Part One

THE CHRONOLOGY OF THE LATE-GLACIAL & EARLY POST-GLACIAL PERIODS IN NORTHERN AND WESTERN EUROPE

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Chapter I

THE CHRONOLOGY OF NORTHERN EUROPE

1. INTRODUCTION

The recession of the last ice-sheets in Europe induced changes of far-reaching effect, which materially altered the shape and climate of the area, thus modifying the environment for plants, animals and man. The geographical events were of the first order, since they opened up and made available new land for human settlement, but the prime factor was climatic. In this changing world the Mesolithic cultures arose in Northern and Western Europe. One of them, which was chiefly centred in North-East Ireland, forms the main subject of this book. Therefore, if the archaeological data relating to this development are to be understood, the natural history of the area at the time of settlement must be established. This is the primary concern of the archaeologist, since therein rests the key to the interpretation of the material culture traits brought to light by excavation. But the problem is even more complex. It is also necessary to know the date of occupation in order that it may be fitted into the existing chronology of contiguous areas. Such a chronology has been established for Late-Glacial and Early Post-Glacial time in Northern Europe, but its extension into Western Europe—Britain and Ireland—has always rested on a somewhat nebulous foundation. The full picture that shows the close degree of similarity which exists between these two areas throughout the periods under discussion has not yet been reconstructed. It is not proposed to deal here extensively with the techniques which have been developed in order to compile the data; such discussions are better left to the specialist. However, the evidence itself, which offers the necessary chronological background for dating the archaeological sequence, will be outlined. In this chapter a brief summary of the history of Northern Europe during the Late-Glacial and Early Post-Glacial Periods is given, since this forms a basic pattern for the interpretation of the material in the two following chapters.

2. THE RECESSION OF THE LAST ICE-SHEET

During the peak of the last glaciation there were five independent centres of ice-dispersal in Northern and Western Europe: Novaya Zemlya and the North Urals, Fennoscandia, the Alps, the Pyrenees, and Great Britain and Ireland. In the latter region there were actually two principal independent sheets, but at the period of maximum advance these were confluent with each other. Thanks to the work of De Geer, Munthe, Sauramo, Tanner, and others, the data on the Fennoscandian Ice are particularly full and may be briefly summarized.

The ice did not retreat everywhere uniformly, as the edge was irregular and the recession was interrupted by pauses or even moderate readvances, as shown in Fig. 1. At the time of maximum advance the southward extension of the ice covered North-East and North Central Germany, and Denmark except the south-western portion of Jutland. The relic of this advance is known as the Brandenburg End-Moraine. During the first retreat period, known as the Daniglacial, or German substage, Denmark and most of North Germany were freed of ice. The first major halt is marked by the Baltic or Pomeranian End-Moraine, and during the next stage, the Gotiglacial, made up of the Danish and Scanian substages, the ice withdrew from Götland to approximately 59° North latitude, and uncovered Southern Sweden. There is evidence for a minor oscillation at this time in Southern Sweden where the Scanian Moraine was formed (Daly, 1934, p. 54). The Fennoscandian End-Moraine, which marks the second major pause in the recession, affords evidence of a slight readvance, and is made up of the Inner Ra Moraines in South Sweden and the Inner Salpausselkä Moraines in Finland. During the ensuing retreat, the Finiglacial, or Bothnian substage, the greater part of Finland was uncovered, and the ice was reduced to two separate lobes in Scandinavia. The split between the lobes occurred at Ragunda in Jämtland. Scandinavian geologists regard this as marking the end of the Glacial Epoch and the beginning of Post-Glacial time in this area.

In the Alpine region, three main series of end-moraines have been found, representing stadia in the retreat of the last ice (Penck and Brückner, 1909, pp. 948–53), which is known in this region as Würm II. Similarly, three stages in the recession of the last ice-cap in the Pyrenees have been traced by Obermaier (1906, p. 299 and p. 244). These phenomena, together with the

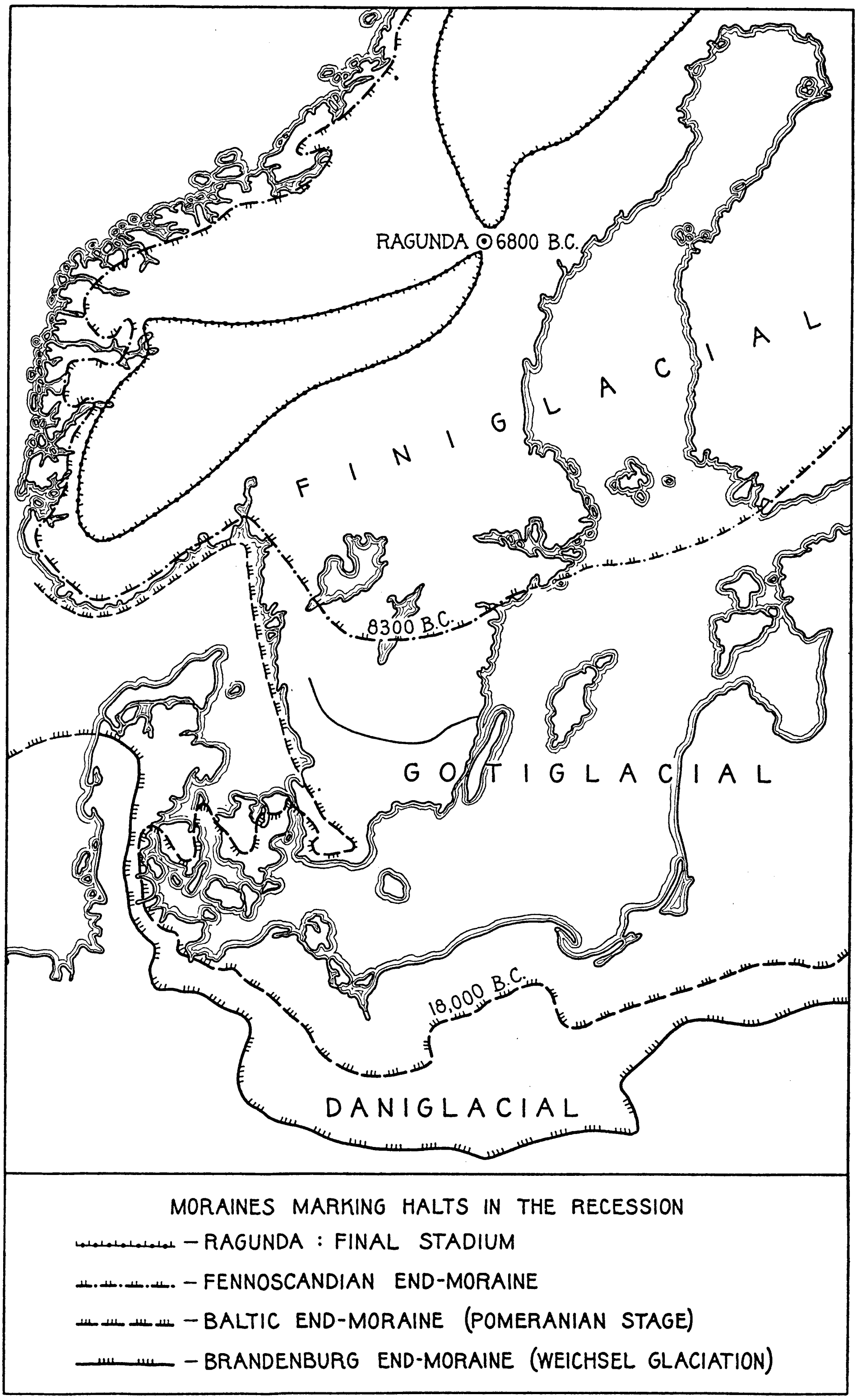

Fig. 1. The Stages in the Recession of the Last Ice-Sheet in Northern Europe. (After De Geer, with later additions.)

three stages of retreat, which will be shown in the next chapter to exist in the British Isles, strongly suggest the assumption that such major oscillations could not have had merely local causes; hence contemporaneity becomes a more plausible explanation. While admitting that actual proof is not possible, Clark (1936, p. 2) suggests the following correlation of the North European and Alpine ice-sheets.

SCANDINAVIA (De Geer)	THE ALPS (Penck and Brückner)
4. *Post-Glacial Period* Final Stadium: bipartition of the ice at Ragunda	4. *Post-Glacial Period* Daun Stadium: snow-line 300 m. below present level
3. *Finiglacial Period* Fennoscandian End-Moraine	3. *Geschnitz-Daun Period* Geschnitz Stadium: snow-line 600 m. below present level
2. *Gotiglacial Period* Baltic End-Moraine (Pomeranian Stage)	2. *Bühl-Geschnitz Period* Bühl Stadium: snow-line 900 m. below present level (Würm III)
1. *Daniglacial Period* Maximum Advance (Weichsel). Brandenburg End-Moraine	1. *Achen Retreat Period* Maximum Advance (Würm II)

The importance of the retreat to archaeology is obvious, as a maximum date can thereby be fixed for any site within the glaciated area. The indirect importance is likewise at once apparent, because the changes induced in sea-level, climate, vegetation and fauna had a marked effect on the development of the successive cultures which occupied the region. Before considering these changes, the method of arriving at an absolute dating for the recession will be presented.

3. GEOCHRONOLOGY

The chronology of the recession was established by De Geer (1910, p. 252), who counted the annual varves deposited in the lakes formed of melt-water in the depressions left by the northward receding ice-front. Varves are formed in lacustrine sediments which are composed of silt, clay and sand. A periodic deposition of materials is fundamental for their formation resulting from a large supply of sediments in summer and little or none in winter. Precisely such conditions are found near the margin of an ice-sheet, where the summer melt-waters bring their annual loads into the lakes. Here the heavier materials, sand and coarse silt, are deposited first, and the finer particles, clay and fine silt, remain in suspension until winter. They are then laid down in the quiet waters of the lakes, whose surface would be frozen over. This alternation forms distinct coarse laminae or varves, which range in thickness from about 0·2 cm. to 3·0 cm., each being made up of (*a*) a lower or summer layer which is thicker and contains more sandy material, and (*b*) an upper or winter layer, which is thinner, darker in colour, and composed of fine clays and silts. At no single place does a complete section of varves occur between two stages of the ice-retreat; but De Geer counted overlapping sections at one kilometre intervals from Scania to Ragunda, and thereby established an absolute chronology for the last sixteen millennia. The importance of De Geer's work in the light of Late-Glacial and Early Post-Glacial archaeology can hardly be overestimated.

On the basis of the geochronological dating established in Scandinavia, the ice reached Ragunda about 6800 B.C., as shown on the map (Fig. 1), and this point is regarded by geologists as marking the beginning of Post-Glacial time (De Geer, 1910, p. 252; 1927, pp. 422–5). It took approximately 11,000 years for the retreat from the Baltic End-Moraine, or Pomeranian stage (± 18,000 B.C.), to Ragunda. The first authentic date, according to De Geer (1928, p. 312), is ± 14,800 B.C., which marks the beginning of the Gotiglacial Period; the earliest stage of the Fennoscandian halt has been fixed at ± 8300 B.C., and the Finiglacial Period began ± 7800 B.C. In the absence of varves, allowing approximately an equal time for the Daniglacial Retreat stage, the recession from the line of maximum advance probably began ± 30,000 B.C. On the basis of Milankovitch's solar radiation curve, however, which places the last ice-advance at 72,000 B.C. (Zeuner, 1938, p. 56), this figure seems absurdly low.[1] Whether or not the Milan-

[1] It should be pointed out that those who use the solar radiation curve for dating Pleistocene events argue that there is a close agreement between De Geer's date (± 18,000 B.C.) and Milankovitch's date (± 23,000 B.C.) for the Pomeranian stage (Würm III of the Alpine sequence), if allowance is made for the inevitable time-lag (in this case 5000 years) between cosmic cause and geological effect (Clark, 1939, p. 139). Before the Milankovitch system can be accepted, however, several fundamental points remain to be proved:

(*a*) That a decrease in solar radiation is the direct cause of glaciation. This is the basic assumption made by those geologists who have accepted Milankovitch's curve of radiation as a means for dating Pleistocene events.

(*b*) That an extension of the curve (calculated by the same method as that apparently established for the Pleistocene) to cover the Tertiary Period be made as well. If similar amplitudes can be demonstrated for other periods (e.g. the Eocene) in Western Europe, then the whole question of the alleged coincidence between the solar radiation and glacial curves for the Pleistocene will have to be reinvestigated.

kovitch system will prove to be absolute, we have the established geochronological date of ±14,800 B.C. for the beginning of the Gotiglacial Retreat, and earlier than this, time-scale computations are based on a different approach, although it appears likely that the Pomeranian stage can be assigned to ±18,000 B.C. After the Pomeranian stage, there was considerable acceleration in the recession, due principally to two factors: first, the thinning of the ice-cap, because the thinner it became the faster it melted, and second, as the area covered by the ice was reduced, the climate became more moderate, since an ice-cap creates its own unfavourable environment. In spite of the continued existence of some ice, the climate was definitely ameliorating, as seen by the plant remains near the ice-front. With the beginning of the Finiglacial, this change was especially marked.

Independent work on the varve clays of Finland has shown that they correlate very closely with those of Sweden (Clark, 1936, p. 6). Since a margin of error of not over a few centuries exists, the natural system of chronology for the last sixteen millennia in Scandinavia may be taken as very nearly absolute for geological and archaeological purposes. This degree of accuracy is not even approached by any system based on the development of early human history. Outside the Baltic, the earliest index of time is the rather dubious northward extension of Egyptian and Near Eastern chronology, which is not practicable before *ca.* 2000 B.C. (Burkitt and Childe, 1932, p. 186). Geochronology is of special importance, therefore, since it furnishes us with fairly reliable prehistoric dates and may form the basic chronological framework in other areas as well.

4. CHANGES OF LEVEL: DELEVELLING

During the last ice-advance there is no doubt that the Scandinavian region was basin-shaped, in consequence of the downward pressure produced by the superposition of the great weight of ice. Corresponding to this basining, or sinking, of the land, there was an emergence in the zone about and beyond the edge of the ice-sheet, which is known as the peripheral bulge. In Scandinavia very complete data, relating to the recoil of the land after the recession of the ice, have been compiled from the study of high-level strand-lines. Since the melting of the ice affected the mutual relations of both land and sea, the study of delevelling is complicated, and will be only briefly outlined here (compare Daly, 1934, Chapters I and II; Wright, 1925 and 1934).

The crustal recoil of the land, isostasy, may be a primarily local phenomenon with local uplift, or general subsidence of the earth's crust as the

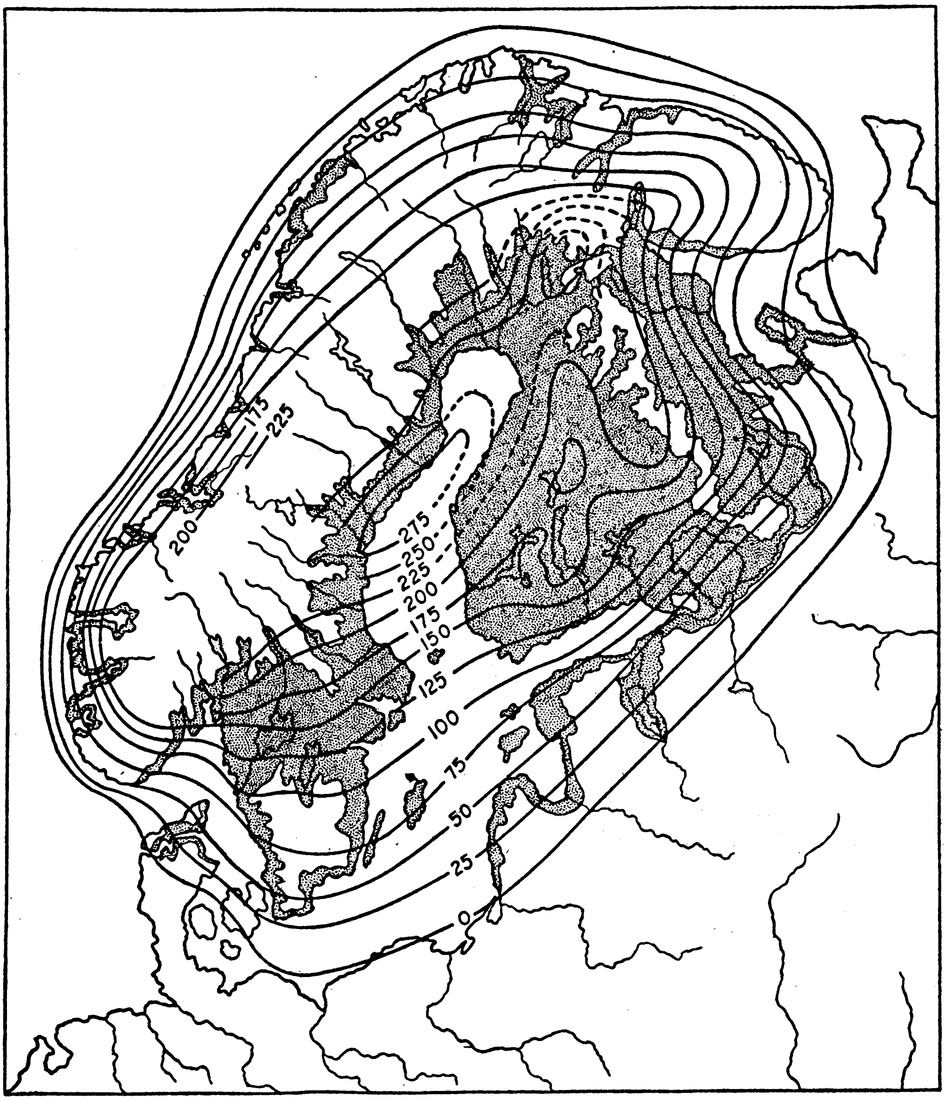

Fig. 2. Map illustrating the Depression of Fennoscandia under the Weight of the Last Ice-Sheet. The contours of the depression, or isobases, represent in metres the Late-Glacial and Early Post-Glacial uplift of the highest strand-lines of the ocean. The area covered by the Yoldia Sea is shown by stippling. (After Daly.)

principal cause. In Fennoscandia, elevated sea beaches and submerged peats, the age of which is determined from fossils and pollen grains, prove that there has been a general isostatic uplift of the whole area. By carefully mapping the points above which there has been no Post-Glacial wave action, the contours or isobases of the depression are produced (Fig. 2). The

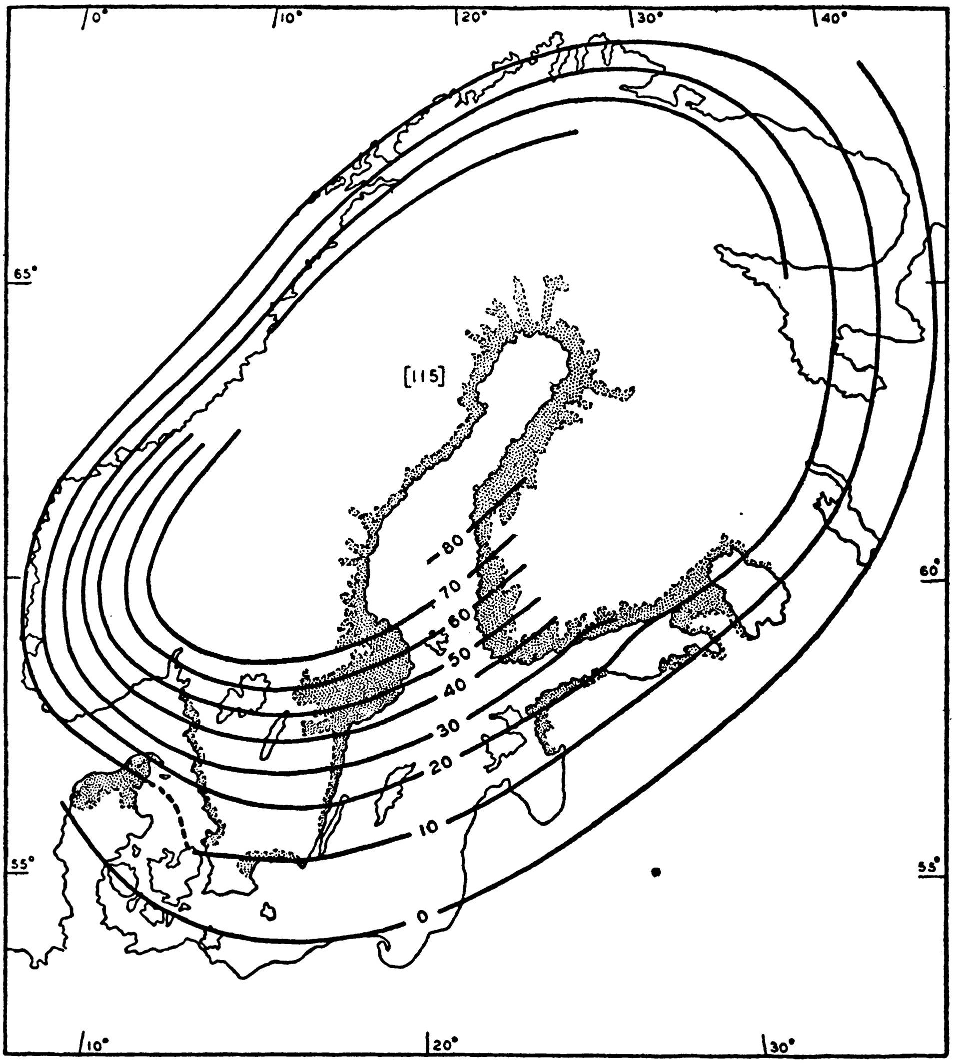

Fig. 3. Map of the Litorina Sea with the isobases of the litorina strand-lines in metres. (After Daly.)

area of greatest depression thus defined may be taken as the centre of greatest ice-dispersal. The present 0-isobase of the Late-Glacial uplift is close to the line marking the 0-isobase in Early Post-Glacial time (Fig. 3). South of this