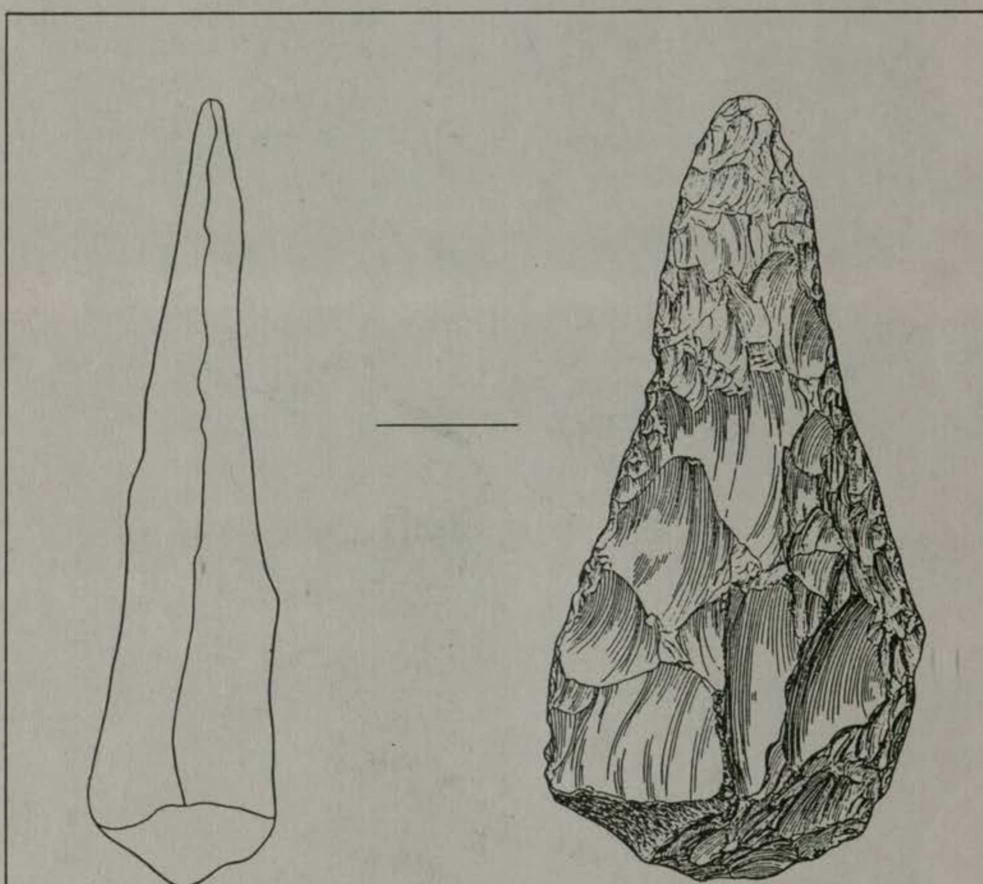
THE ENGLISH PALAEOLITHIC REVIEWED

Edited by
Clive S. Gamble and Andrew J. Lawson



Trust for Wessex Archaeology Ltd
1996

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Registered in England No. 1712772
Registered Charity No. 287786

The English Palaeolithic Reviewed

Papers from a day conference held at the Society of Antiquaries of London, 28 October 1994

Edited by Clive Gamble and Andrew J. Lawson

Trust for Wessex Archaeology Ltd, 1996

Published 1996 by the Trust for Wessex Archaeology Ltd, Registered Charity No. 287786

Produced by Julie Gardiner

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN 1–974350–17–5

The publishers wish to acknowledge with gratitude a grant from English Heritage towards the costs of this publication

Cover illustration: handaxe from Keswick, Norfolk (*drawn by J.J. Wymer*). Scale 1:2

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Acknowledgements

The organisers of the symposium wish to express their gratitute to all those who participated in a successful and edifying occasion. These include, not only the authors listed in this volume, but the other speakers and chairman; Dr Sheridan Bowman, Mr Andrew Currant, Dr Paul Mellars, Mr Mark Roberts and Prof. Alain Tuffreau. We also wish to thank those members of Wessex Archaeology who have either contributed to the *English Rivers Palaeolithic Survey* or with the production of this publication: Linda Coleman, Sue Davies, Julie Gardiner, Phil Harding, Erica Hemming, Andrew Hutcheson and Karen Walker. We are most grateful to the Society of Antiquaries of London for hosting the symposium as part of its research seminar programme and to its Assistant Secretary, Dai Morgan Evans for his help in facilitating the arrangements. Our most sincere thanks go to Prof. Geoffrey Wainwright and English Heritage for their support for the Survey, for financial assistance with the symposium and this volume.

Abbreviations

In this volume, the abbreviation *ka* is used to denote units of a thousand years duration
BP means 'before the present'

Editorial

Clive Gamble and Andrew J. Lawson

In recent years a growing interest in British Palaeolithic sites has developed, in part from an awareness of the wealth of evidence available, but also from the knowledge that Britain forms the most northerly terrain occupied by early humans. However, this interest is also borne out of concern about the means of identifying Palaeolithic sites and of investigating them in the face of potentially destructive threats. In recognition of academic imperatives and because of their national responsibilities for safeguarding archaeological sites of all periods, English Heritage has commissioned a project to study all recorded Lower and Middle Palaeolithic (jointly referred to by some authors as Earlier Palaeolithic) discoveries in England. The potential scale of the study could be gauged from invaluable, earlier work (Derek Roe, this volume) and following discussions to define its scope the project commenced in April 1991. During its first three years it examined the area south of the Rivers Severn and Thames (and, hence, was initially known as the *Southern Rivers Palaeolithic Project*) but the successful conclusion of the first phase led to a logical three year extension to cover the rest of England by April 1997.

The purpose of the *English Rivers Palaeolithic Survey* (described in greater detail by John Wymer in this volume) is twofold: to create a database which relates as accurately as possible the discoveries of Palaeolithic artefacts to their relevant geological contexts, and secondly to make these data available for academic interrogation and the management of the resource. Although the project seeks to create a comprehensive, fundamental record which can be used for strategic planning (such as the establishment of conservation policies or the definition of development plans) it cannot be totally exhaustive: detailed or physical investigation of individual sites is beyond the remit of the project. Similarly, the project does not include within its catalogues sites devoid of any evidence of human intervention but where contemporary environmental evidence, such as faunal remains, have been located. It would be impractical to include all such sites within a reasonable timescale and it is questionable that they are truly archaeological.

A considerable body of information has already been assembled by the project and disseminated in annual reports. In consequence, it is possible to gauge the contribution the project is making to Palaeolithic debates and, gratifyingly, fulfilling its objectives. Nonetheless, a desire to ensure that the purpose and progress of the project were widely understood led to the organisation of a symposium held on 28 October 1994 under the aegis of the Society of Antiquaries of London and sponsored by English Heritage. This publication is based upon the symposium and has been produced to enable both the delegates and those who were unable to attend the opportunity to benefit from the papers presented by various speakers. We hope that explanation of some of the elements which make up the study of the period will help to demystify the subject and through greater familiarity render it less forbidding. We have also taken the opportunity presented by this publication to include an additional paper (by Robert Hosfield) as an early example of the use of the project's data in further research.

The monograph has been produced as economically as possible. Unfortunately, such an approach brings with it limitations: in particular, single colour reproduction makes it impossible to include examples of the detailed locational maps which form an essential section of the *English Rivers Palaeolithic Survey*. The annual project reports contain maps with such a weight of information that multi-coloured plots, generated using a CAD system proved to be the only viable means of displaying the requisite detail. However, copies of these have been lodged with each County Archaeological Officer within the areas studied (as well as with a number of institutions, including the Society of Antiquaries) so that they can be consulted easily. At the end of the project consideration will be given to practical means of publishing a volume which synthesises the results of all six annual reports.

The Palaeolithic period spans the time between the first evidence of tool making by humans and the final retreat of glacial ice from northern Europe. Due to the considerable time span and the fluctuating climatic conditions between these two events much of the archaeological evidence in northern Europe is now buried beneath or within sediments which are more usually studied by geologists (David Bridgland, this volume). Hence, the study of the Palaeolithic is inexorably bound with geology; the archaeological evidence cannot be fully understood in isolation from its physical context and its study is necessarily multi-disciplinary, calling upon the expertise of many specialists in the physical and natural sciences. Dating of significant events is complex but relies upon the analysis of sedimentary sequences (lithostratigraphy), changes through time in the composition of related floras and faunas (biostratigraphy), and a variety of radiometric dating techniques (chronostratigraphy). Fuller explanations of such studies are available elsewhere (Aitken 1990; Bell and Walker 1992; Jones and Keen 1993).

In geological terminology, the Quaternary Period (or System) is synonymous with the Pleistocene and Holocene Epochs together. Climatic events during this period, which are marked by dramatic fluctuations in the extent of ice sheets are best recorded in the build-up of sediments in deep ocean troughs, in terrestrial accumulations of wind blown sediments (loess) and in glaciers themselves. Analysis of this evidence has led to the definition of a number of stages of temperature change (reflected in the balance of oxygen isotopes within the chemical composition of certain marine creatures and crystal structures). Although insufficient data currently exist to correlate these stages with precision across various parts of the globe the Pleistocene is conventionally divided into three units on the basis of them. Correlation is assisted not only by radiometric dating but on occasional reversals of variable duration in the earth's magnetic field, which can be detected both in sediments and volcanic rocks. Thus, the

Lower Pleistocene (up to Stage 19, ie *c.* 2.5–0.7ka BP), Middle Pleistocene (to the end of Stage 6, *c.* 120ka BP) and Upper Pleistocene (to the end of Stage 2, *c.* 12ka BP) have been defined (Fig. 1). The origins of mankind lie much earlier than the start of the Pleistocene and debate continues about the date of the first human presence in Europe but on current evidence the earliest traces of human activity in Britain occur in the Middle Pleistocene (Chris Stringer this volume; Wil Roebroeks this volume). Britain does not appear to have remained occupied continuously thereafter and there appear to be prolonged phases of abandonment, possibly as a result of an impassable channel which rendered Britain an island until sea and river levels were once again lowered under impending glacial conditions.

Sometimes British archaeologists appear to be apologetic about their Palaeolithic evidence. There is no need for reticence because it is clear that both recent excavations and the reports of the *English Rivers Palaeolithic Survey* provide superb opportunities for the consideration of dynamic Middle Pleistocene behaviour and the development of human society (Clive Gamble this volume). During the last half century, discoveries in Africa have stolen the limelight but the refocusing of attention on the latent value of our own archaeological record will undoubtedly bear rich rewards.

These rewards become even more apparent when the English data are combined with their adjacent counterparts. The major rivers of north-west Europe, the Somme, Maas and Rhine, have equally rich records albeit subtly differentiated by local geology, Quaternary processes and the history of Palaeolithic research. But taken together, such contrasted environments provide an opportunity to build a convincing picture of settlement and activity during this remote period of time. This can only be done with systematic records and an agreed goal to both manage and research one of Europe's richest archaeological resources for the study of our common ancestry.

The *Survey* has its own products but these should only be the starting point of an expanding programme of conservation and research. The *Survey* reports may well form a benchmark in period studies and be of strategic importance but they will only realise such significance if used as intended. Having identified the irreplaceable resource, those who have a locus in the management of archaeological or earth science sites will need to formulate detailed tactics for the conservation of the resource or for the mitigation of potentially destructive influences. At the same time, gaps in our knowledge must be identified in research agendas. Following the assessment of the resource through the *Survey* and the setting of research agendas, the challenge, already looming, will be to select priorities, define the methods for management or research, and secure the necessary funding to ensure that the parallel strategies are activated. Only then will the most vulnerable sites be safeguarded for the future and further advancement of knowledge of our earliest ancestors be guaranteed.

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Bell, M.J. and Walker, M.J.C., 1992, *Late Quaternary Environmental Change: Physical and Human Perspectives*, Harlow, Longman

Jones, R.L. and Keen, D.H., 1993, *Pleistocene Environments in the British Isles*, London, Chapman and Hall

Pleistocene Sub-divisions	*British Quaternary Stage*	*Climate*	*Possible correlations with deep-sea core Maritime stage*	*Possible date, years BP*	*Sites and events*	*Divisions of the Palaeolithic*
HOLOCENE	FLANDRIAN	Warm	1	Present 12,000	Development of Postglacial environments	MESOLITHIC–MODERN
UPPER	DEVENSIAN	Mainly cold	2–4 5a–d	40,000 100,000	Maximum of ice sheet 18–20,000 BP reached N. Norfolk and S. Wales	UPPER
	IPSWICHIAN	Warm	5e	120,000	No certain occupation of Britain	MIDDLE
MIDDLE	WOLSTONIAN COMPLEX	Cold Warm Cold Warm Cold	6 7 8 9 10	352,000	*Pontnewydd: sparse occupation of Britain* *Hoxne* *Many Lower Palaeolithic sites*	LOWER
	HOXNIAN	Warm	11	428,000	*Swanscombe skull site*	
	ANGLIAN	Cold	12	472,000	Major glaciation of Britain	
	CROMERIAN COMPLEX	Warm	13	525,000	*High Lodge* *Boxgrove* *Westbury-sub-Mendip*	

Fig. 1 Simplified correlation of British Quaternary events and marine stages

1. Artefact Distributions and the British Earlier Palaeolithic

Derek Roe

Abstract

Artefact distributions can be studied within individual sites, or on the much larger scale of a whole region. For Britain, the making of maps to show distributions of Lower and Middle Palaeolithic sites, in the sense of places where artefacts have been found, is likely to yield confusing results, because many of the assemblages are in derived contexts, and there is little control over the chronology of the occurrences, to indicate what is contemporary with what. Users of such maps should not read into them more information than the compilers set out to provide. Even so, the overall distribution of British Earlier Palaeolithic find-spots shows some features of interest, such as the great rarity of finds north of the Midlands, and the presence of many sites on the higher ground in southern England, as well as in the river valleys. It is important to consider what kinds of factors caused people to abandon stone artefacts at particular points in their contemporary landscape. Some British examples are briefly considered in the discussion of these points. At individual sites, the careful study of artefact distribution may offer remarkable insights into human activities, though few British sites afford appropriate conditions of preservation.

Introduction

It is a pleasure to be invited to contribute to this volume which, *inter alia*, celebrates the completion of the important *Southern Rivers Palaeolithic Project*. The subject assigned to me, artefact distributions, is not an easy one in the context of the British Earlier Palaeolithic, however, and needs to be considered at various levels. It can hardly be denied that a large proportion of archaeological work involves consideration of distributions, whether of whole sites or individual objects, but the scale may vary from one corner of an excavation trench to a whole continent, or may be a hemisphere. Loosely speaking, however, the basic questions remain the same, once a distribution has been recorded: how did the members of the category under consideration get to be where they were found, and what can we learn from the perceived situation about past human behaviour? These two essential questions can of course be broken down to include many sub-questions, and the nature of the answers is likely to depend on the individual archaeologist's own interests and perhaps also his or her theoretical stance within the discipline. There is also the matter of how objects or sites are distributed in time, as opposed to space, but I do not believe that my brief was intended to include that: it is just as well, given the difficulties of dating which so often affect British sites, so few of which are in anything like primary context. This paper will therefore confine itself to spatial distributions: it is a brief personal reflection on how various people approached them in the past, and how we might wish to consider them now, or in the future.

Mapping the British Earlier Palaeolithic

When I began my own research at Cambridge in the early 1960s, with a vague idea of trying to sort out the British handaxe industries, some of the problems confronting me were certainly, in one way or another, distributional. 'Distribution map' was still an almost magical phrase and one had been taught to turn one's nose up at journal articles that did not include such maps, perhaps without stopping to consider very carefully what information they could, and could not, provide. For the British Lower and Middle Palaeolithic, there was certainly no serious distribution map; indeed, there was no general record of sites, finds or extant material. The most serious attempt to provide such a record was to be found in the second edition of Sir John Evans's *Ancient Stone Implements* (Evans 1897), which even then was 60 years old. The Council for British Archaeology had set up Period Research Committees, some time during the 1950s, and its Palaeolithic and Mesolithic group had evidently perceived this gap and attempted to fill it. A questionnaire form had been devised, on a county basis, and a few hundred site record cards printed, and these had been sent out to anyone the Committee members thought might be able to supply information. There had been the usual 30–40% response, showing a variable level of enthusiasm, and the whole thing had ground to a perhaps predictable halt; such cards as had been returned were in the care of my own research supervisor, the late Charles McBurney. Older readers can probably imagine precisely the gleam in Charles's eye when he pushed the half-full card index box towards me one day, with the immortal words: *Here you are, Derek — this might make a good starting point for your research. We think it's at least two-thirds complete: it should take you about three weeks to finish it off.*

This was the birth of the CBA's 1968 *Palaeolithic Gazetteer* (Roe 1968), which John Wymer has been kind enough to say formed a useful basis on which the *Southern Rivers Palaeolithic Project* could build. The task of compiling it actually took me five and a half years, rather than Charles McBurney's projected three weeks; the one half-full card index box turned into five, tightly packed. The *Gazetteer* itself, when published, ran to over 350 pages of tabulated information, site names and totals — this in days when word-processors, and even pocket calculators, did not exist. At least one could claim that it did yield some kind of artefact distribution information for the British Lower and Middle Palaeolithic, though considerations of expense ruled out the inclusion of a set of maps. In the course of assembling the *Gazetteer* records, I did myself make a map of British find-spots — just the first 2000, simply plotting their locations on a large map at quarter-inch to the mile scale against the background of the modern coastline and rivers (Roe 1964, plate xxvii; Fig. 1.1). It is easy to see today that the information such a map provides is minimal. One can observe from it that there are areas where sites are relatively densely concentrated — East Anglia, the Lower and Middle Thames Valley, and the Solent region, in particular—and areas of almost complete emptiness in the north, which require explanation. But this is not a distribution map by period, or by artefact type, or site type, and it bears no explicit relationship to any part or parts of the palimpsest of ancient landscapes of which the British Pleistocene succession is our patchy record. How could it? As for southern rivers, it certainly indicates that large numbers of them have yielded Palaeolithic artefacts, of whatever ages, from their gravels, and one can also pick out that other find-spots lie between the river valleys, on the higher ground; but that is about the limit of the distributional information.

Contrast this with the admirable *Southern Rivers Palaeolithic Project* maps (Wymer this volume). First, they are on a scale of 1:50,000, or for some areas 1:25,000, and have a far more detailed background of modern topographic information; secondly, the find-spots are related on the maps to different geological deposits — gravel terraces, alluvium, brickearth, clay-with-flints, and so forth. Thirdly, each site plotted on one of the maps has a corresponding gazetteer entry, from which at least a first estimate can be made of its actual significance. To this one can add the overview commentaries, region by region, in which useful archaeological and chronological information can be found. This is as good a treatment of the geographical presentation of find-spots over a large area as one could reasonably hope to find. It is not clear that much could usefully have been added, even if time, funding and staffing for the project had been unlimited, if the result were to remain accessible and usable for its intended purpose. It is indeed important to keep the original purpose firmly in mind: this was a study and record of surviving Pleistocene deposits in a given region, which contain, or might contain, Lower or Middle Palaeolithic sites and artefacts, primarily to enable recommendations to be made when commercial threats to such deposits arose. It is in that context that the locational information is most important: this was never intended as an archaeologists' distribution map.

Artefact distributions

How then should we set out to study distributions of stone artefacts, in Britain or elsewhere? I say 'stone artefacts', because that is what can normally be counted on to survive, though in ideal circumstances there ought to be other associated evidence: faunal, floral or environmental data, artefacts or modified objects of materials other than stone, and perhaps even traces of structures. This paper will concentrate on lithic artefacts, but the point made earlier should be stressed, that the main purpose of studying the (static) distributions at all is to try and extract from them information about (dynamic) human behaviour. Humans made the artefacts, always for a purpose, and abandoned them, singly or in groups, at various points in the contemporary landscape. If we are lucky, that is where they have remained; all too often, they have been transported once, or several times, by natural processes, to occur in a 'secondary' or 'derived' context and in far from pristine condition. In these latter cases, the obtainable information is probably limited to a firm indication of human presence, within a rather broad area and also within rather broad limits of time, based on such things as tentative dating of river terraces. That is not enormously helpful, but is not necessarily completely useless: a find of a worn handaxe certainly *in situ* in a Scottish or Irish Pleistocene gravel would always be of interest, for example. But far more important will be the information we can gain when the artefacts have remained more or less where their makers or users left them.

Single sites

It was indicated earlier that the scale of a distributional study could vary from within a single site to over a whole region of very large extent. Some of the very best examples of undisturbed Palaeolithic artefact distributions within one site come from the Later rather than the Earlier Palaeolithic, for example, some of the Late Magdalenian sites of the Paris Basin in France, such as Pincevent or Verberie (Audouze 1987; Audouze *et al.* 1981; Leroi-Gourhan and Brézillon 1966; 1972; all these sources contain further references). In such cases, conjoining of artefacts and microwear analysis, as well as a minute study of how tools and debitage are distributed along with faunal remains, burnt objects and the rest, allow a quite extraordinary level of interpretation of the original site in operation. Domestic areas, activity areas of different kinds, and places where rubbish was tipped, can all be distinguished. Such archaeological analyses may be greatly enhanced by information obtained from ethnographic observation: for example, the work of Lewis Binford (eg 1977; 1978) amongst the Nunamiut people of northern Alaska has taught Palaeolithic archaeologists many things, not least how hunters regard, organise, use and dispose of the kinds of artefacts that are likely to survive as archaeological evidence, whether at a single locality, or over a whole territory in which there are many directly or indirectly related focal points of human activity. As an example of the detailed interpretation of a stone artefact distribution at an undisturbed site, using refitting and microwear analysis, I would select the work of Cahen and Keeley (1980; also in van Noten 1978) at Meer, Belgium, where they were able to reconstruct the activities of two knappers who struck blades from flint cores, made some of them into tools and used these to work bone, first near the edge of the site by a small hearth, and afterwards in what was primarily a habitation area nearer to the centre, where finer finishing of the bone tools took place. One knapper was more skilled than the other, and seems also to have been left-handed.

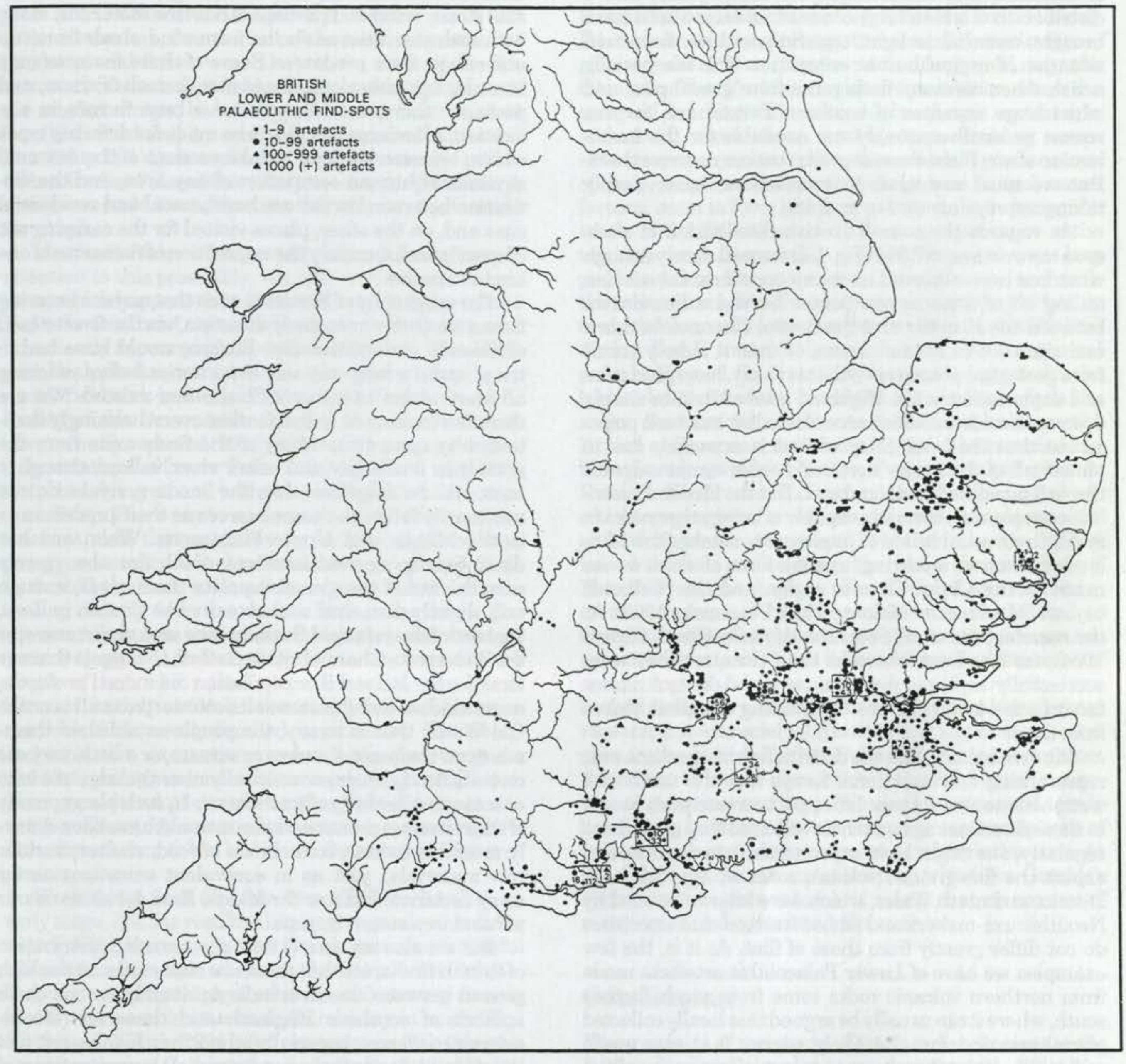

Fig. 1.1 Distribution of British Earlier (Lower and Middle) Palaeolithic find-spots (after Roe 1964)

There is really no reason why we should not gain equivalent information from Earlier Palaeolithic sites, and indeed it has occasionally been achieved. Site FxJj 50 in the Koobi Fora Research Area, Kenya, is an example, around 1.6 million years old (Bunn *et al.* 1980). Recent analysis of the discoveries at Boxgrove makes clear what are the possibilities, even in Britain, of finding sites where undisturbed artefact scatters can be clearly seen to represent knapping places and the locations of other activities, such as the processing of animal carcasses, or parts of carcasses, by the human occupants of an area of land whose nature can be very reasonably reconstructed from study of the sediments and of environmental evidence of various kinds (Roberts *et al.* in prep.). A scatter of knapping debris, even when fresh and conjoinable, is not necessarily the most exciting distribution to study, because most of the pieces are by their very nature untouched debris, on which microwear is hardly to be expected, but it should be possible, as it was at Boxgrove, to say what kinds of tools were being made, at what level of technological expertise, and one may be able to deduce the number of knappers and even their working postures.

Regional distributions

There are various ways in which one can hope to learn from such regional patterns as we can distinguish in Britain, though it sometimes requires the evidence of individual sites within them to provide a key. One has also to keep in mind the often-made points that a map or careful record of find-spots may well reflect a distribution of collectors and researchers over many years, and a distribution of where large commercial excavations have brought material to light, superimposed on the actual situation of original human occupation. This is especially a risk when so many finds come from gravel pits, and when large expanses of southern Britain are, for one reason or another, simply not available for the examination of any Pleistocene deposits that may survive there. But we must use what information we have, simply taking appropriate care in so doing.

As regards the overall British distribution of sites, even my own map of 1964 (Fig. 1.1) showed clearly enough what has been observed on many occasions: the sudden tailing off of finds as one passes beyond a line drawn between the Humber and the Bristol Channel. Is this a real situation in human terms, or does it merely result from geological processes — that is to say, have glaciation and deglaciation in the Highland zone of Britain simply destroyed evidence which once existed? It has been pointed out that the availability of flint is extremely low in almost all of the empty north and west, compared with the well populated south and east. But the Earlier Palaeolithic people were certainly capable of using other rocks to make their usual kinds of implement, notably the Midlands quartzites, occurring in pebble form, of which we see much in the Upper Thames region and the Midlands beyond (MacRae and Moloney 1988; Posnansky 1963). At the remotest site of all, Pontnewydd Cave, Clwyd (Green 1984), far less tractable rocks than the quartzites were successfully exploited for handaxe and flake-tool manufacture, the knappers even extracting Levallois flakes from them.

My own belief is that the distribution is a genuine one, representing only occasional forays into the north and west, with no obvious population pressures to push people in those directions against their will. Had they gone there regularly, one might have expected them to discover and exploit the fine-grained volcanic rocks of, say, the Lake District and north Wales, which were later to be used by Neolithic axe-makers and whose fracture characteristics do not differ greatly from those of flint. As it is, the few examples we have of Lower Palaeolithic artefacts made from northern volcanic rocks come from much further south, where it can usually be argued that locally collected glacial erratics were the likely source. It is also worth making the point that, as one comes to the margins of the main British distribution of sites, there is a tendency for the artefact collections to contain more finished implements and less waste flakes than is the case where sites are more frequent: the Upper Thames Valley is again an example of this. This could imply a situation where the occasional visitors usually brought finished implements with them, rather than expecting to find the wherewithal to manufacture what they needed (cf. comments by MacRae 1988).

The distribution of Palaeolithic find-spots in southern Britain reflects the occupation, or more properly successive occupations, of the whole landscape by humans, who will have been subject to its constraints as well as availing themselves of its particular resources. The contemporary distribution of resources must therefore be the principal explanation of why sites were established where they were, at any particular time. Strategic locations will have been sought, offering convenient access to such commodities as water, animal and vegetable foods, workable stone, wood and perhaps other raw materials, along with such amenities as shelter from wind, shade from sun and refuge from predators. Some of these features may leave little archaeological evidence, but all of them, and perhaps others, are likely to have been factors in site location. Allowance has also to be made for differing types of site, because we need to take account of the seasonal rhythms of human occupation of any area, and the distinction between, on the one hand, social and residential sites and, on the other, places visited for the carrying out of specific tasks, mainly the acquisition of resources of one kind or another.

The geography of Britain is such that anyone entering from a southerly or easterly direction, via the former land connection with continental Europe, would have had to travel quite a long way into the interior before reaching an area where caves or rock shelters existed. We are therefore looking at a distribution overwhelmingly dominated by open sites. Many of the finds come from the gravels in our major and minor river valleys, though it must not be forgotten that the modern rivers do not necessarily follow the same courses as their predecessors in the Middle and Upper Pleistocene. When one has discarded the derived artefacts which are now merely constituents of the gravel deposits themselves, enough only slightly disturbed sites remain, like Cuxton in Kent, the best of the principal Swanscombe area occurrences, or the Wolvercote Channel site in Oxford, to suggest that our local Earlier Palaeolithic population did indeed prefer the same kinds of living places as its counterparts all over the Old World: that is to say, the people established themselves on the bank of a river or stream, or a little way out on to its floodplain, or occasionally near the edge of a lake or some smaller body of fresh water. In such places, many of the resources mentioned above would have been directly available (water, some kinds of food, shelter, various raw materials), just as in equivalent situations as far away as Africa, India or the Middle East, let alone nearer at hand in western Europe.

But we also see clearly from the recorded distribution of British find-spots that there are many sites on the high ground between the river valleys, notably on the chalk uplands of southern England, and these are of considerable interest, especially when they involve not just isolated implements but substantial concentrations of material. These more elevated parts of the landscape evidently had specific attractions for the human population. Because environmental evidence is usually poorly preserved at sites on the chalk uplands, it is not often clear whether we should envisage an open or wooded landscape, or to what extent these were good places for hunting or scavenging. The chalk is often capped by clay-with-flints, usually occurring as patches on the higher points of the topography, clearly remnants of a wider covering. It is these patches of clay-with-flints that have yielded most of the Palaeolithic material and it is good to report that they are now being systematically studied by Julie Scott-Jackson at Oxford, who has kindly allowed me to include here some of her preliminary results. I myself first became aware of the clay-with-flints sites in the 1960s, when, in the course of compiling information for the CBA *Gazetteer*, I encountered the work done by G.W.Willis and others on the chalk uplands of northern Hampshire, in the 1920s to 1940s (Crawford *et al.* 1922; Willis 1947). It seemed to me then, as it had to the discoverers, that the best of the localised scatters of handaxes and flakes were likely to be associated with remnants of an ancient land surface on the high ground: the artefacts might be heavily weathered, but they had been disturbed only by recent agricultural activities (cf. Roe 1981, 183–4). It could well be that virtually undisturbed Earlier Palaeolithic sites were awaiting discovery, if only one could locate them on the wide tracts of arable farmland.

Mrs Scott-Jackson has recently been devoting proper attention to this possibility, not only in northern Hampshire, which happens to be her home area, but also in east Kent; the first brief report on her work in the latter area has recently appeared (Scott-Jackson 1992). At Wood Hill, near Deal, she has carried out an excavation, following up earlier fieldwork in the mid-1980s by G. Halliwell and K. Parfitt, of the Dover Archaeological Group, which they have recently reported (1993). Her work has revealed two concentrations of Lower Palaeolithic artefacts, very little disturbed, lying on and in the clay-with-flints which caps the hill-top. There can be no doubt, from the nature of the artefacts, that the people here were making handaxes, using good quality flint obtained from the clay-with-flints on the hill-top itself, and perhaps also nodules that were eroding directly from the chalk a little lower down. The site as a whole has yielded several handaxes and roughouts, and abundant knapping debris, representing all stages of handaxe manufacture from the first hard-hammer, mainly cortical, flakes to delicate soft-hammer removals from nearly-finished implements. Mrs Scott-Jackson's own excavation produced one fine complete handaxe, and typical manufacturing debitage of all sizes. Sieving produced pieces of knapping debris down to one or two millimetres in maximum dimension, showing how little disturbance there had been. Some burnt flint was present.

Work on the finds from the Wood Hill site is still at an early stage, but the results already give good grounds for hoping that we may in the future gain much useful information from upland sites in the British distribution. One can certainly think of other manufacturing sites in broadly comparable situations: Frindsbury in north Kent (Cook and Killick 1924), for example, or Worthington Smith's principal Caddington site in Bedfordshire (Smith 1894; Sampson 1978). It is not to be thought, of course, that such stone tool manufacturing sites will only be found at high altitude on the chalklands: they will occur wherever any form of erosion has exposed abundant nodules, of good quality, in flint-bearing chalk, giving us such sites as Baker's Hole, Kent (Smith 1911; Wymer 1968, 354–6; Roe 1981, 80–3), Red Barns, Portchester, Hampshire (Gamble and ApSimon 1986), and indeed one section of the Boxgrove site (Roberts in prep.). Some of the high-level sites must certainly reflect human activities of other kinds, since knapping debris is not always abundant. These occurrences are offering us, still essentially in place, evidence for purposeful human presence on the uplands, which elsewhere has all too often been swept away by one geological process or another, eventually to end up far below as a meaningless jumble of derived artefacts in gravels of the local river.

The constantly changing conditions in Pleistocene Britain have produced a confused situation for the Palaeolithic archaeologist, lacking the essential continuity — give or take a few episodes of faulting — of, say, the Olduvai or East Turkana regions of east Africa, where the occupied landscape features high volcanic mountains, with fresh water rivers and streams draining across extensive savannah to a lake. In such cases, the locations of the principal resources, including stone for tool manufacture, seem to have changed relatively little during the whole of the Pleistocene, and human exploitation of the territory is perhaps more predictable, even over long periods of time. There are exceptions, of course, even with the rock sources, like the temporary availability of freshly formed chert nodules in one place at Olduvai (MNK CFS) during Bed II times (Stiles *et al.* 1974), but the general point holds good. Such stability is not to be expected in the higher latitudes of the Northern Hemisphere, given the major fluctuations of climate, which we know as the British or European succession of glacial, interstadial and interglacial episodes. Many of our principal sites in Britain offer direct or indirect evidence for the magnitude of the topographical and environmental changes associated with these climatic events, whether it be the cliff and raised beaches at Boxgrove, the Main Coombe Rock at Baker's Hole, the Anglian tills at High Lodge or Hoxne, or the presence of hippopotamus in deposits dated to Oxygen Isotope Stage 5e. Some of our major Pleistocene events will certainly have been profoundly destructive of archaeological evidence, and some will certainly have caused temporary depopulation of Britain. For all these reasons, it is extremely difficult to link together any set of sites in the British Earlier Palaeolithic and extract from them clear evidence documenting the full human occupation of a distinct territory. We shall always need to rely heavily on individual occurrences for our perceptions of what the general picture was, at any particular time. At the risk of pessimism out of keeping with Clive Gamble's contribution to this volume, it seems that no amount of mapping of find-spots can help us there.

Conclusion

Many aspects of the study of artefact distributions in the British Earlier Palaeolithic are fraught with difficulties that are not the fault of those pursuing such enquiries. Much can be done within well-preserved individual sites, where there may be scope to deploy such techniques as microwear analysis, the refitting of artefacts, experimental knapping and taphonomic experiment, to help discover how and why the artefacts came to be lying where they were found. The conclusions may be supported by other evidence: for example, stone artefacts showing microwear traces appropriate to the butchery of animal carcasses may be found with bones that bear cut-marks. It may not be too difficult to guess, on the basis of work elsewhere in the world, how the Earlier Palaeolithic people are likely to have lived in southern Britain, but good clear evidence for their social and economic strategies has not proved easy to acquire in the field and we must continue to make the best we can of our individual primary context sites, whether in the river valleys or elsewhere. It may be that, over the next few years, sites on the high ground between the southern river valleys will have an important contribution to make, though their nature is such that contemporary faunal and floral evidence will not often be preserved.

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2. The English Rivers Palaeolithic Survey

J.J. Wymer

Abstract

This paper explains the reasons for the initiation of the Southern Rivers Palaeolithic Project *and its logical extension to the new project entitled above: the policies involved and the methods by which information has been collected, edited and published to date. It is stressed that the reports are intended for the use of County Planners, County Archaeological Officers and developers in order to enable them to identify those sites or areas which may require better management or protection. However, such surveys result in a corpus that can be of assistance to Palaeolithic research or Quaternary studies in general. It is this aspect that is mainly considered here by drawing attention to some of the results obtained from relating known find-spots of Palaeolithic artefacts to the distribution of Quaternary deposits.*

The projects

The major reason for the initiation of these projects was the massive increase in the quantity of gravel and sand being extracted for roadbuilding and urban development. Since many of these deposits were of Middle or Late Pleistocene age it was obvious that much evidence for the Palaeolithic period was being destroyed without record. Coupled with the great advance in Quaternary studies during the last few decades and the realisation that this was not an unlimited archaeological resource, some action was necessary. To some extent this came to a head in 1989 when planning permission was granted to a gravel company at Dunbridge in Hampshire to extend some extensive gravel workings of the late nineteenth century which had produced very large numbers of Palaeolithic handaxes. It was also a site where some stratigraphical distinction between two different industries had been alleged. Prior to the granting of consent, objections by archaeologists (amongst others) were raised and an evaluation was made of the site by a specialist. There was insufficient evidence forthcoming from the evaluation to support the objections and planning approval was confirmed following a lengthy Public Inquiry. This outcome had caused considerable distress and inconvenience to both archaeologists and the developers and was to be regretted. It highlighted the unsatisfactory nature of the records available to both planning departments and aggregate companies. It also drew attention to the numerous other commercial activities that were threatening or destroying the Palaeolithic evidence, from major road-building works to pipelines, swimming pools and suchlike. The *Southern Rivers Palaeolithic Project* was devised to remedy this situation.

Palaeolithic archaeology is so integrated with Quaternary studies that it is understandable that many professional archaeologists have tended to regard it as something somewhat apart from later prehistoric periods. There is no justification for this, but it is not unreasonable for a non-specialist to have difficulty in assessing possible threats when sufficient information is not readily available. Most counties in England now have very comprehensive records of known archaeological sites and monuments (SMRs) which cover all archaeological periods including the Palaeolithic. The difficulty lies in assessing the significance of a known site where everything has already been quarried away and the likelihood of something requiring archaeological attention being immediately adjacent. In many cases this problem can be mitigated by knowing the context of the site and its relation to a particular geological deposit. The Project Reports aim to give this information where it is possible. In other words it is a matter of producing maps which relate known find-spots to the Quaternary geology (Fig. 2.1). From such maps it is often possible to pin-point with some accuracy the most likely areas where palaeoliths would be found.

Each site on every map has a number which refers to a gazetteer entry giving the following additional information, where available, tabulated in eight entries:

1. Location
2. Details of discovery
3. Geological deposit as shown on the map
4. SMR number for the county concerned
5. Project map and site number
6. Palaeolithic material known from site and where conserved
7. Major bibliographical references or source of information
8. Present state of site and comments if any.

An example of the gazetteer as published in the Project Reports is given below (Fig. 2.2). It will be seen that each site entry is preceded by a heading giving the administrative parish, county and a six figure National Grid Reference, qualified by:

(A) Accurate (ie precise location)
(E) Estimated (ie related to some name or feature such as a road, farm, copse or hill and considered accurate to within 250m depending on the local topography)
(G) General (ie nothing more known of the provenance other than the parish or district).

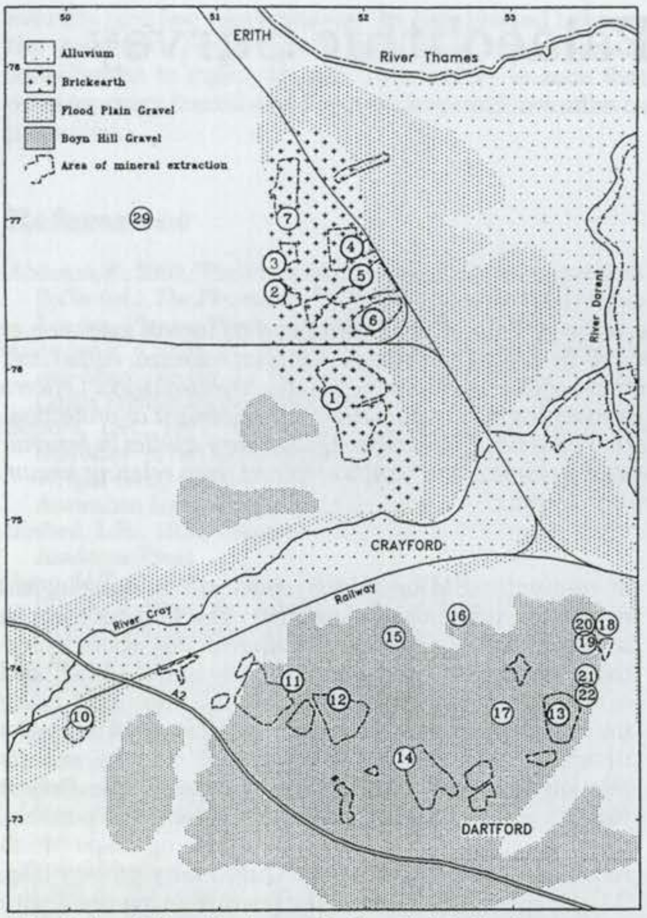

Fig. 2.1 Distribution of Palaeolithic find-spots, Quaternary deposits and mineral extraction sites between Erith and Dartford, in north-west Kent (abstracted from map NWK-3)

It must be stressed that this figure is not an accurate reflection of the quality of the maps produced for the annual reports of the Southern Rivers Palaeolithic Project. *These are multi-coloured CAD maps based on the Ordnance Survey (1:25,000 in this case), onto which are superimposed the areas of deposits, each shown in a different tone. In addition, major Palaeolithic finds are differentiated from less significant discoveries. These maps are too complex to reproduce in monochrome and, hence, this simplified, reduced figure is used as an indication of the detail of the* Project *maps*

The specific objectives of the Project are:

- to identify, as accurately as possible, the find-spots of Lower and Middle Palaeolithic artefacts and the deposits containing them in order to demonstrate fully the distribution of known Palaeolithic sites in England
- to confirm, where necessary, the validity of previous identifications of artefactual collections
- to verify, where necessary, the provenances of discoveries, and to note the current physical condition of such sites
- to chart the extent of relevant Quaternary deposits;
- to review previous aggregate extraction so as to understand the circumstances of the earlier discovery of Palaeolithic material
- to consider current established and potential mineral extraction policies so as to recognise the threat to the Palaeolithic resource
- to assess the varying relative importance of discoveries and the potential for future finds throughout the study area in order to develop predictive models;
- to make recommendations to English Heritage in the light of potential threats
- to disseminate the results as quickly as possible in forms appropriate to different users
- to inform the academic fraternity of the progress and results of the survey
- to put forward proposals for a synthetic monograph which summarises the results of the Project as a final report for sale to a broad market of interested institutions and individuals.

A particularly important feature of the maps is the marking of areas of past, present and currently predicted future mineral extraction by distinctive hachuring. This gives a graphic representation of, as has already been stated, the major threat to Palaeolithic archaeology. Paradoxically, it can also be seen as the source of the majority of discoveries.

In order to achieve the objectives outlined above the *English Rivers Palaeolithic Survey* is funded by English Heritage, as was the *Southern Rivers Palaeolithic Project*. The latter commenced in 1991 for a three year period. The new project is also planned to be completed within three years. At the time of writing it is in the second half of its first year. The administration and management of the Project is conducted by Wessex Archaeology. A team is lead by a Project Manager (Susan Davies) who has responsibility for the preparation, organisation, implementation and execution of the agreed project specification, to agreed performance targets whether academic, financial or timetabled. The Project Team Leader (John Wymer) is responsible for the day-to-day running of the project and specific aspects of the programme. He is assisted by four members of the Unit's staff (Phil Harding, Karen Walker, Andrew Hutcheson, and Linda Coleman), apart from numerous back-up facilities supplied by Wessex Archaeology. Progress is monitored by the Unit Director and a Senior Archaeologist from English Heritage and six-monthly meetings of a Review Team including the English Heritage Chief Archaeologist, an English Heritage Area Inspector, a representative of the Ancient Monuments Laboratory and the senior project staff. Academic advisors of the Review Team consist of Professor Gamble and Doctors Bridgland, Gibbard, Mellars and Roe. A representative of the Association of County Archaeological Officers also attends.

The practicalities involved in achieving what is required are described briefly, so that the merits and shortcomings of the Project can be assessed. The degree of information obtained has to be balanced by the necessity to ensure that the people at whom the Project is mainly directed (Planners, County Archaeologists. Developers, etc) obtain reports on their areas as soon as possible so that Palaeolithic sites get the better management and protection that is needed. For instance, it has

BEXLEY L.B., TQ 514765 (A)
1 Crayford, Rutter's Pit
2 Brickearth dug on both sides of road. Excavations by Chandler
3 Brickearth
4 070448
5 **NWK-3, No.2** Based as for No.1
6 6 Levallois cores
12 Levallois flakes (BM(NH); Manchester Mus)
7 Chandler 1914, 67: 1914, 67; 1916, 240; Kennard 1944, 122; Roe 1968a, 151, 1981, 86
8 Residential or commercial, but depressions of old pits exist on both sides of the main A206 road

BEXLEY L.B., TQ 514767 (A)
1 Erith, Norris' Pit
2
3 Brickearth
4 070561
5 **NWK-3, No.3** Based as for No.1
6 Levallois flake (BM (NH))
7 Chandler and Leach 1912b, 189; Kennard 1944, 122; Roe 1968a, 151, Roe 1981, 86-89
8 Residential

BEXLEY L.B., TQ 519768 (A)
1 Erith, Furner's Old Pit. Otherwise referred to as Furner's North End or North End Pit
2
3 Brickearth
4 070559
5 **NWK-3, No.4** Based as for No.1
6 14 Levallois flakes (BM(NH); Dartford Mus; London Univ Inst Arch)
7 Kennard 1944, 122; Roe 1968a, 151, 1981, 86-89
8 Residential
May include some of the flakes recorded from Furners Old Pit*

BEXLEY L.B., TQ 520766 (A)
1 Crayford, Furner's New Pit. N.W. of Slades Green Station
2
3 Brickearth
4
5 **NWK-3, No.5** Based as for No.1
6 14 Levallois flakes (BM(NH); Dartford Mus; London Univ Inst Arch)
7 Kennard 1944, 122; Roe 1968a, 151
8 Open, hummocky ground

BEXLEY L.B., TQ 521763 (A)
1 Slades Green, Talbots Pit
2
3 Edge of Brickearth
4 070452
5 **NWK-3, No.6** Based as for No.1
6 Levallois flake (BM (NH))
7 Kennard 1944, 122; Roe 1968a, 146
8 Residential
Material recorded as being found "below Crayford Brickearth under boulder bed."

BEXLEY L.B., TQ 515770 (G)
1 Crayford or Erith
2
3 Brickearth
4 070474 and 070449
5 **NWK-3, No.7** Based as for No.1
6 21 hand-axes
1 rough-out
14 flakes retouched (Bradford (CMH); Cambridge (S); Brighton
51 flakes Mus; Bedford Mus; Maidstone Mus;
2 Levallois cores Birmingham (CM); Dartford Mus; BM; BM(NH);
111 Levallois flakes Reading Mus)
7 Spurrell 1886, 213-6; Chandler and Leach 1916, 79-116; Kennard 1944, Roe 1968a, 146, 151; Wymer 1968, 322-326; Roe 1981, 86-89; Roe pers.comm.
8 See Kennard (1944) for information concerning the confusion with the recorded provenances and names of the various brick-earth pits that once existed in Crayford and Erith. However,the majority of the artefacts listed above almost certainly came from Stoneham's Pit (NWK-3, No.1). The commercial exploitation of the brickearth was so extensive that very little remains except under roads or pre-existing buildings, but if any undisturbed sections should be located with associated artefacts, faunal remains or organic sediments:

BEXLEY L.B., TQ 471704 (A)
1 Foots Cray, Crittals Corner
2
3 Flood Plain Gravel or Brickearth
4 070512
5 **NWK-3, No.8** Based as for No.1
6 Hand-axe (Maidstone Mus)
7 Roe 1968a, 153
8 Bypass

Fig. 2.2 Extract from the Project report gazetteer for north-west Kent, part of the Southern Rivers Palaeolithic Project *Report No. 2 (1992–3)* not been possible to check every old Ordnance Survey map, estate maps or similar records to locate the numerous small gravel pits that once existed. Nor has it been possible to check on all unpublished material that may have come into museum collections since the publication of Dr Derek Roe's *Gazetteer of British Lower and Middle Palaeolithic Sites* (Roe 1968). However, it is hoped that all the relevant literature has been seen in which such may have been published. Some ephemera may have been missed but all the relevant county and national journals have been consulted. It is Roe's *Gazetteer* which is the starting point of this survey, and it cannot be emphasised sufficiently that without this seminal publication several further years would have been necessary for the completion of this project. Museum collections have therefore only been examined in specific instances, such as when there are doubts as to artefactual authenticity or knowledge of new material having been donated. Thus, the figures given for the known artefacts from each site (Entry no. 6 in the Project lists of sites; above) are in nearly every instance based on Roe's work, which is hereby acknowledged with gratitude.

For the *English Rivers Palaeolithic Survey*, that part of England north of the Thames and the Severn has been divided into six regions.

These regions are based, as were the regions of the *Southern Rivers Palaeolithic Project*, on watersheds of the major drainage areas, with minor adjustments in places to accord with county boundaries to facilitate administration. They are numbered from 7, in order to prevent any confusion with the six regions previously defined for the *Southern Rivers Palaeolithic Project* (Fig. 2.3). All twelve regions are listed below:

Southern Rivers Palaeolithic Project Regions

1 West Country
2 Severn and Bristol Avon
3 Upper Thames and Kennet
4 Wey and Mole, Darent, Medway, and Stour
5 Solent and Wiltshire Avon
6 Sussex rivers and Raised Beaches

English Rivers Palaeolithic Survey Regions

7 Middle and Lower Thames
8 East Anglian rivers
9 Great Ouse
10 Warwickshire Avon
11 Trent
12 Yorkshire and Lincolnshire Wolds

Each year of the three year project is devoted to two of these regions, not in order of numbering but on the estimated time required for study, based on the known quantity of the evidence. For example, for the first year the prolific number of sites and complexity of the Quaternary deposits in Region 7 has been balanced with the relatively sparse distribution of sites in Region 10. For ease of study and description the regions are usually sub-divided into smaller areas.

The Thames drainage area required a different approach as the great majority of the sediments associated with the main river are on its north side along the middle and lower parts of the valley (Region 7). Thus, when plotting sites along the Wey and Mole and other northward flowing tributaries in the Middle Thames Valley (Region 4), only those were included which were associated with the deposits of the tributaries themselves and not those associated with the Thames itself. In the Lower Thames Valley, the situation was similar but the prolific number of sites in the Crayford–Northfleet area were included in the *Southern Rivers Palaeolithic Project* in view of their association with the Darent and the Medway of north-west Kent. Nonetheless, with the addition of the forthcoming report on Region 7 the whole of the Thames Valley will have been covered.

The policy is to visit every known site which can be given an accurate or estimated six figure grid reference, or where there is sufficient information on the provenance to suggest where it may be located: a parish or district provenance could only be given a general category, but the addition of names of finders, dates or names of farms, streets or topographical features might permit a more precise location.

As previously stated, the starting point and source for lists of find-spots of palaeoliths is Roe's *Gazetteer*, coupled with relevant publications. To this can be added the entries on the Sites and Monument Records for the counties concerned. These have been made freely available to the Project by County Archaeological Officers or Planning Departments and, although much is repetition (as it should be), the records sometimes have additional information on known sites or new ones not yet published. It is also essential to have these records so that the county SMR number can be added to Entry 4 of the lists accompanying the maps in the Project reports. Another valuable source of information is from the unfortunately rare but dedicated local non-professional archaeologists whose interests are in the Stone Age. Many are much more than collectors of 'pretty flints' and have a profound knowledge of the palaeoliths found in their locality. Similarly, non-archaeological local people can frequently explain some puzzling name associated with an unlocated find-spot. It may be the name of a house which no longer exists, or a farm which has changed its name.

Of equal importance in visiting the find-spots is the opportunity to observe the local topography and any geological exposures if they should exist. It can indicate the position of a palaeolith in relation to terrace or erosional features that is not always evident on small scale maps. It is also an obvious way of recording the present state of the site.

Gravel pits are noted in the field or from current and old Ordnance Survey maps. As mentioned, these are marked on to the Project maps.

Another valuable source of the location of pits are the *Mineral Assessment Reports (Sand and Gravel Resources)* published by the British Geological Survey. In order to represent graphically the areas for possible future extraction as indicated by *County Mineral Plans*, the Planning Departments of all the relevant counties have been contacted and in many cases visited. These plans vary considerably in terms of detail or on planning requirements or legislation. They were first made in 1971 following legislation and, as the need for aggregates has risen considerably since then, many are currently being revised. This information is included in detail as an

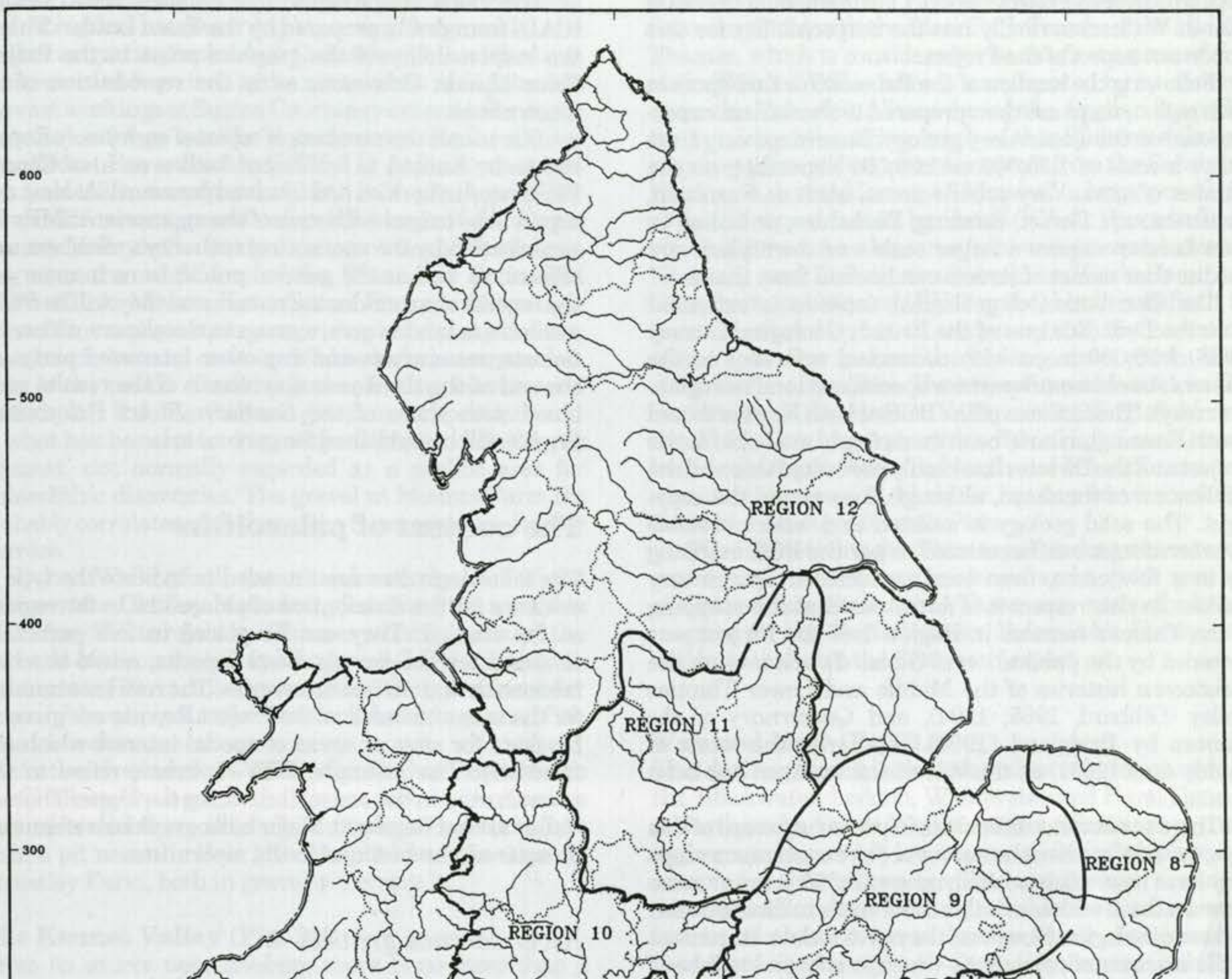

Fig. 2.3 Geographical regions defined for the Southern Rivers Palaeolithic Project *(Nos 1–6) and the subsequent* English Rivers Palaeolithic Survey *(Nos 7–12). These are based primarily on the major river drainage systems*

appendix to each Project Report. One member of the team (Karen Walker) normally has the responsibility for this important aspect of the Project.

Following the location of the Palaeolithic find-spots in each region, maps are then prepared to show them superimposed on the Quaternary geology. Base maps vary from either a scale of 1:50,000 or 1:25,000 depending on the number of sites. Very prolific areas, such as Farnham, Bournemouth, Dorset, Reading, Berkshire, or Ealing in west London require a larger scale and town plans are used so that names of streets can be read from them.

The distribution of geological deposits is extracted from the Drift Editions of the British Geological Survey (BGS) 1:50,000 maps with occasional reference to the *Mineral Assessment Reports* or specialised local or regional surveys. The facilities of the BGS at both Keyworth and South Kensington have been made freely available to the Project and the Director has kindly permitted this and the publication of the maps, although they retain the copyright. The solid geology is omitted and where possible river terraces are differentiated as per the BGS mapping or, in a few cases, from local, specialised Quaternary studies. In this respect it is fortuitous that the mapping of the Thames terraces in Region 7 of the Project was preceded by the publication of Gibbard's volumes on the Pleistocene histories of the Middle and Lower Thames Valley (Gibbard, 1985; 1994), and *Quaternary of the Thames* by Bridgland (1994). Similarly, the work of Maddy *et al.* (1991) on the Warwickshire Avon has been invaluable.

There are obvious difficulties in preparing maps of this type, especially when the surveys of two contiguous maps may have been made with an interval of 50 years or more between them with inevitable differences in distributions and terminologies. However, they give a clear statement of the contexts of palaeoliths which it is hoped will be of use to both planners and archaeologists.

Reports are to be prepared for distribution to cover each year of the Project, as has already been done for the *Southern Rivers Palaeolithic Project*. Thus, each report covers two regions:

Report for year 1 (1991–2) Regions 3 and 5
Report for year 2 (1992–3) Regions 1 and 4
Report for year 1 (1993–4) Regions 2 and 6

The first report for the *English Rivers Palaeolithic Survey* will be of Regions 7 and 10.

The reports are each in two comb-bound volumes, one of A4 size with text, and the other of A3 size with the maps. The textual volume contains introductory chapters to assist people who do not specialise in the archaeology of the Quaternary period and a summary of the policies and legislation concerning the protection of Palaeolithic sites. The main body of the text consists of the lists of sites within each division of the regions, relating to the maps in the other volume. Each section is preceded by a short account of the geology and history of research, and followed by a summary of present interpretations with an assessment of the Palaeolithic evidence. At the end are bibliographic references and appendices giving details of mineral extraction in each of the counties covered by the two regions.

The maps are produced by Computer Aided Design (CAD) from drafts prepared by the Team Leader. This is the responsibility of the graphics artist in the Project Team (Linda Coleman), as is the reproduction of all illustrations.

Due to cost the numbers of copies of each year's Report has to be limited to interested bodies such as County Planning Authorities and involved personnel. At least one copy will be lodged with each of the appropriate SMRs for consultation by the sponsoring authority's members and officers, as well as the general public. In no manner are the reports of a confidential nature and they will be freely available to landowners, managers, developers, conservationists, researchers and any other interested party. At the end of the third year a synthesis of the results combined with those of the *Southern Rivers Palaeolithic Project* will be published for general sale.

The context of palaeoliths

The following notes are intended to indicate the type of evidence for the distribution of palaeoliths in the regions so far studied. They can be placed in five particular contexts: terrace gravels, head deposits, raised beaches, brickearth and surface discoveries. The reference number for the maps included in the Project Reports are given in brackets for sites or areas of special interest which are mentioned (for example, UTV–7, below, refers to the seventh map in the series illustrating the Upper Thames Valley area of Region 3). Major bibliographical references, if required, can be found in the report lists.

River terrace gravels

Upper Thames (Fig. 2.4)

Vast areas of Floodplain Gravel have been quarried not far from the source of the Thames around Ashton Keynes and South Cerney, and more is likely to be dug if the minerals local plan is implemented. However, only three find-spots of palaeoliths are known. There is a spread of terrace gravel at Fairford and considerably more east of Lechlade but, apart from large pits in Terrace 2 north of that town, there are no large areas of gravel extraction before the confluence with the Windrush, and most of that is in Floodplain Gravel. This lower reach of the Windrush has produced a few handaxes, as has Standlake nearer the Thames itself. Not until Stanton Harcourt is reached has the higher Summertown–Radley Terrace been dug commercially on a fairly large scale (UTV–7). Considerable numbers of handaxes, many of quartzite, have come from the 'Gravelly Guy' pit, only a kilometre distant from the interglacial channel under the main body of the gravel of this terrace at Linch Hill (the Stanton Harcourt Channel) (*see also* Bridgland this volume).

There is a scatter of about 20 handaxe find-spots in the city of Oxford, mainly found as a result of house or road construction, although pits existed at Iffley and Wolvercote, both of which produced palaeoliths. The latter site, now an ornamental lake is at the level of the Wolvercote Terrace, which is higher than the Summertown–Radley Terrace Gravel in which most of the Oxford finds have been made (UTV– 9).

The Floodplain Gravel between Nuneham Courtenay and Abingdon has been dug on a very large scale, and further extraction is planned. Only a few palaeoliths have been recorded from it. It is the same below Abingdon, but the vast workings at Sutton Courtenay extend so far south that they infringe into the Summertown–Radley Gravel near Didcot Power Station (UTV–11). At least one quartzite palaeolith was found *in situ* in a pit there. Wide spreads of terrace gravel occupy this part of the Upper Thames Valley and considerable quantities of it have been dug near the confluence of the Thame at Berinsfield (UTV–12). At Mounts Farm Gravel Pit some 240 palaeoliths of flint and quartzite comprising handaxes, cleavers, Levallois flakes and cores and flakes have been recorded. This is the result of methodical collecting over several years by Mr R.J. MacRae and gives rise to speculation as to what has been missed in many other pits in the Upper Thames, not normally regarded as a prolific area for Palaeolithic discoveries. The gravel at Mounts Farm Pit probably correlates with that of the Summertown–Radley Terrace.

Below Wallingford, the abandoned channel of the Thames (the Cholsey Meander) goes round the west side of Cholsey Hill to rejoin the Thames which goes round the east side of the same hill at Mongewell (UTV–13 and 14). Remnants of Terrace 2 survive within this great meander loop and have produced a couple of handaxes, one of an igneous rock.

As the river narrows within the Goring Gap through the Chalk escarpment, so the terrace deposits become less extensive and there are only a couple of find-spots, one from a pit near the Fair Mile Hospital and the other on Streatley Farm, both in gravel of Terrace 2.

The Kennet Valley (Fig. 2.4)

From its source near Avebury there is no more than a narrow deposit of valley gravel flanking the river and the two handaxes which are known from the valley bottom may have come from alluvium. From Hungerford, however, Lower Terrace Gravels survive as consistent features each side of the river and a few palaeoliths have been found in them, especially at Newbury. Except for a pit at Kintbury, little gravel is actively dug in the valley above Newbury. Between Newbury and Reading it is very different and much of the Floodplain Gravel and some of the Lower Terrace Gravel has been removed all along the valley. There is only one record of a handaxe, found at Theale, and this was dredged from the river. The distribution of the gravels (KV–4) shows very clearly the former course of the Kennet probably during the Devensian Stage when it flowed through the present Pang Valley to join the Thames at Pangbourne.

At Newbury, where the Kennet is joined by the Lambourn, the river flows in a wide but steep-sided valley, cut through a plateau at about 45 m above the present floodplain. Virtually none of the intermediate terraces between this High Terrace Gravel and the Lower Terrace Gravel survive. There is one patch at Brimpton which has produced a handaxe from a small gravel pit. This could correlate with the Boyn Hill Gravel of the Middle Thames Valley (KV–3).

The High Terrace Gravel which forms such a conspicuous flat from Newbury to Burghfield on the south side of the Kennet Valley represents the Silchester Stage of the evolution of the Kennet–Thames system. It has been correlated with the Black Park Terrace of the Middle Thames, which is considered to be the first course of the main Thames Valley after it was diverted by ice coming down the Vale of St Albans during the Anglian Stage. In the opinion of the writer much of this Silchester Gravel may be earlier and represent outwash from the Salisbury Plain area, but at Hamstead Marshall a large gravel pit at this level produced 23 handaxes (KV–3). Sporadic finds of palaeoliths have also come from various sites between Newbury and Sulhamstead, such as Wash Common, Greenham and Wasing (KV–3 and 4) but it is difficult to know whether they are contemporary with the formation of the gravel or palaeoliths of later date which were discarded on its surface. The only comparable sites on the north side of the Kennet Valley are at Englefield and Bradfield. Very large quantities of this High Level Gravel have been dug between Padworth and Ufton Nervet and considerably more is likely to be dug in view of the Berkshire *County Minerals Plan*.

The Kennet joins the Thames at Reading where numerous gravel terraces are preserved and a great number of Palaeolithic sites exist. These are currently being mapped for the *English Rivers Palaeolithic Survey* and will be included in the first years' report.

Wey and Mole (Fig. 2.5)

This drainage area also includes other tributaries such as the Blackwater, Loddon, Whitewater and Hart. There is a North and a South Wey and other tributaries in their higher reaches and it is a matter of choice which one is accepted as the main source. The branch which rises near Alton has a fair claim to be regarded as the trunk stream, but in all these streams there are only discontinuous remnants of terrace gravels above Farnham or Guildford. The gravel has been little exploited and there are no Palaeolithic finds recorded. This is surprising in view of the very prolific sites in Terraces A and B at Farnham (W&M–5), and may be explained by this lack of gravel pits. None of the higher implementiferous terraces at Farnham are now dug and the area is entirely residential. On modern standards, the numerous pits which once existed were small. Some were in operation until the 1950s but the early ones were hand-dug and hand-screened, thus accounting for the large numbers of palaeoliths which were collected. The district has received considerable attention from both archaeologists and geologists and provides one of the best sequences of palaeoliths within a flight of terraces in southern England.

The area north of Farnham provides one of the classic examples of river capture in the Thames drainage system, with the original course of the North or Farnham Wey being the present River Blackwater being captured by the headwaters of a tributary of the South Wey, some time during the Devensian Stage (W&M–4). Terraces are well preserved along the Blackwater from Farnborough downstream, but have been much less exploited than the Floodplain Gravels which have been and still are dug on a large scale. No palaeoliths are known from these Floodplain Gravels and there is only one handaxe recorded from Terrace 3 at Yateley. Extensive quarrying of the high level gravels around Eversley Common is not known to have produced any palaeoliths. A few handaxes from gravel at

Fig. 2.4 Distribution of principal river gravel deposits in central southern England. Based on OS (1977) Quaternary Map of the United Kingdom, 1:625,000

Wokingham (W&M–2) may relate to a former course of the Blackwater.

South of Wey Gap through the chalk escarpment at Guildford, there are wide spreads of Lower Terrace Gravel, with a little known but possibly primary context site recorded from a small pit at Peasmarsh, now a landfill site. North of the Wey Gap there are also wide spreads of Lower and Higher Terrace Gravels but these have been very little exploited and no palaeoliths have been recorded. However, at St George's Hill near Weybridge a few handaxes are known from what is mapped as Plateau Gravel, but equated by Gibbard (1985) with his Dollis Hill Gravel, considered to represent the course of the Wey/Mole during the Early Anglian Stage, prior to the diversion of the Thames from its course through the Vale of St Albans. Between Weybridge and Walton, where the Wey and Mole drain into the Thames there are wide spreads of Taplow and Boyn Hill Gravels, but very little is recorded from them, probably as it is a thickly populated residential area and there has been correspondingly little digging of them. The Floodplain Gravels have been dug on a large scale between Thorpe and Walton. Nothing has been recorded from them.

Further east, the Wandle valley has produced a few handaxes from its Lower Terrace Gravels (Terraces 1 and 2, map W&M–10). Some small pits operated earlier in the century. Nothing is dug now, but a few finds from Wimbledon Common are of great interest as the High Level Terrace Gravel of the Common is possibly of Anglian Age.

North-west Kent (Fig. 2.5)

Between Erith and Northfleet is a concentration of some of the most famous and well-studied Palaeolithic sites in Britain: Crayford, Dartford, Swanscombe and Northfleet. For the most part the sites are in areas mapped as Boyn Hill Gravel, but it is evident that the terrace sequence in this area is very complex. On Dartford Heath the terrace gravel reaches a maximum thickness of about 18 m and there are differing views as to its age. Barnfield Pit, the site which produced the three fragments of the human skull is now a National Nature Reserve and the adjacent Alkerden Lane Allotments is a Site of Special Scientific Interest (SSSI). At the latter site there is preserved an undug complete succession of the Barnfield Pit sequence (NWK–4). Depressions of some of the old pits in the Crayford Brickearth can still be seen, but the area is now almost entirely built over. The Wansunt Pit at Dartford is also a SSSI, although an industrial estate is in part of it. The Levallois site of Baker's Hole is a landfill area, but it is not entirely back-filled and some islands of undug deposits are also designated as SSSI.

Gravel is no longer dug anywhere in this area, although the immense scale of previous quarrying is obvious (NWK–3, 4 and 5). Undisturbed deposits still remain in the Ebbsfleet Valley at Northfleet and will be threatened if the rail route from the Channel Tunnel to a tunnel beneath the Thames is eventually cut through the valley.

Apart from a number of palaeoliths from old pits at Wilmington, south of Dartford, the Darent Valley has produced very little in its course through the chalk escarpment. Nothing but Floodplain Gravel survives, which has been quarried extensively up the valley as far as Sutton at Hone. The remainder of this area of North-west Kent is remarkable for its very large number of surface sites (*see below*).

Medway (Fig. 2.5)

West of Tonbridge there is little terrace gravel surviving in the upper reaches of the Medway and no find-spots of palaeoliths are known. Plans for future extraction downstream from Tonbridge may extend on to the terrace gravels covered by brickearth (M–2) and will require watching.

When the Medway, joined by the Beult and Teise, cuts through the lower greensand escarpment at Maidstone, it emerges on to the gault vale and there is a wide expanse of Terrace 2 Gravel at Aylesford which has been dug for many years and pits are still operating. In the past this gravel has yielded numerous palaeoliths, as have pits in Terrace 3 Gravel at New Hythe (M–4).

No terrace deposits survive in the spectacular Medway Gap through the chalk escarpment, although it is difficult to know whether some of the sediments at the prolific Cuxton site are Head or Terrace Gravels. Similarly, the relatively numerous Palaeolithic find-spots in the Rochester–Chatham–Gillingham area are in deposits mapped as head by the British Geological Survey. A site at Hoo St Werburgh with material in very fresh condition is mapped as head but may have come from Lower Terrace Gravel obscured by overlying head deposits.

The most important site in the Medway system on the Hoo Peninsula is the Shakespeare Farm Pit at St Mary Hoo for it has produced at least two handaxes and the Terrace 3 Gravels have been correlated by lithostratigraphy with their counterparts on the other side of the Thames estuary at Southend, demonstrating its earlier confluence with the Thames at that point (M–5) (Bridgland this volume). Gravel is still dug around St Mary Hoo, although the Shakespeare Farm Pit is worked out and partly levelled. Future plans include the opening of pits in Terrace 3 Gravels between here and Hoo St Werburgh.

Great Stour (Fig. 2.5)

There are only remnants of terrace deposits in the upper reaches of the Great Stour, although they become a little more extensive around Ashford. Little of it is or has been dug. Floodplain Gravel is quarried east of Ashford. Apart from one handaxe from the fringe of Terrace 3 at Ashford, no Palaeolithic sites have been recorded until Chartham, where a handaxe possibly comes from Terrace 4 Gravel. Downstream from here there is a remarkable cluster of sites along the valley as far as Westbere (Maps S–4 and 6). Although these sites are mainly on terraces mapped as brickearth, they come for the most part from the gravels underlying the brickearth.

The majority of the palaeoliths found in these gravels of the Great Stour come from deposits of Terrace 2 though, significantly, the rich site of Fordwich is on the higher terrace 3. Discoveries actually within the City of Canterbury were made in small pits or during construction work, but very large pits were working in the Sturry area early in this century, exploiting Terrace 2 Gravel. Gravel is presently extracted from the Floodplain at various places south-west of the city, but the current *County Minerals Plan* indicates the possible future extraction of Terrace 2 Gravel between Harbledown and Chartham.

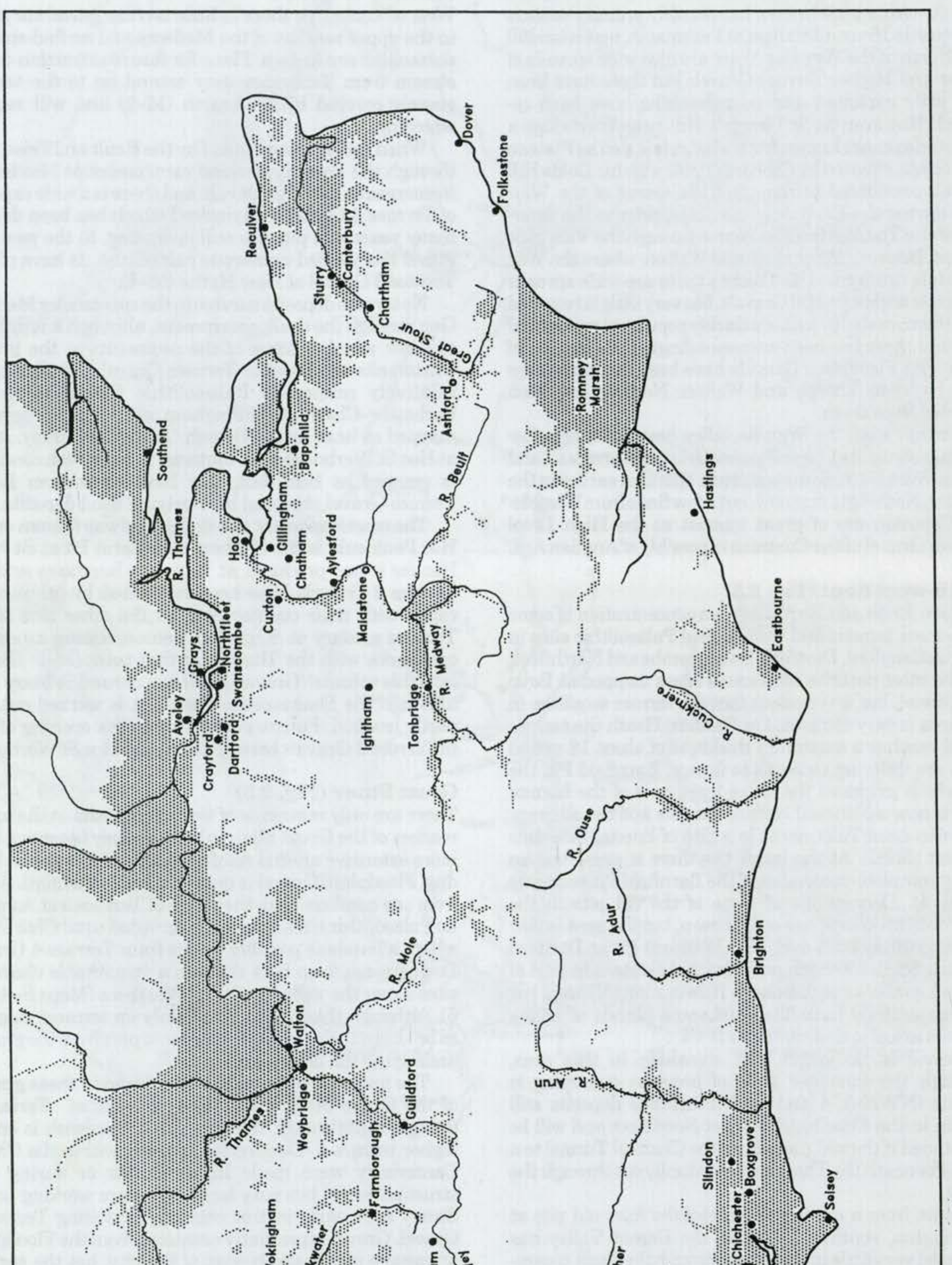

Fig. 2.5 Distribution of principal river gravel deposits in south-east England. Based on OS (1977) Quaternary Map of the United Kingdom, 1:625,000

There is a well-known site near Reculver on the north Kent coast, where brickearth and gravel can be seen in section at the top of a cliff of Thanet sand. It is mapped as head gravel but would appear to represent at least five channels of a braided river. It has been suggested that these channels represent a former floodplain of the Stour when it flowed northward across the Blean instead of along its present course, but this explanation is not accepted by the British Geological Survey. In this respect it is pertinent to note that the *County Minerals Plan* indicates possible future extraction of these head deposits in the nearby area of Beltinge.

Sussex rivers (Fig. 2.5)
The rivers of Sussex divide into two groups although they all have their sources in the Weald. One group flow along the strike of the rocks in the anticline between the North and South Downs (Eastern Rother, Tillingham and Brede) and discharge into Romney Marsh. The others (Cuckmere, Ouse, Adur and the Arun with its tributary, the Western Rother) cut spectacular gorges through the chalk escarpment.

Terrace gravels have been mapped along all the valleys of the second group but very few palaeoliths are known from any of them. No gravel is dug on any large scale at present in the whole area and only few small pits in the past, mainly in the Arun Valley. Most if not all of the gravel is not regarded as a suitable aggregate for commercial purposes. This could explain the paucity of Palaeolithic finds, for with so many surface sites on the Downs (*see below*) it would be surprising if some sites did not exist in the valleys.

Test (Fig. 2.4)
The River Test rises near Overton and terrace gravels are well developed below Whitchurch but do not appear to have been dug before reaching Longparish, where a handaxe and a few flakes have been recorded. Apart from a very few small pits there has been no removal of gravel commercially on any large scale until reaching Dunbridge, 18 km down the valley. A handaxe may have come from a small pit in valley gravel at Chilbolton, and several were found in a disused gravel pit at Kings Somborne, otherwise no other find-spots are known. However, at Dunbridge, close to the confluence of the Dun and the Test, over 1000 handaxes have come from a pit in what is probably Terrace 5 or 6 Gravel. This is the most prolific site for handaxes in Hampshire, if not Britain, and has already been mentioned at the beginning of this paper in connection with the initiation of the *Southern Rivers Palaeolithic Project*. Dunbridge is not the only rich site in the area, for gravel was once dug on a large scale to the north and south of Romsey (TTV–5; SOTON 1), with many palaeoliths coming from Terrace 4 or 5 Gravel. Only one pit is now being worked in this area, at Ridge to the south of Romsey, and it is currently yielding large numbers of palaeoliths.

Gravel has also been extracted from the higher terraces to the west of Romsey (Terrace 6 and 7 Gravel) and it must be significant that no palaeoliths have been recorded from them.

The River Itchen does not have very well developed terraces and there are no large spreads of terrace gravel until reaching Twyford, downstream. A few small pits existed at Colden Common (TTV–6) where a surprisingly large number of handaxes came from gravel of Terrace 3.

Wiltshire Avon (Fig. 2.4)
Terrace Gravels are well developed downstream from Pewsey but they have not been dug on any commercial scale and there are few records of any palaeoliths being found in them. The valley is narrow where it cuts through the chalk until it reaches Salisbury, where there is a major confluence of several rivers: the Bourne, Nadder and Wylye (AV–3). The same is true of the latter two rivers. No palaeoliths are known from terrace gravels in the Wylye Valley and the only gravel worked is in the floodplain at Steeple Langford. Nothing is known from terrace gravels in the Nadder Valley either. The few isolated handaxes recorded appear to be surface finds.

In contrast to the paucity of Palaeolithic finds in the rivers above the city, Salisbury is particularly rich in having one area with prolific finds, and another with valuable environmental associations. The latter site is generally referred to as the Fisherton Brickearth. It is really not one site but a few small pits which were working in the nineteenth century along the Wilton Road (SAL–1) in which were found two handaxes in association with mammalian and molluscan remains. The former site is the whole area of Milford Hill on the east side of the city (SAL–2). At least 36 find-spots can be identified with fair precision on a remnant of Higher Terrace Gravel. The finds were made mainly at the end of the last century, from a few small pits or during the construction of houses and roads in what was then a new suburb. In spite of the good records kept by the then curator of the Blackmore Museum, not a single section drawing or detailed description of the deposits seems to exist.

Below Salisbury there are wide areas of Lower Terrace and Floodplain Gravel but with virtually nothing that can be associated with them. As the valley widens towards its estuary so higher terraces survive well on each side (AV–6): Lower Terrace Gravels of Terraces 1–4, and Middle Terrace Gravels of Terraces 5–10. At Wood Green there is a prolific site in Terrace 7 Gravel and in this part of the valley a few isolated finds from the same terrace and also Terrace Gravel 5 and 6.

Gravel is not dug in this part of the Avon valley, but from Ibsley downstream there are many large working pits, mainly in the Lower Terrace Gravels, but also in old worked-out pits in the Middle Terrace 8 Gravel on Rockford Common. Large areas of Terrace 7 Gravel on the west side of the valley are also on the *County Minerals Plan* for possible future extraction. The same Terrace Gravels are to be found lower down the valley towards Christchurch but little has been dug and very few finds recorded. A couple of important sites in Terrace 8 Gravel were in old pits on St Catherine's Hill, just north of Christchurch. The numerous finds of palaeoliths in the gravels of that town have been included with the survey of the Solent drainage system (below).

Solent (Fig.2.4)
The great spreads of high level gravel which underlie the New Forest, in fact created it, is part of the survival of the deposits of a drainage system that now has little relationship with the existing drainage system. Yet, the Frome, Piddle and the Stour remain to perpetuate something of

the former topography. Drastic changes have taken place with this ancestral Solent system in relatively recent geological time, even by Quaternary standards. It would seem certain that at least in Middle Pleistocene times the Solent flowed as a great river roughly across Bournemouth, Christchurch and the New Forest to Southampton before swinging to the south-east across Warsash, Lee-on-the-Solent and out on the east side of what is now the Isle of Wight into the English Channel. The Stour and the Wiltshire Avon would have been its major tributaries. This would have been when the Isle of Wight was part of the mainland and it was the breaching of the Purbeck anticline of chalk that must have brought about something akin to the present drainage system. Recent work suggests that the Frome may have been a separate stream from the ancestral Solent and have breached this Purbeck anticline at an earlier date than has hitherto been considered (Bridgland this volume)

The only large extent of Higher Terrace Gravel in the upper reaches of the present Frome Valley is between West Knighton and Moreton, of which about a third has already been quarried away by past and current quarrying (SOL–1). These pits have yielded at least 70 handaxes.

Gravel has also been taken from pits in the Lower and Higher Terrace gravel nearer to and beyond Wareham, but no finds have been recorded from them. In the Bournemouth district the terrace gravels are well preserved and so many find-spots of palaeoliths occur in parts of the town that it has been necessary to map them for the Project reports on base maps of the town plan.

Recent studies have identified 14 terrace levels within the old Solent system and, although it can be accepted that the higher they are the older they are, there is little to date them or understand the chain of events which led to the breaching of the Purbeck anticline and its consequences. The successive lines of the terraces indicating the gradual southwards shift of the ancestral Solent can be traced across the New Forest (SOL–6 and 7).

The oldest sites are probably those in Terrace 12 Gravel at Corfe Mullen in the valley of the Stour northwest of Bournemouth. One hundred and thirty-five handaxes are recorded from the Ballast Pit there. Perhaps older is one handaxe in Terrace 13 Gravel at West Howe, alleged to have been found at the base of the gravel. Other find-spots in the Bournemouth area relate palaeoliths almost entirely to Terrace 10 Gravel although there are a few from Terrace 11 and some others from Terrace 12 which may be as old as the Corfe Mullen sites. Gravel is no longer dug in Bournemouth itself but several large pits existed in the past (BMTH–1 to 6). Many of the isolated discoveries were made during the course of road-building, drainage work and housing construction as were others in the Lower Terrace Gravels nearer Christchurch. Gravel was also once extensively dug there around the confluence of the Avon and the Stour. There is a marine element in the deposition of these terraces which probably date to the Devensian Stage. The typology of some of the handaxes found in these Lower Terrace Gravels seems to accord with this dating.

Southampton is also very rich in Palaeolithic sites, most of the being in Terrace 3 and 4 Gravels (SOTON–2). Some came from small pits on the Common in the nineteenth century but others were casual finds. A smaller number come from Terrace 6, 8 and 10 Gravels. Little gravel in this area comes from anywhere but extensive pits in the floodplain of the Test just above the tidal range (Hosfield this volume).

Gravel is no longer dug at Warsash. The last pits closed about the early 1970s but many palaeoliths were found in some of the pits, most of which were in Terrace 2 or 3 Gravels (SOL–8). Solent gravels are well-exposed in the cliffs between Brownwich and Lee-on-the-Solent and numerous handaxes have been found by collectors at the foot of the cliffs, the richest site being Hill Head at the mouth of the Titchwell Haven (SOL–10). Close to Hill Head, near the shore but covered at high tides is Rainbow Bar, on which numerous crude cores and flakes have been found reminiscent of a Clactonian industry, but there is no dating evidence and Mesolithic artefacts are found with them in the same condition. Gravel is currently being dug in the terrace west of the River Alver and a few finds are recorded from them. Further extraction in the future in this area is predicted by the *County Minerals Plan*.

There are a few isolated finds in gravels at Portsmouth, but gravel is not worked in the area. Those from Southsea Common are mapped as plateau gravel, but the terrace is only a few metres above sea level (SXRB–3).

Isle of Wight (Fig. 2.4)

The drainage of the Island perpetuates a pattern originating from when the rivers flowed northwards into the ancestral Solent. Thus the Eastern and Western Yar are virtually 'through valleys', having once had their sources in what is now the English Channel. This helps to explain the height of one of the few but richest sites on the Island on Bleak Down, which is 80 m OD (IOW–3). Gravel is no longer worked there or anywhere else on the island.

Great Pan Farm at Newport is the most intensively investigated site. Marine sand within the terrace at 8 m OD suggests correlations with other raised beach sites at Fareham on the mainland. The industry contains Levallois flakes and handaxes and thus considered to be of Mousterian of Acheulean Tradition.

Some 300 or more palaeoliths have been collected from the present sea beach at Priory Bay, Bembridge, and presumably derive from a gravel at the top of the cliff (now heavily wooded) which may be of fluviatile or marine origin (IOW–4). A few isolated finds of handaxes have been made in remnants of this Higher Terrace Gravel.

Axe (Fig. 2.6)

The only large spreads of river gravel that have been exploited in this river valley are those between Chard and Hawkchurch, particularly at Broom, well known since the nineteenth century for its yield of large numbers of handaxes. Many of these are made of upper greensand chert, which is one of the major constituents of the gravel. The pits near Broom railway crossing have ceased working and are mainly levelled, as are the pits nearer Axminster at Kilmington (AX–2). The same gravel is still dug at pits near Chard Junction but nowhere else, although large areas of it remain untouched, especially south and west of Axminster.

The origin of this remarkably wide and thick deposit of river gravel remains controversial, but would undoubtedly seem to be connected with the Chard Gap for, to the east of Chard, the River Axe is virtually devoid of any terrace deposits. River gravels exist in the tributary valleys of the Axe, especially the Yarty but, with the exception of a handaxe from Colyton (AX–3) no palaeoliths are recorded from them, nor are they commercially dug.

Exe (Fig. 2.6)
This area is on the fringe of the highland zone of the West Country and terrace gravels above the floodplains are rarely preserved. Few palaeoliths are recorded west of the River Otter and none of the isolated discoveries of handaxes in the Budleigh Salterton region can be attributed definitely to the patches of terrace gravels near the estuary of it. Similarly, although there are a few spreads of higher river gravels along the Exe and the Culm, only at Exeter is there record of a handaxe as coming from them (EX–1). As is noted below, the few known palaeoliths in this area and further westward appear to have become incorporated in head deposits, if not surviving as surface finds. Small pits have existed in the past but there is no current large scale commercial working of gravel deposits.

Tone (Fig. 2.6)
Scattered palaeoliths have been found in the area around Taunton but they are all surface finds. Some are associated with spreads of gravel and may be derived from them, but it is difficult to know whether the higher gravels are associated with the main river and its tributaries or are head deposits. A few discoveries at Bradford-on-Tone have come from alluvium or a low terrace on the edge of the floodplain. Such low terrace gravel has been dug along the Tone at or near Taunton but nothing can be definitely attributed to it.

Bristol Avon (Fig. 2.4)
There are wide spreads of river gravel east of Bradford-on-Avon, mapped as Terrace 1 and 2 Gravel, as far upstream as Sutton Benger where what appears to be Terrace 2 Gravel was once dug on a fairly large scale. In the 1940s, it produced at least one handaxe and mammalian remains. Otherwise there has been little or no exploitation of these gravels.

The Bristol Avon has an unusual drainage pattern, rising less than 20 km from its confluence with the Severn at Avonmouth, but flowing eastward and southward in a great loop, eventually turning back towards the Severn below Melksham, although in order to get there it has had to cut a gorge through coal measures between Bradford-on-Avon and Bath, another minor one near Keynsham and the spectacular Clifton Gorge through hard carboniferous limestone. Thus, apart from some small patches of Terrace Gravel (Terraces 1–3) at Batheaston, Somerdale and at St Anne's Park, east of Bristol, nothing remains. However, the small patch of Terrace 2 or 3 Gravel at the latter has yielded at least eight handaxes (SEV–4), although it is not quite certain whether the gravel in question may be head.

Other handaxes have come from Terrace 1 Gravel at Portway, but the area of the Lower Avon is best known for its prolific palaeoliths in the gravels on each side of the Avon at about 30 m OD as it emerges from the Clifton Gorge, at Shirehampton on the north side and Abbot's Leigh on the other (SEV–5). These are mapped as Terrace 2 Gravel, although they are probably best described as head gravel formed from degraded terrace gravel. Handaxes, cores and flakes, mainly of quartzite, have been found at Abbot's Leigh on the surface.

Head deposits

Head has been described as:

> an unstratified or poorly stratified accumulation of rock fragments of local origin which sometimes mantles high ground or occurs on slopes and in the bottoms of valleys. Formed under cold conditions by solifluxion, or the bodily flow of the surface layers of soil down quite gentle slopes. Soil which is saturated with melt-water from ice and snow will, under repeated freezing and thawing, suffer considerable change in volume and tend to creep downhill. (Himus 1954, 70)

It is obvious that the conditions required to induce such soil movements have occurred many times during the period when Palaeolithic people were active in England, especially as a result of periglacial climates. Thus, whole landscapes have suffered and the Palaeolithic artefacts discarded upon their surfaces have become incorporated within head deposits. Sometimes fluvial deposits such as sands and gravels of one terrace feature may sludge down on to a lower one, taking with them any artefacts that may already have been washed into them at an earlier date. Even on level ground, the effects of permafrost can cause cryoturbations of the upper part of a deposit, whether it be one of Quaternary date or of much earlier geological time, and totally destroy the primary context of any archaeological material lying on its surface. Many factors are involved, especially the hydrogeology of underlying rocks, but the effects have to be considered when assessing the nature of surface sites as noted below. This brief section merely brings attention to the presence of palaeoliths that are sometimes found within the body of head deposits.

Mention has already been made of the predominance of head deposits in the highland areas of southern Britain, especially in the West Country. West of Exeter, terrace gravels rarely exist except in the lower Late Pleistocene stages of the river valleys and the few palaeoliths that have been found to occur in coombe deposits. They have been scoured off higher ground and become part of the constituents of the shattered rock fragments that constitute this material which is found along the floors of steep-sided coombes. Not surprisingly, the artefacts are often so abraded and broken, they are barely recognisable.

Examples of river terrace deposits containing palaeoliths and being mainly transformed into unstraitified head deposits are the Avon gravels at Shirehampton and Abbots Leigh (SEV–5) and at Bouldnor Cliff on the Isle of Wight (IOW–1) where Higher Terrace Gravel has sludged down over the soft Oligocene clays onto the present beach.

Head gravels are rarely worked commercially for aggregate because of their clay content, but are sometimes exposed in road-cuttings or by the natural erosion of sea cliffs. The discovery of numerous handaxes from the Doniford head gravels on the north Somerset coast (SEV–1) suggests that the paucity of finds in much of the

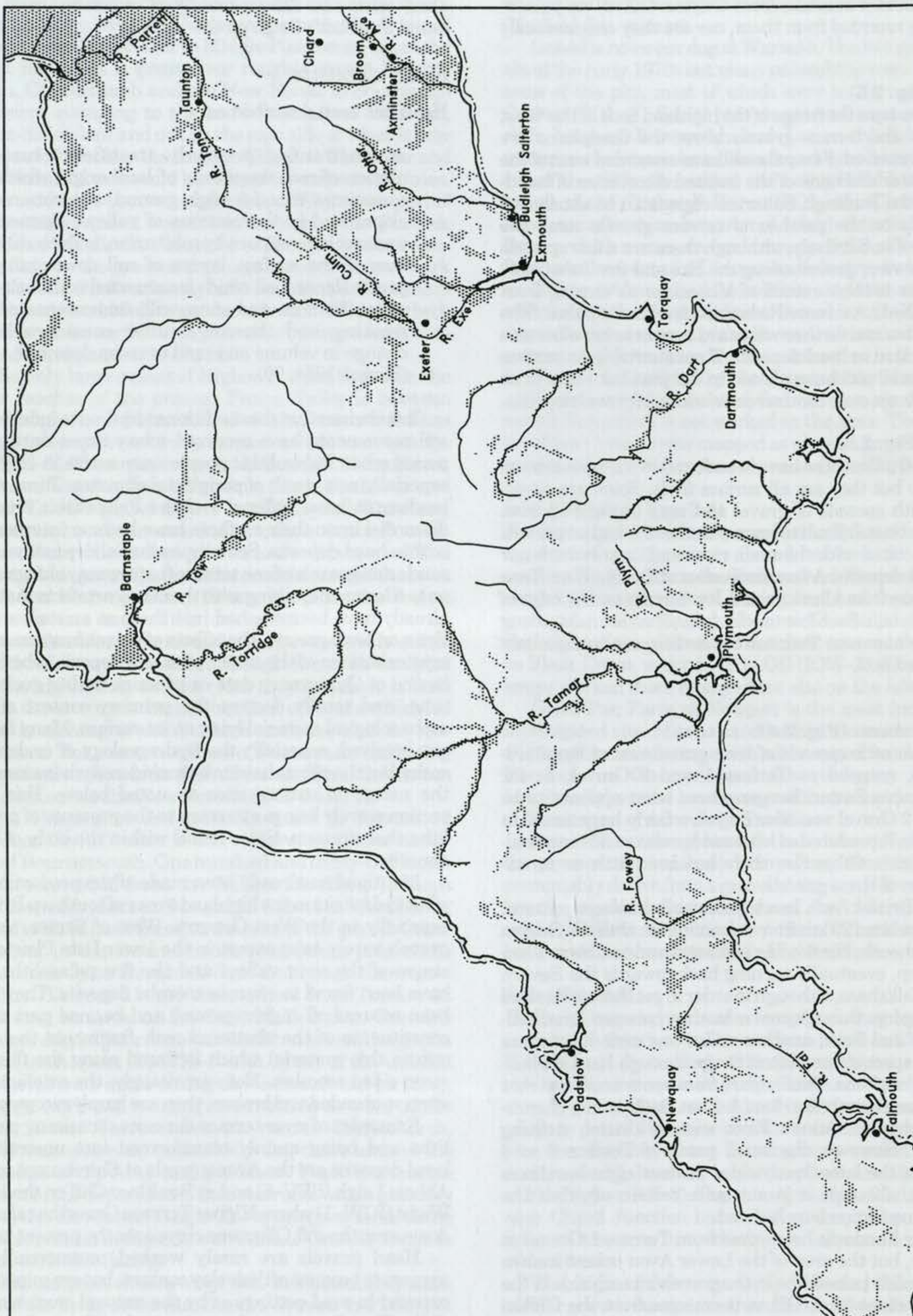

Fig. 2.6 Distribution of principal river gravel deposits in south-west England Based on OS (1977) Quaternary Map of the United Kingdom, 1:625,000

West Country may be partly or wholly the result of inadequate exposures and observation.

Chalk slopes under periglacial conditions are particularly vulnerable to solifluction and such conditions have been responsible for the massive accumulation of Levallois artefacts at the famous Baker's Hole site at Northfleet, Kent (NWK–5). Some of the artefacts at Red Barns, Portchester, Hampshire (SXRB–1), also seem to have moved down-slope from higher ground.

Head deposits on plateaux such as at Limpsfield, Surrey, at the head of the Medway drainage (M–1) are inextricably associated with fluvial deposts, both of which contain palaeoliths. At this particular site the palaeoliths are also found on the surface so it is clear that many natural agencies have been involved.

Fan Gravels are, likewise, generally a mixture of fluvial and solifluction deposits. The best example in the area of the *Southern Rivers Palaeolithic Project* is the spread of gravel and rock debris that has been washed off the Cotswold escarpment into the valley of the Severn (SEV–7). A few palaeoliths have been recorded in these fan gravels where they happened to be suitable for commercial exploitation. These gravels are of special interest because the British Geological Survey has been able to correlate them with different episodes represented by the terraces of the River Severn.

Periglacial conditions can also cause layers of sedimentary deposits to be thrust up by pressures into others above them, often producing so-called 'flame structures'. These have sometimes been mistakenly identified as resulting from human activity, such as the nodules of flint at Frindsbury, Kent (M–5), which appear to have been placed in piles.

As has already been noted, head deposits may cover undisturbed river gravels and this must be taken into account when assessing the geology of an area from maps which are based on surface outcrops. Sites in the Medway Valley have been mentioned as examples. Similarly, thick head deposits overlie most of the raised beach deposits between Slindon and Chichester in Sussex.

Raised beaches

Evidence of high sea levels are preserved in various places around the English coast, in the form of wave-cut platforms or marine sediments. Some are associated with palaeoliths and when in primary context, such as at Boxgrove, West Sussex (SXRB–1), are sites of great importance. This site is one of several known locations of a high level marine platform at about 45 m OD between Slindon and Chichester and, as noted immediately above, they are generally covered by thick deposits of chalky head which has been derived from the chalk downland behind them. Boxgrove is no exception and there are even traces of the original sea cliff from which people were grubbing flint nodules for making handaxes. Some of the finished products lie nearby within or on the marine sands in their position of discard, associated with mammalian faunal remains. There is also an abundance of derived material in the overlying head deposits and some which is also in primary context, presumably indicating intervals in the formation of it.

The height above Ordnance Datum of wave-cut platforms and associated beach deposits is obviously significant for any interpretation of the age of such features. This is a complex matter for raised beaches reflect sea levels which have been rising and falling throughout the whole of the Pleistocene period in response to the glacial–interglacial cycles. A general, slight but gradual tectonic rise during the last half a million years could account for the higher sea levels, such as at Boxgrove, being earlier than lower ones. This seems certain as it has been calculated that if all the present ice in the arctic and antarctic were to melt, the resulting rise in global sea level would not be much more than about 20 m.

Raised beaches along the present south coast of England at about 8 m OD are generally considered to belong to the Last Interglacial or Ipswichian Stage (eg. Black Rock, Brighton (SXR–4) or Selsey, Sussex (SXRB–2)) and are associated with a few handaxes, but these could be derived from earlier contexts. However, marine deposits at Earnley, Sussex, are just below present sea level and have been pollen-dated to the much earlier Hoxnian Stage.

Brickearth

Brickearth is a blanket term used to cover fine sediments in the clay, silt or sand fraction which may have formed as a result of several different agencies, or combinations of them. Colluvial (hillwash) deposits often predominate, but fine-grained fluvial sediments may be involved and there is frequently a loessic element. The latter, not surprisingly, is better represented in such sediments the closer the site is to the European continent. Up to 4 m of loess has been recorded from Pegwell Bay, Kent.

The relatively gentle conditions which produce brickearths are conducive to the preservation of Palaeolithic material in primary context. The best examples in the *Southern Rivers Palaeolithic Project* area are at Crayford (NWK–3) and Bapchild, Kent (S–1). None of these sites have received the benefit of modern, controlled, archaeological investigation, although the work of Spurrell at Crayford in the 1880s was exemplary for the time. Other sites in the area of the *English Rivers Palaeolithic Survey* are in the Middle Thames Valley at West Drayton and Creffield Road, Acton, west London (forthcoming, respectively MTV–3 and 4A). The most comprehensively recorded are those sites of the Caddington brickearths, Bedfordshire (forthcoming LV–1). Here, Worthington Smith at the end of the last century was able to find palaeoliths in primary (sometimes rejoinable) context within fine sediments that are now considered to be the mainly colluvial infill of solution hollows. He was also responsible for recording the prolific primary context sites in the Stoke Newington area of north-east London (MTV–8A). The component of the brickearths in this area are mainly if not entirely fluviatile and are termed the Langley Sands and Silts by Gibbard (1985; 1994). This is the same sediment that covers the Levallois sites at West Drayton mentioned above. In spite of very careful recent surveys and excavation the so-called 'Palaeolithic floor' at Stoke Newington has not yet been rediscovered, although something similar was found at South Woodford when the M11 motorway was built (forthcoming LTV–1).

Brickearth caps most of the terrace gravels in the Middle Thames Valley and in the London area vast areas were skimmed off for making bricks before the advent of the factory-production of them elsewhere.

Isolated finds of palaeoliths have been reported, apart from such sites as Creffield Road, Acton, mentioned above. Much greater thicknesses of such sediments exist in the Lower Thames Valley, as at Aveley and Grays which have so far produced numerous mammalian remains but no palaeoliths.

Surface discoveries

There are several locations in England where flint artefacts have been found on ploughed fields or other bare ground and, on the basis of their typology and condition, identified as being of Palaeolithic age. Caution is obviously required in dating flint artefacts on no other evidence than their typology and flakes must remain in doubt unless perhaps they are associated with diagnostic handaxes in the same condition. Misidentifications have been made in the past and the Eolithic controversy has tended to blur the reality of genuine material. However, it is clear that a considerable number of palaeoliths are to be found on the modern surface. There are two very different contexts for such material: it may lie virtually where it was discarded in the sub-soil or it may have been derived from some underlying deposit where it was not in primary context. The former implies that the landscape has not been subjected to fluvial activity or solifluction which would have transported soil, rock and artefacts down slopes into river gravels or head deposits. Thus, not surprisingly, such sites generally exist on high ground on plateaux, well above past and existing drainage systems. Good examples are on the clay-with-flints that overlies the chalk downs, or on the high outcrops of the chalk itself, as around Marlborough, Wiltshire (KV–1), Basingstoke (TTV–1) and Alton, Hampshire (W&M–3), Banstead, Surrey (W&M–9), Ash (NWK–2) and Dover, Kent (S5 and S6) and Eastbourne, East Sussex (SXR–3). However, such material is not confined to the clay-with-flints and chalk for palaeoliths occur on the high plateaux of other solid formations such as the lower greensand and Hythe Beds around Ightham, Kent (NWK–6).

In some cases, these palaeoliths which are judged to be virtually where they were discarded have merely become incorporated in the sub-soil by normal worm action, roots and burrows, but others have probably been disturbed by past periods of permafrost activity. The near primary context of some material has recently been demonstrated by Scott-Jackson (1992). Hence, some artefacts are relatively fresh while others are worn or broken. With rare exceptions they are patinated.

It has been noted above that in the West Country, where the harder Palaeozoic formations tend to produce steep coombes, palaeoliths have been found in the head deposits that have sludged into them. Others have escaped such transportation, as on Goonhilly Down in Cornwall.

Surface finds as described above give useful information on the distribution of people during the Palaeolithic period outside the river valleys. However, surface finds of palaeoliths on deposits which contain palaeoliths themselves are problematical. They could be lying where they were discarded, but they may have been derived from the upper levels of the underlying deposit by permafrost or some other natural agency. The palaeoliths found in association with the gravels of the Silchester Stage above the Kennet Valley in Berkshire are a good example: at Hamstead Marshall (KV–3) they have come from the body of the gravel and must this be no more recent in age than its formation, but at Wasing and Ufton Nervet (KV–4) a few have been found on the surface of the same gravel.

Another problem with surface material is that later, relatively recent, human activity may have moved palaeoliths from one place to another. Collectors' throw-outs are one source of spurious find-spots, but Romans paid attention to palaeoliths long before John Frere, for they regarded them as Jupiter's thunderbolts and sometimes placed them in places that were presumably sacred to that particular god. There is even a record of a handaxe being found in an Irish Iron Age site, presumably picked up as a curiousity or just as a useful piece of flint. In view of the absence of palaeoliths in Ireland it probably came from the mainland! There may be similar explanations for the discovery of isolated palaeoliths at such odd places as one at Brent Moor, Devon at 476 m OD, and on Martinsell Hill on Salisbury Plain (AV–1) at 289 m OD.

Acknowledgements

Gratitude is expressed to English Heritage for their commissioning and funding of these Projects which, apart from their necessity for assisting with the planning process of County Councils in order to promote the better management of Palaeolithic open sites, give information that will benefit academic research into the period. The Projects could not be completed without the facilities and administration received from Wessex Archaeology and thanks are rendered to the Unit Director, Andrew Lawson, the Assistant Director. Sue Davies and the Administrative Director, Peter Dawes. Their efficient organisation of the day to day running of the Projects has enabled the team members to conduct the work without hindrance.

Especial thanks are given to the team members with whom it is a pleasure to work: Phil Harding (fieldwork, editing); Linda Coleman (graphics, production of maps on CAD machine; and Karen Walker and Andrew Hutcheson (history of aggregate quarrying and future minerals policies of County Councils).

It has also been a pleasure to have the advice and encouragement of my colleagues on the Review Team: Clive Gamble, David Bridgland, Derek Roe, Paul Mellars and Geoffrey Wainwright, Chief Archaeologist for English Heritage.

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3. Quaternary River Terrace Deposits as a Framework for the Lower Palaeolithic Record

David Bridgland

Abstract

The majority of the Lower Palaeolithic artefacts found in Britain come from river terrace deposits of Middle Pleistocene age. Sequences of river terraces provide an important record of terrestrial environments during the Quaternary; indeed, it is thought that climatic fluctuation during this era has been the driving force behind terrace formation. Increasing numbers of geologists are now endeavouring to correlate terrace sequences with the global Quaternary palaeoclimatic record from the deep oceans. In Britain the Lower Thames terraces seem particularly suited to such correlation, as they provide a wealth of biostratigraphic evidence. Happily, they are also an abundant source of Palaeolithic artefacts. It is hoped that the Palaeolithic sequence in the Lower Thames can be used as an exemplar for other terrace systems in Britain, and perhaps further afield, and that through comparison with the Thames sequence it might be possible to suggest ages for Palaeolithic assemblages from less complete and/or less well dated terrace systems. This idea is explored in connection with three of the areas covered by the Southern Rivers Palaeolithic Project, *the Upper Thames, the River Medway and the Solent River.*

Introduction

This paper is concerned with that part of the Palaeolithic that is best known from discoveries in Middle Pleistocene sediments, a significant proportion of which are of fluviatile origin. This fact gave rise to the term 'River-drift implements' (Evans 1872), which can be regarded as broadly synonymous with Lower Palaeolithic, as applied to these, the only relics from the earliest phase of human occupation of Britain. The river deposits that have provided the archaeological evidence, in the form of countless stone artefacts collected mainly in the days of manual gravel extraction, are generally disposed in flights of aggradational terraces. These may fringe the valley of the river that formed them, if this still exists, but in some cases they provide sedimentary evidence of fluvial systems that no longer operate, such as the Solent River of southern England (Allen and Gibbard 1994) and the Thames–Medway extension across eastern Essex (Bridgland 1988a).

Many of the assemblages of artefacts from these deposits, although numbering many individual specimens, are motley collections of disparate pieces in differing states of preservation. More or less abraded by transport in the bedload of the river, they are merely clasts (pebbles) in the gravels. Occasionally concentrations of artefacts of characteristic type, or in near mint condition, suggest that the river has disturbed a nearby flint-working site, the material from which has been only slightly dispersed in the gravel. Such occurrences are of considerable importance, although much less so than the rare instances of finds in genuine primary context, recognised from the fact that artefacts are in mint condition and knapped material can be refitted. Sites such as this provide an important indication of human occupation at the time of sediment deposition. The geological evidence from the sediment can be of great importance in providing information about the palaeoenvironment and, if characteristic fossils or datable material are present, in providing an indication of the age of the artefacts.

Thus the Lower Palaeolithic lies at the frontier between archaeology and geology, where interests are shared and there has traditionally been much exchange of information between the two disciplines. Geologists and archaeologists nowadays contribute just two of the many strands that go together to make up the multidisciplinary subject of Quaternary studies.

The role of rivers during the period represented by the Lower Palaeolithic

River terrace deposits record the existence of old valley floors at higher levels than the modern floodplain. Each aggradational terrace is part of an abandoned floodplain, the sediments forming it having accumulated on that floodplain when it was at the bottom of the valley. With very few unequivocal exceptions, rivers have repeatedly incised their valleys to progressively lower levels during the course of the Pleistocene, so that terrace deposits are progressively older with increasing height. This progression is believed to relate to continued isostatic uplift of land areas in response to the removal of material by erosion, a process that will have been accelerated by the climatic conditions that prevailed during some parts of the Pleistocene. Areas of sediment accumulation have been subsiding during the Pleistocene as a result of the same isostatic adjustment, but operating in reverse. Such areas are generally offshore at present, but where rivers extend into them they can be seen to have formed, not terraces, but vertical accumulations of sediment, like that beneath the Netherlands, laid down by the Rhine and Meuse Rivers (Ruegg 1994).

The familiar beds of sand and gravel that have been quarried in the valleys of many of our rivers are generally the product of deposition during relatively cold episodes, when fluvial discharge was much higher than at present and the sparsity of vegetation allowed an abundance of sediment to be washed into river channels. Activity is likely to have been lower during the coldest parts of the Pleistocene, the maxima of the glacials, and was certainly lower during interglacials, when rivers would rarely have had sufficient energy to transport coarse-grained sediment. The formation of considerable thicknesses of mainly fine-grained alluvial sediments during the present interglacial is thought to have resulted to a great extent from partial anthropogenic destruction of the natural interglacial vegetational cover, particularly in connection with the expansion of agriculture, from the Neolithic onwards. Earlier interglacials were not marked by fluvial activity of this type, but instead there was sporadic accumulation of overbank deposits on floodplain surfaces and, within meandering river channel systems, lateral accretion took place in areas where channels were migrating and abandoned loops were infilled with sediment primarily from suspension. These interglacial sediments were emplaced on a much smaller scale than the ubiquitous cold-climate gravels and sands and, being fine-grained, were readily eroded away in subsequent cold episodes, when there would have been a return to high fluvial energy conditions. Thus interglacials are relatively poorly represented in the Pleistocene record of fluvial sediments.

The Pleistocene background

The Pleistocene, the geological period that covers the interval between about 2 million and 10,000 years before present, was one of nearly continuous fluctuation between the cold 'glacials', or 'ice ages', for which it is famous and rather shorter 'interglacials' between them, which were characterised by warmth comparable with the presentday climate, if not greater. This pattern of climatic fluctuation increased in intensity for the last *c.* 700,000 years of the Pleistocene, during which time the coldest glacials saw the build up of ice over large parts of the northern continental masses, including much of Britain. Early views of the Pleistocene, from the first acceptance of widespread glaciation in the geologically recent past, envisaged a single ice age (*see* Imbrie and Imbrie 1979). In the middle decades of the present century this monoglacialist view finally gave way to a scheme in which repeated glacials and interglacials were recognised, culminating in an attempt to allocate the various Pleistocene deposits in different parts of Britain to named glacial and interglacial stages (Mitchell *et al.* 1973).

A problem with most Pleistocene sedimentary sequences is that they are fragmentary. Pleistocene deposits tend to occur as superficial drift, rather than forming thick accumulations of different sediments in superposition. River terraces, which have already been described, are a case in point; they comprise series of disjunctive sediments separated by erosion surfaces that mark considerable gaps in the geological sequence, during which the river cut down to a new floodplain level. Although substantial terrace sequences provide continuous records of a type, given the continuity provided by a single and continually existing agent of deposition, they do not provide the clear stratigraphic successions formed in subsiding areas, such as the lower Rhine, where erosion surfaces may still be present, but where there is less doubt about the order in which sediment bodies have accumulated. A considerably more satisfactory record of Pleistocene time is found in deposits on the deep ocean floors, where sedimentation is thought to have been continuous. A measure of palaeoclimate at the time of deposition can be obtained by the analysis of oxygen isotopes in the remains of foraminifera (calcareous micro-organisms) found in oceanic sediments. The ratio of isotope ^{18}O against ^{16}O actually records the size of contemporaneous ice caps, which provides an indirect measure of sea level as well as climate (for explanation, *see* Patience and Kroon 1991). Results from such analyses have consistently pointed to a greater frequency of climatic oscillation during the Pleistocene than had been supposed from stratigraphic studies on land. Gradually the oceanic record has come to be accepted by most as the best representation of Pleistocene climatic history and it is now recognised as a potential means, through the provision of a framework, for the global correlation of sediments of this age. This goal, the attainment of which will rely heavily on absolute (geochronological) dating of oceanic and terrestrial deposits where possible, reinforced by biostratigraphic and lithostratigraphic correlation with terrestrial deposits that cannot otherwise be dated, is one for the early decades of the next century.

Figure 3.1 reveals the oceanic oxygen isotope record of glacials and interglacials, the preferred framework for modern Pleistocene correlation. Note that warm and cold Oxygen Isotope Stages are numbered backwards from the present (Holocene) interglacial, Stage 1. Odd-numbered stages are thus warm and even-numbered ones are cold. Ideally, in terrestrial studies, sediments should be allocated to named stages within the Pleistocene, defined at type localities (Mitchell *et al.* 1973). This is becoming increasingly difficult in Britain, with the recognition that the existing scheme of Pleistocene chronological nomenclature is inadequate, in that it fails to include all the climatic episodes recognised from the oceans. This is in part a problem that stems from the use of climate as the basis for the division of Pleistocene time, although in strict geological terms the stages within the Pleistocene Period should be defined as parcels of time. In the absence of separate names to cover each climatic episode in the British Pleistocene, it may be necessary to resort to naming complexes, which would be parts of the Pleistocene known to have included several climatic episodes, but which cannot at present be clearly resolved within the terrestrial sequence. It is important that terrestrial sequences are classified in such a way that they remain independent of the oceanic nomenclature, particularly while correlation between the land and the oceans remains uncertain.

Pleistocene biostratigraphy, while of considerable importance, is based largely on variations in floral or faunal assemblages rather than evolutionary change, restricting its value for dating. This fact, and the paucity of opportunities to use absolute dating techniques on Pleistocene sediments, has meant that significant stratigraphic

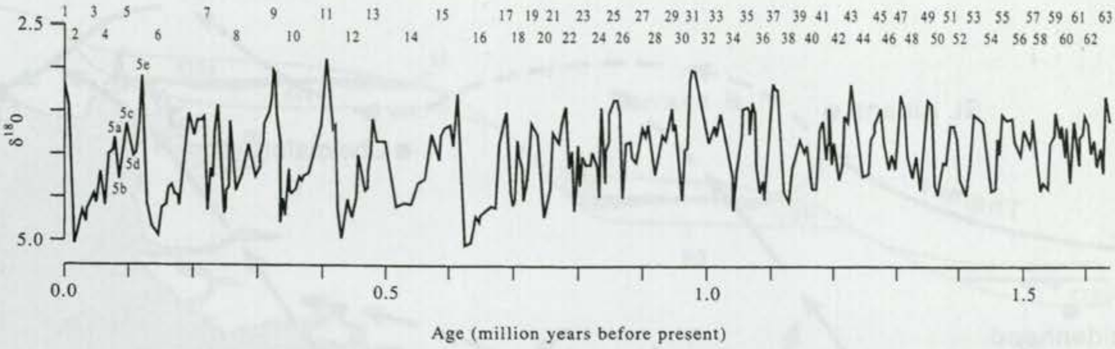

Fig. 3.1 The oceanic record of Quaternary climatic fluctuation, taken from data from the mid Atlantic (modified from Bridgland 1994a; data from Ruddiman et al. 1989)

markers resulting from events such as major glaciations or marine transgressions take on particular importance. One such, in southern Britain, is the marker provided by the most extensive Pleistocene glaciation in this area, during the Anglian Stage. During the Anglian, ice sheets extended as far south as north and east London, where they left deposits that interdigitate with the Thames terrace sequence. This glaciation had a profound effect on the Thames catchment, diverting the river southwards so that it flowed through what is now central London for the first time (Fig. 3.2) and causing it to adopt the former valley of its tributary stream, the Medway (Gibbard 1977; Bridgland 1988a). These events are clearly recorded in the Thames terrace sequence by changes in the gravel composition, providing a stratigraphic marker that assists correlation over a wide area. South of the Thames valley, however, in most of the areas covered by the *Southern Rivers Palaeolithic Project*, there were no direct effects of this glaciation and the stratigraphic marker is missing.

The traditional British Pleistocene chronology, based largely on the differentiation of different climatic episodes using pollen analysis, recognised two interglacials, the Hoxnian and the Ipswichian, and two glacials, the Wolstonian and the Devensian, between the Anglian Stage and the present warm period, the Holocene (Mitchell *et al.* 1973, fig. 1). Over the years this scheme had been questioned by a number of workers, but it was the development of a technique for assessing the ages of fossil mollusc shells, based on a change in the relative proportion of certain types of amino acid following death, that led to the publication of the first alternative chronology for the British Middle and Upper Pleistocene (Bowen *et al.* 1989). Bowen *et al.* recognised four post-Anglian interglacials and suggested correlation of these with Oxygen Isotope Stages 11, 9, 7 and 5 (Oxygen Isotope Stage 3 is a minor warm oscillation within the last glacial that would not have been separately numbered in the oceanic sequence had it not been so close to the present). They advocated a correlation of the Anglian Stage with Oxygen Isotope Stage 12, which forges an important link between the oceanic sequence and the stratigraphic marker provided by the deposits and other effects of the extensive Anglian glaciation.

The Lower Thames as a standard sequence for the late Middle Pleistocene

Recent reappraisal of the Pleistocene sequence in the Thames basin (Bridgland 1994a) has confirmed that four post-Anglian interglacials can be recognised. It is claimed by Bridgland that the Thames sequence provides an important long sedimentary record covering a significant part of the Pleistocene. Although this terrace succession is inferior, as a record of the Pleistocene, to the superimposed sedimentary sequences found in the deep oceans, it does provide an extensive if punctuated stratigraphy that can be related to climatic fluctuation. This is possible because climatic fluctuation is seen as the driving force behind terrace generation, so that the fluvial cycle of *aggradation—downcutting—aggradation* can be broadly related to the *warming—cooling—warming* climatic cycle which led to interglacial—glacial—interglacial conditions. Unlike previous schemes for explaining terrace formation in relation to climate, which attributed aggradation to temperate episodes (an idea now largely discredited), this newer model envisages nearly all important fluvial activity occurring in the cold episodes, with the interglacials marked by relative quiescence (as described above). According to this model (Fig. 3.3), the sediments forming a typical aggradational terrace include deposits from two separate glacials, sandwiching any interglacial sediments that may survive. Downcutting is also thought to occur during cold episodes, following a period of aggradation (the latter burying the sediments of the previous interglacial). After the downcutting, further cold-climate sediments are aggraded at the new, lower, terrace level. Thus, the same cold-climate episode is represented at different terrace levels, but interglacial sediments from different terraces will always represent different temperate episodes, provided that they are the product of the main river. This has important stratigraphic considerations, for although tributary streams can deposit later sediments at higher terrace levels, these levels will not again be attained by the main river once downcutting has lowered its floodplain.

Thus the Lower Thames terrace sequence represents the most complete record of the post-Anglian Pleistocene

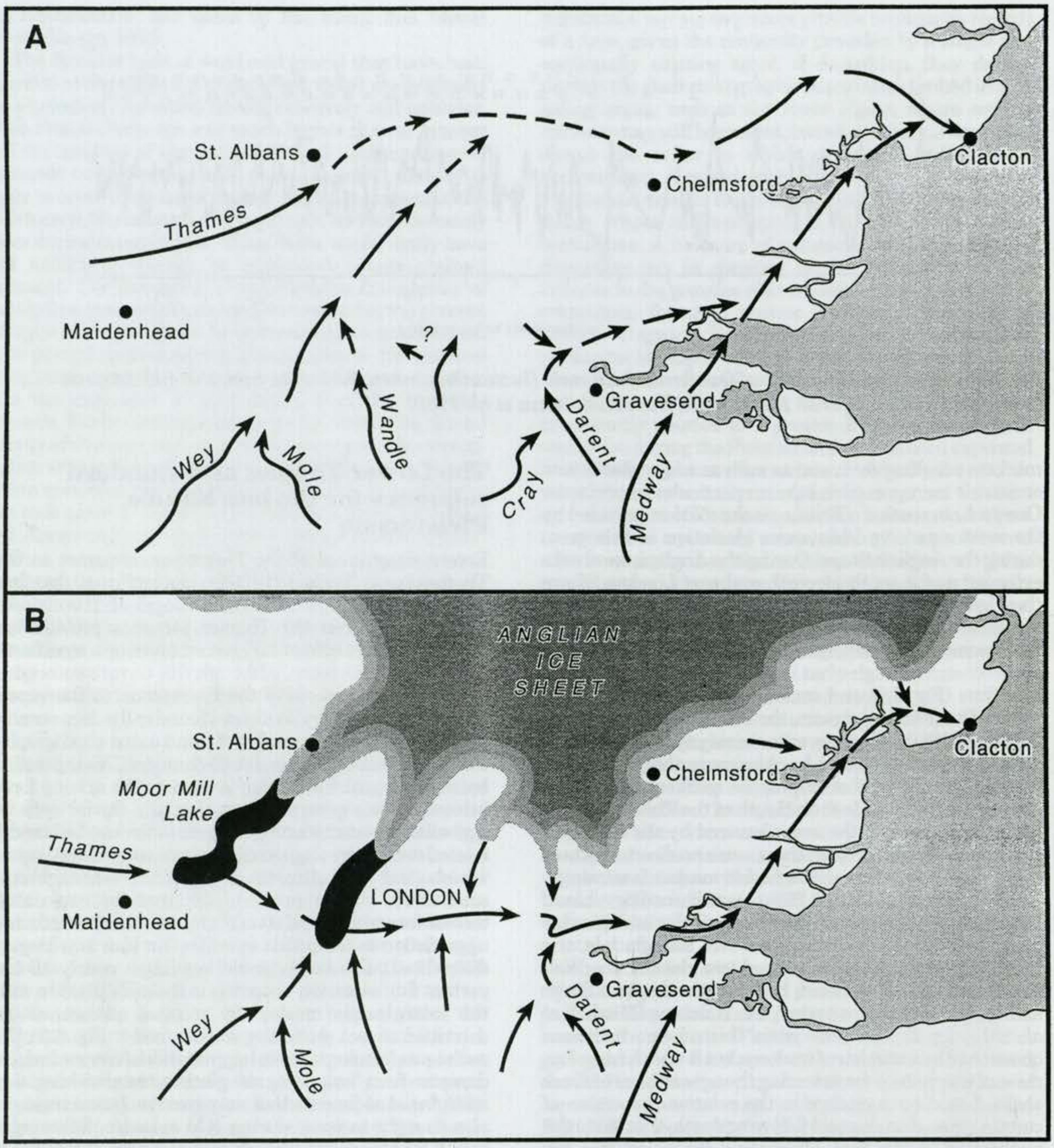

Fig. 3.2 The diversion of the Thames by an Anglian Stage ice sheet. A: drainage pattern immediately prior to the Anglian glaciation. B: extent of Anglian ice and the resultant early post-Anglian drainage pattern. Note that ice-dammed lakes were formed in the old valleys of the Thames and Mole–Wey

in Britain (Bridgland 1994a). This a happy situation for Palaeolithic studies, since it is from here that many of the most important artefact assemblages have been collected. Bridgland (1988a; 1994a) recognised four terraces in the Lower Thames valley, only three of which appear on geology maps, since the lowest is buried by the Holocene alluvium of the Thames estuary. He identified interglacial sediments in each of these four terraces and, in line with the climatic model outlined above, attributed these to four different interglacials, essentially the same four that were recognised by Bowen *et al.* (1989). This view of Lower Thames stratigraphy, for which biostratigraphic and geochronological support can be claimed (the latter from amino acid analyses) is summarised in Figure 3.4. The Lower Thames terraces thus provide a standard sequence with which to compare the deposits of the southern rivers.

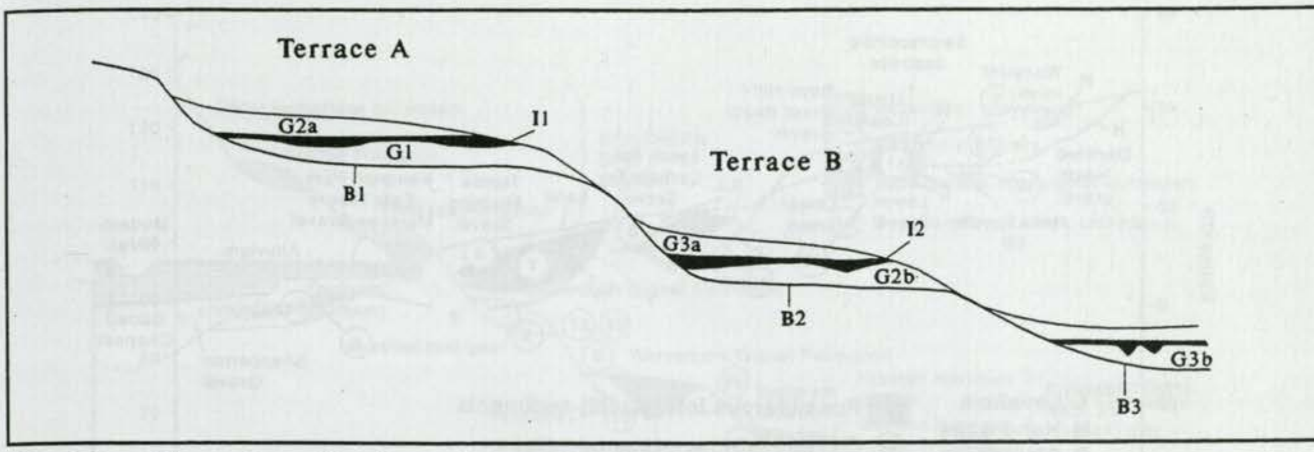

Fig. 3.3 Schematic model of fluvial terrace formation

Key: B1: bench cut during glacial 1; G1: aggradation of gravels during later part of glacial 1; I1: interglacial sediments deposited during interglacial between glacials 1 and 2; G2a: aggradation of gravels during earlier part of glacial 2; B2: bench cut during glacial 2; G2b: aggradation of gravels during later part of glacial 2; I2: interglacial sediments deposited during interglacial between glacials 2 and 3; G3a: aggradation of gravels during earlier part of glacial 3; B3: bench cut during glacial 3; G3b: aggradation of gravels during later part of glacial 3.

In this model Terrace A is older than Terrace B; both contain evidence from two successive glacials and an intervening interglacial. Glacial 2 is represented within both terraces.

If correlation with the Thames can be achieved, using biostratigraphy or perhaps even Palaeolithic assemblages, an indirect correlation with the deep sea record is attainable.

Looking at the Lower Thames sequence in more detail, a discrepancy is apparent between the stratigraphies of Bowen *et al.* (1989) and Bridgland (1994a) in the way in which some of the deposits previously classified according to the traditional palynology-based stratigraphy have been reinterpreted. According to Bowen *et al.*, in their scheme based on amino acid ratios, sediments formerly attributed to the Hoxnian are variously correlated with Oxygen Isotope Stages 11 and 9, whereas sites previously classified as Ipswichian are attributed to Stage 7 or Substage 5e, the latter (the earliest of three warm peaks within a complex Stage 5) being the true equivalent of the Ipswichian. Bridgland's scheme for the Lower Thames, however, involves no sites that have been identified as Hoxnian on the basis of palynology, although sediments at the classic Swanscombe Palaeolithic site in Kent have long been attributed to that stage and were convincingly correlated with the pollen-bearing Hoxnian deposits at Clacton, Essex by Kerney (1971), using Mollusca. The Swanscombe sediments fall within the highest of the four Lower Thames terraces, that formed by the Boyn Hill/Orsett Heath Gravel Formation (Fig. 3.4). Sediments at Grays, Essex, in the next terrace within the sequence, the Lynch Hill/Corbets Tey Formation (Fig. 3.4), have also been attributed to the Hoxnian (formerly the 'Great Interglacial') by some workers (King and Oakley 1936; Conway 1970), but this was always equivocal and palynological work there led to a re-interpretation as Ipswichian (West 1969; Hollin 1977). Bridgland (1994a) correlated the Swanscombe and Clacton sediments with Oxygen Isotope Stage 11, which is in full agreement with Bowen *et al.* (1989). This, the first interglacial after the Anglian Glacial, and therefore the first during which Lower Thames drainage was in existence, was considered by Bowen *et al.* to predate the type Hoxnian interglacial, so they named it after Swanscombe. All other interglacial sediments in the Thames valley downstream from central London were attributed by Bridgland either to Stage 9 or Stage 7, according to whether they occur in the Lynch Hill/Corbets Tey Formation (Stage 9 sediments) or the next terrace in the sequence, the Taplow/Mucking Formation (Stage 7) (*see* Fig. 3.4). Again there is support from amino acid analyses for this, ratios suggestive of Stage 7 having been obtained from Aveley, Essex, and Crayford, Kent (Bowen *et al.* 1989), both within the Taplow/Mucking Formation, and a ratio suggestive of Stage 9 from Belhus Park, Essex, where the interglacial sediments are believed to be part of the Corbets Tey Formation (Bowen 1991; Bridgland 1994a). Other interglacial sediments from the Corbets Tey formation, and therefore attributed by Bridgland to Stage 9, have given older ratios, however, including very high ratios from Purfleet, Essex, where a pre-Anglian age would seem to be indicated in sediments that clearly relate to a river system not in existence at that time. Bowen *et al.* (1989) correlated the type Hoxnian sediments with Oxygen Isotope Stage 9, implying that they are younger than the Swanscombe deposits and that they correlate instead with the various Corbets Tey Formation interglacial sediments. However, where pollen has been recovered from sediments within the Corbets Tey Gravel, at sites such as Grays, Purfleet, Belhus Park and Upminster (West 1969; Hollin 1977; Gibbard 1994), this has had Ipswichian rather than Hoxnian affinities. Indeed, Gibbard (1994) continues to regard such occurrences as of genuinely Ipswichian age (ie., equivalent of Oxygen Isotope Substage 5e), implying that they cannot be mainstream Thames deposits, as this interglacial is represented in the Thames sequence within the significantly lower Kempton Park Formation. This situation is exemplified by the

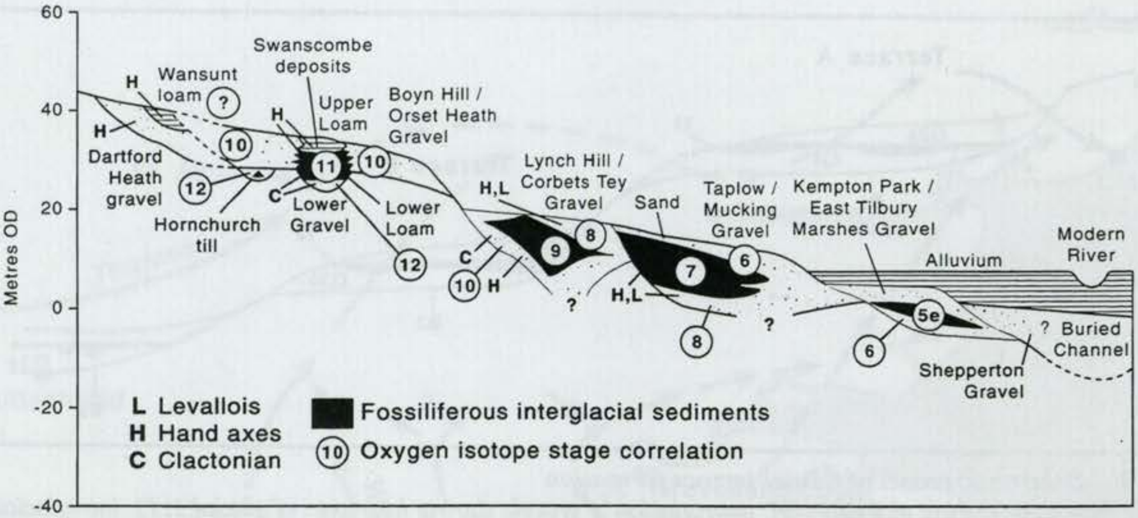

Fig. 3.4 Idealised transverse section through the terrace sequence in the Lower Thames Valley, showing the distribution of Palaeolithic artefacts of different types. Interglacial sediments are attributed to numbered Oxygen Isotope Stages, as in Fig. 3.1 (modified from Bridgland1994a)

Ipswichian sediments at Trafalgar Square, in the lowest of the four terraces described above, in central London (Fig. 3.4). A possible implication of the range of pollen spectra from the Lower Thames terraces is that there is only one post-Anglian interglacial with Hoxnian palynological affinities, thus casting doubt on the separation of traditional Hoxnian sites in the amino acid-based scheme of Bowen *et al.* (1989). Bridgland (1994a) circumvented this difficulty by referring to the interglacial represented at Swanscombe as 'Hoxnian *sensu* Swanscombe', noting that if future research confirms that the type Hoxnian sequence belongs to a later episode, redefinition of the earlier interglacial will be required.

Fitting the archaeological evidence into the framework

As well as having an excellent record of the post-Anglian interglacials, the Lower Thames has a wealth of Palaeolithic localities, in most cases the sources of artefacts coinciding with sediments belonging to the terrace sequence outlined above. The new model for dating the terraces, based on lithostratigraphy and reinforced by biostratigraphy and geochronology, is in marked contrast to the earlier scheme of King and Oakley (1936), which was greatly influenced by Palaeolithic typology. Many of the typological assumptions made in the 1930s are now discredited. Notably, King and Oakley regarded Clactonian assemblages as older than those with handaxes, a view that prevailed until the last 5–10 years. Clactonian-bearing gravels at Swanscombe, at the base of the sedimentary sequence forming the highest terrace in the Lower Thames, were not a problem, but a similar assemblage was recognised at Little Thurrock, Essex, in gravels belonging to the next terrace in the sequence, then known as the 'Middle Terrace'. To explain the Little Thurrock occurrence, in the light of handaxe assemblages being found in the gravels immediately above the Clactonian-bearing deposits at Swanscombe, King and Oakley suggested a complex reconstruction of events in which the Thames, after depositing the basal gravel of the highest terrace (with its Clactonian artefacts), cut down to the 'Middle Terrace' level while the Clactonian occupation continued, then aggraded back to the level of the highest terrace, thus burying the Clactonian-bearing sediments at Swanscombe and Little Thurrock. The final configuration of the highest two terraces was only achieved following a second downcutting event, which took the river back to the Middle Terrace level, where it deposited sediments with 'later' artefact types. This complex scheme retained credibility as long as the pollen-based classification of Pleistocene interglacials prevailed, since it helped to explain how only two post-Anglian interglacials could be represented by warm-climate deposits in more than two terraces. With the recognition that there were more than two interglacials after the Anglian, as well as a strong move away from the use of Palaeolithic typology as a means of dating Pleistocene sediments, the King and Oakley scheme can now be rejected as overcomplicated. The terrace sequence can instead be explained in terms of a simple climatically driven downcutting/aggradation sequence, with each downcutting event progressively lowering the valley floor. It is into this scheme that the Palaeolithic record must now be fitted, with the geological stratigraphy providing the dating for the archaeology rather than vice versa.

A clear pattern emerges when the incidence of Palaeolithic artefacts is superimposed upon the terrace stratigraphic record (Fig. 3.4). This has been discussed at length elsewhere (Bridgland 1994a; 1994b) and will only be summarised here in the following statements (*see* Fig. 3.4):

1. Derived artefacts occur in the oldest Lower Thames sediments. This conforms with the current view that humans were present in Britain before the Anglian glaciation (Roberts 1986; Roberts *et al.* 1994; Ashton *et al.* 1993), which means that the

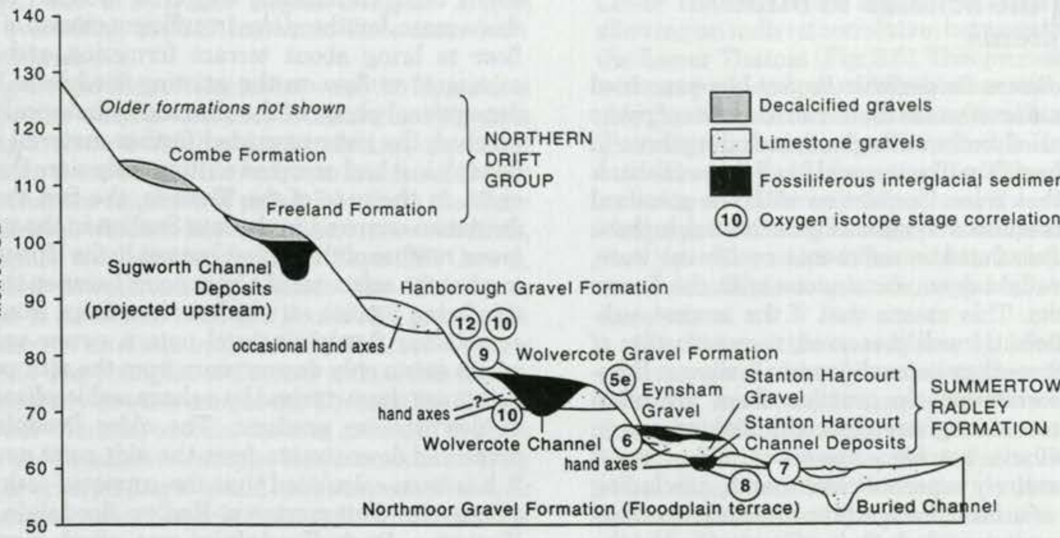

Fig. 3.5 Idealised transverse section through the terrace sequence in the Upper Thames Valley, showing the distribution of Palaeolithic artefacts of different types. Interglacial sediments are attributed to numbered Oxygen Isotope Stages, as in Fig. 3.1 (modified from Bridgland1994a)

Lower Thames sequence does not accommodate the complete Lower Palaeolithic story.

2. Artefacts are common in the highest two terraces, and in the basal gravels of the third highest terrace. According to the dating of these deposits by Bridgland (1994a), this encompasses ages of Anglian (Oxygen Isotope Stage 12) to mid-Saalian (Oxygen Isotope Stage 8 or 7).
3. Handaxes occur throughout the above-mentioned part of the sequence.
4. Clactonian assemblages occur in the highest terrace (Boyn Hill/Orsett Heath Formation) and in the lowest deposits of the next terrace (Lynch Hill/Corbets Tey Formation). The implication of this range is that Clactonian assemblages in the Lower Thames date from Late Anglian to early Saalian (the youngest deposits in which they occur in abundance, at Little Thurrock, are dated to Oxygen Isotope Stage 10 (Bridgland and Harding 1993)).
5. Levallois technique first appears within the sequence in the upper deposits of the Lynch Hill/Corbets Tey Formation, implying that it was first used during the mid-Saalian (Oxygen Isotope Stage 8).
6. No rich Lower Palaeolithic assemblages have been found in sediments laid down subsequent to the interglacial represented within the Taplow/Mucking Formation, suggesting that the valley was no longer occupied by humans in the late Saalian (Oxygen Isotope Stage 6). The absence of assemblages from unequivocal Ipswichian sites suggests a continued absence through the last interglacial. It seems that the rather severe late Saalian glacial represented by Oxygen Isotope Stage 6 caused the southward migration of hunter-gatherers from what was then the British peninsula, that they did not return to the British Isles (as they then were) during the last interglacial, and that they did not return again until the peninsula was reformed during the last glacial.

There are a number of elements in the above record from the Lower Thames that may be of value in assessing the Lower Palaeolithic sequences of other valleys, and perhaps for using these to date the deposits in which they occur. Firstly, the range of artefact occurrences is important. Clearly there is a strong potential for reworking to blur the younger end of this range, unless only primary context occurrences can be used. The first appearance is clearly significant, but here it is necessary to look beyond the Lower Thames for guidance. There is now a significant body of evidence suggesting that Lower Palaeolithic hunters were in Britain by the end of the Cromerian Complex (Roberts 1986; Roberts *et al.* 1994; Ashton *et al.* 1993), during at least the last of the Cromerian Complex interglacials (equivalent to Oxygen Isotope Stage 13). Amino acid ratios from the site at Waverley Wood in Warwickshire, which has yielded some fine handaxes made from andesite, may indicate a human presence in Stage 15 (Shotton *et al.* 1993). Dating of the Somme sequence by Antoine (1990) also places the first artefact assemblages in Stage 15, in an area that at that time was connected by land to southern England, and at no great distance. The first appearance of artefacts showing the use of the Levallois technique is also of potential stratigraphic value. The association of handaxes, Clactonian and Levallois material in terrace deposits of the Great Ouse at Biddenham, Bedfordshire, has already led to the suggestion that these are of similar age to the Corbets Tey Formation of the Lower Thames, where this same combination of artefact types occurs (Harding *et al.* 1992; Fig. 3.4). Unfortunately, the recognition of Levallois technique is not always straightforward, and this somewhat wasteful method is unlikely to have been used in areas where raw material was scarce or of small size.

Extending the scheme to other terrace systems

The *Southern Rivers Palaeolithic Project* has examined the occurrences of artefacts in the terrace deposits of rivers over a wide area of southern England, including those in the upper reaches of the Thames and in all the southbank tributaries of that river. Correlation with the standard Lower Thames sequence is potentially facilitated, in these cases, by the fact that the sediments concerned were, when they were laid down, continuous with the Lower Thames deposits. This means that if the terrace sediments are sufficiently well preserved, reconstruction of their original three-dimensional form will allow a lithostratigraphic correlation. In practice there are often problems because of long stretches of fluvial courses in which terraces have not been preserved. Other areas studied lie in entirely separate catchments, precluding any possibility of a lithostratigraphic correlation, unless by means of an event marker, such as is provided by the Anglian glaciation in the area further north.

There is insufficient space here to examine all the terrace systems covered by the SRPP, so three examples will be taken as case studies.

The Upper Thames

The term Upper Thames applies to that part of the river's catchment lying upstream from the London Basin, which the Thames enters through the Goring Gap, a steepsided section of valley that cuts through the Chilterns chalk escarpment. The fact that terraces are almost entirely absent through the Goring Gap has made correlation with lower reaches of the river extremely difficult, so that the Upper Thames has generally been studied in isolation. Bridgland (1994a) has recently proposed an updated scheme for correlation through the gap and has provided a comparison with the terrace record in the Lower Thames. All four of the post-Anglian interglacials are thought to be represented in the Upper Thames (Fig. 3.5), although the oldest (the Swanscombe interglacial) is known only from reworked bones of temperate-climate mammals in the basal gravels of the Hanborough Terrace, which is correlated with the Boyn Hill/Orsett Heath Formation of the Middle and Lower Thames. The Upper Thames sequence is somewhat condensed, in that two climatic cycles appear to be represented in the Summertown–Radley Formation, the upstream equivalent of both the Taplow/Mucking and Kempton Park/East Tilbury Marshes formations (Figs 3.4 and 3.5). Thus interglacial sediments within the lower part of the Summertown–Radley sequence date from the late Saalian (Oxygen Isotope Stage 7), whereas higher in the sequence last interglacial (Ipswichian) sediments occur. This is a situation that may be common in other parts of Britain, such as in the Fenland rivers (Bridgland *et al.* 1991). It seems that the intra-Saalian downcutting event that occurred between Oxygen Isotope Stage 7 and Substage 5e, the event that led to the Middle Thames abandoning the Taplow Gravel level and forming a new floodplain at the level of the Kempton Park Gravel, did not achieve a complete rejuvenation in the Upper Thames, nor in areas such as Fenland. The erosional event, being climatically triggered, probably occurred in these areas, but there was insufficient erosion of the valley floor to bring about terrace formation and the river continued to flow on the existing floodplain. When the depositional phase of the climatic/hydrological cycle was reached, the river aggraded further material above the floodplain it had occupied continuously since the previous cycle. In the case of the Thames, the fact that terrace formation occurred in the late Saalian in the middle and lower reaches of the valley, but not in the Upper Thames, implies the existence of a 'nick point' between these areas, this being a point at which a river drops from an older established floodplain level onto a newer valley floor, which exists only downstream from the nick point. Nick points are characterised by a sharp and localised increase in downstream gradient. The older floodplain is represented downstream from the nick point as a terrace. It has been calculated that the supposed nick point between the Summertown–Radley floodplain and the Kempton Park floodplain was sited significantly downstream from the Goring Gap, in the Marlow area (Bridgland 1994a).

The updated correlation between the Upper and Lower Thames sequences has been achieved without redress to the archaeology; it is based on lithostratigraphy and biostratigraphy and is supported by amino acid analyses (Bridgland 1994a). Rich Palaeolithic assemblages are scarce in the Upper Thames, but there are a number worthy of examination. The best known is that from Wolvercote brick pit, from interglacial deposits filling the Wolvercote Channel (Fig. 3.5). This assemblage includes a number of well-made plano-convex handaxes of a type likened by Roe (1981) to continental industries of last glacial age. From a typological viewpoint, therefore, the Wolvercote assemblage appeared to be comparatively advanced, suggesting a recent date. This was always difficult to reconcile with the channel's stratigraphic position in the Upper Thames sequence, associated with the second-highest limestone gravel terrace, which is formed by the deposits of the Wolvercote Formation (Fig. 3.5). Indeed, typological arguments were often used to support the attribution of the channel sediments to the Ipswichian Interglacial (Shotton 1973; Briggs and Gilbertson 1974), whereas others, swayed by the stratigraphic position, favoured an earlier age (Bishop 1958; Wymer 1968). The more recent move away from the use of typology for dating Quaternary deposits, coupled with the evidence from deep sea cores for the greater complexity of climatic fluctuation during the Middle Pleistocene, has led to the interpretation of the Wolvercote site on purely geological criteria, and from these it is suggested that the interglacial represented is a relatively early one, perhaps equivalent to Oxygen Isotope Stage 9 (Bridgland 1994a).

According to Wymer (1993a), the richest source of Palaeolithic material in the Upper Thames is the Summertown–Radley Formation. This has become clear during the last two decades when, thanks primarily to the assiduous searches of R.J. MacRae, significant concentrations of artefacts have come to light at Berinsfield and Stanton Harcourt, Oxfordshire (MacRae 1982; 1985; 1991). These have surpassed early find-spots in the Summertown–Radley deposits at Iffley and within the built-up area of Oxford. The Berinsfield assemblage now comprises some 240 artefacts, including Levallois cores and flakes, and is thus the largest from the Upper Thames, overtaking the 111 known to have come from Wolvercote brick pit.

Having arrived at a correlation between the Upper and Middle Thames without reference to the archaeology, it is interesting to observe whether the distribution of artefact discoveries in the two areas is consistent. It is immediately apparent that the numbers of palaeoliths from the Hanborough Gravel, which is limited to just one or two finds, are very much smaller than from the Boyn Hill Gravel, its supposed downstream equivalent. The Wolvercote Formation is correlated with the Lynch Hill gravel, the richest source of artefacts in the Middle Thames (Wymer 1968; 1988). The youngest sediments within this formation, particularly downstream in the Corbets Tey Gravel of the Lower Thames, contain the first artefacts to show the use of the Levallois technique. This is not known from Wolvercote brick pit, but it would not be expected here, as the Wolvercote assemblage is from sediments near the base of the sequence, pre-dating or dating from the interglacial, whereas the Levallois artefacts from the Lynch Hill/Corbets Tey Gravel are from the uppermost post-interglacial gravels (Bridgland 1994a). That the Wolvercote Formation is not the very rich source of palaeoliths that are its supposed downstream equivalents in the London Basin may be a result of the poor preservation of this formation in the Upper Thames, where it has seldom been exposed by quarrying. Records from the Summertown–Radley Formation suggest that the artefacts it contains are concentrated in the lower part of this complex sequence and that they are often in a derived condition. Neither is this surprising, as the two downstream equivalents of this formation, the Taplow and Kempton Park Gravels, are sources of mainly derived palaeoliths. However, the oldest gravel within the Taplow aggradation, particularly in the Lower Thames, is associated with rich assemblages that include (and are sometimes dominated by) artefacts showing Levallois technique. The Berinsfield material would seem comparable with these assemblages, particularly since Levallois technique is likely to have been used sparingly in the Upper Thames, where supplies of large flint would have required transporting from the chalk escarpment to the south-east. Thus the evidence from Palaeolithic occurrences in the Upper Thames broadly supports the correlation, made on geological grounds, of the gravels there with those in the lower reaches of the river.

The River Medway

The Medway is an important south-bank tributary that currently joins the Thames near the mouth of latter's estuary. Prior to the Holocene rise in sea level, however, the two rivers joined here and flowed together across Essex. Further back in time, before the Anglian glaciation, the Medway was a much longer river, since it had an independent valley extending to the north-eastern corner of Essex (Bridgland 1983; 1988a; Fig. 3.2). Because the rivers have been confluent in the area of the present Thames estuary, it is possible to project the terraces of the Medway downstream to the Southend area, where they are continued, in the case of those post-dating the Anglian diversion of the Thames, as Thames–Medway terraces. A similar projection is possible between the important Lower Thames terrace sequence and the Southend area, allowing an indirect correlation between the Medway and the Lower Thames (Fig. 3.6). This process is not entirely without problems, particularly since there is a considerable gap without terrace preservation between the Lower Thames sequence around Stanford-le-Hope and Southend, coinciding with the widening of the modern estuary in the area of Canvey Island and the confluences with Vange and Benfleet Creeks. Therefore, as in the case of the Upper Thames, it is desirable to look to evidence from the Palaeolithic to provide support for the suggested correlations.

The Palaeolithic record from the Medway terraces is not extensive, although more so than from the Upper Thames, as would be expected with a river flowing through the flint-bearing North Downs chalk escarpment. Unfortunately, the valley through the Kent Downs, between Snodland and Rochester, is constricted by the relative resistance of the chalk to erosion and, exactly as with the Goring Gap in Oxfordshire, there is little terrace preservation. This is not just a restriction on the potential occurrence of palaeoliths, it also presents a problematic gap in the downstream continuity of the Medway terraces, raising questions about correlation between the upper and lower reaches of the valley. A tiny terrace remnant in the valley through the North Downs, at Cuxton, is the most prolific source of artefacts from Medway gravel (Tester 1966; Cruse 1989); other, more prolific sites in the catchment at Frindsbury and Twydall are in slope deposits.

The Medway terraces on the Hoo peninsula, between the Thames and Medway estuaries, have been considered elsewhere (Bridgland and Harding 1985; Bridgland in Cruse 1989), although their suggested relation to the Thames terraces requires correction in view of the subsequent re-evaluation of the correlation between the Lower Thames and the Southend area (Bridgland *et al.* 1993). Consideration by the author of the correlation between the Lower and Upper Medway has been greatly assisted recently by the kind provision by Professor A.W. Skempton of unpublished information on the distribution and altitude of terrace remnants throughout the Medway catchment. This information enhances that available from Geological Survey mapping and from previous publications, notable amongst which is that by Skempton and Weeks (1976).

The published geological mapping, used as the basis for the maps of artefact distribution produced as part of the SRPP, recognised four numbered terraces throughout the Medway valley, increasingly poorly preserved with height above the floodplain, with a fifth terrace and sporadic higher-level gravels preserved in the Malling–Barming area, west of Maidstone. Skempton and Weeks retained this scheme of numbered terraces, but pointed out that Terrace No.4 in the upper valley is continued around and downstream from Maidstone by deposits mapped as Terrace No.3 (Fig. 3.6). These authors suggested a correlation with the Thames, based on the elevation of terrace remnants above the valley floor as well as faunal and artefact assemblages, in which they suggested that Upper Medway Terrace No.4 was equivalent to the Boyn Hill Terrace at Swanscombe. This correlation requires re-evaluation in the light of revisions in the interpretation of the Thames sequence since 1976.

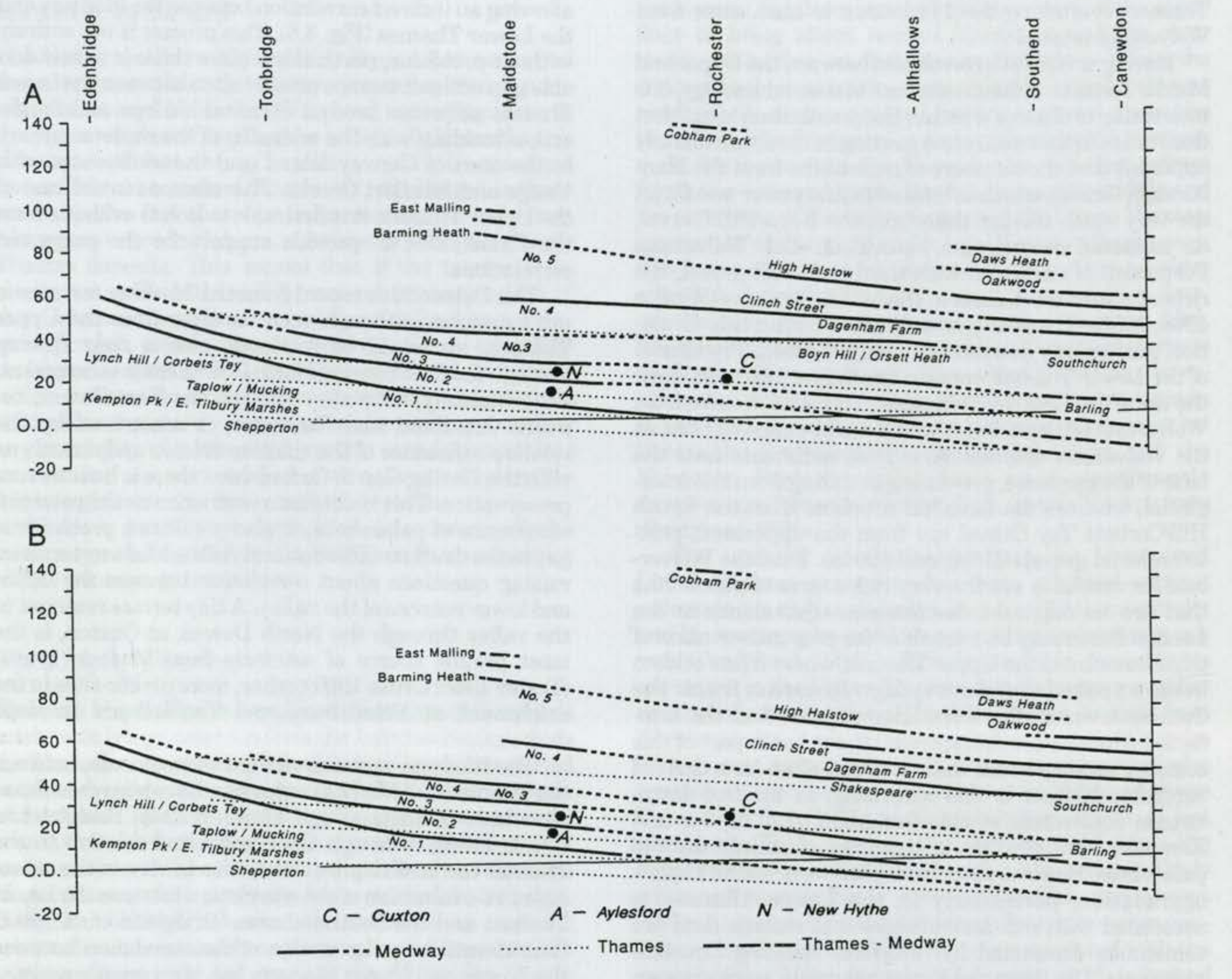

Fig. 3.6 Long-profiles of the terraces of the River Medway, showing relation to terraces in the Lower Thames and south-eastern Essex. A: projection through the North Downs suggested by Skempton and Weeks (1976); B: alternative interpretation, with a steeper projection through the North Downs. Note that two terraces can be recognised within what is mapped as Terrace No.3 in the Maidstone area

A comparison of terrace long-profiles in the Thames, Thames–Medway and Medway systems, using the reconstructions of Bridgland (1994a, fig. 1.3) and Skempton and Weeks (1976), reveals a difficulty in projecting terraces between the Medway valley and the Southend area. The downstream gradient of the Thames–Medway terraces across eastern Essex, itself a continuation of the gradients of the Lower Thames terraces, is around 0.28 m per km, whereas, according to Skempton and Weeks, the maximum gradient of the Medway terraces downstream of Maidstone is only 0.15 m per km. The supposed decrease in gradient of the Medway terraces in the lower valley parallels a similar flattening of the modern floodplain, as the river approaches its estuary. A similar flattening might not be expected for the Pleistocene Medway floodplains, now represented as terraces, since these were not graded to a high sea level. In fact the terraces in the tributary valley would be expected to be significantly steeper than those in the main valley upstream from the confluence, since the tributary has a smaller catchment.

Using the Skempton and Weeks reconstruction (Fig. 3.6A), their fourth terrace of the Upper Medway feeds into the Boyn Hill/Orsett Heath/Southchurch gravel of the Thames/ Thames–Medway, their third terrace links with the Lynch Hill/Corbets Tey/Barling Gravel, while the second and first Medway terraces correlate with Thames formations that fall below sea level before reaching the Southend area, the Taplow/Mucking and the Kempton Park/East Tilbury Marshes formations respectively. This leaves no equivalent of the lowest Thames formation, the Shepperton Gravel, identified in the Medway valley. It is possible, however, to project terrace surfaces between the Medway valley and the Southend area at gradients similar to those of the gravel formations in eastern Essex (Fig. 3.6B). In this case the fourth terrace of Skempton and Weeks equates with the Lynch Hill/Corbets Tey/ Barling Gravel of the Thames, with other correlations adjusted accordingly. This allows the first terrace of the Medway to be correlated with the Shepperton Gravel, in line with the identification of the first terrace site at

Halling, near Rochester, as a type locality for the Lower Floodplain Terrace (King and Oakley 1936). This version requires that the terrace numbering north of Rochester is even further 'out of sync' with that in the Upper Medway than was realised by Skempton and Weeks. The fourth terrace of the Upper Medway would equate with the Stoke Gravel of the Hoo Peninsula, which is mapped as Terrace No.2. It would perhaps be simplistic to imagine that one or other of these options is correct to the exclusion of the other. An important consideration is that the Medway terrace record might be condensed upstream in the same way as is that in the Upper Thames (*see above*), particularly as there are clearly fewer terraces recognised in the upper catchment. It is thus necessary to draw upon evidence from other sources, such as faunal assemblages and the distribution of Palaeolithic finds in the Medway terraces, to evaluate the various options for correlation.

The record of palaeoliths from the Medway Valley requires further appraisal, since many are recorded only as discoveries from a particular location, with no further information about their provenance nor a record of their condition; in particular, the provenance of artefacts from within the gravels could perhaps be confirmed if examination in museum collections revealed them to be in a waterworn condition. Happily, the provenance of the larger assemblages is securely known and these can be assessed with profit. The largest assemblage, from Cuxton, is in that part of the valley where its altitude is a relatively poor guide as to which terrace it represents, given the uncertainty about correlation between the Upper and Lower Medway. Using the Skempton and Weeks projections (Fig. 3.6A), the Cuxton remnant falls midway between projections of Terraces No.3 and No.2 of the upper valley, suggesting that it is a degraded remnant of Terrace No.3, which would imply correlation with the Lynch Hill/Corbets Tey Gravel of the Thames. In the alternative, steeper reconstruction (Fig. 3.6B), the projection between Terrace No.3 of the Upper Medway and the Binney Gravel of the Hoo Peninsula passes right through the Cuxton remnant. Thus Cuxton is still attributed to Terrace No.3, but in this case the implied correlation is with the Taplow/Mucking Gravel. The combination of handaxes and Levallois technology recognised at Cuxton is in keeping with either interpretation, as similar assemblages have been obtained from the two Thames terraces mentioned. In the case of the Lynch Hill/Corbets Tey Gravel, the presence of Levallois artefacts would indicate a stratigraphic position high (late) within the aggradation, deposited after the mid-Saalian (Stage 9) interglacial. In the case of the Taplow/ Mucking Gravel, rich Palaeolithic assemblages in near primary contexts are known only from deposits low (early) within the aggradation, such as at West Thurrock (Bridgland 1994a), where the material has a Levallois element. The provenance of the Cuxton material, in gravel immediately above the chalk and well below the projected terrace surface in the Skempton and Weeks version, is perhaps more in keeping with the alternative (Fig. 3.6B) option. It should be noted, however, that Levallois material is only recorded from the 1962 excavation at Cuxton, which was from the highest part of the outcrop. No evidence of Levallois technology was recognised in the assemblage from the lower 1984 excavation site (Cruse 1989).

Further upstream, modest assemblages of artefacts are known from sites at Aylesford, Boxley, Larkfield (Snodland) and New Hythe. The last of these is the largest, comprising 88 handaxes, 5 Levallois cores and numerous flakes, including 41 Levallois flakes (Wymer 1993b). This and the nearby Larkfield site, which has yielded a further 43 handaxes and a Levallois flake, are in gravels of the (Upper Medway) third terrace. They therefore reinforce the connection between the third terrace and rich Palaeolithic assemblages with Levallois technology, but do not greatly assist the problem of correlation with the Thames. The Aylesford assemblage comes from the second terrace gravels that have been exploited over a very large area to the north-west of this village. Some 42 handaxes are known to have come from these particular workings, with a further 315 known only to have come from Aylesford. Levallois material from Aylesford unfortunately occurs only amongst the poorly provenanced collections. The second Medway terrace correlates either with the Taplow/ Mucking Gravel or with the Kempton Park Gravel, according to which of the options described above is correct. Rich Palaeolithic assemblages are unknown in the Kempton Park Formation, which would appear to argue against the correlation model based on steeper downstream projections. However, the very large amount of gravel removed from the Aylesford area raises the question of whether this really was a rich site, or whether the collections have arisen from the continued accumulation of sporadic finds. Examination of some of the Aylesford material in the Maidstone, Rochester and Dartford Museums has shown it to include most types of handaxe, including cleavers and examples with twisted profiles, although pointed forms predominate (P. Harding, pers. comm.). The vast majority of the pieces are water-worn which, together with the dearth of flakes from the site, might indicate a secondarily derived assemblage. A few handaxes made from greensand chert, presumably from the Folkestone Beds and/or the Hythe Beds from the local area, were noted amongst the predominant flint examples.

The Aylesford site has also produced a noteworthy assemblage of bones and teeth of large mammals. Such material is often found sporadically in Pleistocene gravels, so again this assemblage could represent an accumulation of material collected from a very large volume of not particularly fossiliferous gravel, although the record of a Geologists' Association excursion visit to the pit in 1876, when numerous teeth and bones were collected and a 3 m long mammoth tusk protruded from the section (Hudleston 1876), does suggest that concentrations of mammalian remains may have been present. The assemblage, as summarised by Skempton and Weeks (1976), comprises:

lion	*Panthera leo*
mammoth	*Mammuthus primigenius*
straight-tusked elephant	*Palaeoloxodon antiquus*
horse	*Equus caballus*
woolly rhinoceros	*Coelodonta antiquitatis*
pig	*Sus scrofa*
red deer	*Cervus elephus*
giant deer	*Megaloceros giganteus*
extinct ox (aurochs)	*Bos primigenius*
bison	*Bison priscus*

At first impression this assemblage is reminiscent of the characteristic mammal fauna, which includes horse and mammoth and lacks hippopotamus, that has been regarded as diagnostic of the late Saalian interglacial, equivalent to Oxygen Isotope Stage 7, represented at sites such as Aveley and Stanton Harcourt in the Thames valley (Shotton 1983). However, given that there are no precise records of the provenance within the Aylesford deposits of these remains, considerable caution is required. An assemblage such as this might also have resulted from the aggregation of remains from deposits dating from the last interglacial (Ipswichian) and from the Devensian interstadials (Chelford and Upton Warren), now thought to represent the later two warm peaks of the tripartite Stage 5 (Substages 5c and 5a; Bowen 1989). Thus the straight-tusked elephant and pig, the only unequivocally interglacial species in the above list, could have come from Ipswichian sediments and the remaining taxa from interstadial sediments. A mixture of this sort would not be surprising, as lenses of sediment attributable to these three warm episodes within Stage 5 are found in the Kempton Park Gravel of the Thames. In the first terrace of the River Welland, at Maxey, near Peterborough, numerous lenses and channel-fills of Ipswichian and Devensian interstadial age have been observed in juxtaposition (Davey *et al.* 1991; Seddon and Holyoak 1991). Here, however, a basal channel was observed that might well have been infilled during an earlier temperate episode, possibly Oxygen Isotope Stage 7 (Davey *et al.* 1991). As noted earlier, the occurrence of Stage 7 and Stage 5 deposits within a single terrace formation also occurs in the Upper Thames basin, where it reflects the condensing of the terrace sequence upstream. The possibility that the Upper Medway sequence is similarly condensed, and that the Aylesford deposits span a comparable part of the Pleistocene to the Summertown–Radley Formation of the Upper Thames, incorporating sediments dating from Stages 7 and 5, should be carefully considered, although to put forward such an interpretation on the basis of the present evidence would be speculative in the extreme. It would, however, explain the occurrence of the palaeoliths. Of possible relevance to this debate is the record, from the lower first terrace at Aylesford (which outcrops to the south-east of the Terrace No.2 site), of a molluscan fauna that clearly dates from the late Devensian and Holocene (Burchell 1933; R.C. Preece pers. comm.). The occurrence of such recent sediments in the first terrace here would seem to suggest that the second terrace, at least in part, dates from the previous climatic cycle, and would thus incorporate late Saalian, Ipswichian and early Devensian sediments. The absence of hippopotamus from the Aylesford assemblage would seem to indicate that Oxygen Isotope Substage 5e cannot be well represented at the site, as this animal is consistently among the most common fossils from that interval, especially in fluviatile deposits.

The Boxley site, about which relatively little is known except that it has yielded both handaxes and Levallois flakes, was thought likely by Wymer (1993b) to be located on the edge of Terrace No.1. The outcrop of Terrace No. 1 at Aylesford, mentioned above, has also yielded a number of artefacts. Whichever scheme for correlation is adopted, Terrace No.1 is clearly of more recent age than those Thames terraces that have provided abundant Palaeolithic material, so it is likely that the artefacts from the this terrace of the Medway have been secondarily derived from older gravels.

There are no rich Palaeolithic assemblages from the Upper Medway in terraces higher than No.3. Terrace No.4 may have yielded occasional handaxes, such as at Nettlestead (Wymer, 1993b), but the terrace is poorly preserved. Two handaxes in Maidstone Museum, from Barming (TQ 733 557 and TQ 695 550) may have come from a Terrace No.5 outlier at this locality (Wymer 1993b); confirmation that they are waterworn might provide corroboration for this suggestion, which could have some bearing on the question of correlation. However, occasional finds of handaxes, without evidence for the use of the Levallois technique, would be expected from the correlatives of both the Boyn Hill and Black Park Gravels of the Thames and, given the implication that handaxes were being made in Britain before the Anglian, of the Winter Hill Gravel also, although finds from this particular terrace of the Thames have yet to be confirmed.

It has to be concluded, therefore, that correlation of terraces between the Upper and Lower Medway is problematic, but evidence from Palaeolithic archaeology, while not providing a clear answer to the problem, is of considerable value in assessing the various possible correlation models.

The Solent River

The largest fluvial system in Britain wholly outside the limits of the Pleistocene glaciations, that of the Solent River, has been largely extinguished, perhaps only temporarily, as a result of the flooding of the Solent by the rising Holocene sea. Although the river no longer exists in its Pleistocene form, it has left an excellent record of its former extent in the form of its terrace deposits, which cover large areas of Dorset and southern Hampshire. The Solent gravels west of Southampton have recently been thoroughly re-examined, with the result that a new system of nomenclature is in place for their description and classification (Allen 1991; Allen and Gibbard 1994). These authors have divided the Solent catchment into four separate areas and named the gravel bodies that form the terraces separately in each area. Three of these, the Bournemouth–Southampton area, the valley of the Stour and the valley of the Avon, have been considered together, it being possible to correlate the surviving deposits in each with some degree of confidence (*see* Allen and Gibbard 1994, fig. 9; Wymer this volume, Fig. 2.4). There are considerable difficulties in relating the gravels in these three areas to those of the fourth, namely the Frome valley, which is thought to represent a higher reach of the erstwhile Solent River valley. Allen's studies have revealed that the gravels in this area have considerably steeper downstream gradients than those further east (Fig. 3.7). Allen and Gibbard (1994) suggested that a change in gradient occurred between the two areas, in the region of Poole harbour, where there is no preservation of the terrace record. Another possible explanation should perhaps be considered, that of Pleistocene tectonic activity, something that has been mooted in this area on other grounds in recent years (Preece *et al.* 1990).

Allen and Gibbard concentrated on lithostratigraphic classification of the gravels and paid scant attention to

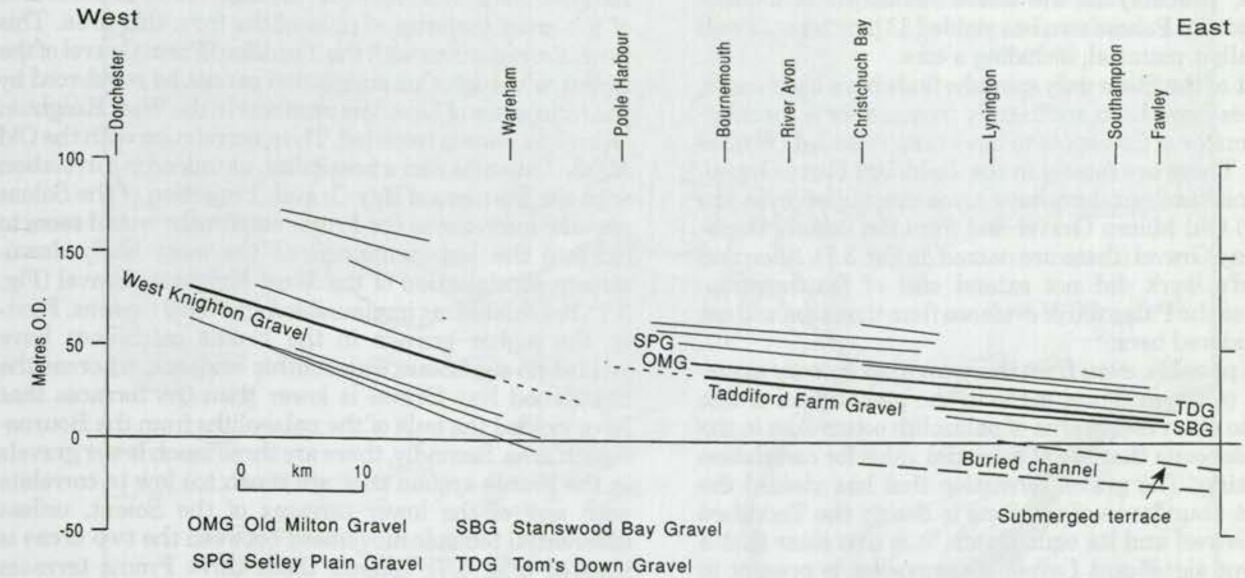

Fig. 3.7 Long-profiles of the Solent River terraces (modified from Allen and Gibbard 1994). The gravel formations containing abundant Palaeolithic material are indicated (see text)

their archaeological content. They made the important observation that gravels in the Bournemouth area contain clasts of Jurassic chert from the Purbeck region, providing evidence that a Solent River, incorporating the catchment of the modern Frome, was indeed in operation during the Pleistocene. Their allocation of member status to the individual gravels cannot be supported, for reasons stated elsewhere (Bridgland 1988b; 1994a); in particular, it is clear from the description of their methodology that the individual gravels have been identified as primary mappable units, defined at type localities. As such they can only be formations.

Allen and Gibbard were unable, by reconstructing the three-dimensional form of gravel bodies from the surviving remnants, to suggest correlations between the terraces of the Frome valley and those in the Bournemouth area. This resulted from the absence of data from the intervening area, now occupied by the erosional basin of Poole Harbour, from the sparsity of palaeontological evidence, and from the fact that the reconstructed terrace formations to the west and east of Poole Harbour do not tally when projected across the intervening gap (Fig. 3.7), notwithstanding the difference in gradient alluded to above. These authors did not attempt to make use of the evidence from palaeoliths, however, which is available in great abundance. The recent cataloguing of find-spots as part of the SRPP (Wymer 1993a) has allowed this evidence to be considered here, although it must be emphasised that there is considerable potential for further development of this approach, by incorporating information on the condition of artefacts (as a guide to their likely provenance from fluviatile deposits, and their likelihood of being reworked).

In the area west of Poole Harbour there are few important Palaeolithic occurrences. Artefacts found in this area are mainly from the West Knighton Gravel of Allen and Gibbard. This includes the only prolific locality, at Moreton, where old gravel workings yielded at least 70 handaxes (Arkell 1947; Wymer 1993a). Large numbers of artefacts have been obtained from the gravels between Poole Harbour and Southampton, from deposits forming terraces of the Stour and Avon as well as those thought to have been laid down by the Solent River. Plotting of their find-spots as part of the SRPP has shown that they have come primarily from the Old Milton Gravel, the Taddiford Farm Gravel and the Stanswood Bay Gravel or their equivalents in the tributary valleys. Prolific sites occur only in the Bournemouth area, where they are concentrated in the Taddiford Farm Gravel or the equivalent Ensbury Park Gravel of the Stour. The latter deposit has yielded 31 handaxes and a Levallois core at Canford and over 200 handaxes from various pits at Corfe Mullen. The attribution of the Corfe Mullen deposits to the Ensbury Park Gravel is by Wymer (1993a), since the outcrop is to the west of Allen and Gibbard's map. Geological Survey mapping, reproduced by Wymer (1993a) puts the gravel at Corfe Mullen in a higher terrace (No.12) to that at Canford (No. 9/10). Wymer cited the views of Calkin and Green (1949), who believed that the artefacts at Corfe Mullen were concentrated at the riverward bluff edge of the terrace, and suggested that the Corfe Mullen assemblage is of equivalent age to those from the lower (No. 9/10) terraces. The Ensbury Park Gravel, or a slightly lower terrace formation of the Stour, has also produced 90 handaxes at Redhill Common, in an area not covered by Allen and Gibbard's map.

There are three rich sites in the Taddiford Farm Gravel between Boscombe and the Stour, the easternmost part of this area representing the contemporary confluence between the Stour and Solent Rivers. The first of these, an agglomeration of pits in King's Park, Boscombe, included one known as Thistlebarrow Pit, is the richest source of palaeoliths in the Bournemouth area. Around 300 handaxes come from Kings Park, with a further 49 from Queen's Park, the second important site at Boscombe. Levallois technique has been recognised amongst the flakes from these sites. Further east on the same outcrop, probably in the above-mentioned confluence area, a site at Pokesdown has yielded 33 handaxes as well as Levallois material, including a core.

East of the Stour only sporadic finds have been made, but these have been sufficiently frequent for a considerable number of find-spots to have been recorded (Wymer 1993a). These are mostly in the Taddiford Farm Gravel, but significant numbers have come in addition from the (higher) Old Milton Gravel and from the (lower) Stanswood Bay Gravel (these are named on Fig. 3.7). Allen and Gibbard's work did not extend east of Southampton Water, so the Palaeolithic evidence from that area will not be considered here.

It is possible, even from the somewhat cursory examination of the evidence made in the preparation of this paper, to observe patterns of palaeolith occurrence in the Solent deposits that are of potential value for correlation and dating. The gravel formation that has yielded the greatest abundance of artefacts is clearly the Taddiford Farm Gravel and its equivalents. It is also clear that a small but significant Levallois component is present in this gravel. Both facts invite comparison with the Lynch Hill/Corbets Tey Gravel of the Thames, in which the youngest part of the aggradational sequence contains the first appearance of Levallois technique (*see above and* Fig. 3.4) and is attributed to the mid-Saalian (Oxygen Isotope Stage 8). The records from the Solent catalogued by Wymer (1993a) show that Levallois technique is not represented in material from higher terrace deposits. One possible exception comes from Moordown, an area that is covered by the significantly higher Setley Plain Gravel of Allen and Gibbard (1994). The assemblage from this locality, which also includes 50 handaxes, is not well provenanced and the occurrence of Levallois is based on a single flake. It must thus be regarded with suspicion. The Old Milton Gravel is associated, therefore, mainly with handaxes. Given that the Taddiford Farm Gravel has been likened to the Lynch Hill Gravel, the Old Milton Formation has obvious similarities with the Boyn Hill/Orsett Heath Gravel of the Thames, the next terrace formation above the Lynch Hill Gravel in the Thames sequence. One problem with suggesting these as correlations between the two river systems is that Allen and Gibbard have identified an intervening gravel between these two formations in the area east of Bournemouth, their Tom's Down Gravel (Fig. 3.7). This deposit does not seem to have yielded much Palaeolithic material. Another problem, perhaps related to the first, is that the Solent sequence includes four terrace formations below the level of the Taddiford Farm Gravel, whereas only three post-Lynch Hill Thames formations are recognised. Given that inequality between the numbers of terraces in different river systems, and between different reaches of the same system, has already been noted, disparity between the Thames and Solent sequences is perhaps to be expected. It is felt that the distribution of artefacts within the Solent gravels represents, at present, the best means for judging their likely age, and that the evidence points to a mid-Saalian age for the Taddiford Farm Gravel and a late Anglian to early Saalian age for the Old Milton Gravel.

The Palaeolithic evidence from the Solent gravels also yields information on the outstanding problem of correlation between the isolated terrace sequence to the west of Poole Harbour with that to the east. As noted, the West Knighton Gravel of Allen and Gibbard (1994) is the source of the great majority of palaeoliths from this area. This invites comparison with the Taddiford Farm Gravel of the Solent, although this suggestion cannot be reinforced by the occurrence of Levallois artefacts in the West Knighton Gravel, as none is recorded. Thus, correlation with the Old Milton Gravel is also a possibility, as indeed is correlation with the Stanswood Bay Gravel. Projection of the Solent gravels upstream to the Frome catchment would seem to indicate the last-mentioned as the most likely downstream continuation of the West Knighton Gravel (Fig. 3.7), but this seems implausible for several reasons. Firstly, the higher gravels in the Frome catchment have yielded no significant Palaeolithic evidence, whereas the Stanswood Bay Gravel is lower than the terraces that have yielded the bulk of the palaeoliths from the Bournemouth area. Secondly, there are three much lower gravels in the Frome system that are much too low to correlate with any of the lower terraces of the Solent, unless differential tectonic movement between the two areas is invoked (Fig. 3.7). Indeed, these three Frome terraces appear to be graded to a base-level that would take them below the buried channel of the Solent, raising serious doubts about whether they truly belong to that river system. A separate low-level route connecting the Frome to the English Channel River may be the only viable explanation of these long profiles. The existence of such a valley, curving southwards between the Isles of Wight and Purbeck, has been suggested previously (Nicholls 1987), but only for the Late Pleistocene. The evidence from the distribution of palaeoliths gathered by Wymer (1993a), together with the reconstruction of terrace long profiles by Allen and Gibbard (1994), suggests that the Frome might have been separated from the Solent much earlier than this. Thus the West Knighton and Taddiford Farm Gravels might represent broadly contemporaneous aggradations in separate tributaries of the English Channel River (Fig. 3.8B). It is noticeable that the highest terraces in the Frome catchment have a shallower downstream gradient (Fig. 3.7), suggesting that only these were part of the Solent system. The clasts of Isle of Purbeck cherts in the gravels of the Bournemouth area would have been transported eastwards while the connection still existed and have subsequently been reworked into later gravels. This suggestion is seemingly borne out by the fact that these occur at greater frequencies in the higher gravels of the Bournemouth–Southampton area (Allen and Gibbard 1994, table 2).

The possibility that the Frome and other western Solent drainage had a separate outlet to the south before the Holocene was considered by Allen and Gibbard and rejected by them on the grounds that no such valley to the west of the Isle of Wight is revealed in bedrock surface mapping offshore by the Geological Survey (Fig. 3.8A). However B. d'Olier (pers. comm.), who has studied this area using seismic reflection profiling, has obtained evidence for the existence of a substantial drowned river system to the west and south-west of the Needles. He claims that this system, which involves a number of submerged terraces, crosses the west-to-east trending chalk outcrop about 10 km to the west of the Needles. It seems likely that this was the route taken by the rivers draining south Dorset during and since the Middle

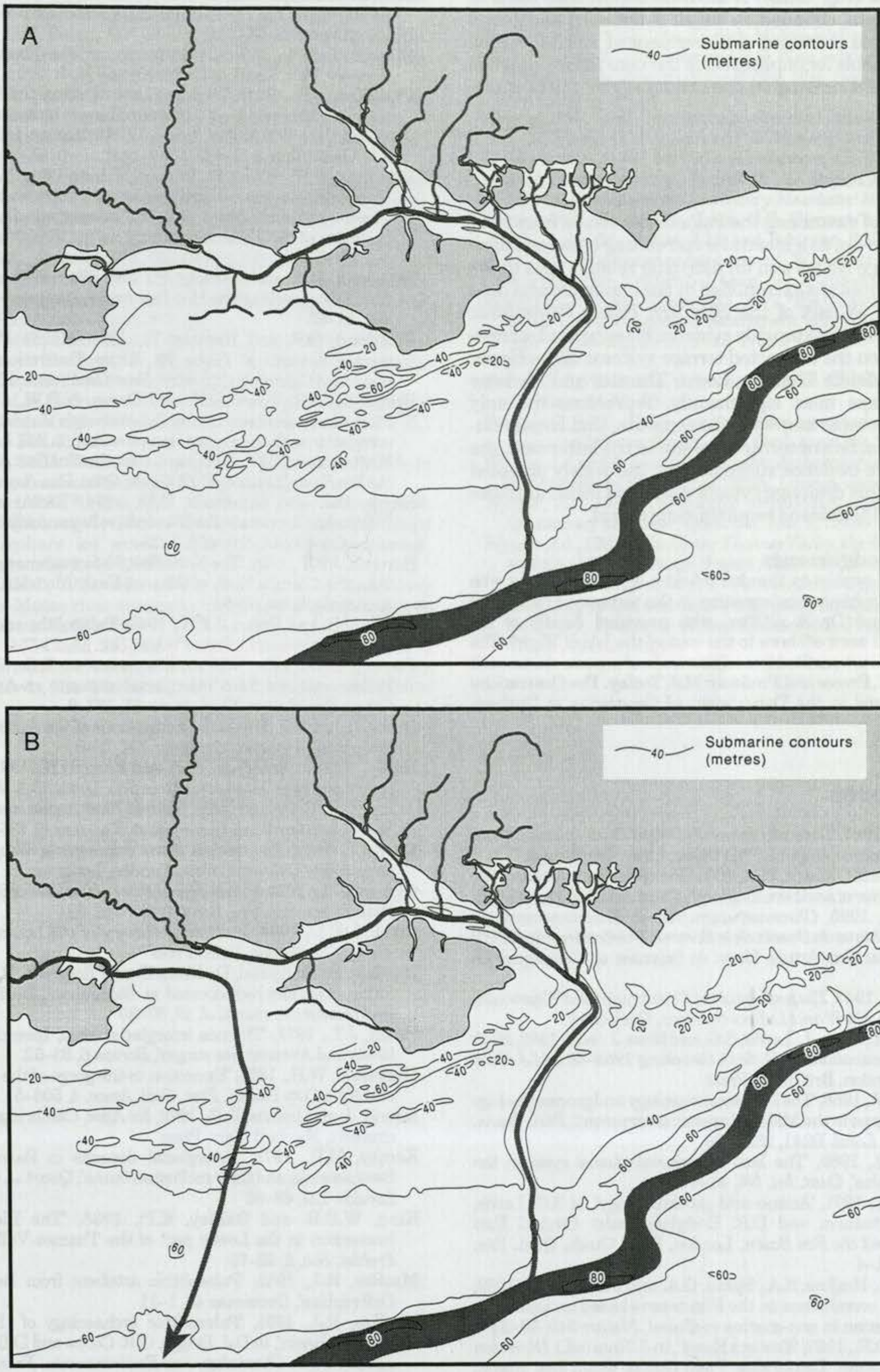

Fig. 3.8 The Solent River at the end of the Middle Pleistocene. A: after Allen and Gibbard (1994); B: modified to incorporate a separate valley taking the Frome and related rivers southwards to the west of the Isle of Wight (incorporating unpublished information supplied by B. d'Olier)

Pleistocene (Fig. 3.8B). It is to be hoped that some of D'Olier's data, obtained on behalf of the sand and gravel industry and therefore of a confidential nature, can be made available for publication in the near future, as it has an important bearing on the history of the Solent catchment.

Conclusions

The value of examining the Palaeolithic record from river terrace gravels, as a means for correlating between different drainage basins and for ascribing relative ages to the various deposits, is exemplified by the implications of data assembled as part of the *Southern Rivers Palaeolithic Project*. These data provide evidence for enhanced correlation between the connected terrace systems of the Upper Thames, Middle Thames, Lower Thames and Medway and, perhaps most significantly, represents the only means of comparison with the separate, and largely unfossiliferous, Solent terrace system. In the latter case, the Palaeolithic evidence suggests that the widely accepted view that this drainage system remained intact until the end of the Pleistocene requires reappraisal.

Acknowledgements
The author wishes to thank Professor A.W. Skempton, who supplied unpublished information on the terraces of the Upper Medway, and Dr B. d'Olier, who provided details of his unpublished work offshore to the west of the Isle of Wight. The author has also benefited from discussions of aspects of this work with Dr R.C. Preece and Professor M.J. Tooley. The illustrations were prepared in the Department of Geography at Durham University.

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4. Quantifying the English Palaeolithic: GIS as an Approach

Robert Hosfield

Abstract

The Southern Rivers Palaeolithic Project (SRPP) *and the* English Rivers Palaeolithic Survey (TERPS) *are providing a new, comprehensive source of information documenting the English Lower and Middle Palaeolithic. These studies place the recorded archaeological material within its Pleistocene, geological context, as well as relating it to the pattern of mineral extraction during the last 150 years. The database created offers scope for the investigation of the English Palaeolithic from a regional rather than a single site perspective. In order to understand the regional distributions of archaeological material, the processes which may have influenced the recovery and recording of Palaeolithic data are examined. An attempt is made to convert previously documented accounts into systematic information so as to permit statistical manipulation at a range of spatial scales using Geographic Information System (GIS) techniques.*

Introduction

The completion of the *Southern Rivers Palaeolithic Project* (SRPP), and the approval for the *English Rivers Palaeolithic Survey* (TERPS), in 1994, provided archaeologists with a new, comprehensive resource for the study of the English Lower and Middle Palaeolithic.

Although Derek Roe's (1968) *Gazetteer* previously documented the archaeology of this period, the SRPP offers two considerable advantages over that seminal study. Firstly, the inclusion of Pleistocene deposits and gravel extraction site data, reflecting the cultural resource management aspect of the project, provides an important context for the assessment of the recorded Palaeolithic find-spots. Secondly, the visual presentation of the data highlights the potential for renewed, spatially-orientated analysis of the entire Lower Palaeolithic data set[1].

The relationship between the discovery of Palaeolithic material and the excavation of Pleistocene deposits, especially gravel, in England and northern Europe has long been acknowledged by archaeologists. However, this relationship has typically been assumed or discussed only in passing at the anecdotal level, rather than actively investigated. In his 1981 review of the English Palaeolithic, Roe (1981, 23) remarks:

> This [the later nineteenth century] was in the heyday of gravel-digging by hand and the gravels which were being worked by shovel and pick were mainly the high and middle terrace gravels of the major river valleys, where so many implements were to be found.

The consequences of this relationship, and the simple acceptance of it, can be seen in the distribution maps of Palaeolithic material, which are typically biased towards the intensive zones of modern industrial development (Roe, this volume, Fig. 1.1). The associated lack of confidence in regional archaeological data for the English Lower Palaeolithic would seem to be a key cause behind the traditional site-orientated approach of the subject.

Nonetheless, the uncritical acceptance of this relationship is understandable, especially as the factors which bias the discovery of Palaeolithic material, including the influences of local collectors, payment for lithic discoveries, and the importation of artefacts for reward, are frequently unknown for individual sites. Even where such data is documented, to investigate the history of each site would be a monumental task.

However, while the specific circumstances of site discovery are commonly unknown, the broader scale human activities which apparently influence the distribution of Palaeolithic discoveries can be recorded at the regional level. These 'industrial' activities include aggregates extraction, urban development and infrastructure construction. Furthermore, when the area of archaeological focus is the region, the point of interest is not so much those recorded sites, but those areas where the presence, or absence, of archaeology is unknown.

The availability of a uniform, regional data base (the SRPP), combined with the facilities of Geographic Information Systems (GIS) software, offers for the first time a practical opportunity to test the existence and nature of the relationship between industrial activity and the discovery of Palaeolithic material. For example, the concentration of Palaeolithic find-spots within urban Salisbury, Wiltshire, as mapped in *c.* 1900 would certainly suggest a relationship worth investigating (Fig. 4.1).

The suitability of GIS software to an analysis of spatial relationships stems from its basic function. Burrough (1986, 6) defines a GIS as 'a powerful set of tools for collecting, storing, retrieving at will, transforming, and displaying spatial data from the real world for a particular set of purposes.' Unlike traditional non-spatial data bases, a GIS stores entities (the geographical data) in terms of three components; their position in space (a locational component); their characteristics (an attribute component); and their inter-relationships with one another (a topological component). The organisation of those entities into layers enables the individual representation of different data themes, for example archaeological sites, water channels and soil types, without losing the ability of

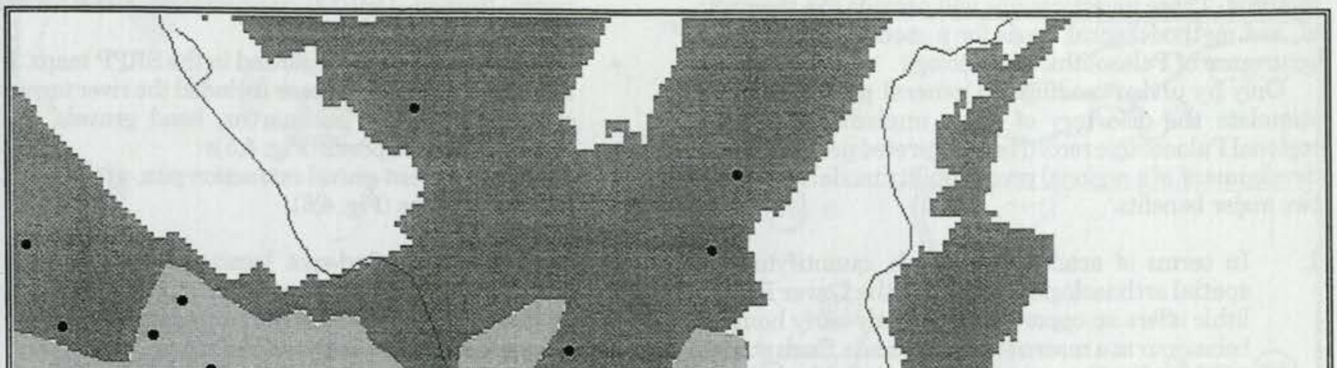

Fig. 4.1 Distribution of Palaeolithic find-spots in urban Salisbury

comparative analysis (Fig. 4.2). This structure allows the spatial relationships between geographical data to be freely investigated (Burrough 1986).

Although such work was possible previously, by overlaying transparent map sheets for example, it was time consuming and therefore rarely undertaken. GIS offers the combination of computing speed with a wide range of analytical capabilities including statistical analysis of point distributions, classifying regional properties and testing the spatial associations between point and/or regional data, for example, the distance of a site from water (Burrough 1986).

The last 15 years have seen increasing examples of GIS application in archaeology for the management and analysis of regional data sets (Kvamme 1990). A common theme in American and European archaeology has been the predictive modelling of hunter-gatherer archaeological site locations, although these studies have frequently only emphasised environmental variables such as elevation, relief, aspect and slope (eg. Warren 1990; Carmichael 1990; Kvamme 1985). The employment of GIS with non-environmental variables, for example group territoriality and social landscapes, has, in contrast, been a slower development (eg. Savage 1990).

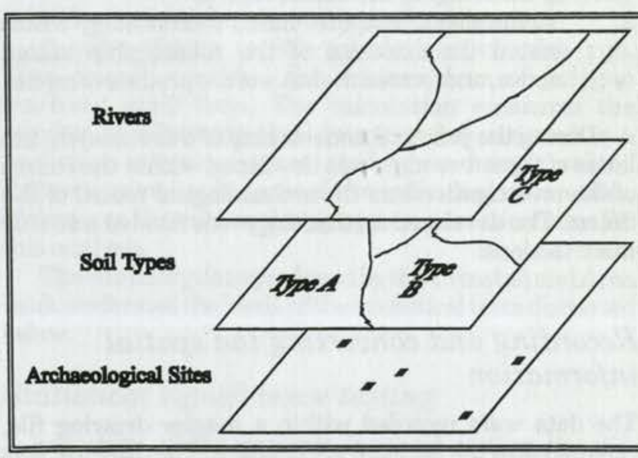

Fig. 4.2 Schematic representation of data themes within a GIS

The aim of Palaeolithic distribution studies and their investigation through GIS is not to interpret particular sites, but to broadly investigate the variables which may, or may not, influence the discovery of archaeological material. These investigations will provide the theoretical, and methodological, basis for a model predicting the occurrence of Palaeolithic archaeology.

Only by understanding the general processes which stimulate the discovery of stone implements can the regional Palaeolithic record be interpreted profitably. The development of a regional predictability model could offer two major benefits:

1. In terms of academic research, quantifying the spatial archaeological record for the Lower Palaeolithic offers an opportunity to study early hominid behaviour at a macro/landscape scale. Such studies would utilise the majority of the available evidence, instead of purely focusing upon the site.
2. With respect to the management of the Palaeolithic resource, a model predicting the history of amateur artefact collection (where our predecessors have and have not looked for lithics) would be a valuable evaluation tool.

Naturally any such model will not locate Palaeolithic sites. But by modelling the context of discovery it can assist in the identification of likely, and unlikely, patches of archaeological interest. The following preliminary study is based upon an MSc dissertation, undertaken at the University of Southampton in 1994, the principal aim of which was to investigate the relationship between twentieth-century urban development, just one of the final model variables, and the discovery and perceptions of the Lower Palaeolithic record in the Solent region.

Methods

The aims of the study were two-fold:

1. To investigate the relationship between urban growth and the distribution of lower Palaeolithic archaeology in the Solent region.
2. To develop a computer-based methodology which tested the existence of the relationship stated above, and formed the basis of the predictive model.

During the practical undertaking of this research, the latter of these two aims was developed within the course of the investigation into the archaeological record of the Solent. The developed methodology was divided into four main sections:

Recording and converting the spatial information

The data were recorded within a master drawing file, referenced to the national grid system. The drawing was created using the AutoCad drawing software. The spatial data included:

- Palaeolithic find-spot/'site' locations, as recorded in the SRPP maps (Fig. 4.3)
- Principal urban sites of interest within the study region (Southampton and Fareham). These sites were spatially delimited according to the 1974 Ordnance Survey 1:50,000 map sheet for the Solent (sheet 196) (Fig. 4.4).
- Pleistocene deposits as plotted in the SRPP maps. In the Solent study area these included the river terrace gravels, alluvium, brickearths, head gravels, and loam and clay deposits (Fig. 4.5).
- Past and present gravel extraction pits, as plotted in the SRPP maps (Fig. 4.6).

The Palaeolithic find-spot locations were imported from the SRPP AutoCad files and converted from block to point data, for the purposes of the subsequent GIS raster-based cross-tabulation analyses (*below*).

To record the Pleistocene deposits and aggregate extraction sites, selected CAD data produced for the SRPP reports were utilised. Within the SRPP AutoCad files the deposits and sites were spatially recorded as irregular polygons, constructed from a succession of polylines (Fig. 4.3). To acquire these data the SRPP CAD files were inserted into the master drawing as blocks. That is to say, the spatial data in the SRPP files were saved as a single drawing entity (a block). After insertion, the blocks were transformed to align the spatial data in the two drawings. This transformation involved rotating (where the inserted drawing blocks were aligned east–west, as opposed to north–south), moving (around a fixed grid reference point) and scaling the inserted blocks. Finally, the drawing blocks were exploded. This process splits the SRPP file back into its constituent data entities, so enabling redundant spatial data (text, grid lines, keys, and natural features such as rivers) to be deleted from the drawing.

Once all the spatial information had been recorded and converted from the OS map sheet and SRPP AutoCad files, the data were separately exported by theme (geological deposits (Fig. 4.4), Palaeolithic find-spots, and gravel extraction sites (Fig. 4.5)) to a Geographic Information System for spatial analysis. The GIS was constructed using the *Idrisi* software.

Recording data attributes in GIS

In the GIS, ten attribute values files were created for the find-spot data. These files recorded the number of artefacts (of the nine different implement types and the total number present) at each find-spot[2]. The values in each of the attribute files (representing for example the number of handaxes) were related to their associated findspots by a system of numerical codes (Tables 4.1–4.3). The use of the linking codes allows as many attributes as the user wishes to be attached to each data point (in this case the find-spots), as opposed to a single attribute value.

Table 4.1 Attribute values file (no. handaxes)

Code	*Attribute*
1	7
2	15
3	13

Table 4.2 Attribute values file (no. debitage flakes)

Code	*Attribute*
1	9
2	23
3	34

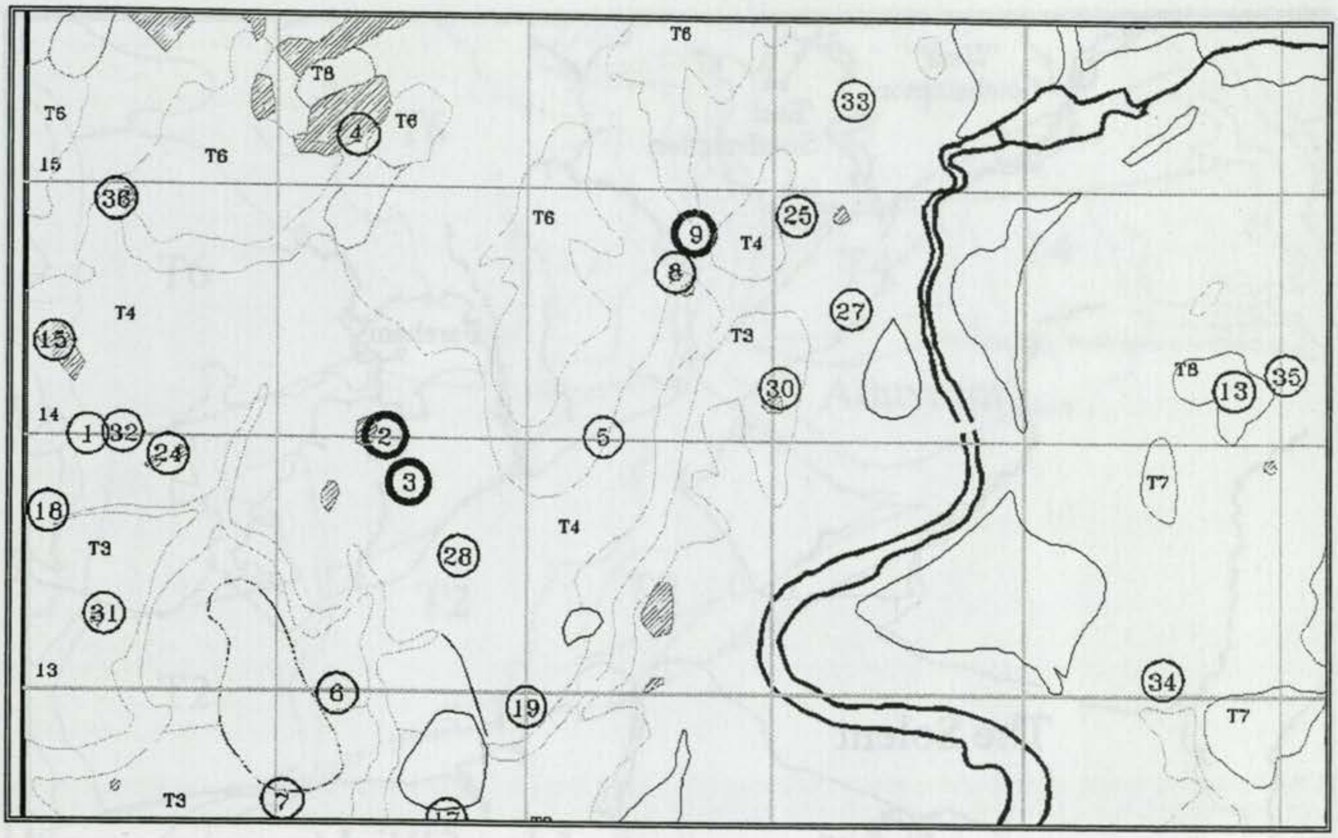

Fig. 4.3 Extract from SRPP Auotcad file for map SOTON 2, showing the National Grid, the limits of terrace deposits and numbered Palaeolithic find-spots. This represents a working stage in the production of the maps and does not reflect the quality of the end product (see Editorial, above)

In the example shown, two maps displaying the number of handaxes or the number of debitage flakes recorded at each findspot may be produced from a single file (the point file: Table 4.3), by combining it with the respective attribute file (Table 4.1 or Table 4.2).

The recording of these data allows the spatial distribution of different artefact types, for example handaxes and debitage flakes, across a selected study region to be practically examined.

GIS spatial analysis

A series of data cross-tabulations were carried out using the *Idrisi* Crosstab module. This procedure summarised

Table 4.3 Point file (Palaeolithic find-spots)

Code	*No. co-ordinate pairs*
x Grid ref.	*y Grid ref.*
1	1
103.97	*98.43*
2	1
143.75	*103.79*
3	1
110.85	*93.63*

the spatial associations between different data themes. Point (find-spot) data were cross-tabulated against polygon data, the analysis recording how many find-spots (point entities) co-occurred with the polygon cells assigned to individual categories. These categories were typically individual urban sites, for example Southampton.

A series of Area module calculations was also run. This module recorded the surface area of polygon (enclosed area) data. The calculation measures the number of cells (individual image units) assigned to a particular category (represented by an integer value). Polygons were used to record the individual urban sites, Pleistocene deposits and aggregates extraction sites for this analysis.

The summary data produced by the Crosstab and Area modules formed the basis of the statistical tests discussed below.

Statistical significance testing

A key stage of the analysis involved testing the distributions of find-spots and artefact totals within and between pre-defined study areas. The statistical test used to examine the material distributions recorded was the simple (one-sample) chi-squared test. Shennan (1988, 67) describes the test as follows:

> The one-sample chi-squared test pre-supposes a set of observations divided up into a number of

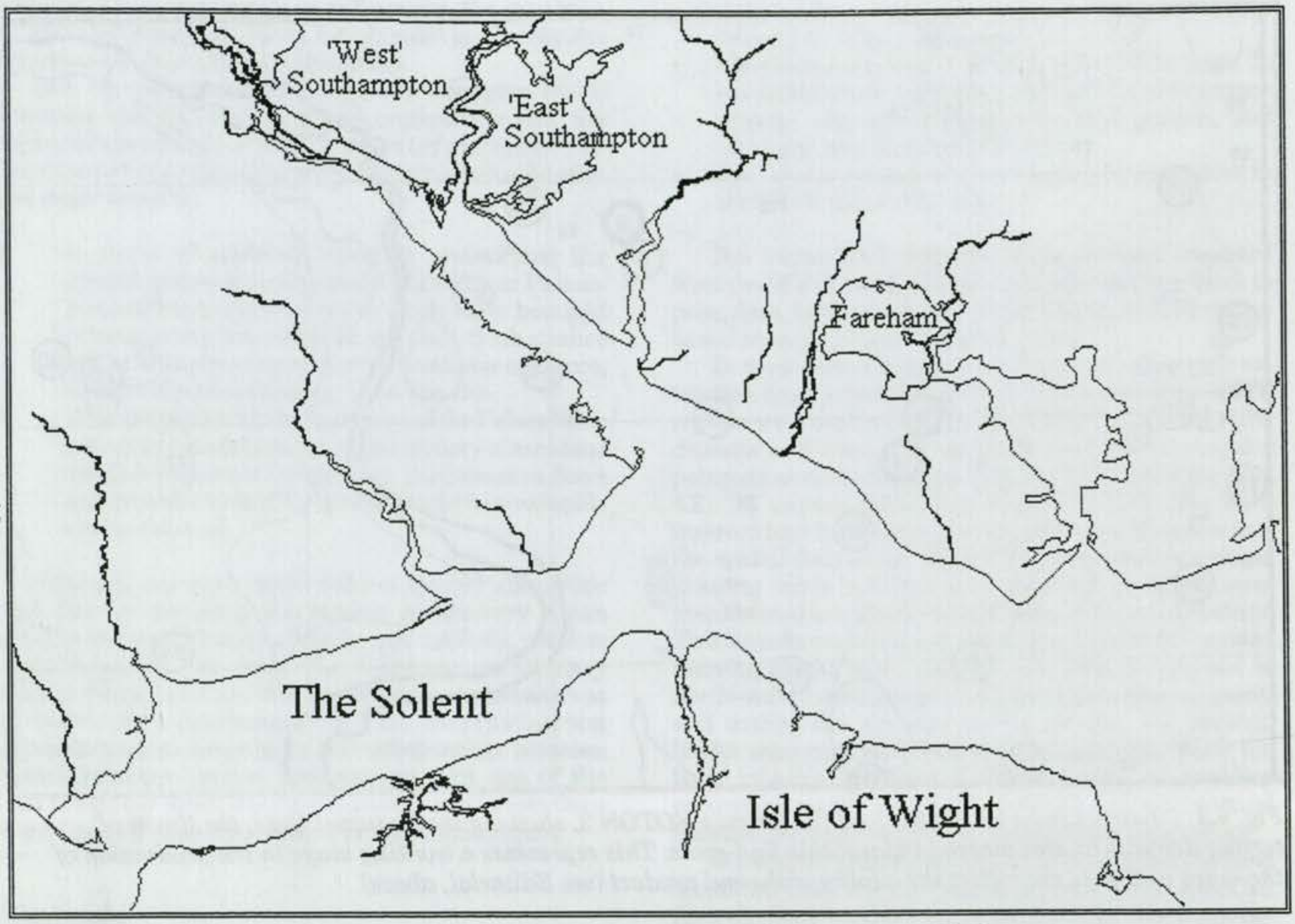

Fig. 4.4 The Solent study area and the urban sites incorporated within the analysis

> mutually exclusive categories. A comparison is then made between the distribution of observations across the categories and the distribution to be anticipated under some theoretically derived expectation, specified by the null hypothesis. The differences between the two distributions for each category are noted and a chi-squared value is calculated, based on the sum of the differences. The calculated value is then compared with the minimum value required to reject the null hypothesis at the level of significance which has been set. In effect, in setting the situation up as a significance test we are asking whether our observations could be a random sample of a population which has the characteristics specified in the null hypothesis.

For the data in Table 4.6 (*below*), the null (H_0) and alternative (H_1) hypotheses were:

H_0: Palaeolithic findspots are equally distributed across the two urban areas (Southampton and Fareham).

H_1: Palaeolithic findspots are not equally distributed across the two urban areas.

The level of significance (α) for all the tests was set at 0.01. That is to say, the null hypothesis would be rejected if, on the assumptions that it held, the observed results would only occur once out of a hundred or less. This more cautious value for the level of significance was chosen, as opposed to the other commonly used value of 0.05, because of the numerous bias factors associated with this data set. These were discussed by Doughty (1978) and include; favourable recovery of handaxes; discarding of less refined artefacts; localised material discovery; purchase of artefacts by collectors; and a lack of detailed record keeping.

These one-sample chi-squared tests indicated a number of statistically significant patterns in the distribution of the Solent's Palaeolithic archaeology. The key point is that a probable relationship can be suggested between the distribution of the archaeology and the processes of modern urbanisation. The following discussion of those distribution patterns, in terms of the GIS analysis and the documentation of Southampton and Fareham's recent histories, is an attempt to explore specific and general issues influencing the discovery of Palaeolithic material. It was never intended as the definitive interpretation of these Southampton find-spots, nor is that the intention of the model as a whole.

Case study

The study area selected for a first test of the approach outlined above was the Solent region (Fig. 4.4). Within

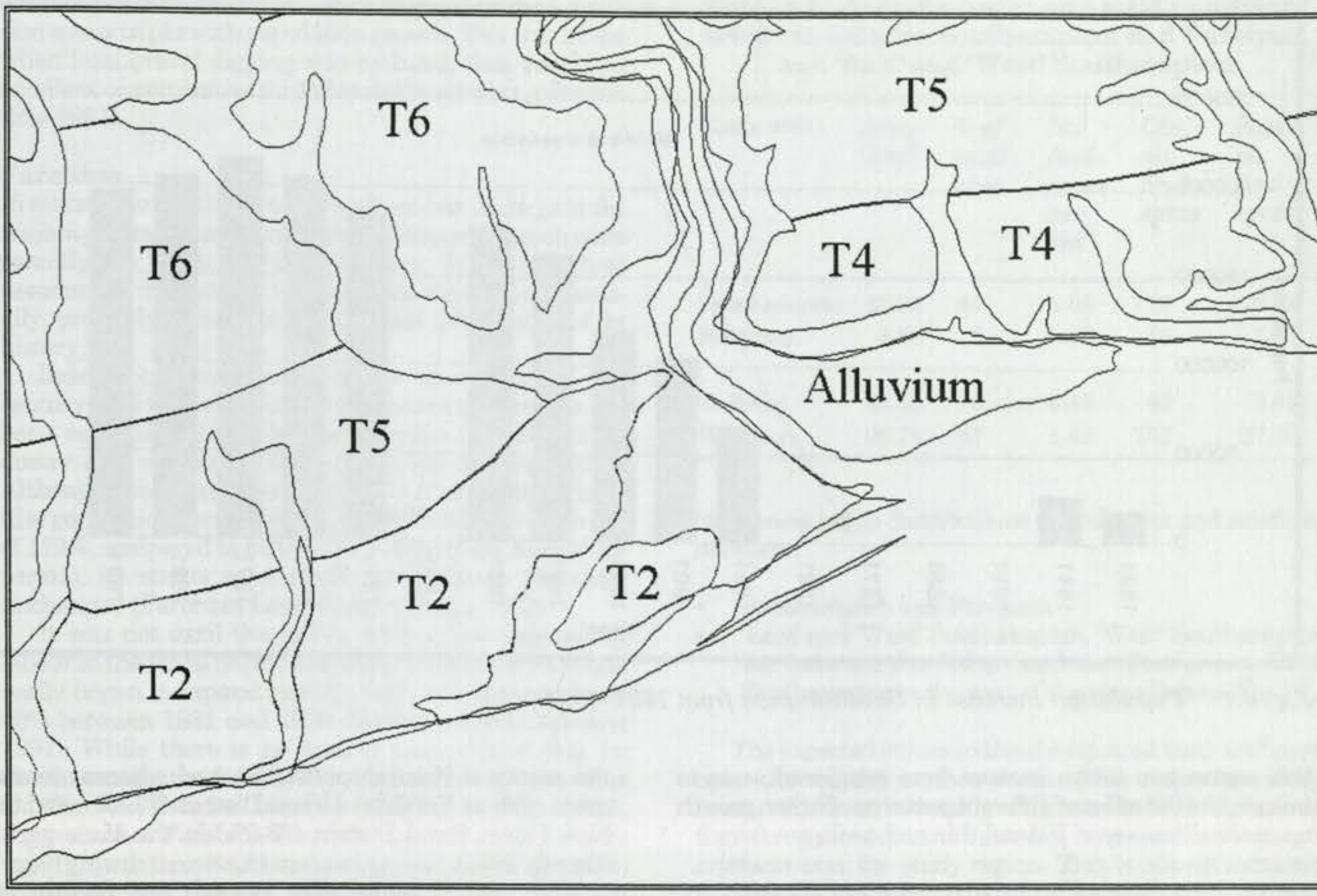

Fig. 4.5 Pleistocene deposits recorded as irregular polygons, from the SRPP AutoCad files

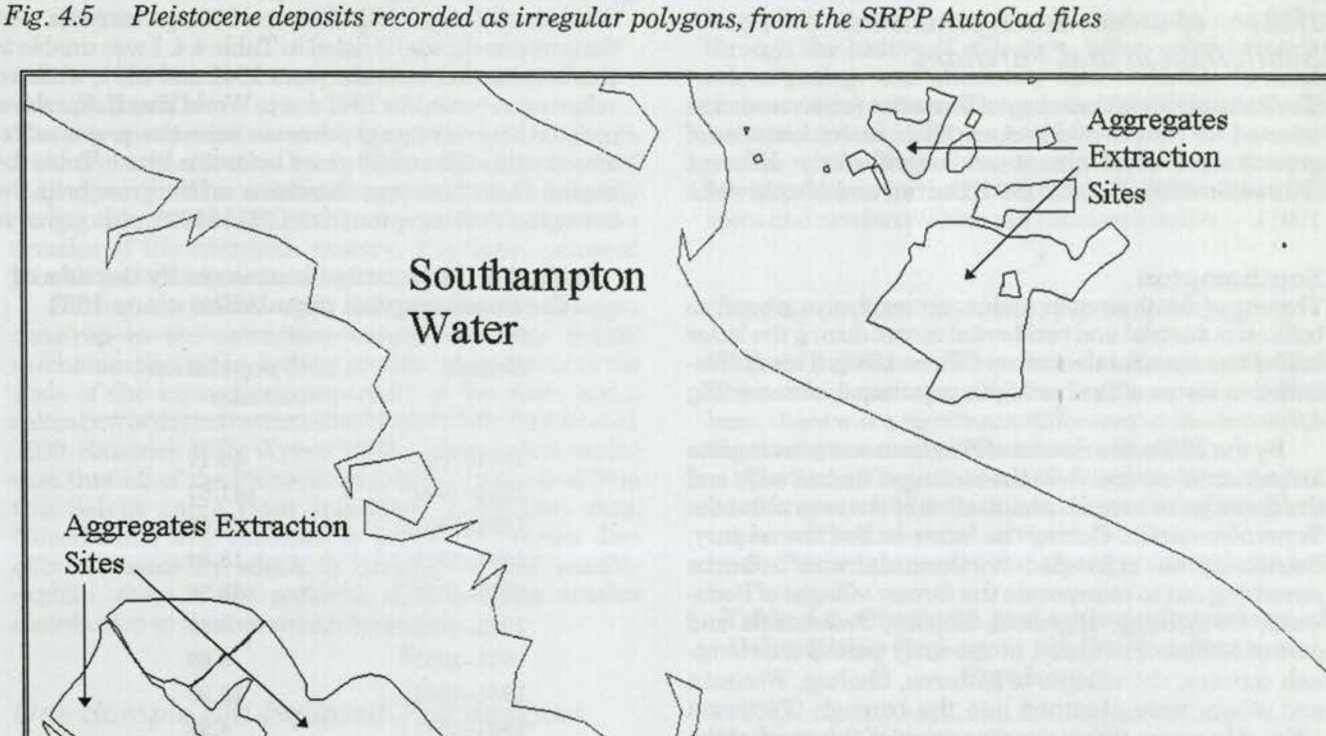

Fig. 4.6 Aggregate extraction sites recorded as irregular polygons from the SRPP AutoCad files

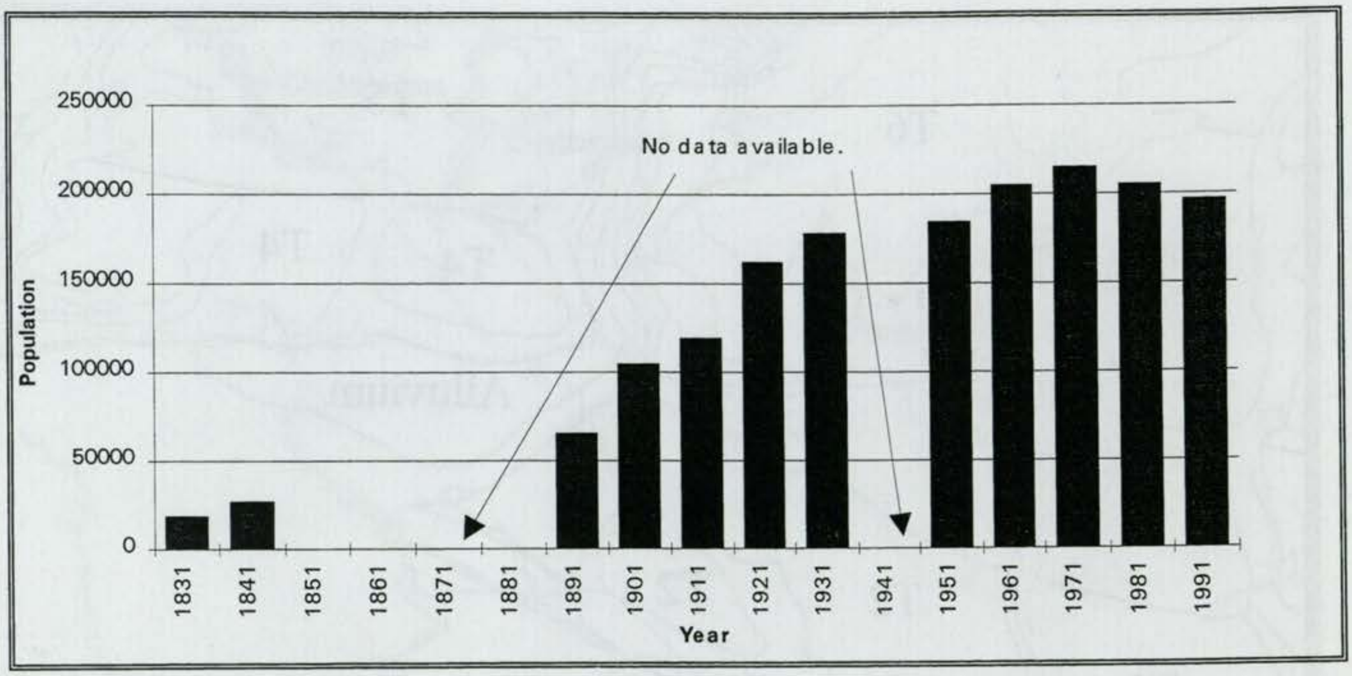

Fig. 4.7 Population increase in Southampton from 1831–1991

this region two urban centres were compared so as to investigate the affect of different patterns of urban growth upon the discovery of Palaeolithic archaeology.

History of urban development in Southampton and Fareham

The Palaeolithic archaeology of these two urban areas was selected for comparison because their recent histories of growth and development are significantly different (Patterson 1964; Broady 1964; Burton and Musselwhite 1991).

Southampton

The city of Southampton underwent explosive growth as both an industrial and residential centre during the latter half of the nineteenth century (Shore 1892). This is illustrated in terms of the borough's population increase (Fig 4.7).

By the 1850s, the district of Northam was growing into an industrial centre while the coming of the railways and the docks led to a rapid urbanisation of the area about the Terminus station. During the latter half of the century, Southampton expanded northwards with suburbs stretching out to incorporate the former villages of Portswood, Swaythling, Highfield, Shirley, Freemantle and part of Millbrook. Finally, in the early part of the twentieth century, the villages of Bitterne, Sholing, Woolston and others were absorbed into the borough (Patterson 1964). However, the main expansion of this part of the town did not occur until after 1919 (Broady 1964).

In contrast, the rate of population growth in the Southampton borough has decreased since 1931, with the population actually falling since 1971. Even during the decade 1951–1961 the real rate of population increase was only 10.99%. This rate of growth was well below that of the county of Hampshire (21.2%), and adjacent coastal areas such as Fareham Urban District (37.1%), and the New Forest Rural District (28.0%) in the same period (Broady 1964).

The rate of population growth per decade for Southampton since 1831 (as a percentage increase over the previous decade) is listed in Table 4.4. I was unable to obtain values between the years 1841 and 1891, while no value was recorded for 1941 due to World War II. For these periods, the percentage increase over the previous recorded value (50 and 20 years before) is listed. Table 4.4 implies that there was extensive urban growth in the borough of Southampton from 1831 to 1921, although this

Table 4.4 Percentage increases by decade of the Southampton population since 1831

Decade	*% population increase*
1831–1841	45.17
1841–1891[1]	141.67
1891–1901	60.03
1901–1911	13.54
1911–1921	36.36
1921–1931	9.87
1931–1951[2]	3.60
1951–1961	10.99
1961–1971	4.92
1971–1981	–4.55
1981–1991	–4.13

1 Average % increase per decade for this period = 28.33%
2 Average % increase per decade for this period = 1.80%

obviously assumes that house building and services provision was on a par with population growth. This was a time when local gravel digging was by hand, thus providing excellent opportunities for Palaeolithic artefact collection (Roe 1981).

Fareham

In contrast to Southampton, Fareham has undergone the majority of its major change and development much more recently. As Webb (1991, i) observes, 'in the last three decades the character of Fareham has changed dramatically, probably more than in the last 2000 years of its history.'

Indeed, it is only really in the second half of this century that the essentially rural nature of Fareham has been seriously altered by the growing demands of industry and commerce (Burton and Musselwhite 1991). Although the town grew during the nineteenth century (the population increased from 3030 to 8246 — a growth of 172%, compared to 461% for Southampton during this period), its status as a small market town remained unchanged (Fareham Local History Group 1972).

It was not until the 1930s, with a new demand for labour in the naval bases, that the population of Fareham really began to expand rapidly, with an increase of over 50% between 1931 and 1939 (Burton and Musselwhite 1991). While there is no specific comparative data for Southampton, the far smaller percentage increase value for the two decades between 1931 and 1951, 3.60%, suggests that Fareham was boasting considerably more rapid growth than Southampton at this time. This growth continued after the war, with the population increasing by 38% between 1961 and 1971.

Comparison

The key contrast between the history of development in these two urban centres lies in their respective periods of major growth. Whereas Southampton expanded rapidly during the second half of the nineteenth and first two decades of the twentieth century, Fareham's principal growth period only occurred after 1930.

During the 1920s and 1930s three key changes occurred in the extraction industries of the Solent: mechanisation of the sorting process; an increase in the scale of the excavations, especially at Warsash; and a relocation of the extraction sites (Poole 1932; Burkitt *et al.* 1939; Raistrick 1973; Wymer 1993). Of course it is not the case that all of the Palaeolithic artefacts recovered from the Solent came from industrial extraction sites. Nonetheless, this variation in industrial practice does offer a means by which to investigate, and possibly explain, some of the patterns of Palaeolithic artefact distribution in the two urban boroughs.

One-Sample Chi-Squared Test analyses

Using the *Idrisi* Crosstab and Area modules (*above*), find-spot and artefact density values were produced with respect to the Southampton and Fareham Lower Palaeolithic materials (Table 4.5), from the SRPP data set. The one-sample chi-squared test was applied to the Table 4.5 data to test the statistical significance of the

Table 4.5 Area, find-spot and total number of artefacts data for Southampton and Fareham, and 'East' and 'West' Southampton

Study area	*Area (km^2)*	*% of total area*	*No. find-spots per km^2*	*Obs. no. find-spots*	*Exp. no. find-spots*
Southampton	41.89	44	1.05	778	18.57
Fareham	8.98	3	0.33	15	1.67
E. Soton	15.15	6	0.40	46	3.04
W. Soton	26.74	38	1.42	732	27.38

differences in the distributions of find-spots and artefacts between:

- Southampton and Fareham
- 'East' and 'West' Southampton. 'West' Southampton lies between the Itchen and the Test rivers, 'East' Southampton to the east of the river Itchen (Fig 4.3).

The expected values in the chi-squared tests are based upon the relative surface areas of the respective study areas, which can be readily computed in GIS. The values therefore assume, unrealistically, an even distribution of artefacts over the study region. This is almost certainly not the case, but reflects the aim of the analysis: to attempt to explain spatial patterning in find-spots and lithics through the history of collection, before considering the role of geology and ultimately how hominids discarded their material culture. The results of the statistical tests are summarised in Tables 4.6–4.8.

The results of the chi-squared tests indicated a number of patterns in the distribution of Palaeolithic find-spots and artefacts which are discussed below.

Find-spot distributions: further thoughts

While no significant difference existed between the densities of find-spots recorded for Southampton and Fareham, there was a significant difference in the densities of the artefacts recovered from those find-spots.

The archaeological record for Fareham documents 15 artefacts recovered from at least three find-spots. Eleven implements are recorded as 'Fareham: No specific provenance'. These data seem indicative of small-scale finds as

Table 4.6 Observed and expected numbers of Palaeolithic find-spots for Southampton and Fareham

Study area	*Area (km2)*	*% of total area*	*Obs. no. find-spots*	*Exp. no. find-spots*
Southampton	41.89	82.33	44	39
Fareham	8.98	17.67	3	8
Total	50.57	100	47	47

Table 4.7 Observed and expected numbers of Palaeolithic artefacts for Southampton and Fareham

Study area	*Area (km2)*	*% of total area*	*Obs. no. artefacts*	*Exp. no. artefacts*
Southampton	41.89	82.33	778	653
Fareham	8.98	17.67	15	140
Total	50.57	100	793	793

Table 4.8 Observed and expected numbers of Palaeolithic find-spots for 'East' and 'West' Southampton and Fareham

Study area	*Area (km^2)*	*% of total area*	*Obs. no. find-spots*	*Exp. no. find-spots*
E. Soton	15.15	29.79	6	14
W. Soton	26.74	52.54	38	25
Fareham	8.98	17.67	3	8
Total	50.87	100	47	47

opposed to large artefact collections from single find-spots. While this pattern could reflect small archaeological deposits, two additional factors may also be suggested:

1. While Pleistocene river gravel and brickearth deposits cover nearly one-third (29.40%) of urban Fareham's surface area, 95% of the terrace gravels, and presumably the associated brickearths, are described by the SRPP as 'lower', below 10 m OD according to Keen's 1980 classification (Wymer 1993). As Wymer (1968) and Roe (1981) have both observed, Lower Palaeolithic material is very unlikely to be found *in situ* in the lower terraces. Yet it is *in situ* rather than derived deposits which tend to yield higher concentrations of artefacts.
2. The predominantly recent growth and development of Fareham during the last half century may be another factor. Doughty observed that after the 1920s very few artefacts were recovered from Southampton (Doughty 1978). He attributes this trend to the increasing mechanisation of aggregates extraction (steam and mechanical diggers and mechanised sorting processes) which restricts human observation (Smith 1909; Poole 1932; Doughty 1978; Roe 1981). Of equal significance in the Solent region was the relocation in the 1920s/1930s of the larger aggregate extraction sites away from the urban centres towards the river Hamble deposits at Warsash and Hook, which were subsequently extensively dug away (Wymer 1993). This emphasis upon the date of urban growth is also supported by the distribution of material within Southampton (*below*).

In conclusion, it appears that the lack of Palaeolithic material in Fareham reflects a combination of the techniques and location of aggregate extraction in operation at the time of the town's, and the naval bases, growth (when demand for aggregates would be at a peak), and an absence of artefact-rich higher terrace gravels.

The Lower Palaeolithic record for Southampton is in marked contrast to that of Fareham. The 44 find-spots recorded in the Southampton study area produced 778 artefacts at an average of 17.68 artefacts per find-spot. This is partially due to a large collection of unprovenanced material (296 artefacts are recorded in the SRPP as 'Southampton: No specific provenance'). If these artefacts are removed from the analysis the average number of lithics per find-spot falls to 11.21.

Nonetheless, a significant number of the Southampton find-spots yielded multiple numbers of lithics as opposed to single artefacts. Of the 43 find-spots (excluding the 296 unprovenanced artefacts), 26 produced 9 or less lithics, while the remaining 17 yielded between 11 and 89 lithics (Fig. 4.8). This pattern may be considered in terms of four geological and human factors:

1. The extensive presence of the higher, implementiferous river terrace gravels in the Southampton study area. Terrace gravels cover 32.78% of the surface area, of which 80% are gravels from terraces 3, 4 and 6.
2. The extensive growth and development which occurred in Southampton before and around the turn of the century would have created a major, local demand for aggregates. Wymer (1993, 144, my emphasis) notes that 'in the 19th century gravel was mainly extracted from relatively small pits, particularly on the *fringes* of Southampton *prior* to its urban spread'. Combined with the new enthusiasm for stone implement collecting, the frequent, small-scale, hand digging of gravel pits would have created favourable conditions for long-term, and large-scale, artefact collection (Wymer 1968; Raistrick 1973; Roe 1981).
3. The major construction of the docks during the latter half of the nineteenth century and their need for imported gravel (Doughty 1978).
4. The greater social standing and population of Southampton which may simply have resulted in more amateur collectors (typically social professionals) living in the borough than in the neighbouring (and considerably smaller) market town of Fareham. Similarly, as the city gained a reputation for artefact rich deposits, other collectors may have become attracted to its gravel pits. William Dale (a 'keen collector' according to Doughty) recorded that a gentlemen from Kent gave a standing order to certain gravel diggers for all Palaeolithic artefacts found to be sent to him (Dale 1896; Doughty 1978).

Earlier, I suggested that the opportunities for artefact collection are influenced by the date of an urban area's growth and expansion. The significance of this variable appears to relate to historical changes in the nature and practice of the aggregates industry (and possibly the general mechanisation of the construction industry also).

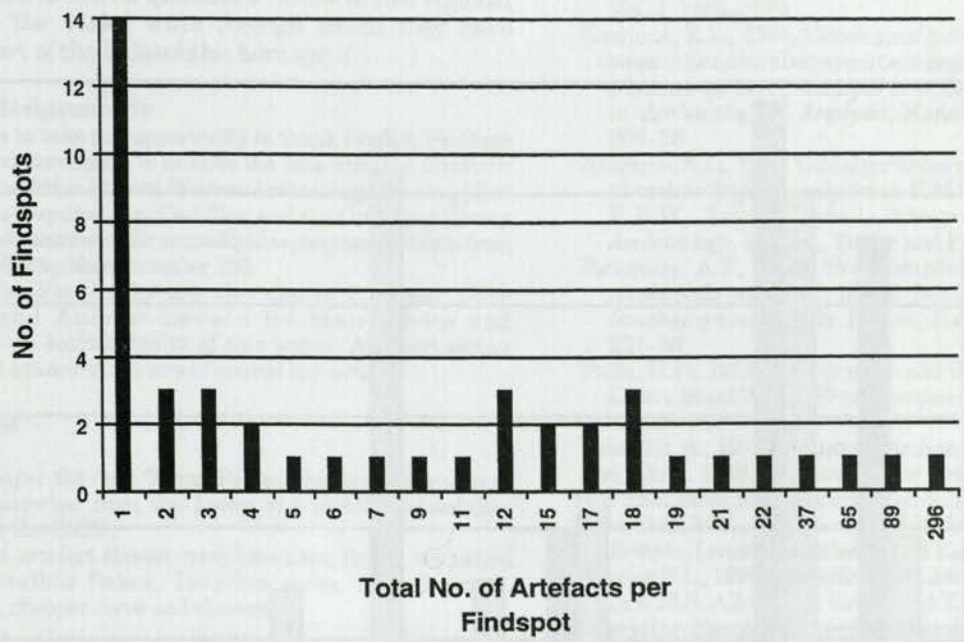

Fig. 4.8 Number of artefacts per Lower Palaeolithic find-spot in Southampton

The distribution of Palaeolithic material within Southampton lends support to this idea.

The find-spot and artefact density values for Southampton east and west of the Itchen are notably different (Table 4.8). Furthermore, this variation might not be related to the geological context since the distribution of river gravel deposits across the two sites is reasonably similar (Fig. 4.9).

A potential alternative factor could be the later growth and development of 'East' Southampton when compared to 'West' Southampton. The 'villages' of Bitterne, Sholing, Woolston and others all underwent their main expansion after 1919 (Patterson 1964; Broady 1964). The post-1920s saw a decrease in the discovery of Palaeolithic artefacts in the city (due to the increasing mechanisation of aggregates extraction works), and the apparent relocation of gravel digging activities to Warsash and Hook, outside of Southampton (Poole 1932; Wymer 1993).

The difference between the rates of Palaeolithic discovery either side of the river Itchen may therefore reflect not simply a difference in 'implementiferous' deposits, but also a change in those circumstances which are favourable to artefact collection.

Conclusions

This investigation into the relationship between urban growth and the recorded distribution of Lower Palaeolithic archaeology has suggested two interesting trends:

1. That the historical era during which urban areas undergo major growth and development influences the potential opportunities for the discovery and collection of Palaeolithic artefacts from Pleistocene geological deposits.
2. The significance of the period of urban growth partially reflects, as might be expected, the historical developments in the aggregates and construction industries during the twentieth century. From the turn of the century to the 1930s, '40s and '50s there was a progressive mechanisation and relocation from urban to rural sites by the gravel industry, reflecting the increasing bulk aggregates demands of the transport industry and resulting in larger quarry sites (Raistrick 1973). Similarly, mechanical and steam diggers began to replace human labour in excavation projects over the same period. Not surprisingly, these two shifts in industrial practice appear to have restricted opportunities for artefact discovery in the urban areas.

As the introduction indicated, the work presented here was undertaken primarily to test the application of GIS software in quantifying spatial data for the Lower Palaeolithic.

Methodologically, the study was successful, indicating that site distributions could be statistically tested against spatially-recorded variables. This type of analysis allows the nature of the relationships between individual var-

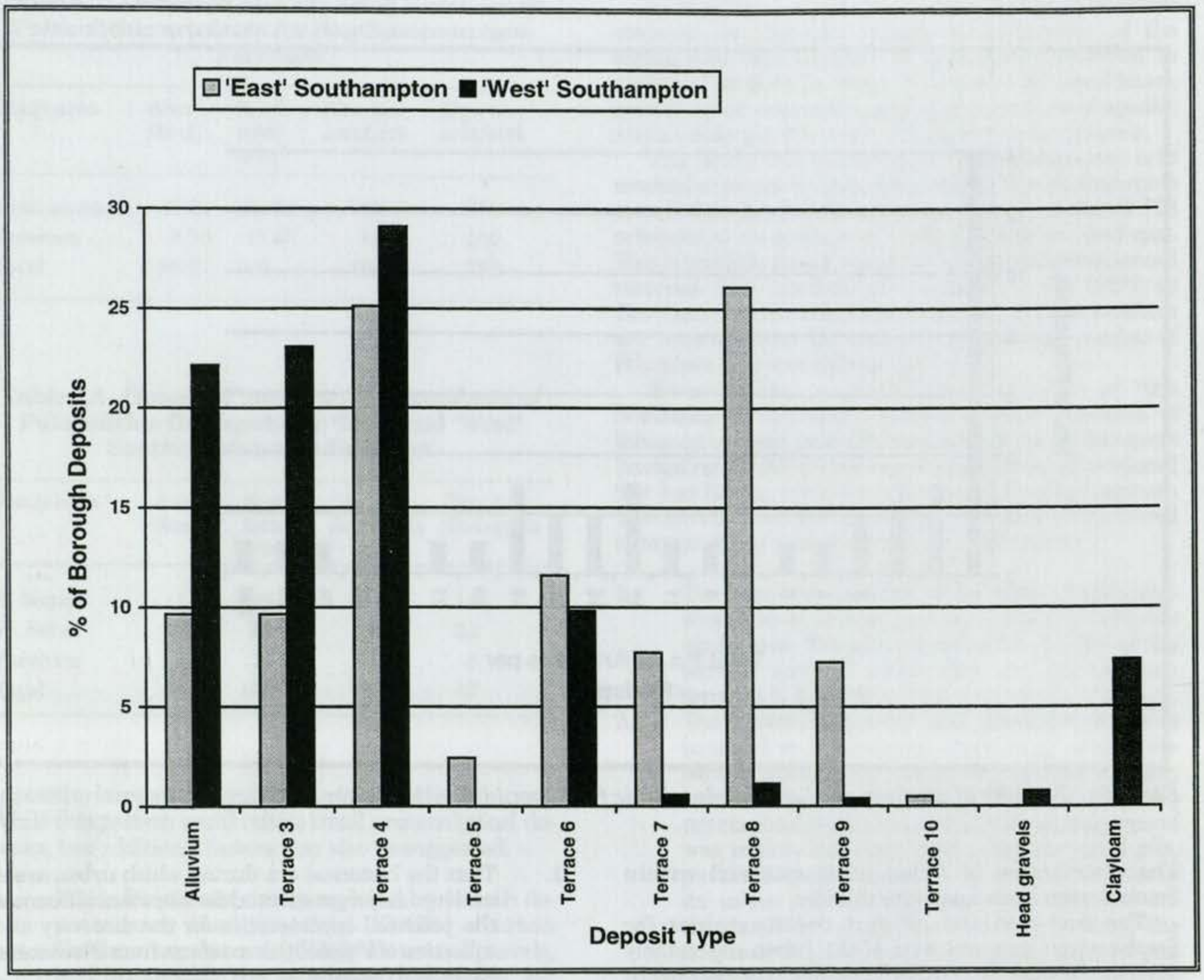

Fig. 4.9 Comparison of the geological deposits in 'East' and 'West' Southampton

iables and the discovery of Palaeolithic archaeology to be investigated.

Theoretically, the study was more frustrating, revealing both the limits and the possibilities of this type of spatial analysis approach. The sample data revealed a number of patterns in the distribution of the Solent's Palaeolithic archaeology which could be partially explained in terms of local urban history. The analysis also suggested that as a model variable urban development does influence the discovery of Palaeolithic archaeology.

However, a major problem is that the conclusions presented here are based on the investigation of a specific local situation. In many respects they are therefore just as anecdotal as any previous observations regarding the distribution of Palaeolithic finds.

Nonetheless, what this preliminary study has highlighted is the need for further research into the complex array of variables which the work of Roe, Wymer and others has shown to have influenced the recovery of Palaeolithic data at the regional scale. Indeed, this study has illustrated that if Palaeolithic studies are to harness the potential of surveys like SRPP, priority must be given to this basic research, difficult as it is proving to be.

The ultimate goal has to be a predictive model of regional artefact distributions. Such a model will have to assess variables including the fieldwork activities of amateur lithic collectors, infrastructure construction, the history of the aggregates industry, dredging activity (of particular relevance in the Solent), Pleistocene geology and geomorphological processes, in particular the transportation of lithic artefacts by fluvial and solifluction means. The initial task is to convert the currently anecdotal data which documents these variables into systematic, quantified information suitable for statistical manipulation at a range of spatial scales. The wide availability of GIS techniques offers the means to achieve what would previously, and rightly, have been regarded as impossible. This pilot study has highlighted some of those methods which may be employed.

This conclusion does not underestimate the difficulty of the task ahead. But, just as the archaeologists of later periods willingly devote time to the reconstruction of monuments and landscapes through the detailed investigation of variable, and sometimes highly suspect, antiquarian accounts, so too must Palaeolithic archaeologists explore others ways of understanding the data available to them. Excavation of *in situ* artefacts under the umbrella of Quaternary science is only one route to finding out what people did in the Palaeolithic. The challenge of the SRPP data is to realise that, in order to maximise the archaeological return on the work done thus far, we need to start a quantified review of this regional data and the varied ways through which they have become part of the Palaeolithic heritage.

Acknowledgements

I would like to take this opportunity to thank English Heritage who granted permission to analyse the data from the *Southern Rivers Palaeolithic Project*; Wessex Archaeology who supplied me with the required AutoCad files; and the Ordnance Survey who granted permission for me to digitise geographical data from the 1:50,000 map sheet, number 196.

Considerable thanks are also due to Professor Clive Gamble and Andrew Lawson for their advice and comments on earlier drafts of this paper. Any remaining errors and inaccuracies are of course my own.

Endnotes

[1] In this paper the term 'Lower Palaeolithic' is used to refer to all the discoveries, from the Lower and Middle Palaeolithic, recorded by the SRPP.

[2] The nine artefact classes were handaxes, flakes, retouched flakes, Levallois flakes, Levallois cores, miscellaneous, rough-outs, chopper-cores and cleavers.

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5. The Boxgrove Tibia: Britain's Oldest Hominid and its Place in the Middle Pleistocene Record

C.B. Stringer

Abstract

The Boxgrove Project has recovered the earliest hominid remains from Britain. Their context indicates a Middle Pleistocene age of about 500 ka BP and, hence, they are currently among the oldest definite hominid remains in Europe. Comparison with the anatomical details of other specimens suggests that they are attributable to Homo heidelbergensis *or possibly an early antecedent of* H. neanderthalensis. *The paper reviews the taxonomic status of the European specimens.*

Introduction

The Boxgrove Project, centred on gravel quarries east of Chichester in West Sussex, was begun in 1985 to excavate areas of Middle Pleistocene land surfaces under threat from mineral extraction. Initial work demonstrated evidence of human activity at a number of levels within the stratigraphical sequence but concentrated particularly in two discrete horizons within, and on the surface of a lagoonal silt deposit which had developed beneath a former sea cliff line (Roberts 1986). Detailed excavation has led to the discovery of prodigious *in situ* artefacts and knapping debris but also the remains of butchered animals and the contemporary fauna. In December 1993 a hominid tibia was excavated from calcareous silts laid down by a spring, originating at the old cliff line (Roberts *et al.* 1994). Subsequent excavation in 1995 adjacent to the find-spot of the tibia has revealed further quantities of artefacts and bones, including two human incisors.

Dating the sediments and associated assemblages has been undertaken using correlative mammalian biostratigraphy. The Boxgrove mammalian fauna has many affinities with the type Cromerian: it post-dates the Forest Bed fauna but pre-dates the Anglian glaciation which is correlated with Oxygen Isotope Stage 12. The best fit for the Boxgrove interglacial sediments is in Oxygen Isotope Stage 13 between about 524 ka BP and 478 ka BP and, hence, contains some of the oldest, demonstrably *in situ* Palaeolithic artefacts and hominid remains in Europe (Roebroeks this volume).

At the time of discovery, the tibia which is from the left side, consisted of four major proximal portions separated by a clean transverse break close to the midshaft, from two distal portions. It is exceptionally large and robust; indeed, certain transverse and circumferential dimensions place it near, or beyond the ranges of comparative samples and suggest that it belonged to an individual weighing more than 80 kg. The tibia can only be definitely assigned to *Homo* sp. but has possible affinities with other Middle Pleistocene hominids. Although both the archaeological and hominid evidence from Boxgrove will be discussed in detail elsewhere (Roberts *et al.* forthcoming; Stringer and Trinkaus in prep. resp.) the opportunity is taken here of placing the tibia in its current taxonomic context.

The Middle Pleistocene hominid record

Europe has held a central place in discussions of Pleistocene human evolution since the Neander Valley, Germany, discovery of 1856 consisting of a Late Pleistocene archaic human skeleton (Stringer and Gamble 1993). (The sites mentioned in the text are located on Fig. 6.2, below.) The discovery of the Mauer mandible in 1907, coupled with the subsequent and spurious Piltdown material ensured that Europe remained a focus of interest for those investigating the origins of both Neanderthal and modern humans. The gradual demise of Piltdown was counterbalanced by a plethora of discoveries of important new material such as those from Ehringsdorf, Steinheim, Germany; Swanscombe, Kent; and Montmaurin, France and Europe has continued to produce important material, right up to the remarkable collection of disassociated skeletons from Atapuerca, Spain. Palaeo-anthropologists no longer expect Europe to provide evidence of very early hominids, and claims for archaeological evidence of an Early Pleistocene colonisation of Europe are still treated with scepticism by many workers (*see* Roebroeks and van Kolfschoten 1994; Roebroeks this volume). However, the discovery of a human mandible associated with Villafranchian mammals at Dmanisi, Georgia and hominid finds from the base of the TD6 sequence at Atapuerca suggest that Europe may yet prove to have had at least sporadic human occupation in the earliest Pleistocene (Gabunia and Vekua 1995; Carbonell *et al.* 1995).

Even today, Europe undoubtedly has the best record of Middle Pleistocene hominids, although significant finds continue to be made in Africa, mainland Asia and Indonesia. European specimens include rather incomplete material such as the fossils from Mauer, Vértesszöllös, Hungary, and Bilzingsleben, Germany, which are classified as *Homo erectus* by some workers, and from their

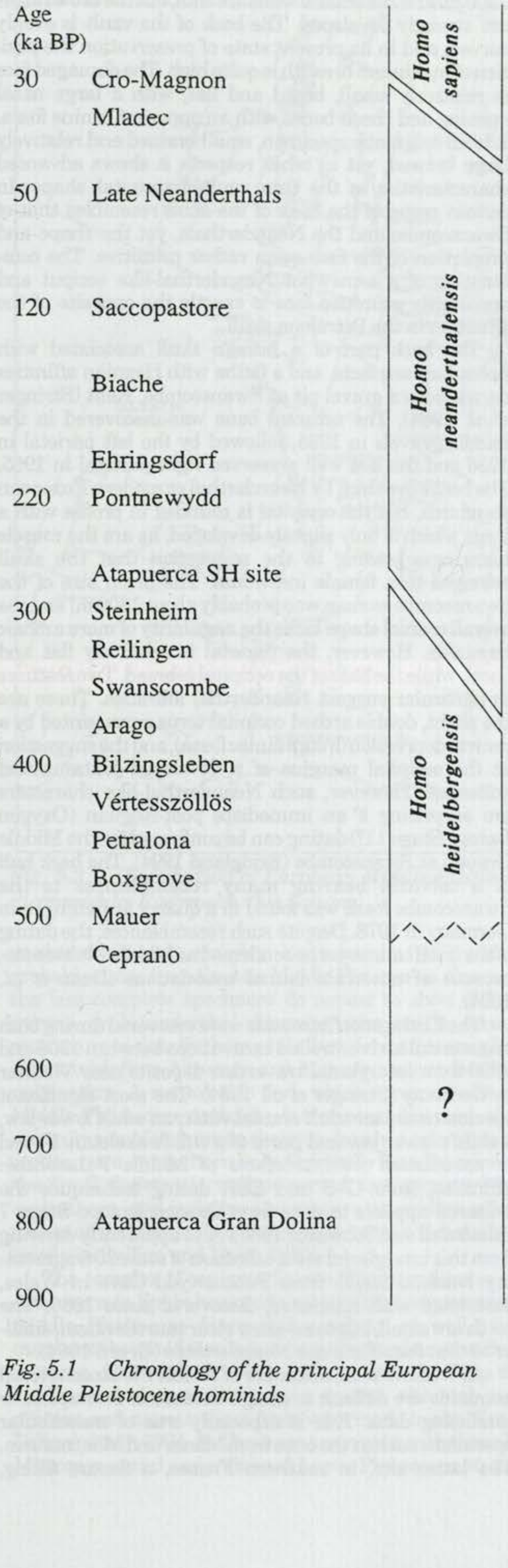

Fig. 5.1 Chronology of the principal European Middle Pleistocene hominids

preserved parts it is difficult to resolve their taxonomic status (Stringer *et al.* 1984).

The Dmanisi mandible, which does appear to represent an early Pleistocene *Homo erectus*, lies outside the borders of Europe, and so apart from the Atapuerca TD6 material and some fragmentary and disputed finds, the Mauer jaw is probably the oldest European fossil hominid yet discovered. This mandible was discovered during quarrying at a sandpit at Mauer, near Heidleberg, Germany, in 1907. The associated fossil mammals suggest a middle Pleistocene and post-Cromerian *sensu stricto* age, perhaps about 500 ka BP. The mandible has a thick corpus and a very broad ascending ramus. There is no chin development, but the teeth are quite small, leading to the suggestion that this could represent a female individual, despite its robusticity. Although there is no retromolar space development, characteristic of Neanderthal jaws, the specimen is long, indicating that the associated face was probably quite projecting. It was originally classified as the type of a new species, *Homo heidelbergensis:* some workers accept this designation as valid, while others regard the jaw as representing a European form of *Homo erectus.* However, both assignations are subject to further discussion as a result of new material from Atapuerca (*below*). Boxgrove, correlated with the Mauer site by biostratigraphy, provides us with some of the first post-cranial evidence of these earliest Europeans.

The travertine site of Vértesszöllös, near Budapest in Hungary, produced two hominid specimens in 1964 and 1965. The site is generally dated to an interstadial within the 'Mindel' glaciation of continental Europe or to an undesignated post-Cromerian interglacial and Uranium Series (U–S) dates originally suggested an age of greater than 300 ka. However, recent dating by U–S suggest an age of only about 200 ka BP for the hominid levels, in conflict with the biostratigraphy (Schwarcz and Latham 1984). The hominid specimens comprise some teeth of a child and an adult occipital bone. The latter specimen has been the subject of much dispute regarding its affinities. It is quite thick and fairly angulated, with a centrally developed occipital torus, but it is also large and relatively rounded in its occipital portion. Endocranial size was probably more than 1300 ml, leading some to suggest that it represents *Homo heidelbergensis* or 'archaic *Homo sapiens*'. Others emphasise its supposed antiquity, thickness and shape, and classify it as *Homo erectus*.

The large sample of fossil human material from the Arago Cave has also been classified as *Homo erectus* by some workers, mainly on the basis of primitive characteristics such as a projecting face, strong brow ridge, and small endocranial size as well as the claimed high antiquity of the specimens (*c.* 400 ka) (Stringer *et al.* 1984). The cave, near Tautavel in the French Pyrenees, has been under excavation since 1964. The Arago specimens include a face, facial fragments, mandibles, a hip bone, teeth and limb bone fragments. As an alternative to classification as *Homo erectus* it has been suggested that the Arago material represents *Homo heidelbergensis* or 'archaic *Homo sapiens*', or even that it derives from a population related to the ancestry of the Neanderthals: characters of the Arago 21 face and the Arago 2 mandible have been cited in support of this view.

An appropriate taxonomic assignment for the Bilzingsleben cranial fragments has also been much debated.

The open travertine site of Bilzingsleben in eastern Germany had long been known to palaeontologists but it is only since 1973 that its importance has been realised through large scale, productive, excavations. Abundant faunal and archaeological remains have been found in hominid occupation levels which apparently include extensive butchery debris and possibly even remains of hut structures. The faunal and palaeobotanical remains indicate a warm interglacial stage, and various lines of evidence including U–S dating suggest, correlation with Oxygen Isotope Stages 9 or 11 (Mania *et al.* 1994). The frontal and occipital fragments are certainly the most *Homo erectus*-like of all the European cranial specimens in the strong brow ridge and occipital torus development, and in the proportions and angulation of the back of the skull. However, the occipital region is less robust than that of any of the Zhoukoudian *Homo erectus* adults from China, and is similar in proportions to that of the African Elandsfontein cranium, which is usually referred to as *Homo heidelbergensis, Homo rhodesiensis,* or 'archaic *Homo sapiens*' (Stringer 1989). New cranial fragments, including a large frontal fragment and temporal bone, will certainly help in more definitely reconstructing and assigning this material. A new Middle Pleistocene calvaria from Ceprano, Italy shows a number of resemblances to the Bilzingsleben material, and will also be important in resolving taxonomic issues surrounding it (Ascenzi *et al.* in press).

Where more complete Middle Pleistocene material is known from Europe, it is apparent that referral to *Homo erectus* is not the most appropriate option. One specimen is a particularly fine example of such a fossil, and it is unfortunate that dispute about its antiquity has clouded its significance. It was found in 1960 deep within a cave near the village of Petralona in north-eastern Greece (Stringer 1983). Although it has been claimed that a whole skeleton was originally present, this seems unlikely. Because the original location was not excavated carefully at the time of discovery, many uncertainties about the associations and age of the skull can never now be resolved. Absolute dating by U–S, Thermoluminescence (TL), and Electron-Spin Resonance (ESR) suggests that the cranium could be as young as 200 ka BP or older than 350 ka. Study of mammalian fauna supports the more ancient age estimates, but claims for an antiquity of more than 700 ka BP are extremely unlikely. The cranium does show some *erectus*-like characters in its uniformly thick brow ridge, its broad upper face, palate and base, its centrally strong occipital torus and thickened brain case. Endo-cranial size is about 1220 ml while the endocranial cast of the brain cavity is rather less flattened than in typical *erectus* specimens. There are also advanced (derived) characters which are shared with later Pleistocene (especially Neanderthal) crania. These include a lesser degree of total facial prognathism, but increased midfacial projection, a double curvature of the brow ridge, prominent nasal bones, and occipital torus which is lower in position and reduced laterally, and extensive pneumatisation including an enormous frontal sinus.

The Steinheim skull was found in a quarry near Stuttgart, Germany, in 1933 together with fauna suggesting a Holsteinian age (Stringer *et al.* 1984). It is nearly complete but badly distorted. Endocranial size is less than 1200 ml and the cranial walls are thin, but the brow ridges are strongly developed. The back of the vault is evenly curved, and in its present state of preservation the position of maximum breadth is quite high. The damaged face is relatively small, broad and flat, with a large nasal opening and cheek bones with an apparent canine fossa. It is an enigmatic specimen, small brained and relatively large browed, yet in other respects it shows advanced characteristics in the thin vaulted occipital shape. In certain respects the back of the skull resembles that of Swanscombe and the Neanderthals, yet the shape and proportion of the face seem rather primitive. The combination of a somewhat Neanderthal-like occiput and apparently primitive face is exactly the opposite of the situation in the Petralona skull.

The back part of a human skull associated with Acheulian artefacts, and a fauna with Hoxnian affinities derive from a gravel pit at Swanscombe, Kent (Stringer *et al.* 1984). The occipital bone was discovered in the middle gravels in 1935, followed by the left parietal in 1936 and the less well preserved right parietal in 1955. The bones are thick by Neanderthal or modern European standards, but the occipital is rounded in profile with a torus which is only slightly developed, as are the muscle markings, leading to the suggestion that the skull belonged to a female individual. The brain size of the Swanscombe woman was probably about 1300 ml and the overall cranial shape lacks the angularity of more archaic hominids. However, the parietal is relatively flat and short, while the base of the occipital is broad. Two features in particular suggest Neanderthal affinities. These are the slight, double arched occipital torus surmounted by a central depression (a suprainiac fossa), and the suggestion at the occipital margins of a developed juxtamastoid eminence. However, such Neanderthal-like characters are surprising if an immediate post-Anglian (Oxygen Isotope Stage 11?) dating can be confirmed for the Middle Gravels at Swanscombe (Bridgland 1994). The back half of a calvaria bearing many resemblances to the Swanscombe fossil was found in a quarry at Reilingen in Germany in 1978. Despite such resemblances, the dating of the fossil cannot yet be confirmed as Middle Pleistocene, because of uncertain faunal associations (Dean *et al.* 1994).

The Ehringsdorf hominids were recovered during both commercial and controlled excavations between 1908 and 1925 from interglacial travertine deposits near Weimar in Germany (Stringer *et al.* 1984). The most significant specimens are an adult cranial vault, an adult lower jaw, a child's lower jaw and parts of a child's skeleton. Found in association with artefacts of Middle Palaeolithic affinities, from U–S and ESR dating techniques the material appears to date from Oxygen Isotope Stage 7 (Blackwell and Schwarcz 1986). Also apparently deriving from this interglacial are a collection of some 20 fragmentary hominid fossils from Pontnewydd Cave in Wales, associated with handaxes, discovered since 1980. The teeth are small, but some show clear taurodontism, similar to that found in some Neanderthals (Green 1984).

As we have seen, a number of Middle Pleistocene fossil hominids are difficult to assign because of incomplete or conflicting data. This is especially true of mandibular specimens such as the ones from Mauer and Montmaurin. The latter site, in southern France, a fissure filling,

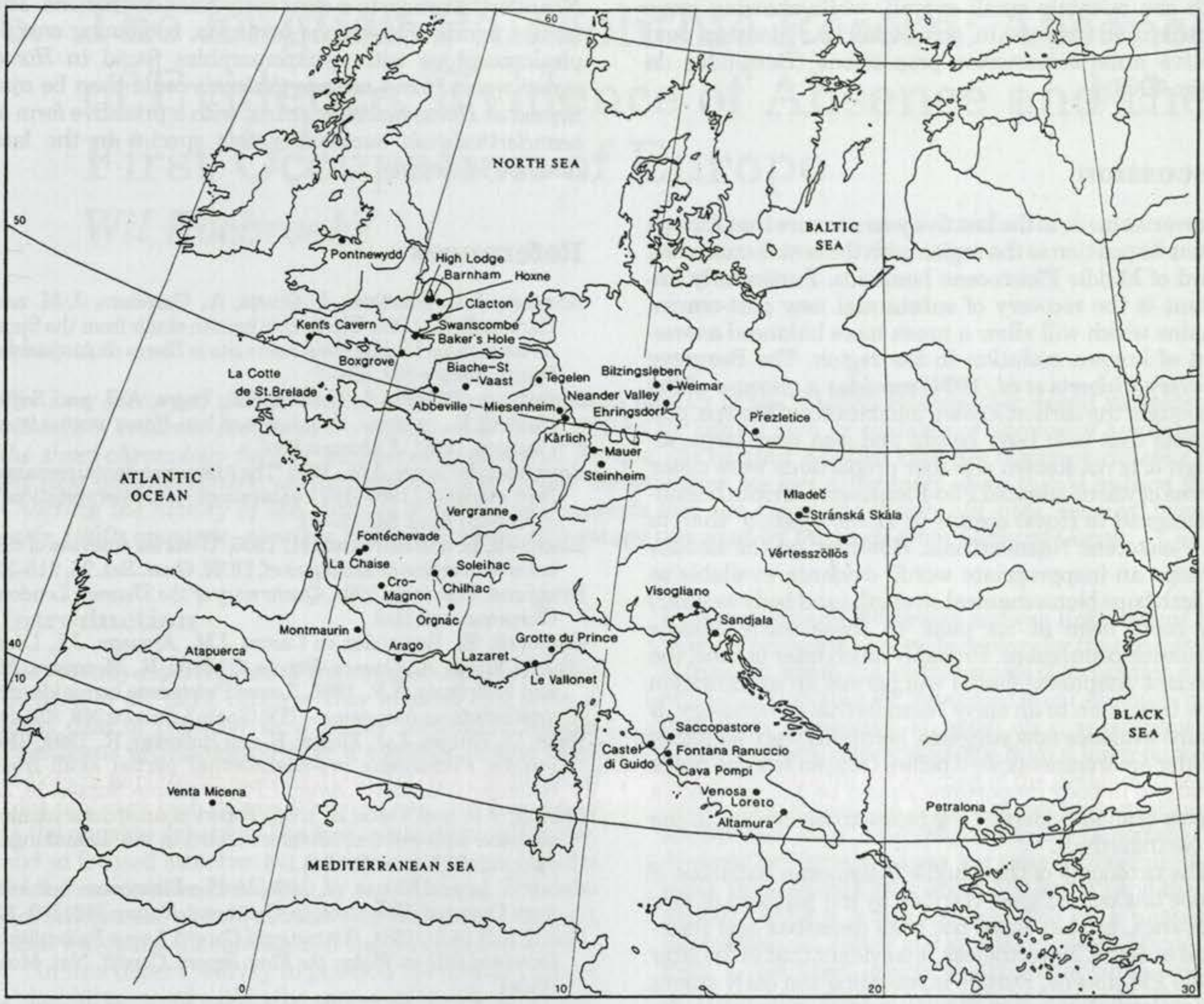

Fig. 5.2 Distribution of European Middle Pleistocene hominid sites and Lower Palaeolithic sites (as discussed by Roebroeks, this volume)

produced a nearly complete lower jaw in 1949, which probably dates from the late Middle Pleistocene. Some of the less complete specimens do appear to show either *erectus* or Neanderthal characteristics but it seems premature to classify them while the informative samples of hominids from Altamura and Atapuerca await detailed publication. A remarkable find, which appears to be of Middle Pleistocene antiquity, is the recent discovery of a virtually complete human skeleton deep in a cave system at Altamura, in southern Italy. Originally found by cavers, the fossil skeleton is well preserved, but encrusted by speleothem, and includes a cranium with evident affinities to other Middle Pleistocene specimens (it is described briefly in Delfino and Vacca 1994).

The complex of separate fissure fillings and caves at Atapuerca in Spain has produced stratified sequences of middle Pleistocene fauna and artefacts, as well as a number of hominid fossils from stratified and unstratified contexts. Almost all of the hominids are from the 'Sima de los Huesos', deep within a cave system, although significant and more ancient finds were made in the 'Gran Dolina' site in 1994–5. These are associated with the vole *Mimomys savini* and a claimed Lower Pleistocene stratigraphy and could therefore considerably antedate the Mauer mandible (Carbonell *et al.* 1995). From U–S dates, an age of about 300 ka BP was suggested from the 'Sima' fossils, but this is currently under revision. The material represents over 1100 jumbled cranial and postcranial bones, teeth and fragments from at least 30 individuals, including crania from at least 6 adults and children. The best preserved cranial specimens display features found in the rest of the Middle Pleistocene sample, including facial resemblances to both the Petralona and Steinheim crania. The temporal and occipital bones show few *erectus*-like features, and foreshadow those of Neanderthals in the presence of an incipient suprainiac fossa. Temporal morphology looks more 'modern' in the relatively large mastoid process and small juxtamastoid eminence (as appears to be the case for fossils like Reilingen and Ehringsdorf), but one younger individual does display a closer resemblance to the Neanderthal morphology. However, the clearest sign of Neanderthal affinities is the well developed midfacial prognathism of the small cranium 5 (Arsuaga *et al.* 1993). The extensive postcranial sample shows archaic and Neanderthal features, but overall body size does not appear to be large, and the teeth are certainly small overall, while showing some Neanderthal features in occasional taurodontism and relative anterior/posterior proportions (Bermúdez de Castro 1993).

Discussion

Discoveries made in the last five years ensure that Europe retains its position as the region with the best documented record of Middle Pleistocene hominids. Particularly important is the recovery of substantial new post-cranial remains which will allow a much more balanced assessment of human evolution in the region. The Boxgrove discovery (Roberts *et al.* 1994) provides a glimpse of the physique of the earliest known inhabitants of Europe, and suggests that both body height and size were large, although it is not known whether proportions were closer to those of warm-adapted Plio-Pleistocene African hominids assigned to *Homo erectus* or *'Homo ergaster'* than to late Pleistocene Neanderthals. However, on the slender (perhaps an inappropriate word!) evidence available so far, limb bone biomechanical strength (and body weight?) may have been at its peak in these early Middle Pleistocene populations. Probably much later in time, the abundant Atapuerca fossils will permit an examination of the transition to an early Neanderthal morphology. If as some evidence now suggests, hominids were adapting to colder environments well before Oxygen Isotope Stage 6, changes in body proportions should be documented in the post-cranial evidence long before those evident in the late Neanderthals.

The taxonomy of the Middle Pleistocene hominids of Europe has not yet been clarified by the plethora of new discoveries, as they have not been described and interpreted in detail. Nevertheless, it is evident that in the later Middle Pleistocene, Europe is recording the early stages of Neanderthal evolution. How far back that evolution can be traced depends on how certain fossils are dated and interpreted. Initial indications that the Atapuerca 'Sima' sample was stratified below a speleothem dated by Uranium Series to about 300 ka BP has proved mistaken, and further dating work is in progress. Whether this material will eventually prove to be no older than the Stage 7 age fossils from Ehringsdorf and Pontnewydd, which it resembles, remains to be seen. These do provide clear and early evidence of specific Neanderthal features in the dentitions, and in the occipital region of Ehringsdorf 9. However, the dating and classification of the Swanscombe hominid remains a problem, for its Neanderthal-like occipital morphology would be exceptional as far back as a Stage 11 age interglacial (*c.* 400 ka BP), and would imply at least approximate contemporaneity with the decidedly more archaic Bilzingsleben fragments. Either Middle Pleistocene European human evolution was more complicated than is generally believed, with extreme polymorphism or even contemporaneity of distinct grades or even species, or Neanderthal-like specimens such as Swanscombe and Atapuerca cranium 5 derive from later in the Middle Pleistocene than has been indicated by recent dating work. If the latter possibility proves correct, then it would still be possible to argue for an *in situ* evolution or replacement event switching from a pre-Neanderthal stage to a clear early Neanderthal one. The earlier middle Pleistocene hominids, combining *erectus* plesiomorphies with synapomorphies found in *Homo sapiens* and *Homo neanderthalensis* could then be confirmed as *Homo heidelbergensis,* with a primitive form of *neanderthalensis* succeeding this species in the late Middle Pleistocene.

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6. The English Palaeolithic Record: Absence of Evidence, Evidence of Absence and the First Occupation of Europe

Wil Roebroeks

Abstract

The long history of archaeologial research and the high quality of the English Palaeolithic record indicate that absence of evidence for human occupation before c. 500 ka BP can be seen as evidence of absence of hominids. In the short chronology for the earliest occupation of Europe, the earliest English sites are contemporaneous with the first ones elsewhere, while proponents of longer chronologies see age differences of up to two million years. Charting the history of the various chronologies suggests that the discovery of very old sites 'boomed' from the early 1960s onwards, possibly related to the search image provided by the finds from Olduvai Gorge.

Introduction

The recently reported find of the massive Boxgrove tibia (Roberts *et al.* 1994; Stringer this volume) has given a great deal of publicity to a highly important Middle Pleistocene archaeological site, a complex whose archaeological importance exceeds the find of that one hominid bone to a very high degree. The find has also added fuel to the ongoing debate on the first occupation of Europe, and so focused attention on a short chronology scenario for that occupation, developed by my colleague Thijs van Kolfschoten and myself, about a year before the Boxgrove fossil was found (Roebroeks and van Kolfschoten 1994).

In this paper I will try to position the English Lower Palaeolithic record within the context of the discussion on the earliest occupation of Europe. To do this I will first give a sketch of this short chronology and then survey some aspects of the history of Palaeolithic research in England, discussing the value of the evidence available in both its 'positive' (evidence for occupation) and its 'negative' (absence of traces of human occupation before a certain point in time) aspects. The suggestion is then made that *in the English case absence of evidence indeed seems to be evidence of absence*. The last part of the paper consists of a short discussion of the quality of the record from other parts of Europe.

The short chronology: a summary

The dates given for the first occupation of Europe vary enormously, depending on the book or journal one opens. On the 'very old' side of the continuum, the Bonifay and Vandermeersch (1991) volume, presents a number of sites allegedly dating from earlier parts of the Early Pleistocene, around two million years ago. An age of about one million years is considered a good estimate for the first occupation of Europe by most workers (cf. Rolland 1992), placing the earliest traces at the end of the Lower Pleistocene. These include sites such as Le Vallonet in France and Kärlich A in Germany. In contrast to these various 'long chronologies' Roebroeks and van Kolfschoten (1994) recently proposed a short chronology for the occupation of Europe, in which the earliest traces of occupation date to roughly 500–600 ka BP. As argued in our *Antiquity* paper, this short chronology is based on a reassessment of artefactual and dating evidence from a large number of European sites. In our reading of the evidence, there is a difference between the European record from before the appearance of a biostratigraphically important vole, *Arvicola terrestris cantiana* (for sake of convenience this taxon first appears after about 500 ka BP) and the later periods (Table 6.1; also Dennell 1983 for a comparable interpretation). *Before* 500 ka BP virtually all finds come from a disturbed, coarse matrix: afterwards we have primary context sites in fine-grained deposits. The small assemblages dating from *before* 500 ka BP are virtually all the result of selection by archaeologists of isolated 'worked' pieces from natural deposits; by contrast, younger assemblages are often excavated from knapping floors. We propose two basic ways to interpret these differences. The pre-500 ka BP finds could reflect the sparse traces of intermittent occupation of Europe by people with 'primitive', 'Oldowan' toolkits different from later ones, while substantial colonisation of Europe took place from about 500 ka BP onwards (cf. Turner 1992). In view of the attributes of the 'artefacts' and contexts of the pre-500 ka BP sites (see the *Antiquity* paper) we instead interpret these differences as strongly suggesting that there is *no indisputable proof for human occupation of Europe prior to about 500 ka BP*. The first primary context sites with good archaeological evidence date from a later period within the Middle Pleistocene. These fall at the end of the Cromerian complex, possibly from about Oxygen Isotope Stage 13, and date to about 500 ka BP.

Our scenario has several advantages. Firstly some of its basic elements are *very easy to falsify*. The find of only one Early Pleistocene primary context site in the area reviewed here would disprove it. As a result it has to be concluded that before 500 ka, occupation existed but was largely intermittent. A further advantage is that our short chronology is supported by a body of data *independent* of

Table 6.1 Schematic difference within the European Palaeolithic record between the period before and after *c*. 500 ka BP

Before 500 ka BP	*After 500 ka BP*
Small series of isolated pieces selected from a natural pebble background	Large collections from excavated knapping floors with conjoinable material
'Artefacts' found in a disturbed context (coarse matrix)	Primary context sites (fine-grained matrix)
Contested 'primitive' assemblages	Uncontested Acheulian and non-Acheulian industries
No human remains at all	Human remains common

Source: Roebroeks and van Kolfschoten 1994

arguments concerning stone tools: the chronological distribution of human remains. From the 'Boxgrove' time period onwards we have Middle Pleistocene human remains all over Europe (for the location of these sites see Stringer this volume, Fig. 5.2): Altamura, Arago, Atapuerca, Biache-Saint-Vaast, Bilzingsleben, Boxgrove, Cava Pompi, Castel di Guido, La Chaise, Ehringsdorf, Fontana Ranuccio, Fontéchevade, Grotte du Prince, Lazaret, Mauer, Montmaurin, Orgnac III, Petralona, Pontnewydd, Steinheim, Swanscombe, Venosa, Vergranne, Vértesszöllös and Visogliano, to mention them in alphabetical order (cf. Cook *et al.* 1982). From the long period before we do not yet have a single (uncontested!) tooth, despite the huge amounts of other mammalian fossils known from this time range.

In our scenario, to a large extent based on the biostratigraphy of small mammals, the earliest British sites are among the first traces of occupation of Europe. The Boxgrove fossil is more or less contemporaneous with the human mandible discovered in 1907 at Mauer (Germany) and the material from the Italian site of Fontana Ranuccio and possibly Visogliano. Recently reported hominid material from Atapuerca TD6, Spain (that is from the 'Gran Dolina' site), not to be confused with the prolific but younger Middle Pleistocene material from the Sima de los Huesos at first glance seems to be older than the three hominid sites just mentioned. The TD6 material is associated with a fauna containing a vole ancestral to the Boxgrove *Arvicola*, *Mimomys savini* which is suggestive of an older age. However, it is currently difficult to establish a correlation between the Atapuerca faunas and faunas from non-Iberian parts of Europe. For example, a recent study indicates endemism in the Arvicolids from Atapuerca (A.J. van der Meulen, pers. comm. 1994). The endemic character of part of the fauna may have resulted in a chronological extension of the range of particular species, and this makes the correlation between Iberian faunas and those from other parts of Europe on the basis of a single species very problematic. Moreover, nowadays the Iberian peninsula is inhabited by a particular vole (*Arvicola sapidus*) whose origin is unclear, as is its relation to *Arvicola terrestris* which occurs in the rest of Europe up to the northernmost part of the Pyrenees. These aspects imply that the occurrence of *Mimomys savini* in Atapuerca TD6 cannot as such be used to claim an age much higher than 500 ka, and the excavators interpretation of the Atapuerca TD6 level as dating from around 500 ka BP seems to be the best current option (*but see* endnote 2 and Roebroeks and van Kolfschoten 1995).

A solid chronological framework does set significant limits to the various behavioural scenarios one can develop to account for the Palaeolithic record. In that sense it is important to discuss the empirical limits and values of the various long and short chronologies in detail, as they have highly varying implications (Roebroeks and van Kolfschoten 1994; Gamble this volume). Obviously, our short chronology interpretation of the European Palaeolithic record is a contested one, banking heavily on the validity of the 'vole clock' and on our interpretation of specific assemblages as pseudo-artefacts (or, at their best as *possibiliths*!). If one assumes with us that the short chronology is at least a valuable working hypothesis, the next question is: how representative is the body of evidence now at our disposal in terms of evidence for the first occupation, and what is the quality of the archaeological record? *One* way to approach this question is to look at the history of Palaeolithic research, and the English case furnishes a very good and well documented example.

The European Palaeolithic record: an English example

In comparison with other areas of the world, England is certainly one of, if not *the*, most heavily researched. Nineteenth-century social and economic developments led to large scale exploitation of natural resources, the construction of railways and canals, the expansion of cities and the intensification of agriculture. As a result huge amounts of earth were moved and ancient surfaces exposed by manual labour. Moreover, numerous 'antiquarians' were either screening these exposures or paying others to do so. The English case provides a very good illustration of the grand scale of this search for Palaeolithic artefacts and fossils, both for the positive and the negative evidence that these 'flint hunters' came up with.

At the close of his famous 1859 paper presented to the Society of Antiquaries, in which he argued that Boucher de Perthes's finds indeed were humanly worked flints and 'original component parts of the gravel', John Evans called upon his fellow antiquarians to start an extensive search for Palaeolithic artefacts all over England (Evans 1860). As described by Roe (1981) this was the heyday of gravel digging by hand, with a large number of loam and gravel pits in the high and middle terraces of the major river valleys. Following Evans's advice, numerous nineteenth and early twentieth-century collectors surveyed miles of exposures along 'the banks of the Thames, the eastern coast of England, the coast of western Sussex, the valleys of the Avon, Severn and Ouse, and of many other rivers, in fact ... nearly every part of England' (Evans 1860). Furthermore, according to Reid Moir's (1927, 1) description of *The Pleasures of Flint Hunting* they had a good time doing it!

The burst of collectors' activities in the second half of the last century led to the discovery of a great number of Palaeolithic sites (cf. Wymer 1968; Roe 1981). Sites still in the centre of discussion or even under actual excava-

Table 6.2 Date of first reported artefacts from some major British Palaeolithic sites, still under excavations or other forms of study

Site	*Date*	*Source*
Baker's Hole	before 1883	Wymer 1968, 355
Barnham	c. 1900	Ashton *et al.* 1994, 599
Boxgrove	pre-1925	Calkin 1935
Clacton-on-Sea	c. 1898	Wymer 1985, 264
La Cotte (Jersey)	1881	Mourant and Callow 1986, 13
High Lodge	late 1860s	Ashton 1992, 25
Hoxne	1797	Frere 1800
Pontnewydd	1870s	Green 1984, 12
Swanscombe	1885	Wymer 1968, 334
Kent's Cavern	1825	Roe 1981

tion, such as Hoxne, Swanscombe, High Lodge, Boxgrove (or rather, the Slindon sands), Barnham, Clacton and Pontnewydd Cave were all already well known around the turn of the century, if not much earlier (Table 6.2). John Frere's finds at Hoxne, Suffolk, date from almost two *centuries* before the recent monograph on the site (Singer *et al.* 1993). The first artefacts at High Lodge, Suffolk were discovered in the 1860s by workers digging the clay for brick-making (Ashton 1992, 25), while Warren had already published the Clacton, Essex, wooden spear point in 1911, four years after the Mauer mandible was found.

The English Palaeolithic record is thus a database to which hundreds of amateur and professional collectors have contributed. It is therefore important to realise that our current image of the earliest occupation of the region is also supported by a large, but rarely mentioned, database concerning the *absence* of stone artefacts before a certain point in time. The nineteenth- and early twentieth-century quest for Palaeolithic finds not only resulted in the discovery of many uncontested Palaeolithic sites, but also saw a tremendous amount of energy being invested in the search for, and documentation of, what are now considered to be assemblages of pseudo-artefacts of Lower Pleistocene and Tertiary age.

A good example of this negative evidence is the well-known case of the East Anglian Cromerian 'Forest Beds'. These sediments comprise clays and organic lenses of both fresh water and estuarine origin, deposited during the Lower and Middle Pleistocene in a wide embayment in the coastal region of north and north-east East Anglia. For the upper part of the series, immediately below the Anglian till, both plant and mammal remains indicate temperate conditions, while the small mammal fauna, with the extinct vole *Mimomys savini*, is in general more primitive than the late Cromerian fauna recovered at Boxgrove (cf. Roberts *et al.* 1994; Stuart 1982; 1988). Fossils were collected from these deposits from about 1800 onwards. In the early 1860s Charles Lyell predicted that one day these beds would yield traces of human presence, and before the end of the century 'flints showing unmistakable signs of human workmanship' were reported. More activities and reports of similar findings followed, all within the context of the nineteenth- and early twentieth-century hunt for early man (cf. Spencer 1990). In his monograph on *The Antiquity of Man in East Anglia* Reid Moir (1927) concluded that 'there is now in existence a large and important body of evidence to show that East Anglia was inhabited by races of Early Palaeolithic men in the remote Forest Bed epoch' (1927, 51). This conclusion, however, was not uncontested at the time, and the controversies that developed around the authenticity of the Forest Bed and earlier (Crag and pre-Crag) assemblages were longlasting (*see* Coles 1968 for a good summary of this topic; Wymer 1985).

Despite more than a century of continuous archaeological and two centuries of palaeontological research the Forest Beds have yielded no certain traces of human occupation (Wymer 1985, 26 and 335). Neither did any deposits earlier than the Slindon sands of Boxgrove. One could therefore, with Derek Roe, think of Reid Moir's and others' quest for Lower Pleistocene and Tertiary humans as 'byways in the history of British Palaeolithic research ... and not spend too much time exploring them' (Roe 1981, 28). But in actual fact, such a presentist interpretation judges earlier workers only in terms of the *outcome* of discussions they were involved in, usually clear-cut only in retrospect. Even more important here, Roe's judgement tends to forget one crucial thing, that researchers like J. Reid Moir assembled an impressive *negative* data set that is still extremely relevant for current scientific research, especially as it was obtained in a period when many more Lower and Middle Pleistocene sediments were accessible than today. The many sampling points screened by these nineteenth and twentieth century Palaeolithic 'hunters', densely packed in both Pleistocene space and time, support the assumption that in the English case, absence of evidence indeed seems to be evidence of absence. The intensity and long history of archaeological research seems to indicate that we have established a baseline here, since more than 150 years of collecting fossils and artefacts has yielded only finds from the last 500 ka. Is this also the case in other parts of Europe?

The European evidence

The nineteenth- and early twentieth-century search for Early Man was a pan-European phenomenon, and every European country had its own searchers and sets of early sites. As in England, besides various uncontested sites many presumed 'primitive' artefacts were discovered in Early Pleistocene and Tertiary deposits. This was in line with evolutionary theory which implied that the first artefacts would have been hardly distinguishable from naturally fractured rocks (Boule 1921; Grayson 1983; Obermaier 1912; Spencer 1990; Sollas 1924). In this quest all over Europe countless exposures of Pleistocene sediments pre-dating the 'Boxgrove' time period were subjected to close scrutiny. Many of these had, over many decades, occasionally centuries, yielded rich mammal faunas, but never any traces of human activities.

The Somme valley in northern France is one such classic area. Despite one and a half centuries of intensive research all sediments older than the Abbeville deposits are bereft of artefacts, although archaeologists and geologists are still surveying Lower Pleistocene sections for

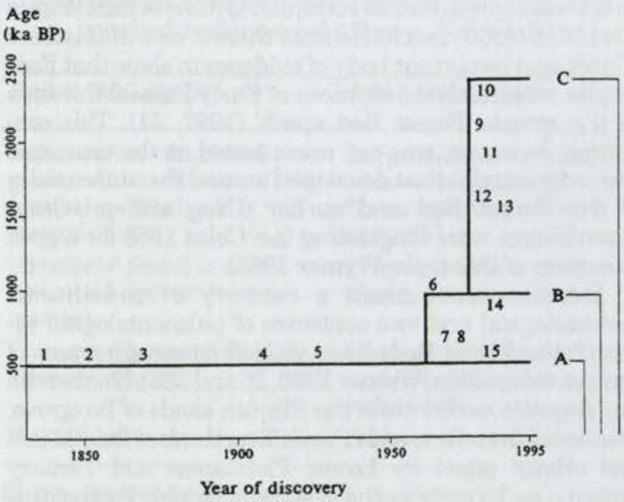

Fig. 6.1 Graph showing the age and year of discovery of some of the key sites in the discussion on the earliest occupation of Europe. 1. Kent's Cavern; 2. Abbeville; 3. High Lodge; 4. Mauer; 5. Slindon Sands (Boxgrove); 6. Le Vallonet; 7. Prezletice; 8. Stránská Skála; 9. Blassac; 10. St Eble; 11. Venta Micena; 12. Chilhac; 13. Nolhac; 14. Kärlich A; 15. Miesenheim. The A (500 ka BP) block contains sites relevant to the short chronology, while B (900 ka BP) and C represent various forms of longer chronologies. See text for further explanation

them; for instance, in the 1994 exposures of the high terrace of Grace near Montières (Antoine, pers. comm 1994; Tuffreau 1987; Tuffreau and Antoine 1995, *contra* Bourdier *et al.* 1974).

In the Lower Pleistocene Tegelen clay pits in the Netherlands mammal fossils were collected around the turn of the century, by Eugène Dubois amongst others. People did, and still do, look for artefacts there, but no convincing ones have ever been uncovered (Dubois 1904; *see also* Luttschwager and van Bemmel 1962; Peeters *et al.* 1988). A similar situation can be found in the Upper Val d'Arno Basin in Italy, whose mammal fauna was already known to the seventeenth-century naturalist Nicolaus Steno. This was a beloved place for 'Palaeolithic hunters' in the nineteenth century (de Mortillet 1883). Goethe collected mammal fossils at the prolific early-Cromerian site of Süssenborn near Weimar (Germany), a site that has kept on producing fossils ever since (Nolte *et al.* 1969), while the Voigtstedt sediments have been yielding early Pleistocene fossils from 1850 onwards (Nolte *et al.* 1965). Neither have new projects, like the Palaeolithic of the Neuwied Basin in Germany yielded unambiguous evidence of occupation prior to the Miesenheim I – Kärlich G – Boxgrove time period, though older deposits were explicitly surveyed there too, with contested results (cf. Roebroeks and van Kolfschoten 1994).

A basic problem in this discussion is how to ascertain what fraction of the earliest sites has been recovered. In other words: how representative is our sample? In the European case a rough indication might be obtained by comparing the pre-World War I sample of important sites with that of sites discovered later and to look for a skewness in chronological information. Not surprisingly, in our short chronology reading of the European record we did reach a kind of baseline similar to the English case, as the period after World War I did not yield sites convincingly older than 'classical' ones like Kent's Cavern, Abbeville, High Lodge or Mauer. Interestingly, the picture is completely different if one takes a point of view of those who propose an earlier occupation of Europe, be it around 900 ka BP (cf. Rolland 1992) or even at around two million years ago (cf. Bonifay and Vandermeersch 1991). I have presented this situation in a graph (Fig. 6.1), where the horizontal axis represents years of discovery of major sites still in the centre of discussions, and the vertical axis their inferred age. The three chronologies sketched in the graph are the short one (A), a longer one (B) and an extremely long one, that supposes that Europe's first traces of human occupation date back to more than two million years ago (C). The resulting pattern is very interesting. Whereas the short chronology's ceiling of about 500 ka BP seems to have been reached quite early in the history of our discipline, the sites relevant to the various forms of current long chronologies are rather recent discoveries: Le Vallonet, France, provides a strong 400 ka BP shift to the curve in 1962, followed by many later 'Oldowan'-like' additions to this 900 ka block in the three decades since (eg Stránská Skála, Prezletice, Sandalja, Soleilhac and Kärlich A and Bb). In the mid 1970s the curve made another shift, this time a quite spectacular one of more than a million years, ending at about 2.5 million years, and mainly consisting of sites in the French Massif Central, some Czech sites and Venta Micena (Spain).

What caused these shifts, so late in the history of our discipline? The reasons may have been varied and complex but *one* part of an explanation may be the strong *search image* afforded by the pebble culture from Olduvai Gorge. This was especially so since 1959 when the site became a centre of interest as far as human origins was concerned. The find of Zinj (1959) and other hominids, the unexpectedly high Potassium–Argon dates for the lower beds (1961) and the lavishly illustrated articles in the *National Geographic* (Leakey 1960; 1961) may have been among the factors behind the real boom in discoveries of Oldowan-like assemblages in Europe from the sixties onwards[1]. In my opinion, this 'Oldowan' search image started an uncritical quest for 'primitive' industries, that ultimately led to the situation summarised in Table 6.1, in which the first Acheulian industries appeared in Europe about one million years later than they did in Africa.

Some conclusions

The quality of the English Palaeolithic record indicates that in the English case *absence of evidence* for human occupation from before approximately 500 ka BP might indeed be *evidence of absence.* Other well-researched areas of Europe have yielded a comparable picture of first occupation at around 500 ka BP, a ceiling that was reached at an early date in the history of our discipline. However, as we have seen above, proponents of a long chronology might stress that there remain a lot of very old sites to be discovered in Europe. As a result of regional differences in economic developments the intensity of research and density of sampling points indeed varies within Europe, with some areas having a somewhat greater possibility for 'surprises' than well-researched regions like northern France and England. It is from such areas that sites ultimately disproving the short chronology might come[2].

However, the history of our discipline shows that the absence of very clear traces of occupation before about 500 ka BP cannot simply be explained by the fact that archaeologists have not looked at sediments from the relevant time range. On the contrary, to say that would be a denial of the history of our discipline and an insult to the numerous well-known and anonymous 'Palaeolithic flint hunters' who in retrospect made a very important contribution to European archaeology by studying early Middle Pleistocene and various older deposits. Their contribution may be for other reasons than they thought at the time, because they showed that absence of evidence sometimes *is* evidence of absence. And that is an important point of departure for studying Middle Pleistocene hominid behaviour.

Endnotes

[1] We must, however, not forget that the suddenness of the shifts shown in the graph (Fig. 6.1) is also partially an artefact of our retrospect, our focus on sites that have survived three decades of discussion. In fact, the 1950s saw increasing attention to pebble industries in Europe, be it on a much smaller scale than the '60s and '70s. In England work on the 'early pebble and flake-tool industries of Africa and Asia ... placed the Clactonian in a new perspective' (Warren 1951, 107), while central European finds were identified as 'Lower Oldowan' at the end of the 1950s (cf. Krüger 1959, 165–6). Le Vallonet was something special because of its good stratigraphic context. In their *Note préliminaire* on Le Vallonet, De Lumlet *et al.* (1963) explicitly stress the contemporeneity of the Le Vallonet pebble-tool assemblage with the African Oldowan: *dont l'industrie était associée à un Australopithèque*, and place the finds in the context of other recently discovered traces of a very early occupation of Europe.

[2] Newly reported dating evidence for the Atapuerca TD sequence yielded such a surprise. As mentioned above, earlier estimates assigned an age of about 500 ka BP to the TD6 level, wherease it is now thought to date from the Matuyama period, and is consequently older than about 800 ka BP (Carbonell et al. 1995; Parés and Pérez-González 1995).

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7. Hominid Behaviour in the Middle Pleistocene: an English Perspective

Clive Gamble

Abstract

The character of the English Palaeolithic is discussed and its opportunities for behavioural analysis assessed. Comparisons are drawn with the East African evidence. A method of tacking between data of different chronological and spatial resolution is outlined. A model of Middle Pleistocene behaviour is presented which stresses the importance of individual action. This is discussed at the spatial levels of camp sites, landscapes and colonising territorories.

Introduction

Twenty years ago Glynn Isaac (1975) addressed the problem of the 'muddle in the middle'. He was referring primarily to the problems of dating the period after the demise of the Australopithecines, where Potassium/Argon techniques no longer provided an absolute chronology, and before the Upper Palaeolithic which, by happy co-incidence, fell within the range of ^{14}C[1]. However, he could also have been drawing attention to the problems that face archaeologists in interpreting hominid behaviour over this long period of more than a million years duration.

These problems are partly the result of the archaeological record and partly of our own making. At either end of the period we have a major threshold in human evolution; the behavioural origins of the early hominids and the emergence of modern humans. At times the long wait between these two Palaeolithic 'highspots' seems like an even duller version of the European Mesolithic, the stale sandwich (after the Late-glacial glories of Lascaux) eaten in the waiting-room of agricultural arrivals (Gamble 1986a). I will argue in this paper that the English evidence both from recent excavations and the *Southern Rivers Palaeolithic Project* alters these expectations by providing us with the opportunity to start investigating the variety of Middle Pleistocene behaviour. This goal can be achieved without recourse to the excitement of origins research. Instead we can view the data against more familiar spatial scales of archaeological enquiry designed to elicit behavioural information. A necessary step in such endeavours remains, naturally, the characterisation of the archaeological record itself. I hope to show that one outcome of such investigations is to remove the inferiority complex suffered by studies of the English Lower Palaeolithic. I will contend that stripped of its 'origins' glamour, the record from East Africa is neither less problematic nor richer in potential behavioural insights into early hominid behaviour than either the English or European evidence.

Background to behaviour

In the terminology of the 1990s, forged in a long running debate over the fate of the Neanderthals, the period into which the English Lower and Middle Palaeolithic fits starts with the *Out of Africa 1* exodus, associated by most physical anthropologists with *Homo erectus* (*but see* Groves 1989; Clarke 1990; Wanpo *et al.* 1995; Wood and Turner 1995; Stringer this volume). This range extension probably started over a million years ago (Gamble 1993a)[2]. When it finishes is more problematic. The evidence from physical anthropology would tie it to the *Out of Africa 2* departure by anatomically modern humans (Stringer and Andrews 1988). This took place sometime after 150 ka years ago. However, this migration was followed by almost 100 ka BP when modern looking humans behaved in very similar ways to the earlier regional populations selectively distributed throughout the Old World (Gamble 1993a). The archaeological evidence points instead to the period between 60 ka and 40 ka ago as the time when the transition to modern behaviour took place and led to major population movements into Australia, Asia, Europe and, soon after, the islands of the Pacific margins.

The behavioural questions which need answering in the period between 130 ka and one million years ago are simple. What exactly could these hominids do? How varied were their solutions to the many different types of ecological settings that they inhabited — from north Wales to the southern Cape, Gibraltar to Beijing and south to the savannah/forest interface of south-east Asia? Were they hardwired for survival or did they adapt through the interface of culture ?

In this context I am following the definition of behaviour as the dynamics of adaptation (Binford 1972, 133). Behaviour is under selection pressure which is the reason why we can study patterning in the archaeological record. This approach has usefully served the behavioural debates surrounding human origins in Africa as well as the adaptive success of modern humans throughout the Palaeolithic Old World. It has been less frequently applied to European data from the Middle Pleistocene.

For example, I was struck when preparing this contribution by the extensive literature that exists on the behaviour of early hominids in East Africa and the equally large outpourings on the respective behaviours of Neanderthals and anatomically modern humans. This situation is well illustrated by Binford's (1985) influential review on the behaviour of early humans that is decidedly thin on the period covered by the English and European Lower Palaeolithic (*ibid.*, 315–20). While we still await consensus on the issues of hunting vs scavenging, central place foraging *vs* stone caches or even the demography of the East African hominids there is at least a debate. This is also the case with the study of the Neanderthals from the Upper Pleistocene where their subsistence and organisational skills are contrasted with the anatomically modern humans whose regions they shared and eventually, in Europe, replaced (Farizy and David 1992; Kuhn 1991; 1992; Stiner 1991; Chase 1989; Stringer and Gamble 1993). However, I shall argue that this period in the middle will not go away just by making its inhabitants a little cleverer or a little stupider than earlier or later hominids. That is not the way to conduct behavioural analysis. Neither shall we understand past behaviour just by reconstructing individual actions to demonstrate, for example, that hunting once took place over the cliffs at La Cotte, Jersey, or that flint knapping occurred in the Swanscombe, Kent, lower loam. But before looking at alternative frameworks for interpretation we need to consider the record itself.

The English Lower Palaeolithic

The value of a survey such as *The Southern Rivers Palaeolithic Project* is that it provides us with the opportunity to systematise and take stock of taphonomic issues before proceeding to the analysis of past behaviour. The English data from the Middle Pleistocene document the earliest occupation of this corner of north-west Europe 500 ka BP (Roberts *et al.* in press). This date may also be the age of the occupation of most of Europe (Roebroeks this volume; Roebroeks and van Kolfschoten 1994; *but see* Carbonell *et al.* 1995). The English data consist of two forms. On the one hand there is the highly precise information from well preserved sites such as the Swanscombe lower loams, the Slindon silts at Boxgrove, West Sussex, the Hoxne, Suffolk, lake shore and the Barnham, Suffolk, river banks. These are all high quality 'flagship' sites with remarkable preservation due in part to geology and sedimentation but also to the episodic nature of the behaviour which resulted in the deposition of artefacts and ecofacts. What Roman villa has such *in situ* evidence for behaviour? What Iron Age rubbish pit allows the archaeologist to construct the shortest of inferential chains concerning the role of hominid behaviour among the process of site formation? The only evidence with similarly short chains-of-inference from later prehistory and the protohistory of Roman and medieval England comes from human burials and isolated examples of ritual behaviour. The preservation of landscapes with a comparably high spatial resolution is rare indeed outside the Lower Palaeolithic, but common within it given the antiquity of the surfaces being investigated.

So much for the good sites. What about the second class of data, the rolled handaxes and occasional flakes from at best a secondary deposit? In contrast to the 'flagship' sites these 'dredgers' form the bulk of the *Southern Rivers Palaeolithic Project* data (Wymer, Roe this volume). While we can all see how Barnham or Clacton, Essex, might be analysed for past behaviour, and their results compared to build up a larger picture, what can be done with the 1000 handaxes from Dunbridge, Hampshire, the mass of artefactual material from the Swanscombe gravels or an isolated handaxe from Midanbury, Hampshire?

While we might not like the data because they are derived and lack a precise geological, biostratigraphical let alone archaeological context, this seems to me a poor reason for abandoning them and concentrating *all* our efforts on finding the next Boxgrove. The data are the data and, like children, should not be blamed for being difficult. If we cannot make immediate sense of them with a behavioural approach then possibly it is because we are asking the wrong questions and analysing them in inappropriate ways.

East African insights[3]

The recent debates on the character of the early hominid record in East Africa are relevant to these discussions. The past decade has seen some spirited exchanges over the formation of many of the 'good' sites in the region. These include locations in Olduvai Gorge (Leakey 1971; Binford 1981; Bunn and Kroll 1986) selected localities in the Koobi Fora region[4], where Isaac (1978) constructed his important model of central place foraging, home bases and food sharing (Bunn *et al.* 1980; Potts 1991), and large artefact collections such as Olorgesailie (Isaac 1977) and Kilombe (Gowlett 1984) where the quantity of material and full recovery of artefact types is exceptional even though the artefacts are not *in situ*.

These key locations for the reconstruction of early hominid behaviour have different taphonomic histories as Isaac (1971) recognised. For example, it is probable that *Homo habilis* (OH 7) at Olduvai site FLK was a crocodile kill and that the stones and bones on the same living floor have been displaced (Davidson and Solomon 1990). Isaac's later interpretations of such evidence was that 'the majority of Plio-Pleistocene sites are very likely fossilised, shady picnic spots which were used recurrently' (Kroll and Isaac 1984, 27). The appeal of this model where settlement behaviour selected for trees as convenient shady feeding spots, as well as escape routes from predators, also had the advantage of incorporating onsite and offsite data, better known perhaps by Isaac's (1981) descriptions of scatters and patches. A patch could be well preserved but also just a dense accumulation of derived material. Both Boxgrove and Dunbridge would be East African patches, surrounded no doubt in their geological units by *in situ* and redeposited scatters. Isaac's scatters led behavioural reconstruction back out into the landscape, the theatre of evolution through selection pressure[5].

Stern (1993; 1994), however, has gone further and questioned the ability of the African archaeological record of the Lower Pleistocene to support many of the current behavioural interpretations. Her point is that the formation of the record has resulted in time-averaged accumulations of material remains parcelled up into 70 ka long units (*ibid.*, 214). She argues that archaeologists still lack a theory of human action over such time spans but prefer to ignore the difficulties of the data and turn such palimpsests into Polaroid snapshots of the past. This is because we are good at reconstructing behaviour on an ecological timescale since that is how we observe behaviour in the present. She suggests, but provides no clues as to how we do it, that we need to build 'uniquely archaeological theories of human action over long time spans' (*ibid.*, 215). Judging by the responses to her *Current Anthropology* article (Juell and Edwards 1994; Conard 1994) such hard-headedness about the Lower Pleistocene record in East Africa is unwelcome in some quarters and only reluctantly acknowledged in others.

East Africa and southern England compared

The purpose of this brief East African safari can now be summarised. My interest has been in alleviating the inferiority complex exhibited by English Lower Palaeolithic archaeologists in respect of the quality and integrity of their data. I cite their reluctance to 'take-the-data-further' and attempt behavioural analysis as evidence for such a condition.

For instance, we can see that many similarities exist between these two Lower Palaeolithic data bases in terms of structure. We may not have volcanic tuffs and tectonically induced erosion but neither do they have the Anglian ice sheet and periglacial conditions. However, the *Southern Rivers Palaeolithic Project* shows that we do have a record that could, in some instances, already be characterised in terms of scatters and patches. What is needed most is a change in the scale of Lower Palaeolithic fieldwork. In Koobi Fora the Karari ridge, along which sites have been located and excavated (Stern 1993, fig. 4) winds sinuously for over 10 km. The 40 m raised beach in West Sussex, to which the notable patches of Boxgrove and Slindon are related, can be traced for at least twice this distance. While the archaeology may be buried at greater depths the principles concerning the structure of the English record, once available for study, are comparable.

Instead of East African and European research adopting rather different field methods, based on a different perception of their Lower Palaeolithic records, the opportunity for a unified approach seems attainable. For example, following Bridgland's recent systematisation of terrace deposits in southern England (Bridgland 1993, and this volume) the possibility now exists for a change in investigative methods. Following the East African model, 70 ka long temporal units would not be unexpected in northern Europe within the chronology fixed by the glacial/interglacial cycles of the Middle Pleistocene. Indeed, some calibration between this standard chronology, the duration of deposit formation and the artefacts they contain could be very useful for the investigation of long-term hominid behaviour. One question which could then be investigated is the different rates of artefact deposition between the low and mid latitudes as represented by the two datasets. While this would not be a comparison of contemporaneous deposits it would nonetheless provide a means of evaluating aspects of longterm land use. I would expect that differences in the scales of scatters and patches would reflect both larger and more permanent populations in low latitudes — a demographic variable which would be good to demonstrate rather than just assume.

However, there are other steps to trace before such a programme could be realised. The records are also very different, and in two principle ways. Firstly there is the history of research. The English Lower Palaeolithic, as the *Southern Rivers* survey now documents through plotting find-spots not only against Quaternary geology but also against former clay, sand and gravel pits and urban development, probably requires a degree in industrial as much as Palaeolithic archaeology if we are to interpret the data. Wenban-Smith (1990) has traced the history of one locality, Baker's Hole, Ebbsfleet, soon to be the site of the high speed train car park, and related the history of extraction to archaeological recovery. Hosfield (this volume) applying a GIS approach to a sample of the *Southern Rivers* data, has standardised what is known anecdotally concerning the history of development of Southampton and Fareham, Hampshire, and the differential recovery of Lower Palaeolithic archaeology both within and between these urban centres. The importance of these case studies is that we can begin to assess the importance of negative evidence in the formation of the record available to study past behaviour (*see also* Roebroeks this volume). We need more studies of this nature and the *English Rivers Palaeolithic Survey* will provide the basis.

The situation could not be more different in East Africa. No industrial revolution opened up Olduvai Gorge or the Koobi Fora badlands. As far as I am aware no TGV terminal or land fill reclamation threatens their survival. The tradition of amateur collectors who gave us most of our record is also missing. Instead we have systematic searching by professional teams. Fieldwork led by sampling strategies rather than bus routes and good pubs[6]. But rather than assert that this makes the African data 'better' than the English, we should recognise that the geological accidents which revealed artefact deposits are of a similar order to the demands for minerals which opened up the deeply buried landscapes of northern Europe. Unlike the surface archaeology of later prehistory the Lower Palaeolithic records from both areas require the methods and techniques of deep landscape archaeology. This is not restricted to this period alone as Torrence (1994) has shown when studying past landscapes buried by massive volcanic eruptions 3000 years ago on the Pacific island of New Britain. What we can now see is that many archaeological projects face a common problem of time averaging, investigating landscapes buried at various depths and as a result the inappropriateness of 'sites' as analytical concepts. Undoubtedly, as Stern (1993) has indicated, more basic research is needed to transform the samples obtained through deep landscape archaeology into reconstructions of past behaviour. The *Southern Rivers Palaeolithic Project* is a step down that track.

Moreover, it is my impression that the African evidence lacks one crucial component that makes it seem even stranger that workers in this region have been largely responsible for most of the behavioural interpretations of the Lower Palaeolithic. Notably, they lack those well preserved localities where, for example, we can see where the knapper knelt for 15 minutes half a million years ago and can refit, in a tradition started by Worthington Smith, the flakes back together. There may be the Laetoli footprints and refitting is certainly well known in the East African excavations. But because of the range of other animal species, also preserved as footprints at Laetoli, and their disruptive — to the archaeology —

behaviour under trees and around water (Haynes 1991), this density of activity has always blurred the picture of who was responsible for what. On the contrary, less activity, reflecting different forces of selection in northern environments, has in the English context sharpened the behavioural focus, at least in our flagship 'sites'. It is for these reasons that we need to finally shed any last vestiges of our collective inferiority and be demanding what the quality of our Lower Palaeolithic data requires; World Heritage status, and the recognition this affords, for areas as sensitive and internationally important as the 40 m Sussex raised beach. A process which has begun (Keys 1994) and is being actively pursued by the Ministry for National Heritage and English Heritage. However, given the quality of our data why should we settle for just one area?

Towards a model of Middle Pleistocene behaviour

It would strengthen our hand in demanding such World Heritage recognition if we were clearer about how we might contribute to Stern's call for a theory of human action over long time-spans. I want to propose that the English data, as an example of what is available in north-western Europe provides a suitably structured record with which to tackle this question.

What the English record allows us to do is to 'tack', rather like a yacht, between the two classes of data (Wylie 1993, 23–4). From the precision of mint fresh artefacts in the Clacton channel to the coarse palimpsest of Furze Platt, Berkshire (Fig. 7.1)[7]. To tack from the patches (whether fine or coarse structured) to the scatters of which they are a part. The point of such methodological manoeuvres is to contrast the scale of past behaviour as preserved in the archaeological record. We know we can recover 15 minute episodes and we know we can recover assemblages to be compared through time averaging in 70 ka chunks. The tacking works because we can recognise through the structure of the record exactly what temporal resolution is attainable. But while this might suggest different questions due to different timescales, I would suggest that what has to be recognised are the different spatial– temporal scales to which behavioural questions are relevant.

As Gould (1994) has argued, we can get too specific in our discussions about adaptation. His point is that we need to hit the right level of abstraction where the data and the models have a chance of contributing to our understanding of the processes involved. In this case these are longterm hominid behaviours.

The levels I put forward here are behaviours associated with individuals in the contexts of camp sites, landscapes and colonising territories (Fig. 7.2). What follows is a preliminary tacking operation between the types of data I have discussed above in order to establish the character of Middle Pleistocene behaviour. The concept I apply to hominid behaviour in these contexts is that it was *routinised*. This follows the view that most behaviour is based on habit and expresses the recursive, or repetitive, nature of social life (Giddens 1984). Gosden (1994, 188) has discussed at length the importance of habit in human action and how it underpins our complex lives precisely because so much of it can be carried out

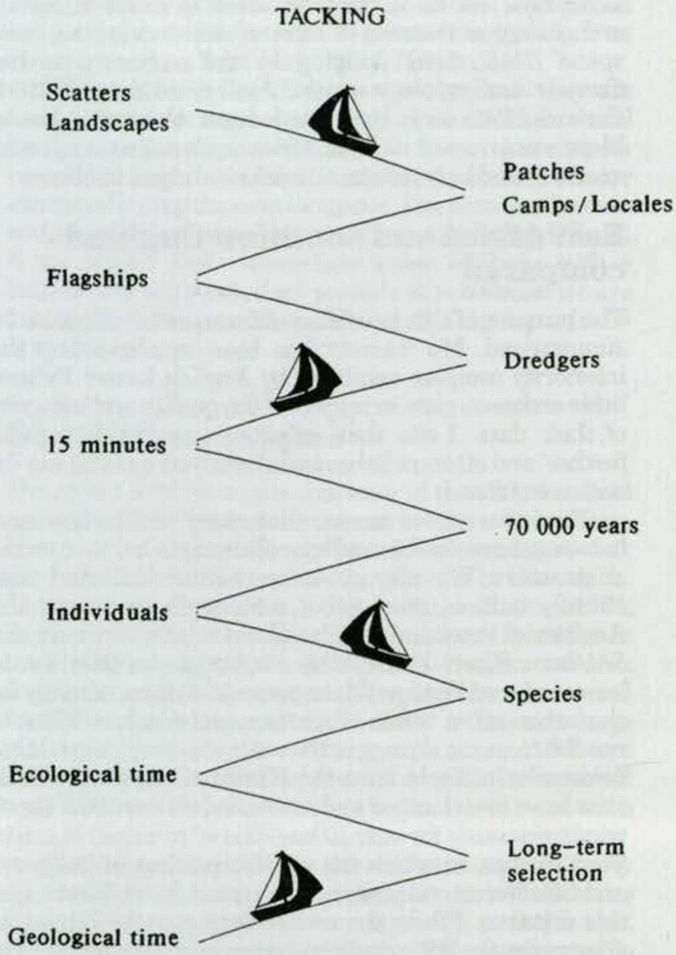

Fig. 7.1 'Tacking' as a strategy for interpreting the Lower Palaeolithic

without us reflecting upon our every action. It will come as no surprise to archaeologists, given their definitions of culture, that repetition and recurrence in time and space accounts for much of the patterning in our data. However, routinisation calls for a different outlook on the significance of these data as opposed to one which explains such patterning through ecological and functional forces alone. What I am suggesting here is a rather different Middle Pleistocene hominid, a thinking, social actor that was also capable of constructing the social fields in which he/she lived as well as being capable of transforming them. This does not make them more like us and less like primate societies with which they have often been compared. It makes them more like themselves — active agents in the construction of their environments — no less human beings than we are. Routinisation is a means to explore those constructions by establishing the human-being-in-its-environment (Ingold in press) where such environments are simultaneously a force for constraint and an opportunity for enabling action.

However, before you cry 'Too subjective; give me some Hypothetico–Deductive realism', let me remind you that the scenario operates at two levels. At the level of ecological or day-to-day-time, new archaeological details will suggest very different behaviours — locally, regionally and even between continents as resources and the

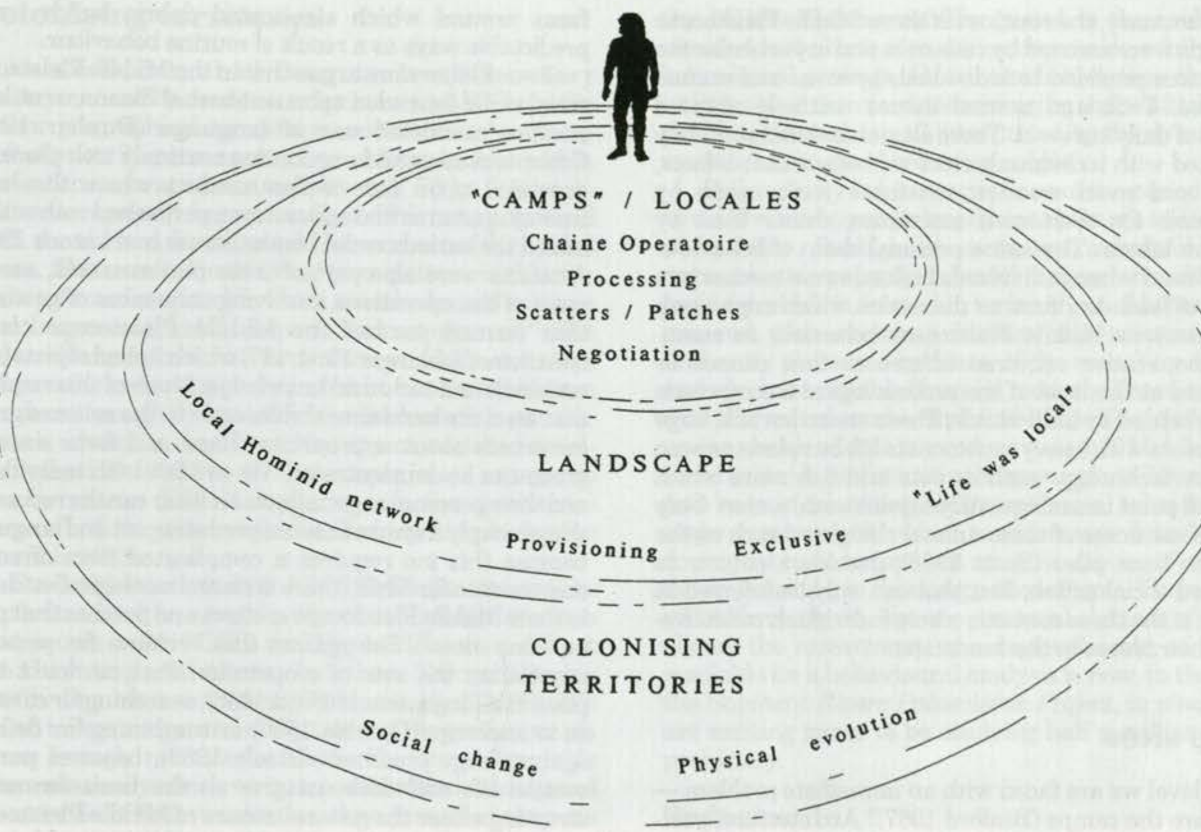

Fig. 7.2 Routinised behaviour among Middle Pleistocene hominids

structure of those resources varies (Gamble 1986b). At that level any behavioural reconstruction is an exercise in plausibility, very comparable to the many hundred artists reconstructions of such daily activities that enliven our archaeological texts. However, at the level of evolutionary time, those notional 70 ka blocks, I can do better than plausibility because the sum of those repetitive actions has been subject to selection pressure. While each of my three contexts for discussing behaviour interlocks with every other level it is at the scale of landscapes and colonising territories that we see the clearest evidence for the social character of Middle Pleistocene behaviour.

Individuals and their traces

The individual is the appropriate unit for behavioural analysis[8]. These are the agents engaged in the routine nature of life and the active construction of society (Gosden 1994; Gamble 1995 for full discussion of these concepts). Negotiation during day-to-day existence was the key mechanism behind the creation of what must have been, by their reckoning, highly varied social outcomes. Their routine habits are expressed archaeologically in at least two ways. In the first place there are the routines of tool manufacture, the *chaîne opératoire* (Schlanger 1994). These can be varied in outcome — for example the very different forms of Acheulian biface as documented by Roe (1981). Alternatively our deep site archaeology has on occasion only recovered partial aspects of these chains as Ashton and McNabb (1992; Ashton *et al.* 1994) have recently shown for both High Lodge and Barnham, Suffolk, and where the Clactonian appears to be a component of wider Acheulian technological practice. Behaviour is therefore varied and depends on situations where affordances (Gibson 1979) in the form of raw materials, food, water and other hominids all exert selective forces on life routines. These would be decisions made on the spot, in ecological time. At longer time-scales and as the result of evolutionary pressures there are developments within these technological routines as shown for example by Bridgland (this volume) who convincingly argues that Levallois reduction sequences only appear in the Thames Valley during Oxygen Isotope Stage 8, some time after 300 ka BP.

A second example of routinisation among these hominids is provided by the processing of faunal remains. Auguste (1993) presents data for the Lower Palaeolithic in northern France which is dominated by carcass scavenging, although at Biache (Auguste 1992) there is evidence for hunting both herbivores and carnivores. These distinctions concerning how food was obtained appear to be coupled with differences in the patterns of bone breakage and cutmarking. While both patterns appear to be different again to carcass treatment in the Middle Palaeolithic of the region they are still understandable in terms of habit applied to individual needs. Consequently, such Lower Palaeolithic behaviour is no less systematic and, as with the stone tools, the varied routines (scavenging/hunting; low/high intensity of carcass processing) depended upon the situations which faced the hominids.

In summary, the routines of these Middle Pleistocene hominids were assisted by resources and in particular the affordances provided to individuals by stone and animal carcasses. Tools and animal tissues routinely assisted aspects of daily survival. These elements were intimately connected with individuals since we believe that bifaces, flakes and even wooden artefacts were made by individuals for their own assistance, rather than by collective labour. The same personal chain of behaviour can be found when individuals broke down a carcass into parcels of food. Any further discussion which might seek to characterise Middle Pleistocene behaviour as essentially cooperative requires inferences that cannot be supported at the level of the archaeological traces, made and left behind by individuals. There are no burials, large monuments with heavy capstones to lift into place, or even collective technology such as nets and fish weirs which would all point unambiguously to joint social action. Only the rare instances of mass animal slaughter, such as the La Cotte bone piles (Scott 1986), provide a pointer to combined social action. But that can only be inferred at the first of the three contexts where individuals collectively left their traces in the landscape.

Camp sites

At this level we are faced with an immediate problem — where are the camps (Binford 1987)? Architecture, postholes and any other elements that might indicate storage are missing even though preservation, as we have seen, can on occasion be excellent[9]. The inference is that locales were used episodically rather than continuously by Middle Pleistocene hominids. Their routinisation did not require villages, permanently settled poor season camps, or even long term ritual areas as indicated by burials or art. These episodes, however, may not be as simple as they seem. They urgently need much more investigation. A prime example being the horse butchery episode at Boxgrove. However, one aspect of camp site behaviour from the Middle Pleistocene can already be elaborated upon. In particular the lack of hearths and the conversation rings of debris (better known by Binford's (1978) drop and toss zones) which would have surrounded them, provide pointers to the means of negotiation as people met at these locales and created their social networks. The lack of archaeological evidence for structured camp sites comparable, for example, to the Upper Palaeolithic at Pincevent, France, is the clearest indication we have that Middle Pleistocene people did not use spoken language in these negotiations. Speech has its own archaeological signature that is very clearly seen in the arrangement of people around hearths (Gamble 1986b, 264). The reasons are simple, they adopt these positions so that they can hear each other. Dunbar (1993, 690) has studied the spatial dimensions of informal conversation groups and recorded distances of 1.7 m nose to nose, and group sizes of no more than five. Conversation becomes more difficult with larger numbers and over greater distances. Binford's (1978) study in Alaska of outdoor Nunamiut conversation groups confirm these distances from the coffee rooms of University College studied by Dunbar. The addition of a hearth (and the absence of refectory cleaners) provides a focus around which size-sorted debris builds up in predictable ways as a result of routine behaviour.

I would therefore argue that in the Middle Pleistocene social skills depended upon non-verbal means, or at least a more restricted use of language (Dunbar 1993). Communication and negotiation routinely took place but depended upon face to face contact where the body, through gestures and appearance, performed rather than stated the various social bonds (Strum and Latour 1987). Artefacts were also part of these performances, an element of the operations, involving sequences of gestures, that formed part of the Middle Pleistocene *chaîne opératoire* (Schlanger 1994, 147) which linked objects (raw material) and technical knowledge. None of this requires that an ovate handaxe exhibits style in the sense of group constructs about appropriate shape and form since no group can be demonstrated. We are left with individuals and their personal negotiations. Neither can the recurrent shapes imply a symbolic sense predating art and language because this too requires a complicated form of social construction for which there is no archaeological evidence in these Middle Pleistocene scatters and patches that pass as camp sites[10]. Set against this evidence for personal negotiation the acts of cooperation that no doubt took place in killing animals (Scott 1986), searching for carcasses to scavenge (Gamble 1987) or combining for defence against large predators (Steele 1989), becomes part of routine life and does not give us the basis for reconstructing either the general nature of Middle Pleistocene society or characterising specific social behaviours.

Landscapes

Elsewhere I have discussed how these scatters and patches camp sites fitted in to what I have called a local hominid network (Gamble 1993b; 1995) where aspects of provisioning (primarily involved with obtaining lithics) were routinely optimised in terms of the use of time–space. The concept of a local hominid network emphasises that these people followed paths and tracks through their landscapes rather than using surface area territories[11]. Raw materials may be found up to 100 km from source but such elements are invariably poorly represented in any assemblage and when they do occur they are broken, retouched pieces. In these cases 'exotic' stone is only represented in collections by the later stages of the reduction sequence. What is entirely lacking are the items indicating long distance exchange — shell, amber, obsidians, ivory — that are a feature of the Upper Palaeolithic. This regional context where individuals are meeting, interacting, creating social bonds is impoverished in alternative types of contexts (no burials, monuments or rock art) for the negotiation to take place. Neither is it crosscut by linking mechanisms expressing either exchange or the mobility of individuals over distances sometimes in excess of 1000 km. Consequently I would characterise the dominant outcome of these Middle Pleistocene societies as one where social life was local and strangers were not recognised. The accent would be on exclusion from the networks constructed on a daily basis through such archaeologically visible activities as implement manufacture and carcass processing.

Colonising territories

This exclusivity had long term evolutionary consequences. The conditions of existence set limits on the extent geographical occupation, and in these northern latitudes on its permanence. I would expect that within those time averaged accumulations of 70 ka local populations regularly became extinct. This was combined with the ebb and flow of people into and out of the settled areas. The reason for this long term pattern is that the elaboration of routine life which stretched social systems over large areas and time spans, had not occurred[12]. The material supports in the form of items which contained information whereby society could be constituted at a distance through the mobility of individuals did not exist. Hence, where the conditions of existence stretched sociality beyond its limits — as for example in sea voyages to new territories like Australia or into the continental 'deserts' of Siberia we find a barrier to colonisation (Gamble 1993a).

Such a characterisation of Middle Pleistocene society can be tested. It is a healthy sign that already the notion that people in the Middle and Upper Pleistocene did not use the interglacial forests of northern Europe (Gamble 1986b) has been contested (Roebroeks *et al.* 1992). We stand to learn a great deal by turning the environments we so lovingly recreate for Middle Pleistocene hominids into a means by which we test models of their society and its attendant behaviour rather than just what they ate and the mean July temperature.

The long term pattern of continental colonisation, both the timing of initial colonisation and the ebb and flow (if proved) of subsequent occupation, is also eminently testable by archaeological means. The hominid tibia from Boxgrove has now focused attention on the question of the colonising abilities of these same hominids (Roebroeks and van Kolfschoten 1994). How do we characterise this process? Was it entirely the result of environmental happenstance — a conjunction of the right hominid in the right place at the right time with the result that colonisation took place as a passive reaction to changes in the conditions of existence?[13] Or were hominids more actively involved in the social changes that resulted in them leaving sub-Saharan Africa in the first place? In this context the current debate over a long or short chronology for *Out of Africa 1*, the settlement of Europe (Roebroeks this volume) will be a great interest, not just to get the chronology right but because the two chronologies carry very different implications for the social organisation of Middle Pleistocene hominids. Such differences concern the motivation for individuals to disperse. This is not readily apparent from their cranial and post-cranial morphology (Stringer this volume) since it is a social skill relating the human being to its environment.

Conclusion

I started this paper by referring to Isaac's problem of the muddle in the middle. I believe that now, almost 20 years later, we can begin to see our way out. The muddle may well have persisted beyond its chronological resolution because the study of behaviour in the Palaeolithic has generally been seen in terms of a series of models that deal with those points of origin in the human story — early humans and modern humans — that fall before and after the Middle Pleistocene. The period in the middle only *received*, in the form of ex-African hominids, a fully formed behavioural package. Once established, they then went quietly about their business changing shape a little (hence the Neanderthals) until interrupted by the dynamism of modern looking and behaving people.

This unfairly led to descriptions of the period covered by the British Lower Palaeolithic as part of a million years of boredom. Such judgements are unhelpful. I have argued in this paper for a broad comparative view of the problem which is framed in terms of social behaviour. To proceed, this requires further characterisation, so brilliantly pioneered by Isaac, of the record we deal with and which is available for social analysis. I have suggested that this record can be exploited by 'tacking' between the various levels of data to produce a view of Middle Pleistocene hominids as distinctive human agents. Moreover, we now have in colonising ability and social behaviour some major questions with which to address our data. No longer do we just have to turn out adaptive stories of what they did, or didn't do, in this long period of time. There is much still to investigate, but one essential element of the task ahead, the assessment on a regional scale, of the data available for a behavioural analysis is now, in the form of the *Southern Rivers Palaeolithic Project*, in place. These are exciting times to be studying half a million years of prehistory.

Endnotes

1 Science-based dating solutions are now appearing (Aitken 1990).

2 Recent claims for much earlier dispersals have been made by Swisher *et al.* (1994). This involves age estimates for the Java *H. erectus*. While provocative, the finds are poorly provenanced and the Quaternary geology of the area is still confused. However, if accepted, their effect will not change the nature of the problems involving behavioural reconstruction in the Middle Pleistocene but rather underscores its conservative character by adding a further 800 ka to the timescale.

3 I am restricting the debate to East Africa and omitting southern Africa where the focus has been on cave deposits rather than open sites (eg. Brain 1981; Singer and Wymer 1982).

4 FxJj50 (Bunn *et al.* 1980) is probably the best known.

5 Isaac (1981, 136) estimated at a rough guess that a scatter was one artefact piece per 10,000 m^2 and a patch 100 pieces per m^2.

6 We even know enormous amounts about the principal investigators, their motives, food-fads and driving skills, through several popular accounts of their fieldwork and fossil-hunting achievements (eg. Johanson and Edey 1980).

7 Collection methods rather than quality of assemblage is largely responsible for the Cannoncourt Farm collection from Furze Platt being considered as a coarse palimpsest (Wymer 1968).

8 See also Mithen's (1990) well-named *Thoughtful Foragers*. They are thoughtful and thinking, irrespective of antiquity and cranial morphology.

9 Either we have to admit to awfully bad luck in not finding a Lower Palaeolithic camp site or well-preserved sites are not in positions where a camp would be built.

10 Complicated is used in the sense of Strum and Latour (1987) where social life draws on the use of symbol, place and object rather than just the hominid body and its associated social skills. Societies based on the use of the body alone are described as complex and are limited, unlike complicated societies, to negotiating one factor at a time.

11 The idea of webs rather than territories was suggested by Isaac (1981) and the implications of Gibson's (1979) ecological

approach to perception that stresses tracks and paths has been explored for mobile foragers by Ingold (1986).

[12] Referred to by Giddens (1984) as 'distanciation' and where the basic mechanism involves social and system integration.

[13] For definitions of terms such as colonisation and migration, see Gamble 1993a, table 1.1.

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ISBN 1–974350–17–5