ARCHAEOLOGY AND ENVIRONMENT IN THE VALE OF YORK

Studies in the use of insect remains in the interpretation of archaeological environments

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of Philosophy in the Faculty of
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Synopsis

This research is united by both geographical area, principally the Vale of York, and methodology, stressing the use of insect remains in interpreting archaeological environments. Firstly the Cover Sands of North Lincolnshire and the Vale of York are considered. A terminal Devensian age is suggested for the majority of this extensive aeolian deposition and evidence for mode of origin and palaeoenvironment is discussed, with particular regard to insect faunas from within the Sands at Flixborough and Messingham, near Scunthorpe. A brief examination of the nebulous Creswellian industry in relation to the Sands is followed by the study of Mesolithic and Neolithic artifacts from on top of the Cover Sands at Misterton Carr, Nottinghamshire, and the affinities of the earlier part of this assemblage are considered with some current archaeological models of the palaeoenvironment.

The trackway beneath Thorne Moor provides an opportunity to examine a local Bronze Age environment and the problems of the genesis of this lowland raised bog and also to discuss more widely the insect fauna of undisturbed forest and the effects of human interference, particularly forest clearance, upon it. The Roman sewer in York contrasts with the largely natural environments examined previously and the attempt to interpret the slight environmental data obtained leads into an essay upon synanthropic insects and the archaeological evidence for their long association with man. This unwanted alliance provides the means to reinterpret a Roman deposit, the Malton burnt grain, which has been linked with the historical events of A.D. 296. The apparent evidence for barbarian attack in northern England is reviewed and a less histrionic interpretation suggested.

Acknowledgements

A research programme of this pattern, a complex interweaving of data from archaeology, geology, entomology, botany and many other branches of the environmental sciences, would have been impossible without the ready cooperation of many scientists in each of several fields. I am particularly grateful to Margaret Herbert-Smith and James R.A. Greig, who provided the respective pollen counts for comparison with my data from other sources at Thorne Moor and Misterton Carr; the conclusions drawn from these and any errors, must fall to me, although I have profited much from their discussion. James Greig, with Dorian Williams, also considered the botanical aspects of the York sewer and A.G. Greenfield provided diatom and sponge identifications. Ruth Jones identified the willow charcoal from the Messingham site.

The entomological aspects of the research would clearly have been impossible without the training and assistance with identification and interpretation provided by G. Russell Coope and Peter J. Osborne, in the Quaternary Research Laboratory of the University of Birmingham; it is upon their work that I founded the natural historical sections of my programme and both have been free in discussion and access to unpublished information. Discussion with my contemporaries in the Department of Geology, particularly Maureen Girling, James Rackham and Harry K. Kenward, has also been of considerable value and many entomologists have provided both assistance and facilities for indentification, including Robert B. Angus (Helophorus spp.), Martin Brendall (Hypophloeus spp.), Peter Hammond (Staphylinidae and Metophthalmus sp.), Colin Howes (Arachnida), Colin Johnson (Atheta spp., Ptiliidae, Lathridiidae and Scarabaeidae), Chris O'Toole (Aculeata), Peter Skidmore (Diptera) and R.T. Thompson (Notaris sp.); much has also been derived from enthusiastic dialogue with all. Facilities for research at the British Museum (Nat. Hist.), Doncaster Museum, Manchester Museum and Dept. of Biology, University of York, as well as the Dept. of Geology of this University are gratefully acknowledged.

The acceptance by several archaeologists of my somewhat biased and unorthodox approach to their subject deserves comment. Considerable gratitude must be expressed to Peter V. Addyman of the York Archaeological Trust, who not only provided facilities and encouragement for work on the York and Malton material, but has continued to promote the environmental approach to archaeology in urban centres. Among other archaeologists, the author has profited much from discussion with Malcolm J. Dolby, Roger Jacobi, John R. Magilton, Arthur MacGregor, Paul Mellars, Keith Miller, Neil Loughlin, John Samuels, Alan Saville, Roger F. Smith, Tony B. Sumpter, J. Ben Whitwell and many others. I am grateful for permission to quote from unpublished work from several of these, duly acknowledged in the text, and for similar permission from Susan Limbrey and Professor F.W. Shotton. The Trustees and Local Authority who own the Malton Museum kindly made available a sample of the burnt grain in their possession. Much of the location of obscure sources would not have been possible but for the ready cooperation of the Library Service of Doncaster M.B.C. and E. Trevor Howell provided considerable assistance with his knowledge of foreign languages.

I am particularly grateful to Geoffrey D. Gaunt for advice and his experience of the geology of the Vale of York, both of which he made freely available, as well as arranging the loan of artifacts in the collection of the Institute of Geological Sciences, to whom acknowledgement is here made. His colleague, Terry Fletcher, also discussed the North Lincolnshire Cover Sands and the stratigraphy of the Ancholme valley with the author.

The considerable body of fieldwork would not have been possible without the ready cooperation of many landowners and others. I am indebted to Michael Elford of British Steel for access to their quarries in the Scunthorpe district and for borehole data. The successive managers of British Industrial Sand's pit at Messingham also allowed frequent visits to their workings. Among local naturalists, William Bunting, self-appointed guardian of the Waste, stands out and, but for his vigilance, the Thorne Moor site would not have been located and he has also provided much background information, not found in the history books, for which I am grateful. Assistance in the field has also been provided by Derek Allen and Ian McDonald and, but for my wife's find of an end scraper at Messingham, the first section could never have been embarked upon.

In its genesis, this thesis owes much to the training and advice received over many years from Ian M. Stead and thegeological polish applied to this by my supervisor, Professor F.W. Shotton, who has patiently accepted all the blind alleys I have followed up before arriving at this final text. Finally, amongst the academicians to whom I am indebted, special mention must be made of Professor Glynn Ll. Isaac, whose anthropological and geological approaches to archaeological questions had considerable influence on my own approach to the problems considered herein. Perhaps the debt to works not elsewhere cited in this study need not be admitted but reference ought to be made to Graham Clark's <u>Archaeology and Society</u> (1957) and Glyn Isaac's unpublished doctoral dissertation on the Acheulian site at Olorgesailie in Kenya; the former provided the springboard and the latter the interpretational approach adopted.

The typing and collation of the finished product are probably the most tedious part of any dissertation. The former has been divided evenly between Fiona Barnard and my wife, who has also finally checked and collated the entire work. She has shown enormous patience in my neglect of duties and absences to complete this research and it is therefore to Joan M. Buckland and our two sons that this dissertation is dedicated.

Doncaster

15.10.1976

'Terminat hora diem; terminat Author opus'

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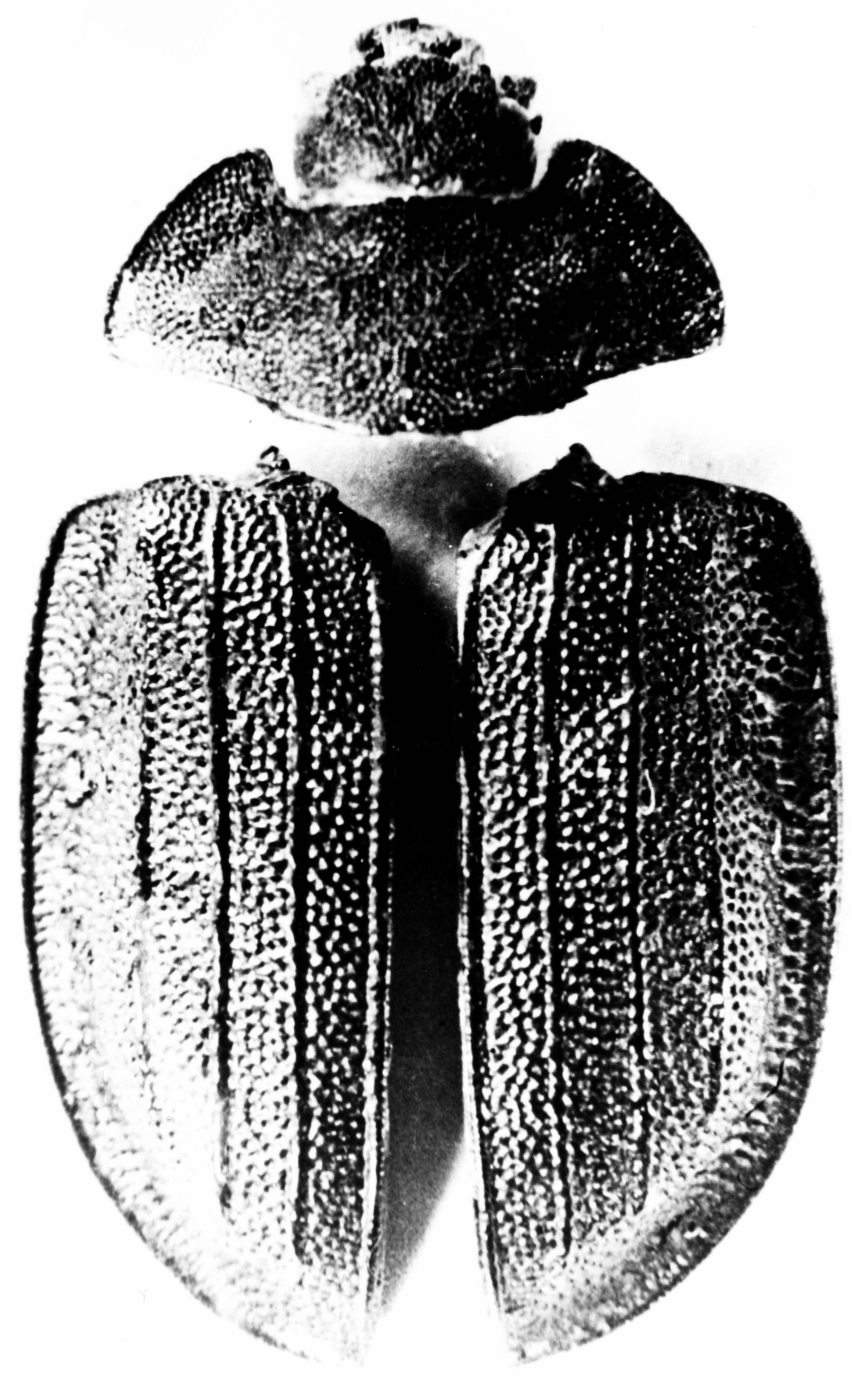


Frontispiece. *Zimioma grossum* from Thorne Moors

Well, Prometheus was a very clever fellow, of course, and invented all sorts of wonderful things. But, unfortunately, when they were set to work, to work was just what they would not do: wherefore very little has come of them, and very little is left of them; and now nobody knows what they were, save a few archaeological old gentlemen who scratch in queer corners, and find little there save Ptinum Furum, Blaptem Mortisagam, Acarum Horridum and Tineam Lacinarum.

Charles Kingsley, 1863

'The Water Babies'

Introduction

The final product of this research programme differs considerably from the initial prospect. Four years ago I set out to provide a period by period study of the archaeology of a somewhat neglected area, a regional study after the pattern of Fox's Archaeology of the Cambridge Region (1923), tied more closely to the geological and environmental background. It soon became apparent that not only was my orbit too broad, but that some modifications would have to be made to avoid repeating work already done. The basic geology, with particular reference to the Quaternary, had already been revised by Gaunt (1975 & refs. therein) and both Smith (1958) and Turner (1962) had carried out palynological research. Whilst it was possible to expand any of these contributions, I felt that a modified approach was necessary if I was to make a wholly original contribution of more than local significance. The primary modification, therefore, was to seek good successions of organic deposits and to examine as many aspects of the preserved plant and animal remains as possible. The area initially selected - Hatfield Chase - lying close to and in part below sea level, seemed ideal for this and attempts were made to locate good successions with inter-stratified archaeological material, which could be correlated. Two major successions examined - Misterton Carr and Thorne Waterside - had poor archaeological correlation and not only was preservation unpredictable but the bases of both were considerably more recent than was anticipated. The options remaining were to accept the vagaries of preservation and concentrate on these late successions, for which there was, after all, a reasonable body of archaeological data, if not directly related, or to excavate a known earlier succession as that at Tadcaster (Bartley, 1962). Specialisation would, however, have been inevitable and palynology would clearly have provided the most effective regional background study, although, again, somewhat remote from the archaeology. A different approach was necessary and, from the research already being carried on in the Department of Geology at the University of Birmingham, principally by Coope and Osborne on Quaternary geological deposits, it was apparent that the most important field open to me was to follow up the research of Osborne (e.g. 1969, 1971) into insects from archaeological deposits. The original thread, if progressively more like Ariadne's, was retained to provide a certain regional cohesiveness to the study, although the area had to be expanded from merely the Chase to include other sites in the Vale of York. The sequence of sites appeared as much by chance as by design. Messingham sand-pit was visited by the Quaternary Research Association in 1971 and the sedimentology of the Cover Sands interested me. On a subsequent visit, the chance find of a flint end scraper, stratified in the underlying peat, by my wife, provided the artifactual piece to the jigsaw for the environment of the Late Creswellian, the first major chapter in this thesis. I had already been concerned with flint assemblages from the Cover Sands in preparing the second chapter, the rather stark artifactual account of the finds from Misterton Carr, a report which contrasts markedly with the wealth of environmental data from the Cover Sands. Some discussion of the probable environmental background is attempted. The Thorne Moor site, found accidentally during the cutting of new ditches to drain the peat workings, had no portable artifacts, only the remains of a rough timber trackway, dated by ^{14}C to the Middle Bronze Age, but the well-preserved insect remains lead on to research into the problems of man, climate and forest clearance, perhaps the most important study here presented. During my tenure of a research grant at Birmingham, I was appointed Researcher in Roman Studies with the York Archaeological Trust and thereby became involved in attempts to provide environmental research facilities for this unit. A preliminary study of the first site, an Anglo-Danish tannery, carried out jointly with H.K. Kenward and J.R.A. Greig has already been published (1974) and this site forms no part of this thesis, although some of its conclusions are relevant to it and are discussed where appropriate. A more general discussion of environment and archaeology in York has also been published (Buckland, 1974); it shows more gaps in our knowledge than it fills. Late in 1972, the discovery of the Roman sewer in Church Street provided the material for a study of insect remains from a wholly man-made biotope. This, together with a discussion of synanthropy, provides the next chapter. Whilst Thorne Moor highlights the losses in the British insect fauna, both York and the final site, Malton, outline some of the increments by human agency. The final section is perhaps the most controversial - the study of the Malton burnt grain acts as a wedge for an excursus into the limitations of archaeological interpretation and an attack on one of the traditional dates in the historical framework of Romano-British archaeology. The latter might appear a little remote from insect faunas but it agrees well with the general theme of the research, the progressively greater detachment of man from his environment as reflected in the fossil insect populations.

Some of the preliminary conclusions of this research programme have already been published or are in press. Copies of these and other publications are appended to the text.

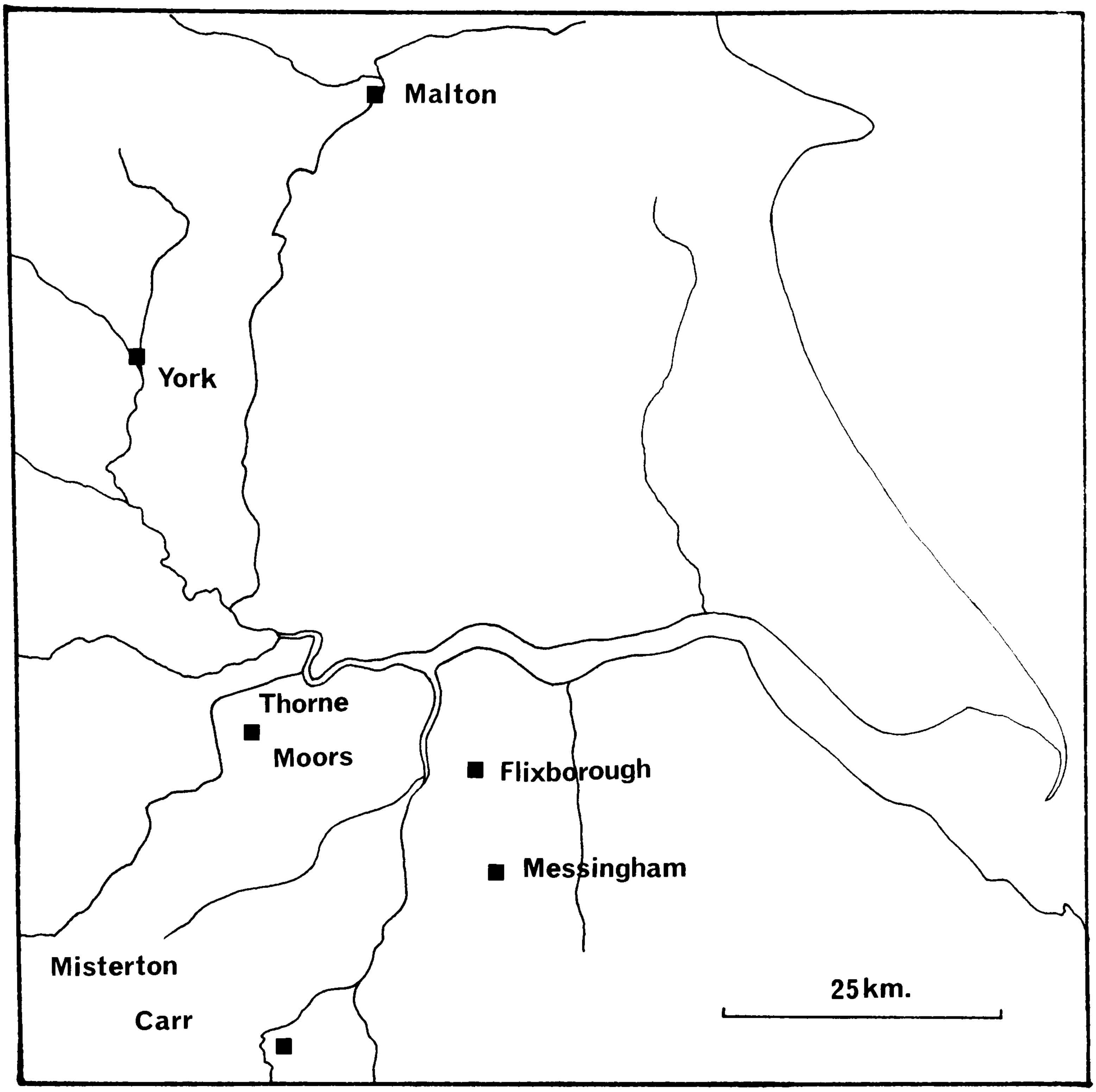


Figure 1. Principal Sites discussed in the text.

Having passed over the Trent at Althorp, or Authrop, in my going to the aforesayd town, I saw nothing observable but the barrenness of the country, and the sandy commons that I passed over; which I no sooner saw, but it brought into my mind the sandy desarts of Egypt and Arabia, which I had a most clear idea of when I beheld these sandy planes. For here the sand is driven away with every wind, and when the wind is strong it is very troublesome to pass, because that the flying sand flys in one's face, and shoos, and pockkets, and such like, and drives into great drifts, like snow drifts. This sandy plane is some miles in length, and about a quarter of a mile in bredth. In great winds it does great damage, for sometimes in a night's space it will cover all the hedges that it is near, and cover all the corn land adjacent, etc. I have observed huge hedges quite sandyd up with it to the very top; and a cloas of thistles that was one day almost a yard tall, the wind changing, and I returning the same way the next day, I could but just discover the tops of them. This plane was formerly a much higher country than it is now, for here and there are left a few hills (now we may call them) three yards in height perpendicular, which blows away by degrees, but were formerly eaven with the rest of the blown away land, etc.

Abraham de la Pryme 1695.

THE COVER SANDS OF NORTH LINCOLNSHIRE AND THE VALE OF YORK: AGE, PALAEOENVIRONMENT AND RELATION TO ARCHAEOLOGICAL INDUSTRIES

Introduction

During the mapping of Lincolnshire and Yorkshire by the officers of the Geological Survey in the late nineteenth century, extensive spreads of 'blown sand' were recorded along the western side of the Vale of York, from the neighbourhood of Northallerton, southwards into the Trent Basin, at least as far as Torksey and eastwards to the foot of the Lincolnshire Wolds. The term 'blown sand' tended to be employed for a group of superficial sands of varying origin and probable age, ranging down to the still active dunes of certain areas of North Lincolnshire. Apart from some recorded sections in the sheet memoirs (Dakyns et al., 1886; Ussher, 1890), these deposits gained little comment. The guide to the geology of the region (Wilson, 1948) only refers to post-Glacial blown sand and the most recent local sheet memoir, to the Ollerton district (Edwards, 1967), has a similar comment. Edwards (1936) noted the occurrence of dreikanter in the Pleistocene succession in the Vale of York and, although most of his localities suggested an origin prior to the maximum ice advance of the last glaciation, Kendall and Wroot (1924) had noted a similar occurrence of wind faceted boulders over deposits north of the York moraine complex, proving more than one period of formation. Swinnerton (1914) had also obtained evidence for Late Pleistocene dreikanter formation in south Nottinghamshire.

Little data on the actual blown sand, however, was forthcoming from geological sources and the first dating evidence was provided, inadvertently, by archaeologists working in North Lincolnshire. In 1931, Armstrong published an assemblage of flints from

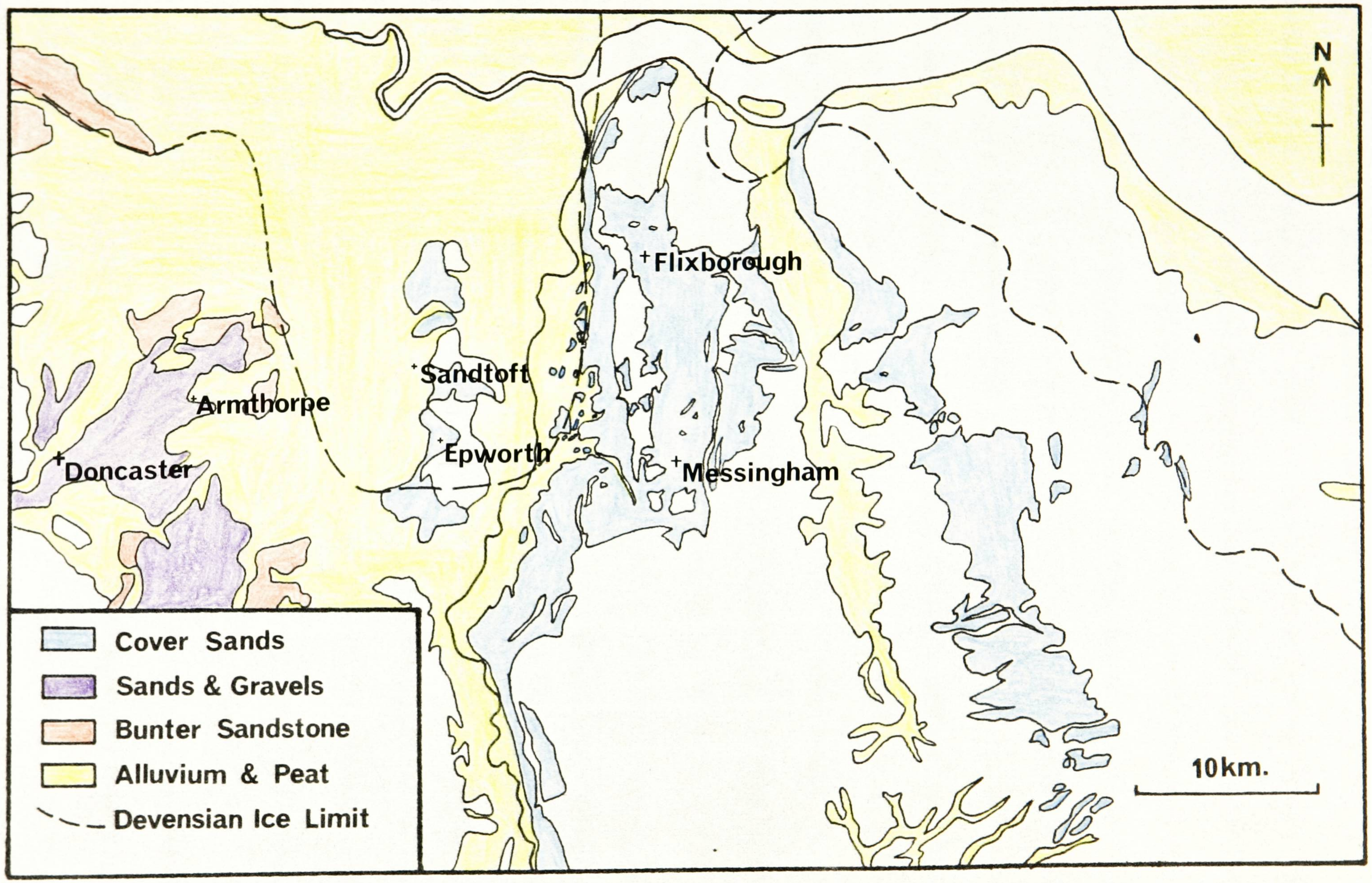


Figure 2. Hatfield Chase and North Lincolnshire: the outcrop of the Cover Sands.
(Based on Q.R.A., 1972).

a site in the Sands at Sheffield's Hill, 5 km. north of Scunthorpe. He regarded this group, despite the associated forest vertebrate fauna, as a hunting station of an Upper Aurignacian (Creswellian) group and went on to excavate and partially publish two similar sites near Willoughton, 11 km. east of Gainsborough (Armstrong, 1932 (a) & (b)). Although subsequent research has shown that these assemblages of backed blades, obliquely blunted points, end scrapers and a few smaller geometric implements with, in the case of one of the Willoughton sites, tranchet axes, belong to the Mesolithic (below, p.108), Armstrong's discussions did imply that the Sands, in part, belonged to either the Devensian or early Flandrian. Armstrong (1932 (b); 1956) was also familiar with other flint assemblages from the blown sand areas of north Lincolnshire and saw, in the small geometric artifacts, a relationship with the Tardenoisian of France and the Low Countries; the prolific finds from Risby Warren, 4 km. north-east of Scunthorpe formed, in his opinion, the type group for this cultural grouping in Britain. Whilst the European connections of this material would currently be treated with more circumspection, these finds appear to belong to the later Mesolithic and, since the finds tend to be incorporated in the Sands, suggest that they had been emplaced by this period. The extensive fieldwork carried out by Dudley (1931; 1949) and others for archaeological finds from the Sands support this contention but the still active nature of dunes on some of the warrens made any satisfactory secure stratigraphic relationship difficult to obtain. Two implements from Risby Warren, however, do seem to have been satisfactorily stratified in a clay layer beneath the Sands, an Acheulian ovate and a shouldered point, the latter a typical Upper Palaeolithic piece (Lacaille, 1946) (fig. 1, no.2), suggesting that the Sands were deposited in the latter half of the Devensian. Dudley (1949) also records teeth and a tusk of mammoth from pockets of gravel beneath the blanket of sand at Flixborough and Thealby. Neither occurrence, however, provides anything more than a broad terminus post quem.

When Straw (1963) came to examine sections in the Sands around Caistor, on the scarp slope of the Lincolnshire Wolds, and at Crosby Warren, near Scunthorpe, he noted stratigraphic evidence for the influence of periglacial conditions and was able, on geomorphological grounds, to suggest that the Sands were probably partially contemporary with the last advance of the Devensian ice sheet and, in part, subsequent to its retreat from the foot of the Chalk dipslope. He further suggested that the Sands must have been emplaced before the establishment of a complete vegetation cover in the post-Glacial and the podzolisation of the deposits, a process which he tentatively ascribed to the Atlantic period; deposition must have therefore ceased no later than the Late Boreal (c. 8,000 B.P.). Straw (op. cit.), recognising the probability of diverse origins for the so-called 'blown sands', introduced the non-commital term 'Cover Sands', which was already widely used for similar deposits in the Low Countries (Maarleveld, 1960), for this formation.

The Quaternary Research Association's field guide to East Yorkshire and North Lincolnshire (1972) lists five specific problems relating to the Cover Sands of the Scunthorpe area:

"1. Source and provenance of the sand.
2. Period and manner of emplacement.
3. Environmental conditions during deposition.
4. Influence on ground-water conditions and soil evolution.
5. Influence on vegetation development and circumstances for human settlement."

It was to examine some aspects of these problems that this research was carried out.

Further north, in the Vale of York, Matthews (1970) had already provided some data on the age of the Cover Sands. At Stockton-on-the-Forest, 5 km. north-east of York (N.G.R. SE608640), a ^{14}C date of 10,700 $\pm$ 190 B.P. (N-488) was obtained on a layer of compact, humified peat at a depth of 1.5 m. into the Sands and 0.2 m. above the underlying till. Nearby, a further ^{14}C date of 9950 $\pm$ 180 B.P. (N-820) was gained from a frost contorted layer of gyttja at a depth of 0.94 m., 1.3 m. above the base of the Sands. At least some of the Cover Sands were therefore to be dated to the terminal cold phase of the last glaciation, Pollen Zone III, although the small amount of sand below the first dated horizon, partially filling frost wedge casts, could belong to any time from the retreat of the Devensian ice sheet from the York Moraine to the first part of Zone III. Particle size analysis confirmed the aeolian nature of the deposits and a pollen count, from close to the base of the second section, implied a Pollen Zone I or III age (op. cit.). Gaunt, Jarvis and Matthews (1971) examined the Late Devensian sequence in the Vale of York on a more regional basis and placed this aeolian phase between an older fluvial depositional phase, associated with the drainage of pro-glacial Lake Humber, and a younger phase of aggradation from a base level of the order of -15 m. below the present. A ^{14}C date from just within the top of the older deposits, a buried soil within the '25 foot Drift' at West Moor, Armthorpe, 7 km. north-east of Doncaster (N.G.R. SE649072), came out as 11,100 $\pm$ 200 B.P. (N-810), showing the superincumbent blown sand to be more recent. The position of some of the Cover Sands was thus fixed, at two widely separate localities, to within the terminal cold phase of the Devensian, although the date of final cessation of sand blowing, apart from post-forest clearance movement, has yet to be ascertained.

The Stratigraphy

Mineral extraction in North Lincolnshire provides extensive exposures in the Cover Sands. Around Messingham, 7 km. south of Scunthorpe, the Sands are quarried over large areas for use as a glass sand and for refractories and a similar pit is in operation on the west side of the Isle of Axholme, near Haxey. North and east of Scunthorpe, the Sands are continually exposed in a series of ephemeral sections, as they are removed with many metres of bedrock in the mining of the Frodingham Ironstone from the Lower Lias. On both Hatfield Chase and at the edges of the Trent floodplain, the cleaning out and cutting of drainage ditches also provide sections. In many of the smaller sections, however, it is not possible to distinguish the true Cover Sands from the partially reworked top of the deposits of the 'Older fluvial depositional phase' of Gaunt et al. (1971), since the two are inter-related. Similarly, more recent dunes are often difficult to localise, unless they overlie archaeological features or buried soil.

In the more extensive exposures, the Cover Sands present a relatively uniform appearance, a succession of thin beds of yellowish orange (Munsell no. 10YR6/6) to yellowish brown (10YR4/2) loose sands, with occasional thinner laminae of darker (5Y 3/2) grey sand with evident organic debris. Table 1 records a typical section in the pit of British Industrial Sand at Messingham (N.G.R. SE919040) and this is closely matched by sections at the second sampling site, in the Ironstone quarries near Flixborough, 4 km. north of Scunthorpe (N.G.R. SE900154). The deposits vary radically in thickness, from a sandy component in the topsoil on the crest of the Wolds (Straw, 1963) and the Isle of Axeholme to an average of 3 m. at the base of the escarpments and in the river valleys. Borehole records from British Steel show several places, both on the scarp

Figure 3. Messingham sand pit, Lincs.: section looking south (1972).

Figure 4. Messingham sand pit, Lincs.: detail of section showing thin bedding and organic horizons.

Table 1 Messingham Sand-pit

Section through Cover Sands at N.G.R. SE 919040

0 - 0.5 m.	Dark yellowish brown (10YR 4/2), medium grained sand, loose, with fine dune bedding visible on a weathered face.
0.04 m.	Grey-brown (5YR 3/2) sandy soil horizon.
0 - 0.7 m.	(?) field boundary ditch, 1 m. wide; date unknown.
0.4 m.	Greyish orange (10YR 7/4) medium grained sand, mottled and thin-bedded, bedding visible on a weathered face, largely horizontal but some low angle cross bedding and ripples.
0.002 m.	Greyish yellow green (5GY 7/2) fine silt lamina, deposited over irregular group of ripples in sands (discontinuous).
0.11 m.	Dark yellowish orange (10YR 6/6) sand, thin bedded with some low angle cross bedding.
0.55 m.	Thin bedded, mottled moderate yellowish brown (10YR 5/4 to 5YR 5/6) thin bedded, medium grained sands with some dark yellowish brown (10YR 4/2) laminae and thin, more organic beds, some appearing more silty. 53 units in section but variation occurs along face, with ripples and some cross bedding. Extensive iron deposition around former rootlets.
0.4 m.	As above, but lacking darker component. 25 units but difficult to count (10YR 5/6).
0.06 m. (10,550 ± 250 B.P.)	Dark olive grey sand (5Y 3/2) with much organic debris, largely a varying content of fibrous moss (*Drepanocladus* sp.); traces of ripples. (Insect faunal sample 1)
0.5 m.	Similar to above but less organic, containing discontinuous laminae of plant debris. No. of units not directly counted being only visible on a weathered face, due to less definition by differential iron deposition.

Table 1 (Continued)

0.09 m.	Similar to 0.06 m. thick horizon above but with more woody tissue to base.
1.8 m.	Brown (10YR 5/3) thin, largely horizontally bedded sand. On the whole, individual beds cannot be traced for any distance. Some ripple and very shallow cross bedding and some good graded bedding in some laminae. Some thin horizons approach coarse sand/fine gravel grade and exhibit clear rounding by aeolian action.
0.05 m.	Hard, compressed, irregularly laminated peat, black (5Y 2.5/2), with recognisable plant remains and occasional insects; much of plant material consists of mosses. <u>Insect faunal samples 2 & 3</u>.
	Disturbed Lias clay with many frost fractured pebbles and cobbles, some apparently wind facetted.

and dipslope of the Lincolnshire Limestone, where the Sands exceed 7 m. in thickness (Elford, pers. comm.). In several exposures, particularly on Crosby Warren (N.G.R. SE921127), the blanket of sands can be seen to sweep up the Lias escarpment, with dips in excess of 5^{o}, attenuating from a thickness of nearly 3 m. to less than 1 m. and carrying over the crest into the expanse of recently stabilised dunes which make up Risby Warren and the adjacent reclaimed farmland. From organic horizons in the upper part of the Sands on Crosby Warren, Holland (1975) has obtained three ^{14}C dates, 2285 $\pm$ 70 B.P. (UB-860); 2070 $\pm$ 50 B.P. (UB-859) and 1640 $\pm$ 435 (UB-862), which show that some movement of sand was again taking place by the Late Iron Age and Roman period. A fundamental difference exists, however, between the Late Glacial Cover Sands and the more recent reworking in that, unlike the Sands north of York (Matthews, 1970), dunes appear to be absent from the older deposits. The thin beds, usually less than 5 cm. thick and often only apparent on a winnowed vertical face, are traceable for considerable distances within the same series of exposures, although they cannot be regarded as units capable of any form of teleconnection since each tends to run out eventually, often into a slight channel deposit or an area of more distinct ripples or shallow cross-bedding. Some layers also show graded bedding and other features consistent with water action during deposition. In the Messingham pit, close to the escarpment of the Upper Lias and Lincolnshire Limestone, more evidently water-lain elements appear in the Sands, with coarsely false-bedded units up to 30 cm. in thickness (fig. 5) running out at right angles to the line of the scarp and gradually attenuating and ramifying into channels westwards, amongst the thinner bedded part of the Sands. Frequently, sedimentary features are picked out by lines of iron compound deposition, resulting from leaching during podzolisation and

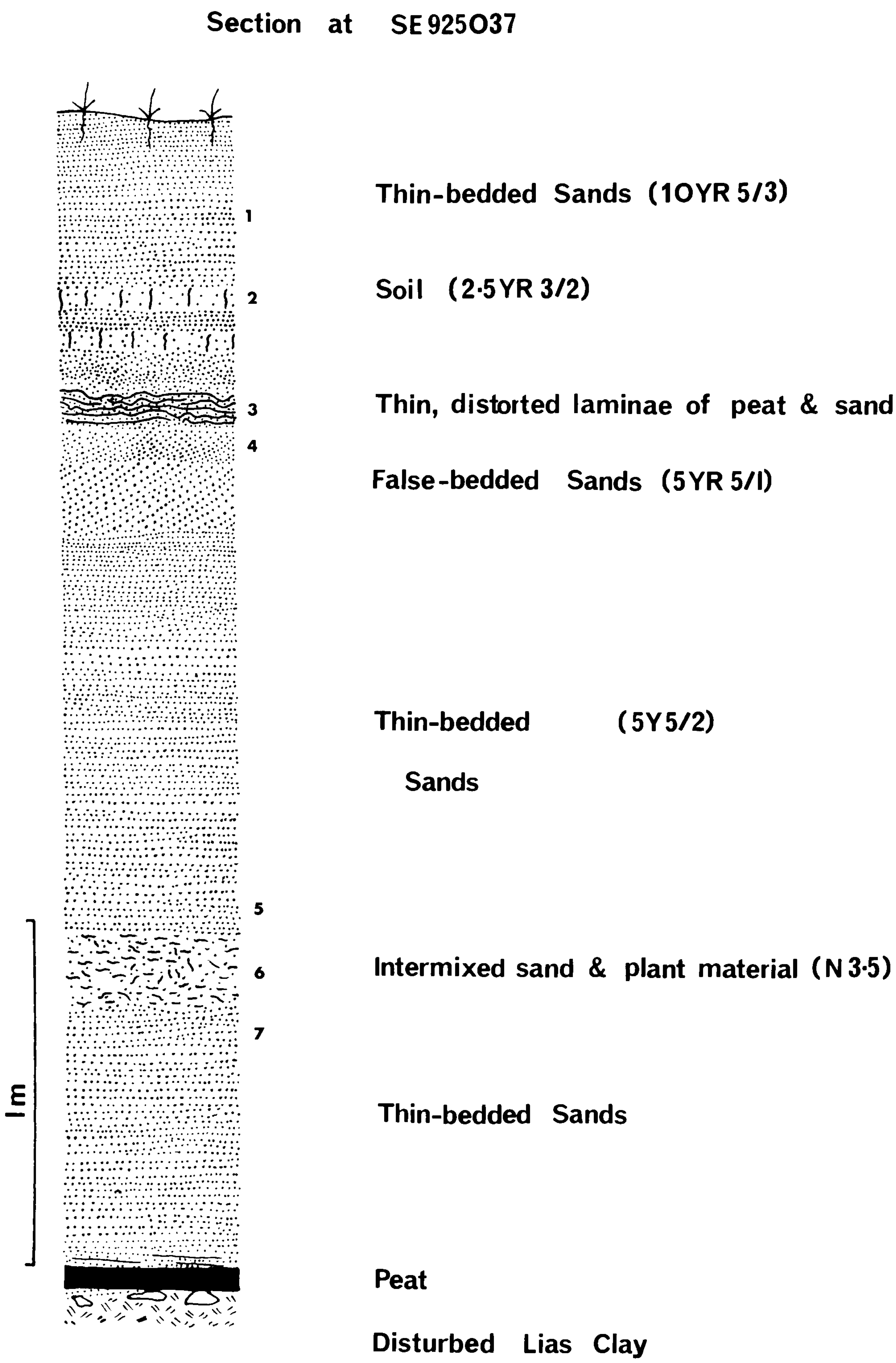


Figure 5. Messingham sand pit, Lincs.: section showing locations of samples (1-7) for grain size analysis. (1976).

redeposition. Casts of rootlets, formed in this manner, are also a feature of most sections. The presence of thin, more silty organic horizons exerts some control on the redistribution of iron compounds in the Sands, those below such a discontinuous lamina often retaining a grey (5YR 5/1) colour. This coloration is also more evident closer to the escarpment, where much of the succession is sealed by a group of interbedded, slightly contorted silty laminae.

Closer examination of the loose sands shows that they consist of rounded to subangular grains, principally of quartz, most of which lies in the size range 0.15 to 0.2 mm. (mean of 0.22 - 0.28 mm.). Occasional lines of much coarser grains occur, however, ranging up to 2.0 mm. in diameter (fig. 7). The grain size analyses (fig. 6) confirm the initially aeolian nature of the deposits. The curves from Messingham compare closely with those obtained by Matthews (1970) from near York and with that obtained from a more recent dune derived from the Cover Sands, blowing across the Cover Sands surface in the pit, although more of the coarser element is clearly involved. The additional curve, from the 'Older River Gravel' beneath Doncaster (N.G.R. SE573034) stands in clear contrast to the aeolian deposits but is similar to that from sample 3 (below, p. 22).

Where the base of the Cover Sands is exposed, both in the Messingham pit and in the more extensive exposures of the full succession in the quarries on Crosby and Flixborough Warrens, a compact layer of peat occurs. This bed, seldom more than 20 cm. thick, like much of the actual sand succession, conforms to the gentle dip of the land and extends for a short distance up the gentler sections of the scarp slope. At Messingham, the same bed can be traced throughout the workings, extending to over 1 km^2., and at least 5 km^2. of it once overlay the quarrying area north of Scunthorpe. Both Dakyns et al. (1886) and Ussher (1890) record a peat bed in a similar position elsewhere in North Lincolnshire and into East Yorkshire. Men working the sand pits at Scotter, 10 km. south of Scunthorpe (N.G.R. SE876036), and Haxey (N.G.R. SE745005) also report similar finds although, since these pits are worked while flooded, the stratigraphic position of the peat recovered by the grab is in doubt. The flint end scraper which initiated this research was found in this peat bed during fieldwork in the Messingham pit; a Bovid astragalus was also recovered. From a similar stratigraphic position, Lacaille (1946) noted a shouldered point from Risby Warren, although it has to be remarked that the same deposit of 'clayey sand' yielded the unworn Acheulian ovate. A sample of the peat from the Messingham pit (at N.G.R. SE915037) provided a ^{14}C date of 10,280 $\pm$ 120 B.P. (Birm. 349). 2 m. above this compacted peat, a further date was obtained on a less well developed organic layer, consisting largely of the remains of mosses (Drepanocladus sp.). This date, of 10,550 $\pm$ 250 (Birm. 707), is older than that from the lower horizon but the overlapping standard deviations suggest that this merely reflects the relatively rapid rate of accumulation of the Cover Sands. The possibility of hard water error, giving too old a date for the upper horizon, however, should be considered (Shotton, pers. comm.). The dates are closely comparable with others obtained on these deposits elsewhere in the Vale of York (Gaunt et al., 1971) (fig.30). Discontinuous layers of darker, slightly organic sand with some silt and often obvious fibrous fragments of moss, occur throughout much of the Cover Sands succession but the horizon which provided the upper of the two ^{14}C dates is the only one which is in any way consistent, occurring throughout the Messingham pit and reappearing in the same relative position in exposures at Flixborough. Dudley (1949) records a somewhat similar division of the Sands, lacking the underlying peat bed, on Risby Warren but, in view of Holland's (1975)

Iron Age and Roman dates from organic layers on Crosby Warren, it would be unwise to assume a correlation over the escarpment. Close to the base of the escarpment in the Messingham pit, towards Manton Warren, a succession of silty laminae with occasional plant fragments, rarely in excess of 1 mm. each in thickness, occurs at the very top of the Cover Sands (fig. 5). These beds, thrown into a series of irregular ripples either by frost action or slip down the face of the scarp, form a band, interspersed with sands and totalling 20 cm. in thickness, which thins and disappears westwards about 250 m. from the scarp. This unit is overlain by about 10 cm. of slightly iron stained (10 YR 5/3) sand and a brown(2.5 YR 3/2) soil, in part divided by a further sand blow and capped by 50 cm. of more recent blown sand. The soils, where sealed by later dunes, are less heavily podzolised than those of the current land surface.

On the Hatfield Levels a peat bed occurs within sands over 'Lake Humber laminated clays' at both Epworth Turbary (N.G.R. SE754037) and Sandtoft (N.G.R. SE734090) (below, p. 30), but comparison with extensive sections seen during the construction of the M18 motorway at West Moor, Armthorpe (N.G.R. SE642056), suggests that this layer may belong to an earlier event, within Zone I or II. At Armthorpe, this peat is disturbed by frost action and overlain by a solifluction deposit and it may be the lateral equivalent of the buried soil dated to 11,100 $\pm$ 200 B.P. (N-810) nearby (Gaunt et al., 1971).

The Cover Sands, including the underlying peat bed, by their very mode of deposition, overlie a wide variety of substrates. Frequently they rest directly on the Triassic or Jurassic rockhead, although this has often been subject to considerable disturbance. At Haverholme, near Appleby, 6 km. east of Scunthorpe (N.G.R. SE952125), a borehole for the British Steel Corporation encountered 2 m. of sand and broken limestone, beneath 7 m. of Cover Sands. At Messingham, the top of the Middle Lias, unfortunately largely below water level, appears to be disturbed and a remanie deposit of pebbles and cobbles, including some flint much shattered <u>in situ</u> by frost action, appears in some sections beneath the peat. Several of the sandstone erratics in this discontinuous horizon show evidence of facetting by wind action, a feature noted elsewhere in the Vale of York (Edwards, 1936; Gaunt, 1976). At one point, the peat grades laterally and vertically into a grey silt (N4) with abundant freshwater mollusca and ostracoda suggesting a small pool environment before sand deposition began. It was a sample from this facies which produced the willow (<u>Salix</u> sp.) charcoal (below, p. 56). In sections at Flixborough the Cover Sands overlie extensive pockets of hard panned, poorly sorted gravel, with occasional larger erratics, usually of calcareous nodules from the adjacent Jurassic but also of Carboniferous sandstones and flint. Where structures are discernible, the gravel and adjoining bedrock are seen to be heavily disturbed, many of the included erratics being shattered wedges of gravel penetrating down into the Lias clays for up to 2 m. (fig. 28). It was presumably from similar deposits that the teeth and tusk of mammoth, recorded by Dudley (1949) from Flixborough Warren and Thealby, came.

On Hatfield Chase and in the lower part of the Vale of York, the Cover Sands overlie a variety of rocks from the Keuper to the terminal deposits of Lake Humber. North of the York Moraine, Matthews (1970) found sands, beneath a peat bed dated to 10,700 $\pm$ 190 B.P. (N-488), which filled ice wedge pseudomorphs in the underlying till and these could relate to an earlier episode of aeolian activity, before the rapid climatic amelioration of Zone I and the spreading of a vegetational cloak on the landscape in Zone II. Straw (1963) found similar evidence for sand deposition before peat formation on Crosby Warren and, both here and at Caistor, the sand filled fissures.

probably ice wedge casts, penetrating the rockhead. It is uncertain, however, whether these relate to events earlier in Zone III or a previous phase within the Devensian, and indisputable frost structures have yet to be found in the Cover Sands or its basal peat.

Petrography

Although no detailed study of the petrography of the Cover Sands has been embarked upon, a number of points germane to the environmental interpretation have been examined. Mechanical analyses were carried out for a succession of seven samples from the Messingham pit, from a section (fig. 5) close to the base of the escarpment (N.G.R. SE925037). All samples (table 2) show a high degree of sorting; with the exception of the finer grained sample 3, all have over 90% of the sand grains within the range <0.5 mm. >0.125 mm. Sample 3 is less well sorted, with all less than 0.5 mm. and over 90% between the limits <0.5 mm. >0.063 mm. Whilst the cumulative curves (fig. 6) are in marked contrast to the comparative sample from the 'Older River Gravel' from Doncaster, they show the deposits to be somewhat less well sorted than the aeolian sands from a similar formation, north of York, analysed by Matthews (1970). In part, this must relate to the difficulties involved in sampling single laminae in a more variable succession but the stratigraphic evidence for at least partial deposition by running water suggests that the close sorting of individual sand beds has been masked and modified by limited reworking after initial deposition. The mid-Devensian Chelford Sands of Cheshire provide a close parallel in grading to the Cover Sands (Harrison, 1968) and a similar sequence of aeolian action followed by partial reworking has been suggested (Evans et al., 1968). It should be noted, however, that the samples from the more recent dune and its underlying soil (samples 1 & 2) are also less sharply

Table 2

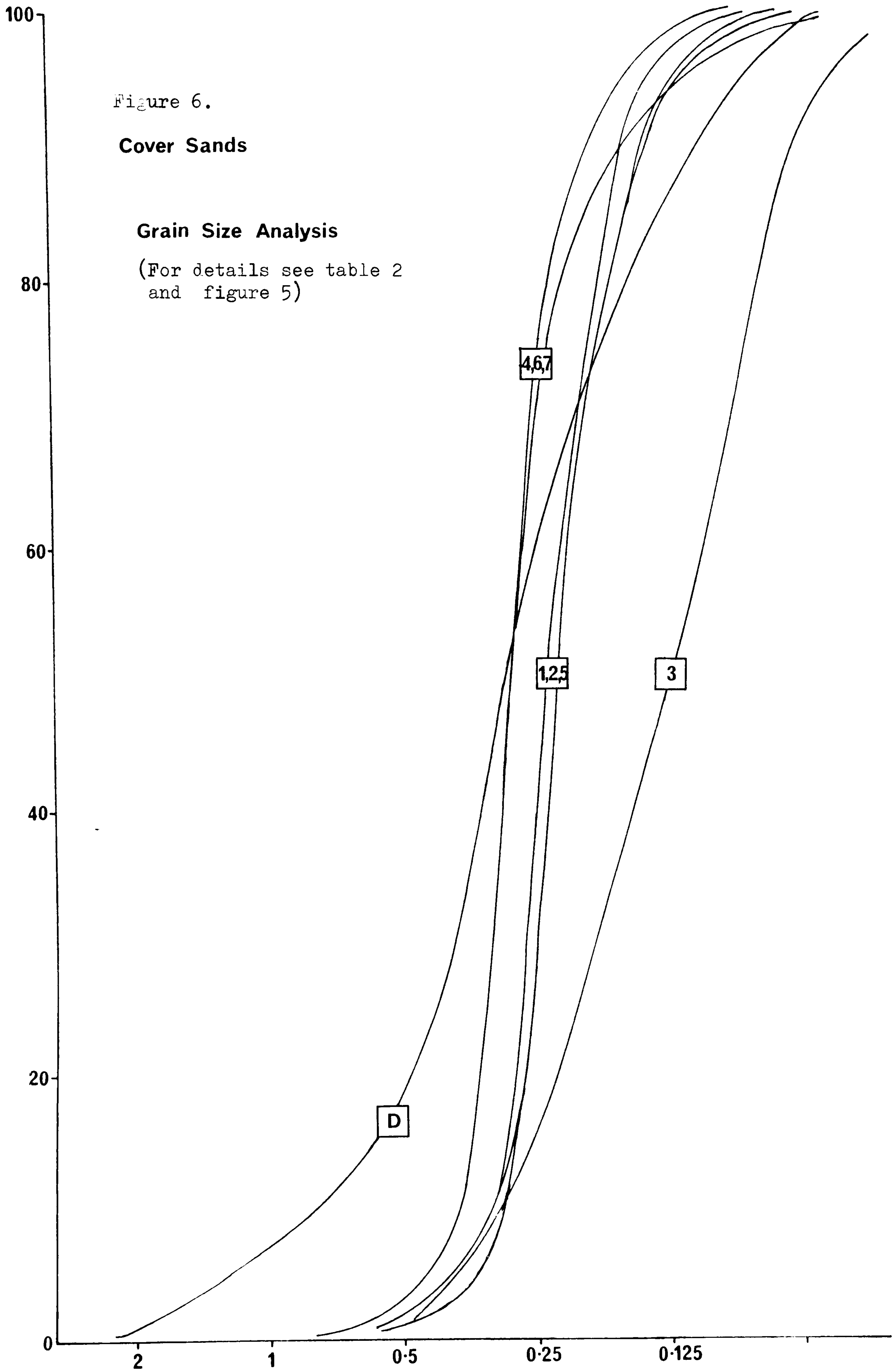
Cover Sands: Messingham (SE 925037)

Grain Size Analyses

	1	2	3	4	5	6	7	Dl.	
n =	115.09	116.59	113.53	115.14	109.50	111.36	107.54	112.56	(g.)
2 mm.	0.01%	-	-	-	-	-	-	1.35%	
1 mm.	0.02%	0.02%	-	0.03%	0.04%	0.03%	0.01%	5.05%	
0.5 mm.	0.54	0.20	-	2.83	1.46	1.09	0.57	12.72	
0.25 mm.	35.59	32.71	15.86%	67.38	37.37	65.84	61.02	40.77	
0.125 mm.	58.39	64.21	32.77	28.16	54.62	27.73	36.75	26.04	
0.063 mm.	5.20	2.66	42.02	1.57	6.45	3.68	1.38	10.02	
-	0.25	0.20	9.46	0.05	0.06	1.63	0.27	4.05	

For location of samples 1 - 7, see fig. 5.

(Comparative sample Dl. is from 'Older River Gravel' at Doncaster N.G.R. SE 573034)


100
80
60
40
20
0
2
1
0·5
0·25
0·125
Figure 6.
Cover Sands
Grain Size Analysis
(For details see table 2
and figure 5)
4,6,7
1,2,5
3
D

defined than Matthews' (1970) material and there can be no doubt about the wholly aeolian nature of this structure.

Although the small number of samples examined cannot be assumed to be representative of the entire formation, the variations in grain size between samples seem to have some, if very local, significance. The curves (fig. 6) from the recent dune and soil are closely matched by that from sample 5, immediately over the horizon which, elsewhere in the quarry, provided faunal sample 2 (fig. 5). The finer grained sample 3 represents the highest unit within the undisturbed formation to provide faunal evidence, the fine sands being interspersed with discontinuous groups of black, organic laminae, and were perhaps laid down during a more quiescent phase, probably of only a few years' duration, at the very end of the principal period of aeolian activity. Certainly the grain size analysis shows more evidence of water deposition (fig. 6), the curve paralleling that from Doncaster, and the deposit may represent resorting by water action after the cessation of sand blowing. The few centimetres of sand which seal this horizon appear similar to samples 1 and 2 and its movement to the base of the scarp may have occurred during the amelioration which opened the Flandrian, before the establishment of vegetation cover. The remaining samples, 4 from the cross-bedded unit beneath 3, and 6 and 7, intermixed with and below the organic layer within the body of the Sands, betray a more turbulent regime and it is within these that the coarser lines of sand, with grains approaching 2 mm. in diameter, occur.

Despite the level of sorting and topographic evidence for an aeolian origin, under the microscope the individual grains show a wide range of degrees of rounding. The predominant mineral, quartz, ranges from grains with merely the edges rounded to classic millet-seed grains, the latter still retaining their brick-red coating of iron oxides, which suggests that their source lies in the Lower Mottled and Bunter Sandstones on the western fringe of Hatfield Chase. The majority of the grains, however, are less distinctive, the majority tending towards being sub-rounded and lacking any evidence of origin. Occasional sub-rounded fragments of fine grained rocks, both igneous and metamorphic, occur and recognisable pieces of flint are not infrequent. These are usually subangular, perhaps of more local derivation. The Chalk and Permo-Triassic outcrops, however, lie to either side of the Lincoln Edge, along the base of which the Cover Sands are most extensively developed, and one has to postulate either that the depositional winds blew from both east and west or that flint or Bunter sand had been obtained through an intermediate erosional cycle. The distribution of Cover Sands (fig. 2) would imply deposition by winds blowing across the Lower Trent Valley and the Vale of York, where the exposed extensive flats of sands and gravels of the terminal meltwater phase of pro-glacial Lake Humber and the Triassic outcrops would provide the rock types noted. Certainly, dunes and spreads of sand occur in the correct stratigraphic relationship in the Vale of York (Gaunt et al., 1971) and these provide similar evidence for wind direction (fig.29). The surface of the Older Drift around Wroot and Finningley, south east of Doncaster, presents the appearance of a remanie, the finer faction having been removed, yet this could have taken place long before the emplacement of the Cover Sands. A wind direction slightly south of west would increase the possibility of the inclusion of unabraided millet-seed grains from the Bunter in the Messingham sands since this outcrop widens considerably into Sherwood and such a direction has been suggested for Younger Dryas Cover Sands in the Netherlands (Maarleveld, 1960) but the available data remain inconclusive and de Jong (1967) suggests a north westerly wind direction during both

Figure 7. Photomicrograph of sample of coarse sand from Messingham. Millet seed grains of Bunter sand and subangular flints are evident.

Figure 8. Messingham sand pit, Lincs. Disturbance of silty organic layers, probably by frost action.

Older and Younger Dryas times. The efficiency of the wind in rounding sand is uncertain (e.g. Pettijohn, 1957) and the varying degrees of roundness exhibited by the Cover Sands reflect not their Late Glacial history but their various polycyclic origins. There is no evidence to suggest that the small proportion of subangular flints need not have been derived subaerially from outwash in the Vale of York but they could equally have been incorporated at Messingham by washing down the slope from some earlier, presumably Wolstonian, sand and gravel pockets on the escarpment. Heavy mineral analysis has not been employed to examine the possible sources of the sand but Loughlin (pers. comm. & in press) in his search for the manufactories of Dales Ware, a common Romano-British cooking pot type, has noted frequent subhedral crystals of apatite in a sample of sand from Messingham; in the absence of detailed knowledge of the mineralogical composition of Drift deposits in the Vale of York and its environs, this information is somewhat enigmatic but it should be noted that Smithson (1931) found that apatite was frequent in the Trias of Yorkshire, particularly the Keuper, and this is extensively exposed on the Isle of Axholme, 12 km. west of the Messingham site. It is apparent that much more work is needed upon the petrography and origin of the Cover Sands.

The Samples

Although a preliminary sample had been washed out from the basal peat from the Messingham pit to attempt to verify a presumed Late Glacial date for the Cover Sands by a cursory examination of the insect fauna, no detailed study was envisaged until the casual find of a flint end scraper (fig.31) in the peat on the floor of the quarry provided an archaeological perspective. The flint industries of the Late Glacial, particularly the Creswellian, are poorly defined, with few securely dated sites in Britain, and their relation to the succession of rapidly changing environments has been little explored, despite the wealth of data from non-archaeological sources. The connection between scraper and peat bed, expanded by the later discovery of charcoal in one sample from the basal horizon, gave an opportunity to attempt an environmental model for its erstwhile user at one moment in time, 10,280 ± 120 B.P., at the very end of the Palaeolithic.

Sampling was initially carried out in the Messingham pit, close to the find-spot of the scraper (N.G.R. SE915037). A Bovid astragalus was also found in the peat near this locality but there is no direct connection with the artifact and, as the most durable bone in the body, it could be residual. The hard, compressed fibrous peat on the quarry floor was exposed, cleaned and 5 kg. samples taken in two arbitrary layers of about 5 cm. in thickness. Samples were also recovered from a number of vaguely organic lenses and laminae within the Cover Sands. These, unfortunately, failed to provide any insect remains but, on a subsequent visit, as the extraction face had progressed eastwards, the principal organic horizon within the Sands became better developed and the moss sample which gave the ^{14}C date of 10,550 ± 250 B.P., from N.G.R. SE918039, also yielded a limited insect fauna. Close to this locality, the basal peat graded laterally into a more silty deposit, which, upon sampling, gave a small fauna and, perhaps of archaeological significance, a few fragments of charcoal of willow. A final visit, to collect samples for grain size analysis, resulted in the location of higher organic laminae in the Sands and these also produced a small insect fauna, from N.G.R. SE 925037, close to the base of the escarpment. North of Scunthorpe, the Ironstone mines provided abundant sampling locations and it was possible to select a section on Flixborough Warren (N.G.R. SE900154) where both basal peat and intraformational organic horizon were well developed, although, in the event, the faunas were rather limited. Additional samples were recovered from within sand successions at both Epworth Turbary and Sandtoft (N.G.R. SE754037 and N.G.R. SE734090 respectively) but the resultant faunas were radically different from the Cover Sands material, certainly more thermophilous, and were therefore not included in this study.

All the samples from within the Cover Sands consisted of loose aggregations of mosses, identified as predominantly Drepanocladus sp. (Dalby, pers. comm.), in a sand matrix and were easily washed out over a 300 micron sieve. These contained only a few grams of organic material and this could be sorted in its entirety for insect remains. The compact, felted peat from beneath the Cover Sands presented more of a problem. This also contained much moss but there were also poorly preserved straplike fragments of the leaves of higher plants, principally aquatic grasses and sedges; nutlets of the latter were frequent in these samples. No woody tissue, other than the charcoal, was noted in the samples but a few small twigs were found in the peat on the quarry floor and a well preserved leaf of Salix, probably herbacea, was found whilst splitting the peat. Samples were broken down in frequent changes of hot water and washing soda and attempts were made to split the peat along the poorly defined irregular bedding planes. Over a period of about ten days, it was possible to wash each sample out over a 300 micron sieve. The material retained on the sieve was then subjected to paraffin (kerosene) flotation (Coope & Osborne, 1968) but, although a good separation of an insect-rich flotant was obtained, large amounts of indeterminate plant debris also floated and the insect fragments had to be laboriously culled from this. The two samples of the basal peat at Messingham provided faunas which showed no significant variation and the results are combined in the table of animal remains (table).

Table 3 Insect remains from the Cover Sands

	1	2	3	4	5	6
Hemiptera						
Saldidae						
Salda littoralis (L.)	-	-	1	-	-	-
Coleoptera						
Carabidae						
Carabus sp.	-	1	-	-	-	-
Notiophilus aquaticus L.	-	1	-	-	-	-
**Diacheila arctica* Gyll.	-	1	-	-	1	-
Elaphrus lapponicus Gyll.	-	1	-	-	-	-
E. cupreus Duft.	-	1	-	-	-	-
Dyschirius globosus (Hbst.)	-	3	-	-	-	-
D. politus (Dej.)	-	-	-	1	-	-
Dyschirius sp.	1	-	-	-	-	-
**Bembidion lapponicum* Zett.	-	-	1	-	-	-
B. schüppeli Dej.	1	7	-	-	-	-
B. doris (Panz.)	-	7	-	-	-	-
Bembidion spp.	-	10	-	-	-	-
Trechus rivularis (Gyll.)	1	18	-	-	-	-
Feronia diligens Sturm.	-	1	-	-	-	-
Feronia sp.	-	-	-	-	1	-
Agonum fuliginosum (Panz.)	1	3	-	1	1	-
Dytiscidae						
Hygrotus quinquelineatus (Zett.)	-	1	-	-	-	-
Hydroporus melanarius Sturm.	-	-	1	-	-	-
H. palustris (L.)	-	2	-	-	-	2
H. erythrocephalus (L.)	-	1	-	-	-	-
Hydroporus spp.	-	3	-	-	1	-

Table 3 (Continued)

Agabus arcticus (Payk)	-	2	1	-	-	-
A. bipustulatus (L.)	-	1	-	-	-	-
Agabus sp.	-	1	2	-	-	-
Ilybius spp.	-	2	-	-	-	-
Rantus (?) exsoletus (Forst.)	-	1	-	-	-	-
Colymbetes sp.	-	2	1	-	-	1
Hydrophilidae						
Ochthebius lenensis Popp.	1	1	-	-	-	-
O. minimum (F.)	-	2	-	-	-	-
Ochthebius spp.	5	15	-	-	-	-
Hydraena britteni Joy / riparia Kug.	-	1	-	-	-	-
*Helophorus sibiricus Mots.	-	2	5	-	3	-
*H. glacialis Vill.	-	-	3	3	-	-
Hydrochus brevis (Hbst.)	-	3	-	-	-	-
Coelostoma orbiculare (F.)	-	2	-	-	-	-
Sphaeridium (?) lunatum (F.)	-	1	-	-	-	-
Cercyon haemorrhoidalis (F.)	-	3	-	-	-	-
C. convexiusculus Steph./ subsulcatus Rey	1	11	-	-	-	-
Cercyon spp.	4	14	-	-	-	-
Hydrobius fuscipes (L.)	-	4	-	-	-	-
Helochares lividus (Forst.)	-	2	-	-	-	-
Enochrus sp.	-	2	-	-	-	-
Chaetarthria seminulum (Hbst.)	-	1	-	-	-	-
Silphidae						
Thanatophilus sp.	1	1	-	1	-	-
Catops sp.	-	-	-	-	-	1
Ptiliidae						
Acrotrichis spp.	-	2	-	-	-	-

Table 3 (Continued)

Staphylinidae						
Olophrum fuscum Grav.	1	39	31	3	16	3
*O. rotundicolle Sahl.	1	-	-	-	-	-
*O. boreale Payk.	-	1	3	-	-	-
Arpedium brachypterum (Grav.)	-	48	4	4	31	1
Acidota crenata F.	-	2	-	-	1	-
A. cruentata (Mann.)	-	1	1	-	-	-
*Boreaphilus henningianus Sahl.	-	2	-	-	1	-
*Pycnoglypta lurida (Gyll.)	1	-	-	-	-	-
Trogophloeus corticinus Grav.	-	-	1	-	-	-
Oxytelus rugosus (F.)	-	4	-	-	-	-
Platystethus nodifrons Sahl.	-	2	-	-	-	-
Bledius (?) opacus (Block)	-	-	-	5	-	1
B. fuscipes Rye	-	-	5	4	-	1
*B. vilis Makl.	-	-	2	1	-	-
Bledius spp.	-	-	-	9	-	-
Stenus juno F.	-	3	-	-	-	-
S. pallitarsus Steph.	-	1	-	-	-	-
Stenus spp.	-	14	2	3	10	1
Euaesthetus laeviusculus Mann.	-	1	-	-	-	-
Lathrobium filiforme Grav.	-	2	-	-	-	-
Lathrobium spp.	-	3	-	-	-	-
Cryptobium fracticorne (Payk.)	-	1	-	-	-	-
Philonthus punctus (Grav)/binotatus (Grav.)	-	2	-	-	-	-
Philonthus sp.	-	1	-	-	-	-
Gabrius sp.	-	1	-	-	-	-
Quedius cruentus (Ol.)	-	1	-	-	-	-
Quedius sp.	1	-	-	-	-	-

Table 3 (Continued)

Quedius / *Philonthus* spp.	-	4	-	-	1	-
Gymnusa variegata Keis.	-	1	-	-	-	-
G. brevicollis Payk.	-	-	-	-	1	-
Aleocharinae indet.	-	26	9	8	7	5
Cantharidae						
Rhagonycha limbata Thoms./*lignosa* (Muell.)	-	1	-	-	-	-
Helodidae						
prob. *Cyphon* spp.	1	26	-	-	1	-
Dryopidae						
Dryops sp.	-	1	-	-	-	-
Byrrhidae						
Simplocaria semistriata (F.)	-	1	-	-	-	-
**S. metallica* Sturm.	-	-	-	1	-	-
Simplocaria sp.	-	-	-	1	-	-
Cytilus sericeus (Forst.)	-	1	-	-	-	-
Lathridiidae						
Corticarina sp.	-	1	-	-	-	-
Mordellidae						
Anaspis sp.	-	2	-	-	-	-
Scarabaeidae						
**Aphodius* (?) *scrutator* (Hbst.)	-	1	-	-	-	-
**A. obscurus* F.	-	1	-	-	-	-
**A. contaminatus* Erich.	-	3	-	-	1	-
A. merdarius (F.)	-	2	1	1	-	-
Aphodius spp.	3	6	2	2	-	-
Chrysomelidae						
Plateumaris sericea (L.)	-	3	-	-	-	-
Phyllodecta sp.	-	-	-	-	1	-
Phaedon sp.	-	1	-	-	-	-

Table 3 (Continued)

	1	2	3	4	5	6
Curculionidae						
Apion minimum Hbst.	-	2	-	-	-	-
Apion sp.	-	1	-	-	-	-
Otiorrhynchus nodosus (Muell.)	-	-	1	-	-	-
O. rugifrons (Gyll.)	-	1	-	-	-	-
O. ovatus (L.)	1	1	-	-	-	-
Sitona suturalis Steph.	-	1	-	-	-	-
Bagous (?) *limosus* Gyll.	-	1	-	-	-	-
Bagous spp.	3	4	-	-	-	-
Notaris bimaculatus (F.)	2	2	-	-	-	-
N. scirpi (F.)	1	-	-	-	-	-
N. aethiops (F.)	-	20	-	1	-	-
Thryogenes sp.	-	2	-	-	-	-
Grypus equiseti (F.)	-	1	-	-	-	-
Limnobaris pilistriata (Steph.)	-	6	-	-	2	-
Phytobius canaliculatus Fah.	-	1	-	-	-	-

Sample locations:

1. Silt beneath peat bed, Messingham.
2. Basal peat, Messingham.
3. Within Cover Sands, Messingham
4. Top of Cover Sands, Messingham (see Table 1 & Figure 5).
5. Basal peat, Flixborough.
6. Within Cover Sands, Flixborough.

* Species no longer recorded from Britain.

Preservation of insect remains was somewhat fitful, with great variation in degree of survival within individual samples. It is therefore not surprising that, despite Holland's (1975) successful recovery of pollen from Holocene horizons on Crosby Warren, slides prepared from the Messingham basal peat produced only crumpled grains of wormwood, Artemisia spp. and meadow rue, Thalictrum spp. It is probable, however, that more detailed palynological research on the Cover Sands would be rewarding.

Notes on Particular Species

The insect faunas of the Late Glacial have been quite extensively studied, particularly by Osborne (1972), Coope and Brophy (1972) and Ashworth (1972; 1973), and several species have received some detailed discussion (e.g. Coope, 1966; Angus, 1973). Only those beetles which have not previously been recorded fossil or those of particular interest within the context of the Cover Sand faunas are therefore discussed here.

Bembidion lapponicum Zett.

A single elytron of the Bembidion subgenus Chrysobracteon was recovered from the thin organic layer within the Sands at Messingham. Both size and microsculpture separate this individual from the British members of this subgenus, B. litorale and B. argenteolum, and similarly eliminate other Continental species, except B. lapponicum and B. velox; the latter can be excluded on the form of the 'mirrors' on the third interstice and presence of similar structures on the outer interstices. B. lapponicum is a markedly stenotopic species, strongly heliophilous, on sterile sand or fine gravel (Lindroth, 1943) and is restricted to the mountains of Norway, north of 62^{O}N., and, in scattered localities, northwards into Finnmark and parts of Lapland (fig. 13). Elsewhere, it is recorded from the Petschora district of European Russia and Siberia, east to the Lena and Kamtschatka. Lindroth (op. cit.) records the species in Scandinavia from his Regio betulae and in the upper parts of the conifer zone; he also includes a record from the tundra in Petschora. Superficially, the north European distribution suggests that this ground beetle prefers a cold oceanic climate but its appearance in strongly continental areas like Siberia shows that this aspect does not control its distribution. Fossil records from phases of the Devensian which, on other insect evidence, were strongly continental, (Coope & Girling, pers. comm.) support this view.

Trechus rivularis

Superficially, the cryptic fenland ground beetle T. rivularis would seem an improbable component of Late Glacial assemblages. Lindroth (1945; 1974) suggests that it is strongly stenotopic, restricted to "dark forest swamps with Sphagnum among damp sedge litter." In Britain, it is only known from the Cambridge and Norfolk Fens and Askham Bog, near York, an isolated relict fen famous for its water beetle fauna (below, p. 233). Neither the latter locality nor its most prolific Fenland site, Wicken Fen, can really be described as 'forest swamp' and the damp sedge litter, with minimum human disturbance and reasonable shade, not necessarily from trees, are perhaps the most important factors. As well as a Hoxnian record (Shotton & Osborne, 1965), there are several Devensian records from phases with little or no evidence of any tree cover - from Four Ashes (Morgan, 1973) and Rodbaston, Staffordshire (Ashworth, 1973), the Tame Valley, Warwickshire (Coope & Sands, 1966) and Colney Heath, Hertfordshire (Pearson, 1961). There are also several records from western England for the early Flandrian - from Rodbaston (op. cit.), Lea Marston, Warwickshire (Osborne, 1974) and Red Moss, Lancashire (Ashworth, 1972). Despite Pearson's (1961) very optimistic distribution map (compare Lindroth, 1949; Hansen et al., 1961; & fig. 14), T. Rivularis is not recorded from the tundra and Lindroth (1945) does not note it beyond his regio coniferina. It is probable that the species resembles the weevils Barynotus squamosus and Otiorrhynchus nodosus (Coope, 1965) in some of its ecological requirements and is able to avoid direct sunlight by being nocturnal in low latitude near-tundra situations, an environment which finds no direct analogue at the present day within its Palaearctic distribution. In the far north, it would be unable to achieve this because of the increased daylength in summer. Its strongly continental distribution, however, suggests that it is unable to take advantage of the more extensive cloud cover of oceanic areas and that other factors, perhaps wetter and warmer winters, exclude it from the West at the present day. Other Trechini show varying degrees of being photobic: T. micros (below, p. 324) becomes increasingly cavernicolous towards the southern limit of its range.

Bledius vilis

The wet, sandy substrates provided by the Cover Sands formed ideal habitats for species of Bledius and the rare, north European species, B. vilis, was identified on thoraces and elytra. Although Reitter (1909) synonomises this insect with the more common B.pallipes Grav., later authors (Horion, 1951; Lohse, 1964) have regarded the two as distinct. In Central Europe, B. vilis is only known from Oldenburg in Schleswig-Holstein and the nearby Danish island of Zealand. It is not known from Sweden and is only recorded from the far north of Norway, from eastern Finnmark (Hansen et al., 1960): Finnish records are restricted to the Kuusamo region (fig. 21) (op. cit.). With such a scattered north European distribution and probable confusion with B. pallipes, further comment is of little value.

Philonthus punctus/binotatus

Although earlier authorities (Reitter, 1909; Horion, 1951) synonomise these species, they are regarded as separate entities by Palm (1952) and Coiffait (1967), the former providing a key to identify the two. Despite clear distinctions in the aedeagi and thoraces (op. cit.), there would appear to be some overlap in the shape and puncturation of the heads, at least of the males, and the species cannot be separated on the Messingham material. The synonomy makes any attempt to draw conclusions from the current distribution of each species difficult, but P. binotatus is recorded from Skane, at the southern tip of Sweden, and the Baltic coast of Holstein. Lohse (1964) suggests that it may be a halophile. P. punctus is more widespread, occurring, if somewhat rarely, throughout Central Europe (op. cit.) and eastwards to the Caucasus and Turkestan (Horion, 1951). Further north, the species tends to be rather southern and is restricted to southern England (Joy, 1932), absent from Norway and restricted to south of the 61°N. line of latitude in Sweden and Finland (Hansen et al., 1960) (fig.22). Joy regards the beetle as a coastal species but continental sources range from Reitter's (1909) common, in woodland, by flowing sap on trees, to Lohse's (1964) uncommon, on banks of large lakes and rivers. Insects which are often regarded as halophiles occur in other Late Glacial assemblages, for example Ochthebius marinus from Glanllynau (Coope & Brophy, 1972), and are probably to be related to the raw nature of the soils, prior to the Post-Glacial leaching out of soluble salts. The distribution of these species at the present day suggests that these Staphylinids are relatively thermophilous but P. punctus is also recorded from a very similar cold assemblage of insects from the Tame Valley at Minworth from deposits late in the Upton Warren Interstadial Complex of the Mid-Devensian (Coope & Sands, 1966) and other factors, probably degree of continentality, are clearly involved in its distribution.

Aphodius (?) scrutator (fig. 9).

A sizeable fragment of elytron, including the scutellum hole, which clearly belongs to the subgenus Colobopterus, is most closely matched by A. scrutator but insufficient survives for an identification to be made with confidence. Recorded from horse and cattle dung, A. scrutator is a predominantly Mediterranean species ranging eastwards through Anatolia to the Caucasus (Balthazar, 1964) and reaching its northern limit in southern Bavaria (Machatske, 1969); the species shows a marked preference for steppe habitats (op. cit.). If the identification can be confirmed by further, better preserved fossil specimens, it provides an interesting parallel to the group of steppe plants discussed by Bell (1969) and the Clerid Opetiopalpus sp. from Mid-Devensian deposits at Brandon (Coope, 1968) and Four Ashes (Morgan, 1973), although it has to be noted that Paulian (1959) suggests that A. scrutator has a montane distribution at its northern limit in France, in the Midi, implying that it may be heliophilous.

Aphodius obscurus

This dung beetle has been previously recorded from deposits of earliest Pollen Zone II age, between ^{14}C dates of 11,790 $\pm$ 140 B.P. (N.P.L. 81) and 12,135 $\pm$ 200 B.P. (Birm. 158), at Church Stretton, Shropshire (Osborne, 1972). Its distribution at the present day is both southern and continental, occurring in sheep, goat, chamois and cattle dung in the Central European mountains, the Pyrenees, Alps, northern Apennines, Anatolia and the Caucasus (Balthazar, 1964)(fig.24).

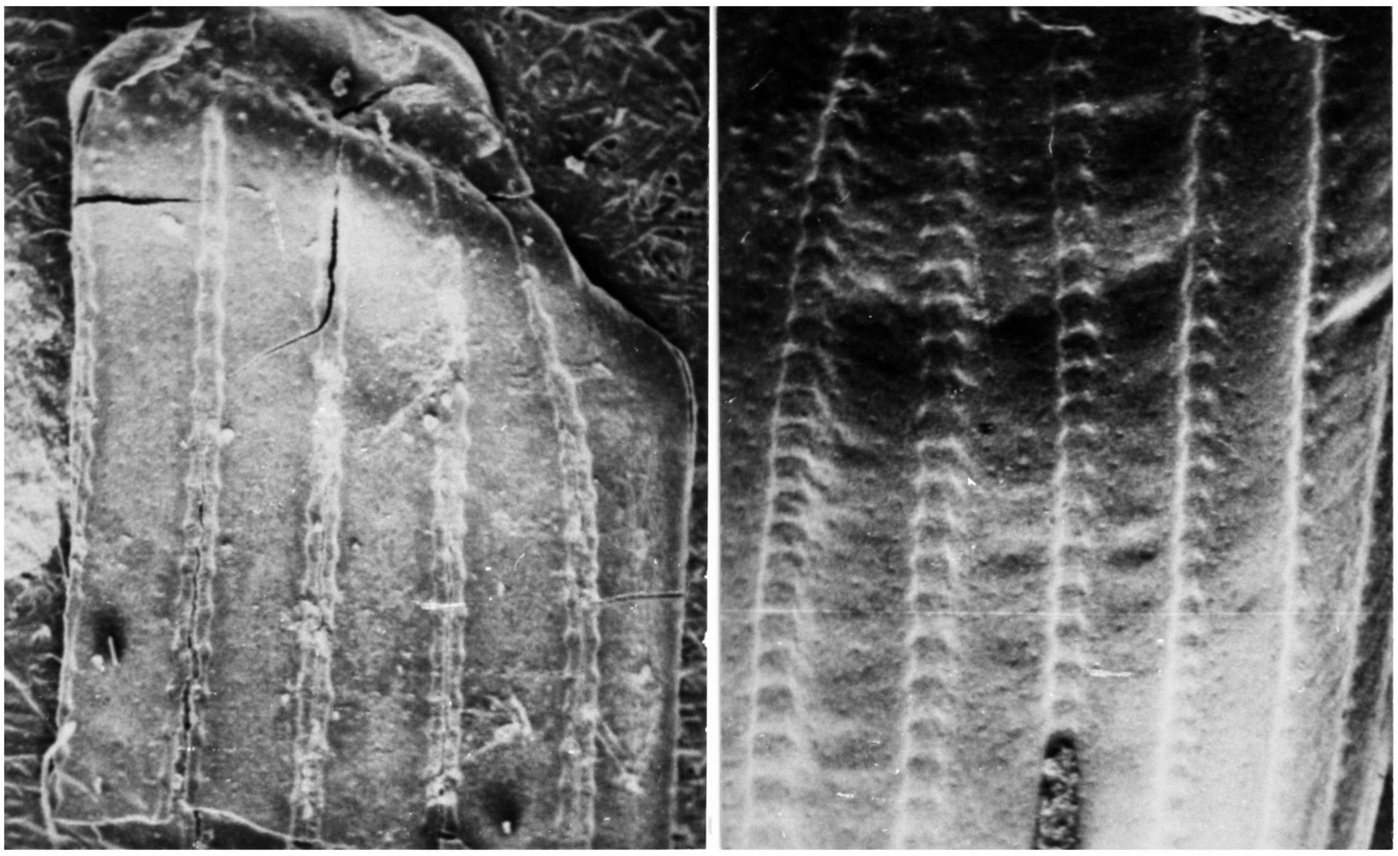


Figure 9. Fossil (left) and modern specimen of Aphodius scrutator, showing similar areas on the elytra.

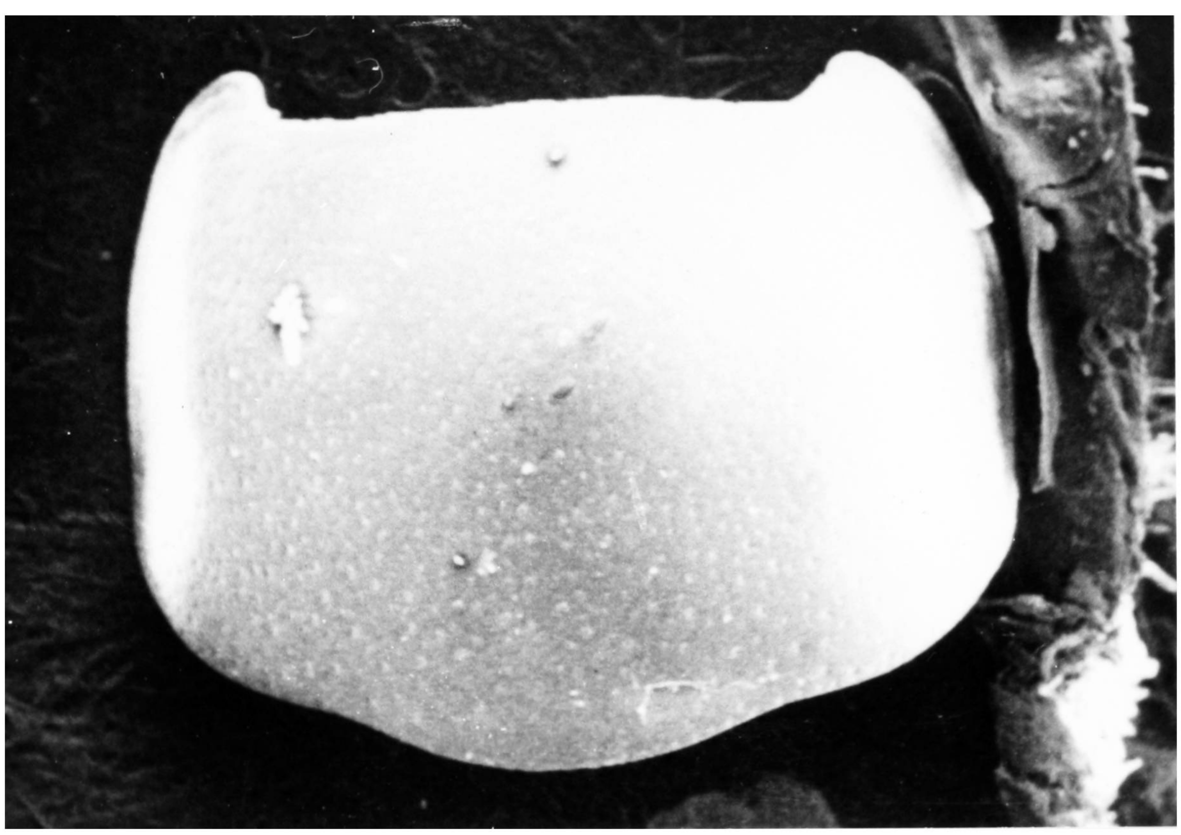


Figure 10. Fossil thorax of Aphodius montanus from Messingham, showing characteristic lack of posterior margin and slight inflexion in the lateral body of the thorax.

Such a distribution suggests a preference for a high alpine environment but Machatschke (1969) also notes the species from the lower areas of the Black Forest and Thuringerwald. This could imply that **A. obscurus** is an anomalous thermophilous element in the Messingham fauna and Osborne's (1972) record is not associated with a particularly cold assemblage. Although it is generally thought that day-length is not a significant factor in insect distribution (Downes, 1965; Morgan, 1973), dung beetles, with their propensity for nocturnal flight activity (Landin, 1961), appear to be an exception and the absence of this species from northern Europe may relate to both macro- and microclimatic factors associated with this. It is impossible to ascertain, without extensive experimentation, at what stage is an insect's development a climatic factor becomes limiting but a cold stenotherm could occur in the areas occupied by A. obscurus if it required the combination of days with high insolation for larval development and cold nights for imagine dispersal; the latter could be engendered by katabatic airflow from surrounding uplands and mountains. Similar conditions would have prevailed in eastern England due to the proximity of the Fennoscandinavian ice-sheet, halted at the Salpausselka moraines during the Younger Dryas.

Aphodius montanus(fig.10).

Heads, thoraces and an elytron were recovered from samples from Flixborough and Messingham of a distinctive species of Aphodius. Using Machatschke's (1969) key, the small relative size of the head, absence of a posterior margin on the thorax and the single sized puncturation of the latter immediately placed these individuals in the subgenus [illegible]. The size eliminated most members of this group but left a group of four species, in which A. montanus could be differentiated on the presence of slight lateral inflexions in the dome of the thorax towards the posterior angles. Examples standing over this name in the Doncaster Museum collections, however, keyed out to the rather similar species A. montivagus. The resemblance to the fossil specimens was sufficiently close to confirm their subgeneric affinities and identification was confirmed from specimens in the Manchester Museum. Unlike the majority of Aphodius species, members of the subgenus Aegolius are plant feeders and all are predominantly high alpine in distribution (op. cit.). A. montanus is not recorded from either Germany or Austria but has a discontinuous montane distribution from the Pyrenees through parts of the Alps and northern Appennines to Bosnia and Herzegowina; it is also known from the Caucasus (Balthazar, 1964). The comments on diurnal rhythm for A. obscurus may be equally relevant to this species, although it appears to be a more specifically high altitude insect, the problems of interpretation of which, in a less extreme manner, approach those of the Tibetan A. holdereri Reit. from Mid-Devensian sites (Coope, 1973).

Notaris bimaculatus

One elytron and a thorax of a weevil from Messingham (sample 1) could not be matched with the material in the British Museum's main collection of Coleoptera. Although its Notarine affinities were fairly evident, it was much more strongly rugose and shining in its intersticial ornamentation, smaller than any species of Notaris and larger than most Thryogenes spp. M. Girling (pers. comm.), however, found six undescribed specimens in the collection, standing under the generic name Lixellus, which compared very closely with the fossil. The modern individuals, from Nova Scotia and Hudson's Bay, Canada, were subsequently determined by R.T. Thompson as lying within the range of variation of the holarctic species N. bimaculatus, also recorded, in its more usual form from this and other Cover Sands samples.

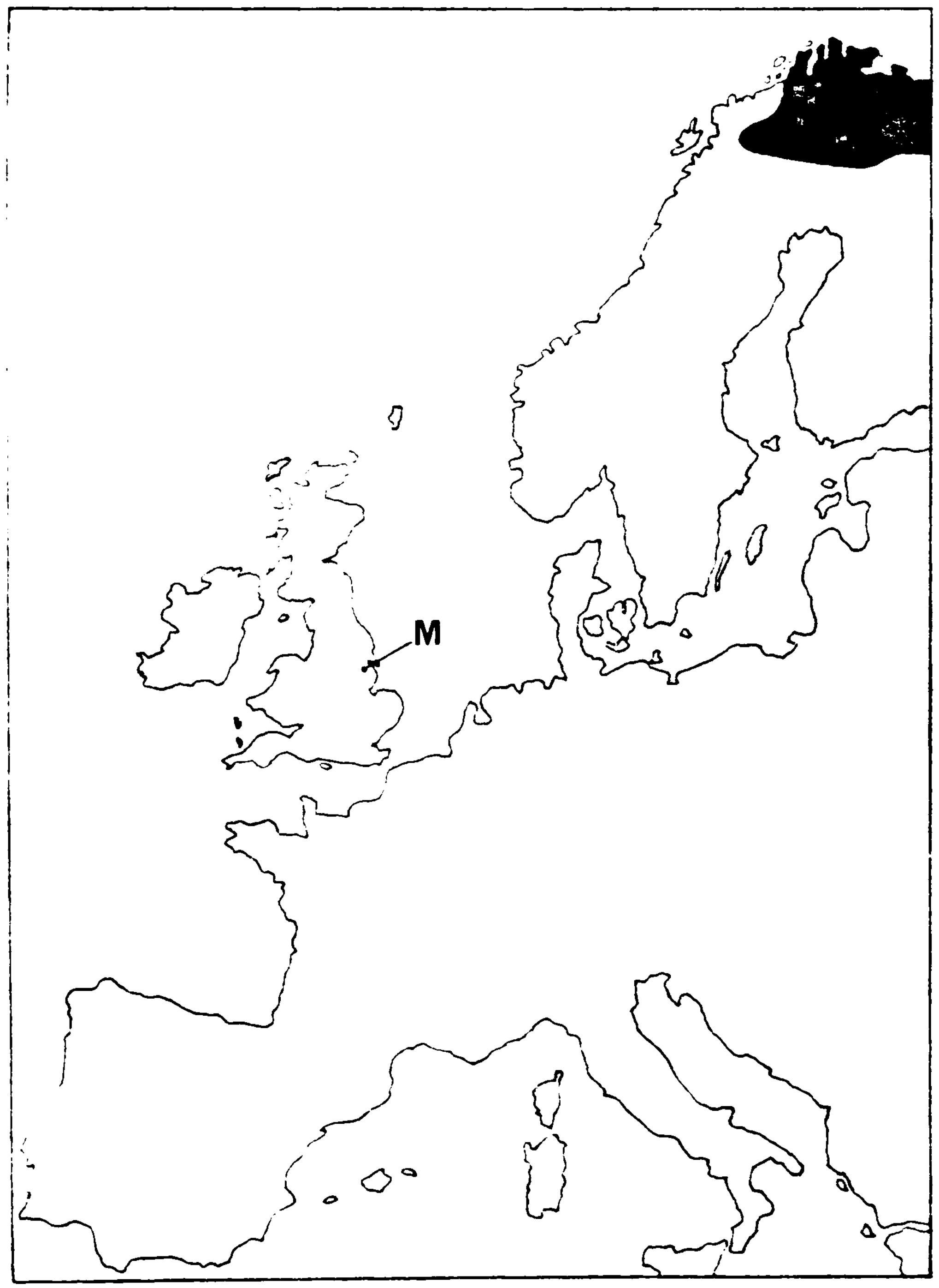


Figure 11. *Diachila arctica*

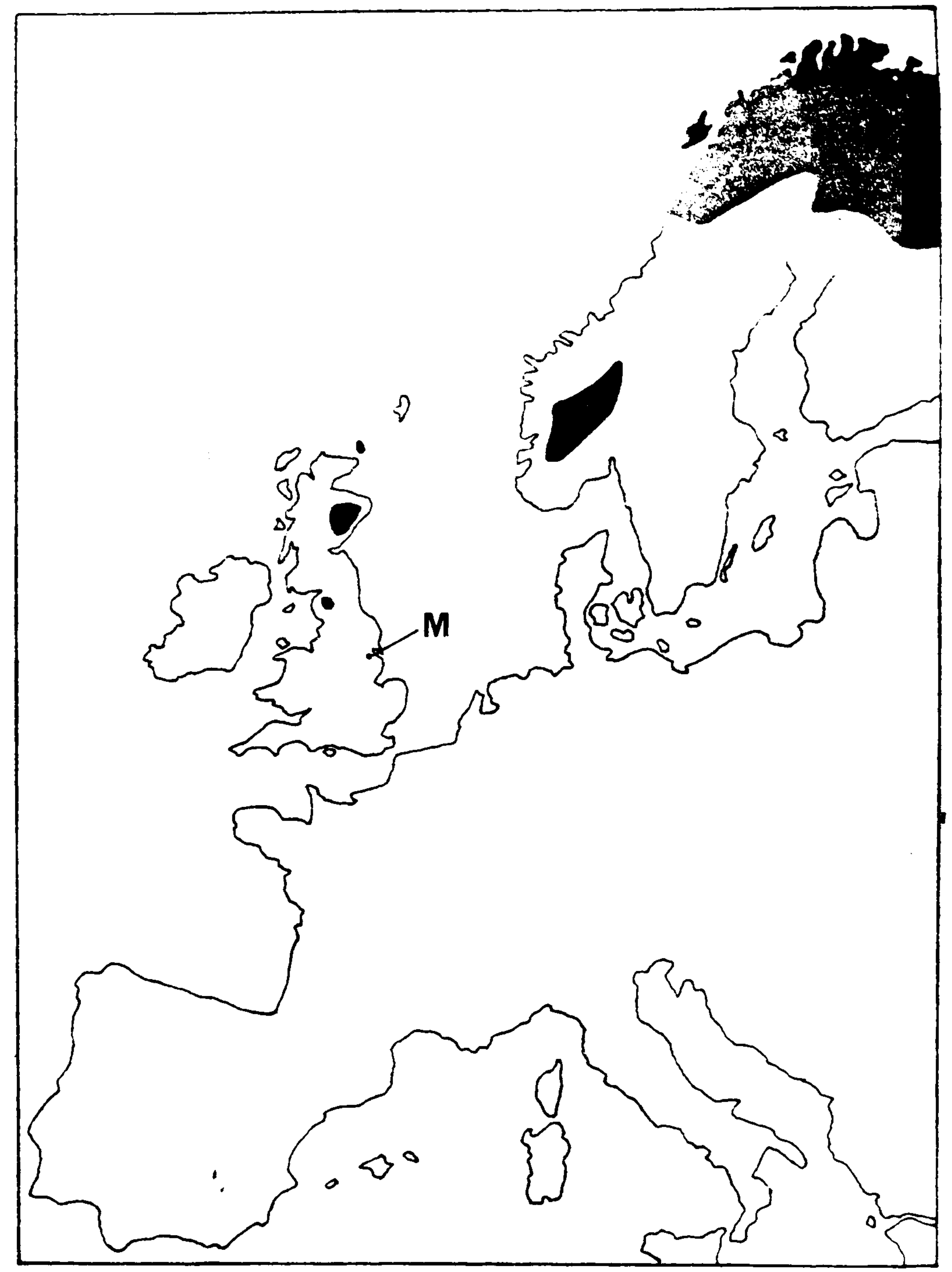


Figure 12. *Elaphrus lapponicus*

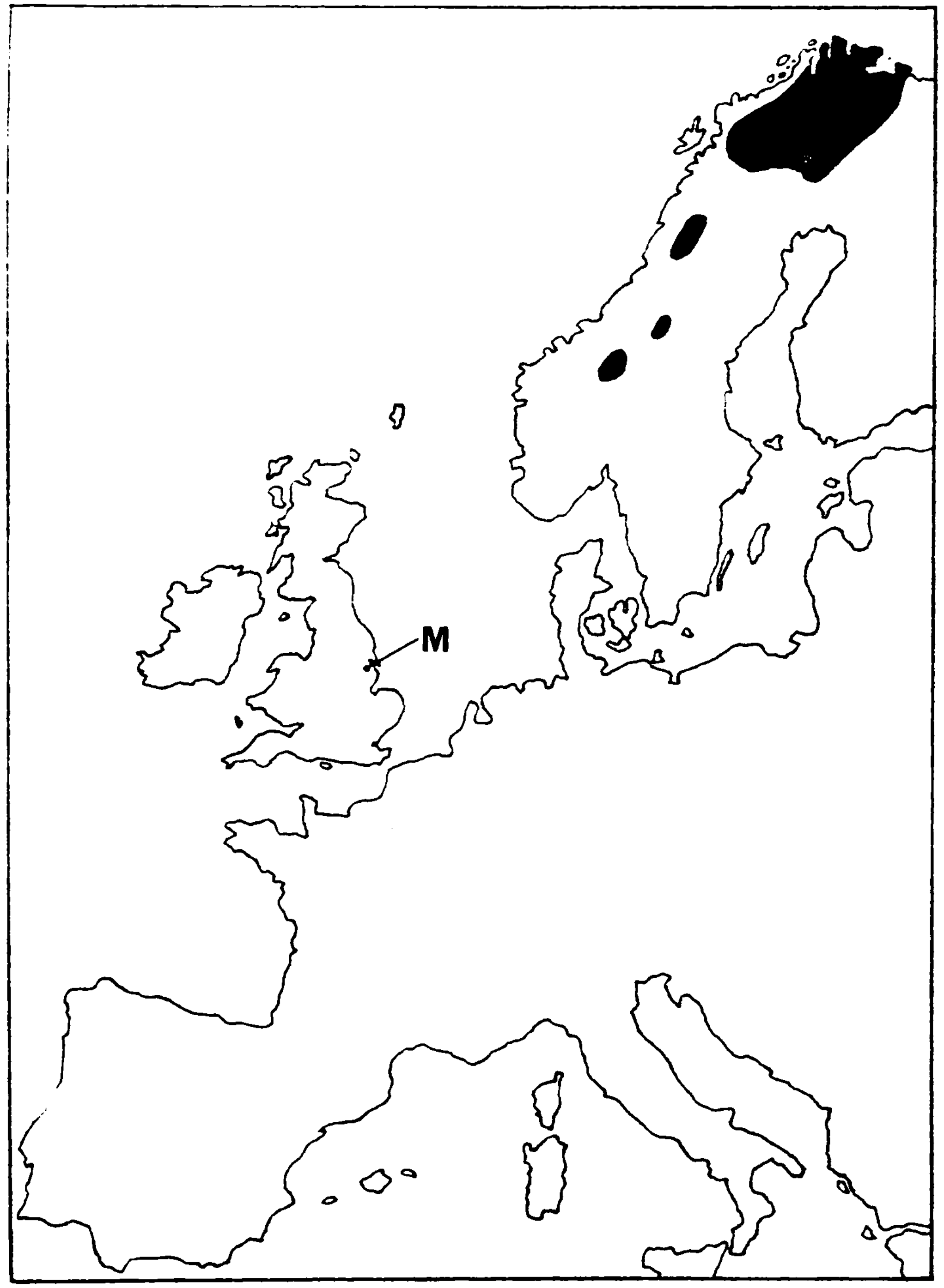


Figure 13. *Bembidion lapponicum*

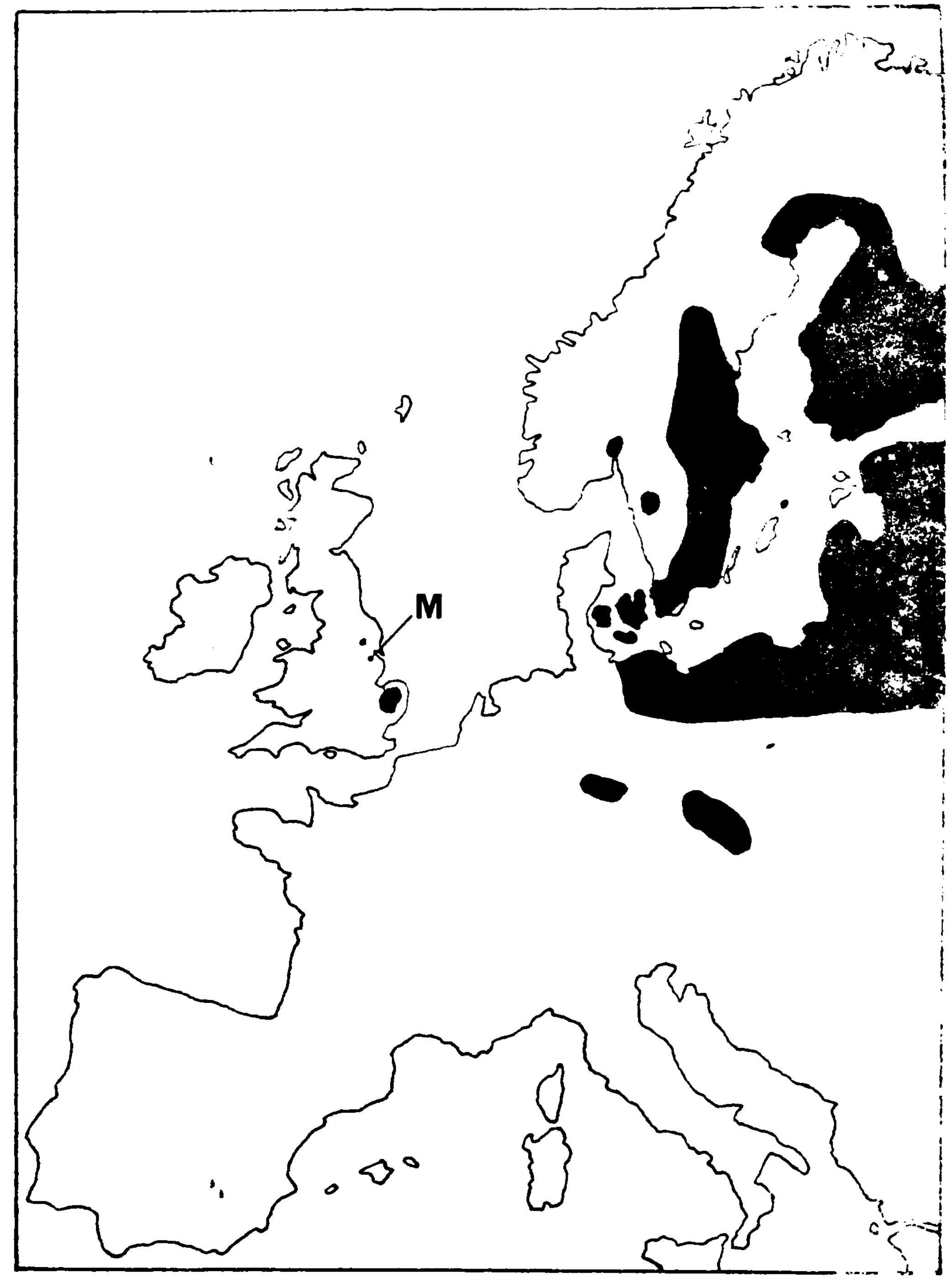


Figure 14. *Trechus rivularis*

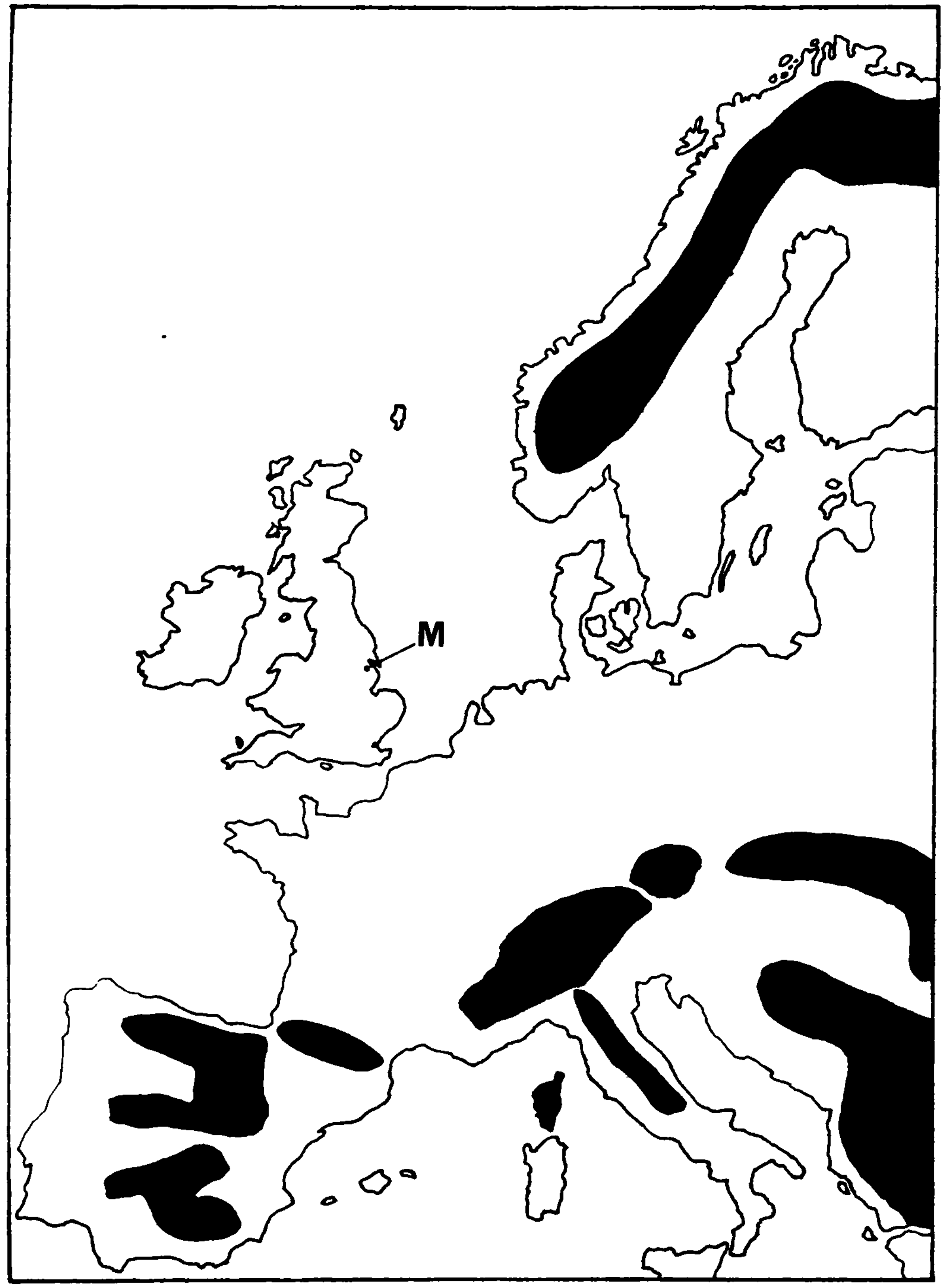


Figure 15. Helophorus glacialis

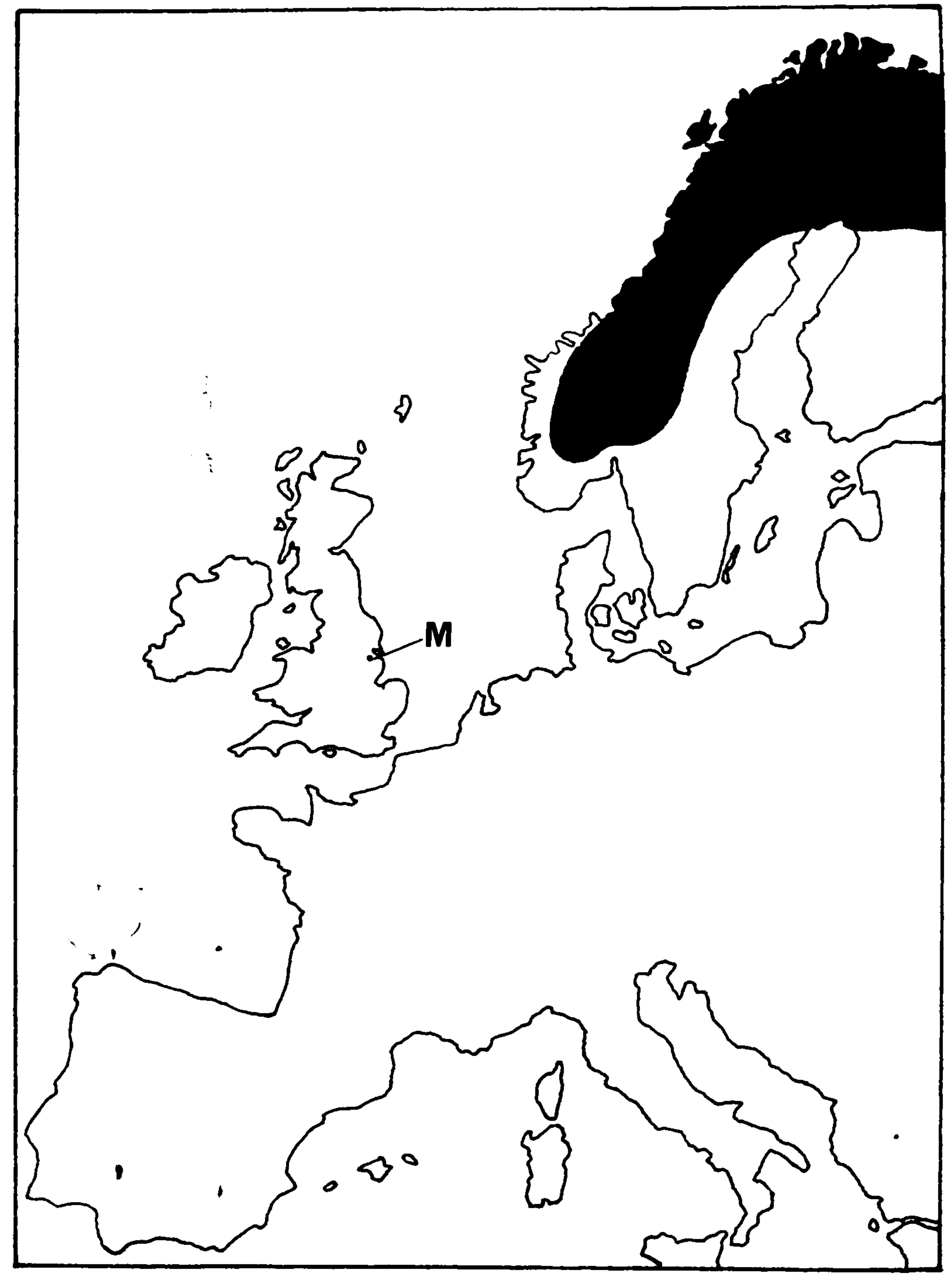


Figure 16. Helophorus sibiricus

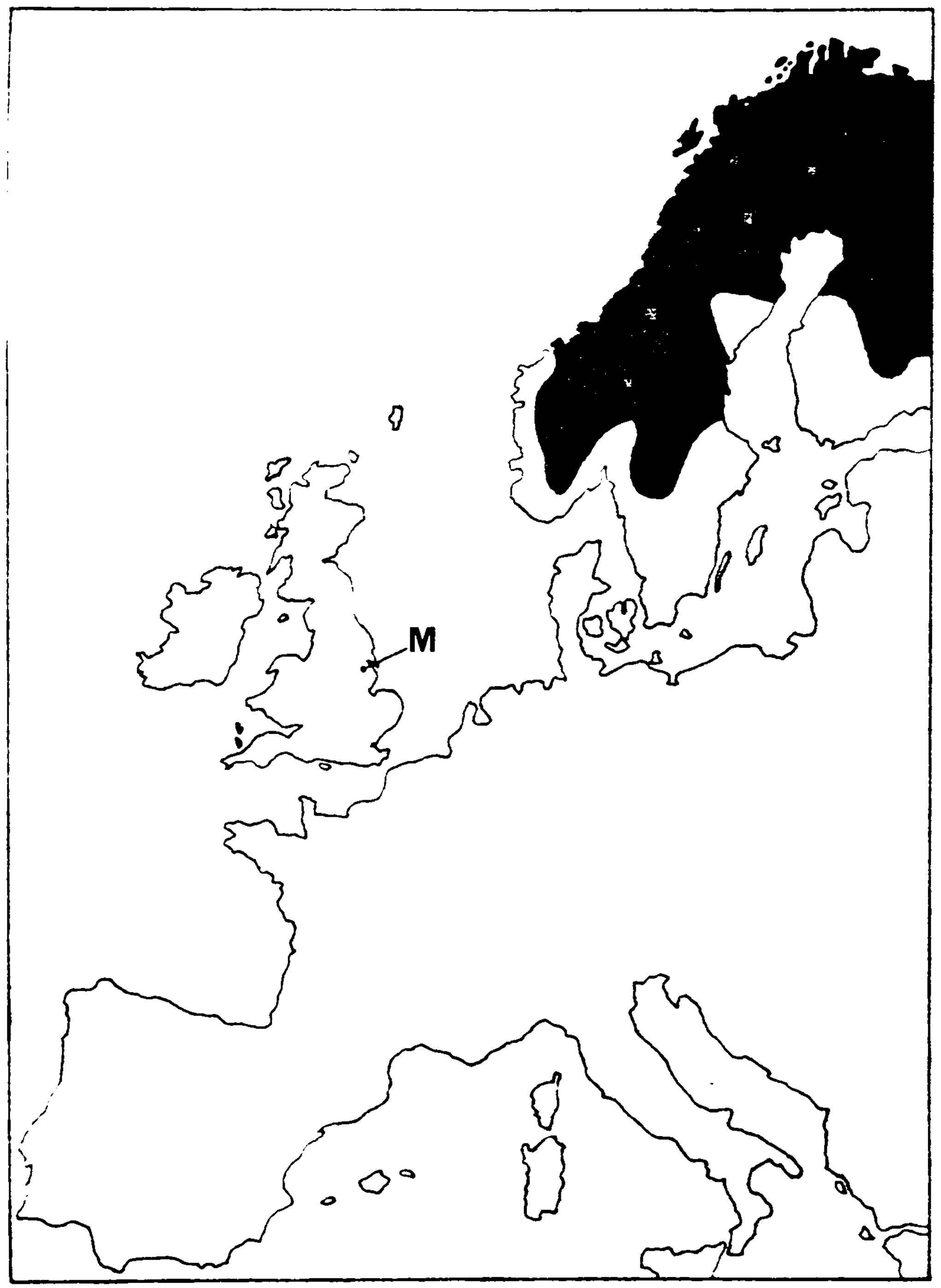


Figure 17. Olophrum boreale

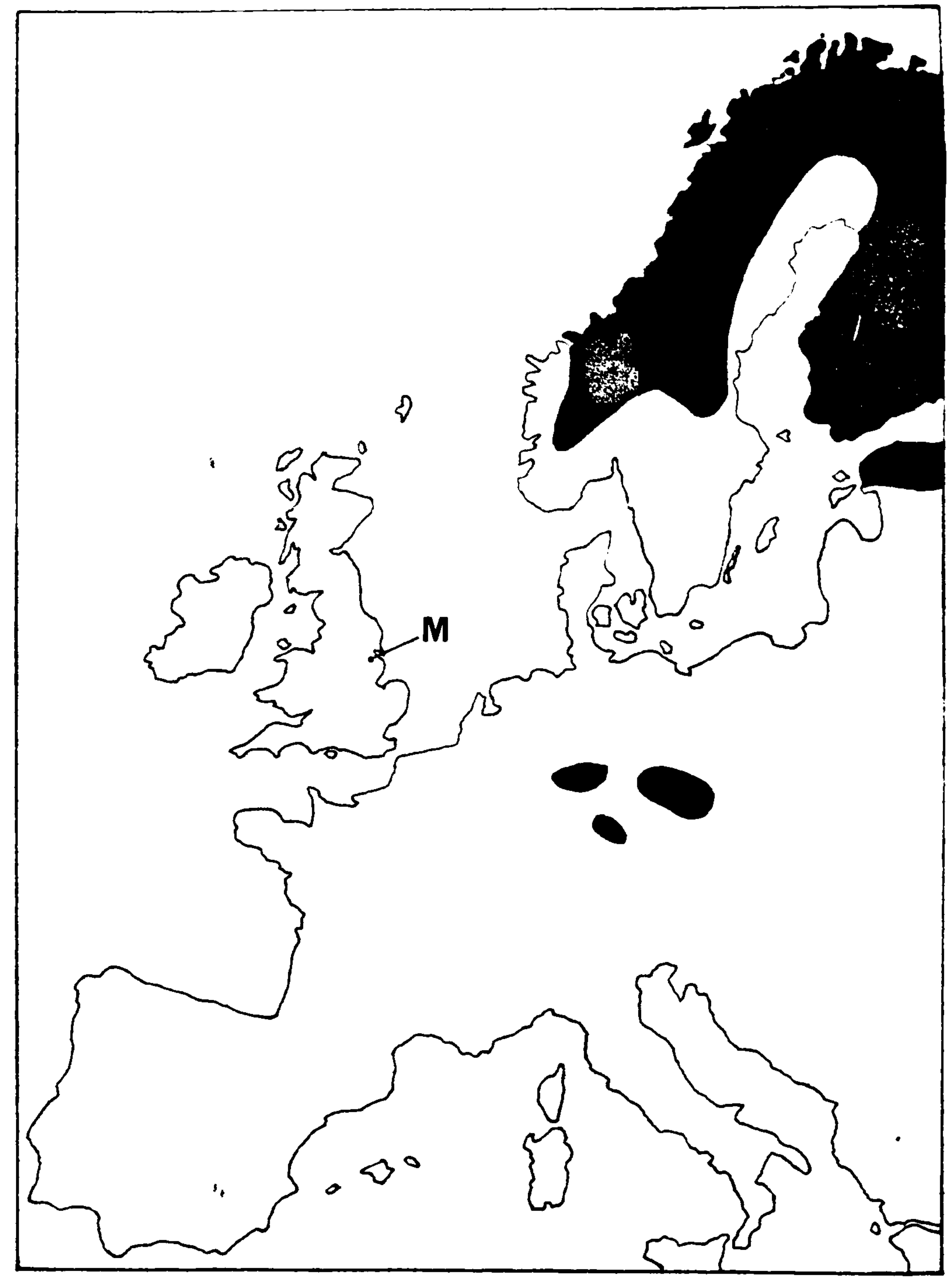


Figure 18. Olophrum rotundicolle

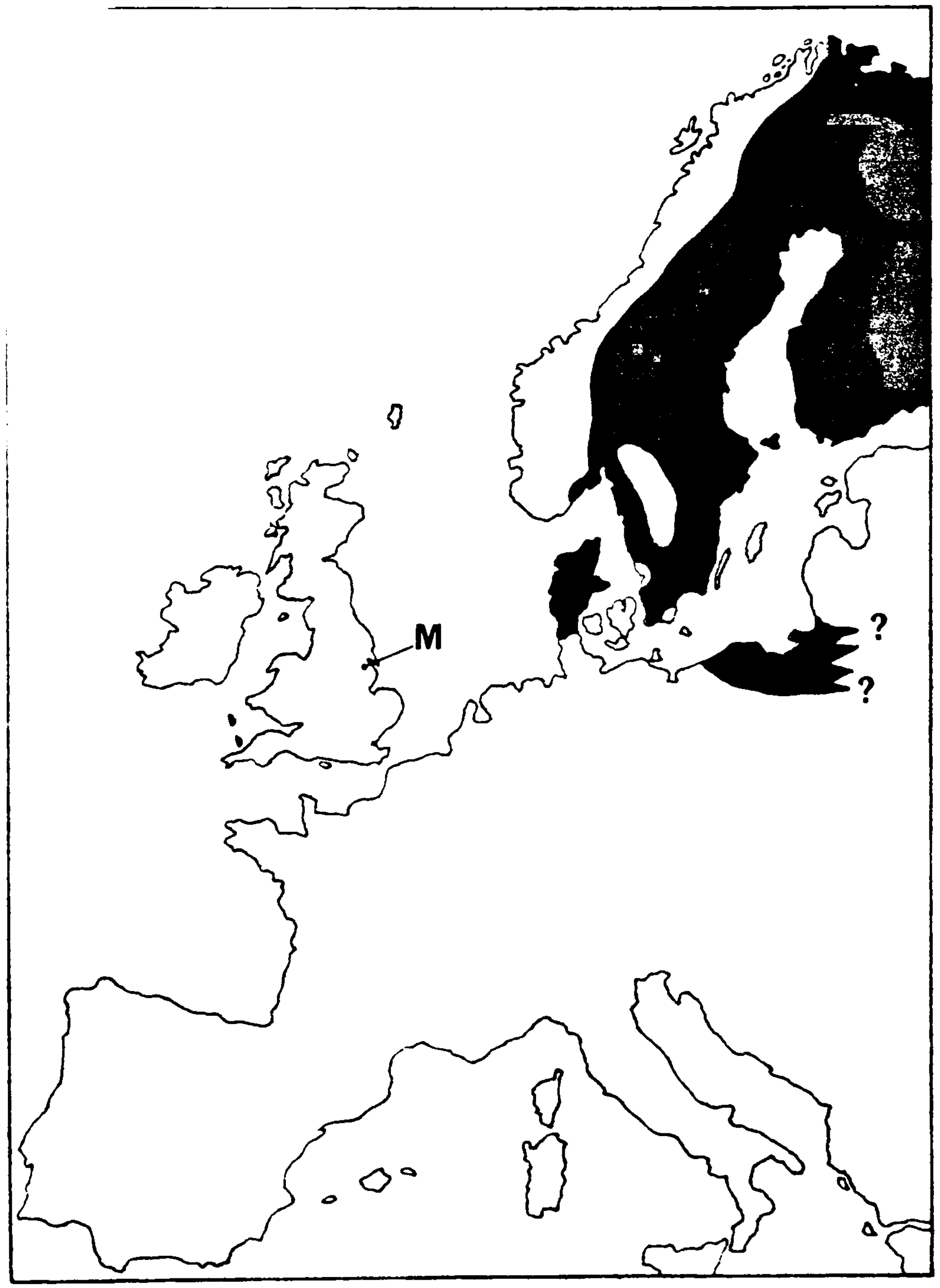


Figure 19. Pycnoglypta lurida

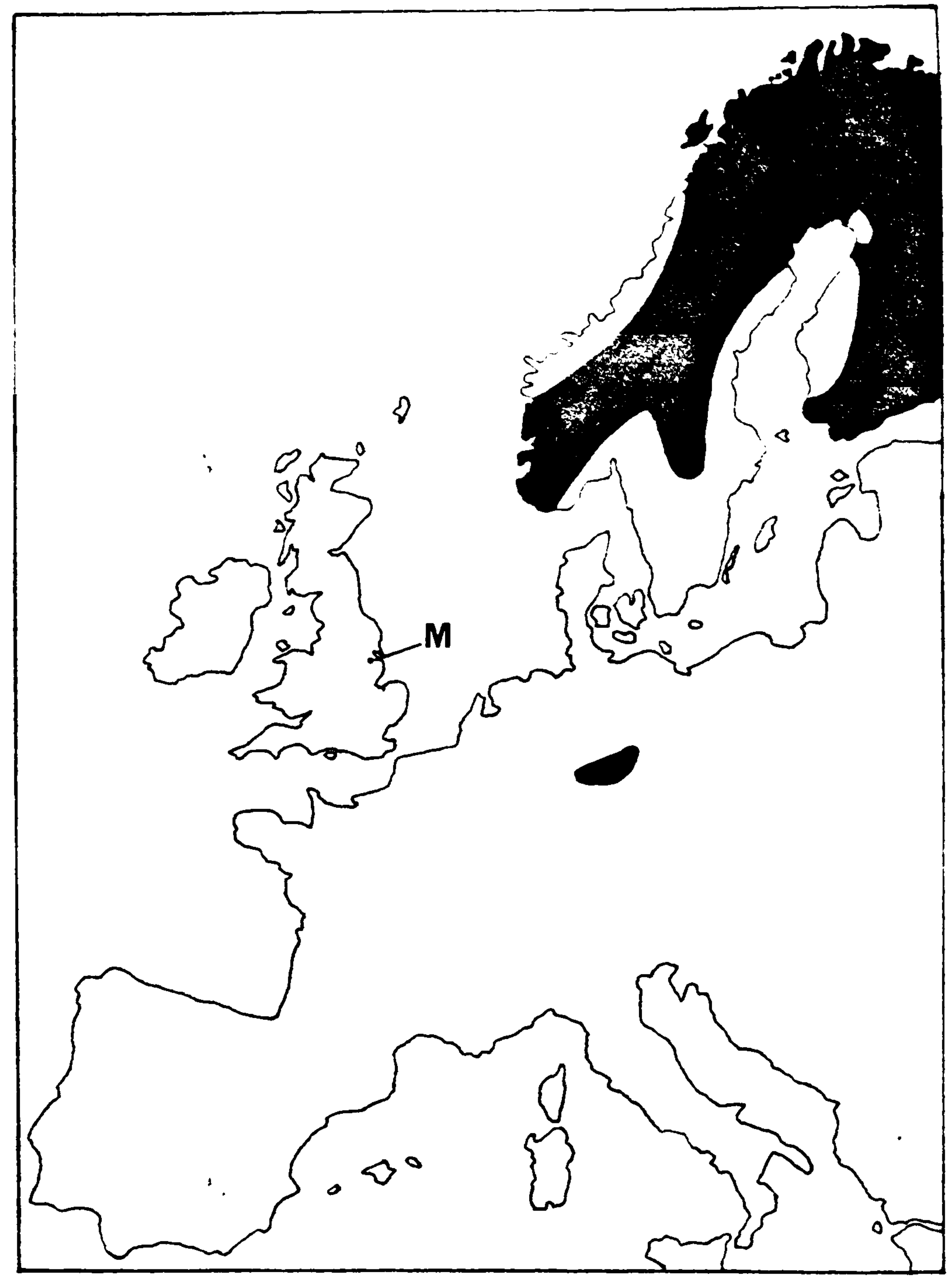


Figure 20. Boreaphilus henningianus

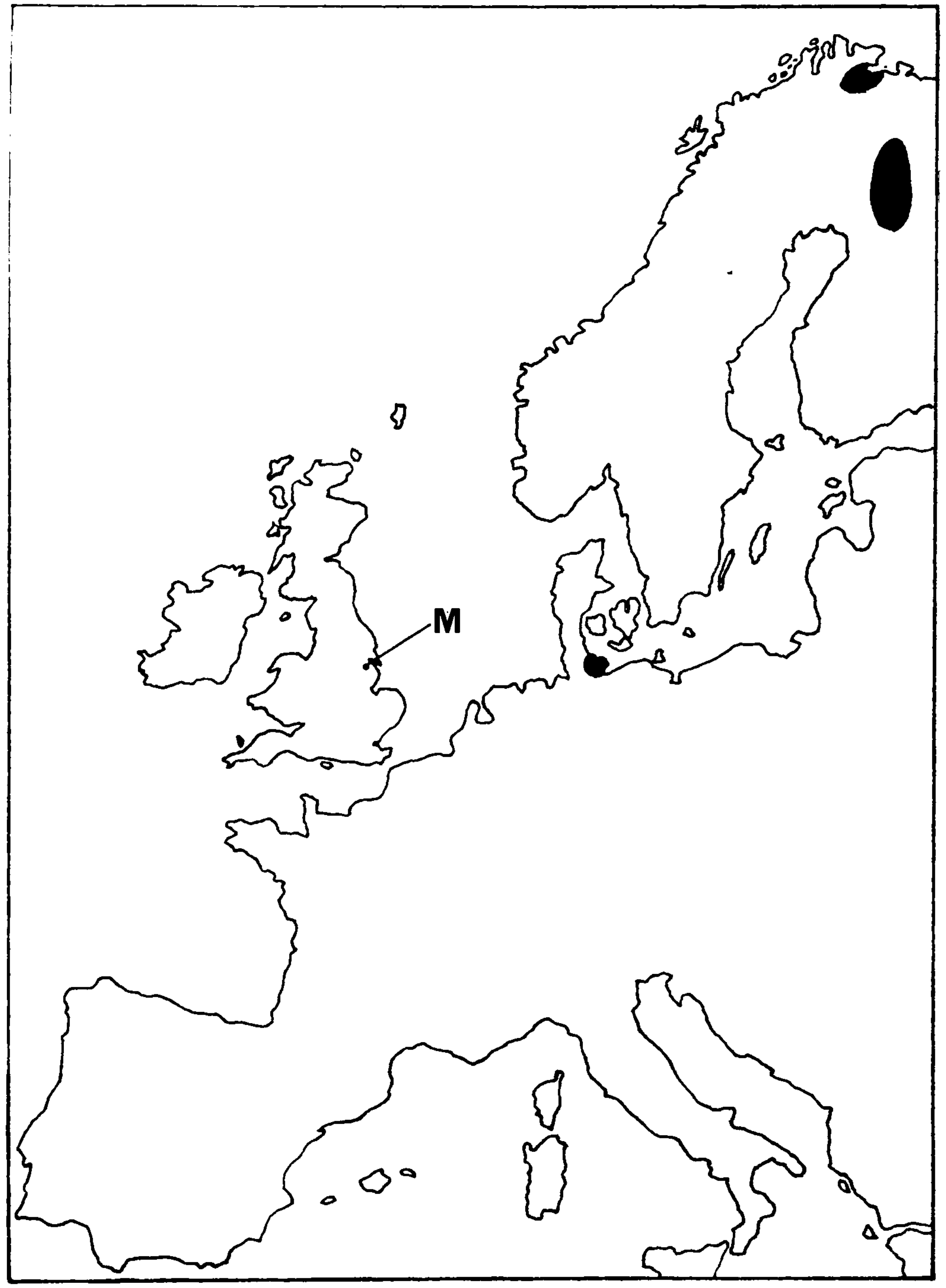


Figure 21. Bledius vilis

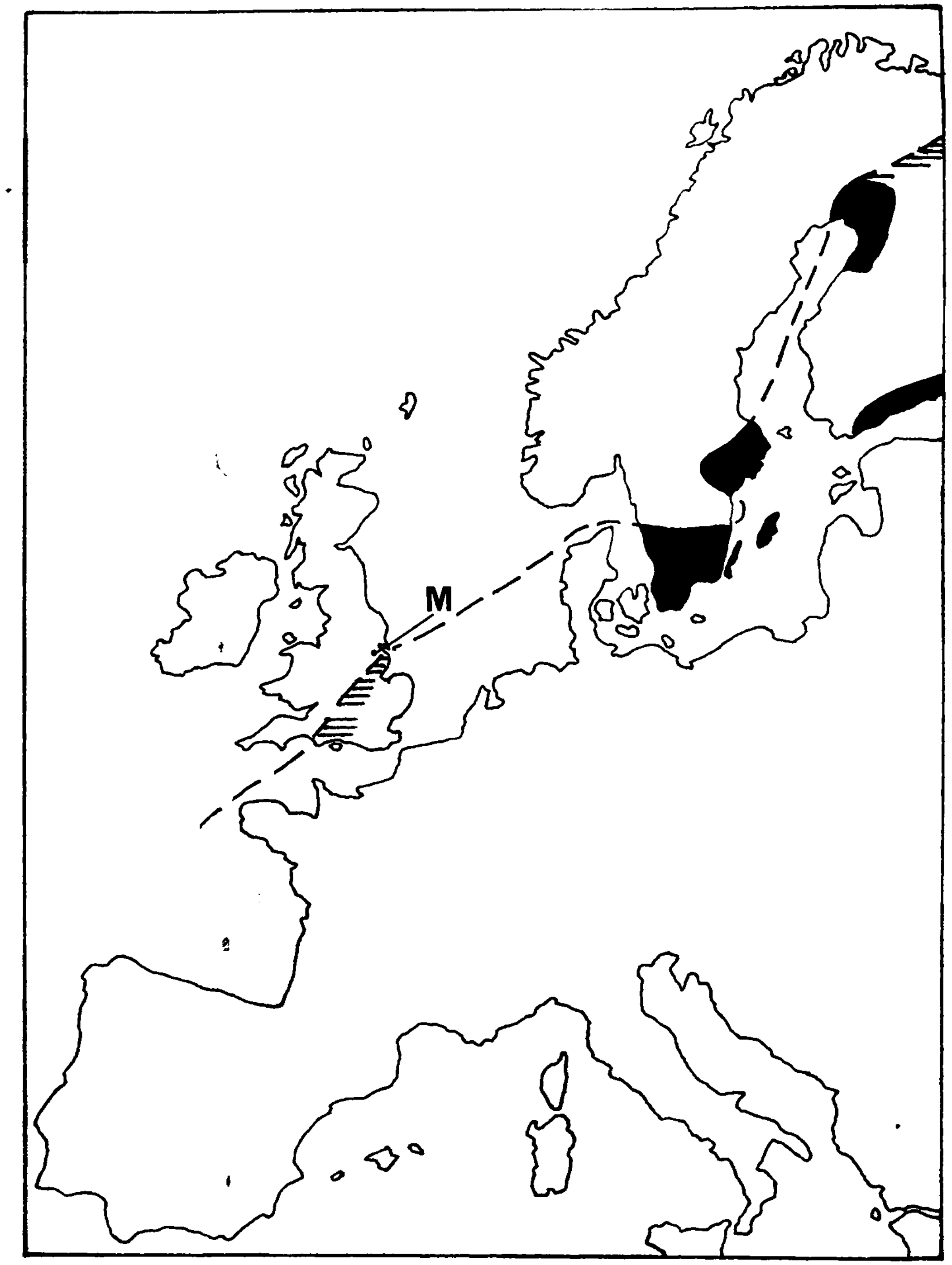


Figure 22. Philonthus punctus

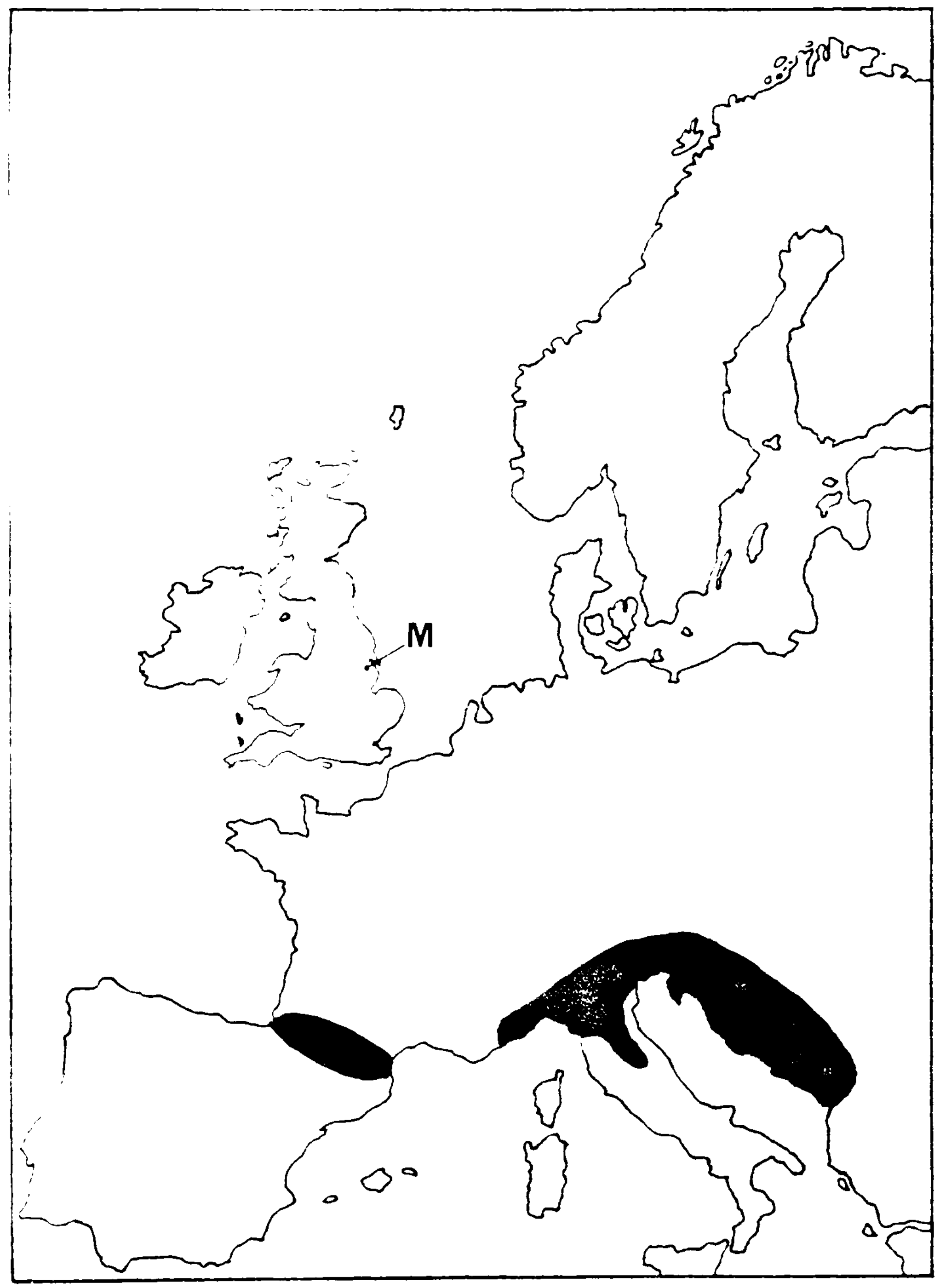


Figure 23. Aphodius montanus

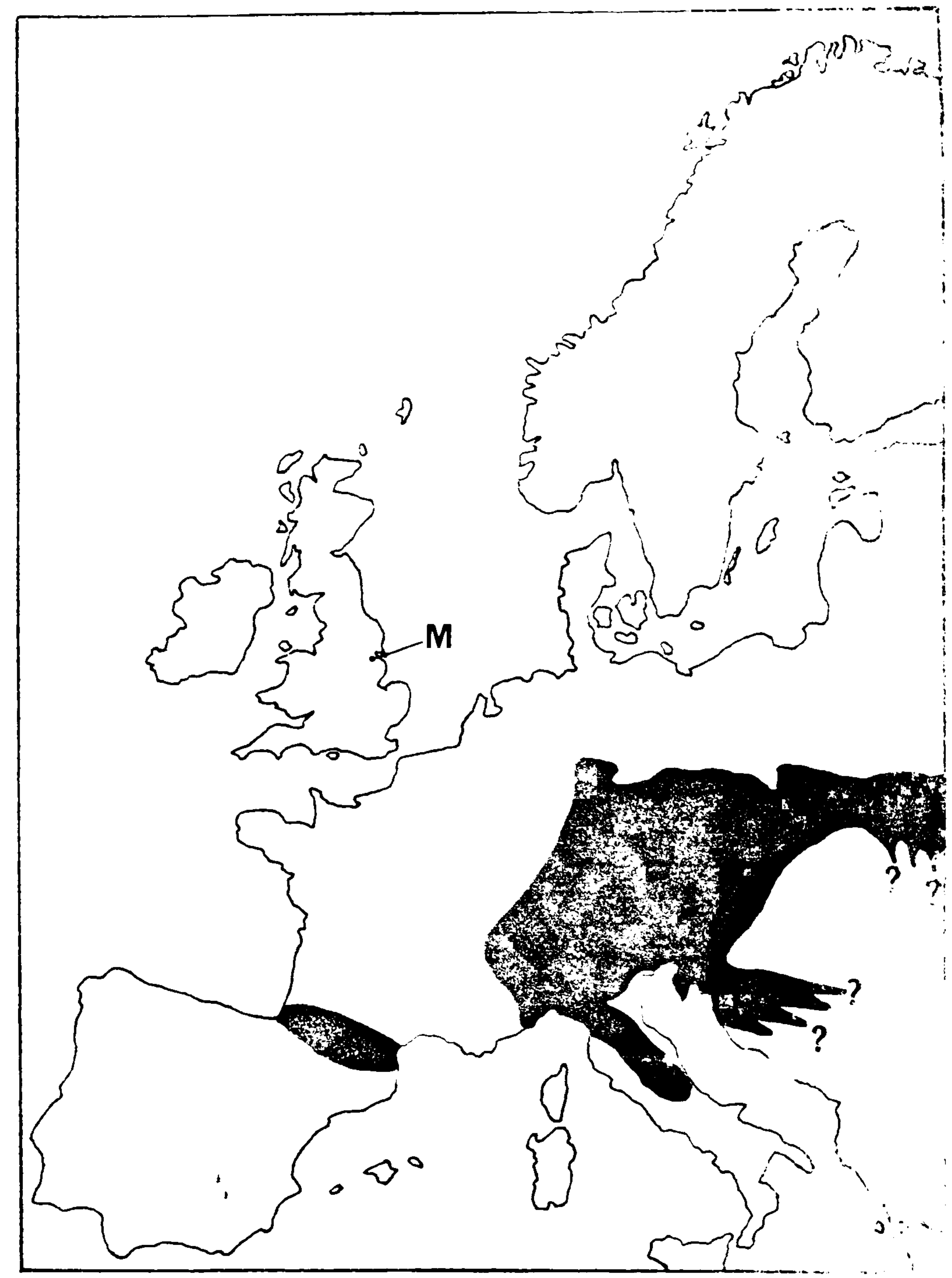


Figure 24. Aphodius obscurus

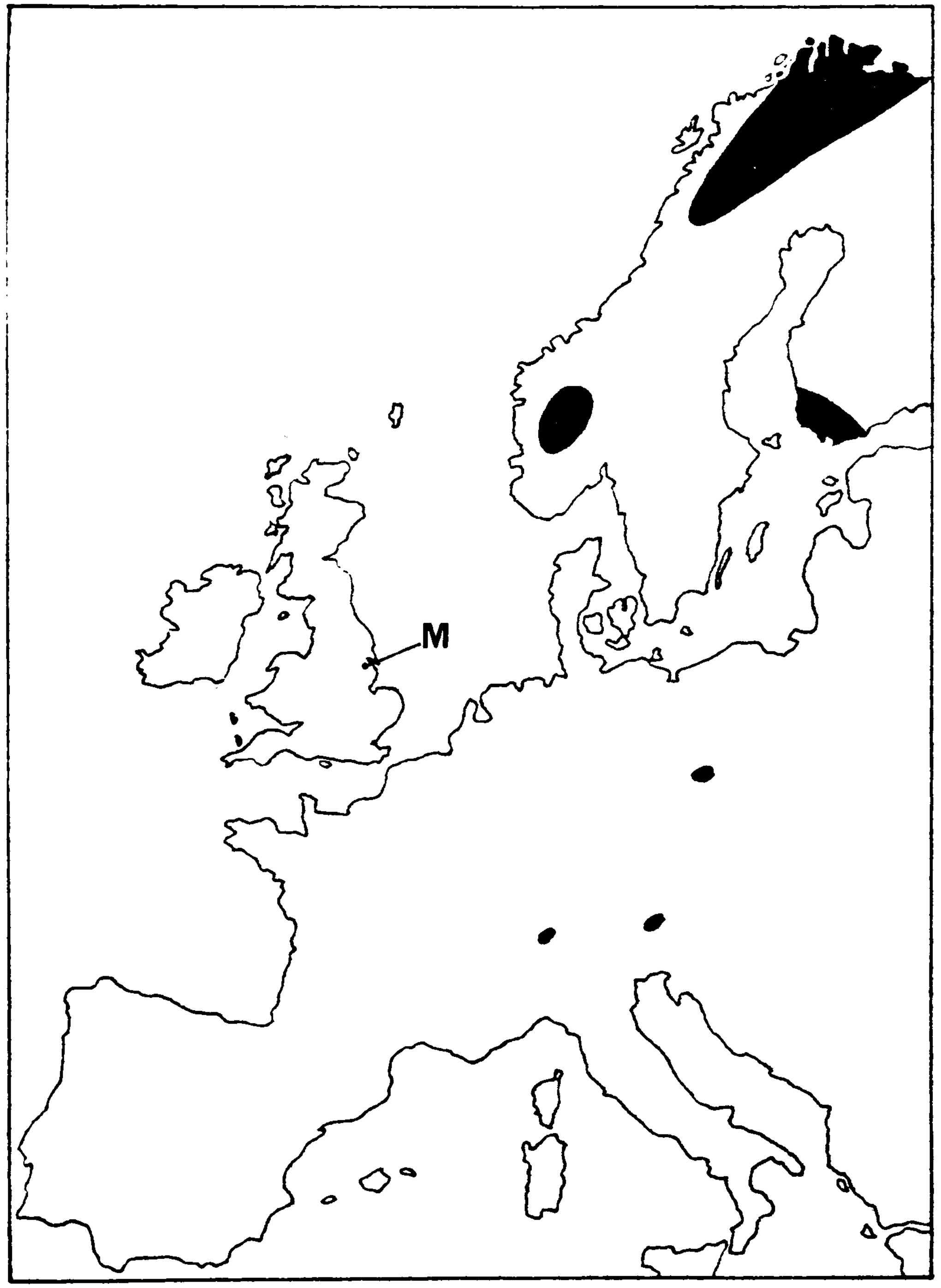


Figure 25. Simplocaria metallica

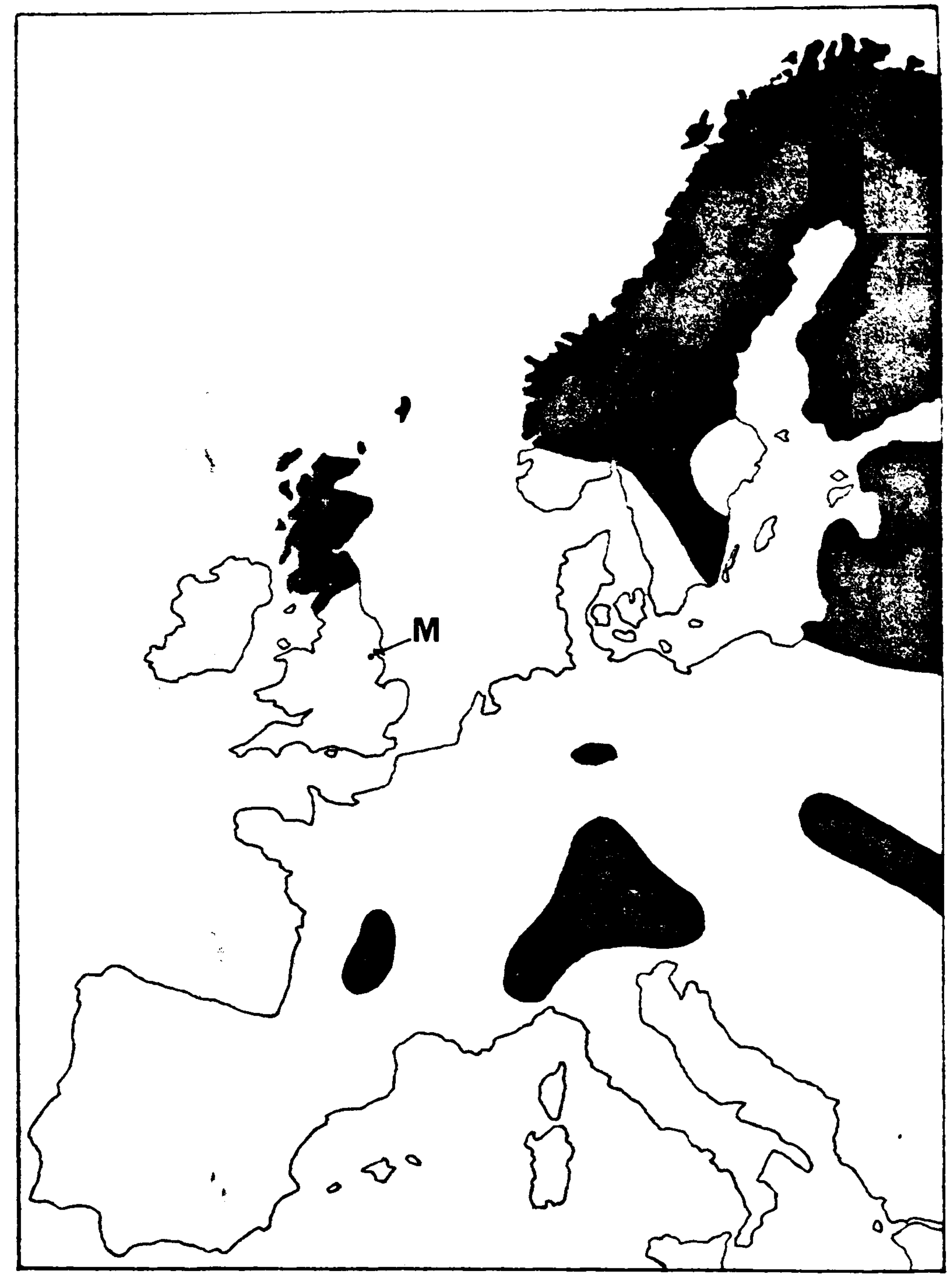


Figure 26. Otiorhynchus nodosus

The Palaeoenvironment

1. The Basal Peat

The close similarity between the faunas from beneath the Cover Sands at Messingham and Flixborough implies a similar environment at both localities and probably, on the extent of the peat bed, over much of the Lias dipslope during the Younger Dryas period. At Messingham, an extensive water beetle fauna occurs and several species suggest the presence of a pond with open water. The Dytiscids include large, free-swimming species of Ilybius and Agabus, together with Rantus (?) exsoletus and Colymbetes sp. Agabus arcticus prefers small, shallow pools of standing water, frequently with Sphagnum (Lindroth, 1935; Balfour-Browne, 1950). The Hydrophilids occupy thickly vegetated margins to ponds, although Chaetarthria seminulum is found in wet mud, away from vegetation, at the edge of pools (Balfour-Browne, 1958). Helophorus sibiricus shows an interesting variation in habitat across its range. In Scandinavia, it is found by the sides of rivers but Siberian records are also from grassy pools, particularly those from melting snow (Angus, 1973), and it is this latter habitat which accords best with the other faunal evidence from Messingham. A considerable proportion of the fauna is associated with decaying plant debris, including the large numbers of Cercyon spp. and several species of Staphylinid. Mosses were apparent in both collection and preparation of the samples and, with these, are associated the Byrrhids, Coelostoma orbiculare and Helodids, as well as many of the Staphylinids, including the most frequent taxa in both major samples, Olophrum fuscum and Arpedium brachypterum. The Carabids, Elaphrus lapponicus and Diachila arctica, also occur on moss cushions in small bogs (Lindroth, 1945). Among the other ground beetles, the association of Trechus rivularis, Bembidion doris, Feronia diligens and Agonum fuliginosum is typically that of a shaded Carex marsh (op. cit.), although B. schüppeli, also relatively common in the principal Messingham sample, is comparatively more riparian, preferring sand mixed with plant debris and sparser vegetation (Lindroth, 1974). Patches of a more sandy substrate do occur beneath the peat bed and occasional intercalations of sand were noted towards the top of the peat in a number of localities. B. schüppeli may well be associated with such areas of sand blows, prior to the onset ofthe major phase of Cover Sand deposition.

The evidence for the actual species of plant growing in this marshy environment, from the phytophagous insects, is relatively limited. This element in the fauna is dominated by taxa associated with the Cyperaceae, whose seeds were abundant in both main samples. Although Joy (1932) has the bur-reed, Sparganium erectum (ramosum Huds.), as the food plant of Notaris aethiops, this weevil, the most common in the Messingham sample, is probably more polyphagous and could find suitable hosts among the sedges; Osborne (1973) suggests Scirpus spp. and Pearson (1961) adds Carex spp. Its congener, N. bimaculatus has been recorded feeding upon Typha latifolia and Phalaris arundinacea (Hoffman, 1958). The other Notarine weevils in the sample, Thryogenes sp., all feed upon various species of Carex and Scirpus, although Hoffman (1958) notes T. nereis from Calamagrostis arundinacea and Joy (1932) has T. scirrhosus from Sparganium. Limnobaris pilistriata occurs on various Cyperaceae and also Juncus effusus (Hoffman, 1954) and the reed beetle Plateumaris sericea is also largely associated with the sedges (Stainforth, 1944).

Evidence for floating vegetation on the pond at Messingham is provided by Phytobius canaliculatus, which is found on the pond-weed Potamogeton natans and, where their hosts are known, the species of Bagous are found on floating aquatics, the one uncertainly identified taxon, B. (?) limosus occurring on P. lucens, P. natans and P. crispus. Gryphus equiseti appears on the marsh horsetail, Equisetum palustre. Both species of Otiorrhynchus are polyphagous, although O. rugifrons seems to prefer Thymus serpyllum in Iceland (Larsson & Gigja, 1959), and Sitona suturalis has been recorded from several species of Ononis, Vicia and Lathyrus. The small Chrysomelid Phaedon sp. - P. tumidulus can be excluded - appear on various plants in damp situations (Mohr, 1966), usually on Umbelliferae (Joy, 1932).

Despite the high percentage of birch pollen from Aby Grange, near Louth in eastern Lincolnshire (Suggate & West, 1969), the continuous curve for Betula in Bartley's(1962) Tadcaster diagram and macroscopic records during Zone III, which range northwards into north-east Scotland (Godwin, 1975), there is neither macroplant nor insect evidence for the presence of this tree at the basal peat horizon in north Lincolnshire. Some wood is perhaps implied by Anaspis sp., the larvae of most species developing in rotten wood, but this habitat could have been provided by the willows, for which there is good evidence. As well as the charcoal from the underlying sample, a leaf of Salix, probably herbacea, was recorded in splitting the Messingham sample along the bedding planes and two individuals of the small weevil, Apion minimum, were identified. This species has been recorded from many willows (Hoffman, 1958), although not S. herbacea, developing in the leaf galls of various Tenthredinid sawflies. Some of the Staphylinids, particularly Arpedium brachypterum and Boreaphilus henningianus, also appear in willow leaf litter. From Flixborough, an example of Phyllodecta can be added to the list of willow feeders, although species are also found on poplars.

Several of the decaying plant debris species of Hydrophilids and Staphylinids also occur frequently in dung and this habitat is also indicated by the Aphodius spp. A. merdarius is predominantly an open ground insect, recorded from horse and cattle droppings (Landin, 1961) and A. obscurus, a south and central European beetle, is found in sheep, goat and chamois dung (Balthazar, 1964). Of these animals, perhaps only horse was available in England during Zone III but, as Landin (op. cit.) has shown, dung beetles are not tied to the species of origin of herbivore dung but to its character, situation and microclimate. Both species could equally have occurred in the droppings of reindeer, the most frequent large vertebrate fossil recovered from Zone III deposits, and perhaps those of 'tundra bison', Bison bonasus arbustotundrarum Deg., recorded from this period in Denmark (Degerbøl, 1964). It would be tempting to relate the one bone found, a Bovid astragalus, to this species but, unfortunately, this bone is insufficiently diagnostic (Sutcliffe, pers. comm.). All members of the sub-genus Agolius, to which Aphodius montanus belongs are plant feeders rather than coprophagous (Machatschke, 1969).

The image of the pre-Cover Sands landscape on the Lias dip-slope is therefore relatively complete. An extensive Carex dominated marshland, with some scrub willow and occasional pools, probably fed by meltwater from localised snowdrifts, forms the backdrop against which the users of the flint end scraper from Messingham and perhaps the shouldered point from Risby must stand. His prey, probably reindeer, picked their way across the bog, selectively feeding off the vegetation, to drink at the scattered water-holes, by which man, the hunter, occasionally crouched with a few dry twigs of willow for a fire to warm himself against the cold winds of the latter part of the Younger Dryas. Caution must be exercised, however, in extending this picture and ascribing the inferred pyromania of the Mesolithic to the Upper Palaeolithic. Charcoal is frequent in the so-called Usselo layer of the Netherlands, of late Allerød or early Younger

Dryas age (Maareveld, 1960) and the Messingham association of scraper and charcoal could be employed to provide support for an anthropogenic origin for this more extensive phenomenon, as charcoal from sites in southern England already has (Evans, 1975). Natural fire is a potent factor in maintaining sub-climax vegetation in conifer woodland in North America (Wright & Heinselman, 1973) and lightning strikes into pinewoods, made moribund by climatic deterioration seems at least an equal possibility. Paddayya (1972), after Waterbolk (1954), has blamed ash from volcanic eruptions in the Eifel for the burning of the moribund pine forests.

Away from the extensive marsh, stands of birch and scrub of dwarf birch and willow must have existed in favoured localities but the insect evidence from the north Lincolnshire sites implies a continuous landscape of unconfined arctic mires, the muskeg of the Canadian and Alaskan tundra (Bellamy, 1972). Despite the evidence for solifluction and cryoturbation during Zone III elsewhere, frost structures have not been proven in either the basal peat or overlying Cover Sands, a point which will be returned to later (below, p. 70).

2. The Cover Sands

Towards the top of the basal peat in several sections, occasional laminae of sand, rarely more than a few millimetres in thickness, make their appearance, a feature perhaps evident in the Messingham basal peat fauna in the presence of Bembidion schüppeli. The transition to a phase of widespread sand deposition, however, is relatively abrupt and it is apparent that the vegetation cover was broken over a very wide area in a short space of time, allowing extensive aeolian redeposition. Organic horizons are virtually absent for up to 2 m. of the sand succession, the occasional stringers of vaguely organic material consisting, where recognisable, entirely of

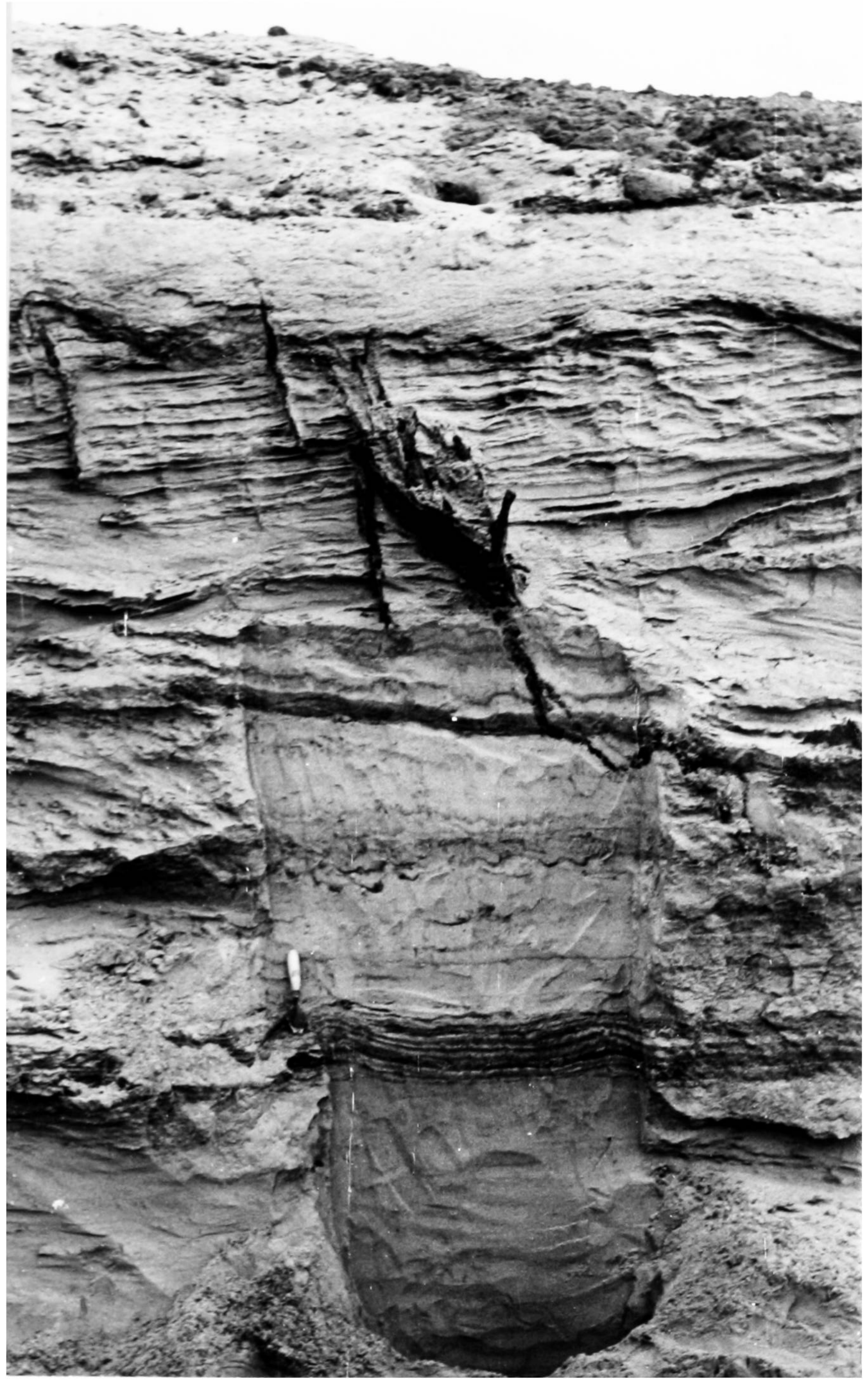


Figure 27. Flixborough ironstone mine, Lincs.
Section in Cover Sands (1973).

Figure 28. Flixborough ironstone mine, Lincs.
Sand-filled ice wedge pseudomorph (1973).

moss fragments. It was initially thought that the succession of thin, sub-horizontal sand beds and laminae (fig.27) represented almost an annually deposited sequence but, as the quarry face at Messingham advanced towards the base of the escarpment and the Crosby and Flixborough sections were examined, it became evident that water had played a part in the redisposition of the sands and the sequence was less easily interpretable. Nevertheless, although direct counts of laminae proved not only impossible but useless, the very character of the deposits and overlapping, inverted ^{14}C dates imply rapid accumulation, in probably less than one hundred years for the first 2 m., taking the overlap zone of the two dates, 10,550 ± 250 and 10280 ± 120 B.P., at its face value.

When faunas reappear within the Sands, at a horizon detectable in most sections and lying roughly 2 m. above the base in the Messingham pit, the phytophagous insects are absent and the beetles are those associated with a sandy substrate. Species of sand burrowing Staphylinids, Bledius spp. appear and the only ground beetle is the bare ground stenotope, Bembidion lapponicum. It is probably the edaphic transformation and paucity of litter which reduce the numbers of Arpedium brachypterum, although the other Omaliine which tends to be co-dominant on cold sites, Olophrum fuscum, maintains its relative numerical superiority and other moss living species, O. boreale and Acidota cruentata remain. At both Flixborough and Messingham, some open water is indicated by the larger Dytiscid water beetles, again including Agabus arcticus, but the Hydrophilids are seriously reduced and only represented by small species. Helophorus sibiricus is supplemented by H. glacialis, also a cold stenotherm, in northern Europe confined to the margins of snow patches on bare ground always near freezing point (Angus, 1973). That large herbivores were still, at least intermittently, present in the area is suggested by the two specimens of Aphodius.

After this apparently more quiescent interlude, perhaps a solitary particularly favourable summer or one winter's moderation of gales, aeolian deposition of sand began again and a further 1 - 2 m. was lain down against the west facing scarps. Away from the escarpment, any organic component has not survived but, at the eastern limit of the Messingham pit, a singularly coarse cross-bedded unit of sand is capped by several thin beds of finer sand with traces of organic material (fig. 5), and these, here 1.5 m. above the previous sampling horizon, yielded faunas, sampled in two arbitrary units of c. 5 cm. Apart from the decline in the number of individuals, these faunas remain substantially the same as the lower horizon within the Sands. The species of Bledius are joined by their predator Dyschirius politus, a ground beetle of sparsely vegetated fine sand habitats (Lindroth, 1974), and a phytophagous element creeps back in, with moss feeders, Simplocaria sp., and the weevils Notaris aethiops and Otiorrhynchus nodosus. The dung beetles again imply large herbivores in the region. No higher organic horizons were found in the Cover Sands succession and it is unfortunate that the progression through into the post-Glacial could not be followed. Dudley (1949) had noted a peat bed, nearly 2 m. thick, containing a temperate vertebrate fauna, within sands near Santon (N.G.R. c. SE930115), 3 km. east of Scunthorpe, but this has been destroyed by quarrying.

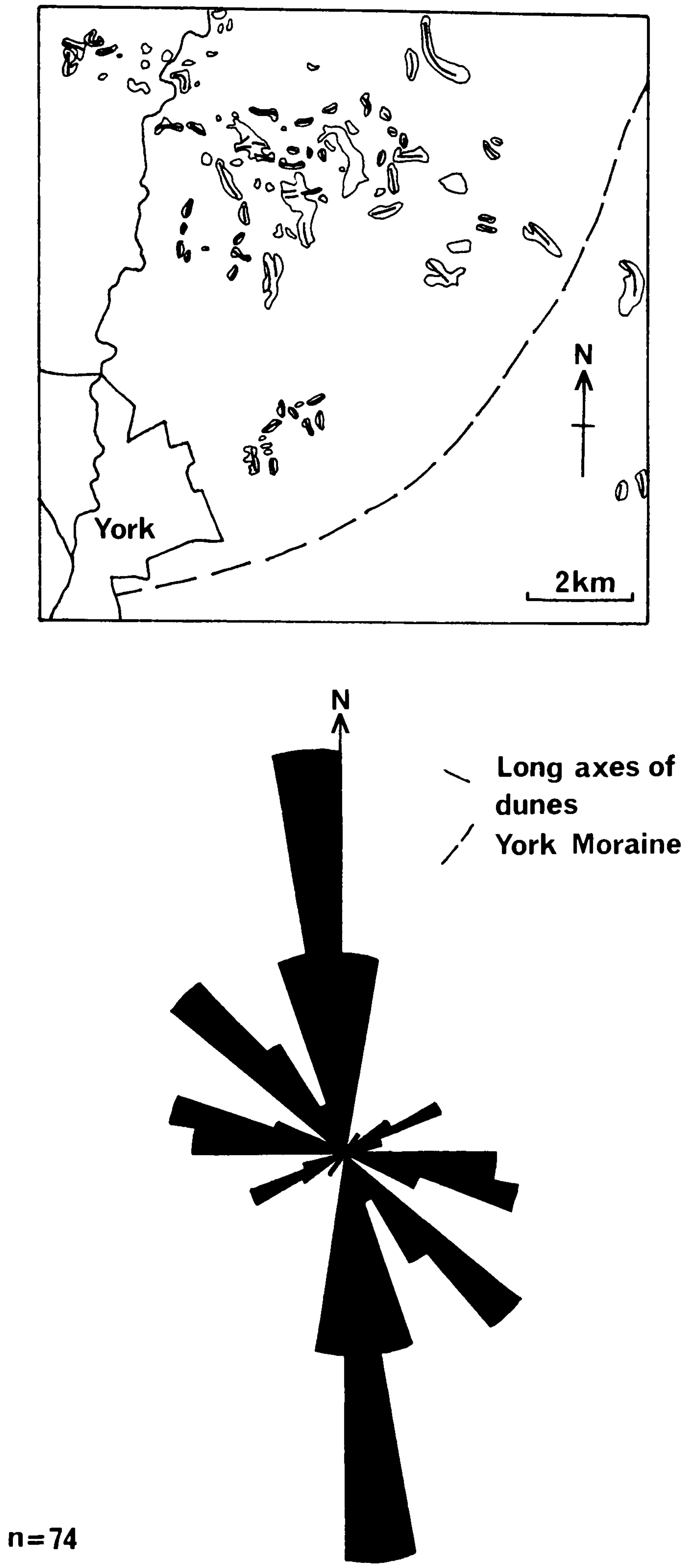


Figure 29. Distribution and orientation of dunes in Cover Sands, north east of York. (map after Matthews, 1970).

The Climate

Several climatic models have been attempted for the Late Devensian (Manley, 1959; Lamb & Woodroffe, 1970). Such syntheses of the available data, however, imply a stability of regime, which may be misleading during a phase of relatively rapid and probably erratic change like the Late Glacial, when no single atmospheric circulatory pattern may have survived long enough for its salient features to be discernable from the biological, geomorphological and geochemical record. Conflicting data can lie within the standard deviation of ^{14}C dates and, as geographical separation increases, the contradictions become less evident and information from diverse localities can be fitted into a model which does not obviously include data of divergent ages. The evidence for wind directions provided by such deposits as the Cover Sands is not necessarily relevant to prevailing conditions of general air circulation but relates to the strongest winds, perhaps concentrated in one atypical season of the year. In itself, the biological data for gross thermal regime can be similarly problematic, particularly in situations where there is no direct modern analogue and a bald statement of conditions may gloss over many inconsistencies. Our knowledge of the factors which control insect distribution is very superficial and, although experiments (Bertram, 1935; Salt, 1961) suggest that temperature and humidity are dominant factors, a simple climatic model cannot be constructed from the assumed requirements of the various species, for many of which even overall habitat information is not available. Coope (1968) attempted to overcome these difficulties by using Lindroth's (1945; 1949) exhaustive studies of ground beetles and their occurrence within the vegetational zones of Scandinavia. Too great a reliance on this method, however, places insufficient weight upon the remainder of the fauna and leaves uncertainty where the number of appears to relate directly to climate rather than the distribution of its host plants, the Cyperaceae. This northward range overlaps with the current southern limit of Diachila arctica, which is known from the tundra down into the northern coniferous belt (Lindroth, 1949; Coope, 1966). Both D. arctica and Helophorus sibiricus, from their present distribution, suggest rather continental conditions, with considerable contrast between summer and winter temperatures, although it has to be emphasised that, on Scandinavian distribution, Trechus rivularis, a more southerly element in the contemporary Messingham fauna, implies an even more severely continental regime and yet this ground beetle has relict populations in eastern England (above, p. 37). Increased continentality, however, would be expected as a consequence of the much lower sea level during the Late Glacial (Jelgersma, 1966) and finds considerable support in the distribution of periglacial features (Williams, 1975), although absolute contemporaneity with such features cannot be assumed.

As an initial hypothesis, the data from the weather station at Karesuando (Lat. 68° 27' N., 300 m. A.S.L.), on the border between Sweden and Finland in this part of Lapland, can be employed. July average temperatures, at c. +15°C., lie slightly below summer averages from the Vale of York but January averages are depressed to -13°C., a winter contrast with the Cover Sands area at the present day of the order of 16°C. The insect fauna, however, is not susceptible to averages but to extremes at varying points in their life cycles and the distributional limit of individual species may fluctuate considerably between good and adverse years, a point underlined by the spread of the bug Ischnodemus sabuleti in recent years (below, p. 2[illegible]7) and the mortality in the introduced Cis bilamellatus during the harsh winter of 1962-63 (Paviour-Smith, 1969). Table 4, therefore, from the Meteorological Office tables (1966), gives a better idea of conditions in this locality over a twenty year period. Under these

Table 4 — Comparative temperatures for modern localities with majority of insect fauna (Karesuando) and the Cover Sands (York).

	Karesuando, (330.5m, A.S.L.) 68°27 N 22°30 E. Temperature °C. Average Daily		Absolute		York (17.4m A.S.L.) 53°57 N. 1°05'W. Temperature °C. Average Daily		Absolute	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Jan.	-7.8	-16.7	+5.0	-37.8	+6.1	+1.1	+15.0	-13.9
Feb.	-8.9	-18.3	+6.1	-41.1	+7.2	+1.7	+16.1	-9.4
Mar.	-3.3	-15.6	+10.0	-35.0	+9.4	+2.2	+22.8	-12.8
Apr.	-1.67	-10.6	+15.6	-26.9	+12.2	+4.4	+23.9	-3.3
May	+7.8	-1.7	+24.4	-21.1	+16.1	+6.7	+29.4	-1.1
Jun.	+15.0	+4.4	+30.0	-3.9	+19.4	+10.0	+32.2	+2.8
Jul.	+19.4	+8.9	+32.2	+1.7	+21.1	+12.2	+31.7	+2.8
Aug.	+16.7	+6.7	+28.9	-3.3	+20.6	+11.7	+31.7	+3.9
Sep.	+9.4	+1.1	+20.6	-11.1	+17.8	+9.4	+28.9	-0.6
Oct.	+1.1	-5.6	+12.2	-26.7	+13.3	+6.7	+23.9	-5.0
Nov.	-3.9	-11.7	+7.2	-32.8	+8.9	+3.3	+23.9	-7.8
Dec.	-5.0	-13.3	+5.6	-34.4	+6.7	+2.2	+14.4	-7.2
Year	+3.3	-5.0	+32.2	-41.1	+13.3	+1.1	+32.2	-13.9
No. of Years	10	10	10	10	30	40	30	30

conditions the ground is frozen for over six months of the year (O'Dell, 1963) and, whilst it is insufficiently cold for permafrost and ice wedge formation (Pewe, 1969), some evidence for frost disturbance of waterlogged deposits, after the manner of those referred to by Moore and Bellamy (1974) in Arctic Canada, might be expected and such have yet to be satisfactorily proven within the Cover Sands succession. Their virtual absence, however, can be explained by postulating deep winter snow cover, since thicknesses in excess of 40 cm. insulate the ground from frost action and permafrost formation (Brown, 1970). Such winter protection might also explain several of the apparently anomalous thermophilous elements in the insect assemblages, as the presence of the Central European dung beetle _Aphodius obscurus_ (above, p. 40), and it is not a feature of most existing northern continental environments, where the tundra landscape is exposed to more rigorous conditions, the wind sweeping the snow from vast expanses. In part, snow would have tended to collect in the angles between dip and scarp slopes and cryoturbation and solifluction structures in more exposed localities and further west may be contemporary with the basal peat bed. The peat, however, tends to conform to the more gentle slopes of the topography and overlies substrates of varying porosity, suggesting little movement in the groundwater regime during the period of its growth. Frost structures appear below the peat (fig. 28), although these have no satisfactory _terminus post quem_, and the reason for the initiation of widespread preservation of organic debris, in the form of a thin layer of peat, may lie in the cessation of an active layer without the actual melting out of permafrost. A climatic change towards heavy autumn and early winter snowfall, or merely the failure of removal of snow cover by winter gales, with little or no diminution of the arctic to subarctic nature of the climate, would fit both insect and field evidence.

Fig. 30 ^{14}C dates on the Creswellian, the Cover Sands and insect faunas from Zones III and IV

Archaeological Sites

1.	Anston Cave, Yorkshire	9,750 ± 110 B.P.	(BM-440(b)	(Mellars, 1969)
2.	" " "	9,850 ± 115 B.P.	(BM-439)	" "
3.	" " "	9,940 ± 115 B.P.	(BM-440(a))	" "
44.	Flixton Carr (the date comes from a horizon over that yielding the artifacts)	10,413 ± 210 B.P.	(Q-66)	(Moore, 1954)
5.	High Furlong, Lancashire	11,665 ± 140 B.P.	(St-3836)	(Hallam et al., 1973)

In view of the uncertainty of the association in Robin Hood's Cave, Creswell (below, p. 73), the two dates - 10,390 ± 90 B.P. (BM-603) and 10,590 ± 90 B.P. (BM-604) - have been omitted from the diagram.

Cover Sands and Artifacts

6.	Messingham, Lincolnshire	10,280 ± 120 B.P.	(Birm. 349)	- Basal peat

Cover Sands

7.	Messingham, Lincolnshire	10,550 ± 250 B.P.	(Birm. 707)	- Peat within sands
8.	Stockton, Yorkshire	9,950 ± 180 B.P.	(N-820)	(Gaunt et al., 1971)
9.	" "	10,700 ± 190 B.P.	(N-488)	" " " "
10.	Armthorpe, Yorkshire	11,100 ± 200 B.P.	(N-810)	" " " "

Insect Faunas, Late Zone II - III

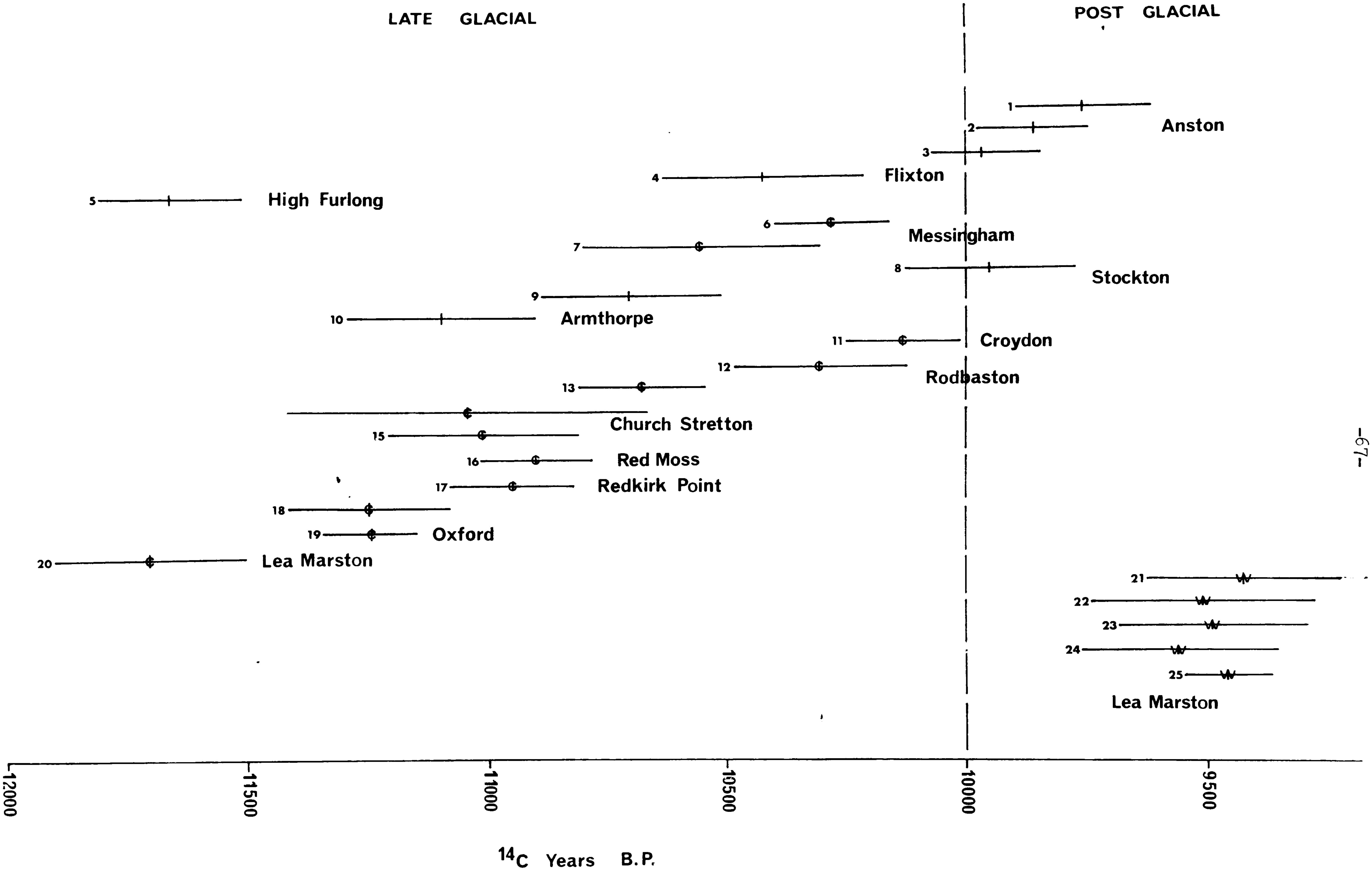
Fig. 30 (Continued)

11.	Croydon, London	10,130 ± 120 B.P.	(Birm. 101)	(Peake & Osborne, 1971)
12.	Rodbaston, Staffs.	10,300 ± 170 B.P.	(Birm. 92)	(Ashworth, 1973)
13.	" "	10,670 ± 130 B.P.	(Y-464)	" "
14.	Church Stretton, Salop.	11,048 ± 376 B.P.	(Birm. 9)	(Osborne, 1972)
15.	" " "	11,000 ± 200 B.P.	(Birm. 148)	" "
16.	Red Moss, Lancashire	10,850 ± 120 B.P.	(Birm. 128)	(Ashworth, 1972)
17.	Redkirk Point, Dumfriesshire	10,898 ± 127 B.P.	(Birm. 40)	(Peake & Osborne, 1971)
18.	" " "	11,205 ± 177 B.P.	(Birm. 41)	" " "
19.	Northmoor, Oxon.	11,250 ± 100 B.P.	(Birm. 105)	" " "
20.	Lea Marston, Warwickshire	11,700 ± 200 B.P.	(Birm. 208)	(Osborne, 1973)

Insect Faunas, Zone IV

21.	Lea Marston, Warwickshire	9,420 ± 200 B.P.	(Birm. 311)	(Osborne, 1974)
22.	" " "	9,510 ± 235 B.P.	(Birm. 215)	" "
23.	" " "	9,470 ± 200 B.P.	(Birm. 310)	" "
24.	" " "	9,550 ± 200 B.P.	(Birm. 312)	" "
25.	" " "	9,450 ± 90 B.P.	(Birm. 329)	" "

Cool to cold faunas are indicated by a 'C' over the mid-point of the date and warm faunas by a 'W'.


LATE GLACIAL
POST GLACIAL
1
2
3
Anston
4
Flixton
5
High Furlong
6
Messingham
7
8
Stockton
9
10
Armthorpe
11
Croydon
12
Rodbaston
13
Church Stretton
15
Red Moss
16
17
Redkirk Point
18
19
Oxford
20
Lea Marston
21
22
23
24
25
Lea Marston
12000
11500
11000
10500
10000
9500
^{14}C Years B.P.

Carabids is small. More recent attempts have relied increasingly on the known distribution of species, particularly in Scandinavia, where the information is readily available from the Catalogus Coleopterorum Fennoscandiae et Daniae (Hansen et al., 1960); Horion (1951) provides similar data for Central Europe. This method does not allow for species restricted to particularly warm or cold localities within a province and records have to be constantly checked against the often inadequate habitat data. The occasional appearance of southern and montane species in Late Glacial assemblages further reinforces the picture of an environment with no direct recent parallel, a point which Williams (1975) has also made from the evidence of periglacial phenomena. The problems are less severe than in the Mid-Devensian, where eastern Asiatic elements enter into the insect faunas (Coope, 1973; Angus, 1973), but one is still forced to weigh inadequate modern data to obtain a satisfactory fit and an acceptable image.

Bearing in mind this caveat, some attempt can be made to provide climatic parameters for the environmental model constructed from the Cover Sands and underlying peat bed. The distribution of the Sands and limited amount of petrographic data suggest deposition by westerly winds blowing across the Vale of York and Lower Trent valley but similar conditions need not have prevailed during the period in which the underlying peat bed accumulated and the two have to be treated separately, although both belong to the Younger Dryas phase. The whole of the small fauna from the basal peat at Flixborough may be found today in the adjoining provinces of Torne Lappmark, in northern Sweden, and Lapponia Kemensis in Finland, although not necessarily within the same altitudinal range. This area lies within the Arctic Circle but south of the region of extensive permafrost (Pewe, 1969). In these provinces, lies the northern limit to the distribution of Limnobaris pilistriata, a limit which

In part, this agrees with Pennington's (1975) twofold division of Pollen Zone III on Lake District and Scottish palynological evidence but there is no supporting insect evidence for a rapid rise in temperatures between ca.10,500 - 10,000 B.P. and faunas remain cold throughout the Cover Sands episode in north Lincolnshire. As far south as Croydon there is no hint of amelioration as late as 10,130 ± 120 B.P (Birm.101) (Peake & Osborne, 1971) and possibly hard water error may be involved in Pennington's dates on aquatic materials. When temperatures did rise it was surprisingly rapid (Osborne, 1974) and the changes within Zone III in pollen frequencies in north-west Britain may have another explanation; the protection given by increased snows and a more quiescent winter allowing expansion by Empetrum and Juniperus into formerly heavily frost disturbed habitats.

There is no reason to postulate a further climatic change to explain the transition from basal peat to Cover Sand deposition. If the growth of peat is, in itself, a factor of the termination of active permafrost, the failure of winter renewal of the active layer could result in the gradual wasting of the ice layer, particularly on the more porous formations of the Bunter Sandstone and Drift in the Vale of York. The disappearance of the ice-perched surface wet layer, a process which would take longer on the finer grained substrates, allowed the westerly winds access to the poorly consolidated sands and sandstones and these were extensively reworked. Black (1951) notes that only the presence of permafrost, perching the water table and allowing summer plant growth, stops the Arctic Coastal Plain of Alaska becoming a cold, arid desert with extensive sand blowing. Aeolian deposition is restricted to the margins of major rivers (Richert & Tedrow, 1967) where the dunes, although containing frequent organic lenses, are a poor parallel for the extensive sheet blows of the Cover Sands. The transition from peat growth to aeolian sand deposition in all exposures of the Cover Sands is fairly abrupt but some indication of the progressive breaking of the slight and scattered vegetation cover is provided by the occasional lamina of sand towards the top of the peat. As at the present day in the Vale of York (Radley & Simms, 1967), one particularly ferocious storm may be sufficient to initiate sand movement over a large area and, once started, movement would only be checked by the cessation of the winds. Embleton and King (1968) note that wind speeds in excess of 30 km./hr. are required to move sand in the size range 0.25 - 0.5 mm. and, in the Vale of York, such conditions prevailed seasonally until a rough average depth cover of 2 m. had accumulated against the Keuper, Lias and Lincolnshire Limestone escarpments. The presence of occasional organic laminae within the Sands, some of which produced sufficient faunal evidence to show the continuance of cold conditions, and the preponderance of thin beds of sand suggests a rhythmic process of sedimentation, perhaps on an annual basis, although the evidence for partial reworking by water action precludes any effective direct count of laminae being attempted. A sequence of relatively warm summers with considerable plant growth, particularly of semi-aquatic mosses, on the wet surface of the sand, followed by vigorous storms sweeping in from the west during the autumn and deep early winter snowfall would produce conditions consistent with the geomorphological evidence. Continuance of discontinuous permafrost would have ensured a wet ground surface with frequent pools and this would act as a trap for sand blowing across from the western part of the Vale of York and Lower Trent catchment. The disposition of the Sands, running up slopes of low angle and paucity of dune structures can thereby be explained, although dune structures do appear to be more frequent north of the York-Eskrigg moraines (Matthews, 1970) (fig. 29). Uniform subhorizontal laminae of sand do occur under arid conditions in the sand seas of Libya over many square kilometres between seif dunes (McKee, 1964) but the biological evidence for wet conditions and water-logging precludes a cold, arid origin, such as obtains in present polar deserts. The frequent structures associated with water deposition must relate to spring melts redistributing much of the sand from off the faces of the escarpments. Cold conditions continued throughout the phase of Cover Sands deposition and only a hint of a transition to Post-glacial conditions is provided by the grain size analysis of the highest unit providing faunal information. Although the limited fauna remains cold, westerly storms seem to have declined and a less well sorted unit of thinner, largely finer material accumulated, largely by water action, at the base of the scarp at Messingham. Gaunt's evidence (pers. comm.) from elsewhere in the Vale of York for the horns of dunes in the Cover Sands turned to suggest north-easterly winds may relate to the immediately Post-glacial or post-forest clearance redistribution, since this is the direction of the most effective winds at the present day.

Views on the climate of the Younger Dryas vary considerably. Although all accept the period as being cold, its severity and character have produced markedly discordant ideas, often from the same author. Manley (1965) favours an oceanic regime with a depression of summer temperatures of the order of 4° - 5°C. and no corresponding fall in winter temperatures, a change which lies within the range of year to year variation at the present day. His earlier paper, however, (Manley, 1959) suggests July temperatures of + 7.5°C. and January ones not higher than -7.5°C. for the Lake District. The insect evidence suggests a more severely continental regime. Coope (1975) has a minimum July average of $+9^{\circ}$C. towards the end of Zone III, although the presence of such relatively southern species as *Trechus rivularis*, *Helochares lividus* and *Aphodius obscurum* at Messingham at 10,280 $\pm$ 120 B.P. could imply that the coldest phase, with its evidence for extensive periglacial action (Williams, 1975), fell somewhat earlier within the zone. Botanical evidence also supports a strongly continental regime (Bell, 1969) but it is difficult to reconcile the evidence with that for dominant westerly winds throughout Europe from geomorphological sources (Williams, 1975). The most evident winds, however, need not be the prevailing and the seasonal nature of the intrusion of westerly gales deduced from the Cover Sands need not conflict with other evidence for a continental pattern. Certainly before the northwestward retreat of the Polar Front and dissolution of extensive pack-ice in the North Atlantic, perhaps as far south as the Irish coast, westerlies derived from this quarter would be low in moisture content both because of their low temperature and slight contact with open water, providing a 'pseudo-continental regime' with no direct modern analogue but somewhat reminiscent in seasonality of parts of the Barren Grounds of eastern Canada (Birket-Smith, 1929), although with quieter winters. The breaking up of any extensive pack-ice by the intrusion of a warm current from the southwest, itself a feature of changing atmospheric circulation patterns, would allow these still cold westerly winds to pick up more moisture, leading to increased precipitation, as snow, in Britain, without necessarily modifying the continentality of the climate significantly until the Polar Front had fallen back to its current position, a point which is relevant in relation to the presence of more continental elements in the insect faunas of much of the Post-glacial (below, p. 292). Mercer's (1969) hypothesis of a sudden increase in pack-ice in the North Atlantic, caused by the disintegration of an extensive ice shelf, to explain the purely European phenomenon of the Younger Dryas, need not conflict with this view.

Other evidence can be drawn into line with this model. Manley's (1959) Lakeland evidence for snowlines could relate to the final surge given to the enascent ice caps by the increased snowfall of this terminal phase of Zone III, rather than being representative of the whole of the Younger Dryas. The varying position of the Polar Front has been deduced from ocean core data (Ruddiman & McIntyre, 1973), although the short duration of the period creates problems in establishing its southern limit. Saltzman and Vernaker's (1975) mathematical model for climatic zonation during a glacial maximum allows for a marked increase in strength and progression of the westerlies with decreased strength in winter, a necessity if snow is to remain to insulate the ground. More intense storminess would occur along the intensified Polar Front, which, if lying across northern Britain, would account for the phase of Cover Sands deposition. At the present day, the Arctic Front in Europe shows a close concordance with the tundra-taiga boundary (Krebs & Barry, 1970) but this represents a stable regime and the two, on floral evidence, would be expected to be considerably out of phase in the Late Glacial.

Although several problems remain, a reasoned picture of the palaeoclimate of the Cover Sands has been constructed, which is not wholly at variance with evidence from elsewhere in Europe and the North Atlantic.

The Archaeology of the Cover Sands

The reconstructed palaeoenvironment of the Cover Sands and basal peat provides a detailed model in which to fit the individual who left the flint scraper (fig.31) in the peat and who perhaps warmed himself by a small fire of willow twigs in the subarctic air. It remains to add some comments on other archaeological finds from the Sands and contemporary sites elsewhere. The Cover Sands of the area north of Scunthorpe, particularly on Risby Warren, have long been known for their flint assemblages (Dudley, 1949). The majority of these finds, however, have been secondarily incorporated in the still occasionally mobile sand. Armstrong (1939) excavated two sites which he regarded as belonging to the Upper Aurignacian (Creswellian of Garrod, 1926) in north Lincolnshire, at Sheffield's Hill and Willoughton. Although the excavator (1931; 1932) thought that both sites showed evidence of disturbance by solifluction, the industries are closely matched by that from on top of the Cover Sands at Misterton Carr (below, p. 86) and clearly belong to the early Post-Glacial. The similar site at Brigham, north of the Humber in Holderness, published as Creswellian (Manby, 1966), also belongs to this group of early Maglemosian industries (Radley, 1969; below, p. 111). Besides the Messingham scraper, only one other implement has been found clearly stratified beneath the Cover Sands, a shouldered point (fig.31) from Risby Warren (Lacaille, 1946), and, in the absence of the peat bed, it cannot be assumed that this is contemporary with the Messingham piece. Elsewhere in the Vale of York and adjoining areas, Radley (1964) has recorded possible Creswellian material from open sites on the Coal Measures and Magnesian Limestone in south Yorkshire and the large angle-backed blade from Tickhill (fig.31) probably belongs with this group. Mellars (1973) recovered an assemblage from slope wash below a Magnesian Limestone

Fig. 31

Upper Palaeolithic Artifacts from North Lincolnshire and South Yorks.

1. End scraper in a fine black to dark grey flint on a blade; the left hand edge bears some trace of use. From the basal peat at Messingham; ^{14}C dates of 10,280 ± 120 and 10,550 ± 250 B.P.
2. Shouldered point, finely retouched along the left hand edge and the base, in a creamy white patinated flint. From a clay layer beneath Cover Sands on Risby Warren (after Lacaille, 1946).
3. Broad blade, obliquely blunted on the left hand side with some inverse retouch, in a rough moderate brown flint, dissimilar to that used for any of the other artifacts from the area. A surface find from Tickhill, Yorks. (N.G.R. SK592944), but its affinities seem to lie with the Upper Palaeolithic rather than the Mesolithic; c.f. some of the less well finished pieces from Mother Grundy's Parlour (Armstrong, 1939).

The remaining pieces come from Mellar's (1973) site in Edlington Wood and have yet to be published:

4. A large end scraper in a fine white patinated flint with a small amount of cortex remaining on the upper surface. The left hand edge again shows some trace of wear.
5. End scraper on a rough blade in similar flint; some wear on both long edges.
6. As 5, on a better struck blade.
7. Scraper, worked on both long edges and probably broken at the end.
8. Broken tip of an awl, finely worked down both edges.
9. Awl, finely worked down both edges and to the point.
10. Point, obliquely blunted on the right hand side and retaining smooth cortex on the remainder of this edge; a fine, white patinated flint.
11. As 9, but retaining some cortex on the upper surface.
12. Small, curved backed blade, broken towards the bulbar end.
13. Point, obliquely blunted on the left hand side.
14. Semicircular scraper in a fine, white patinated flint.
15. Oval scraper, retouched all round, in a poor, dirty white patinated flint.
16. Awl, rouched along both sides to a point. The surface retains much cortex and the left hand edge has some trace of use.
17. Awl, retouched along the whole of both long edges and to the point.
18. End scraper, with retouch or wear along the whole of both long edges.
19. Broken point or awl, retouched to a point from both edges.
20. Small fragment of a point or awl, backed along both edges.

Fig. 31 (Continued)

Upper Palaeolithic Artifacts from North Lincolnshire and South Yorks.

21. End of narrow blade, retouched obliquely across and with wear down the right hand edge.

22. Broken end of blade with slight working across the end.

23. Point, tip missing, obliquely backed from the left.

24. Awl, point broken, blunted along both edges.

25. Small scraper, retouched along both edges and the end. A rather similar piece occurs among the Mesolithic material from Misterton Carr (below, fig. 39).

26. Awl, steeply backed along the left hand edge and retouched along the opposite.

27. Point of awl, in a white patinated but burnt flint.

28. Broken point, obliquely blunted from the left.

29. Small, curved backed blade, broken, in a fine white patinated flint.

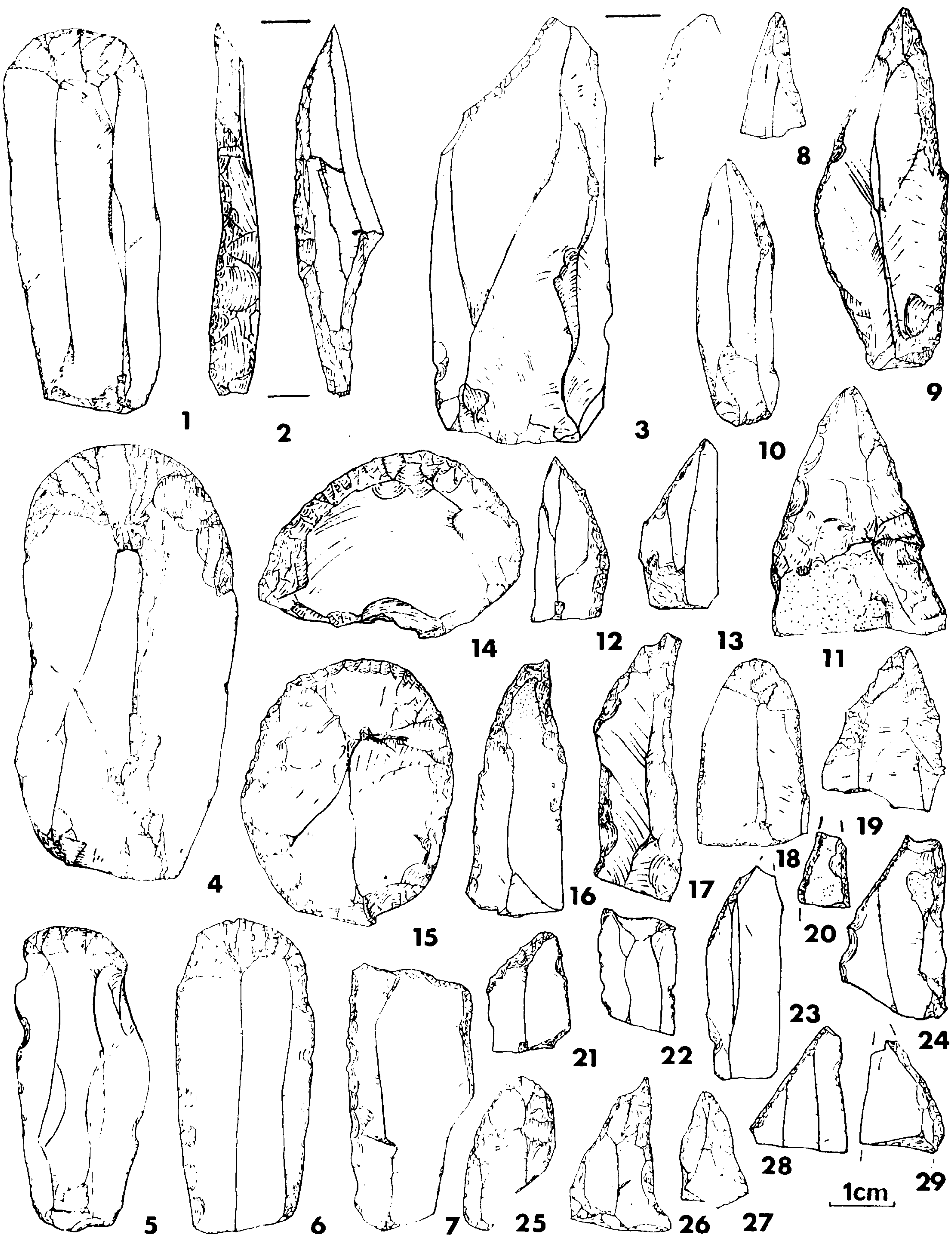


Figure 31. Upper Palaeolithic Artifacts from North Lincolnshire and South Yorkshire.

outcrop in Edlington Wood and a selection of the more typical pieces is illustrated here (fig.31). In the absence of floral or faunal material, none of these sites can be dated. In the same region, the Anston Cave produced a small flint assemblage, associated with a few bones of reindeer, which provided material for three ^{14}C dates (Mellars, 1969). All, on collagen fraction, fall within the Pre-Boreal (BM.439, 440(a) & (b)), which is most improbable on the faunal evidence, although the standard deviations of two of the dates extend back into the Younger Dryas period (fig.30). The eponymous site of Creswell has also produced two relevant dates, of 10,390 $\pm$ 90 B.P. (BM.603) and 10,590 $\pm$ 90 B.P. (BM.604), from Robin Hood's Cave, overlapping with the Messingham dates. Campbell (1971; in Mellars, 1974) has obtained Late Glacial pollen spectra from deposits overlying the archaeological horizons at both localities. Whilst there is no reason why the environmental model created for north Lincolnshire during the latter part of Pollen Zone III should not also be applied to the Anston material, Creswell itself presents serious difficulties. Armstrong (1939; 1956) never published any of his sites in full and, although Kitching (1963) succeeded in reassessing the stratigraphy of the Pin Hole Cave, the records from all the Creswell sites are inadequate to provide data directly relevant to the Late Glacial. Both McBurney (unpubl.) and Campbell (1970; 1971) attempted to solve some of the problems by further excavation. Whilst typologically Creswellian pieces were recovered from Robin Hood's Cave by Campbell (op. cit.), the associated vertebrate faunas include elements not satisfactorily attested in the Late Glacial. It is most unlikely that the hyena (Crocuta crocuta Erx.) and woolly rhinoceras (Coelodonta antiquitatis Blum.) survived the maximum extension of the Devensian icesheet in Britain. Although Alimen (1967) notes a record of the latter from the Jura of the order of 14,600 B.P., Degerbøl (1964) includes no Late Glacial records of either species in Northern Europe.

Both are represented in all Campbell's horizons but only by teeth (Campbell, 1971). Other records from cave deposits of this period are also based upon teeth (op. cit., tables 41-48) and, although post-cranial material may lie amongst the unidentified fragments, it is more probable that the teeth, durable recognisable items, are either derived or manuports. Although one cannot espouse Kitching's (1963) osteodontokeratic cause, his very high count of rhinoceras molars from the earlier Upper Palaeolithic levels in the Pin Hole Cave at Creswell may suggest their deliberate collection for utilisation. Their presence in later levels may be a result of similar collection from earlier screes as possible raw materials or simply curios, as Campbell (op. cit.) himself suggests for some of the other records of hyena teeth. The remainder of the fauna from Robin Hood's Cave includes such diverse ecotypes as red deer (Cervus elaphas L.), giant deer (Megaloceras giganteus Blum.) and reindeer (Rangifer tarandus L.) in the same layer and this also implies mixing. The whole assemblage, fauna, artifacts and radiocarbon dates, has to be regarded with considerable mistrust. In the nearby Mother Grundy's Parlour, only the presence of three incisors of giant deer in the lowest layer (op. cit.) extinct in Britain by the end of the Allerød (Coope, 1973), suggests a Late Glacial assemblage and the ^{14}C dates - 8800 ± 300 B.P. (Q.551), 7602 ± 140 (Q.552), 6915 ± 140 B.P. (Q.553) and 6705 ± 140 B.P. (Q.554) - all relate to the Mesolithic.

Vertebrate remains associated with some artifacts have been recovered from several other cave sites on the Magnesian Limestone and Carboniferous Limestone of Derbyshire but none is securely dated. Armstrong claimed a Late Palaeolithic group, with hyena and reindeer, from the Whaley rock shelter but Radley (1967) was more sceptical and Armstrong's (1956) Ash Tree Cave faunas show similar confusion to his Creswell groups. Bramwell (1962) has obtained material from several

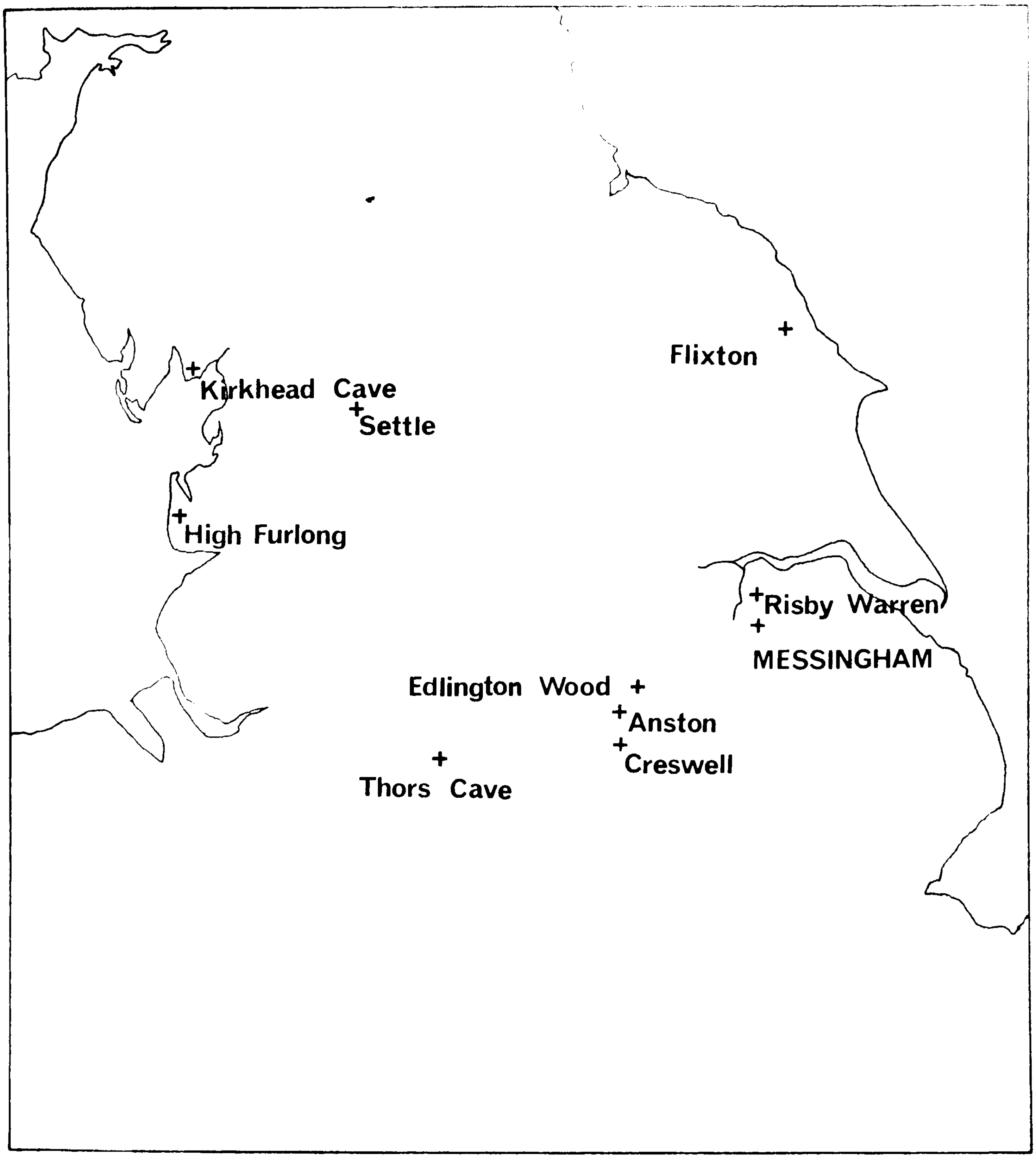


Figure 32. Late Upper Palaeolithic Sites in the North of England. (The material from the Settle region is of doubtful affinities).

cave sites in the Peak and reindeer bones associated with flintwork are known from One Ash Shelter, Lathkilldale (op. cit.) and Harborough Cave, Brassington (Armstrong, 1923).[1] Similar minor collections have been recovered from the Victoria Cave, Settle (Jackson, 1945),[2] and Kinsey Cave, Giggleswick (Jackson & Mattinson, 1932),[2] both in the North Pennines, and the Kirkhead Cave, on the north side of Morecambe Bay (Wood et al., 1970). Open sites, however, are less frequent, although Clark predicted their discovery as long ago as 1938, when he published three flints of Creswellian character from Oare in Kent. The only date from an open site, other than Messingham, comes from Flixton Carr in the Vale of Pickering, where two flints associated with horse bones were assigned to Pollen Zone II of the Late Glacial (Moore, 1954); a ^{14}C sample from immediately over this horizon provided a date of 10,413 $\pm$ 210 B.P. (Q.66). The elk (Alces alces L.) from High Furlong in north Lancashire had two uniserially barbed points lodged in it (Hallam et al., 1973) and has ^{14}C dates of 11,665 $\pm$ 140 B.P. (St.3836) and 12,200 $\pm$ 160 B.P. (St.3832). Although palynological work was carried out (op. cit.), little attempt was made to construct a detailed environmental model and the source of many of the injuries on the skeleton has recently been brought into doubt (Noe-Nygaard, 1975). In southern England, several roughly contemporary cave sites have been examined (Garrod, 1926; Campbell, 1971) but open air sites remain in the minority and several are doubtful, despite large artifactual assemblages (Mace, 1959; Wymer, 1971; Campbell, 1971; Mellars, 1974); none has produced independent dating evidence. Brigham (op. cit.), High Furlong (op. cit.), Hengistbury (Mace, 1959; Campbell, 1971), and Sproughton, Suffolk (Wymer et al., 1975) illustrate the problems and possible reasons for confusion with later Mesolithic elements and extreme caution must be exercised in the interpretation of small groups of artifacts.

1. see Manby (1966); Armstrong (1923) is less certain.
2. both groups are probably Mesolithic (Campbell, 1971).

The evidence from the insect faunas shows that the warmest part of the Late Glacial fell during the first part of Pollen Zone I, followed by a progressive decline into the subarctic cold of Zone III (Coope, 1975), and it is therefore not surprising that there is at least a little evidence to extend the Creswellian back into the Oldest Dryas period. Two dates from Kent's Cavern, Devon, - 14,273 ± 120 B.P. (GrN.6203) and 12,180 ± 100 B.P. (GrN.6204) (Campbell & Sampson, 1971) lie early in the Late Glacial sequence and a less securely associated determination from Sun Hole, Cheddar, provides a date of 12,378 ± 150 B.P. (BM.524) (Campbell et al., 1970). There is insufficient data to subdivide, or perhaps even define, the industries of the British Late Glacial or to relate them directly to the apparently related groupings of the Low Countries and north Germany and the succession of changing vertebrate faunas in in relation to the archaeology is still far from clear. As Bohmers (1956), Paddayya (1972) and others have noted, the Creswellian assemblages show close affinities with contemporary flint industries in the Low Countries, particularly the Federmesser (Tjongerian) group, and the same cultural group, in the ethnological sense, if not the same people, may be represented on both sides of the North Sea Basin, largely dry during the latter half of the Devensian (West, 1968). In a general sense, therefore, it is possible to utilise some of the Continental data to provide some of the detail lacking from British sites. The major vertebrate associations with the varying flint assemblages are summarised by Hijszeler (1957). The retreat of the ice-front from the North German Plain left a region which was colonised by a group, the Hamburgian, who specialised in hunting the reindeer. It is possible that this association is a relatively transient phase since the British insect evidence (Coope & Brophy, 1972; Osborne, 1972), which Coope (pers. comm.) has recently extended to the Dutch type section of Usselo, shows a rapid warming to summer temperatures beyond those tolerated by reindeer, although the strongly continental regime indicated would allow the region to serve as winter feeding grounds, as Sturdy's (1975) study of the antlers from Stellmoor and other sites would suggest. In the succeeding Bromme group, elk predominate over reindeer (Hijszeler, 1957) and this, with at least part of the Federmesser, correlates with the deteriorating climate of the Allerød the immigration and destruction of a boreal forest environment. The Ahrensburgian marks a return to a reindeer based economy and a sub-arctic tundra during the Younger Dryas period, that of the Messingham date. Other sites in North Germany show a preference for horse (Equus przewalskii Pol.), an animal which shows a remarkably wide ecological tolerance, from steppe and tundra to light forest, and which appears throughout the Late Glacial (Degerbøl, 1964); there is some suggestion, as the Flixton kill-site (Moore, 1954), of similar associations in the British Late Palaeolithic.

Sturdy (1975) has presented an exhaustive study of the reindeer remains from several of the larger German sites of the Late Glacial and some work has also been carried out in France by Bouchud (1954). It is tempting to transfer the more recent of these models to the Younger Dryas period in eastern England but there are insufficient data to provide parameters for the model. Mobility would be essential to any human group during this period, just as it is to surviving hunter-fisher groups in the Far North (Birket-Smith, 1929; Balikci, 1968; Gubser, 1965), and it is doubtful whether late autumn and winter occupation was at all feasible during the phase of Cover Sand deposition. Snow, in excess of 60 cm. deep, forms a major obstacle to reindeer in their quest for food (Loughrey & Kelsall, 1970) and the herds are forced to seek the edge of the taiga, where trees moderate the effects of the snow and break up the cover.

Although not all reindeer need leave the tundra, the few caribou remaining on the Barren Grounds of north-east Canada during the winter at the present day relying on the wind to clear them feeding areas (Birket-Smith, 1929), the majority trek southwards, taking their predators with them. A few extant groups of hunter-fishers remain in the north throughout winter by exploiting other resources, principally maritime (op. cit.; McGhee, 1972), but such alternative food sources would be distant from the north Midland sites of the Creswellian and a southward, or south-eastward withdrawal to regions of lesser snowfall and the protection of the taiga must be envisaged. Where the edge of the continuous forest lay during Zone III is difficult to ascertain and, although some birch woodland may have remained in east Lincolnshire and East Anglia (Suggate & West, 1959; Godwin, 1975), the true forest probably lay far to the south. The London site of Croydon failed to produce any trace of trees at 10,130 ± 120 B.P. (Birm.101) (Peake & Osborne, 1971) and movement of any hunting population of the order of at least 300 km. between winter and summer hunting territories may be postulated. A graphic description of the rigours of such a journey is provided by Hearne (1769-72) in his account of a walk with the Chipewyan Indians from Hudson's Bay to the mouth of the Copper Mine River on the Arctic Ocean and back. With such a degree of transhumance and a small human population, it is not surprising that few archaeological sites of the Younger Dryas period have been located. Although this evidence does not wholly agree with that from the Ahrensburgian of Stellmoor (Sturdy, 1975), it has to be stressed that absolute contemporaneity cannot be assumed and that the geographical separation is also considerable (over 600 km.).

The north Lincolnshire evidence has considerable significance, both for the Late Devensian and for its associated archaeological cultures. Its relevance to the Creswellian, however, is restricted to a solitary episode. Many more close associations between detailed environmental evidence and artifacts will be necessary before a reasoned picture can be constructed for the changing patterns of exploitation by Upper Palaeolithic hunters in Britain. Several sites for further study suggest themselves: Flixton (Moore, 1954), the laminated clays in Armstrong's Whaley excavation (Radley, 1967) and the peat bog adjoining Campbell's (1971) Hengistbury site. It is hoped that work on at least one of these can be initiated in the near future.

"Just a few dry leaves lightly powdered to chaff in the hand! Think of it! Just a few dry leaves, then a few dry twigs, then a small dry bit of wood, and so on. You must blow it up and build it up from an absolutely tiny beginning that hardly looks like a fire at all."

I saw the idea. "Well done," I nodded.

"Wherever we go now," Father said happily,"we can have a fire at will. You just take this new red stone with you - a mere flake will do - and a flint, and start it up when you want it. The possibilities are stupendous."

"The fire you made is getting pretty big, too," I said.

"Oh, we only made quite a small one," said Father. "It will go out in a minute. It doesn't matter, because we can start another when we like. Let's show them, Wilbur. It's nice and dry here."

"Before you start another," I said, "we'd better make sure that one goes out, hadn't we?"

But it was suddenly clear that the fire was not going out. On the contrary, even while Father had been speaking, it had grown tremendously. Smoke was now billowing upwards in great clouds and began to reach us. The children started coughing. A tremendous roar rolled up from the plain.

"I expect it will go down in a moment," said Father uneasily. "We only left a couple of logs on to keep it going while we fetched you."

"A couple of logs," Oswald said. "Look at that!"

Half-way up the slope of the hill a thornbush suddenly burst into flames. Then the wind freshened, and sparks began to fly over our heads.

"That's awkward," said Father, biting his lips.

A tuft of dry grass suddenly flickered into flame under his feet.

Roy Lewis
"The Evolution Man"

MESOLITHIC AND LATER MATERIAL FROM MISTERTON CARR, NOTTS.

The detailed environmental picture which it has been possible to construct for the terminal Upper Palaeolithic in the area, despite the comparative dearth of artifacts, stands in stark contrast to the succeeding Mesolithic and Neolithic, from which artifacts are relatively frequent and the environmental data minimal. In an attempt to balance this situation, several sites were examined on Hatfield Chase and the adjoining areas with a view to locating sites of these periods inter-stratified with waterlogged deposits, to prepare a study after the fashion of Clark and others (1954) work at Star Carr, working primarily from the insect rather than the plant record.

In 1966 Mr. Macfall, the farmer at Misterton Carr Farm, had brought into Doncaster Museum a small group of flint artifacts. Mr. M. J. Dolby, the Museum Keeper of Antiquities, recognised amongst them a number of probable Mesolithic pieces and arranged for the area where the finds were made to be searched annually after ploughing for further surface finds; in this he was ably assisted by the farmer and his family. The resulting collection of over six thousand pieces is here described. From the yearly visits to the site, it was evident that deep ploughing was rapidly destroying any archaeological features which might exist. Accordingly, trial excavations, principally to recover peat samples, perhaps with the stone industries interstratified, were carried out during autumn, 1971, by the author in conjunction with the Museum.

The Geographical Setting

Misterton Carr (Fig. 33) lies towards the southern edge of an expanse of fen and carrland, in part covered by blanket bog, known

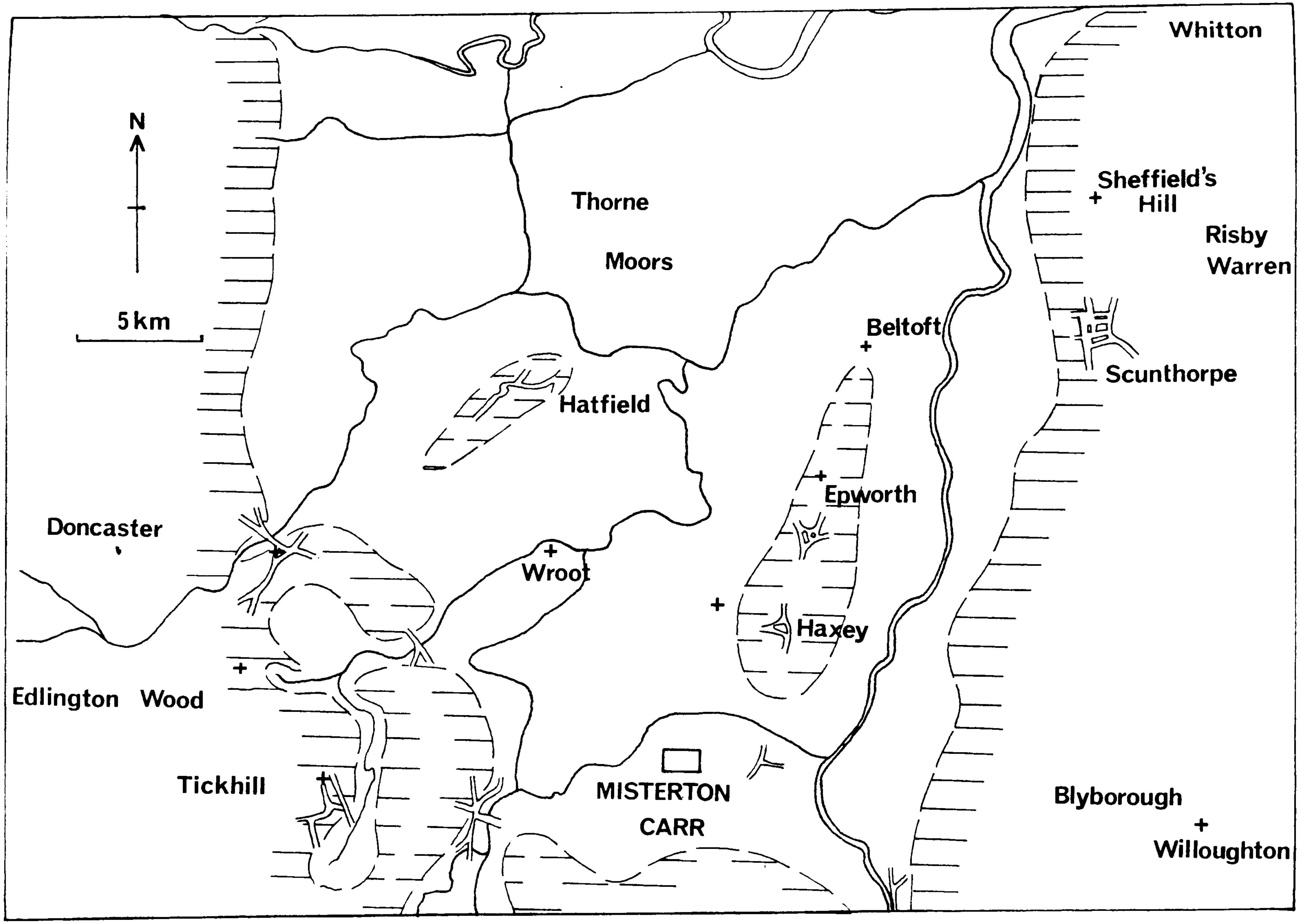


Figure 33. Hatfield Chase and adjacent areas: Mesolithic Sites.

as Hatfield Chase. To the south, this is bounded by the Keuper Marl ridge of Gringley, Drakeholes and Scaftworth. The Bunter Sandstone forms the western margin, north from Bawtry, through Doncaster to Askern and beyond; to the north, the Chase grades imperceptibly into the Vale of York. The River Trent, contained on the east by the Jurassic escarpment, forms an eastward limit, although in part separated from the main body of the Chase by the higher ground of the Isle of Axholme.

Into this area, floored at depth by the Keuper Marl, overlain by a variable succession of Devensian sands, gravels and lacustrine deposits, and lying largely below the 10 ft. O.D. contour, flow the rivers Idle, Torne, Don, Went and Aire, which, before the drainage in the seventeenth century, weaved common and frequently changing courses north-eastwards to the Lower Trent and Ouse, across a subdued, if somewhat irregular, topography of Late Glacial manufacture. Until Vermuyden's works drastically altered the landscape, much of the area was a morass of fen and acid blanket bog. Although the fen environment is now dispersed and restricted to the drainage channels, the raised bog survives precariously in the rapidly shrinking areas of Thorne (below p.157& Skidmore, 1970), Hatfield and Lindholme Moors.

The Chase was set aside as a Royal deer forest throughout the Middle Ages and settlement was mainly restricted to the sandy ridges, as that upon which Hatfield, Stainforth and Thorne stand, and to the higher ground of the Isle of Axholme, where the market towns of Epworth and Haxey lie. During the Roman period there was considerable settlement both on and around the Chase and, as well as finds from Gringley (Oswald, 1938), Everton, Bawtry, Misson, Finningley and Sandtoft extensive systems of small rectangular fields with enclosures have been traced along the sandy ridge from Armthorpe eastwards through Edenthorpe, Hatfield and Tudworth. Examining the area from the air, it would appear that much of the land suitable for farming had been cleared by the Roman period (below p.303). The not inconsiderable pottery industries of Rossington, Branton and Blaxton utilised the River Torne to distribute their wares. Some of these settlements, to which must be added those on the Levels at Sandtoft and enclosures at Epworth and Misterton, may have had Iron Age antecedents, as those further west on the Magnesian Limestone at Scratta Wood and Edlington (Dolby, 1973), but the generally aceramic nature of the local Iron Age, in contrast with Lincolnshire east of the Trent, makes any conclusions uncertain without further excavation. The extensive clearance suggested on pollen evidence from Hatfield Moor (Smith, 1958) and Thorne Waste (Turner, 1965) during the Iron Age must be viewed in this light (below p.303). Earlier prehistoric material seems to reflect a somewhat different picture (Fig.33) with more finds in the lower lying areas of the Levels and some evidence, as that recovered from Misterton, that much precedes the main period of growth of the blanket bogs, although the picture is somewhat biased by the large concentration of polished axeheads from the Isle of Axholme.

Hatfield Chase, noted into the eighteenth century for its fish and wildfowl, supplemented by larger game, red deer, until three hundred years ago, represented an environment particularly favourable to a hunter-fisher economy and it is not surprising therefore that a number of Mesolithic sites are known.

<u>Misterton Carr</u>

The scatters of flint artifacts found in the ploughsoil by

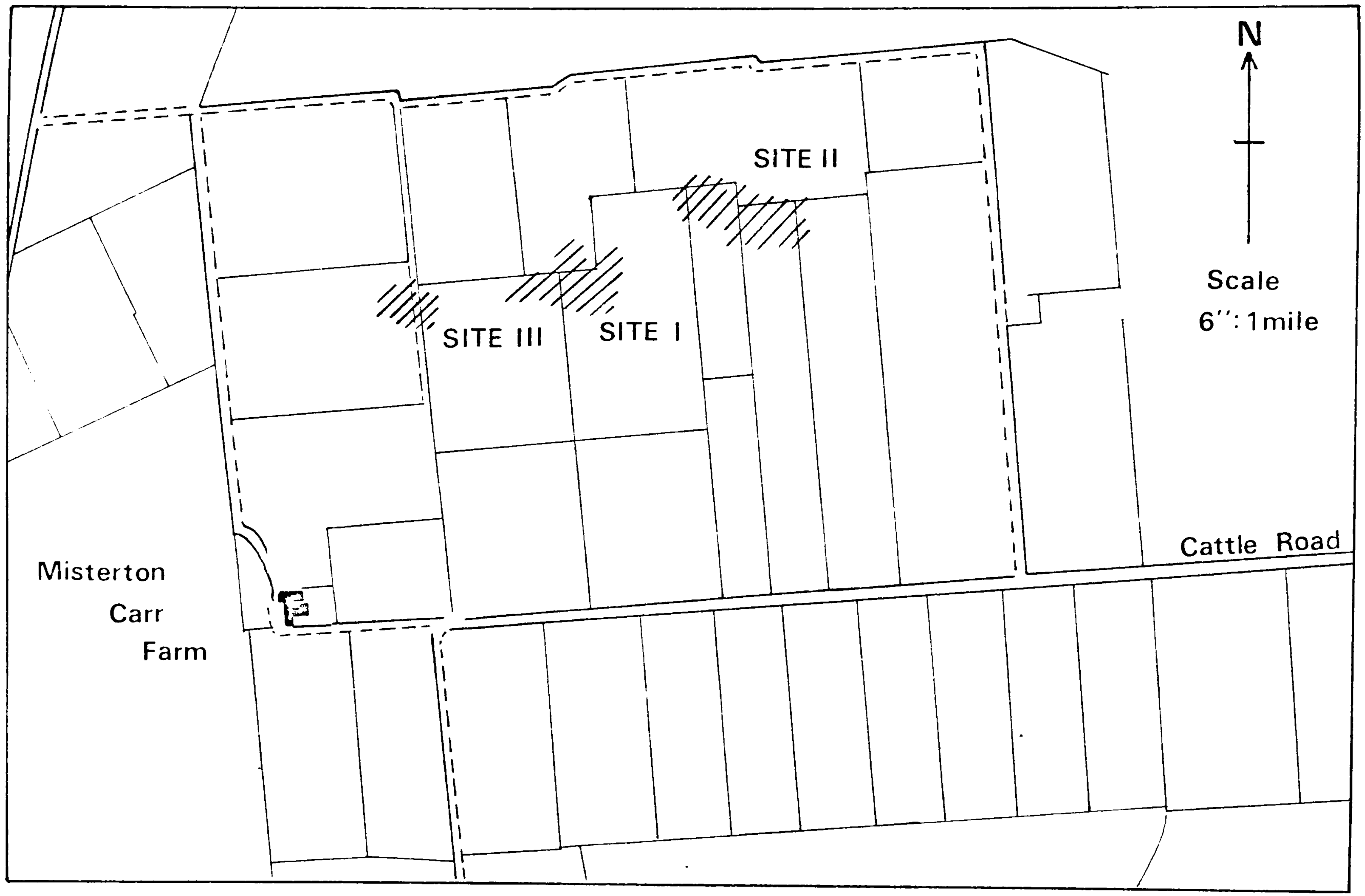


Figure 34. Misterton Carr : Areas of concentration of artifacts.

Macfall and Dolby, north-east of Misterton Carr Farm, lie along a slight east-west ridge of orange sand of Late Glacial origin. This feature is being gradually further exposed by contraction of the peat due to improved drainage. There are three main concentrations of finds, Sites I - III, (Fig. 34) although there tends to be a general slight scatter of material wherever deep ploughing has disturbed the base of the peat, which thins to less than 0.35m. thick over part of the bank (Fig. 36). Since all of the sites produced an admixture of Mesolithic and later flint material, it was decided to cut trial trenches on the most prolific site, Site I (Fig. 35). An area 20m. by 25m. was opened up on the highest part of the sand ridge and a trench 2m. by 25m. cut southwards from this to the base of the ploughsoil with a mechanical excavator. Careful cleaning off of the area failed to define any features other than modern plough marks, and only at the extreme southern end of the trench were a few undiagnostic flakes found stratified in the top of the sand underlying the peat. It is significant, however, that, of the pieces picked up on the field surface, many, particularly those of Mesolithic affinities, had this yellowish-orange sand adhering to them whilst some of the specifically later stone implements had a surface residue consistent with an origin in the peat. Artifacts showing every variation in patina were recovered from the sand and this provides little clue as to the period to which any piece might belong, although it must be noted that deep white patination is absent from all typologically late tools.

Although surface indications were that the density of finds decreased northwards over the ridge, the ditch section to the west and the general topography implied that the peat succession thickened rapidly in this direction into a former mere. A trench was therefore cut, 2m. wide by 20m. long, northwards from the ridge into the peat, in

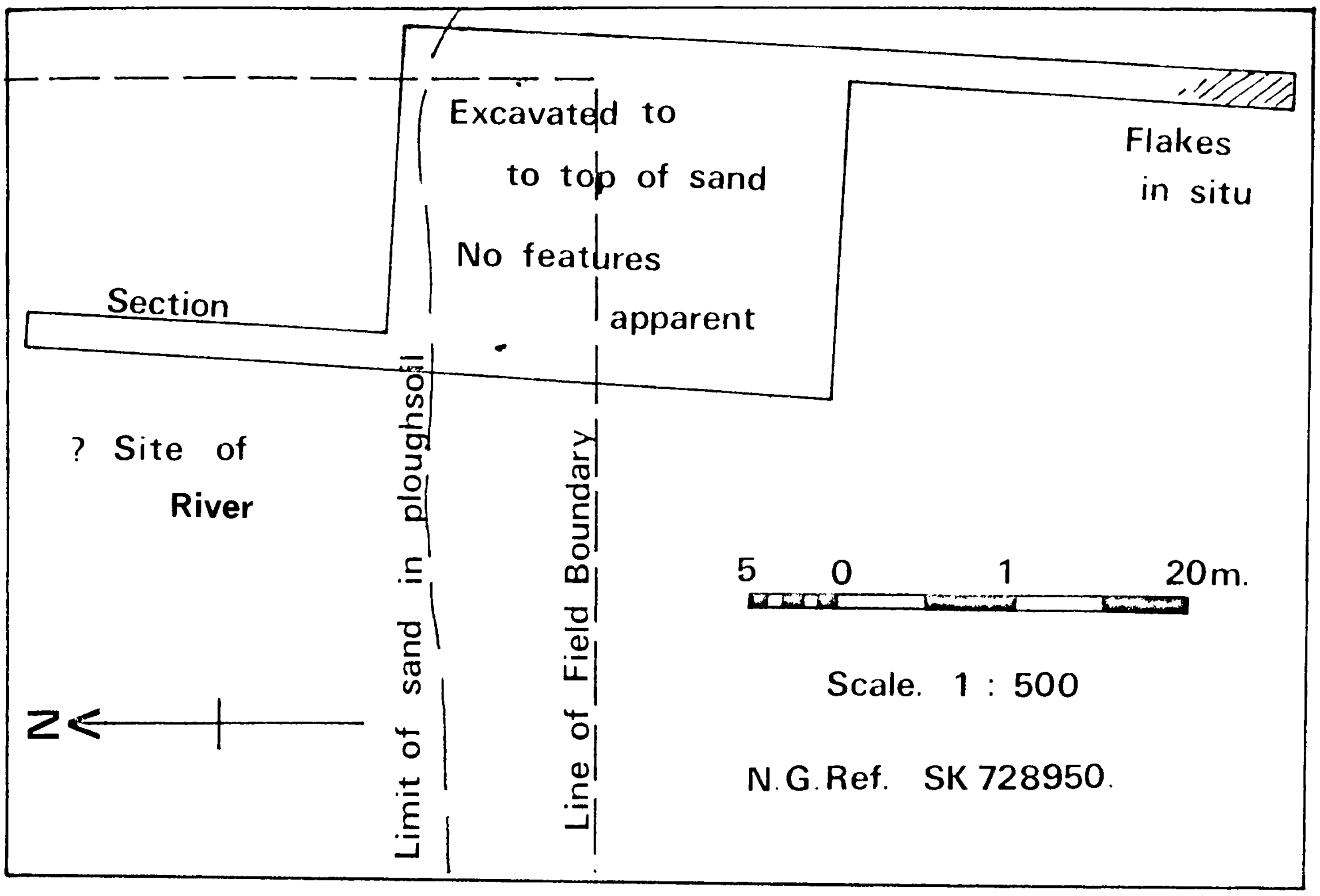


Figure 35. Misterton Carr : site plan (1971).

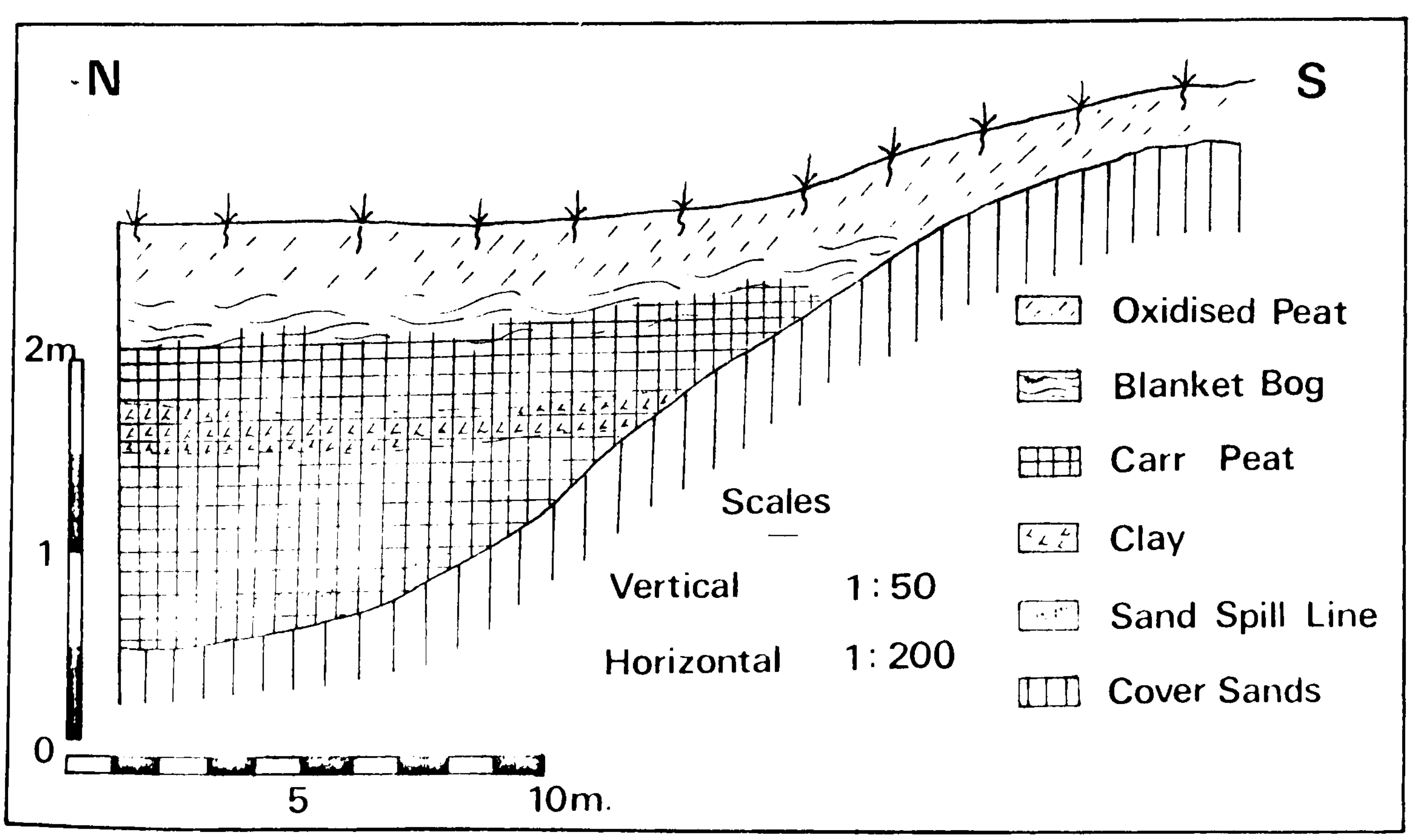


Figure 36. Misterton Carr : section (1971).

the hope of finding implements stratified in the succession. The high water table and unstable nature of the ground, despite shoring, made work difficult and it proved only possible to define the base of the peat and not to examine the underlying deposits, which, by their thixotropic character, made excavation dangerous; work had to be abandoned after sampling, before more detailed study could be attempted. No flints were found stratified in the peat. The peat succession (Fig.36), 2.2m. thick, however, did reveal a sandy horizon, 0.15m. from the base, which is interpreted as the result of localised clearance by the late Neolithic/Early Bronze Age population; a ^{14}C date of 2380 B.C. $\pm$ 100 (Birm.337) was obtained on the base of the peat.

At least 1.5m. of yellowish-orange sand, grading to a light grey colour, where reduced by the ground water percolating through the thicker peat deposits, underlies the peat and this was examined by augering and a 0.5m. deep trench on the crest of the ridge. Some more silty horizons occurred and these showed considerable disturbance, probably a result of cryoturbation. This deposit forms part of the Cover Sands, a Late Glacial aeolian formation which banks up against the Isle of Axholme and the Lincoln Edge and occurs in localities further north in the Vale of York (above, p. 7). Although the major part of the redistribution of these sands seems to have occurred late in pollen zone III, on the Chase as in North Lincolnshire some movement continued until relatively recent times, (De la Pryme, 1701 & above p. 7), in some areas accentuated by agricultural activities. As a result, although an apparently Zone III peat occurs within the sands at Epworth Turbary and the Misterton and Risby Warren industries appear in the top of the Sands, it is of little use as a stratigraphic indicator in an archaeological sense.

The Stone Industries

A total of 6,289 flint and chert artifacts have been recovered from the Misterton Carr sites, together with fragments of 5 stone axes, and this constitutes the largest assemblage so far recorded from Hatfield Chase. As a group of surface assemblages - the largest, from Site I, consisting of 2,798 pieces - its value is somewhat limited since tools of typically Neolithic and Bronze Age forms are mixed with Mesolithic material. Some differentiation into groups can, however, be obtained; none of the late material is deeply patinated and, although Mesolithic pieces occasionally occur unpatinated, the majority is in a rather poor grey-white flint with cherty inclusions, of both tabular and nodular origin. This flint shows a gradational sequence into patinated and lightly patinated pieces of better quality flint and any attempt at further subdivision than into 'lightly patinated and grey-white flint' and 'patinated and grey-white flint' would be both subjective and misleading, although it should be noted that both Radley (1964) and Mellars (1973) feel confident enough to do this. The use of a poor grey-white flint, probably of North Lincolnshire or East Yorkshire origin, has been noted by Radley and Mellars (1964 & op. cit.) in the Pennine 'broad blade' industries and in stray finds of Mesolithic affinity from Hatfield Chase and adjacent areas in Doncaster Museum. The so-called Creswellian site at Brigham, near Driffield, East Yorkshire, showed this same preference (Manby, 1966). The few pieces of black, Carboniferous chert allow the map prepared by Radley (1968), showing its distribution, to be extended considerably eastwards.

Of the artifacts, 6.29% can be classified as tools and a further 4.75% are utilised flakes, although the actual percentage of

Table 5

Artifacts from Misterton Carr

ARTIFACT	Site I U.	Site I L.	Site I P.	Site II U.	Site II L.	Site II P.	Site III U.	Site III L.	Site III P.	Unlocalised U.	Unlocalised L.	Unlocalised P.	Total
Primary flakes	305	741	706	23	24	33	28	80	84	200	725	786	3,735
		1 of chert			1 of chert						1 of chert		3
'Blades'	80	161	147	-	3	-	2	7	6	29	83	148	666
Angular waste		(57)			(3)			(6)			(136)		202
Unworked flint		(7)			-			-			(32)		39
Cores: single platform	13	27	20	-	3	2	4	8	4	32	53	60	226
two platforms	7	6	10	-	-	2	2	2	-	10	19	16	74
bipolar	1	11	9	-	-	-	-	2	1	4	24	26	78
three platforms	-	4	1	-	-	-	-	-	1	1	4	3	14
'discoidal'	3	2	-	-	-	-	-	-	-	6	7	7	25
irregular	3	7	3	1	-	-	-	-	-	11	13	12	50
Core rejuvenation flakes:													
platform edge	2	16	17	-	1	1	3	1	3	4	20	31	99
edge triangular	-	5	8	-	-	2	1	-	-	-	13	16	45

Table 5 (page 2)

	Site I			Site II			Site III			Unlocalised			Total
	U.	L.	P.	U.	L.	P.	U.	L.	P.	U.	L.	P.	
Core rejuvenation flakes:													
platform removal	3	6	-	-	1	1	-	-	1	1	5	8	26
apex of core	-	1	3	-	-	1	-	-	-	4	16	12	37
Burnt flint		(129)			(5)			-			(110)		244
Hammerstones		(8)			(1)			-			(13)		22
Microburins	-	-	1	-	-	-	-	-	-	-	3	1	5
TOTALS OF WASTE	417	987	925	24	32	42	40	100	100	302	985	1126	5,590
		(+1 of chert)			(+1 of chert)						(+1 of chert)		
TOOLS:													
Retouched flakes	23	33	37	-	7	7	10	8	8	51	51	63	298
		1 of chert											1
Flakes with abraded ends	-	-	-	-	-	1	-	-	-	1	-	1	3
Microliths	-	44	4	-	1	4	-	-	-	2	5	12	72
Scrapers: end	7	7	10	1	4	-	-	2	-	12	11	14	68
both ends	1	-	-	-	-	-	-	-	-	-	1	2	4
end & one edge	5	6	3	-	-	-	-	-	1	6	10	6	37

Table 5 (page 3)

		Site I			Site II			Site III			Unlocalised			Total
		U.	L.	P.	U.	L.	P.	U.	L.	P.	U.	L.	P.	
Scrapers:	end & both edges	5	5	4	-	1	1	-	-	-	5	6	4	31
	edge	1	4	6	-	-	-	-	-	-	6	2	7	26
	both edges	1	1	4	-	-	-	-	-	-	-	1	1	8
	concave	-	2	1	-	-	-	-	-	-	1	-	-	4
	'beaked'	-	-	1	-	-	-	-	-	-	1	-	3	4
	irregular	6	8	2	1	-	-	2	-	-	4	2	4	29
	core	2	1	3	-	-	-	1	-	-	3	7	-	17
Burins		2	2	1	-	-	-	1	-	-	8	9	9	32
Scraper-burins		1	1	2	-	-	-	-	-	-	3	2	-	9
Truncated blades		1	1	1	-	-	-	-	-	-	1	-	-	4
Awls		-	-	2	1	-	-	-	-	-	-	1	3	7
Saws		1	1	-	-	-	1	1	1	-	2	4	3	14
Tranchet axes		-	-	4	-	-	-	-	-	-	-	-	-	4
Axe sharpening flakes		-	-	-	-	-	-	-	-	-	-	1	-	1
Polished discoidal knives		1	1	-	-	-	-	-	-	-	-	-	-	2
Plano-convex knives		-	-	-	-	-	-	-	-	-	1	-	-	1

Table 5 (page 4)

	Site I			Site II			Site III			Unlocalised			Total
	U.	L.	P.	U.	L.	P.	U.	L.	P.	U.	L.	P.	
Unifacially worked points	-	-	-	-	-	-	-	-	-	2	-	-	2
Bifacially worked points	-	-	-	-	-	-	-	-	-	-	1	-	1
Leaf shaped arrowheads	-	-	-	-	-	-	-	-	-	1	2	-	3
Barbed & tanged arrowheads	-	1	-	-	-	-	-	-	-	-	-	-	1
Petit tranchet derivative	-	-	-	-	-	-	-	-	-	1	1	-	2
Flakes from flint axes	1	1	-	-	-	-	-	-	-	-	-	-	2
'Fabricator'	-	-	-	-	-	-	-	-	-	-	-	1	1
? pestles	-	-	-	-	-	-	-	-	-	-	(2)	-	2
Polished stone axes	-	(4)	-	-	-	-	-	-	-	-	-	-	4
Chipped quartz pebbles	-	-	-	-	-	-	-	-	-	-	(2)	-	2
Block of (?) ganister	-	-	-	-	-	-	-	-	-	-	(1)	-	1
TOTALS - flint	475	1106	1010	27	45	56	55	111	109	413	1102	1259	
	(+2 of chert)			(+1 of chert)						(+1 of chert			

TOTAL NUMBER OF PIECES 6,287

U = Unpatinated
L = Lightly patinated and grey-white flint
P = Patinated and some grey-white flint

retouched pieces may be much higher since dubious examples have been discounted, particularly since modern plough damage is evident on several flakes and tools. Employing the criteria of patination and grey-white flint ('p' in table 5), taken together with tool types, an absolute minimum of 2,329 pieces in this assemblage are of Mesolithic origin and it is probable that much more than 75% is actually of this age.

Cores:

A total of 467 cores has been found at Misterton; of these, 127 come from Site I, 8 from Site II, 24 from Site III and the remaining 328 were found and not ascribed to locality by the farmer. The average weight of cores is 28.1g., excluding two exceptionally large samples, one weighing 127.6g. (Fig.38, no.14), and the other 418.9g. A total of 78 bipolar cores occur (Fig.37, nos. 7 & 9) and it is relevant that only five occur in an unpatinated condition. The most frequent forms, however, are cores with partial single platforms (Fig.37, nos. 1-3) and cores with two platforms at varying angles, often incompletely developed (nos. 6, 10-12). The unpatinated examples show a tendency towards less regularity in form and are often rather discoid. Apart from slight edge trimming preparatory to striking further flakes, there is little retouch upon cores (nos. 11, 110-2), and the main site produced only three scrapers on cores and one core-burin; there is a further scraper edge removed as a core rejuvenation flake.

Core Rejuvenation Flakes:

A total of 207 rejuvenation flakes were recovered from Misterton, of which 61 were surface finds on Site I and 130 were in the general material recovered by the farmer, mostly from the same site. Flakes struck transverse to the platform edge predominate (nos. 16, 18

& 105) and the majority are in the grey or patinated flint characteristic of the Mesolithic assemblages; only one of the triangular 'keeled' flakes are unpatinated and only nine of the less regular edge flakes are. Flakes removing the apex of the core are relatively infrequent (no. 15) as are platform removal flakes (no. 19). A few show some edge wear or utilisation (nos. 15 & 18) and one (no. 105) has been retouched into a concave scraper. The flake to core ratio is fairly high, approximately 1:23 on Site I, the most extensively scrutinised site, although in the unlocalised material recovered by the farmer this ratio falls to 1: 13, a perceptability factor rather than an artifactual one.

Primary Flakes and 'Blades':

There are few pieces which can be regarded strictly as blades but near parallel sided flakes in excess of 3cm. long have been placed in a blade-like flake catergory; smaller more regular 'bladelets' are also included in this group. Most of the microlithic part of the assemblage is worked upon these 'blades', although occasional points occur on less regular flakes (no. 60). On Site I the proportion 'Blades : flakes' is 388:1,753 and pieces in grey-white and patinated flint are commonest, many of the better blades being apparently struck from bipolar cores. The unpatinated flakes, as the cores, tend to be less regular in form. The minute chippings associated with any flint working site are under-represented in the Misterton assemblage, as a result of the collection being made by eye from the surface of ploughed fields.

Microliths:

A total of 72 microliths, some broken, have been found at

Misterton, principally from Site I, and these form 18.8% of the tools, excluding retouched flakes, and 1.2% of the whole assemblage, although the value of these figures is clearly limited by the admixture of later artifacts. Most are illustrated in figures 39 and 46. Nearly all the pieces are simple obliquely blunted points or variants thereof, on narrow flakes and blades, although a few are made on less regular flakes (nos. 60 & 69). Blunting to the point from the left hand side (L.H.S.) is most frequent, sometimes with opposed retouch, and occasionally blunted all or part of the way down the back. Only three were certainly made by the microburin technique, which accords with the paucity of these waste flakes on the site, and most either retain the bulb of percussion or have been blunted obliquely across the bulb. This method of manufacture is shown by the uncompleted example (no.142). Although there are no true geometric forms, a number of narrow, rod-like microliths occur (nos. 59, 65-6), perhaps to be classed as elongate isosceles triangles along with no. 64, although no. 67 is best regarded as a trapeze.

The microliths may be summarised as follows:-

<u>Site I</u>	
Obliquely blunted points - L.H.S. blunted to point.	14
(nos. 30-3, 36, 38-40, 42-48 & 63)	
Obliquely blunted points - L.H.S. with opposed retouch at tip.	4
(nos. 37, 49, 51 & 60)	
Obliquely blunted points - R.H.S. blunted to point.	4
(nos. 52-55)	
Obliquely blunted point - R.H.S. with opposed retouch at tip.	1
(no. 56)	
Points blunted down whole of L.H.S.	2
(nos. 59 & 61)	
Points blunted down whole of L.H.S. with opposed retouch.	1
(no. 62)	

Obliquely blunted points blunted across bulbar end (L.H.S.). (nos. 34-5 & 37)	3
Points blunted down whole of R.H.S.	2
Rod-like points ('elongate isosceles triangles')(R.H.S.). ((no.65 & no.66, the former with opposed retouch)	2
Trapezes/elongate isosceles triangles. (nos. 64 & 67)	2
Fragmentary pieces backed both edges.	3
Backed pieces and fragments. (nos. 57 & 68-71)	10
<u>Site II</u>	
Obliquely blunted point - L.H.S. with opposed retouch. (no. 58)	1
Obliquely blunted point - R.H.S. and most of back.	1
Backed flakes.	2
<u>Unlocalised</u>:	
Obliquely blunted points - L.H.S. to point.	7
Obliquely blunted points - L.H.S. to point (uncompleted).	1
Obliquely blunted points - L.H.S. with opposed retouch.	1
Points blunted down whole of L.H.S.	1
Points blunted down whole of L.H.S. with opposed retouch.	1
Obliquely blunted points - R.H.S. to point.	2
Both edges blunted (frag.)	2
Rod-like point with opposed retouch.	1
Small trapezoid piece.	1
Backed flakes.	2
Total	72

<u>Scrapers</u>:

Of the 228 scrapers from the sites, over half are some form of end scrapers (nos. 76-92) and, amongst the patinated and grey-white flint pieces, examples on short, rather thick, blade-like flakes with a steep flaking angle to the cutting edge predominate (nos. 76-80). More discoid forms do occur in these materials (nos. 88-9, 103, 105 & 108) but similar pieces in better quality unpatinated flint (nos.82 & 84) probably relate to the Late Neolithic occupation. To this latter phase also belong the two scalar flaked end-edge scrapers (nos. 83 & 85) and these are similar both in material, a good dense grey flint, and method of working to the two unifacial 'points' (nos. 123-4) and one bifacial point. Two unpatinated scrapers, one discoidal (no. 87) and the other, one of only four double end scrapers (no. 102), are so battered that they must have been utilised as chisels or wedges, probably for splitting wood or bone. On the main site only seven scrapers are worked on cortex flakes, although nearly a quarter of the remainder retain some cortex or outer surface of the pebble, no. 109 being, apart from the cutting edge, entirely a small smoothed fragment from the local Drift.

Burins and Scraper-burins:

Burins are relatively infrequent in the Misterton collection; only 32 have been recognised, together with 9 scraper-burins and of these 15 are unpatinated and possibly belong to the Late Neolithic assemblage. All are angle burins, mostly single blow (no. 114), although no. 112, a scraper on a core with partial single platform, could equally well be a multiple blow burin and several of the bipolar cores could also be included in this category. The small burin no. 118 shows a deliberate blunting of the edge opposite the burin facet. Some burin spalls were recognised (no. 98), but since examples can be produced by the removal of particularly sharp carinae from cores, they have not been included as a separate category.

Truncated Blades:

Four small blades with oblique truncations have been found, (no. 127), although the scraper cut obliquely on the end of a blade (no. 86) could be included in this group; only one is in a heavily patinated flint.

Tranchet Axes and Picks:

The roughly flaked pick like implement (no. 119) is in a poor grey-white flint with cherty inclusions and has been sharpened by a slight tranchet blow. The butt retains some cortex and the abrasions on this taken with the slight polishing due to wear of the opposing side of the butt, suggest that this is a completed tool and was hafted. The examples from Blubberhouses and Rishworth (Davies & Rankine, 1960) in West Yorkshire probably represent similar rough implements rather than uncompleted tranchet axes, particularly since they occur in areas where flint was at a premium. The butt end of a similar implement was also found on Site I (no. 120). This piece resembles the so-called 'fabricators' from later sites in the south of England (Wheeler, 1943) but the dense white patina of this piece is more in keeping with a Mesolithic date and it is best regarded as the butt end of a narrow tranchet axe or pick. Whilst this report was being prepared, two further tranchet axes were found on Site I (nos. 135 & 136). Although rather small, these are more typical examples, in fairly good flint, densely patinated to a creamy white colour. On one (no. 136) the edge is somewhat battered and there is some smoothing of flake scar intersections on the butt end probably as a result of hafting. As well as axe sharpening flakes (no. 137), several rather large thin flakes amongst the assemblage are suggestive of axe manufacture on the site.

Apart from on the Wolds and the Vale of Pickering, there have hitherto been few tranchet axes from the East Midlands and the North East. In the Pennines, the specimens quoted above may be supplemented by the sharpening flake from Pike Low (Radley & Marshall, 1965), the atypical implement from Deepcar, near Sheffield (Radley & Mellars, 1964), and an example from near Arbor Low, Derbyshire (Mellars, 1974). They are represented in North Lincolnshire by pieces from Bagmoor and Willoughton (Dudley, 1949), and the examples figured below (Fig. 53 & 55) from Whitton and Blyborough. On Hatfield Chase, in an environment which has much in common with that of the Vale of Pickering, the Misterton examples can be matched by a further one from the southern tip of Thorne Moor (below, p.153), and two axes amongst the assemblage from Clouds Lane Farm, Belton, (below p.149).

Arrowheads:

Six arrowheads have been recovered from Misterton Carr; a barbed and tanged example in a light grey flint with mottled patina obviously relates to Late Neolithic or Bronze Age occupation. Three small leaf-shaped arrowheads occur in similar flint, one uncompleted and still retaining some cortex (no.143). The 'petit tranchet derivative' types, whilst having Mesolithic precursors, are also of this period. The latter appear in the North East in two distinct groups: one largely restricted to the Yorkshire Wolds and the other to the Pennines; (Radley, 1964); that this is a gap in knowledge rather than a reality is suggested by the Misterton examples falling between these.

Knives:

No. 125, a plano-convex knife in a brown, honey coloured flint is a typical implement on Early Bronze Age sites and belongs to the same basic group as the two unifacial 'points' noted above (nos. 123-4).

A more specialised form of knife is represented by the polished discoidal knife of Clark Form I (no. 128) (Clark, 1929), in a fine translucent dark grey flint, bifacially polished to a smooth rounded edge; such tools were probably for flensing skins. The roughly flaked area around the bulb of percussion would have served as a grip, as on the very similar specimen from Green Crag Slack in North Yorkshire (Cowling, 1963). The bifacially polished fragment, no. 129, in a light grey flint probably represents the edge of another knife of this type, although it is possible that this is the cutting edge of a rather thin polished axe.

Despite the finding of other examples, Clark's distribution map of 1929 remains fundamentally unchanged, the gap between the East Yorkshire and Derbyshire groups being only partially filled by these examples, and ones from Whitwell in eastern Derbyshire (Dolby, 1966) and Crosby Warren in North Lincolnshire, with fragments from other nearby localities.(Dudley, 1949). The association, indirect though it is, at Misterton supports a Late Neolithic to Early Bronze Age date for these tools.

Other Tools:

The only pieces of flint implements not included in the above descriptions are the probable awls (nos. 71-2), both broken and in a white patinated flint and the small blades with micro-denticulation or 'saws' (nos. 22-4). Of the former only seven examples were recognised, six in patinated or grey-white flint and they are therefore probably to be wholly related to the Mesolithic industry. Fourteen 'saws' appear in the group, all except three, in unpatinated and lightly patinated flint and, although they occur at Star Carr in the Vale of Pickering, (Clark, 1954), some of these pieces could belong to the Late Neolithic.

Retouched Flakes:

A total of 298 flakes exhibit retouch or edge utilisation, of these only 11 were reworked on older patinated flakes and, proportionally, there were more flakes utilised amongst the unpatinated and probably younger part of the assemblage than amongst the remainder. Of the few flakes illustrated, nos. 20-1 and 25 are probably 'becs' or awls, no. 27 a concave scraper, and 26, 28-9 rough scraping tools. Since many flakes showed damage due to agricultural activities, it is probable that this total is considerably below the actual, any dubious pieces having been discounted.

Stone Pestles:

Two other pieces of stone from the site are of some interest. One (no. 146), a tapering cylindrical quartzite pebble with rounded ends, is probably derived from the Bunter Pebble Beds by way of the Drift. One end shows considerable abrasion through use as a pestle (fig. 48). The other (no. 147) is an elongate piece of a micaceous greywacke, also derived from the Drift, rectangular in section and slightly hollowed on one face. It is uncertain whether this is an artifact but it must be a manuport since the immediately local sand deposits are free of pebbles. Part of one of the thinner faces has a pock-marked surface suggesting use as a hammerstone, perhaps against a wood or bone punch. Similar pieces are known from other Mesolithic sites, including Thatcham (Wymer, 1962) and Sheldon, Derbyshire (Radley, 1968), although the latter, described by the author as a 'whetstone', may belong to Neolithic occupation. Similar pestles and so-called 'limpet scoops' are well known amongst the Obanian assemblages from western Scotland (Lacaille, 1954).

Polished Stone Axes:

Parts of four stone axes and two flakes from flint ones (no. 130) have been found on Site I at Misterton Carr:

131. A complete round butted axe of Group I, a uralitized gabbro of Cornish origin.

132. Part of a large axe of Cumbrian type in a fine, light green volcanic ash - Group VI, from the Langdale group of factories in Westmoreland. The distribution of axes of this type has been discussed by Manby (1965).

133. Axe in a fairly fine dark, brownish-green rock. There are slight facets on the edges and the cutting edge has been totally destroyed, probably by use as an anvil. Group VII, a porphyritic microgranodiorite from Craig Lwyd in North Wales.

134. Battered fragment of a polished axe in a fine grained grey-brown rock with some small phenocrysts. Group VII.

A further axe belonging to Group VII is in the Hull Museum labelled 'from Misterton Carr, Notts.', and two axes, not yet sectioned, were found near Cattle Carr Farm, a kilometre, east of the site. On superficial examination these would appear to belong to Group VI.

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Misterton Carr - Discussion

The Mesolithic Material

The presence of tranchet axes and the predominance of simple obliquely blunted points clearly relates the Misterton Carr sites to the Maglemosian tradition, with many similarities to the English type-site of Star Carr in the North Riding of Yorkshire (Clark, 1954). In Yorkshire and the East Midlands, these sites occur in two distinct concentrations: around the meres and small rivers of the Vale of Pickering and Holderness and on the moors of the South

Pennines, where Buckley's (1924) 'broad blade' industries represent the highland expression of this culture, or perhaps the summer camps of its people (Clark, 1972). 'Narrow blade' assemblages, with geometric microliths, are recorded from North Lincolnshire and the Pennines, but the intervening area of Hatfield Chase and the Vale of York has produced little material, the two small geometrics recovered by Gaunt from Wroot (fig.55,9 &10) being the only pieces recorded from the Chase. A small geometric assemblage was also recovered from a site on Hail Mary Hill, in the Rother Valley, south of Rotherham (Radley & Mellars, 1963). Misterton lies between the two areas, geographically closer to the well known sites with industries characterised by geometric microliths on Risby Warren (Dudley, 1949) than to the Pennines, but in an environment which must once have closely resembled that of the lowland sites in East Yorkshire.

In North Lincolnshire, one site, which has produced industries with close parallels amongst the Misterton material, is Sheffields Hill, 6 km. north of Scunthorpe. Although not published in detail (Armstrong, 1931), the microlithic component is dominated by simple obliquely blunted points, rarely showing definite evidence of the use of the micro-burin technique and, in the majority of illustrated examples, blunted from the left hand side; a number of rod-like pieces, as nos. 59 and 66 from Misterton, also occur as well as some pieces with opposed retouch. A few small geometric forms are present, a feature more in keeping with the Maglemosian of the South-East, where small triangles and crescents occur with an otherwise typically Maglemosian assemblage at Thatcham, Berkshire (Wymer, 1962). Sheffields' Hill was excavated in 1927 and the industry was regarded as Upper Palaeolithic, its stratigraphic position being apparently at the base of the Cover Sands. This, however, cannot be considered definitive since this deposit has been subject to continual reworking since its initial deposition during the final cold phase of the Last Glaciation (above, p. 7). Movement continues on both Risby and Manton Warrens, close to the Sheffields' Hill site, and material of Palaeolithic to Mediaeval date occurs mixed indiscriminately in the dunes (Dudley, 1949). The Sheffield's Hill industry could therefore be mixed. Although the report is insufficiently detailed to clarify the situation, there is no evidence for disturbance of the floors by frost action, of wind polishing and facetting of artifacts, of frost damage to artifacts or of the peat bed which underlies the Cover Sands over much of north-west Lincolnshire (above p. 72). In a phase when much of the country was subject to temperatures low enough for permafrost and intense cryoturbation, when, in places, over 30 m. of these aeolian sands were deposited against the westerly facing scarps of the Lincoln Edge and the Isle of Axholme (above p. 56), it is unlikely that an exposed site like Sheffield's Hill, close to the crest of the ridge, would escape unscathed. The site also yielded "bones of deer and small animals", suggesting a Post-Glacial fauna, and, chronologically more significant, scattered patches of charcoal. The site has recently been partially re-excavated by R. Jacobi (pers. comm.), who has suggested that two phases can be discerned. The publication of this new material and provision of ^{14}C dates is a matter of some importance for the Mesolithic of Eastern England. Until this is carried out, the close relationships of Misterton Carr to this site remain a matter for speculation.

Further north, at Brigham, near Driffield in East Yorkshire, a similar assemblage in the same poor grey-white flint as the majority of the Misterton material, occurs; the obliquely blunted points are more regular on narrower blades, although the same forms and lack of geometrics are apparent. The narrow rod-like pieces backed down the whole of one side were regarded by Manby (1966) as Creswell points and the whole assemblage classified as Upper Palaeolithic. Despite the absence of tranchet axes, this industry, as Radley (1969) noted, has many affinities with the early Maglemosian, indeed more so than with the Creswellian, although the former need not be denied a Creswellian connection. The geology of the site - interbedded sands and sandy gravels overlain by a metre of 'a mixed layer of structureless sand and gravel' - suggests that the site is Post-Glacial. A post-Late Glacial date would therefore be acceptable for both Sheffield's Hill and Brigham; Misterton falls into this bracket, although the presence of tranchet axes relates it at least to the same season as Star Carr.

Close parallels to the Misterton assemblage are found on the uplands and moors immediately west of Sheffield, at Pike Low, Mickleden (Radley & Marshall, 1965) and Deepcar (Radley & Mellars, 1964), where the application of opposed retouch to the tips of fairly narrow obliquely blunted points appears in roughly the same proportions; Deepcar also produced a large scalene triangle similar to no. 67. A feature which relates Misterton to Pike Low and Mickleden rather than to Deepcar is the paucity of microburins, although this has to be regarded with some caution in a surface assemblage. As on the Pennine sites burins are relatively infrequent and, although there is a greater number of them, the scrapers show a similar typology to the Deepcar pieces. Tranchet axes, represented in the Pennines only by the finds mentioned above, are widely distributed in East Yorkshire and the Misterton examples probably relate to the similar environmental conditions. The relatively large number of cores is more a factor of the distance from the Lincolnshire and East Yorkshire sources of flint and its presence in the local Drift - a flint nodule ('paramoudra') weighing over 25 kg. was found on nearby Gringley Carr in 1971 - than any cultural trait.

Other Mesolithic material from the area seems to bear out this Maglemosian connection. Besides the tranchet axe from Hatfield already alluded to, there is a sizeable assemblage with two axes from Beltoft (table 6) and obliquely blunted points and backed blades have been recorded from Cove Farm and Star Carr Farm, Haxey, from Hatfield Moors, Rossington Bridge, from Eastfield Farm, Tickhill and Westfield Farm, Tuxford (below, p. 146). To the west, on the Magnesian Limestone, pieces of Maglemosian aspect have been found at several sites, including Hooton Roberts (Radley, 1964). The wider affinities of this group of finds have been examined by Mellars in the Deepcar report (op. cit.).

Since the Misterton Carr finds occur in the top of reworked Late Glacial Cover Sands, beneath the desiccated remains of blanket bog which did not begin forming until the Bronze Age, it is not possible to date the Mesolithic industry on purely stratigraphic grounds. Without a date from any Pennine site with a related industry or from Sheffield's Hill, it is perhaps still a little hazardous to suggest a date in the eighth millenium B.C. in keeping with the evidence from Star Carr.

Details of Figures

Unless otherwise stated, all drawings are of finds from Site I; X refers to the unlocalised material, largely from I, recovered by Macfall.

Fig. 37 Cores

1.	Partial single platform;	unpatinated.
2.	" " "	lightly patinated; Site III.
3.	" " "	grey-white flint.
4.	Complete single platform;	grey-white flint; X.
5.	" " "	" " " .
6.	Two platforms; light brownish grey flint; X.	
7.	Bipolar; lightly patinated.	
8.	" ; patinated; X.	
9.	" ; lightly patinated; X.	
10.	Two platforms - keeled; heavily patinated.	
11.	Two platforms; slight utilisation of lower edge; grey-white flint; X.	
12.	Two platforms at 90°; heavily patinated.	
13.	Three platforms; heavily patinated; X.	

Fig. 38 Core (14); Rejuvenation flakes (15-19) and Utilised flakes (20-29) (22-24 Saws)

14. Three platforms; heavily patinated pale grey-white.
15. Core rejuvenation flake removing 'apex' of core - some edge utilisation; heavily patinated.
16. Core rejuvenation flake - transverse, removing edge of platform; patinated; X.
17. Core rejuvenation flake - transverse, removing edge of platform, triangular in section; grey-white flint; X.
18. Core rejuvenation flake - transverse, removing edge of platform - slight, concave retouch; unpatinated light grey flint; X.
19. Platform removal flake; grey-white flint.
20. Retouched flake - trimmed across the point and lightly on left hand side near butt; white patinated flint.
21. Retouched flake - trimmed across the point, with a considerable gloss on utilised area; patinated grey; X.
22. Microdenticulate blade/saw with some blunting retouch on opposite edge; lightly patinated grey flint.
23. Microdenticulate blade/saw; lightly patinated grey flint; from Site III.

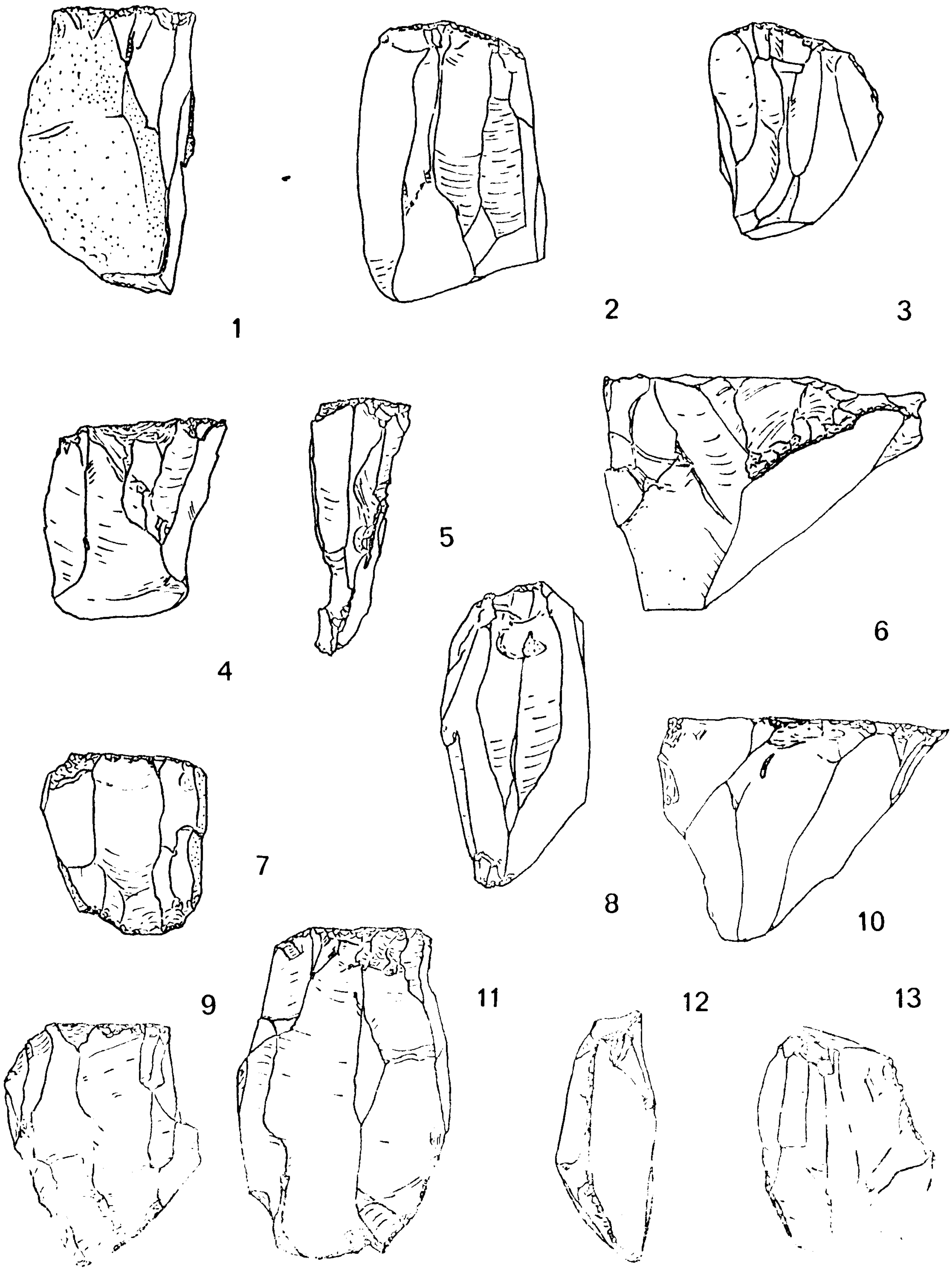

Figure 37. Misterton Carr : Cores.

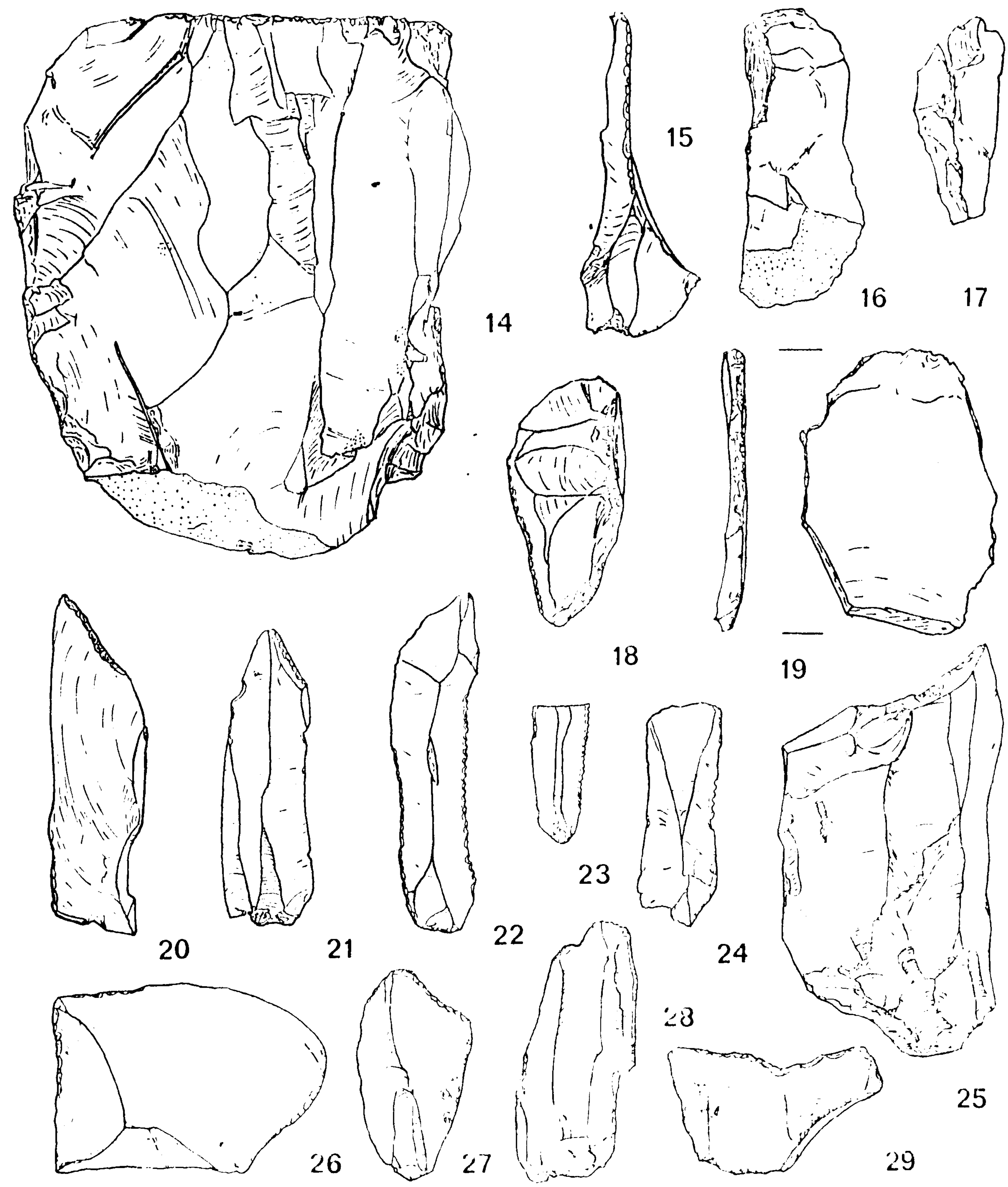

Figure 38. Misterton Carr : Core, core rejuvenation flakes
and utilised flakes.

Fig. 38 (Continued)

24. Saw with a small edge of coarse denticulation; white patinated flint; from Site II.

25. Retouched flake, trimmed on end to point; in a poor grey flint.

26. Flake retouched on edges of bulbar surface; white patinated flint.

27. Flake, retouched on point and right hand side; patinated grey flint; Site III.

28. Flake, retouched on both edges and in part on bulbar surface; poor grey flint; Site III.

29. Flake, retouched on right hand edge at each end; poor light grey flint; X.

Fig. 39 Microliths and related forms

30. Obliquely blunted point - L.H.S.; some trimming around bulb; grey-white flint.

31. Obliquely blunted point - L.H.S.; grey-white flint.

32. " " " " " " " .

33. " " " " some trimming down back; patinated.

34. Obliquely blunted point - L.H.S.; across bulbar end; grey-white flint.

35. Obliquely blunted point - L.H.S.; across bulbar end and part of way down back; patinated.

36. Obliquely blunted point - L.H.S.; patinated.

37. " " " " ; unpatinated.

38. " " " " ; broken; grey-white.

39. " " " " ; " ; patinated.

40. " " " " ; " ; lightly patinated.

41. Obliquely blunted point - L.H.S.; broken; patinated; X.

42. " " " " ; " ; " .

43. " " " " ; some basal retouch; patinated.

44. Obliquely blunted point - L.H.S.; grey-white flint.

45. " " " " ; broken; patinated.

46. " " " " ; " ; grey-white.

47. " " " " ; " ; some basal retouch; patinated.

48. As 47.

49. Obliquely blunted point - L.H.S.; broken; with opposed retouch; unpatinated.

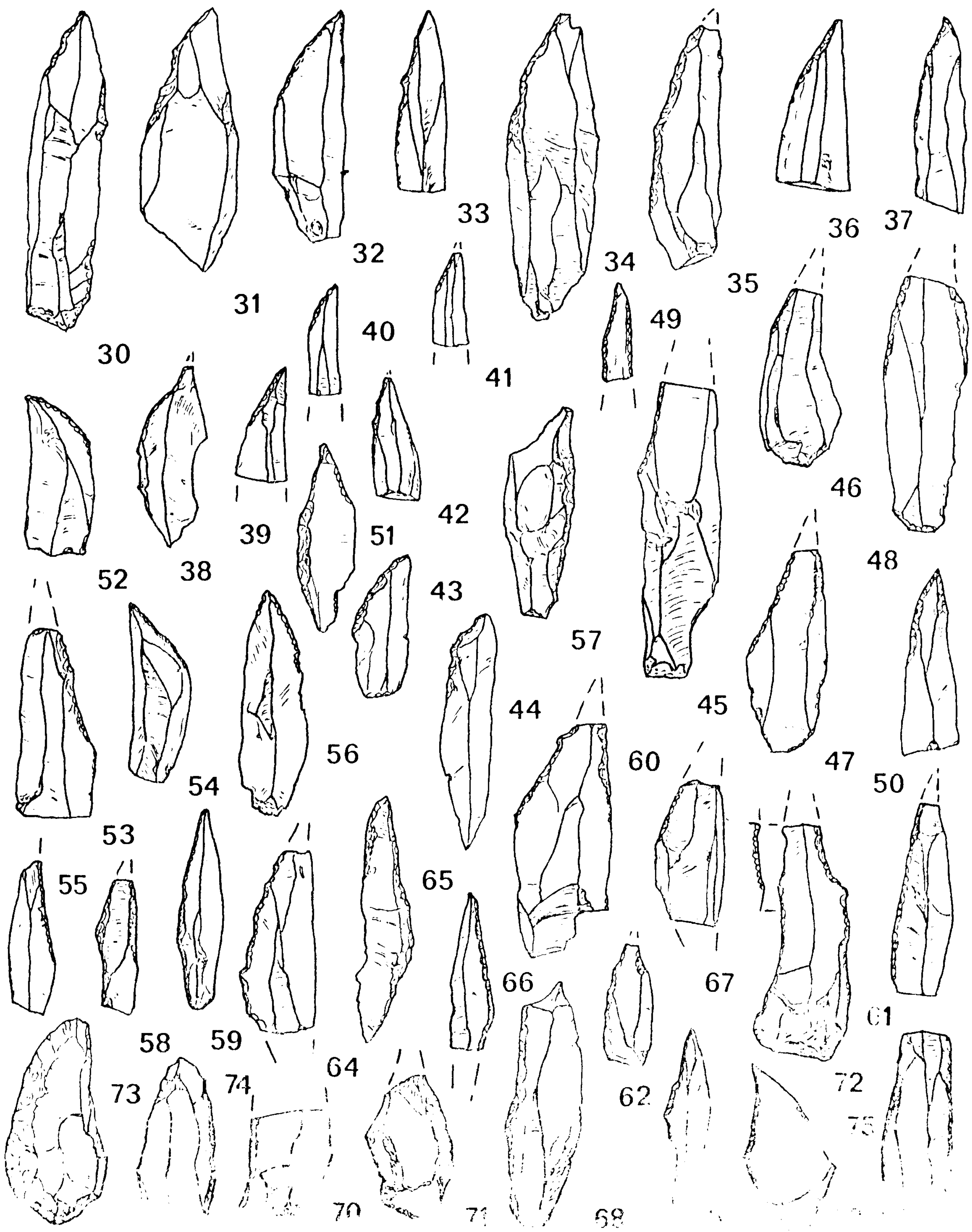

Figure 39. Misterton Carr : Microliths and related forms.

Fig. 39 (Continued)

50. Obliquely blunted point - L.H.S.; broken; with opposed retouch; patinated.
51. Obliquely blunted point - L.H.S.; with opposed and some basal retouch; grey-white flint.
52. Obliquely blunted point - R.H.S.; unpatinated and burnt.
53. " " " " ; tip broken; lightly patinated; X.
54. Obliquely blunted point - R.H.S.; grey-white flint.
55. " " " " ; tip broken; grey-white.
56. " " " " ; with opposed retouch; dark grey flint.
57. Backed blade/point; R.H.S.; grey-white flint.
58. Obliquely blunted point - L.H.S.; with opposed retouch; patinated; from Site II.
59. Obliquely blunted point - L.H.S.; grey-white flint.
60. " " " " ; with opposed retouch; tip broken; grey-white flint.
61. Obliquely blunted point - L.H.S.; blunted down whole of back; patinated.
62. Obliquely blunted point - L.H.S.; with opposed retouch; patinated.
63. Obliquely blunted point - L.H.S.: patinated.
64. 'Trapeze'/isosceles triangle - L.H.S.; light grey flint.
65. Rod-like point - R.H.S.; with opposed retouch; unpatinated.
66. " " " ; unpatinated light grey flint.
67. 'Trapeze'/isosceles triangle - L.H.S.; unpatinated.
68. Backed blade - L.H.S.; grey-white flint.
69. Backed flake/point - L.H.S.; grey-white flint.
70. " " " " ; " " " .
71. Awl; point missing; patinated light grey flint; Site II.
72. " " " ; patinated.
73. Scraper; finely worked on one edge; patinated.
74. Flake worked down right hand edge; patinated.
75. Blade with 'edge wear' down both edges; patinated.

Fig. 40 — Scrapers

76. End Scraper; patinated.
77. " " ; grey-white flint.
78. " " ; " " " .
79. " " ; " " " .
80. " " ; patinated.
81. End scraper on cortex flake; broken; patinated.
82. Discoidal scraper; unpatinated light grey flint; Neolithic.
83. End/edge scraper; unpatinated light grey flint; Neolithic.
84. Small discoidal scraper; unpatinated black flint; Neolithic?
85. End/edge scraper; unpatinated light grey flint; Neolithic.
86. Scraper trimmed obliquely on end of flake; grey-brown flint.
87. Discoidal scraper, battered at both ends as if used as a chisel; unpatinated light grey flint.
88. Small 'discoidal' scraper; patinated.
89. " " " " .
90. End scraper; lightly patinated; Site III.
91. " " ; on cortex flake; unpatinated; Site III.
92. " " ; unpatinated; Site III.
93. Side scraper; lightly patinated.
94. " " ; patinated.
95. " " ; grey-white flint.
96. Side scraper on a cortex flake; grey-white flint.
97. " " " " " " ; patinated.
98. Burin spall; some retouch/blunting along edge; light grey flint.
99. Edge of end scraper; patinated; Site III.
100. Concave scraper on flake; grey-white flint.
101. Slightly concave scraper on rough flake; grey-white flint.
102. Double ended scraper; battered as a result of use as a chisel; unpatinated.

Fig. 41 — Scrapers and Burins

103. Large discoidal scraper in grey-white flint; Site II.
104. End scraper on cortex flake; patinated; Site III.
105. Concave scraper on core rejuvenation flake; patinated.
106. End scraper on large flake; brown flint; K.

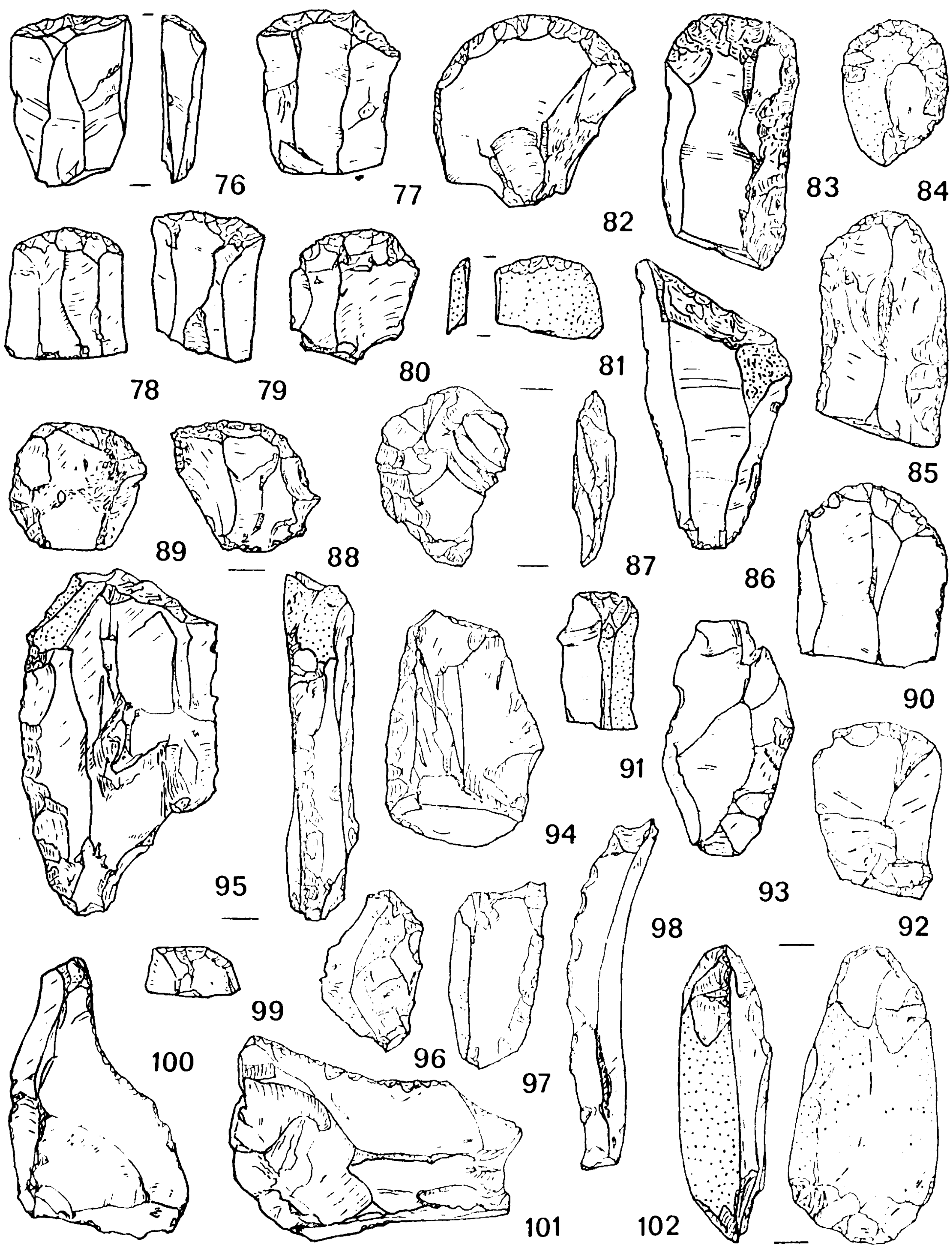

Figure 40. Misterton Carr : Scrapers and burin spall (98).

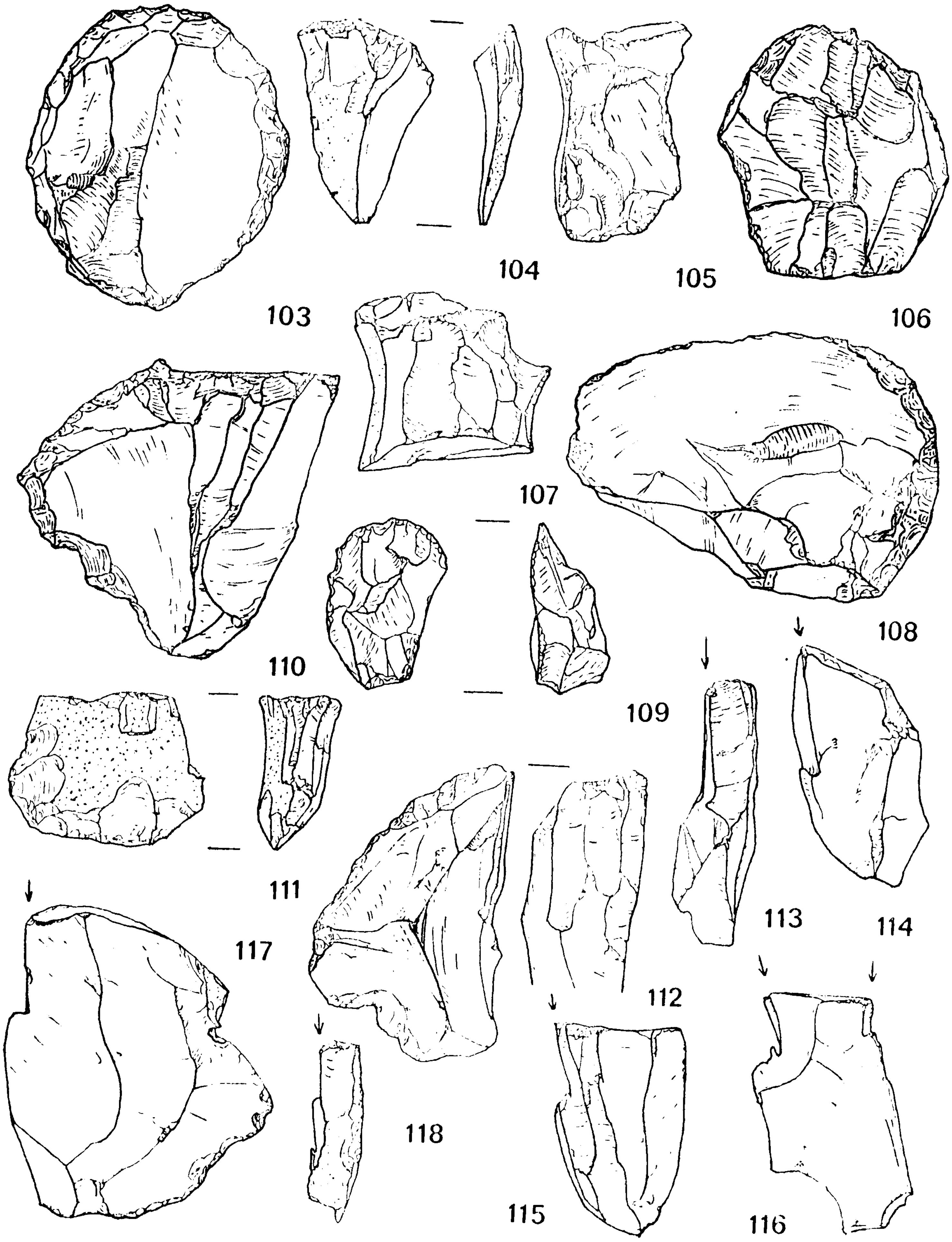

Figure 41. Misterton Carr : Scrapers and burins.

Fig. 41 (Continued)

107. End scraper; poor brown flint.

108. Scraper on bulbar surface of large flake; grey-white flint; X.

109. Scraper on small, smooth pebble of flint from the local Drift deposits.

110. Scraper on edge of core; grey-white flint; X.

111. " " " " " ; unpatinated; Site III.

112. " " " " " / burin; patinated; X.

113. Single ended burin; unpatinated.

114. " " " on angle of a flake; patinated; X.

115. " " " " " " " " ; unpatinated brown flint; X.

116. Double burin on two angles of a flake; grey-white flint; X.

117. Scraper/angle burin; grey-white flint.

118. Angle burin on small blunted flake; unpatinated brown flint; X.

Fig. 42 — Flint Pick

119. A rough pick in a poor grey-white flint, sharpened by irregular tranchet blows from both sides; marks on the cortex of the butt and slight polishing due to wear on the other side suggests use as an adze. A similar tool comes from Bagmoor, near Scunthorpe in North Lincolnshire; c.f. Dudley 1949, p.40.

Fig. 43 — Various Implements

120. The butt end of a triangular axe or chisel in a heavily patinated white flint; a Mesolithic piece, but for a similar find in a Neolithic context c.f. Maiden Castle, Fig. 40, no. 19 - 'fabricator'.

121. Barbed and tanged arrowhead in a light grey flint with a mottled patina; Late Neolithic or Bronze Age.

122. 'Petit tranchet' derivative arrowhead in a fine grey flint; c.f. Radley 1964. X.

123. Flat, scalar flaked point/scraper in a fine grey flint; X.

124. " " " " " " " " " " ".

125. Plano-convex knife in a brown flint; X.

126. Flake of chert retouched on the bulbar surface.

127. Obliquely truncated blade; brown flint with mottled patina.

128. Polished discoidal knife in a dark grey translucent flint; c.f. Clark (1929) and Dudley (1949), fig. 26.

129. Edge of polished discoidal knife or somewhat thin axe in a light grey flint; Neolithic to Early Bronze Age.

130. Flake from a polished axe in a light grey flint.

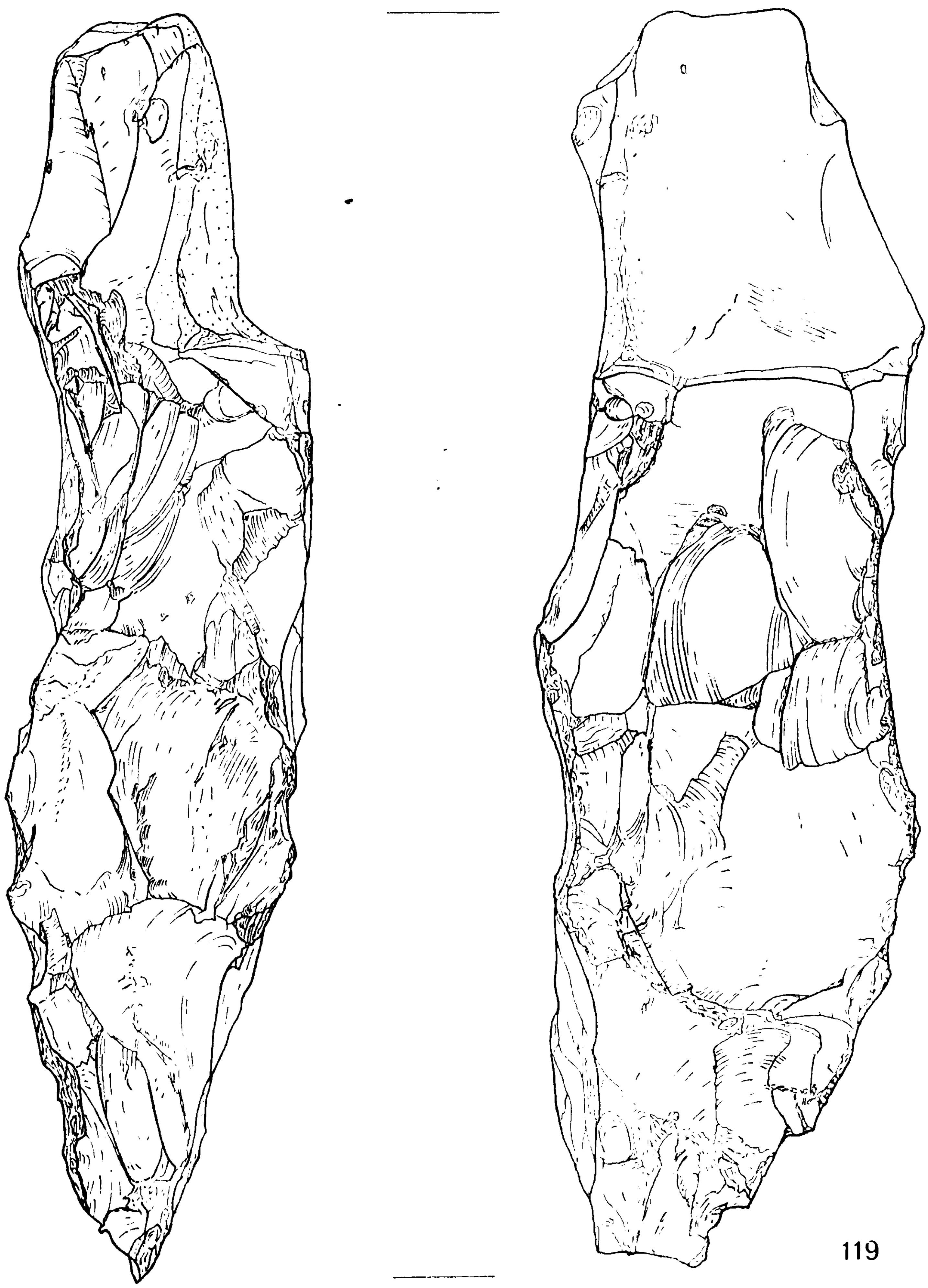

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Figure 42. Misterton Carr : Tranchet pick.

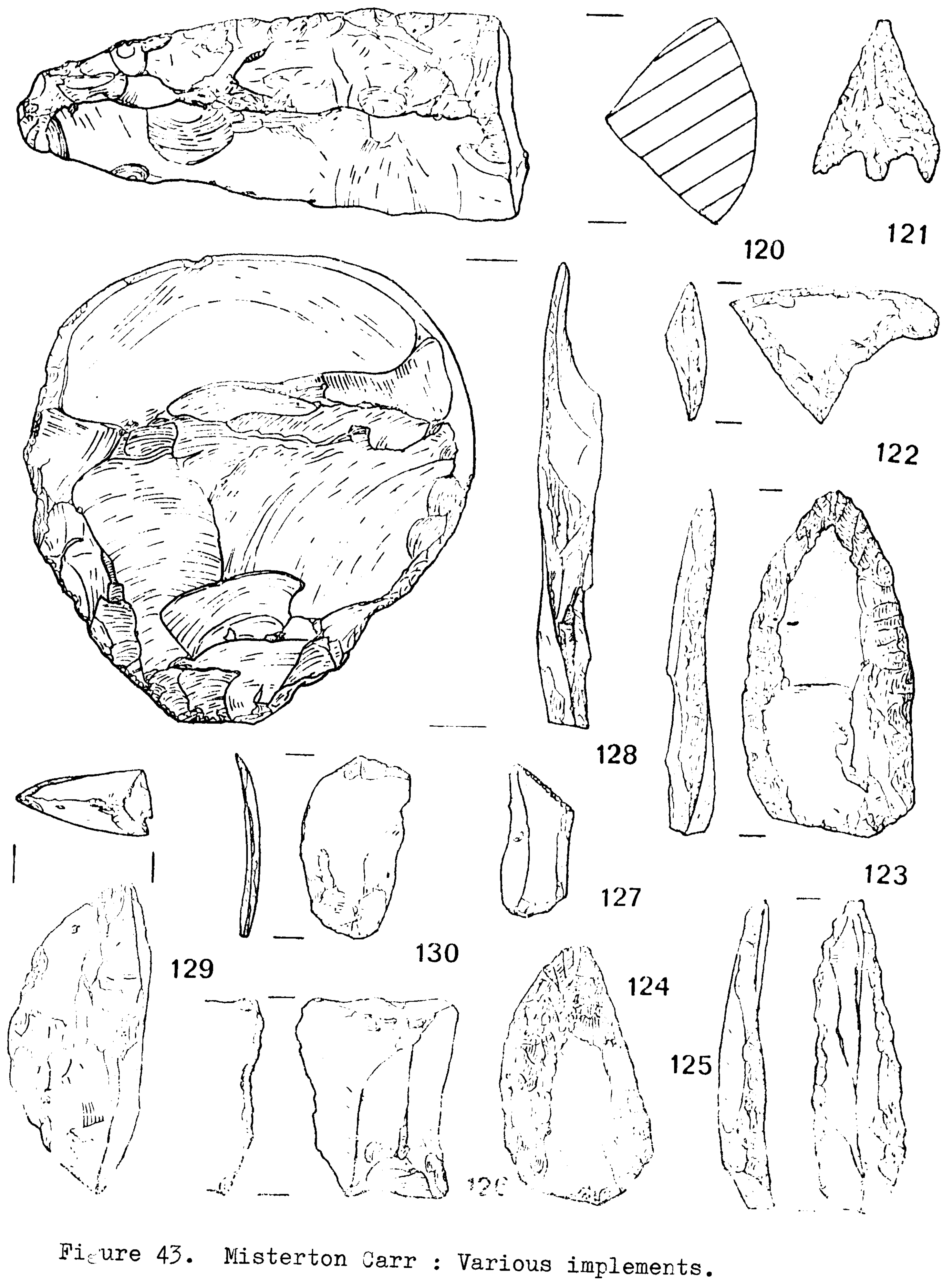


Figure 43. Misterton Carr : Various implements.

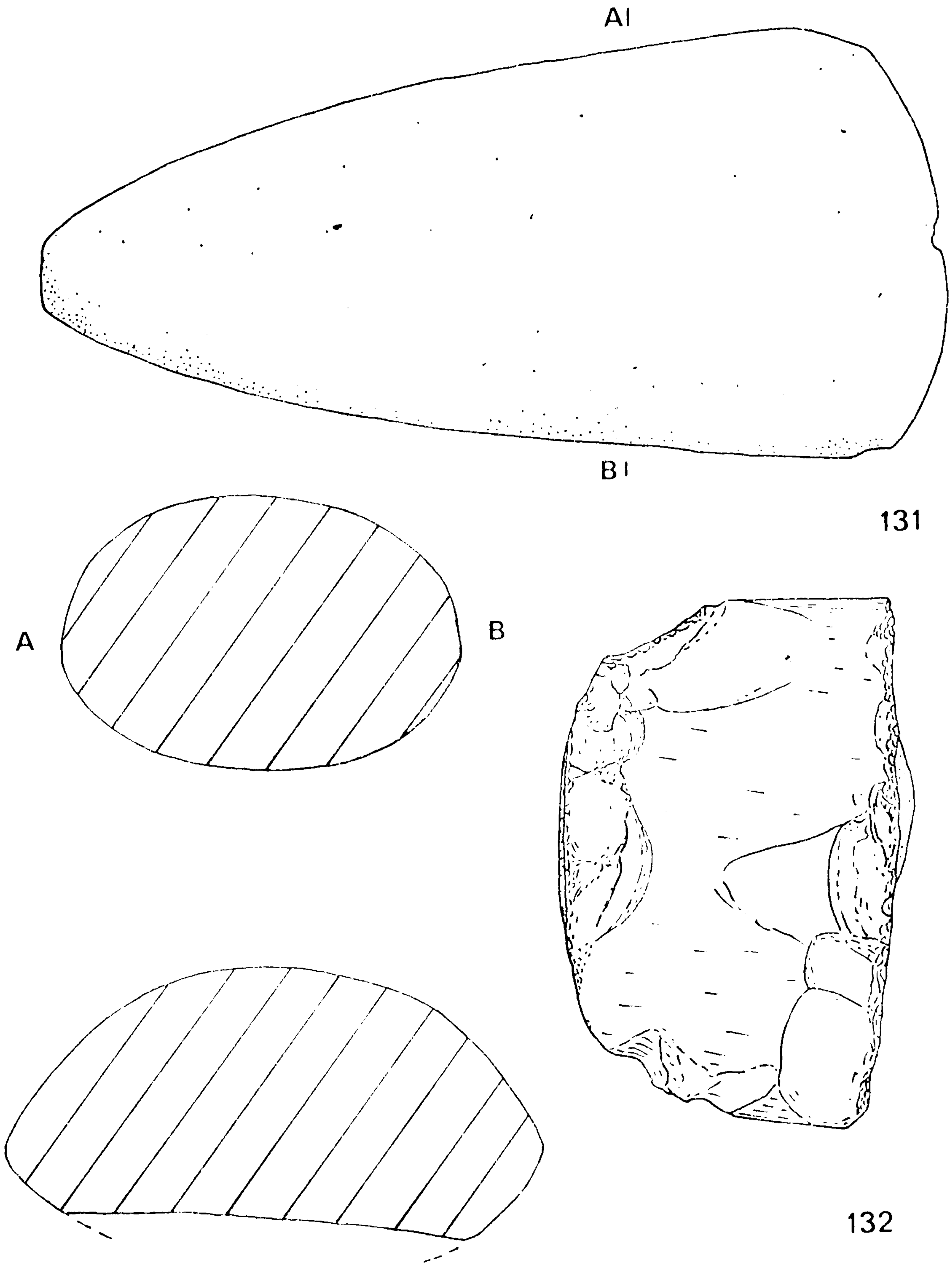
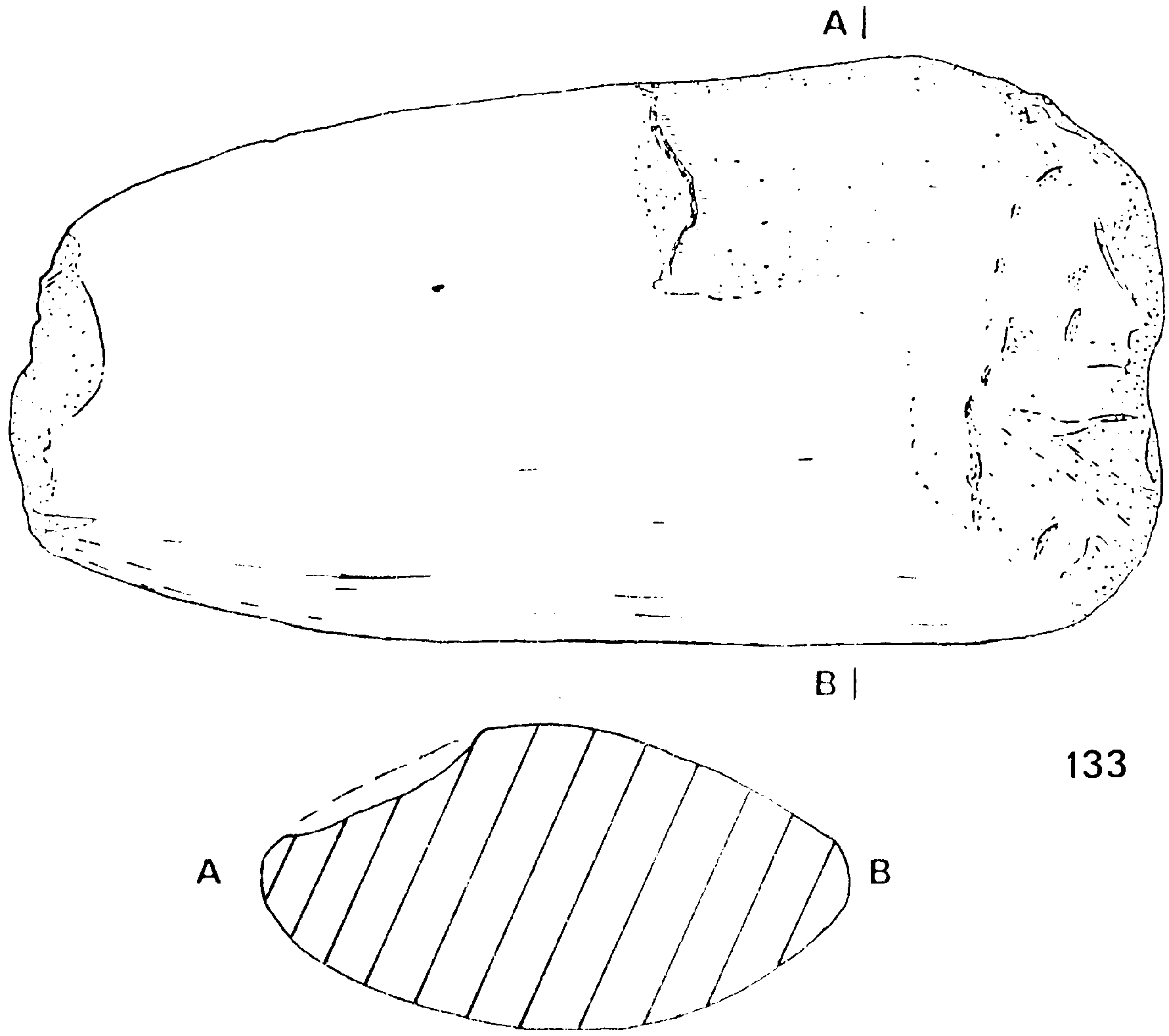


Figure 44. Misterton Carr : Polished stone axes.



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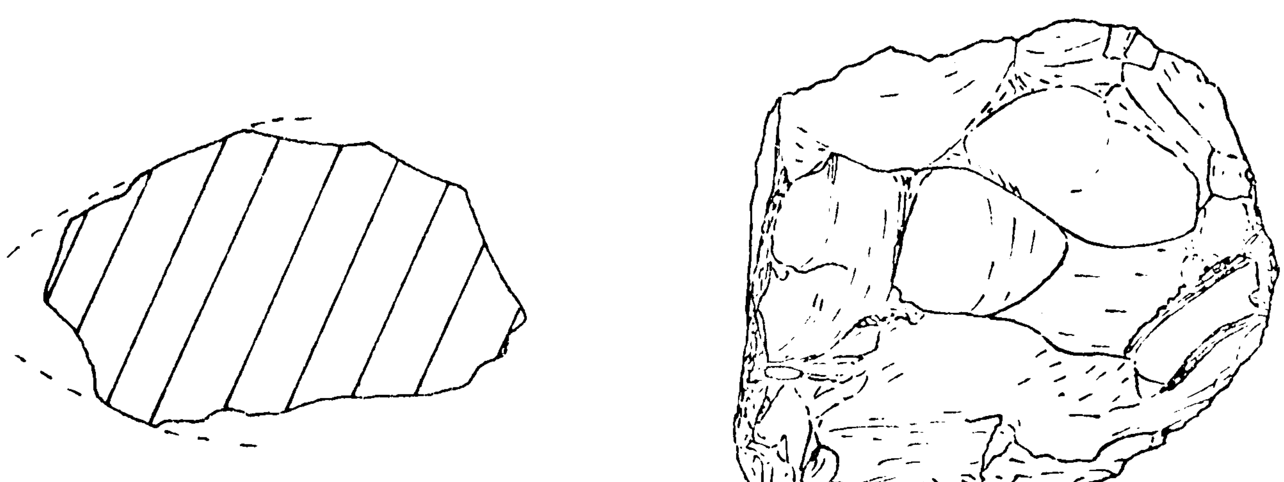

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Figure 45. Misterton Carr : Polished stone axes.

<u>Figures 44 & 45</u> <u>Polished Stone Axes</u>

131-134 Described above, p.109.

<u>Fig. 46</u> <u>Additional Material from the Misterton Carr Sites (1973-75)</u>

135. Tranchet axe in a good, grey-white flint with some small cherty inclusions.

136. Small tranchet axe in a white patinated flint; there appears to be some smoothing of the ridges between flake scars on the butt, presumably a result of wear when hafted.

137. Axe sharpening flake in a white patinated flint. The cutting edge of the axe lay on the right hand side of this flake, which has been struck off by a blow on the upper edge.

138. Small crescent, broken at the base, backed down the whole of the left hand side and about half the right; in a white patinated flint.

139. Small crescent, backed down the whole of the L.H.S. and retouched on about half the other. In a light grey-brown translucent flint.

140. Small trapeze, backed on three sides and in a white patinated flint.
These three small geometric microliths are the only certain 'narrow blade' pieces from Misterton Carr. The finder, Mr. MacFall, did not recollect whether they were found together or on the same site.

141. Obliquely blunted point in a poor white flint, backed down the whole of L.H.S.

142. Obliquely blunted point, partially backed to a point on the L.H.S. The cherty inclusion, which has caused this artifact to be abhortive, bears several percussion scars; lightly patinated.

143. Uncompleted leaf-shaped arrowhead on a thin flake of grey flint, with slight patina and retaining much cortex.

144. Hollow-based, or slightly irregular tranchet arrowhead in a light grey patinated flint.

145. Broken leaf-shaped arrowhead, similarly patinated.

<u>Fig. 47</u> <u>Other Stone Artifacts from Misterton Carr</u>

146. Stone pestle, one end showing considerable wear (fig.48). A utilised natural pebble from the Bunter Pebble Beds, probably collected from the Older River Gravels, which outcrop 2 km. to the west of the site.

147. Utilised pebble, discussed above, p.108.

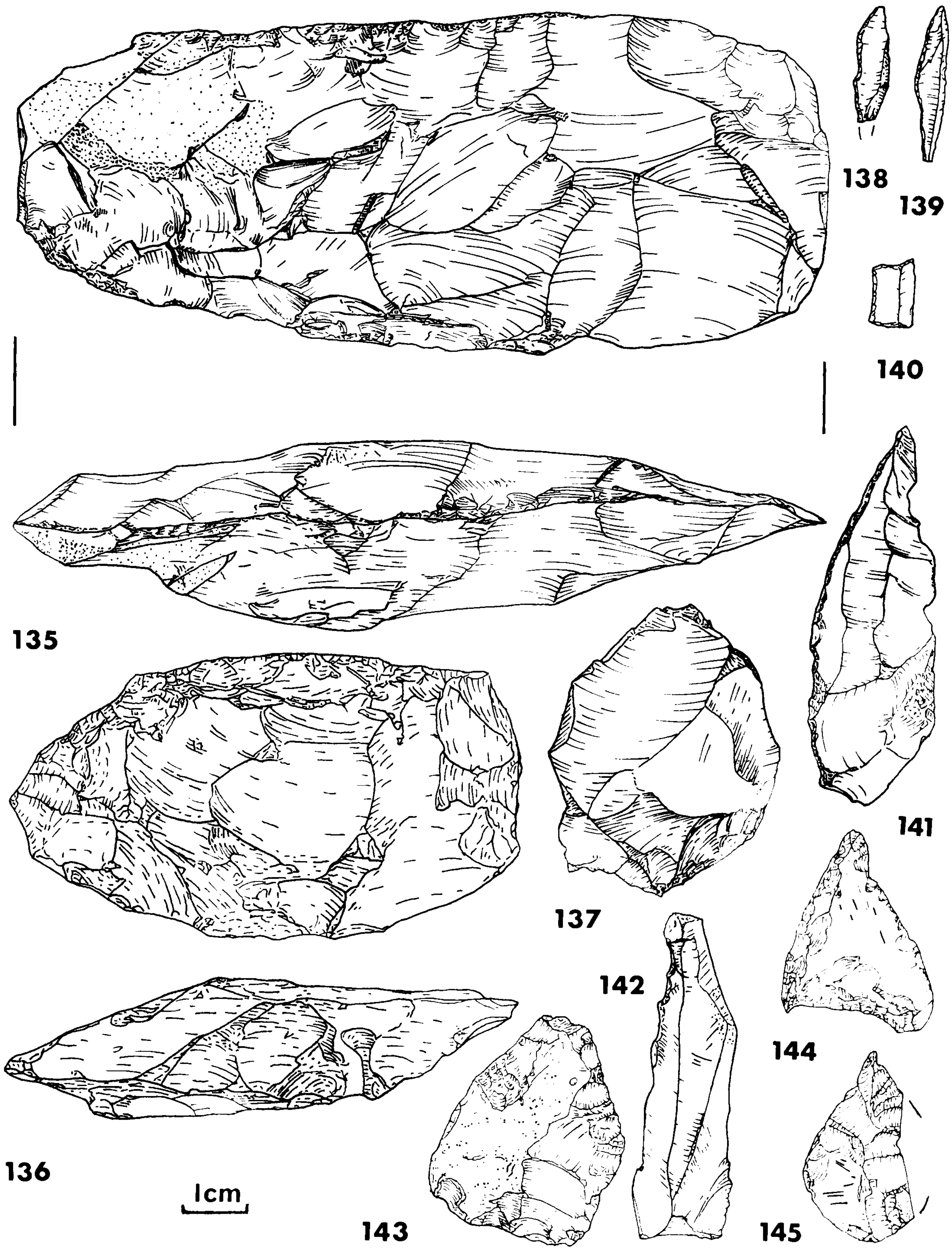

Figure 46. Misterton Carr : Additional material (1973-75).

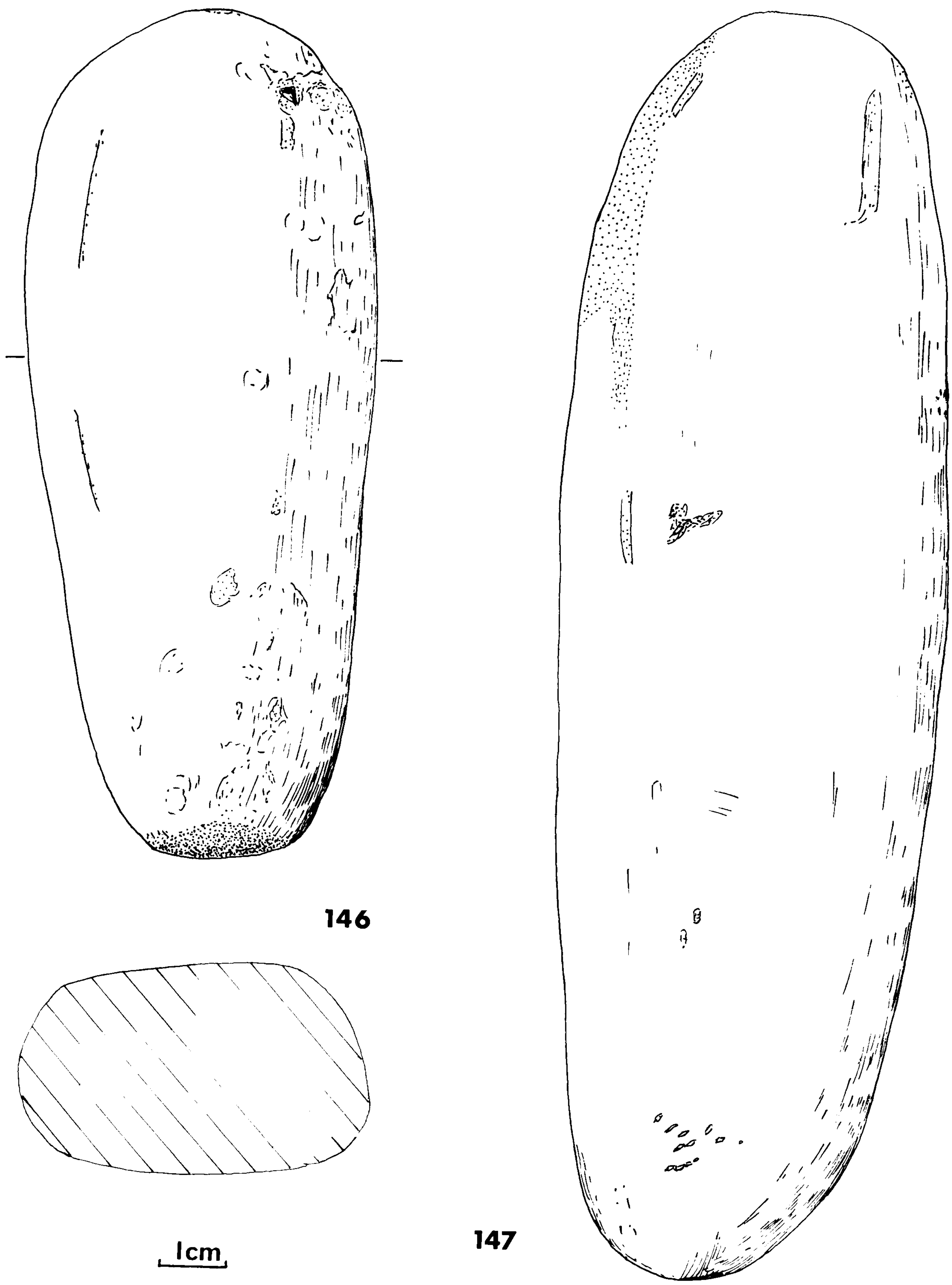

Figure 46. Misterton Carr : Stone pestles.

The Environmental Background to the Mesolithic Site: an attempt at Interpretation

The complete absence of biological materials from the Misterton Carr sites reduces any attempt at economic interpretation to the level of a purely theoretical model yet, in view of several attempts to examine the Mesolithic in its ecological setting from this basis (e.g. Mellars, 1975) and an essay in site catchment analysis for Star Carr (Clark, 1972), some discussion, based upon local topography and geology, may not be entirely fruitless. Clark (op. cit.) has already suggested that the winter campsites of the users of 'broad blade' industries in the Pennine foothills must lie between the Humber and the Trent and Misterton Carr clearly falls into this group. The assemblages were recovered from a slight east-west ridge of sand, lying at about 3 m. O.D., surrounded by extensive peat deposits, frequently in excess of 2 m. in thickness. Accepting a rough chronological bracket of c. 10,000 - 8,500 B.P. for the Maglemosian (c.f. Mellars, 1974), no alluvial or peat deposits on the Chase are known to belong to this period. The earliest post-Glacial organic deposits located, on Hatfield Moors, belong to Pollen Zone VII(a) (Smith, 1958) and are less than 7,500 years old. At both Misterton and Thorne Waterside, 19 km. to the north, deposition began in Zone VII(b), about 4,000 years ago, and the extensive peat deposits of Thorne Moors began to form about 3,000 years ago (below, p. 157). Since such recent deposits cover over 50% of the region under discussion, current soil and land utilisation maps are of little use in examining the Mesolithic environment. The Drift maps, produced by the Institute of Geological Sciences (1969; 1971), however, provide a more satisfactory base, although considerably more borehole data would be necessary to reconstruct the buried topography, particularly of the Trent valley, east of Misterton, prior to the aggradation of its present alluvial plain.

Figure 48. Misterton Carr : wear on end of quartzite pestle

Figure 49. Misterton Carr : trench through peat looking north

Division of the substrate into meaningful categories creates further complications. Whilst the Keuper Marl now forms extensive islands in Axholme, Misterton village and Gringley Beacon (fig. 33), the extent of erosion and redeposition of Late Glacial Cover Sands since forest clearance began remains an unquantifiable factor and what are now heavy claylands may once have had a thin mantle of sand. The limited amount of information available, largely from aerial photography and some excavation, implies, in contrast with north Lincolnshire, little movement since the Iron Age and Roman periods, although Roman pottery has been found in sand lenses in the channel beneath the present alluvium of the river Idle at Sandtoft. Extensive field systems can be traced from the air associated with the Sandtoft Romano-British sites (fig. 86) and these have provided no evidence for serious wind erosion, a problem in dry summers at the present day (Radley & Simms, 1967). On the western and southern slopes of the Isle of Axholme, Roman sites are also apparent from the air at Epworth and Misterton and features do not appear to be obscured by drifting sand. In preparing the maps (fig. 50) therefore, the existing outcrop of the Cover Sands and its approximate incrop against the base of the alluvium and peat has been adhered to, although some downgrading off the crests of the Keuper Marl cored ridges has to be allowed for in interpretation. Superficially, the 'Older Drift' deposits might seem best grouped with the Cover Sands as a single subsoil unit, which would have supported similar plant cover during the Mesolithic, yet there is considerable variation in silt and clay content and examination of numerous sections in the Blaxton, Finningley and Misson areas frequently shows a surficial remanie layer of frost-cracked pebbles and gravel over cryoturbated gravels, presumably a result of Devensian deflation (Gaunt et al., 1971; above, p.57). During the first two thousand years after the rapid climatic amelioration which ended Pollen Zone III, these deposits could have offered a more stable substrate for plant colonisation than the Cover Sands but their nutrient status would be poor, having been exposed to leaching throughout the Devensian and been impoverished during the preceding interglacial, although cryoturbation may have brought up nutrients from below (Limbrey, 1975).

The large amount of disturbance created by gravel working over many square kilometres of the outcrop of the 'Older River Gravel' between Austerfield and Hatfield has created many temporary habitats which must more closely resemble the immediately post-Glacial than the vegetation cover of the ploughed and podzolised soils of the present day. Primary colonisation is frequently dominated by such weeds of broken ground as the willow herbs, which are abundantly recorded in Pollen Zone IV (Godwin, 1975), with its undeveloped soil profiles. Birch rapidly follows the ruderals with some hazel, later followed by seedlings of the more competitive forest trees, particularly the introduced sycamore. The dominant species of the underbrush in these areas of primary colonisation, however, the brambles, briar rose and elderberry, have a poor early Flandrian record (op. cit.) and pine is now too infrequent outside the occasional plantation to be able to colonise areas. It is of limited value to compare modern communities of differing subsoils and subtract those species not recorded from the early Flandrian.

The only pollen diagram which covers the relevant period is that of Bartley (1962) from near Tadcaster, on the western edge of the Vale of York, 53 km. north-west of the Misterton site and, using this data in conjunction with Godwin's (1975) general synthesis and the Star Carr evidence (Clark, 1954; 1972), an environmental framework can be constructed for Pre-Boreal and Boreal man on Hatfield

For figure 50, see folder at end of text.

Chase and, employed with the geological maps, to examine probable site catchment areas for Misterton and the other sizeable group of artifacts from Beltoft (below, p. 148). The overall picture is one of birch-pine woodland, of which the former was the dominant element throughout much of Zones IV and V. Hazel, poplar, willow and mountain ash were also present (Godwin, 1975). The massive expansion of hazel during the Late Boreal, however, often regarded as anthropogenic (Simmons, 1975) probably post-dates the early Maglemosian flint assemblages.

The concept of 'site catchment analysis' was largely formulated by economic geographers in the assessment of modern land utilisation patterns (Chisholm, 1968). Taken up by anthropologists, it has been employed in archaeology principally by associates of the early agriculture project in Cambridge (Higgs & Vita-Finzi, 1972), particularly in the Mediterranean region (e.g. Webley, 1972), where the degree of change in the total environment appears more easily allowed for. While such largely theoretical models provide a different approach to the interpretational problems of individual sites, the magnitude of change, even in the Mediterranean (c.f. Bintliff, 1975), can often be underestimated and there remains the tendency to assume that sites with similar artifactual assemblages and lacking significant catchment overlap are contemporary, despite the ephemeral nature of the occupation of many of the sites. It must always be considered that the standard deviation of a ^{14}C date spans many human generations. Clark (1972) has examined the site catchment of Star Carr, using as an approximate limit a circle of 10 km. radius, centring on the site. This represents a two hour maximum walking distance out from the base-camp, a distance suggested by Chisholm (1968) and found to be operative among the Kalahari bushmen by Lee (1968). Beyond this distance, the cohesion of the settlement starts to break down and either the whole community moves to a more advantageous camp site or subsidiary hunting bases are set up. The !Kung bushmen practise the former (op. cit.) and the Ainu of Japan the latter (Watanabe, 1964). Clark (op. cit.) further assumes that land over 30.5 m. would be either minimally or not exploited, a supposition which cannot be substantiated and which would be largely unnecessary for the less broken topography of Hatfield Chase and the Isle of Axholme. From only two sites, Misterton and Beltoft (below, p. 148) are there sufficient artifacts to localise centres and make the inclusion of maps worthwhile and it should be noted that there is considerable overlap between the two projected territories and that several small assemblages fall within these areas. Accepting a naïve premise of contemporaneity, Epworth (below, p. 151) may be a subsidiary of Beltoft on the crest of the Keuper Marl ridge and Haxey, with its group of points, merely a lost spear or butchering site. Little additional constructive comment can be given until similar maps are prepared for every similar site in the country but both principal sites do include roughly equivalent areas of the heavier soils of the Keuper outcrop in their catchment. Omitting both peat and alluvium, the sites are situated on sand and blown sands, although this may be incidental to the exploitation of contiguous fowling and fishing resources. Some difference in character between woodlands on the sand and marl substrates can be suggested and perhaps the limited resources of hazel, with their nutritious nuts, were concentrated on the more base rich soils of the Keuper. The resurvey of the Drift geology of Lincolnshire east of the Trent has yet to be completed but there is some suggestion of roughly similar proportions of Cover Sands and Lias Clay soils around the Sheffield's Hill and Willoughton sites. All these sites show a considerable contrast with Pennine sites like Deepcar (Radley & Mellars, 1964), between steep sided valleys in Coal Measure shales and sandstone edges, with easy access to uplands which, although now open, peaty moors, would have carried birch and pine forest in the Boreal. The more continental climate, perhaps with warmer summers (Osborne, 1974), may have fostered transhumance between upland and lowland sites, although the forest itself would be a considerable moderating influence on the microclimate (Geiger, 1965). Clark's (1972) mobility may only be a feature of the transient phase of closed forest development during Zone IV. It has also to be considered that sites like Deepcar are ideally situated to exploit both upland and lowland ecotones and could also control deer migration routes up the valleys onto the gritstone plateaux. A more sedentary economy could therefore be practised, with the emphasis on red deer that the animal bone evidence from other sites seems to imply (Jarman, 1972), although cases for other animal preferences have also been put forward (Evans, P., 1975). The Ainu of Hokkaido Island, off the north coast of Japan, in many ways the most satisfactory ethnographic analogue to the Maglemosians, practised such an exploitation of an extended territory with primary settlements in the river valleys and permanent seasonal huts for deer and bear hunting in the uplands (Watanabe, 1964; 1968) into the nineteenth century.

The scatter of flint concentrations along the sand ridge at Misterton, however, does suggest frequent temporary occupations by a small group, at slightly different spots over a period of years. Although Noe-Nygaard (1975) has pointed out that there is some evidence for summer occupation at Star Carr, it is perhaps better to attempt to build on Clark's (1972) working model of largely winter lowland residence, with transhumance, following the red deer on their presumed migration to summer pastures in the Pennines. This movement, over about 50 km., would also help to explain the presence of chert from the Carboniferous Limestone on the Misterton site. The economic evidence inferred from the varying proportions of tool types (op. cit.; Mellars, 1973) cannot be applied to the Misterton assemblage because of the admixture of later tools but the small number of burins is more in keeping with Deepcar than Star Carr, although the core : tool ratio is nearer the latter site. It is possible that the differences are chronological.

It remains possible that older and infirm members of any group, perhaps with the women, remained in the lowland camps throughout the year, relying on fowling, fishing and collecting, supplemented by the hunting of small vertebrates, much as the Ainu do (Watanabe, 1964). As Lee and Devore (1968) stress, it is only in the arctic and subarctic zones that groups are wholly dependant upon meat; elsewhere up to 80% of subsistence comes from plant sources, although much would probably be of low palatability and, as among the Hazda of the Lake Eyasi region of Tanzania (Woodburn, 1968), eaten of necessity rather than inclination. The exploitable productivity of pine or birch forest is considerably lower than that of mixed deciduous woodland (c.f. figures in Mellars, 1975) and the Pre-Boreal and early Boreal record of such staples as <u>Rubus</u> spp. and <u>Vaccinium</u> spp. is poor, although several species were undoubtedly present and crowberry (<u>Empetrum nigrum</u>) may have formed some heath on the more acid Cover Sands. Other, less obviously edible plants, including <u>Phragmites communis</u> and <u>Menyanthes trifoliata</u>, were recovered from Star Carr (Clark, 1972) and could have been intensively collected around the sites on Hatfield Chase. It has been suggested that fire was widely used to increase both plant and animal productivity (Mellars, 1975) but the role of natural lightning-set fires in maintaining sub-climax vegetation in continental regions (Rowe & Scotter, 1973) has to be considered before the current archaeological trend of mesolithic pyromania is allowed to run away with palaeoenvironmental interpretation.

It is improbable that sites with good, waterlogged successions will be found on the Hatfield Levels but Dudley (1949) has noted deep post-Glacial peat deposits over the Cover Sands, near Scunthorpe, unfortunately now destroyed by quarrying. It is perhaps from sites in this area, like Sheffield's Hill, where bone and charcoal were recorded (Armstrong, 1931), that a fuller picture may eventually emerge of the local early mesolithic environment.

The Neolithic Site

The presence of a number of Late Neolithic and Early Bronze Age tool types in the Misterton collection provides some measure of agreement with the ^{14}C date of 4330 ± 100 B.P. (Birm.326) from the base of the silty peat deposit adjoining Site I (fig.36). The radiocarbon sample was obtained from below a thin lens of clean sand in the organic deposit and it seems probable that this is contemporary with disturbance, possibly clearance, on the contiguous sand ridge. Some caution, however, must be exercised in assuming that this event is contemporary with the artifacts since no stratigraphic link was established. It is unfortunate that pollen preservation was poor throughout the section and counts were only possible in the basal 20 cm., below the sand lens, and at depths between 60 and 120 cm. from the ground surface. The accompanying diagram (fig. 51), kindly prepared by J.R.A. Greig, summarises the palynological data. In all samples, tree pollen amounts to over 90% of the total, implying fairly continuous, closed woodland. There is a change in forest composition, however, between the base and the 120 cm. mark, with

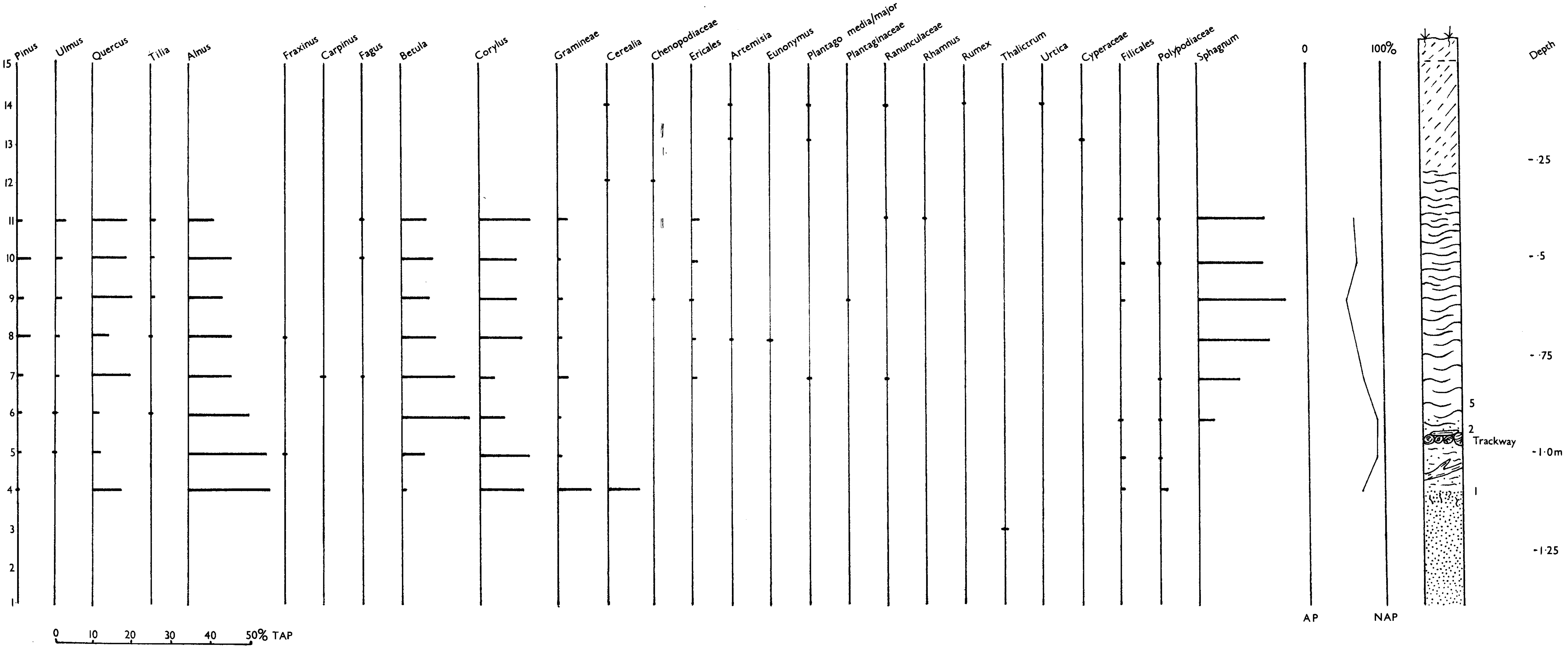

Figure 66 : Thorne Moors, Trackway Pollen Diagram

high counts of lime giving way to increased alder. Turner (1962) has discussed similar changes, in rather smaller proportions of tree pollen, in her somewhat later Thorne Moor diagram and suggested an anthropogenic origin for the changes, perhaps the selective felling of lime trees for fodder, bast fibre or agriculture on the fertile mor soils which this tree favours (Godwin, 1975). The high percentage of _Tilia_ pollen in the basal Misterton samples can be supplemented by macroscopic remains of both seeds and the lime-specific bark beetle, _Ernoporus caucasicus_. Smith (1958) obtained high counts of _Tilia_ pollen from both Hatfield Moor, adjacent to the Misterton site, and Brigg and both macrofossils and the bark beetle were recovered from the lower part of a succession from the bed of the old river Don at Thorne Waterside, from the base of which a ^{14}C date of 4230 $\pm$ 120 B.P. (Birm. 359) was obtained. Similar quantities of lime were noted from the Warwickshire site of Shustoke (Kelly & Osborne, 1965) and it is apparent that, in some areas, lime was an important element in the forest flora, until Bronze Age selective clearance allowed oak and alder to replace it. In Denmark, Iverson (1969) has suggested that lime was theprincipal component of the climax forest, rather than the oak, and similar views have been recently expressed for eastern England (Birks et al., 1975; Rackham, 1976). Lime woods, usually remnants of former coppice, are still fairly common on the Magnesian Limestone (Jackson & Sheldon, 1945; Shimwell, 1973), although it has virtually disappeared from the now podzolised soils of the Chase, a process which was well advanced by the Late Bronze Age (below, p. 285).

The reoccupation of the sand ridge at Misterton during the Late Neolithic, after a lapse of some thousands of years, is paralleled by similar occurrences on many other sites, including the nearby Beltoft site (below, p. 14-). The re-use presumably reflects a similar suitability for agricultural purposes and a hunter-fisher economy, exploiting related site catchment areas. In part, a scatter of re-usable flint may have attracted settlers but the occurrence of Pennine and east Yorkshire parallels for several of the more distinctive artifact types is interesting and could suggest a similar hunting pattern to that proposed for the Maglemosian community, coupled with a more sedentary element practising shifting agriculture; again the Ainu, in their more recent state of adaptation to a partial crop-growing economy, present a reasonable analogue (Watanabe, 1964). The distribution of both polished discoidal knives (Clark, 1929) and 'petit tranchet derivative' arrowheads (Radley, 1964) illustrate these possible connections, although they may be apparent rather than real, due to the paucity of systematic fieldwork in the intervening areas. Of particular note is the association, loose though it is, of polished stone axes of groups I, VI and VII with one of flint. Surface finds of polished axes are not infrequent on the higher ground of the Chase and adjacent areas and two have recently been found at Cattle Carr Farm, 1 km. east of the Misterton site. Finds are particularly frequent on the heavier Keuper Marl lands of the Isle of Axholme (Cummins & Moore, 1973) but, on the carrlands and moors, many sites must remain hidden by the peat. (fig. 52).

No pottery was recovered from the site and extensive excavation on the top of the slight sand ridge, exposed by ploughing on Site I, failed to locate any archaeological features. It is possible that any Neolithic or Early Bronze Age structures, if not totally destroyed by the plough, lie further south, where the plough has yet to penetrate the sand underlying the peat. The deep section running northwards on the site (fig. 36) did not extend out into the deepest part of the organic deposits and it is possible that environmental material relevant to earlier occupation may be preserved there.

Figure 52. Polished Axes from Hatfield Chase.

Key

F = flint.

I = petrological group I, a uralitised gabbro of Cornish origin.

VI = petrological group VI, an epidotised andesitic ash from Langdale, Westmoreland.

VII= petrological group VII, an epidotised microgranodiorite from Graig Lwyd, Caernarvonshire.

IX = petrological group IX, a porcellanite from Antrim, Ireland.

XIV= petrological group XIV, a camptonite from near Nuneaton.

XVIII = petrological group XVIII, quartz-dolerite, probably from the Great Whin Sill from Northern England but also from Drift boulders of this rock.

A = axe not sectioned or ungrouped.

Data from Cummins & Moore (1973) and own sections.

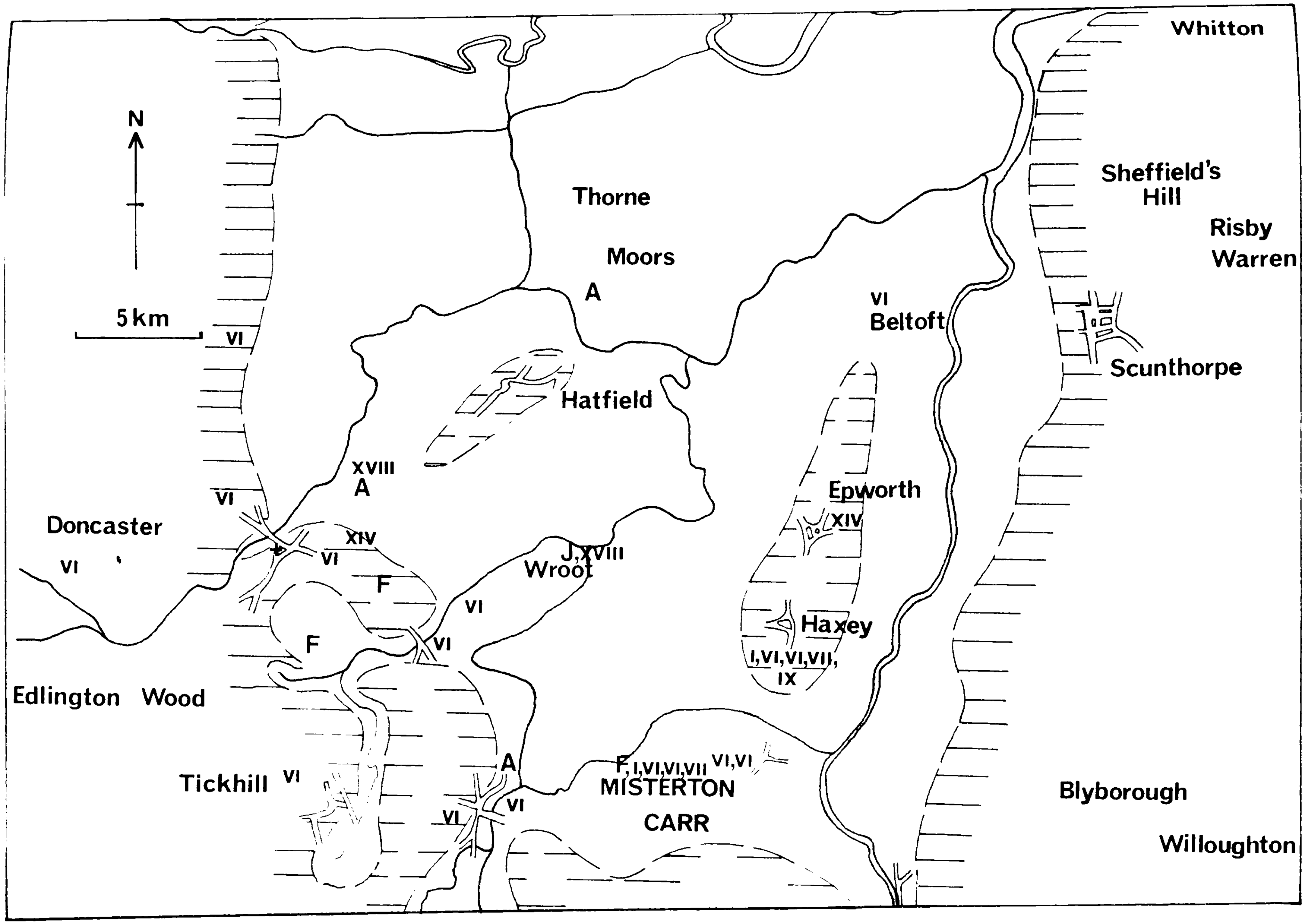

Figure 52. Hatfield Chase : Distribution of stone and flint axes.
(J = jade axe)

Other Mesolithic Material from Hatfield Chase and Adjacent Areas

Although a preliminary list of other Mesolithic finds from the area has been published (Buckland & Dolby, 1973), in order to set the Misterton assemblage in its local and regional context, it is necessary to list and illustrate some of the other unpublished material and draw attention to some of the published finds. Dudley (1949) has dealt with much of the material from north west Lincolnshire and the major assemblages from Sheffield's Hill and Willoughton have recently been studied by Jacobi (pers. comm.); only two additional finds of tranchet axes, which help to fill out the distribution pattern, are therefore listed below. To the west, sites on the Coal Measures have received some measure of attention from the late J. Radley and P. Mellars (Radley, 1964; Radley & Mellars, 1963; Radley & Mellars, 1964) and these sites are also omitted here.

Beltoft, Lincs. (N.G.R. SE817060): A scatter of both Mesolithic and later flints along a sand ridge overlooking more peaty ground (Table 6 & figs. 53 & 54). The situation is very similar to that of the Misterton Carr site. Finds include a tranchet axe, a perforated pebble macehead and a fragment of a Neolithic or Bronze Age flint sickle. Material in possession of M. Felcey, Crowle, Institute of Geological Sciences, Leeds and Scunthorpe Museum.

Blyborough, Lincs. (unlocalised): The tranchet axe (fig. 55) may belong with the Willoughton assemblage from the adjoining parish, which includes several axes. In Doncaster Museum.

Doncaster, Yorks. (N.G.R. SE583034): An obliquely blunted point (fig. 55) from soil over Older River Gravel beneath Roman and mediaeval occupation site. In Doncaster Museum.

Edlington Wood, Yorks. (N.G.R. SK550985): The finds from the Crags area are apparently Creswellian (Mellars, 1973; above, p. 73).

Table 6

Beltoft - Clouds Lane

		U.	L.	P.
Cores:	complete single platform	1	-	-
	partial single platform	2	-	7
	two platforms	-	1	1
	bipolar	1	3	2
	irregular	1	-	-
'Core rejuvenation flakes'-	edge triangular	-	-	3
	platform removal	1	-	-
Primary flakes		49	82	105
'Blades'		44	92	127
Angular waste		4	4	2
Burnt flint		-	8	-
Retouched flakes (largely of blade form)		16	13	17
Notched flakes		1	2	4
Microliths		1	4	10
Scrapers:	end	6	1	8
	end + both edges	1	1	-
	edge	1	2	1
	end + 1 edge	3	1	-
	both edges	1	1	-
Burins		1	1	3
Scraper-burin		1	-	-
Awls		3	-	-
Saws		2	1	1
Tranchet axes		-	-	2
Axe sharpening flakes		-	1	-
Pebble mace head		-	1	-
Plano-convex knife		-	1	-
Flint sickle		1	-	-
Leaf-shaped arrowheads		2	-	-
Unworked Drift flint		-	1	-
Burnt quartzite pebble fragments		-	3	-

Fig. 53 Clouds Lane, Beltoft : Tranchet axes and microliths.

1. Tranchet axe in a poor grey-white flint with frequent cherty inclusions. The cutting edge has several flake scars from flakes detached during use.

2. Tranchet axe in a similar but better quality flint. The cutting edge also shows some evidence of use.

3. Obliquely blunted point, L.H.S. to point, on a blade in grey-white flint retaining some cortex on the left hand edge.

4. Obliquely blunted point, L.H.S. to point but broken; a minimal amount of retouch is also employed on the left hand edge of the base, creating a large, irregular crescent form. In a light grey flint.

5. Small crescent, blunted down the whole of the L.H.S. and with some opposed retouch; in a grey-white patinated flint.

Fig. 54 Clouds Lane, Beltoft : Microliths, pebble macehead and other tools.

6. Obliquely blunted point, L.H.S. to point (broken), in a white patinated flint.

7. Obliquely blunted point, L.H.S. to point, in a white patinated flint.

8. Obliquely blunted point, L.H.S. to point, in a grey-white flint.

9. Obliquely blunted point, L.H.S. and part of back to point, in a grey-white flint.

10. Small trapeze, blunted across one end from L.H.S., in an unpatinated light grey flint.

11. Small, narrow backed blade, in a white patinated flint.

12. Obliquely blunted point, L.H.S. to point (broken), in a white patinated flint, burnt.

13. Obliquely blunted point, R.H.S. to point (broken) with some opposed and inverse retouch on L.H.S.; in a white patinated flint.

14. Large crescent (broken), backed down the whole of the R.H.S., with slight opposed retouch at point; in an off-white flint.

15. Obliquely blunted point, L.H.S. to point (broken), in a light grey flint.

16. Obliquely blunted point, R.H.S. to point (broken), in a white patinated flint.

17. (?) obliquely blunted point, L.H.S. to point with opposed retouch; on a rather thick flake of white patinated flint. From Epworth site II.

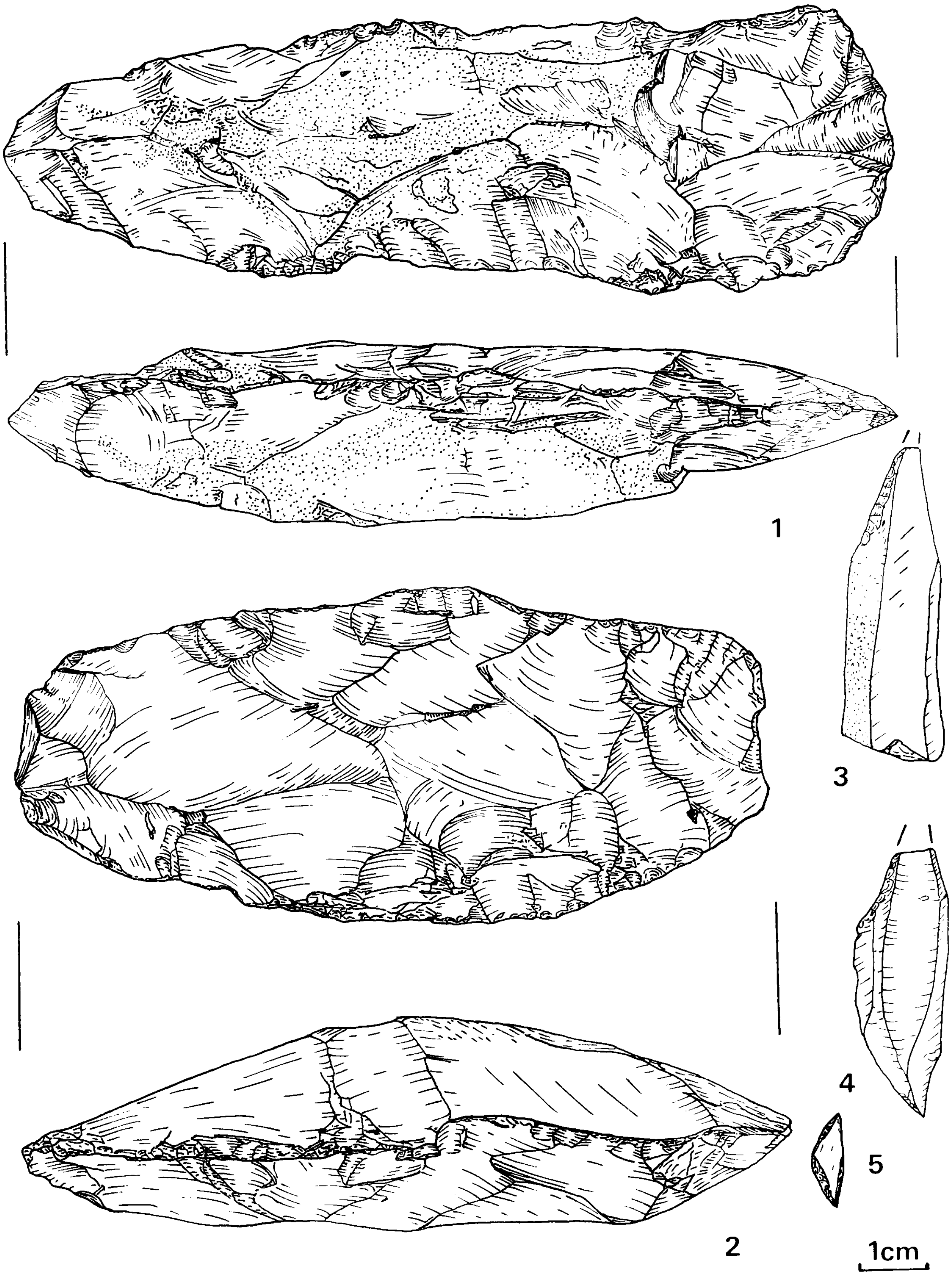

Figure 53. Beltoft : Tranchet axes and microliths.

Figure 54 (continued)

18. Small rod, backed down the whole of the L.H.S. A flake has been struck off, perhaps during use, creating a burin facet on the right hand edge, where there is some trace of further wear afterwards; in a white patinated flint.

19. Pebble macehead with hourglass perforation (broken), made from a natural pebble of a fine grained greenish sandstone from the Drift.

20. Small single edged burin; the opposed side (L.H.S.) has been partially blunted and a nick taken out on the burin spall side to stop the facet blow removing a flake from the whole length of the artifact. In a white patinated flint.

21. Double edged burin in a patinated grey and white flint.

22. End scraper in a white patinated flint.

23. End scraper in a grey and white patinated flint.

24. End scraper, with some retouch along both long edges, in a cherty grey-brown flint.

25. Awl in a fine grey flint.

26. Butt end of a flint sickle, in a fine, translucent greenish brown to black flint. C.f. the complete example from Scunthorpe (Dudley, 1949).

27. Leaf-shaped arrowhead in a similar flint.

28. Leaf-shaped arrowhead in brown flint.

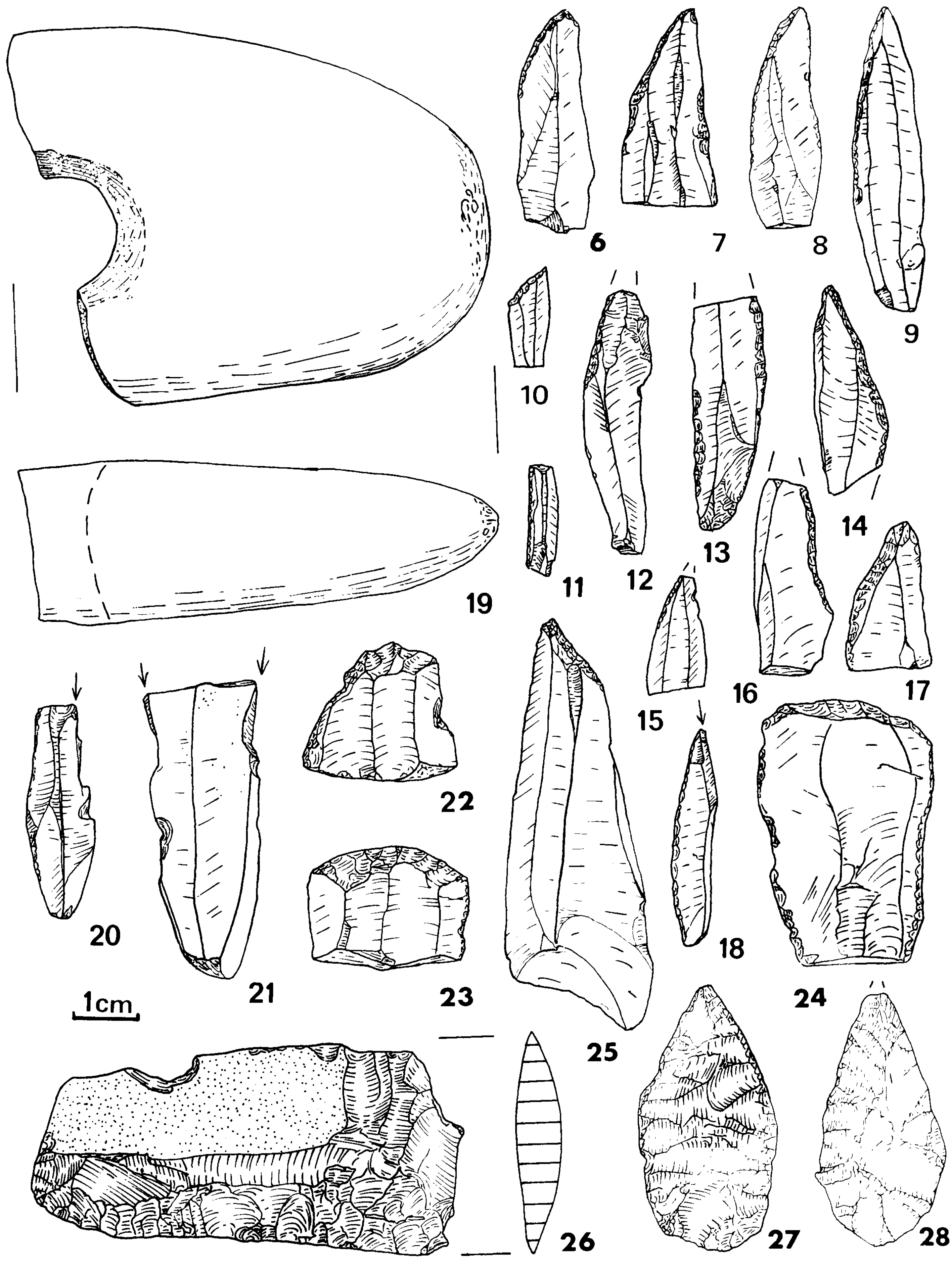

Figure 54. Beltoft : Various implements.

Epworth, Lincs. (N.G.R. SE785046): Two small concentrations of flints, each a few metres across, the one containing no diagnostic pieces but heavily patinated and theother including an obliquely blunted point, two end scrapers and three bipolar cores (table 7). Finds in possession of M. Felcey, Crowle, and Institute of Geological Sciences, Leeds.

Hatfield Moor, Yorks. (unlocalised): Among the artifacts in Doncaster Museum are an obliquely blunted point and a backed blade (fig. 55). The former has previously been published as a Creswellian shouldered point (Manby, 1966); see also Radley & Marshall (1963).

Haxey, Lincs. (N.G.R. SE737090): Ten obliquely blunted points and seven unretouched flakes from top of Cover Sands, beneath ploughed out peat (fig. 55). In Doncaster Museum.

Scratta Wood, Notts. (N.G.R. c. SK541800): M.J. Dolby reports microliths from fieldwork in this area (pers. comm.).

Thorne Moors, Yorks. (SE725125): Tranchet Axe in white, patinated flint (fig. 55), previously published as Hatfield Moor, unlocalised (Buckland & Dolby, 1973). In possession of J. Bertwhistle, Thorne.

Tickhill, Yorks. (N.G.R. SK594943): A scatter of 128 artifacts, including 1 obliquely blunted point, 1 backed blade (fig. 31), 14 scrapers and 4 cores (2 bipolar). In Doncaster Museum.

Tuxford, Notts. (N.G.R. SK715708): Two obliquely blunted points, 14 backed blades, cores and flakes. In Nottingham University Museum. (Manby, 1963).

Whitton, Lincs. (N.G.R. SE889231): Half a tranchet axe in a rough, dirty white flint with inclusions (fig. 55). Institute of Geological Sciences, Leeds.

Wroot, Lincs. (N.G.R. SE711037): Two small geometrics and an unworked flake (fig. 55) found together, perhaps a lost implement. Institute of Geological Sciences, Leeds.

Table 7 Flint material from Epworth, Lincs. (N.G.R. SE785046)

	U.	L.	P.
Site I (SE78500458)			
Primary flakes	3	9	33
'Blades'	-	1	36
Cores: single platform	-	1	1
bipolar	-	-	3
irregular	-	-	1
Core rejuvenation flakes: platform edge	-	1	2
Burnt flint		(10)	
Totals of waste	3	12	74
Retouched flakes	-	-	2
Microlith: L.H.S., across bulb with slight, opposed retouch, point broken	-	-	1
Scrapers: end	1	-	1
Totals	4	12	78
Site II (SE77950460)			
Primary flakes	2	8	21
'Blades'	1	-	13
Core: single platform	1	-	-
Burnt flint		(7)	
Retouched flake	-	1	-
Scraper: end and both edges (discoidal)	1	-	-
Totals	5	9	34

Additional material from the same general area but not with these concentrations includes an end scraper on a blade in white patinated flint.

Fig. 55 Mesolithic material from Hatfield Chase and North Lincolnshire

1. Tranchet axe from Blyborough, Lincs. (unlocalised) in an off-white flint with cherty inclusions.

2. Blade half of a tranchet axe from Whitton, Lincs. (SE89 231) in a similar flint.

3. Tranchet axe from southern end of Thorne Moors, Yorks. (SE725125), in a grey-white flint with cherty inclusions. (from a pencil drawing by M.J. Dolby, original in private possession).

4. Large obliquely blunted point (angle-backed blade), backed down the whole of L.H.S., from Doncaster (SE583034). This piece resembles material from Creswell (c.f. Armstrong, 1939) and should perhaps be included with the Tickhill point (fig. 31) as possibly late Upper Palaeolithic. In a fine, dark grey translucent flint.

5. Obliquely blunted point, backed down the whole of the L.H.S.; in an off-white flint. From Epworth, site II (SE785046).

6. Obliquely blunted point, L.H.S. to point and along part of back; some retouch towards the base on R.H.S.; in a grey-white flint. Hatfield Moors (unlocalised).

7-8. Two obliquely blunted points from the Haxey group (SE737090), in grey-white flint. For other pieces see Buckland & Dolby, 1973.

9. Rod, backed on both sides, in a poor cherty grey flint.

10. Small trapeze, retouched on all faces, in a white patinated flint.

11. Unretouched small blade in grey-white flint.

Pieces 9-11 were found together at Wroot, Lincs. (SE711037).

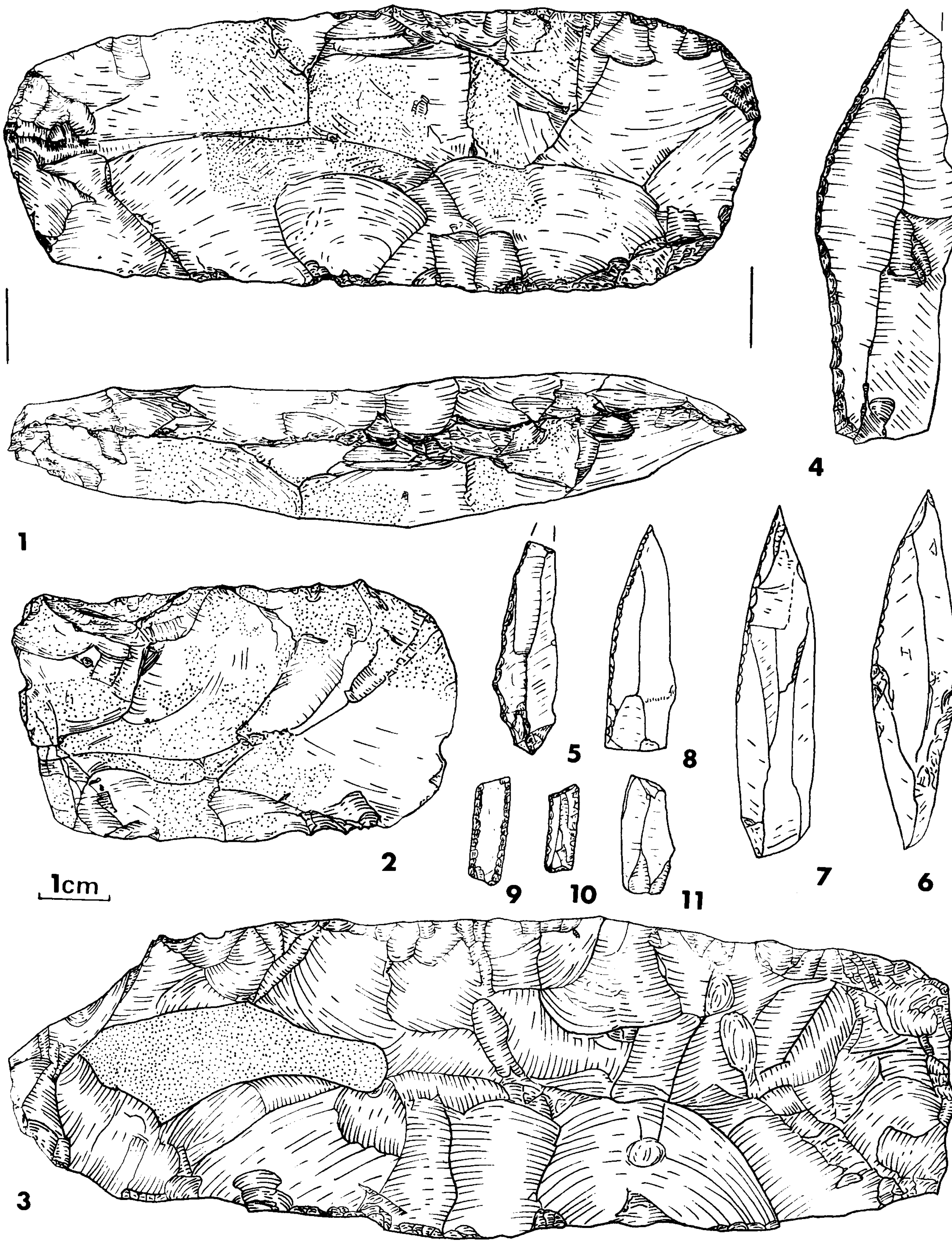

Figure 55. Mesolithic material from Hatfield Chase and North Lincolnshire.