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BARRY CUNLIFFE

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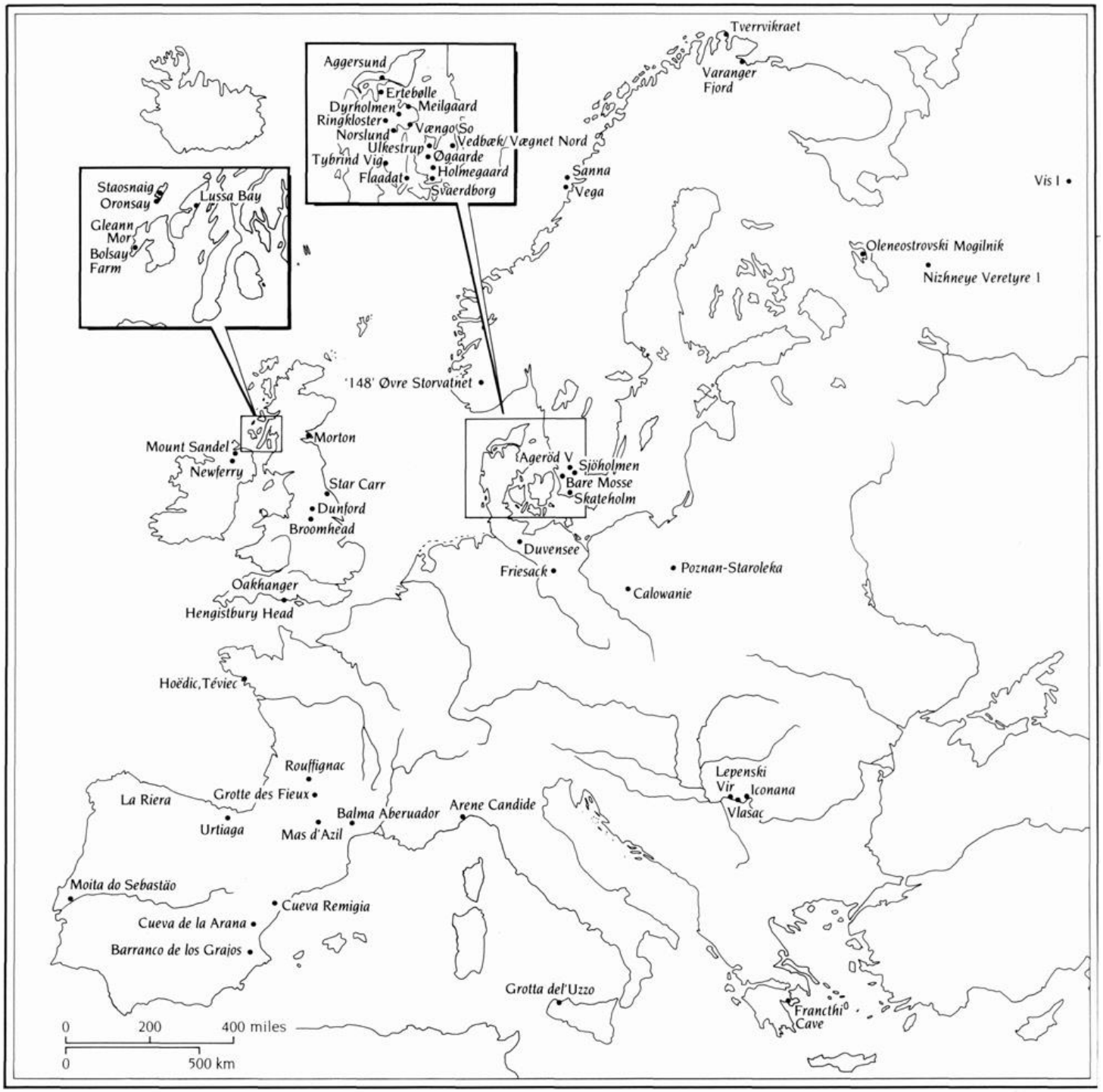
The Mesolithic Age

STEVEN J. MITHEN

Introduction

THE Mesolithic denotes the period following the end of the last Ice Age and prior to a predominantly farming economy. Both of these time boundaries are extremely fuzzy. The late-glacial interstadials (*c.*13,000–12,000 BP) provided a 'false start' to the post-glacial during which hunter-gatherers adapted to warmer environments. They then had to re-adapt to a final period of intense cold before warmer conditions returned. Consequently, quite where one draws the line between the Palaeolithic and Mesolithic is to some extent arbitrary—a date of 10,000 BP is often chosen. Rather than seeing any clear separation in the archaeological record between the behaviour of Palaeolithic and Mesolithic hunter-gatherers, we see a process of continuous behavioural change stretching back into the last glacial as foragers explored and exploited a series of ever-changing landscapes. The same underlying process of human adaptation to the environment structured both Mesolithic and Palaeolithic societies. Moreover, many of the traditionally diagnostic features of the Mesolithic, such as microlithic technology and the exploitation of coastal resources, are now firmly traced back into the Palaeolithic.

The juncture between the Mesolithic and Neolithic is similarly blurred. The use of pottery, sedentism, and complex social organization were once thought to be the sole domain of Neolithic populations. These are now known to have been prevalent in the later Mesolithic. Similarly the economy of many early Neolithic groups is now recognized to have been based on wild rather than domesticated resources. They are perhaps more appropriately described as 'complex hunter-gatherers' rather than farmers. While it is impossible to specify precisely when the Mesolithic began or finished, it is nevertheless one of the most critical periods in European prehistory. At the end of the Pleistocene (10,000 BP) populations were living in a manner that had not changed in its essence since the first arrival of biologically modern humans in Europe 30,000 years previously. They were characterized by an egalitarian social organization and highly mobile lifestyles. Within 5000 years three irreversible events had occurred that underwrite the developments of later prehistory: ranked societies had appeared; agricultural economies had been adopted; man had interfered with, and dramatically altered, the natural environment.



MAP OF EUROPE showing principal Mesolithic sites mentioned in the text.

Yet we discredit the Mesolithic if we only see it as a period of transition and study it for that sake alone. While many of its social and technological traits are found in the Palaeolithic and Neolithic, their particular constellation and interplay in the Mesolithic was unique. It was a period of significant cultural achievement in the spheres of technology, subsistence, and art. Indeed many view the Mesolithic as a period when the

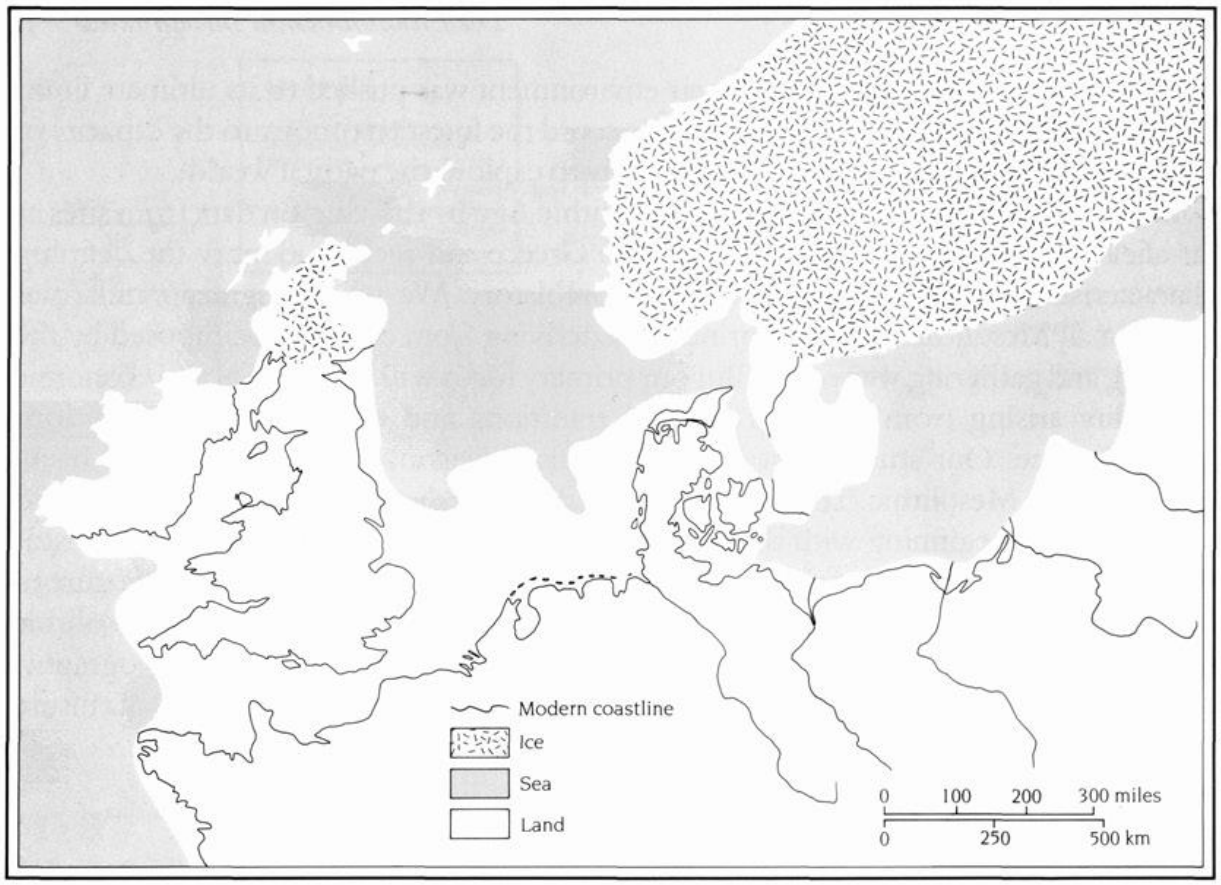
engagement between humans and their environment was pushed to its ultimate limit. In this sense we have in the archaeological record the finest testimony to the capacity of humans to become part of, rather than simply to exploit, the natural world.

In this chapter we will consider the Mesolithic Age by drawing on data from sites as far afield as northern Norway and southern Greece and seek to identify the defining characteristics of this phase of European prehistory. We will recognize similarities between all Mesolithic societies, principally deriving from constraints imposed by the hunting and gathering way of life. But our primary focus will be on social and economic variability arising from different cultural traditions and environmental conditions across Europe. Our study must start by briefly reviewing the environmental background of the Mesolithic. Then we will gradually construct a picture of settlement and subsistence by beginning with the artefacts, the faunal remains, and the features excavated from sites. We will consider how these may be integrated to interpret the nature of individual settlements and then how these may be related to build models of Mesolithic settlement-subsistence systems. We will then need to discuss aspects of demography, social organization, and art, and conclude with general models for the process of culture change during this critical phase of European prehistory.

The Environmental Background

The prehistory of the Mesolithic Age is intimately tied to the sequence of environmental changes that ensued following the end of the last Ice Age. The increasing warmth changed the extent of land and sea, the distribution of vegetation and of animals. The most dramatic and well-researched environmental changes occurred in northern Europe in the immediate vicinity of the retreating glaciers. In this area the physical geography, flora, and fauna underwent a series of dramatic changes, at least on a geological time-scale. Whether or not these were perceptible to the Mesolithic peoples themselves is open to debate. One may well imagine that folk memories existed about times when there were large hunting lands available that had become drowned by the sea.

Land/sea relations Two processes occurred in northern regions to create new sizes and shapes for the land masses; isostatic rising of the land, which had been depressed by the weight of the ice, and eustatic rising of the sea level due to melted water from the glaciers. Isostatic recovery was limited to the land which had been beneath the ice sheets, and was so dramatic in the far north so as to leave relic post-glacial shorelines over 250 metres above the present sea level. This unwarping of the land was a slow and time-lagged process; land in northern Scandinavia is still rising today. In such areas this isostatic land recovery created much larger areas of land to be claimed by spreading vegetation and exploited by Mesolithic hunter-gatherers. Working in the opposite direction, was the eustatic rise of the sea level. In contrast to isostatic land recovery this was a rapid process affecting all areas. It led to the drowning of glacial, and early post-glacial coastlines and in some areas, such as southern Scandinavia, the loss of large areas



LAND, SEA, AND ICE IN NORTHERN EUROPE at *c.*10,500 BP. Britain was joined by extensive lowlands to the continent which became progressively flooded during the course of the Mesolithic due to the continued retreat of glaciers.

of land and hence the reduction in hunting territories. Britain became cut off from the Continent at around 8500 BP. One can appreciate that the combination of these two processes, together with variable rates of deglaciation, created considerable variability across northern Europe in the specific alteration in shorelines.

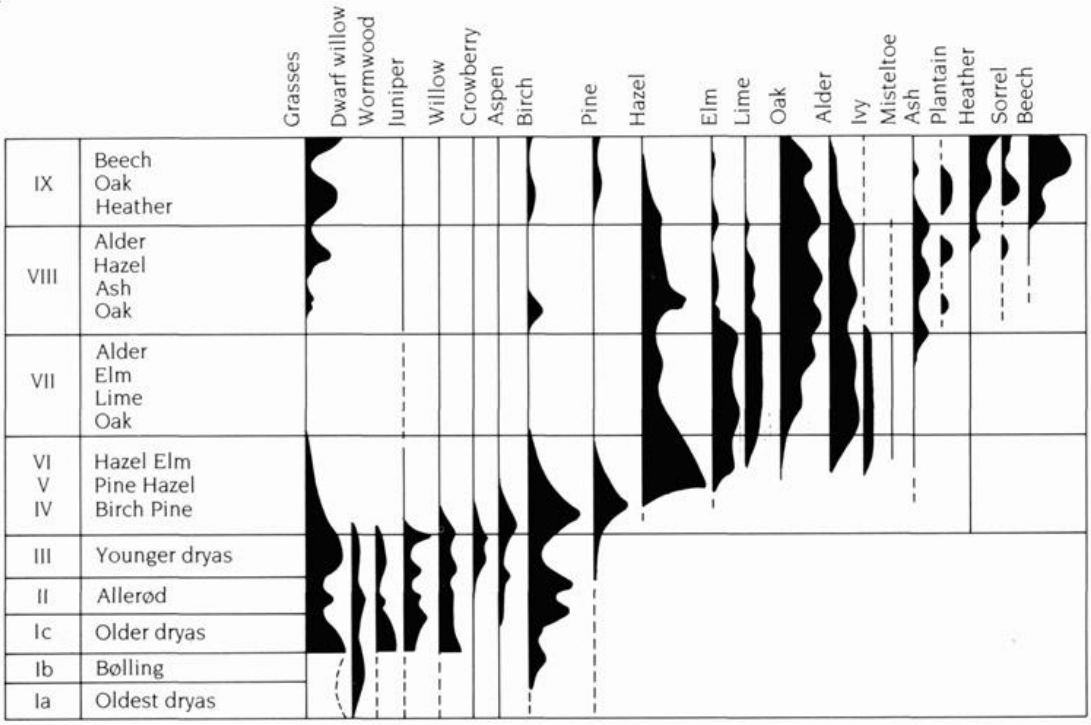
The Gulf of Bothnia illustrates the complexities of these environmental changes. During the last glacial this area was filled by an ice-dammed lake that spread over what is now southern Sweden, the Baltic islands, Estonia, and Finland. As the ice retreated, salt water penetrated the basin bringing in marine organisms. Delayed isostatic recovery of the land, however, soon outstripped the eustatic rise of the sea level and a freshwater lake was once again created, the Ancylus lake. At *c.*7000 BP the land barrier to the south-east was once again breached by rising sea level to return the area to a marine environment, the Litorina Sea.

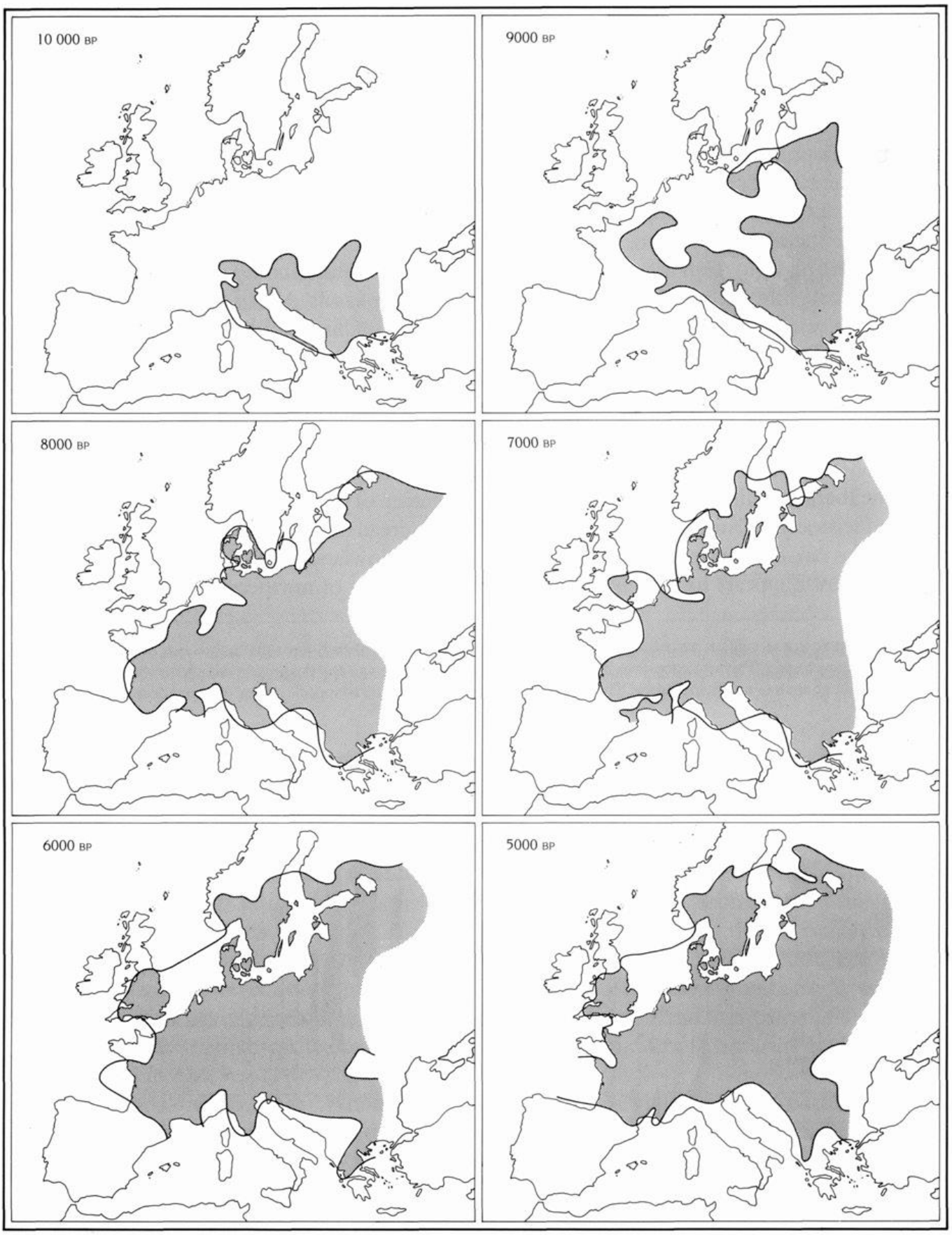
Vegetational change While these changes in land–sea relations were occurring there was a transition from open, tundra landscapes to those dominated by trees. Pollen cores from northern Europe show a succession of tree varieties resulting in the formation of thick forest. We can construct 'isopoll' diagrams to show the spread of specific species across Europe, such as lime and oak. The spread and succession of different tree types

was determined by a complex interplay of factors involving increasing warmth, processes of soil formation, tree migration rates, and the location of refugia. Evidence from beetle remains shows that many areas had been sufficiently warm for tree species for many years prior to their arrival from refugia in south and east Europe. In northern Europe the earliest post-glacial landscape was dominated by herbs of open land with the cold-tolerant species of birch, aspen, willow, and juniper. As the temperature increased, pine, and then hazel, rose to prominence followed by warm-loving, broad-leaved species eventually to form the mixed forest of the mid-post-glacial composed predominantly of oak, lime, and elm, with alder on less well-drained soils. A consequence of the increasing warmth and vegetational succession was the infilling of lakes with organic sediments. This process began immediately after the melting of the ice and many shallow lakes became completely filled in during the course of the Mesolithic.

In southern Europe, away from the former edge of the ice sheets, the vegetational changes were less dramatic. Here the lack of moisture, rather than low temperature, was probably the critical limiting factor for late Pleistocene vegetation. In southern France and the Iberian peninsula there was sparse tree vegetation of pine and juniper at the end of the Pleistocene. During the early post-glacial, pine spread to the higher ground while deciduous oak-dominated forest spread throughout the lowlands. The composition of the oak forest appears to have been rather different to that of northern Europe with

THE DRAMATIC CHANGES IN VEGETATION during the Mesolithic can be inferred from the frequencies of pollen grains in sediment cores. This sequence from Denmark between *c.* 13,000 years ago and the present day shows a pattern common to large areas of northern Europe. The Roman numerals to the left refer to specific 'zones' of vegetation development.

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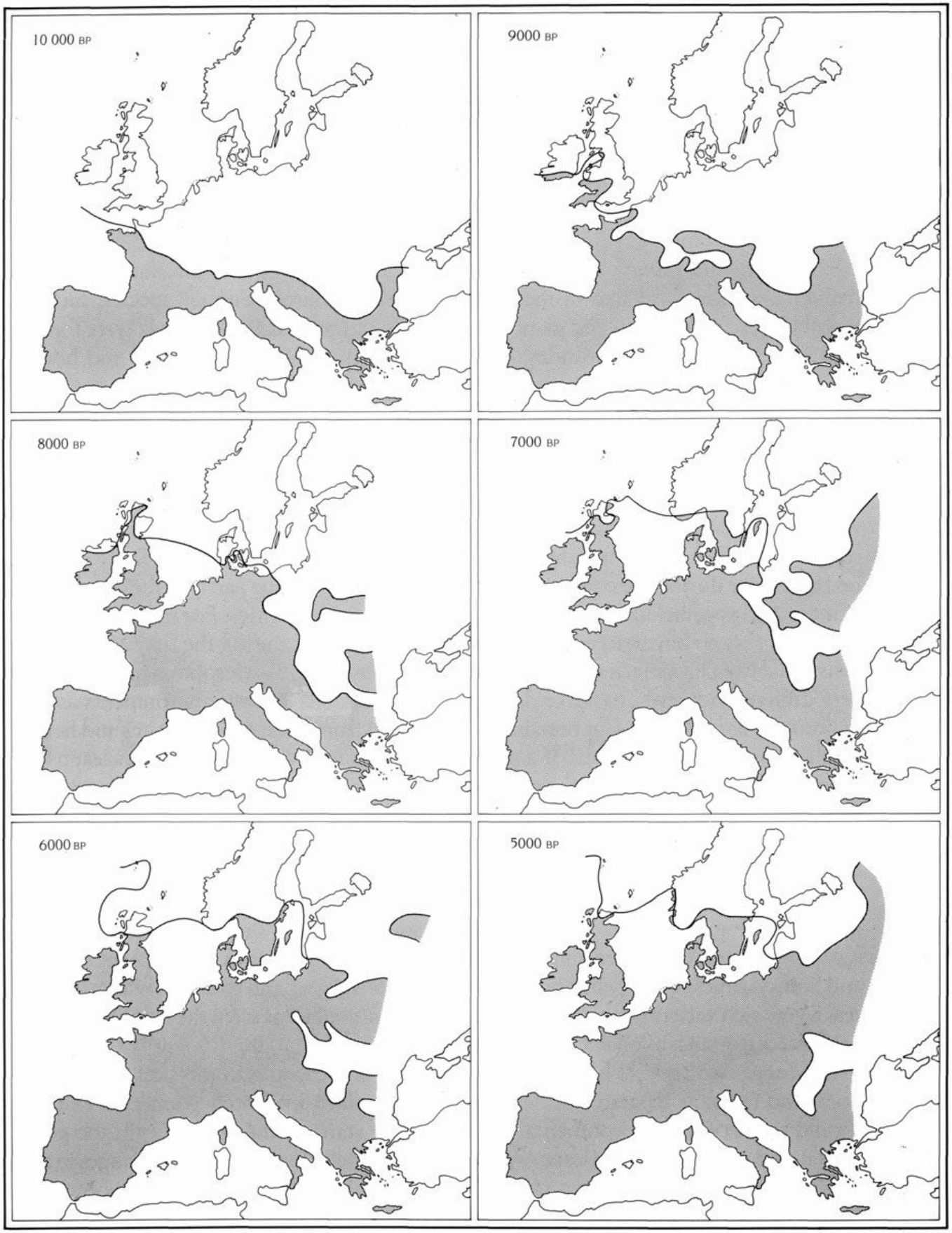


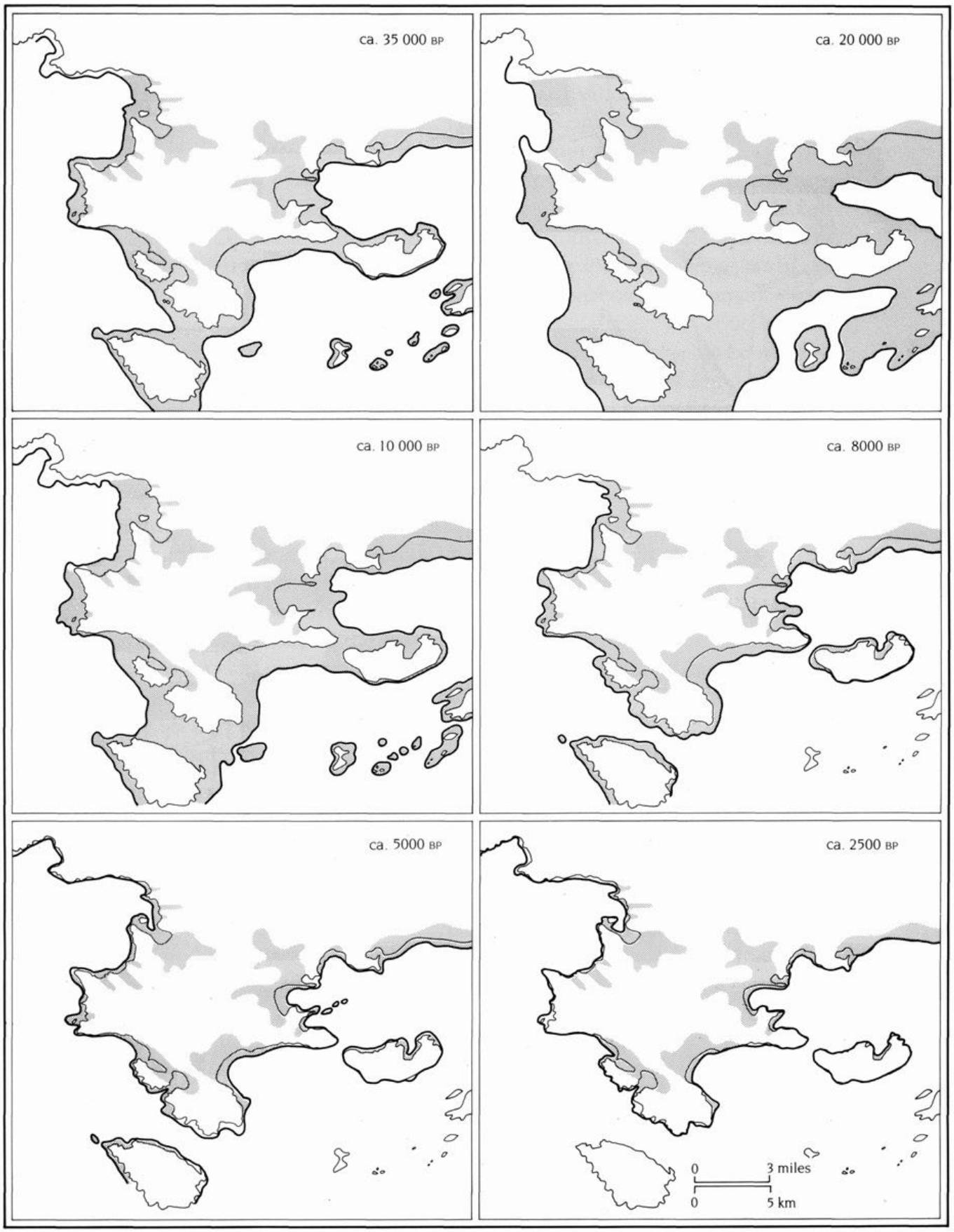
ISOPOLL MAPS can be used to describe the spread of specific plant species across Europe. The diagrams illustrate (*left*) the spread of lime (*Tilia*), and (*above*) the spread of oak (*Quercus*), by denoting the area in which they constitute at least 1% and 5% respectively of the total tree and shrub pollen.

much less elm, lime, and alder. In the eastern Mediterranean there were pockets of woodland at the height of the last glaciation, within a predominantly steppe environment. As the climate improved, first pine, and then oak, spread rapidly. Further increases in temperature and precipitation led to the spread of other tree species such as beech and hornbeam. In the drier areas, such as southern Greece, it is unlikely that woodland would ever have been substantial and the environment is most appropriately described as an open parkland.

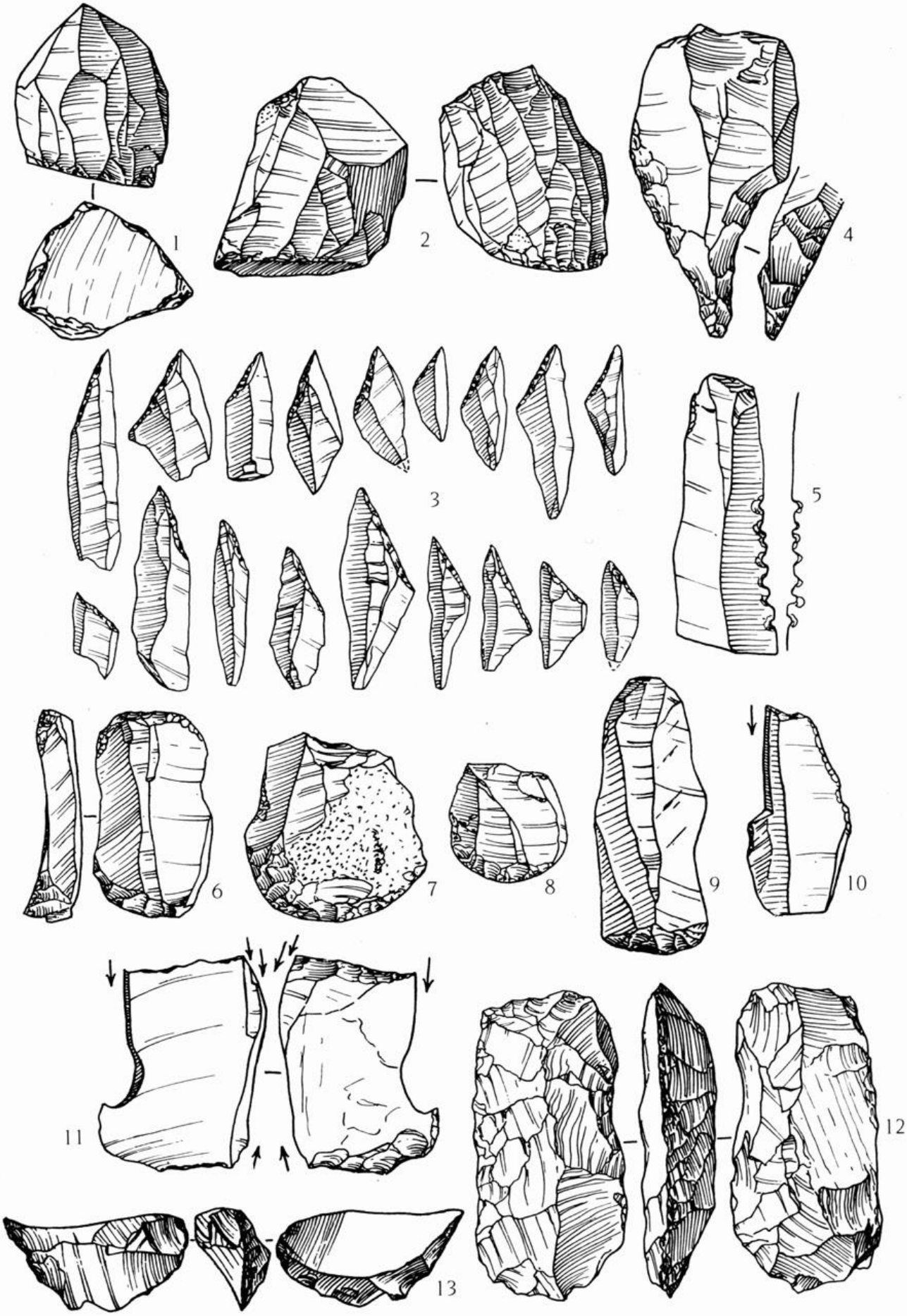
The post-glacial fauna Along with the vegetation, the post-glacial fauna showed marked contrasts with that of the late glacial. Several large mammal species, such as woolly rhino, mammoth, and giant deer, became extinct. Reindeer and elk were forced into the most northerly latitudes. The large migratory herds of reindeer and horse, which had inhabited the open tundra landscapes, were now replaced with a more diverse set of ungulates which lived in smaller groups and lacked marked migratory behaviour. Pre-eminent among these were red deer, roe deer, wild pig, auroch, and elk. The small mammal fauna also increased in numbers and diversity, notably in the thick forest of the mid-post-glacial. The particular character of the post-glacial fauna in any one region was, like that of the vegetation, dependent upon a broad range of climatic and ecological factors which caused considerable variability throughout Europe. The fauna continued to change during the course of the Mesolithic. This was due partly to the continuing climatic and vegetational changes, and partly to human activities. For instance, auroch and elk appear to have become extinct in eastern Denmark during the later Mesolithic. This is likely to have been caused partially by overhunting by Mesolithic foragers. It is very difficult, however, to make detailed reconstructions of past environments as the majority of animal and plant remains are recovered from archaeological sites and hence pass through a 'cultural filter'. If a particular species is absent, it is often unclear as to whether it was not present in the early post-glacial environment or simply not exploited by the Mesolithic hunter-gatherers.

The marine biotopes were also much richer in number and diversity of species during the post-glacial period than in the preceding glacial. Marine vertebrates ranged from whales and sharks to porpoises and dolphins. A wide range of salt-water fish became available for exploitation together with many species of shellfish. Many of these resources would have been migratory, becoming available for exploitation at specific and limited times of the year. The freshwater lagoons, lakes, and rivers also came to possess a very rich variety of animal life. Wildfowl were prolific as were the many species of freshwater fish such as pike, tench, and bream.

Landscape evolution While it is easiest to treat the changes in physical geography, flora, and fauna as separate entities, these were, in fact, intimately connected and we should think of the environmental changes at the start of, and throughout, the post-glacial, and a process of landscape evolution. This is well illustrated by the changes in the Argolid peninsula of southern Greece, an area exploited by the late Pleistocene and Holocene inhabitants of Franchthi cave. At 20,000 BP there was an extensive coastal



PALAEOGEOGRAPHY OF THE COAST of the southern Argolid in the late Quaternary showing the changing relationship between land and sea. The shaded areas denote coastal plains and lower valleys.



plain with sea levels more than 120 metres lower than today. This plain would have been covered with a steppe vegetation, though patches of trees are likely to have been present particularly around oases and watering holes. Large herds of horse and most probably bovids grazed on this plain. As the sea levels rose, this plain, and the resources it provided, were gradually reduced in extent until by 8000 BP there was only a narrow strip of sandy beach and marsh. This is lost today and the coastline is a series of rocks and cobbles set against steep buffs. Consequently, the Holocene hunter-gatherers had continuously to adapt their subsistence strategies to cope with a rapidly evolving landscape. These adaptations are reflected in the sequence of archaeological remains from Franchthi cave, as we will see below.

Environmental structure The floral and faunal changes should not only be noted in terms of the number and diversity of species. The whole structure of the post-glacial ecosystem was markedly more complex and less stable than that of the late glacial. Each species, including man, was involved in many more connections with other animal and plant species in terms of predator–prey and competitive relationships. The ecosystems became more susceptible to periodic, but unpredictable, fluctuation in species composition and numbers. The environment was also characterized by marked seasonal changes in vegetation and animal populations. In addition to this temporal variability, an important feature of the post-glacial landscapes was their spatial patchiness. Certain regions, and certain locations within those regions, were particularly abundant in resources, notably rivers, lakes, and the coast. Interior regions had a lower biomass and less diverse resource set. In understanding the Mesolithic lifestyle we need to take into account this temporal and spatial patchiness as well as the numbers and types of species. The technology used to exploit this environment, to which we will now turn, can be seen as geared to coping with the structure, as much as with the content, of the environment.

Technology

As with the earlier prehistoric periods, stone tools dominate the archaeological record of the Mesolithic. Flint was available in the majority of areas, and from this elegant arrowheads and other tools were fashioned. The preservation of organic materials in the bog sites of northern Europe provides a glimpse into the diverse and very sophisticated use of antler, bone, and wood. We also have a few instances from which larger items of technology have been preserved—those for shelter and transport.

FLINT WAS THE MOST IMPORTANT RAW MATERIAL during the Mesolithic and used to fashion a wide range of stone tools. The specific types vary considerably from site to site due to the nature of the flint (size of nodules, texture, location of source), functional considerations relating to the activities at the site, and the cultural context of those making the tools. These tools from Star Carr provide a typical range of the artifacts one finds on Mesolithic sites. 1–2: blade cores used for producing the blanks to be later retouched into tools; 3: microliths which were probably used in projectiles; 4: an awl; 5: a denticulate; 6–9: scrapers; 10–11: burins probably used for working bone and antler; 12: an adze and 13 a flake detached to a sharpened adze.

The use of stone Flint quarries dating to the Mesolithic are rare and probably absent in many parts of Europe. An exception are those found on the northern slopes of the Swietokrzyskie (Holy Cross) mountains on the southern edge of the Polish plain. From here a high-quality chocolate-coloured flint was quarried and this is found over a wide area, probably reflecting mobility patterns rather than exchange networks. In most areas, surface outcrops of flint were sufficient for the needs of the Mesolithic stone-knappers. These may have been primary deposits, such as from the chalk of southern England, or secondary deposits in the form of either erratic nodules in glacial sediments or beach pebbles. Such deposits may have been exploited either by special visits or by embedding the procurement of stone in other activities, such as hunting trips. Some primary workshops are known. For instance at Poznan-Staroleka in Poland a primary knapping site is known at an abundant source of erratic flint. The assemblage here typifies such a site in having very high frequencies of cores and primary cortical flakes and very few retouched tools.

Flint was not the only stone used during the Mesolithic. In areas where it was unavailable, or when inappropriate for the task in hand, the Mesolithic foragers turned to a wide range of other stones. Quartz and quartzites could also furnish sharp flakes for either scrapers or arrowheads. Excavations at the sites of Gleann Mor, Staosnaig, and Lussa River in the Hebridean islands of Scotland indicate the increasing use of quartz in Mesolithic tool-kits, as one moves further away from the flint sources. Slates lent themselves to splitting and polishing and slate knives are an important part of the Mesolithic tool-kit in northern Scandinavia. Fine-grained greenstones were also flaked while gneiss and a variety of rock types were worked by pecking to produce a range of artefacts such as axes and adzes. It is characteristic of the Mesolithic that a wide range of local raw materials were used.

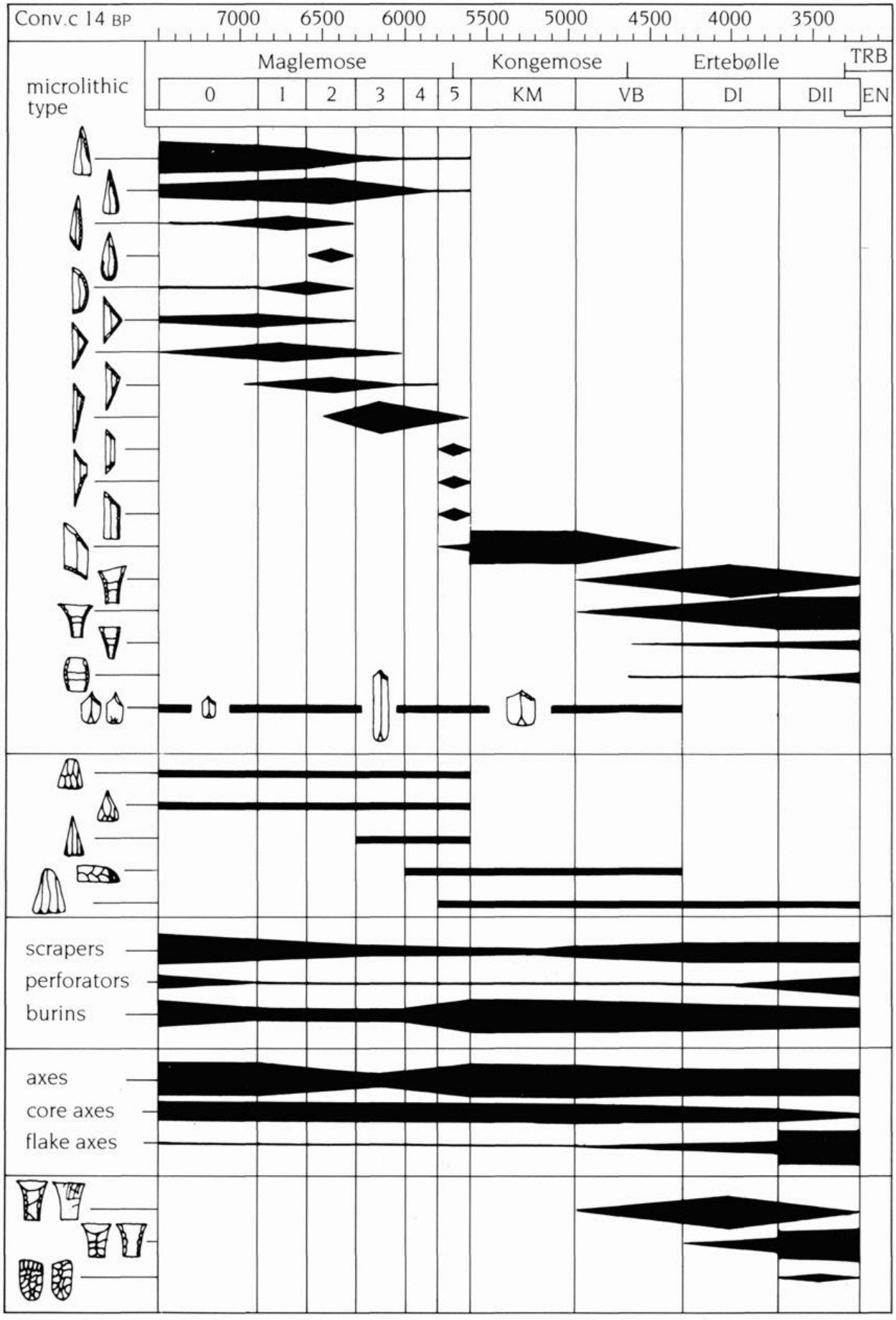
In certain areas of Europe we can document a change in the types of raw material used through time, which may reflect important changes in socio-economic organization. For instance, there is a marked difference in the raw materials used during the earlier and later Mesolithic of northern England, the boundary falling in the ninth millennium BP. In the earlier period, tools were made from a high-quality white/grey flint. Through time this was replaced by a variety of low-quality cherts and translucent flint. This change may reflect the failure of the high-quality flint to meet demand, perhaps due to a rising population, the exhaustion of its source, or its loss caused by a rising sea level. Alternatively, it may reflect a change in mobility patterns. The later Mesolithic foragers may have covered smaller distances when conducting their economic activities and hence had to rely on more local, and poorer quality, materials. Similar reasons may explain the change from the use of obsidian to quartz and quartzite at *c.*8000 BP by Mesolithic populations in the Danube gorges.

Many of the flint tools from the Mesolithic were made on small bladelets produced from pyramidal cores. An extraordinary level of flint-knapping skill is often evident as these cores are frequently very small and beautifully worked. It is likely that some

wooden supports may have been used to hold the cores in place when detaching the blades. In certain areas, such as Scandinavia, handle cores were produced. These are elongated cores so that the knapper could keep a firm hold at one end while detaching blades from the other. While such blade technology dominates the Mesolithic, a range of other reduction methods for producing flakes were also used. In areas where raw material nodules were small and/or of poor quality, bipolar working was used to produce thin and razor-sharp flakes and blades.

When the level of recovery and analysis is sufficient, considerable information about Mesolithic knapping strategies can be acquired. This is particularly the case when refitting of debitage and tools is used to reconstruct the 'biography' of a core. For instance at Bare Mosse II, an early Mesolithic site in Scania, 48 per cent of the 817 artefacts have been refitted to produce seven principal clusters of flakes and blades. From these, the specific knapping stages used on each core can be reconstructed. These include

LEAF-SHAPED SLATE POINTS
from Mesolithic Finland.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Maglemose
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KM
VB
DI
DII
EN
scrapers
perforators
burins
axes
core axes
flake axes

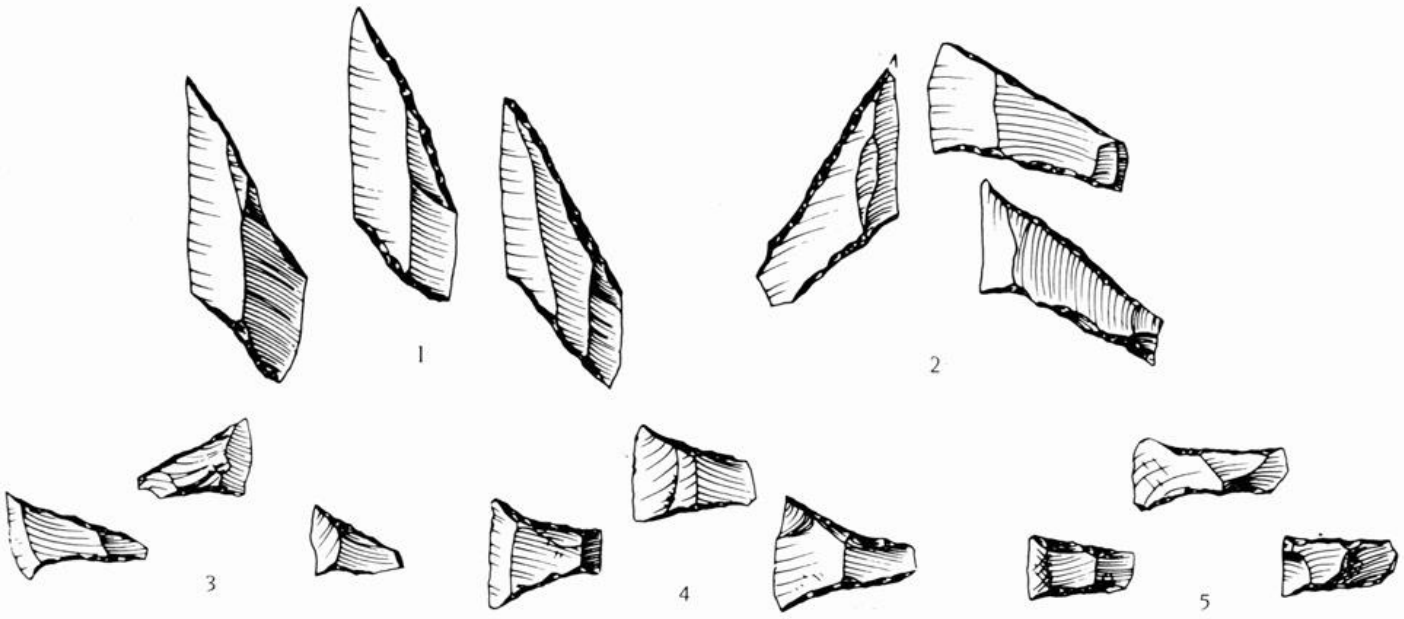
the removal of cortex and irregularities, the preparation of platforms, the removal of flake and blade blanks, and the retouching of these into tools. Some of the pieces from the refitted groups, such as the cores themselves, were missing suggesting that these had been kept and carried to other settlements. At Bare Mosse II one can recognize a consistent method of reduction and tool manufacture applied to each core. This probably reflects factors such as the constraints imposed by raw materials, similar functions for the tools, and traditions of tool manufacture within the group. Moreover, spatial patterning could be detected in the distribution of debitage types indicating that different stages of tool production were undertaken at different parts of the site. In general, the study of debitage in terms of reconstructing knapping strategies has become a central part of Mesolithic studies in recent years, overriding a more old-fashioned concern with typology.

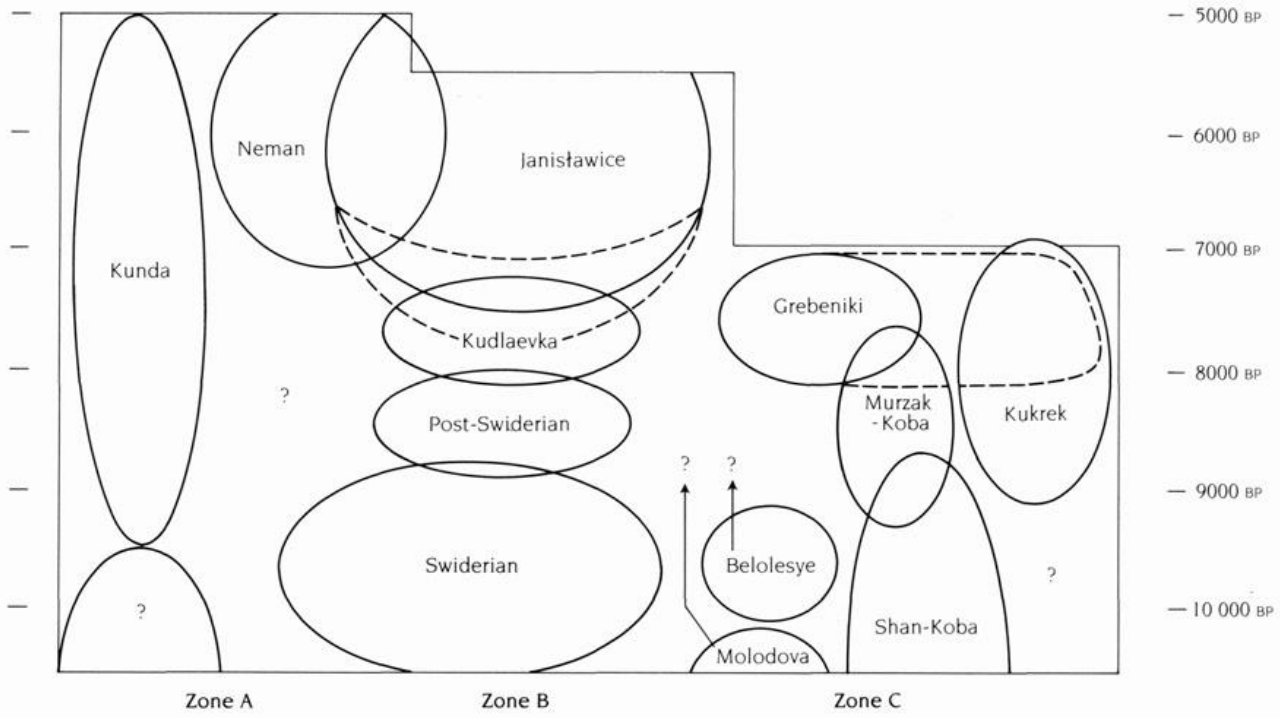
The microlith The Mesolithic is often directly associated with the use of microliths—small retouched blades or blade segments. This relationship is not absolute however; some Mesolithic industries, such as the Larnian (the later Mesolithic) of Ireland used a large blade technology—a 'macrolithic Mesolithic'. In addition microliths are found in several Late Pleistocene industries such as the Magdalenian (*c.*17,000–11,000 BP). Nevertheless the microlith is at least symbolic of the Mesolithic Age.

Microliths come in a diverse set of shapes and sizes. It has been, and remains, one of the principal concerns of archaeologists to classify these into types based on morpho-

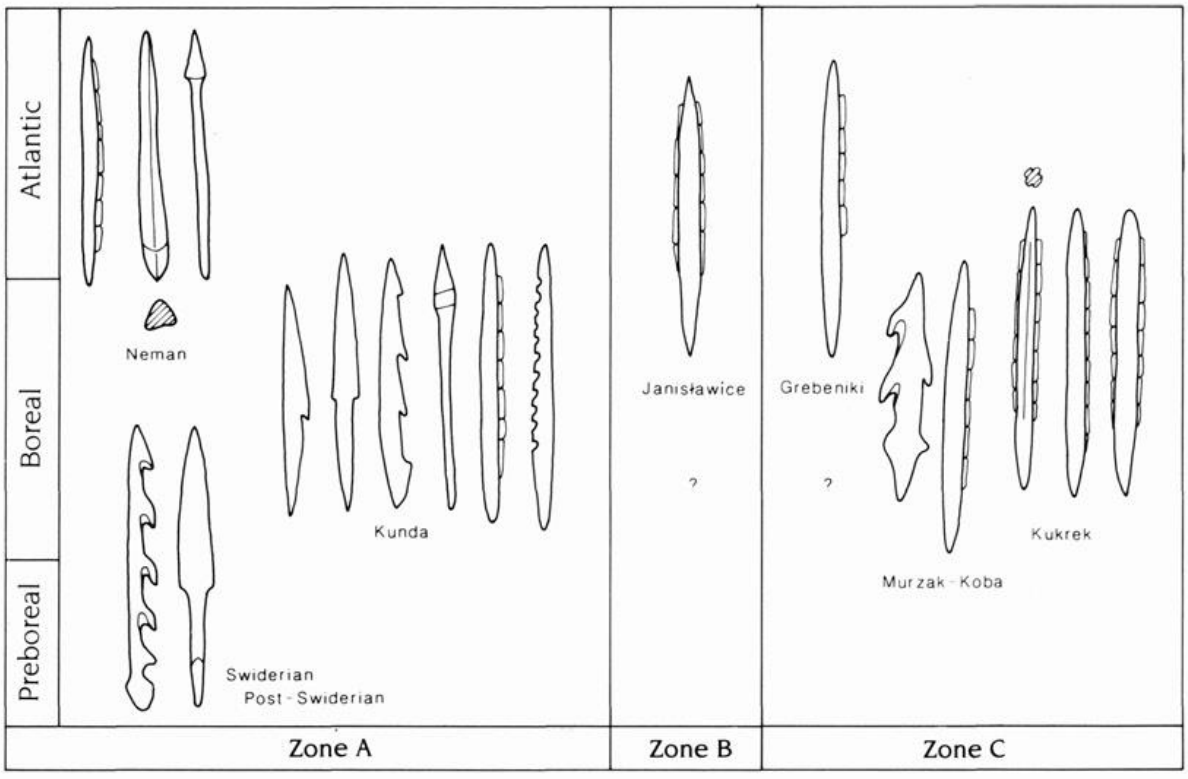
CHRONOLOGICAL SEQUENCE of microliths and other lithic types during the Mesolithic period in Denmark (*left*).

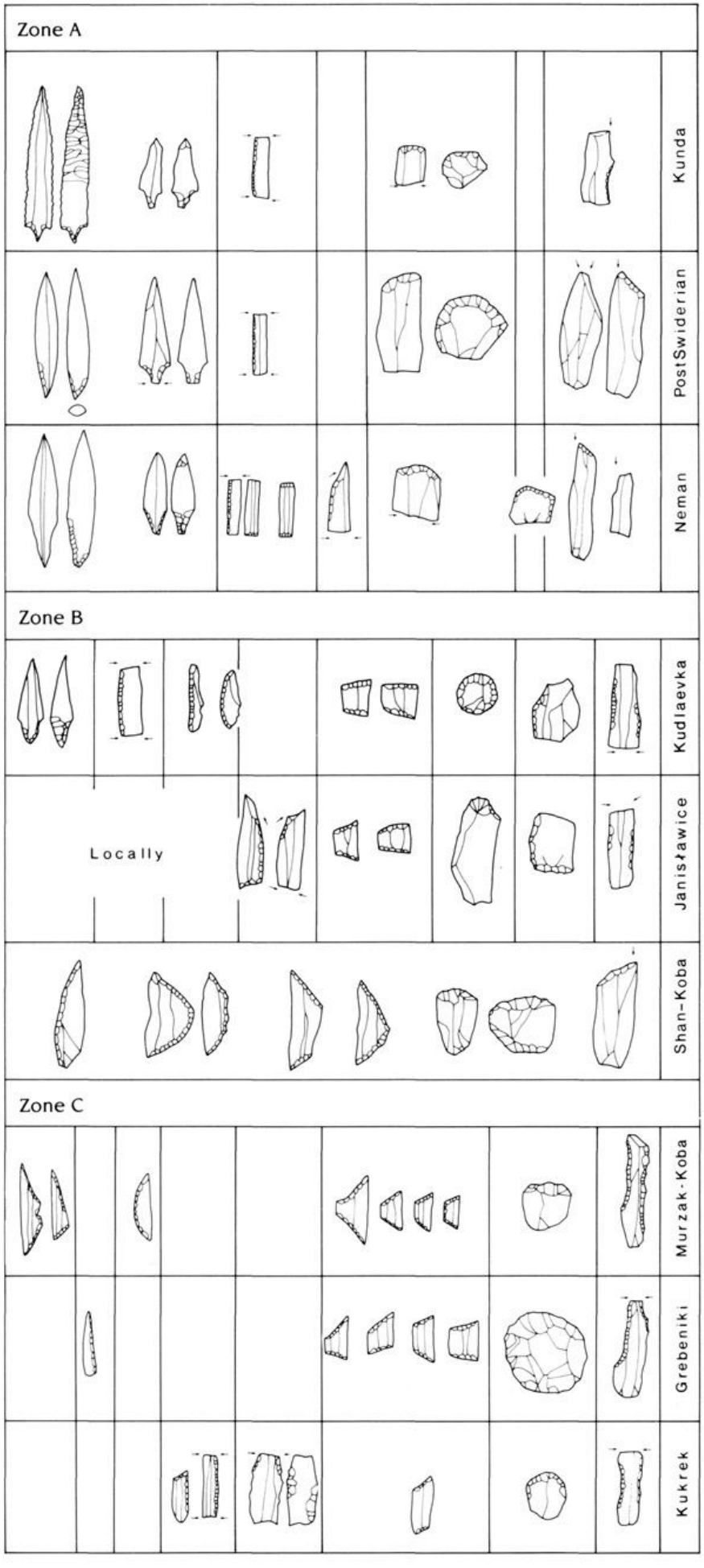
THE SUCCESSION OF PROJECTILE-POINT TYPES during the five phases of the late Mesolithic in north-east Denmark (*below*). (1) Villingebaek phase (early Kongemose); (2) Vedbaek phase (late Kongemose); (3) Trylleskov phase (early Ertebølle); (4) Stationsvej phase (middle Ertebølle); (5) Aalekistebro phase (late Ertebølle).





ARCHAEOLOGICAL INDUSTRIES and cultures of the Mesolithic (and other periods) have been defined on the basis of artifact types and their associations. The resulting patterns are often complex, as illustrated by those from the western part of the East European Plain. At least nine different taxonomic divisions have been made in this area. The three zones refer to the latitudinal/ecological subdivisions of this area. Zone A: northern lowlands and lakes; Zone B: central lowlands and river valleys; Zone C: the southern upland-lowland steppe. The meaning of such 'cultural variation' in space and time remains unclear.




Zone A
Kunda
PostSwiderian
Neman
Zone B
Kudlaevka
Janisławice
Locally
Shan-Koba
Zone C
Murzak-Koba
Grebeniki
Kukrek

logical characteristics. Their frequences in lithic assemblages are then measured and assemblages grouped into industries and cultures. Quite what the cultures represent in terms of past populations remains unclear, but some form of ethnic identity is often assumed. The best illustration of this typological approach is from southern Scandinavia where a rich archaeological record, a long history of fieldwork, and a quickly changing past technology combined to provide a wide set of microlith types. By 1973 these microlith types, together with other artefactual evidence, were used to identify ten industrial phases of the Mesolithic which could then be grouped into three cultures—the Maglemose (*c.*9500–7600 BP), the Kongemose (*c.*7600–6500 BP), and the Ertebølle (*c.*6500–5200 BP). More recently even finer distinctions have been drawn. The data sets from east Denmark have been used to divide the Kongemose and Ertebølle periods into five different phases based on changes in the shape of microliths. Elsewhere in Europe similar cultural historical sequences have been established. For instance, the Mesolithic data from north-east Europe has been classified into a complex series of cultures varying through time and space in their typical artefacts.

If we stand back from these regional sequences, three main phases of the Mesolithic for Europe can be established on the basis of microlith form and radiocarbon dating. The first phase is characterized by obliquely blunted points. Star Carr is the classic British site of this period, which ends at around 9000 BP. The second phase witnesses an immense diversification of microlith forms made on smaller blades, often referred to as 'narrow blade' or 'geometric' industries. They contain a range of forms such as scalene triangles, lancelots, and rods, and the earliest dates for these industries appear to be in southern France at the sites of Grotte des Fieux and Rouffignac during the tenth millennium BP. In the first half of the ninth millennium BP they are found at other French sites and in Holland and Britain; by 8500 BP they are widespread. These industries last about a millennium, and are in turn replaced by those dominated by rhomboids and trapezes made on broad blades. The latter industries appear almost synchronically across Europe, although, perhaps due to its isolation from the Continent, they are not found in Britain.

If we are to ask what caused this change in microlith types we must first consider what they were used for. The most likely answer is that they were a standardized element for a wide range of multi-component tools. One of their uses, perhaps the most important, was as points and barbs for hunting weapons. There are several lines of evidence for this. Numerous arrows have been found with microliths still attached to a wooden haft by resin and twine. Some microliths also show characteristic fracture patterns caused by impact with meat or bone. There have also been numerous finds of animal (and human) bones with microliths still embedded, indicating that they had been the cause of death. As such they would have killed either by slicing muscle and arteries to cause severe bleeding or by penetrating organs to cause almost immediate death.

Experiments with replica bows and arrows have suggested that microliths can have great penetrative power. Such replicas can be made due to finds of bows from sites such

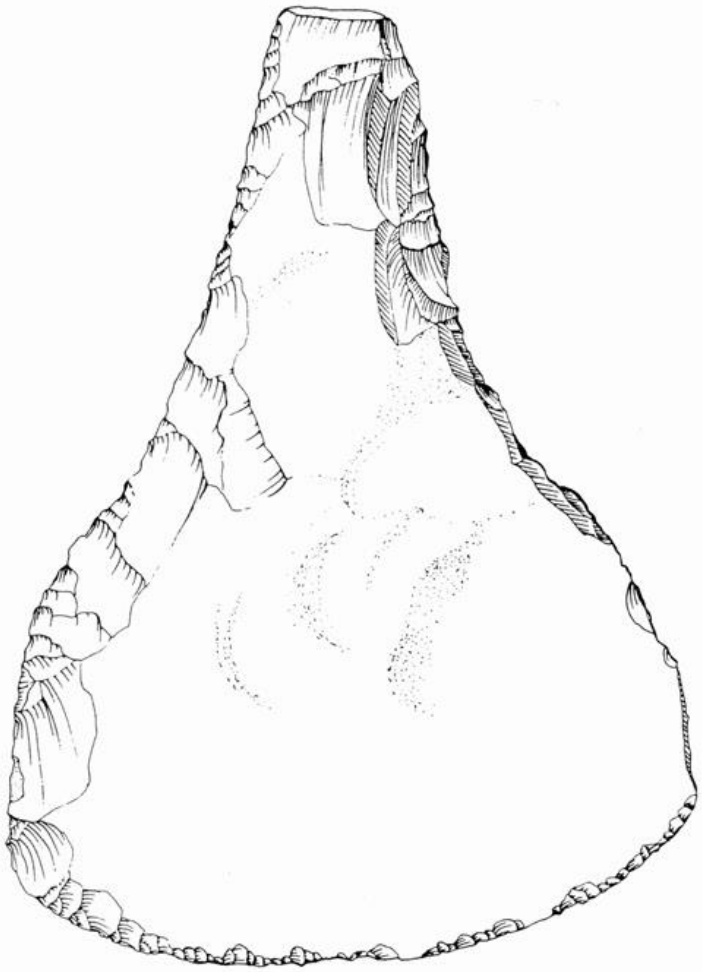
as Ageröd V, Holmegaard, and Ringkloster. All of these were made from elm and measure between 150 and 190 centimetres long. Three qualities make for a particularly efficient arrowhead: the ability to penetrate, the capacity to produce sharp cuts, and symmetry to ensure maximum directional stability of the arrow. The variation in shape of microliths through time and space may well relate to a continuous interplay between these variables. Some would argue that the trapeze and rhomboid microliths made on broad blades characterizing cultures such as the Ertebølle provided particularly good combinations of these three variables. The increased hunting efficiency from their use may have been a major factor for their rapid adoption throughout Europe.

It must be stressed, however, that microliths may have been used in many tools not associated with hunting activities, notably in those used for processing plant materials. The large numbers often found on sites may be due to their use as the cutting parts of implements such as graters. Microliths from the Scottish site of Gleann Mor have been found with a circular wear pattern around the tip, rather than longitudinal striations, indicating they had been used as borers, or possibly drill bits. Hence, some of the variation in microlith shape may simply relate to the wide variety of tasks for which they were employed. Alternatively, it may have had little functional significance of this type. Other factors may have been important. The shape of a microlith may have had symbolic value denoting that it belonged either to a particular individual or to a member of a particular group. Such signalling may have been significant when retrieving carcasses by indicating who had killed the beast.

Other stone artefacts Microliths were just one of many different artefact types manufactured during the Mesolithic. Flaked flint axes and adzes are also characteristic of the period. These were made by bifacially working large flakes or nodules and then detaching a flake from one end by a blow either transversely or obliquely to the axis of the implement. This produced a sharp edge. More flakes of this type were removed when the axe/adze required sharpening and these characteristic resharpening flakes are often found on Mesolithic sites. Other stone artefacts from Mesolithic assemblages include scrapers—retouched flakes or blades coming in a wide variety of shapes and sizes; borers—artefacts with a convergent backing to produce a stout point; and burins—artefacts from which a spall has been detached to create a chisel-like edge. Artefacts of these types are found in most assemblages throughout Mesolithic Europe with varying degrees of refinement and standardization.

Some sites provide quite unusual artefacts for the Mesolithic. For instance, from the boreal period site of Nizhneye Veretye I (*c.*8520–9050 BP) in northern Russia five flint 'hoes' have been recovered. These have broad working edges, rounded sides, and short handles carefully finished by transverse chipping. Similar artefacts are found in Neolithic assemblages from eastern Europe and the Near East, where they are assumed to have been used for tilling land. These Mesolithic artefacts are likely to have had a different function. They may have been made to imitate artefacts created from elk antler.

The function of the more regularly found, mundane flint tools is also not easy to elu-

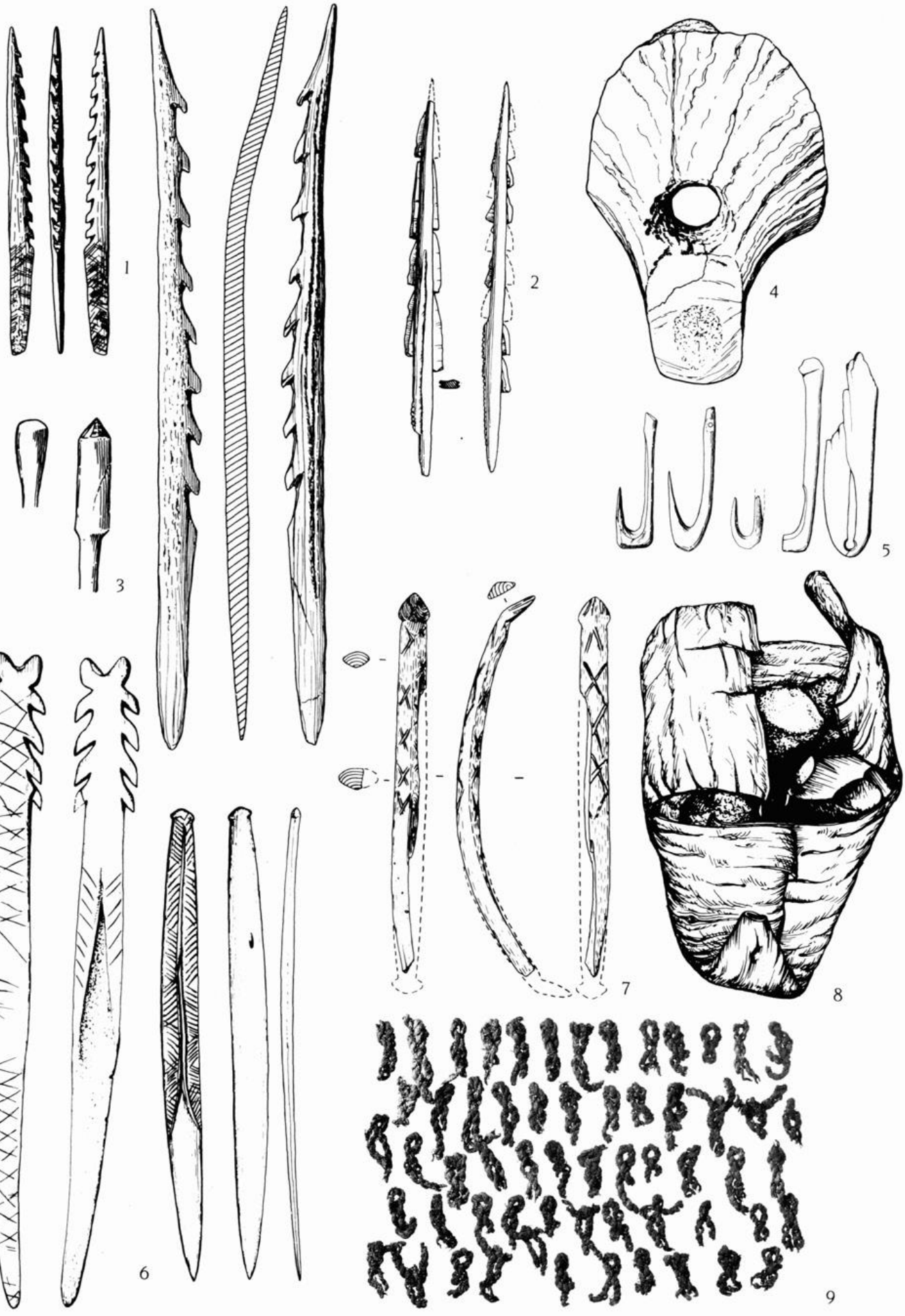


FLINT 'HOE' (*left*) from Nizhneye Veretye. The maximum width of the artifact is 17.5 cm.

DURING THE MESOLITHIC there was an extensive use of organic materials for the manufacture of tools (*right*), deriving from an understanding of natural materials that probably far outstrips ours today. These have been preserved at numerous sites, particularly the waterlogged sites of northern Europe. 1. Barbed points from Star Carr, probably used for hunting large game. Both are made from red-deer antler, 28.7 cm & 31 cm long. Note that on one of them the tang is heavily incised, which may have been to create a rough surface to facilitate binding. 2. Bone projectile heads inset with micro-blades of flint from south Scandinavia, *c.*22 cm. 3.Wooden bolt heads for shooting birds or small furred animals from Danish Mesolithic sites, half size. 4. Mattock head from Star Carr made from lower part of an elk antler. The working edge has been carefully shaped, but is not sharp, 20.7 cm. 5. Bone fish hooks from Mesolithic sites in Denmark and north Germany, two-thirds actual size. 6. Knives/daggers from Nizhneye Veretye I made from elk bone. These were probably personal weapons and usually show careful manufacture and extensive decoration, *c.* 24 cm and 34 cm. 7. Small wooden bow from Vis I. While the function of this and other similar objects remains unknown, the most likely possibility is that they were used for boring or for making fire, *c.* 25 cm. 8. A birch-bark container from Nizhneye Veretye I, *c.* 18 cm. This was made from a single strip of birch bark, with the sides bent to form the walls and the ends the lid. Eighteen cores, 9 flakes, one scraper and an implement for flaking were found inside. 9. Fragments of a net made from plant fibres from Friesack.

cidate. It is difficult to imagine any other function that an artefact with a sharp point could be used for other than boring. However, the catch-all term 'scraper' is applied simply to flakes or blades retouched in a particular manner and coming in a wide variety of forms, and not to imply that they were necessarily used for scraping. Microwear analysis can give us some information concerning function—although the results are often controversial. A study of the flint tools from the site of Star Carr in northern England (*c.*9500 BP) showed that there were very few clear patterns between tool form, the material it had been used upon, and the manner in which it had been used. For instance fifty-six of the 374 scrapers from the site were examined for wear patterns. Only thirty-six (64 per cent) showed traces of use, representing fifty-five use episodes. These were mainly of scraping/planing actions and directed against hide (40 per cent), bone (22 per cent), antler (22 per cent), wood (13 per cent), and either bone or hide (*c.*4 per cent). There did appear to be some difference in the morphology of the artefacts used on different materials. The tools used on antler tended to be longer and more curved than those used against bone, wood, or hide.

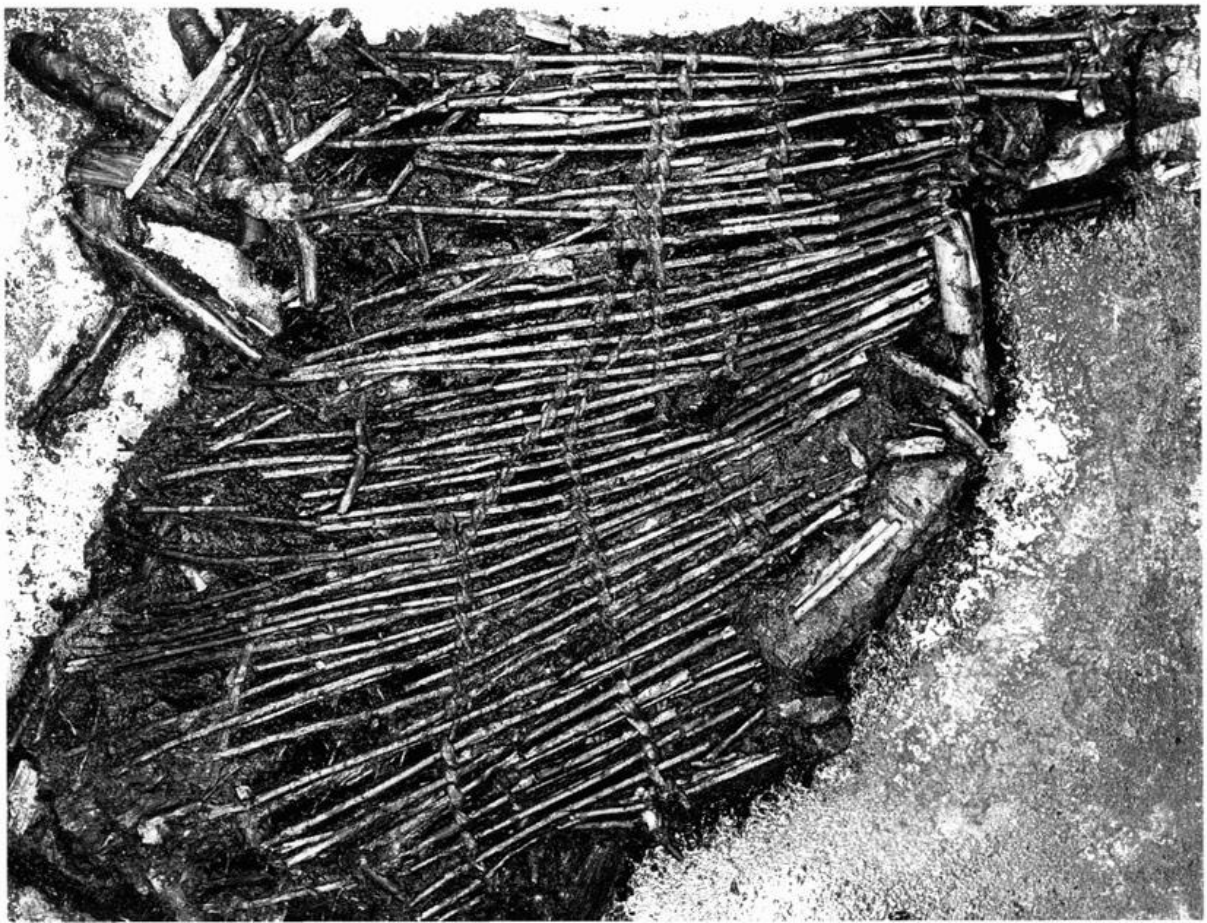
Wooden, antler, and bone tools The bog sites of northern Europe, which preserve organic materials, demonstrate that the Mesolithic hunter-gatherers had an immensely



diverse tool-kit made from antler, bone, and wood to complement that of stone. These artefacts can be divided into two classes—those forming hand-held implements and those forming traps and facilities which worked without human presence. Of the first type, the diversity in the form of arrows, spear points, and harpoons is vast. Arrow shafts were fashioned from a variety of wood types. These had either stone tips attached by the use of resin or blunted tips so that they would not damage the pelts of birds and mammals when killed. Bone was also used as a support for microliths. Narrow grooves were made in the bone and microliths inset by using resin. Long, narrow pieces of antler were produced by using a groove and splinter technique, and were fashioned into various forms of barbed points. A great variety of forms was created with either small or large barbs placed either close together or far apart on one or both sides of the harpoon. These harpoons have been used by archaeologists in a similar way as microliths to create industries and cultures.

Another type of artefact that was made from either red deer or elk antler was the mattock. In the earlier Mesolithic, mattocks were produced by removing the palmate part of the antler and then obliquely piercing the remainder so that a wooden handle could be inserted. A variation on this was to use part of the antler shaft and perforate through the stump of the trez tine which could then be used for the socket for the handle. Mattock heads were also manufactured from the limb bones of auroch and elk.

FRAGMENT OF A WICKER CAGE from Agerod V, likely to have been part of an eel or fish trap. This is the largest (82 cm × 52 cm) of several examples from the site. Eight separate rows of bindings made from pine roots had been used to join at least 48 branches of cherry and alder wood. These had been cut during the winter months when the branches were one or two years old.



ERTEBØLLE VESSEL from Tybrind Vig. Charred food remains were found encrusted on the inside of this vessel which gave a radiocarbon date of *c.*5640 BP. The pot measures *c.*30 cm from the pointed base to the rim.

The other class of artefact made from wood, antler, and bone is best represented by wickerwork baskets, which are most likely to have been eel and fish traps. Several examples of these have been found and they display immense technical skill. A range of different raw materials was used to construct the frame and the bindings. The examples from Ageröd V were made from cherry wood while that from Nidløse was made of birch twigs and bound by using split pine roots. Both the frame and bindings of an example from Magelby Long were made of lime.

Plant material was put to a great number of other uses during the Mesolithic, although for many of these we have only minimal evidence. The submerged Ertebølle site of Tybrind Vig, on the west coast of Fyn, Denmark provides some of our best evidence for Mesolithic plant use. From here we have a fish hook with a short length of twine still attached and a few pieces of textiles. These had been woven using plant fibres that had been spun together to form a yarn. Similarly, from the site of Friesack in the Potsdam district of Germany fragments of a net have been found dating to the early boreal period occupation of the site (9050–8800 BP). It remains unclear whether these nets had been used for carrying or fishing.

Pottery Pottery has traditionally been seen as a product of the Neolithic. Yet in recent years it has become apparent that many late Mesolithic communities were manufacturing and using pottery vessels, first appearing in southern Scandinavia at *c.*5600 BP. This is often taken to indicate that those communities had established a semi- or wholly

FEATURES DENOTING MESOLITHIC HUT
and associated structures at Mount Sandel. These are found within an artificially enlarged hollow and are likely to represent a substantial dwelling constructed from posts driven into the ground. This hut appears to have had a large central hearth, from which burnt hazelnuts and bone were recovered. Large pits outside of the dwelling are likely to have been used for storage.

sedentary lifestyle. In the Ertebølle of Denmark two types of vessels were made; pots with pointed bases and oval bowls. Examples of each have come from Tybrind Vig; some contained charred-food residues, which were analysed, and found to be composed of grass and fish.

Dwellings Many Mesolithic sites have post holes, which indicate past structures ranging from simple windbreaks to substantial huts. Evidence for the first of these are found on many sites—a few post holes making a straight line or arc. For instance, the site of Morton, Scotland (*c.*6700–6300 BP) is interpreted as a location repeatedly visited for short periods and has several sets of post/stake holes which are likely to derive from rather flimsy windbreaks.

A rather larger structure is found within the massive shell midden of Moita do Sebastiâo in the Muge valley of Portugal (*c.*7080–7350 BP). Here sixty-one post holes were found in one area of the site, forming a half circle with an opening to the south. This appears to represent a light shelter providing protection from northerly winds. The roofing may well have been made from rushes and stems of *Gramineae* and then water-proofed with clay, since numerous fragments of clay with imprints of *Gramineae* have been found nearby. Associated with it were numerous pits and features representing

cooking, storage, and disposal pits. At Mount Sandel, an early Mesolithic site in Ireland (*c.*8960–8440 BP), an exceptionally large number of post holes provides clear evidence for a substantial dwelling. Some of these were over 20 centimetres deep and sloped inwards at a slight angle from the vertical. Others were cut by hearths and pits to suggest that there had been extensive reoccupation on the site.

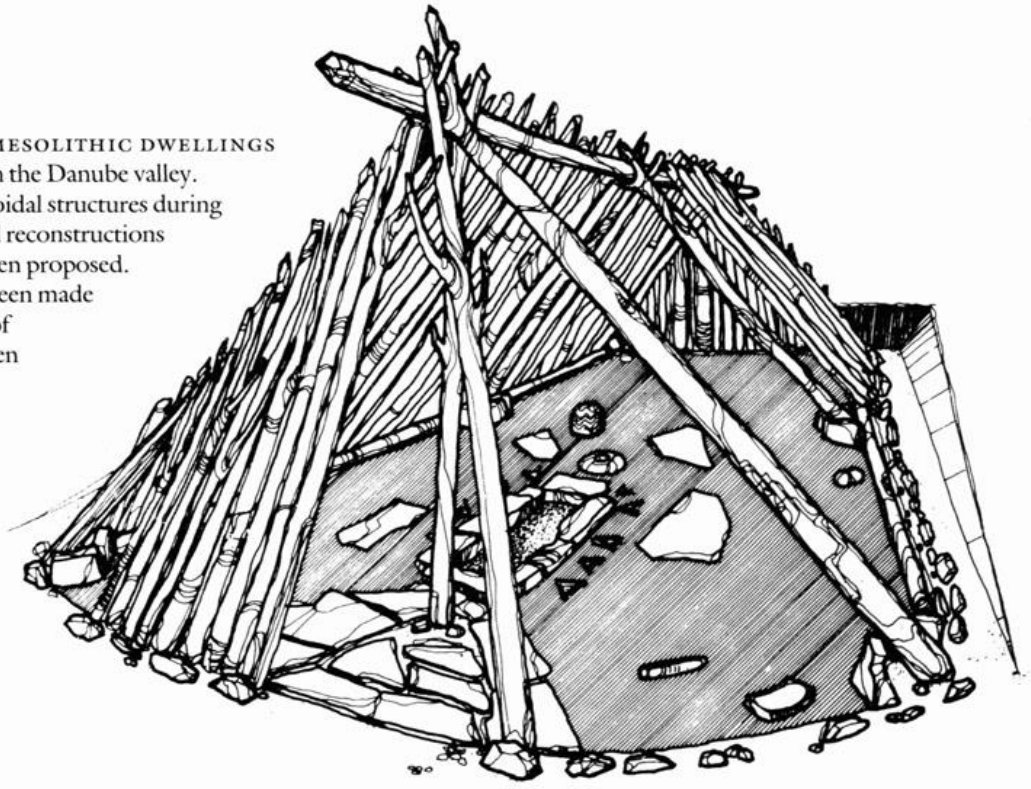
In Arctic Norway several Mesolithic sites have been found with substantial remains of stone walls and foundations. At Tverrvikraet in Gamvik on the outer coast of Finnmark there are the remains of a small rectangular house. Similarly on the island of Saana, Traena the remains of a house, dating somewhere between 8000 and 6000 BP, have been found with stone foundations, post holes along the interior of the walls, and a single, centrally placed hearth. Even further north around the Varanger Fjord there is evidence for several different types of dwelling structures including pit houses and tents, indicated by circular arrangements of post holes.

In Denmark several sites have been excavated which preserve the remains of hut floors, such as the Maglemosian sites of Ulkestrup Øst I, Holmegaard IV, Duvensee, and Sværdborg I. These floors were made from interlaced bark sheets and split logs of birch and pine. At Ulkestrup I a line of branches was found stuck into the ground along part of the floor edge, which may be the remains of the superstructure. The huts themselves had been either rectangular or trapezoidal in plan ranging from 2.5 × 2.5 metres to 4 × 6 metres. The roofs and walls are likely to have been made from bark and/or reeds. At Holmegaard and Duvensee superimposed birch bark floors suggest either reoccupation or repair during a long period of use. One of the problems with interpreting these 'hut floors' is illustrated by the site of Sværdborg I. Here the remains of nine huts were found and while one was demonstrably earlier than the others it was not possible to identify whether the remaining eight had been in contemporary use or relate to separate visits to a favoured hunting location.

Of course, it is extremely rare that structural remains of dwellings survive in the archaeological record. But the character of past dwellings may be inferred from the distribution of stone tools. Concentrations of worked stone may indicate where people had sat, and the spatial arrangement of such concentrations may indicate the size and shape of a structure in, or beside, which they had been sitting. For instance two adjacent crescent-shaped concentrations of microliths at Flaadat, a Maglemosian site in Denmark, may mark the location of a large dwelling 7–8 metres in diameter. Similarly, cobbled surfaces have been found at sites such as Eskmeals in Cumbria, England and may trace the presence of past structures. Such inferences are highly contentious, however, and we require further studies of the spatial structure of ethnographically documented campsites before they can be verified.

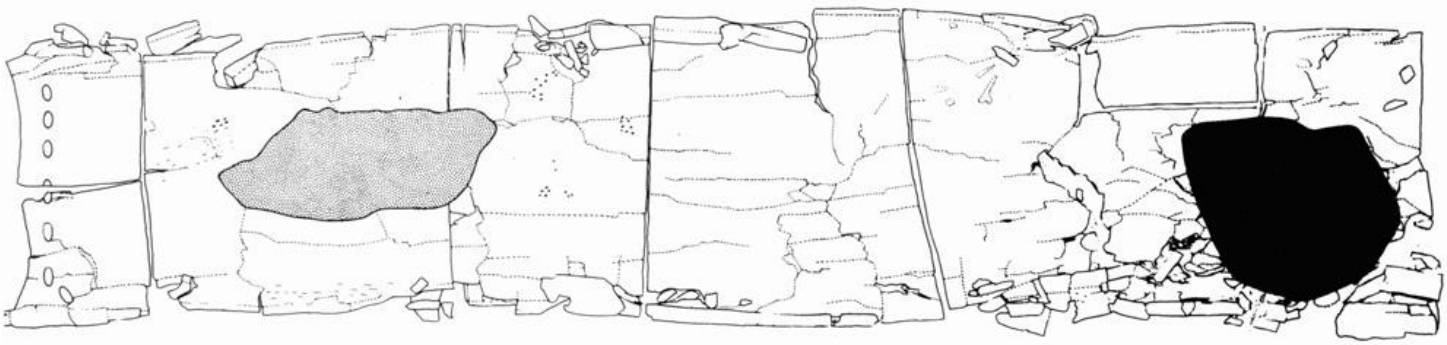
The best preserved dwellings come from the site of Lepenski Vir, in the Danube valley (*c.*7750–6250 BP). This is a very complex and important site at which Mesolithic hunters had 'settled down' to live sedentary lifestyles. The dwellings were trapezoidal in plan varying in size from 5 to 30 metres square. They were built on terraces which had

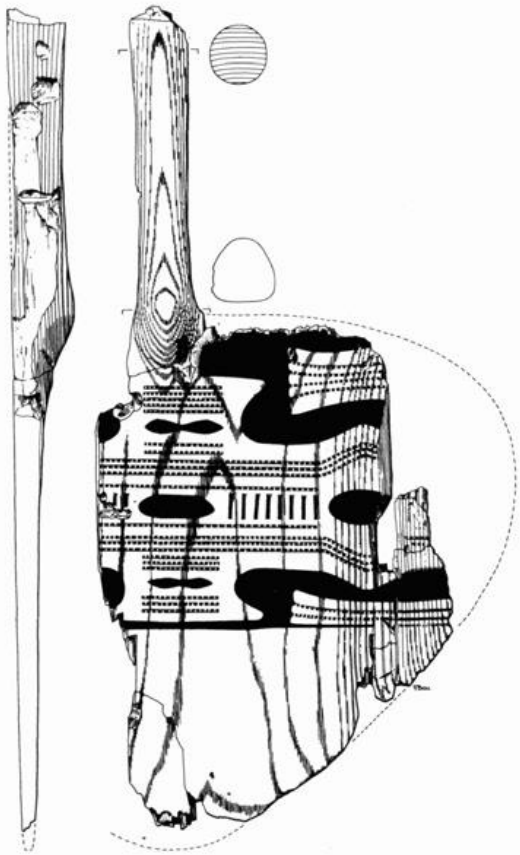
THE BEST PRESERVED MESOLITHIC DWELLINGS come from Lepenski Vir in the Danube valley. *Above*: one of these trapezoidal structures during excavation. *Right*: detailed reconstructions of these structures have been proposed. The roof is likely to have been made from two inclined planes of branches and may have been covered with hides.



been cut into the sloping banks of the Danube and conformed to regular proportions and internal arrangements. All had their wide ends pointing towards the river. The floors were made of hard limestone plaster and these were surrounded by post holes which must have supported a wooden structure. Inside, large, elongated pits lined with limestone blocks functioned as hearths. In some houses human burials had been made close to these pits while in almost every house there was a large rounded block of limestone carved into a human/fish image.

Transport technology Efficient water transport would have been essential for the Mesolithic communities of Europe for various subsistence activities, to move between different habitats, and for communication between groups. During the Mesolithic,





BOAT AND PADDLE from Tybrind Vig. A fireplace and a large stone for ballast (dark) have survived in the stern of the boat. The design on the paddle was created by filling carved incisions with a brown substance. This is just one of ten paddles from Tybrind Vig, all of which were carved to the same heart-shaped design from ash wood. Only two appear to have been decorated.

many offshore islands were colonized, such as the Hebrides and those of the Mediterranean, and substantial boats would have been necessary for the sea crossings. The remains of ling at settlements in western Sweden indicate that deep-sea fishing had been undertaken, probably requiring substantial crafts.

The best preserved Mesolithic boats come from Tybrind Vig. Here the remains of two canoes were found along with decorated paddles. The largest measures 9.5 metres long and 0.65 metres wide and is estimated to have been able to carry six to eight people together with their gear. Within it was a large stone weighing 30 kilograms, which had probably acted as ballast. The sides of the canoes were smooth and rounded and the stern cut into a square. Both of the boats had the remains of a small fire placed at the stern. This may have been related to eel fishing.

From the site of Vis I (8300–7000 BP) in the north-east of the CIS fragments of skis have been preserved. These had been cut from massive hardwood logs. They tapered towards the front end while the lower surface became increasingly convex. On one of them an elk head had been carved to prevent reverse movement of the ski through the snow and to act as a stabilizer. While these are unique finds from the Mesolithic, they closely resemble the skis of the Yakut people of Siberia as documented in the seventeenth century.

Subsistence Activities

The economic basis of Mesolithic societies varied with the nature of their environment. As a whole, the archaeological record reflects an immense flexibility by the Mesolithic hunter-gatherers to exploit diverse environmental types and to cope with the short- and long-term fluctuations in resources availability. This flexibility would have been based upon an exhaustive knowledge of their surroundings and a constant monitoring of the changes in resource distribution.

Hunting terrestrial game Large terrestrial mammals have, for many years, been assumed to be the essence of Mesolithic economies. Their pre-eminence is gradually being eroded, however, as the productivity of the marine and freshwater environments are appreciated and as studies of human bone provide direct evidence for a significant amount of aquatic foods in the diet. Nevertheless, the hunting of large terrestrial mammals remains central to the Mesolithic, for, even if they were not the staple food supply in all areas, they may have required the greatest time to exploit, and they had considerable social significance. Throughout Europe the faunal assemblages attest to the exploitation of a mix of large ungulates; varying frequencies of red deer, wild pig, roe deer, elk, and auroch are found. It is very rare for any assemblage to be dominated by just one of these ungulates. The Danish site of Ringkloster (*c.*5630–5230 BP) is one exception as remains of pig dominate the faunal assemblage.

Hunting of these large mammals appears to have been predominantly by an encounter strategy, and hunters are likely to have searched in forests for tracks and trails

of deer and pig. Having found and inferred information about their makers' age, sex, state of health, and direction of travel, a stalk may have been initiated. If the animal was large, a hunter may have elicited help from other members of the group. Once located, an attempt would have been made either to kill the animal outright or to wound it so it would bleed and could be tracked until it collapsed. The tracking of animals may have been facilitated by the use of dogs. The burial of dogs in Mesolithic cemeteries, generally of animals like German shepherd dogs, indicates that these had been domesticated and were held in much esteem. Pits and traps were also used for hunting large game. Microliths embedded in the bones of an auroch found in a bog at Vig in northern Zealand indicate that it had been shot by arrows released from a trap. In northern Scandinavia there are many pit traps that had been used for hunting large game, notably reindeer.

In those parts of Europe which were not covered by thick forests, and where animals may have aggregated in larger numbers, other types of hunting strategies may also have been employed. From the Levantine art of Spain (which we will discuss below) we have a scene depicting a red deer drive towards an ambush of archers. The picture is at Cuevo de los Caballos and depicts twelve hunters. Eight act as beaters to drive a herd of deer towards four waiting archers. The herd appears to be a group of females with their young—a typical pattern of herd structure for the summer months. Such drives may well have also taken place in northern Europe on particular occasions, but the weight of evidence points towards a more individual stalking pattern.

In addition to large mammals, smaller terrestrial game were also available and exploited during the Mesolithic. Rabbits, badger, otter, and pine marten would have provided furs as well as a source of meat. It is likely that such animals were principally trapped using snares rather than actively hunted. Some sites appear to have been locations where particular species of small game were targeted; Ringkloster has a particularly high frequency of pine marten remains.

The exploitation of aquatic resources The hunting of large terrestrial game was just one element of the diverse subsistence base of the Mesolithic. For those living along the coast or by large lakes and rivers, aquatic resources would have rivalled, if not surpassed, the large terrestrial mammals in their productivity. Sea birds may have been an important source of food. Recent history indicates the potential food value of those birds which nest in colonies; the 180 inhabitants of St Kilda are reputed to have made an annual harvest of 22,600 gannets. Some Mesolithic sites have a bird fauna dominated by just one or two species. At Aggersund and Øgaarde, Ertebølle sites, the avian fauna is dominated by single species, whooper swan and white-tailed eagle respectively. At other sites, such as Ertebølle itself, many different species are found, often in large numbers. Wholesale slaughter appears likely at such sites, perhaps by driving birds into nets. Inland birds were also regularly hunted mainly for their feathers although these may also have provided a valuable source of food.

The bones of large sea mammals—seals, dolphins, porpoises, and whales—have been

AN IMAGE FROM THE ROCK ART of the Spanish Levant depicting a red-deer hunting drive. The picture is in the Cueva de los Caballos and shows a herd of animals being driven towards a party of archers. The schematic figures and depiction of hunting activity are typical for this rock art tradition.

found in many of the coastal shell middens of the late Mesolithic. These animals may have been actively hunted by using boats, as illustrated in rock engravings from Arctic Norway. Alternatively, beached animals may have been killed. This would almost certainly be the case for the larger animals such as the blue and sperm whales which are occasionally represented in the middens. Many species of seals are also found in the shell middens, and indeed seal bones are found at inland sites such as Ringkloster.

Fish bones are frequently found on well-preserved sites and both salt-water and freshwater fish must have been a valuable source of food. This is particularly the case when migratory species were exploited, since these can provide spectacular harvests. Sites in southern Scandinavia show that a wide range of freshwater species was exploited includ-

ing eels, pike, tench, bream, and perch. These would have been caught by various techniques including hook, leister, trap, and net. Many coastal sites also have a high representation of salt-water fish. For instance, excavations of the middens on the small Scottish island of Oronsay (*c.*6300–5200 BP) indicate that marine fish, notably saithe, had been systematically exploited and probably exceeded shellfish in their contribution to the diet. Fish remains from the massive shell midden of Ertebølle are predominantly (71 per cent) of freshwater species caught in nearby lakes. Consequently, the coastal location of a site does not necessarily imply that marine species were of principal significance.

At the bottom of the aquatic resource spectrum are shellfish such as oysters, limpets, and periwinkles. These appear to have been an essential source of food in the later Mesolithic when large shell middens are found in many coastal areas. They are, however, very costly to exploit; it has been calculated that 52,267 oysters, 156,800 cockles, or 31,360 limpets would be needed to supply the same calorific value as a single red deer carcass. However, such resources can be gathered by the very young, the old, and the infirm. Also, they are always available and hence could have been relied upon when other resources failed.

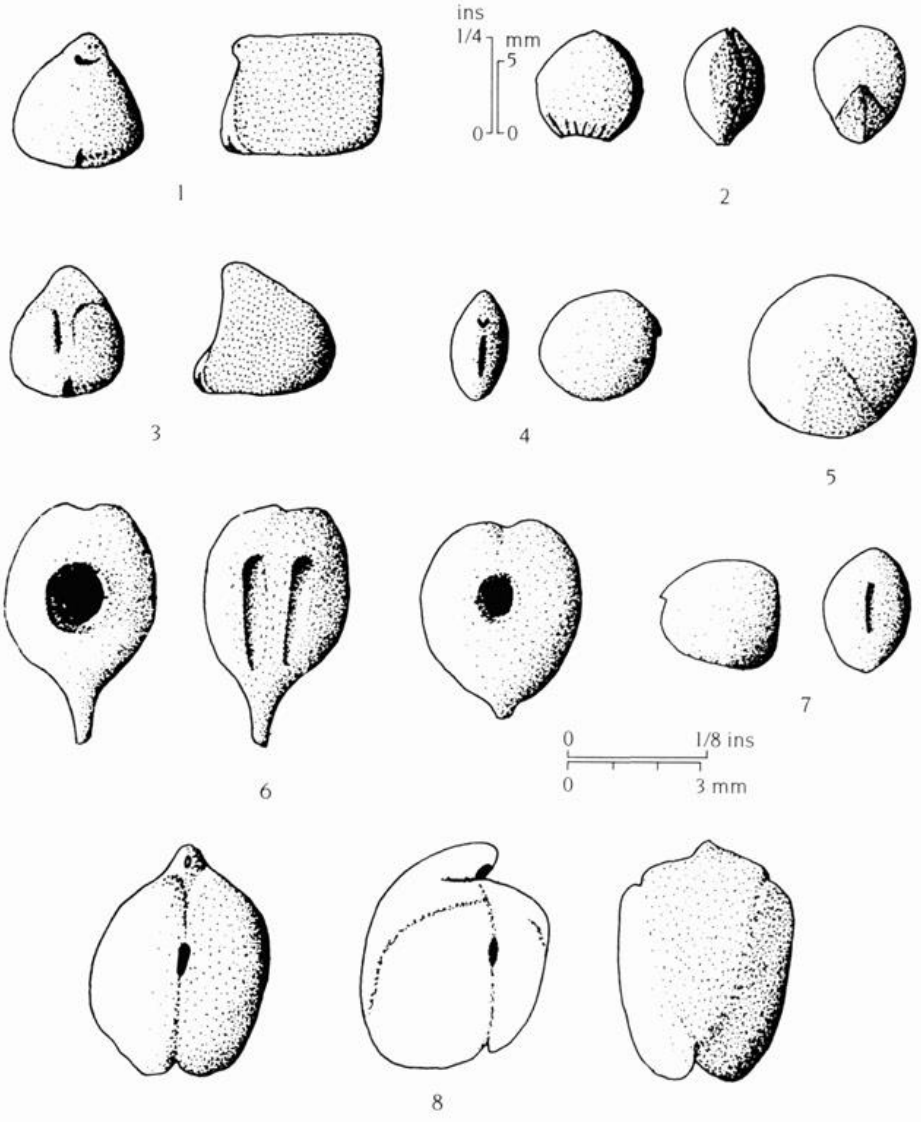
The increasing importance of coastal and aquatic resources in the diet during the early post-glacial is clearly shown at the site of Franchthi cave in southern Greece. When this cave was first occupied at 20,000 BP it lay some 5–6 kilometres from the coast. With the rise in sea level, this distance fell to only 1 kilometre by 8500 BP. The faunal remains in the cave show a concomitant increase in the amount of fish and shellfish in the Mesolithic diet.

Plant foods Plant foods are likely to have been an essential part of the diet during the Mesolithic Age. The post-glacial forests would have provided a rich variety of edible plants, berries, fungi, nuts, and roots. Grass seeds could have been collected from the more open landscapes of southern Europe. While impressive lists of potentially edible species can be made, it is very rare that any plant remains are actually preserved on Mesolithic sites; it is rarer still that these can be confidently identified as a source of food. It is impossible to evaluate the contribution made by plant material to the diet. Studies of wear patterns on human teeth from sites in the Danube gorges suggest this may have been substantial.

Hazel nuts are by far the most common plant material. These are often found at British Mesolithic sites, usually in small quantities but occasionally in larger numbers suggesting extensive exploitation and perhaps storage. For instance, at Oakhanger VII in Hampshire, broken hazel-nut shells were found scattered across the whole of an occupation floor. Some people have suggested that the high frequency of hazel in early post-glacial pollen diagrams may indicate a deliberate encouragement of this species. Acorns are surprisingly scarce on Mesolithic sites in light of their significance as a plant food in other periods. Possibly the need to remove their tannic acid by leaching prior to consumption reduced their attractiveness as a food source. Other edible plant remains

include water chestnuts from sites in north-east Europe, fat hen, nettle, and yellow water lily at Star Carr; raspberry at Newferry; and grass (maybe cereal) pollen in copralites from Icoana and Vlasac in the Danube gorges. From 11,000 BP the occupants of Franchthi cave exploited a wide range of plant species including wild almond, pear, bitter vetch, lentils, oats, and barley. The apparently increasing use of plant resources may be compensating for the loss of hunting territories for large game due to rising sea level. All of these plants would have been found growing wild in the valley floors and gentle hill slopes.

Important botanical remains have also been acquired from the site of Balma Abeurador, a cave on the southern margins of the Massif Central and about 50 kilometres from the present Mediterranean coast. The carbonized remains of lentils, chick-peas, and peas have been found in stratified contexts dating between 10,000 and 8,000 BP. These are morphologically similar to the cultigens from early Neolithic sites in south-west Asia. The increasing use of plant material in west Mediterranean sites such as Balma Abeurador appears to be associated with an increase in the exploitation of fish and birds.



CARBONIZED PLANT REMAINS from Balma Abeurador. These are abundant in the sediments of this small cave dating between 10,000 and 8,000 BP and principally belong to legumes, nuts, and fruit.
1: *Ervum ervilia* L.;
2: *Prunus* sp.;
3. *Lathyrus cicera* L.;
4: *Lens cf. esculent* Moench;
5: *Pisum cf. sativum* L.;
6: *Vitis vinifera* L.;
7: *Lathyrus aphaca* L.;
8: *Cicer cf. arietinum* L.

It is clear that the Mesolithic foragers had a detailed knowledge of the vegetal resources they exploited for food and that the adoption of domesticates at the start of the Neolithic did not present any major transformation in their economies. Indeed, it is a matter of debate as to whether the occupants of Balma Abeurador and of Franchthi caves could have exploited such legumes over the long term by a simple collecting strategy. Incipient cultivation may have been necessary using techniques such as burning, weeding, and irrigation.

In addition to the acquisition of foodstuffs Mesolithic foragers appear to have interfered with the natural vegetation in other ways. In Britain there is considerable evidence of burning, particularly in upland areas. This implies that large areas of vegetation were burnt, but the extent to which this results from human activity, or from natural events, remains unclear. If Mesolithic foragers were burning large areas, it may have been to encourage the growth of young shoots either to exploit for food or as a means to attract deer. If the latter, they would have been increasing the numbers of deer, and the extent to which their location in the landscape could be predicted. Consequently, foraging efficiency would have been improved.

Settlement

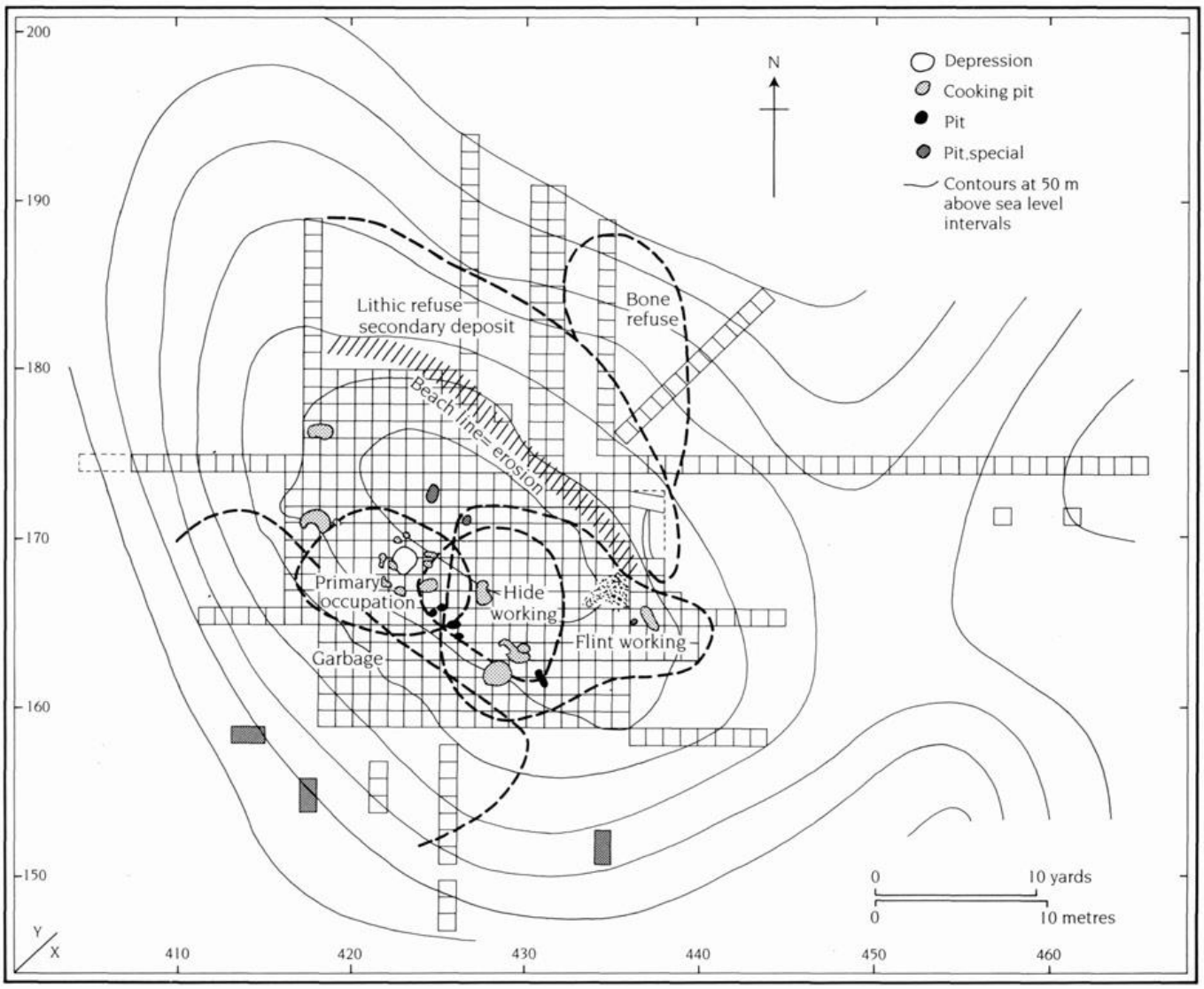
We have seen that the post-glacial environments provided the Mesolithic foragers with many different resources to exploit for food and raw materials. This exploitation was not random or haphazard but pursued with great skill and organization. We cannot doubt that the Mesolithic foragers were like the hunter-gatherers recorded in the ethnographic record in having an immense knowledge about their natural environment, the habits of the game, and the changing seasons. Such knowledge would have been used to organize their subsistence activities in an efficient manner so that they were positioned at the appropriate places in the landscapes to exploit those resources which were 'in season'. In addition, however, they needed to be able to take advantage of, or guard against, the unpredictable events of the natural world—the lucky find of a beached-whale or the failure of a migratory resource to arrive. In exploring this aspect of the Mesolithic we can begin by recognizing the many different varieties of settlement types.

Site types and interpretation The diversity of site types during the Mesolithic is immense. At one end of the scale are small campsites which represent a single occupation for perhaps just a few hours by a small group of hunters. At the other, we have large site complexes which have settlement remains indicating occupation throughout the year by large groups of people. Between these extremes we have various types of hunting camps, raw material extraction sites, and specialized activity locations. Much of the research in recent years has been concerned with inferring the function and season of occupation of such settlements. We can appreciate this diverse range of site types, and the means by which they are interpreted, by looking at a selection from Mesolithic Europe.

The most common Mesolithic site is a small discrete scatter of worked-flint with no organic preservation. These may denote short-term camps, perhaps just overnight stops by hunting parties, or even events during the course of a hunt such as the field butchering of a killed animal. Many of these sites are scattered throughout the highland areas of Europe. Typical examples are the flint scatters from the Pennines of Britain, such as Dunford A and Broomhead 5, which have microliths making up over 90 per cent of the retouched tools. Such sites often command prominent positions with extensive views over the countryside and are assumed to relate to the hunting of red deer. Similar sites in the Norwegian highlands would have been concerned with reindeer exploitation. For instance site '148' (*c.*5870 BP) in the Ryfylke-Setesdal mountains is found on a slight slope just above the edge of standing water and near to a path used by modern reindeer. Just seven flint artefacts were found, six of which fitted back into one nodule. This site appears to represent just a single event, perhaps a butchering episode or the remains of a hide.

When interpreting flint scatters, which are larger than those from '148', the main difficulty is knowing how many occupation events are represented. Are they simply palimpsests from many short-term occupations by a few hunters or from a more extensive period of occupation by a relatively large group? Acquiring a series of radiocarbon dates from such sites can help decide. For instance, flint scatters at the open-air site of Calowanie, near Warsaw, had once been interpreted as representing individual occupation units. But new radiocarbon dates indicate that each individual flint scatter had formed over as much as 1000 years between *c.*9400 and *c.*8300 BP and are therefore palimpsests from a series of reoccupations.

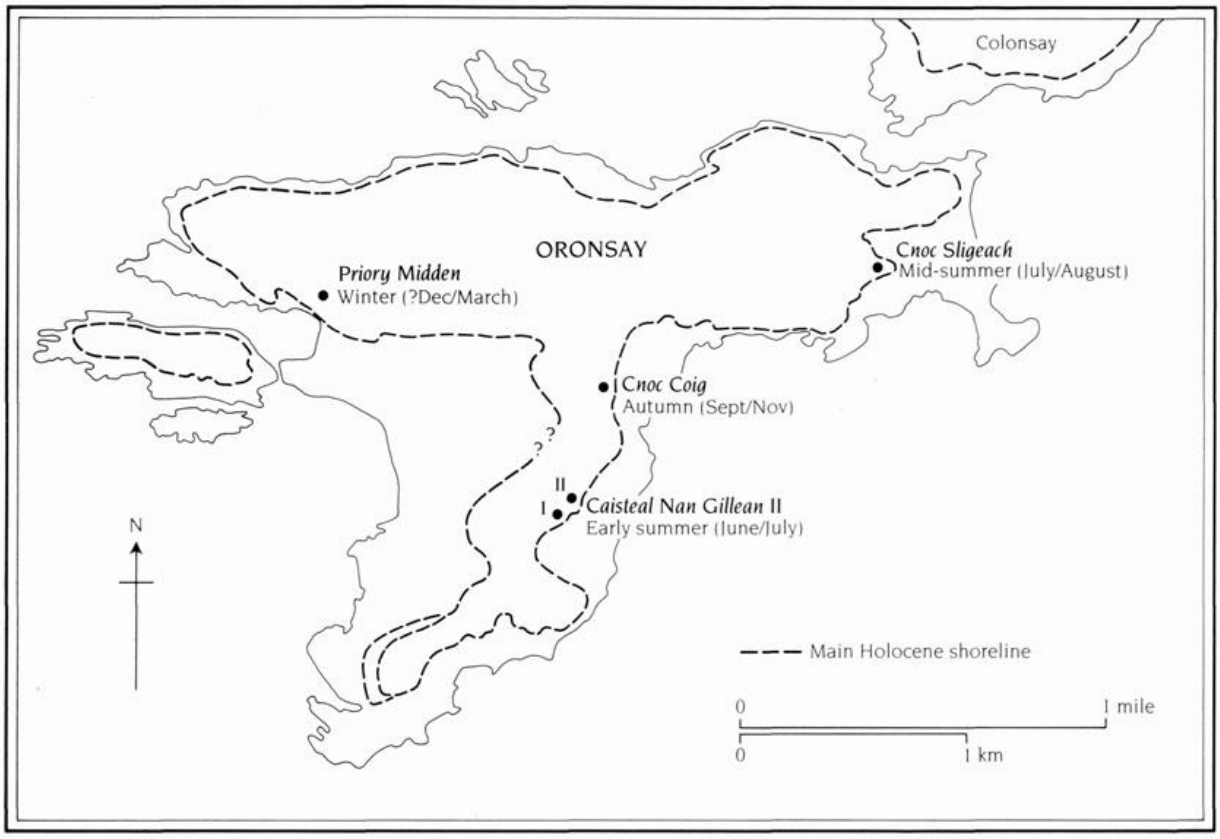
When radiocarbon dates cannot be attained, the refitting of flakes, which are horizontally or vertically dispersed, is another way to demonstrate that an assemblage relates to just one occupation, or, at least, a limited number. This has been used at the Mesolithic site at Hengistbury Head in southern England. This site is a dense spread of flint artefacts stratified in wind-blown sand deposits which have been heavily podzolized. Excavation of over 78 square metres yielded 38,000 flint artefacts. Refitting has not only shown that the site consisted of a series of overlapping knapping clusters but also that the considerable vertical distribution of artefacts is purely a result of post-depositional processes. Artefacts have been refitted from vertical intervals of up to 39 centimetres. When all the rejoined items are combined, they form a series of interlocking fits spread over a vertical distance of 60 centimetres. Processes such as trampling, bioturbation, drift, and deflation would have been responsible for the vertical distribution. Had it not been for refitting, this site might easily have been interpreted as one of multiple occupations within a gradually accumulating sand deposit. At other sites, the possibilities for either numerous radiocarbon dates or refitting are limited due to preservation and the character of the raw materials. Often, however, the sheer quantity of artefacts and knapping debitage suggests that the sites had been reoccupied many times. For instance, at Bolsay Farm on the Isle of Islay in western Scotland, excavations

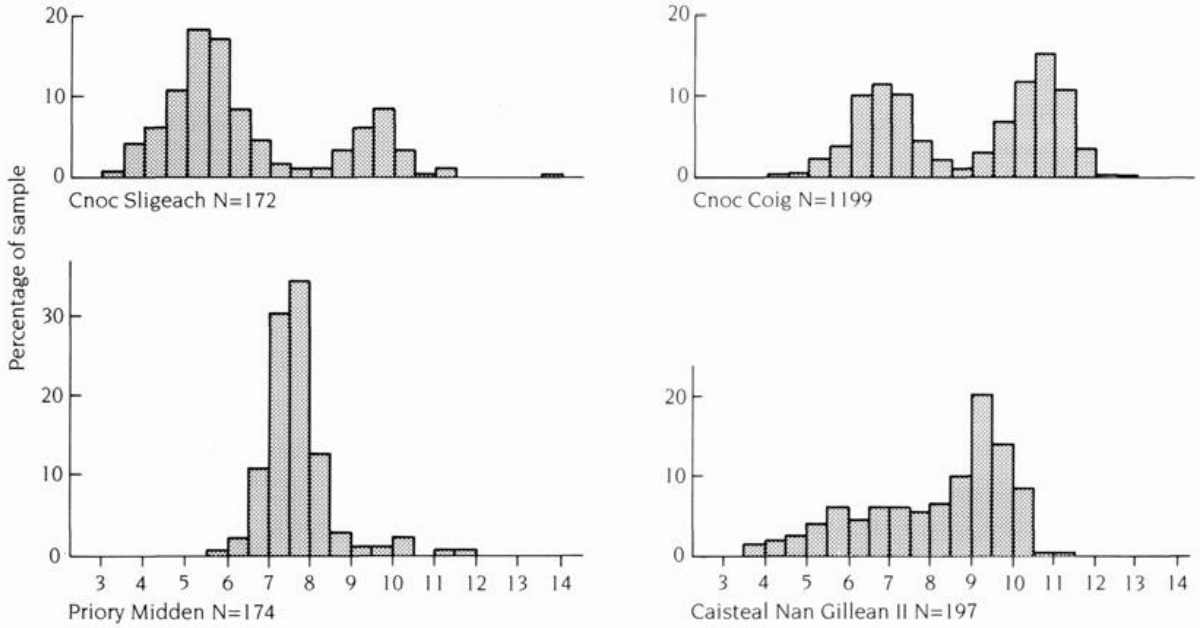


EXCAVATION PLAN AND ZONATION of activity areas of Vaenget Nord. The activity areas have been defined by the distribution of artifacts, features, and wear analysis on stone tools. The 'primary occupation' area is likely to have been where the hut(s) were placed. Just to the north of this, and at the highest part of the island, a single burial likely to have been of an adult male was made.

suggest that several million pieces of worked stone were originally present, including many thousands of microliths. The quality of preservation is low, but it is most likely that such quantities of material had built up gradually from many occupations of the site, probably due to its excellent location as a hunting site.

The reconstruction of activity areas within sites can be achieved by wear analysis. One of the most successful examples of this has been at the site of Vænget Nord, an Ertebølle site at Vedbæk dated to *c.*7000 BP. This is one of a whole complex of sites that have been discovered in the Vedbækfjord area of Zealand, Denmark. Wear analysis has shown that the site can be divided into two distinct areas. One is characterized by burins for working bone or antler and the other by tools which had been used for hide working, such as end-scrapers and unretouched blades. The first of these has been referred to as the area





LOCATION OF MESOLITHIC SHELL MIDDENS on Oronsay showing the main seasons of site occupation as inferred from the size distribution of otoliths of saithe, shown below. Saithe was the most important species of fish exploited from Oronsay and, due to its rapid growth, its size as estimated from otolith length can provide a direct indication of the season in which the fish had been caught.

of primary occupation since it coincides with the concentration of features, rhomboid points, and microburins. Around the hideworking zone is an area of flintworking and behind these a waste dump, which was an area dark in colour and rich in charcoal and fire-cracked rocks. In some places individual dumps have been located such as a flint scatter containing all the debitage from the manufacture of an axe, except for the axe itself and the tiny chips, which would presumably have remained at the knapping location when the waste was cleared up.

When faunal remains are preserved, many more inferences about the seasonality and the function of a site can be made. For instance, at the Ertebølle site of Aggersund in northern Denmark, the faunal remains are dominated by the migratory whooper swan. These would only have been available in that area between November and March. Consequently, the site is interpreted as a specialized winter swan-hunting camp. The faunal remains from Star Carr provide a classic example of attempts to infer site season and function. These remains have been intensively studied and frequently reinterpreted. Current views suggest that they indicate a late spring/early summer occupation for the site. This is indicated by the dentition from red deer and roe deer jaws and the numerous red deer skulls with shed antlers—something that occurs in April and May. The loose antlers at the site, which on prima-facie evidence would indicate an autumn occupation, could have been collected throughout the year. Since the skeletal elements at the site are those which hunters typically dispose of after initial butchery, because they bear little meat, this spring/summer occupation appears to have occurred at a temporary hunting camp rather than at a more permanently occupied base camp to which the meat-bearing bones would have been returned.

Faunal remains from the shell middens on the tiny island of Oronsay in the southern Hebrides are also worthy of mention. Here five middens are found on an island that would have been no more than 4 kilometres square when occupied. As mentioned above, saithe was a very common fish species and the otoliths (ear bones) of these have been used to calculate the season during which each midden was occupied. This is possible since during the first two to three years of life the growth of young saithe is very rapid and its size, as measured by otolith length, indicates the season in which it was killed. By using this technique it appears that each midden on Oronsay had been occupied in a different season. Presumably, the particular topographic location of the midden made it particularly favourable for one specific season. Two alternative interpretations could be made for this pattern. Permanent, year-round occupation might be proposed with foragers moving from one midden to another as a seasonal round. However, this seems unlikely on such a small island in this part of Europe where other resources (such as deer) may have been unavailable. The middens may, therefore, represent a very gradual accumulation over many years by short-term visits to the island for fishing and sealing. The Mesolithic foragers would have used their knowledge of the landscape, tides, and prevailing winds to choose the most favourable location on each visit.

More likely candidates for year-round permanent occupation are the large midden

and settlement sites of southern Scandinavia. Many of these are found at the interface of several different ecological zones and would have provided the foragers with an array of seasonally overlapping resources. For instance, in the north of Denmark we find the massive shell midden of Ertebølle (*c.*5800–5100 BP), which gave its name to the Ertebølle culture. It has been suggested that the inhabitants of this site would have relied upon the produce from large terrestrial animals during the summer and autumn months, while migratory and breeding sea mammals would have been the mainstay during the winter. A possible 'spring gap' would have been filled by the oyster, the shells of which constitute the bulk of the midden. Similarly, the site of Skateholm (*c.*7000–5400 BP) in the south of Sweden appears to be located at the interface between the terrestrial, lagoon, and marine biotopes because of the variety of resources such a mix of environments provided. The faunal assemblage from this site, or rather sites since three periods of occupation are known, testify to an amazing diversity of resources exploited from each of these biotopes. Seasonality indicators are dispersed throughout the year.

Subsistent-settlement systems We have so far discussed site types as individual entities, but the thrust of much recent research has been to make associations and hence reconstruct the 'subsistent-settlement' system. Now, it is very rare for an archaeologist to be able to state confidently that two sites were sufficiently contemporary to have been used by the same group of people, even with the rather fine chronological resolution we have for the Mesolithic. Consequently, the settlement systems we reconstruct are often amalgams using sites which may not have been precisely contemporary and hence represent idealized models, rather than detailed reconstructions, for any particular region or phase of the Mesolithic.

The simplest type of Mesolithic settlement system is that involving movement between low and high ground. Among many historically documented hunter-gatherers, people aggregated in lowland areas during the winter months, when many communal activities were undertaken, and then dispersed into the upland areas in smaller groups during the summer. It is most likely that such a pattern of fission and fusion extended back into the Mesolithic. Often one can detect differences in the lithic assemblages from highland and lowland areas which suggest different activities had been undertaken and which relate to past mobility patterns. For instance, in Britain, Mesolithic sites in upland areas tend to have a high frequency of microliths, suggesting the repair/manufacture of hunting equipment. In contrast, those in more lowland areas often have much higher frequencies of tools such as scrapers which would have been used in base-camp activities, for example, in the preparation of skins. It is very likely that the small flint scatters in the Norwegian highland relating to reindeer hunting derive from spring-autumn hunting parties who moved up from either the western or eastern lowlands. The artefacts found at these sites are made of flint, which could only have come from coastal sites.

The excellent preservation of Mesolithic sites in Denmark allows us to reconstruct settlement systems which were more sophisticated than a simple aggregation/dispersion

cycle. For the Ertebølle period we have several sites which, by virtue of their location, the faunal remains, and artefact inventories, are thought to have been seasonal camps used for very particular subsistence activities. We have already mentioned Aggersund which was devoted to the hunting of swans during the winter. The site of Vængo So is at a location that is particularly suitable for the standing of whales, a species that figures prominently in its faunal assemblage. The catching of eels is likely to have been the main activity undertaken at the site of Dyrholm, which was only occupied during the autumn and winter. Ringkloster appears to have been a winter camp-site where hunters specialized in hunting wild piglets and pine marten. The occupation of these sites is likely to have been by hunters making special forays from their base camps. These were large coastal midden sites, such as Ertebølle, Meilgaard, and Norslund, in locations suitable for a range of different activities, and contain evidence of occupation throughout much of the year.

It is rare to find high levels of organic preservation throughout an entire region enabling the reconstruction of a spatially extensive settlement system using faunal remains to infer site function and seasonality. When such remains are absent, one must rely on factors such as site size, features, and the character of lithic assemblages. Such variables can be used with great effect. For instance on the island of Vega in northern Norway a series of sites have been classified as to their respective roles in the Mesolithic settlement system. Åsgarden is the largest site with a lithic assemblage of over 250,000 pieces, a diverse range of tools and a large house structure. This has been interpreted as a residential base. From here Mesolithic foragers may have visited satellite field camps, such as at Hesvik where the sites are smaller in area and the structures less substantial. A further class of site, smaller still in area and in the size of the lithic assemblage, may represent 'boat stations'—temporary landing places around the coast, or 'stops', locations where a single activity had taken place. Quite whether such reconstructions are correct is questionable, but there is no reason why the settlement systems in areas with poor organic preservation need have been any less complex than those in areas such as southern Scandinavia.

An example of reconstructed settlement systems from southern Europe is useful in that it shows the demise of the 'culture' concept as a valid explanation for assemblage variability. Along the coast of northern Spain two 'types' of Mesolithic sites are found within the same period (9500–8500 BP) and which have been given different 'cultural' labels, the Asturian and the Azilian. For instance, the term Asturian is applied to the material from level 29 at La Riera dating to 8650 ± 300 BP while that from level C at Urtiaga dated to 8700 ± 170 BP (i.e. contemporary in archaeological terms) is referred to as Azilian. The differences lie partly in the tool assemblages. Asturian assemblages have fewer retouched pieces and backed bladelets than Azilian assemblages together with a much higher frequency of heavy duty tools such as picks and choppers. Asturian sites are found predominately at lowland locations and in estuaries, while Azilian sites are found throughout lowland and highland areas. The faunal remains also vary;

Asturian assemblages are always dominated by red deer with low frequencies of roe deer and wild pig, while Azilian assemblages show much greater variation. In upland areas, they are dominated by ibex. Traditionally, the Azilian and Asturian sites have been attributed to different groups of people, different cultures. More likely, however, they are two components of a single subsistent-settlement system. Asturian sites are probably the bulk disposal of garbage from base camps while the Azilian sites represent the locations where various hunting, gathering, and fishing activities were carried out. Other elements of this settlement system, such as the base camps, have yet to be discovered.

Foraging decisions We must be very careful when 'reconstructing' these subsistent-settlement systems not to lose the view of Mesolithic foragers as extremely flexible in their subsistent behaviours by forcing them into a regular seasonal round. Although much of their subsistence pattern may have been routinized—waiting for the migrating fish in spring, and moving to the inland sites in summer—the efficiency of their foraging behaviour had to have been based on a readiness to respond to new opportunities or to cope with unexpected shortfalls in resources. To do this they would have depended on their knowledge of the surroundings and have had a continuous updating of their 'information banks' about the availability and location of different resources. Hence, rather than thinking of Mesolithic subsistence in terms of a seasonal round, a more appropriate perspective is to view it as a series of choices made by individuals and groups as to what resources to exploit at which time of year.

We can think of such decisions as either 'patch choices' (which type of biotope to move to, such as inland forest or the coast) or 'prey choices' (which specific resources to exploit once within those patches). In making such decisions foragers would have gathered and processed much information concerning their current needs and the likely returns from different patch/prey types. They would have been trying to make a balance between the cost, benefit, and risk of exploiting different resources. Cost concerns the amount of energy and time invested into hunting or gathering them; benefit is the return in terms of meat and raw materials; the risk is the chance that much effort will be invested for no return. For instance, if a hunter successfully kills a red deer then the yield in terms of meat, hide, and antler will be substantial; but hunting red deer is a risky activity—one may not find the tracks, fail to strike it when a shot is made, or fail to find the carcass after a wounded and dying animal has fled. In contrast, gathering molluscs has no risk associated with it for they are easy to find in large quantities. However, one must invest much back-breaking work if a sufficient amount is to be gathered for a decent meal!

Ageröd V Much of the Mesolithic subsistence behaviour and technology can be understood from this decision-making, cost–benefit–risk perspective. As an example we might finish this look at Mesolithic subsistence and settlement with a brief consideration of the site of Ageröd V (*c.*6860–6540 BP), an early Atlantic settlement in central Scania. The faunal remains from this site testify to a wide range of animals being exploited.

Red deer, elk, roe deer, and pig are represented and the site appears to have been a hunting camp where hunters went in search of these animals on the encounter basis described above. The number of individual carcasses of each of these represented at the site suggests that considerable effort was placed in hunting and much meat and raw materials acquired. Preference appears to have been for the larger and more difficult to find species such as red deer; many opportunities for hunting the smaller roe deer are likely to have been passed over. In light of this focus on terrestrial hunting it initially appears strange that the site is placed on a small island in a marshy area about 400 metres to the nearest firm land. However, such placement would have been very appropriate for the setting of fish traps to catch the perch, bream, and tench represented at the site. On a daily basis these fish traps may have been far more regular in supplying food than hunting large terrestrial game as there was little risk associated with them. Hence, the foragers could afford to go off in the risky pursuit of red deer—and return home empty-handed on many occasions—for the fish traps assured a supply of food.

Population and Society

The Mesolithic is widely regarded as a period of rapid population growth. Estimates for population densities vary markedly, not surprisingly in light of the difficulties in making such estimates and the likely pattern of variability across Mesolithic Europe. Population densities between 0.50 and 0.005 people/kilometres square are probable and are relatively high for hunter-gatherers. The difficulty in estimating past population sizes and rates of change can be illustrated with the Mesolithic of southwest Germany. Here we see a marked reduction in the number of sites at *c.* 8000 BP, the boundary between the earlier and later Mesolithic. This may reflect a reduction in the size of the human population. However, as there were considerable environmental changes at this time, such as increasing vegetational diversity, the reduction in site numbers may reflect a change in settlement pattern. It is possible that the hunter-gatherers responded to their new environment by living in fewer, but larger, residential camps, or by restricting the location of these to specific areas.

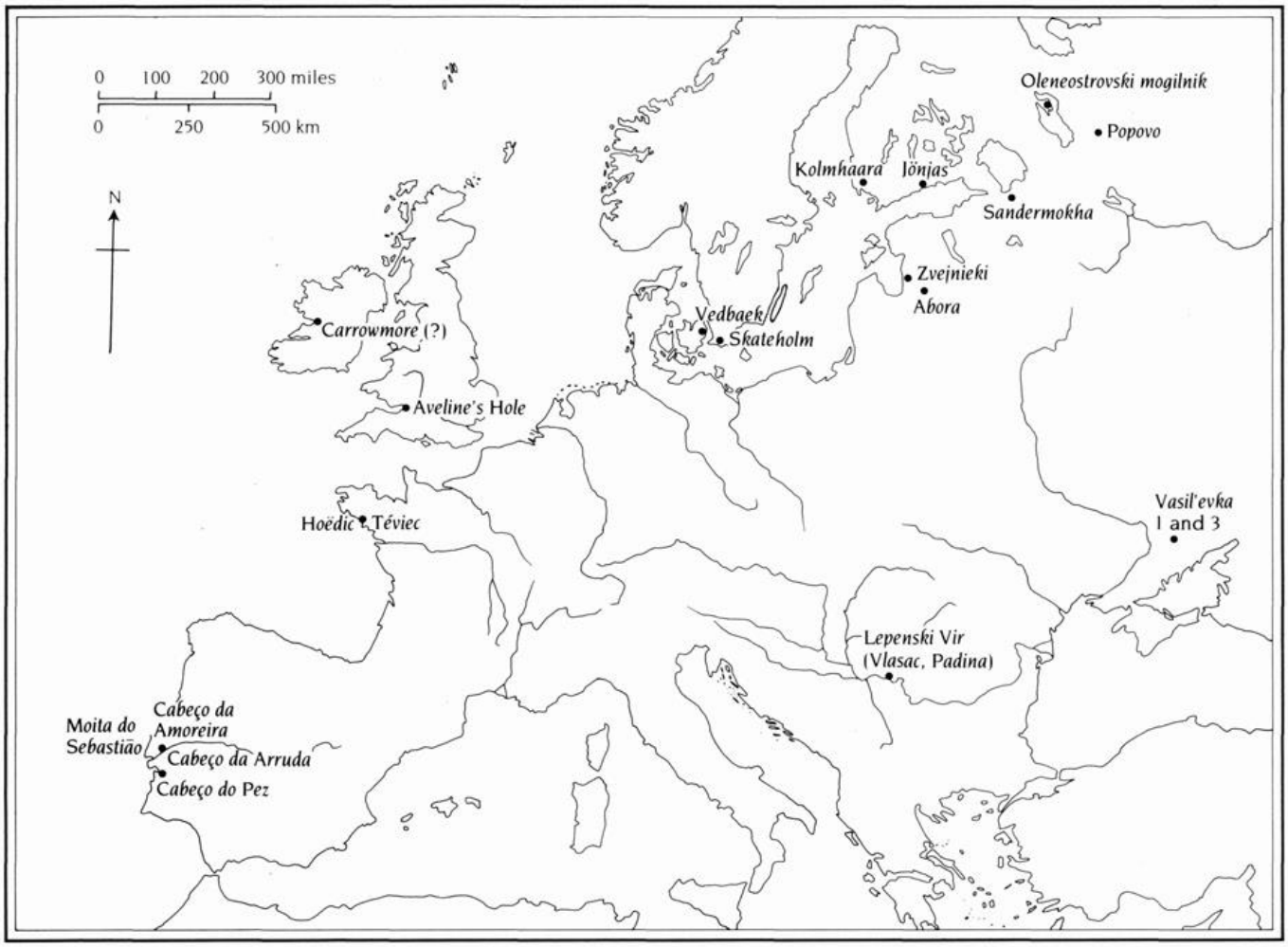
On analogy with documented hunter-gatherers, the social organization of populations are likely to have been hierarchically structured with three principal tiers. At the base would have been the family group. For much of the year families would have congregated to form groups ranging in size from twenty-five to a hundred individuals. These would then have been associated into networks stretching over extensive regions. Contact between groups and individuals in this network would have been made by visiting and periodic aggregation, at which time information, goods, and marriage partners may have been exchanged. However, as with subsistence patterns and technology, one must also recognize that considerable variability in social organization is likely to have existed across Mesolithic Europe. In part this is because social organization, like technology, is a means by which the Mesolithic foragers adapted to their natural envi-

ronments. Speculation on the nature of Mesolithic populations and social organization is easy; hard evidence is more difficult to find. One of the best sources comes from the burial of the dead.

It is during the Mesolithic Age that the first cemeteries were created in Europe. Throughout the Upper Palaeolithic, and perhaps even in the Middle Palaeolithic, individuals had been buried with varying amounts of ritual. But it is only during the Mesolithic that formal burial grounds were created, with the largest containing several hundred individuals. The existence and contents of these cemeteries provides many insights into the Mesolithic; we can re-create the demographic structure of the society; learn about the state of health; make inferences about the social structure and the symbolic meaning of artefacts, which are placed with the dead.

Cemeteries Cemeteries are a late Mesolithic phenomenon with a mean age of *c.*6250

DISTRIBUTION OF MESOLITHIC CEMETERIES in Europe showing preference for coastal, lake, and riverine locations. This may partly be a factor of discovery, although most likely reflects a true pattern of social complexity and incipient territoriality in these areas of high resource abundance and diversity.



BP. During the earlier Mesolithic, burial continued to be of an individualistic nature—at least no cemeteries have yet been discovered. Their appearance seems to represent a distinct event in European prehistory; perhaps the passing of a demographic threshold at *c.*6500 BP. Cemeteries, and the 'complex' societies they reflect are predominantly found in coastal areas or adjacent to large lakes or rivers. There is good reason for this, as such areas would have been the most productive and hence best able to support the largest populations. Some believe this led to the need to mark, perhaps defend, territory achieved by many traditional societies through the use of ancestor presence, i.e. by burial.

The cemeteries show a marked variation in size: the two largest are Oleneostrovski Mogilnik, in Karelia, and Cabeço da Arruda, in Portugal. From each of these over 170 graves have been excavated. Most cemeteries, however, have between twenty to sixty burials each. There are many difficulties in trying to calculate the actual size of a cemetery and to make appropriate comparisons. It is often hard to estimate how long a cemetery was in use and the rate at which people were added to it. Are some larger simply because they were used over a longer period or because they relate to a much larger population? Similarly, comparisons are confounded by the marked variability in the quality of preservation between cemeteries, as well as with the extent and detail of excavation.

Palaeopathology One of the most interesting types of datum from the skeletal remains concerns the state of health of past populations. Many types of disease and injury are represented in the skeletal material. Particularly common are arthritis and caries, but other pathologies include porotic hyperostosis, enamel hypoplasia, rickets, and osteomalacia. Some patterning in the intensity and types of pathology between different populations is evident. Cemeteries relating to more sedentary groups, such as Skateholm, Vedbæk, and Vlasac, contain individuals who have few caries but a wide range of other pathological conditions and had been in poor states of health when alive. In contrast, the populations from cemeteries relating to more mobile groups, such as at Grotta dell'Uzzo, Arene Candide, and Moita do Sebastiâo, have high frequencies of caries, as much as 50 per cent in some cases, but otherwise had been much healthier when alive, with little evidence for pathologies in the skeletal material. No doubt this pattern relates to the greatly increased exposure to parasites and infectious diseases that arise due to hygiene problems created in permanent settlements.

Numerous skeletons from these Mesolithic cemeteries have injuries caused by projectile points. These are often still embedded in the bone and are likely to have been the cause of death. For instance, grave 19A at Vedbæk contains a male with a bone point embedded between the second and third thoracic vertebrae, while that in grave 7 has a trapeze embedded in a long bone. At Skateholm, the remains of an adult man, which had been deposited in a pit, now labelled grave 13, had a transverse arrowhead embedded in the pelvis indicating that death was caused by a projectile which had pierced the abdomen. Several different scenarios are possible to interpret these injuries. They may

GRAVE FROM SKATEHOLM I.
This Mesolithic burial contains an elderly man to the left in a supine position, and a young female in a slight hocker position.

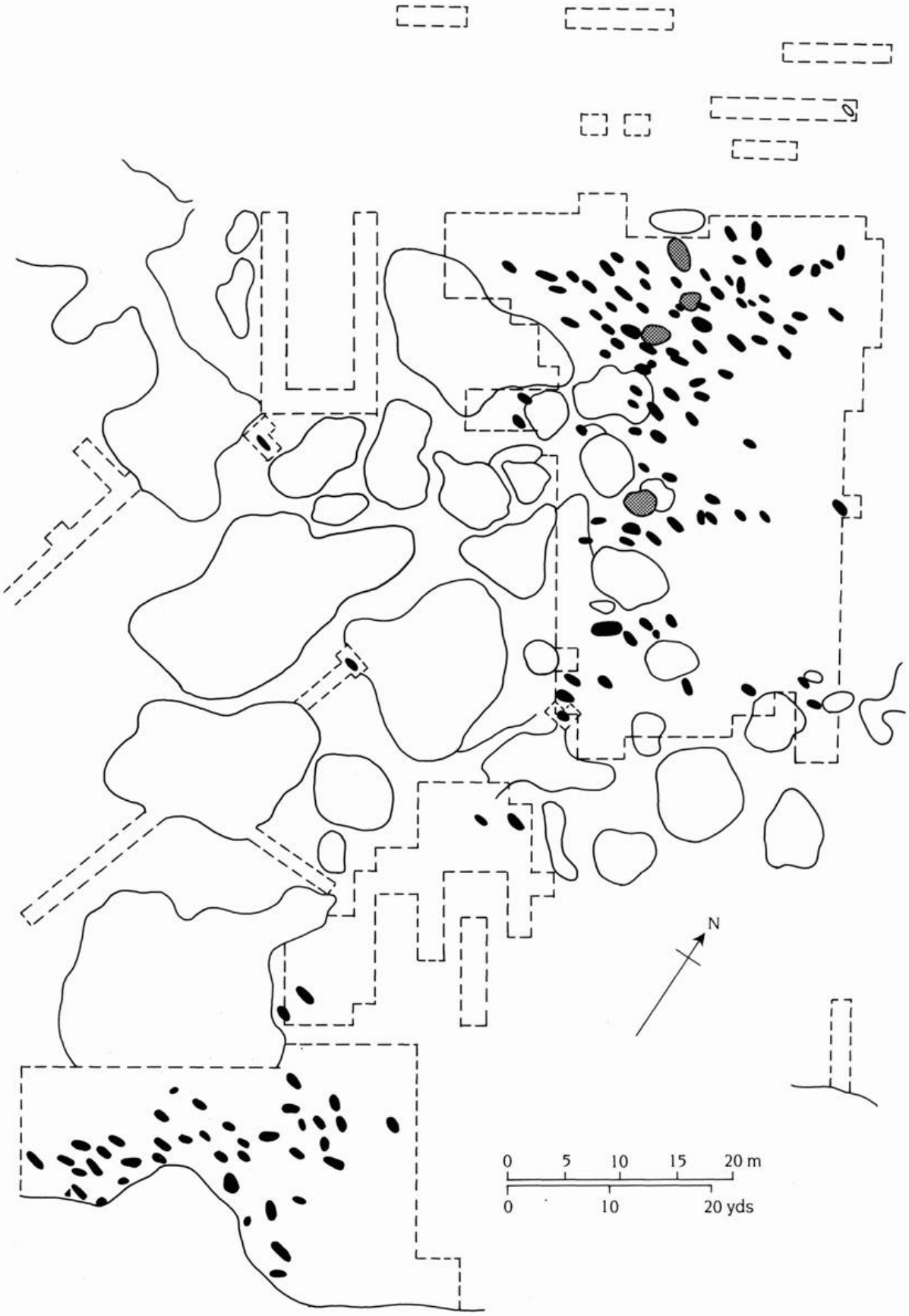
have been caused by hunting accidents, when a group of hunters were slaying a large ungulate such as an adult red deer. Alternatively they may relate to fighting between individuals. A third possibility is that they may derive from organized warfare between groups, as illustrated in the Spanish Levantine paintings discussed below.

Grave goods and burial ritual Moving from the skeletons to the grave goods and the manner of burial we again find considerable variability within and between cemeteries. The variation within cemeteries may relate to the past social organization of the groups, whereas that between cemeteries may relate to the particular traditions of the groups concerned. We might contrast Vedbæk and Skateholm I. At the former, all seventeen graves were of the same simple type—a trough-shaped excavation 0.5–1.0 metres below the surface. They had been laid out in parallel rows and all but three contained just one individual. With the exception of one grave, the deceased had been placed in the supine position with their feet close together and arms along their sides. At Skateholm I, however, there was immense diversity in burial customs, including cremation, and bodies were found sitting up, lying outstreched on their back or stomach, in the hocker position (sideways with knees folded up below the chest), and in a range of contortions.

In addition to the variation in burial ritual across space we can also use the multiple cemeteries at Skateholm to monitor changes through time, for significant differences in burial ritual used in cemeteries I and II are evident. Whereas the hocker position was the most commonly used at Skateholm I, it is absent at Skateholm II, as is the sitting position. The number of grave goods increase at Skateholm II and the burials appear to be laid out according to a more rigid plan, in contrast to the apparent randomness in the earlier cemetery. Moreover, dogs are no longer accorded the same degree of burial ritual at Skateholm II. Previously they appear to have been treated in very similar ways to people. Another fascinating find at Skateholm II is the remains of a large ceremonial structure: a rectangular area demarcated by a belt of red ochre and containing deposits of various parts of different animals.

The burial of dogs at Skateholm deserves further comment. Dogs are likely to have been extremely valuable to the Mesolithic hunters and this is likely to account for the ritual often associated with dog burials. Certain dogs have been found buried individually and with very rich grave goods, such as antlers and flint blades, positioned as if the dog had been a human. Others appear to have been killed to accompany their masters in death, their skeletons being found within the backfill of the grave. In other cases, single canine skeletal elements have been found within graves, implying dismemberment. As a whole, the treatment of dogs, as of humans, appears to have been complex and variable.

We might note, also, other evidence for ritual behaviour during the Mesolithic. Although many of the artefacts found in the bogs of northern Europe, such as the arrows from Loshult, may have been chance losses, others are likely to have been votive depositions. Some of these finds appear to have been deliberately destroyed prior to deposition. Flint nodules have also been found with lines engraved into the cortex prior to being reduced to chips without any intention of manufacturing tools. At Dyrholm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traces of cut marks and fractures on human bones suggest the extraction of marrow and cannibalism.

Social organization The very existence of cemeteries suggests a more complex social organization among hunter-gatherer populations than that found during the early post-glacial and the preceding glacial period. Insights into the nature of this social organization can be gained by examining the relationship between grave goods, the age and sex of those interred, and the variation in burial ritual. Two types of social differentiation can be searched for in the data. The first, horizontal, refers to the status attached to a person due to their intrinsic characteristics—age, sex, personal achievements—and is typical of an 'egalitarian' society. The second, vertical, is that by which status is acquired by virtue of birth—i.e. hereditary inequality—and is the basis of 'ranked' society. The classic indicator for this is the burial of children with great wealth that could not possibly have been obtained by their own actions.

In the majority of cases, social differentiation appears to have been of the horizontal type. Most of the variability in the distribution of grave goods and burial ritual can be accounted for by referring to age and sex alone. Other features, such as the distribution of ochre, are uniform within cemeteries. In these societies status may well have derived from one's success at hunting large game, notably red deer and wild pig, since antler and tooth pendants figure prominently in the repertoire of burial goods. Three cemeteries contain evidence for vertical social differentiation, indicating that the first ranked societies of Europe appeared during the Mesolithic. At Hoëdic and Téviec on the Brittany coast, children had been buried with a very elaborate graveside ritual and many grave goods. These cemeteries are also notable for having multiple burials, in contrast to the otherwise almost universal pattern of single burials, implying that graves were periodically re-opened and resealed to inter members of a single descent group. Complex burial structures are also found at Téviec involving slab-lined graves covered by small mounds.

The cemetery of Oleneostrovski Mogilnik in Karelia has evidence for the most complex social organization currently known from the Mesolithic. Hereditary social positions and economic ranking were prevalent. The 170 graves excavated—roughly a third of the total number in the cemetery—showed marked variability in the quantity of grave goods. Twenty per cent of the graves had no items while others had more than 400 items. Much of this variability can be accounted for by horizontal social differentiation, that is, by reference to age and sex alone conforming to the pattern found elsewhere in Mesolithic Europe. For instance, there were few child burials, suggesting that the inheritance of wealth was limited. Males and females were regularly associated with different types of grave goods: bone points, slate knives, and bone pins with males and carved

THE CEMETERY AT OLENEOSTROVSKI MOGILNIK. This cemetery has a diverse range of burial types including upright internments marked here by bold stipples. The finer stipples represent ground surface irregularities, primarily depressions. Some 170 burials have been excavated leading to the recovery of more than 7000 artifacts, the majority of which were pendants made from the perforated teeth of elk, beaver, and bear.

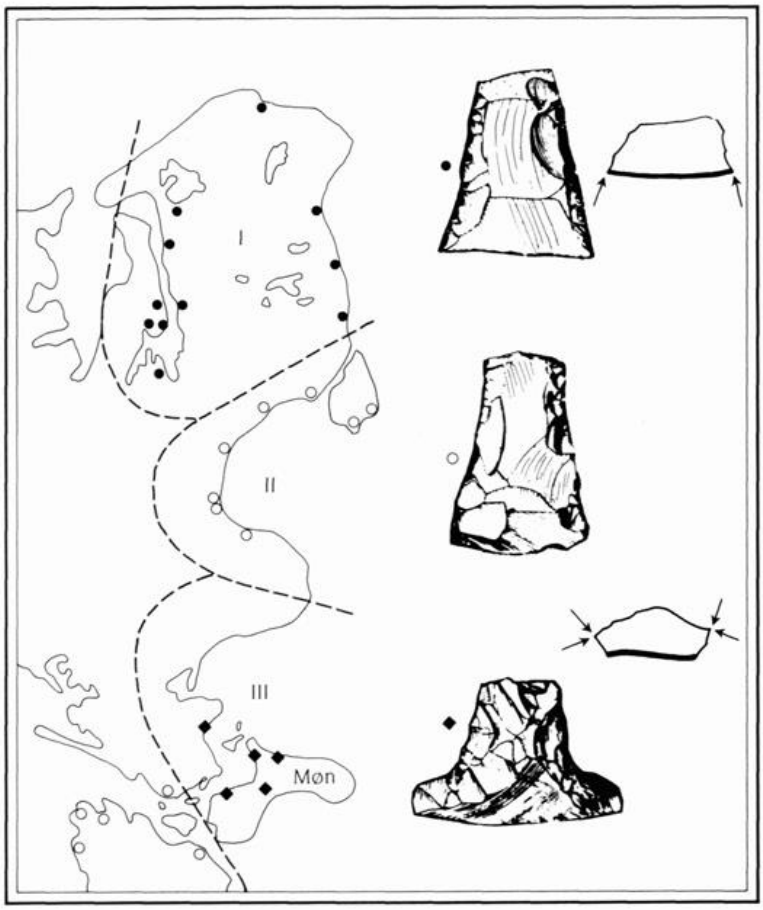
beaver incisors with females. The wealth possessed by an individual was apparently expressed through the type and quantity of pierced animal tooth pendants with which they were interred. These were of bear, elk, and beaver—just three of the many animals that were hunted and, which one can presume had symbolic importance. Individuals in their prime of life had the greatest number of these pendants, probably reflecting their greater abilities as hunters versus the young or old.

Cross-cutting this horizontal social differentiation are patterns which suggest that certain individuals had social positions independent from achieved social status. Nine graves contained carved effigies of snakes, elks, and humans, suggesting that those individuals had some special social position. In addition there were four shaft graves in which the deceased assumed a standing position. These are likely to be the graves of shamans. A third type of social distinction at Oleneostrovski Mogilnik is division of the entire cemetery into two grave clusters, probably reflecting a bipartite division of the society, perhaps into two clans. Elk effigies were restricted to graves in the northern cluster, whereas snake and human effigies predominated in the southern cluster. We can describe Oleneostrovski Mogilnik as an incipient ranked society. Together with Téviec and Hoëdic, Vedbæk and Skateholm, and the many smaller cemeteries we can readily appreciate that the hunter-gatherer societies of the later Mesolithic had reached a level of social complexity greater than that of any preceding society in prehistoric Europe.

Social boundaries A further aspect of social organization concerns ethnic boundaries between groups marked by distinctive changes in artefact types and styles. Identifying such stylistic variability requires that we hold other variables, such as raw material types and function, constant. Rarely is this possible, and much of the artefactual variability across Europe is most readily explained by reference to utilitarian factors, rather than to style and ethnicity.

A recent study has attempted to investigate whether any regional patterning can be detected in the many different shapes of microliths found which may be considered functionally equivalent to each other. By using sophisticated statistical techniques, the majority of variation in microlithic shape was shown to be random. However, some patterning was apparent in the later Mesolithic. Certain regions seemed to have a clear preference for specific shapes of microlith. This may well relate to the establishment of socio-cultural boundaries and territoriality in the later Mesolithic period. By studying the distribution of other artefact types, it appears that southern Scandinavia was divided into three major areas each having distinct traditions during the later Mesolithic: Jutland, the east Danish islands, and Scania. A boundary between west and east Denmark is indicated by different artefact distributions: certain harpoon types, bone combs, T-shaped antler axes, and decorative motifs are not found east of Funen. Other artefacts, such as certain types of stone axe are not found in Jutland. Scania is noticeably different in its mortuary practices, as discussed above, and in the designs found on bone harpoons and Ertebølle pottery.

Social boundaries can also be detected at a smaller spatial scale. Flake axes from Erte-



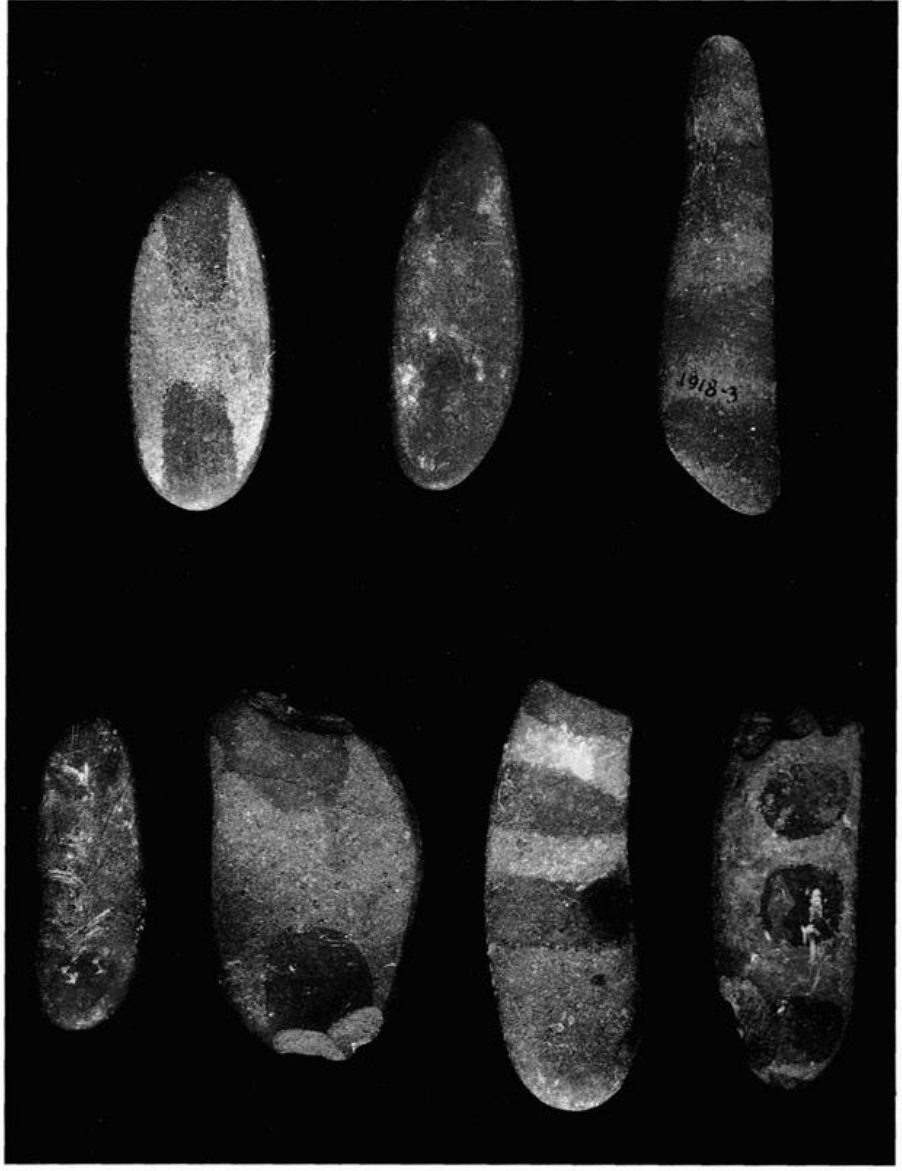
DISTRIBUTION OF FLAKE AXES in the late Ertebølle culture in eastern Zealand. In each of the three groupings one specific type of axe prevails. Such variation over a small spatial area may derive from a variety of factors including raw material availability for axe manufacture, contrasting activities for which axes were used, and stylistic differences relating to discrete social groups and perhaps reflecting territoriality. The latter is generally preferred for this specific example.

bølle sites in eastern Zealand come in a range of different shapes varying with respect to symmetry and the breadth of cutting edge. Three principal variants show clear spatial patterning, and this may well reflect the boundaries of social groups. We clearly have not only a complex social organization but also the emergence of a complex social geography in the later Mesolithic.

Art

As in any period, it is difficult to draw a line between what is, and what is not, an object of art. As we have seen, the tools of the Mesolithic often display a skill that teeters on the edge, if not falls into, the realm of creativity that we call art rather than craft. The finely worked flint objects and the houses of Lepenski Vir all demonstrate that an aesthetic sensibility was involved in the manufacture of even the most utilitarian of objects.

It is often only when we have little idea of the function of an artefact that we describe it as art. This is illustrated by the Azilian painted pebbles which come principally from sites in France and Spain at around 11,000 BP. These are small, flat or ovoid pebbles mainly of a blue-grey schist which were selected from a river and then painted. This decoration is in the form of dots, lines, and, occasionally, more complex motifs such as chevrons and crosses. There are no depictions of animals or indeed of any representa-



AZILIAN PAINTED PEBBLES from Mas d'Azil. Such pebbles tend to be rather small, *c.*2–3 cm in length.

tional figures. The majority of these pebbles come from the cave/tunnel of Mas d'Azil in the foothills of the Pyrenees and were discovered at the same time as Palaeolithic cave paintings. Although we describe these as art, they have none of the elegance or craftsmanship that we find in the antler harpoons or woven fishtraps that convention required us to discuss under 'technology'. But these pebbles have their own beauty, part of which is contained in the mystery as to what they were used for. Perhaps they were markers in a game, or constitute an early counting system; possibly they were used in cult or ritual activities. The idea that they were just playful doodlings has been falsified by a recent study which demonstrated that there is order and pattern in these designs. For instance, sixteen different motifs have been identified but only forty-one of the 246 possible binary combinations were ever used. The pebble collections from different sites have markedly different frequencies of motifs: for example, dots dominate on those from Mas d'Azil while lines are most common on the pebbles from Rochedare.

From Lepenski Vir we have another Mesolithic art tradition based on rounded stone, but one of impressive proportions. Found among the ruins of the trapezoid houses, we

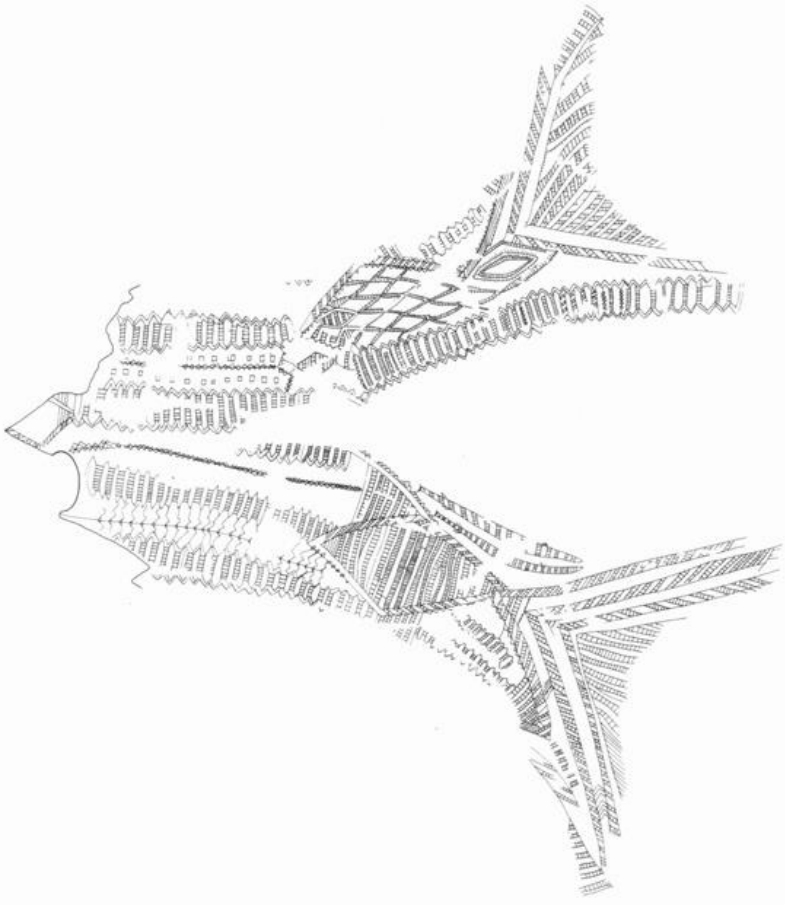
have a striking series of carved sandstone boulders varying from 20 to 60 centimetres in height. Many of these have purely abstract designs of either a geometric or a more amorphous nature. Others are anthropomorphic—haunting faces with heavy eyebrows, ears, noses, and wide, large lips. They are often described as half human and half fish. The power of these simple designs is immense and provides a glimpse into the mythological world of the Lepenski Vir hunter-fishers.

For the art produced on organic materials we must once again return to the waterlogged sites of northern Europe. The most significant find of recent years is the wooden paddle from the submerged settlement of Tybrind Vig. An elegant geometric design had been either engraved or pressed into the face of this paddle and then filled with a brown pigment. The design itself is unique from the Mesolithic and provocatively suggests the visual riches that we only glimpse at through such lucky finds.

Throughout southern Scandinavia there have been many finds of decorated antler and bone objects. Engraving or pitting was used to build up geometric designs. Most of these were constructed from basic shapes such as rhomboids, squares, lozenges, and barbed lines. More complex mesh images are sometimes found, and, occasionally, representational imagery. Some spatial and temporal patterning in decorated objects can be identified. In the Maglemosian, bone objects and pointed antler tools were the main items decorated. In the Kongemose and Ertebølle, antler axes and long antler shafts were also decorated. Likewise, some designs had limited geographical distribution as noted in the discussion above on social boundaries.

An artefact from the site of Sjöholmen in southern Sweden is part of a red deer antler that had been extensively ground down to prepare the surface for engraving and to exaggerate the Y formed by the beam and a tine. The surface is covered with a complex of shapes involving rhomboids and hexagons. Amid this complexity, two zoomorphic forms are present which appear to be images of fish. They have long, slender bodies and oblique lines which may be fins. Whether this artefact was once part of a functional object is difficult to decide; there are the remains of a shaft hole opposite the Y suggesting it was part of a multi-component object, but no wear is apparent on the engraved surface.

Engraved animals are rare and, as with the supposed fish on the above example, may be so schematized that they are difficult to identify. A few engravings of deer are known, such as the red deer on the mattock head from Ystad, Scania. Anthropomorphic designs are rather more numerous and often intermixed; indeed they grade into, geometric designs. A few carvings of animals are known from southern Scandinavia. There is a small set of objects carved in amber including a wild boar (or bear) and a duck. The boar once again shows the pervasiveness of geometric designs since these are engraved on its side, while the bird has an elegance that matches any Brancusi. From further north a tradition of carving elk heads existed. There is a splendid series of these from the cemetery of Oleneostrovski Mogilnik. Whether such objects had any utlitarian value is unknown. They may have been symbols denoting power or wealth and were possibly involved in



exchange networks. They certainly testify once again to the observational and creative skill of the Mesolithic hunter-gatherers. A beautiful elk head carving in wood has been recovered from the site of Vis I. As noted above, this carving had acted as the brake on a wooden ski. Once again we are reminded of the foolishness of trying to demarcate between that which is utilitarian and that which is art during the Mesolithic.

For a final glimpse of Mesolithic art we return to southern Europe and briefly look at the rock art of the Spanish Levant. Whether this art can be described as 'Mesolithic' is a bone of contention. More probably, it was created after agricultural economies had become established in the coastal lowlands of Spain. But in the high, rugged mountains, where we find this art, it is most likely that the Mesolithic hunting and gathering way of life was continued either by those same farmers during particular seasons or by separate populations. Hence to call the art Neolithic and not mention it in this chapter would be to fall foul of the terminological distinctions that recent research has shown to have such little meaning in terms of past lifestyles. A further reason for discussing it here is that the predominant subject of the art is hunting and gathering activities and hence it informs on many aspects of this way of life in prehistoric Europe, for which we have no other evidence. Rather than attempt a summary of this tradition, I shall briefly outline four paintings to appreciate both the beauty and academic significance of this art.

The first is the scene of a red deer drive from Cueva de los Caballos that was mentioned above when considering hunting techniques. Most of the hunting scenes are of this type—small schematic stick men with bows and arrows hunting herds of deer, horse, or wild boar. The scenes are vibrant with the excitement of the chase. Often the hunters are seen herding animals towards an ambush of archers. From Cueva Remigia in the Gasulla gorge, a painting may depict a wounded bull chasing the hunter who had failed to slay his game. From the Cueva de la Arana there is a depiction of a man or woman gathering honey. He/she is climbing a tree or possibly a rope ladder. One arm is outstretched to collect honey from a hive and is surrounded by swarming bees while the other holds the collecting jar. For Mesolithic foragers throughout Europe such honey gathering must have been a regular, perhaps mundane activity; here we have our only glimpse. A wonderful dance scene is depicted at the Barranco de los Grajos. Here twenty women and a few men are shown in a variety of poses; some women are swaying from their hips; others throw their arms into the air; all appear to keep their feet quite still. A third type of communal activity is illustrated at Les Dogues—a confrontation between

THIS RICHLY DECORATED ARTEFACT (*above and far left*) from Sjöholmen is 31.7 cm long and 3.5 cm thick at its midpoint and made from the beam of a red-deer antler. Although originally found broken into several pieces, its is complete except for minor parts. Traces of a shaft hole, *c.* 2 cm wide, survive at the end of the Y, and except for the concave part the whole surface is covered with shallow incisions.

EFFIGY OF AN ELK HEAD (*left*) from Oleneostrovski Mogilnik. Such elk figures were only found in six burials, all of which were in the northern cluster of graves (*see p. 124*). As such they may relate to both individual status and group identity. The elk was an important economic resource for northern hunters and, on the basis of such carvings, is likely to have had some mythological status.

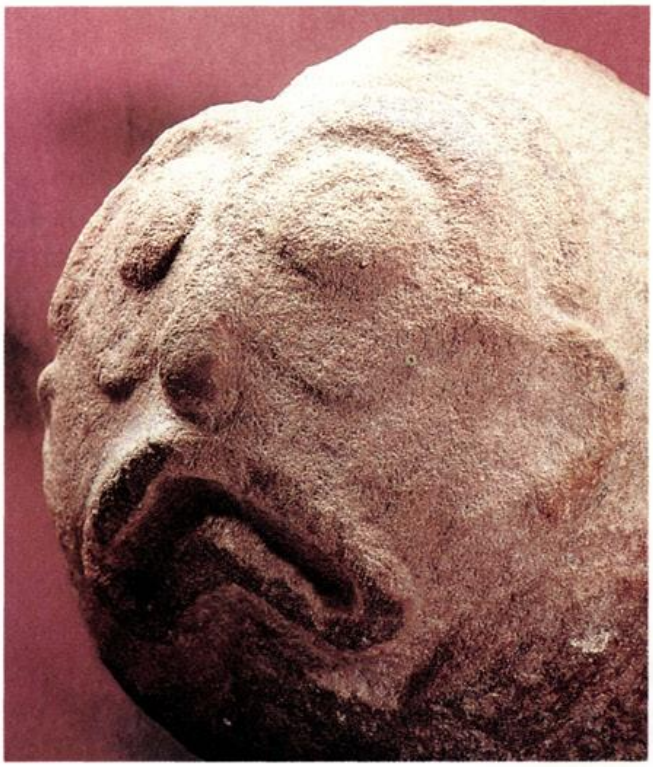
two groups of archers. One group, which appears to have a leader wearing a hat with plumes, is sustaining an attack from a larger group of archers of much slighter build. It is unclear whether this depicts ritualized warfare or bloody combat for the defence of territory. Whatever it is, this scene, along with that of communal dancing and co-operative hunting, gives us rare insights into the social life of the Mesolithic communities of Europe.

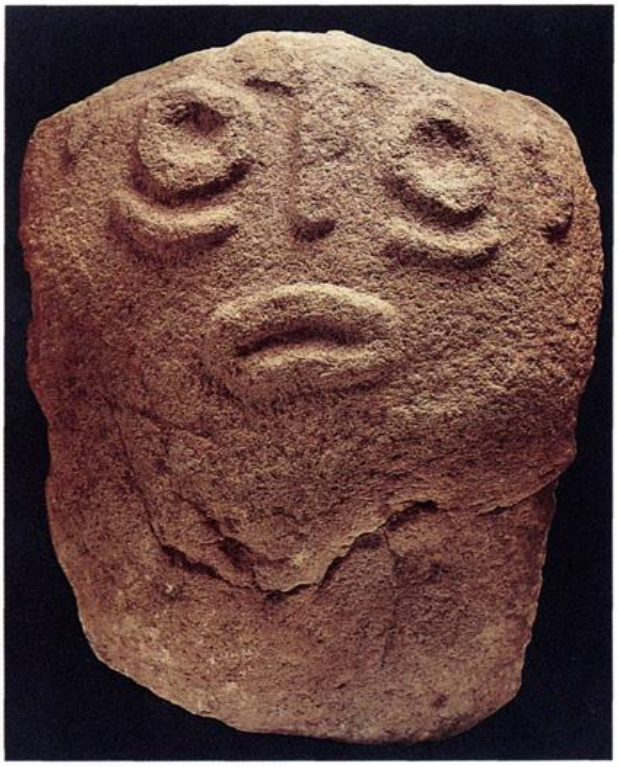
Socio-economic Organization and Change

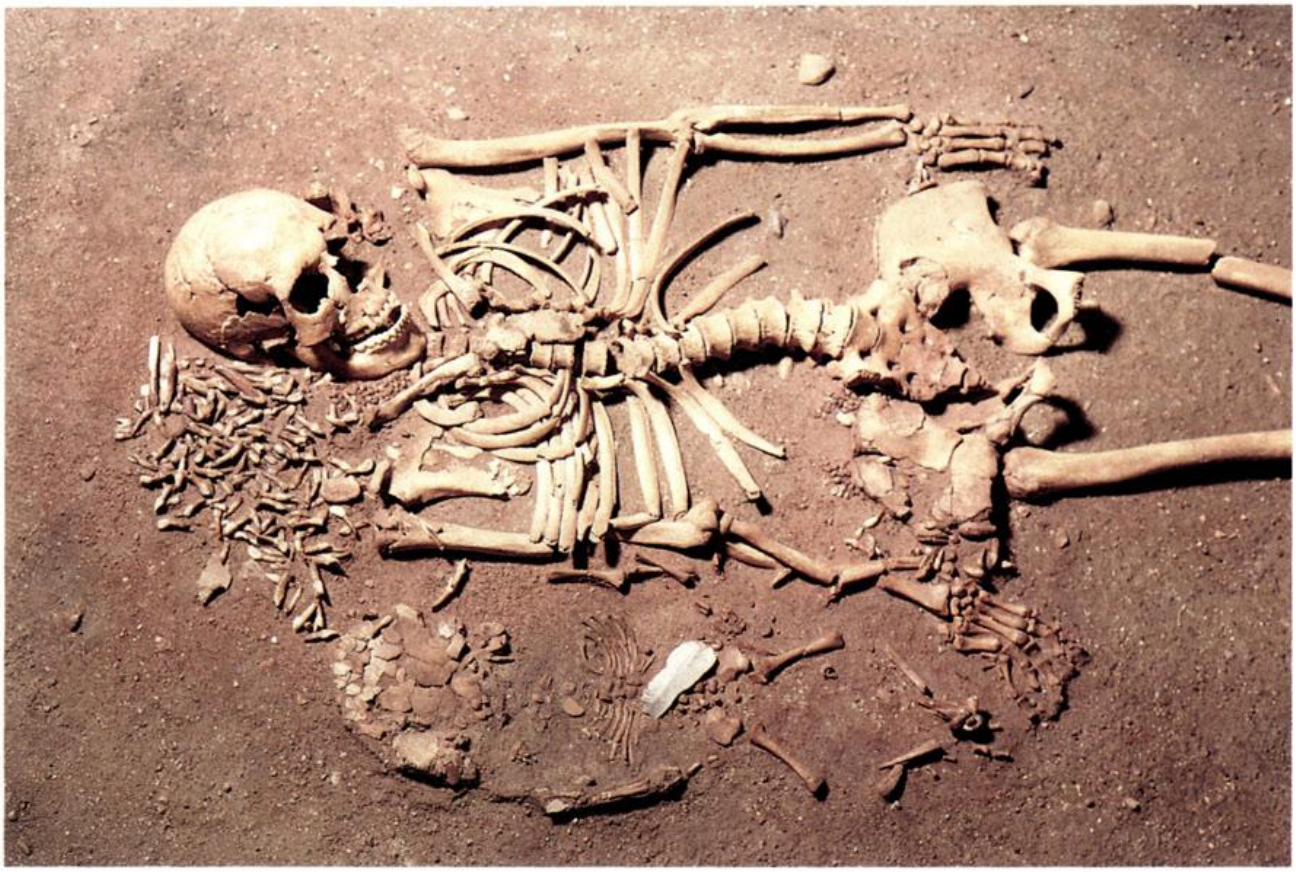
In reviewing the Mesolithic archaeological record I have had to separate the data into different categories—technology, subsistence, settlement, society, and art. Such divisions are, of course, artificial since all of these areas are intimately tied up with each other. It is very unlikely that a Mesolithic forager would have made the same divisions that we draw today for academic expediency. The connections between these different areas are most apparent when we consider socio-economic change during the Mesolithic. In providing an overall picture of the Mesolithic I have purposefully combined material from different areas and phases. But it must be appreciated that the Mesolithic was not a period of stasis in European prehistory; rather it was a time of considerable socio-economic change. This is particularly the case for northern Europe. In the south, continuity rather than change appears to be the key to the Mesolithic, as apparent from the long, continuous sequence of occupation in sites such as Franchthi cave.

The evidence from southern Scandinavia provides us with a picture of a very dynamic socio-economic organization in a continuous process of adjustment. If we compare the earlier (Maglemose and Kongemose phases) with the later (Ertebølle phase) Mesolithic, many contrasts can be drawn. There appears to be an intensification of subsistence practices; an increase in the number and diversity of resources exploited. In particular, there are indications of a far greater concentration on coastal and marine resources in the later period, many very 'costly' to exploit, such as shellfish. A problem here, however, is that much of the early post-glacial shoreline is now submerged and hence coastal resources may have been more heavily exploited in the earlier Mesolithic than is currently believed. Underwater surveys around the coast of southern Scandinavia are beginning to locate submerged early Mesolithic coastal settlement for future excavation.

Related to this subsistence intensification is an increase in the diversity and specialization of the tool-kit. The range of arrowheads is greater in the later Mesolithic, with each appearing to be dedicated to specific tasks. Similarly, there is an increase in the technology that relates to aquatic resources such as fish hooks, nets, weirs, and leisters. A third related change is the number and range of site types. There are quite simply many more known sites belonging to the Ertebølle than to the earlier periods. This is likely to reflect both an increase in population and the diversification of subsistence practices so that many more specialized types of site are created, each dedicated to the exploitation of a specific resource at a specific season.

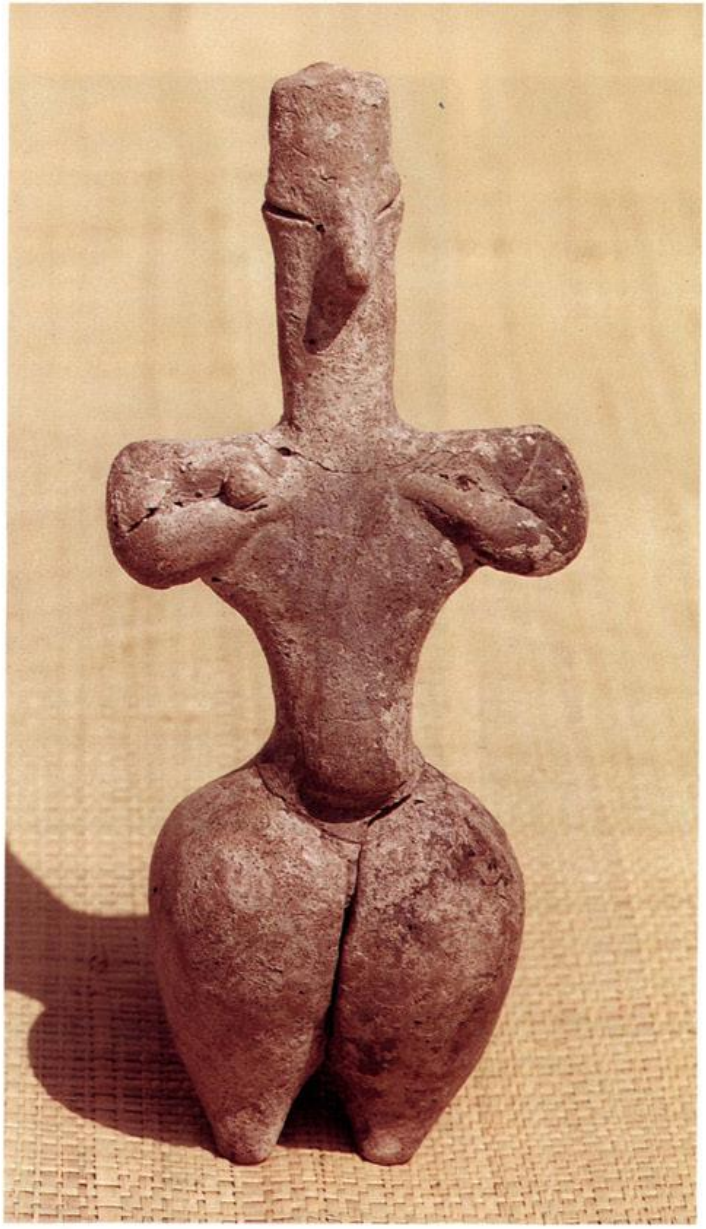






SCULPTURE FROM LEPENSKI VIR. *Above*: These stone sculptures were closely associated with the architecture of the site and often embedded in the foundations of dwellings. As such, they have been described as a 'magic stone' and the 'navel of the world'. That on the left was found from the frontage, and the other, which has been described as the first monumental 'portrait' in the history of European Sculpture, in the rear wall of the sanctuary of dwelling XLIV at Lepenski Vir II.

A MESOLITHIC BURIAL FROM VEDBAEK. *Below:* This is grave 8 and contains a woman with a new-born baby. Beside the skull are a series of pendants, possibly a necklace, made from the teeth of red deer and wild pig. Substantial quantities of red ochre are found in the grave and a single, large flint blade is associated with the baby.



FEMALE ANTHROPOMORPHIC FIGURINE (*left*) in fired clay from the tell at Nea Nikomedeia, Macedonia, north-east Greece.

AN UNUSUAL DOUBLE POT (*below*) decorated in the Cardial style, from the Cova de l'Or, Alicante, eastern Spain.

A further set of changes concerns social organization. The spatial area of style zones, defined by the distribution of specific artefact types, appears to decrease throughout the Mesolithic, perhaps suggesting that territories were becoming smaller and/or required clearer definition. Similarly the phenomenon of cemeteries occurs only in the late Mesolithic and is likely to relate also to increasing territoriality.

By drawing all this information together and combining it with our knowledge of environmental change, we can suggest a likely scenario for the process of culture change in southern Scandinavia. The dramatic fall in available land area and an expanding population may have seriously increased population densities. To cope with this the foragers may have needed to diversify their subsistence base and, in particular, exploit those resources which had previously been ignored. This would have required a new range of technology. A further result of this pressure would have been the reduction of mobility and definition, and perhaps more intense defence, of territory.

Such scenarios of change forced on the Mesolithic hunters by increasing resource stress should be complemented by change deriving from the internal dynamics of Mesolithic society that occurred irrespective of environmental change. In the resource-rich areas of southern Scandinavia it is likely that there was intense social competition for prestige and power. This may have been the motor behind the innovation of new technology that allowed additional resources to be exploited so that surpluses could be created. Investing time and energy in this technology, such as construction of weirs, and the storing of food, is likely to have led to the delimitation of territorial boundaries. It is probable that both of these processes of change—stress imposed by population/resource imbalances and internal competition for power—were occurring simultaneously and were intermixed in a rather complex manner. This may also be the case for regions of Mesolithic Europe other than southern Scandinavia, such as the Morbihan area of Brittany where the cemeteries of Hoëdic and Téviec are found. At the heart of these processes of change we can envisage the individual Mesolithic forager making decisions about how to behave. The goal would have been to maintain the achieved standard of living in the face of continuous change in the physical and social environment. Such decision-making was equally at the heart of the process that denotes the end of the Mesolithic Age: the adoption of agricultural economies.

Summary

How can we summarize the Mesolithic Age? Was it the glorious finale to hunter-gatherer adaptations in Europe or the prelude to the social and economic systems of later prehistory? Or, was it a play within itself, requiring reference neither to what went before, nor after, for its identity. Perhaps we should try to see it as all three; a period with many complex threads which we are only just beginning to unravel and understand. If we need a single image to characterize the Mesolithic we cannot choose a particular environmental type, settlement system, or socio-economic organization. These all var-

IMAGES FROM THE ROCK ART of the Spanish Levant. (*a*) The honey gatherer, Cueva de la Arama; (*b*) Dance scene, Barraco de los Crajos; (*c*) Combat between two bands of archers, Les Dogmes. The interpretation of rock-art images such as these is extremely difficult as, on the basis of the work of recent hunter-gatherers such as Australian Aborigines, any image may contain multiple symbolic meanings which are impossible to infer without knowledge of the mythology of the group. At face value, however, they show, by a masterful use of line and form, some of the likely activities of Mesolithic hunter-gatherers that would otherwise be difficult to infer from the archaeological record.

a

b

c

ied markedly across Mesolithic Europe and through time. The only constant we have is at the level of the individual forager making decisions about which tools to produce, which resources to exploit, and which social alliances to form. Such decisions were made on the basis of imperfect information about the options available, under the influence of the society's traditions, and with the creativity that is inherent to the human mind. It was from such decisions, from the many intended and unintended consequences, that the social and economic structures of the Mesolithic emerged. It was these day-to-day, indeed minute-to-minute, decisions—made as Mesolithic foragers went about their daily business—that created one of the most critical periods of transformation in European prehistory.

I thank Dr Chris Scarre, Dr Peter Rowley-Conwy, and Dr Bill Finlayson for reading and commenting on the whole of an earlier version of this chapter and Dr Petra Day for commenting on those sections concerning vegetation and plant resources.