record spanning the period from about 12,500 - 10,000 BP. The palaeoenvironmental reconstructions supported coloeoptera evidence from elsewhere in Ireland and Britain for a severe climate at the end of this time period. Subsequent studies on Belle Lake by Helena Feehan (UCC) have focused upon the description of the post-glacial vegetational history and impact of human activity in the lake's area.

A1 Knockeen S 5754 0648 (MM)

This is one of the finest portal tombs in Ireland and displays many diagnostic features of this type of tomb. It is built on high ground and is facing up the slope. The tomb is complete with two portals, sill stone, two side stones and back stone. It is remarkable in that it has a subsidiary capstone over the backstone and supporting the main capstone. This was probably necessitated by the low height of the back and sidestones in relation to the portal stones.

A2 Carriglong S 5908 0503 (MM)

This is one of the five entrance tombs in Waterford. Recently O'Nuallain (1986) has re-examined these tombs and has re-classified two of them, though not this one, as wedge tombs. The entrance tombs have a circular cairn defined by a kerb and the passage broadens out from the entrance inwards (Figure A2). They are all aligned to the east or south east. In this respect they conflict with wedge tombs which usually open to the south west and the cairns of wedges are usually D-shaped with a shallow court at the entrance. This tomb was excavated by Powell (1941b) but the finds were disappointing; eighteen sherds of undiagnostic pottery and three thumbnail scrapers were recovered.

A3 Castletown Henge-type Monument S 6104 0468 (MM)

The change from the Neolithic to the Bronze Age was a traumatic time everywhere, creating new sources of wealth, and new social groups, ideologies and rituals to cope with it. The new rituals

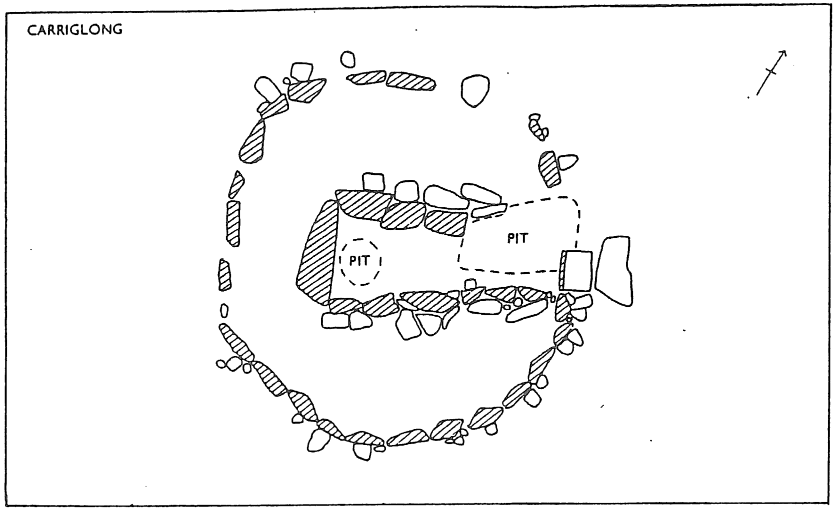

Figure. A2 Plan of Carriglong Entrance Tomb

were centered on large, open-air enclosures as exemplified by the classic sites of Stonehenge and Avebury in Britain. Henges are generally unknown in Ireland outside the Boyne valley but this example at Castletown is one of the few recognised outside that area. It is unusual in that it is sited on a hill, since the Boyne henges are all lowlying. It is defined by a large earthen bank 11 m wide at the base and 2 m to 2.5 m high. Henges do not have an external fosse and usually have a shallow, wide depression inside the banks probably marking the area from where the bank material derived. At Castletown only the bank at the north east and south west is original. The bank at the north west is altered and it is removed at the south east. It measures about 90 m north east - south west and 80 m north west - south east. Castletown does not have an inner fosse but there is quite a deep broad pit at the southern end. It is only the massive nature of the bank which identifies this site as a henge. Henges usually have two opposed entrances but these may have been removed in the destroyed parts of the bank.

A4 Lisselty - Corbally More S 625 002 (NM)

Along the east side of Rinnashark Harbour, preserved in the low cliff face and at the junction of the boulder till with the overlying blown sand deposits, is evidence of extensive prehistoric activity. This activity is in the form of a number of small stone-lined hearths cut into the boulder clay, associated charcoal spreads and a fulacht fiadh. All are present in section in the cliff face. Fulachta fiadha are ancient cooking places which today are present as mounds of fire-cracked stones in a charcoal-rich matrix and in general date to the first millennium B.C. It is likely that the hearth sites at Lisselty are contemporary with the fulachta fiadha.

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