Curran Point, Larne, County Antrim: The Type Site of the Irish Mesolithic

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CURRAN POINT, LARNE, COUNTY ANTRIM:
THE TYPE SITE OF THE IRISH MESOLITHIC

By HALLAM L. MOVIUS, Jr.

WITH SECTIONS BY

Knud Jessen, W. S. Benninghoff, (Mrs.) N. F. McMillan, Arthur Earland and
(Mme.) Paul Lemoine

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ABSTRACT

The Early Post-Glacial section revealed at the site excavated in 1935 on Curran Point, Larne, County Antrim, by the Harvard Archæological Expedition to Ireland shows a most interesting and important sequence of depositionary processes, changes in the mutual relations of land and sea, as well as contemporary climatic and ecological changes. The series of strata exposed in a pit 5-00 metres square and over 8-00 metres deep have been studied not only from point of view of a mechanical method of sediment analysis, but also on the basis of their contained fauna. No polleniferous deposits were encountered, but a nearby locality on Island Magee has provided the information necessary for tying in the Curran Point section with the palæobotanical zone sequence for Northern Ireland. A total of 116 species of mollusca, 92 species of foraminifera, and 5 species of calcareous algae was collected, and a detailed study of these, together with the results of the analysis of the sediments, has led to a clear understanding of the changes of level that have taken place in the region during Early Post-Glacial times. On the basis of these data it is now possible to establish more accurately than had previously been done the interval covered by the climatic optimum, or Early Post-Glacial warmth maximum, in terms both of the stratigraphic sequence of the coastal localities in Counties Antrim and Down, and the palæobotanical succession worked out for this region. It is demonstrated that this event does not correspond with the maximum of the transgression of the Early Post-Glacial Sea, as was formerly supposed. Furthermore, it can now be shown that the later stages of the submergence were interrupted by a second relatively minor phase of sinking, following which the movement of emergence began, the maximum of the transgression having been attained during the transition from Late Atlantic to Early Sub-Boreal times in terms of the climatic succession.

The archaeo logical wealth of Curran Point, Larne—the type locality for the Irish Mesolithic—was first recognized in 1863. Presumably during the long interval of relative stability represented by the Estuarine Clay (Deposit H) at the site, the Late Larnian Culture, so abundantly represented in the Curran deposits, was developed. The numerous foreshore localities in the region apparently were transgressed by the sea during the second phase of the sinking, and their contents were transported by long-shore currents and wave action into the intertidal sand and gravel deposits that were being laid down on the rapidly growing spit that was then being formed at the northern end of Larne Lough, now known as Curran Point. A statistical analysis of over 5,500 artifacts belonging to the Late Larnian Culture and found at the excavated site is given, together with illustrations and descriptions of the various types of tools characteristic of the assemblage as a whole. In this development of the Irish Mesolithic several new and interesting classes of implements were devised in response to the exigencies of the new environmental conditions. In Part IV the origin of
the Larnian Culture, its affinities with contemporary developments in Scotland, and the nature of the cultural influences which affected the various Mesolithic complexes in Northern Britain and Ireland as a whole is considered. It is concluded that, contrary to the generally accepted view held by many authorities, the Azilian of Southern France and the Pyrenean region never reached the areas under consideration. On the other hand the diffusion of certain Forest Culture traits, of ultimate Baltic origin, is believed to account for the appearance of perforated antler tools and also for certain types of barbed bone points in the Scottish Mesolithic, as well as for the sporadic occurrence of bifacial core axes in the Late Larnian of North-eastern Ireland. Finally, it is suggested that the Bann Culture of the region immediately north of Lough Neagh, which persisted throughout Sub-Boreal times, represents a continuum in Ulster of a fundamentally Mesolithic way of life, long after the introduction of the new arts of agriculture and metallurgy.

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It is with great pleasure that I take this opportunity on behalf of the 1935 Harvard Archaeological Expedition to Ireland of acknowledging the very kind and generous assistance of the following, without whose co-operation and help in many ways the investigation of the Larne site and the preparation of this report would not have been possible:

The Ancient Monuments Advisory Committee of Northern Ireland for granting the Expedition permission to carry out the work.

The American Council of Learned Societies, the American Philosophical Society, the Division of Anthropology of Harvard University, and a large number of private individuals for financial assistance.

The Ministry of Finance of Northern Ireland for kindly allowing the Expedition to participate in the Northern Irish Government's Unemployment Relief Scheme, which materially helped to defray the labour costs of the Larne excavation.

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A. D. Lacaille, Esq., F.S.A., of the Wellcome Historical Medical Museum, London, whose enthusiastic support and information generously provided concerning the Scottish Mesolithic material has made it possible for me to present a far more comprehensive picture of the important contemporary developments in that country than would have otherwise been possible. Not only did Mr. Lacaille graciously make available to me his very important unpublished data bearing on the Obanian Culture, but also he has brought to my attention a wealth of published material of the existence of which I would not otherwise have been aware.

In addition to my colleagues in the Division of Anthropology and the Peabody Museum of Harvard University, I wish to acknowledge the advice and assistance of the late Professor Kirk Bryan and Professor Marland P. Billings, both of the Division of Geological Sciences; Professor Karl Terzaghi of the Harvard Engineering School; and Dr. William J. Clench of the Museum of Comparative Zoology, in connection with the preparation of this report.

Finally, I am grateful to Miss Helen A. Cabot for the drawings of the maps, sections, and diagrams; my wife for the drawings of the flint implements; and Mrs. Margaret Snyder for typing the manuscript.
PART I—INTRODUCTION

1. Regional Setting

Larne, or Latharna (see Macalister, 1921, p. 67), which lies on the County Antrim coast some eighteen miles north-north-east of Belfast, was known to antiquarians as early as 1863. It is the classic site of the Irish Stone Age, and an historical summary of the investigations there prior to 1935 has been published elsewhere (Movius, 1953). In the vicinity of Larne deposits of Early Post-Glacial age have an extensive distribution, but the water-laid sands and gravels of Curran, or Corrán, 1 Point are by far the most prolific of human implements manufactured of local flint. "The Curran," as the point is known locally, is a long, tapering and sickle-shaped spit; it forms an extension of the coast southward into the narrow entrance of Larne Lough. The Curran deposits consist of stratified beds formed under intertidal conditions, as demonstrated by the fact that they often exhibit colonies of marine shells still in the position in which they lived (Praeger, 1890, p. 202; Coffey and Praeger, 1904, p. 147). These shells, which are described by Mrs. McMillan in Appendix III, once contained animals which crawled about on the foreshore between tides or in shallow water.

Larne Lough is a large inland bay cut off from the sea by a long peninsula. This peninsula, the axis of which is roughly north-south, is known as Island Magee (Fig. 1). Both the Curran and Island Magee are situated on the west side of the lough, at the northern end of which lies the town of Larne. In height above high-water level, the Curran varies from 6 to 26 feet (approximately 20 to 40 feet above O.D.), and it is about three-quarters of a mile long. As shown on the map (Fig. 2, p. 18), the site excavated by the Harvard Archaeological Expedition to Ireland in 1935 is located near the extreme southern portion of the Curran (see Pl. I, Fig. 1). The main purposes of this excavation were (a) to check pre-existing data, (b) to obtain a large series of documented archaeological specimens, and (c) to secure additional information concerning the nature of the Early Post-Glacial sediments—their relative age, as well as the natural agencies involved in their deposition—of which Curran Point has been built.

2. Nomenclature

At the outset the question of the nomenclature that has been adopted with reference to the gravel and sand deposits recording the transgression of the Early Post-Glacial sea should be made clear. The history of this submergence is abundantly documented at the Larne locality investigated in 1935. Elsewhere the present writer (Movius, 1942, p. 86) has referred to this event as the LITORINA SUBMERGENCE, and to the contemporary marine formations now occurring above sea-level as LITORINA RAISED BEACHES, on the

1. Irish for sickle.
Fig. 1—Map showing Localities in North-eastern Ireland.
basis of the common occurrence of the Periwinkle, *Littorina littorea*, as the characteristic fossil. This nomenclature was suggested since (a) the generally used term "25-Foot" Raised Beach is an obvious misnomer, because its elevation is by no means constant; (b) the designation "Early Neolithic" Raised Beach, proposed by Wright (1928, p. 99) and recently adopted by Steers (1948, p. 494; compare footnote on p. 112), is based on a misunderstanding of the significance of the contained human industry; and (c) the more correct reference to it as the "Mesolithic" Raised Beach (McCallien, 1937, p. 196) is rejected, inasmuch as it only perpetuates the very bad practice of naming geological deposits on the basis of archaeological terminology. But, as Lacaille (1948, p. 167) has pointed out, "it seems undesirable to confuse a British (and Irish) coastal feature with the memorial of a submergence in the Baltic trough." In this report, therefore, the formation under discussion, which is of wide geologic and archeologic interest, is referred to as the EARLY POST-GLACIAL RAISED BEACH, as proposed by Lacaille (1951, p. 105, footnote 2), although a more precise term would be desirable.

3. **Summary of the Geological Sequence in the Larne Area**

This outline of the geology of the region under consideration is based for the most part on work of the Geological Survey of Ireland (Hull, 1876; 1878) with later additions. Actually the survey was begun by G. V. Du Noyer in 1867-68 but was left unfinished until 1876, owing to Du Noyer's death. The deposits which have a bearing on this report are as follows in ascending order:

D. Post-GLacial: Deposits of Peats, Marine Clays, Silts, Sands and Gravels.
C. Pleistocene: Glacial Deposits.
A. Cretaceous: Upper Chalk.

A. **Cretaceous: Upper Chalk**

This is a formation of comparatively pure white limestone; it contains nodules, and occasional bands, of flint which have been formed in the planes of the bedding (Pl. VII, Fig. 1). During the Mesolithic and later Stone Age Periods in Ireland, the Cretaceous Chalk provided an almost inexhaustible supply of flint for manufacture into artifacts.

B. **Tertiary: Volcanic Rocks**

The trachitic and basaltic volcanic rocks which compose this series "are referrable to three distinct periods of eruption, ranging in all probability from

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1. Compare Hume, 1897, pp. 562-563; on page 603 this authority points out the interesting fact that the bands of flint, which are especially abundant near the base of the White Chalk of the Larne area, occur in horizons or zones where fossil sponges attain their maximum development.
the Late Eocene down to the close of the Miocene stages of geologic time" (Hull, 1876, p. 16). At the end of the Cretaceous the sea-bed, on which the flint-bearing chalk had been laid down, was elevated, and its surface was subjected to erosion and weathering, as evidenced by an ochreous gravel, containing red flints (Cleland, 1938; Lamont, 1946), lying in the irregularities on the weathered surface of the chalk (Walton, 1932). When the hot lava poured out on this surface, and the chalk was metamorphosed into limestone, some of the flints in the gravel were cracked by the heat.

C. **Pleistocene: Glacial Deposits**

These deposits, which are generally grouped under the term "drift," belong to the Late Pleistocene, and they consist of several members, as follows (compare Hull, 1876, pp. 32-34; Dwerryhouse, 1923, pp. 373-374; Charlesworth, 1926-a, pp. 45-47; 1939, p. 256 and pp. 277-287; Charlesworth and Hartley, 1948, pp. 16-18; Movius, 1940-b, pp. 3-9; 1942, Chap 11):

(a) Lower **Boulder Clay**—laid down by ice from the Scottish Highlands during the so-called "Old Drift Glaciation" of Britain and Ireland. This ice-sheet overrode North-east Ireland and extended inland as far as a line west of the Bann Valley and Lough Neagh, where it was in contact with local Ivernian Ice.

(b) **Interstadial Deposits**—consisting of stratified sands, gravels, and occasionally laminated clays, which have a limited distribution in North-east Ireland. These deposits were laid down during the Interstadial Period between the "Old" and the "New Drift Glaciations" of Britain and Ireland. During this same interval the sea transgressed the coast of County Antrim. The only deposits thus far discovered which testify to the occurrence of this event consist of the marine beds at Ballyrudder, which contain an arctic fauna (Praeger, 1893).

(c) **Upper Boulder Clay**—Highland Ice, less powerful than during the previous glacial episode, was responsible for this deposit. The union of this ice with the local Irish Ice-Sheets, farther east than formerly, led to the formation of "confocal hyperbolae, more or less symmetrically disposed about Lough Neagh" (Charlesworth, 1939, p. 256). The Upper Boulder Clay of Counties Antrim and Down represents the ground moraine of the "New Drift Glaciation" of Britain and Ireland.

(d) **Boulder Clay of the Scottish or Antrim Coastal Readvance**—for a third time the Scottish Ice advanced on the coastal districts of Counties Antrim and Down, the Ibernian Ice having retreated to a line west of the Lower Bann Valley. This was the final glacial episode in the area, and the details connected with its five retreat stages have been worked out by Charlesworth (1926-a, pp. 45-47;

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1. Elsewhere (Movius, 1940-b, p. 6; 1942, p. 70, Table 5) the present writer has suggested that this event should be correlated with the Pomeranian Stage of Northern Europe, when the Baltic End-Moraines and the Lower Dryas Clays of palaeobotanical Zone I were being formed (compare Godwin, 1947; Conolly, Godwin and Megaw, 1950; Jessen, 1949, p. 214). On this basis the Antrim Coastal Readvance in Northeastern Ireland is of Late Glacial age and antedates the Allerød Period (= Zone II: Late Gotlacial in terms of the North European sequence), when the Reindeer, *Cervus tarandus*, and the Giant Deer, *C. giganteus*,...
1939, pp. 281-287). In the Larne region the record is revealed by a series of extra-glacial lakes; both Lake Kilwainter (ponded below Kilwainter in the valley of the Larne River, south-west of Larne), and Lake Glynn (formed in the Glynn Valley, west of Black Hill) belong to Charlesworth's Stage C—the third stage in the retreat of this ice-sheet. Lake Larne was a glacier-lake of considerable dimensions, " which lay in Larne Lough and drained at its southern end by a dry valley to Whitehead; this lake had no other outlet until it ceased to exist by the withdrawal of the ice from the northern end of Island Magee—" (Charlesworth, 1939, p. 286). Lake Larne may be assigned to Stage D, the fourth stage in the retreat, but it was not finally drained until the beginning of Stage E—the final retreat stage.

(c) The Late Glacial Sea—following the withdrawal of the Scottish Ice from the coast of North-east Ireland, the Late Glacial Sea invaded the region and the land was submerged to a depth of approximately 50 feet below present sea-level. This event, which has been summarized elsewhere (Movius, 1942, pp. 57-60 and Appendix V; see also Steers, 1948, pp. 482-483), resulted in the formation of raised beaches, wave-cut platforms and caves eroded by the sea, which very roughly follow the 50-foot contour-line in County Antrim. In this report, however, it is not proposed to deal with the changes of level which took place during Late Glacial times in consequence of the glacial retreat and the liberation of the land from the effects of the load of ice.

D. Post-Glacial: Deposits of Peats, Marine Clays, Silts, Sands and Gravels

On the basis of present data, it was during this period that Man first appeared in Ireland. In North-east Ireland the Post-Glacial deposits have a very extensive distribution; they may be summarized as follows:

(a) Deposits Referrable to a Period of Relative Emergence. The Post-Glacial history of North-east Ireland begins with a period of relative emergence, during which the land probably stood some 120 feet (20 fathoms) higher with respect to the sea than at present and a partially complete land-bridge existed between

were extant in Ireland (Mitchell, 1941; 1941-a; 1942; Mitchell and Parkes, 1949). This correlation is further confirmed by the fact that at two localities near Belfast peat deposits of Zone II have been identified overlying boulder clays and sands laid down at the time of the Antrim Coastal Readvance (Farrington, 1949, p. 225: Footnote; Mitchell and Parkes, 1949, pp. 297-298; Mitchell, 1951, pp. 156 and 189). Thus, if the Athdown Mountain Glaciation of the Dublin region to the south belongs in Zone III, as Jessen and Farrington (1938; see also Farrington, 1948, p. 34) have shown, this event is certainly not the equivalent of the Antrim Coastal Readvance (a correlation originally suggested by Farrington, 1945, p. 242), but of a younger glacial episode, probably corresponding with the Fennoscandian (Ra—Salpauskis) End-Moraines of Northern Europe.

1. As the sea-level itself has undergone a change since the end of the Glacial Period, all statements regarding depressions and elevations of the land made in this report are relative to present sea-level. Thus, as a result of the fact that a considerable amount of water was still bound up in the form of ice inducing a lowering of the level of the ocean, it is incorrect to assume that, during the period of the Early Post-Glacial emergence, (a) the land was 120 feet higher than to-day, or (b) that the sea was 20 fathoms shallower. In either case the net result would be essentially the same, but it cannot be too strongly emphasized that both factors were involved.
Ireland and Britain (Movius, 1940, p. 76; 1940-b, pp. 9-10; 1942, pp. 87-89). On Island Magee, in the vicinity of Larne, a polleniferous horizon, discovered by Burchell (1934, p. 367) at an approximate depth of 11 feet 6 inches below present high-water level, documents the final stage of this period of relative emergence. From a paleobotanical point of view, the Island Magee peat representing an old land surface may be assigned to Sub-Zone VIb in Ireland; it roughly corresponds in age with similarly situated horizons at Cushendun and Belfast (compare Jessen, 1940, pp. 45-46).

(b) Deposits Referrable to a Period of Relative Submergence. Subsequent to the formation of the submerged peat, recorded at numerous localities in North-east Ireland, a period of relative submergence ensued. At the time of the maximum of this event, known as the Post-Glacial marine transgression, the land stood some 25 feet lower with respect to sea-level than at present, and the climate was somewhat warmer than it is to-day. With the deposits laid down during this interval of time, which are well represented at Larne, this report is intimately concerned.

By far the most widely distributed of the sediments of the Post-Glacial marine transgression in Counties Antrim and Down is the so-called Estuarine Clay. As Stewart (1871, p. 28; 1871-a, pp. 56-57) first pointed out, there is good evidence to support the view that since the basal portion of this clay was formed, there have actually been several oscillations of the sea-level, and subsequent research has confirmed this statement. It is now apparent, however, that the term, Estuarine Clay, is a misnomer. In fact as Baden-Powell (1937, p. 95) states: "It is most unfortunate that the term 'Estuarine Clay' was originally chosen for the Holocene clays of Northern Ireland, because the fauna is certainly not estuarine, in the sense of having lived in brackish water, and the foraminifera and the mollusca in the present collection [derived from samples obtained by Burchell at Island Magee] testify to the truly marine conditions under which the deposits containing this fauna were laid down." A similar opinion has also been expressed by Mr. Arthur Earland (see p. 156) on the basis of his study of the foraminifera from the excavation which forms the subject of this report. Furthermore, Mr. Benninghoff's analysis of samples of this sediment, which appears on page 126, reveals that, although the Estuarine Clay is rich in pulverized shell fragments, it contains no more than 5 % of clay and silt. Nevertheless, following Stewart (1871, p. 27) and Praeger (1892, p. 212), the term is used here with reference to those deposits which have accumulated in the bays and estuaries of North-east Ireland since the close of the Glacial Period, and which, superficially at least, closely resemble clay.

The Estuarine Clay may be divided into three zones, mainly on the basis of the contained fauna. These zones, each of which was laid down in progressively deeper water, are summarized below. In addition to the Island Magee deposits, those at each of three other localities excavated by the Harvard Archaeological Expedition to Ireland—Cushendun (Movius, 1940), Glenarm (Movius, 1937),
and Rough Island (Movius, 1940-a)—are fitted into this coastal sequence; their position is also indicated on the chart (Pl. X).

1) Lower Estuarine Clay (Scrobicularia Zone). This deposit is absent at Larne but, as revealed by the evidence from Belfast Lough and elsewhere, it is of littoral character and apparently belongs to palaeobotanical Sub-Zones VIb and VIc in Ireland. During the period represented by the Lower Estuarine Clay, much of the foreshore at Larne was probably still above the sea, although it is very likely that the coarse black gravel and black sand (Deposits I and H respectively) described by Praeger (1890, p. 203) at the base of the section at the Railway Cutting (Section B on Pl. IX) are to be correlated with this stage. In the coarse black gravel several chips of flint were found at a depth of 28 feet below the surface. Similarly at Island Magee, Burchell (1934, p. 366) records alternating layers of black sand and gravel (Deposits D to G) overlying the old land surface of Sub-Zone VIb, which apparently correspond in age with the Lower Estuarine Clay. In these deposits Burchell found implements belonging to the Early Larnian culture (Movius, 1940, p. 67; 1942, p. 137), although he originally described them as “Late Magdalenian” (Burchell, 1931, pp. 270-281; 1932; 1933; with Whelan, 1930). That deposits other than Estuarine Clay accumulated on the coast during the initial stages of the Early Post-Glacial submergence is further demonstrated at Cushendun, County Antrim, where the Peat (Deposit F), Lower Lagoon Silt (Deposit E), the Lower Gravel (Deposit D) and the Upper Lagoon Silt were formed at this time (Movius, 1940, pp. 29-33; Jessen, 1940, pp. 41-44; 1949, pp. 135-137). As at Island Magee, Early Larnian implements occur in both Deposits E and D at the Cushendun locality. Since a thin gravel layer laid down by the sea (Deposit B) at Rough Island (Movius, 1940-a, pp. 118-120) was accumulated during the early part of the Post-Glacial marine transgression, it is also correlative with this zone of the Estuarine Clay. The contained artifacts likewise belong to the Early Larnian culture.

2) Intermediate Zone of the Estuarine Clay. Recent work has led to the recognition of an Intermediate Zone, first suggested by Stewart (1871, p. 28) and Praeger (1888, p. 31), separating the Lower and Upper divisions of the Estuarine Clay. This sediment was formed in water up to 2 to 3 fathoms deep. In the Larne region the Intermediate Zone has been identified at Island Magee (Burchell, 1934, p. 370; Baden-Powell, 1937, p. 96) overlying the alternating deposits of black sand and gravel, mentioned above. On the basis of his analysis of samples collected in this horizon, Professor Jessen has assigned it to the lower portion of palaeobotanical Sub-Zone VIIa in Ireland (see p. 117 and Jessen, 1949, p. 139). As mentioned on p. 46, flint implements occur sporadically in
the Intermediate Estuarine Clay; they are of Late Larnian type. The 1935 excavation at Curran Point established the fact that the Estuarine Clay found at many sections underlying the raised beach in the vicinity of Larne (compare Pl. IX: lower) belongs to this zone, as Dr. Praeger originally suggested. But, although Praeger (1892, p. 214) assigns the Estuarine Clay at Larne to an intermediate zone, he states on p. 225 of the same report that it is "essentially a lower or Scrobicularia clay" (compare Coffey and Praeger, 1904, p. 149). At the time this deposit was laid down at this locality the Post-Glacial climatic optimum was attained in North-east Ireland (see pp. 139-140 of Mrs. McMillan’s Report).

(3) Upper Estuarine Clay (Thracia Zone). A further period of submergence is indicated by this zone, which accumulated in approximately 5 fathoms of water. According to Jessen (1949, p. 137), the maximum of the submergence was not attained until the transition between palaeobotanical Sub-Zones VIIa and VIIb in Ireland, which coincides with the Atlantic/Sub-Boreal boundary (see p. 119). Actually the Upper Estuarine Clay, extensively developed in the Belfast region (compare Grainger, 1852; 1859; Stewart, 1871; 1871-a; Praeger, 1888; 1892, pp. 228-237; McMillan, 1947),1 is absent at Larne, and its place is taken by a series of deposits consisting of intertidal sands and current-bedded gravels up to 21 feet in thickness. Collectively these have been incorrectly referred to as the "Raised Beach." But, as Praeger (1896, p. 39) has stated, "the vertical position of the bivalves proves that they lived in the gravels during the period of their accumulation." This fact, as well as the character of the bedding, "shows that the deposit is an old intertidal or submarine bank" (compare Bell, 1890, p. 291; Praeger, 1892, p. 226; Praeger, 1896, p. 35; Coffey and Praeger, 1904, pp. 155-156). From top to base these deposits contain worked flints, derived by the waves from occupation sites along the foreshore at the time of the maximum of the marine transgression and swept by strong currents into the gravels; these are typical of the Late Larnian culture (Movius, 1942, p. 158). At Island Magee and Cushendun similar intertidal gravels, containing Late Larnian implements, have been recognized. During this stage the Rough Island locality (Movius, 1940-a, p. 133) must have been completely submerged; at Glenarm an erosion surface and a steep scarp in the boulder clay were being formed (Movius, 1937, p. 187).

(c) Deposits Referrable to a Second Period of Relative Emergence. Following the maximum of the submergence, the land began to rise with respect to the sea, until it attained an elevation slightly in excess of that to be observed at present. The coastal deposits in North-east Ireland which document this event are known

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1. For additional references see Praeger, 1896-a.
as Raised Storm Beaches. These are true raised beaches in the sense that they were actually formed by wave action partly during the maximum of the sub-
sidence, but mainly during the emergence of the land. At many localities the
surface of the Estuarine Clay was eroded at this time. The Raised Storm Beaches
are contemporary with part of the period represented by palæobotanical Sub-
Zone VIIb in Ireland. At Larne, Island Magee, Glenarm (Deposit B), and
Cushendun (Deposit B—upper), Late Larnian implements occur in profusion
in secondary position in this horizon; in the overlying recent deposits, archaeo-
logical material referable to the Neolithic Period in Ireland has been recorded
(Movius, 1942, pp. 214-222). Inland, in the Lower Bann Valley, a Neolithic
culture, which belongs to Sub-Zone VIIb (= former Upper Zone VI4), developed
during this period (Movius, 1936). By this time the Post-Glacial warmth maxi-
 mum had completely passed and the climate was definitely cooler and drier than it is at present. In Ireland, as in Britain, the height of the Post-Glacial raised
beach relative to present sea-level decreases from north to south (Hull, 1872, p.
113; Coffey and Praeger, 1904, pp. 152, 157 and 200; Wright, 1928, p. 100; Martin,
1930, pp. 494-500), its O-isobase being located on a line between the south-
western coast of County Sligo and Wexford Harbour (Movius, 1942, Fig. 11, p. 79). At none of the sites investigated by the Harvard Archaeological Expedi-
tion to Ireland has any evidence been secured which substantiates Burchell’s
claim (compare Burchell, 1931, pp. 287-296) that there are two Post-Glacial
raised beaches in North-east Ireland—an earlier “25-foot” raised beach and a later one at the “20-foot” level above O.D.

(d) Evidence of Submergence during the Recent Period. The question of
whether or not the coast of North-east Ireland has been sinking slightly during
recent times, to account for the marine erosion now taking place at many localities, has never been adequately discussed, although Knowles (1914, pp. 90-91) was convinced that such was the case. Knowles states he noticed that the raised beach gravels along the Antrim side of Belfast Lough were being gradually swept away by the sea, and that in 1910 he talked with a man living
between Carrickfergus and Kilroot who “remembered the land reaching out
a considerable distance into the present sea, and that what would be equivalent
to a good-sized farm of land had been washed away by the sea within his own
memory.” On the opposite side of the lough, Staples observed in 1869 that the
raised beach at Holywood, County Down, was being gradually eroded by wave-
action (Staples, 1869, p. 42). But perhaps the most striking account of recent
marine erosion has been given by Miss Andrews (1892; 1893). At Cultra Bay,
a mile north-east of Holywood, Miss Andrews describes how, in 1892, the stack
of an old windmill-pump, used in 1824 to remove water from a now submerged
sandstone quarry, was surrounded by 3 feet of water and situated over 50 feet
from the shore at high tide.2 She estimated that some 5 acres of land had been

1 For summaries of the present numeration system used for zoning the Irish pollen-
diagrams, see Jessen, 1949, pp. 104-107; Mitchell, 1951, pp. 117-123.
2 See photograph reproduced by Andrews, 1892; 1893, facing p. 530.
washed away in this vicinity and that between 1829 and 1892 the sea had encroached on the land by from 100 to 150 feet in the vicinity of Cultra. This observation is confirmed by comparing the old Ordnance Survey Maps and Admiralty Charts showing the coastline on the south side of Belfast Lough with more recent editions of the same sheets.

Further evidence of a small depression of the land in recent times is cited by Coffey and Praeger (1904, pp. 153 and 156). At Alexandra Dock, Belfast (for section see Praeger, 1888), a layer of clean yellow beach-sand 2 feet thick, containing derived shells is overlain by 6 feet 6 inches of mud, the surface of which is at present between tide marks and which is full of littoral burrowing molluscs (compare Praeger, 1888, p. 30; 1892, pp. 233-234). Also, near Portrush, County Antrim, there is a peat-bog now washed by the waves (Jessen, 1949, p. 135). With reference to Larne, where wave-action is eroding the Curran deposits at present, Coffey and Praeger state that following the Post-Glacial submergence, the land rose "slightly higher than at present—probably about 5 feet above its present level. A slight movement in recent times has left the surface as we now find it." On the basis of the above evidence, it seems likely that the low erosion scarp on the seaward side of the Warren at Cushendun, referred to by Jessen (1940, p. 51), was also formed by erosion following a recent slight sinking of the land.1

E. Summary of the Late Cenozoic History of the Larne Region.

The Late-Glacial and Post-Glacial events in the Larne region may be summarized as follows:

Late-Glacial Period. During the Late-Glacial Period Scottish Ice invaded the coastal portions of Northern Ireland on three separate occasions. These are:

1. Old Drift Glaciation. Ice from the Highlands of Scotland covered all of Counties Antrim and Down as far as a line from Lough Swilly to Carlingford passing through Dungiven and Monaghan, where it was confluent with local Ivermian Ice.

2. New Drift Glaciation. The Highland Ice, less powerful than before, advanced only as far as Lough Neagh and the Bann Valley where it was in contact with the ice-sheets from North-west Ireland. The Boulder Clays laid down at this time are separated from those of the Old Drift Glaciation by sands, gravels and clays accumulated under the conditions of an Interstadial Sub-Stage.

3. Antrim Coastal Readvance. After completely withdrawing, the Scottish Ice advanced once more on the coast of North-east Ireland. At this time the local Irish Ice had retreated west of the Bann Valley.

1 In Scotland this movement was apparently even more intense, according to Callander (1929, pp. 318-322) who cites a great deal of very convincing evidence showing that a general sinking movement of the land has taken place throughout Northern Britain since "Late Neolithic" times.
It has been suggested by the writer that the three events described above may be correlated with the continental Würm I, Würm II, and Würm III glacial episodes respectively (Movius, 1940-b, pp. 3-7; 1942, pp. 60-63).

**Glacial Lake in Larne Lough.** Careful mapping has revealed that during the final retreat stages of the Antrim Coastal Readvance Ice, the basin of Larne Lough contained an extra-glacial lake of considerable dimensions.

**Late-Glacial Sea.** As the ice withdrew from the coast, the Late-Glacial sea transgressed the foreshore to a depth of approximately 50 feet above present sea-level.

**Period of Post-Glacial Emergence.** When Early Post-Glacial conditions were finally established the land stood at a height of 120 feet (20 fathoms) higher than at present with respect to the sea. At this time a partially complete land-bridge existed between Britain and Ireland, and peat-beds, now submerged, were formed at Belfast, Island Magee, Cushendun, and elsewhere on the coast.

**Period of Post-Glacial Submergence.** A period of relative submergence ensued during the time represented by Jessen’s paleobotanical Sub-Zones VIb, VIc and VIIa in Ireland, and the sea invaded the bays and estuaries of North-east Ireland as far as the present 25- to 30-foot contour-line. By far the most extensive deposit referable to this stage is the so-called Estuarine Clay, an analysis of the fauna in which reveals that actually several oscillations occurred in the movement. In addition current-bedded and intertidal sediments consisting of gravel and sand were accumulated at some localities. These have been incorrectly referred to as “Raised Beaches;” they contain Mesolithic implements of the Larnian culture in secondary position. During the lower part of Sub-Zone VIIa the Post-Glacial climatic optimum was attained in North-east Ireland.

**Second Period of Emergence.** It has been established that the maximum of the submergence took place during the transition between palaeobotanical Sub-Zones VIIa and VIIb in Ireland and was followed by a movement of emergence.\(^1\) Storm beaches were now formed by wave-action on top of the submarine gravel and sand banks that had been formed during the previous stage. These contain rolled artifacts of Late Larnian affinities in profusion. As a result of this movement, which was relatively more advanced in the north than in the south, and which was of a negative character south of the O-isobase or fulcrum on a line between Counties Sligo and Wexford, the land rose some five feet above its present height with respect to sea-level.

**Slight Recent Submergence.** Since the beginning of the last century there appears to have been a slight submergence—possibly a result of a general rise in sea-level—taking place. The amount of this recent submergence, which has led to severe and extensive erosion at some localities, has been estimated at 5 feet.

\(^1\) Thus the palaeobotanical evidence shows that “by far the greatest part of the transgression falls in Boreal time, only the latest stages of it are Atlantic, and the regression began with the opening of the Sub-Boreal Period” (Jessen, 1949, p. 137).
PART II. THE HARVARD EXCAVATION

1. Introduction

Between July 22 and September 5, 1935, an excavation was conducted at Curran Point, Larne, County Antrim. This was part of the fourth season's programme of the Harvard Archaeological Expedition to Ireland. Dr. H. O'Neill Hencken was Director of this expedition, and it formed part of the Harvard-Irish Survey, under the general supervision of Professor E. A. Hooton, Chairman of the Division of Anthropology at Harvard University. The writer was in charge of the work at Larne; he was ably assisted by Miss Dorothy Newton, Mr. Lauriston Ward, and Mr. Gordon Palmer of Harvard, in addition to his wife. A total of twelve local men was employed. The site was excavated under the Unemployment Relief Scheme of Northern Ireland, whereby the Government of Northern Ireland, through the Ministry of Finance, contributed a large share of

![Location Map](https://example.com/map.png)

*Fig 2—Location Map based upon the Northern Ireland Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office.*
the expenses. The men employed were all obtained through the Larne Unemployment Exchange.

The site excavated in 1935 is situated near the extreme southern portion of the Curran, as shown on the map (Fig. 2), on the property leased by the Larne Electric Light and Power Company, Ltd., from Mr. William Chaine, M.A., D.L., of Larne. Although Miss Nina Layard did a small excavation on Mr. Chaine's property in 1909 (Layard, 1909), its location was never established. Earlier Coffey and Praeger (1904, p. 169) had recorded a section at the point marked P on Pl. IX: upper. But with these two exceptions, no previous workers have investigated the deposits of the southern half of Curran Point. Indeed, the famous "Railway Cutting" (marked B on Pl. IX: upper) systematically examined and described by the Belfast Naturalists' Field Club in 1886 and again in 1890 (Swanston, 1886; Praeger, 1890), is located approximately one half a mile to the north, and no observations are available on any intervening sections. It is unfortunate that in 1896 or 1897 "the Northern Counties Railway Company cleared out the gravel which formed an escarpment on the southern side of their line at Larne Harbour, back to the boundary of their property, and dressed the cutting down to an even slope; and thus the classical section of the Larne raised beach, so often visited by geologists and archeologists, disappeared for ever" (Coffey and Praeger, 1904, p. 166). At present, as a result of various commercial developments and building activities, there are very few remaining points on the Curran where deposits are entirely undisturbed. The Harvard Archaeological Expedition to Ireland was extremely fortunate, therefore, to obtain the consent of all parties concerned to excavate at one of these localities.

2. Method

The excavated site, a pit 5-00 m. square laid out in conformity with the axes of the adjoining buildings of the Larne Electric Light and Power Company, Ltd. (Fig. 2 and Pl. III, Figs. 1 and 2), was located on one of the few remaining undisturbed sections in the southern portion of Curran Point. To a depth of 1-00 m. below datum (established at Point S—the south-western corner of the pit) this pit was dug in 20 cm. levels; from -1-00 m. to -4-25 m. (the base of the Inclined Beds of Coarse Gravel and Sand: Deposit C; see Pl. VIII) this unit was increased to 25 cm. to facilitate in handling the material. All flints believed to be of human manufacture found in these arbitrary levels were saved. Below -40 cm. no evidence of disturbance was found, with the exception of a drain running north-south more or less parallel to the north-eastern side of the pit. This drain, which consisted of a tile pipe laid in a trench that averaged 70 cm. deep, fortunately did not extend into the pit proper: it was located in the so-called "expansion area," as indicated on Pl. VIII. After the pit had been dug

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to a depth of 1·25 m., the sides were expanded 1·00 m. in order to reinforce the walls and to provide a shelf for shovelling. As shown in Pl. IV, Fig. 1, this was repeated at 2·50 m. and 3·75 m., a process which made it possible to excavate safely in the lower levels. Furthermore, except in the pit itself, the sides were sloped (their horizontal component = 50 cm.) in order to provide the maximum reinforcement for work in the loose beds of gravel and sand. Since our main objective at the site was to secure a documented series for study purposes from a vertical shaft of known size sunk through the deposits, the archaeological material from these "expansions" is not considered in this report, except where specifically stated.

Below a depth of 5·00 m. it became increasingly difficult to remove the sorted material by shovelling. Indeed, had it not been for the ingenuity of Mr. George Sanders, Manager of the Larne Electric Light and Power Company, Ltd., it would have been impossible to make a thorough investigation of the lower levels. Mr. Sanders improvised and helped with the installation of a winch and pulley mechanism whereby a barrow could be raised and lowered into the pit (Pl. III, Fig. 2). In this manner it was possible to continue the excavation to a total depth of over 8·00 m. below the surface.

3. Stratigraphy

A section showing the four faces of the pit excavated in 1935 is given in Pl. VIII; see also Pl. IV, Fig. 2 and Pl. V, Figs. 1 and 2 for further details. At Point \( \odot \) (datum for the excavation) the following deposits occur:

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Thickness</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Surface Accumulation</td>
<td>40 cm.</td>
<td>0·00-0·40 m.</td>
</tr>
<tr>
<td>B. Storm Beach Material</td>
<td>90 cm.</td>
<td>0·40-1·30 m.</td>
</tr>
<tr>
<td>C. Inclined Beds of Gravel and Sand</td>
<td>2·95 m.</td>
<td>1·30-4·25 m.</td>
</tr>
<tr>
<td>D. Fine Reddish-Brown Sand</td>
<td>55 cm.</td>
<td>4·25-4·80 m.</td>
</tr>
<tr>
<td>E. Hard Grey Sand</td>
<td>20 cm.</td>
<td>4·80-5·00 m.</td>
</tr>
</tbody>
</table>

[High-water level during August-September, 1935 (-4·85 m.)
  coincides fairly closely with this deposit]

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Thickness</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>F. Fine Reddish-Brown Sand</td>
<td>15 cm.</td>
<td>5·00-5·15 m.</td>
</tr>
<tr>
<td>G. Dark Blue Sand</td>
<td>85 cm.</td>
<td>5·15-6·00 m.</td>
</tr>
<tr>
<td>H. Estuarine Clay(^1)</td>
<td>—</td>
<td>6·00- —</td>
</tr>
</tbody>
</table>

Below -7·50 m., which coincides with low-water level, there was so much water in the pit that progress was extremely slow. This factor, in addition to the extreme toughness of the Estuarine Clay, made it necessary to abandon further digging at a depth of 8·10 m. It was originally hoped that the base of

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\(^1\) Total thickness undetermined. Dug to a depth of 8·10 m. (in a shaft 2·00 square), and bored a further 3·00 m. (total depth = 11·10 m.) without noting any material change in the deposit.
the Post-Glacial sediments could be reached by boring with a 2-inch pipe. But this too had to be given up after the "boring" had been driven 300 m. below the base of the excavation, at which level there appeared to be little change in the nature of the deposit. Although valuable and fairly well documented samples for analysis were obtained in this manner, the depth of the surface of the boulder clay, which underlies the Post-Glacial deposits at Section P in the close vicinity of the site (see Pl. IX: upper and lower; Coffey and Praeger, 1904, p. 169), was not established.

4. Description of Deposits in Ascending Order

In the following description of the Curran deposits, as revealed at the site excavated in 1935, the main conclusions arrived at by Mrs. McMillan, Mr. Earland Madame Lemoine and Dr. Benninghoff, whose reports appear in Appendices II-V, pp. 119-168, have been incorporated in as comprehensive a manner as possible. This will enable the non-specialist to obtain the information necessary to understand the stratigraphy at this locality without reference to the detailed reports. The deposits are described below in ascending order.

Deposit H—Estuarine Clay (6-00 m.—base not reached). Although the Estuarine Clay at Curran Point contains no more than 5% of clay and silt (Benninghoff, p. 126), and although the fauna is definitely not "estuarine" (McMillan, p. 138; Earland, p. 156), the term has been so long in use that it is retained here (see p. 12). Deposit H, actually an accumulation of calcium carbonate, is rich in pulverized shell fragments and contains up to 40% of angular to subangular grains of fine micaceous sand. It is a dark blue colour, and superficially it closely resembles clay. It is a very tough, wet, sticky material which lies in tightly packed, coarse, horizontal laminae. In it several basalt boulders (one 75 cm. in diameter was found at a depth of 75 cm. below the top of Deposit H), medium-sized stones of limestone, and small rounded pebbles of flint, chalk, vein quartz and basalt were observed. Five flint artifacts were found—three of them patinated the same dark blue colour which characterizes the clay. A sandy layer 40 cm. thick occurred 1-20 m. below the top of this horizon; sand was also encountered at depths of approximately 3-00 m., 4-00 m., and 5-00 m. by boring. Vegetable matter, consisting of Zostera remains was abundant, as were complete shells and fairly large, broken fragments of shells. According to Mrs. McMillan, the marine fauna proves that the accumulation took place in a maximum depth of 2-3 fathoms of water, and Dr. Benninghoff's analysis of this sediment demonstrates that "such deposition could take place only in water several fathoms in depth" (p. 128). In all 81 species of molluscs, 78 species of foraminifera and 5 species of calcareous algae, in addition to a fish tooth (from the 2-00 m. level) and fragmentary crab remains (found at several levels) were collected in the Estuarine Clay. These assemblages, especially the foraminifera—which include several Mediterranean forms numerous in deeper gatherings (5-00 m. below the top of Deposit H)—are all in unanimous agreement
that at the time of deposition warmer conditions obtained. Indeed the temperature was probably "at least as high as that now prevailing on the southern shores of England and Ireland" (Earland, p. 156). This evidence, together with that of the overlying deposits (see below), proves that the Post-Glacial climatic optimum in Ireland does not correspond with the maximum of the Post-Glacial marine transgression, as had been heretofore maintained. Rather, on the basis of present evidence, this period of maximum warmth may be assigned to the so-called "Intermediate Zone" of the Estuarine Clay (see p. 13), to which Deposit H at the Curran site belongs.

Numerous samples for palæobotanical analysis were taken throughout this stratum, but unfortunately their pollen frequency was too low for a counting. Professor Jessen has established, however, that the corresponding layer of Estuarine Clay at Island Magee may be assigned to the lower portion of Sub-Zone VIIa (Atlantic Period) in Ireland (see p. 117, and Jessen, 1949, p. 139), and it is fairly safe to assume, therefore, that this is also the age of Deposit H at the Curran site. Such a dating agrees with the evidence from Cushendun (Jessen, 1940, p. 44) and elsewhere, that the maximum of the submergence took place during the period represented by the transition from palæobotanical Sub-Zone VIIa to VIIb (Atlantic/Sub-Boreal) in Ireland.

Deposit G—Dark Blue Sand (5.15 m.-6.00 m.). Deposit G is of the same colour as Deposit H but the line of demarcation between the two sediments is very distinct from point of their composition. Whereas all the other deposits at the site slope to varying degrees from north to south, the Dark Blue Sand slopes slightly in a different direction—i.e., from north-east to south-west. Actually, as Benninghoff points out (p. 129), the clay content in the lower part of this stratum is greater than it is in the Estuarine Clay. Toward the top the clay content decreases, whereas the upper levels are composed predominantly of sand. The clay occurs in wet, coarsely laminated bands, probably laid down during intervals when the water was relatively quiet. Near the surface a large flat boulder (28 cm. in largest diameter) was found; on the whole, however, stones and pebbles were comparatively rare. These included examples of flint, chalk, vein quartz, quartz biotite, schist, granite (probably from Cushendun), glauconitic sandstone, jasper, diorite, dolerite, limestone, and flint breccia. No implements were found in Deposit G, but, as in the case of Deposit H, shells, shell fragments, and Zostera remains were abundant. The nature of the sediments of which the Dark Blue Sand is composed show that it was laid down in shallower water than the Estuarine Clay. Since sand increases in the upper levels, whereas clay decreases, it is probable that a relative emergence took place, and "that the then-existing strand-line was approaching the vicinity of the site" (Benninghoff, p. 129). In other words a gradual silting up of this portion of Larne Lough, under conditions of relative stability, was taking place. No evidence whatsoever to support Burchell's (1932, p. 726) suggestion that a "considerable period" elapsed between the deposition of the Estuarine Clay and the overlying beds of
sands and gravels was obtained. In fact nowhere in the Larne region is there any indication that such is the case.

The marine fauna is characteristic of a sea-bottom composed of muddy sand. It includes 64 species of mollusca and 68 of foraminifera, which indicate deposition in shallow water—between low-tide level and about a fathom in depth. The climate was still somewhat warmer than that of the present, but the climatic optimum had passed. This is proved by the fact that Rissoa albella (a "warm" mollusc, abundant in deposit H but absent in Deposit F) is completely replaced in the upper part of this layer by Rissoa parva (McMillan, p. 140). That warm conditions still pertained, however, is confirmed by the assemblages of foraminifera and calcareous algae collected in Deposit G.

Deposit F—Fine Reddish Brown Sand (5·00 m.-5·15 m.). With the exception of the fact that its colour is different and the clay content is slightly smaller, this thin layer of fine, Reddish-Brown Sand is very similar to Deposit D. Pebbles of flint, chalk and vein quartz were noted in this horizon; shells in all stages of decomposition were abundant throughout, and, as shown in Pl. II, Fig. 2, razor clam shells were found in situ. One trimming flake, patinated a dark greyish-brown colour was found, As Mrs. McMillan states, the same general assemblage of shells occurs in this stratum as in Deposit D, but Benninghoff (see p. 130) is more specific regarding probable conditions at the time the sedimentation occurred. According to him, the size-grades of the sand particles shows that the beach was closer to the site than during the deposition of the two preceding beds. On this basis Deposit F was laid down at or near the ordinary low-water level. The reddish-brown colour of this bed is due to the presence of limonite, which results from the oxidation of iron compounds. This process is common in beach sediments.

Deposit E—Hard Grey Sand (4·80 m.-5·00 m.). This deposit coincides with present high-water level. It is mainly composed of fairly coarse, grey, tightly-packed, angular to subangular sand, containing a few small to medium-sized pebbles and stones of flint, chalk and vein quartz. This layer yielded several unrolled implements, including a core and a small utilized blade. Shells were abundant, especially under stones where they occurred in association with a fine, silty, ferruginous substance. All the marine fauna—9 species of mollusca and 34 species of foraminifera—is in situ. It includes many specimens of Ensis (Solen) siliqua (full-sized razor clams) and Phacoides borealis, the former occurring in their natural upright position with ligament and epidermis intact. The conditions of deposition are, therefore, a sandy foreshore exposed at low-water, since E. siliqua does not normally range below this depth. According to Benninghoff's analysis, the material is sorted in a manner commonly found on the lower portion of a tidal beach. Furthermore, Deposit E was laid down in sheltered or fairly quiet water, and it is post-climatic optimum in age. The foraminifera demonstrate that similar conditions to those of the present prevailed, which is also indicated by the mollusca.
Deposit D—Fine Reddish-Brown Sand (4-25 m.-4-80 m.). Although this bed appears to be composed predominantly of sand, angular to subangular, and of a light ferruginous colour, Benninghoff's analysis shows that actually it contains a high proportion (60 %.-80 %) of fine sediments—silt and clay. Many round pebbles, a few small to medium-sized stones and occasional boulders of chalk, flint, vein quartz and basalt were found. It was noted that towards the base the content of fine silty clay increased; this clay occurred in layers in the sand giving it a soapy or greasy feel. Dark streaks of brown vegetable matter were found throughout. The water content of this layer was high, which gave the sand a very definite salty smell. Some 25 flint implements, both rolled and unrolled forms, were found in Deposit D. Shells were extremely abundant—79 species of mollusca were collected—and 32 species of foraminifera were obtained in the washing-samples. More or less egg-shaped pockets (up to 10 cm. long and 7 cm. deep), composed almost entirely of shells, were common in the upper portion of this layer, usually under flat stones. In addition to shells, these "pockets" contained many small rounded pebbles and silty, ferruginous material. According to Mrs. McMillan, all the mollusca in the upper part of the deposit are worn and have been derived from deeper water. That beach conditions prevailed at this time is also indicated by the finding of a large stone with barnacles (Balanus balanoides) adhering to it at a depth of 4-35 m., as barnacles do not range below low-water level.

The lower part of Deposit D was laid down under slightly different conditions. Here the razor clam (Ensis siligua) was found in situ proving that the deposition occurred at approximately low-water level. In Deposit D, therefore, we have the record of a gradual rise of 55 cm. in the accumulation of a beach, since 55 cm. is a sufficient amount to cause the change in the proportion of the materials deposited (Benninghoff, p. 131). As regards climate, the molluscs and foraminifera represent a typical cool-water assemblage, very similar to that found in the region to-day. One otolith, representing an undetermined species of fish, was found.

Deposit C—Inclined Beds of Coarse Gravel and Sand (1-30 m.-4-25 m.). The series of beds represented by Deposit C were clearly laid down under conditions of a sinking coastline, accompanied by extensive and rapid erosion, as evidenced by the slightly rolled nature of some of the materials. At this time Curran Point must have been a partially submerged spit or gravel bar near the mouth of Larne Harbour, which was exposed at low tide and which possessed the same general form as it does at present. These inclined beds, which dip from north to south at an angle of 8°-10°, represent an abrupt change in sedimentation; indeed there is a slight unconformity separating these from the underlying strata. Throughout flint implements are abundant in Deposit C, especially in the 40 cm.-60 cm. level and the beds of coarser material.

Deposit C is predominantly composed of very coarse, clean angular to subangular sand and gravel containing boulders up to 30 cm. in diameter and many lenses of fine grey sand. The sand, which is a dark, yellowish-grey colour,
contains many quartz particles, and in it the large stones (many are the size of ostrich eggs) and boulders lie in conformity with the bedding-planes. Except in cases where breakage has occurred during the period of deposition, the stones are all much rolled. They are composed mainly of quartzite, schist, basalt, flint, and granite; limestone, common in Deposit A, is rare. As pointed out by Coffey and Praeger (1904, p. 170), the source of much of this material is obviously in part glacial, since it includes erratics common in the local Boulder Clays originally derived from Scotland, Ailsa Craig, and further north on the County Antrim coast, and the degree of rolling may be ascribed in part to this erosion cycle. Nowhere in this horizon was any definite evidence of imbrication, typical of storm beach deposits, found. As shown in Pl. VI, Figs. 1 and 2, the stones seemed to lie in confusion. The character of the beds in ascending order is as follows (Pls. VIII; IV, Fig. 2; and V, Figs. 1 and 2):

Layer (l): coarse gravel in a matrix of brown sand containing many shells and ferruginous stains; Sample 13. The histogram for this sample demonstrates that the sedimentation was now taking place at a lower level on the beach than during the period represented by Deposit D. That this deposition did not occur at a level on the beach higher than at or near the low-water mark is indicated by at least six complete specimens of *Phacoides borealis* found in situ in layer (l). Therefore this horizon indicates that a submergence—i.e., a rise in sea-level relative to the land—had commenced.

1 A random collection of examples of the larger stones and pebbles from Deposits B and C was submitted to J. J. Hartley and J. A. S. Stendall for identification; their list is as follows (the number of specimens collected is given after each kind of material):
- Quartzite—probably for the most part derived from the Old Red Sandstone of Cushendun (38); Daldrician mica schist (34); Ferruginous sandstone—Carboniferous or Old Red (26);
- Basalts (18); Epidiorites and Green schists (14); Porphyrites and Porphyrites—probably Arran (12); Cushendun granite (10); Cushendall porphyry (10); Orthoclase biotite porphyry—probably Arran (9); Limestone—Carboniferous? (8); Fair Head gabbro (7); Ferruginous grits (7); Chalk (4)—dunuated (1) and Glaucolithic (1); Vein quartz (5); Schistose grit (4); Fair Head dolerite (4); Greywacke—probably Silurian (4); Tertiary granite—probably Arran (3); Calcareous shale (3); Riebekite micro-granite—Ailsa Craig (3);
- Diorite—probably Scottish (2); Grit—Silurian? (2); Sandstone—Carboniferous? (2);
- Andesites (2); Gneiss (2); Jurassic limestone—Liassic? (2); Rhyolites (2); Volcanic ash—probably of Old Red age (2); Banded slate—probably Silurian (1); Porphyritic epidiorite (1); Calcite (1); Quartzitic sandstone—Carboniferous? (1); Hornblende orthoclase porphyry (1); Flint breccia (1); Albite schist (1); Black limestone—probably Dalradian (1); Fine-grained micaceous sandstone (1); Calcareous sandstone—probably Carboniferous (1); Baked shale (1); and Calcareous schist (1).

2 Erratics of Ailsa Craig microgranite from the Firth of Clyde (compare Dollar, 1935) have an interesting distribution in Ireland. In addition to many north-eastern coastal localities, this rock has been reported at Whitepark Bay in County Antrim (Charlesworth, 1936; 1937, p. 269) and Inishowen in County Donegal (Corkey, 1937; 1939, Stellox, 1940, p. 240; Charlesworth, 1942), while in the Dublin area to the south an erratic pebble of the same material has been found in the Greenhills Esker some six miles inland (Seymour, 1941; Charlesworth, 1950, p. 65). In addition to these localities, A. Farrington has informed the writer that Ailsa Craig microgranite is a common erratic all down the Irish east coast to Wexford and has been noted as far south as Cork.

3 For further details see Benninghoff’s report, pp. 132-135; only Benninghoff’s main conclusions are included in this paragraph.

4 Compare Jeffreys, 1963, p. 243, who states that the normal habitat for this mollusc is from the low-water mark of spring tides to a depth of 82 fathoms.
Layer (k): fine, grey, ferruginous-stained sand with small to medium-sized pebbles and occasional large stones; in the south corner of the pit traces of silty clay were present in the sand; no sample taken. At the base of layer (k) several large stones with barnacles (Balanus balanoides) adhering to them were found. Since these are unworn and in situ their occurrence proves that this portion of the section represents a tidal beach deposit. According to Mrs. McMillan, barnacles do not range and are never found below low-water level.

Layer (j): coarse gravel containing small to medium-sized stones mixed with fine, grey sand; no sample taken. Since fresh, unworn barnacles also adhered to several stones in this layer, the accumulation occurred between tide marks.

Layer (i): a thin (7 cm.) band containing well-sorted sand and many rounded pebbles; Sample 12. The histogram for this sample reveals that either (a) these materials accumulated at a low level on the beach, or (b) they were swept up from such a deposit.

Layer (h): fine, grey, angular to subangular, well-sorted sand; Sample 11. The size and character of the grains found in layer (h) indicate quiet-water deposition, probably in a tidal pool.

Layer (g): fine, gravelly, well-sorted sand; small rounded pebbles common; Sample 10. As Benninghoff points out, it is probable that deposition took place near low-water level, as the influence of outer margin deposition is clearly apparent.

Layers (f) and (f') : coarse gravel and sand in inclined beds; (f): dark yellowish-grey colour; Sample 8; (f') : black streak in the gravels; Sample 9. At the time of deposition this layer formed the upper surface of the spit or gravel-bar (see Pl. VI, Fig. 2). It was probably derived from coastal deposits north of the site and laid down on an intertidal beach during a period when the coastline was sinking. The black staining found in layer (f') is due to oxide of manganese, which must have been formed in pools on the growing spit by the decomposition of certain dark mineral rocks. The sorting of Sample 9 shows that during the period of the deposition this portion of the section was near high-tide mark and was under water very little of the time.

Layer (e): fine, grey, angular to subangular sand (see Pl. VI, Fig. 1) of the same general character as layer (h) with no pebbles; average thickness = 6 cm., maximum thickness = 12 cm. (south corner); Sample 7. According to Benninghoff, the profile of sorting of layer (e) is characteristic of a lower beach deposit; this sand was probably laid down at a time when the area was temporarily sheltered by a local gravel-bar or some similar feature.

Layer (d): medium to large, angular to subangular, current-bedded sand with deep ferruginous stains and many small, rounded pebbles; average
 Movius—Curran Point, Larne, County Antrim

thickness = 12 cm., maximum thickness = 28 cm. (south corner); Samples 5 and 6. On p. 134 of his report, Benninghoff states that deposits of this type were laid down as a result of the fact that “as certain sections of the gravel spit accumulated faster than others, tidal water ran off the spit along definite depressions, the courses of which were constantly changing.” Therefore layer (d) represents an intertidal beach deposit.

Layers (c) and (c'): coarse gravel and sand in inclined beds containing occasional lenses of sand; Sample 4 = lower portion of layer (c); Sample 2 = upper part of (c); Sample 3 = a black band in the lower one-third of the (c) horizon. The histogram for Sample 4 shows the type of sorting found on an intertidal gravel-bar, whereas the sorting revealed by an analysis of Sample 2 indicates deposition “on an upper beach where large stones and boulders are abundant” (Benninghoff, p. 134). As in the case of layer (f'), the blackening of the particles in (c') is due to the presence of oxide of manganese; the sorting of Sample 3, taken from layer (c'), shows that this band was laid down above the level of high-tide, at a point on the beach reached only by the larger waves. Thus, as Benninghoff has shown, “in the (c) and c') strata, a progressive building-up above high-tide mark is demonstrated by the differences in the physical composition at successively higher levels.”

Throughout Deposit C shells were plentiful, but the only species found in situ were the barnacles and small clams from layers (j), (k) and (l), as previously mentioned. All the others, as well as the foraminifera, are derived and worn specimens from deeper waters outside the lough; the shells were found lying in all positions throughout the deposit, especially below large stones. As the result of the disintegrating effect of percolating water, which has been penetrating these beds ever since the beginning of the period of emergence, the majority of the shells were very fragile. The mollusca (54 species) and foraminifera (5 species) prove that a climate very similar to that of the present existed at the time of deposition.

Deposit B—Storm Beach Material (40 cm.-1.30 m.). The upper part of the section (Deposit B) is composed of heavily rolled material which displays no regular planes of bedding. It is an atypical and rather feebly developed storm beach formed by the waves during the emergence of the land. Some of the rocks in this horizon were probably derived from layer (c) of Deposit C; others came from the adjacent mainland. The fact that the storm beach (Deposit B) unconformably overlies the inclined beds of coarse gravel and sand (Deposit C) indicates that some erosion of C occurred before the deposition of B began. Most of the material in the storm beach consists of tightly-packed, small to medium-sized limestone pebbles, but larger stones up to 8 cm. in longest diameter were present as well. Numerous flint implements were found in this part of the deposit. They are heavily rolled for the most part (unrolled forms are also present), and large crudely worked types predominate. In fact heavy, coarse implements are
more common in Deposit B than in the deeper strata. Two horizons are readily discernible in Deposit B:

*Layer (b)*: mostly medium-sized, very tightly packed pebbles in a loose matrix of coarse sand; a few stones up to 12 cm. in diameter present;

Sample 1-B. The coarseness of the sand from layer (b) is due to the fact that the fine-grained sediments have been “largely washed away by storm-wave action, the agent of deposition” (Benninghoff, p. 135).

*Layer (a)*: small subangular to rounded pebbles in a matrix of fine sand and clay; Sample 1-A. As a result of ground-water seepage (from the comparatively recent layer of vegetation on the surface of the spit, formed after the land had risen above the reach of storm waves), this layer contains much more clay and silt than is present in (b).

Ten species of molluscs were collected in the storm beach, all of which, according to Mrs. McMillan, are found on the present coasts of North-east Ireland. They represent a typical littoral fauna characteristic of a deposit accumulated close to high-water level. This is the first section at which a storm beach deposit, absent at the places investigated by the Belfast Naturalists’ Field Club (Swanson, 1886, p. 521; Praeger, 1890, p. 202), has been recognized at Larne. Indeed, according to Coffey and Praeger’s observations (1904, p. 156), “the conformation of the coast at Larne, and of the ground on which this beach was laid down, is against the formation of a storm-beach there.” On this basis, it seems probable that the site of the 1935 excavation was somewhat more exposed to wave-action during the emergence than any of the Curran localities hitherto investigated.

*Deposit A—Surface Accumulation (0-40 cm).* This is comparatively recent fill, containing bricks, china, glass, iron objects, etc. Flint implements and molluscs, derived from Deposit B, are common. The molluscs represent 29 species, all of which are common littoral types found on the present coast of North-east Ireland. The general appearance of this deposit indicates that probably it was formed during recent building operations when the surface of the Curran was levelled. At the excavated site, therefore, the actual surface of the “raised beach” proper occurs at the base of Deposit A, and should be taken as +8.76 m. (28-80 feet) O.D. or 4.45 m. (14.60 feet) above high-water level.

*Summary and General Comments.* Boulder clay very probably underlies the Post-Glacial deposits revealed at the section excavated in 1935 on Curran Point, but no positive information in this regard was obtained. The Estuarine Clay (Deposit H) at the base of the section is a quiet-water type of sediment; its lower part was accumulated in about 3 fathoms of water, and its higher levels under progressively shallower conditions. During this stage of deposition the Post-Glacial climatic optimum, which continued into the base of Deposit G, was attained in Northern Ireland, proving that the time of maximum warmth does not correspond with the maximum of the marine transgression. The pollen diagram from the corresponding deposit on Island Magee, less than one mile distant, belongs to the lower portion of Sub-Zone VIIa in Ireland.
An analysis of the Dark Blue Sand (Deposit G) shows that a gradual silting-up of this portion of Larne Lough was now taking place under relatively stable conditions. Deposition was now going on at the site from just below low-water level to a depth of one fathom. The climate was still moderate, but the replacement of Rissoa albella by R. parva in the upper part of G shows that a gradual deterioration of conditions was beginning.

Deposit F, Fine Reddish-Brown Sand, marks a break in the appearance of beds between the dark blue silts, sands and clays (Deposits G and H) and the overlying light- or ferruginous-coloured sands and gravels. This 15 cm. thick stratum was laid down a little below ordinary low-water level.

The Hard Grey Sand (Deposit E) was accumulated on a sandy foreshore exposed at low-water. The fauna proves that the Post-Glacial climatic optimum had now passed, and that the then-prevailing conditions were like those of the present.

Deposit D, a second layer of Fine Reddish-Brown Sand, records a gradual sedimentation between tide-marks. The fauna is a typical cool-water assemblage, such as is found in the region to-day. Up to this point there is no indication of a change in the mutual relationships of land and sea, but it is very probable that a eustatic rise in sea-level played an important role in moulding the history of the lower series of sediments at Curran Point following the initial submergence.

The Inclined Beds of Coarse Gravel and Sand (Deposit C), which are some 3-00 m. thick, mark an abrupt change in sedimentation indicated by a slight unconformity. These beds were laid down under conditions of a sinking coastline and, as the movement of submergence intensified, a tidal-spit or gravel-bar was built southward into the bay, the shape of which was determined primarily by currents. All the layers of Deposit C are intertidal, except near the top of layer (c), which represents an upper beach deposit, showing that the sinking movement had now ceased and a progressive building-up process was taking place. This second phase of submergence, not previously recognized in the Larne region, amounted to 1-85 m., or approximately 6 feet (Movius, 1953-a). The nature of the bedding throughout suggests that deposition was in tempo with the movement, which may have taken place comparatively quickly judging by the slightly rolled nature of some of the archaeological material. Presumably this was derived by the waves from the now submerged Early Post-Glacial land-surface, as well as the neighbouring headlands and foreshores where numerous occupation sites provided the source for the flint implements. It is also possible that some of the artifacts came from higher levels on the beach, above the level of ordinary high-tide but within the reach of storm waves. Prevailing currents and, to some extent, wave action, were responsible for the selection of the sediments, and changes in local conditions played the dominant role in determining the characteristics of the individual beds. At this time the climate was very similar to that of the present. The top of Deposit C, 11-8 feet above present high-water level
(+ 25.8 feet O.D.),\textsuperscript{1} may be taken as marking the highest point attained by ordinary high-tide at the site—i.e., the maximum of the marine transgression—during Early Post-Glacial times, although storm waves, of course, reached a higher level.

The surface of Deposit C was eroded prior to the accumulation of Deposit B, a Storm Beach formed by wave-action during the emergence. At this time the Curran was almost certainly connected to the mainland and, as the movement of uplift continued, it assumed its present shape. Following a slight relative sinking of the land during recent times (about 5 feet), the height with respect to present high-water level was established. The top of Deposit B, the surface of the undisturbed portion of the section, is 14.6 feet above H.W.L. (+ 28.8 feet O.D.), but further inland it attains a height of 26 feet above H.W.L. (Coffey and Praeger, 1904, p. 168).

The Surface Accumulation (Deposit A) overlying the Early Post-Glacial sediments on Curran Point consists of recent fill containing modern objects, as well as gravel and flints derived from Deposit B.

The archaeological material from the 1935 excavation is described on pp. 46-72 of this report; throughout it is characteristic of the phase of the Irish Mesolithic known as the Late Larnian (Movius, 1942, p. 133).

5. Observations on the Method of Formation of Curran Point

Prior to the Early Post-Glacial marine transgression, the topography of the coastal plain in the Larne region must have presented a markedly undulating relief. Apparently this uneven surface had been eroded in the Late Glacial deposits (morainic and outwash material dating from the time of the last readvance of the Scottish Ice) during the period of the Early Post-Glacial emergence. On the basis of the evidence of a deposit of submerged peat recorded by Burchell (1934, p. 369) on the western side of Island Magee, directly opposite Curran Point, forests containing Birch, Pine, Elm, Alder, Oak, some Willow, and a high frequency of Hazel (probably Boreal: Jessen's Sub-Zone VIb in Ireland) were growing in the vicinity immediately prior to the earliest record of an incursion of the sea.

As far as Larne is concerned, thanks in the main to the work of Dr. R. Lloyd Praeger\textsuperscript{2} between 1889 and 1904, a sufficient number of accurately published sections (shown on the plan, Pl. IX) is now available to permit a fairly accurate reconstruction of the method of formation of Curran Point. These may be listed as follows:

\textsuperscript{1} Actually 5 feet must be added to this figure to allow for the slight submergence in recent times (see p. 16). On this basis, 16.8 feet above H.W.L. or + 30.8 feet O.D. is the correct figure.

\textsuperscript{2} The account of the Curran deposits given here is based on pp. 168-171 of Coffey and Praeger's 1904 report.
Section A: at the eastern end of the cutting of the Northern Counties Railway Company.¹ (Coffey and Praeger, 1904, p. 170).

Section B: in the central portion of the so-called Railway Cutting. This is the classic Larne Section investigated by the Belfast Naturalists' Field Club in 1886 and 1889.¹ (Swanston, 1886, pp. 520-523; Praeger, 1890; 1892, pp. 225-226; 1896, p. 39; Coffey and Praeger, 1904, p. 166; Knowles, 1914, pp. 86-89).

Section C: at the western end of the Railway Cutting.¹ (Coffey and Praeger, 1904, p. 170).

Section D: near the shore of Larne Lough north-west of C. This section was never measured; it is located on Olderfleet Road at the south side of the arch over the railway. (Coffey and Praeger, 1904, p. 168).

Section P: on the southern tip of Curran Point. (Coffey and Praeger, 1904, p. 170).

Section V: at the Old Larne Pottery. (Swanston, 1886, pp. 523-524; Praeger, 1890, p. 204; 1892, pp. 224-225; 1896, p. 39; Coffey and Praeger, 1904, p. 170).

Sections W and X: at the western and eastern ends of Bay Road respectively (see Pl. IX and Fig. 3, p. 32). (Praeger 1892, p. 225; 1896, pp. 39-40; Coffey and Praeger, 1904, pp. 166-170).

Section Y: at the British Aluminium Company's Works (see Pl. VII, Fig. 2 and Pl. IX). (Praeger, 1890, p. 204; 1896, p. 39; Coffey and Praeger, 1904, pp. 168, 170, and 178-180, Pl. IV; Knowles, 1914, p. 88).

Section Z: at the Harbour Ballast Pit. (Coffey and Praeger, 1904, pp. 168 and 180, Pl. VII).

These sections, together with the one exposed in 1935 by the Harvard Expedition, are shown at a uniform scale in Pl. IX, with the exception of the so-called Bay Road Section (running from W to X on the plan), which is illustrated in Fig. 3, p. 32. At Point P the sequence revealed on the beach at the southern tip of Curran Point (cf. Coffey and Praeger, 1904, Fig. 3, p. 169), approximately 10 feet of gravels are shown resting on the Boulder Clay, the top of which is 2 feet above high-water level.² Then, a scant 600 feet north-east of this point, where the Harvard Excavation of 1935 penetrated the Estuarine Clay to a depth of over 10 feet, no trace of the Boulder Clay was found. Between this site and the Railway Cutting (Sections A, B and C)³ no section is available, but at B an excellent series of beds was exposed by the Belfast Naturalists' Field Club in 1889 (compare Praeger, 1890). As at the Harvard site, this section demon-

¹ As stated on page 19, these sections have disappeared.
² It seems likely that the locality investigated by Miss Layard in 1909 (see p. 19), where 12 ft. 4 in. of gravels and sands were observed resting on the Boulder Clay, was situated not far from Point P on the plan.
³ According to Coffey and Praeger (1904, p. 170), "the three sections A, B, and C form a west-to-east cross-section along the southern edge of the Railway Cutting, A being distant 150 feet from B, and B being 170 feet from C."
strates a depression in the Boulder Clay that is occupied by the Estuarine Clay and the Sand, Silt and Fine Gravel series, which in turn is overlain by a considerable depth of the Raised Marine Gravels. However, only 350 feet to the north of this section, at the Aluminium Works (Section Y), the Boulder Clay rises abruptly to form a ridge or mound (see Pl. VII, Fig. 2), "which attains a maximum height of 18 feet above present high water" (Coffey and Praeger, 1904, p. 168). These authorities go on to state that this ridge "runs (or ran—for much of it has been long removed) north-east from the south side of the arch over the railway across the site of the British Aluminium Company's Works (from D to Y on the plan). It has a steep slope on either side." At one place on the Aluminium Company's property the Boulder Clay "rises up to within 2 feet of the surface, the gravels resting directly on it" (Praeger, 1890, p. 204).

Section Z, located in the old Harbour Ballast Pit some 300 feet east of Y, clearly shows the rapid dip of the Boulder Clay. This locality also proves that the Boulder Clay ridge was exposed to wave action prior to the deposition of the Raised Marine Gravels. For in one of Coffey and Praeger's trial pits its surface "was found to be covered with large subangular blocks of stone clearly derived from the attrition of the clay. On this boulder beach, the characteristic implement-bearing gravels were laid down to a depth at this spot of 10 feet" (Coffey and Praeger, 1904, p. 168).

To the northward of the Boulder Clay ridge the ground drops off rather steeply, and there is a marked depression running across the base of the Curran from the sea on the east to the upper end of Larne Lough on the west. In the centre of this depression the so-called Bay Road Section (W-X) was recorded by Dr. Praeger (1896, Pl. I, Fig. 3 and pp. 39-40). As shown in Fig. 3, no trace of

![Fig. 3—Section X-Y, the Bay Road Section, at Larne Harbour.](image-url)
the Boulder Clay was revealed in a 600-foot long sewer construction trench dug in 1887 to a depth of 10 feet, or just below mean tide-level. Finally, 200 feet north of Point W there existed the now-destroyed Section V at the Old Larne Pottery. Here again the surface of the Boulder Clay is well below mean sea-level, and this portion of the depression is filled with Estuarine Clay overlain by Raised Marine Gravels. It is therefore evident, as Coffey and Praeger state (1904, p. 168), that during the period of the Early Post-Glacial submergence, when the Curran deposits were accumulated, the Boulder Clay ridge (running from D to Y on the plan) "formed an island, and later a tidal bank, against and finally over which the gravels were deposited. The gravels are thickest just to the leeward (southward) of this feature; and the whole conformation of the Curran shows that the gravels collected around, and as a long tail behind,1 this Boulder Clay islet, on each side of which the tides streamed up and down.

"Prior to the deposition of the gravels, fine blue Estuarine Clay was laid down in the depressions, both to the north and south of this knoll.2 The formation of this mud is not so easy to account for, since it requires water free from violent currents. Perhaps we may reasonably assume that at that period the gravels formed a barrier further on the seaward side, and shut out the waves of the open sea, even as the Curran gravels do now; and that on further subsidence of the land, the gravelly beach advanced till it covered the clay as at present. Across the Bay Road depression, a broad, yellow, sandy beach-deposit intervenes between the clay and the overlying gravels [Section W-X], facing the open sea; but on the other [south] side of the Boulder Clay islet, fronting the sheltered waters of the lough, thin beds of black sand, the product of the muddy waters of the bay, overlie the clay."

As shown in Pl. IX, the Raised Marine Gravels vary greatly in thickness in the various sections. For the most part it is "a coarse, clean gravel, with an abundant sandy matrix" (Coffey and Praeger, 1904, p. 170). In addition to pebbles of basalt, chalk, and flint (90%), it contains "erratics common in the local Boulder Clays, from the washing down of which it was probably mainly derived. The base is usually sandy; and at various levels in the gravels, sandy beds several feet thick alternate with the coarser material. The several zones are often cross-bedded; thus, in Section B examined by the Belfast Naturalists' Field Club in 1889, two thick beds of coarse gravel were separated by several feet of sands, all three zones having a different bedding.3 At the Harbour Ballast Pit

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1 This interpretation is supported by Swanston's (1888, p. 521) observation, namely, that at the Railway Cutting (Section B) the beds of Coarse Gravels and Sands dip at an angle of 8° to 10° toward the south-west.
2 At Section B in the old Railway Cutting some 4 ft. 6 in. of blackish, clayey sand and coarse gravel containing large rounded boulders (base not reached) has been described by Dr. Praeger (1890, pp. 203-204). The associated fauna, as well as the nature of these beds, indicates the existence of true beach conditions on the south-eastern slope of the Boulder Clay ridge prior to the deposition of the Estuarine Clay in this area of the Curran.
3 Compare layers (d) and (e) of Deposit C at the site of the 1935 Harvard Excavation, described on p. 26 of this report.
(Section Z) . . . on the other hand, 10 feet of gravels and 3 feet of underlying sands had a uniform, slight dip northward from top to base."

The following statement quoted from pp. 170-171 of Coffey and Praeger's 1904 paper clearly summarizes the recent history of the Curran: "In Early Post-Glacial times, we find a ridge of Boulder Clay occupying roughly the site of the present raised beach. At the period of the growth of the peat-bed of Belfast— the earliest Post-Glacial deposit locally recognizable—this ridge was joined by a broad base to the rising lands north of Larne town; and its crest was at least 50 feet above high water. Depression setting in, the ridge, lying in the tide-swept entrance of Larne Lough, suffered denudation, and the sea presently broke through across the neck which joined it to the mainland. The sweeping away of the clay on the seaward (eastern) side left a beach of boulders, which no doubt served to check further denudation. A barrier, probably of gravels, occupying somewhat the position of the present sea-margin from the steamboat quays northward, allowed of the deposition locally of fine mud and blackish sand in the shallow waters at the back of it. As submergence continued, we find a mass of yellow sand, full of shells, thrown across the seaward end of the Bay Road channel, and gravels began to be laid down against and around the Curran islet, especially on the southern side, where they formed a long tail moulded by the tides. Depression continued to a total of some 50 feet or more, and until the islet sank below the sea, allowing a few feet of gravel to cover its highest point. By a subsequent emergence (and, according to the evidence of Belfast and other places, a final slight depression), the Curran was left as it was until the advent of railways and factories broke up its surface, and exposed for a while cuttings through the several beds of which it is built up."

On the map, Fig. 2, p. 18, the probable extension of the sea in the vicinity of Larne during the maximum of the Post-Glacial submergence is shown. Since no sections are available for the area lying immediately north of Larne Lough, the character of the sediments in that sector is unknown. But the nature of the bedding at all of the Curran localities investigated to date indicates that long-shore currents provided the dominant agent of deposition at the time of maximum sinking. For the greater part of the area was well protected to the east, not only by the northern tip of Island Magee, but also by the newly-formed gravel-bar or spit, projecting southward so that there is no extensive development of a storm beach here, as is found at such localities as Portrush, White Park Bay, Cushendun and Glenarm in County Antrim (Jessen, 1949, p. 134; Praeger, 1892, p. 42; Coffey and Praeger, 1904, p. 194; Movius, 1937; 1940, p. 28), and at Termontiecken in County Louth (Jessen, 1949, p. 143). Indeed Coffey and Praeger (1904, p. 156) deny the existence of a storm beach at any of the sections investigated by them at Larne, and they state that "the conformation of the coast at

1 According to Jessen (1949, p. 136), the submerged peat at Milewater Dock, Belfast, published by Charlesworth and Erdtman (1935), is of Boreal age and may be assigned to Sub-Zone VIa in Ireland.

2 See discussion on page 16.
Larne, and the ground on which the beach was laid down, is against the formation of a storm beach there.” In any case, the latter feature is definitely present albeit somewhat feebly and atypically developed in comparison with other localities, at the site excavated in 1935 near the southern end of the Curran, and it yielded over 2,700 flint implements exhibiting all degrees of rolling (see chart, Pl. XI). Comparable beds, formed by the waves during the early stages of the emergence, also seem to exist elsewhere in the region. In fact, with reference to the Railway Cutting Section, Coffey and Praeger (1904, p. 176) state “our experience is, and it appears to have been that of the Field Club Committee, that the flints with abraded crusts occur chiefly in the upper layers, and for the most part in the disturbed surface portion. Lower down the flints are sharper and often unpatinated or only partly patinated.” In any event, depositionary processes in this area were never strongly modified by storm wave action, and hence the figures for the extent of the submergence at this locality are probably reasonably accurate.

Fifty years ago, when the photo (Pl. I, Fig. 2) reproduced from Coffey and Praeger (1904, Pl. IV) showing a general view of the Curran was taken, there was almost no evidence of an erosion scarp along the southern portion of this promontory, such as exists to-day (compare Pl. II, Fig. 1). At Cushendun a comparable feature has clearly been formed by storm wave action since the time of the slight movement of relative submergence that has taken place in recent times (Jessen, 1940, p. 51). For this reason it was the writer’s original idea that the erosion of the Curran could also be attributed to this factor. But storm waves are almost completely shut out of the harbour at present, just as they seem to have been at the time of the Post-Glacial emergence. Therefore, it is believed probable that the modern erosion of the Curran has resulted from twentieth century activities at Larne—steamboats, dredged channels, Electric Light and Aluminium Works, etc.—which had only just begun to encroach upon the area in the early 1900’s. Indeed the photo referred to above shows no less than eleven sailing ships—one a square-rigger—peacefully anchored in the harbour, not a single one of which has a smokestack. Furthermore, south of the ruined Olderfleet Castle there were only one or two small buildings on the Curran, and the topography of the promontory appears smooth and rounded as it had been left by the Sub-Boreal seas during the emergence.

PART III—THE ARCHAEOLOGICAL MATERIAL

1. Introduction

As stated on page 7, one of the major objectives of the Curran Point excavation was to obtain a large series of documented archaeological specimens for study. In order to achieve this a vertical pit 5.00 metres square was sunk
through the deposits, as explained in Part II of this report. A total of 5,515 artifacts—the largest series ever obtained from a single Mesolithic site in northeastern Ireland—was obtained in this manner. With the exception of one illustrated specimen (Fig. 12, No. 119), a unique piece found in the gravels of Deposit C that had fallen from the wall of the pit between 1.75 m. and 2.50 m. below datum, and the series of bifacial tools shown in Figs. 14 and 15, only material from the numbered layers (L/A-1 to L/A-20 inclusive) and underlying levels is considered here. Every object believed to be of human manufacture from these numbered layers within the area of the 5.00-metre pit was saved, and the frequency distribution of the various types is given in Pl. XI, a chart that will be discussed presently. At this point, however, it seems appropriate to consider briefly certain aspects of the theory of taxonomic determination, or systematics, as applied to archaeology.

It should be emphasized that systemization, as long as it is not regarded as exact, is a necessary approach to the handling of large collections from any given site or series of sites within the same region. But it must be constantly borne in mind that these groupings are based on arbitrary and completely subjective criteria and therefore are flexible units. Indeed they never can be exact. Furthermore, as pointed out by Tallgren (1937, pp. 154-155), this approach “has not led and does not lead to an elucidation of the organic structure of the whole life of the period studied, to an understanding of social systems, of economic and social history, to the history of religious ideas. In short, forms and types, that is, products, have been regarded as more real and alive than the society which created them, and whose deeds determined these manifestations of life.”

In the final analysis, human culture must be regarded as a social rather than a natural product. As such the approach to it never can be reduced to the same rigid classificatory disciplines, applied at present with varying degrees of success by the natural scientists (compare Brew, 1946, pp. 44-66). Far from being constant, human culture is an extremely variable factor. Prehistoric man was repeatedly faced with new situations, and he was continually experimenting with new methods of adapting his way of life to the ever-changing environmental conditions which confronted him. For “culture does not consist of artifacts. The latter are merely the results of culturally conditioned behavior performed by the artisan” (Rouse, 1939, p. 15). In many instances it has been due to a failure to appreciate the scope and character of the problems involved in the study of prehistoric man that has led to an acceptance of the categorical pronouncements of the taxonomists as dogma.

Admittedly tool types should be described as precisely as possible in each case; the difficulties arise when these forms are divorced from their context and compared on a purely typological and technological basis with accepted “norms” recognized at some other locality, or series of localities, perhaps several hundred or more miles distant. In reality these latter should be regarded as having played an intrinsic and vital role in a once-functioning cultural whole. In other
words, although we can formulate definitions which seem logical to the majority of workers (and for this reason are "accepted") whereby the material from a given site, or series of sites, can be systematized, this emphatically cannot be done with regard to cultures. Since the men who manufactured the artifacts were themselves social beings, who were not thinking in terms of how their imperishable material culture equipment was to be classified, the entire concept of what constitutes a culture reduces itself to a sort of artificial "standard," which has reality only in the minds of archaeologists. As long as it can be understood that such groupings of the field-worker, as are discussed in this report and shown on the chart (Pl. XI), are not rigid, but rather consist of a series of completely subjective categories for which no very precise definition can be given, and which are only intended to help clarify and interpret the present data, progress can and will be made.

2. **General Considerations**

   During the second half of the nineteenth century the most famous collecting-grounds for the "large coarse flake implements" were along the shores of Belfast Lough, notably at Whitehead, Kilroot, and Carrickfergus in County Antrim, and at Holywood, Cultra and Ballyholme Bay in County Down (see Fig. 1, p. 8). But in the early 1900's Coffey and Praeger (1904, p. 172) state that "the growth of watering places and the great increase of building along the shores of the lough have destroyed most of the best sites." At that time Larne was regarded as the richest remaining locality, a position it still retains. Indeed, on account of the abundance of characteristic artifacts that occur in the Curran gravels, and the ease with which they can be amassed, these deposits have been a favourite resort for collectors ever since G. V. Du Noyer (1868; 1869; 1869-a) first called attention to the fact of their existence in 1868. However, it was not until R. Ll. Praeger drew up the final report of the Committee of the Belfast Naturalists' Field Club, appointed "to investigate the Larne gravels and determine the position in them of the flint flakes and cores for which they are noted" that any of the Raised Beach localities in North-eastern Ireland was systematically examined (Praeger, 1890). Notwithstanding the data summarized in this and later papers, however, there still exists a considerable measure of confusion with regard to the typology of the worked flints contained in the gravels, a situation that has arisen in part as the result of unintentional selection.

   In all the older collections the occurrence of large coarse forms is always stressed, and these are invariably depicted as typical of the Irish Mesolithic. For the early workers normally obtained their specimens on the present foreshore (compare Pl. II, Fig. 1) where modern wave-action has played and is playing the dominant role in sorting the objects, according to size, that are being derived from the adjacent raised beach exposures. Here the lighter—small- to medium-sized flakes and blades—have been swept away by the currents in most instances leaving only the massive, crudely worked and very heavily rolled forms, and it is
generally believed that these comprise an overwhelming majority of the industry. But a glance at the chart (Pl. XI) will reveal the fallacy of this concept. Actually the totals of the massive and large categories show them to be in the minority, and this is also true at other Late Larnian sites investigated by the Harvard Expedition to Ireland (Movius, 1942, p. 158). In all cases the evidence indicates that there is actually a considerable mixture of types exhibiting all degrees of rolling, and including specimens which are absolutely unrolled, and as fresh as when they were struck.

The occurrence of delicate unrolled flakes and blades in the raised beach gravels, especially at Curran Point, Larne, has been commented on by various authorities (compare Praeger, 1890, p. 205; Coffey and Praeger, 1904, p. 182; Knowles, 1914, p. 98, Fig. 13; Whelan, 1928, p. 188; 1934, p. 128; 1938, p. 122). Generally speaking, however, these have been completely overlooked by the other collectors, who were invariably preoccupied with obtaining the large, coarse artifacts which, as previously stated, they considered to be characteristic of the site. A typical series of these sharp unrolled and little patinated flakes and blades is illustrated in Fig. 4. None of these occurred in Deposit B (Storm Beach); Nos. 1-6, 8 and 9 were found in Deposit C (Coarse Gravel and Sand), while

![Fig. 4—Sharp, Unrolled and Little Patinated Flakes and Blades from the Curran Deposits at Larne.](image-url)
Nos. 7 and 10 come from Deposits D and E (Reddish-Brown Sand and Hard Grey Sand at the base of the gravels). To account for the presence of this material in the Curran gravels several possibilities are open: (a) the more heavily rolled specimens represent an older industry, since they are larger, coarser and more deeply weathered, as Knowles (1883; 1884; 1886) originally suggested; (b) the question of degree of rolling is determined by the former location of the sites themselves—material derived from those farthest removed from the locality would thus have been subject to the greatest amount of sea erosion; (c) the unrolled material was lost directly on the foreshore during time of low water, as suggested on page 72; (d) it either lay directly in the path of the tidal and longshore currents, or higher up on the beach where it did not have to be transported far; and (e) the sea itself has played the major role in sorting the material. Actually the first possibility—i.e., that based on état physique—while apparently the more plausible, results in a complete reversal of the true sequence. Indeed it must be discarded altogether on the basis of the following evidence: (i) there is a large body of stratigraphic material showing that the large, coarse forms, which are invariably heavily rolled, represent an evolved industry peculiar to Northeastern Ireland, and constitute an integral part of the Late Larnian complex; (ii) whereas nearly all the coarse forms are rolled, some of the most heavily rolled specimens in the entire series are small artifacts typologically identical with absolutely fresh material; and (iii) the coarse implements are rare in the sandy deposits and most frequent in the Storm Beach (Deposit B), proving that the material has been sorted.

A combination of (b), (c), (d) and (e) must be evoked, therefore, to account for the mixture of artifact types at this locality. It is necessary to consider each of these possibilities in order to account for the situation at Curran Point. Here the majority of the coarse implements are rolled, since they were too heavy to be transported directly by the currents and had to be moved along the bottom of the lough. As a result a great deal of this material was incorporated into the Storm Beach (Deposit B) at a time when wave action appears to have been more severe than it had been formerly. Due either to being lost directly on the intertidal gravel spit or to the proximity of the occupation sites, some of the smaller material is unrolled. It seems probable that the farther removed the original site was from the growing spit or gravel-bar, now known as Curran Point, the greater the degree of rolling.

On the basis of the various sections described by Knowles, Coffey and Praeger, it can be stated that there is considerable variation with respect to the condition of the worked flints found at corresponding depths at different localities in the Larne region. This is especially marked with respect to patination and degree of rolling, as well as chance selection of the material depending on local conditions. For the artifacts were transported by a natural agency—the sea—and depending on the particular conditions prevailing at any given point on the coast, they were deposited, together with the littoral sands and gravels, in formations whose shape was determined by wave-action, as well as tidal and
long-shore currents, especially during time of storm. Thus, although the broad outline as revealed by the investigations to date in the Larne region is fairly clear, each particular section when examined in detail is found to present its own local facies. This applies not only to the sediments themselves, but also to the archaeological material which they contain.

At the site excavated in 1935 the inclined beds of coarse gravel and sand comprising the lower one-third of Deposit C—sandy layers (d) and (e) together with the underlying gravels as shown in the section (Pl. VIII)—yielded flints that appeared fresher and on the whole less oxidized than those in either the upper part of the same gravel—layers (c) and (c')—or the Storm Beach (Deposit B). In general this material was not as deeply patinated and exhibited somewhat sharper edges, in contrast with the much chipped and abraded edges of the artifacts from the upper beds. ¹ In the latter, especially in the Storm Beach portion of the section, flints with rolled and abraded crusts are frequent (up to 67.45 % in level L/A-4). But the degree of rolling and intensity of patination varies considerably, not only with depth, but also with the part of the beach examined. For example, according to Coffey and Praeger (1904, p. 176), a large number of the artifacts found at Section Y (Aluminium Works), where the upper beds of sands and gravels directly overlie the Boulder Clay (see Pl. VII, Fig. 2 and p. 73), are “comparatively sharp, unrolled and virtually unpatinated.” Indeed with reference to the archaeological material as a whole from the various Curran localities, a marked degree of beach rolling is only generally characteristic of the coarser material, as stated above. At the excavated site this occurred in slightly greater frequency in the series from the Storm Beach (Deposit B)—levels L/A-3 to L/A-6 inclusive—than in the underlying deposits. ² This fact alone suggests that this portion of the section was exposed to strong wave-action for a prolonged interval during the time of deposition.

As Knowles (1886, p. 437) has remarked, many of the massive and large- to medium-sized flint implements found in the Curran gravels have had the hard glazed or patinated surface worn off along the ridges, showing that the porcellaneous crust had already been formed and partially worn away by rolling before the material in question had been laid down in the gravels. Although Knowles believed this was proof of his claim for a high antiquity for the material in question, in point of fact this feature appears to have very little significance except as an indication that conditions of exposure were especially favourable to rapid patination prior to the time when the Late Larneian sites were transgressed by the sea. As stated above, if the normal procedures of sorting on the basis of the physical state of the artifacts (état physique) were applied to a normal

¹ This agrees with Coffey and Praeger's (1904, p. 176) observation on the series from the Railway Cutting (Section B), for they state “In the lower beds the flints appear to be somewhat less deeply patinated, and—a more important difference—are, as a rule, sharper at the edges.”

² The frequency figures for the heavily rolled material from these deposits are as follows: Mixed Surface (Deposit A) = 62.64 %—presumably most of this material is derived from Deposit B; Storm Beach (Deposit B) = 60.66 %; and the Inclined Gravel and Sand Beds (Deposit C) = 58.86 %.
series from Larne, the resulting sequence would be the reverse of that based upon the stratigraphic facts recorded to date.

All of the flints thus far described as being heavily patinated exhibit a chalky white, delf- or porcellaneous-like appearance. The surface is glazed and very hard, but the inner altered crust, which often extends to a depth of 3 mm. (ca. \( \frac{1}{8} \) in.), is granular and resembles in appearance the inner surface of delf. The glazed surface itself, as previously observed, has often been broken through as the result of rolling, thus exposing the inner granular portion of the weathered crust before the flints were included in the Curran gravels. These weathered flints are mostly white or light cream coloured, but others, especially in the disturbed surface level (Deposit A), are often a blotchy ferruginous colour. Some of the material from the beds of coarse gravel and sand (Deposit C) has been stained by iron oxide in solution, but this feature was not observed below a depth of 4.00 metres—level L/A-17. On the whole the series from this portion of the deposit is patinated varying shades of white and grey; a few bluish-white and mottled examples also occur.

The pieces that had remained unexposed in non-porous parts of the section, such as the damp, tightly-packed sands (Deposits D to G) at the base of the gravels and the underlying Estuarine Clay (Deposit H), were quite fresh in appearance when found. Artifacts from these sands normally exhibited a dark and partly translucent surface when first uncovered, but they became grey and opaque on drying out (compare Fig. 4, Nos. 7 and 10). Several of the specimens from the Estuarine Clay (Deposit H), such as the small core illustrated in Fig. 16, No. 145, have retained the freshness of fracture and translucent appearance as if only recently fractured. Also from this horizon, which is covered by the sea at high water, there are two flints which apparently were originally white, but have become stained a clouded dark bluish shade as the result of having been imbedded in that formation.

In the surface layer (Deposit A) there occurs a small series of comparatively fresh-looking primary flakes and blades, as well as a true blade core (Fig. 16, No. 147) of a type characteristic of the Neolithic industry found overlying the raised beach at Cushendun\(^1\) and Glenarm, County Antrim and Rough Island, County Down (summarized in Movius, 1942, pp. 214-222; see also Nougier, 1950, pp. 222-225). These specimens are mixed with typical Late Larnian material derived from the underlying deposits. Some of the flakes and blades of the earlier industry have in fact been used by the later settlers, as a series of older types of flints with freshly chipped edges occurs. This horizon has been badly disturbed by tillage, and it contains modern glass, iron objects and bricks, hence there is no way of demonstrating that the archaeological material found in it is \textit{in situ}. Probably these comparatively recent-looking flints are the same age as those collected by Coffey and Praeger (1904, p. 178) at Section P (see Pl. IX) which is nearby. In any case, at the site excavated in 1935 this was the only evidence of a Post-Larnian horizon.

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\(^1\) Recently Evans and Mitchell (1943, p. 147 and Fig. 1) have described a polished axe of Tievebulliagh stone almost certainly eroded out of Horizon 4 at this locality.
3. Comments on the Classification of the Material and Its Frequency Distribution by Levels

The chart (Pl. XI) is based on a classification devised by the present writer. Before discussing the typological aspects of each specific tool type, which are presented in the next section (see p. 46) and which are illustrated by drawings of as nearly a representative series of objects as possible, certain general comments on method will be recorded. In the first place, it should be quite obvious that inherent in the specimens themselves there are a variety of different schemes of classification (or taxonomy) and systematization. The purposes of the present scheme are (a) to show the frequency distribution of the various categories of implements in the gravels of Curran Point; (b) to make the description of this material more easily comprehensible; and (c) to facilitate in drawing interpretations and making conclusions. In other words, it is not regarded as constituting an end in itself and was not conceived of for that purpose. Concerning the validity of such classificatory approaches, J. A. Ford (in Ford and Willey, 1949, p. 38) has recently published a very clear statement summarizing the scope and limitations of this method. He states: "Many students of ancient cultures seem to regard the classification of cultural remains as a somewhat esoteric business in which the classifier, aided by some inherent insight, examines an assembled mass of prehistoric handiwork and separates the type groupings which the ancient artisans have put there. He decides which features are important and which may be safely ignored. If the classifier is competent the groupings are believed to approximate the true ones; if not the classification is incorrect and useless."

"This attitude is highly questionable. It derives directly from the notion that there is a basic order in these phenomena, and the scientist's duty is to search for and discover this order. This was the viewpoint of the 'natural sciences' in the nineteenth century. It fails to recognize that the apparent order has been imposed on the material either by chance circumstances or, more commonly, by the classifier himself. In actuality the same group of archaeological material may be classified in an almost unlimited number of ways, each equally valid from an empirical point of view. A single inevitable and natural order apart from a posed problem is not there to be found, and each classificatory arrangement of material must be tested by the question of how well it serves the end purpose which the classifier has in view.

"The primary purpose of classifications of archaeological material until about 1920 was description of the material. In the second decade of this century, the pioneer work of Kroeber (1916; 1917), Spier (1917), and Kidder (1931) has introduced the concept of the classification system as an instrument for measuring culture history in time and space. This is the major goal of classification in most present-day archaeological studies."¹

¹ Without making an explicit statement to this effect, Rouse (1939), Clark (1936) and Movius (1942; 1944; 1949) have used their classifications in this manner. Further discussions of the subject are presented by Brew (1946, pp. 44 ff.), Krieger (1944) and Willey (1949, pp. 3-5).
Now insofar as the present classification or breakdown of the Larne series is concerned, the main grouping—that on the basis of type—is in part based on technique of manufacture employed in artifact production, and in part on the widely-accepted "standard" terms used for describing stone tools. The question of technique of manufacture is further discussed on pp. 48-53; as regards such terms as "scraper," "point," "perforator," etc., which imply the hypothetical use for which the artisan is presumed to have made a given tool, admittedly these are purely artificial categories mainly based on form. For they have very little significance from a purely functional point of view, which must always remain a matter for speculation until organic materials are found showing how the objects were hafted and other details concerning the daily life of the people who made them.

It is otherwise with regard to the subdivisions based on size, however, since here definite limits may be established and adhered to on a somewhat more objective and finite basis. But, it must be made clear at the outset that the limits set up for each group are completely arbitrary. For purposes of the series excavated at Curran Point in 1935 the various categories have been defined in terms of the following measurements:

- Massive = 9 cm. long and over.
- Large = 7.5 cm. to 8.9 cm. long.
- Medium = 5 cm. to 7.4 cm. long.
- Small = 4.9 cm. long and under.

The most subjective groupings of all are those based on degree of rolling. Not only does this reflect entirely the experience and judgment of the classifier, but also the limits of each category vary on a relative basis depending on the general characteristics of the material from a given layer considered as a whole. Probably there would be very little disagreement on what constitutes an unrolled specimen, and theoretically the same should apply to the bulk of the material in the heavily rolled category. But the dividing line between the latter and the medium rolled group is where opinions will inevitably differ. The same applies to the slightly rolled series, and whether or not objects in the upper brackets of this sub-division should be considered rolled to a medium degree. The present writer tried to be as consistent as possible in this respect at the time the classification was made prior to World War II. However, he is only too well aware that he would never arrive at the same figures a second time, nor would any other worker going through the same material for that matter. What then is the value of this breakdown? It conveys a general impression of the distribution in the gravels of heavily rolled material, on the one hand, and slight and unrolled objects, on the other.\(^1\) \textit{It is not intended to be regarded as absolute.} Furthermore, in a broad sense this qualifies in some measure certain of the statements made in the text concerning correlations between gross size of the material and the degree of rolling to which it has been subjected.

\(^1\) Actually the medium category is a "catch-all" division and therefore of very little significance.
All the material recovered from the numbered layers in the 5-00-metre pit that is believed to be of human manufacture is included on the chart, as previously stated. This fact explains why the "General and Miscellaneous" category is so large—total: 1,846 objects, representing 33.47% of the entire series. For here trimming flakes, or débitage, and other waste material, chips, broken pieces, etc., are included. The quantity of this material in association with the actual implements demonstrates that the flint-working must have been practised either at the occupation sites themselves, or in the immediate vicinity of them. In any case it must have been done at points along the foreshore that were transgressed by the Early Post-Glacial sea. The figures show that the percentages of the totals based on degree of rolling reflect fairly closely the figures for the series as a whole. The breakdown of the latter on the basis of the beds exposed at the sites shows the following:

Mixed Surface (Deposit A: L/A-1 and L/A-2)

<table>
<thead>
<tr>
<th>Degree of Rolling</th>
<th>Percentage</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>Heavy Rolling</td>
<td>7.66 %</td>
<td>(422)</td>
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<tr>
<td>Medium Rolling</td>
<td>2.35 %</td>
<td>(129)</td>
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<tr>
<td>Slight Rolling</td>
<td>1.39 %</td>
<td>(77)</td>
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<tr>
<td>Unrolled</td>
<td>0.99 %</td>
<td>(55)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12.39 %</strong></td>
<td><strong>(683)</strong></td>
</tr>
</tbody>
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Storm Beach (Deposit B: L/A-3 to L/A-6)

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<tbody>
<tr>
<td>Heavy Rolling</td>
<td>30.41 %</td>
<td>(1,677)</td>
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<tr>
<td>Medium Rolling</td>
<td>7.99 %</td>
<td>(441)</td>
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<tr>
<td>Slight Rolling</td>
<td>4.12 %</td>
<td>(227)</td>
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<tr>
<td>Unrolled</td>
<td>6.81 %</td>
<td>(376)</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>49.33 %</strong></td>
<td><strong>(2,721)</strong></td>
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Inclined Gravel and Sand Beds (Deposit C: L/A-7 to L/A-18)

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<th>Degree of Rolling</th>
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<tbody>
<tr>
<td>Heavy Rolling</td>
<td>23.57 %</td>
<td>(1,300)</td>
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<tr>
<td>Medium Rolling</td>
<td>7.29 %</td>
<td>(402)</td>
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<tr>
<td>Slight Rolling</td>
<td>3.05 %</td>
<td>(168)</td>
</tr>
<tr>
<td>Unrolled</td>
<td>4.04 %</td>
<td>(223)</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>37.95 %</strong></td>
<td><strong>(2,093)</strong></td>
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</table>

Red-Brown and Hard Grey Sand (Deposits D & E: L/A-19 to L/A-20)

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<th>Degree of Rolling</th>
<th>Percentage</th>
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<td>Heavy Rolling</td>
<td>0.18 %</td>
<td>(10)</td>
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<tr>
<td>Medium Rolling</td>
<td>0.05 %</td>
<td>(3)</td>
</tr>
<tr>
<td>Slight Rolling</td>
<td>0.02 %</td>
<td>(1)</td>
</tr>
<tr>
<td>Unrolled</td>
<td>0.08 %</td>
<td>(4)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.33 %</strong></td>
<td><strong>(18)</strong></td>
</tr>
</tbody>
</table>

---

100.00% (5,515)
In the main the chart calls for no special interpretation. The percentages for the sub-totals in each category of a given level are computed on the basis of the total number of artifacts from that particular stratum. The latter is in turn expressed in terms of the grand total given at the base of the right-hand column. At the base of the chart, the totals for each category are also indicated in terms of the 5,515 figure, while the percentages for each sub-total are computed with respect to the figure for that particular category.

With respect to the material from the arbitrary horizontal levels (L/A-1 to L/A-20 inclusive), the richest single assemblage (total: 1,331, representing 24.13 % of the entire series) comes from level L/A-3 (40 cm. to 60 cm. below datum)—the upper portion of the Storm Beach (Deposit B). Other levels yielding over 10 % of the total collection were L/A-2 (20 cm. to 40 cm.), L/A-4 (80 cm. to 1.00 m.), and L/A-10 (2.00 m. to 2.25 m.), the latter being in the middle portion of the layer (c) beds comprising the upper portion of Deposit C (see Pl. VIII). A total of 2,721 artifacts were found in the Storm Beach gravels (levels L/A-3 to L/A-6)—just under 50 % of the entire series from the site. The over-all frequencies from the various deposits, as well as the classification based on degree of rolling in each case, are shown in the above table.

Perhaps the most significant fact revealed by the chart is the overwhelmingly large number of flakes and blades in relation to forms showing secondary working: 50.30 %, as contrasted with 13.66 %. With regard to the relatively small number of cores (total: 142; 2.57 % of the entire series) the fact that a fairly large number (38.73 %) of them are either unrolled or only slightly rolled supports the view discussed on page 73, namely, that some of the knapping may have been done on the beach itself during time of low water. For normally one would expect these relatively large-sized artifacts to exhibit the heaviest degree of rolling in the collection as a whole. In any case, this is certainly borne out by the figures for the flake (75.79 %) and Larne pick (78.22 %) categories, both of which groups include heavier and coarser forms than are typical for the series as a whole. The over-all totals for each of the main categories may be summarized as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flakes</td>
<td>22.39 %</td>
<td>(1,235)</td>
</tr>
<tr>
<td>Blades</td>
<td>27.91 %</td>
<td>(1,539)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scrapers</td>
<td>7.91 %</td>
<td>(436)</td>
</tr>
<tr>
<td>Points</td>
<td>1.49 %</td>
<td>(82)</td>
</tr>
<tr>
<td>Perforators</td>
<td>2.43 %</td>
<td>(134)</td>
</tr>
<tr>
<td>Larne picks</td>
<td>1.83 %</td>
<td>(101)</td>
</tr>
<tr>
<td>Cores</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General and Miscellaneous</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As stated on page 41, a small series of rolled and heavily patinated Larnian-type flints that had been reworked during Post-Mesolithic times were found in the topmost levels. Together with these, there occurred 27 artifacts that were unrolled and very lightly patinated—clearly later than the formation of the Raised Beach. Both of these groups, which are included in the "unrolled" category on the chart, indicate that the Curran region was still being frequented by stone-using peoples in Neolithic and later times. The totals for these two categories are as follows:

<table>
<thead>
<tr>
<th>Unpatinated and Unrolled</th>
<th>Reworked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed Surface:</td>
<td></td>
</tr>
<tr>
<td>L/A-1</td>
<td>7</td>
</tr>
<tr>
<td>L/A-2</td>
<td>7</td>
</tr>
<tr>
<td>Storm Beach:</td>
<td></td>
</tr>
<tr>
<td>L/A-3</td>
<td>10</td>
</tr>
<tr>
<td>L/A-4</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
</tr>
</tbody>
</table>

The sands at the base of Deposit C yielded only four worked flints out of a total of 18 artifacts from levels L/A-19 and L/A-20. Not included on the chart is one very slightly rolled trimming flake from the Reddish-Brown Sand (Deposit F) at a depth of 5.00 m. to 5.15 m. below datum. Also omitted are five specimens from the Estuarine Clay (Deposit H), no archaeological material having been recovered from the Dark Blue Sand (Deposit G). The flints from the Estuarine Clay, with the depth given below the surface of this deposit in each case, are as follows:

2 medium-sized, heavily rolled blades exhibiting a dull chalky-white patination (0 to 1.00 m.).

1 small core very slightly rolled and with a dark blue patination (75 cm. to 1.00 m.). This specimen is illustrated in Fig. 16, No. 145.

1 small flake and 1 chip, both slightly rolled and patinated a dark blue colour (1.00 m. to 1.25 m.).

On the basis of the typology of the objects from the Estuarine Clay, it is very probable that they should be included with the Late Larnian assemblage from Curran Point locality.

4. Typology and Description of the Material

In the majority of instances it is extremely difficult to differentiate between secondary working and edge-chipping that has resulted from use, on the one hand, and "pseudo-working" of the edge caused by wave action, on the other. As discussed above and stated by Knowles (1914, p. 96) "owing to the long time the flakes and implements were beneath the sea, and the injuries they received
by being rolled about by the waves on a rocky beach and dashed against stones, the purpose for which an implement was intended is often greatly obscured." Due allowance for these factors has been made throughout in classifying the
material obtained at the Curran Point excavation in 1935, which, as already indicated on the chart, falls in the following typological categories:

**Massive and Large Flake Implements** (Total: 167). The correlation between gross size and degree of rolling, previously discussed, is clearly demonstrated by the artifacts in this series, the majority (78.44 %) of which are heavily rolled (compare Fig. 5, Nos. 11-17). Actually most of the massive forms from this site may be classified as choppers (compare Knowles, 1914, p. 107; Burchell, 1931, p. 291; Movius, 1942, p. 164), and some very large ones occur. During the 1935 excavation, one was found which was over 15 cm. long and weighed 1 lb., 2 oz., while Knowles (1914, p. 97) mentions examples that were up to 3 lbs. in weight. But, as the illustrated specimens show, there is very little uniformity as to type; in fact this category includes some tools which apparently served as end scrapers (Fig. 5, No. 13), although normally the end is blunt and displays a portion of the original crust, as in the case of No. 16. There has been very little if any core preparation prior to the detachment of the flake. The striking platforms are plain, being formed of the original cortex of the flint nodule in a number of instances. The bulbs are prominent, and there are even some examples of double bulbs. There does not seem to have been any intentional working of the edges, which are battered and chipped as a result of extensive use and further modified by rolling. Very coarse resolved flaking is characteristic. The butt end is thick and heavy, and the upper surface normally exhibits large areas of cortex. In a few cases the edge is concave, but a straight to slightly convex form is normal. One example of a broad notched tool was noted in this series. Presumably the artifacts in this category served as general all-purpose tools for working wood.

**Flakes and Blades : General.** A total of 2,774 artifacts representing 50.30 % of the entire series were classed as either flakes or blades. But it is manifestly impossible to formulate a clear-cut definition establishing the boundary between these two categories. For classificatory purposes—both in order to obtain a quantitative expression in the form of a chart (Pl. XI), and to facilitate in the description of the material—the policy of only including relatively well-struck, parallel-sided flakes, carefully prepared on the core prior to detachment, in the blade category has been adhered to. On this basis the series shown in Figs. 6 and 7 are considered to be flakes, while a normal series of blades is shown in Fig. 8. Throughout both assemblages plain striking platforms, normally at an angle greater than 90° with the artifact’s major axis, are typical. Although the Larnian knappers were capable of producing well-made implements, they made very frequent use of primary flakes and blades, which has caused the removal of chips along the edges as the result of wear, very few being actually retouched. In addition, as Knowles (1914, p. 97) has observed, many flakes and blades of primary type with their edges free of any trace of natural chipping occur in the Curran deposits. Throughout the gravels of the raised beach at Larn a considerable quantity of broken flakes and blades, as well as débitage material occurs, and the edges of these specimens have been utilised.
in many instances for scraping the cutting. In view of the presence of literally thousands of well-struck forms, however, one wonders why so many scrapers, points and perforators of various types were made on irregularly-shaped trimming and waste flakes.

Fig. 6—Flake Artifacts from the Curran Deposits at Larne.
Flake Artifacts (Total: 1,068). In addition to the massive and large flake implements described above, two basic types of flakes are typical of the Late Larnian, which are as follows: (a) large to medium-sized forms, which tend to be thick and normally to exhibit either a triangular, or in a few rare instances, a trapezoidal, section (Fig. 6, Nos. 18-29 and Fig. 7, No. 39); and (b) large-, medium- and small-sized artifacts, which are flat and relatively broad in proportion to their length (Fig. 7, Nos. 30-38 and 40-42).
The very large flake series is one of the distinguishing features of the Late Larnian, since artifacts in this category are rare in the earlier deposits (Movius, 1940, p. 52; 1940-a, p. 125; 1942, p. 149). In comparison with the blades, however, the majority of these specimens are not as skillfully struck—they are coarse and clumsy, as if the industry, in which flakes were originally of infrequent occurrence, had lost its vitality to a certain degree. Although over 1,500 blade tools also occur, they are not as thin and well-struck as is the case in a normal Early Larnian series.

Flakes with fairly pronounced bulbs, plain striking platforms at an angle of over 90° to the long axis of the specimen, and very thick butt ends are present. Whether or not this feature represents a degeneration in the flint-working technique is difficult to say. In any case it certainly is not a marked feature of the Early Larnian and seems to be connected with the common production of flake tools at this time. Examples of this kind of flaking technique may be observed on both the main classes of flake tools listed above.

As a comparison of the present series with material from the older levels at Island Magee, Cushendun and Rough Island will reveal (compare Movius, 1942, Figs. 21 and 22), one of the most pronounced differences between the early and the late phases of the Larnian Culture may be detected in the flaking technique. Emphasis was placed on the production of thick, heavy forms, and their frequent occurrence is a striking feature of the industry from the Curran deposits at Larne. As the more element conditions of the climatic optimum approached, coarser, and more generalized forms were apparently sought after. In this connection the material effect of the Early Post-Glacial marine transgression itself must be taken into account. For the forested lowlands, where the Early Larnian was developed, once extended far off the present coasts. But now this area was under the sea and the settlements were along the shore, which led to the adoption of a new mode of life patterned to meet the exigencies of an economy based primarily on the products of the sea rather than those of the forest. Thus perhaps it is not surprising to find these geographic changes reflected in a modification in the typology of the stone tools, and even in the technique employed in their manufacture.

In general the larger specimens in this category are now more heavily rolled than the medium- and small-sized material, the flake facets in some instances (Fig. 6, Nos. 18, 19 and 24) being battered and rounded to a pronounced degree. Careful retouching is very rarely found; the edge-chipping has resulted in the first instance from utilization, and later has been modified by rolling in the sea. Frequently notches indicating use as hollow scrapers (Fig. 6, Nos. 20 and 24) occur. Normally the worked edges display an irregular or even a scalloped outline (compare Fig. 6, No. 25), a feature that is of very common occurrence in the Late Larnian.

Blade Artifacts (Total: 1,539). The following observations emerge from an analysis of the material included in this category: (a) no massive forms over 9 cm. long occur; (b) small forms less than 5 cm. long are fairly common, and these
include a series of very small examples between 2.5 cm. and 3 cm. in length; 
(c) the same general characteristics as regards degree of rolling is exhibited by 
these normally smaller and more delicate forms, as noted above with reference 
to the flake series; (d) just as in the case of the Early Larnian (compare Movius,
1940, p. 54), on the one hand, and the material classified as flakes from the Curran gravels, on the other, forms with purposely reworked edges are extremely rare, although a few side-scrapers (Fig. 8, No. 43) may be noted; (e) as the illustrated specimens reveal, there is a marked emphasis on forms that are heavier and coarser than those commonly found in a typical Early Larnian context, but blades which would not be out of place in any of the older horizons at Island Magee (Horizon 1), Cushendun (Horizons 1 and 2) or Rough Island (Horizon 1) are also present, demonstrating that there is a considerable overlap between the techniques that were employed during the two stages; (f) secondary working on the upper surface of the bulbar end in an effort to reduce thickness (compare Fig. 8, Nos. 46 and 54-58) occurs in the case of approximately 10% of the specimens; and (g) as in the case of the flake series, notched forms are present, probably used as hollow scrapers (Fig. 8, No. 47), occur.

The first impression one receives on examining a large series of Late Larnian material is that massive, crudely worked, and very heavily rolled flake tools constitute an overwhelming majority of the industry. But, as pointed out on pages 37-38, this is not the case. Actually there are more artifacts in the blade category than there are flakes. The latter are larger, however, which probably is in part responsible for the erroneous concept that they constitute the dominant type. This matter of the occurrence of a large number of small- to medium-sized blades in the Curran gravels is further discussed on page 78.

Scrapers (Total: 436). With the exception of a few examples of the type shown in Fig. 9, Nos. 68-69, true end-of-blade scrapers are virtually non-existent in the Late Larnian. However, a wide range of other types of scrapers can be recognized, all of which exhibit a crude, irregular, steep retouch that is often in combination with a variety of resolved flaking. The working edge is normally straight or concave; forms with edges that have a rounded or convex outline are rare. Doubtless many of the flake and blade implements described above were used for scraping among other purposes, but such generalized artifacts are not included in this category.

(a) Side-Scrapers (Total: 21). The specimen illustrated in Fig. 9, No. 65, is very similar to a type of large flake implement previously discussed (see p. 48 and Fig. 5, No. 12), except that it is smaller and is made on a comparatively short, broad flake that has been rather carefully prepared on the core prior to detachment. The steeply worked edge is nearly straight; the flake scars are larger and they extend further back than is normally found in the Larnian. This specimen is very similar to the series illustrated by Knowles (1914, Figs. 19, 20, 23 and 24), although it lacks the "projecting point" on one side which he describes (compare Knowles, 1914, p. 101).

The characteristic side-scrapers from the Curran locality are made on coarse, thick flakes, often with the original cortex of the flint adhering to a large area of the upper surface (Fig. 9, No. 67). The illustrated specimen is typical of the small series of side scrapers found. The secondary working along the steep edge, which has a jagged but nevertheless roughly straight outline, is of the
stepped or resolved variety. This feature is also apparent on the example shown in Fig. 9, No. 66. The latter is made on the butt portion of a small broken blade, and it exhibits a less irregular and steep cutting edge than is typical of the implements in this category.

(b) Concave Scrapers (Total: 53). Medium- to small-sized forms with a concave rather than a straight scraping edge (Fig. 9, No. 74) were presumably used as
spokeshaves. The working is restricted to the area of the concavity, and it is of the same coarse resolved type previously noted. Many of the implements of this type have been used to such a pronounced degree that the worked edge forms an angle of 90° with the plane of the object's lower surface. This is true in the case of No. 74, but normally the angle is more nearly acute.

Fig. 10—Scrapers of Various Types, Points and Perforators or Reaming Tools from the Curran Deposits at Larne.
(c) Notched Scrapers (Total: 77). A series of implements with crescent-shaped notches (Fig. 10, Nos. 80-81 and 83-84), which may have served for rounding wooden or bone shafts, occur in the Late Larnian of the Curran gravels, just as they do in the raised storm beach deposits at Glenarm (compare Movius, 1937, p. 194). Forms with double notches, such as Fig. 10, No. 83, are not common. This category exhibits a wide range of typologic variation, not only with regard to shape and depth of the notch, but also there is no uniformity as to the outline of the finished tool. But there are also notches on many of the objects classed as flakes and blades (cf. Fig. 7, No. 30 and Fig. 8, Nos. 46 and 47), which means that the actual frequency of this form is greater than is indicated by the figures shown on the chart. The latter include only those objects made on trimming flakes and other fragments of flint that exhibit notches on either one or both sides, such as are shown by the illustrated examples. As in the case of the various categories of scrapers discussed above, resolved flaking is typical of this series.

(d) End-Scrapers (Total: 66). As previously mentioned true end-of-blade scrapers are extremely rare, the prevailing type being made on a short thick flake or flake fragment (Fig. 9, Nos. 70-73). The majority are straight-ended forms (Nos. 68, 72 and 73) made with a minimum of retouching and exhibiting rough stepped or resolved flaking in the area immediately adjacent to the cutting edge. In the case of No. 73 a short, thick square-ended form, evidence of working on the lower surface is apparent. A small series of sub-discoidal types (Fig. 9, No. 71) was found in the Curran gravels; these seem to be flatter and better made than the majority of implements in this category. No. 70 is a very heavily rolled, round-ended form of which there are very few examples. Ordinary end-scrapers with rounded ends, such as No. 69, are comparatively rare; there are less than one-third as many specimens of this type as there are of the square-ended form.

(e) Concave-Ended Scrapers (Total: 56). This is a large and relatively uniform category. It includes scrapers exhibiting a concavity at the end (Fig. 9, Nos. 75-79) rather than along one side (compare sub-type b above). A coarse resolved flaking technique is normally present along the working edge. In addition to average-sized forms, this category also includes a series of thumbnail scrapers with concave edges (cf. Nos. 76 and 77). But there is no typologic break between the two series which can be differentiated only on the basis of size. None of the concave-ended scrapers or concave thumbnail scrapers found in the Curran gravels is made on a flake or a blade intentionally struck for this purpose. Rather they have been made on fragments of chips or trimming flakes which have no special form. In the case of No. 78, the bulb of percussion is on the upper rather than the lower surface.

(f) Steep Scrapers (Total: 12). These are rare. They are exceedingly short, thick-ended scrapers with steeply-worked ends (Fig. 10, No. 82) and not true core or nucleus form scrapers of Upper Paleolithic type, such as are commonly found in the Early Larnian (compare Movius, 1940, p. 57; 1940-a, p. 126;
1942, p. 155). The illustrated specimen is typical of this small series, all of which are made on very irregularly-shaped fragments of flakes often exhibiting an area of crust on the upper surface. Actually these are short steep-ended scrapers rather than true steep scrapers.

(g) **Thumbnail Scrapers** (Total: 151). Although these are typical of the Early Larnian, a fairly large series of them, representing 34-63% of the total of the scraper category, was found in the Curran gravels (Fig. 10, Nos. 86-92). They have a tendency to be ovate or discoidal in outline and are normally made on broken-off portions of fairly thick flakes, which have been carefully worked. The retouched edge is normally straight or convex, although both notched or concave-ended forms occur (Fig. 9, Nos. 77 and 78). There is, likewise, a small series of relatively steep-ended forms. The average diameter of the specimens in this category is less than two centimetres, and in instances where this dimension is exceeded the worked edge is parallel to the worked edge of the object (Fig. 10, Nos. 86 and 87). In some instances an area of cortex adheres to the upper surface, and in the case of Fig. 10, No. 88, the bulbar face is uppermost. It is difficult to understand how these small-sized tools were used, unless they were hafted. Furthermore, an examination of a large series of them gives one the impression that in the majority of instances the edge has been worn back by use until the piece was no longer serviceable. On the basis of present evidence, however, it is very difficult even to speculate on the possible function of these tools.

**Points** (Total: 82). Of the total of roughly triangular or leaf-shaped flakes and/or blades which may be classified as points, 16 exhibit secondary working on the upper surface of and along both edges adjacent to the butt end, apparently for hafting (Fig. 7, Nos. 35-38). Actually this technique may be noted on certain of the unrolled flakes from the sands underlying the Curran gravels, as shown by Fig. 4, Nos. 7 and 10. The former was found in Deposit D (level L/A-20) and the latter in Deposit E (L/A-19); No. 8 in the same figure, also an excellent example of this type of trimming, was found in Deposit C (level L/A-7). In Fig. 7, Nos. 35 and 36, the process has been carried to a pronounced degree, but this occurs in only a very few instances. These superficially tanged forms carry on a tradition already present in the Early Larnian (Movius, 1940, p. 54), which culminated in the development of the classic examples associated with the Early Neolithic hearths at the base of the diatomite near Newferry, County Londonderry, excavated in 1934 (Movius, 1936). That prototypes of the classic Bann Point were present in the series from the Curran gravels was originally pointed out by Whelan (1928, p. 188, Fig. III). Although more evolved forms also occur in the so-called Bann Culture of Northern Ireland and very sporadically at the surface stations in Ulster and Eire (compare Raftery, 1944; Davies, 1948, p. 6; 1948-a; May and Batty, 1948, pp. 134-141; D'Evelyn, 1904, p. 216; Mitchell, 1949, pp. 179-181), as well as in the Isle of Man (Clark, 1935-a), these are to be regarded as descended from the examples that occur in both phases of the Larnian Culture of the Post-Glacial raised beaches of the North-east Irish littoral.
This type of slightly tanged point has not yet been reported, however, in any of the various Larnian assemblages found in Scotland (compare McCallien and Lacaille, 1941, pp. 68-70; Lacaille, 1945, pp. 87-92; Lacaille, 1948-a, pp. 27-28, 33 and Fig. 12).

Knowles (1914, pp. 96 and 101) noted the occurrence of pointed flakes and blades at Larne, which he considered to be spear points, but he states that they are rare. The fact that only 66 were found during the 1935 excavation certainly

Fig. 11—Points, Perforators and/or Reaming Tools from the Curran Deposits at Larne.
confirms this observation. Actually such examples as Fig. 10, Nos. 93 and 95, which exhibit inverse working on either side of their blunt ends, possibly served as reaming tools. The butt ends of both of these specimens, in addition to that of Fig. 11, No. 101, are thick and have been trimmed on the upper surface in characteristic fashion. Fig. 11, No. 97 is an obliquely truncated flake, the pointed end of which has been extensively worked along either side. Figs. 10 and 11, Nos. 94, 99, and 100, are points with slight notches or constrictions on both sides of the end. All the objects illustrated in this series exhibit irregular edge-chipping as the result of use and in some cases this may be observed on the lower surface as well. This feature, which is very typical of the specimens in the point category, suggests use as general all-purpose tools.

*Perforators or Awls* (Total: 134). There are four basic types of perforators or awls included in the series excavated at Curran Point in 1935, as follows:

(a) Pointed flakes and/or blades which exhibit inverse working on one or both sides of the point (Fig. 11, Nos. 96 and 98). Except for the fact that these objects are more definitely worked, they are very similar to the forms described above as possible reaming tools.

(b) Obliquely blunted flakes and blades with a pointed projection for drilling on either the right (Fig. 11, Nos. 105 and 106) or the left (Fig. 11, Nos. 108-110) side at an approximate angle of 45° to the long axis of the piece. The majority of these tools, which appear to be made on broken fragments of flakes and waste material, exhibit inverse retouching. Although the working is mainly on either side of the point it also extends along one or both edges in many instances.

(c) Small fragments of flakes and débitage material with pointed beaks or projections that have been worked in such a way as to produce a clearly defined neck (Fig. 11, Nos. 102-104, 107 and 111-114). Inverse retouching is by no means as characteristic of this series as it is in the case of sub-type (a). Cortex is present on the upper surface of Nos. 102 and 104, as in the case of so many of the pieces previously noted in the scraper series.

(d) Very small chips and fragments of trimming flakes of rough oval or discoidal outline seem to have served as combination tools, and to have been used as hollow thumbnail scrapers as well as perforators (Fig. 11, Nos. 115-118). Some of these exhibit inverse working.

The material included in this series taken as a whole further emphasizes the fact, previously noted with regard to the scraper category, namely, that in the majority of instances almost any odd-shaped flake or blade fragment, chip, or broken piece of waste material has been utilized, if it possessed the proper outline for the tool-type that was sought after. In other words, flakes and blades carefully struck from prepared cores for the sake of obtaining the kind of material illustrated in Figs. 6, 7 and 8 has seldom been used for subsequent manufacture into specialized types of tools, such as various kinds of scrapers, points, and
Fig. 12—Massive Flake Tool and Larne Picks from the Curran Deposits at Larne.
perforators or awls. Indeed it is the chips, broken fragments and waste material struck off during the process of knapping that have normally been utilized in this manner.

*Larne Picks* (Total: 101). These tools, which are fairly common in the Curran gravels, may be considered the type implements of the Irish Mesolithic, as discussed elsewhere (Movius, 1942, p. 166). The illustrated specimens (Figs. 12 and 13, Nos. 119-130) show the range in type and size of these very curious

![Fig. 13—Larne Picks from the Curran Deposits at Larne.](Image)
picks that are so characteristic a feature of a Mesolithic cultural development strictly indigenous to Ireland. The type was originally described by Coffey and Praeger (1904, p. 180), who recognized this artifact as a specialized class of flake tool, but did not appreciate its significance. These authors state "a noticeable feature of the Larne flakes is the number of examples in which the bulb of percussion is at the narrow end of the flake, the opposite end being broad and thick. Moreover, the broad thick end often shows a portion of the outer crust of the nodule from which the flake was struck. Flakes of this type are so numerous that they are regarded by some collectors as characteristic of the Larne gravels, as also of the raised beach sites around Belfast Lough. There can be no doubt that these are the outer waste flakes, struck off in the process of reducing a block of flint to the proper truncated cone shape, from which the desired flakes could then be struck." But Knowles recognized that these curious plunging flakes had been used as tools and were not to be regarded as mere débitage material. He (Knowles, 1914, pp. 83 and 96) says "many of the large and coarse flakes are narrow, rather tending to a blunt point at the bulb, and they are broad and heavy at the opposite end. ... I have seen large flakes of this kind made into hand weapons with the point at the bulb end" (see also Knowles, 1914, Figs. 3, 7, 17 and 40, described on pp. 97-99). Later workers, including Burchell (1931, p. 289, Fig. 43) and Whelan (1938, pp. 122-123, Pl. II, Figs. 3 and 4) have described these specialized pick forms as pointed implements made on plunged or core-rejuvenation flakes, while Whelan (1930, pp. 179-183; 1931; 1931-a; 1932; 1933, p. 1216), following Bremer (1927; 1928; 1928-a, p. 7) saw in them evidence of an Asturian influence on the Irish Mesolithic. This idea was rejected by Burchell and Moir (1931), Obermaier (1932, p. 544; 1933, p. 1288), and the present writer (Movius, 1942, pp. 205-206; 1950); manifestly the Irish examples are flake tools and not manufactured on pebbles, as is the case with the Asturian pick. Furthermore, the distribution of the latter complex, recently discussed by Ferrier (1949; 1950), provides no support whatsoever for the view that influences from Iberia penetrated Ireland during Early Post-Glacial times.

The size of the Larne pick varies from massive examples over 15 cm. long (Fig. 12, No. 119), to small specimens with an average length of 6 cm. (Fig. 13, Nos. 127-130). Prior to detaching these peculiar implements the core has been carefully prepared, often by the removal of short flakes which have broken off before reaching the end of the core opposite the striking platform (Figs. 12 and 13, Nos. 121-122, 124 and 128-129). In other examples the preparation was along the angle of a core so that flakes with very pronounced ridges, or keels, on the upper surface have been produced (e.g., Fig. 12, Nos. 119-120 and 123). In any case the net result sought after was a flake, the proximal end of which was relatively broad and thick and in many cases exhibiting a large area of the crust of the original flint nodule (Figs. 12 and 13, Nos. 119, 124 and 126). The heaviness of the proximal end has been further contributed to by the plunging method employed in delivering the blow for the removal of the flake from the core. Experimentation has shown that it is extremely difficult to manufacture these
implements intentionally, especially those which are long and tapering at the bulbar end.

Fig. 13, No. 124 is an excellent example of a Larne pick made by the technique described above. The large specimen (Fig. 12, No. 119) may be considered as a crude adze rather than a pick, but nonetheless it is made on a typical plunging or core-rejuvenation flake with a high ridge running down the back. A very similar large chopper or adze also made on a massive flake, has been described by Knowles (1914, p. 107 and Fig. 51); it is over 15 cm. long and weighs 1 lb., 10 oz.

In the majority of instances the bulb of percussion is in evidence at the pointed end of the Larne picks, and occasionally (Fig. 13, No. 126) the striking platform is still intact. However, normally the latter feature has been removed as the result of extensive use at the pointed or bulbar end. Because of this fact it is clear that these implements served as picks, but the marked degree of edge-chipping along the sides suggests that they were also used for other purposes. Judging by their form it is very improbable that they were ever hafted, and for this reason may be regarded as hand tools. Since they occur with a fairly uniform distribution throughout the Curran gravels, it is clear that a definite need for them must have existed in the material culture equipment of the people who were occupying this region during Late Mesolithic times. As discussed elsewhere (Movius, 1942, p. 155), the prototype of the Larne pick is present in the Early Larnean levels at Cushendun and Island Magee. The Cushendun pick (Movius, 1940, pp. 57-58; 1940-a, p. 128) is a somewhat more massive implement with a ventral keel. It is also made on a flake and may be related to this group of typical Late Larnean tools.

Axes or Celts. In most of the early reports describing the archaeological material from this region the core axe or celt (Figs. 14 and 15) is considered to be very characteristic of the industry found in the raised beach at Larne, Island Magee, along the shores of Belfast Lough, and elsewhere in North-eastern Ireland in association with this marked topographic feature. But this concept seems to have arisen as the result of selective collecting. At the site excavated on Curran Point in 1935 not a single axe or celt was found in a total series of 5,515 implements, a fact which gives us a reason to believe that their occurrence must be extremely sporadic. Since the appearance of these axes in the Late Larnean demonstrates that a definite influence from the Mesolithic Forest Cultures of Northern and Western Europe penetrated North-eastern Ireland during Early Post-Glacial times (compare Movius, 1942, p. 210), the evidence for the occurrence of axes or celts will be discussed. At the outset, however, the writer wishes to state that he has examined at first-hand only four of the finds described here. The core axes or celts from Larne may be discussed under the following headings:

(a) Celt found at Section B. At the locality investigated by the Belfast Naturalists' Field Club's Committee on the south side of the old Railway Cutting (see Pl. IX) "one fine example of a rude celt" was found at a depth of 3-35 m. (11 feet) from the surface (Praeger, 1890, p. 205; Coffey and Praeger, 1904, pp.
Fig. 14—Larne Axes from the Curran Deposits at Larne. No. 131: Specimen found by R. Young (after Coffey and Praeger, 1904, Fig. 8, No. 3); No. 132: Specimen from Section Z, the Harbour Ballast Pit (after Coffey and Praeger, 1904, Fig. 8, No. 2); No. 133: Specimen found by C. B. Whelan (after Whelan, 1938, Pl. II, Fig. 9); and No. 134: Specimen found by J. P. T. Burchell (after Burchell, 1931, Fig. 42, p. 288).
Fig. 15—Larne Axes from the Curran Deposits at Larne. No. 135: Specimen from Section Y, the Aluminium Works Locality (after Coffey and Praeger, 1904, Fig. 6, No. 4); Nos. 136 and 137: Specimens found by W. J. Knowles (after Coffey and Praeger, 1904, Fig. 8, Nos. 4 and 6); Nos. 138 and 139: Specimens found by C. B. Whelan (after Whelan, 1938, Pl. II, Nos. 12 and 13).
173 and 182; Knowles, 1914, p. 87), a level which would correspond with L/A-15 at the site excavated in 1935. This specimen was published by W. Gray (1893, Pl. II, No. 3—facing p. 614) as one of a series of ten cels, all allegedly from Early Post-Glacial raised beach deposits in North-eastern Ireland. Unfortunately this series is shown in a very indistinctly reproduced photograph at a scale of one-quarter natural size; apparently the original object, no other illustration of which exists, measured approximately 12 cm. long by 4 cm. at the widest point.

(b) Celt found at Section Y. At the so-called Aluminium Works Section (see Pl. VII, No. 2, Pl. IX and p. 73 for location and section), where approximately 1-50 m. (ca. 5 feet) of raised beach gravels formerly overlay an outcrop of Boulder Clay, a "rude flint celt" was found at a depth of 97 cm. (3 ft. 2 in.) below the surface (Coffey and Praeger, 1904, Fig. 6, No. 4). It lay at the base of a layer of sand and rested on the surface of the underlying gravels. Neither this object nor the associated flakes and blades found in the same horizon were deeply patinated, and the edges were sharp and unrolled. (See p. 40 for further comments on the archeological material from this locality). This specimen (Fig. 15, No. 135) measures 11-5 cm. long by 3-6 cm. wide; it is apparently an adze of plano-convex section rather than an axe. According to Coffey and Praeger (1904, p. 185), the celt found at Section B in 1890 was of the same type as the Aluminium Works specimen.

(c) Celt found at Section Z. In 1904 Coffey and Praeger examined a typical section of raised beach deposits exposed at Section Z, the Harbour Ballast Pit (see Pl. IX for location and section). In the gravels at a depth of 1-52 m. (5 feet) below the surface near Z a third specimen was found in association with a normal series of typical Late Larnian flakes, blades and cores (Coffey and Praeger, 1904, p. 184 and Fig. 8, No. 2). This roughly rectangular small axe, which is 16-5 cm. long and 7-5 cm. wide, is illustrated in Fig. 14, No. 132.

(d) Miscellaneous: Examples found by Knowles and Young. This completes the list of documented specimens found in situ at specific localities in the Larne area. But Knowles (1893, p. 140) states that he collected additional examples at various depths in the gravels, although the locality is not given. Two of these finds were apparently accepted by Coffey and Praeger (1904, Fig. 8, Nos. 4 and 6) as coming from the raised beach, and they are illustrated in Fig. 15, Nos. 136 and 137.1 Both of these small axes or cels agree fairly well in type, but among the larger specimens there is no such uniformity as to shape as that shown by the present objects.

A further example was collected by Mr. R. Young of Belfast "at a considerable depth in the gravels" (Coffey and Praeger, 1904, pp. 183 and 184, Fig. 8, No. 3; Gray, 1893, Pl. II, No. 8—facing p. 614). This specimen (Fig. 14, No. 131) measures 15 cm. by 7 cm.; it has a lenticular section and a more regular outline than any of the large axes thus far described.

1 In the "Irish Stone Age" (Movius, 1942, p. 170 and Fig. 31, No. 6) it is erroneously stated that this specimen was found at the "base of a sand layer, 11 ft. below the surface."
(e) Miscellaneous: Examples found by Burchell and Whelan. During the past twenty-five years the finding of only four Larne Axes has been recorded in the literature. These include a very typical specimen some 13 cm. long, slightly rolled, and exhibiting a creamy-white, porcellaneous patination, flecked with patches of ferruginous staining found by Burchell (1931, p. 287 and Fig. 42, p. 288) and two smaller examples illustrated and described by Whelan (1938, p. 123 and Pl. II, Figs. 12 and 13). The latter are 9 cm. and 10-5 cm. long respectively; they are reproduced, together with Burchell’s specimen, in Figs. 14 and 15, Nos. 134, 138 and 139). The fourth specimen, actually a shoe-shaped adze (Fig. 14, No. 133) was found at Curran Point by Whelan (1935; 1938, p. 123 and Pl. II, Fig. 9), is bifacially flaked, although it has a plano-convex section. This object, which is 18 cm. long, is one of the largest tools ever found in the raised beach deposits at Larne. It recalls an earlier example collected by Knowles (1884, p. XIV, Fig. 2), but it is even larger.

The distribution of these chipped flint axes or celts, commonly referred to as the “Larne Type” (compare Knowles, 1893, p. 140; Coffey and Praeger, 1904, p. 184), is by no means confined to Larne, although the only in situ specimens recorded to date all come from the Curran gravels. According to Knowles (1893, p. 140; 1914, pp. 109-111) and Gray (1879, p. 142; 1893, Pl. II, No. 6—facing p. 614), as well as Coffey and Praeger (1904, p. 184 and Fig. 8, No. 1), comparable examples also occur on Island Magee and elsewhere along the shores of Larne Lough. In the Belfast Lough area finds have been reported from Kilroot (Gray, 1879, p. 142; Coffey and Praeger, 1904, p. 184; Knowles, 1914, pp. 109-111) in County Antrim, and from Holywood, Cultra and Ballyholme Bay (Gray, 1879, p. 142; 1893, Pl. II—facing p. 614; Knowles, 1884, Pl. XV, No. 5) in County Down; Knowles (1893, p. 140) also mentions the occurrence of Larne Axes along the shores of Belfast Lough. North of Larne an example from Carnlough, County Antrim, is recorded by Gray (1879, p. 142), while Coffey’s find at Portstewart, also in County Antrim, represents the most northerly occurrence of one of these implements thus far recorded (Coffey and Praeger, 1904, pp. 184 and 192, Fig. 8, No. 5). But these are all surface finds from along the foreshore, and there is no way of being certain of their age. In this connection degree of rolling and depth of patination are only of limited validity for establishing age, as stated on page 40, and typologically there is very little difference between axes or celts of the Late Larnean culture and many of the later—Neolithic and Early Metal Age—examples. Admittedly heavily rolled specimens exhibiting a patina similar to that observed on in situ flints from an immediately adjacent raised beach at any given locality are probably to be regarded as belonging to the Late Larnean culture. However, even if it is very doubtful that all the specimens described in the literature as “Larne Axes” are authentic, it is apparent that they occur in greater numbers in the Larne-Island Magee area than they do elsewhere in North-eastern Ireland. In addition to the Knowles and Gray Collections, W. H. Patterson, the Rev. John Grainger, and the Rev. G. R. Buick are also stated to have collected examples from this region which, unfortunately,
were never published. An analysis of these old collections in the Belfast and Dublin museums would unquestionably bring to light many interesting facts, not only concerning the distribution of this class of implement, but also its typological range.

With regard to the latter Knowles (1893, pp. 140-142; 1914, p. 109) states that most of the specimens in his collection are triangular in section and often terminate at one or both ends in blunt points. Since no consistent attempt seems to have been made to form a broad cutting edge like that found on ordinary axes, he suggests that they should be called picks. Other types with a plano-convex section and an asymmetrical cutting edge, which unquestionably served as adzes, have been described above. Thus there is a wide typological range covered by the present material. Until an objective study is made of the series as a whole, however, the term axe has been retained for the present.

Coffey and Praeger (1904, pp. 184-187) did not regard the Larne Axes (or Celts) as finished implements, but rather as "blanks" or roughed out forms for subsequent manufacture into cutting tools with a sharp edge. This, of course, is entirely consistent with their idea (see p. 73) that Larne was not a dwelling site, but rather a quarry-shop or factory. In any case they compare the examples which they found in situ in the Curran gravels with roughly analogous specimens from the great Tievebulliagh axe-factory, near Cushendall, County Antrim, which is of Neolithic age and which is overlain by Sub-Boreal peat (Knowles, 1903; 1906; 1906-a; Movius, 1942, pp. 222-227; Jessen, 1949, pp. 142-143). Thus the Larne series was of Neolithic age according to their view (Coffey and Praeger, 1904, p. 190), on the basis of the occurrence of these "blanks" intended for subsequent manufacture into implements with a sharply chipped or even a partially polished edge. For them the site was a Neolithic workshop, and the archaeological material found there, instead of consisting of implements derived by the sea from occupation sites along the foreshore, was made up ofdiscards and factory refuse. In view of the fact that at the time Coffey and Praeger wrote their report the Mesolithic was still only a vague and little understood shadow on the archaeological horizon, it is easy to understand how they arrived at this conclusion.

Cores (Total: 142). A series of typical cores showing the range in size and form is illustrated in Fig. 16, Nos. 140-147. In all essential respects these agree with types illustrated by Coffey and Praeger (1904, Fig. 4, p. 175) from various sections investigated by them. The examples from the site excavated in 1935 are all made on nodules or pebbles of flint, only one face of which has been prepared for flake detachment. The striking platform is plain, at a considerable angle to the axis of the flake scars, and has been formed by the removal of a single flake. As previously stated, Fig. 16, No. 145 is a small core found at a depth of 75 cm.-1.00 m. in the Estuarine Clay (Deposit H). It is slightly rolled and patinated a dark blue colour in contrast with the porcellaneous white to grey colour of the series from the overlying gravels (Deposits B and C). In the latter no true blade cores were found; the specimen illustrated (Fig. 16, No. 147) came from the
Fig. 16—Cores from the Curran Deposits at Larne.
surface layer (Deposit A). It is an old core with a deeply patinated striking platform that has been reworked in Post-Larnian times. Since the worked face is fresh and of a light bluish grey colour, this object is certainly referrable to Neolithic or later times.

Knowles (1914, p. 103 and Figs. 31-38) dogmatically asserts that cores are plentiful in the raised beach gravels at Larne and elsewhere in the vicinity, but this statement is obviously based on his study of a collection made, for the most part, on the modern foreshore where cores are numerous (compare Coffey and Praeger, 1904, p. 173). As pointed out on page 37, however, this is due to the selective action of the sea, which is at present eroding the raised beach deposits. For in proportion to the material as a whole—flakes, blades and other artifacts—recovered at the site excavated in 1935, cores were found to be comparatively rare—1-83 % of the total series. Perhaps their most distinguishing feature is the uniform typology they display regardless of size.

**Possible Microliths** (Total: 2). In the large series of stratified material from the Curran gravels recovered in 1935 there are two possible microliths (Fig. 17, Nos. 148 and 149). The former, which suggests a large crude lunate, or crescent, came from the 60 cm.-80 cm. level (L/A-4), and its shape is apparently fortuitous. It is steeply retouched all around the edge; this feature, together with the fact that the object averages 5 mm. thick, indicates that it belongs in the thumbnail scraper category, and that it is not a true microlith. On the other hand, Fig. 17, No. 149, which was found at a depth of 1-75 m.-2-00 m. (L/A-9), may possibly be a very crude attempt to manufacture a trapeze, although it exhibits a maximum thickness of 8 mm. at the midpoint along the very steeply retouched back. If so this would indicate the presence in Ireland of an extremely faint and diluted influence from Tardenoisian sources, which at this time had apparently penetrated Southern Scotland (evidence summarized in Movius, 1942, pp. 193-196). It is also possible that, as in the case of Fig. 19, No. 148, the trapezoidal shape of this enigmatic specimen is also completely fortuitous.

**Possible Angle Graver or Burin** (Total: 1). Only one artifact, which came from level L/A-3 (40-60 cm.), that could have possibly served as a graver or burin was found at the locality excavated on Curran Point in 1935. As shown in Fig. 17, No. 150, it is of the angle variety, made on a short thick blade with cortex on the upper surface, and exhibiting two flake scars on the slightly obliquely truncated end. The bulb is prominent, and the striking platform is at an angle of approximately 130° with the long axis of the implement. But the burin facet does not exhibit the same deep bluish grey patina as is present on all the other surfaces, including the worked edges and the flake scars on the adjacent end. Therefore it is believed that this should be considered a *burin de fortune*—a fortuitous angle graver—and not as evidence for the presence of tools of this type in the Irish Mesolithic. For, if this specimen were genuine, it would be unique in any of the Larnian assemblages, both Early and Late, thus far investigated.
Hammerstones. Undoubtedly some of the rolled quartzite pebbles, especially those exhibiting abraded and battered areas on one or both ends, noted in the Curran gravels have served as hammerstones. But no specimens purposely shaped for this function were found, and no objective criteria could be formulated to distinguish between battering caused by wave-action, on the one hand, and use in knapping, on the other. Knowles (1914, p. 104 and Fig. 39) illustrates and describes a rounded piece of flint weighing 2 lb. 3 oz. covered with comparatively fresh-looking marks of percussion. This object was not found in situ, however, consequently its age is doubtful.

Bone. Although two fragments, one possibly Wolf, were found in the gravels at the excavated site (see p. 170), no worked bone occurred. If bone tools were ever present they were either destroyed during the marine transgression, or they have decomposed in the gravel where access of air and the lack of calcium would not be conducive to preservation.

Summary and Conclusions. The above analysis of the typology of the archaeological material excavated at Curran Point in 1935, including that described by earlier authors, clearly demonstrates that the Late Larnian is a flake-blade complex, which developed with certain modifications from the Early Mesolithic of Ireland. But core tools—choppers, axes, celts, adzes, and picks—chipped from flint nodules, also occur. As yet it is impossible to subdivide this Late Mesolithic culture, since primary stratigraphy is lacking, and local conditions in the Larne region have determined the type of sedimentation at the
various exposures. The material has been sorted during the process of deposition, and it is impossible to distinguish between variations which have resulted from local development, and those caused by natural selection on the part of the sea. One fact is clear: in the Early Post-Glacial raised beach at Larne and elsewhere in North-eastern Ireland, degree of rolling and intensity of patination are not necessarily criteria of age. Therefore, until undisturbed settlement sites of this period have been discovered in which primary stratigraphy has been preserved, it will be difficult to trace the cultural development in detail. Presumably subdivisions of the Late Larnian exist, but the material recovered to date is of such a nature that these cannot be determined. Thus, for the present, it must be considered as a whole. It is believed that the bulk of it has been derived from numerous coastal settlements—similar in type to the later Oyster shell middens at Rough Island, County Down (Movius, 1940-a), and Rockmarshall, County Louth (Mitchell, 1947; 1949-a)—covering an interval of perhaps two and a half millennia, and transported to its present position. As suggested on page 73, however, it is possible that some of the extremely fresh-looking artifacts, which comprise nearly 12 % of the entire series, were actually lost directly on the beach, but with this exception nothing seems to occur in situ. Coastal midden sites, especially in Counties Antrim and Down, will unquestionably repay excavation, and in them some trace of organic remains should be expected, as well as a possible clue as to the use of the Larne pick.

5. The Nature of the Mesolithic Occupation in the Larne Region

The conditions pertaining at the time the Curran gravels were being accumulated, summarized on pp. 28-30 of this report, rule out the possibility of considering that the site was ever actually occupied by the people who developed the Late Larnian Culture. For, as several authorities have stated (compare Praeger, 1896, pp. 35 and 39; Coffey and Praeger, 1904, pp. 155-156; Bell, 1890, p. 291), these deposits consist of current-bedded banks of sand and gravel formed in the intertidal zone, and containing a rich assortment of shells of littoral species. These include such bivalves as Tapes decussatus, Ostrea edulis, Ensis (Solen) siliqua and Phacoides borealis with the pairs of shells still in the natural position, as first recorded by Praeger (1890, p. 202) with reference to Bed C at the Railway Cutting. The vertical position of these molluscs proves that they lived in the gravels during the period of their accumulation.

The absolutely fresh-looking and little-patinated primary flakes and blades, which occur in the gravels (Deposit C) and in the underlying Reddish-Brown and Grey Sands (Deposits D and E), conceivably may have been lost directly on the foreshore of the Curran during times of low tide in the Atlantic Period. This possible indication of occupation contemporary with the accumulation of the Curran deposits is further confirmed by Coffey and Praeger’s (1904, p. 178) observation; they state “the evidence of the unrolled flakes in the lower beds
points to the working of the flints having been contemporary with the laying down of the gravels.” The overwhelming majority of the unrolled specimens recovered during the 1935 excavation exhibit no traces whatsoever of working or edge-chipping resulting from use. This fact suggests the possibility that nodules of flint were collected on the beach when the latter was exposed at low tide, and that knapping was done on the spot. In any case, regardless of how one accounts for the presence of the very little patinated and unrolled specimens from the Curran deposits, it is apparent that they “were buried before being much exposed to the weather,” as Knowles has observed (Knowles, 1914, p. 92).

At Section Y the Aluminium Works Section (see p. 40 and Pl. VII, Fig. 2), a deposit of gravelly clay 38 cm. (1 ft. 3 in.) thick directly overlay the Boulder Clay, which occurs here at a height of 5-50 metres (18 feet) above high-water mark, is described by Coffey and Praeger (1904, pp. 174 and 178). According to these investigators (1904, p. 180), the condition of the flints found in the gravelly clay beds “indicates that here, on the slope of the bank of Boulder Clay, they escaped the beach action, and lay as they fell from the hands of the flint-workers, being covered up gradually as the land sank, till at length a sandy shore overspread the bed on which, as the land sank further, the gravels of the upper bed were thinly spread.” The evidence of this locality, in addition to the implication of the extremely fresh material from the gravels and sands comprising the Curran deposits, represents the sum total of the data thus far brought to light bearing directly on the problem of human occupation in the Larne region during Late Mesolithic times. But the wealth of indirect evidence must also be considered. That people were living in the vicinity immediately prior to and during the time of the Early Post-Glacial marine transgression is a self-evident fact. The question is what was the character of this occupation; here several views have been put forward.

Coffey and Praeger (1904, p. 182) did not consider that the archaeological material found in the Curran gravels was derived from dwelling-sites. They base this contention on their impression that “the general evidence leads to the conclusion that it came from a quarry-shop, or roughing-out place, where flint was sought and flaked to carry away. This appears to be the only adequate explanation of the enormous number of cores and waste flakes found there.” They further state that “the absence at Larne of scrapers and flakes with secondary dressing is thus sufficiently accounted for. The site was not a settlement, but was resorted to as a quarry for procuring flakes, which were then carried away to be used for various purposes, and possibly as blanks for further specialization.” Admittedly the proportion of pieces exhibiting secondary working to primary flakes and blades, many of which exhibit traces of use, is very small, but this is true of all the Larnean localities investigated to date, not only in Ireland, but also in Scotland (summarized in Movius, 1942, pp. 148-170 and 176-178). Furthermore, it implies that the Mesolithic inhabitants of the region lived elsewhere, a view which is emphatically not supported by the present evidence. Indeed at the only two occupation sites which have been documented
in Ireland thus far—Rough Island, County Down (Movius, 1940-a) and Rock-marshall, County Louth (Mitchell, 1947; 1949-a)—at both of which middens dating from just after the maximum of submergence and composed mainly of oyster shells were found, the associated industry included almost no reworked pieces. On this basis one is forced to reject Coffey and Praeger's suggestion, and to conclude that the Larnian knappers only very occasionally produced finished tools. For in an area where the flint supply was so abundant, flakes and blades could be fashioned virtually at will. As will be presently discussed, however, specialized forms for specific functions do occur.

Knowles (1914, p. 96) also disagrees with Coffey and Praeger's conclusion; he states: "I believe the people who made the older implements, whether at Larne and neighbouring sites, shores of Belfast Lough, Carnlough or Whitepark Bay, must have dwelt there." According to him (Knowles, 1914, p. 95), "Larne and other localities of the same kind having been sunk beneath the sea, all trace of dwelling sites, if such existed, have been destroyed," a conclusion with which the present writer's views are in complete accord. Knowles (1914, p. 94) believed that the manufacture of implements had ceased by the time the sinking began, and that the change in conditions obliged the people to abandon the area leaving the products of their industry "lying around the shore, and whitened with long exposure to the weather before the sinking of the land began. During the sinking they were dashed about by the waves and knocked against other stones till all sharp and thin-edged flints were much chipped. Thinner flakes and smaller objects may have been carried away by currents, or conveyed by the waves to the outskirts of the raised beach. Any unpatinated flakes that have been found can be accounted for by their having been covered up before being exposed to the weather." This concept is in fundamental agreement with statements made elsewhere by the present writer (compare Movius, 1940, p. 76; 1942, p. 172). But it is very improbable that the archaeological material was simply "lying around the shore," as stated by Knowles; rather it must have been localized at specific occupation sites, which, presumably, were middens. For the present evidence from both sides of the North Channel indicates that the Late Mesolithic inhabitants of this region led a littoral existence depending in the main on products of the sea for their livelihood.

The data from Cushendun (Horizons 1 and 2), Island Magee (Horizon 1) and Rough Island (Horizon 1)—all discovered since Knowles' day—shows (a) that the sites occupied by the Early Larnians, on the old Early Boreal land surface then existing in now-submerged area of the Irish Sea—North Channel basin, were inundated during the first major phase of the sinking during the Late Boreal/Early Atlantic phase; and (b) that the industry associated with these sites suggests an economy of Upper Palaeolithic tradition presumably based on hunting. Following this event the sea was dominant in the economy of the

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1 It is possible that the small midden reported by Mrs. McMillan (1938) at Greensland, Belfast Lough, County Antrim, was occupied during very Late Larnian times, but this fact can only be determined by excavation.
settlers. As a result they adapted their way of life to a coastal existence under the conditions of a mild climate which was warmer than that obtaining in the region at present. There is good reason to believe that the contemporary occupation was in the immediate vicinity of shell middens, as opposed to the hunting camps of the earlier period. These shell-heaps, which must have been particularly prolific along the then-existing foreshore in the Larne region, judging by the extraordinary wealth of archaeological material in the Curran deposits, were in turn inundated by the sea during the second phase of the submergence, which amounted to 1.85 metres (6 ft. 3/4 in.) at the locality excavated in 1935 (Movius, 1953-a). Following the sinking, wave-action and long-shore currents swept the contents of these sites into the secondary sand and gravel formations where it now occurs. But there is absolutely no evidence that the people abandoned the area in consequence of this event. On the contrary, the extremely fresh nature of some of the flints found in the inter-tidal and shallow water Curran deposits, as well as the evidence of those found by Coffey and Praeger at Section Y, suggests contemporary occupation, as discussed above. However, the bulk of the flint tools must have been derived from the foreshore sites during the movement of submergence, when erosion processes were operative that had practically ceased by the time the uplift began. That the richest concentration of archaeological material is in the Storm Beach horizon (Deposit B) results from the fact that this was accumulated during an interval when wave action was particularly severe. In any case it is unlikely that any new localities were being inundated at this time.

The Rough Island and Rockmarshall middens provide us with direct evidence concerning the way of life during very Late Larnian, or what Mitchell (1949, p. 173) has called "Ultimate" Larnian, times. These foreshore sites were manifestly occupied after the maximum of the submergence during the time interval represented by the upper portion of Deposit B at Curran Point: Late Atlantic/Early Sub-Boreal transition in terms of the climatic sequence. But many slightly earlier sites of this same type near the then-existing high-water mark must have been destroyed by wave action as the result of the comparatively recent submergence amounting to 1.52 metres (ca. 5 feet) or so (compare p. 30). In this connection the records of nineteenth century denudation in the Belfast Lough region, summarized on pp. 15-16, provide us with an index for gauging what must have occurred during prehistoric times when the mutual relations of land and sea were altered. For such an event would have inevitably led to severe and widespread erosion all along the coast, thereby destroying the debris accumulated by littoral settlers at various unprotected localities. It also explains why so much rolled archaeological material is now found spread out on the modern foreshore. On this basis it is very unlikely that any significant primary occupation sites along exposed portions of the foreshore will ever be found in North-eastern Ireland dating from Late Atlantic times, although localities of this sort may possibly come to light around such inland bodies of water as Strangford Lough.
6. Economy of the Late Larnian Settlers

The view that the basic economy of the Late Larnian settlers was adapted primarily to a littoral existence, and that the sea played the dominant role in their daily life, leads to a consideration of what can be said about their activities. For their subsistence, it seems fairly clear that they depended in large measure on collecting shell-fish. Presumably their heavy tools served for working wood, including the building of boats. Although no boats of this period have ever been found in Ireland, contemporary evidence from Scotland shows that the art of navigation was fairly well developed at this time (see p. 92; also evidence summarized in Movius, 1942, pp. 206-207). Now the data from Rough Island and Rock-marshall indicates that the direct descendants of these people were dwelling either in, or immediately adjacent to, coastal middens at a time just after the maximum of the submergence had been attained, and the evidence discussed on page 75 makes it seem very likely that Late Larnian occupation sites were of the same type. It is, therefore, only logical to assume that they had boats, which could be used for sea fishing, as in the case of the Obanian midden-dwellers of Oronsay (see p. 94, and S. Grieve, 1923, pp. 49-56; evidence summarized in Clark, 1948, pp. 61-62; 1951, pp. 84-85). In order to supplement further their otherwise extremely monotonous diet of shell-fish, the possibility that they pursued seals and other sea mammals, including stranded whales, as well as sea-birds, should not be overlooked (compare Clark, 1946, p. 19; 1947, p. 91; 1948-a, p. 124; 1951, pp. 38, 63 and 73). Furthermore, since their Early Larnian ancestors apparently were primarily hunters of forest and fenland types of animals, the suggestion that they also indulged in this activity is perhaps not entirely without foundation.

At the time the Late Larnian was developed, it has been shown that the Post-Glacial climatic optimum occurred. This resulted in an exuberance of molluscan life in the coastal waters of the entire region. The situation is made clear by the evidence from Magheramorne, on the western shore of Larne Lough and about three miles due south of Curran Point. Here Praeger (1892, p. 227) has observed extensive deposits of Estuarine Clay, the zone exposed at the eastern outcrop of which is “almost entirely made up of thousands upon thousands of oyster shells, the pairs of valves being still in juxtaposition. The shells are pear-shaped, and average 5 inches long by 3 inches broad. The thickness of this great old oyster-bed cannot be determined, but it was considerable, and generation must have succeeded generation hundreds of times. The variety and exuberant growth of the Estuarine Clay shells has already been commented upon, and this is especially noticeable at Magheramorne, when compared with the present paucity of molluscan life in Larne Lough.” Possibly the occurrence of such rich beds as these was an important inducement to settlement in the Larne region during Late Mesolithic times.

In addition to oysters (Ostrea edulis L.), the following were also living in the waters of the lough at the time the Curran deposits were being accumulated:
Periwinkles or "Winkles" (*Littorina littorea* L.); Cockles (*Cardium exiguum* Gm. and *C. edule* L.); Limpets (*Patella vulgata* L.); Razor Clams (*Ensis silicia* L. and *E. ensis* L.); Scollops (*Pecten maximus* L.); Whelks or "Buckies" (*Buccinum undatum* L.); and "Horse Mussels" (*Modiolus modiolus* L.). Another edible form, fairly common at the excavated site, is *Tapes (Paphia) pullastra* Mont., but according to Dr. W. J. Clench, Curator of Molluscs, Museum of Comparative Zoology, Harvard University, this invertebrate has no common name.

7. **Summary and Conclusions**

In the development of the Larnian the actual technique of manufacturing tools differs in several respects between the so-called "early" and "late" phases. To what extent and how this is related to environmental conditions, on the one hand, and to the availability of the raw material, on the other, are questions to which no objective answer can be given at present. It seems clear, however, that these latter factors have played a very important, although not dominant, role. Admittedly the variations in the percentage frequencies of the occurrence of the various types of implements is not constant in the various arbitrary levels at the Curran locality, reflecting in the main the natural conditions which prevailed at the time the beds in question were laid down. But the tools themselves must always be regarded as the imperishable products of man's manufacture—artifacts designed to assist him in his struggle for survival. The actual technique(s) employed in their production, the types which were thereby fashioned, and the percentage frequencies of the occurrence of the various forms, depend not only on cultural tradition, environmental factors and the raw material(s) employed, but also on the particular ways of doing things developed by the group or groups in question. In the final analysis these are the net result of the basic economy of the social unit, and the relations of the individuals within that unit to one another. Just as with contemporary societies, where modifications in types of implements are often due solely to the personality of certain resourceful individuals, so it must have been in prehistoric times—yet another important variable which archaeologists must recognize. However, at present we have at our disposal no basis whatsoever for evaluating contributions to material culture which arose in this manner.

Concerning the archaeological wealth of Larne, Macalister (1949, p. 41) points out that this "is not necessarily a proof of extensive population; rather does it indicate an intensive if not wasteful exploitation of lavish available wealth of raw material by a long succession of unprogressive generations.” Certainly in comparison with the Early Larnian, this observation on the Late Larnian of the type station seems warranted within certain technological limits. For in the former complex, the emphasis throughout was on the production of small- to medium-sized blades of Upper Paleolithic type. Whereas burins are absent at the Irish coastal stations, several have been recorded in South-western Scotland.
must make very p. Palaeolithic of away of of of characteristic flint varietys and artifacts dressed cated abrupt emphasis struck it. In the absence of primary occupation sites yielding Late Larnian implements, it is difficult to reconstruct the daily activities of these settlers with any degree of accuracy. Nevertheless, as stated on page 76, there is some evidence to support the view that they lived in coastal middens and ate shell-fish as their main article of diet. During the time of the submergence such contemporary dwelling-sites must have been continually inundated by the sea, and their contents, washed away by wave action, were incorporated into the coastal marine deposits, subsequently elevated to their present height. In the main these deposits consist of sands and gravels, unfortunately inimical to the preservation of organic remains. On the basis of contemporary evidence from elsewhere, however, it is very probable that wooden boats, together with artifacts of bone and antler,
should be included in the list of Late Larnian traits. If diagnostic materials in
the latter category are some day recovered, it should be possible to reconstruct
a much broader and far more meaningful picture of the Larnian Culture than is
now possible, notwithstanding the vast quantity of tools made of flint that have
been recovered at the sites thus far excavated.

PART IV. ORIGIN AND AFFINITIES OF THE LARNIAN CULTURE

1. INTRODUCTION

The spread of the Early Post-Glacial forests in the wake of the retreating
ice-sheets came at a time when the culturally homogeneous North European Plain
extended as far as Britain, then only separated from Ireland by a comparatively
narrow arm of the sea. Upper Palaeolithic settlers, whose material culture
equipment was already undergoing change—both in response to the new con-
ditions, and as the result of contacts with the recently-arrived groups from the
Continent—began to move north and west. Ultimately this led to the develop-
ment of a new culture, the Larnian.1 Although it is possible that sporadic
hunting parties crossed to Ireland on the ice or on land-bridges at an earlier
period, to date there is no proof that Ireland was permanently settled until Early
Mesolithic times. Then in North-eastern Ireland, where there is an almost
inexhaustible flint supply, a very interesting development occurred with its main
centre along the Antrim-Down littoral, and with outliers in South-western
Scotland. An understanding of the environmental factors involved is funda-
mental to an interpretation of this development. Typologically the earlier
assemblages, called Early Larnian, are very much closer to the Creswellian
(Late Upper Palaeolithic) of Britain than are those descended from them,
collectively known as the Late Larnian—a fact which reflects environmental
conditions. For there is a noticeable tendency throughout toward the production
of larger and heavier implements. In fact the prevailing conditions of the
climatic optimum are reflected in the Late Larnian by the occurrence of massive
tools, including a few core axes, presumably used for working wood.

A complete reorganization of the mode of life must have resulted from the
inundation by the sea of huge tracts of land. In the Early Larnian the economy
apparently consisted of hunting, fishing, fowling and collecting activities in
a forest-fenland kind of environment. But in the Late Larnian a coastal type of
existence, mainly based on collecting edible molluscs and fishing, seems to have
been adopted. The latter development represents the final breakdown of Upper
Palaeolithic tradition in response to the new geographical and climatic conditions.
As pointed out elsewhere (Movius, 1937, p. 209), the implement types are, for the
most part, crude and generalized, and retouched forms are rare. Its entire nature

1 In his recent book, Raftery (1931, pp. 62-67) continually refers to the various Irish
Stone Age assemblages simply as Early and Late Mesolithic, without offering any explanation
of why he considers this practice preferable to employing the term Larnian.
indicates a peripheral culture, which had lost its vitality, surviving in a favourable region where the flint supply was abundant. In other words, a "strand-looper" type of existence superseded a more vigorous hunting economy, just as in the case of the Maglemose-Ertebølle transition in the Baltic.

During the early period Scotland and Ireland comprised one continuous culture area with nearly identical traits. But the two countries were permanently separated by the transgression of the Early Post-Glacial sea in Late Boreal times, and for this reason it is not surprising to find that a fairly marked divergence in the two regions took place. In order to reach Ireland, however, the effect of any new traits that were introduced either by diffusion or by the coming in of new groups, normally would also be felt in Northern England and Southern Scotland. Indeed to understand fully the cultural factors involved in the development of the Larnian, one is forced to consider certain aspects of the evidence from these contiguous areas. Accordingly, the salient materials available at present will be discussed, notwithstanding the fact that in such an approach one is very greatly hampered by the general lack of scientific excavation of Mesolithic sites in Northern Britain as a whole.

2. Late Glacial and Very Early Post-Glacial Settlement in Northern Britain and Ireland

The evidence for the Palaeolithic colonization of Britain as far north as Yorkshire has recently been summarized by Lacaille (1946, pp. 64-77), but the existence of Man in Scotland at this time has not yet been documented. As far as Early Post-Glacial times are concerned, however, surviving groups of hunters of Upper Palaeolithic ancestry apparently followed the migrating herds into the now ice-free areas of Central and Northern Britain, even as the last glaciers were still receding into the Highlands and other mountain centres of dispersal. At Victoria Cave, near Settle, in the Ribble Valley on the western slopes of the Pennines, Yorkshire, relics of some of the new settlers have been brought to light, apparently in a bed of stiff grey clay that overlay an horizon of cave earth yielding a temperate fauna (compare Breuil, 1922, pp. 273-279; Garrod, 1926, pp. 118-121). The finds consist of three fragmentary points of Reindeer antler (one with a single and one with a double bevel), and a bone borer, all of Maglemesian type as pointed out by Breuil (1922, p. 275-276 and Fig. 9; see also Jackson, 1945). This site is of great importance since it shows that an Upper Palaeolithic settlement was effected in this area soon after the melting of the ice, when the steppe and tundra fauna was withdrawing to new regions along the retreating margins.

That the fauna arrived first in the now ice-free areas is demonstrated by the evidence from a large number of localities in Scotland and Ireland, summarized elsewhere (Movius, 1942, pp. 36-39, 266-269, 282-284; see also Gregory and Currie, 1928; Ritchie, 1929; Charlesworth, 1930; Lacaille, 1946, pp. 71-74;
1948-a, pp. 20-21; 1950, pp. 138-140). However, as McCallien (1937, p. 175) has stated, there are no data supporting the claim for a Palaeolithic occupation of Scotland, notwithstanding the material published by Smith (1909) and Mann (1936). But in the late 1930's a more serious claim was put forward for a possible occupation of Scotland during Late Glacial times when Breuil (1937) published what was believed to be a genuine implement, possibly of interstational age, found near Comrie, Perthshire (Movius, 1942, pp. 48, 53 and 71). Recently this object has been examined by Lacaille (1946, p. 76), who states that neither it nor the several suspicious-looking flakes found in association can be accepted as of human manufacture. On this basis the evidence of this locality should be rejected.

Thus there is nothing to prove that Man arrived in Scotland before Early Post-Glacial times, and the same is true of Ireland (data summarized in Movius, 1942, pp. 105-117; compare Mahr, 1937, pp. 281-283; O'Riordáin, 1946, pp. 143-144; Raftery, 1951, pp. 58-60). Notwithstanding the fact that charcoal was found in Kesh Cave, County Sligo, below a stalagmite layer and in association with remains of Bear and Arctic Lemming (Gwynn, Riley and Stelfox, 1940, pp. 88-89), the facts that (a) there was considerable evidence of disturbance throughout the upper portion of the deposits, and (b) bones of both Bear and Arctic Lemming were found in the overlying stalagmite together with remains of domestic animals, invalidate the claim that this site was occupied by Man during very Late Glacial times. Thus it can only be concluded that the inducement of hunting the newly-arrived herds of animals in the now ice-free portions of Britain and Ireland was not sufficient reason for the surviving Upper Palaeolithic groups to leave the still fairly well-stocked regions of Central and Southern England and Wales. With a further amelioration of the climate, however, which brought about an actual change in the fauna and flora of the country, and which witnessed the arrival in Britain of new groups of food-collecting peoples from the now continuously forested North European Plain, the northward migration of the indigenous population seems to have begun. Although the documentation on this movement is scanty, the fact that the earliest undisputed archaeological horizons in Scotland and Ireland (Breuil, 1922, pp. 261-265; McCallien and Lacaille, 1941; Movius, 1940, p. 75; 1942, pp. 198-202) yield materials that are directly developed from the Creswellian, together with elements found in the overlying levels at Mother Grundy's Parlour, Creswell Crags, Derbyshire (Armstrong, 1925, pp. 155-172; Garrod, 1926, pp. 140-145), renders an alternative explanation unlikely. For at the latter locality a definite Tardenoisian influence may be detected in the Post-Glacial survival of the provincial Aurignacian (Clark, 1932, p. 20), probably during Early Boreal times.

1 There is no factual evidence whatsoever to support Macalister's suggestion that Kilgreany Man dates from Mesolithic times (Macalister, 1949, p. 21; Movius, 1935).
2 As shown by the evidence from Peacock's Farm, Shippea Hill, Cambridgeshire (Clark, 1935; 1936, pp. 210-212), a stage known as the Late Tardenoisian in England (= the typological counterpart of the Middle Tardenoisian of the Continent) had developed in England by Late Boreal Times.
As new settlers with a more highly developed economy moved into the Lowland Zone of Britain, the surviving Upper Palaeolithic groups were displaced. Elements of this latter population traversed the Pennines ultimately arriving in those portions of North-eastern Ireland and South-western Scotland that border on the North Channel, where extensive tracts of land, now under the sea, must have supported a rich fauna and flora. And the rich flint-bearing strata of the Antrim and Down Coasts offered a further inducement to settlement. On the basis of the data presented by the writer on pages 87-89 of The Irish Stone Age, it seems very probable that the 20-fathom line represents a safe figure for indicating the actual amount of uplift in the Irish Sea Basin during Early Post- Glacial times. Although this would have resulted in a considerable extension of the present coastal regions, at no time was the whole area dry land. Even during the maximum of the emergence the sea must have been present, although admittedly it was restricted to a great river or estuary separating Britain and Ireland (Charlesworth, 1930, p. 386). Since the submergence, however, seafloor erosion has been so extensive that the course of this river can only be postulated. Nevertheless the North Channel was considerably narrower than it is to-day, and at low tide it was probably possible to walk all but a few hundred yards of the way from Islay to Inishowen (compare Hull, 1912, p. 7; Charlesworth et al., 1935, p. 483). In any case, as Beirne (1943; 1947; 1948) has shown (see Movius, 1953-a), the expanse of water was not sufficiently great as to impede the dispersal of Bats and Lepidoptera from Scotland to Ireland. Further to the south a second partially complete route was available from Anglesey to the coastal position of the Dublin area, but there is no evidence to suggest that this was used.

From point of view of the Early Post-Glacial spread of fauna, flora and Man, it is difficult to over-estimate the material effect of this emergence in Western Europe. Wide areas off the present coasts were now available for settlement under improving climatic conditions. According to the existing data, it was at this time that the first migrating groups of settlers arrived in Northern Britain and North-eastern Ireland—both regions having been formerly heavily glaciated. That Stone Age hunters with a very typical Early Larnian culture reached Scotland during Boreal times is implied by the occurrence of artifacts in secondary position in deposits of the Early Post-Glacial sea at Campbeltown, Kintyre, Argyll (Gray, 1893, pp. 270-274; Breuil, 1922, p. 261; McCallien and Lacaille, 1941; Movius, 1942, pp. 177-178). But whether or not there was an even earlier occupation of the area cannot be clearly demonstrated on the basis of the existing data. In a cave near Inchmadamp, three miles south of Loch Assynt, Sutherland (Callander, Cree and Ritchie, 1927; Cree, 1927; Ritchie, 1929, pp. 192-193; Peach and Horne, 1917, pp. 338-342, Movius, 1942, pp. 72-74) some charcoal, a horn implement, and Reindeer antlers exhibiting cuts were found in the lower layer in association with a fauna of Late Glacial type. But no characteristic implement was found, and the geology of the region has never been completely worked out. Therefore, it may well be that Arctic Rodents, Cave Bear, Arctic Fox and Reindeer survived in this isolated region into Early Post-
Glacial times. In any case this problem is in urgent need of clarification, since it would be important to know if this locality was occupied when much of Scotland was still covered with ice.

In addition to the Magdalenian objects of Reindeer horn, described on page 80, Victoria Cave, in the Valley of the Ribble, near Settle, has yielded a series of artifacts believed to record a very Early Post-Glacial occupation in the south-central portion of the Highland Zone of Northern Britain. These objects include a symmetrically barbed antler point, a bone borer, a small almond-shaped side- and end-scraper, and a kit of tools for making ochreous colours. These objects were found in a deposit that had been badly disturbed during Celtic times by Man and burrowing animals (Burkitt, 1925, pp. 35-36; Garrod, 1926, pp. 118-121; Breuil, 1922, pp. 275-279; Clark, 1932, pp. 14 and 93; Movius, 1940, pp. 68-69; 1942, pp. 189-192; Lacaille, 1948-a, pp. 25-26). Formerly it was thought that the barbed point was made of Reindeer horn, but J. W. Jackson (quoted by Wright, 1939, p. 126) has identified it as Red Deer antler. On this basis, the argument for an Azilian penetration of Britain during Early Post-Glacial times, because of a typological similarity between this object and forms from Southern France, is considerably weakened. Certainly the use of red ochre was very widespread throughout Western Europe during the closing stages of the Ice Age, and the Azilian is only one of a number of complexes in which it was in fairly general use. Furthermore, the time when the colour-making kit was being employed is uncertain, and it may well date from comparatively recent times, along with the small flint scraper. Thus all one can say on the basis of the sum total of the evidence from this site is that the assemblage in question in part, at least, may be regarded as belonging to a phase of migration toward the Irish Sea of people whose full equipment comprised implements like those represented in the middle zone (Armstrong, 1925, Fig. 4, p. 147, 151 ff.) at Mother Grundy’s Parlour, and therefore to a movement anterior to the intrusion of the Tardenoisian upon the decadent Creswellian” (Lacaille, 1948-a, p. 26). But this conclusion must be regarded as tentative until it has been confirmed by the excavation of an undisturbed site in the same general region.

A small locality on the northern shore of Lough Neagh, in County Londonderry and not far from Toome, clearly demonstrates that Ireland was occupied at an earlier period than is indicated by the deposits which contain the oldest implements in secondary position at Cushendun (i.e., Sub-Zones VIb and Vlc: Late Boreal) as shown on the chart, Pl. X. This locality, which was discovered by Whelan (1930-a, p. 95; 1933, pp. 1213-1214; 1933-a, pp. 149-150; 1938, pp. 128-129), is the only Mesolithic station hitherto reported from the interior of this island. In 1951 Mr. G. F. Mitchell (unpublished) did a small excavation here; the industry is predominantly of British Upper Palaeolithic (Creswellian) tradition and reveals no evidence whatsoever of either Tardenoisian or Baltic influences. Furthermore, it includes several burins, a type of tool absent at the Early Larnian coastal stations, although a few have been reported from Scotland (see p. 85). Now the archaeological horizon at the Toome Bay
station consists of a greenish-grey sand, and it is overlain by a layer of swamp peat (compare Mitchell, 1949, pp. 176-188; Movius, 1940, p. 67; 1942, pp. 117-120, where a summary of Whelan’s observations is given). This peat, a sample of which was originally studied by Erdtmann (1932, p. 106), was formed during Sub-Zones VIa and VIb in Ireland, according to Jessen (1949, pp. 120-121; see also Jessen, 1936, p. 36; 1937, p. 276; 1940, p. 51). Thus, as Jessen has shown, the Early Larnian industry from this site is found in the earliest archaeological horizon thus far discovered in Ireland to be dated by pollen analysis.

3. MESOLITHIC DEVELOPMENTS IN SOUTH-WESTERN SCOTLAND

During Early Post-Glacial times the main focus of settlement was in North-eastern Ireland which, prior to the marine transgression, strongly influenced South-western Scotland. In fact the two regions formed a single almost continuous culture province during the time of the emergence. But in comparison with Ireland, Scotland seems to have been very sparsely populated throughout the Mesolithic. The reason is probably a direct reflection of the fact that this area possesses no ready supply of flint to attract settlers, whereas North-eastern Ireland is abundantly productive of it. This important commodity occurs in a native state in only one restricted area in the Peterhead region of Aberdeenshire in the north-east (Ferguson, 1874; Anderson, 1896; Lacaille, 1940, p. 316). Elsewhere, especially in Wigtownshire and South Ayrshire (Smith, 1879; Charlesworth, 1926, p. 8), nodules of it occur sporadically in the form of glacial erratics that have been derived and incorporated in the deposits of the raised and modern beaches. A limited amount is also available on the south shore of the Island of Mull (Turner, 1871, p. 161; 1895, p. 432, who quotes Geikie), but these local occurrences do not begin to compare with the almost inexhaustible supply in the chalk outcropping along the Antrim-Down littoral. Perhaps this is one reason for the emphasis on the production of bone and antler implements, as well as gravers to assist in working these media, that is so characteristic a feature of the Late Mesolithic industries of Scotland. But before considering these latter developments, the nature of the Early Larnian settlement in South-western Scotland will be briefly discussed.

As at Cushendun, Island Magee and Rough Island, the Early Larnian flints found at Campbeltown, Kintyre (for location see Fig. 18, p. 88), were apparently derived from an occupation site on the old land surface and washed inland during the early stages of the transgression of the Early Post-Glacial sea. But they could not have been transported far, since (a) they are sharp and for the most part unrolled, and (b) many of them are heat cracked (McCallien and Lacaille, 1941, p. 67). To date this is the only site which seems to be referable to Late Boreal times that has been discovered in Scotland, but this deduction is based on the typology of the tools and the implications of the artifact-bearing strata, rather than on objective data. Notwithstanding the recent detailed investigations of
the Albyn Distillery site at Campbeltown (McCallien and Lacaille, 1941), however, the age of the sands and gravels of the raised beach in this region has never been accurately determined with respect to the Early Post-Glacial changes in mutual level of land and sea. But it is believed that the archaeological material was derived from occupation sites dating back to the time of the transgression of the Early Post-Glacial sea and that it was incorporated into the beach formation during the rising of the land. At the Albyn Distillery site the culture horizon consists of a layer of dark soil 3 ft. 4 in. (ca. 1·00 m.) below the present surface, which at this point is 32 ft. 2 in. O.D.\(^1\) Although in the Machrihanish District, a few miles to the west, a peat bed has been found intercalated with sands and gravels of this same formation (McCallien and Lacaille, 1941, p. 62; Lacaille, 1950, p. 130), its palaeobotanical age has never been worked out. Until such a study is undertaken, we have only the typology of the flint, quartz and schistose grit artifacts to rely on.

Now this series from Campbeltown, the patination of which is by no means uniform (compare Vaufrey, 1951), differs from any of the known Early Larnian assemblages from Ireland in the following respects:

\(a\) In contrast with the situation in Ulster, flint was a fairly rare commodity in South-western Scotland, where the only local supplies are on the opposite shores of the Firth of Clyde. As previously stated, it occurs here in the form of erratics in the drifts of South Ayrshire and Wigtownshire. For this reason it is believed that the Mesolithic inhabitants of Kintyre transported their material from Ulster, automatically implying intercourse via the partially complete land-bridge of Early Post-Glacial times (compare McCallien and Lacaille, 1941, p. 61; Movius, 1942, p. 177; Clark, 1951, p. 243). In addition to the utilization of flint chips, quartz pebbles and schistose grit, this comparative scarcity of raw material is manifest in the small size of the Campbeltown series as a whole when compared with the artifacts from Cushendun (Horizons 1 and 2), Island Magee (Horizon 1) and Rough Island (Horizon 1).

\(b\) The occurrence of two micro-burins at the Albyn Distillery site (McCallien and Lacaille, 1941, p. 72 and Fig. 3, Nos. 29 and 30) demonstrates the existence of the specialized Tardenoisian technique in this portion of Argyll during Early Post-Glacial times. In Ireland this manifestation has never been detected in a Mesolithic context, although pure Upper Palaeolithic types of small blades with steeply trimmed backs do occur.

\(c\) At Albyn Distillery five rather poorly-made burins and two burin spalls have been recorded (McCallien and Lacaille, 1941, pp. 82-83 and Fig. 6, Nos. 73-78; Lacaille, 1938, p. 186), but from the Larnian coastal deposits on

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\(^1\) The Early Larnian archaeological horizon at Campbeltown is by no means confined to the Dalaruan, Milliknowe and Albyn Distillery sites, as shown by the fact that some 400 flint artifacts belonging to the same industry were collected by members of the Kintyre Antiquarian Society during the course of building operations at Calton, as reported in *The Campbeltown Courier* for 6 July, 1946.
the opposite side of the North Channel the only possible burin recognized to date is the specimen illustrated on page 71 (Fig. 17, No. 150), which seems to be a completely fortuitous form.

(d) Although one Larne Pick was found in the Early Larnian levels at Cushendun (Movius, 1940, p. 57, Fig. 15, No. 65), tools of this type are characteristic of the Late Larnian. In any case, the occurrence of two of these specialized forms at the Albyn Distillery locality (McCallien and Lacaille, 1941, pp. 80-81 and Fig. 6, Nos. 68 and 69) is interesting.

(e) That influences of ultimate Forest Culture inspiration were felt in Scotland by this time is demonstrated by a very small core implement—either a chisel or a pick—only 4.6 cm. (1.13/16 in.) long and flaked bifacially in its lower part and on one face only in the upper found at Albyn Distillery (McCallien and Lacaille, 1941, p. 81, Fig. 6, No. 72). As Lacaille points out, this is the most important single specimen in the entire series of 1,235 artifacts from this site. This piece provides the earliest evidence yet obtained of Forest Culture influence in either Scotland or Ireland during Early-Post-Glacial times. But, as will be discussed below, there is abundant evidence that the Late Mesolithic assemblages from both areas adopted traits of ultimate Baltic inspiration.

Campbeltown is like the Early Larnian of Ireland in that there are not only very few retouched flakes and/or blades, but also Upper Palaeolithic types—small blades with blunted backs, small obliquely truncated blades, and steep or core scrapers—exist. As at the Antrim and Down stations, the upper surface of the bulb end of the flakes and blades is often worked in characteristic fashion. Furthermore, in both instances there is a strong resemblance between the artifacts as a whole, and a poor Upper Palaeolithic series, as Breuil (1922, p. 261) originally observed with respect to the Millknowe material. But the occurrence of two micro-burins and a bifacial core tool at Albyn Distillery suggests that this industry is derived from some such complex as that found in the upper level at Mother Grundy's Parlour (summarized by Clark, 1932, pp. 19-20), which had already been slightly influenced by the extensively developed Tardenoisian and Maglemosian sources of the eastern side of the Pennines. In the Mesolithic of North-eastern Ireland, only 16 miles distant on the opposite side of the North Channel, no Tardenoisian traits have ever been detected, although in the Late Larnian a few core axes of Forest Culture inspiration are present.

On the basis of a pure typological analysis of the assemblage of flint artifacts from the Albyn Distillery site, it appears to represent a somewhat more developed facies of the Early Larnian than has yet been documented elsewhere in either Ireland or Scotland. But it is very unlikely indeed that detailed stratigraphic studies of this locality will demonstrate that the culture horizon was accumulated during Late Atlantic times, as implied by Mitchell (1949, pp. 173-174), who suggests the interesting possibility that the Albyn Distillery series represents
some sort of an Early Larnian complex which has survived into Late Larnian times.\footnote{As shown by the evidence from Rough Island, Co. Down, where an Early Larnian industry was found in gravels just below the surface humus (Movius, 1940-a), the depth of a given Mesolithic horizon in deposits accumulated during Early Post-Glacial times is not necessarily diagnostic as regards the cultural affinities of the archaeological material in question.}

The only other site where artifacts of Early Larnian type have thus far been recorded in Scotland is Ballantrae (Fig. 18, p. 88) on the River Stinchar, Ayrshire (Lacaille, 1945, pp. 84-91). Typologically one group of flints in the late Rev. Dr. Edgar’s surface collection from the ploughed fields in this region is in the main indistinguishable from the Early Larnian of Antrim, Down and Kintyre. Stratigraphic evidence in support of this claim, however, is completely lacking.

As far as South-western Scotland is concerned our knowledge of cultural developments during Atlantic times is exceedingly sketchy. Indeed there is only indirect evidence that this region was occupied at all during the period of the submergence when the Late Larnian was developing in Ireland. For caves formed by the sea, either at this time or during a previous Interglacial Stage, were not lived in until after the land began to rise in very late Atlantic/Early Sub-Boreal times. As the result of the transgression of the Early Post-Glacial sea, the area was nearly cut in half, and Northern and Central Scotland were only connected to the rest of Britain by an isthmus about 8 miles wide between Gartmore and Loch Lomond, which was then a sea loch or fjord (Jamieson, 1865, p. 163; Morris, 1925, p. 140; Erdtman, 1928, p. 181). The partial land connection between Scotland and Ireland was now severed, and traffic between the two regions became increasingly more hazardous as the result of continual deepening and widening of the North Channel by marine erosion and tidal scour. As far as Southern and Western Scotland is concerned, however, we have very few facts on which to base a reconstruction of human settlement in the area during Late Mesolithic times.

In the south-west (Ayrshire, Wigtownshire, and the Clyde region) Lacaille has called attention to sporadic surface finds of large, coarse, rolled and heavily patinated flint implements, often deeply porcellaneous, which, on typological grounds, suggest possible affinities with the Late Larnian (Lacaille, 1945, p. 84, footnote 1; 1948-a, p. 33 and Fig. 12, p. 34). Not one of these artifacts has ever been found in situ; they have been reported from the shores of the Firth of Clyde (Arran, Bute and Shewalton), the west coast of Kintyre, as well as adjacent coastal portions of Ayrshire (Ballantrae) and Wigtownshire (Stranraer and Drummore on Luce Bay), where deposits of the Early Post-Glacial sea have left their mark (see Fig. 18, p. 88). These isolated finds are suggestive of contacts between Ireland and Scotland during Late Mesolithic times, but until further work has been done on this problem, it is difficult to go any farther. On the basis of the twenty or so surface finds of flake and blade tools that have so far been published, it is impossible to determine whether the evidence indicates occasional
Fig. 8—Map showing Stone Age Localities in Scotland, Northern Britain, and North-eastern Ireland mentioned in the Text.
visits to South-western Scotland by the Late Larnian settlers of the Antrim-Down coastal area, or an actual Late Larnian cultural development, such as Lacaille has postulated. In this connection, Shewalton, near Irvine, where good exposures of the Early Post-Glacial raised beach have been preserved (Bailey, Ritchey, Anderson and MacGregor, 1930, p. 243; Lacaille, 1940, pp. 328-335), and Ballantrae, where there is a good local supply of flint (compare Lacaille, 1945, pp. 84 and 86) should be given high priorities. It is even possible, although by no means proved, that a kitchen-midden, or even a series of middens, formerly existed at the latter locality. Lacaille (1945, p. 87, footnote 2) states "one of the Ballantrae shell-mounds must have been a feature of sufficient prominence to have dictated the place-name 'Shell Knowe' for a cluster of houses (John Smith, Prehistoric Man in Ayrshire, London, 1895, pp. 227-228)." Since the latter reference is not available to the writer, the evidence on which this interesting comment is based cannot be evaluated. In the meantime, all that can be asserted on the basis of the existing data is that subsequent to the transgression of the Early Post-Glacial sea, there appears to have been sporadic intercourse between Ulster and South-western Scotland, a scant 16 miles distant.

To date the results achieved by cave excavation in South-western Scotland have been very disappointing. Although a number of cave sites opening on the Early Post-Glacial raised beach have yielded an abundance of occupational refuse, thus far nothing has come to light to demonstrate that any of them was occupied during Mesolithic times. At Keil Cave, Southend, Kintyre (Maxwell, 1934; 1934-a) and Borness, near the mouth of the River Dee, Kircudbright (Corrie, Clarke and Hunt, 1874) Iron Age levels rested directly on bed rock, while a series of caves and rock-shelters in the Loch Ryan-Portpatrick region of Galloway yielded no clearly defined tools (Gregory, Ritchie, Kennedy and Leitch, 1930). At the two sites investigated by Marshall (1938, pp. 113-115) on the Island of Bute no artifacts at all came to light. At the Freeland Cave, Great Cumbrae (Marshall, 1938, pp. 115-116), some fragments of worked lignite and two bone needles were found, but at the Waterloo Cave on Little Cumbrae (Marshall, 1938, pp. 117-118) the only evidence of occupation consisted of kitchen refuse. Of possible Mesolithic age, however, is the midden reported by Bryce (1903, pp. 42-44) directly underlying the Glecknabae Cairn (also known as the Craigengew Tumulus) on the west coast of Bute. But since this site yielded no archaeological material whatsoever, all one can be sure of is that it is of pre-Bronze Age date.

4. Isolated Finds and Settlements in the Forth Valley

The archaeological data from the carse-lands of the Forth Valley, which were accumulated during the transgression of the Early Post-Glacial Sea (Movius, 1942, pp. 80-82; Wright, 1914, pp. 380-381), are somewhat more satisfactory, although again the urgent need for excavation of selected sites in this area is only too apparent. Here, especially in the region around
Stirling, no fewer than twenty localities have been recorded where remains of Greenland (*Balaena mysticetus*) and Finner (*Balaenoptera musculus*) Whales, as well as Seals, have been found (summarized by Morris, 1925; see also Clark, 1947, pp. 91-92; 1951, pp. 64-65; Dinham, 1927, p. 490). Associated with these skeletons various remains of land mammals, molluscs and vegetable matter (Haswell, 1865; Cadell, 1913, pp. 118-119), in addition to human implements of Deer horn, have been discovered (see Fig. 18, p. 88). The latter, which consist of three antler axe-hammers perforated for the insertion of a handle, a few pieces of worked wood and several worked branches of antler, have been reported from Airthrey, near Stirling (Bald, 1819), Blair Drummond in the Barony of Burnbank 3\(\frac{1}{4}\) mile from Kincardine Parish Church (Blackadder, 1824, pp. 437-439; Drummond, 1824) Meiklewood, near Cargunnock (Turner, 1889; figured by Munro, 1899; Fig. 18, p. 58) and Causewayhead, near Stirling (Morris, 1898; figured by Munro, 1899, Fig. 19, p. 63).\(^1\) Furthermore, at Cornton near the Bridge of Allan, a stick approximately one foot long that D. Milne Home (1871, p. 26), who saw the object *in situ*, has described as a wooden handle, was recovered in association with a Whale skeleton (Morris, 1892, pp. 32-33; 1925, p. 138). As Munro (1899, p. 63) states, the evidence indicates that these tools were used for removing the flesh and blubber from the carcases of Whales, which the ebbing tide had left stranded on the shallow carse flats of this once very extensive estuary. This interpretation is supported by Turner's (1899, p. 791) observation that each of the skeletons associated with implements was lying within 400 yards of the edge of the carse-lands where it approaches the adjacent high ground. Furthermore, according to Clark (1947, p. 93), such antler tools were used in Denmark during Mesolithic times as Whale blubber mattocks.

No Mesolithic settlement sites have yet been reported in the Stirling region, but it is very probable that the extensive series of kitchen-middens on the edge of the Forth Valley, where the River Avon enters the carse-lands, date from this period. These sites, which are all approximately the same height (ca. 30 feet) above the sea (Stevenson, 1946, p. 137), have never been satisfactorily dated, although their association with the carse deposits, implies an Atlantic age.

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\(^1\) At Airthrey two pieces of Stag horn were found, one of which had a hole approximately one inch in diameter through it, while the perforated Deer antler implement from Blair Drummond is stated to have been similar to the Airthrey specimen (compare Cadell, 1913, pp. 123 and 277; A. Geikie, 1862, pp. 225-226; Jamieson, 1865, p. 190; Home, 1871, pp. 25-26; Lyell, 1873, pp. 59-60; Turner, 1889, p. 790; 1912, pp. 4-7; Morris, 1892, pp. 30-32; 1925, p. 138). The Meiklewood antler implement is better documented as the result of Turner's (1889, pp. 790-791) detailed description: it is a very typical antler axe-hammer found with a portion of the wooden handle in the hole and resting on the skull of a Whale (see also Childe, 1935, Fig. 2, p. 18; Clark, 1947, Fig. 4, p. 93; 1951, Fig. 31, p. 65; Lacaille, 1948-a, Fig. 9, No. 1; Munro, 1888, pp. 271-272; 1898, p. 58; 1908, pp. 226-227; Morris, 1892, p. 33; 1925, p. 189; Movius, 1942, Fig. 42, p. 192; Turner, 1912, pp. 8-9 and photo on p. 70). According to Morris (1898, p. 60; 1925, p. 139), a fragment of a Whale's rib showing traces of human workmanship came to light at Causewayhead in association with a pronged antler implement (Morris, 1898, pp. 57-58; Munro, 1899, Fig. 19, p. 83; Lacaille, 1948-a, Fig. 9, No. 2; Turner, 1912, p. 10). A second Deer's antler implement of similar type was found here which was accidentally buried before it had been examined (Morris, 1888, p. 89). Recently Lacaille (1948-a, Fig. 9, No. 3) has illustrated another of these pronged tools with two worked tines found near Stirling Bridge in the last century.
As early as 1870 David Grieve described a huge midden in the Parish of Bo’ness, between Inveravon and Kinneil (see Fig. 18, p. 88), but apparently this site consists of a whole series of middens, since Grieve mentions "heaps" of shells up to 70 yards in extent, 6 feet thick in the centre and tapering off at the extremities. In 1879 A. M. Peach1 investigated one of these sites exposed at the base of the bluff bordering the carse and reported plentiful hearths among the shells. Possibly the occupants of this locality belonged to the same group as did those who cut up the Whale carcases with antler tools at Airthrey, Blair Drummond, Meiklewood and Causewayhead, for Peach observes that it is "as if, when it was the limit of high water, the people who formed the middens, after searching the shores during low water, had retreated thither to enjoy their feast while the tide covered their hunting ground." In addition two other middens—one in the vicinity of Kinneil, near Polmonthill (Callander, 1929, pp. 314-316, and Figs. 1 and 2), and one near Polmonthill, Falkirk (Stevenson, 1946)—have been investigated, but both of these sites proved to be very poor in archaeological remains. Several Red Deer antlers which had been cut were recovered at the former locality, while charcoal of oak, associated with heat-fractured pebbles and burnt stones, is all Stevenson found at Polmonthill.

The most interesting single locality thus far reported in the Forth region, however, is a midden on the Island of Inchkeith, near Edinburgh. This was discovered by David Grieve (1872) and dug by a Dr. T. B. Sprague, who never published the results of his work. Except for a footnote in Anderson (1898, p. 304) and two very brief statements in Munro (1899, p. 57; 1908, p. 230), there is nothing in the literature on the archaeological material. Apparently the Inchkeith midden yielded many broken and split bones (including Sheep, Pig, Ox and Horse) and shells; the artifacts include the same blunt-ended, chisel-like tools, and rubbers or fabricators of bone and deer horn that are characteristic of Oban and Oronsay (summarized in Movius, 1942, p. 185). In spite of the fact that the published data do not permit one to arrive at a satisfactory conclusion regarding the age of this site, it seems probable that it dates from the closing centuries of the second millenium B.C. when domestic animals had already been introduced into Scotland. On the basis of the evidence of the bone and horn tools it has been assigned to the Obanian complex of Western Scotland (compare Movius, 1942, p. 188).

That a strand-looper way of life may have persisted into Post-Mesolithic times in Eastern Scotland, just as in the Oban-Risa-Onsary area of the west (see page 101), as well as in Ireland, is shown by the stratigraphic position of a kitchen-midden excavated in the 1870's at Stannergate within the limits of the city of Dundee on the northern shores of the Firth of Tay (Mathewson, 1879). This site clearly dates from the very Late Atlantic/Early Sub-Boreal times, since its outer margin is stated to have been interstratified with the marine sands and gravels of the immediately underlying "25-foot Raised Beach." In the centre of

1 Mem. Geol. Surv. of Scotland, Explanation of Sheet 31. This reference, which is not available, is quoted from Wright, 1914, p. 386. See also Munro, 1899, pp. 65-66.
the deposit was a rather elaborate hearth, and charcoal occurred throughout. Also present were broken and split bones, several fragments of Red Deer antler, two rather nondescript flints, considered by Lacaille (1944, p. 12 and Fig. 2, Nos. 4 and 5, p. 9) to exhibit "Early Larnian" affinities, and a polished stone celt. That the latter was associated with the midden and not with the overlying Bronze Age cist burials seems more than likely, inasmuch as the two horizons were separated by 7 to 8 feet of undisturbed and sterile earth. Presumably the series of flint artifacts collected at the nearby site in the vicinity of Broughty Ferry in an old land surface on the slope of a hill some 50 feet above sea-level that was exposed during constructional operation (Hutcheson, 1886) belongs to the same complex, although it may well be even later in date. For an economy that was in part at least based on food collecting still survived in Aberdeenshire and Sutherland after the introduction of metal into North-eastern Scotland, as shown by the evidence of the middens at the mouth of the Ythan (Dalrymple, 1866), which yielded iron objects, and those near Littleferry in the Glen of Strathfleets (Tait, 1868; 1869), which were associated with Bronze Age hut-circles and tumuli. On this basis it seems reasonable to assume that even further north a fundamentally Mesolithic tradition persisted well into the Christian Era, just as in the case of remote parts of the west of Ireland. Indeed the site near Gullane, East Lothian (Younger, 1936) demonstrates that on the southern shores of the Firth of Forth edible molluscs were still collected as a seasonal activity during late prehistoric times.

In addition to the stray finds of antler tools from the carse-lands of the Stirling area, and the rather poorly documented midden sites of the Forth and Tay Valleys, our knowledge of prehistoric life in Eastern Scotland contemporaneous with the Late Larnian development in North-eastern Ireland is limited to (a) several old finds of dug-out canoes associated with deposits of Atlantic age (summarized in Movius, 1942, pp. 206-207; see also Morris, 1892, pp. 38-39; Munro, 1899, pp. 66-68; Lacaille, 1950, p. 124) in the Perth, Falkirk and Stirling regions,1 and (b) a series of surface sites in the Tweed Valley that have produced microlithic assemblages of Tardenoisian type (see Movius, 1942, pp. 193-196 for a summary; also Lacaille, 1942; 1948-a, pp. 28 and 32) suggesting that this complex may have been introduced into the south-eastern part of the country before the close of the Atlantic climatic phase.2 With the possible exception of these typologically early sites in Southern Scotland, however, the Tardenoisian, which later becomes fairly widespread in the country, may be regarded as a

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1 Dug-out canoes have also been recorded in the marine deposits of the Clyde Basin to the west. But, as Bailey, McGregor, Dinham and Anderson (1925, p. 238) state, in this region all traces of the Early Post-Glacial raised beach seem to have been covered up by river deposits; hence some of these finds are apparently of Bronze Age or even earlier date. Others were certainly made by Mesolithic peoples, however, since Munro (1899, pp. 70-73) mentions one find in particular where the dug-out canoe was uncovered in clear and undisputed association with deposits of the Early Post-Glacial sea.

2 At a surface site on Woodend Loch, near Coatbridge (in Clydesdale, approximately nine miles east of Glasgow), a series of stone artifacts, including microblades, has been collected (Davidson, Phemister and Lacaille, 1948), which recalls assemblages from the Tweed Valley sites.
Mesolithic survival apparently coeval with the full-fledged Neolithic and Bronze Age Cultures of Southern Britain, as Lacaille has stated (1947, p. 62; 1948-a, p. 32). In any case, since the possibility of only very faint influences from this source have to be considered in connection with the main Mesolithic complexes (Larnian and Obanian) of the region under consideration, and since no true Tardenoisian technique seems to have ever reached Ireland, a discussion of this interesting and distinctive Stone Age complex is not included here.

In connection with the origin of certain Forest Culture traits in the Larnian and Obanian developments of Ireland and Scotland, the significance of the Forth Valley antler axe-hammers is a matter of primary concern. Now, as Childe has rightly pointed out (Childe, 1931, p. 332; 1935, pp. 17-18), these tools were clearly inspired by earlier Forest Culture prototypes found in Maglemosian contexts in Denmark and elsewhere (compare Clark, 1936, p. 112 and Fig. 40, Nos. 1 and 2). On this basis the Scottish finds have even been referred to as "Maglemosian" by some writers who have failed completely to grasp the fact that the diffusion of a single trait does not imply cultural unity. Furthermore the specimens from the Stirling carse-lands date from the Atlantic climatic phase, as shown above, whereas the Maglemosian was developed in the very extensive fenland and lake shore country, an unbroken stretch of which existed from Eastern England to the Baltic, during Boreal times. In England the evidence from Star Carr, near Seamer, Yorkshire (Clark, 1949; 1950), and Broxbourne in the Lea Valley, Hertfordshire (Warren, Clark, Godwin and Macfadyen, 1934), as well as other localities in Berkshire, Middlesex, Essex and Norfolk (summarized Clark, 1932, pp. 16-18; Movius, 1942, p. 203) demonstrates that a high development of Maglemosian Culture took place in the Lowland Zone of Eastern and Southern England, east of the great Palaeozoic outcrops, from the Thames Valley to the north-eastern Midlands during the late Pre-Boreal and Boreal climatic phases. And an expression of this same tradition persisted at West Hartlepool, Durham, into Early Atlantic times after the connection with the Continent had been severed by the transgression of the Early Post-Glacial sea, as Trechmann (1936) has shown. Among the distinctive traits of this culture is a rich assortment of large cutting tools of flint and antler—heavy equipment necessary for coping with the rapidly expanding Early Post-Glacial forests—as well as barbed bone and antler points for fishing and fowling. Now the Forth Valley antler axe-hammers may be regarded as derivatives of tools in the former category—forms that were inspired by Forest Culture examples. But to date barbed bone and antler points are unknown in Eastern Scotland, although, as will be presently shown, they are widely distributed in the Obanian complex of the west at a somewhat later date.

The small, bifacially flaked core tool found in an Early Larnian context at Albyn Distillery, Campbeltown (see p. 86), is the only indication that influences

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1 O. Davies (1948, pp. 4-5) has even gone so far as to refer to the Larnian Culture of Ulster as a complex developed by "Maglemosian settlers," while G. E. Fay (1951, pp. 82-84), quoting Davies as an authority, has stated that the Curran Point site at Larne "contains material attributed to the cultural manifestation known as Maglemosian."
from ultimate Forest Culture sources reached Scotland before Atlantic times. Then, as far as Eastern Scotland is concerned, it is documented only by three isolated finds of perforated antler axe-hammers associated with Whale skeletons in the Forth Valley—meagre data indeed on which to hypothecate the actual existence of a Forest Culture development in this region during Mesolithic times. On the other hand, the evidence of the Avon Valley and Inchkeith middens suggests the possibility that at the time this region was a tidal estuary as far west as Gartmore, the basic economy was more closely along the lines of the Obanian pattern of the west, than that it was modelled on the way of life of the Forest Culture survivors of North-eastern Britain and the Baltic. For the latter was essentially an inland complex adapted to forest and fenland conditions, while in both the Forth Valley and in Western Scotland we are dealing with a coastal fishing and collecting ("strand-looper ") culture, which must reflect in large measure the same fundamental way of life as that developed by the Late Larnian settlers of North-eastern Ireland.

5. The Age and Affinities of the Obanian Culture

A series of cave, rock-shelter and midden sites in Western Scotland document the survival of a very Late Mesolithic way of life in this marginal area after the movement of emergence was well under way subsequent to Late Atlantic/Early Sub-Boreal transition times. Collectively these constitute a development known as the Obanian (Movius, 1940, p. 76). Larnian traditions of stone-working played a secondary role to tools made of bone and antler at these littoral stations, all of which are in Argyll. Now, as stated elsewhere (Movius, 1942, p. 180) the Obanian is widely known as the "Azilian" of Scotland, but it seems necessary to re-examine the basis for this claim in the light of our present knowledge. Since a summary of the Obanian is given on pages 180-188 of The Irish Stone Age, and since Mr. Lacaille is devoting an entire chapter to it in his forthcoming book, The Stone Age in Scotland, only the salient facts pertaining to the chronology and cultural affinities of this complex are given here.

The Obanian has been reported from the following Argyllshire localities, all of which are shown on the map (Fig. 18):
(a) Caves and rock-shelters at Oban on the mainland;
(b) Three open-air middens on Oronsay; and
(c) A single midden on the small island of Risga in Loch Sunart between Ardnamurchan and Morven.

The occupants of these sites, like the Late Larnian peoples of the Ulster sea-board, were Mesolithic food-gatherers living in the open, as well as in caves and under overhanging rocks. Their basic economy included hunting, fowling, fishing and collecting activities (evidence summarized by Clark, 1946, p. 19; 1947, p. 95; 1948, pp. 61-62; 1948-a, p. 124; 1951, pp. 38, 65, 73 and 84-85), while the use of boats is attested by their settlements on islands far out from land
The evidence of the sites in the Oban region is as follows:

(a) MacArthur Cave (Anderson, 1895, pp. 211-230). On the floor of this cave, which is 30 feet above H.W.L., there was 4 feet of beach gravel. Above this and in part intercalated with it was the occupation refuse. Apparently the cave was cut during the maximum of the submergence; hence it could not have been occupied until after the re-elevation of the land began in Late Atlantic/Early Sub-Boreal times. But the sea could not have receded very far, as Childe (1935, p. 14) has pointed out, since in a storm the waves could still carry material into the cave mouth, whereas to-day the shore is over 100 yards away. The archaeological material from this locality includes seven barbed points of deer horn, two of which are complete; one of these is pierced with a small slit near the butt for the attachment of the line. According to Turner (1895, pp. 423-431), the remains of three adult skeletons were found by Anderson at the MacArthur Cave.

1 There is no factual evidence to support Clark’s (1951, p. 283) suggestion that the vessels used by the Late Mesolithic peoples of Northern Ireland and Scotland “were made from skins stretched over a light frame.” Since large trees were readily available in the forests of both regions and since the only definitely Mesolithic boats are dug-outs (cf. p. 92), it is highly improbable that the distribution of the basic umiak type of the arctic regions of Asia and America extended west to the northern British Isles during Early Post-Glacial times.

2 To be described in full by Lacaille in his forthcoming book.
(b) Druim Vargie (Anderson, 1898, pp. 298-306). This is a large rock-shelter, which looks towards a marsh rather than the sea. Presumably the occupation here is the same age as that of MacArthur Cave. Two bone points barbed on one side were found here, together with a portion of perforated antler implement, suggesting a form similar to that of the axe-hammers of the Stirling case-lands (see page 90).

(c) Miscellaneous Sites. Sir William Turner (1871; 1895, pp. 410-423) has described three other caves at Oban—the Mackay Cave, the Gasworks Cave and the Distillery Cave—which contained traces of prehistoric occupation. In each case the entrances had been sealed in antiquity. The Mackay Cave yielded two human skeletons, shells, animals and bird bones (including Dog), fragments of waterworn pebbles, several flint cores and two worked implements, together with some chips and flakes. At the Gasworks Cave the remains of an adult male were associated with shells, animal bones, a cock's spur, a flint chip and sherds from vessels of the cinerary urn type. In addition to the remains of eight persons, the Distillery cave contained many shells, a few bones of animals, small birds and fish, a spatulate-ended tool of Deer antler, a bone borer, and several flint artifacts. More recently MacDougall (1907) excavated a midden under an overhanging cliff one mile north of Oban Bay and near Dunollie Castle, which produced similar material, including a bone needle some 3 inches long. Finally, a very late Obanian site has recently been reported on by Lethbridge (1950, pp. 7 and 8) at Ardantrive, on Kerrera not far from Oban. The materials from this small cave, which was on the "25-foot" raised beach, included several pot-sherds, a leaf-shaped arrowhead and a small scraper of "Beaker" type, indicating that the Obanian tradition still persisted in this region when the Early Bronze Age was in full swing in the south of Britain.

On Loch Crinan, Argyll, north of the Firth of Clyde and a little over half-way between Bute and Oban, a midden under an overhanging cliff was excavated near Duntroon in the last century by Mapleton (1873). This site, which is 25 feet above present H.W.L. and approximately 60 yards inland presumably was occupied at about the same time as the Oban Caves. For beach gravel was found associated with an horizon containing charcoal and calcined flints. Although the only archaeological material—two flint scrapers and one core found near a hearth, broken animal bones and mollusc shells—is of an extremely generalized nature, it seems probable that this locality should be included in the Obanian complex. In addition to the midden material, this shelter contained nine fragmentary skeletons of individuals apparently killed in antiquity by a rock-fall which sealed the entrance.

The Oronsay sites, collectively known as Sithean, which means "of the fairies or magicians" (S. Grieve, 1923, pp. 16 and 45), are open-air middens up to 4½ feet thick that are situated along or above the Early Post-Glacial raised beach. This feature occurs here at a height of 22 to 24 feet above H.W.L. As at MacArthur Cave, Oban, the occupation dates from shortly after the beginning of the uplift. In fact the refuse layer at one of the sites (Cnoc Sligeach),
which is well above the maximum reach of present-day storm waves, had been disturbed by wave action. The first relics on this small island, some 10 miles west of Jura, were brought to light by Symington Grieve in 1879; the pertinent material from each site is as follows:

(a) Caisteall-nan-Gillian (S. Grieve, 1883; 1885; 1922; 1923, pp. 40-65; Anderson, 1898, p. 306; Wright and Peach, 1911, p. 167). According to both Bishop (1914, p. 55) and S. Grieve (1923, p. 57), ten barbed bone points, which are now lost, were found here. Of the two examples which have been illustrated, one has opposing barbs, while the other exhibits alternating barbs. In addition, eight perforated antler tools were recovered, belonging to the same class of implements as the perforated fragment of deer horn from Druim Vargie. There is also an imperforate antler adze-like tool from this site, which suggests derivation from Forest Culture prototypes (Lacaille, unpublished).

(b) Cnoc (or Croch) Sligach1 (Anderson, 1898, p. 311; Bishop, 1914, pp. 56-101). The finds from this site included seven barbed points—six of bone and one of Deer horn. No perforated antler tools have ever been reported from here, although there are some large adzes or wedges of Deer horn similar to the one found at Caisteall-nan-Gilean.

(c) Cnoc (or Croch) Riach (Anderson, 1898, pp. 312-313). This locality yielded material stated to be essentially like the other two Oronsay sites, but no excavation report has ever been published.

The Risga midden, which was briefly mentioned by Callander (1929, p. 317) and recently published by Lacaille (1951, pp. 115-126), is situated on a wave-cut platform about 30 feet above H.W.L. and within the limits of the Early Post-Glacial sea. Therefore it cannot be older than the time of the Late Atlantic/Early Sub-Boreal transition in terms of the climatic sequence for Northern Ireland, and it may well be even younger. This site yielded a few fragmentary barbed bone points of typical Obanian form, its far richer flint tool component being the feature which distinguishes the Risga assemblage from those of Oban and Oronsay. Although native quartz was also used, these settlers had access to a 20-foot thick bed of chalk flints underlying the Carsaig cliffs on the south shore of the Island of Mull, reported by Geikie (quoted by Turner, 1871, p. 161; 1895, p. 432). The Risga stone industry, which includes a micro-burin, similar to the one described by Breuil (1922, p. 265) from Caisteall-nan-Gilean, as well as several gravers, a small blade with a steeply trimmed back, and steep or core scrapers (Lacaille, 1951, pp. 117-120), suggests an ultimate Early Larnian derivation, but a very great deal later in time. Furthermore, there occur some pick-like objects of quartz and other types of heavy tools which, as in the case of the Early Larnian, must have been made in response to the changing environmental conditions. With the exception of this single locality, however, a

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1 On page 180 of *The Irish Stone Age* Croch (or Cnoc) Sligach is erroneously listed as one of the Oronsay midden sites. In reality no such site exists; the confusion is due to the alternate spellings for Sligach given by Anderson and Bishop. The name is Gaelic for "The Shelly Mound."
general lack of flint or other easily worked rocks in Scotland has led to the production of a very wide range of bone and antler artifacts.

In a general sort of way the barbed bone and antler points of the Obanian have been traditionally regarded as far too characteristically Azilian to be the result of independent invention (Childe, 1935, p. 15; Movius, 1942, p. 185; Lacaille, 1947, pp. 58-59), although Lacaille (with McCallien, 1941, p. 85) has cautioned against using the term Azilian in referring to Scottish raised beach relics. However, as a group the series from Northern Britain is not only very much later (compare Geikie, 1914, p. 298; Grieve, 1923, p. 65), but also a great deal more evolved than the Continental examples, most of which come from Southern France. In the first place many of the Obanian barbed points are made of bone rather than Deer horn (Breuil, 1922, p. 279); the seven from MacArthur Cave, and one of the seven from Cnoc Sligeach are the only ones made of antler. Secondly, most of the Scottish forms are longer than those of the Azilian and, thirdly, the Obanian series normally exhibits a biconvex rather than a flat section, several of them even being grooved near the point to facilitate penetration. Notwithstanding these facts, there is a superficial resemblance to Azilian "harpoons," and this fact has led many authorities to conclude that Azilian influences actually reached Western Scotland during Early Post-Glacial times (compare Breuil, 1922, pp. 280-281; Clark, 1932, pp. 14-16; Childe, 1935, p. 15; 1935-a; 1940, p. 4; 1946, p. 3; McCallien, 1937, p. 203; Mitchell, 1949, pp. 173 and 177; Movius, 1942, pp. 178-192; Lacaille, 1947, pp. 58-59; Hawkes, C. and J., 1949, pp. 36 and 38; Piggott, 1949, pp. 59-60, Wright, 1925, p. 232). But, in the light of what we now know concerning Mesolithic developments in Northern and Western Europe as a whole, the typological basis for this postulation urgently needs to be reexamined.

As far as the examples from the cave and rock-shelter sites at Oban are concerned, the two points from Druim Vargie (cf. Movius, 1942, Fig. 38, p. 187) are atypical in that they are barbed on one side only—a common Forest Culture trait with many close parallels in the Baltic area (Clark, 1936, pp. 116-117, Fig. 41, No. 10 and Fig. 44, No. 6). For the most part the barbed points or fish-spears from the Oban midden are not as symmetrical, and they do not have as regularly cut jags as is true of the mainland examples, particularly those from MacArthur Cave. This applies to the now-lost series from Caisteall-nan-Gillean, sketches of which have been examined by Lacaille (unpublished), as well as six of the seven specimens found at Cnoc Sligeach. Furthermore, all but one of this series has a biconvex rather than a flat section, the antler example from Cnoc Sligeach exhibiting a more or less cylindrical shaped body. The latter, the only one of Deer horn, has a round stem from which the barbs stand out like thorns (Childe, 1931, p. 332; 1935, p. 15). As Breuil originally recognized (1922, p. 280), this is definitely not an Azilian type; its closest parallels exist with Danish examples from sites of Early Atlantic age. Indeed, if compared with the specimen illustrated by Childe (1931, Fig. 2, No. 9, p. 331), the resemblance is very striking. Childe (1931, p. 332) refers to certain of the Oronsay barbed bone
points as approximating closely to Baltic types—"again not Maglemose forms, but their descendants of Early Atlantic times." This is an important and fundamental consideration, which fits directly into the argument supporting the ultimate derivation of several of the basic Obanian traits from somewhat earlier Forest Culture developments in the region of the North Sea basin, rather than in the Early Mesolithic of Southern France and the Pyrenees.

In point of fact the age of the Azilian has never been very precisely established: it is immediately post-Magdalenian from a stratigraphic point of view, and it may be of Pre-Boreal or even Early Boreal age. On the other hand, the main Obanian development, which began in Late Atlantic/Early Sub-Boreal times, probably occurred during the early part of the Sub-Boreal climatic phase. Therefore the time gap separating these two complexes is enormous. Whereas it is conceivable that certain Azilian traits may have still persisted for three or four millenia on the remote coasts of Argyll, the fact that the Azilian Culture is unknown in Southern Britain and Northern France north of the Loire Valley (compare Lacaille, 1948-a, p. 24; 1952) makes such a possibility seem extremely unlikely. Certainly the small, more or less round or oval scrapers, called "thumbnail" scrapers, which occur in both the early and late phases of the Larnian and which have been attributed to an Azilian influence (Movius, 1940, pp. 68-69; 1940-a, p. 126; 1942, p. 202), can no longer be accepted as indicating any sort of culture contact between these two regions. On the other hand there is nothing particularly distinctive about the series of small scraper types in the Larnian, and they can perfectly well be accounted for as the result of independent local development. Therefore, in view of the strong Forest Culture influences that have been detected in the Obanian, the stray finds of barbed antler and bone points from Northern England—Victoria Cave, near Settle, Yorkshire (see p. 83) and Whitburn, near Newcastle-on-Tyne, Durham (Munro, 1899, p. 57; 1908, p. 230; Clark, 1932, p. 14)—and Southern Scotland—the bed of the River Dee, near Cumstoun, Kirkcudbright (Childe, 1935, p. 14; Lacaille, 1939, p. 49 and Pl. XXIV, No. 4; 1948-a, Pl. 2, No. 4) and the bed of the River Irvine, near Shewalton, Ayrshire (Childe, 1938, p. 323; Lacaille, 1939, pp. 48-49; 1948-a, Pl. 2, No. 1)—can no longer be accepted as evidence of a northward diffusion of Azilian elements. Furthermore, the Shewalton specimen has a pronounced midrib, which is a Baltic feature. As Lacaille points out in his forthcoming Stone Age in Scotland, one should regard these objects as the result of local invention, or possibly as a modification of Upper Palaeolithic forms, rather than a blending of Azilian and Maglemosian traits. But the influence exerted by the latter on both the Larnian and Obanian complexes cannot be denied, although on the basis of

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1 On the basis of the geological evidence, Lacaille (1951, pp. 126-127) has stated that the occupation of the Obanian caves and middens "cannot be anterior to Late Atlantic times (ca. 3000-2500 B.C.)." However, in view of the recent data from North-eastern Ireland bearing on the palaeobotanical age of the maximum of the submergence, discussed on page 17 even this date seems too high. Accordingly, it is suggested that this regional development of the Larnian (compare Movius, 1942, p. 180; Hawkes, 1943, p. 377), which was influenced from ultimate Forest Culture sources, dates from the closing centuries of the second millenium B.C. and persists well into Sub-Boreal times.
the evidence of three antler axe-hammers, it is very unlikely that any actual Maglemosian colonists ever reached Scotland, as some authorities have postulated. The fact that there is a Maglemosian site at West Hartlepool (see p. 93), however, provides strong supporting evidence for the view that the indigenous Scottish Mesolithic acquired many Forest Culture traits as the result of diffusion. Thus the concept that the sites of Atlantic age in the Forth Valley, discussed on pages 90-91, mark the camping places of settlers of Maglemose ancestry is regarded as definitely not proved. On the other hand the evidence of the midden in the Avon Valley and on the Island of Inchkeith, such as it is, suggest very strong Obanian affinities for this development. Therefore, it seems very likely that the culture of the Whale hunters of the Stirling carse-lands should be considered as a local Obanian development and slightly earlier than the Western Scottish complex in time. Possibly further work on this problem will even show that it belongs to an Early Obanian phase, and the Argyll strand-looper's sites to a Late Obanian. But this suggestion must be regarded as a purely tentative working hypothesis until some fresh facts are brought to light by the controlled excavation of selected sites in the area. In the meantime, little more can be deduced on the basis of an analysis of the available literature.

6. **Cultural Developments in Northern Britain and Ireland during Sub-Boreal Times**

After the movement of emergence was well under way, an Early Neolithic complex of Campignian affinities superseded the indigenous Late Larnian culture of Counties Antrim and Down. This is proved by the evidence from Cushenden, Glenarm and Rough Island (summarized in Movius, 1942, pp. 214-222; Nougier, 1950, pp. 222-225; 380-381), where the archaeological material referable to this complex is found in the humus overlying the Early Post-Glacial raised beach. In south-western Scotland this same complex, including tranchets, derivative forms, and such Larnian survivals as flakes with superficially developed tangs, has been recognized at Ballantrae, Ayrshire (Lacaille, 1945, pp. 92-100; 1948-a, p. 37). Pottery and polished stone are absent as at the Irish stations, but a narrow blade element, found also in the Bann Valley of Northern Ireland (Knowles, 1912, p. 202; Batty, 1938), is represented (Edgar, 1939; Lacaille, 1945, pp. 102-104). This latter tradition seems to have persisted in the Orkneys, as Lacaille's (1935) work has shown. Elsewhere in Scotland, at Luss on Loch Lomond and in the Tweed Valley, surface finds of flaked stone tools with tranchet-like cutting edges occur in association with core implements (Lacaille, 1940, pp. 318-328; 1940-a). Although made in Mesolithic tradition in certain respects, there is no basis whatsoever for assigning either series to an Early Post-Glacial context; on the other hand these assemblages may well date from Early Metal Age times (Lacaille, 1940, p. 328; 1940-a, pp. 6-10). And it is very possible that the series of artifacts, stated to include some "unfinished celts,
undoubtedly of the ‘Larne type’ found in deposits overlying the Early Post-Glacial raised beach at New Mawbray, near Silloth, Cumberland (Tonks and Maden, 1926, p. 79), also should be included here.

Certainly, as Childe has pointed out (1934, pp. 18-19), the stray groups of fishers and hunters already in possession of the coasts were completely incapable of offering any very effective opposition to the Neolithic colonizers. But to what extent the old Mesolithic strand-looper’s way of life survived is unknown. Just as in Ireland—especially in the remote northern and western parts of the country—it is probable that an economy based on food-collecting persisted in the marginal regions of Western Scotland long after the art of metallurgy had been introduced into the very much more progressive regions of the south. For it is apparent that Mesolithic people were still occupying the Oban region as late as “Beaker” times (Lethbridge, 1950, p. 8); similarly a very late survival of the Obanian tradition is demonstrated by the materials from Ardnamurchan and Morar (Lethbridge, 1927; Lacaille, 1951, pp. 107-115 and 128-134). Furthermore, at Galson, Lewis, in the Outer Hebrides, a Pre-Norse kitchen-midden has yielded the skeletal remains of a middle-aged female exhibiting many very striking Upper Palaeolithic features (Hill, 1948). It is, therefore, clear that, notwithstanding the various waves of Post-Mesolithic invaders who penetrated Western Scotland, including the Hebrides, very early elements in the population survived, just as they did in Ireland (evidence summarized in Movius, 1942, pp. 208-209). Thus it is probable than an intensive anthropological survey of Western Scotland would reveal that a fundamentally Palaeolithic element still survives in the present population—descendants of the original Mesolithic settlers who arrived during Early Post-Glacial times.

7. MIDDEN SITES ON DUNDALK BAY, COUNTY LOUTH

As demonstrated by the stratigraphic evidence, the main occupation of the Oban caves and rock-shelters was in part contemporaneous with the Early Neolithic industries from the surface deposits overlying the Early Post-Glacial raised beach in North-eastern Ireland and South-western Scotland. For these sites were all occupied after the movement of emergence was well advanced as the Late Atlantic climate gave way to Sub-Boreal conditions, and they are in turn, coeval with the full Neolithic of the Lowland Zone of Britain. Therefore there is a considerable difference in age between the Late Larman of the Ulster littoral and the Obanian of the coastal stations of Argyll. That the latter represents a development patterned on a basic Larman mode of existence and technological tradition is shown by the flaking industry of Risga, a shell mound which probably dates from the very end of the third or the first half of the second millennium B.C. Since bone and antler tools, so characteristic a feature of the Obanian, are lacking at the Irish localities and since, with the single exception of Risga, very few stone artifacts occur at the Argyll sites, it is exceedingly
difficult to make further comparisons. However, it is very probable that some day it will be proved that the barbed bone points and heavy antler tools occur in the Late Larnian, just as they do in the Obanian. In any case, the occurrence of advanced traits at certain Obanian localities, as the evidence of the Irish Sand Hill sites indicates (compare Movius, 1942, pp. 252-254), demonstrates the persistence of Mesolithic traditions—i.e., a mode of life based primarily on food gathering—in regions of isolation well into Metal Age times, notwithstanding numerous contacts with more advanced sources.

Until recently there was a veritable lacuna in the Irish archaeological record between the Late Larnian, on the one hand, and the Early Neolithic of the humus accumulations on top of the raised beaches of Counties Antrim and Down, on the other. Prior to 1946 the only material which could be assigned to this interval was that from the Rough Island midden (Movius, 1940-a). But the 23 flints actually found in situ in this midden were very rough, and it is only possible to consider them as probably representing a Mesolithic rather than a Neolithic facies. In any case, in view of the thinness of the shell layer (maximum: 25 cm.) at this site, it is probable that only a very short interval of time is represented by this occupation.

During the years 1946 and 1948 further light was thrown on this problem as the result of Mitchell's excavations of a series of three midden localities at Rockmarshall on Dundalk Bay, County Louth (see Fig. 1), to which reference has previously been made in this report (Mitchell, 1947; 1949, pp. 171-175, 1949-a). These middens were all occupied after the maximum of the Early Post-Glacial submergence, in fact the shells on the seaward side of two of them had been disturbed by the retreating waves at the time the storm beach was beginning to accumulate, during the transition from Late Atlantic to Early Sub-Boreal times in Ireland. Scattered throughout these primary occupation sites, which are some 350 yards from the present shore and + 28-50 feet to + 30 feet O.D., were concentrations of charcoal and ash, together with some burnt stones. According to Mitchell (1949, p. 171), “there seems to be no reason to doubt that the three undisturbed middens so far discovered at Rockmarshall are contemporaneous.” In any case, it is certainly true that, although the quantity of archaeological material recovered from these settlements is very limited, it comprises a coherent unit apparently of one period only (Mitchell, 1949-a, p. 19).

In addition to an imposing list of edible molluscs, remains of Crabs, Fish, a Porpoise, and small carnivore, possibly a Fox or a Cat, were found. Charcoal fragments attest that Birch, Willow, Pine, Hazel, Elm and Oak were growing in the

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1 This prediction is in part based on the fact that perforated antler tools have been found in the so-called “black-layer” (probably of Sub-Boreal age) at Whitepark Bay (Knowles, 1885, p. 119, Pl. IX, Fig. 91; Movius, 1942, p. 253, footnote 1).

2 Mitchell (1951, pp. 196-198) is inclined to place the maximum of the transgression in Ireland early in the Atlantic Period, rather than at its end, as claimed by Jessen. It is apparent that a great deal of further work must be done on this problem; in the meantime, Jessen's scheme has been followed throughout this report, on the basis of the geological evidence of the Cushendun and Larne sections.
adjacent forests at the time of the occupation. Besides the local flint, pebbles of
which occur along the shore of the bay, chert and even fine-grained igneous rock,
were used in the production of artifacts. From point of view of their size alone,
the limited series of unrolled and unaltered stone tools from Rockmarshall is
medium to small—more strictly comparable with the Early Larnian in this regard
that with a normal Late Larnian development. Two bone points from Midden I,
one made from the fibula of a Dog¹ and the other of a Fish-bone, were probably
probably used as gorges in catching fish. As regards Midden II the artifacts were
very rough, but the technique of manufacture “appeared to be in the Larnian
tradition” (Mitchell, 1949-a, p. 14). Midden I produced approximately 100
deliberately broken flints, but finished implements were very rare. Included in
the assemblage were 7 leaf-shaped points, 3 of which exhibited secondary
working on the upper surface of the bulbar end in typical Larnian fashion. Five
additional leaf-shaped points, and a broken tanged implement, in addition to
a large chert flake extensively worked on the upper surface of the bulbar end,
were among the materials recovered at Midden III. At this latter locality were
found several elongated beach pebbles, whose ends had been altered by rubbing
and pounding. Although these are somewhat larger, they are, nonetheless,
identical with the limpet-hammers of the Obanian sites of Western Scotland.²
But the common use of such a very elementary type of artifact can scarcely be
regarded as having any very great significance from a cultural point of view, other
than denoting a basic similarity in collecting activities. It is very possible that
comparable tools were also used by the Late Larnian strand-loopers of the coasts
of Antrim and Down. If such were the case it is going to be very difficult to secure
the proof since, as Mitchell points out (1949, p. 177), a stone object of this type
“under even trifling wave action would soon cease to be distinguishable from
the other beach pebbles.”

Notwithstanding the fact that the Rockmarshall middens must be late in
time—probably contemporary with the Early Neolithic of Cushendun, Glenarm
and Rough Island—none of the material from them shows any trace of Neolithic
influences. But the frequent occurrence of leaf-shaped points, both with and
without extensive trimming of the upper surface of the bulbar end, may indicate
some sort of connection with the Bann Culture, centred in the Toome-Newferry
region (Movius, 1936). Indeed these sites on Dundalk Bay may represent a

¹ The presence of actual Dog remains in Ireland at this time is interesting in view of the
fact that gnawed bones are fairly common at most of the contemporary Obanian sites of
Argyll. However, Dog bones have only been reported from one of the Oban sites (Turner,
1871; 1889, pp. 410-417), and this place contained only a very limited amount of archaeologi-
gical material.

² See Fig. 36, p. 184 in The Irish Stone Age. According to Lethbridge (1950, p. 7),
practically identical objects are known by the Gaelic equivalent of the term “Limpet-
Hammer” in the west of Scotland to-day. Furthermore, it has been shown by experimenta-
tion that if elongated beach pebbles are used for the purpose of collecting limpets, it not
only causes abrasions on the end, but also holes in the limpet shells just as those found in the
occupation sites. Very similar objects, called “Limpet-Scoops,” have also been reported
from Cornwall and Wales (Cantrill, 1915, pp. 179-189, 196-203; Clark, 1932, pp. 45, 47-49;
Wheeler, 1925, pp. 43-44).
southern extension of influences from this source, which, at the northern end of
the Bann Valley, exerted a very marked influence on the Sand Hill settlements of
the Coleraine region, as May and Batty (1948, pp. 134-141) have shown. But
until this problem can be clarified further it seems advisable to adopt Mitchell's
(1949, p. 173) term of "Ultimate" Larneian for the culture of the Rockmarshall
midden-dwellers. An even later midden site excavated by Mitchell (unpublished)
at Sutton, County Dublin, indicates that in Eastern Ireland, just as in the north
and west as well as in Scotland, a food-collecting economy survived long after
the old Mesolithic settlers had been driven off the more favourable regions by
new groups of Neolithic peoples, who had a superior economy and organization.
In any case, at the Sutton strand-looper's midden, which directly overlay the
Early Post-Glacial raised beach, many leaf-shaped flakes of flint, chert and felsite
were found in direct association with a polished stone axe.

In a recent publication Mitchell (1949, p. 177) states with reference to the
Larnian as a whole, including the closely related Obanian: "I picture this
tradition as permeating both shores of the North Channel [during Late Boreal
and Early Atlantic times] appearing in small implements where and when flint
was scarce, inflating into coarse implements where and when flint was accessible
(e.g., Larne and Glenarm), only partially revealed to us where the material was
swept into beaches by the rising sea, fully revealed where late middens, immune
from leaching, remained above the edge of the receding sea." However interesting
and plausible this concept may be it makes no allowance for several very
important and fundamental factors, one of which is the reason why the Early
Larnian implements are of relatively small size. Throughout the entire complex
there is a very strong survival of Upper Palaeolithic technological tradition; this,
in addition to the prevailing environmental conditions, is believed to be of more
basic importance in connection with the actual size of the Early Larnian tools
than the accessibility of flint. Secondly, although it must be admitted that
certain limitations in the size of the tools themselves are imposed by the nature
and availability of the raw material (i.e., flint) employed in the manufacture of
a given series of artifacts, the types of tools produced are basically a function of
the daily needs of a given group. This, in turn, largely reflects the environmental
conditions obtaining in the particular region under consideration. In other words,
just because there is an abundant supply of flint in Eastern Antrim and Northern
Down, this factor alone would not lead to the production of an abundance of
large coarse tools during Late Larnian times. There had to be a fundamental
need for them. Moreover, in the Dundalk region to the south, there is no great
shortage of flint, although the supply could conceivably be exhausted, which is
hardly true of the regions to the north. But the Rockmarshall middens are not
only later in time than the deposits containing the true Late Larnian material in
Counties Antrim and Down, but also they were occupied under somewhat
different climatic conditions. For now the Post-Glacial warmth maximum had
passed, which is believed to be a matter of fundamental concern with regard to
this problem. In any case, if the presence of the Late Larnian can be demon-
strated in a context for South-western Scotland (at present it is only hinted at on the basis of the few scattered finds summarized on page 87), Mitchell's (1949, p. 174) contention that the "local exuberance into larger and coarser implements of Late Larnian type" was entirely a function of the availability of flint could be shown to be inadequate as a working hypothesis. This is already suggested on the basis of the fact that, according to Mitchell (1947, p. 174), rolled flints of Late Larnian type actually occur in the storm beach deposits below the level of the Rockmarsh all middens, and also on the surface of the raised beach gravels at Greenore, County Louth (see also Mitchell, 1949, p. 174). Furthermore, the fact that the Late Larnian is not confined in its distribution to a few sites on the coast of County Antrim is shown by the wealth of material of Late Larnian type from sites in the Strangford Lough-Ards Peninsula region included in the Kirk Collection in the National Museum, Dublin. Indeed it is even probable that a thorough survey of Mr. Kirk's sites in the Strangford area would result in the identification of an undisturbed Late Larnian occupation site.

8. LARNIAN SURVIVALS IN THE LOWER BANN VALLEY

With the arrival of Early Neolithic settlers, who came from Western Europe via Britain (Movius, 1942, pp. 232-239), in the favourable lowlands of Counties Antrim and Down bordering on the North Channel towards the close of the third millennium B.C.¹ the indigenous food-gathering population was apparently dispersed for the most part. Probably some elements were absorbed, but other groups moved southward and westward along the coasts where they clung on to the old Mesolithic way of life, apparently for as long as two thousand years in certain isolated areas. Still other groups penetrated the interior where, in the fertile valley of the Lower Bann River north of Lough Neagh, the Bann Culture was developed. That the basic roots of the Bann Culture lie in the Mesolithic of the littoral of North-eastern Ireland is suggested by the facts that (a) the most distinctive implement type of this complex—the leaf-shaped point with trimmed (or superficially tanged) butt—occurs in all the Early and Late Larnian horizons thus far investigated in Counties Antrim and Down; and (b) the evidence of the hearths excavated in 1934 at Newerry, County Londonderry, at the outlet of the

¹ Jessen (1949, p. 246 and Pl. XVI), apparently following Brønsted (1938, p. 129), gives a date of 3000 B.C. for the beginning of the Neolithic in Ireland, but this is regarded as somewhat too early by the present writer. Following Childe (1947, Table III, p. 333), who gives a date of circa 2300 B.C. for the Windmill Hill Culture; Fox (1943, p. 9), who estimates a maximum age of circa 2400 B.C. for Neolithic "A" in the Lowland Zone of Britain; Piggott (1949, p. 68), who believes the first agricultural settlements were established in Southern England soon after 2800 B.C.; and Hawkes (1940, p. 142 and Table IV), who suggests circa 2500 B.C. as a reasonable figure, and allowing for the inevitable time-lag for the diffusion of this new economy to Ireland, something of the order of 2200 B.C. ± 150 years, or so, seems to be a more reasonable date for the advent of this new economy in North-eastern Ireland (compare Movius, 1942, Fig. 89, p. 255). In this connection it is interesting to note that Glob (1952, p. 78) in his recent book on the Neolithic antiquities of Denmark gives a date of circa 2500 B.C. for the beginning of the Early Neolithic Period.
Bann from Lough Beg, demonstrates that here we are dealing with a food-gathering complex practised by a group of people who were sufficiently sedentary in their habits to repair to the same locality during the dry season for many years in succession for the purpose of fishing (Movius, 1936, p. 29). And Jessen has shown that the Bann Culture extends through most of Sub-Boreal (Sub-Zone VIIb) time (Jessen, 1936; 1949, p. 123 and Fig. 13, p. 251). That the Bann Culture was strongly influenced as the result of contacts with the coastal Neolithic, as well as the Megalithic invaders, is shown by the fact that both flake and polished stone axes, picks, and pottery constitute important components in the assemblage found at Newerry.¹ But essentially it represents a continuum of Mesolithic tradition persisting into Sub-Boreal times.

Now on the basis of the fact that the well-known tanged point, very characteristic of the Bann Culture, is similar to certain Scandinavian forms, a direct cultural connection has been suggested by some authorities (compare Clark, 1936-a, p. 243), indicative of “Nordic” affinities of the Irish Neolithic (Mahr, 1937, pp. 322-323). Such a view was originally proposed by Peake and Fleure (1927, pp. 105-114, 118 and Fig. 65 b and e), and it has been accepted in Ireland by Whelan (1933-a, p. 150; 1934; 1938), and Ratery (1944, p. 158). But the evidence of the coastal stations shows that this interpretation is no longer tenable. Whereas it cannot be denied that there were contacts between Ireland and the Baltic during Neolithic times, the fairly common existence of convincing prototypes for these distinctive implements at Cushendun, Glenarm, Larne, Rough Island and the Rockmarshall middens shows that here we have a fairly clear case for the independent development of these characteristic objects. Thus the “Bann Point” is considered to be an indigenous Irish development, although both it and its Scandinavian counterpart possibly have an ultimate common ancestry in the Upper Palaeolithic of Northern Europe. Rather than evoking an outside influence, therefore, it seems very likely that the Bann Culture was developed by some groups of the indigenous Mesolithic survivors who, as stated above, were pushed inland by invading Neolithic elements and clung on to a basic food-gathering economy until nearly the end of Sub-Boreal times. They were strongly influenced by, and possibly even mixed with, the more advanced food-producing newcomers, as well as being in receipt of Megalithic ideas. Probably sooner or later these people learned the new art of crop cultivation, as Evans and Gaffkin (1933, p. 245) have suggested. But in this inland fishing complex the old Larnian tradition seems to have survived in an almost purer and more vigorous form that it did in the Sand Hill sites in Northern and Western Ireland, notwithstanding the influences it received from higher sources.

In the vicinity of rivers, lakes and bogs isolated finds of leaf-shaped “Bann” flakes have been recorded in many parts of Ireland, emphasizing their probable

¹ Although not found in a datable context, it is very probable that the bone points described by May (1939) and Whelan (1952) recovered by dredging the bed of the Lower Bann River near “The Cutts,” approximately 2 miles south of Coleraine, and in the channel east of Loughan Island, 1½ miles farther upstream, should be considered as belonging to the Bann complex, as defined elsewhere by the present writer (Movius, 1942, pp. 238-252).
function as an item of fishing equipment, as Mitchell (1949, p. 179) has stated. According to Davies (1948, p. 6) these objects occur in the Lagan Valley, and an example from Annaghmakerrig, near Newbliss, County Monaghan, mentioned by Davies (1948, p. 6), has been illustrated by Mitchell (1949, Fig. 3, p. 179). Further specimens from a site on Argery Hill, near Ballindrait, County Londonderry, are figured by Davies (1948-a, p. 118, Figs. B and E). D’Evelyn (1904, p. 216, Pl. XV, Fig. 4) has also recorded a chert flake of this type from a coastal site near Raghly, west of Ardtermon Castle, County Sligo, and more recently Raftery (1944, p. 158, Figs. 1 A, B and C) has shown three examples from Drumshambo, County Leitrim, Derrysheridan, County Meath, and Lough Gur, County Limerick, respectively. Furthermore, Mitchell has found these artifacts in middens at Sutton, County Dublin, and Rockmarshall, County Louth (Mitchell 1947; 1949, p. 180; 1949-a), and recorded additional examples from Castlereban, on the River Barrow, County Kildare, Urlaur, near Ballyhaunis, County Mayo, and Crossakeel, County Meath (Mitchell, 1949, p. 180). Finally, as previously stated, leaf-shaped points from Sand Hill sites in the Bann estuary are illustrated by May and Batty (1948, pp. 136-140, Figs. 2 and 5). In that the culture of the Sand Hill settlements in general is likewise in the Larnian tradition, the fairly frequent occurrence of these artifacts at the numerous coastal localities in Northern and Western Ireland is to be expected. Outside of Ireland tanged points of “Bann” type have been reported from some 21 surface sites in the Isle of Man (Clark, 1935-a, pp. 74-75), as well as at Ballantrae, Ayrshire (Lacaille, 1945, pp. 94-95; 1948-a, p. 38), but this is not regarded as evidence for demonstrating the occurrence of the very characteristic and distinctive Bann Culture of the inland valley stations of Ulster on the eastern shores of the North Channel. But the question is what is the significance of these widespread finds?

At the outset it should be made clear that we agree with Raftery (1944, p. 159) and Mitchell (1949, p. 180) in rejecting the scattered occurrence of leaf-shaped points with trimmed butts as indicative of the former extensive distribution of the Bann Culture in Ireland. For, as Raftery points out, by itself this single trait does not define a culture any more than does a socketed bronze knife, for example. However, it is the presence of these tools which indicates that we are dealing with a specialized type of fishing industry that is of Early Mesolithic tradition. Indeed in North-eastern Ireland these implements are first met with in deposits that were laid down during Boreal times. But isolated finds of these points, on the one hand, and the very highly developed complex found in the Lower Bann Valley, called the Bann Culture, on the other, are two quite fundamentally different matters, as Raftery (1951, pp. 71-76) has finally admitted. Although there is an industrial link between them in that both are related to fishing, the occurrence of 198 flint artifacts in association with a series of 30 hearths either in or overlain by Sub-Boreal diatomite in an area only 30 feet square (cf. Movius, 1936) is surely indicative of intermittent occupation by a group or groups of people whose fundamental economy and basic patterns of culture remained relatively constant over a period of many centuries, although
they were under strong influence from sources of higher culture that came into the region. For the Newferry site demonstrates a whole series of temporary occupations by a people whose main occupation seems to have been fishing, and whose most characteristic single material culture trait was a flint point trimmed at the butt-end, presumably for hafting either as a point or a knife. It is certainly not a workshop where leaf-shaped points were manufactured for the purpose of a single specialized function, nor is it by any means a unique locality insofar as the Toome-Newferry region is concerned. Throughout this entire area there is abundant evidence for long and continued seasonal occupation by fishing peoples during Sub-Boreal times (compare Jackson, 1909; Knowles, 1881; 1912; Whelan, 1930-b). Indeed Clark's (1948, pp. 63-64 and 72-73; 1951, p. 56) suggestion that here we have to do with "the scene of a specialized fishery\(^1\) on the part of peasant farmers" is not considered likely in view of the enormous wealth of material from the very numerous and prolific fishing localities in the Lower Bann Valley. Therefore, on the basis of the sum total of the evidence, it is felt that here we must recognize a definable culture, rooted in the Larnian, and not merely either the sporadic occurrence of a single specialized type of implement, or a few intermittent seasonal camping-places of peasants who visited the valley during the dry periods of the year for the purpose of obtaining fish.

9. Cultural Affinities of the Larnian

With regard to the Mesolithic developments in Scotland and Ireland as a whole, it is clear that prior to the transgression of the Early Post-Glacial sea, the two regions comprised a single culture province, to use Fox's term (Fox, 1943, p. 44), that was fairly well isolated from the rest of Britain by the Highland Zone. Following the retreat of the last ice-sheets and the establishment of extensive forest and fenland conditions in the deglaciated tracts, at a time when much of the present basin of the Irish Sea was dry land, this refuge area was peopled by descendants of Upper Palaeolithic stock from Southern and Central Britain, including Wales, who followed the migrating herds northward, as discussed on pages 80-84. But the archaeological evidence is far too scanty to serve as a basis for reconstructing the route, or routes, followed by the migrants. Here all one can say is that one group apparently passed through the Ribble Valley in Western Yorkshire, on the basis of the evidence from Victoria Cave. The salient fact remains, however, that in the North-eastern Ireland—South-western Scotland province remarkably uniform cultural developments took place. Contributing factors must have been (a) the existence of a partially complete land-bridge in the region now occupied by the North Channel, (b) the fact that in both areas the climatic conditions were practically identical, and (c) the various groups of

\(^1\) As Clark points out (1948, p. 72), it is probable that the fish concerned were Salmon, although no bones have ever been found. But, since the river abounds in Eels at present, the possibility that this situation prevailed during Sub-Boreal times should not be ruled out.
migrants shared a common cultural tradition descended from the Creswellian. Since human needs were based on the same fundamental hunting economy, the several Early Larnian assemblages that have been found to date reveal a very striking degree of uniformity. Nevertheless, in comparing the various series of stone tools from Ireland and Scotland it must be recalled that suitable raw material is relatively scarce in Southern and Western Scotland in comparison with North-eastern Ireland.

In addition to the new traits devised by necessity, it is important to bear in mind that the lithic tradition introduced by the newcomers was already somewhat mixed on their arrival. Furthermore, certain of the innovations were acquired not only by diffusion, but also by culture contact. Since the question of an Azilian "penetration" can be ruled out (see pages 98-99), one need not look beyond Southern Britain for the place of origin of the new settlers. But there are other factors to consider—the degree and kind of the influences which were exerted on these provincial Mesolithic hunters and fishers from Tardenoisian and Forest Culture sources. Here again an analysis of the evidence suggests that the concept of the term "penetration" has been very greatly overstressed.

With respect to the Larnian of the localities in Ireland thus far investigated, not a single typically Tardenoisian artifact has ever been found in any of the Early Post-Glacial horizons thus far excavated. Indeed true Tardenoisian technical methods do not seem ever to have reached the Ulster seaboard. The microlithic forms that do occur are confined to the Early Larnian; they consist of small, narrow blade implements with steeply retouched backs, and they are made in the Upper Palaeolithic manner on complete bladelets, rather than on pieces divided by the specialized micro-burin technique of the Tardenoisian. These forms are also present at both of the Early Larnian sites at Campbeltown in South-western Scotland, but they are by no means common. To date only a total of eight (8) have been recorded, as follows:

<table>
<thead>
<tr>
<th>Site</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cushendun</td>
<td>3</td>
</tr>
<tr>
<td>Rough Island</td>
<td>1</td>
</tr>
<tr>
<td>Albyn Distillery</td>
<td>1</td>
</tr>
<tr>
<td>Millknowe</td>
<td>3</td>
</tr>
</tbody>
</table>

These artifacts, together with steep or core scrapers, obliquely truncated blades and a few gravers at Campbeltown, and the Lough Neagh site in County Londonderry (see page 83), are regarded as holdovers of the fundamental Upper Palaeolithic tradition shared in common by the various Early Larnian industries. Hence their occurrence in small numbers is by no means surprising.

It is otherwise, however, when one considers the question of micro-burins, which to date have only been found at one Early Larnian site—Albyn Distillery at Campbeltown. Here a total of 1,235 stone artifacts of human manufacture, of which 724 have been recognized as definable tools, were found. Of these
two (2) micro-burins and two (2) flakes apparently divided by micro-burin technique have been identified. These have been regarded as proclaiming the "penetration of Tardenoisan culture into the Scottish raised beach industry, and also that its elements reached Scotland at an earlier period than was formerly suspected" (McCallien and Lacaille, 1941, p. 91). Now, as Mitchell (1949, p. 178) has pointed out, this is extremely slender evidence on which to base a claim for the existence of actual Tardenoisan culture in Scotland during Early Larnian times. Nor does it mean that there were marked divergences between the Early Larnian of Scotland, on the one hand, as compared with that of Ireland, on the other (compare Lacaille, 1944, p. 12). For the presence of a single trait by no means establishes a genetic relationship between two cultures, even when the frequency occurrence of that trait is fairly high. In any case the micro-burin technique of Albyn Distillery, which seems to persist in the very much later Obanian complex of Western Scotland,¹ can perfectly well be accounted for on the basis of the evidence of the upper zone at Mother Grundy's Parlour. In other words, this specialized technique was already an element in the developed Creswellian of Lowland Britain before all the various groups of Upper Palaeolithic hunters had moved northward.

The partial land connection between Scotland and Ireland was severed during Late Boreal times as the result of the transgression of the Early Post-Glacial sea. As shown in this report, the Late Larnian culture developed on the north-eastern Irish littoral under the conditions of the so-called "climatic optimum," or Post-Glacial warmth maximum. Indications of the presence of this development have been detected at a few widely scattered surface stations in South-western Scotland, but its presence there has not yet been confirmed in a stratigraphic context by excavation. Indeed the occurrence of a few dozen Late Larnian-type flints from the coasts of the Firths of Clyde and Solway may document no more than occasional visits to the Scottish shores by the Late Larnian settlers of the Ulster seaboard, rather than extensive traffic and/or actual occupation. But this matter cannot be resolved on the basis of the present data, and the cave sites thus far excavated in South-western Scotland have yielded no satisfactory evidence to support the claim that this region received significant Late Mesolithic influences from North-eastern Ireland.

To this same interval of time belongs a small series of Baltic-type antler tools found in association with Whale skeletons in the carse-lands of the Forth Valley, near Stirling, as well as a group of midden sites along the edge of the carse on both banks of the River Avon in the Parish of Bo'ness, which may possibly have been occupied at this time. Whereas these sites have proved to be extremely

¹ Two micro-burins have been found at the Obanian stations of Argyll—one (1) at Caisteall-nan-Gillean, Oronsay, and one (1) at Risga in Loch Sunart. Whether these are to be regarded as a survival of the Early Larnian tradition of Albyn Distillery, or as due to an influence from the evolved type of true Tardenoisan Culture which finally appeared in Scotland, possibly as early as the closing phases of the Atlantic Period and lasted well down into Bronze Age times (see pp. 92-93), is impossible to determine on the basis of the evidence at present available.
poor in archaeological remains (see pp. 90-91), an inadequately published midden on the Island of Inchkeith in the Firth of Forth had yielded evidence of an Obanian occupation, and probably dates from an early stage of the emergence during Early Sub-Boreal times. Therefore, as in the case of the various Obanian sites of Argyll, the occupation of the Inchkeith midden seems to be separated from both the main Larnian development and the finds in the Stirling region by a period of perhaps a thousand years’ duration. But this statement is of a somewhat speculative nature, since the stratigraphic evidence concerning the age of the various horizons in question has never been worked out in detail.

Now in the Obanian, which is not regarded as a separate cultural entity that replaced the Early Larnian, but rather as a regional development of it, ¹ frequent reference has been made to the existence of Forest Culture influences. The full significance of these influences, however, has not been considered in detail. Since the same source is believed to be responsible for the presence of the core axe in the Late Larnian of Ireland, it is important to consider the implications of the available evidence from Scotland and North-eastern England in connection with the affinities of the Late Larnian culture. Again the essence of this problem is concerned with actual migrations of peoples bringing with them new cultural elements, versus the diffusion of independent traits.

The sum total of the present data emphatically does not suggest that a group of people of Forest Culture ancestry ever reached Scotland, bringing to the indigenous Upper Palaeolithic survivors new types of tools of stone, bone and antler, as implied by Lacaille (1948-a, p. 25) and Mitchell (1949, p. 178). Certainly this possibility can be completely ruled out with regard to Ireland, on the basis of a few sporadic finds of core axes in deposits of Atlantic age in County Antrim. And the fact that not a single example of this type of tool was found at the site excavated in 1935 on Curran Point, Larne, out of a total of over 5,515 artifacts, provides an objective basis for appreciating how rare they are. As far as Scotland is concerned the following evidence of Forest Culture influence has thus far come to light:

1. One very small, partially bifacial, chisel- or pick-like tool 4-6 cm. (1 13/16 in.) long from the Early Larnian site of Albyn Distillery, Campbeltown, possibly from deposits of Late Boreal age.
2. Three perforated antler axe-hammers from the carse-lands of the Forth Valley, near Stirling, apparently of Atlantic age.
3. A series of antler tools, eight (8) of which are perforated, together with some Baltic-type barbed points of bone and antler from the very Late Atlantic/Early Sub-Boreal Obanian sites of Argyll.
4. A few artifacts of stone, bone and antler stated to be of Obanian-type from an undated midden on the Island of Inchkeith in the Firth of Clyde.

¹ Comparable with the Lower Halstow Culture of South-eastern England, which developed a special local facies subsequent to the severing of the land connection between Britain and the Baltic, as the result of the Early Post-Glacial marine transgression (compare Burchell, 1925; 1927; 1928; Clark, 1936, p. 158).
Certainly these traits do not portray a consistent and uniform pattern of a development which one can identify as belonging to the Forest Culture complex in this region. Not only does the material include a wide assortment of types, but also it covers a considerable range of time from the Late Boreal (?) down to the Early Sub-Boreal climatic phase. Therefore, unless a site like the one at West Hartlepool, Durham, comes to light in Scotland, the nature of the evidence emphatically does not justify the assumption that "Maglemosian settlers" ever migrated as far north as the Midland Valley of Scotland. Speculations of this sort may seem very attractive and plausible, but in the final analysis they are based completely on imaginative and wishful thinking rather than on factual evidence. For every single fact bearing on this problem suggests that the traits in question were spread by diffusion (i.e., the taking over of an idea, or a series of related ideas, by one group from another), rather than by the coming together of two groups who set about producing a hybrid culture, the perishable items of which have been completely destroyed at the Irish stations. Of course, the real trouble is that our knowledge of Larnian antler and bone tools is nil, three "prickers" made from Deer ulnae from the base of a raised beach near Holywood, County Down (Home, 1912) being the sum total of the Larnian bone work reported to date. But it is almost inconceivable that these people did not have barbed bone points, as well as the various kinds of antler implements found in the later Scottish localities, when the ancestry of the Larnian is considered, as both Lacaille (1948-a, p. 36) and Mitchell (1949, p. 174) have stated. For the tradition of making the former can be traced back to the Upper Palaeolithic via the Early Mesolithic level at Victoria Cave, and the sporadic finds at Whitburn, Cumstoun, and Shewalton suggest that these implements were in fairly general use throughout the area. On the other hand it should be remembered that such evidence is entirely of an inferential nature, and may be completely meaningless. After all no true bifacial core axes, admittedly of sporadic occurrence in Ireland, have ever been found at any of the Scottish localities, although some of the latter lie directly on the route between North-eastern England and Ulster. In any case, the Irish core axes from Larne and elsewhere in County Antrim\(^1\) were almost certainly derived ultimately from Forest Culture sources, and hence it is not surprising to find that Scotland likewise received influences of the same fundamental inspiration. But, just as in the case of the micro-burins from the Early Larnian of Cambeltown, the adoption of a new trait, or even a series of new traits, does not mean that a new culture has been introduced by some sort of a grafting process, which is not even understood by biologists.

\(^1\) Burchell (1934, p. 370) suggested that the "Larne axe" was related to the "Thames pick" of South-eastern England, an object which owes its inspiration to the Forest Cultures of the Baltic, whereas Erdtman (1928, p. 163) compared the Irish examples with types known from Næstvet, a Late Mesolithic station in Southern Norway. In that all three are derived in common from a Maglemosian source, these statements may be considered valid. As mentioned on page 68, until twenty years ago it was held that the "Larne axe" was Neolithic. This misinformation has given many geologists, who have attempted to date the Early Post-Glacial raised beaches of Britain and Ireland on the basis of the archaeological date (compare Steers, 1948, pp. 493-496), a false impression of chronology.
The field of research on Mesolithic problems in Scotland is vast, and it has a very direct and important bearing on the Larnian Culture of Ireland: its origin and affinities. Apart from McCallien’s and Lacaille’s work at the Albyn Distillery site at Campbeltown, the cave sites in the Clyde basin dug by Marshall, Lethbridge’s work at a small rock-shelter near Oban, and Stevenson’s excavation at a midden in the Falkirk area, very little serious excavation has been conducted since the last century. And very little has even been published on the subject, with the exception of Lacaille’s studies of the collections from various surface sites in several parts of the country. But what is urgently needed is a series of stratigraphic investigations, and in this connection there is a wide range of inviting possibilities:

1. Is the Ballantrae material stratified as indicated by an analysis of the surface material collected by the Rev. Dr. Edgar, and if so what is the age of the various horizons based on the evidence of the natural sciences?

2. What material culture traits did the midden-dwellers of the Avon Valley, West Lothian, possess? Were they the forerunners of the groups who later settled in the Oban-Oronsay-Risga area, as implied by the evidence from Inchkeith, or were they more closely related to the strand-looper peoples of the localities on the Firth of Tay? These sites in the Forth drainage are of great importance for, if they are contemporary with the formation of the carse, they may well be the only Late Mesolithic occupation sites in either Northern Britain or North-eastern Ireland dating from the time of the maximum of the transgression of the Early Post-Glacial sea that have been preserved. In any case, the scattered finds thus far recovered strongly suggest that the Forth Valley equivalent of the Hiberno-Scottish (Larnian-Obanian) Mesolithic complex will eventually be demonstrated for this area.

3. Finally, a detailed geological study should be made of the relation of the Argyll midden, cave and rock-shelter sites to the deposits of the Early Post-Glacial sea. It is possible that new sites will come to light in this area, which will help to establish with greater precision than is now possible the chronologic position of the Obanian, as well as how long it persisted in the marginal sections of Argyll. This problem should be of great interest, inasmuch as the main Obanian development was apparently coeval with the thriving Neolithic economy of Lowland Britain, and it persisted well down into Metal Age times.

Although a number of important stations are still awaiting investigation in Ireland—including the locality at Mill Strand, Portrush (cf. Simpson, 1889; Patterson, 1896; 1896-a; Jessen, 1949, pp. 130-135; Mitchell, 1949, pp. 170-171), Burchell’s section at Island Magee (see pp. 12-13), and several large sites in the Strangford Lough—Ards Peninsula region represented in the Kirk Collection—the
broad outlines of the main developmental pattern of the various Stone Age manifestations and their chronological sequence are beginning to emerge. During Early Post-Glacial times the coasts of Counties Antrim and Down constituted the centre of a refuge area, which included all of South-western Scotland to the east and extended as far inland as Lough Neagh and the Lower Bann Valley on the west. On the basis of the present evidence, this region was first settled in the Early Boreal climatic phase by people of Upper Palaeolithic ancestry, who came from the Lowland Zone of Britain and who were already developing new culture traits as well as modifying old ones in response to their daily needs. For the latter were gradually becoming patterned to the changing climatic conditions. This process was further stimulated by the comparatively sudden transgression of the sea in the Late Boreal Period, which is regarded as a geographic event of the first order of magnitude. The entire mode of life, as well as the actual conditions of settlement, in the region, were profoundly affected by this movement, following which the climatic optimum was attained. A study of the material culture traits developed under the influence of the new environmental conditions provides a basis for gauging the actual rate and extent of the change that took place in this more or less isolated area.

Now the only elements of exotic origin that were introduced at this time can be accounted for on the basis of diffusion. This factor rather than the postulated arrival of new settlers is believed to be responsible for the appearance of the objects of exogenous origin during the period under discussion. In other words, it is felt that the whole picture of Mesolithic development in Northern Britain and Ireland should be conceived of as a very much more straightforward affair than most authorities have been willing to admit. And, when some of the really key sites in Scotland have been excavated, the fact that much too complex and involved a structure has been erected on the basis of far too little evidence inevitably will be admitted. For the proportion of distinctive but nonetheless relevant implement types in the assemblages under consideration are in themselves sufficient indication of a natural growth of autochthonous native culture, instead of a conglomeration resulting from some sort of a hybridization of intrusive elements introduced by new settlers who are believed to have come from various widely separated areas, and who are represented only by a few scattered finds of specialized types of artifacts. In short, the various Mesolithic assemblages of Ireland and Scotland, known as Larnian and Obanian, are indigenous entities with their own growth and life, and they cannot be explained on the basis of a blending of different cultural elements introduced by successive waves of migrants from the south.
APPENDIX I

PALÆOBOTANICAL REPORT ON THE ESTUARINE CLAY AT ISLAND MAGEE, COUNTY ANTRIM

By Professor Knud Jessen, Copenhagen

1. INTRODUCTION

On July 14, 1934, Mr. C. Blake Whelan of Belfast conducted the writer, together with Messrs. H. Jonassen and G. F. Mitchell, on an excursion to Island Magee, County Antrim. This afforded us an opportunity to study the Estuarine Clay on the north-western coast of this peninsula as part of the programme of work done by the writer on behalf of the Committee for Quaternary Research in Ireland. Previously, J. P. T. Burchell (1934) had studied the stratification of the marine deposits at this locality and their contained artifacts, while the mollusca and foraminifera collected by Burchell were subsequently published by D. W. F. Baden-Powell and W. A. Macfadyen (Baden-Powell, 1937).

2. DESCRIPTION OF THE SITE

The purpose of our visit was to try to secure samples of the Estuarine Clay for a pollen-analytical examination. Approximately a quarter of a mile south of the harbour (the section investigated by Burchell was exposed during the construction of this harbour\(^1\)), and about ten yards west of the bank which rises from the foreshore, a pit was sunk in the clayey beach, which at this point is strewn with stones. The top of this pit was situated very close to the level of ordinary high-tide. However, the base of the Post-Glacial marine deposits could not be reached by us, owing to the lateral drainage of water into the hole. The sequence of deposits from the surface downward was as follows:

Deposit A—0 to 1-25 cm. Grey, sandy fjord clay ("Estuarine Clay"), containing numerous thin brown layers consisting of decomposed Zostera marina. Molluscs were common (see list below). Throughout the entire deposit there occurred broken branches, twigs and stems of Oak and Elm, as well as Pine (Pinus sylvestris) in the lower portion of the layer. In addition to the ordinary tree-pollen, some grains of Ivy (Hedera helix) and spores of the Common Polypody (Polypodium vulgare) were found. A core and a few roughly flaked pieces of flint were the only cultural remains observed in Deposit A.

Deposit B—1-25 m. to 1-60 m. Grey, sandy clay with numerous rounded to subangular stones.

Deposit C—1-60 m. to 1-80 m. (base not reached). Dark grey, somewhat clayey sand, containing a few fragments of shell. In this layer two small, humanly flaked cores of flint were found.

\(^1\) The location of Burchell’s site is shown on the map, Fig. 2, p. 18.
3. Report on the Molluscs

Professor R. Spärck of Copenhagen has been kind enough to identify the molluscs collected in Deposit A. The list of species is as follows (r: rare; f: frequent):

- **Cardium exiguum** (Gm.) . . . .  r.
- **Aloidis (Corbula) gibba** (Oliv) . . .  r.
- **Ensis (Solen) siligua** (L.) . . .  r.
- **Phacoides (Lucina) borealis** (L.) . . .  r.
- **Mysia (Lucinopsis) undata** (Penn.) . . .  r.
- **Ostrea edulis** (L.) . . . .  f.
- **Pecten varius** (L.)—** (= Chlamys varia, L.)** . . .  r.
- **Abra (Syndosmya) alba** (Wood) . . . .  r.
- **Paphia (Tapes) virginus** (L.)—** (= edulis, L.; rhomboïdes, Penn.)** r.
- **P. — — (T. — ) pullastra** (Mtg.) . . . .  r.
- **Teredo sp.** . . . .  r.
- **Venus gallina** (L.)—** (= striata, da C.)** . . . .  r.
- **Buccinum undatum** (L.) . . . .  r.
- **Bittium (Cerithium) reticulatum** (da C.) . . . .  r.
- **Gibbula cineraria** (L.) . . . .  f.
- **Lacuna divaricata** (Fabr.)—** (= vinca, Mont.)** . . . .  r.
- **Littorina littorea** (L.) . . . .  f.
- **L. — — littoralis** (L.)—** (= obtusata, L.)** . . . .  f.
- **Nassarius reticulatus** (L.)—** (= Nassa reticulata, L.)** . . . .  r.
- **Patella vulgata** (L.) . . . .  r.
- **Turritella communis** (da C.)—** (= terebra, L.)** . . . .  f.

With the exception of **Teredo** sp., all these forms have been recorded at Larne on the opposite side of the lough (compare Praeger, 1892, and pp. 149-151 of N. F. McMillan’s report). This list of fauna also may be compared with the one published by Baden-Powell (1937) for Sample 3 (“Estuarine Clay”) at Burchell’s section. As a supplement to it, Professor Spärck has added the following comments: “The molluscan fauna from this layer shows that the deposits must have been laid down in a shallow fjord or lagoon with a soft bottom, as indicated by the presence of **Turritella communis** and **Abra alba**. The relative abundance of **Gibbula cineraria**, as well as the presence of **Lacuna divaricata**, is suggestive of the growth of seaweed in the vicinity. Only **Mysia undata** is indicative of more open water. At the time of deposition of this layer the temperature of the sea at Island Magee may be compared with that obtaining in Limfjorden Fjord, Jutland, at the present time. **Ostrea edulis, Pecten varius, Cardium exiguum**, and all the species found with the single exception of **Paphia (Tapes) virginus**, not only occur to-day in this fjord, but also in the north-western part of the Kattegat, and along the coast of Western Europe.” So far Professor Spärck; his conclusions agree quite well with those of Baden-Powell.
4. DISCUSSION OF THE POLLEN-DIAGRAM

Samples for pollen-analysis were collected in Deposit A, the deeper-lying beds being too sandy and coarse. After treating them with hydrofluoric acid, sufficient pollen was found to permit a counting. The diagram, Fig. 19, is characterized by the rather uniform trend of the curves throughout the layer, which strongly suggests that Deposit A represents a comparatively short period. The abundance of Pinus and Alnus, together with the level for the curve for Ulmus (which is far below that characteristic of Zone VI\(^1\) in the Northern Irish sequence), place the diagram in Sub-Zone VIIa. But not in the upper part of this Sub-Zone; on the contrary, the maximum of Pinus in the lowest part of the diagram, where the curve for Alnus is rising from low values, as well as the crossings of these two curves near Spectras 7 and 8, which resembles the situation in the early portion of Sub-Zone VIIa in most other pollen-diagrams from North-eastern Ireland, show that Deposit A at Island Magee should be placed in the lower part of the Atlantic Period in Ireland.

\(^1\) For the definition of pollen-diagrammatical Zones VI and VII (formerly Vb and VI), see Jessen and Farrington, 1938, pp. 254-256; Jessen, 1949, pp. 104-106.
5. **Palaebotanical Age of the Maximum of the Post-Glacial Marine Transgression in North-eastern Ireland**

In connection with the Island Magee material it is of interest to consider some other sections in North-eastern Ireland where polleniferous marine deposits dating from the Early Post-Glacial transgression of the sea have been studied. Thus at Somerset in the Bann Valley, 14 miles (2 kilometres) south of Coleraine, County Londonderry (see Fig. 1, p. 8), the maximum of the submergence, which just reached the vicinity of this locality, is registered at the transition from Sub-Zone VIIa to Sub-Zone VIIb by the presence of a layer of mud (Jessen, 1949, pp. 125-127). The middle portion of this mud-layer contains a rather rich flora of diatoms characteristic of brackish and salt-water; in the lower, as well as in the upper part of this deposit, fresh-water diatoms predominate. Consequently the Somerset section affords definite proof that the regression of the sea had begun by the beginning of Sub-Zone VIIb. This fact is further confirmed by a section situated in a marshy meadow on the western side of the Bann Estuary, 1 7/8 miles (3 kilometres) north-west of Coleraine (see Fig. 1, p. 8), County Londonderry (Jessen, 1949, pp. 127-130). Here estuarine deposits reveal evidence for a maximum of salinity at a level which, in terms of the pollen-diagrams, corresponds with the transition from Sub-Zone VIIa to Sub-Zone VIIb at the Somerset locality. At a third locality near the entrance of the Bann Estuary—Mill Strand, immediately south-west of Portrush, County Antrim (see Fig. 1, p. 8)—the analysis of a peat-layer (at about 5·50 m. above O.D.) demonstrates that this old land-surface was formed before the maximum of the submergence, the uppermost peat layers still being of early Sub-Zone VIIa age (Jessen, 1949, pp. 130-135). It was transgressed by the sea during the upper part of Sub-Zone VIIa.

As regards the time of the beginning of this movement in terms of the palaebotanical sequence in Ireland, the evidence of submerged peats at Cushendun (Jessen, 1940, p. 42; 1949, p. 136), which may be assigned to Irish Sub-Zone VIb, and at Milewater Dock, Belfast (Charlesworth and Erdtmann, 1935; Jessen, 1949, p. 136), which is of VIa age—possibly older than the Boreal Hazel maximum—demonstrate that by far the greatest part of the transgression in North-eastern Ireland falls in Boreal time. Only the latest stages of it are Atlantic, and the regression begins with the opening of the Sub-Boreal Period, on the basis of the evidence from the Bann Estuary.

Investigations in County Louth on the north-eastern coast of Eire confirm the date secured from samples of the Upper Lagoon Silt at Cushendun, County Antrim (Jessen, 1940, pp. 44 and 50; 1949, p. 136). At Termonfeckin, 2 1/5 miles (3·5 kilometres) south of Clogher Point and north-east of Drogheda, the maximum of the transgression must have taken place after the end of Zone VI. For at this locality in the shore-cliff a thin peat-layer belonging to the lower part of Sub-Zone VIIa is overlain by a storm beach formed during the maximum of the submergence. Since some of the original peat-layer must have been eroded away
at the time of the incursion of the sea, the surviving surface does not indicate the time at which the transgression took place, but is rather older.

On the basis of the information summarized above, it seems very probable that the pollen-diagram from Island Magee, Fig. 19, dating from the early part of Irish Sub-Zone VIIa, is somewhat older than the maximum of the marine transgression. Furthermore, these facts make it possible to synchronize the changes of level that have taken place in Northern Ireland during Post-Glacial times (compare Coffey and Praeger, 1904, pp. 153-156, and Pl. V) with the pollen-diagrammatical zones. Thus the base of the Lower Estuarine Clay belongs rather far back in Zone VI (probably in Sub-Zones VIb and VIc), while the Upper Estuarine Clay is contemporaneous with the upper part of Sub-Zone VIIa. By the beginning of Sub-Zone VIIb (Sub-Boreal Period) the regression of the sea was in progress. However, in Larne Lough—at Curran Point as well as at Island Magee—gravel and sand layers, dating from the period of the maximum of the submergence, must be correlative with certain portions of the Upper Estuarine Clay at Belfast. It, therefore, seems likely, as Baden-Powell (1937, p. 96) suggests, that the Estuarine Clay at Island Magee (Deposit A, see p. 115) is to be correlated with an Intermediate Zone of the Estuarine Clay at Belfast (compare Praeger, 1888, p. 31). This conclusion is not in fundamental disagreement with Burchell's opinion that it is contemporaneous with the Lower Estuarine Clay (Burchell, 1934, p. 369). On the basis of the conchological evidence (Baden-Powell, 1937, p. 93), Deposit A at the Island Magee locality appears to have been laid down in about 2 or 3 fathoms of water.

APPENDIX II

ANALYSIS OF SEDIMENTS FROM CURRAN POINT, LARNE, COUNTY ANTRIM

By William S. Benninghoff

1

1. Introduction

The application of sediment analysis to the study of archaeological sites is an approach which is giving encouraging results, as Zeuner (1938; 1945, pp.80-92, 129 and 177) has pointed out. From the observations made in a sediment analysis, it is possible to deduce information regarding the nature of topography, climate, and other characters in the environment of the deposit during the sedimentation. The conclusions drawn from a sediment analysis, however, must not be considered as sufficient in themselves, but rather as

1 Manuscript completed in 1939, but publication delayed because of the war. Re-examination of material using methods since developed was not possible; references to later publications were added.—W.S.B., April, 1951.
valuable corroborative evidence to be synthesized and used in conjunction with the results of studies in palæontology, palæobotany, and stratigraphy.

2. Method

At the site on Curran Point excavated by the Harvard Archaeological Expedition to Ireland in 1935, eight distinct strata occur in the section exposed (see Pl. VIII), and representative samples of each type of sediment were taken by Dr. Movius. The materials (all of which were clastics in this series) were forced into wide-mouthed glass bottles of 200 c.c. capacity by holding the open mouths of the bottles against given points along the south-western face of the pit and filling them by loosening the material with a knife. Metal screw caps were put on the filled and labelled bottles. Rock fragments larger than 3 cm. in diameter could not be obtained in this manner, but Dr. Movius recorded observations on the larger material. The following table lists the strata in descending order, their thickness, and the numbers of the samples taken from each stratum:

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Depth below Point A</th>
<th>Sample Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Surface Accumulation</td>
<td>0 - 40 cm.</td>
<td>No sample taken from this stratum.</td>
</tr>
<tr>
<td>B. Storm Beach Material</td>
<td>40 cm. - 1·30 m.</td>
<td>No. 1-A from layer (a).</td>
</tr>
<tr>
<td>C. Inclined Beds of Coarse Gravel and Sand</td>
<td>1·30 m. - 4·25 m.</td>
<td>No. 2 from the upper part of layer (c).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 3 from layer (c1)—a dark lens in the lower one-third of layer (c).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 4 from the lower part of layer (c).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nos. 5 and 6 from two regions of layer (d).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 7 from layer (e).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 8 from layer (f).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 9 from layer (f1)—a dark lens in the middle of layer (f).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 10 from layer (g).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 11 from layer (h).</td>
</tr>
</tbody>
</table>

1 A description of the operations is given on pp. 19-21 of this report.
2 Clastics are those sediments which are made up of fragments of pre-existing rocks.
<table>
<thead>
<tr>
<th>Stratum</th>
<th>Depth below Point A</th>
<th>Sample Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Fine Reddish-Brown Sand</td>
<td>4.25 m. - 4.80 m.</td>
<td>No. 12 from layer (i). No samples were taken from layers (j) and (k). No. 13 from layer (l).</td>
</tr>
<tr>
<td>E. Hard Grey Sand</td>
<td>4.80 m. - 5.00 m.</td>
<td>No. 14 from the upper part. No. 15 from the lower part.</td>
</tr>
<tr>
<td>F. Fine Reddish-Brown Sand</td>
<td>5.00 m. - 5.15 m.</td>
<td>No. 16 from the middle part. No. 17 from the middle part.</td>
</tr>
<tr>
<td>G. Dark Blue Sand</td>
<td>5.15 m. - 6.00 m.</td>
<td>No. 18 from the upper part. No. 19 from the middle part. No. 20 from the lower part.</td>
</tr>
<tr>
<td>H. &quot;Estuarine Clay&quot;</td>
<td>6.00 m. - ——</td>
<td>No. 21 from the upper part. No. 22 from 50 cm. lower.</td>
</tr>
</tbody>
</table>

The bottled samples were given to the writer by Dr. Movius in November, 1938, by which time they were thoroughly dry. The first analysis was for size-grades in each sample. Approximately one-half of each sample was used for size-grade analysis, and the remainder set aside so that a check could be performed if necessary. For each sample the portion for analysis was loosened by stirring, poured quickly on to a sheet of paper, and weighed on a beam balance to the nearest milligram. The material was then carefully brushed from the paper on to a nest of five wire screens for dry sieving.¹ The screen sieves used were of the type employed by the United States Bureau of Soils; the five sieves

¹ There are three generally practicable methods of mechanical analysis: panning, sieving, and elutriation. Panning is used only for concentrating the large or heavy particles of a sediment; it does not serve for exact quantitative work. For coarse sediments, such as sands and gravels, sieving is the most applicable. The sieves may be made of wire screen or of bolting cloth. It is difficult to obtain accurate results with sieves having openings of less than 0.062 mm. For sediments with particles all smaller than 0.50 mm., the method of elutriation is generally used. This method employs the rate of subsidence of particles in liquids to determine the size, shape, and density of the particles. For additional information concerning the techniques of sedimentary petrology see Atterberg, 1912; Joffe, 1949; Krumbein, 1932; with Pettijohn, 1938; Ross, 1920; Steiger, 1926; Trask, 1930; Twenhofel, 1932, 1880; with Tyler, 1941; Wentworth, 1928; 1929. The method used here corresponds to what Zeuner (1938, pp. 34-41) describes as "Gravel Analysis."
had openings of 2·00 mm., 1·00 mm., 0·50 mm., 0·250 mm., and 0·062 mm., respectively. The apparatus was shaken with a rotary motion while held upright. Five minutes of vigorous shaking achieved practically as complete separation as is possible by manual operation. The six grades were then removed from the five sieves and the catch pan at the bottom and each grade was weighed. The weights of the grades were recorded and checked against the total weight determined beforehand. After all the samples had been sieved and weighed in this manner, the percentage composition according to size-grades was calculated for each sample.

Semi-permanent glycerine mounts of material from each grade smaller than 2·00 mm. were prepared in microscopic slides and studied under a ten-power binocular microscope by reflected light, and under a monocular microscope of 60 and 264 magnification by transmitted light. Larger fragments were examined under the hand lens. The occurrence of only the more important and abundant minerals was recorded, except where rarer minerals were significant. Under the microscope the minerals were identified by their optical properties, cleavage, and crystalline form and, in some cases, by simple chemical tests.

3. Record of Observations

The following table shows the definite limits of the six size-grades obtained by the sieving operations:

<table>
<thead>
<tr>
<th>Sieve screen openings</th>
<th>Size limits of particles</th>
<th>Designation for size-grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>2·00 mm.</td>
<td>1. All particles larger than 2·00 mm.</td>
<td>&gt; 2·00 mm.</td>
</tr>
<tr>
<td>1·00 mm.</td>
<td>2. Particles between 1·00 mm. and 2·00 mm.</td>
<td>&gt; 1·00 mm.</td>
</tr>
<tr>
<td>0·50 mm.</td>
<td>3. Particles between 0·50 mm. and 1·00 mm.</td>
<td>&gt; 0·50 mm.</td>
</tr>
<tr>
<td>0·250 mm.</td>
<td>4. Particles between 0·250 mm. and 0·50 mm.</td>
<td>&gt; 0·250 mm.</td>
</tr>
<tr>
<td>0·062 mm.</td>
<td>5. Particles between 0·062 mm. and 0·250 mm.</td>
<td>&gt; 0·062 mm.</td>
</tr>
<tr>
<td></td>
<td>6. All particles smaller than 0·062 mm.</td>
<td>&lt; 0·062 mm.</td>
</tr>
</tbody>
</table>

The > 2·00 mm. grade includes material from 2·00 mm. up to approximately 30·00 mm. in largest diameter. The < 0·062 mm. grade includes all the material less than 0·062 mm. in largest diameter.

1 These grades of openings were selected from the Wentworth scale, which is based on the ratio of 2 (cf. Wentworth, 1922).
In Table I (see below), the recorded weights in the analysis for grain size are given. The weight before screening is given for each analysis to provide a check against the sum of the weights of the individual size-grades.¹

The percentage composition according to grain size is presented in Table II, page 125. The histograms in Figure 20, page 127, were constructed upon these percentages and were made to show the percentages graphically.²

The significant observations on the component rocks and minerals and features of weathering are included in the discussion of each of the deposits. The percentages given for the various rocks and minerals were estimated by counting grains of different rocks and minerals on a definite area of the microscope slide, and in the case of the > 2·00 mm. grades, by counting the grains of the different materials for the entire grade. Percentages were not compiled for the rarer materials. The comprehensive terms "light minerals" and "dark minerals" have been used here in order to simplify the record. However, significant particular rocks and minerals, such as chert, basalt, quartz, and granite have been recorded separately.

4. Description of Deposits in Ascending Order

The various horizons in the stratigraphic column are discussed here in order, beginning with the lowest levels exposed at the excavated site.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>1-A</th>
<th>1-B</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight before screening</td>
<td>77·367</td>
<td>77·277</td>
<td>44·366</td>
<td>56·077</td>
<td>50·524</td>
<td>95·662</td>
<td>59·764</td>
</tr>
<tr>
<td>&gt; 2·00 mm.</td>
<td>26·908</td>
<td>27·148</td>
<td>16·513</td>
<td>37·419</td>
<td>22·818</td>
<td>78·235</td>
<td>22·701</td>
</tr>
<tr>
<td>&gt; 1·00 mm.</td>
<td>1·801</td>
<td>10·229</td>
<td>9·088</td>
<td>13·318</td>
<td>10·392</td>
<td>7·095</td>
<td>29·386</td>
</tr>
<tr>
<td>&gt; 0·50 mm.</td>
<td>6·069</td>
<td>15·590</td>
<td>9·613</td>
<td>2·874</td>
<td>5·620</td>
<td>2·477</td>
<td>5·208</td>
</tr>
<tr>
<td>&gt; 0·250 mm.</td>
<td>13·349</td>
<td>16·142</td>
<td>6·492</td>
<td>1·391</td>
<td>5·440</td>
<td>3·166</td>
<td>1·719</td>
</tr>
<tr>
<td>&gt; 0·062 mm.</td>
<td>17·144</td>
<td>6·605</td>
<td>2·070</td>
<td>0·940</td>
<td>5·453</td>
<td>5·710</td>
<td>1·284</td>
</tr>
<tr>
<td>&lt; 0·062 mm.</td>
<td>11·650</td>
<td>1·229</td>
<td>0·500</td>
<td>0·046</td>
<td>0·270</td>
<td>0·132</td>
<td>0·082</td>
</tr>
<tr>
<td>Total</td>
<td>76·921</td>
<td>77·013</td>
<td>44·276</td>
<td>55·988</td>
<td>49·993</td>
<td>96·815</td>
<td>60·380</td>
</tr>
</tbody>
</table>

¹ The difference in total weight before and after sieving is due to unavoidable factors such as loss of fine dust and loss or absorption of moisture during exposure to the air.
² Histograms were used in this paper because they may easily and quickly be comprehended (Wentworth, 1932).
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight before screening</td>
<td>35.686</td>
<td>81.455</td>
<td>90.540</td>
<td>78.381</td>
<td>31.358</td>
<td>109.478</td>
<td>68.917</td>
</tr>
<tr>
<td>&gt; 2.00 mm.</td>
<td>7.682</td>
<td>42.463</td>
<td>76.426</td>
<td>64.013</td>
<td>0.127</td>
<td>101.721</td>
<td>38.345</td>
</tr>
<tr>
<td>&gt; 1.00 mm.</td>
<td>0.874</td>
<td>5.227</td>
<td>7.957</td>
<td>3.673</td>
<td>0.014</td>
<td>2.573</td>
<td>5.956</td>
</tr>
<tr>
<td>&gt; 0.50 mm.</td>
<td>0.838</td>
<td>2.252</td>
<td>2.647</td>
<td>0.889</td>
<td>0.033</td>
<td>0.274</td>
<td>1.652</td>
</tr>
<tr>
<td>&gt; 0.250 mm.</td>
<td>4.973</td>
<td>10.732</td>
<td>1.467</td>
<td>3.072</td>
<td>2.354</td>
<td>0.562</td>
<td>4.447</td>
</tr>
<tr>
<td>&gt; 0.062 mm.</td>
<td>20.889</td>
<td>19.334</td>
<td>1.226</td>
<td>6.059</td>
<td>28.067</td>
<td>3.940</td>
<td>17.076</td>
</tr>
<tr>
<td>&lt; 0.062 mm.</td>
<td>0.430</td>
<td>2.161</td>
<td>0.098</td>
<td>0.538</td>
<td>0.683</td>
<td>0.320</td>
<td>2.240</td>
</tr>
<tr>
<td>Total</td>
<td>35.686</td>
<td>82.169</td>
<td>89.821</td>
<td>78.244</td>
<td>31.278</td>
<td>109.390</td>
<td>69.716</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight before screening</td>
<td>64.476</td>
<td>36.076</td>
<td>10.026</td>
<td>56.367</td>
<td>63.073</td>
</tr>
<tr>
<td>&gt; 2.00 mm.</td>
<td>0.211</td>
<td>0.036</td>
<td>0.045</td>
<td>0.206</td>
<td>0.129</td>
</tr>
<tr>
<td>&gt; 1.00 mm.</td>
<td>0.280</td>
<td>2.342</td>
<td>0.285</td>
<td>0.263</td>
<td>0.046</td>
</tr>
<tr>
<td>&gt; 0.50 mm.</td>
<td>0.486</td>
<td>3.856</td>
<td>0.975</td>
<td>1.236</td>
<td>0.560</td>
</tr>
<tr>
<td>&gt; 0.250 mm.</td>
<td>3.071</td>
<td>3.222</td>
<td>5.174</td>
<td>7.683</td>
<td>5.346</td>
</tr>
<tr>
<td>&gt; 0.062 mm.</td>
<td>53.327</td>
<td>21.168</td>
<td>3.314</td>
<td>40.478</td>
<td>46.104</td>
</tr>
<tr>
<td>&lt; 0.062 mm.</td>
<td>7.898</td>
<td>5.199</td>
<td>0.188</td>
<td>6.275</td>
<td>11.519</td>
</tr>
<tr>
<td>Total</td>
<td>65.273</td>
<td>35.823</td>
<td>9.981</td>
<td>56.141</td>
<td>63.704</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight before screening</td>
<td>68.796</td>
<td>67.183</td>
<td>75.055</td>
<td>117.042</td>
</tr>
<tr>
<td>&gt; 2.00 mm.</td>
<td>0.725</td>
<td>0.076</td>
<td>0.000</td>
<td>0.532</td>
</tr>
<tr>
<td>&gt; 1.00 mm.</td>
<td>0.228</td>
<td>0.411</td>
<td>1.831</td>
<td>1.339</td>
</tr>
<tr>
<td>&gt; 0.50 mm.</td>
<td>2.080</td>
<td>2.215</td>
<td>11.957</td>
<td>6.862</td>
</tr>
<tr>
<td>&gt; 0.250 mm.</td>
<td>8.822</td>
<td>5.355</td>
<td>11.103</td>
<td>8.769</td>
</tr>
<tr>
<td>&gt; 0.062 mm.</td>
<td>47.307</td>
<td>37.254</td>
<td>24.459</td>
<td>62.121</td>
</tr>
<tr>
<td>&lt; 0.062 mm.</td>
<td>9.299</td>
<td>21.455</td>
<td>24.899</td>
<td>36.794</td>
</tr>
<tr>
<td>Total</td>
<td>68.461</td>
<td>66.766</td>
<td>74.249</td>
<td>116.417</td>
</tr>
</tbody>
</table>
**Table II**

**Percentage Composition According to Grain Size**

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>1-A %</th>
<th>1-B %</th>
<th>2 %</th>
<th>3 %</th>
<th>4 %</th>
<th>5 %</th>
<th>6 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 2-00 mm.</td>
<td>34-65%</td>
<td>35-13%</td>
<td>37-29%</td>
<td>66-83%</td>
<td>45-16%</td>
<td>80-81%</td>
<td>37-59%</td>
</tr>
<tr>
<td>&gt; 1-00 mm.</td>
<td>2-33%</td>
<td>13-24%</td>
<td>20-52%</td>
<td>23-81%</td>
<td>20-57%</td>
<td>7-32%</td>
<td>48-67%</td>
</tr>
<tr>
<td>&gt; 0-50 mm.</td>
<td>7-84%</td>
<td>20-17%</td>
<td>21-71%</td>
<td>5-12%</td>
<td>11-12%</td>
<td>2-56%</td>
<td>8-62%</td>
</tr>
<tr>
<td>&gt; 0-250 mm.</td>
<td>17-25%</td>
<td>20-89%</td>
<td>14-66%</td>
<td>2-48%</td>
<td>10-77%</td>
<td>3-27%</td>
<td>2-85%</td>
</tr>
<tr>
<td>&gt; 0-062 mm.</td>
<td>22-16%</td>
<td>8-55%</td>
<td>4-67%</td>
<td>1-68%</td>
<td>10-79%</td>
<td>5-89%</td>
<td>2-13%</td>
</tr>
<tr>
<td>&lt; 0-062 mm.</td>
<td>15-06%</td>
<td>1-68%</td>
<td>1-13%</td>
<td>0-08%</td>
<td>0-53%</td>
<td>0-13%</td>
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</tr>
<tr>
<td>Total</td>
<td>99-29%</td>
<td>99-66%</td>
<td>99-98%</td>
<td>100-00%</td>
<td>98-94%</td>
<td>99-98%</td>
<td>99-99%</td>
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<tr>
<th>Sample No.</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
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<tr>
<td>&gt; 2-00 mm.</td>
<td>21-52%</td>
<td>51-68%</td>
<td>85-09%</td>
<td>81-81%</td>
<td>0-40%</td>
<td>92-99%</td>
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<tr>
<td>&gt; 1-00 mm.</td>
<td>2-45%</td>
<td>6-36%</td>
<td>8-86%</td>
<td>4-69%</td>
<td>0-04%</td>
<td>2-35%</td>
<td>8-54%</td>
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<tr>
<td>&gt; 0-50 mm.</td>
<td>2-35%</td>
<td>2-74%</td>
<td>2-95%</td>
<td>1-14%</td>
<td>0-11%</td>
<td>0-25%</td>
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<tr>
<td>&gt; 0-250 mm.</td>
<td>2-35%</td>
<td>13-06%</td>
<td>3-92%</td>
<td>7-52%</td>
<td>0-51%</td>
<td>6-39%</td>
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<tr>
<td>&gt; 0-062 mm.</td>
<td>58-50%</td>
<td>23-53%</td>
<td>7-74%</td>
<td>7-49%</td>
<td>2-60%</td>
<td>22-49%</td>
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<tr>
<td>&lt; 0-062 mm.</td>
<td>1-20%</td>
<td>2-63%</td>
<td>0-11%</td>
<td>0-69%</td>
<td>2-18%</td>
<td>0-29%</td>
<td>3-37%</td>
</tr>
<tr>
<td>Total</td>
<td>99-95%</td>
<td>100-00%</td>
<td>99-99%</td>
<td>99-98%</td>
<td>99-89%</td>
<td>98-17%</td>
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<th>Sample No.</th>
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<th>15</th>
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<th>17</th>
<th>18</th>
<th>19</th>
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<tr>
<td>&gt; 2-00 mm.</td>
<td>0-32%</td>
<td>0-10%</td>
<td>0-45%</td>
<td>0-35%</td>
<td>0-20%</td>
<td>1-00%</td>
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<td>&gt; 1-00 mm.</td>
<td>0-43%</td>
<td>6-54%</td>
<td>2-85%</td>
<td>0-45%</td>
<td>0-07%</td>
<td>0-33%</td>
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<td>&gt; 0-50 mm.</td>
<td>0-74%</td>
<td>10-76%</td>
<td>9-77%</td>
<td>2-20%</td>
<td>0-88%</td>
<td>3-04%</td>
<td>3-32%</td>
</tr>
<tr>
<td>&gt; 0-250 mm.</td>
<td>4-70%</td>
<td>8-99%</td>
<td>51-83%</td>
<td>13-68%</td>
<td>8-39%</td>
<td>11-42%</td>
<td>8-02%</td>
</tr>
<tr>
<td>&gt; 0-062 mm.</td>
<td>81-65%</td>
<td>59-09%</td>
<td>33-20%</td>
<td>72-10%</td>
<td>72-37%</td>
<td>69-10%</td>
<td>55-80%</td>
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<tr>
<td>&lt; 0-062 mm.</td>
<td>12-10%</td>
<td>14-51%</td>
<td>1-87%</td>
<td>11-18%</td>
<td>18-08%</td>
<td>13-58%</td>
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<tr>
<td>Total</td>
<td>99-94%</td>
<td>99-99%</td>
<td>99-97%</td>
<td>99-96%</td>
<td>99-99%</td>
<td>98-53%</td>
<td>100-00%</td>
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Deposit H—"Estuarine Clay."

The "Estuarine Clay" is actually a deposit of calcium carbonate with 30-40 % of angular and subangular grains of fine quartz sand (< 0.250 mm.), and not more than 5 % of clay and silt particles of other minerals. In this matrix are occasional basalt boulders, pebbles (1.5 cm. to 3 cm. in diameter) of limestone, and small (< 1.5 cm.) rounded pebbles. There is approximately 8 % of light mineral and dark mineral rock fragments in the > 0.062 mm. and < 0.062 grades. The smaller size-grades contain fragments of Zostera.1 Recognizable fragments of mollusc shells are abundant in the larger size-grades, and such shells were undoubtedly the source for at least the greater part of the calcium carbonate component of the marl.

The histogram for Sample 22 shows > 0.062 mm. (53.36 %) as the primary maximum grade, with < 0.062 mm. (31.61 %) as a secondary maximum grade. The percentages decrease quite uniformly from 7.53 % in the > 0.250 mm. grade to 0.46 % in the > 2.00 mm. grade. The two larger size-grades are composed largely of recognizable fragments of mollusc shells; the > 0.50 mm. and > 0.250 mm. grades are made up almost entirely of lumps of finely divided calcium carbonate2 with only a small percentage of recognizable shell fragments. The > 0.062 mm. grade is of nearly equal parts of fine sand and lumps of calcium carbonate with a small percentage of light mineral and dark mineral rock fragments, and the < 0.062 mm. grade is composed mainly of quartz (70 %) with small amounts of light mineral rock fragments (15 %) in silt and clay grades. This arrangement indicates two sources for the sedimentary materials; the calcium carbonate from the gradual pulverization of the mollusc shells, and the quartz sand with associated rock fragments from a beach or other nearby.

1 Zostera, eel-grass or sea-wrack, is a marine vascular plant (Naiadaceae) which grows totally submerged on sandy or muddy bottoms in shoal waters.
2 The particles of calcium carbonate are nearly all larger than 0.062 mm. and are partially consolidated into these lumps. Therefore, although the histogram does not present an entirely accurate picture, it would have had less meaning if these natural lumps had been broken apart by strong crushing.
Fig. 20—Histograms of the Mechanical Analyses showing the Percentage Composition according to Size Grades.
land source. Such deposition could take place only in water of several fathoms in depth, because this is a "quiet water" type of sediment formed where there was a continual slow oscillation of the water near the bottom to effect the pulverization of the shells, and where there was a general bottom current ("undertow") toward the deeper water to carry the sandy components from the land. The presence of abundant fragments of *Zostera* in this horizon may indicate that the deposition took place in shallow water (1 to 2 fathoms), but the fragments may have been transported from a shallower portion nearer the shore. It is possible to infer that this locality was sheltered to a certain degree during the deposition. There is enough silt and clay present to indicate that the water in which this sediment was laid down was fairly quiet at least part of the time.

Approximately 5% of glauconite was found in the < 0.062 mm. grade, doubtless derived from the local deposits of glauconitic sandstone on the coast immediately north of Larne. The occasional basalt boulders and various pebbles found throughout the deposit probably came from the boulder clay ridge, shown on Pl. IX and described by Praeger (see Coffey and Praeger, 1904, p. 168); originally, they may have been derived from the trap rock series of the Antrim Plateau. There are no very obvious indications of the agency of deposition for these boulders. It may have been that the whole assortment of material in portions of the boulder clay ridge entered into the composition of the "Estuarine Clay." Tidal currents and waves of oscillation and translation on the bottom could have distributed the underwater portion of the boulder clay ridge contemporaneously with the deposition of the calcareous material in the "Estuarine Clay." The importance of the boulder clay ridge in the formation of Curran Point is discussed on page 34 of this paper.

The occurrence of layers of high sand concentration at intervals up through the bed (see p. 21 of Dr. Movius' report) may be related to periods of strong seaward bottom currents. Samples of this more sandy material could not be obtained for analysis. The decrease in general concentration of sand as the upper levels of this bed are reached seems to indicate that the water was becoming quieter, perhaps due to becoming more sheltered by a spit or other shore feature.

Sample 21 was taken just below the top of the "Estuarine Clay." The histogram shows clearly that the sorting of particles was much poorer in these upper levels. The calcium carbonate is still in greatest quantity, but the quantity of other minerals in the silt grade has increased to nearly 8%. Recognizable shell fragments are quite common, and the fragments of *Zostera* are more abundant. An increase in the deposition of sand also took place in these uppermost levels of the "Estuarine Clay." These features indicate deposition in shallower water, perhaps even less than one fathom below tide level.

**Deposit G—Dark Blue Sand.**

This bed is similar to the "Estuarine Clay" with regard to constituent materials, but the percentage composition of these constituents shows a definite change. The Dark Blue Sand contains principally micaceous sand, shell frag-
ments, and shell marl with other minerals amounting to 10 - 25 % in the < 0.062 mm. grade. Inclusions of cobbles and pebbles are rare. The clay mineral content is greater in the Dark Blue Sand than in the "Estuarine Clay" (5 - 20 % in the < 0.062 mm. grade), but apparently decreases toward the upper levels of the deposit. The quartz sand content also is greater in the Dark Blue Sand (average for > 0.062 mm. and < 0.062 mm, grades = 65 %) than in the "Estuarine Clay" (average for > 0.062 mm. and < 0.062 mm. grades = 50 %), but the proportion of quartz sand increases toward the upper levels. The histograms for Samples 18 and 19 show that the sorting in the upper two-thirds of the bed is better than in the "Estuarine Clay."

The greater sand content of this bed, as compared with Deposit H, indicates that Deposit G was laid down in shallower water, and the increase in sand content toward the upper levels may indicate a relative emergence. The higher percentage of clay in Deposit G suggests still more quiet water, but this fine material may have been held by a heavy growth of Zostera on the bottom, as fragments of Zostera are abundant in this bed. The decrease in clay toward the upper levels of the bed is another indication that the then-existing strandline was approaching the vicinity of the site.

The histograms for Samples 20, 19 and 18 indicate that there is progressively better sorting toward the upper levels of the bed. Sample 20 from the lower third of the bed shows again the same kind of size-grade distribution that occurred in Sample 22 from the "Estuarine Clay." Sample 21, from the uppermost "Estuarine Clay," is an example of very poor sorting. Therefore it is plain that some disturbing conditions, such as changes in the force or direction of tidal currents, left the top of the "Estuarine Clay" unsorted (or, perhaps, reworked); then (at the level of Sample 20) a sorting process similar to the original type (as in Sample 22) was restored, but with the deposition of sand in a greater proportion. It is evident that there was a change in the currents at the time the Dark Blue Sand was deposited, because this bed has a slight dip to the south-west, whereas all the other deposits at the site dip in varying degrees to the south. The upper two-thirds of the Dark Blue Sand (Samples 19 and 18) shows good sorting, with a tendency for the percentage of material in the size-grades greater than 0.250 mm. to be greatly reduced.

There is evidence, then, that Deposit G was laid down in quiet water, probably protected by some shore feature, and in water not more than one fathom in depth. There is evidence also that a relative emergence of this portion of the coast was taking place during the deposition of this bed.

Deposit F—Fine Reddish-Brown Sand.

Deposit F is a thin bed of light brown sandy sediment lying unconformably upon Deposit G. In Sample 17, the only sample from this deposit, the > 0.062 mm. grade (72.10 %) is the primary maximum grade; the > 0.250 mm. grade (13.68 %), the secondary maximum, with the < 0.062 mm. grade (11.18 %) nearly as great. Angular quartz sand is the most abundant con-
stituent; 80% in the < 0.62 mm. grade, 70% in the > 0.62 mm. grade and 30% in the > 0.250 mm. grade. Shell fragments are abundant in all of the size-grades. The sediment is slightly consolidated due to the large amount of calcium carbonate from shells. The percentage of other light mineral and dark mineral rock particles taken together range from 5% to 15% with light mineral constituents in the greater abundance in each grade; all of these particles are considerably weathered. Silt and clay sizes are present only in very small amounts. Traces of limonite are found on some of the pebbles in the > 0.50 mm. grade, and a very small amount of limonite in the form of flakes occurs in the < 0.062 mm. grade.

The sorting of material in Deposit F is slightly different from that of Deposits H and G; the primary maximum grade is just as strongly in the > 0.062 mm. size-grade, but the < 0.062 mm. size-grade has less material in it, while the > 0.250 mm. size-grade contains somewhat more material. Probably the deposition took place in quiet shallow water where there was a constant oscillatory washing movement of the water near the bottom, and a gentle but steady sea-ward current.

There is no true marl in Deposit F despite the abundance of shell fragments. This would indicate somewhat stronger movement of the water than was the case for the formation of Deposits H and G. The presence of quartz sand in the > 1.00 mm. grade (20%) and the > 0.50 mm. grade (5%), and the occurrence of a considerable amount of other light mineral and dark mineral rock particles in all the size-grades, demonstrates that the beach source was closer or the transporting agents stronger than during the deposition of the two preceding beds. The light mineral and dark mineral rock particles are generally subangular and considerably weathered by chemical agents as they might have become on an exposed beach. That the water was not as quiet as during the sedimentation of the two underlying beds is indicated also by the very small amount of silt and clay. The traces of limonite could have resulted from subaerial oxidation of iron compounds from the light mineral and dark mineral rocks; but this could have occurred after as well as during deposition.

Deposit E—Hard Grey Sand.

This deposit is a compacted, grey, medium to fine sand. In Sample 16 quartz sand comprises more than 50% of the total sediment. It consists primarily of the rounded sand grains typical of beach deposits—60% of the > 0.250 mm. grade, 20% of the > 0.50 mm. grade, and 15% of the > 1.00 mm. grade. Micaceous sand and silt, more characteristic of quiet water deposition (60% of both the > 0.062 mm. and < 0.062 mm. grades), also occurs in this sediment. Pebbles of both light mineral rocks and dark mineral rocks are frequent; they are subangular to rounded, and often pitted as the result of collision with other pebbles. These pebbles show the form which results from mechanical weathering on a stony beach, rather than chemical weathering. Dr. Movius estimated in the field that in places approximately 25% of the
sediment is composed of shells, but Sample 16 contained only a very small percentage of shell fragments. Pieces of a fine-textured limestone are present in all the size-grades except the $< 0.062$ mm. grade; these pieces are not chemically weathered to any great extent. A ferruginous stain covers nearly all the grains in the $> 0.250$ mm. grade, and there are some flakes of limonite in the $< 0.062$ mm. grade. This limonite tends to cement some of the particles together and is partly responsible for the firmness of the sediment. The grey colour of the sediment is due to the presence of dark mineral and limestone particles. The grain-size distribution profile shows poorer sorting than in Deposit F. This profile indicates the influence of tidal beach and shallow water foreshore types of sorting.

Deposit E is composed of material derived from upper beach and lower beach sediments, and it was deposited in sheltered or fairly quiet water. At the time of its accumulation this sediment was probably exposed at low water.

Deposit D—Fine Reddish-Brown Sand.

There is 60-80% of $> 0.062$ mm. grade particles in Deposit D (Samples 14 and 15); quartz sand, shell fragments, and light mineral rock fragments are the dominant materials. Pebbles, 1.5 cm. to 3 cm. in diameter, and boulders occur in small numbers in the bed. Shells and fragments of shells are extremely abundant. The proportion of silt and clay sizes in the sediment decreases toward the upper levels, and some of this fine material occurs in lenses. The vegetable debris observed by Dr. Movius (cf. p. 24) and distribution of silt and clay indicate that Deposit D was laid down in moderately quiet water, probably just above low-tide mark, and that the material in the upper levels was laid down farther above low-tide mark. Deposit D is 55 cm. in thickness, and a 55 cm. rise due to accumulation of sediment may have been sufficient to cause the change in the proportion of materials deposited.

The histogram for Sample 15 shows poorer sorting than the histogram for Sample 14, but this feature is due to an error difficult to avoid. Actually 90-95% of the larger size-grades of Sample 15 is composed of smaller size particles cemented together by calcium carbonate from shells. Crushing these aggregate particles or loosening the cement with water would have caused errors in other size-grades of the sample, so the microscopic examination was relied upon to correct the profile of sorting. Sample 15 actually possesses sorting of the same general type of Sample 14. The improvement of sorting here over that of Sample 16 may have been due to fewer storms and less rain wash from the shore, or to the fact that the locality was at this time more sheltered by gravel bars or other off-shore features, causing the agents of sorting (wave action and tidal currents) to be gentler and more uniform.

Further evidence that Deposit D was formed by an accumulation of the lower part of a tidal beach is shown by the lenses of plant debris. That the

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1 No samples for sediment analysis were taken from these lenses of silt and clay.
2 See (Mrs.) Nora Fisher MacMillan’s report on the Mollusca from this site, p. 141.
sediments were exposed to the atmosphere part of the time is indicated by the decomposed state of this debris and the presence of limonite. The increase in limonite in the upper levels of the bed may indicate decreased exposure to the atmosphere (increase of depth of a standing water at low-tide), an indication that the low-tide mark was beginning to approach again this particular area.

Deposit C—Inclined Beds of Coarse Gravel and Sand.

Deposit C represents the period of deposition during which this submerged gravel spit was being built upward and outward into the general form now possessed by Curran Point. The lowest levels rest unconformably on Deposit D—evidence of an abrupt change in sedimentation. All the beds of this deposit dip toward the south at an angle of 8°-10°; the excavation exposed the south-west slope of the spit.

Layer (l): coarse gravel in a matrix of sand. The histogram for Sample 13 emphasizes the poor sorting in this stratum, for the primary maximum is in the > 2-00 mm. grade, and the secondary maximum is in the > 0-062 mm. grade. This type of sorting indicates the possibility that the components of layer (l) are reworked materials from Deposit D (> 0-062 mm. grade) and new materials from the upper beach region (> 2-00 mm. grade). The > 2-00 mm. grade is composed of both light mineral and dark mineral rocks (60 %), many of them rounded, pitted, and weathered; limestone (20 %); and numerous abraded shell fragments. This assortment suggests that the material was derived from the upper beach region. The composition of the > 0-062 mm. grade is similar to that of Deposit D: angular quartz sand (40 %); light mineral rocks (30 %), rotten and generally bearing ferruginous stains. The ferruginous staining probably was derived from the decomposition of dark mineral rocks (Antrim Plateau basalt ?), and indicates slow deposition and subaerial oxidation, or the deposition of previously worked materials. Sorting of the sediment and rotten character of particles suggest that layer (l) was accumulated at a lower level on the beach than was Deposit D, and it seems to mark the beginning of a period of submergence (a rise in sea-level relative to the land).

Layers (k) and (j): no samples for analysis were taken from these horizons.

Layer (i): well-sorted sand with many rounded pebbles. The histogram for Sample 12 shows good sorting with the primary maximum in the > 2-00 mm. grade (92-99 %); the secondary maximum is in the > 0-062 mm. grade (3-60 %). Included shell fragments, which are rare, are strongly abraded and chemically weathered, but the quartz particles, however, show little mechanical weathering. This condition implies that the quartz sand was not formerly a part of the upper beach sediments; possibly these materials accumulated at a lower level on the margin of the growing spit than layer (l) or were swept up from such a deposit.

Layer (k): fine grey sand. The histogram for Sample 11 shows a profile of very good sorting with the primary maximum in the > 0-062 mm. grade (89-73 %). This type of sorting, linked with the scarcity of material larger than 2-00 mm., indicates that this lens of sand is the deposit of an intertidal depression.
The quartz sand grains and light mineral rock grains are generally angular—further evidence of quiet water deposition of material which had been mechanically worked on upper beach levels or on other parts of the spit. Dark mineral rock grains and limonite are very rare; small particles of dark mineral rocks are generally disintegrated by weathering before they reach lower beach deposits.

Layer (g): fine gravelly sand with many rounded pebbles. The histogram for Sample 10 also shows good sorting—the primary maximum is well in the the > 2.00 mm. grade (81.81 %), and the secondary maximum falls in the > 0.062 mm. grade (7.74 %). In the > 2.00 mm. grade, dark mineral rocks constitute 40 %, limestone 20 %, and light mineral rocks 10 % of the total composition. The dark mineral rocks are generally subangular with some pieces deeply decayed. Both the light and dark mineral rocks bear pitted surfaces characteristic of vigorous mechanical working. A few greatly worn and deeply rotted shell fragments occur. The > 0.062 mm. secondary maximum (cf. Sample 13) shows the influence of outer margin deposition still present at this horizon.

Layers (f) and (f1): coarse gravel and sand. In the histogram for Sample 8 the primary maximum (51.68 %) is in the > 2.00 mm. grade and the secondary maximum (23.53 %) in the > 0.062 mm. grade. The profile of sorting shows distinctly two modes of deposition—the large material: upper beach type of sorting, and the fine material: lower beach type. The part of the stratum from which this sample was taken was probably deposited on an intertidal beach. The histogram for Sample 9 [which was taken from layer (f1)—the same stratum but corresponding to a higher level on the beach] shows good sorting, with the primary maximum (85.09 %) in the > 2.00 mm. grade and the secondary maximum (8.86 %) in the > 1.00 mm. grade. This material was deposited near high-tide mark and was under water very little.

The rocks of Sample 8 are predominantly dark mineral rocks, of which much is basalt. Many of the larger pieces show polishing from rolling and pitting from collision. From the appearance of the finer materials it is evident that both mechanical and chemical weathering were vigorous. These conditions lend support to the view that the material in this deposit was derived from the mainland beach to the north. Sample 9 contains nearly all rounded particles, the result of gentler mechanical weathering. Many of the particles in this sample were blackened with oxide of manganese, but not to the great extent that pieces in Sample 3—from Layer (c1)—were stained.

Layer (e): a fine grey sand with no large pebbles. The histogram for Sample 7 has the primary maximum (58.50 %) in the > 0.062 mm. grade and the secondary maximum (21.52 %) in the > 2.00 mm. grade. The profile of sorting is characteristic of a lower beach deposit which receives some larger material from the upper beach. The > 0.062 mm. grade consists of 40 % generally angular quartz sand. Rounded and weathered particles of basalt constitute nearly half of the material in the > 2.00 mm. grade. Shell fragments were not common in this sample.
The mode of deposition represented by this horizon probably obtained over only a small portion of the area of the spit, and might have been due to the area having been temporarily sheltered by a local gravel bar or some similar feature. The relative thinness of (e) and the composition of both the underlying and overlying strata are the main reasons for ascribing a local occurrence to this layer.

Layer (d): a heterogeneous, current-bedded sand containing ferruginous stains and many small, rounded pebbles. The histogram for Sample 6 shows relatively poor sorting with the primary maximum (48-67 %) in the > 1-00 mm. grade and the secondary maximum (37-59 %) in the > 2-00 mm. grade. The histogram for Sample 5, which was taken from a lower level in the part of the stratum exposed, shows better sorting with the primary maximum (80-81 %) in the > 2-00 mm. grade and the secondary maximum (7-32 %) in the > 1-00 mm. grade. A comparison of these two samples demonstrates the variation in sorting within this stratum due to changing currents. As certain sections of the gravel spit accumulated faster than others, tidal water ran off the spit along definite depressions, the courses of which were constantly changing; hence, deposits of current-bedded sands such as (d) accumulated along the train of material already shaped into the rough form of Curran Point. Layer (d) contains pebbles of dark mineral and light mineral rocks, limestone, and chert in great abundance. Some of the pieces bear ferruginous stains.

Layers (c) and (c1): coarse gravel and sand in inclined beds, as shown on the section (Pl. VIII). The histogram for Sample 4, collected in the lower portion of layer (c), shows the poor sorting that might be found on an intertidal gravel bar. The primary maximum (45-16 %) is in the > 2-00 mm. grade and the secondary maximum (20-57 %) in the > 1-00 mm. grade; but the high percentages of finer grades demonstrate the poor sorting. Probably there was very little steady current or constant wave action. The histogram for Sample 3, on the other hand, shows fairly good sorting; the primary maximum (66-83 %) is in the > 2-00 mm. grade and the secondary maximum (23-81 %) in the > 1-00 mm. grade. That part of the stratum in which Sample 3 was collected [layer (c1)]—approximately 40 cm. above the base of layer (c) and to the north of Sample 4] was probably above high-tide mark during deposition and was reached only by the stronger waves. The small quantity of the finer grades testifies to vigorous wave action near the high-tide mark. Sample 2 was taken from the upper third of layer (c), and the histogram for this sample shows the poor sorting which would be found in an upper beach where cobbles and boulders are abundant. In the (c) stratum a progressive building up above high-tide mark is suggested by the differences in the physical composition at successively higher levels.

In Sample 4 the materials in order of their relative abundance are: quartzite, chert, limestone, light mineral and dark mineral rocks. A small amount of glauconite (possibly from larger pieces of glauconitic chalk) is present in the > 0-250 mm. and > 0-062 mm. grades. In Sample 3, basalt and other dark
mineral rocks are most abundant. Many of the pieces are well-rounded. All the particles in the \( > 2.00 \) mm. grade of Sample 3 are stained, generally on one side only, with black oxide of manganese (probably pyrolusite). Most of the dark mineral rock fragments and many of the sand grains in the \( > 1.00 \) mm. grade are blackened over all surfaces with the oxide; in the \( > 0.50 \) mm. grade, nearly all the grains are stained; and in the remaining finer grades, the oxide of manganese occurs as flakes. This oxide of manganese apparently originated as a decomposition product of certain dark mineral rocks. The manganese occurs over lens-shaped areas, a condition suggesting that the formation of the oxide of manganese took place in tidal and rain-water pools. The presence of the black stain on only one side of the large pebbles shows that the pebbles remained undisturbed for considerable periods of time. Sample 2 consists of dark mineral rocks, quartzite, light mineral rocks, and limestone. The dark mineral rocks are, for the most part, weathered to the extent of being rotten. A small percentage of glauconite is present in the finer grades, as in Sample 4.

**Deposit B—Storm Beach.**

Deposit B is typical storm beach deposit, the upper levels of which have been modified by land surface accumulation and the growth of vegetation on the spit after the surface had risen above the effective reach of the storm waves.

**Layer (b):** subangular and rounded pebbles in a matrix of coarse sand with a small amount of limonite. The histogram for Sample 1-B shows very poor sorting with the primary maximum (35.13%) in the \( > 2.00 \) mm. grade. There is a small amount (1.68%) of material in the \( < 0.062 \) mm. grade. The profile of sorting shows that the material deposited here was unselected except for the \( < 0.062 \) mm. size-grade, which was largely washed away by storm-wave action, the agent of deposition. The assemblage of rocks is similar to that of layer (c) in Deposit C, except that a greater amount of flinty chert occurs in the lower half of Deposit B.

**Layer (a):** small subangular and rounded pebbles in a matrix of fine sand and clay. The histogram for Sample 1-A again shows poor sorting with the primary maximum (34.65%) in the \( > 2.00 \) mm. grade. The secondary maximum (22.16%) is in the \( > 0.062 \) mm. grade, and it is in the centre of a well-proportioned secondary distribution curve. Much more clay and silt occur in Sample 1-A than in Sample 1-B; this is probably owing to post-deposit soil development. The remainder of the rock composition for Sample 1-A is very similar to that of layer (c) of Deposit C. The materials in Deposit B were probably derived partly from a reworking of layer (c) of Deposit C and partly from the adjacent mainland.

**Deposit A—Surface Accumulation.**

No samples for analysis were taken from this deposit.
APPENDIX III

REPORT ON THE FAUNA

By Nora Fisher McMillan

(Department of Geology, The University, Liverpool)

1. Introduction

The material collected by the Harvard Archaeological Expedition during the 1935 excavation at Curran Point has added many species to the known fauna of the various beds of gravel, sand, and Estuarine Clay at this locality. Here a general account is given of the fauna from each bed, with its ecological significance. Also a complete list is presented of all species (exclusive of the foraminifera) recorded from the Curran deposits, showing their distribution in the various beds. This includes previous records. A separate report on the foraminifera is appended to which frequent reference is made in the present paper.

2. Historical

Many archaeologists and geologists have worked on the Curran deposits, but comparatively few scientists have dealt with the fauna. As regards the molluscan fauna, Hull (1872, p. 114) listed eleven species from the gravels, to which number Grainger (1874, p. 75) added a further seventeen species. Grainger’s list was reprinted by Hull (1876, p. 35) unaltered, with the exception that “Solen pellucidus” was substituted for Grainger’s “Helcyon pellucidum.” The following year Stirrup (1877, pp. 52-54) added a further five species. Swanston (1886) listed a few common species from the gravels, and Praeger (1890) gave the first comprehensive account of the various beds which comprise the Curran. Finally the same authority (Praeger, 1896, pp. 38-41) published a complete list of the fauna of the Curran sands and gravels as then known.

The Estuarine Clay was first referred to by Gray (1879, p. 130); Swanston (1886) mentioned a few common shells from it, and Praeger (1890) listed 48 species as occurring in this deposit at Larne. The latter (Praeger, 1890-a; 1892) also recorded a number of additional species, but a subsequent examination of the Praeger Collection of Estuarine Clay fossils, now in the National Museum of Ireland, revealed that in compiling the 1892 list, species which occurred only in the underlying black sand and gravel had been included in the Estuarine Clay fauna. Such species have been ignored in this paper, as the strata underlying the Estuarine Clay were not reached during the Harvard excavations of 1935.

Regarding the foraminifera, Wright (1881) listed 68 species from the Estuarine Clay, and 60 from the sands and gravels; Praeger (1892) recorded a number of additional species from the Estuarine Clay.

Lists of other fossils from the Curran deposits are negligible. Grainger (1874) noted a boring sponge (Cliona sp.) in shells from the gravels, and Praeger (1890)
mentions Cancer remains from the Estuarine Clay and the underlying bed of black gravel.

3. **Material Collected by the Harvard Archaeological Expedition**

The material as received by me consisted of a vast number of shells from various levels throughout the section, and also large samples of unsorted sand and clay from the following horizons:

- **Deposit D—Reddish-Brown Sand:** two samples from the following depths
  - 4-25 m. (top of the deposit), and 4-80 m. (base of the deposit).
- **Deposit G—Dark Blue Sand:** two samples from the following depths:
  - 5-15 m. (top of the deposit), and 6-00 m. (base of the deposit).
- **Deposit H—Estuarine Clay:** eleven samples from the following depths below the top of the clay (6-00 m. below datum):
  - 0 cm.; 50 cm.; 1-00 m.; 1-50 m.; 2-00 m.; 2-50 m.; 3-00 m.; 3-50 m.; 4-00 m.; 4-50 m.; and 5-00 m. (The last level was the lowest reached during the course of the excavation).

None of the material was collected by me, although on September 29, 1936, I studied the section and the mode of occurrence of the shells in the various beds.

The shells (those above the size of a Littorina) were collected during the excavation of each stratum by Dr. Movius, who also saved the complete contents of a number of "pockets" of shells which occurred in the Reddish-Brown Sand. These latter samples were merely washed through three sieves of graduated fineness of mesh, and then dried. But the Dark Blue Sand and the Estuarine Clay samples, which were dug out in a wet condition, had to be slowly and completely dried, and then soaked in water for about 48 hours before it was possible to wash them through the sieves. In some cases the process had to be repeated two or even three times to free the shells thoroughly from the clay. The residues were then dried slowly and carefully examined; the finest grades of this material were then floated for foraminifera and ostracoda.

During the examination of the material, representatives of several other phyla, in addition to mollusca, were noted. In the identification of these specimens I have been fortunate in obtaining the help of several experts, and my best thanks are due to the following for their assistance: Dr. M. Burton (Porifera), Mr. A. Earland (Foraminifera), Dr. Anna B. Hastings (Polyzoa), Mr. R. R. MacDonald (Crustacea: Ostracoda and Decapoda), Mr. C. C. A. Monro (Annelida), and Dr. H. B. Moore (Crustacea: Cirripedia). Mr. F. Taylor kindly named the two land-shells obtained, and to Mr. R. Winckworth I am greatly indebted for much help with the critical species of mollusca. I am, likewise, very grateful to my colleague, Dr. D. E. Owen, F.G.S., for his most generous help during the writing of this report.

Some of the shells obtained from the Dark Blue Sand and the Estuarine Clay bore encrusting calcareous algae, and through the kind co-operation of Dr. Helen Blackler these were submitted to Mme. P. Lemoine, whose most interesting report appears separately.
The total fauna of the Curran beds, as far as it is known at present, comprises 297 species and varieties, made up as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>Species</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foraminifera</td>
<td>131</td>
<td>297</td>
</tr>
<tr>
<td>Porifera</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Annelida</td>
<td>3</td>
<td>(at least)</td>
</tr>
<tr>
<td>Ostracoda</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Cirripedia</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Decapoda</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Gastropoda</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Lamellibranchia</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Polyzoa</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Echinoidea</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Pisces</td>
<td>76</td>
<td>tooth and otolith</td>
</tr>
</tbody>
</table>

4. Nomenclature and Arrangement

The nomenclature and arrangement of the species recorded in this report follow generally those of the Plymouth Marine Fauna, 2nd ed., 1931, except in the case of the marine mollusca which follow Winckworth's 1932 list (Journ. Conch. XIX [1932] pp. 217-252; 334-338; XX, pp. 9-15; 51-53). The few land and fresh-water mollusca obtained have been named according to Kennard and Woodward's Synonymy of the British Non-Marine Mollusca, published in 1926.

5. Description of Deposits in Ascending Order

A complete list of all the material collected during the 1935 excavations is given on pp. 149-151; only pertinent comments on the assemblages from each horizon are included here.

Deposit H—Estuarine Clay, 6-00 m.-11-10 m. (base not reached).

The Estuarine Clay, which was full of Zostera remains and shells, was the lowest stratum exposed during the 1935 excavations (compare Pl. VIII). It was penetrated by boring to a depth of 5-00 m. without reaching the underlying strata, although it became much sandier towards the lower levels. The samples examined from depths of 3-00 m. to 5-00 m. (below the top of the clay) were very much smaller in bulk than those from the upper part, hence comparison of the relative abundance of their included shells is not very satisfactory.

The clay yielded an abundant and varied fauna: 81 species of mollusca and 78 of foraminifera were obtained, as well as 5 species of polyzoa, 2 echinoderms, tubes and borings of at least three species of polychaete worms, crab remains, 5 species of ostracoda, sponge-spicules, and a teleostean fish-tooth. Four species of encrusted calcareous algae occurred on the shells (see separate report by
Mme. Lemoine) and Zostera ( ? marina) was generally distributed throughout. The latter was fairly abundant in the upper part of the deposit, but in the 4-00 m., 4-50 m., and 5-00 m. samples it was scarce. This is also indirectly shown by the distribution of the mollusca: those species which live mainly on Zostera (Lacuna vincta in particular) become very rare or absent in the material from the lowest levels. On the other hand, Skeneopsis, Omalogyra atomus, and Turtonia are all common in the lower levels, whereas these two gastropods are rare in the upper portion of the deposit. Perhaps this may be correlated with the greater sandiness of the clay contained in the samples from depths of 4-00 m., 4-50 m. and 5-00 m., respectively. Material from these levels included greatly increased quantities of quartz-grains as compared with the amount of this material yielded by samples from the top of the clay.

Levels 0-2-00 m. below the top of the clay contained the following species in abundance: Gibbula cineraria, Lacuna vincta, L. pallidula, Cingula semicostata, and Abra alba. This faunule is characteristic of a Zostera-bed, the gastropods living on the leaves and stems, and Abra burrowing in the muddy ground.

On the basis of the shells, the Estuarine Clay was accumulated in shallow water ranging in depth between L.W.O.S.T.1 and perhaps 2 or 3 fathoms. The absence of Macoma balthica and Scrobicularia plana shows that the deposit is not littoral, but it is much more difficult to estimate the probable lower limit of range. In suggesting about 3 fathoms as the maximum depth of water in which the upper levels (0 m.-3-50 m.) of the clay were laid down, I am influenced by the abundance of Zostera. To Prof. T. G. Tutin, who has made a special study of the biology of the British species of Zostera, I am indebted for the information that Z. marina occurs to a depth of 2 to 3 fathoms at L.W.O.S.T., although its usual range in British waters is from L.W.O.S.T. down to 1 to 2 fathoms. Neither of the other British species of Zostera range as far down the shore as does Z. marina.

There is not sufficient material from the lower levels (4-00 m., 4-50 m., and 5-00 m.) upon which to base any definite conclusions regarding the depth of water at the time of deposition.

Rissoa albella and Rissoa parva are in almost equal numbers throughout, an unusual occurrence in the Estuarine Clay of North-east Ireland (compare Praeger, 1892, p. 260).

The facies of the molluscan fauna of the Estuarine Clay (Deposit H) of the Curran is slightly more southern than that of the present time. This is demonstrated more by the absence of such northern genera as Fusus, Trophon, Astarte and Cyprina, than by the presence of any markedly “warm” species comparable with the Mediterranean foraminifera obtained by Mr. Earland. But this evidence is inconclusive and I agree with Dr. Praeger (1892, p. 215) that insofar as the shells are concerned “The Estuarine Clay fauna differs to no material extent from that now existing within a short distance.”

1 L.W.O.S.T. = Low Water Ordinary Spring Tides.
The foraminifera, however, provide more definite proof of a warmer climate during the deposition of the Estuarine Clay (see p. 156 of the Foraminifera Report); Mme. Lemoine's report on the calcareous algae also indicates that a warmer climate prevailed during the period represented by the Estuarine Clay.

Deposit G—Dark Blue Sand, 5.15 m.-6.00 m.

The Dark Blue Sand yielded an abundance of shells, many in situ; a total of 64 species were obtained from it. *Gibbula cineraria*, *Lacuna vincta*, *Cingula semicostata*, *Rissoa membranacea*, *Retusa alba*, and *Abra alba* were all common species. The fauna indicates shallow water, probably between L.W.O.S.T. and a fathom or so in depth, with a bottom of muddy sand. *Zostera* was abundant, a fact which also suggests deposition in shallow water.

It is interesting to note the rapidity with which *Rissoa albella* seems to have dwindled in numbers once the Post-Glacial climatic optimum had been passed. In the deposit now under discussion it is represented only by four specimens from the base of the bed, where, in addition, more than a score of *Rissoa sarsii* specimens occurred. Dr. Praeger (1892, p. 260) says of this species "var. *sarsii*: occurs with the species [*R. albella* of which *R. sarsii* was formerly considered a variety] at a number of stations, but is less abundant. Its recent distribution is directly the reverse of this." Hence its occurrence in the Dark Blue Sand agrees with its recent distribution rather than with that of Estuarine Clay times. *Rissoa parva* is moderately plentiful throughout the bed; a total of some thirty specimens were obtained, and in the upper part it quite replaces *R. albella*.

The evidence of the shells shows that the climate during the deposition of the Dark Blue Sand (Deposit G) was warmer than at present, but that the Post-Glacial warmth maximum had passed and a gradual deterioration of the climate had set in. This is confirmed by the foraminiferal fauna (see p. 157 of the Foraminifera Report) of 68 species.

This Dark Blue Sand appears to be the same as the "Black Sand" (Bed F) of the Second Larne Gravels Committee's Report (Praeger, 1890, p. 203). No separate list of species is given there, but *Paphia aurea* and *Cardium exiguum* are mentioned as characteristic species.

Deposit F—Fine Reddish-Brown Sand, 5.00 m.-5.15 m.

This deposit contained an assortment of worn shells, some contemporaneous with the deposition and others probably derived from Deposit G. The same assemblage also occurred in Deposit D, a second horizon of Fine Reddish-Brown Sand, from which the lower stratum was separated by a thin bed of Hard Grey Sand (Deposit E) containing an abundance of *Ensis (Solen) siliqua* (L.) in situ and in their natural upright position (cf. Pl. II, Fig. 2). This indicates that the Fine Reddish-Brown Sand (Deposit F) was probably laid down a little below low-water level. The *Solen*-bed (Deposit E) determines the probable depth of water in which this 15 cm. of Fine Reddish-Brown Sand was deposited, as discussed in the next paragraph.
Deposit E—Hard Grey Sand, 4·80 m.-5·00 m. (Solen-bed).

This layer contained many complete specimens of Ensis (Solen) siliqua and Phacoides borealis, with ligament and epidermis (periostracum) intact. The former were in their natural upright position, according to Dr. Movius, and evidently in situ. Ensis siliqua finds its optimum conditions in that zone of shore exposed only by L.W.O.S.T., nor does it range into deeper water. Therefore its abundance in this deposit indicates a sandbank at L.W.O.S.T., a habitat which is also suitable for Phacoides borealis.

All the Phacoides were full-sized, contrasting with the small examples so abundant in the overlying Fine Reddish-Brown Sand (Deposit D), and in the gravels of Deposit C. Other mollusca (7 species) are represented only by insignificant fragments, or single, worn specimens. The fact that Ensis siliqua is the only solenid present demonstrates that the Hard Grey Sand was laid down after the climatic optimum had been passed, since during the period of maximum warmth, Solen marginatus Mont. was the dominant species, whereas Ensis siliqua was absent (Praeger, 1892, p. 255). That the replacement of Solen marginatus by Ensis siliqua was not merely due to changes in the nature of the ground in which the Solenids burrow is shown by the fact that at present both species inhabit the same kind of ground, and in some places live together, according to information received from Mr. Winckworth.

The foraminifera (34 species) also indicate a climate similar to that of the present time. Many of them, however, are probably derived fossils from contemporaneous and older deposits in the neighbourhood (see p. 155) of the Foraminifera Report.

Deposit D—Fine Reddish-Brown Sand, 4·25 m.-4·80 m.

The overlying deposit was full of worn shells and small pebbles of local derivation. It represents a beach-deposit, and very few of the shells in it are in situ.

That this sand was laid down between tide-marks is shown by the presence of a small boulder bearing a few complete examples of Balanus balanoides (L.) in situ. This was found at a depth of 4·35 m. in the deposit. Referring to this barnacle, Moore (1935, p. 283) states: “This species definitely requires these intertidal conditions, since it is not normally found below the level of low-water . . .”, and again: “in more sheltered localities, where low water conditions are definitely disadvantageous to all but the youngest barnacles.” It may be argued that the boulder could have been washed from its original level either into deeper water or higher up the shore, but the fresh condition of the barnacles seems to rule out this suggestion, and supports the view that the boulder was lying at its original level. Consequently, Deposit D may be considered a littoral accumulation of sand containing Balanus balanoides.

A total of 79 species of mollusca was obtained, the most abundant being Gibbula cineraria, Larcana vincula, L. pallidula, Cingula semicostata, and Phacoides borealis. The last-mentioned species was very plentiful throughout—single
valves about \( \frac{1}{2} \) in diameter being far more abundant than full-sized valves, and outnumbering them by more than twenty to one. Six complete specimens occurred at the base of the bed. These may have been in situ, as this species is abundant in situ in the underlying Hard Grey Sand. Assuming that the Phacoides were still in the position in which they lived and died, it is possible to place the lower part of the Fine reddish-brown sand (Deposit D) at a level on the shore somewhere about the low-tide mark. This is in accordance with my observations at the excavation, where Deposit D was seen to merge imperceptibly with the underlying Hard Grey Sand (Deposit E), a stratum which was certainly laid down at L.W.O.S.T., as discussed above.

The occurrence of Rissoa parva in some quantity in Deposit D, and the complete absence of Rissoa alibella is of special interest. This indicates a cooler climate than that which obtained during the deposition of the Estuarine Clay (Deposit H). Rissoa alibella is an abundant and highly characteristic species of the Estuarine Clays of Northern Ireland. In these deposits R. parva is very rare, whereas the reverse holds true to-day. The presence of the northern shell, Crenella decussata, also suggests a cool climate.

The evidence of the foraminifera confirms that of the shells, since the Fine reddish-brown sand (Deposit D) yielded a "typical cool-water fauna" consisting of 32 species (see p. 156 of the Foraminifera Report).

Deposit C—Inclined Beds of Coarse Gravel and Sand (Raised Beach) 1-30 m.-4.25 m.

In the so-called "Raised Beach" fossils were fairly plentiful—a miscellaneous assortment of species being present, many probably derived from waters outside Larne Lough. The gastropods are all worn, and the lamellibranchs are represented by single valves only. None appeared to be in situ. A few examples of the barnacle, Balanus balanoides, in fairly fresh condition were noted in situ on two small boulders from sand near the base of the deposit (at depths of 3.75 m.-4.00 m. and 4.00 m.-4.25 m. respectively). This barnacle is a strictly littoral species, as stated above, which does not range below the level of low water. A few barnacle fragments also occurred at the base of the gravels, and these have been identified by Dr. H. B. Moore as "probably Balanus balanoides."

Paphia aurea, Tellina squallida, T. donacina, and Solecurtus chamasolen are the most noteworthy of the 54 species of mollusca obtained from Deposit C. Small valves of Phacoides borealis about \( \frac{1}{2} \) in diameter were very abundant, especially near the base of the deposit, but full-sized valves were very rare. Only about a dozen of the latter were noted, while the small ones occurred in hundreds. This predominance of small specimens has already been commented on by Dr. Praeger (1892, p. 250) with reference to its occurrence in the Estuarine Clay, but I do not think that a similar state of affairs in a later deposit has been observed heretofore.
The climate during the time these gravels were accumulating was probably very similar to that of the present time; there is no evidence that a warmer climate prevailed during the time of deposition.

Deposit B—Storm Beach, 40 cm.-1.30 m.

The fauna of this bed consists of 15 species of shells from Deposit C mixed with later forms from the comparatively recent Storm Beach (Deposit B). *Patella vulgata, Gibbula cineraria, Littorina littorea, L. saxatilis, and L. littoralis* predominated, all of which are common littoral molluscs. This fauna differs in no essential respect from that of the present day, and it demonstrates that the beach was formed close to the level of high water.

Deposit A—Surface Accumulation, 0-40 cm.

This deposit, which has been disturbed, yielded a total of 29 species, all occurring as recent forms in North-eastern Ireland. The predominating species were all common littoral forms: *Littorina littoralis, Patella vulgata, Gibbula cineraria, Littorina littorea*, and *L. saxatilis*. Of these the first species was by far the most abundant, and the specimens were very large.

6. **Comparisons of the Curran Fauna with Other Post-Glacial and Recent Faunas from the Vicinity of Larne**

In the vicinity of Larne two assemblages of fauna, one from Island Magee (Post-Glacial) and the other from Larne Lough (Recent) are available for comparative purposes.

(a) **Comparison with the Fauna from the Island Magee Section Investigated by Burchell.**

Island Magee is a long peninsula separating Larne Lough from the open sea, which is connected to the mainland by a narrow neck of land at the south end. The section investigated by Burchell (1934) lies on the west side of Island Magee, less than a mile from the Curran site (see Fig. 2, p. 18), but the sequence of deposits is rather different. The Island Magee sequence is as follows:

A—Raised Beach gravels.
B—Black Sand.
C—Estuarine Clay *(Sample 3).*
   **Note**—This is called Deposit A by Prof. Jessen *(cf. p. 115).*
D—Black Sand.
E—Subangular Black Gravel and Sand.
F—Black Sand *(Sample 2).*
G—Subangular Black Gravel and Sand *(Sample 1).*
H—Old Land Surface.
I—Boulder Clay.
The total thickness of the Deposits B to G inclusive overlying the old land surface was 10 ft.; the base of the Estuarine Clay was 18 ins. below low-water level. No other measurements are given by Burchell.

Unfortunately, samples from all these deposits were not preserved, and only the mollusca and foraminifera of three strata are discussed by Mr. Baden-Powell in his report (Baden-Powell, 1937). The most noteworthy absentee from the Island Magee clay (Sample 3), as compared with that of the Curran (Deposit H), is *Rissoa albella*. This small gastropod is "one of the most characteristic Estuarine Clay Rissoae, occurring generally in profusion in almost every deposit" (Praeger, 1892, p. 260). It occurs at Curran Point, but is apparently absent in the Island Magee deposits on the opposite side of Larne Lough. Forty-eight other Curran Estuarine Clay species are not recorded from Island Magee in Sample 3, but the greater thickness of the Curran clay probably accounts for this. Four species of mollusca occurred at Island Magee in Sample 3 which have not yet been obtained in the Curran Estuarine Clay: *Modiolaria* cf. *costulata* (Risso), *Axinus* cf. *ferruginea* (Winckworth), *Circe minima* (Mont.), and *Saxicavella jeffreysi* (Winckworth). All were rare, with the exception of the last-mentioned species which is described as "common." *Saxicavella jeffreysi* has a wide present-day range from Norway to Algiers. Thus its occurrence at Island Magee unfortunately has no particular significance as to climatic conditions at the time this deposit was accumulated.

In both the Island Magee and Curran deposits of Estuarine Clay the fauna suggests about the same depth of water at the time of deposition, probably a maximum depth of about 3 fathoms.

No comparison as regards the fauna of Samples 1 and 2 (Black Gravel and Black Sand) from Island Magee with that of the Curran (Harvard site) is possible, for the base of the Estuarine Clay (Deposit H) was not reached during the 1935 excavation. But it may be remarked that during the Belfast Naturalists' Field Club's work on the Curran in 1886-89 similar beds of black sand and one of black gravel were found to underlie the Estuarine Clay (Section B on Pl. IX) as at Island Magee (Praeger, 1890). In the lowest level of the black gravel a few hazel-nuts were found, which suggests that a land-surface may underlie the gravel, although the base of this deposit was not reached.

With reference to the foraminifera from Island Magee, Mr. W. A. Macfadyen (see report in Baden-Powell, 1937) states "as regards climatic indication, the Island Magee foraminifera do not appear to show any difference from present-day conditions," and he does not record any of the "warm" species obtained by Mr. Earland in the Curran material (e.g., *Nubecularia lucifuga*, *Miliolina pulchella*, and *Miliolina disparilis*).

(b) *Comparison with the Recent Fauna of Larne Lough.*

The molluscan fauna of Larne Lough, as at present known, comprises 48 species of shelled molluscs, 39 of which occur in the Curran deposits. The 95 additional species, found in the Curran beds, have not yet been recorded from
the Lough. The worn condition of a number of species obtained from the Reddish-Brown Sand (Deposit D) and the Raised Beach gravels (Deposit C), which do not now live in the Lough, strongly suggests that they have been washed in from deeper and less muddy waters lying outside. None suggests a warmer climate than that now prevailing in the district, and all probably live in the immediate neighbourhood.

On the other hand the molluscan fauna from the Dark Blue Sand (Deposit G) and the Estuarine Clay (Deposit H) approximates that now living in the Lough (compare Hyndman, 1858, p. 285), speaking generally. Many of the 52 species, known from the Estuarine Clay and not recorded from the Lough as recent forms, probably occur there, but have not yet been looked for. There are some exceptions, however; a notable one is *Rissoa albella*, now absent on the coasts of North-eastern Ireland, but occurring in abundance in the Estuarine Clay at the Curran and elsewhere. It is also present in the lower part of the Dark Blue Sand, but is replaced by *Rissoa parva* in the upper part of the latter deposit.

On the whole, a comparison of the present fauna of the Lough with that of the Curran beds is unsatisfactory. For a large proportion of the shells found in the Curran sands and gravels were certainly derived from grounds outside the Lough, whence dead shells and single valves were washed on to the Curran as it formed.

7. Lists of Species Recorded from the Curran Deposits

The following is a list of all species obtained from the 1935 material, together with species previously recorded from the Curran beds and not obtained by the Harvard Expedition.

**Foraminifera**

Ninety-two species and varieties were obtained from material collected by the Harvard Expedition; of this number 32 species and 2 varieties have not previously been recorded from the Curran deposits. (See separate Report on the Foraminifera for full account).

**Porifera**

Only one species of sponge, represented by borings in an oyster valve, has been identified from the Curran deposits. Dr. M. Burton has seen this specimen, and tells me that it is practically impossible to identify the British species of boring sponges by their perforations alone, and it is impossible to regard it as anything but *Cliona* sp.

*Cliona* sp. Borings in valve of *Ostrea* from the Dark Blue Sand (Deposit G). Sponge-spicules were moderately frequent in the Estuarine Clay (Deposit H), level: 0-1-00 m, below the top of this deposit. Borings of *Cliona* sp. have previously been recorded by Grainger (1874) in shells from the Curran gravels.
Annelida: Polychaeta

The calcareous tubes of various polychaete worms occurred on shells from several levels in the Curran deposits. A few shells also showed borings made by worms. Mr. C. C. A. Monro has examined all the specimens and identified them as far as possible.

*Polydora* sp. Borings which are probably of this species were noted in two *Ostrea* valves from the upper portion of the Estuarine Clay (Deposit H), level: 0-1-00 m. Also in another *Ostrea* valve from the Surface Accumulation (Deposit A).

Serpulid tubes occurred on shells in the Dark Blue Sand (Deposit G), and on shells from the Estuarine Clay (Deposit H) at levels ranging from 1-00 m. to 2-25 m. below the top of this deposit, but it is impossible to give even generic names to the majority of these tubes.

*Spirobis* sp. Dextral tubes of a species of this genus were fairly plentiful on shells in the Dark Blue Sand (Deposit G), and at various levels in the Estuarine Clay (Deposit H), from 1-00 m. to 4-50 m. below the top of this deposit.

The only previous record of Annelida from the Curran deposits is *Spirobis* sp., mentioned by Praeger (1890) as of frequent occurrence in the Estuarine Clay.

Crustacea: Cirrepeda

A few fragments of acorn barnacles occurred in a sandy layer of the gravels (Deposit C), and in the Reddish-Brown Sand (Deposit D). Three small boulders bearing *Balani in situ* in very good, unworn condition, were found at the following levels: two in the Raised Beach Gravels, and one in the Reddish-Brown Sand.

*Balanus crenatus* (?) Bruguière. One fragment, sandy layer of gravels (Deposit C), level: 4-00 m.-4-25 m.

*Balanus balanoides* L. *In situ*, good condition and unworn, on three small boulders from these levels: two in the gravels (Deposit C) at 3-75 m.-4-00 m., and 4-00 m.-4-25 m.; one in the Reddish-Brown Sand (Deposit D) at 4-25 m.-4-50 m. Also several fragments, referred with doubt to this species by Dr. Moore, from the gravels (Deposit C) level: 4-00 m.-4-25 m., and from the top of the Reddish-Brown Sand (Deposit D).

The only previous record of *Balani* in the Curran deposits is by Praeger (1890), who states that *Balanus* sp. was rare in the Black Gravel underlying the Estuarine Clay.

Crustacea: Decapoda

A number of decapod remains, mostly claw fragments, occurred in the Curran deposits. Mr. R. R. MacDonald has kindly examined these, and reports that he has been able to identify the following species:

*Portunus puber* (L.) One claw, from Deposit F, level 5-00 m.-5-15 m.
Portunus depurator (L.)? Fragments from the base of the gravels (Deposit C), the Reddish-Brown Sand (Deposit D), and the base of the Dark Blue Sand (Deposit G).

Carcinus maenas (Pennant). Top of the Reddish-Brown Sand (Deposit D).

Cancer pagurus L. With the last species—top of the Reddish-Brown Sand (Deposit D).

Indeterminable claw fragments also occurred in the lowest level of the gravels (Deposit C), the base of the Reddish-Brown Sand (Deposit D), the base of the Dark Blue Sand (Deposit G), and in the Estuarine Clay (Deposit H) at various depths.

Dr. Praeger (1892, p. 246) recorded Carcinus maenas (Leach) remains from the Estuarine Clay of Curran Point, and these are probably the specimens referred to as “Cancer—claws chiefly—indeterminable” in his 1890 report. The other three species obtained from the Harvard material are new to the Curran fauna.

Crustacea: Ostracoda

Numerous ostracod valves occurred in all the Curran deposits, with the exception of the Raised Beach Gravels (Deposit C), where they only occurred in a sandy layer at a depth of 3:75 m.-4:00 m. When floating the fine material for foraminifera I picked out the ostracods and sent them to Mr. R. R. MacDonald, who agreed to report on them. Later Mr. MacDonald found himself unable to work out all the material in detail, although he has named some of the most abundant species. His notes are included below.

Estuarine Clay (Deposit H): depth of 1:00 m. below top of deposit.

Cythere pellucida (Baird)—Estuarine to Coralline Zone.

C. - - - villosa (Sars)—Littoral to great depths.

C. - - - convexa (Baird)—Littoral zone to a depth of 30 fathoms.

C. - - - lutea Muller—Littoral and Laminarian Zones.

Loxoconcha impressa (Baird)—Littoral zone to a depth of 25 fathoms.

Hard Grey Sand (Deposit E): depth of 4:80 m.-5:00 m. below datum.

Loxoconcha impressa (Baird)—3 specimens.

Fine Reddish-Brown Sand (Deposit D): depth of 4:25 m.-4:50 m. below datum.

Cythere pellucida (Baird).

C. - - - villosa (Sars).

C. - - - convexa (Baird).

C. - - - albo-maculata Baird—Common between tide-marks and at moderate depths.

Raised Beach Gravels (Deposit C): depth of 3:75 m.-4:00 m. below datum (Sandy Layer).

Cythere villosa (Sars).

C. - - - viridis Muller—Littoral zone to a depth of 30 fathoms.
Loxoconcha impressa (Baird).
Cytheridea elongata Brady—Littoral zone to a depth of 70 fathoms or more.

No ostracods have been previously recorded from the Curran deposits. The eight species listed above are all found in British and Irish waters at the present time (compare Malcomson, 1886); all of them have, likewise, been reported in a fossil state from Post-Glacial deposits in Scotland and Ireland (cf. Praeger, 1892, pp. 244-245). The above list includes only about one quarter of the total number of species present.

Mollusca

The following tabulated list shows the distribution of the molluscan species in the various Curran deposits, and I have followed Mr. A. S. Kennard in using the symbols listed below to indicate comparative frequencies:

VR very rare, less than 5 examples.
R rare, between 5 and 10 examples.
C common, more than 10 examples.
j juvenile.
f fragment.
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<thead>
<tr>
<th>Name of Species</th>
<th>Estuarine Clay Deposit II</th>
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<th>Dark Blue Sand Deposit G</th>
<th>Hard Grey Sand Deposit E</th>
<th>Fine Reddish-Brown Sand, Deposits D &amp; F</th>
<th>Engulfed Beds of Gravel Deposits C</th>
<th>Storm Beach Deposits B</th>
<th>Surface Accumulation Deposits A</th>
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* Since substantially the same assemblages are found in both horizons of Fine Reddish-Brown Sand—Deposits D and E—the molluscan fauna from these beds is combined in one column on the table.
## TABULATED LIST OF SPECIES

<table>
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<tr>
<th>Name of Species</th>
<th>Beds laid down before the Post-Glacial climatic optimum</th>
<th>Beds laid down after the Post-Glacial climatic optimum</th>
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<th>Name of Species</th>
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<td>P. rhomboidea (Pennant)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. pullulata (Mont.)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>P. decussata fusca (Gm.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mystia undata (Pennant)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tellina squallida Mont.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. fabula Gmelin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. donacina L.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. alba (W. Wood)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>A. nitida (Mueller)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. prismatica (Mont.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gari ferversis (Gm.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solearcius chamasolen (da C.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. pelliculus (Pennant)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensus sisluga (L.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. ensis (L.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spissula solida (L.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. elliptica (Brown)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. subtruncata (da C.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lutaria lutraria (L.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mya truncata L.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. arenaria L.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aloidis gibba (Olivii)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hiatella arctica (L.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. gallicana (Lam.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barnea candida (L.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thracia phaseolina (Lam.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Since substantially the same assemblages are found in both horizons of Fine Reddish-Brown Sand—Deposits D and F—the molluscan fauna from these beds is combined in one column on the table.
The following species of marine mollusca recorded from the Curran deposits were not obtained in the 1935 material:

<table>
<thead>
<tr>
<th>Species</th>
<th>Level</th>
<th>Frequency</th>
<th>Recorded by</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Diodora apertura</em> (Mont.)</td>
<td>Estuarine Clay</td>
<td>VR</td>
<td>Praeger, 1892</td>
</tr>
<tr>
<td><em>Calliostoma zizyphinum conuloide</em> (Lam.)</td>
<td>Gravels</td>
<td>—</td>
<td>Grainger, 1874</td>
</tr>
<tr>
<td>do.</td>
<td>Storm-beach (?)</td>
<td>VR</td>
<td>Praeger, 1890</td>
</tr>
<tr>
<td><em>Gibbula umbilicalis</em> (da Costa) do.</td>
<td>Estuarine Clay</td>
<td>VR</td>
<td>Hull, 1872, &amp;</td>
</tr>
<tr>
<td></td>
<td>Gravels</td>
<td>—</td>
<td>Stirrup, 1877</td>
</tr>
<tr>
<td><em>Littorina neritoides petraea</em> (Mont.)</td>
<td>Estuarine Clay</td>
<td>VR</td>
<td>Praeger, 1892</td>
</tr>
<tr>
<td><em>Rissocella opalina</em> (Jefl.)</td>
<td>Estuarine Clay</td>
<td>frequent</td>
<td>Praeger, 1892</td>
</tr>
<tr>
<td><em>Caecum glabrum</em> (Mont.)</td>
<td>Estuarine Clay</td>
<td>1 specimen</td>
<td>Praeger, 1890</td>
</tr>
<tr>
<td><em>Ocenebra erinacea</em> (L.)</td>
<td>Estuarine Clay</td>
<td>1 do.</td>
<td>do.</td>
</tr>
<tr>
<td><em>Neptunea antiqua</em> (L.)</td>
<td>Gravels</td>
<td>—</td>
<td>Hull, 1872</td>
</tr>
<tr>
<td><em>Nassarius pygmaeus</em> (Lam.)</td>
<td>Gravels</td>
<td>—</td>
<td>Grainger, 1874</td>
</tr>
<tr>
<td>do.</td>
<td>Estuarine Clay</td>
<td>VR</td>
<td>Praeger, 1890</td>
</tr>
<tr>
<td><em>Retusa mammillata</em> (Phil.)</td>
<td>Estuarine Clay</td>
<td>R</td>
<td>Praeger, 1892</td>
</tr>
<tr>
<td><em>Nucula sulcata</em> Bronn.</td>
<td>Estuarine Clay</td>
<td>VR</td>
<td>do.</td>
</tr>
<tr>
<td><em>Musculus marmoratus</em> (Forbes)</td>
<td>Estuarine Clay</td>
<td>VR</td>
<td>Grainger, 1874</td>
</tr>
<tr>
<td><em>Kellia suborbicularis</em> (Mont.)</td>
<td>Gravels</td>
<td>—</td>
<td>do.</td>
</tr>
<tr>
<td><em>Montacuta ferrugiosa</em> (Mont.)</td>
<td>Estuarine Clay</td>
<td>R</td>
<td>Praeger, 1892</td>
</tr>
<tr>
<td><em>Tellina tenuis</em> da Costa</td>
<td>Gravels</td>
<td>—</td>
<td>Grainger, 1874</td>
</tr>
<tr>
<td><em>Macoma balthica</em> (L.) do.</td>
<td>Estuarine Clay</td>
<td>frequent</td>
<td>Praeger, 1890</td>
</tr>
<tr>
<td></td>
<td>Gravels</td>
<td>—</td>
<td>do.</td>
</tr>
<tr>
<td><em>Scrobicularia plana</em> (da Costa)¹</td>
<td>Estuarine Clay</td>
<td>R</td>
<td>Praeger, 1890</td>
</tr>
</tbody>
</table>

Two specimens only of non-marine mollusca occurred, and Mr. Fred Taylor has kindly identified these. They are:

*Vallonia pulchella* (Muller)—One adult shell, from the Estuarine Clay (Deposit H) at a depth of 1.00 m.

¹ This species occurred in the Estuarine Clay at the Old Pottery site (Section V in Pl. IX) only.
*Vallonia costata* (Muller)—One half-grown shell, from the top of the Dark Blue Sand (Deposit G).

The following species of non-marine shells recorded by Praeger (1892), were not obtained in 1935:

- *Limnaea palustris* (Muller)—One, from the Estuarine Clay.
- *Goniobolus rotundatus* (Muller)—Several
- *Helicella nitidula* (Drap.)—One from the Top of the Dark Blue Sand (Deposit G).
- *G. radiatula* (Alder)—One from the Estuarine Clay at the Old Pottery site.

**Polyzoa**

No polyzoa were obtained from the Curran sands and gravels, but a single species occurred on an *Ostrea* from the Dark Blue Sand (Deposit G), and the same species, together with four others, occurred on shells from the Estuarine Clay (Deposit H). Dr. Anna B. Hastings has kindly identified these species, all of which are common and widely-distributed. They are as follows:

- *Chorizopora brongniartii* (Aud.)
- *Mucronella peachi* (Johnston)
- *Mucronella ventricosa* (Hassall)
- *Schizoporella auriculata* (Hassall)
- *Schizoporella linearis* (Hassall). On an *Ostrea* valve from the Dark Blue Sand; also on a valve of *Pecten maximus* from a depth of 1-00 m.-1-25 m. in the Estuarine Clay.

No species of polyzoa had previously been recorded from the Estuarine Clays of Curran.

**Echinodermata**

Echinoderm remains were extremely rare in the Curran material, due, no doubt, to the muddy habitat at this locality which is unsuitable for these animals. Tho species only were represented:

- *Psammechinus miliaris* (Gm.). One spine of this species was obtained from a depth of 2-00 m. in the Estuarine Clay (Deposit H).
- *Echinocardium cordatum* (Pennant). One of the characteristic primaries from the plastron region of this heart-urchin was found at the base of the Reddish-Brown Sand (Deposit D). Two minute spines also occurred at the top of the Estuarine Clay (Deposit H).

Echinoderm remains have not hitherto been recorded from the Curran deposits.

**Pisces**

A single fish-tooth occurred in the 2-00 m. level of the Estuarine Clay at the Curran site, and an otolith was found in the Reddish-Brown Sand. The tooth has been examined by Mr. J. R. Norman, who reports that it is a teleostean tooth but otherwise unidentifiable. The otolith was submitted to Mr. Frost, who stated that it was impossible to determine the species. These are the first fossil fish specimens to be reported from the Larne region.
APPENDIX IV

REPORT ON THE FORAMINIFERA

By Arthur Earland, F.R.M.S. and Nora Fisher McMillan

1. Introduction

A total of seven floatings were examined from the following levels in the Curran deposits; the depths are recorded below datum at the top of the excavation, except in the case of the Estuarine Clay (Deposit H), where they are taken below the top of the clay:

Deposit C—Sandy Layer in the Gravels: Depth = 3-75 m.-4-25 m.
Deposit D—Fine Reddish-Brown Sand: Depth = 4-25 m.-4-80 m.
Deposit E—Hard Grey Sand: Depth = 4-80 m.-5-00 m.
Deposit G—Dark Blue Sand: Depth = 5-15 m.-6-00 m.
Deposit H—Estuarine Clay: Penetrated to a depth of 5-00 m., but base not reached. Three samples examined: 0 cm.; 2-00 m.; and 5-00 m.

2. Description of Deposits in Ascending Order

Deposit H—Estuarine Clay

5-00 m. below the top of the Clay: Just a very small quantity (exactly one spread slide 1 inch square) of dark vegetable detritus (Zostera ?) with abundant Elphidium crispum (L.), and many other species of foraminifera. Elphidium macellum (F. & M.), Rotalia beccarii (L.), Cibicides lobatulus (W. & J.), Discorbis globularis (d’Orb.), and Miliolina lamarckiana (d’Orb.) frequent. Other species represented by single or few specimens. The whole of the specimens were picked out, and their numbers are probably an approximate indication of the frequencies of the dominant species in the other deposits: Elphidium crispum (L.)—200; Rotalia beccarii (L.)—15; Cibicides lobatulus (W. & J.)—44; Discorbis globularis (d’Orb.)—46; 24 other species—132 specimens.

2-00 m. below the top of the Clay: Dark vegetable detritus with plentiful foraminifera and molluscan debris. There is distinct evidence of fossils redeposited from Cretaceous and other strata, and in the finest grades of material minute particles of chalk were observed, together with Inoceramus prisms and Cretaceous sponge-spicules.

0 cm. below the top of the Clay: A small quantity of dark vegetable detritus with many foraminifera. Specimens mostly large and well developed, indicating favourable surroundings. Elphidium macellum (F. & M.)

1 The identifications and notes were made by Mr. Earland nearly fifteen years ago. Mr. Earland, now very old, has lost touch with alterations in nomenclature which have arisen during that period and feels unable to revise his contribution. The notes and list are therefore printed as originally made. It is not likely that many changes in nomenclature are necessary.
is common at this level, and *E. crispum* (L.) rare; these frequencies are the reverse of those in the 5-00 m. level of Deposit H.

**Deposit G—Dark Blue Sand.**
A mixture of vegetable debris, foraminifera, and molluscan fragments. Foraminifera abundant, well developed, and varied, but represented by single or few specimens, except for a few species which occur in great numbers. The large size and abundance of the common species indicate favourable surroundings in water of moderate depth, certainly under 40 fathoms. The size of the specimens of *Planorbulina mediterranensis* d'Orb., which is considerably above the British average, and the presence of such species as *Nubecularia lucifuga* Defr., *Miliolina bicornis* (W. & J.), *M. laevigata* (d'Orb.), and *M. disparilis* (d'Orb.) indicate warm water.

Many of the smaller forms may have been redeposited from older strata; they have a worn surface aspect different from the general appearance of the other small forms.

**Deposit E—Hard Grey Sand.**
These specimens were washed from shells of *Ensis siliqua* (L.). A light grey-brown sand, rather coarse, with many shell fragments. Mineral grains angular, of varying sizes, a few large rounded grains. Abundant fragments of indurated chalk, clay and flint. Much glauconite. A few recognizable chalk foraminifera, many fragments of Cretaceous fossils and a few similar fragments of Liassic fossils. One, or perhaps two, identifiable Liassic foraminifera.

Foraminifera form a very small percentage of the total bulk, but *Cibicides lobatus* (W. & J.), *Rotalia beccarii* (L.), *Elphidium crispum* (L.) occur abundantly. *Elphidium incertum* (Will.) and *E. macellum* (F. & M.) in lesser numbers. The other species of foraminifera are comparatively rare, often represented by single or few specimens.

The almost entire absence of miliolids, and the dull opaque surface of nearly all the foraminifera, suggests that the deposit has been subjected to leaching.

The deposit was evidently laid down under conditions unfavourable to life, possibly a sand-bank in shallow water where turbulent conditions prevailed. It would not be surprising if the majority of the foraminifera were derived from adjacent contemporary deposits and transported to the spot by current action.

**Deposit D—Fine Reddish-Brown Sand.**
A small quantity of pale-brown residues almost entirely foraminifera. Three species, *Rotalia beccarii* (L.), *Elphidium crispum* (L.), and *Cibicides lobatus* (W. & J.), form the overwhelming proportion of the specimens in the foregoing order of dominance. They are all large and well-grown specimens, but their frosted dull surfaces, often tinged with iron, the comparative absence of miliolids, and the decayed condition of the few miliolids seen, indicate that the deposit has been leached. None of the remaining species of foraminifera occurs in any considerable numbers, and most of them are very rare.
Deposit C—Sandy Layer in the Gravels.

In a very small quantity of material five species occurred, *Rotalia beccarii* (L.) being the most plentiful.

3. General Comment

The term "Estuarine Clay" appears to be distinctly a misnomer, at least insofar as the material examined for foraminifera is concerned. The most typical of all estuarine species, *Miliolina fusca* (Brady), was not observed at all, while the several species of *Elphidium*, incorrectly assigned by Brady, Wright and the older authorities in general to *E. striato-punctatum* (F. & M.), are comparatively rare. On the other hand *E. crispum* (L.), which does not figure at all in Brady's list of brackish-water foraminifera (Brady, 1870), is dominant in nearly all the gatherings, as it is in most shore gatherings and shallow water dredgings round the Southern and Western British coasts to-day. Many other discrepancies might be noted.

On the basis of the foraminifera observed in the samples from Deposit H, there can be no doubt that this stratum was laid down under warmer conditions than those existing to-day in the locality. This fact is indicated by the comparative frequency of such species as *Miliolina laevigata* (d'Orb.), and the occurrence of *M. rotunda* (d'Orb.), *M. pulchella* (d'Orb.), and *M. disparilis* (d'Orb.). Praeger (1892, p. 215) has already noted that the "Estuarine" species of mollusca usually have their habitat further southward at present. But he adds: "There is very little in the latter point, for the Estuarine Clay fauna differs to no material extent from that now existing within a short distance." This may be true with respect to the majority of the recorded species of foraminifera, but, on the other hand, most of these species have a very wide distribution, and they give no real clue to the existing climatic conditions. On the basis of the rarer species, we should expect the temperature to have been at least as high as that now prevailing on the southern shores of England and Ireland.

The maximum development of the warm-water species is in the deeper gatherings—the 5·00 m. and 2·00 m. levels of the Estuarine Clay (Deposit H). They are hardly noticeable in the 0·00 m. level (6·00 m. below datum), and in the overlying Dark Blue Sand (Deposit G), though in the latter the occurrence of *Nubecularia lucifuga* Defr. is an outstanding exception to the general facies of the fauna. The overlying deposits of Hard Grey Sand (Deposit E) and Reddish-Brown Sand (Deposit D) present such a typical cool-water fauna as might be found in the locality to-day.

As regards the depth at which the Dark Blue Sand and Estuarine Clay were laid down, foraminifera in general have comparatively wide range, and are probably less certain factors than the mollusca on which Praeger (1892, p. 214) bases his estimate of one to two fathoms. On the foraminiferal standard we should have regarded anything between 2 and 20 fathoms, or possibly more, as the probable depth of water at the time these sediments were formed. In this view we are to some extent influenced by the large size of the miliolids in general.
Apart from the few warm-water species already mentioned, the general facies of our fauna is very similar to that listed by Gough (1905) from Larne Lough in shallow water. The dominant species are more or less identical, but there are some striking discrepancies. *Verneuilina polystropha* (Reuss) is a dominant species in much of Gough's material, but does not figure at all in our list, and in Wright's 1881 list only as "rare." Gough described *Ophthalmidium carinatum* B. & W. as "common"; we have only a single specimen, and Wright (in Praeger, 1892) lists the species as "very rare" at Larne, though "frequent" at Limavady, County Londonderry (compare Wright, 1911, p. 16). *Cassidulina laevigata* d'Orb. is "rare," and *C. crassa* d'Orb. "very common" in Gough's material, while in ours the genus is represented by single specimens of each, and Wright records both species with varying frequencies. *Cristellaria rotulata* (Lamk.), recorded by Gough as "frequent," and by Wright as "very rare," was not seen in our material. Many other discrepancies will be noted if the three lists are compared, but we do not attach any particular importance to them, though probably the greatly increased frequency of *Verneuilina polystropha* (Reuss) and *Cassidulina crassa* d'Orb. indicate a somewhat lower range of temperature to-day.

There are certain discrepancies between the lists of foraminifera published by Joseph Wright in 1881 and 1892 (in Praeger, 1892, pp. 282-9), some species occurring in the former which are not listed in the latter, and vice versa. In the interim there had been great additions to our knowledge of the foraminifera, and the publication of the *Challenger* monograph in 1884 (Brady, 1884) in particular no doubt caused Wright to revise his nomenclature. Moreover, the fact that additional material was examined in connection with his 1892 list would in itself account for some of the discrepancies, as no two samples of material from any locality are likely to be identical as far as the rarer species are concerned. This well-recognized fact, and the probability that our samples were smaller than those examined by Wright, will account for the absence from our list of many species recorded by him. The additional records in the present list are partly due to our increased knowledge of the foraminifera in the intervening forty years. During this period the study of original types has led to the suppression of some specific names used in 1892, and the erection of new species in their place. Some of the additions, on the other hand, are due to the fact that Joseph Wright, in his day the greatest authority on British foraminifera, was not widely experienced in the study of other material. He, like most of the workers of his day, was a "lumper," and was also by nature endowed with an ultra-conservative tendency as regards the admission of new species to the British list.
Tabulated List of Species

(Abbreviations: C—common; F—frequent; R—rare; VR—very rare)

<table>
<thead>
<tr>
<th>Name of Species</th>
<th>Beds laid down before the Post-Glacial climatic optimum</th>
<th>Beds laid down after the Post-Glacial climatic optimum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estuarine Clay Deposit H</td>
<td>Dark Blue Sand Deposit G</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Nubecularia lucifaga Defr.</td>
<td>3</td>
<td>R</td>
</tr>
<tr>
<td>Pyrgo depressa (d'Orb.)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>P. bradyi Schlumberger</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Spiroloculina planulata (Lam.)</td>
<td>1 j</td>
<td>1</td>
</tr>
<tr>
<td>Miliolina circularis (Born.)</td>
<td>4</td>
<td>R</td>
</tr>
<tr>
<td>M. rotunda (d'Orb.)</td>
<td>1</td>
<td>F</td>
</tr>
<tr>
<td>M. trigonula (Lam.)</td>
<td>2</td>
<td>F</td>
</tr>
<tr>
<td>M. tricarinata (d'Orb.)</td>
<td>8</td>
<td>F</td>
</tr>
<tr>
<td>M. subrotunda (Mont.)</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td>M. seminuda (Reuss)</td>
<td>2</td>
<td>F</td>
</tr>
<tr>
<td>M. vulgaris (d'Orb.)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>M. seminulum (L.)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>M. planciana (d'Orb.)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>M. dunkerquiana H.-A. &amp; E.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. oblonga (Mont.)</td>
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</tr>
<tr>
<td>M. lamarekiana (d'Orb.)</td>
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<td></td>
</tr>
<tr>
<td>M. ? cuvieriana (d’Orb.)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>M. chiarensis H.-A. &amp; E.</td>
<td>3</td>
<td>C</td>
</tr>
<tr>
<td>M. sclerotica (Karrer)</td>
<td>3</td>
<td>F</td>
</tr>
<tr>
<td>M. contorta (d’Orb.)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. angulata Williamson</td>
<td>1</td>
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</tr>
<tr>
<td>M. laevigata (d’Orb.)</td>
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<td></td>
</tr>
<tr>
<td>M. bicornis (W. &amp; J.)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Name of Species</td>
<td>Beds laid down before the Post-Glacial climatic optimum</td>
<td>Beds laid down after the Post-Glacial climatic optimum</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
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<tr>
<td></td>
<td>Estuarine Clay Deposit H</td>
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</tr>
<tr>
<td></td>
<td>500 m. 200 m. 0 cm. Dark Blue Sand Deposit G</td>
<td>Hard Grey Sand Deposit E Fine Reddish-Brown Sand Deposit D Sandy Layer in Gravels Deposit C</td>
</tr>
<tr>
<td>M. brongniartii (d'Orb.)</td>
<td>1 VR 4 R</td>
<td></td>
</tr>
<tr>
<td>M. disparilis (d'Orb.)</td>
<td>1 VR 1 R</td>
<td></td>
</tr>
<tr>
<td>M. pulchella (d'Orb.)</td>
<td>1 VR 1 R</td>
<td></td>
</tr>
<tr>
<td>Massilina secans (d'Orb.)</td>
<td>1 VR 1 R</td>
<td></td>
</tr>
<tr>
<td>M. secans (d'Orb.) var. tenuistrata Earland</td>
<td>1 VR 1 R</td>
<td></td>
</tr>
<tr>
<td>Ophthalmidium carinatum B. &amp; W.</td>
<td>1 VR 2 R</td>
<td></td>
</tr>
<tr>
<td>Cornuspira involvens (Reuss.)</td>
<td>1 VR 2 R</td>
<td></td>
</tr>
<tr>
<td>C. selseyensis H.-A. &amp; E.</td>
<td>1 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>C. foliacea (Phil.)</td>
<td>1 VR 2 R</td>
<td></td>
</tr>
<tr>
<td>C. diffusa H.-A. &amp; E.</td>
<td>1 f VR 2 R</td>
<td></td>
</tr>
<tr>
<td>Haplophragmoides canariensis (d'Orb.)</td>
<td>1 VR 2 R</td>
<td></td>
</tr>
<tr>
<td>Trochammina squamata</td>
<td>1 VR 2 js 1 R</td>
<td></td>
</tr>
<tr>
<td>Jones &amp; Parker</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>Textularia sagittula Defr.</td>
<td>2 VR 2 js 1 R</td>
<td></td>
</tr>
<tr>
<td>T. gramen d'Orb.</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>T. conica d'Orb.</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>Bulimina marginata d'Orb.</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>B. aculeata d'Orb.</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>B. elegans d'Orb.</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>B. pupoides d'Orb.</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>B. fusiformis Will.</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>B. elongata d'Orb.</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>Virgulina schreibersiana Czjzek.</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>Bolivina difformis (Will.)</td>
<td>2 VR 3 R</td>
<td></td>
</tr>
<tr>
<td>Name of Species</td>
<td>Beds laid down before the Post-Glacial climatic optimum</td>
<td>Beds laid down after the Post-Glacial optimum</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Estuarine Clay DEPOSIT H</td>
<td>Hard Grey Sand DEPOSIT E</td>
</tr>
<tr>
<td></td>
<td>500 m.</td>
<td>200 m.</td>
</tr>
<tr>
<td>B. variabilis (Will.)</td>
<td>-</td>
<td>R</td>
</tr>
<tr>
<td>B. pseudoplicata H.-A. &amp; E.</td>
<td>-</td>
<td>R</td>
</tr>
<tr>
<td>Cassidulina laevigata d'Orb.</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>C. crassa d'Orb.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lagenaria bicarinata (Terque)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L. clavata (d'Orb.)</td>
<td>-</td>
<td>VR</td>
</tr>
<tr>
<td>L. hexagona (Will.)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>L. laevis (Mont.)</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>L. lineata (Will.)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L. lucida (Will.)</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>L. marginata (W. &amp; B.)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L. orbignyana (Seguenza)</td>
<td>-</td>
<td>R</td>
</tr>
<tr>
<td>L. semistriata (Will.)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L. squamosa (Mont.)</td>
<td>-</td>
<td>VR</td>
</tr>
<tr>
<td>L. squamosa v. montagui</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(Alcock)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L. striata (d'Orb.)</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>L. sulcata (W. &amp; J.)</td>
<td>1</td>
<td>VR</td>
</tr>
<tr>
<td>L. williamsoni (Alcock)</td>
<td>9</td>
<td>C</td>
</tr>
<tr>
<td>Polymorphina gibba d'Orb.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Uvigerina angulosa</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Williamson</td>
<td>-</td>
<td>F</td>
</tr>
<tr>
<td>Globigerina bulloides d'Orb.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>G. dutertrei d'Orb.</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>G. triloba Reuss.</td>
<td>-</td>
<td>VR</td>
</tr>
<tr>
<td>G. inflata d'Orb.</td>
<td>-</td>
<td>VR</td>
</tr>
<tr>
<td>Patellina corrugata</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Williamson</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Name of Species</td>
<td>Beds laid down before the Post-Glacial climatic optimum</td>
<td>Beds laid down after the Post-Glacial optimum</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Estuarine ClayDeposit H</td>
<td>Dark Blue Sand Deposit G</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td><strong>Discorbis globularis</strong> (d’Orb.)</td>
<td>F  C  F  C</td>
<td>R  R</td>
</tr>
<tr>
<td><strong>D. rosacea</strong> (d’Orb.)</td>
<td>1  VR  1  R</td>
<td>-</td>
</tr>
<tr>
<td><strong>D. praegeri</strong> H.-A. &amp; E.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>D. turbo</strong> (d’Orb.)</td>
<td>-</td>
<td>VR</td>
</tr>
<tr>
<td><strong>D. nitidus</strong> (Williamson)</td>
<td>-</td>
<td>VR</td>
</tr>
<tr>
<td><strong>D. orbicularis</strong> (Terquem)</td>
<td>-  2  2</td>
<td>-</td>
</tr>
<tr>
<td><strong>D. wrightii</strong> Brady</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Planorbulina mediterranensis</strong> d’Orb.</td>
<td>6  F  1  F</td>
<td>R  VR</td>
</tr>
<tr>
<td><strong>Cibicides refugens</strong> (Montf.)</td>
<td>-  5</td>
<td>-</td>
</tr>
<tr>
<td><strong>C. lobatulus</strong> (W. &amp; J.)</td>
<td>C  VC  F  VC</td>
<td>VC  VC</td>
</tr>
<tr>
<td><strong>C. variabilis</strong> d’Orb.</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Rotalia beccarii</strong> (L.)</td>
<td>C  VC  C  VC</td>
<td>VC  VVC</td>
</tr>
<tr>
<td><strong>Gypsina inhaerens</strong> (Schultze)</td>
<td>-  F</td>
<td>-</td>
</tr>
<tr>
<td><strong>Nonion depressulus</strong> (W. &amp; J.)</td>
<td>9  F  2  F</td>
<td>R  C</td>
</tr>
<tr>
<td><strong>N. asterizans</strong> (F. &amp; M.)</td>
<td>1  VR  1</td>
<td>-</td>
</tr>
<tr>
<td><strong>N. stelligera</strong> d’Orb.</td>
<td>-  2</td>
<td>-</td>
</tr>
<tr>
<td><strong>Nonionella turcida</strong></td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>(Williamson)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Elphidium macellum</strong> (F. &amp; M.)</td>
<td>F  R  C  F</td>
<td>C  R</td>
</tr>
<tr>
<td><strong>E. crispum</strong> (L.)</td>
<td>VC  VC  F  VC</td>
<td>VC  VC</td>
</tr>
<tr>
<td><strong>E. incertum</strong> (Williamson)</td>
<td>3  F  4  F</td>
<td>R  F</td>
</tr>
<tr>
<td><strong>E. excavatum</strong> (Terquem)</td>
<td>2  R  3  VR</td>
<td>R  1</td>
</tr>
</tbody>
</table>

Derived fossils were observed in the Hard Grey Sand (Deposit E) and also in the 2-00 m. level of the Estuarine Clay (Deposit H). In the Hard Grey Sand a few recognizable Chalk foraminifera were noted, many fragments of Cretaceous
fossils, and a few fragments of Lias fossils, together with one or perhaps two recognizable Liassic foraminifera. The latter were: *Frondicularia tenera* (Bornemann) and *Ammodiscus incertus* (d'Orb.).

The following derived fossils were observed in the material from the 2·00 m. level of the Estuarine Clay. They are all distinctly Cretaceous, but in the circumstances verification of the specific names was not considered essential.

- *Globigerina* sp.  ? *G. cretacea* or *G. subcretacea*. One.
- *Nodosaria* sp. A chamber of *N. filiformis* d'Orb.
- *Bolivina* sp.  ? *B. decorata* Jones MS. One.

In addition, one fragment of *Frondicularia tenera* (Bornemann) was obtained from the same level as the above Cretaceous species. *Frondicularia tenera* is a Liassic species and has been recorded (as *Lingulina tenera*) by Wright (1871, p. 26; 1881, p. 159) from Island Magee, County Antrim, and Limavady, County Londonderry.

The total number of species and varieties in the tabulated list is 92, and to this must be added a further 38 species and one variety recorded by Wright in 1881 and 1892 (in Praeger, 1892, pp. 282-289) and not found in the 1935 material. As Wright gave no levels for his records except "gravels" and "Estuarine Clay," these records are not included in the tabulated list of species already given, but are set out separately here.

Two columns are allocated to the Estuarine Clay records, as the 1881 and 1892 lists were based on different lots of material and are therefore not identical. In compiling the 1892 list, material from two stations on the Curran was examined—the Railway Cutting and the Old Larne Pottery (for location of these sites see Swanston, 1886, map on p. 530). At the Old Larne Pottery site the Estuarine Clay was essentially a lower or *Scrobicularia* Clay, and intertidal shells were much more abundant than elsewhere in the Estuarine Clay deposits of Curran Point; here only occurred *Scrobicularia plana* (da Costa). In the following list, when a species has been recorded only from the Old Larne Pottery site, this fact is stated in parentheses. Generic names used by Wright, and which have since been altered, are given thus: *Pyrgo* (*Biloculina*) *ringens*.

Species Recorded by Wright and not Obtained at the Site Excavated in 1935

<table>
<thead>
<tr>
<th>Name of Species</th>
<th>Estuarine Clay, 1881</th>
<th>Estuarine Clay, 1892</th>
<th>Raised Beach Gravels, 1881</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pyrgo</em> (<em>Biloculina</em>) <em>ringens</em> (Lam.)</td>
<td>VR</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><em>Spiroloculina canaliculata</em> d'Orb.</td>
<td>—</td>
<td>VR</td>
<td>R</td>
</tr>
<tr>
<td><em>S. limbata</em> d'Orb.</td>
<td>—</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td><em>Trochammina inflata</em> (Mont.)</td>
<td>—</td>
<td>VR</td>
<td>—</td>
</tr>
<tr>
<td><em>T. inflata</em> v. <em>macrescens</em> Brady</td>
<td>R</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Name of Species</td>
<td>Estuarine Clay, 1881</td>
<td>Estuarine Clay, 1892</td>
<td>Raised Beach Gravels, 1881</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----------------------</td>
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<td>---------------------------</td>
</tr>
<tr>
<td><em>Verneuilina polystropha</em> (Reuss)</td>
<td>—</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td><em>Bulimina ovata</em> d'Orb.</td>
<td>C</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><em>B. elegantissima</em> d'Orb.</td>
<td>C</td>
<td>R</td>
<td>—</td>
</tr>
<tr>
<td><em>B. subulata</em> Brady</td>
<td>R</td>
<td>VR (Pottery)</td>
<td>—</td>
</tr>
<tr>
<td><em>Bolivina punctata</em> d'Orb.</td>
<td>R</td>
<td>F</td>
<td>VR</td>
</tr>
<tr>
<td><em>B. dilatata</em> Reuss.¹</td>
<td>R</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><em>Lagena costata</em> (Williamson)</td>
<td>R</td>
<td>VR (Pottery)</td>
<td>VR</td>
</tr>
<tr>
<td><em>L. globosa</em> (Mont.)</td>
<td>R</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td><em>L. gracillina</em> (Seguenza)</td>
<td>—</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td><em>L. lagenoides</em> (Williamson)</td>
<td>VR</td>
<td>VR (Pottery)</td>
<td>—</td>
</tr>
<tr>
<td><em>L. melo</em> (d'Orb.)</td>
<td>VC</td>
<td>—</td>
<td>VC</td>
</tr>
<tr>
<td><em>L. ornata</em> (Williamson)</td>
<td>R</td>
<td>—</td>
<td>C</td>
</tr>
<tr>
<td><em>Nodosaria communis</em> d'Orb.</td>
<td>—</td>
<td>VR</td>
<td>VR</td>
</tr>
<tr>
<td><em>N. obliqua</em> (L.)</td>
<td>VR</td>
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<td>—</td>
</tr>
<tr>
<td><em>N. pyrula</em> d'Orb.</td>
<td>—</td>
<td>VR</td>
<td>R</td>
</tr>
<tr>
<td><em>N. scalaris</em> (Batsch)</td>
<td>R</td>
<td>VR</td>
<td>R</td>
</tr>
<tr>
<td><em>N. radicula</em> (L.)</td>
<td>VR</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><em>Lingulina carinata</em> d'Orb.</td>
<td>—</td>
<td>VR</td>
<td>—</td>
</tr>
<tr>
<td><em>Vaginulina legumen</em> (L.)</td>
<td>R</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><em>Cristellaria crepidula</em> (F. &amp; M.)</td>
<td>—</td>
<td>—</td>
<td>VR</td>
</tr>
<tr>
<td><em>C. rotulata</em> (Lam.)</td>
<td>VR</td>
<td>VR</td>
<td>VR</td>
</tr>
<tr>
<td><em>Polymorphina lactea</em> (W. &amp; J.)</td>
<td>R</td>
<td>VR</td>
<td>R</td>
</tr>
<tr>
<td><em>P. concava</em> Williamson</td>
<td>—</td>
<td>VR</td>
<td>—</td>
</tr>
<tr>
<td><em>P. williamsoni</em> Terq.</td>
<td>VR</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>(also recorded as <em>P. oblonga</em> Will.)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><em>P. compressa</em> d'Orb.</td>
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<td>VR</td>
<td>R</td>
</tr>
<tr>
<td><em>Orbulina universa</em> d'Orb.</td>
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<td>VR</td>
<td>—</td>
</tr>
<tr>
<td><em>Spirillina vivipara</em> Ehrenberg</td>
<td>—</td>
<td>VR</td>
<td>VR</td>
</tr>
<tr>
<td><em>Discorbis</em> (Discorbina) <em>parisiensis</em></td>
<td>—</td>
<td>R</td>
<td>—</td>
</tr>
<tr>
<td>(d'Orb.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>D. (D.) berthelotii</em> (d'Orb.)</td>
<td>—</td>
<td>VR</td>
<td>—</td>
</tr>
<tr>
<td><em>Eponides</em> (Pulvinulina) <em>auricula</em></td>
<td>VR</td>
<td>R</td>
<td>—</td>
</tr>
<tr>
<td>(F. &amp; M.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Globorotalia</em> (Pulvinulina) <em>patagonica</em> (d'Orb.)</td>
<td>—</td>
<td>VR</td>
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</tr>
<tr>
<td><em>Nonion</em> (Nonionina) <em>umbilicatus</em> (Mont.)</td>
<td>—</td>
<td>—</td>
<td>VR</td>
</tr>
<tr>
<td><em>N. (N.) pauperatus</em> (B. &amp; W.)</td>
<td>—</td>
<td>VR (Pottery)</td>
<td>—</td>
</tr>
<tr>
<td><em>N. (N.) scapha</em> (F. &amp; M.)</td>
<td>VR</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

¹ Recorded as *Textularia pygmaea* d'Orb. in Wright's 1881 list, but later corrected by Wright (1886, footnote on p. 318) to *Bolivina dilatata* Reuss.
The above species, when added to the tabulated list of species obtained from the 1935 material, give a total foraminiferal fauna for the Curran deposits of 131 species and varieties; of this number, 54 species and 3 varieties have not been taken in Larne Lough as recent species, according to Gough's lists (1905; 1906).

4. Notes on Some of the Additional Species Not Recorded by Wright

*Nubecularia lucifuga* Defr.—Those from the Dark Blue Sand (Deposit G) are large for British specimens.

*Miliolina rotunda* (d'Orb.)—This is a common Mediterranean species figured by Schlumberger (1893, p. 64, pl. 1, figs. 48-50). Also recorded by Heron-Allen and Earland from Selsey, Sussex (Heron-Allen and Earland, 1911, pp. 303-304).

*Miliolina contorta* (d'Orb.)—Wright apparently did not separate *M. contorta* from *M. sclerotica*, listing all specimens under the latter name throughout. The two species are very similar, but *contorta* has an unpolished surface without built-in sandgrains, whereas *sclerotica* is always more or less arenaceous. Both are very variable in construction.

*Miliolina lamarchiana* (d'Orb.)—All British records of *M. auberiana* (d'Orb.) including Wright's, should be referred to *M. lamarchiana*. The two species are identical and *lamarchiana* has priority (Heron-Allen and Earland, 1930, p. 57).

*Miliolina brongniartii* (d'Orb.) and *Miliolina (Adelosina) laevigata* (d'Orb.)—Wright cannot have failed to find these; he probably included them with his records of *M. bicornis*.

*Miliolina vulgaris* (d'Orb.) and *Miliolina planciana* (d'Orb.)—Wright probably included these with *M. seminulum*.

*Miliolina circularis* (Bornemann)—How Wright failed to record this species we cannot think. The specimens are quite typical and of average size for shallow water.

*Miliolina angulata* Williamson—Wright's records of *M. ferussaci* d'Orb. and probably all British records of that species should be referred to *M. angulata* (Heron-Allen and Earland, 1916, p. 214, pl. XL, figs. 1-9; 1930, p. 60; 1913-a, p. 30).

*Miliolina dunkerquiana* Heron-Allen and Earland—A short broad form of *M. seminulum*; no doubt included by Wright with that species (Heron-Allen and Earland, 1930, p. 56, pl. II, figs. 8-11).

*Miliolina cliarensis* Heron-Allen and Earland—A very rare but characteristic species (Heron-Allen and Earland, 1930, p. 58, pl. III, figs. 26-31).¹

¹ *Miliolina stelligera* (Heron-Allen and Earland, 1913-a, p. 31) is placed in the synonymy of this species.
Miliolina cuvieriana (d'Orb.)—One would have no hesitation in referring the specimens to *M. cuvieriana* if found in a tropical or subtropical gathering. But taking into consideration the frequency of *M. lamarckiana* in the deposits, and the constant tendency of miliolids to vary by striae and costae, we should hesitate before adding the species to the British list.

*Miliolina disparilis* (d'Orb.) and *Miliolina pulchella* (d'Orb.)—Single very fine specimens were found of these typical Mediterranean and warm water species. Each has already been recorded from Devon and Cornwall (Heron-Allen and Earland, 1930, p. 62). Their occurrence in North-east Ireland is definite proof of warm water conditions.

*Cornuspira selseyensis* Heron-Allen and Earland—This was regarded by Wright as an annelid up to 1904 (Earland, 1905, p. 199, Pl. XIII, figs. 2-4; Heron-Allen and Earland, 1909, p. 319, pl. XV, figs. 9-11). He subsequently admitted the species.

*Cornuspira diffusa* Heron-Allen and Earland—This species, which is frequently found in a fragmentary condition in recent Irish dredgings, Wright would not admit as a foraminifer at all, until perfect specimens were found in Goldseeker dredgings (Heron-Allen and Earland, 1913).

*Textularia conica* d'Orb., *Bulimina elegans* d'Orb. and *Bolivina variabilis* Williamson—We do not know how Wright can have missed these species. He must have been well acquainted with them in recent material and included *B. variabilis* in his 1881 list under its original name *Textularia variabilis* (compare Brady, 1870, p. 299).

*Bolivina pseudoplicata* Heron-Allen and Earland—Up to 1930 this species was generally referred to *Bolivina plicata* d'Orb., which is a particularly local species confined to deep water off the coast of South America (Heron-Allen and Earland, 1930, p. 81, pl. III, figs. 36-40).

*Discorbis praegeri* (Heron-Allen and Earland)—This was presumably described by Wright in his records of *D. rosacea*.

*Cibicides variabilis* (d'Orb.)—No doubt Wright included this species in his records as *C. lobatulus*, and with good zoological reason, although the specific name has some taxonomic value.

*Cibicides refugens* Mont.—It is doubtful whether many of the specimens are true *refugens*. This is a large and very characteristic species, but the young are with difficulty separable from thick specimens of *C. lobatulus*, a species which varies in every direction to an amazing degree.

*Elphidium incertum* (Williamson) and *Elphidium excavatum* (F. & M.)—Up to quite recently everything of this kind was referred to *E. striato-punctatum*, which is a tropical species hardly known outside the Red Sea. There are quite a few variations, but they all fall more or less readily into either *incertum* or *excavatum*. Without an examination of Wright's specimens, it is impossible to say which of his numerous records refer to either species.
APPENDIX V

REPORT ON THE CALCAREOUS ALGAE

By Mme. Paul Lemoine, D.Sc.

1. INTRODUCTION

The Post-Glacial deposits of the raised beach at Curran Point contain shells of different species of molluscs (Tapes, Buccinum, Trochus) on which there occur thin, white crusts. Dr. Helen Blackler of the Free Public Museums, Liverpool, recognized that these crusts were calcareous algae of the family Melobesiidae, and she kindly entrusted me with their identification. This study has been made difficult by the bad state of preservation which seems to result from the method of fossilization of this deposit; the thalli are fragile and tend to crumble during the handling necessary to study them under a microscope.

The presence of Melobesiidae on the shells is completely normal. At the present time most of the shells collected at low tide, or dredged up from the sea-floor, are covered with rose- or white-coloured crusts, depending on whether the algae was collected live or dead.

2. LIST OF CALCAREOUS ALGAE FROM THE CURRAN DEPOSITS

On the fossil shells from the Curran deposits I have identified at least five species of calcareous algae. These are as follows:

1. Lithothamnium Lenormandi (Aresch.) Fosl. var. sublaevis Fosl.—on Tapes virgineus.
2. L. polymorphum (L.) Aresch.—on Buccinum undatum.
3. L. laevigatum Fosl.—on Trochus cinerarius.
4. Lithophyllum (Dermatolithon) hapalidioides (Crouan) Fosl.—on Trochus cinerarius and T. magus.
5. Melobesia (Pliostroma) zonalis (Crouan) Fosl.—on Trochus cinerarius and T. magus.

3. DISCUSSION OF THE SPECIES

Lithothamnium Lenormandi (Aresch.) Fosl. var. sublaevis Fosl.,
Deposit H—Estuarine Clay. Two specimens from depths of 75 cm.-1-00 m.
and 2-00 m.-2-25 m. below the top of the clay; both on Tapes virgineus.

These two valves are partly covered by two thalli of L. Lenormandi which form crusts of 50 micra to 70 micra thick, finely striated at the edges. The central part reveals remains of fructification. One of the thalli shows adult conceptacula and others are represented by a scar enclosed by a ring. The second one only displays the scars of conceptacula that have been lost.

In Ireland this species has been recorded on the east coast, particularly in Belfast Lough. On the other hand, on the west coast in the dredging of Clew Bay, it was collected on a Pecten shell at a depth of 5-00 m. to 9-00 m.
**L. Lenormandi** is a very common species on the rocks, stones and shells of the coasts of Great Britain, France, etc., in the intertidal zone; in the dredgings done in the Channel it is abundant down to a depth of 35 m.

**Lithothamnium polymorphum** (L.) Aresch.

Deposit G—Dark Blue Sand. Found on a shell of *Buccinum undatum* at a depth of 5-15 m. to 6-00 m. below the top of the section.

This species has been noted in the east of Ireland at Belfast Lough. In Ireland it only seems to have been found at low tide, but the Channel dredgings have demonstrated its existence down to a depth of 49 m.

**Lithothamnium laevigatum** Fosl.

Deposit G—Dark Blue Sand. Found on a shell of *Trochus cinerarius*.

Deposit H—Estuarine Clay. At a depth of 1-00 m.-2-00 m. below the top of the clay on a shell of *Trochus cinerarius*.

*L. laevigatum* has been recorded on all the Irish coasts on rocks and shells (*Patella*); it has particularly been recognized at Larne.

This species is unknown in the Channel. In the North Sea it has been found down to a depth of 36 m.

**Lithophyllum (Dermatolithon) hapalidioides** (Crouan) Fosl.

Deposit G—Dark Blue Sand. One specimen on a shell of *Trochus cinerarius*.

Deposit H—Estuarine Clay. Found on *Trochus magus* (2 specimens) and on *Trochus cinerarius* (7 specimens) at a depth of 1-75 m.-2-00 m. below the top of the clay.

This species is the most abundant in the small collection from Curran Point. Most of the thalli are fructified, showing the conceptacula and the scars of old conceptacula. Two thalli are sterile.

In general *L. hapalidioides* is quite common on dead shells; it has been noted on *Anomia, Solen, Haliotis, Patella*, and on *Trochus*. It has not been recorded in Ireland except on the west coast; at Clew Bay it has been recovered in a dredging between 5-50 m. and 9 m. In the Channel it seems to live down to a depth of 35 m.

**Melobesia (Pliostroma) zonalis** (Crouan) Fosl.

Deposit H—Estuarine Clay. Two specimens from depths of 1-00 m.-2-00 m. (on a shell of *Trochus cinerarius*) and 1-75 m.-2-00 m. (on a shell of *Trochus magus*).

This very small species lives on the same shells as *L. hapalidioides*, but it can only be seen with a magnifying glass. It has been noted at various localities on the coasts of Ireland—particularly on the east coast at Malahide on Dublin Bay. Elsewhere, dredging led to its discovery between 5-50 m. and 9 m. below mean tide level in Clew Bay.
M. zonalis has frequently been collected on the shells of different kinds of molluscs (Buccinum, Haliotis, Trochus), and also on miscellaneous objects such as glass and porcellain. It was absent in the dredgings done in the Channel.

4. **General Comment**

The study of the Melobesiidae from Deposits G and H at Curran Point gives us some information concerning the depth at which this deposit possibly was formed. The five species listed above live at the present time in the intertidal zone and in the littoral zone down to a certain depth, which is known as a result of dredging. In Ireland the only dredging of which I know is the one done in Clew Bay in shallow water (less than 10 m.), and I have studied the specimens from it kindly sent me by Mr. Cotton (Lemoine, 1913). Precise data on the depths at which these algae live is afforded us by the results of an important series of dredgings methodically done in the Channel by Commander Charcot (Lemoine, 1923). Of the five species from Curran Point, four live in the Channel and are found there in numerous dredgings at a depth generally not exceeding 35 m. This indicates to us the maximum depth of water at which the deposit containing the shells could have been formed, but it is possible that the deposition took place in shallower water.

The species discovered at Curran Point are all part of the present-day flora of Ireland. One of them, Lithothamnium laevigatum, lives at Larne; two others Lithothamnium polymorphum and L. Lenormandi, have been recorded in Belfast Lough; Melobesia zonalis has been discovered, among other places, at Malahide on Dublin Bay. These four species are known, therefore, on the east coast of Ireland at localities more or less distant from Larne. This is not true of the last species, Lithophyllum (D.) hapalidioides, which only appears to have been found on the west coast of Ireland. In this connection I have advanced the hypothesis that its absence on the east coast was perhaps related to a colder climate (Lemoine 1913, p. 143). However, its presence in the Post-Glacial deposits in the Larne region gives rise to a new problem. For, if this species is really absent at the present time in this region, there is reason to ask why its distribution has been changed, and if its disappearance may be explained on the basis of a change in the climate since the period represented by the Estuarine Clay (Deposit H) and the Dark Blue Sand (Deposit G) at Curran Point.

**APPENDIX VI**

REMAINS OF VERTEBRATES FROM THE CURRAN DEPOSITS

*By Hallam L. Movius, Jr.*

In 1874 the Rev. John Grainger claimed that the thigh-bone of a Mammoth (*Elephas primigenius*) had been found in 1869 by workmen in the Harbour Ballast Pit (Section Z on Pl. IX) at Larne, in association with some fragments of
whale bone (Grainger, 1874, p. 75). According to Grainger, the finds came from about the level of high-water, but apparently he was mistaken regarding the locality at which the mammoth bone was collected. For in 1879, Gray (1879, pp. 131-132) challenged the authenticity of Grainger's find. He stated that the specimen, a molar tooth and not a thigh-bone, was found in Late Pleistocene deposits at Ballyrudder, north of Larne on the County Antrim coast. Leith Adams (1877, p. 247; 1878) accepted the Ballyrudder tooth as authentic, and asserted that he was informed by Grainger that the find from Larne "referred to him in his communication to the British Association (Grainger, 1874) now turns out to be doubtful" (Adams, 1878, p. 94). On this basis, it appears likely that only the fragments of whale bone, recorded by Grainger, are to be accepted as coming from Post-Glacial marine deposits on Curran Point.1 But, although Grainger's claim that E. primigenius is present at Larne must be rejected, there are two apparently authentic records of mammoth remains from this locality.

In 1889, Dr. John Moran (1889, p. 35) described a molar tooth of Elephas primigenius from a layer of "silt or coarse laminated clay" 3 to 5 inches thick, which occurred at an approximate depth of 3 feet, 9 inches (some 16 feet, 3 inches above high-water level) in the Post-Glacial gravels2 at the Harbour Ballast Pit (Section Z on Pl. IX). The second find was made by Knowles (1914, p. 117), whose statement is as follows: "I have myself a bone found 18 feet down in one of the sections of the raised beach gravels near Larne Harbour. I sent it for identification to Professor Newton, of Cambridge, and he sent it back labelled 'Qu. upper outside portion of the left ulna of Elephas.'" Without question these mammoth remains were derived by the Early Post-Glacial Sea from Late Pleistocene deposits (probably of the Interstadial Period) in the vicinity of Larne3 during Atlantic times, when the Curran gravels were accumulated. As yet, however, there are no localities anywhere in Ireland which conclusively demonstrate that Man occupied the region contemporaneously with the mammoth. The Larne evidence only shows that this mammal became extinct prior to the deposition of the Curran deposits.

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1 Since these remains were found in secondary position, they should not be cited as evidence that the Larnians of Curran Point were "among the Mesolithic groups to make use of Whales" (Clark, 1951, p. 69). Although these food-collecting groups very probably salvaged the meat and blubber off the carcases of stranded whales, as did their contemporaries of the carse-lands of the Forth Valley (see p. 90), the Rev. Grainger's finds cannot be accepted as proof that such was the case.

2 Moran (1889, p. 36) ascribed these deposits to the Glacial Period, and considered that they had been swept down from a higher level by the Inver River.

3 In addition to Larne and Ballyrudder, stray finds of Elephas primigenius have been recorded at several additional sites (Kilwaughter, Carncastle, and Glenariff) along the County Antrim coast (Charlesworth, 1928, p. 323). The only other vertebrate remains documented from the Late Glacial deposits of this region consist of a pair of antlers and an almost complete skeleton of the Giant Irish Deer found in lacustrine deposits, possibly of Zone II age, on the townland of Ballymoney, on Island Magee, approximately three miles south-east of Curran Point (Belfast Naturalists' Field Club, 1874, p. 75; Mitchell, 1949, p. 298). This area was overridden by ice during the Antrim Coastal Readvance (Charlesworth 1939, pp. 280-287).
Remains of Wild Ox (Urochs?) have also been recorded from the Larne region. Stirrup (1877, p. 54) states: "Near Larne, at the junction of the band of sand with the gravel, I found firmly imbedded in the sand, a fragment of bone and a tooth, which has been identified by Professor Boyd Dawkins as a tooth of Bos longifrons." According to Praeger (1896, p. 40), the horizon of this find corresponds with the sand layer exposed in 1887 in the so-called "Bay Road Section" (Section W-X in Fig. 3, p. 32). Elsewhere in North-east Ireland bones of Wild Ox (Urochs?) have been recovered at only one site belonging to the Early Post-Glacial Period; in 1934 several fragments identified as Bos were found at a depth of over 1-00 m. in the raised storm beach (Deposit B) at Glenarm, County Antrim (Allen, 1937, p. 216; Movius, 1937, p. 198).

The only osseous material obtained during the 1935 excavation consists of two fragments found in a pile of debris that fell from one of the walls of the pit. One of these is unidentifiable; the other is a portion of medium-sized long-bone, possibly Wolf, according to the late Professor Glover M. Allen, formerly Curator of Mammals, Museum of Comparative Zoology, Harvard University. Judging by the appearance of this bone as well as the circumstances under which it was found, it is probable that it came from Deposit C.

Thus the total list to date of mammal remains from the Curran deposits is not imposing. It is as follows: Elephas primigenius (presumably derived from Late-Glacial deposits in the vicinity); Bos longifrons (Urochs?); Wolf (?); and Whale (sp. unknown).

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Heron-Allen, E. and Earland, A. . 1909. On the Recent and Fossil Foraminifera of the Shore-Sands of Selsey Bill,


--- . . 1940 . An Early Post-Glacial Archaeological Site at Cushendun, County Antrim. [With
Reports by Jessen, K.; McMillan, (Mrs.) N. F.; and Richardson, F. L. W., Jr.]


Proceedings of the Royal Irish Academy


Fig. 1—Larne Lough, Island Magee and Curran Point showing the Location of the Site.

Fig. 2—Same View as that shown in Fig. 1 (above). Photo taken by Mr. R. J. Welch of Belfast ca. 1900. (After Coffey and Praeger, 1904, Pl. IV).
Fig. 1—The Foreshore on Curran Point showing Erosion Scarp.

Fig. 2—The Sandy Deposits at the Base of the "Raised Beach" Gravels showing a Razor Clam (Ensis [Solen] siligua L.) in situ in Deposit F.
Fig. 1—Work in Progress showing Location of the 5.00-metre Square Pit to the Adjacent Buildings

Fig. 2—General View of the Excavated Site.
Fig. 1—The Pit at the Completion of the Work showing the System of Stepping the Walls.

Fig. 2—Photograph and Key showing the Stratification of the Excavated Site.
Fig. 1—Detail of the Upper Portion of the Deposits.

Fig. 2—Detail of the Lower Portion of the Deposits.
Fig. 1—The Surface of Gravel Layer (f) directly Underlying Sand Layers (d) and (e). Note the fact that there is no evidence of imbrication.

Fig. 2—Detail of the Surface of Gravel Layer (f) showing Shells of Gibbula sp. in the Position in which they were found.
The Antrim Basaltic Plateau shows Pockets of Altered Flints on Eroded Surface of Indurated Chalk, the latter containing Bands of Flints in situ and overlain by Basalt. (R. J. Welch photo; reproduced by courtesy of the Belfast Municipal Museum and Art Gallery).
Section through the Early Post-Glacial Deposits at Curran Point, Larne.
NORTHWEST

DATUM + 30.05 FEET O.D.
(9.16 M.)
16 FEET (4.88 M.) ABOVE H.W.L.

A SURFACE

28.60 FEET O.D. (8.76 M.),
16.60 FEET (4.55 M.) ABOVE
HIGH-WATER LEVEL.

B STORM BEACH

C INCLINED BEDS OF
COARSE GRAVEL AND
SAND

D FINE RED-BROWN SAND

- HIGH-WATER LEVEL

E HARD GREY SAND

F FINE RED-BROWN SAND

G DARK BLUE SAND

H ESTUARINE CLAY

LOW-WATER LEVEL

WAS SAMPLED BY BORING TO A
DEPTH OF 11.00 M. (36.1 FEET) BELOW DATUM.

EARLY POST-GLACIAL DEPOSITS

COUNTY ANTRIM

BORNE
NOTES: $h = \text{height above H.W.L.}$
B.C. = BOULDER CLAY

NOTE: ALL SHIMED AREAS CONNECTING MEASURED
SECTIONS ARE CONJECTURAL.
Plate and Section showing the Method of Formation of Curran Point.
CURRAN AND DRUMALISS

OLD LARNE POTTERY

MUD

CHAINE MONUMENT

ANTRIM GLACIAL DEPOSITS

VERTICAL SCALE EXAGGERATED 25 TIMES
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**Note:** The table above describes the stages of the Post-glacial marine transgression, indicating the transition from preboreal to post-glacial conditions. Each stage is characterized by specific environmental and sedimentary conditions, reflecting changes in climate and sea level. The table outlines the transition from one stage to another, highlighting the shift from a marine environment to a more continental setting.
ABRIDGE

LARNIAN:

ISLAND MAGEE — (Burcheil's Section)
Deposit A (upper): Raised Storm Beach
Deposit B: Black Sand
Deposit C: Estuarine Clay (Intermediate Zone)

is early Sub-Zone VIb
(This corresponds to Deposit A in the section described in this report by Jessen)
Deposit D-G: Alternating Beds of Black Sand and Gravel. (Probably = Sub-Zone VIb)
Deposit H: Old Land Surface. (Age=Sub-Zone VIb)
Deposit 1: Boulder Clay

GLENARM — (Harvard Excavation)
Deposit A: Surface Humus
Deposit B: Raised Storm Beach — overlying erosion surface and scarp formed on the Boulder Clay foreshore during the maximum of the submergence

LATE LARNIAN:

EARLY LARNIAN:

(Intermediate Zone)
Deposit C: Estuarine Clay (Intermediate Zone)

is early Sub-Zone VIa
Deposit D-G: Alternating Beds of Black Sand and Gravel. (Probably = Sub-Zone VIb)
Deposit H: Old Land Surface. (Age=Sub-Zone VIb)
Deposit 1: Boulder Clay

EARLY LARNIAN:

ISLAND MAGEE — (Burchell's Section)
Deposit A (upper): Raised Storm Beach
Deposit B: Black Sand
Deposit C: Estuarine Clay (Intermediate Zone)

is early Sub-Zone VIb
(This corresponds to Deposit A in the section described in this report by Jessen)
Deposit D-G: Alternating Beds of Black Sand and Gravel. (Probably = Sub-Zone VIb)
Deposit H: Old Land Surface. (Age=Sub-Zone VIb)
Deposit 1: Boulder Clay

GLENARM — (Harvard Excavation)
Deposit A: Surface Humus
Deposit B: Raised Storm Beach — overlying erosion surface and scarp formed on the Boulder Clay foreshore during the maximum of the submergence

PLATE X

and Archaeological Sequence in North-eastern Ireland.
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**TOTAL & PERCENT**

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- **Small**: 14/27.4
- **Medium**: 5/10.7
- **Large**: 2/10.7
- **MISCELLANEOUS**: 1/10.7

**Larne Picks**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Perforators**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Ordinary**
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**TOTAL & PERCENT**

- **General Core**: 69/1,950.9
- **Small**: 14/27.4
- **Medium**: 5/10.7
- **Large**: 2/10.7
- **MISCELLANEOUS**: 1/10.7

**Larne Picks**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Perforators**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Ordinary**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Thomann**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Steep End**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Chipped End**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Notched**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Concave**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Concave Side**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Rolling**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7

**Rolled of Degree of**
- **Small**: 2/10.7
- **Medium**: 2/10.7
- **Large**: 2/10.7
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Plate XI

Chart showing the Frequency Distribution of the Archaeological Material from the Excavated Site by Levels.
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CORRIGENDA.

Page 8, Fig. 1.
For Ards Peninsular read Ards Peninsula.

Page, 226, 4th line from bottom.

Page 228, 3rd line from bottom of text.
For was created read succeeded as.