The early middle Palaeolithic of Britain; origins, technology and landscape

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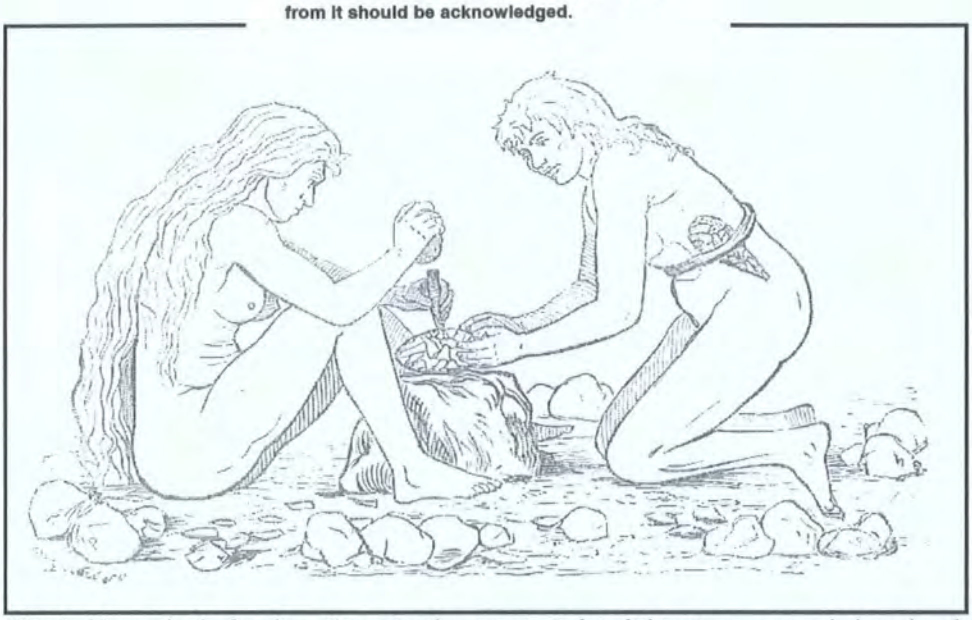

"Probable method of making Stone Implements in Palaeolithic times, grounded on the plan adopted by modern forgers". Frontispiece to Palaeolithic Man in N.W. Middlesex by John Allen Brown (1887); block lent to Allen Brown by Worthington G. Smith.

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Abstract

This thesis examines technological behaviour during the early British Middle Palaeolithic (Late OIS 9-7), as reflected by lithic artefacts. The British data-set, whilst containing few high-resolution sites providing information relevant to ethnographic-scale behavioural reconstruction, actually forms a valuable corpus of well-contextualised locales within a tightly constrained chronostratigraphic framework. Lithic artefacts from these sites can be used to address broader questions concerning the emergence and nature of particular "Middle Palaeolithic" behaviours; specifically, the emergence of, and variability within, Levallois technology in Britain, and increasing complexity in the organisation of technology in the landscape.

The assemblages analysed in this thesis comprise the nine best-preserved British sites dated to this period, which can be placed within secure chronological, geographical and ecological contexts. Whilst previous surveys have emphasised the typological composition of such assemblages, this thesis considers the specific technological behaviours evident at particular locales, in terms of which stages of lithic reduction are represented, what specific Levallois preparatory and exploitation strategies were applied, and how the choices between such options are explicable. On this basis, it is possible to discuss the development of a technologically complex treatment of particular places in the landscape during the early Middle Palaeolithic, linked to the increased transport and curation of particular Levallois products. Whilst on a European scale, such patterns are seen as typical of the Middle Palaeolithic but are essentially undated; this study shows that such behaviours are apparent from at least OIS 8 onwards in Britain, with concomitant implications for our understanding of developing Middle Palaeolithic behaviours in Europe.

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Declaration

None of the material contained in this thesis has previously been submitted for a degree at the University of Durham, or at any other university.

Statement of Copyright

Chapter 1
Introduction

1.1 Investigating the early Middle Palaeolithic

The early Middle Palaeolithic has emerged as a period demanding investigation in its own right only in recent years. Previous approaches to the Middle Palaeolithic (see papers in Mellars and Stringer 1989) have erred towards examining the period solely in contrast with the Upper Palaeolithic record, leading to the impression that the only interesting thing Neanderthals ever did was die out. They have been variously characterised as obligate scavengers, behaviourally static and incapable of innovation, sitting waiting in Europe to marvel briefly at the accomplishments of their superhuman successors before shuffling quietly away to expire. However, there are logical inconsistencies in such picture; it is difficult to see how any group could survive the frequently hard and rarely stable conditions of Middle and Upper Pleistocene Europe whilst lacking the ability to adapt or innovate. Increasingly, it has become apparent that any attempt to characterise the early Palaeolithic record is teleologically compromised by comparison with the Upper Palaeolithic, and research has instead moved toward characterising the behaviour of earlier hominins on their own terms (*cf.* Gamble 1999, Gamble and Roebroeks 1999).

It is now accepted that by the later Middle Palaeolithic (c. 70 000 – 37 000 BP) European Neanderthals possessed a complex range of social and practical skills. Gamble and Roebroeks (1999, 11) have characterised these as centred around qualities of "primeness" and "protection". For instance, later Middle Palaeolithic Neanderthals have been characterised as occupying a trophic position analogous to "top carnivores", such as wolves, on the basis of isotopic analyses, emphasising the importance of meat as a prime source of protein (Bocherens 1999, Bocherens *et al.* 1999, Richards *et al.* 2000, Bocherens *et al.* 2001). They additionally demonstrate a clear ability to target prime-age adult prey, frequently in large quantities (e.g. adult male reindeer at Salzgitter-Lebenstedt; Gaudzinski 1999, Gaudzinski and Roebroeks 2000), as well as deliberately selecting prime elements of the individuals they brought down. Similarly, specific "prime" elements of Neanderthal tool kits are transported further, and curated for longer, than other material; notably Levallois cores and flakes (e.g. see Geneste 1989, Féblot-Augstins 1993, 1999). "Prime" locations also appear to be selectively targeted within the landscape; for instance, in south-west France, sites where raw material was extracted and artefacts produced are not only located directly on top of sources of lithic material, but frequently also high up, in positions which permitted monitoring of the valley below (Duchadeau-Kervazo 1984, 1986; Turq 1989). Similarly, particular places were used repeatedly as topographic traps during hunting (e.g. Mauran, France; Salzgitter-Lebenstedt, Germany; Starosele, Western Crimea; Gaudzinski 1996, Gaudzinski 1999, Gaudzinski and Roebroeks 2000, Burke 2000).

"Primeness" could also be argued to be a quality pertaining to flint working techniques; it is now apparent that a variety of technological options were exercised by Neanderthals, at different times, in different ways and in response to different needs. In particular, several Levallois flaking methods have been defined, some of which were deliberately geared towards the production of specific types of product (especially points; Boëda 1982, 1986, 1994). Other techniques are also represented, including Quina flake production (Boëda *et al.* 1990, Jaubert and Farizy 1994) and blade production (Révillion 1995, Tuffreau and Révillion 1996), as well as handaxe manufacture (Turq 2001, Sorressi and Hays 2003). Not only do particular technological options appear to have been selected from amongst a range of possible strategies, but variability in technology is also argued to reflect the emergence of geographically and temporally restricted practices, potentially reflecting culturally discrete regional hominin groupings within which particular technological traditions were maintained (*cf.* Gamble 1999). This could also be argued to represent a situation in which "primeness" of lithic technology – using the "right" tools (socially or functionally) – could be related to the quality of "protection"; connections within particular groups being reinforced through the existence of a shared body of socially transmitted technological practices.

Other practices also argued to relate to the quality of protection include shifts towards the repeated occupation of caves in areas such as the south of France and to modification of the space within them (Kolen 1999), including the construction of protected hearths (Vilas Ruivas, Portugal; Vega Toscano *et al.* 1999, 23). Other changes in behaviour elude interpretation; most particularly, unambiguous burials increase in number and quality after 70 000 BP, examples including Le Moustier, La Chapelle-aux-Saints and Le Ferrassie (Mellars 1996). By the later Middle Palaeolithic, Neanderthal life can certainly be characterised as complex, particularly in terms of patterns of landscape use, differentiation of place, technology and hunting behaviours, through which they were able to successfully adapt to a wide range of conditions; it was this period which witnessed the first occupation of the Russian plain as far east as the Urals (Hoffecker 1987).

It is easy to draw contrasts between this classic package of "Neanderthal behaviours" and the technological and behavioural monotony of the Lower Palaeolithic; however, it is more difficult to determine how and why such behaviours emerged and became widespread. The early Middle Palaeolithic has therefore become the focus of much research. Whilst no single behaviour defines the Middle Palaeolithic, Levallois flaking first becomes widespread in

Europe around 300-250 000 BP and can be viewed as the first of this suite of emergent practices, marking the beginning of the period (papers edited by Ronen 1982, Gamble and Roebroeks 1999). Other behavioural changes are apparent during the earlier Middle Palaeolithic, in particular, shifts in hunting techniques (Gaudzinski 1999), and technological strategies, as evidenced by on one hand, variability between sites (Geneste 1985, Turq 1988) and on the other, an apparent increase in raw material transfer distances (Féblot-Augustins 1999). It has been suggested that these changes are linked to the changes in the landscapes within which Middle Palaeolithic hominins were active; OIS 8 sees the first extension of the productive mammoth steppe biotope into western Europe (Guthrie 1984, 1990, Gamble and Roebroeks 1999), and Ashton (2002, Ashton and Lewis 2002) views the Middle Palaeolithic as reflecting a shift in adaptation towards such environments.

The investigation of the early Middle Palaeolithic entails more than simply cataloguing the "first appearance" of separate elements of the classic Neanderthal behavioural package; in order to truly investigate Neanderthals on their own terms, it has become necessary to investigate the dynamic practices of the period. The study of the Middle Palaeolithic can be characterised as concerned with the process of "becoming Neanderthals", not simply in terms of morphological change, but of complex trajectories of behavioural adaptation. Key questions raised in respect to emergent Middle Palaeolithic practices now include those familiar from the study of later periods; did apparent changes occur within Europe, or do they reflect the incursion of new groups from outside (*cf.* Foley and Lahr 1997)? Why did such changes come about and why did they persist? How can they be related to changes in material conditions or the nature of social relationships? For the first time, the appreciation of dynamism within the Middle Palaeolithic actually allows the period to be studied in archaeological terms, and not simply as the "muddle in the middle".

1.2 The importance of Britain within Middle Palaeolithic Europe

The emergence of the earlier Middle Palaeolithic as a period worthy of study in its own right has led to the teasing out of some of these emergent patterns in Europe. The expansion of the study of the Middle Palaeolithic from the classic Mousterian record of south-west France has emphasised regional diversity, through the investigation of particular Middle Palaeolithic landscape settings, in particular the Maas valley, Belgium (Roebroeks and Hennekens 1987, Roebroeks *et al.* 1988a, 1988b, 1992a, 1993) and the Rhineland, Germany (Conard and Adler 1997, Conard and Fischer 2000, Conard and Prindiville 2000). Re-investigation of material from old sites (e.g Salzgitter-Lebenstedt) and the landscape-scale excavation of particular key locales (e.g. Maastricht-Belverdere) do seem to indicate that changes in technological practice, provisioning and hunting strategies are well-attested from OIS 7 onwards in north-west Europe.

One of the greatest strengths of the British Middle Palaeolithic record is its history; the material now available is the product of a prolonged period of inter-disciplinary research. Careful collection of archaeological material since the late 19th century has provided a contextually-secure corpus of assemblages, as well as environmental data which can be used to assess the conditions which prevailed at these sites. Moreover, in more recent years, the acceptance of a secure terrestrial Quaternary framework has provided good chrono-stratigraphic control (Bridgland 1994), potentially to oxygen isotope sub-stage level (e.g. Schreve 2001a). On this basis, it is therefore possible to begin to assess the settlement history of the British Isles during the Middle Palaeolithic, as well as changes in behaviour over time.

However, it could be argued that Britain remains somewhat peripheral to researching the early Middle Palaeolithic; few British sites have been subject to modern excavation, and sites which have yielded evidence pertinent to behavioural reconstruction at an ethnographic scale are rare. Britain also appears to have been less intensively occupied than adjacent areas of the continent. Not only was it abandoned for a major part of the Middle Palaeolithic (OIS 6-OIS 4/3), but it has also been suggested that when it was actually occupied, sites and artefacts are relatively sparse (Ashton 2002, Ashton and Lewis 2002). Added to this is the position of Britain; situated at the north-westernmost tip of the European landmass, it seems remote from well-studied areas of the European mainland. However, these factors actually contribute towards the value of studying the development of early Middle Palaeolithic behaviours in Britain. Whether as the north-westernmost tip of the European peninsula, or isolated from mainland Europe, Britain can be treated as a geographically-circumscribed entity within which landscape use and technological practice can be examined. The alternating island-peninsula nature of Britain (whether the channel breach is regarded as dating to OIS 12 or later; papers edited by Preece 1995a, Ashton and Lewis 2002) and abandonment of Britain during glacial episodes provides a framework against which the settlement history of the region can be evaluated, and arguably allows the Middle Palaeolithic to be viewed as a series of discrete temporal intervals. Such resolution is not possible in more continuously occupied areas of Europe.

However, despite the fact that Britain does boast an enviable sample of age-constrained and contextually secure early Middle Palaeolithic sites, between which immense artefact variability is apparent (Roe 1981, Wymer 1999), few attempts have yet been made to investigate the technological practices undertaken at them. Given that changes in technology seem to underwrite many of the behavioural developments apparent throughout the Middle Palaeolithic (especially the lasting adoption of Levallois flaking), such a re-assessment is necessary to investigate this period in Britain and Europe. Lithic artefacts provide an insight into several facets of hominin life; not only individual choices or behaviour at the site level, but also how particular landscape settings related to each other within hominin itineraries. Lithic technology is intimately related to wider behaviours, most obviously food acquisition, but also less prosaic factors, such as which techniques formed part of the technological repertoires of early Middle Palaeolithic hominins, how choices were made between them, and how they engaged with the material limitations of their world. This study aims to address these questions, through investigating the immense variation in lithic technology apparent between early British Middle Palaeolithic sites.

1.3 Aims and objectives

Working from the premise that lithic artefacts represent durable evidence of hominin behaviour, and that lithic technology was fundamental to, and intimately enmeshed with, hominin lives, this study concentrates upon this one class of evidence as reflective of hominin behaviour in the early British Middle Palaeolithic. Although clearly not reflective of all aspects of hominin behaviour, such material does repay investigation, and is frequently the only class of evidence available. The aims and objectives of this study are fourfold;

- To use innovative techniques widely used by continental researchers to investigate technological variability in the early Middle Palaeolithic of southern Britain.

- To attempt to interpret this variability in terms of the specific technological practices undertaken within well-contextualised and chronostratigraphically-constrained landscape settings, and to relate these practices to the material affordances of, and other activities undertaken in, such settings.

- On this basis, to reconstruct patterns of hominin landscape use in the early British Middle Palaeolithic and discuss broader hominin behaviours in Britain throughout this period.

- To relate these patterns to the emerging picture of hominin behaviour during the period OIS 9-7 in north-west Europe.

1.4 Outline of research

This chapter has outlined the importance of research into the early Middle Palaeolithic of Europe, how studying the British record is of central importance to exploring hominin behaviour within the region during OIS 9-7, and the key objectives of this thesis. Subsequent chapters will address these objectives in the following ways;

Chapter 2 describes previous work on the Middle Palaeolithic of Britain and definitions of, and approaches to, the study of Levallois technology. The purpose is to examine how and why previous interpretations of the extant record were advanced, and to explain how the period is currently understood. Given that Levallois technology is key to understanding hominin behaviour during this period, current approaches to interpreting such material are discussed; in particular, the work of Eric Boëda. On this basis, the manner in which these approaches have been modified and incorporated into the methodology adopted in this study are presented, together with the specific questions which have been addressed through analysis of the material.

On the basis of the approach outlined in Chapter 2, Chapter 3 presents the methodology employed to analyse the selected samples, and explains the criteria through which sites were selected for study.

Chapters 4 and 5 present the detailed analysis and interpretation of the material from the selected sites. These have been grouped according to the terrace formation (or equivalent deposit) with which they are associated; thus Chapter 4 presents data from assemblages recovered from, or associated with, the Lynch Hill/Corbets Tey formation of the Thames (OIS 10-9-8), and Chapter 5 presents data from assemblages recovered from the Taplow/Mucking terrace (OIS 8-7-6) and deposits of equivalent date. Each site is discussed in terms of its chrono-stratigraphic, environmental and geographical context; detailed taphonomic and technological analyses of each assemblage are presented. On this basis, an interpretation of technological practice and hominin behaviour at each site is then given.

Chapter 6 presents the conclusions which can be drawn from these analyses for understanding the development of Middle Palaeolithic behaviours both within Britain and its wider European context. Specific issues discussed include how the Middle Palaeolithic has been defined and evidence for the origins of the Middle Palaeolithic, particularly the indigenous development of Levallois technology. The technological practices undertaken in Britain are discussed, in terms of how these can inform our reconstructions of hominin landscape use in Europe during this critical period, how such transformations may be related to broader shifts in hominin adaptation, and how these patterns may influence attempts to model demographic patterning.

Chapter 7 presents the conclusions of this study and suggests how the interpretations advanced might be further refined through future work.

Chapter 2

Historical Background; Previous and Current Research Frameworks

2.1 Introduction

Whilst the sites and assemblages considered in this thesis represent the products of a long period of interdisciplinary research, the British Middle Palaeolithic itself has until recently been regarded as a somewhat impoverished interlude. It has been characterised as lacking variety and minimal in quantity (Roe 1981, 233), especially when contrast with the rich Mousterian record from the south of France. However, recent advances in broader Quaternary studies have provide a framework within which re-assessment of the period has begun; building upon such foundations, it is only now possible to attempt a study such as this. Similarly, the last 20 years has witnessed increasing emphasis upon technological approaches to the dynamic study of lithic artefacts. This has led to some debate concerning how Levallois be both defined and interpreted – a technique which was seemingly identified on typo-technological grounds. In particular, the broadening of the definition of the "Levallois concept" offered by Eric Böeda (1986, 1990, 1995) allows greater variety within Levallois technology to be recognised, as well as a providing a methodological basis for the study of such variability. In combination with advances in refitting studies, a more dynamic picture of emergent Middle Palaeolithic technological practice has therefore emerged.

The purpose of this chapter is to present the research framework within which this study has been undertaken. Specifically, it will examine the nature of previous research into the British Middle Palaeolithic, what impact advances in Quaternary studies have had upon the chrono-stratigraphic framework within which we work, and the current state of research into the period in Britain. The manner in which approaches to the definition and recognition of Levallois technology have changed in recent years will also be addressed; in particular, the work of Eric Böeda (e.g. 1986, 1990, 1995) and how particular aspects of his methodology can be integrated with widely-used approaches to studying the technology of lithic assemblages (e.g. Ashton and McNabb 1996a, Ashton 1998b). The particular questions which will be addressed in this thesis are subsequently outlined; this forms the basis for the artefact analysis methodology presented in the subsequent chapter (Chapter 3).

2.2 Investigating the British Middle Palaeolithic

In the past 30 years, two major factors had a profound impact upon attempts to investigate the British Middle Palaeolithic; the first of these was the widely-accepted Bordian definition of the period as synonymous with the Mousterian, whilst the second was the difficulties of working within a compressed chrono-stratigraphic framework, which only recognised two post-Anglian climatic cycles. Problems have long revolved around how the Middle Palaeolithic be defined, both in Britain and the continent, with a concomitant effect upon how the period has been studied. Today most workers would adopt a heuristic definition of the period, as representing the interval anterior to the Upper Palaeolithic within which a broad suite of behavioural changes took place, marked as beginning with the widespread adoption of Levallois flaking at around 350-300 KBP (*cf.* Gamble and Roebroeks 1999, papers in Ronen, ed. 1981). In contrast, until relatively recently, the Middle Palaeolithic was viewed as representing the last interglacial period, within which the classic Mousterian industries of south-west France are best represented. Accordingly, over the last 30 years, attempts to investigate the Middle Palaeolithic in Britain therefore concentrated upon identifying a typologically and temporally circumscribed phenomenon, for that was how it was defined.

For a long time, the Middle Palaeolithic was not really a concept employed by Palaeolithic archaeologists, most instead distinguishing between a Lower or Early Palaeolithic, on one hand, and the Upper Palaeolithic, on the other. De Mortillet (1873) systematised a distinction drawn by Lartet and Christy (1864) between artefacts of the "Reindeer Period" and "Mammoth Period". Whilst Lartet and Christy's "Reindeer period" itself had been characterised on the basis of "finely retouched tools", the presence of art and reindeer-dominated faunas, some confusion prevailed concerning the nature of the deepest-stratified material found in caves in south-west France; this was vaguely referred to an interval which could be seen as broadly equating to the Middle Palaeolithic. de Mortillet, in contrast, distinguished his "Achuléen/Chelléen – characterised by bifacially worked handaxes – from the flake-dominated Mousterién – characterised by scrapers and points (O'Connor 2003, 30). Through relating apparent variation in artefact form to archaeological sites, rather than differences in fauna, he sought to provide an archaeological, rather than palaeontological framework within which artefacts could be placed. During the earliest years of the discipline, British workers sought to establish an equivalent industrial succession to that apparent on the continent; within Britain, therefore, particular assemblages were described as "Le Moustier" in character (e.g. material from Kent's Cavern, High Lodge and Sturry; Smith 1911, Dewey and Smith 1925, Dewey 1926).

The manner in which assemblages – and individual artefacts – were deemed representative of the "Le Moustier" period varied considerably; Levallois flaking was seen as typical of the interval but not as defining it, and retouched artefacts – especially scrapers – were viewed as especially important (Dewey 1919, Smith 1912). The publication by Smith of the material from Baker's Hole, Northfleet, was seen was seen as greatly amplifying evidence for an

English "Le Moustier" period and represents the first instance in which a description of the technique in a British context was published (Smith 1911, 515). The earliest work on the British Middle Palaeolithic – if it can indeed be described as such - was therefore directed largely towards identifying it, although the criteria upon which such identifications were made appear to have been somewhat diffuse and frequently contradictory.

Levallois flaking and the "Le Moustier" period became increasingly decoupled over time, with a shift in interpretative emphasis away from a linear progression of forms towards interpretations which depicted particular, evolving industrial traditions as "parallel phyla". By the early 20th Century, straightforward progression from Chellean, to Acheulean, to Mousterian was already seen as too simplistic, and particular workers held different opinions as to what the term "Mousterian" actually referred to (O'Connor 2003, 168). However, this situation became increasingly complicated throughout the 1930s and 1940s, given widespread British enthusiasm for the Breuil-Koslowski framework of industrial classification. Breuil accounted for pre-Mousterian flake industries as reflecting a evolutionary trajectory independent of handaxe manufacture, and viewed Levallois flaking as a "pre-Mousterian" development, as well as seeing time-transgressive development within Levallois itself (e.g. Breuil 1926).

Breuil advocated categorising assemblages not only through the application of a name indicative of cultural affinity (e.g. Levalloisian) but also a suffix indicative of temporal position (e.g. Levalloisian I – VII). His sub-divided industrial designations were temporally anchored as well, through correlation with the Penck-Bruckner Alpine framework, which served to increase their attractiveness to British workers seeking to correlate deposits in different areas of the country (McNabb 1996, O'Connor 2003). However, how any actual artefact or assemblage was categorised as belonging to any particular grouping is obscure, and something with which British workers trying to apply the framework seem to have struggled (O'Connor 2003, 230). Burchell's series of papers on the Ebbsfleet Channel are exemplar of this difficulty, as he constantly re-assigned industrial labels - Middle Mousterian, Early Mousterian, Middle Levalloisian - for no reason that is now discernable (e.g. Burchell 1933, 1935, 1936 a-c). The situation became increasingly confusing in the 1930s with the introduction of the concept of contact between two parallel cultural streams – flake-dominated and handaxe-dominated - separated by both particular types of tool and the techniques they used, in order to explain the apparently bewildering array of industrial complexity apparent thoughout the world (notably by T.T. Paterson; O'Connor 2003, 248). If "cultures" could interact and adopt techniques and forms from each other, then the highly specific industrial subdivisions of Breuil became meaningless; the Abbé himself abandoned his framework in 1948 (O'Connor 2003, 256).

Bordes was the first worker to propose a formal definition of the Middle Palaeolithic, invoking a variety of technological and typological differences to the Lower Palaeolithic (Bordes 1950a, 1950b). Bordes sought to classify assemblages, but not on the basis of individual "type fossils" – largely in reaction to the approach advocated by Brieul and so widely adopted. Instead, he placed emphasis upon defining industries through the relative frequencies of particular artefact categories, discovering on this basis the classic subdivision of the Mousterian into five major industrial groups (Bordes 1953a, 1953b). He viewed it as a chronologically-restricted phenomenon, occurring temporally from after the Rissian/Saalian (OIS8-6) until the arrival of modern humans, and engaged in some convoluted stratigraphic gymnastics to demonstrate that pre-Saalian Levallois dominated assemblages (e.g. Markleeberg) were in fact post-Saalian. The Middle Palaeolithic – viewed as synonymous with the Mousterian - was therefore restricted to the last interglacial cycle. Bordes' pronouncements impacted upon the British Middle Palaeolithic in two ways; firstly, Middle Palaeolithic assemblages might be expected to occur between the beginning of the Ipswichian and the Devensian, and secondly, it provided a system for describing and comparing such assemblages as were present.

Attempting to work within this definition left British workers with something of a problem; Middle Palaeolithic/Mousterian occupation could only occur during the last interglacial cycle, yet Levallois material was well represented in deposits attributed to earlier periods, especially in the terraces of the Thames. Wymer's magisterial survey of the Thames Valley sites circumvents the issue altogether; all material is described as Lower Palaeolithic, in contrast to Upper Palaeolithic, and he stated that no Mousterian industry could be definitively identified in Britain (Wymer 1968, 389). He regarded Levallois flaking as representing a *technique* practiced alongside handaxe manufacture, but which, when practiced to the exclusion of handaxe manufacture, could be described as an industry. He therefore outlined a pattern whereby Proto-Levalloisian techniques arose during the Hoxnian (Purfleet), and Levallois techniques were variably applied, according to need, alongside the production of handaxes. He also pointed out variation between particular Levallois techniques at different sites – large flakes at Baker's Hole, blades at Crayford, points at Creffield Road – suggesting that functional necessity might explain this variation, although some technological evolution was also involved.

In contrast, other workers did identify a British Middle Palaeolithic; Mellars closely followed Bordes' definition of a Middle Palaeolithic synonymous with the Mousterian, and sought to compare material then dated from the last glacial cycle with the continental sequence (Mellars 1974). Mellars viewed the Middle Palaeolithic/Mousterian occupation of Britain as divisible into two phases; an early (late Ipswichian/early Devensian) period, during which *bout coupés* were the dominant tool-type, and a later period in which other forms of handaxes were manufactured, which he describes as small and "rounded", and explicitly compares to the MTA in France. He therefore considered these to reflect a later Mousterian presence in Britain, through assuming correlation with these industries where dated on the continent (Mellars 1974, 65). Mellars also saw Levallois flaking as persistently present alongside handaxe manufacture from the Hoxnian onwards, in Britain as well as its wider European context.

For Roe, material which could be attributed to the Middle Palaeolithic comprised "the later Levalloisian sites" and those from which *bout coupé* handaxes were known (Roe 1981, 252). In doing so, like Mellars, he accepted a chronological and typological definition of the Middle Palaeolithic/Mousterian and, like both Wymer (1968) and Mellars (1974), viewed Levallois flaking as a technique rather than a "culture", present from the Hoxnian onwards. He considered a number of sites as reflecting the use of Levallois flaking "against a frankly Mousterian background" (Roe 1981, 228) – those at which *bout coupé* handaxes and flake tools which could be classified as of Mousterian type were present (*sensu* Bordes) – and tentatively suggests that development can be traced in how the techniques was applied, from the production of single, large flakes (Baker's Hole, Bapchild, Brundon) to increasingly refined and elongated examples (Creffield Road, Crayford) (Roe 1981, 229). Some of these he did view as Middle Palaeolithic/Mousterian, suggesting that the only facies of the Mousterian that could be clearly identified in Britain was the MTA, dated to between the late Ipswichian/early Devensian. In his survey of East Anglian sites, Wymer (1985) followed other workers in identifying a British MTA tradition, comprising "industries with characteristic small hand-axes and a high proportion of Levallois flakes" (Wymer 1985, 3), whilst in his earlier Thames Valley volume, these handaxes (his "Type N"; flat-butted cordates) had been attributed to the "latest stage of the Acheulian culture" (Wymer 1968, 59). By this stage, therefore, it was widely accepted that a British Middle Palaeolithic/Mousterian could be identified, but it was treated as a sad reflection of its continental counterpart (*cf.* Roe 1981, 252)

However, Roe also suggested that antecedents to the Middle Palaeolithic are represented within the British record. Whilst he did note the co-occurrence of Levallois technology and handaxes at a number of sites (e.g. Caddington, Cuxton), he also pointed out that at some sites, where Levallois was the dominant or near dominant technique, handaxes were not firmly associated with the Levallois material (Roe 1982, 184). He tentatively suggested that such assemblages were best represented during the period in which a transition from the Lower to the Middle Palaeolithic might be expected to occur, but was concerned that none could be explicitly linked to any particular facies of the Mousterian and fought shy of actually regarding them as Middle Palaeolithic. In contrast, he suggested that Mousterian antecedents were probably best represented by sites that produced diverse flake tools; notably the Upper Industry at Hoxne, High Lodge and Stoke Newington – as well as the handaxes from Wolvercote, which he explicitly linked to the Micoquian (Roe 1982, 187), emphasising the presence of material which most closely approached a typological definition of the Mousterian, whilst allowing that the temporal range within which it occurred could be expanded.

The first systematic attempt to investigate the nature of the British Middle Palaeolithic as an entity was undertaken by Sheila Coulson (Coulson 1990, based upon a thesis submitted in 1981). Coulson explicitly attempted to describe the British Middle Palaeolithic using Bordes' methodology (Bordes 1961), in order to compare it with the continental sequence in Northern France and Belgium, and undertook an exhaustive analysis of all sites then felt to represent this stage. The sites selected for study were those deemed "typologically" Middle Palaeolithic, including High Lodge, (Coulson 1990, 396). Coulson suggested that three Mousterian "industries" were represented within the British Middle Palaeolithic; an "ancestral Mousterian" (at High Lodge), a "typical Mousterian of Levallois facies" and "Mousterian of Acheulean Type A" – Levallois flakes not being present in the latter. She viewed the latter two variants as co-occurring in Britain during both the Ipswichian and early Devensian.

Although Coulson's study was minimally interpretative, it did produce an exhaustive catalogue of the material she studied, classified in Bordian terms. Such an analysis was deemed essential to facilitate "objective" comparison with continental industries, underlining the fact that the typological similarities (or otherwise) of the British Middle Palaeolithic to the continent remained a key concern. In addition, she rejected the notion that *bout coupé* handaxes could be regarded as a conceptually-bounded tool type, seemingly based upon the fact that no metrical criteria had been set for the type, and that almost all British handaxes described as such could be classified differently using Bordes' scheme (Coulson 1986, 53), to which she rigidly adhered. However, the most obvious difficulty she faced was that of chronology; when she undertook her study, Baker's Hole and High Lodge were attributed to the Wolstonian, whilst the upper levels (the temperate bed) in the Ebbsfleet channel were viewed as Ipswichian in date, together with Creffield Road, Acton.

Tyldesley (1987) challenged Coulson's suggestion that *bout coupé* handaxes were not a valid typological category, attempting first to define the morphological and technological limits of the group, and second, to investigate whether the type had any chronological or cultural significance. Concentrating on a tightly defined sample, she suggested that they did indeed represent a distinct morphological type, and whilst acknowledging the contextual and stratigraphic difficulties of dealing with such artefacts (many representing chance finds, or being of uncertain provenance), suggested that most could be dated to the early Devensian, together with some late Ipswichian occurrences. She also suggested that occasional *bout coupés* were present within Northern France, but that flat-butted triangular handaxes were more commonly manufactured during the same interval. Whilst Tyldesley did seem to more strongly favour a early Devensian date for the *bout coupé* phenomenon, she did admit some late Ipswichian examples. Later work has indicated that none can in fact be attributed to the Ipswichian; both Coulson and Tyldesley were constrained by dates attributed to the material they examined.

The compressed chrono-stratigraphic framework within which most previous research took place had a profound impact upon the conclusions which past workers were able to draw. Although from the 1950's onwards most archaeologists insisted that deposits containing archaeological remains required dating by independent means (e.g. Zeuner 1952), few such means were available. Whilst it was widely accepted that the British terrestrial record attested to two post-Anglian climatic cycles, it was less clear how these could be correlated between different areas; the Geological Society report of 1973 attempted to impose some order upon this confusion, defining interglacial type-sites and signatures on the basis of palynology (Mitchell *et al.* 1973). However, initial analyses of fluctuations in global temperate drawn from analyses of the marine sediments suggested that far too few oscillations in climate were represented within the terrestrial record thus defined (e.g. Shackleton and Opdyke 1976).

Whilst following the standardised terminology of Mitchell *et al.* (1973), both Roe (1981) and Wymer (1985, 1988) expressed considerable disquiet concerning the state of the British sequence, and how it could be satisfactorily related to the oxygen isotope record. Roe (1981, 65) chose to regard Thames-Ebbsfleet deposits in north Kent (Swanscombe-Northfleet) as reflecting a *relative* depositional sequence, regardless of suggested dates, which was used to order the artefacts contained into an industrial succession. However, he was also constrained to accept such dates as were proposed for the deposits; notably, the temperate deposits of the Ebbsfleet Channel were then regarded as Ipswichian. Other occurrences away from the Lower Thames were tentatively correlated with this relative sequence. Wymer (1985) attempted to correlate the East Anglian succession with the oxygen isotope stage curve, accepting that the Anglian probably represented OIS 12 (following Kukla 1977) and that the subdivided Wolstonian of Mitchell *et al.* (1973) spanned OIS 10-6. Supporting Bowen's (1978) suggestion, made on stratigraphic grounds, that two interglacials were represented within the interval termed the Wolstonian, he named the latter of these the "Ilfordian" (equivalent to OIS 7). He expanded this attempt to encompass the entire British Palaeolithic record, pointing out that there was no convincing evidence for human occupation within the Ipswichian (OIS 5e), and viewing the British Middle Palaeolithic as restricted to sites producing *bout coupé* handaxes and Levallois flakes at the beginning of the Devensian (Wymer 1988). However, the attribution of particular sites to particular interglacial intervals was not fully resolved.

The fact that palynological analyses reflected only two post-Anglian interglacial-glacial cycles had long sat uncomfortably with the many terraces contained within the long fluvial sequence of the Thames, which were explained through complicated theories of terrace formation invoking sea level as a driving force. However, reinvestigation of these fluvial sequences – particularly the Thames (Bridgland 1994) – suggested that incision and deposition was in fact almost in complete synchrony with climatic cycling (Bridgland 2001). Altitudinally-separated terraces, previously treated as one and the same formation (e.g. Gibbard 1995) were re-attributed to separate glacial-interglacial cycles and re-classified as separate lithostratigraphic formations. This work drew strongly upon advances in other Quaternary investigations, which also suggested greater climatic complexity within the British record, most especially mammalian biostratigraphy (Sutcliffe 1976, Stuart 1982, Currant 1989, Lister 1992) and analyses of molluscan faunas (Keen 1990, Preece 1995b). The re-attribution of individual terrace formations to particular glacial interglacial intervals was strengthened by amino-acid geochronology (Bowen *et al.* 1989, Bowen *et al.* 1995), although conflicts were apparent with biostratigraphic information towards the limit of its range (OIS 9).

The British terrestrial Quaternary sequence is therefore widely accepted as reflecting four post-Anglian interglacials, corresponding to oxygen isotope stages 11, 9, 7 and 5e. The re-investigation of several key localities, especially within the Thames sequence, resulted in the attribution of many sites previously assigned to either the Ipswichian or Hoxnian to these intermediate stages; for instance, Purfleet, Aveley, Ilford and Ebbsfleet had all previously been regarded as Ipswichian, but are now equated with OIS 9 (Purfleet) and OIS 7 (Aveley, Ilford, Ebbsfleet) (Bridgland 1994). Particular temporal intervals can be distinguished by distinct mammalian signatures (Schreve 2001a, Currant and Jacobi 2001), allowing sites preserved in sediments which do not form part of a terrace sequence to be dated. In addition, mammalian evidence also appears to reflect climatic and environmental change within specific interglacials (OIS 11 and 7), allowing temporal discrimination, if not to the level of the oxygen isotope sub-stage, then at least to earlier and later parts of interglacials (Schreve 2001b). Recent research suggests that similar discrimination to substage level is possible through AAR analyses of opercula (Penkman 2004).

The emergence of a secure, chronostratigraphically-constrained Quaternary record has had profound implications. Key sites can be placed within the framework, providing a basis upon which the evidence for hominin behaviour in Britain during the Middle Palaeolithic can be investigated; it is therefore now possible to begin to assess patterns of hominin settlement history and technological practice. As noted above, this period is now widely accepted as beginning around 350-300 KBP (late OIS 9) with the widespread adoption of Levallois flaking, the first of a suite of behavioural innovations apparent prior to the Upper Palaeolithic. Given this expanded definition, the British Middle Palaeolithic can be regarded as spanning the period from late OIS9-3, although in his 1999 survey, Wymer describes this as "Period 3" of the *Lower* Palaeolithic occupation of Britain (Wymer 1999).

In recent years, the expanded British Middle Palaeolithic has begun to form the focus for much research. White and Ashton (2003) have suggested that Levallois flaking as an emergent practice is arguably represented at Purfleet (Late OIS 9), supporting broader European evidence for the indigenous development of this key technological practice at several different sites in different ways. It has also become clear that a distinction can be drawn between the early and later British Middle Palaeolithic (White and Jacobi 2002), the former typified by the dominance of Levallois flaking, spanning the period late OIS 9-7 and within which handaxes may still have been sporadically produced, whilst the latter is restricted to late OIS 4/3. There is in fact little evidence during the later phase for the use of Levallois technology, and it is typified by the manufacture of handaxes, including *bout coupés* which, when contextually secure, are restricted to the middle Devensian (White and Jacobi 2002).

The re-attribution of many sites to OIS 7 has awakened interest in the settlement history of the period; Levallois sites on top of the Lynch Hill terrace in West London previously attributed to the Ipswichian are now regarded as immediately post-dating the formation of the terrace and pre-dating the aggradation of the Taplow terrace, interpreted as indicating a late OIS 8/early OIS 7 date (Ashton *et al.* 2003). It has additionally been suggested that late OIS 8/7 Britain was host to low population numbers, given the paucity of artefacts from the Taplow terrace, the low number of sites dated to late OIS 8/7, and the fact that artefacts are apparently not abundant at sites dated to this interval (Ashton and Lewis 2002, Ashton 2002). Whilst a probable absence of humans from Britain during OIS 5e was previously suggested (Stuart 1976, Currant 1986, Wymer 1988), a longer period of absence now seems likely, extending throughout the latter part of OIS 5 and most of OIS 4 (Currant and Jacobi 1997, 2001, Ashton 2002). Hominin absence during OIS 6 is unproblematic; however, it has also been suggested that population numbers may have declined *throughout* OIS 7 (Ashton and Lewis 2002), based upon the fact that the largest sites date to the early part of the interglacial cycle.

Clearly, given the expanded definition of the Middle Palaeolithic and a chrono-stratigraphic framework which permits investigation of the interval, broad scale patterns of industrial variability and settlement history have attracted much attention. However, without re-examination of the material itself it is difficult to go further; such investigations as have been undertaken (e.g. Coulson 1990) present a somewhat static picture. In order to actually investigate the nature of hominin behaviour in Britain during the earlier Middle Palaeolithic, it is necessary to turn again to the artefacts themselves and to investigate what technological acts were undertaken at particular points in the landscape and how this might relate to broader exploitation of these landscapes. On this basis, it should be possible to relate these patterns to wider patterning in industrial variability and the settlement history of Middle Palaeolithic Britain.

2.3 Defining and investigating Levallois variability

2.3.1 Typological definitions and the "Levallois Problem"

Just as the definition of the Middle Palaeolithic has been extensively revised over time, Levallois technology has also been defined in many different ways since its recognition. These reformulations are closely linked to broader changes in how artefact assemblages are analysed, with concomitant implications for how such material is interpreted. Descriptions of the technique were suggested from the late 19th century onwards (Schlanger 1996), the description offered by Commont (1909, 122-126) being widely accepted by British workers[1].

[1] Unfortunately Lewis Abbott's (1911) contributions to the understanding of Levallois technology never received widespread support. He suggested that a Levallois core be termed a "Prestwich" and the flake which was removed from it as an "Evans". He additionally suggested that Evanses (flakes) and Prestwiches (cores) represented tokens or "tallys", to be retained by Palaeolithic couples and refitted together after prolonged periods of separation, as an aid to spouse recognition.

This emphasised the fact that the striking platforms on the cores, and resulting flake butts, were carefully prepared, most frequently through facetting, and also noted that flakes detached in this way frequently had large bulbs.

Bordes' dependence upon the identification of Levallois products as typological class within his analytical system led him to formulate what became the "classic" definition of the Levallois technique. He emphasised that a facetted butt need not be present, concentrating instead upon the "special preparation" of the core surface to *predetermine* the size and shape of the flake subsequently detached (Bordes 1950b). His definition allowed for variability in how cores were "specially prepared", notably through using centripetal (flake scars running in from all around the edge), bi-directional and convergent removals; he also noted that in particular instances more than one predetermined flake could be removed from a Levallois core surface. (Bordes 1961). Others continued to suggest that a facetted butt *was* a defining characteristic of the Levallois technique (e.g. Oakley 1949). However, despite proposing a definition for the recognition of Levallois artefacts as a typo-technological class, Bordes acknowledged that actually classifying individual artefacts as such was not so straightforward in the case of "atypical" examples, but could be done by individual researchers with sufficient experience (Bordes 1961, 17).

The emphasis that the Bordes' methodology placed upon the identification and quantification of Levallois products led to increasing concern with how the technique was defined and identified. Marks and Volkman (1987) demonstrated that products morphologically analogous to Levallois products could be produced within reduction strategies which did not conform to the classic definition of Levallois flaking; at Boker Tachtit (levels 1 and 2; Negev, Israel) laminar production from opposed platforms followed the preparation of a "crest" along one edge of a core, terminating in the removal of a "Levallois point" (Marks and Volkman 1987, 14). A flake which "looked like" a Levallois flake therefore need not be produced using the Levallois technique, a point additionally made by Copeland (1983, 1995), while Callow (1986) pointed out that Levallois-like flakes may also result from handaxes manufacture; how then should "predetermined" morphologically Levallois flakes be identified? An experiment undertaken by Perpére (1986) underlined that significant inter-analyst divergence existed in terms of Levallois product recognition, 31% of products from one site (Ault, North France) being classified in a different way (Levallois, non-Levallois or unknown) by three different researchers. This unease led many workers to assert that there existed a "Levallois problem", and that a better definition of the technique was therefore required.

2.3.2 Technology and the "*Chaîne opératoire*"

This concern with definition was largely grounded in the need to quantify the number of Levallois products present within a given assemblage when employing the *méthode Bordes*. However, the validity of the typological system itself was increasingly open to question. French researchers, in particular, were beginning to advocate a technological approach to lithic artefact analysis, emphasising not the morphological form of particular pieces, but the need to understand the methods employed in lithic production through whole-assemblage analysis. Such approaches drew upon two existing academic traditions; social anthropology, and especially the work of Leroi-Gourhan, which stressed that successions of technical acts (the *chaîne opératoire)* were essentially social products, and the philosophy of technology, notably the work of Simondon, which was concerned with the nature and evolution of technological systems (Audouze 1999, 172). Combining these approaches had a twofold impact upon both theory and methodology in French Palaeolithic research, through which a new "volumetric" definition of Levallois was established.

The theoretical impact of importing approaches to technology from social anthropology entailed the intergrated adoption of three terms relating to technical acts; technique, method and *chaîne opératoire*. It is apparent that, as with any theoretical terminology, the precise meanings of each term vary between researchers. Broadly speaking, "technique" (sometime termed manner, or gesture; *cf.* Baumler 1995, 13) refers to how an individual technical act is achieved - for instance, exactly how particular gestures are employed - and although the focus for much anthropological research into technology, is rarely archaeologically accessible (*cf.* Chazan 1997, 721). "Method" (sometimes termed concept or scheme) is a less clearly defined term; it refers to both the conceptual knowledge which is drawn upon to undertake a technological act – the mental representation of the principles that underpin following a particular reductive path – and the manner in which an abstracted representation of the volumetric principles structuring a particular technical act is actually physically realised (Audouze 1999, 174). This ambiguous definition results from the distinction drawn between "*connaissance*" (abstract knowledge of how to achieve particular objectives) and "*savoir faire*" (practical knowledge, know-how, skill), both of which are necessarily practically combined in the achievement of any technological act (Pelegrin 1990, 1991, 1993; *cf.* Boëda 1995). The "*chaîne opératoire*" can be broadly defined as the reasoned and necessarily sequential succession of gestures used to achieve a particular technological act (Schlanger 1994). The importation of such terminology from social anthropology underlined a concern with investigating the social and cultural nature of technology in prehistory.

In practical terms, two main approaches to reconstructing Palaeolithic techniques and methods were adopted as a result of this theoretical shift; Audouze (1999, 170) characterises French prehistorians of the 1970's – mid 1980's as refitters or experimenters. The former (e.g. Pigeot) attempted to reconstruct Palaeolithic *chaîne opératoires* in order to determine the shared mental constructs which underlay them, whilst the latter (e.g. Tixier, Inizan) sought to establish criteria for recognising particular technological practices through experimental flint working. From the mid 1980's onwards, there was an increasing emphasis upon combining both approaches, centred around the appeal of the *chaîne opératoire* as an analytical tool; on one hand, actual reduction trajectories could be reconstructed through refitting, whilst on the other, experimental flint reduction provided a methodology for recognising particular techniques and stages of reduction within archaeological assemblages. However, many researchers became dissatisfied with the *chaîne opératoire*; it did not really live up to its claimed potential for understanding cognitive aspects of Palaeolithic technologies (*cf.* Pettitt 1997). Moreover, it did not offer a solution to the "Levallois problem"; Levallois was no better defined, merely described in increasing greater detail.

In reaction to this perceived problem, French prehistorians looked to the philosophy of technology, and in particular, the work of Gilbert Simondon; the appeal of his work lay in its emphasis upon defining technological systems and how they evolve. Simondon saw technical principles or structures as made up of a series of constituent parts, and evolving through the increasing integration of these parts (Audouze 1999, 172). Thus families of structures underlie flintworking as a technological system (*structures de débitage, structures de façonnage*) and variation exists within these families of structures, which equates to different methods of working flint; each method is itself a "technical principle". A system or method can become saturated, and therefore fixed, if the technological criteria which define it are so closely integrated that they cannot be disassociated. This theoretical approach arguably provided a means by which the seemingly endless variation documented through various *chaîne opératoires* could be described as discrete technological systems. Boëda, in particular, combined both theoretical frameworks to formulate a new, "volumetric" definition of the Levallois concept (Boëda 1986, 1995, Boëda *et al.* 1990).

2.3.3 Eric Boëda and the "Levallois concept"

Boëda sought to investigate technological variability and changes in technology on a broad scale, which entailed delimiting and defining the various levels at which it could occur. He envisaged a hierarchy of technical systems which governed flint working practices, working from the level of "families of structures" (*débitage/façonnage*) to the level of the technique, as expressed through individual reduction sequences (Boëda 1994, 1997). Levallois was regarded as one possible *structure de débitage*, also described as a method or "volumetric concept", which could be defined through delimiting the technological criteria which governed it. These were determined through experimental reduction (Boëda 1986, 29). Thus Boëda outlined six technological criteria which, in combination, define the Levallois method (Table 2.1; Figure 2.1). For Boëda, the Levallois concept represents a "concrete structure" which cannot undergo any further modification; all technological criteria must be present, as they are so tightly integrated they cannot be dissociated (Boëda 1995, 52). In practice, identifying the Levallois concept therefore depends upon the identification of these features on cores and flakes, and arguably offers a solution to the "Levallois problem".

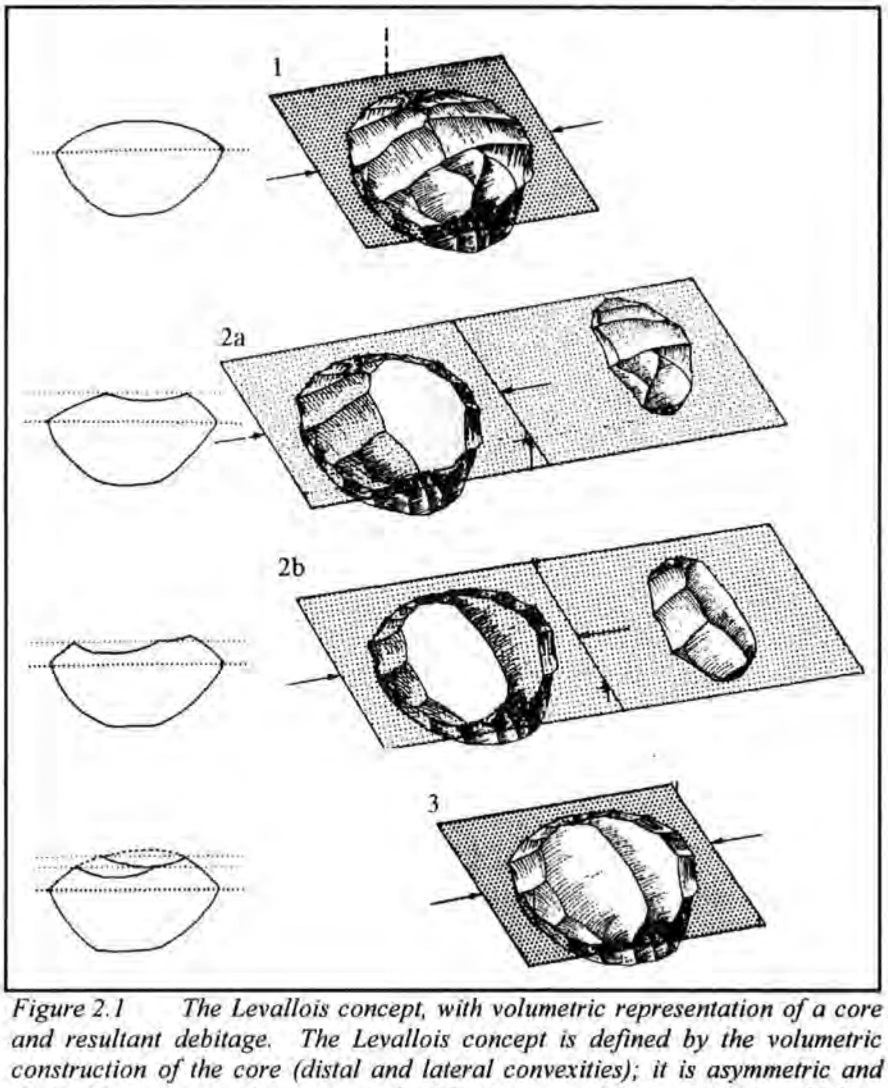

Figure 2.1 The Levallois concept, with volumetric representation of a core and resultant debitage. The Levallois concept is defined by the volumetric construction of the core (distal and lateral convexities); it is asymmetric and divided by a secant plane, one surface functioning solely as a striking platform surface, the other as a flaking surface. Flakes are removed from the upper flaking surface, parallel to the plane of intersection (2a and 2b). The number of predetermined blanks produced is limited by the volume existing between the Levallois preparation surface and the plane of intersection (After Boëda 1988).

Defining Levallois in this way allows for variability in the particular methods employed to achieve Levallois flake production; these are defined by Boëda as conceptually separate guiding plans of action, reflecting the precise ways in which the abstract representation of the Levallois concept were materially realised (Boëda 1986; 1994). A method therefore equates to the actual actions through which "*connaissance*" (knowledge; mental representations, concepts, and catalogues of possible actions and gestures) and "*savoir faire*" (know-how; the organisation and evaluation of possible actions and their results) are brought together (Boëda 1995, 43). A method is enacted in two phases – initialisation/preparation and exploitation – both of which may vary in response to lower-level factors such as the nature of raw material or the individual competence of the knapper. In delimiting the use of a particular method, an individual analyst is therefore trying to look beyond variability at the *chaîne opératoire* level, and determine the underlying mental abstraction around which knapping was organised (Boëda 1986, 30).

1. The volume of the core comprises two surfaces separated by a plane of intersection
2. The two surfaces are hierachically related and non-interchangable; one acts as a flaking surface and the other as a striking platform surface.
3. The configuration of the flaking surface predetermines the morphology of the products through the management of the distal and lateral convexities.
4. The fracture plane for the removal of predetermined blanks is parallel to the plane of intersection between the two surfaces.
5. The point at which the striking platform surface and flaking surface intersect is perpendicular to the flaking axis of the predetermined flakes.
6. Hard hammer percussion is employed.

Table 2.1 The six technological criteria delimited by Boëda (1986, 1995) as defining the volumetric concept of Levallois.

On this basis, Boëda defined two main classes of method, defined by whether a single or multiple flakes were obtained from an individual Levallois surface; lineal (also termed preferential) and recurrent techniques (Boëda 1995, 56). Within these main classes, further variability is also apparent according to how the core was prepared and exploited; a core may be prepared centripetally (preparatory flake scars running into the centre of the core surface from all around the edges), or using unipolar, bipolar or convergent flakes scars to configure the upper (flaking) surface. Similarly, cores from which Levallois flakes are produced using a recurrent method can also be exploited in different ways; these can be termed unipolar, bipolar and centripetal (flakes removing material from the upper flaking surface all around the periphery) recurrent techniques. Any individual core can also undergo any number of stages of re-preparation and subsequent exploitation.

This expanded definition of Levallois as a volumetric concept therefore allows for greater variability within the method to be analytically appreciated, and also circumvents the knotty problem of "predetermination". Particular removals within a Levallois sequence need not be privileged as predetermined or predetermining; instead, the entire process is regarded as carried according to a knowledgeable plan of action, within which removals (whether endproducts or not) can be *both* predetermined and predetermining. However, Boëda also viewed the choice between particular methods as deliberate, and very specific to the type of endproduct desired (Boëda 1995, 58).

2.3.4 Criticisms of the Boëda method and possible ways forward

A number of criticism have been levelled at Boëda's approach; these have been directed at three primary issues; methodology, the limits of the definition and to what extent particular methods are as conceptually discrete as Boëda suggests. Boëda never explicitly presented a methodology for analysing Levallois material, but his approach combines observations based upon experimental Levallois core production and the diacritical analysis of archaeological assemblages (Boëda 1986, 29). Experiment is seen as informing the judgments made in analysis; particular types of flake scar on the core surface are interpreted as serving specific functions, whilst particular types of flake (Levallois or otherwise) are interpreted as having been produced at particular points in a given sequence. On this basis, technological "types" of artefact class are delimited; thus Boëda defined three types of Levallois endproduct (types 1, 2 and 3, or primary, secondary and tertiary; see Figure 2.1), based upon whether they "looked like" the initial Levallois flakes removed during experimental Levallois flake production, the second of a series of recurrent removals, or one which had been preceded by at least two Levallois removals (Boëda 1995, 58).

However, in practice, it is frequently impossible to state at which point in a recurrent sequence a Levallois flake was struck, although it may, very occasionally, be possible to say that a previous Levallois flake may have preceded another, and to describe the method of this recurrent exploitation based upon the orientation of the previous removal. It is debatable whether some of his "tertiary flakes" would in fact even be recognised as Levallois removals at all; many merely bear two large flake scars on their dorsal surface (see Figure 2.2). In the same way, a flake which bears no previous Levallois flake scars on its dorsal surface cannot really be described as "primary"; it may represent the only Levallois flake removed from a particular surface (and therefore result from a lineal exploitation strategy), or it may indeed have been the first of a recurrent series. The link between experimental experience to validate technological observations is tenuous; if a flake "looks like" a particular type of product, then it is classified as such, despite the fact that there could be many reasons why a flake retains a particular type of scar pattern. Accordingly, the methodology presented in Chapter 3 emphasises these uncertainties; Levallois flakes are not attributed to particular types of exploitation sequence without direct evidence.

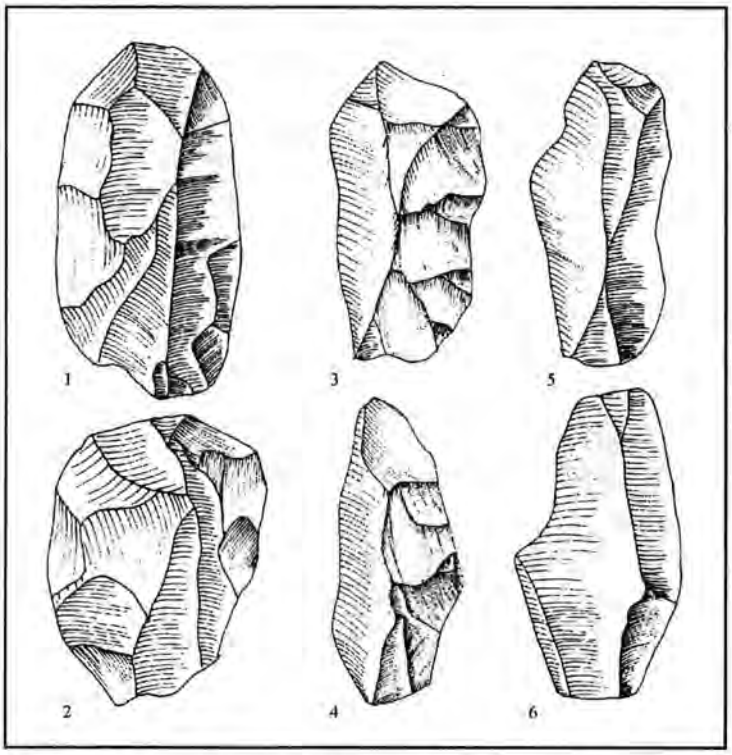

Figure 2.2 Primary (1,2), secondary (3,4) and tertiary (5,6) Levallois flakes; note that a primary flake may either be the first in a sequence, or lineal, a secondary flake (often debordant, but not necessarily) probably does form part of a recurrent sequence, and that a tertiary flake is may be indistinguishable from other debitage. Essentially, these are idealised types which are of little use when dealing with most archaeological assemblages.

Within Boëda's methodology, primacy is placed upon the diacritical analysis of core surfaces, as these retain the most information concerning how the core was finally prepared and exploited (Boëda 1986, 29). This entails determining the order, orientation and preparatory function of each flake scar retained on the core surface; Boëda delimited 13 different categories of flake scar, preparatory function again being imputed on the basis of experimental knapping (Boëda 1986, 73). This system again entails methodological difficulties in terms of imputing past intentionality, but in more practical terms, is simply over complicated; accordingly, a simpler method of recording core surface preparation has been followed here, based upon the predominant orientation of all non-Levallois flake scars (see Section 3.3.4). Others have objected to diacritical analysis on more fundamental grounds; Van Peer (1992, 88) argues that such analyses are only informative concerning the configuration and exploitation of the Levallois core surface immediately prior to discard, and seriously underestimates the number of Levallois surfaces which have been exploited and re-prepared throughout the cores reduction history. He also points out that analysing cores and endproducts independently may suggest contradictory patterns, and that a correct evaluation of the methods employed throughout reduction depends upon the analysis of complete refitting sequences – or at the very least, identification to raw material unit.

These are certainly valid points, but complete refitting Levallois assemblages are rare; and only one is known from the British Middle Palaeolithic (Crayford; Section 5.3). The approach therefore taken to the analysis of the assemblages studied in this thesis therefore takes account of the objections raised by Van Peer, but is intended to extract some technologically informative information from non-pristine assemblages. Levallois cores are identified with reference to Boëda's volumetric definition, whilst Levallois flakes are identified within degrees of confidence with reference to the same criteria. Levallois flaking surfaces on cores are interpreted in terms of broad preparatory strategy (following the types of method delimited by Boëda, and including some additional categories based upon observation and the fact that preparatory strategy cannot always be determined) and exploitation strategy, based upon the orientation of definite Levallois removals.

The methodology followed emphasises that these observations only reflect the final exploitation of the core (see Chapter 3). The fact that cores may not reflect all stages of reduction is addressed in a threefold manner; flat cores, especially those which retain very truncated flake scars on the striking platform surface, may have been cyclically re-prepared and re-exploited; the dimensions of Levallois flakes are compared with those of Levallois flake scars retained on the cores to determine whether earlier exploitation phases were probably undertaken, and the preparatory/exploitation strategies on flakes and cores are contrasted, to determine whether there was a change in preparation/exploitation method during reduction. Additionally, some cores may retain evidence for deliberate surface re-preparation, in the form of peripheral scars cutting previous Levallois removals. Throughout this thesis, the interpretative emphasis is placed upon making limited inferential leaps, and stating the least that can be reasonably assumed from recording scar patterns on Levallois flakes and cores, rather than attempting to estimate how frequently each core may have been re-prepared or how many others methods may have been applied.

Boëda's definition of the Levallois concept has also been questioned; certainly, it has proved unpopular with those seeking a more rigorous techo-typological definition of Levallois endproducts, expanding as it does the notion of predetermination to encompass all flakes produced within a Levallois reduction sequence (e.g. Copeland 1983). However, others have questioned the limits of the definition itself; specifically, whether a core which exhibits some, but not all, of the six technological criteria defining the volumetric model can be considered as Levallois. Kuhn (1995) explored the limits of the definition from the perspective of Pontian Middle Palaeolithic assemblages from the Latium coast, Italy, in which small pebbles are treated in manner reminiscent of a "stripped down" version of the Levallois method. Reduction sequences are necessarily short, given the small size of the material, and the cores are minimally prepared through the creation of one, or sometimes two, simple platforms at either end of a pebble; flakes are removed in parallel from one face. In essence, therefore, although 5 of the 6 technical criteria outlined by Boëda are present upon these cores, the distal and lateral convexities necessary were not emplaced by preparatory flaking (Boëda's criterion 3; see Table 2.1); they were already present and flaking was orientated in relation to these.

However, Boëda himself viewed cores which did not exhibit evidence of a deliberate preparatory phase as non-Levallois; specifically, in the analysis of the material from Bagarre (north France) presented in his thesis, he classified 10 cores as non-Levallois which do conform to the Levallois concept in all essentials, bar the fact that the convexities are not deliberately adjusted (Boëda 1986, 104). In fact, his descriptions suggest that the convexities *had* been emplaced through polarised flaking, but were not additionally accentuated; he suggests that they are in fact unfinished (knapping accidents are common in the assemblage) and although produced using the Levallois concept, cannot be described as Levallois cores. There seems to be a logical inconsistency here; whilst expanding the definition of Levallois to include all material produced during a Levallois reduction sequence, these cores are excluded because they lack deliberate convexity accentuation – a criteria which does not strictly form part of Boëda's definition (Boëda 1986, 134; *cf.* Guette 2002). Notably, this "unspoken" criterion for distinguishing the Levallois concept from other flaking methods has been employed by several workers, especially when attempting to differentiate Levallois from laminar flaking of elongated nodules (e.g. Crayford, Seclin, Coquelles, Saint-Valery-Sur-Somme; Révillion 1995, Tuffreau and Révillion 1996). The latter is frequently termed "direct non-Levallois flaking" (Révillion 1995, 427)

Guette (2002) also questions the value of Boëda's definition, describing an approach taken to reducing cylindrical nodules at Saint-Vaast-La-Hogue/Le Fort (France); the available flint (from local gravels) is not restrictively small and flaking is organised around a secant plane, both faces being hierarchically-organised. Flaking is concentrated upon the broadest surface, which functions as a flaking surface, in contrast to the striking platform surface beneath. The natural convexities of the cylindrical nodule are exploited until they are exhausted, but are not re-prepared. Guette (2002) argues that Boëda's definition is restrictive, and that the Levallois concept must be expanded and applied in a more heuristic fashion, in relation to the possibilities of particular material.

However, the problem here may be purely semantic; Chazan (1995, 732) argues that, following Boëda's criteria, the exploitation surface of the core need only be *organised* in terms of convexities, the convexities themselves do not have to be deliberately emplaced. White and Ashton (2003, 602) adopt a similar position when describing the cores from Purfleet; here again, they suggest that the necessary surface convexities are not created by preparatory flaking, but exploitation from a simple prepared platform is orientated in respect to pre-existing surface convexities. In this case, the approach was not simply adopted in response to the size or shape of available raw material, as large clasts of chalk flint are immediately available from the adjacent cliff (White and Ashton 2003, 603). If one works within the definition of the Levallois concept proposed by Boëda (Table 2.1), it is not strictly necessary that convexities be deliberately emplaced, although Boëda himself (and others) have used it in this way.

The approach adopted throughout this thesis is to use the criteria outlined by Boëda as a heuristic device (*cf.* Guette 2002, Chazan 1995, White and Ashton 2003) and not as a check-list, in order to determine whether the material examined does equate to the volumetric definition of Levallois. Particular endproducts – cores and flakes – can be related to this in order to determine which have been produced within a production sequence organised according to the Levallois concept. When particular Levallois material diverges from the "unspoken" criterion of *deliberate* convexity accentuation, this is related to the specific nature of the assemblages examined (e.g. Crayford, Section 5.3; Purfleet; Section 4.1). The manner in which this is done is delimited in Chapter 3.

Whilst Boëda's reformulation of the Levallois concept allowed the recognition of greater variability within Levallois, some have questioned whether the methods he delimited are as archaeologically discrete as he suggests, and even whether particular variants exist at all. Van Peer (1992, 89) suggests that bipolar and centripetal recurrent methods, whilst experimentally possible, are not represented within the archaeological record. His analysis of refitting Egyptian Levallois assemblages indicated that Levallois endproducts were always detached in the same direction, along the longest axis of the core. He views a single preferential striking platform as an essential characteristic of the Levallois reduction strategy. However, this merely reflects the methods used within the assemblages he analysed, and such an observation cannot be expanded to all possible Levallois variants.

Boëda emphasised that only one method will be represented within a given assemblage, unless different methods were adopted to arrive at different objectives, stressing that methods were deliberately selected in order to produce particular types of endproduct (Boëda 1994, 256). Whilst he does allow that particular factors, such as flaws in material or knapping accidents, may divert the knapper from implementing a particular scheme, he sees specific trajectories, once embarked upon, as fairly inflexible. Several workers have questioned this assertion, demonstrating that the archaeological record does attest to the flexible application of different methods throughout reduction.

Analysis of several archaeological assemblages does appear to indicate a shift from polarised preparation, to centripetal preparation, throughout reduction, as attested by material from Bérigoule (south-east France; Texier and Francisco-Ortega 1995, 220) and Les Rescoundudou (south-west France; Jaubert and Farizy 1995, 232). A re-analysis by Dibble of scar patterns on material from Biache-St-Vaast also suggests a shift from polarised flaking early on in reduction, to radial patterns later (Dibble 1995); arguably, this also represents further evidence for a shift from polarised to centripetal preparation. Dibble, however, does not view Levallois flakes as privileged endproducts, but instead sees Levallois as a reduction method geared towards producing many flakes from a single core (Dibble 1989, 424). Other patterns are also archaeologically attested; for instance, the transition from recurrent unipolar convergent exploitation to centripetal preparation at Kebara, Israel (Meignen 1995, 372), and the shifting of the striking platform from which unipolar recurrent series were struck around the core periphery between productive phases (Abri Suard, south-west France; Delagnes 1995, 207). Not only are such shifts therefore apparent, but refitting analyses suggest that they were applied in a fluid and flexible manner throughout reduction; Schlanger suggests that Levallois methods are better characterised not so much as preconceived plans of action as constructed "in the hand", throughout the core reduction process (Schlanger 1994, 248).

Whilst preparatory and exploitation methods have been recorded as discrete categories for the purpose of the analyses undertaken in this thesis, it is acknowledged that methods are likely to have varied both within assemblages and also within individual reduction sequences. An attempt has therefore been made to relate particular strategies to why and when they may have been adopted, through considering the form of the selected raw material, the properties of the endproducts which result, and the stages of reduction when they were produced (using artefact dimensions as a proxy for reduction stage). The manner in which material was recorded to address these stated aims is outlined in the subsequent chapter (Chapter 3).

2.4 Towards a framework for investigating the early British Middle Palaeolithic

This chapter has outlined how approaches to the study of the British Quaternary Sequence, and particularly the British Middle Palaeolithic, have changed in recent years. Arguably, it is only now that this study can be undertaken; this is attributable to two factors. The first of these is the widespread acceptance of a definition which recognises the Middle Palaeolithic as spanning the period OIS 9-3, and as one in which notable changes in hominin practices are apparent. The second is the establishment of a secure, terrestrial chrono-stratigraphic framework within which to situate British Middle Palaeolithic sites, and through which it becomes possible to consider changing hominin practice over time, and settlement history in relation to apparent technological practice in Britain. At the same time, a broadening of the definition of Levallois allows appreciation of the variability apparent within the system, and provides a methodology which, if adapted with sufficient caution, can shed light upon dynamic technological practice between landscape settings.

This thesis therefore seeks to examine the British material using concepts, practices and terminology widely used in the analysis of equivalent assemblages on the continent. By doing so, the variability apparent within Britain can be related to broader continental patterns, and brought to bear upon wider debates concerning the development of Middle Palaeolithic behaviours in Europe. Britain, for so long regarded as a marginal backwater, can therefore be relocated at the centre of key debates in European Middle Palaeolithic research. The analysis undertaken in this thesis if therefore directed towards answering the following questions;

- What technological variation is apparent within and between sites; specifically
    - What stages of reduction are apparent?
    - What variation in reduction strategies – and especially Levallois preparatory/exploitation strategies - is apparent?
    - How does such variation relate to the material affordances of particular landscape settings?
    - What evidence is there for the deliberate production/selection of particular types of product with particular properties, and how are these influenced by the preparatory/exploitation strategies chosen?

- How can behaviour at the selected sites be related to wider exploitation of the landscape?

In addition to these central aims, the following questions raised by recent investigations into the British Middle Palaeolithic will also be addressed;

- White and Ashton (2003) have suggested that the assemblage from Purfleet reflects an early example of Levallois flaking as an emergent practice, as apparent at a number of European sites of similar date; is this assertion justified?

- White and Jacobi (2002) have described the early part of the British Middle Palaeolithic dominated by Levallois flaking, rather than handaxe manufacture; is this true, and if so, how does such a change in basic technology relate to other changes in hominin behaviour apparent both within Britain, and Europe as a whole?

- Ashton and Lewis (2002) have suggested that Britain was host to low population numbers during OIS 7, and that these declined throughout the interglacial; is this statement justified, and how else might the pattern they observe be explicable?

On this basis, developing hominin behaviours in the early British Middle Palaeolithic will be characterised and placed within the context of patterns apparent in Europe as a whole. Chapters 4 and 5 examine the practices apparent at particular, contextually secure sites dated to the interval OIS 9-7; these are drawn together in Chapter 6, in which the questions outlined above will be addressed in order to explore how the British record can contribute to the emerging pattern of behavioural changes evident in the early Middle Palaeolithic of north-west Europe.

Chapter 3
Methodology and Site Selection Criteria

3.1 Aims and objectives

This thesis aims to examine Neanderthal technological behaviour as reflected by lithic artefacts recovered from British Middle Palaeolithic sites, which can be placed within a secure chronological, geographical and ecological context. Whilst previous research has emphasised the typological composition of such assemblages (see Chapter 2), this material has been investigated using a combination of approaches directed towards determining what technological acts were undertaken within particular landscape settings, including variation in the application of particular techniques and potential explanations for them. Specifically, recording has centred upon the Levallois material recovered from the selected sites; technological observations have been recorded that reflect degree of reduction, the impact of original blank form/raw material source upon the reduction trajectory followed, and the variation in the specific methods employed in Levallois flake production.

The nature of many of the assemblages considered in this thesis has an obvious impact upon what information can be obtained from them. Only one extensively refitting British Middle Palaeolithic assemblage is known (Crayford), and many of the other collections considered below in fact represent primary context, though not *in situ*, records of repeated hominin activity within a particular landscape setting. Lacking refits, it is impossible to relate much of the debitage recovered from such sites to specific reduction episodes in anything more than a general sense (for instance, cortex retention as an index of whether a full reduction sequence is present), and contrary to previous suggestions (e.g. Boëda 1986) it was not deemed possible to determine whether much of the debitage recovered from such sites was in fact produced in the context of Levallois reduction at all, let alone what preparatory function it might have served. However, the fact that such accumulations do not represent individual "snapshots" of hominin activity, but a record of repeated activity within a landscape setting over time, in fact allows broad conclusions to be drawn concerning technological patterning in landscape use over time.

The investigation of all the selected sites therefore entailed an initial assessment of how detailed a level of recording might usefully be employed for each selected assemblage, through examination of the condition and composition of the material and consideration of the published/archive details of recovery context. Analysis was subsequently directed towards addressing three main questions; firstly, the taphonomic history of the available material and its relationship to the deposits from which it was recovered; secondly, characterising the technological acts undertaken at the selected localities – in terms of both broad reduction stage and overall approach to lithic reduction (e.g. whether Levallois flake production or more casual flaking techniques were applied either in isolation or conjunction); and thirdly, variation in the specific nature of Levallois preparatory and exploitation strategies employed. The criteria employed to select sites for technological analysis are outlined below (Section 3.2), whilst the observations recorded to address these questions are presented for each class of lithic material in the section that follows (Section 3.3).

3.2 Site Selection Criteria

The assemblages selected for detailed technological study represent a sample of the best-dated and contextualised earlier Middle Palaeolithic lithic assemblages from lowland Southern Britain. Assemblages from this geo-topographical area were concentrated on in order to examine variation in technological behavioural between comparable landscape settings. Sites were selected for study through consideration of the following criteria;

- Whether the material represents primary context, if not *in situ*, Levallois-dominated assemblages which can be regarded as produced contemporaneously with the sediments from which they were recovered.

- Whether material was recovered from a securely-dated context; sites considered to date to between OIS 8/9 (Botany Pit, Purfleet, the earliest British site to reflect the stable use of Levallois technology) – to late OIS 7 were selected for detailed analysis, Levallois flaking not being represented in primary context British sites after this period.

- Whether material was recovered from deposits which can be characterised in terms of local environmental setting.

- Whether published details or archive notes exist recording details of recovery or excavation methods employed and the position from which artefacts were recovered.

The sample was further restricted by the nature of the extant collections, the choice of sites and collections used being determined by;

- Availability of material for study.

- Curation history of available material.

The following sites were therefore selected for detailed technological analysis (see Figure 3.1);

Sites of the Lynch Hill/Corbet's Tey aggradation	
Botany Pit, Purfleet, Essex	OIS 9/8
Creffield Road, Acton, West London	OIS 8/Early OIS 7
Yiewsley/West Drayton, West London	OIS 8/Early OIS 7

Sites of the Taplow/Mucking aggradation and equivalents	
Lion Pit Tramway Cutting, West Thurrock, Essex	Late OIS 8
Baker's Hole, Northfleet, Kent	OIS 8/7
Ebbsfleet Channel, Northfleet, Kent	Earlier OIS 7
Stoke Tunnel, Ipswich, Suffolk	Later OIS 7
Brundon, Suffolk	Later OIS 7
Crayford, Kent	Later OIS 7

Several large Levallois-dominated assemblages frequently mentioned in discussions of the presence and nature of the technique in Britain are therefore excluded from the current analysis, for a variety of reasons. For instance, substantial amounts of Levallois material have been recovered from New Hythe, on terrace 3 of the Medway in the Maidstone area, Kent (Wymer 1999, Coulson 1990, Roe 1981). This terrace has been correlated with the Mucking aggradation of the Lower Thames (OIS 8-7-6; Bridgland 2003) but only minimal information is available concerning the attribution of such material to this position (Hinton and Kennard 1905). Examination of the bulk of the material attributed to this terrace held in Maidstone Museum indicated that artefacts from other pits had become mixed with the New Hythe material (for which no direct records or publications relating to collection history exist) during storage, and no meaningful sample could therefore be isolated. Similarly, a large collection of material from Bapchild, Kent is clearly heavily reworked and has not been included (Dines 1929).

Because of the variable nature of the assemblages selected, particularly in terms of collection techniques and stratigraphic integrity, different scales of analysis have been employed in response to the nature of individual assemblages. The rationale concerning the particular approaches adopted, and confidence in the interpretations advanced, is explained in sections dealing with the detailed analysis of individual sites. On this basis, variation in the hominin technological behaviour in different settings can be compared in terms of general patterning between all sites selected, whilst the specific details of situational reduction strategies are addressed only when the sufficiently fine-grained data is available.

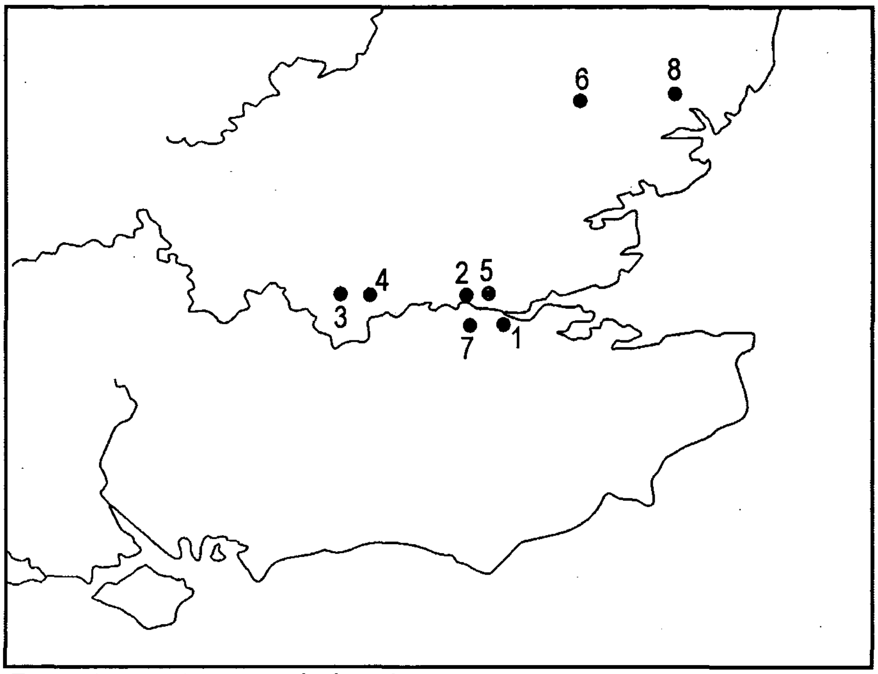

Figure 3.1 *Location of selected sites;*

1. *Baker's Hole and the Ebbsfleet channel, Kent*
2. *Botany Pit, Purfleet, Essex*
3. *Yiewsley/West Drayton, West London*
4. *Creffield Road, Acton, West London*
5. *Lion Pit Tramway Cutting, West Thurrock, Essex*
6. *Jordan's Pit, Brundon, Suffolk*
7. *Stoneham's Pit, Crayford, Kent*
8. *Stoke Bone Bed, Ipswich, Suffolk*

3.3 Methodology for recording artefacts

3.3.1 All Artefacts; qualitative variables relating to condition

The following observations were made for all artefacts in order to assess the taphonomic processes undergone by the assemblages as a whole. Physical damage to artefacts (abrasion, edge damage, battering and scratching) is treated as a broad proxy for the extent to which they have been subjected to movement and re-arrangement (*cf.* Wymer 1968, Shackley 1974). However, no systematic attempt has been made to speculate concerning the duration or distance of movement, or the energetic regime by which artefacts were moved (*cf.* Chambers 2003). Chemical alteration to artefact surfaces was also noted (patination and staining); the interpretation of such surface alteration is poorly understood (Shepherd 1972, Stapert 1976) but may relate variously to contrasts in exposure or burial environment potentially indicative of different taphonomic histories.

1. Abrasion

0. Unabraded
1. Slightly abraded
2. Moderately abraded
3. Heavily abraded

2. Edge Damage

0. Undamaged
1. Slight damage
2. Moderate damage
3. Heavy damage

Where initial examination of the assemblage indicating two phases of edge damage, these were recorded separately (Patinated/less heavily patinated edge damage)

3. Patination

0. Unpatinated
1. Lightly patinated
2. Moderately patinated
3. Heavily patinated

4. Staining

0. Unstained
1. Slightly stained
2. Moderately stained
3. Heavily stained

5. Surface scratching

0. None
1. Light
2. Moderate
3. Heavy

6. Battering (incipient cones visible on artificially flaked surfaces)

0. None
1. Light
2. Moderate

3. Heavy

3.3.2 All artefacts; qualitative variables relating to technology

1. Raw material. Probable raw material source was determined through examination of remnant cortex; flint derived directly from a chalk outcrop retains unrolled cortex which is frequently thick and chalky, whilst flint from a gravel retains thin, rolled cortex, often with chatter marks. Bullhead flint derived from tertiary deposits exhibits green glauconitic cortex with an internal "rim" of orange flint immediately below it.
    1. Fresh
    2. Derived
    3. Indeterminate
    4. Bullhead

2. Mode of Percussion
    1. Hard; hard-hammer flakes exhibit a pronounced bulb of percussion and thick butt; hard hammer flake scars exhibit the same features in negative.
    2. Soft; typical soft-hammer flakes tend to be relatively thin, exhibit a curved profile, a diffuse bulb and a thin, wide butt, which is frequently lipped. Soft-hammer flake scars exhibit the same features in negative.
    3. Mixed; an artefact which retains both hard and soft hammer flake scars is recorded as mixed.
    4. Indeterminate; although the features described above are characteristic of typical hard and soft hammer flakes and flake scars, artefacts often exhibit a mix of features indicative of either mode of percussion. Where mode of percussion cannot be definitively stated, artefacts are recorded as indeterminate.

3.3.3 Non-Levallois Flakes

Given that most of the assemblages considered in this thesis cannot be extensively refitted, it is difficult to directly relate the non-Levallois flake component of the collections to the Levallois flakes and cores themselves and impossible to determine technological information relating to the specific Levallois methods employed. Analysis of the non-Levallois flakes was therefore directed towards recording taphonomically informative attributes (e.g. dimensions as reflective of size distribution) and technological criteria relating to lithic reduction in a general sense (e.g. cortex retention as a reflection of broad reduction stage), rather than the specific methods employed. However, debitage was not recorded at all for some assemblages; those which had already been established as in primary context (e.g. Purfleet) or where doubt concerning contextual integrity means that material from a variety of levels may have been conflated by collection practices. (e.g. West London sites). The reason why debitage has or has not been recorded is presented in each individual section.

Quantitative Variables

1. Length (mm.); along the axis of percussion.

2. Width (mm.); maximum width at 90° to the axis of percussion

3. Thickness (mm.); maximum thickness

Qualitative variables

1. % Dorsal Cortex/Natural
    0. None
    1. >0-25%
    2. >25-50%
    3. >50-75%
    4. >75%<100%
    5. Wholly cortical

2. Whole/Broken
    1. Whole
    2. Proximal
    3. Distal
    4. Mesial
    5. Siret

3. Retouch? (yes/no)
   The position and nature of retouched is additionally recorded separately, according to the criteria outlined below

3.3.4 Levallois Cores

Levallois cores provide direct information concerning the specific preparatory and productive methods employed in Levallois flake production, and therefore represent the most important category of artefact for investigating variability in how and why different techniques were used. Levallois cores were identified following Boëda's (1986, 1995) volumetric definition of the Levallois method; cores that strictly conform to this definition are stated to possess the following six technological criteria (Table 3.1);

1.	The volume of the core comprises two surfaces separated by a plane of intersection
2.	The two surfaces are hierarchically related and non-interchangeable; one acts as a flaking surface and the other as a striking platform surface.
3.	The configuration of the flaking surface predetermines the morphology of the products through the management of the distal and lateral convexities (see Figure 3.2).
4.	The fracture plane for the removal of predetermined blanks is parallel to the plane of intersection between the two surfaces.
5.	The point at which the striking platform surface and flaking surface intersect is perpendicular to the flaking axis of the predetermined flakes.
6.	Hard hammer percussion is employed.

Table 3.1 The six technological criteria defined by Boëda (1986, 1995) for identifying the Levallois method.

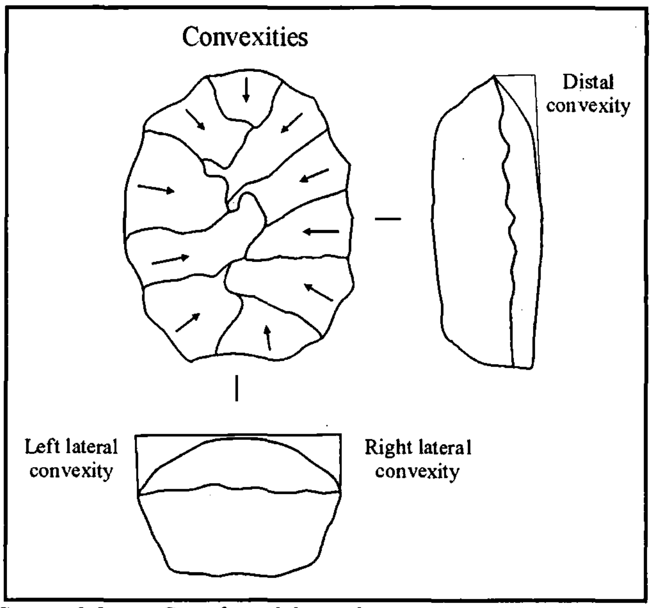

Figure 3.2 Distal and lateral convexities necessary to allow successful of exploitation of Levallois flaking surface.

In particular instances, cores were included within the Levallois cores sample which did not present all six of these criteria or diverged from them in some notable way; for instance, cores which possessed the distal and lateral convexities of a Levallois flaking surface but no consumptive Levallois removal (rendering it impossible to determine the fracture plane or axis of the predetermined blanks – criteria 4 and 5) were treated as unstruck Levallois cores, the volume of the upper, more intensively worked surface being obviously organised in a manner analogous to other Levallois cores from which a Levallois flake had been removed. The above criteria have been treated as an example of how the volumetric principles governing Levallois flake production are most typically imposed, rather than a checklist for its identification.

Analysis of the cores was organized in order to document variability in how particular preparation and exploitation methods were employed. Given that Levallois cores only provide direct information concerning the final phase of preparation and exploitation before discard (*cf.* Van Peer 1992), it is recognized that such techniques are not fixed and may have varied throughout the cores productive life (*cf.* Dibble 1995, Meignen 1995, Jaubert and Farizy 1995, Texier and Francisco-Ortega 1995). Preparatory technique and exploitation method are characterized independently, using the descriptions proposed by Boëda (1986, 1995), with some additions to allow for interpretative uncertainty

Quantitative variables

1. Length (mm); along primary axis of Levallois flake removal, except in the case of unstruck cores, or cores subject to centripetal recurrent exploitation, in which cases the core is orientated in relation to the distal and lateral convexities.

2. Width (mm.); maximum width at 90° to the axis along which length was measured.

3. Thickness (mm); maximum thickness.

Indices

1. Elongation (Width/Length)

2. Flattening (Thickness/Width)

Qualitative variables

1. Blank type; inferred from the retention of cortex/natural fracture surface, or relict ventral/dorsal.
    1. Nodule
    2. Flake
    3. Frost flake
    4. Indeterminate
    5. Frost-shattered nodule
    6. Levallois flake

3. Method of preparation of final flaking surface (After Boëda 1986, 1995); based upon the orientation of flake scars which precede invasive, volumetrically consumptive removals interpreted as those left by Levallois flakes. The core is orientated along the dominant

axis of Levallois flaking, or in respect to the position of the distal and lateral convexities if unexploited. If the core has been subject to a previous cycle of preparation - Levallois flake removal – re-preparation, the orientation of all previous scars is taken into account.

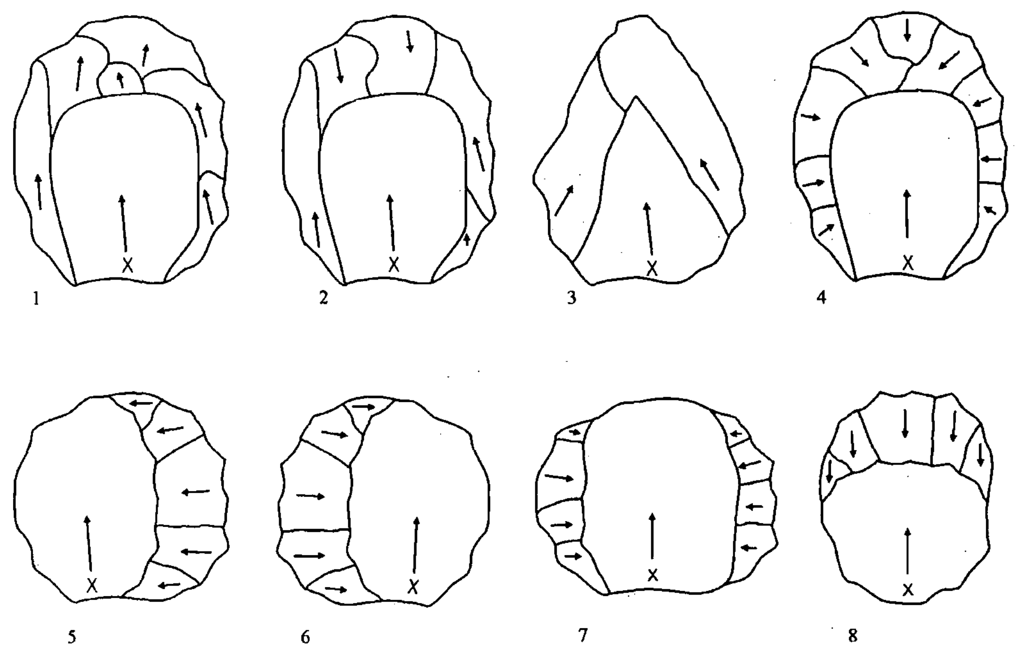

Figure 3.3 Methods of preparation, based upon the location of preparatory flake scars. 1=unipolar, 2=bipolar, 3=convergent unipolar, 4=centripetal, 5=unidirectional right, 6=unidirectional left, 7=bipolar lateral, 8=unipolar distal. (X=direction of Levallois removal).

1. Unipolar
2. Bipolar
3. Convergent unipolar
4. Centripetal
5. Unidirectional right; all preparatory scars run in from the right edge. Could reflect centripetal preparation, or the shifting of the striking platform after unipolar preparation or unipolar recurrent exploitation, but unless clear evidence indicates either of these options, preparation is merely recorded as unidirectional right.

6. Unidirectional left; all preparatory scars run in from the left edge. Could reflect centripetal preparation, or the shifting of the striking platform after unipolar preparation or unipolar recurrent exploitation, but unless clear evidence indicates either of these options, preparation is merely recorded as unidirectional left.

7. Bipolar lateral; preparatory scars run in from both edges. Could reflect the shifting of the striking platform after bipolar preparation or bipolar recurrent exploitation, or centripetal preparation when the flake subsequently removed has overshot the end. However, unless clear evidence indicates one of these options, preparation is merely recorded as bipolar lateral.

8. Unipolar distal; all scars run in from distal end; may have been subject to bipolar or centripetal preparation, or may have been prepared only from the distal end. Unless clear evidence allows one of these options to be distinguished, it is simply recorded as unipolar distal.

4. Method of exploitation of final flaking surface (After Boëda 1986, 1995); based upon the orientation of one or more invasive flake scars on the flaking surface, removed along the same axis as the plane which separates the striking platform surface from the flaking surface, and which are therefore interpreted as resulting from the removal of Levallois flakes. This refers only to the final phase of exploitation of this surface; a core may have been cyclically re-prepared throughout its reduction, but an individual surface is still described as exploited in a lineal fashion if a single flake only was removed.

0. Unexploited
   Core conforms volumetrically to the Levallois concept, but flaking surface does not retain evidence of invasive scars resulting from Levallois flake production.

1. Lineal
   A single Levallois flake has been removed from the flaking surface and was not obviously preceded by an earlier Levallois flake on the same surface.

2. Unipolar recurrent
   Two or more definite Levallois flake scars removed from one striking platform on the same flaking surface.

3. Bipolar recurrent
   Two or more definite Levallois flake scars removed from opposed platforms on the same flaking surface.

4. Centripetal recurrent

   Two or more definite Levallois flakes scars are removed from various locations around the periphery of the same flaking surface.

5. Re-prepared but unexploited

   Differs from an unexploited flaking surface in that the core has clearly been subject to cyclical re-preparation, retaining one or more invasive flake scars interpreted as resulting from Levallois flaking of a previous surface. These are cut by smaller, peripheral scars interpreted as evidence of deliberate flaking surface re-preparation. However, a final preferential removal was never attempted.

6. Failed lineal; a single Levallois removal has been attempted but failed to detach/overshot. Other removals forming part of recurrent episodes of exploitation might also fail, but the exploitation method is still recorded as above, the failure of a final (or other) removal being noted.

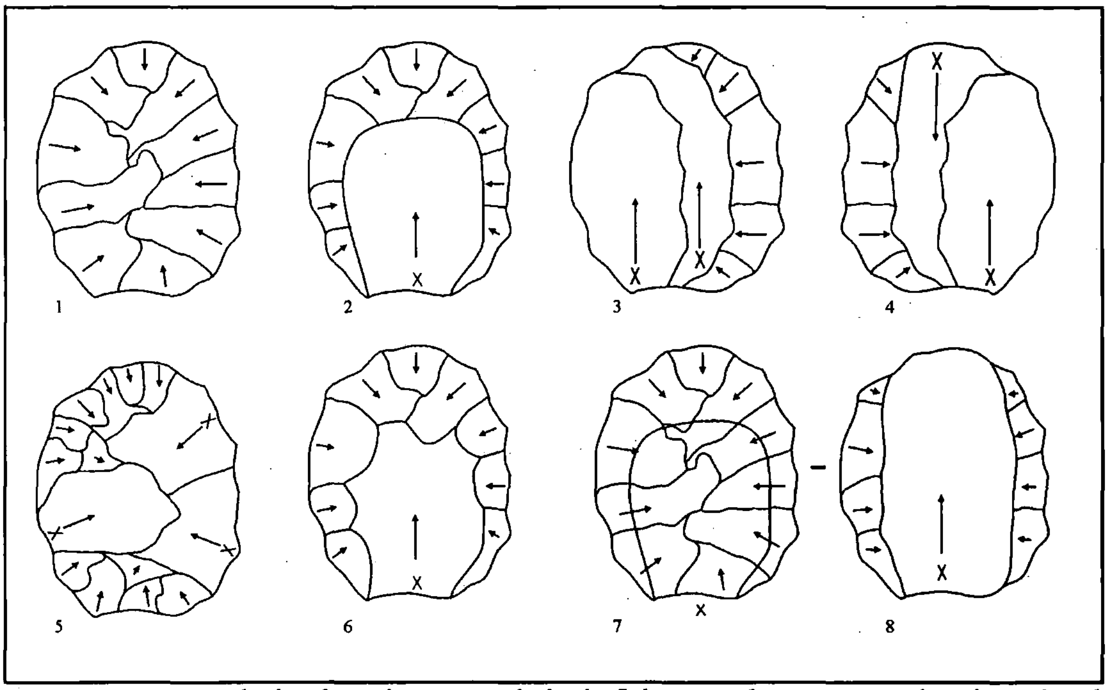

Figure 3.4 Method of exploitation of final flaking surface; 1=unexploited, 2=lineal, 3=unipolar recurrent, 4=bipolar recurrent, 5=centripetal recurrent, 6=re-prepared but unexploited, 7=failed lineal; undetached, 8=failed lineal; overshot. (X=direction of Levallois removal).

5. Evidence for earlier flaking surface? (yes/no). Cores which preserve evidence of a previous phase of Levallois flaking, cut by smaller, peripheral flake scars interpreted as deliberate re-preparation, are viewed as preserving evidence of an earlier flaking surface. The earlier flaking surface might form the final striking platform surface following

flipping of the core. The final flaking surface may or may not be exploited (e.g. Figure 3.4, 6).

6. Morphological description of Levallois products from final flaking surface
    1. Flake
    2. Point
    3. Blade
    4. Debordant flake – has removed one or both lateral core edges
    5. Overshot distal end
    6. Debordant and overshot

7. Number of definite Levallois flake scars (including those from previous exploitation phases).

8. Number of definite Levallois flake scars on final flaking surface only.

9. Dimensions (mm) of Levallois products removed from final flaking surface only. Clearly, the full dimensions of flake scars resulting from recurrent exploitation may be truncated by other removals in the same sequence and so only untruncated flake scar dimensions are recorded.
    1. Length
    2. Width

10. Number of preparatory (non-Levallois) scars on final flaking surface.

11. Number of preparatory scars on final striking platform surface.

12. Pattern of additional accentuation of convexities; if the distal and lateral convexities necessary to create the flaking surface have been deliberately created through a separate series of smaller, peripheral flake scars distinct from the overall shaping of the core surface, or a natural/cortical edge has been retained which imparts this convexity, it is recorded as additionally accentuated.
    0. None
    1. Distal
    2. One lateral edge
    3. Both lateral edges
    4. Distal and one lateral edges

5. Distal and both lateral edges

13. Description of additionally accentuated convexity if present.
    1. Invasive
    2. Minimally invasive
    3. Steep
    4. Semi-invasive
    5. Cortical/natural
    6. Mixed

14. Distribution of preparatory scars on striking platform surface
    0. None
    1. Distal
    2. Right
    3. Left
    4. All over
    5. Distal and one edge
    6. Distal and both edges
    7. Proximal and distal
    8. Proximal
    9. Proximal and one edge
    10. Proximal and both edges

15. Description of striking platform surface working
    1. Invasive
    2. Semi-invasive
    3. Steep
    4. Minimally invasive

16. % Cortex striking platform surface

17. Position of cortex on striking platform surface
    0. None
    1. One edge only
    2. More than one edge
    3. All over
    4. Central

5. Central and one edge
6. Central and more than one edge

3.3.5 Non-Levallois cores

Non-Levallois cores were initially classified by general reduction method and analysis was directed towards establishing whether there were any clear technological factors – for instance, reduction intensity or nature of raw material - affecting why such techniques were applied in assemblages which are otherwise dominated by Levallois flaking. The individual core episodes comprising the reduction of particular cores were additionally identified and classified, following Ashton and McNabb (1996a).

Quantitative variables

1. Length (mm); maximum dimension of core

2. Width (mm.); maximum width at 90° to the axis along which length was measured.

3. Thickness (mm); maximum thickness.

Indices

1. Elongation (Width/Length)

2. Flattening (Thickness/Width)

Qualitative variables

1. Blank type; inferred from the retention of cortex/natural fracture surface, or relict ventral/dorsal.
    1. Nodule
    2. Flake
    3. Frost flake
    4. Indeterminate
    5. Frost-shattered nodule

2. Characterisation of overall core-reduction method
    1. Migrating platform
    2. Discoidal
    3. Unipolar, unprepared
    4. Bipolar, unprepared

5. Minimally prepared

3. Total % cortex

4. Blank form retained? (yes/no)

5. Position cortex
    0. None
    1. One face
    2. Both faces
    3. One edge
    4. More than one edge
    5. All over

6. Total number of core episodes; core reduction can be regarded as divided into a series of separate stages, termed core episodes; each episode comprises a series of removals which naturally follow on from each other, from the same platform.

7. Total number of removals

Term	Core episode type	Description
A	Single removal	Scar resulting from the removal of a single scar from a natural platform, or scars resulting from a previous, unrelated core episode
B	Parallel flaking	Two or more flakes removed in the same direction from the same or adjacent platforms
C	Alternate flaking	The proximal end of one or more previous flake scars was used as the platform for the removal of a further sequence of one or more flakes
Ci	Simple alternate flaking	The core is turned only once; one or more flake scars forms the platform for the one or more subsequent removals from the same platform.
Cii	Complex alternate flaking	The core is turned at least twice, and consists of at least three sets of one or more removals
Ciii	Classic alternate flaking	A single flake is removed; the core is turned and a single flake removed from its proximal end; the core is turned again and the previous scar in turn used as a platform for a single removal, and so forth.
Cip	Simple alternate flaking including parallel episode	A simple alternate episode that includes an episode of parallel flaking
Ciip	Complex alternate flaking including parallel episode	A complex alternate episode that includes an episode of parallel flaking
D	Unnattributed	A flake scar which can be recognised but not attributed to a particular sequence

Table 3.2 Types of core episode, after Ashton and McNabb (1996a).

8. Number of removals per core episode. Classified by type after Ashton and McNabb (1996a). Although episodes of alternate flaking were recorded using the sub-types proposed by Ashton and McNabb (1996a, 1996b, Ashton 1998b; see types Ci-Ciip in Table 3.2 above) these have been recombined as alternate flaking (type C) in subsequent analyses.

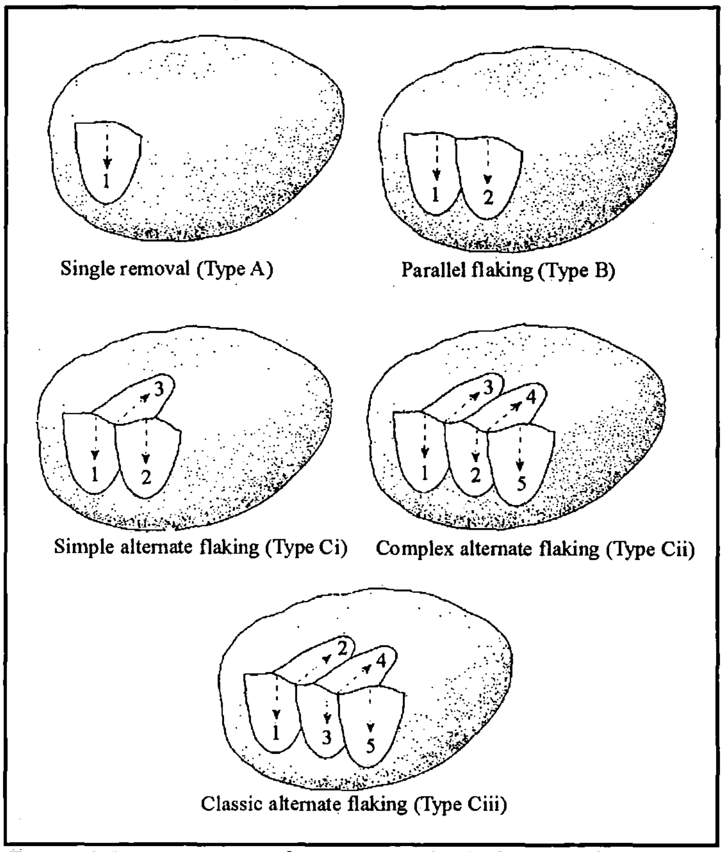

Figure 3.5 Type of core episode (Ashton and McNabb 1996a; after Ashton 1998b).

3.3.6 Levallois Flakes

Levallois flakes are recognised on the basis that they display characteristics indicating that they have been removed from the flaking surface of a Levallois core; they therefore retain features which reflect the preparation of the distal and lateral convexities necessary to control their detachment from the surface, which they remove part of when detached. A flake that exhibits the following features is therefore identified as a Levallois flake;

- Struck using a hard hammer.

- A relatively large number of dorsal scars, and potentially a complex dorsal scar pattern.

- Was removed from a surface, rather than biting into the volume of a core, and is subsequently relatively flat in longitudinal section.

- Exhibits the distal and lateral convexities which controlled detachment along the flaking axis, reflecting the fact that such flakes preferentially consume the flaking surface of the Levallois core.

- May retain evidence of deliberate platform preparation, such as facetting.

- May also retain evidence of deliberate convexity accentuation, in the form of relatively small peripheral flake scars.

The probability of an individual flake being deliberately produced from a Levallois flaking surface was noted as degree of confidence. Although probable and possible Levallois flakes were recorded as Levallois flakes, analysis was concentrated on definite Levallois flakes alone in order to determine how particular preparatory and exploitation methods were applied, in order to avoid artificially inflating the sample and potential representation of particular methods. Similar information can be obtained from the analysis of Levallois flakes as cores concerning the application of such methods, although particular limitations apply; flakes only remove part of a Levallois surface and therefore do not necessarily reflect how exploitation of that surface may have been continued, and it is more difficult to determine the nature of the raw material exploited as they rarely retain cortex. However, Levallois flakes may be present within an assemblage which reflect preparatory and exploitation techniques employed earlier in the reduction sequence represented at a site, cores only reflecting how final flaking surfaces were approached. Both classes of endproduct can therefore usefully be considered in tandem in order to characterise approaches taken to Levallois flake production throughout reduction. This is not to suggest that, in the absence of refitting sequences, individual cores and flakes can be related to specific reduction episodes, but that variation in how particular techniques are represented at particular stages in generalised reduction sequences undertaken at particular landscape settings over time can be suggested.

Quantitative variables

1. Length (mm); along axis of percussion

2. Width (mm.); maximum width at 90° to axis of percussion.

3. Thickness (mm); maximum thickness.

Indices

1. Elongation (Width/Length)

Qualitative variables

1. Confidence of being a deliberately detached Levallois endproduct.
    1. Definite
    2. Probable
    3. Possible

2. % Dorsal Cortex/Natural
    0. None
    1. >0-25%
    2. >25-50%
    3. >50%

3. Whole/Broken
    1. Whole
    2. Proximal
    3. Distal
    4. Mesial
    5. Siret

4. Type of Levallois product; in morphological terms
    1. Flake
    2. Point
    3. Blade
    4. Debordant flake
    5. Overshot
    6. Debordant and overshot
    7. Indeterminate – partial endproducts which cannot be classified morphologically.

5. Butt type
    1. Plain
    2. Dihedral

3. Cortical
4. Natural (but non-cortical)
5. Marginal - from core edge, forming narrow, indeterminate butt.
6. Soft hammer
7. Mixed - combination of natural and flake surfaces
8. Facetted
9. Missing
10. Trimmed – tiny preparatory flake scars running into dorsal in same axis as the flake itself.
11. *Chapeau de Gendarme*
12. Obscured (e.g. by subsequent damage)

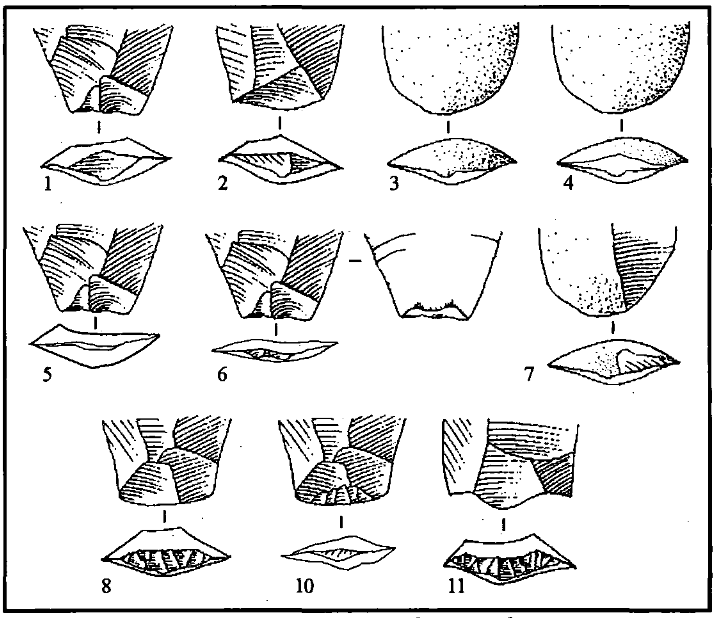

Figure 3.6 Butt types. Numbers refer to categories outlined above (after Inizan et al. 1999).

6. Number of previous Levallois removals from same flaking surface; a Levallois flake may also exhibit one or more invasive dorsal flake scars, either in the same or a different direction to the flake itself, which cut previous, less invasive preparatory removals. These consumptive dorsal scars are interpreted as previous Levallois flake scars and indicate that the flake itself formed part of a recurrent phase of exploitation. Where such scars are cut by smaller, preparatory scars, they are considered to relate to an earlier flaking surface which has been re-prepared.

7. Number of preparatory scars; this includes previous Levallois removals forming part of the same recurrent exploitation sequence, since to allow the removal of a subsequent Levallois flake they also act in a predetermining manner.

8. Method of exploitation (After Boëda 1986, 1995); based upon the orientation of any previous Levallois flake scars retained on the flake dorsal, and whether the flake itself can be definitively stated to have been the only Levallois flake removed from a particular flaking surface.

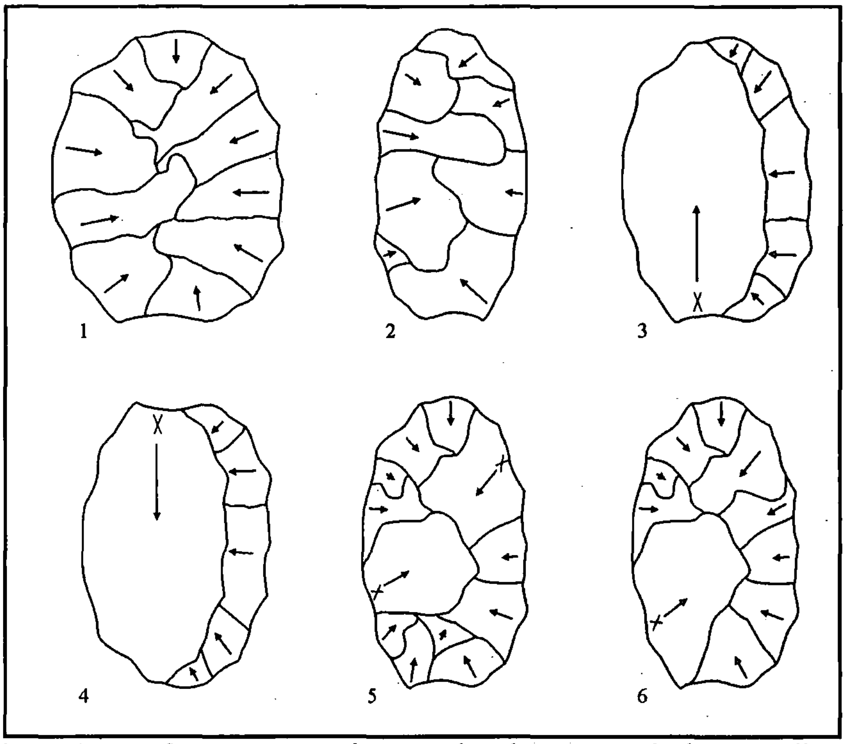

Figure 3.7 Scar patterns indicative of exploitation method on Levallois flakes. 1=Lineal (up to core edges; clearly preventing removal of subsequent flake), 2=single removal, 3=unipolar recurrent, 4=bipolar recurrent, 5=centripetal recurrent, 6=indeterminate. (X=direction of preceding Levallois flake scar).

1. Lineal – does not retain any previous Levallois flake scars and would clearly prevent the removal of a subsequent flake – i.e. has obviously completely consumed volume of entire flaking surface, necessitating complete re-preparation before another flake could be removed.

2. Single removal – does not retain any previous Levallois flake scars but could potentially have been followed by another removal, so cannot be definitively be stated to reflect lineal exploitation.

3. Unipolar recurrent – one or more previous Levallois flake scars have been struck along the same axis as the flake itself.

4. Bipolar recurrent – one or more Levallois flake scars removed in opposition to, or in opposition to and in the same direction, as the flake itself.

5. Centripetal recurrent – one or more Levallois flake scars removed in various directions in relation to the flake itself.

6. Indeterminate – it may not be possible to classify the exploitation phase even if a previous Levallois flake scar is present. For instance, if a previous flake scar is located slightly tangentially to the removal itself but was struck from the same platform, the flake may have formed part of either a centripetal recurrent or unipolar recurrent sequence.

9. Method of preparation (After Boëda 1986, 1995); based upon the orientation of preparatory flake scars, including previous Levallois flakes scars, since these are viewed as predetermining as well as predetermined.
    1. Unipolar
    2. Bipolar
    3. Convergent unipolar
    4. Centripetal
    5. Unidirectional right; all preparatory scars run in from the right edge. Could reflect the shifting of the striking platform after unipolar preparation, unipolar recurrent exploitation, or centripetal preparation when only part of the flaking surface was removed. Unless clear evidence indicates one of these options, preparation is merely recorded as unidirectional right.

    6. Unidirectional left; all preparatory scars run in from the left edge. Could reflect the shifting of the striking platform after unipolar preparation, unipolar recurrent exploitation, or centripetal preparation when only part of the flaking surface was removed. Unless clear evidence indicates one of these options, preparation is merely recorded as unidirectional left.

    7. Bipolar lateral; preparatory scars run in from both edges. Could reflect the shifting of the striking platform after bipolar preparation or bipolar recurrent exploitation, or centripetal preparation when the flake did not actually reach the end of the core. However, unless clear evidence indicates one of these options, preparation is merely recorded as bipolar lateral.

8. Unipolar – distal only

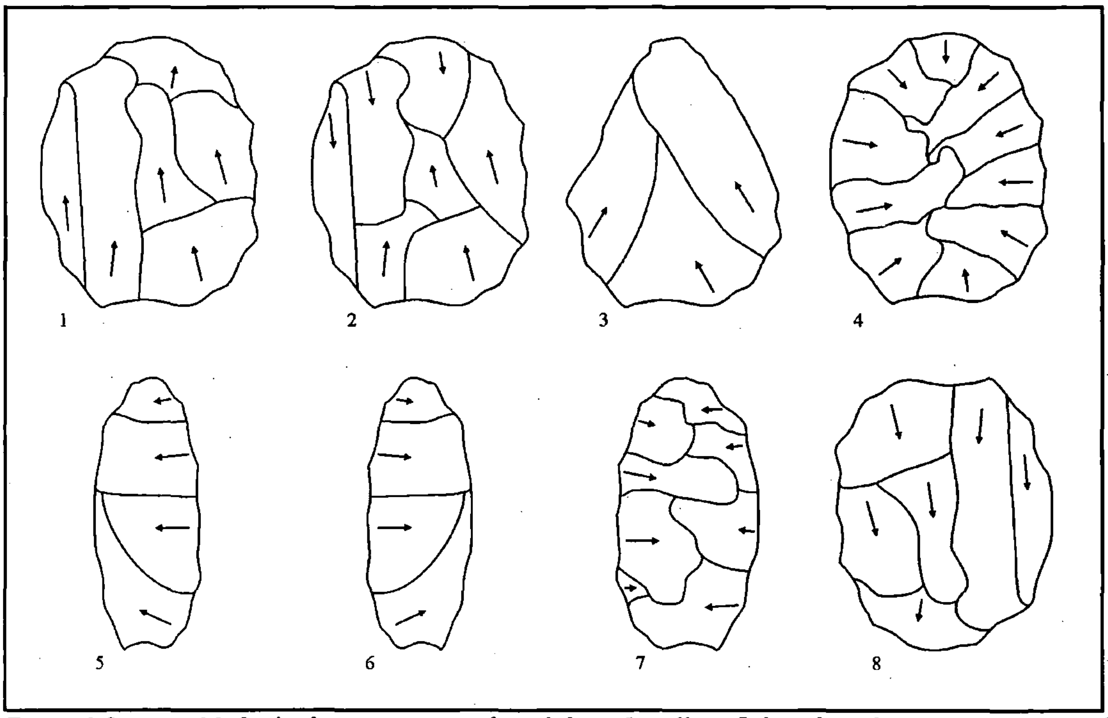

Figure 3.8 Method of preparation inferred from Levallois flakes, based upon orientation of non-Levallois flake scars. 1=unipolar, 2=bipolar, 3=convergent unipolar, 4=centripetal, 5=right lateral, 6=left lateral, 7=bipolar lateral, 8=unipolar; distal only.

10. Pattern of additional accentuation of convexities; some Levallois flakes (usually only debordant flakes or those which have overshot) may remove parts of the core surface which retain evidence of the deliberate accentuation of the distal and lateral convexities, in the form of a separate series of smaller, peripheral flake scars distinct from the overall shaping of the core surface, or the retention of a natural/cortical edge which imparts this convexity.

    0. None
    1. Distal
    2. One lateral edge
    3. Both lateral edges
    4. Distal and one lateral edges
    5. Distal and both lateral edges

11. Description of additionally accentuated convexity if present.

    1. Invasive
    2. Minimally invasive
    3. Steep
    4. Semi-invasive

5. Cortical/natural
6. Mixed

12. Evidence for flaking surface? (Yes/no). A previous Levallois flake scar cut by smaller, peripheral flake scars which serve to re-prepare the flaking surface are viewed as evidence of a previous phase of exploitation.

13. Retouched? (Yes/no); The position and nature of retouched is additionally recorded separately, according to the criteria outlined below.

3.3.7 Handaxes

Although very few handaxes were present within the Levallois-dominated assemblages that form the focus of this study, the handaxes that were present were recorded following an established and widely used methodology which documents variability in handaxe form (Roe 1964, 1968). Additional technological features were noted, following White (1996, 1998), in order to assess the relative influence of material constraints upon the form of the handaxes produced.

Quantitative variables (after Roe 1964, 1968; White 1996, 1998)

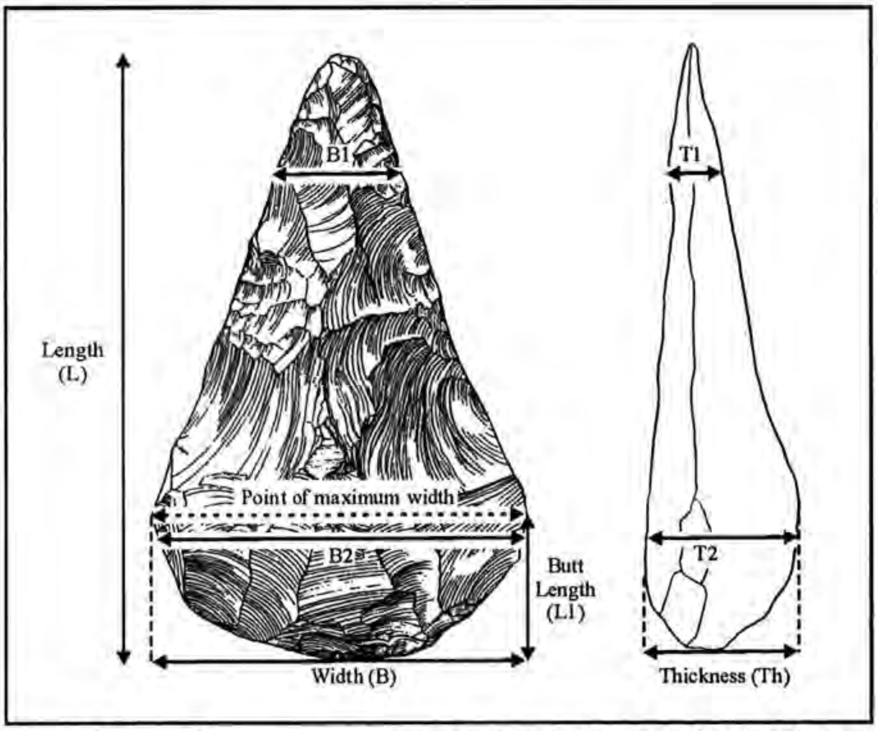

Figure 3.9 Measurements taken on handaxes; after Roe (1964, 1968) and White (1996, 1998).

1. Length (mm)

2. Width (mm)
3. Thickness (mm)
4. T1 (mm)
5. T2 (mm)
6. B1 (mm)
7. B2 (mm)
8. L1 (mm)

9. Scar count 1

10. Scar count 2

Qualitative Variables (After White 1996, 1998)

1. % Cortex/natural surface

2. % Relict ventral

3. Position of Cortex or natural surface
    0. None
    1. Butt only
    2. Butt and edges
    3. Edges only
    4. On face
    5. All over

4. Conditioning
    0. None
    1. In 1 dimension
    2. In 2 dimensions

5. Blank Type
    1. Nodule
    2. Flake
    3. Frost flake
    4. Indeterminate

6. Edge Position
    1. All round
    2. Sharp edges and dull butt
    3. One sharp edge and dull butt
    4. Irregular
    5. One sharp edge and sharp butt
    6. Tip only

7. Edge section
    1. Straight
    2. Zigzag
    3. Twisted

8. Butt Working
    0. Unworked
    1. Partially worked
    2. Fully worked

9. Pattern of working
    1. Fully alternate
    2. 1 side then other
    3. Unifacial
    4. Alternate edges

10. Retouch present? (Yes/no)

11. Tranchet present? (Yes/no)

3.3.8 Flake tools

The distribution and nature of retouch was recorded for all retouched Levallois and non-Levallois flakes, in order to determine whether any patterning existed within or between assemblages in how artifacts were retouched. Typological classifications (Bordes 1961) are also given, in order to communicate what is being described in a widely understood format.

Qualitative variables (after Inizan *et al.* 1999, with modifications)

1. Position of retouch
    1. Direct – retouch on dorsal

2. Inverse – retouch on ventral
3. Alternate (e.g. Right edge of each face)
4. Bifacial (working into both faces from same edge)
5. Crossed (working from both faces to form very steep, backing-type edge)

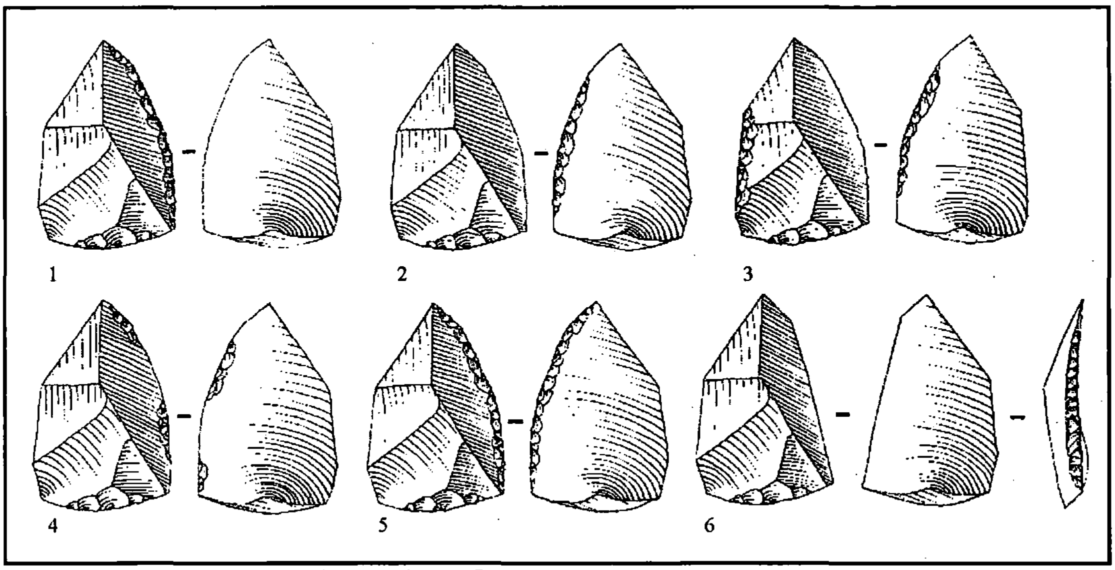

Figure 3.10 Position of retouch on flake tools. 1=Direct, 2=Inverse, 3=Alternate, 4 & 5 = bifacial, 6=crossed. (Modified after Inizan et al. 1999).

2. Location of retouch
    1. Distal
    2. Mesial
    3. Proximal
    4. Right
    5. Left
    6. Continuous except butt
    7. Continuous except other portion of edge (specified in notes)
    8. Both edges

3. Distribution of retouch
    1. Continuous
    2. Discontinuous
    3. Partial

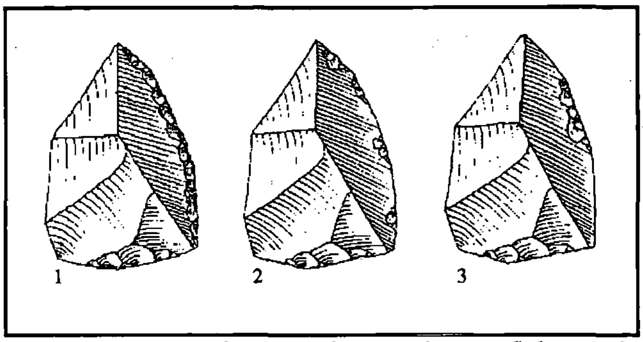

Figure 3.11 Distribution of retouch on flake tools. 1=continuous, 2=discontinuous, 3=partial. (Modified from Inizan et al. 1999).

4. Form of retouched edge
    1. Rectilinear
    2. Concave
    3. Convex
    4. Single removal (notched)
    5. Denticulate

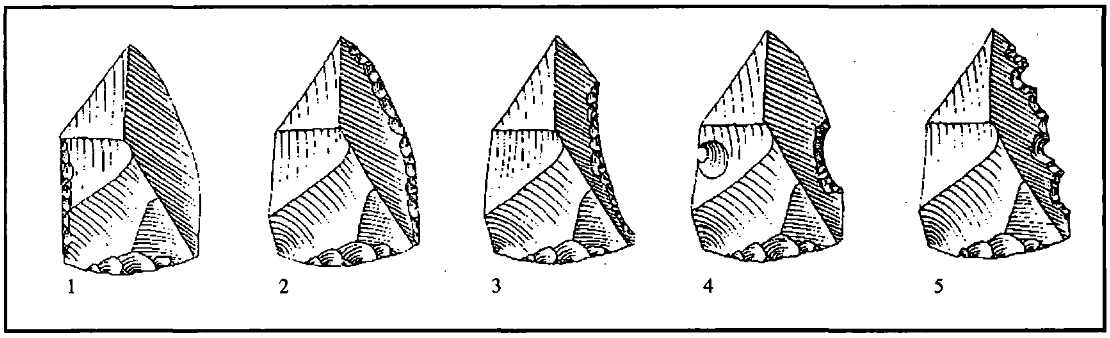

Figure 3.12 Form of retouched edges on flake tools. 1=Rectilinear, 2=Convex, 3=Concave, 4=Single removal/notched, 5=denticulated. (Modified from Inizan et al. 1999).

5. Extent of retouch
    1. Marginal
    2. Minimally invasive
    3. Semi-invasive
    4. Invasive

6. Angle
    1. Abrupt (approaching 90°)
    2. Crossed-abrupt (90°, worked from both edges)
    3. Semi-abrupt (c. 45°)
    4. Low (thinning)

7. Regularity of retouched edge
    1. Obscured by damage that cuts retouch
    2. Regular
    3. Irregular

8. Morphology of retouch
    1. Scaly
    2. Stepped
    3. Sub-Parallel
    4. Parallel

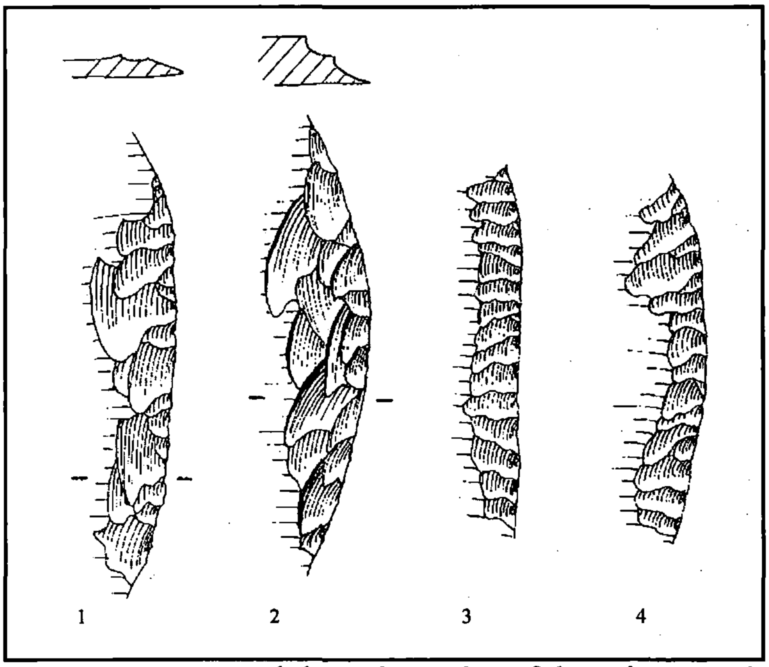

Figure 3.13 Morphology of retouch on flake tools. 1=Scaly, 2=Stepped, 3=Parallel, 4=Sub-Parallel. (Modified after Inizan et al. 1999).

9. Typological description (After Bordes 1961)

Chapter 4

Sites of the Lynch Hill/Corbets Tey Formation and Deposits of Equivalent Date

Introduction

The sites analysed in this chapter comprise material collected from deposits forming part of, or associated with, the Lynch Hill/Corbets Tey formation of the Thames. Material from Botany Pit, Purfleet (Section 4.1) was collected from the gravels laid down during the terminal aggradation of the terrace, and which are dated to late OIS 9/early OIS 8. Purfleet arguably represents one of the earliest European sites to present evidence of Levallois flaking at this date, and is therefore of critical significance to examining the emergence of this key technological practice.

Two large corpuses of Middle Palaeolithic material from the surface of the Lynch Hill terrace in West London are also considered; Creffield Road, Acton (Section 4.2) and collections made in the Yiewsley area (Section 4.3). Since these collections were made from the surface of the Lynch Hill terrace, their dating and environmental associations are more problematic, although they certainly post-date the aggradation of the terrace and are therefore likely to date to either OIS 8 or early OIS 7, before soil formation or colluviation masked the terrace surfaces upon which the artefacts are discarded. A fully glacial OIS 8 date is considered unlikely, given that even modern humans did not occupy Britain whilst such conditions prevailed (Jacobi 1999). The likely dating of these sites, and the uncertainties which surround them, are discussed in the sections that follow (4.2 and 4.3). Each collection is dealt with independently and presented in terms of its chrono-stratigraphic, environmental and geographical context. A detailed taphonomic and technological analysis of each site is provided; different scales of scales of analysis were considered appropriate to each assemblage, given different recovery conditions and collection practices. The approach adopted to deal with each assemblage is outlined in each section. On this basis, an interpretation of hominin activity at each site is presented; these are subsequently drawn together (Chapter 6) to provide a picture of emergent hominin technological practices and landscape use in Britain between OIS 9-7.

4.1 Botany Pit, Purfleet, Essex

Introduction

Palaeolithic artefacts have been recovered from throughout sediments exposed in four chalk quarries at Purfleet, Essex; from east to west, Bluelands, Greenlands, Esso and Botany Pits. These contain terrace deposits occupying an abandoned meander loop of the Lynch Hill/Corbets Tey formation of the Thames (Bridgland 1994), aggraded to a level of 15 m. O.D. and cut through by the Mar Dyke, a westward flowing north-bank tributary of the modern Thames. The deposits are banked up against the steep northern slope of the chalk ridge of the Purfleet anticline, by which they are separated from the modern Thames. Substantial collections of artefacts recovered by A.J. Snelling from Botany Pit (Wymer 1968, 1985), in which only the uppermost gravel units are exposed, together with smaller numbers of artefacts from the upper part of the sequence at Bluelands/Greenlands Pits (Schreve *et al.* 2003) have variously been described as "Proto-Levallois" (Wymer 1968) and "reduced" Levallois with simplified preparatory stages (Roe 1981). Recent re-examination of the cores from Botany Pit has demonstrated that a proportion of the assemblage reflects the exploitation of a particular flaking surface following minimal preparation of a striking platform (White and Ashton 2003) – effectively, Levallois flaking in volumetric terms (*sensu* Boëda 1986, 1995). In contrast, such material is not present within the lower deposits which are represented over a wider area, and the material from Botany Pit is concentrated on hereafter.

History of Investigations

Initial investigations at Botany Pit were undertaken by A.J. Snelling in 1961, following the extension of the quarry. Snelling recovered material from sands and gravels banked up against the chalk cliff, both through searching the floor of the pit, as well as controlled excavation (Wymer 1968). In addition to the many cores and flakes recovered, a few handaxes were collected from gravel overlying the basal chalk (Snelling, in Wymer 1985). Although these could have been produced at the same time as the bulk of the assemblage, they might also equate to the top of the Acheulean assemblage found throughout the lower gravels in the adjacent Bluelands/Greenlands Pits (Schreve *et al.* 2002).

Following the opening of first Greenlands and then Bluelands Pits in the early 1960's, further material was excavated from throughout the exposed terrace deposits (Palmer 1975). Snelling recorded 7.5 m. of Pleistocene deposits in Greenlands, overlying chalk and chalk rubble, comprising a basal gravel overlain by 4 m. of shelly deposits which produced molluscan and mammalian faunas, surmounted by gravels and clays (Snelling, in Bridgland

1994). Between 1965-1968, Palmer opened trenches in both Greenlands and Bluelands pits, on either side of North Road (see Figure 4.1.1) recovering artefacts from the three main aggradational units, as well as molluscs, pollen, ostracods and occasional mammal bones from the shell-rich interglacial deposits (*ibid.*). She interpreted the artefacts as representing a single "Middle Acheulean" industry "with a strong Clactonian element" (*ibid*, 12), describing the material as such on the basis of the co-occurrence of handaxes with large numbers of cores and debitage. Wymer, in contrast, suggested that three industries might be represented in succession at Bluelands/Greenlands, viewing the basal deposits as containing unrolled Clactonian material, the large amounts of cores and flakes from the Middle Gravels as rolled, and associated with handaxes through having been reworked into these deposits from below, and a single Levallois flake from the Upper Gravel (equivalent to the deposits exposed at Botany Pit) as representing a separate industry (Wymer 1985, 311). Schreve *et al.* (2002) also support a tripartite industrial sequence at Purfleet, noting that handaxes and flakes resulting from their manufacture are entirely lacking from the basal gravel, despite 30 years of investigation, but viewing the cores and flakes from the Middle Gravels as indistinguishable from the handaxes in terms of condition and therefore part of the same assemblage.

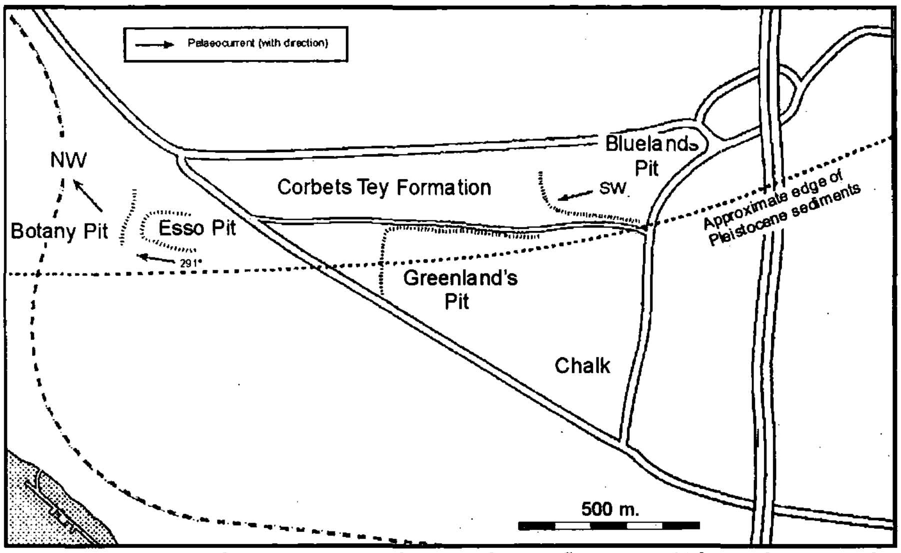

Figure 4.1.1 Relative position of pits in the Purfleet area (After Schreve et al. 2002).

In addition to the complete Purfleet sequence recorded in the Bluelands/Greenlands exposures, other investigations in the locality have also exposed parts of the sequence. Excavations by Bridgland and Davey in 1986 at Esso Pit (a small pit west of Greenlands) revealed deposits comparable to those exposed at Botany Pit, and chalk-bearing gravel equivalent to the shelly deposits in Greenlands/Bluelands; artefacts were also recovered from gravel deposits over the basal chalk (Bridgland 1994, 220). Recent evaluation of the Esso

Pit deposits also produced many artefacts from chalky solifluction material close to the chalk slope, including handaxes, and pollen indicative of interglacial conditions from overlying bedded sands and silts (Bates *et al.* 1998). Trenches opened to the east of Greenlands (Stonehouse Lane) have also produced faunal remains and artefacts from the feather-edge of the Purfleet deposits where they overlie the chalk slope, equivalent to the base of the Bluelands/Greenlands sequence (Bridgland *et al.* 1998).

Work by Schreve *et al.* (2002) between 1995 – 1999 in Bluelands and Greenlands provided the opportunity to re-examine the complete Purfleet sequence exposed in these pits, and to undertake environmental sampling of the palaeontologically-rich interglacial deposits. Artefacts were recovered from throughout the sequence, including classic Levallois flakes from the upper gravel unit (equivalent to the Botany sediments) at Armor Road, broadly confirming the suggestion that three flint industries – Clactonian, Acheulean and a form of Levallois technology – are represented at different points in the Purfleet sequence. Levallois material is restricted to the upper gravels (Botany Member – see below) but is not equally distributed – minimal artefactual material was recovered from this unit during the most recent phase of investigations at Bluelands/Greenlands, in comparison to the large assemblage collected from equivalent units in Botany Pit by Snelling.

Geological Background

The Purfleet sediments form part of the Corbets Tey formation of the Thames (OIS 10-9-8; Bridgland 1994), deposited on the southern margin of an abandoned meander loop of the river flowing south-westwards around the chalk cliff of the Purfleet anticline (Schreve *et al.* 2002). A Thames, rather than Mar Dyke, origin for the deposits is confirmed by the lithological composition of the gravels, the distribution of other remnants of the Corbets Tey terrace north-east of Purfleet following the course of this loop, and bedding structures within the gravel indicative of westward flow (originally seen as supporting a Mar Dyke origin; Bridgland 1994, Schreve *et al.* 2003). The full Purfleet sequence (as recorded at Greenlands Pit) is summarised in Table 4.1.1.

The deposits as a whole are correlated with the Corbets Tey formation of the Thames (OIS 10-9-8) on the basis of altitude and lithological composition (Bridgland 1994; Schreve *et al.* 2002). The Purfleet Member (beds 3-5) is interpreted as fully temperate on the basis of various lines of environmental evidence (vertebrates, ostracods, molluscs and pollen), representing phase 3 of Bridgland's terrace model and therefore correlated with OIS 9 (Bridgland 1994). Correlation of the mammalian fauna from the interglacial deposits (Greenlands Shell Bed, Purfleet Member) with OIS 9 is also suggested, as it is similar in composition to faunas from this interglacial at Grays Thurrock and Cudmore Grove (Schreve *et al.* 2002, 1443). The extensive molluscan assemblage from these deposits also indicates an OIS 9 date on biostratigraphical grounds (*ibid*, 1448). The interglacial deposits are sandwiched between gravels lithologically indicative of deposition under colder conditions; whilst fauna is lacking from the basal gravels, the coombe rock over which they are emplaced is clearly indicative of cold conditions, and these basal deposits are therefore attributed to late OIS 10 (Bridgland 1994). Minimal faunal evidence is present in the phase 4 (post-interglacial) gravels of the Botany Member, from which Levallois material was recovered. However, the presence of horse does seem to indicate open conditions compatible with the cooler conditions suggested by the nature of the deposit (Schreve *et al.* 2002), and their position over the temperate OIS 9 deposits of the Purfleet member indicates on OIS 9/8 date for this phase of human activity. At Greenlands Pit, the Botany Member has produced OSL dates centred on 324 Kbp (E. Rhodes, quoted in White and Ashton 2003), again supportive of an OIS 9/8 date.

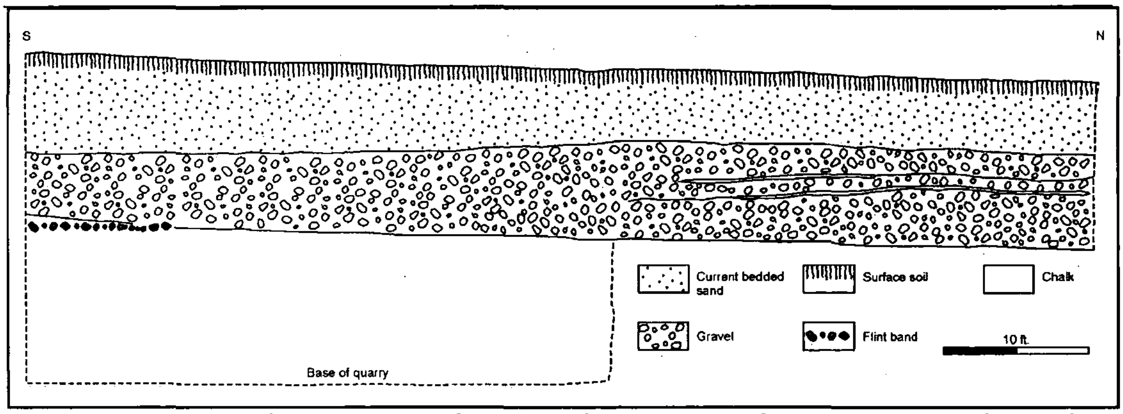

Figure 4.1.2 West-facing section of Purfleet deposits exposed in Botany Pit (after archive drawing by A.J. Snelling).

Only the uppermost part of the Purfleet sequence is represented at Botany Pit (see Figure 4.1.2), comprising 3.4 m. of sand and gravel banked up against the steep chalk cliff of the river edge, overlying chalk and coombe rock at 12 m. OD. (Wymer 1968, 1985). These deposits are laterally equivalent to the OIS 9/8 gravels of the Botany Member at Greenlands/Bluelands, but produced prodigious quantities of artefacts in comparison. During the emplacement of the Botany gravels, the channel edge in the Botany Pit area was notably less steep than that at Bluelands/Greenlands, potentially allowing easier access to the water's edge than elsewhere along the river at this point (Peter Allen, quoted in White *et al.* forthcoming). Notably, examination of Snelling's section though the Botany deposits (Figure 4.1.2) indicates that when the basal gravels were laid down, a flint band was exposed, allowing material to be obtained directly from the chalk. Although subsequently masked by ongoing deposition, large flint nodules from the chalk would have been incorporated into the gravels, forming part of a gravel beach.

Botany Member		
8.	Botany Gravel Dark-orange brown sands under loose yellow-orange cross-bedded sand, surmounted by horizontally-bedded gravels with occasional silty clay lenses.	2.00 m.
Purfleet Member/Botany Member		
7.	Silty clay Structureless grey-brown silty clay with occasional gravel pockets and lenses.	<0.75 m.
6.	Bluelands Gravel Horizontally and cross-bedded sand (c.0.2 m. thick) overlain by horizontally-bedded sandy gravel; erosional contact with shell bed beneath.	<6.00 m.
Purfleet Member (Interglacial deposits)		
5.	Greenlands Shell Bed Horizontally-bedded sand with abundant temperate climate molluscs (many articulated) and abundant temperate vertebrate fauna.	<2.00 m.
4.	Silty Clay Silty clay laminae with fine sand and silt partings; incorporates densely packed band of temperate molluscs, interpreted as shell bank accumulated over sand bank on mudflat.	<0.25 m.
3.	Shelly gravel Finer gravels and sands, some cross-bedded. Contains fully temperate molluscan fauna	<0.75 m.
Little Thurrock Member		
2.	Little Thurrock Gravel Thin flint gravel with chalk	<0.4 m.
1.	Angular chalk rubble ("coombe rock") Angular/sub-rounded chalk clasts in chalk matrix, with seams of silt and laminated sand	1.00 m.

Table 4.1.1 Deposits of the Corbets Tey formation at Purfleet, as recorded at Greenlands (Schreve et al. 2002).

Summary

- *Geographical situation*

  The assemblage from the Botany Pit gravels was recovered from the feather-edge of fluvial gravels, set in a wide riparian plain adjacent to gentle chalk slope. Flint raw material of good quality was immediately available from the gravels, much of which may have eroded from the flint band previously exposed, whilst the slope would also have allowed easy access to this riverside setting from the higher ground above.

- *Climate and environment*

  Lithologically, the Botany Pit gravels suggest deposition during a period of cold/cooling climate, when open environments might be expected. No environmental indicators have been recovered from Botany Pit itself, but the presence of horse amongst the sparse fauna from the equivalent Bluelands/Greenlands deposits also suggests open conditions (Schreve *et al.* 2002)

- *Dating*

  The Purfleet sediments as whole are correlated with the Corbets Tey formation of the Lower Thames on the basis of altitude. The uppermost deposits at Bluelands/Greenlands, equivalent to those which make up the Botany Pit sequence, surmount interglacial sediments attributed to OIS 9 on the basis of biostratigraphy and terrace stratigraphy (Bridgland 1994; Schreve *et al.* 2002). Given that the Botany Gravel reflects a return to cold climate gravel deposition following a fully temperate episode and are attributed to phase 4 of Bridgland's (1994) terrace model, an OIS 9/8 date is advocated for these deposits, supported by an OSL date of 324 Kbp (OIS 9) from an equivalent position at Greenlands (E. Rhodes, quoted in White and Ashton 2003).

Analysis of the assemblage

Treatment and selection of collections

Snelling's collection from Botany Pit was amassed through careful searching of the floor of the pit, as well as some controlled excavation (Wymer 1968). Although such methods might be expected to result in an under-representation of smaller debitage, such material is frequently disregarded anyway when dealing with collections from coarse gravels, as it is likely to result from clast-collision. The large assemblage of flakes, cores and some handaxes can probably therefore be regarded as a reliable sample of the potentially technologically informative material present. However, although the majority of this material has been passed to the British Museum by the excavator (although some was recorded whilst on loan to Mark White at the University of Durham), large amounts of the debitage have been incorporated into the excavator's drive as hardcore (Mark White, personal communication) and are therefore not available for study.

Whilst none of the Botany Pit artefacts are marked with indications of the level from which they were retrieved, the sequence at the pit only represents the uppermost units of the Purfleet sequence. Artefacts collected from this pit can therefore only have come from these levels. Notably, such handaxes as were recovered came from the very base of the gravel over the chalk (Snelling, in Wymer 1968), and are in different condition to the bulk of the material from levels above. It is therefore possible that they represent a final expression of the handaxe-dominated middle gravel assemblage apparent from work at Greenlands/Bluelands and are not actually associated with the core technology that dominates the Botany Pit assemblage. However, this cannot definitively be resolved, and they may indeed be associated with the main Botany Pit assemblage, indicating minimal use of handaxes in conjunction with Levallois/simple prepared core technology at this location.

Given the very large size of the Botany Pit assemblage (at least 303 cores, >2500 flakes) and the nature of the material, only the cores and definite Levallois flakes from the site have been recorded and are analysed below. As previously noted, and as is apparent from analyses of classic Levallois assemblages discussed elsewhere in this thesis, only cores provide direct evidence of the specific reduction techniques employed prior to discard. This is particularly significant in the light of the particular techniques employed at Purfleet, as discussed by White and Ashton (2003). In addition to the occasional classic Levallois cores and flakes present at the site, a large proportion of the assemblage comprises cores in which the objective appears to have been the removal of large flakes from one surface of a core, frequently following the simple creation of a striking platform. The flakes produced using such a strategy, whilst probably (following from the size of the scars retained on the cores) relatively large and slightly elongated, would not be easily differentiable from those produced using more casual flaking methods, which also occur at the site.

Elsewhere in this thesis, debitage has proved technologically uninformative when considering how variable Levallois techniques were employed, and have only been used at all when of possible relevance to assessing the taphonomic integrity of a given collection. Given that the Botany Pit material is in relatively fresh condition (see below) and represents an enormous collection from a particular landscape setting (adjacent to the chalk cliff), it is likely to be only minimally disturbed. Debitage is therefore only considered on the basis of a casual inspection of the British Museum collection, rather than any detailed metrical/technological analysis.

The analysis of the Botany Pit material was therefore directed primarily towards analysis of the cores in order to determine the specific methods of flake production employed, to what extent these do, as suggested, approach the volumetric conception of Levallois reduction (Wymer 1968, 1985; Roe 1981; White and Ashton 2003), as well as any detectable reasons why particular methods of reduction were employed. Definite Levallois flakes are also discussed, although, for the reasons outlined above, debitage has not been subjected to detailed analysis. The handaxes have not been considered, because of the likelihood they do not belong with the majority of the assemblage (although this possibility is not ruled out). The selected sample comprises all the cores and definite Levallois flakes from Botany Pit held at the British Museum, and equivalent material currently on loan to Mark White at Durham University from A.J. Snelling.

Analysis

The selected sample consists of 306 artefacts, 303 of which are cores, summarised in Table 4.1.2.

Artefact	No. of artefacts	% of core assemblage
Definite Levallois flakes	3	-
Levallois cores	25	8.3%
Migrating platform cores	170	56.1%
Discoidal cores	28	9.2%
Simply prepared cores	80	26.4%
Total	303	100%

Table 4.1.2 Selected material from Botany Pit.

Taphonomy

The condition of the recorded material reflects the processes that have affected the assemblage as a whole (see Table 4.1.2). In terms of surface alteration, most cores are unpatinated (92.1%) but tend to be stained (light-moderate 84.2%). The variable nature of such chemical alteration of artefact surfaces is poorly understood, but probably reflects differences in chemical environment.

Most cores show no evidence for abrasion of the arêtes between flake scars (54.5%), or are only lightly abraded (31.0%), although the majority exhibit at least some edge damage (95% light-moderate; see Table 4.1.3). This reflects at least some mechanical damage to the fragile core edges, as a result of gentle fluvial re-arrangement or pressure from the weight of overlying deposits. Additionally, a notable proportion (30.4%) of the cores exhibit incipient cones on humanly flaked surfaces (battering), resulting from repeated impacts on the artefacts by other hard clasts in the context of movement; some also retain scratches (18.8%). The core assemblage as a whole can therefore be considered as having incurred varying degrees of mechanical damage as a result of movement and re-arrangement, subsequent to discard upon and incorporation into the gravels adjacent to the chalk slope. However, the condition of the assemblage indicates that such movement was not protracted or particularly violent. Casual inspection of the non-Levallois flake assemblage indicates that this material is in similar condition and was presumably subject to the same degree of re-arrangement; smaller flakes are somewhat under-represented, probably a result of both visibility during collection and potential winnowing.

Condition of cores (n=303)					
Unabraded	165	54.5%	*No edge damage*	8	2.6%
Slightly abraded	94	31.0%	*Slight edge damage*	121	39.9%
Moderately abraded	44	14.5%	*Moderate edge damage*	167	55.1%
Heavily abraded	0	0.0%	*Heavy edge damage*	7	2.3%
Unpatinated	279	92.1%	*Unstained*	10	3.3%
Lightly patinated	24	7.9%	*Lightly stained*	72	23.8%
Moderately patinated			*Moderately stained*	183	60.4%
Heavily patinated			*Heavily stained*	38	12.5%
No scratching	246	81.2%	*No battering*	211	69.6%
Light scratching	40	13.2%	*Light battering*	68	22.4%
Moderate scratching	17	5.6%	*Moderate battering*	19	6.3%
Heavy scratching	0	0.0%	*Heavy battering*	5	1.7%

Table 4.1.3 Condition of cores from Botany Pit.

In addition, it is worth noting that the Botany Pit material is a very large assemblage from a spatially restricted area; equivalent deposits at Bluelands/Greenlands have not produced similar amounts of material. This suggests that the assemblage has not been extensively re-arranged, as such concentrations would be expected to be dispersed through protracted movement. The Botany Pit assemblage, although clearly not an *in situ* occurrence, can therefore be regarded as fluvially reorganised but in primary context, reflecting hominin activity at the river edge adjacent to the chalk slope.

Technology

Raw material

	Levallois (n=25)	Migrating Platform (n=170)	Discoidal (n=28)	Simple prepared (n=80)
Raw material				
Fresh	28.0%	5.3%	17.9%	5.0%
Derived	64.0%	82.4%	64.3%	91.3%
Indeterminate	0.0%	10.0%	14.3%	3.8%
Bullhead	8.0%	2.4%	3.6%	0.0%
Blank form				
Definite nodule	88.0%	73.5%	64.3%	87.5%
flake	0.0%	0.6%	3.6%	2.5%
shattered	0.0%	7.6%	7.1%	8.8%
indeterminate	12.0%	18.2%	25.0%	1.3%

Table 4.1.4 Raw material and inferred form of blank by reduction strategy.

Only 16 cores (5.3%) do not retain any cortex; the majority retain worn cortex indicative of the selection of nodules from a fluvially-worked source (81.5%). Some cores retain fresh cortex indicating the use of nodules minimally abraded since derived from the chalk (8.3%) and occasional use of bullhead flint is also apparent (3.3%). It is worth noting, however, that flint obtained directly from the chalk at Purfleet has very thin cortex (Mark White personal communication), and would therefore be very quickly abraded without extensive movement. Most cores reflect the fact that the material selected for reduction occurred in the form of whole or split nodules (77.6%); occasionally flakes (1.3%), or extensively fractured blanks were also used (7.3%; see Table 4.1.4).

Notably, particular core reduction strategies may to relate to the raw material selected; fully Levallois and discoidal cores are slightly more likely to be made on flint with unworn cortex than migrating platform or more simply prepared cores. Given the ease with which the thin cortex on flint obtained directly from the chalk might be expected to abrade, however, this does not necessarily reflect a contrast between heavily rolled gravel pebbles and large, amorphous flint nodules, and in this situation there is no definite link between cortex state and blank form. Given that the assemblage considered has been collected from throughout the gravels, contrasts might relate to changes in the material available over time; once the basal coarse gravels immediately over the exposed flint band had become covered, the material available from overlying deposits may not have been as large as those eroded directly from the chalk.

Contrasts in reductive approaches might therefore relate to the volume of available nodules; large, thick nodules allow large flakes to be produced though flaking into the volume of the core all around (discoidal flaking), whereas removing a flat flake from one surface of such a nodule necessarily requires a separated stage of surface preparation. Whereas the nodules worked using a simple prepared strategy already possess the distal and lateral convexities necessary to detach large flakes from a flaking surface, larger, more amorphous nodules may have required deliberate working to create such convexities – resulting in the slight over-representation of this technique when using fresh chalk flint.

Levallois Cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	87.36	82.30	34.70	0.969378	0.423471
Median	86.2	86.5	35.1	0.991972	0.42139
Min	51.1	52.1	15.2	0.684458	0.274894
Max	133.8	117.5	59	1.447044	0.723039
St.Dev	23.18099	17.38415	9.563188	0.182013	0.092696

Table 4.1.5 Levallois cores summary statistics (n=25).

Levallois cores with an obvious and separate preparatory stage from Botany Pit tend to be relatively large in size (see Table 4.1.6) and round in planform (mean elongation = 0.969378). Many were fairly thin when discarded (40% where Th/B=0.2-0.4), though further reduction of a substantial proportion of the assemblage was also clearly possible (56% where Th/B= 0.4-0.6).

Levallois cores; technological observations (n=25)					
Preparation method			Exploitation method		
Unipolar	1	4.0%	*Lineal*	19	76.0%
Centripetal	24	96.0%	*Re-prepared but unexploited*	1	4.0%
			Failed lineal	1	4.0%
			Unipolar recurrent	2	8.0%
			Bipolar recurrent	1	4.0%
			Centripetal recurrent	1	4.0%
Convexities			Type of convexity working (n=4)		
Whole surface shaped as one	21	84.0%	*Steep*	3	-
Distal	2	8.0%	*Semi-invasive*	1	-
One edge	1	4.0%			
Distal and one edge	1	4.0%			
Distribution of preparatory scars striking surface			Position of cortex on striking surface		
All over	17	68.0%	*Central*	14	56.0%
Proximal and distal	4	16.0%	*All over*	7	28.0%
Proximal and one edge	1	4.0%	*One edge*	4	16.0%
Proximal and two edges	1	4.0%			
Distal	1	4.0%			
Distal and one edge	1	4.0%			
Type of striking surface working			% cortex striking surface		
Invasive	4	16.0%	0	0	0
Semi-invasive	17	68.0%	1-25%	5	20.0%
Steep	1	4.0%	26 – 50%	10	40.0%
Minimally invasive	3	12.0%	51 – 75%	8	32.0%
			>75%	2	8.0%
Total number Levallois products from cores			Levallois products from final flaking surface		
0	2	8.0%	0	2	8.0%
1	19	76.0%	1	19	76.0%
2	3	12.0%	2	3	12.0%
3	1	4.0%	3	1	4.0%
Types of Levallois products from core (n=28)			Preparatory scars final flaking surface		
Flake	24	85.7%	1-5	11	44.0%
Overshot distal	2	7.1%	6-10	12	48.0%
Debordant flake	2	7.1%	11-15	2	8.0%
Preparatory scars striking surface			2 cores have evidence for previous flaking surface		
1-5	6	24.0%			
6-10	11	44.0%			
11-15	7	28.0%			
>15	1	4.0%			

Table 4.1.6 Technological observation of Levallois cores from Botany Pit (n=25).

All but one reflect centripetal preparation of the flaking surface, the convexities necessary for Levallois flaking generally being imposed through continuous shaping of the whole surface, although 4 cores also show deliberate accentuation of particular edges using a series of smaller flake scars (Table 4.1.5). Most cores attest to lineal exploitation (19), but individual examples of unipolar, bipolar and centripetal recurrent techniques are also present. In addition, there are also two cores with visible evidence of the re-preparation of flaking surfaces in between Levallois removals, in the form of small, less invasive scars - serving to emphasise the distal and lateral convexities - cutting large, invasive scars interpreted as the result of Levallois flake removal. The presence of cores with evidence for deliberate re-preparatory stages could be taken as reflecting the fact that others may also have been treated in this way, but traces of them having been re-prepared are obscured by subsequent working. A small but notable component of the Botany Pit core assemblage therefore comprises not only classic Levallois cores, but also variations upon this strategy, several large endproducts (almost invariably flakes, as are also evident from the collection) occasionally being produced from the same core.

Migrating Platform Cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	92.89	93.23	52.51	1.047618	0.572357
Median	90.75	91.8	51.45	0.990812	0.562029
Min	41.4	51.2	21.3	0.472358	0.259649
Max	125.8	103.9	52.51471	1.047618	0.572357
St.Dev	19.64813	6.612591	2.529081	0.11516	0.062623

Table 4.1.7 *Migrating platform cores summary statistics (n=170).*

Cores which do not result from a specific volumetric approach to core reduction, but rather the *ad hoc* exploitation of particular platforms as they became available throughout reduction (Migrating platform cores), comprise the majority of the Botany Pit core assemblage (51.6%). These are in general slightly larger than the Levallois cores recovered from the site (See Tables 4.1.5 and 4.1.7), but are similarly round in planform when discarded, though thicker (only 12.9 % of migrating platform cores have Th/B values of between 0.2-0.4, in comparison to 40% of Levallois cores). A variety of types of core reduction types are represented – single removals, parallel flaking, and alternate/alternating methods, including episodes of parallel flaking (see Table 4.1.8) - although many scars cannot be attributed to a particular type of episode (Type D; 51.6%). This probably relates to two factors; on one hand, the large size of the available material allowing relatively extensive reduction, obscuring earlier reduction sequences, and on the other hand, the tendency of many migrating platform cores within the current sample to fracture along existing flaws and coarse inclusions in the flint during reduction. 37 (21.8%) of these cores were noted as being extensively damaged in this way, and some of the blanks worked in this way were extensively fractured nodules when selected (7.6%).

Migrating platform cores; technological observations					
Core episodes (n=719)			Flake scars/core episode		
Type A; Single removal	96	13.4%	*Min*	1	-
Type B; parallel flaking	38	5.3%	*Max*	14	-
Type C; Alternate flaking	214	29.8%	*Mean*	2.82	-
Type D; Unattributed removal	371	51.6%			
Flake scars/core			Core episodes/core		
1-5	39	22.9%	*Min*	1	-
6-10	86	50.6%	*Max*	12	-
11-15	38	22.4%	*Mean*	4.17	-
>15	7	4.1%			
Max	22	-	Blank form retained? (n=170)		
Mean	8.42	-	*No*	90	52.9%
			Yes	80	47.1%
% Cortex (n=170)			Cortex position (n=170)		
0	13	7.6%	*None*	13	7.6%
1-25%	59	34.7%	*One face*	51	30.0%
26 – 50%	77	45.3%	*Both faces*	40	23.5%
51 – 75%	20	11.8%	*One edge*	19	11.2%
>75%	1	0.6%	*More than one edge*	4	2.4%
			All over	43	25.3%

Table 4.1.8 Technological observations of migrating platform cores from Botany Pit (n=170).

The high number of scars retained on the cores (mean=8.42) may reflect the relative intensity of reduction, and the migrating platform cores as a whole retain comparatively little cortex (42.1% <26%). However, the blank form of many (47.1%) of the cores can still be inferred by the position of small amounts of remnant cortex, generally on two faces (23.5%) or all over the core (25.3%), reflecting the use of fairly large, rounded nodules (mean B/L of migrating platform cores for which blank form can be inferred = 1.0431). Such nodules predominantly have abraded cortex (82.4%) and only 5.3% of the migrating platform cores from Botany Pit are on fresh flint. The migrating platform cores from Botany Pit therefore reflect the intensive reduction – at least on given portions of the cores – of large, generally rounded clasts of derived and frequently flawed flint – in a minimally directed manner.

Discoidal Cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	92.30714	78.97143	40.11429	0.873664	0.44621
Median	89.35	80.5	37.7	0.87096	0.419355
Min	61.5	56.3	21.4	0.650782	0.238042
Max	140.6	98.9	79.1	1.287966	0.879867
St.Dev	18.7792	11.47267	13.59155	0.142325	0.151185

Table 4.1.9 Discoidal cores summary statistics (n=28).

Twenty-eight cores within the current sample from Botany Pit (9.2%) reflect the employment of a discoidal reduction strategy, resulting from alternate/alternating flaking from a single, peripheral platform into the volume of two non-hierarchically related surfaces (Boëda 1995). Cores have been classified as such here depending upon the volumetric organisation of the discarded core, although it was noted during recording that several cores within this group did show hierarchical treatment of the surfaces at particular points during reduction (removing flakes from first one side, then the other, rather than strictly alternate flaking – sometimes termed radial; Inizan *et* al. 1999). In many ways this approach is similar in action to centripetal recurrent Levallois flaking, although the flakes that were removed cut into the volume of the exploited face, rather than removing material from its surface. Such cores are therefore not regarded here as conforming to the volumetric conception of Levallois. Additionally, although discoidal flaking has been regarded as a further "specialised" flaking technique comparable to Levallois (Boëda 1995), such an approach need not have been adopted throughout core reduction, but may merely represent the final form in which a migrating platform (or Levallois) core was discarded, as a result of the individual reduction trajectory which evolved throughout working.

Discoidal cores; technological observations					
Core episodes (n=94)			Flake scars per core episode		
Type A; Single removal	7	7.4%	*Min*	1	-
Type B; parallel flaking	4	4.3%	*Max*	24	-
Type C; Alternate flaking	35	37.2%	*Mean*	6.67	-
Type D; Unattributed removal	48	51.1%			
Flake scars per core			Core episodes per core		
1-5	0	0.0%	*Min*	1	-
6-10	6	21.4%	*Max*	10	-
11-15	16	57.1%	*Mean*	3.25	-
16-20	5	17.9%			
>20	1	3.6%	Blank form retained? (n=28)		
Max	24		*No*	24	85.7%
Mean	13.25		*Yes*	4	14.3%
% Cortex (n=28)			Cortex position (n=28)		
0	3	10.7%	*None*	3	10.7%
1-25%	11	39.3%	*One face*	20	71.4%
26 – 50%	13	46.4%	*Both faces*	2	7.1%
51 – 75%	1	3.6%	*One edge*	1	3.6%
			More than one edge	1	3.6%

Table 4.1.10 Technological observations of discoidal cores from Botany Pit (n=28).

The discoidal cores from Botany Pit are comparable in size to the Levallois cores from the site (see Table 4.1.9), although minimally more elongated in planform (mean B/L = 0.874, rather than 0.969 for Levallois cores). As with the Levallois cores, a large proportion are relatively thin when discarded (42.9% where Th/B=0.2-0.4), reflecting the fact that prolonged alternate flaking into both faces of the cores has progressively reduced their volume. As with the migrating platform cores from Botany Pit, many of the discoidal cores preserve flake scars which cannot be attributed to particular core episodes (Type D = 51.1%); single removals and episodes of parallel flaking are also represented (Table 4.1.10). Alternate flaking from the platform formed by the secant plane dominates, but the presence of other unrelated core episodes on cores which are volumetrically discoidal when discarded indicates that at least a proportion of these cores were worked in a less directed manner earlier in their reduction history.

At Botany Pit, discoidal cores appear to be more intensively reduced than migrating platform cores, retaining higher numbers of flake scars (78.6% >11 flake scars) and comparatively little cortex (50% <25%), usually on only one face of the core (71.4%). Blank form is rarely retained, and where it can be inferred, again usually occurred in the form of nodules. Notably, a significant proportion of discoidal cores at Botany Pit are produced on nodules of flint minimally abraded since erosion from the chalk (5; 17.9%), in contrast to only 5.3% of migrating platform cores and 5% of simply prepared cores (see Table 4.1.4); however, given the small number of discoidal cores from Purfleet (28) this apparently elevated representation may merely be a function of sample size. Only two discoidal cores from Botany Pit exhibited visible flaws or fractured during working. It therefore seems likely that such an approach, where prolonged flaking is controlled through alternate flaking from a single peripheral platform, may be more easily applied to large nodules such as those obtained directly from the chalk than smaller, fluvially abraded or flawed clasts. Whether this core form therefore results from the fact that such a technique was deliberately selected from amongst all possible options for working such nodules, or that flaking can naturally be continued for longer using more tractable raw material – resulting in a discoidal core form on discard – is a matter of conjecture. However, it can be inferred that when techniques concerned with flaking into core volume were applied at Botany Pit, the nature of the raw material used appears to have affected the reduction trajectory followed.

Simple Prepared Cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	97.34	88.86	45.42	0.930433	0.518421
Median	98.95	88.05	44.3	0.898965	0.49884
Min	60.5	52.9	19.9	0.489815	0.2851
Max	142.7	128.9	72.3	1.351541	0.929596
St.Dev	16.57972	16.26536	11.85259	0.1923	0.134285

Table 4.1.11 Simple prepared cores summary statistics (n=80).

Within the current sample from Botany Pit are 80 cores (26.4%) that reflect the preferential removal of relatively large, flat flakes from one surface of the core following minimal preparation of a platform from which such flakes were removed, typically through the removal of one or more bold flakes. The flakes subsequently removed from this platform into one flat surface of the core are relatively elongated and remove much of the volume of the exploited face parallel to the line of intersection between the exploited face and the non-exploited striking platform surface below. Frequently, flakes were removed from a single striking platform along the long axis of the flaking surface of the core, but platforms are also opposed or located at several points around the core periphery – effectively equating to bipolar or centripetal recurrent exploitation respectively. In volumetric terms, such cores conform to Boëda's definition of Levallois (Boëda 1986, 1995, White and Ashton 2003), but do not retain evidence of a deliberate preparatory phase geared towards the creation and maintenance of the distal and lateral convexities necessary for the detachment of removals from this surface. The lack of a deliberate phase of surface preparation is notable when contrast with the classic Levallois cores from the site, which do overwhelmingly reflect the centripetal preparation of the entire flaking surface prior to the removal of preferential flakes.

Simple Prepared Cores; technological observations					
Core episodes (n=271)			Flake scars per core episode		
Type A; Single removal	46	17.0%	*Min*	1	-
Type B; parallel flaking	19	7.0%	*Max*	10	-
Type C; Alternate flaking	82	45.8%	*Mean*	2.65	-
Type D; Unattributed removal	124	30.3%			
Flake scars per core			Core episodes per core		
1-5	28	35.0%	*Min*	1	-
6-10	41	51.3%	*Max*	9	-
11-15	10	12.5%	*Mean*	3.36	-
>15	1	1.3%			
Max	16		Blank form retained? (n=80)		
Mean	7.4		*No*	30	37.5%
			Yes	50	62.5%
% Cortex (n=80)			Cortex position (n=80)		
0	0	0	*One face*	42	52.5%
1-25%	6	7.5%	*Both faces*	23	28.8%
26 – 50%	66	82.5%	*More than one edge*	1	1.3%
51 – 75%	8	10.0%	*All over*	14	17.5%

Table 4.1.12 Technological observation of simple prepared cores from Botany Pit (n=80).

The simple prepared cores from Purfleet are generally slightly larger than other cores from the site (see Table 4.1.11) but do not differ significantly in planform to either the Levallois or migrating platform cores (mean B/L = 0.930433; see Table 4.1.11). Most were discarded when relatively thick (26.8% where B/L = >0.6); such cores could have been exploited further if deliberate re-preparation had been undertaken. Indeed, cores which have been treated this way at Purfleet have been less extensively reduced than those on which a different reductive path was adopted; most retain their original blank form (62.5%), usually indicating the selection of nodules (87.5%) from a fluvially abraded source (91.3%), probably the Botany Gravels themselves. Simple prepared cores from Purfleet retain high amounts of cortex (82.5% 26-50%), usually located on one (frequently unexploited) face (52.5%), but often on both faces or all over the core (28.8% and 17.5% respectively). In addition, they retain fewer scars than the other cores (86.3% <10). This could in part relate to the fact that the large, consumptive removals from the flaking surface may have removed any traces of earlier working, but certainly the fact that many of these cores retain the form of the original blank does indicate that they have not been extensively worked. The nodules worked in this way are frequently of relatively high quality; only 8 were noted to be visibly flawed.

It therefore seem likely that, given the fact that many of the minimally prepared cores from Purfleet retain the dimensions of the selected nodules, the manner in which they were worked may in part result from the reductive possibilities of such nodules when attempting to produce large, broad flakes. Volumetrically, minimal effort was directed towards establishing convexities upon the exploited surface; striking platforms were prepared in relation to these existing convexities to enable the removal of several large flakes with minimal effort – unipolar recurrent exploitation. New striking platforms were sometimes established to allow flaking tangentially – or in opposition – across the same flaking surface (bipolar recurrent and centripetal recurrent exploitation), if previous consumptive flakes had resulted in the surface being shaped in a way that allowed this, but the surface never seems to have been deliberately prepared to create such convexities.

Levallois flakes

Levallois flake	Butt type	No. Prep. scars	L	B	Th	Elongation (B/L)
1	*Plain*	7	114.9	94.8	21.1	0.825065
2	*Marginal*	12	106.1	56.9	106.8	0.536287
3	*Plain*	7	91.6	62.8	18.3	0.68559

Table 4.1.13 Definite Levallois flakes from Botany Pit.

Only three definite Levallois flakes are present within the flake collection from Botany Pit; these are relatively large and fairly elongated (see Table 4.1.13). All three result from lineal exploitation following centripetal preparation of the core surface. None have facetted platforms. Other flakes produced from the surface of simple prepared cores – effectively produced in a manner that conforms volumetrically to Boëda's (1986, 1995) definition of

Levallois - are probably also present amongst the flake assemblage, but cannot be differentiated from other large flakes with simple scar patterns.

Technology and hominin behaviour at Botany Pit

Given the very large amounts of lithic material recovered from Botany Pit, the site seems to have been the focus of repeated or prolonged exploitation as a source of flint. Lithic raw material was immediately available – initially from the chalk itself and the surrounding pavement of large flint, and from the gravels following the masking of this exposure. In comparison with surrounding areas of the immediate Purfleet landscape during the emplacement of the Botany Gravels, Botany Pit may have represented an area in which access to the river edge was easier than at other points, as the channel edge was less steep than at Bluelands/Greenlands to the east (Peter Allen, quoted in White *et al.* forthcoming). In addition, the clast size of the Botany gravel exposed in Bluelands/Greenlands Pits is relatively small and potentially less suitable for reduction than the obviously large material selected at Botany (Schreve *et al.* 2002); this might suggest that the large rolled nodules of material from the gravel had become incorporated from the exposed flint band; certainly, although retaining abraded cortex, nodules from the gravel at Botany are of a comparable size to those fresh from the chalk.

Four broad approaches to core reduction are apparent at Botany Pit; migrating platform, discoidal, classic Levallois and a form of simple core preparation to allow the removal of large flat flakes from a particular flaking surface. To an extent, the manner in which these different techniques were applied may partially result from the particular form or tractability of selected nodules of raw material (see Table 4.1.4). Both migrating platform cores and discoidal cores result from the production of medium-sized flakes through the consumption of core volume, but differ in the amount of control exercised throughout reduction; migrating platform cores result from the *ad hoc* exploitation of available platforms throughout reduction in a minimally controlled manner. At Botany Pit, this approach was only rarely adopted when dealing with nodules that can be seen to have come fresh from the chalk, and was frequently used when dealing with visibly flawed nodules. In contrast, discoidal cores also result from flaking that consumes core volume, but in a relatively controlled manner - through the maintenance of a single secant platform around the core periphery. At Botany Pit, discoidal cores are more intensively worked than others; in addition, few discoidal cores exhibit obvious flaws, and a notable proportion retain fresh chalky cortex. It may only have been possible to prolong flaking in this way given tractable raw material that allowed extensive reduction, and at least some of the discoidal cores appear to have been worked in a less controlled manner at an earlier stage of reduction.

In contrast, the classic Levallois and simple prepared cores from Botany Pit reflect the production of flakes from a surface, rather than through biting into the volume of the core. Although here treated as a separate method of core reduction, in volumetric terms the simple prepared cores from Purfleet do conform to the Levallois concept. The volume of the core is comprised of two hierarchically-related surfaces separated by a plane of intersection; only one was exploited as a flaking surface, the other being used to establish the striking platform. Flakes were removed parallel to the plane of intersection, the angle between the striking platform and flaking surface being at 90° to the axis along which flakes were struck, using a hard hammer. What is not apparent is a separate preparatory phase deliberately geared towards the creation of distal and lateral convexities. As White and Ashton (2003) point out, this represents a departure from the six technological criteria proposed by Boëda (1995; criterion 5), but the organisation of the axis of flaking through the preparation of a striking platform relative to existing distal and lateral convexities does effectively represent shaping (White and Ashton 2003, 602). Many of the simple prepared cores from Botany Pit are minimally worked and retain the form of the original blank, typically rolled nodules from the Botany Gravel itself. Few of these cores exhibit visible flaws, probably reflecting the fact that a controlled approach to flaking a surface could not be applied to intractable, flawed nodules.

The simple prepared cores contrast with the small number of classic Levallois cores present at the site, where a separate phase of shaping the flaking surface of the core through centripetal preparation is apparent. White and Ashton (2003) describe this group as "mimicking" classic Levallois, through the removal of a large, final flake, the previous working that resulted in the final configuration of the flaking surface being in many cases unrelated to the final exploitation of the surface. However, the fact that a notable proportion of the cores treated in this way retain fresh chalky cortex might suggest that when core reduction was geared towards the production of large, flat flakes from the surface of large nodules such as might be obtained directly from the chalk slope, the productive face required reducing in volume in order to produce the necessary convexities to remove flakes from this surface. Whether this was done deliberately in order to allow the removal of a preferential flake, or whether (as with simple prepared cores) such a flake was removed relative to convexities resulting from previous work, is a matter of conjecture. However, these removals do equate to a separate preparatory phase, and in some instances at least smaller, peripheral scars clearly do reflect deliberate accentuation of distal and lateral convexities.

At Botany Pit, hominins seem to be exploiting a relatively diverse range of raw material in several different ways, adopting particular approaches from the possible options available to them in response to the evolving potential of selected blanks. Certainly, as has been emphasised previously, fresh flint was available from the chalk slope (Wymer 1985, Schreve *et al.* 2002), but large nodules from the Botany Gravel itself were also used. Most simple prepared cores were produced on such nodules; however, if these nodules were flawed, a more *ad hoc* approach was adopted, through flaking into the volume of the core from wherever platforms became available. Clearly, it seems unlikely that flawed material would allow the control of flaking necessary to remove flakes from a particular productive surface. Fresh flint from the chalk slope clearly permitted control of flaking, either exercised through prolonging controlled flaking into the volume of the core (discoidal flaking) or classic Levallois reduction – the presence of a separate (potentially deliberate) shaping phase on the latter potentially reflecting the need to reduce the upper surface volume of such large nodules before the surface could be exploited.

However, the adoption of particular reduction strategies at Botany Pit does not seem to be merely a response to the nature of the material selected, particularly when viewed in the context of earlier technological strategies in the immediate Purfleet area. Core working during the periods in which the Purfleet and Little Thurrock Members were emplaced does not reflect the deliberate attempt to remove flakes from a core surface – Levallois flaking, whether simply prepared or following the reduction of flaking surface volume - apparent at Botany Pit. Rather, migrating platform core working dominates the material from the earlier deposits, in which flaking into the volume of cores shifts following the availability of platforms throughout reduction, resulting in variable core forms on discard. Such an approach typifies Lower Palaeolithic core technology as a whole (Ashton 1992, Ashton and McNabb 1996b, Ashton 1998a). The deliberate organisation of flaking on particular, hierarchically-organised surfaces of the simple prepared cores from the Botany Gravel contrasts markedly with such approaches. Control was exercised over the products of flaking in order to produce large, flat flakes from a surface, rather than smaller, thicker flakes that bit into the volume of the core, suggesting that large, flat flakes of this sort were desired endproducts at this point. Variability in how flaking was organised does appear to be affected by the nature of the nodules selected – larger nodules directly from the chalk required the lowering of their upper surface volume through flaking all around the periphery before the surface could be exploited in this way, either as a deliberate preparatory phase or merely the result of previous exploitation.

Concomitantly, control was exerted over lithic reduction in a different way at Botany Pit; the elevated proportion of discoidal cores (which do appear in Lower Palaeolithic contexts as the end result of prolonged alternate flaking) potentially reflects extended control of the manner in which flaking into core volume was undertaken. Notably, more of the cores from Botany Pit reduced in this way are formed on nodules of fresh flint than those to which a more *ad hoc* approach was applied – the latter (migrating platform cores) tending to be extensively flawed. It seems, therefore, that two potential conceptual approaches to core reduction were undertaken at Botany Pit; either controlled flaking of a core surface (Levallois and simple prepared cores) or flaking into volume (discoidal and migrating platform cores). Extended control of flaking either surface or volume could not be undertaken if selected nodules proved to be extensively flawed; a migrating platform strategy was therefore undertaken to utilise such material. Whether a discoidal strategy resulted from the fact that flaking could be prolonged given better quality raw material, or was deliberately adopted to maximise production of flakes from working into the body of such material is a debatable point. Similarly, controlled exploitation of a flaking surface was only possible using unflawed clasts. Core variability at Purfleet therefore reflects, on one hand, an active choice whether or not to exploit a particular surface or volume for flake production, and on the other, an "in hand" response to the nature of the material itself – whether controlled flaking could be undertaken at all (depending how flawed the material was) and whether surface exploitation was immediately possible or demanded work which resulted in the modification of that surface. In either case, control over the products of flaking - in particular the production of large, flat flakes – represents a contrast with earlier hominin technological behaviour in the Purfleet area.

4.2 Creffield Road, Acton, West London

Introduction

Levallois artefacts have been recovered from throughout the Acton area. The largest collections were amassed by John Allen Brown from a series of small pits along and around Creffield Road, about two miles north of the modern course of the Thames. These exposed fine-grained sediments overlying gravels of the Lynch Hill terrace, at a level of about 100 m. O.D. In this area, the Lynch Hill gravels extend eastwards from West Drayton to East Acton, intersected near the western end of their extent by the valley of the Crane and closer to the eastern end (between Southall and Hanwell) by the Brent. The surface of the Lynch Hill gravels are here frequently overlain by fine sediments, attributed to the polygenetic Langley Silt Complex (Gibbard 1985). The location and context of much of the material collected by John Allen Brown from Creffield Road itself can be accurately determined, based upon his publications and careful marking of artefacts.

History of Investigations

Reconstructing the collection history of the Creffield Road material relies upon a combination of John Allen Brown's publications (Allen Brown 1885; 1887; 1889), archive material left by other collectors and detailed artefact annotation by Allen Brown, which records the position, depth and collection (or cataloguing) date of most of the finds. He began collecting material from Creffield Road itself from 1885 onwards, the earliest dated finds being March 1885, publishing detailed descriptions of the geological context of his earlier finds (Allen Brown 1886; 1887; 1889). Although his published accounts suggest that he collected predominantly from four small pits (numbered 1-4) at the corner of Masons Green Lane, it is apparent that several other pits were opened not only along the northern side of Creffield Road, but also up to 120 ft away on the southern side, where small collections were made from a variety of depths. Some of these are also mentioned in his publications, whilst others are known only from markings on artefacts. The four main pits for which published details are available were very close together, and apparently open between 12.7.1885 and 4.7.1886 (artefact markings; see Table 4.2.1).

Examination of the 6 inch OS maps indicates that between 1874 and 1894-6 a row of four houses with extensive gardens to the rear were built along Creffield Road, near to the corner of Masons Green Lane (renamed Wegg Avenue by 1894, then renamed again to become Twyford Avenue by 1914). The westernmost of these (on the corner itself) is the vicarage. Allen Brown states that the four main pits were located in the gardens of the house next to the vicarage, St. Barnard's (83 Creffield Road), and the house immediately to its west (Allen

Brown 1889, 57). These pits were filled in during the summer of 1886 after the builders had extracted the sand and gravel they required for building these houses from them.

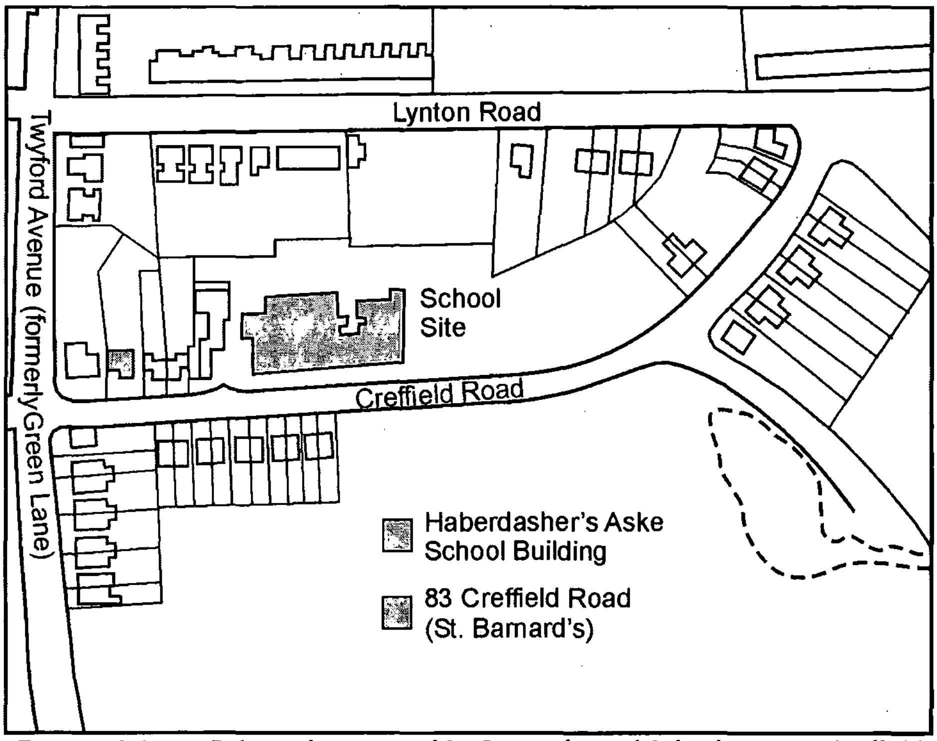

Figure 4.2.1 Relative locations of St. Barnard's and School Sites on Creffield Road. Based on OS 1:2500 series; Middlesex Sheet XVI.9, 1894-6 and 1914 revisions.

A ground plan was apparently prepared showing the location of at least these first four pits (Allen Brown 1887, 57), but this was sadly never published and has not been relocated. Pit 1 was 18 ft. square and only produced a few artefacts; none of those recorded were marked as coming from this pit. Pits 2 and 3 were located 20 ft. to the west, running into each other to form a single continuous excavation 30 ft long by 12 ft. wide. No extant artefacts retain markings which indicate they came from this cutting, and it is only mentioned on labels which read "3d pit joining pit 2". Pit 4 was located only 6 ft south of Pit 3 and was active following the winter of 1885 (2.1.1886 – 4.7.1886; artefact markings; see Table 4.2.1). In addition to the artefacts recovered from the Pit 4, Allen Brown also noted the presence of large flint nodules with minimally abraded cortex at the 6 ft. level. Some of these approached a nearly foot in diameter (Allen Brown 1887, 59).

Allen Brown published a section of Pit 2, showing fluvial gravels overlain by fine sediments and capped with contorted gravel (trail). He describes artefacts recovered from three points throughout the sequence, which he interprets as old land surfaces; two unrolled artefacts from a "black seam" within the gravel at 11-12 ft., 8-10 unabraded flakes from another level in the gravel consisting of "bleached pebbles, humus and black matter" at 8 ft, and a "floor" of bleached pebbles on top of the gravel at a depth of 6 ft., immediately overlain by sandy loam. When the second pit was opened (Allen Brown 1887, 57), Allen Brown retrieved nearly 500 artefacts from this level, offering rewards to the workmen for noting the depths at which they were recovered. Where artefacts from these pits retain indications of recovery depth, they invariably come from this 6 ft. level (Ashton *et al.* 2003).

In addition to the four main pits, Allen Brown also records that he recovered material from other small pits in the area – a circular excavation 120 ft. south of the main pits (Allen Brown 1887, 58 – artefact markings suggests this was in Springfield, to the south-east), and another "small, well-like pit" 32 ft. west of the main excavations. The former showed a greater depth of fine sediments than the pits to the north, two or three sharp flakes being recovered from the surface of the gravel immediately under 9 ft of brickearth; again, sharp Levallois material was also recovered from within the gravel itself (e.g. "11F down in the stone dept. in lower loamy sand S…(illeg) circular excavation 120 F S" – artefact marking, Levallois point, Box 29). Other small pits from which Allen Brown collected in the Creffield Road area are only apparent from the descriptions given on artefacts, and are difficult to relocate. This notably includes a productive pit designated "Pit 5", from which material was recovered between March 1886 – June 1887, small collections from pits 60 or 100 ft. south of Pit 5, a "cep pool" 100 ft. south of the original four pits, and the "cellar excavation". Neither Pit 5 nor those artefacts recovered from positions given only in relation to Pit 5 can be relocated.

Artefact marking indicate a gap in collection between June 1886 (Pit 5) and June 1899, after which a new extension in the grounds of the Haberdashers' Aske Girls' School began to turn up more material (Table 4.2.1). Allen Brown subsequently collected from this pit until September 1901; only one other location was collected from during this period, represented by a single flake (September 1899 – Public library extension). The School site is significant; contrasts in condition are apparent between this material and that recovered from Pits 1-4 located 60 m. to the west, and no published or archival information is available beyond that recorded on the artefacts themselves. Allen Brown rarely marked artefacts from the school site with an indication of depth (1 Levallois flake from 6 ft. down). However, the manner in which he marks a lot of the material ("workshop site extension", "workshop site", "pal floor") suggests that he still considered himself to be collecting from a single level equivalent to the earlier exposure.

Material was also collected from the School site by Haward (12.1.1900); an archive sketch (which also denotes the position of Allen Brown's original four pits in the garden of St.

loamy sand	Black band/floor	Springfield	Circular exc. 120F S of pits	Nr/corner of Green Lane	Pit 3	Pit 4	100 F S of pits (Cep pool)	Pit 5	Pit 5 ext	60 F S of pit 5	100 F S of pit 5	Cellar excavation	School site 1899 - 1901	Public library ext	Collis brickfield
				St. Barnard's Area									School site		
		15/12/1884													
3/2/188															
	03/1885														
	19/03/1885														
		7/4/1885	7/4/1885												
				12/7/1885											
				13/07/1885											
				27/7/1885	27/7/1885										
					30/10/1885										
					2/11/1885										
				27/11/1885			27/11/1885								
					11/1885										
						2/1/1886									
						4/1/1886									
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													9/1899	9/1899	
													10/1899		
													1/1900		
													8/1900		
													9/1901		
															4/1902

Table 4.2.1. Dates upon which John Allen Brown collected from various locations in the Creffield Road area, based upon artefact markings. Pits which make up the St. Barnard's area and School Site samples are outlined in bold; other locations cannot be relocated.

Barnard's) records that he recovered "4 specimens, foundation of the Aske Girls School Acton 1" – 6" deep *under* (my emphasis) the loam" (Haward Catalogue number 88; BM [F] CRA I 1945 2-3 43). These comprise 3 Levallois flakes and a retouched flake; further Levallois material was also recovered by Haward between Montague Gardens and Twyford Avenue, again from the top of the gravel ("under 6F clay on top of white clay band covering gravel"; Haward catalogue number 90; BM [F] CRA I 1945 2-3 43). Marsden also collected Levallois material from the "immediate vicinity" of Allen Brown's original published site (one artefact is marked as coming from 77 Creffield Road), apparently "thrown up from a depth of four to six and a half feet (Marsden 1928, 297), perhaps suggesting that he was collecting material from the upcast of pit workings, rather than directly from the section itself.

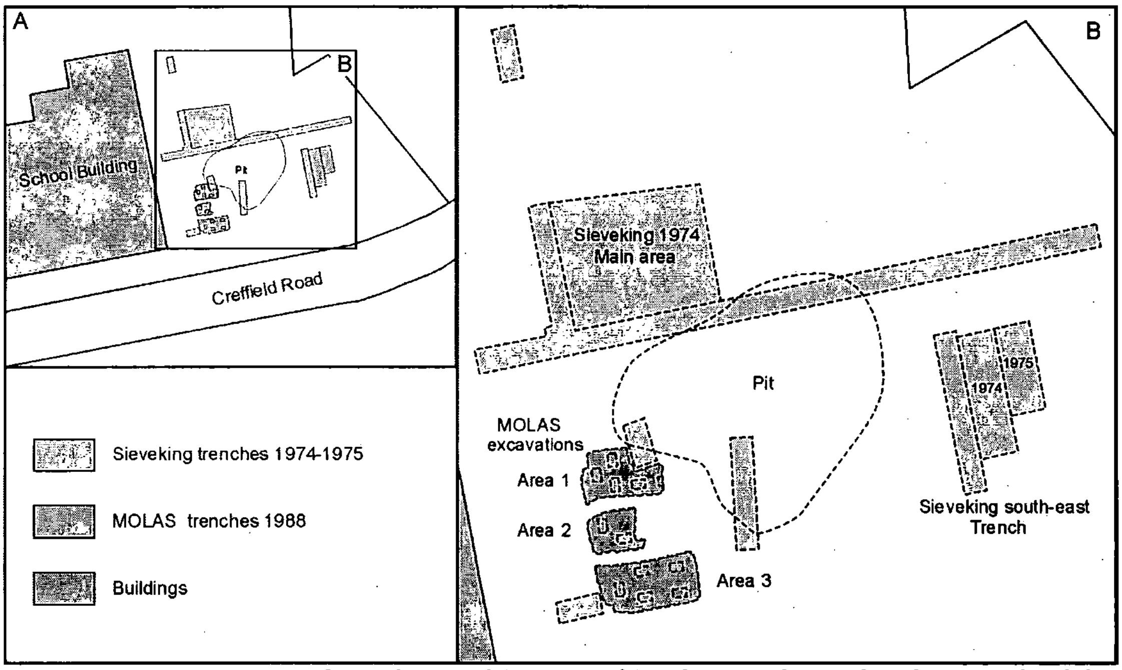

Figure 4.2.2 Location of Sieveking and Museum of London trenches within the grounds of the School, showing position of nineteenth century gravel pit.

Sieveking directed excavations by the London and Middlesex Archaeological Society in the grounds of the Haberdashers' School in September 1974 and August-September 1975 (Burleigh 1976). Resistivity survey revealed a sizable disturbed area subsequently confirmed through trenching to represent a nineteenth century gravel pit; potentially that from which Allen Brown and Haward collected during the 1899 – 1901 extension of the school. Two large areas (designated main area and south-east area) were excavated by hand through the brickearth to the top of the terrace gravels following machine stripping of the modern overburden; (see Figure 4.2.2). The results of these excavations have never been fully published, and the extant site archive contains little useful detail (BM [F] CRA II). Broad attributions to context are provided for some of the Levallois material recovered from the site – either "Brickearth" or "? Base of Brickearth"; however, it is unclear why attributions to the base of the brickearth are qualified in this way – they may in fact come from the top of the gravel. Minimal Levallois material was actually excavated (4 Levallois flakes and 1 core are present within the British Museum collection with attributions to context), although large amounts of later prehistoric flintwork were recovered from throughout the fine sediments. No details of the geological sequence are available.

Further excavations were conducted in the school grounds in 1988 by the Museum of London's Department of Greater London Archaeology (later MOLAS), following the demolition of one of the old school buildings (Bazeley *et al.* 1991). Three areas undisturbed by the Sieveking excavations or modern intrusions east of the school building were sampled by test-pitting; to a depth of 10 cm below the top of the gravel (Unit A, at 27.4 m. O.D.; just over 6 ft. below the modern ground surface) in Area 1 (see Figure 4.2.2), and to the top of the gravel in Areas 2 and 3. Twelve 1 m. by 1.5 m. test pits were cut; only a single Levallois flake was recovered, from fine-grained deposits (Units B-D) overlying the gravel. Bazeley *et al.* (1991) argue that the geological evidence from the 1988 Creffield Road excavations indicates that no stable surface existed between the Lynch Hill gravel and overlying sediments, and that identifying the level from which Allen Brown collected his material is therefore problematic. They suggest that his material may have come from an erosional unconformity within the fine sediments, or within the gravels themselves.

However, the fact that Allen Brown marked material collected from the School site with descriptions indicating that he was dealing with the same level as his earlier collections, together with the top of the gravel resting at the same depth below the ground surface, suggests that material probably did come from the same position in this area. Where marked with indications of depth, the vast majority of the material from the Creffield Road area is recorded as coming from the surface of the gravel – generally from 6 ft. down, but also at greater depths where the brickearth is thicker (e.g. 9ft; circular excavation 120 ft. south of original pits). Brown himself notes the variable depth of the brickearth, the gravel lying directly below the modern overburden half a mile from Creffield Road itself in Freeland Road (Allen Brown 1887, 59).

However, both Allen Brown and later workers also recovered material from fine-grained sediments in the Creffield Road area; small collections of material held by the British Museum are explicitly marked as coming from levels within the Brickearth, unfortunately from small sites which cannot be located (60 ft. south of Pit 5, Cellar excavation). A handful of Levallois artefacts were also recovered from the fine-grained deposits at the School site in both recent phases of excavation (Burleigh 1976, Bazeley *et al.* 1991). Given that the sediments which comprise these fine units are predominantly reworked from the underlying gravels (see below), such artefacts could originally derive from the surface of the gravel. Conversely, they might simply reflect the fact that whilst the gravels were exposed and hominins active upon them, gentle sedimentation was occurring in other areas.

Geological Background

The Creffield Road gravels have been attributed to the Lynch Hill terrace (OIS 10-9-8) of the Middle Thames on the basis of both altitude and composition (Gibbard 1985, Green and McGregor 1991). Two exposures of the sedimentary sequence have been published; Allen Brown's section of Pit 2 (Allen Brown 1885), and that recorded in the vicinity of the School site (Collcutt 1991; Green and McGregor 1991). The sedimentary sequence from the School Site is summarised below (see Table 4.2.2; Figure 4.2.4).

	29.20 m. O.D. Modern ground surface
D	28.60 – 28.70 m. O.D. (upper surface truncated) Silt of aeolian origin; clayey in places, with some sand and occasional gravel lenses (solifluction). Differentiated from C below by lack of even relic fluvial structures and decreased sand component.
C	27.80 – 28.10 m. O.D. Fluvially deposited sand, clays, silts and some gravel which has subsequently been radically disturbed, probably by cold-climate mass-movement and cryoturbation; few bedding structures survive, and only in contorted patches. Erosive contact with unit B below.
B	Well-structured but poorly sorted sands, clays and gravel; indications of rapid deposition, frequent erosion and fluctuating flow stage, characteristic of cooler climate rivers.
A	27.4 m – 27.2 m. O.D. Well-bedded compact fluvial gravels with occasional sand lenses

Table 4.2.2 Summary of geological sequence in Area 1, School Site, Creffield Road (After Collcutt 1991).

The sequence as a whole is comparable to that recorded by Brown 60 m. to the west, the surface of the gravel at c. 27.30 m. O.D. resting at slightly over 6 ft. below the original ground surface. In addition, Allen Brown also records a reduction in sand throughout the fine-grained sediments – a change from "sandy loam" to "brown brickearth" (See Figure 4.2.3), as well as "trail" towards the top of the fine material potentially comparable to the soliflucted gravel lenses towards the top of Unit D.

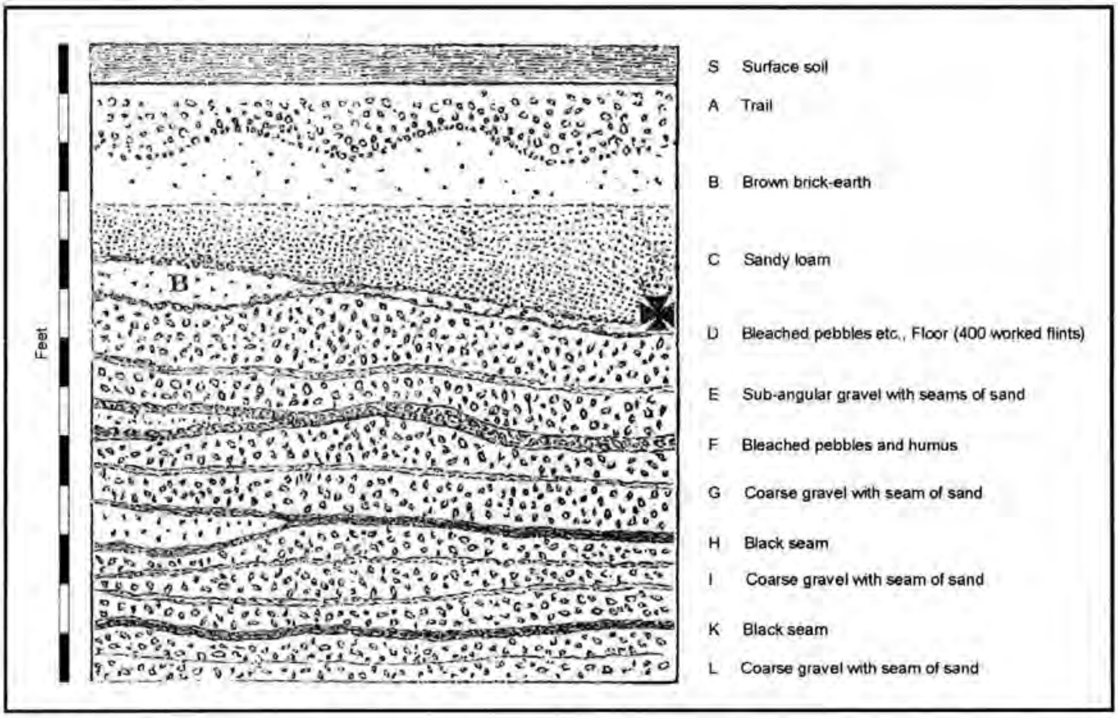

Figure 4.2.3 John Allen Brown's section of Pit 2, St. Barnard's Area. (After Allen Brown 1886). Cross marks position of main artefact level.

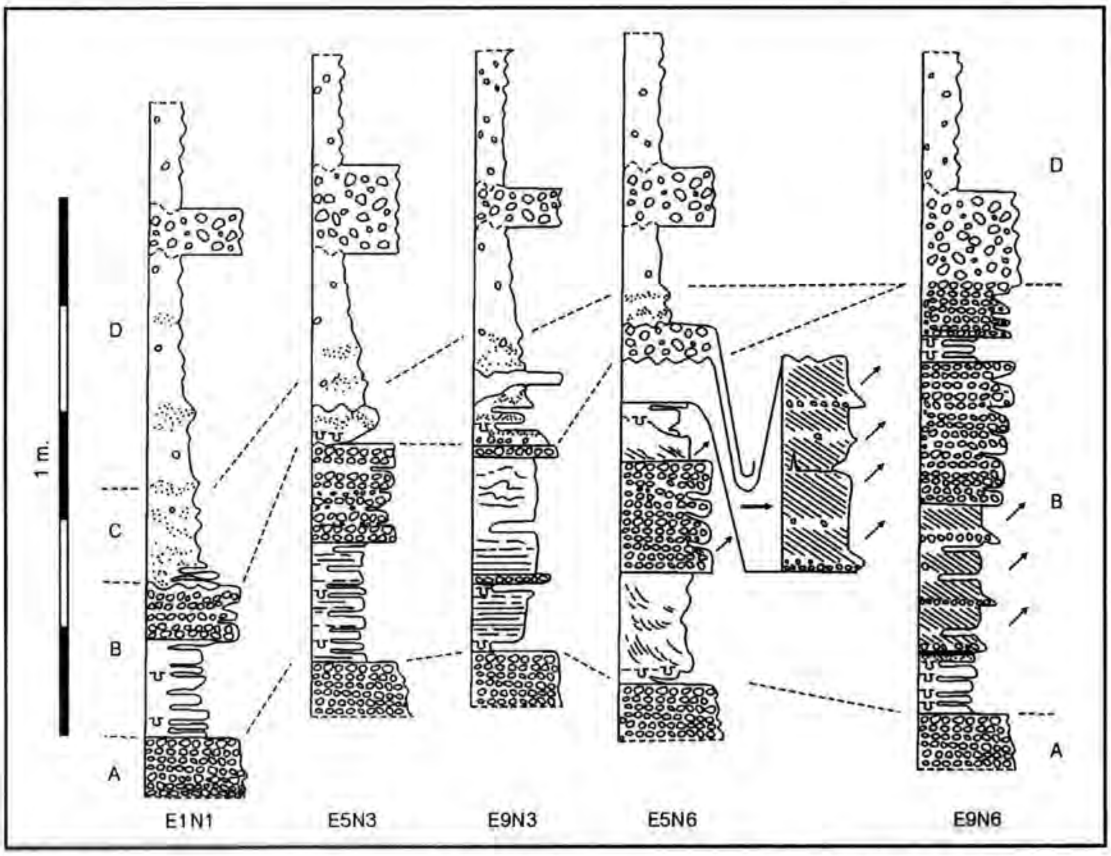

Figure 4.2.4 Sequence in Area 1 of the MOLAS investigations at the School Site (After Bazeley et al. 1991). See Table 4.2.2 for description of Units A-D.

The fine-grained sediments (B-D) have been attributed by Gibbard (1985, 60), and Bazeley *et al.* (1991, 26) to Gibbard's Langley Silt Complex, a complex sequence of fine sediments deposited by a variety of processes (alluvial, fluvial and aeolian) over the Lynch Hill, Taplow and Kempton Park terraces of the Middle Thames. Brickearth overlying the Lynch Hill and Taplow terraces is suggested to have been largely deposited in the late Devensian and to represent predominantly aeolian sediment derived from local sources (Gibbard *et al* 1987). However, earlier TL dates (>75 and >150 kya) have been obtained for samples from the fine-grained sediments overlying the Lynch Hill terrace at Yiewsley (Gibbard *et al.* 1987, 7). At Yiewsley, the lower parts of the fine sediments are weakly stratified, potentially resulting from colluvial or alluvial deposition, which it is suggested may have been part of the final phase of aggradation in this locality (Gibbard *et al.* 1987, 7).

Units B and C at Creffield Road display evidence of widely varying depositional processes – including small-scale fluvial deposition, colluviation and loessic material, the former declining in influence up the sequence to be entirely absent within Unit D. Unit D – the top of which produced the majority of the later prehistoric flintwork – is dominated by silt presumed to be of aeolian origin, the source of which was not determined (Green and McGregor 1991). The gravel samples from units B and D are compositionally similar to the underlying Lynch Hill terrace, from which they presumably derive (Green and McGregor 1991). Collcutt (1991) however, sees Unit B as potentially forming part of the Lynch Hill Gravel, exhibiting as it does structural characteristics common to cooler-climate rivers (Collcutt 1991, 23), whilst Green and McGregor (1991, 27) suggest that it *is* separated from the overlying fine sediments, but that the time interval involved cannot be determined. Similarly, the time intervals separating unconformities within the fine sediments can also not be speculated upon; potentially, a very protracted period of development and a variety of processes may have been responsible for the accumulation of the entire sequence of brickearths at Creffield Road.

Clearly, the relationship between the Lynch Hill gravels at Creffield Road and the overlying sediments demands resolution, given the position of the Levallois material directly on top of the gravels. If, as Collcutt suggests, Unit B does represent ongoing aggradation of fine-grained fluvial sediments referable to the Lynch Hill terrace, they might represent a period of relative quiescence following a major episode of deposition during the aggradation of the phase 4 sediments of Bridgland's (1994) model, suggesting an OIS 8 date for hominin activity at Creffield Road. The interpretation favoured here is the accumulation of the basal fine-grained sediments as a result of small-scale channel development, ponding and colluvial deposition on the terrace surface (Green and McGregor 1991). Similar processes may be responsible for the accumulation of the lowermost brickearth surmounting the Lynch Hill terrace at Yiewsley, which produced TL dates of >75 and >150 kya (Gibbard *et al.* 1987, 7). The variable nature of these processes on different parts of the terrace surface is potentially taphonomically significant. The Levallois material from the surface of the gravel at Creffield Road therefore post-dates the accumulation of the Lynch Hill gravels (OIS 10-9-8), whilst its fresh condition is indicative of swift burial. The position of the material directly on top of the terrace surface suggests that it has not been masked by colluviation, or the formation of soil upon the terrace surface during temperate conditions, potentially suggesting an OIS 8 or early OIS 7 date for the assemblage (Ashton *et al.* 2003). Given that there is no evidence for the occupation of Britain during fully glacial conditions, even during the Upper Palaeolithic (Jacobi 1999), a fully glacial OIS 8 date seems unlikely. The dating of hominin exploitation of the gravels demands resolution; if the terrace surface was targeted by hominins during early OIS 7, it would have formed an exposed terrace flat on the valley side, overlooking the interglacial floodplain

Summary

- *Geographical situation*

  The Levallois material from Creffield Road considered below was recovered from the surface of a fluvial gravel, potentially dissected by small channels and local ponding. This may have been an exposed terrace remnant on the valley side, above the floodplain.

- *Climate and environment*

  The favoured late OIS 8 or early OIS 7 date for hominin activity at Creffield Road could imply very different environmental conditions – from cool/cold to fully temperate. However, no environmental proxies have been recovered during any phase of investigations, making further characterisation difficult.

- *Dating*

  These fluvial gravels are attributed to the Lynch Hill formation of the Middle Thames, based upon their altitude and composition (Gibbard 1985; Green and McGregor 1991). The position of the artefacts on the surface of the deposits suggests that they post-date the aggradation of these sediments (OIS 10-9-8). Although the interval of time separating the aggradation of the gravels and the deposition of the overlying fine-grained sediments cannot be determined, the fresh condition of the artefacts indicates that they were not exposed for any appreciable period of time. A late OIS 8 or early OIS 7 date is therefore favoured for the assemblage (Ashton *et al.* 2003).

Analysis of the assemblage

Treatment and selection of collections

Following John Allen Brown's death on September 24th 1903, his entire collection passed to George Lawrence, who subsequently sold it to Sturge (BM [F] Lawrence archive VI, 8-10). Although Ealing Borough Council apparently expressed an interest in purchasing the collection, and Lawrence offered his assistance to Sturge in "weeding" the material if he wished to do so (in order to sell cast-offs onto other collectors), it apparently passed to Sturge in its entirety and is currently held by the British Museum. This analysis is based predominantly upon this material, together with a handful of artefacts retaining Allen Brown's notation from the Museum of London.

The care with which John Allen Brown collected and annotated the Creffield Road material allowed extensive re-sorting of the British Museum collection. Although he collected artefacts from various small pits in the area, only two positions can be accurately relocated. The remaining material mostly comprises small collections, which do, however, retain markings indicating the depth and context from which they were recovered, together with a date. This probably records the date of collection, but could also represent a cataloguing date. Analysis was concentrated upon the material from the two areas that can be located spatially and for which details of the geological sequence are available (see above); the St.Barnard's area (Allen Brown's published site) and the School Site.

Initially the material was split into groups definitely attributed to a given pit or position regardless of whether these could be relocated (e.g. Pit 3, Pit 5, circular excavation etc.). Subsequently, the dates on which material was collected (or catalogued) were compared, allowing some material to be attributed to a particular pit even when this is not indicated on the label. For instance, with the exception of a single artefact from the "Public Library Extension" collected in September 1899, only the School Site was collected from between June 1899 and September 1901; material collected between these dates has been included in the School Site sample even when not explicitly marked as coming from this location. In contrast, material was collected from both "Near Green Lane" and "100 F. S. of pits (Cep pool) on 27.11.1885; material marked solely with this date could obviously not be attributed a particular location (See Table 4.2.2). Unfortunately, a proportion of the material was either unmarked or the markings had become illegible; these have been excluded from the following analysis.

Additional problems exist with the material collected from the School Site; although Allen Brown's artefact markings indicate that he felt he was dealing with a continuation of his "floor" at the 6ft level, individual artefacts within this collection potentially come from other levels throughout the sequence. This includes several heavily rolled flakes which probably originate from the underlying gravels (which do form the source material for the basal, fluvial brickearths), and a few artefacts in very fresh condition of likely later prehistoric date – blades with carefully prepared (trimmed) butts. These may have been conflated with the Levallois material from further up the sequence; perhaps Allen Brown was collecting from the upcast from the pit at the School Site, rather than directly from the workmen, or the workmen in this area were not as assiduous as those with whom he had co-operated earlier. The level from which this material was recovered is therefore less securely established than the sample from the St.Barnard's area; very rolled material and demonstrably later Prehistoric material has been excluded from the sample, but it is still possible that material of a variety of dates is conflated within the current selection.

The sample of material collected from the area of Allen Brown's published site comprises that marked as coming from Pit 3, Pit 2/3 (no material is marked as solely marked as coming from Pit 2), as well as that marked as coming from "Near" or "Corner of" Green Lane. The collection (or cataloguing) dates given on artefacts with these descriptions overlap completely (12.7.1885 – 27.11.1885) and one artefact marked as coming from "Near Green Lane" has had "pit 3" added to the label by Allen Brown. Material from Pit 4 is also included with the sample from this area. Notably, most of this material is marked with the depth from which it was retrieved, invariably 6 ft.

However, published details of pits indicate that Allen Brown also recovered limited amounts of material from lower down in the gravel, from successive levels which he interpreted as landsurfaces – one being a "black seam" at a depth of 11-12 ft, which produced two unrolled artefacts, and another at about 8 ft. down, comprising a level of "bleached material, humus and black matter" (Allen Brown 1887, 56) from which he recovered 8-10 unabraded flakes. Although not marked with details of where they were recovered from, 10 artefacts present within the collection (4 Levallois flakes, a Levallois core, a scraper and flakes) are marked variously as coming from the "Level of floor" or "Black Band", at depths of either 8-9 or 6-7 ft. These were collected in March 1885 (frequently the date 19.3.85 is given) prior to the first labels that refer to a location on the corner of Green Lane or Pit 3 (12.7.1885) and only a month before other labels refer to a "circular excavation 120F S of pits"(7.4.1885) - presumably referring to the main pits discussed by Allen Brown. It therefore seems likely that they were recovered from the pits mentioned in his publications, perhaps before he felt the need to differentiate the various interventions with a series of pit numbers.

It is possible that some of the artefacts marked as coming from 8-9 ft. may come from the lower "seam" mentioned by Allen Brown; however, given that others retain identical descriptions but are noted as coming from depths of 6-7 ft it is difficult to say whether the "seam" was in fact of a less constant height than his publications imply, or that some do come from the upper, more archaeologically productive layer, his various floors being distinguished by the depths given. Although it is impossible to be sure, it does seem likely that at least a few artefacts recovered from the "black seam" at 8-9 ft are present, that they were probably collected in the area of his main published site, and that they do include definite Levallois flakes in identical condition to those recovered from the upper productive level. However, given the leaps of inference necessary to attribute this material to the published pits, they have been excluded from the current analysis.

Analysis

Artefact	No. of artefacts	% of assemblage
Flakes	97	44.3%
All Levallois flakes	110	50.2%
Definite Levallois flakes	79	36.1%
Probable Levallois flakes	20	9.1%
Possible Levallois flakes	11	5.0%
Levallois cores	10	4.6%
Non-Levallois cores	2	0.9%
Retouched flakes	7	3.2%
Retouched Levallois flakes	5	2.3%
Retouched non-Levallois flakes	2	0.9%
Handaxes	0	0.0%
Total	219	100%

Table 4.2.3 Material from the St.Barnard's area.

Artefact	No. of artefacts	% of assemblage
Flakes	57	46.0%
All Levallois flakes	61	48.8%
Definite Levallois flakes	44	35.2%
Probable Levallois flakes	9	7.2%
Possible Levallois flakes	8	6.4%
Levallois cores	5	4.0%
Non-Levallois cores	0	0.0%
Retouched flakes	8	6.4%
Retouched Levallois flakes	8	6.4%
Retouched non-Levallois flakes	0	0.0%
Handaxes	1	0.8%
Total	124	100.0%

Table 4.2.4 Material from the School Site.

The material considered below therefore consists of 343 artefacts collected from two locations on Creffield Road; the St.Barnard's area published by Allen Brown (219 artefacts) and the School Site (124 artefacts).

Taphonomy

Contrasts in condition are apparent between the two collections; whilst both are predominantly unabraded (84.9 % St. Barnard's, 88.7 % School Site.), differences are apparent in terms of surface modification of the artefacts; the material from the School Site tends to be less heavily patinated and stained than that St. Barnard's (see Figure 4.2.5), potentially reflecting differences in chemical environment. A proportion of the artefacts from all locations exhibit two phases of edge damage; an initial series of spalls around the edges, patinated and stained to the same degree as the artefact itself, and a later series of less heavily patinated scars which cuts these. This second phase of edge damage is frequently lightly patinated itself, and so is unlikely to result from curation practices.

Condition of material				
	St. Barnard's (n=219)		School Site (n=124)	
Unabraded	186	84.9%	110	88.7%
Slightly abraded	32	14.6%	13	10.5%
Moderately abraded	1	0.5%	1	0.8%
Heavily abraded	0	0 %	0	0%
No original edge damage	61	27.9%	40	32.3%
Slight original edge damage	140	63.9%	75	60.5%
Moderate original edge damage	18	8.2%	9	7.3%
Heavy original edge damage	0	0.0%	0	0.0%
No modern edge damage	19	8.7%	42	33.9%
Slight modern edge damage	79	36.1%	66	53.2%
Moderate modern edge damage	111	50.7%	15	12.1%
Heavy modern edge damage	10	4.6%	1	0.8%
Unpatinated	0	0.0%	27	21.8%
Lightly patinated	74	33.8%	44	35.5%
Moderately patinated	144	65.8%	50	40.3%
Heavily patinated	1	0.5%	3	2.4%
Unstained	23	10.5%	35	28.2%
Lightly stained	102	46.6%	39	31.5%
Moderately stained	88	40.2%	40	32.3%
Heavily stained	6	2.7%	10	8.1%
Unscratched	140	63.9%	114	91.9%
Lightly scratched	56	25.6%	6	4.8%
Moderately scratched	18	8.2%	4	3.2%
Heavily scratched	5	2.3%	0	0.0%

Table 4.2.5 Condition of the material from St. Barnard's and the School Site.

The collection from St.Barnard's exhibits a notable degree of this post-surface modification ("modern") edge damage (55.3 % moderate and heavy combined; see Table 4.2.5), in contrast to the School Site (12.9 %). In terms of "original" edge damage, however, the School Site and St.Barnard's are similarly undamaged (32.2 % and 27.9 % respectively) or only lightly so (60.5% and 63.9%). However, the heavier "modern" edge damage of the St.Barnard's material may well be masking earlier damage. The fact that the material from St.Barnard's seems to display two phases of edge-damage could be interpreted as reflecting the effects of the pressure or movement of overlying cold-climate sediments upon the delicate artefact edges. The exact nature of the mechanisms responsible for this edge damage cannot be determined, but may result from ongoing small-scale alluvial processes active on the terrace surface.

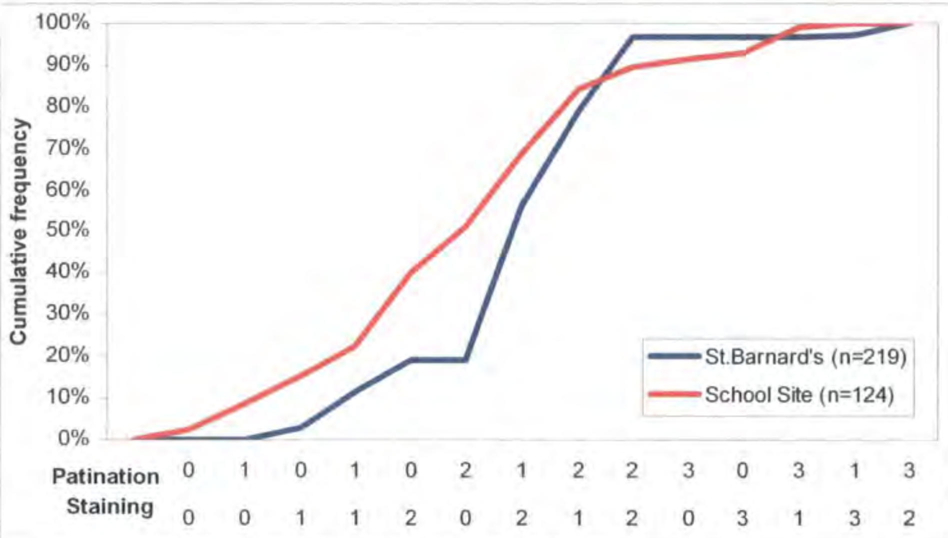

Figure 4.2.5 Comparison of surface alteration of artefacts from St.Barnard's and the School Site.

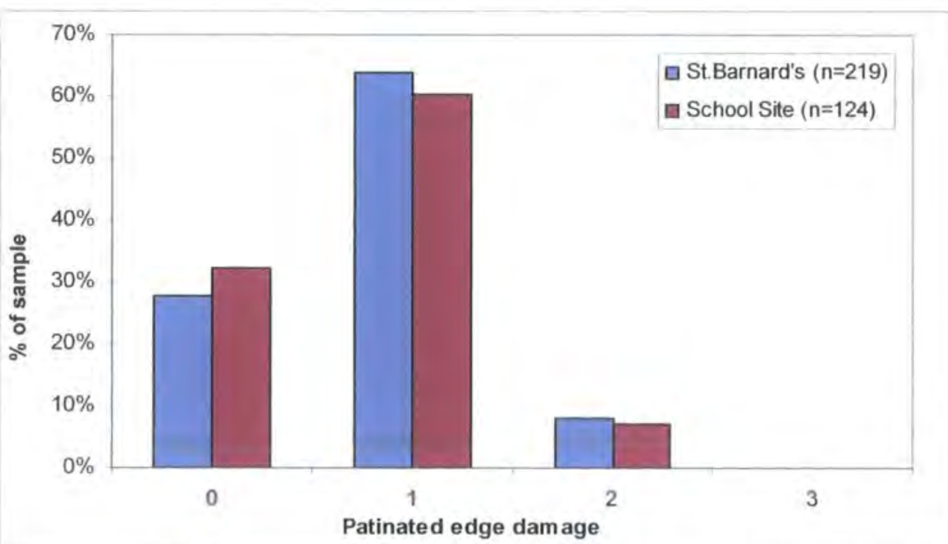

Figure 4.2.6 Comparison of patinated edge damage on artefacts from St.Barnard's and the School Site.

Concomitantly, differences are also apparent in the degree of surface scratching on artefacts; material from the School Site tends not to have such scratches (91.9 % unscratched), whilst that from St.Barnard's does (36.1 % with scratches), a proportion being heavily so (2.3 %). Such scratching may result from the pressure of coarse grains in the sediments passing across the artefacts, and may support the idea that at least some of the mechanical damage affecting the artefacts results from the pressure of overlying sediments grinding the artefact assemblages; such processes may have been slightly more active in the St.Barnard's than the School Site. Similarly, the contrasts in surface modification of the artefacts from the different areas are of uncertain significance, but possibly relate to differences in chemical environment or rate of exposure. The material as a whole can be viewed as having been minimally subject to a variety of taphonomic forces over time, different factors affecting various areas of the terrace surface in different ways, reflected in the contrasts in the taphonomic histories of both collections.

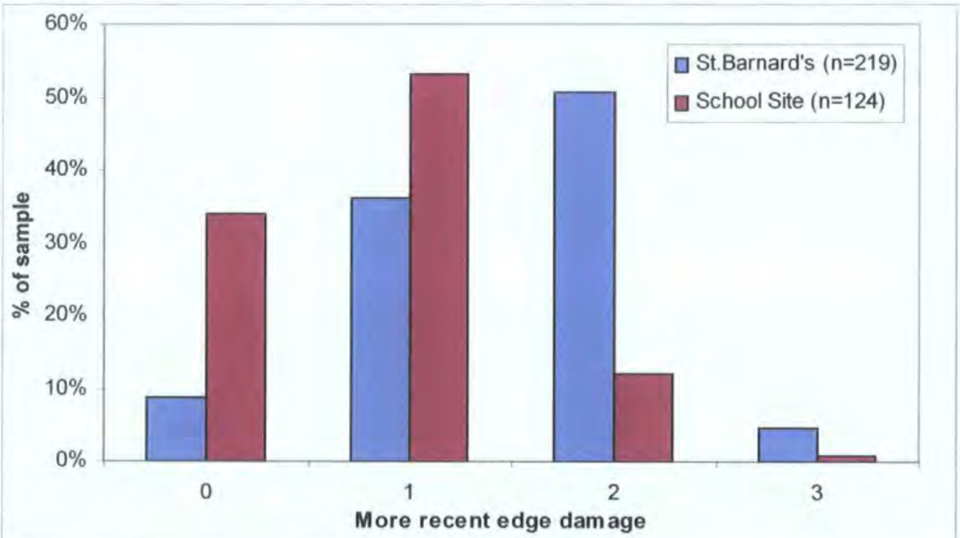

Figure 4.2.7 Comparison of degree of later edge damage on artefacts from St.Barnard's, the School Site, and Pit 5.

Both locations clearly do not represent pristine assemblages; comparison of the size distribution of all debitage with experimentally-generated data (Schick 1987) demonstrates that small material is clearly under-represented in both the School Site and St. Barnard's area assemblages (Figure 4.2.8). This is especially apparent for the St. Barnard's material; none of the debitage within this collection is smaller than 6 cm. in maximum dimension (in comparison with the predicted frequency of 91.1%, or 30.5 % of the material from the School Site). This is notable, given that the collection from the St. Barnard's area seems to have been more controlled than collection from the School Site; at St.Barnard's, Allen Brown kept a careful eye on the excavations, and paid the workers to note the depths from which material was collected, whereas at the School site he may well have been searching up-cast for artefacts. However, it is also likely that Brown himself would have been more likely to spot smaller artefacts than the workmen co-operating with him in the St.Barnard's area. It therefore seems likely that both areas may be missing a proportion of smaller material which may not have been visible during collection.

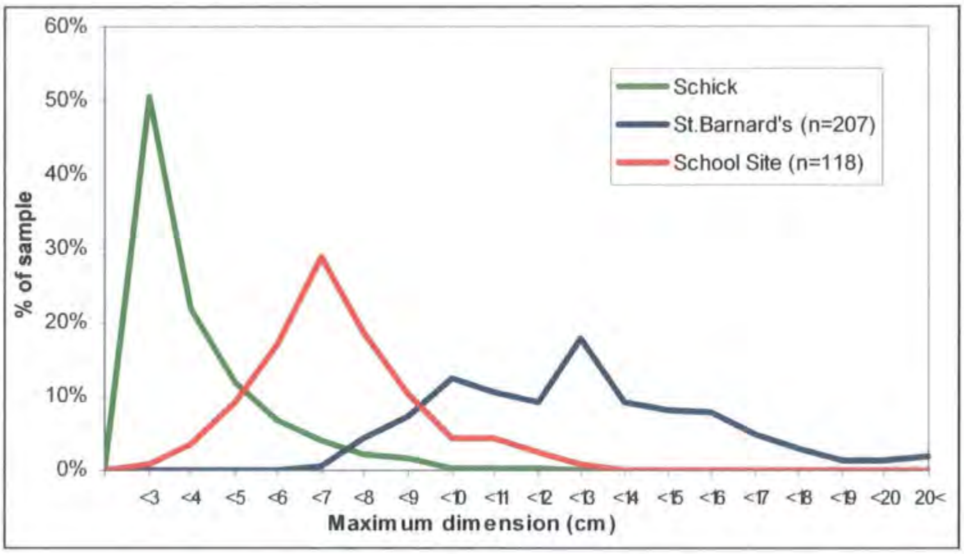

Figure 4.2.8 Comparison of maximum dimension of debitage larger than 2 cm. in maximum dimension from the St.Barnard's area, School site, and experimental data generated by Schick (1987).

The compositions of both assemblages are intriguing in several respects; 79 definite Levallois flakes were recovered from St.Barnard's, in contrast to 97 non-Levallois flakes, a similar pattern being apparent at the School Site (44 definite Levallois flakes to 57 non-Levallois flakes; see Tables 4.2.3 and 4.2.4). This could potentially be seen as suggesting a degree of selection of the sort of products retained – deliberate collection of Levallois flakes. For both collections, definite Levallois flakes and debitage (whole and broken) show similar distributions in terms of maximum dimension; (88.6 % of Levallois flakes and 73.7 % of debitage from the School Site being between 5 - 10cm; 86.1% of Levallois flakes and 86.6% of debitage from the St. Barnard's area being between 4 - 10cm; see Figures 4.2.9 and 4.2.10). This, together with the very elevated proportion of Levallois flakes, could be taken as supporting the fact that the size of material has had a notable effect upon the composition of the collections. However, even allowing for such factors, patterning is evident which is not explicable in these terms.

A notable proportion of the material from St. Barnard's is very large; 37.6 % of the debitage assemblage is greater than 14 cm. in maximum dimension, in comparison to none of the material from the School Site. It seems inconceivable that such large flakes were missed in the latter situation, and it therefore seems probable that this does reflect a further contrast between the two areas. Given that Allen Brown noted the presence of very large flint nodules in Pit 4 in the St.Barnard's area, it is possible that this relates to the initial working of this material in the immediate vicinity, an issue which is considered further below. It is additionally worth noting that when only whole Levallois flakes and debitage from St. Barnard's are compared in terms of maximum dimension the Levallois flakes are notably larger (81.3 % of whole Levallois flakes >8 cm., 31.0 % whole non-Levallois flakes >8 cm.; Figure 4.2.11). In contrast, whole Levallois flakes and non-Levallois flakes at the School site are very similar in terms of size distribution (see Figure 4.2.12). This reflects the fact that much of the larger non-Levallois material from St.Barnard's is in fact broken (33.3% of material >7 cm. in maximum dimension) and would originally have been even larger.

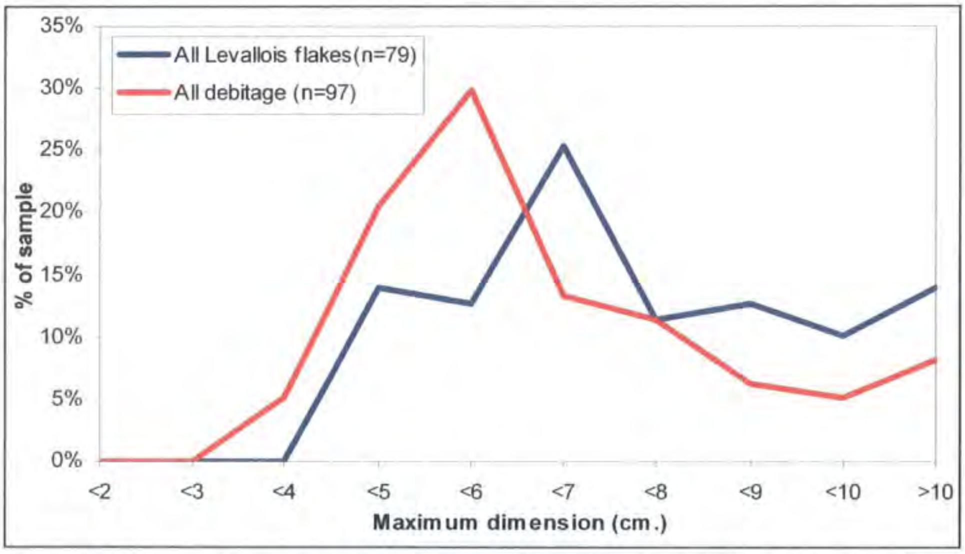

Figure 4.2.9 Comparison of maximum dimension of all definite Levallois flakes and all debitage from the St. Barnard's area.

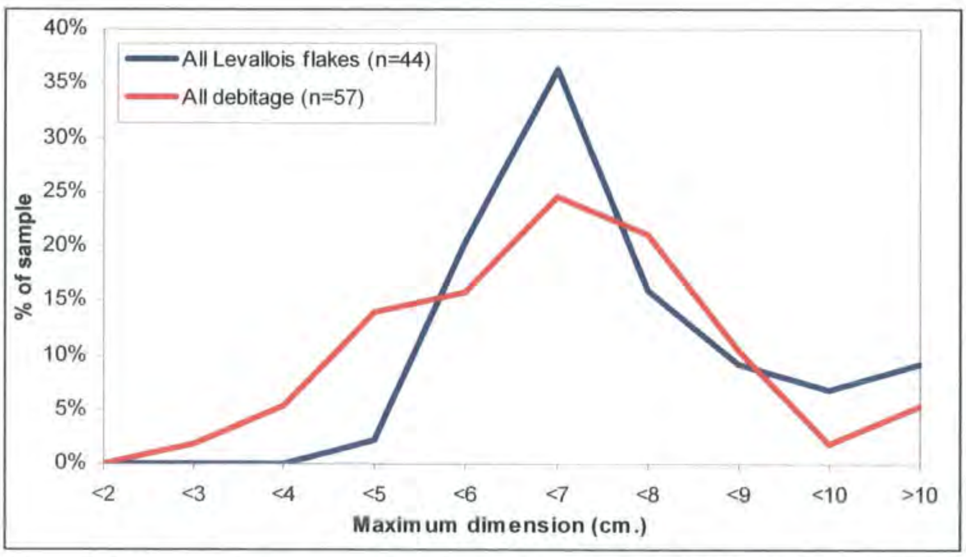

Figure 4.2.10 Comparison of maximum dimension of all definite Levallois flakes and all debitage from the School Site.

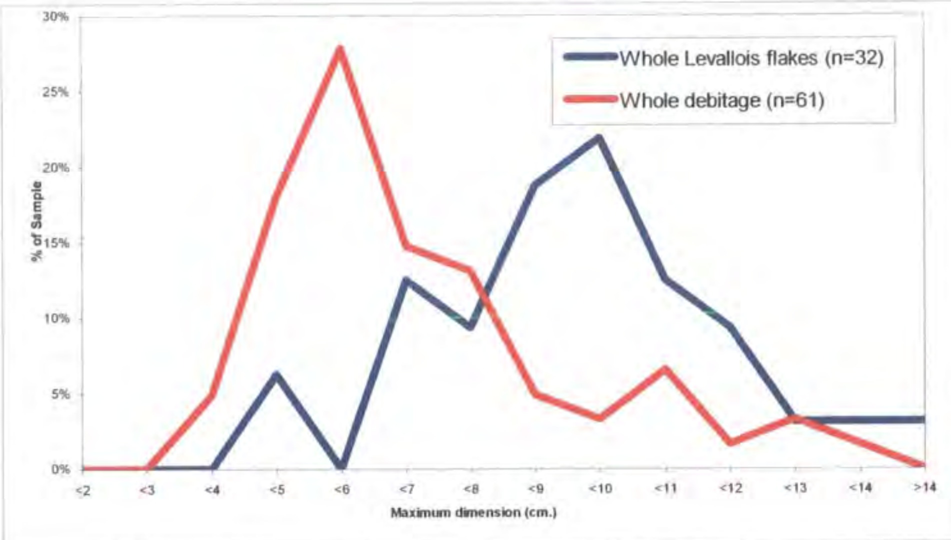

Figure 4.2.11 Comparison of maximum dimension of whole Levallois flakes and whole debitage from the St. Barnard's area.

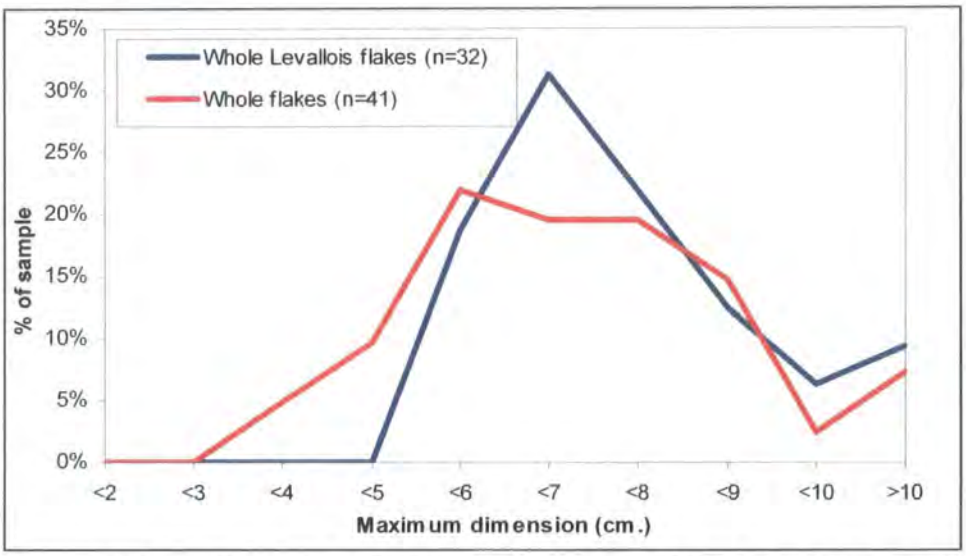

Figure 4.2.12 Comparison of maximum dimension of whole Levallois flakes and whole debitage from the School Site.

The majority of the non-Levallois flakes from St.Barnard's retain at least some cortex (78.3%), in proportions comparable to that expected for a complete non-Levallois knapping sequence (85.8%; Ashton 1998a). However, this generally consists of material with less than 50% dorsal cortex; more heavily and wholly cortical flakes are under-represented when compared with experimentally generated data (see Figure 4.2.13). In comparison, cortical material is even more under-represented at the School Site, where 45.6 % of the debitage does not retain dorsal cortex, in contrast to the predicted 14.2 % (see Figure 4.2.14).

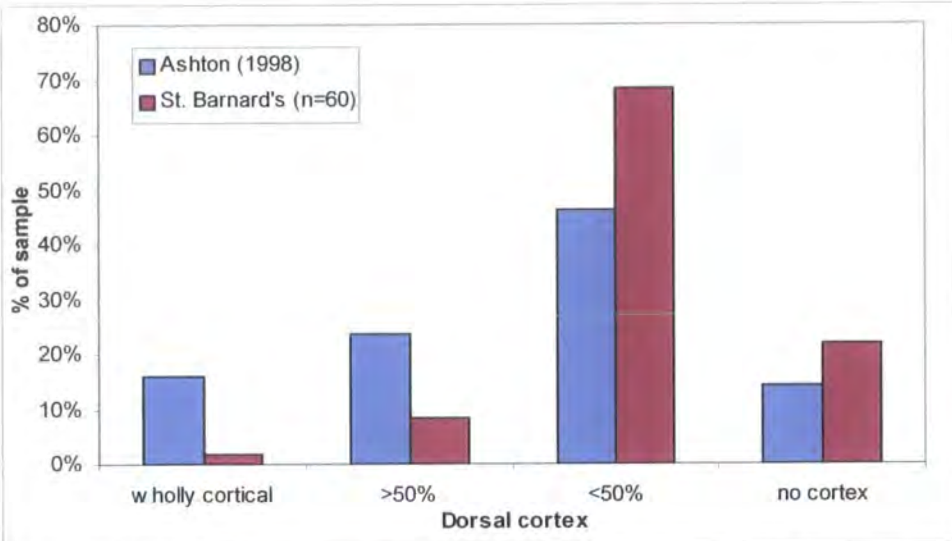

Figure 4.2.13 Comparison of cortex retention of flakes from the St.Barnard's area with proportions resulting from experimental non-Levallois core reduction (Ashton 1998a).

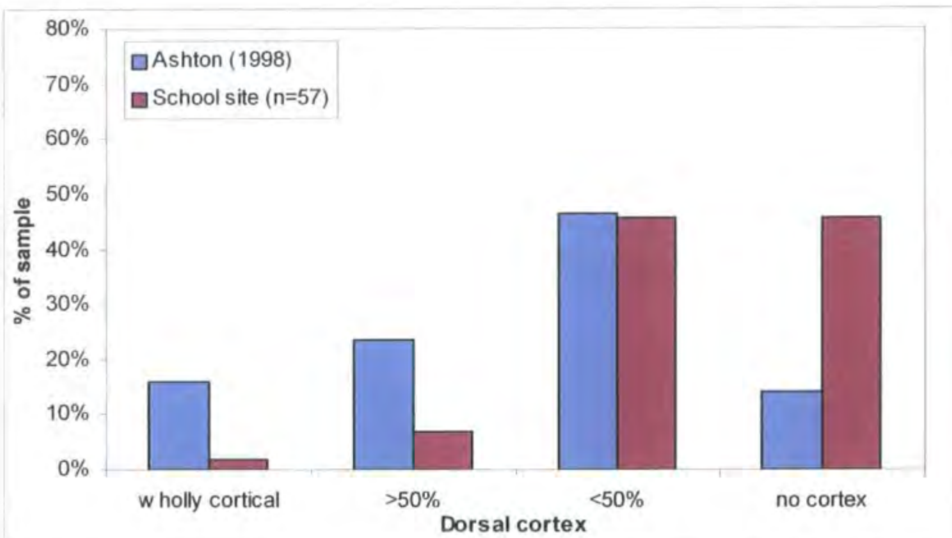

Figure 4.2.14 Comparison of cortex retention of flakes from the School Site with proportions resulting from experimental non-Levallois core reduction (Ashton 1998a).

It is therefore clear that the large material retaining more cortex collected from the St.Barnard's area is not present in the collection from the School Site. Despite the fact that collection may not have been as controlled from the latter, it is difficult to see how this might lead to an *under-representation* of larger material (although potentially one could argue that it would be more difficult to spot material retaining cortex when searching spoil heaps). Given that Allen Brown noted the presence of large flint nodules retaining fresh cortex in the St.Barnard's area, it seems possible that much of the large, more cortical, debitage in this area might result from the early stages of working such nodules. It is therefore possible that some of the differences between the two areas might result from different approaches to, or stages of, lithic reduction on different areas of the terrace surface.

The collections from the St.Barnard's area and the School site probably have slightly different taphonomic histories, as well as arguably reflecting variation in the reduction activities undertaken on different areas of the terrace surface. Material from the School site is less edge-damaged and has been subject to less post-depositional modification than that from the St.Barnard's area; however, more details of the exact position of the St.Barnard's material are available, from both Allen Brown's publications and the depths given on artefacts. Indeed, it seems likely that some material from other points throughout the sequence has been conflated with the Levallois assemblage from the surface of the gravel at the School Site; obviously rolled or later prehistoric material has been disregarded, but other material may still be erroneously included, and cannot be dissociated on the basis of the available information. The two collections have therefore been treated separately below, although it is implicitly acknowledged that they probably form part of the same, broadly contemporaneous, assemblage.

Technology

The St. Barnard's Area

Raw material

Five of the ten Levallois cores from the St.Barnard's area retain no cortex. Four of those that do retain cortex have variable amounts in the centre of the striking platform surface, whilst a single core (on a Levallois flake) retains cortex along one edge of the productive face. Such cortex as is retained is chalky, yet worn, indicating that the nodules selected had potentially been subject to minimal fluvial movement since eroded out of the chalk; in one case it is completely fresh. Four of the cores are formed on flakes - definitely Levallois in two cases, probably in the case of the others - predominantly unsuccessfully; only one produced a successful Levallois flake. The form of the blanks cannot be determined for the remaining 6 cores, although the retention of rolled but chalky cortex on the striking platform surface of three of the cores suggests they may have been nodules or split nodules (or potentially large cortical flakes); given their exhausted state (see below) it is difficult to comment further.

A large proportion of the flake assemblage (including Levallois flakes) does not retain any cortex (59.9% - largely because Levallois flakes have been included). Most retain worn cortex which remains chalky in places (33.3%), and a small amount of the material is definitely fresh (6.8%). It does, therefore, appear that much of the material selected for reduction in the St. Barnard's area may have occurred in the form of nodules partially abraded since their erosion from the chalk; given the dimensions of much of the debitage, these are also likely to have been large in size. Flint nodules (up to a foot in diameter) were noted by John Allen Brown in Pit 4 of the St.Barnard's area (Allen Brown 1887, 59).

Although the material from St.Barnard's may have been re-arranged and the composition of the assemblage altered through collection practices, the large size of flakes and the amount of minimally abraded cortex retained on the flakes suggests that primary working of these nodules was undertaken in this area. In contrast (see below), the discarded Levallois cores are extremely heavily reduced. Certainly, practices at either extreme of the reduction spectrum are represented at Creffield Road; however, it is difficult to explain in terms of complete reduction to exhaustion on-site. Large clasts of raw material were available and worked at the site; however, in all other situations examined (e.g. Ebbsfleet, Baker's Hole, Lion Pit Tramway cutting), when hominins were directly exploiting sources of raw material, cores are abandoned prior to extreme reduction, when failures become more common and reduction more difficult to control; new nodules are selected and worked from that available in the immediate vicinity. This pattern may therefore be explicable in other terms.

Levallois Cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	67.92	62.57	19.7	0.942227	0.316349
Median	68.35	65.35	19	0.926479	0.315694
Min	46.4	47.8	9.2	0.672293	0.160558
Max	79.5	73	27.5	1.234914	0.419207
St.Dev	10.13485	7.494746	5.009103	0.188469	0.079462

Table 4.2.6 Levallois cores summary statistics (n=10).

The Levallois cores from the St. Barnard's area are very small in size (see Table 4.2.6); indeed, all are smaller than 8 cm. in maximum dimension, in comparison with only 4.8% of the debitage (including Levallois flakes) from this area. Most are equally proportioned when discarded (8 with elongation values of >0.8; Figure 4.2.15) and relatively flat, the majority (7) having a flattening index of between 0.2-0.4 (see Figure 4.2.16). Given their small size and reduced volume, these cores can be regarded as completely exhausted; it is debatable whether any re-preparation of these flattened cores is possible, and if it had been undertaken, the products would have been small in the extreme. This is supported by the fact that, despite evidence for re-preparation (see below), Levallois flakes were not produced from the final flaking surfaces of half the cores (5).

Levallois cores from the St.Barnard's area; technological observations (n=10)					
Preparation method			Exploitation method		
None	1	10%	*Unexploited*	1	10%
Bipolar	4	40%	*Lineal*	5	50%
Convergent unipolar	2	20%	*Re-prepared but unexploited*	2	20%
Centripetal	3	30%	*Failed lineal*	2	20%
Convexities			Type of convexity working (n=2)		
Whole surface shaped as one	8	80%	*Semi-invasive*	2	n/a
Distal and one edge	2	20%			
Blank type			Distribution of preparatory scars striking surface		
Flake (possibly Levallois)	2	20%	*All over*	4	40%
Levallois flake	2	20%	*Proximal and distal*	3	30%
Indeterminate	3	50%	*Proximal*	3	30%
Probably nodule	3	30%			
Type of striking surface working			Position of cortex on striking surface		
Invasive	2	20%	*None*	6	60%
Semi-invasive	4	40%	*Central*	4	40%
Steep	3	30%			
Minimally invasive	1	10%			
% Cortex striking surface			Total number Levallois products from cores		
0	6	60%	0	2	20%
1-25%	1	10%	1	7	70%
26 – 50%	0	0%	3	1	10%
51 – 75%	2	20%			
>75%	1	10%			
Levallois products from final flaking surface			Types of Levallois products from core (n=10)		
0	5	50%	*Flake*	3	30%
1	4	40%	*Point*	3	30%
3	1	10%	*Overshot distal*	3	30%
			Debordant flake	1	10%
Preparatory scars final flaking surface			Preparatory scars striking surface		
1-5	4	40%	1-5	3	30%
6-10	6	60%	6-10	4	40%
			11-15	3	30%

Table 4.2.7 Technological observations of Levallois cores from the St.Barnard's area (n=10).

A variety of preparatory strategies have been adopted to shape the productive surface in this final stage of preparation before discard; bipolar, convergent unipolar, and centripetal methods are all used (see Table 4.2.7). Bipolar preparation was most frequently employed (4 cores), and a single core on a Levallois flake was not prepared at all; instead, a striking platform was created on the distal end of the (? broken) flake, and a Levallois flake removed from its dorsal face, which retained the convexities necessary for Levallois production from the core it had itself been removed from. A single removal adjacent to the Levallois flake scars may reflect minimal shaping of this expedient flaking surface, and the product itself overshot the end – essentially failing (see Figure 4.2.17).

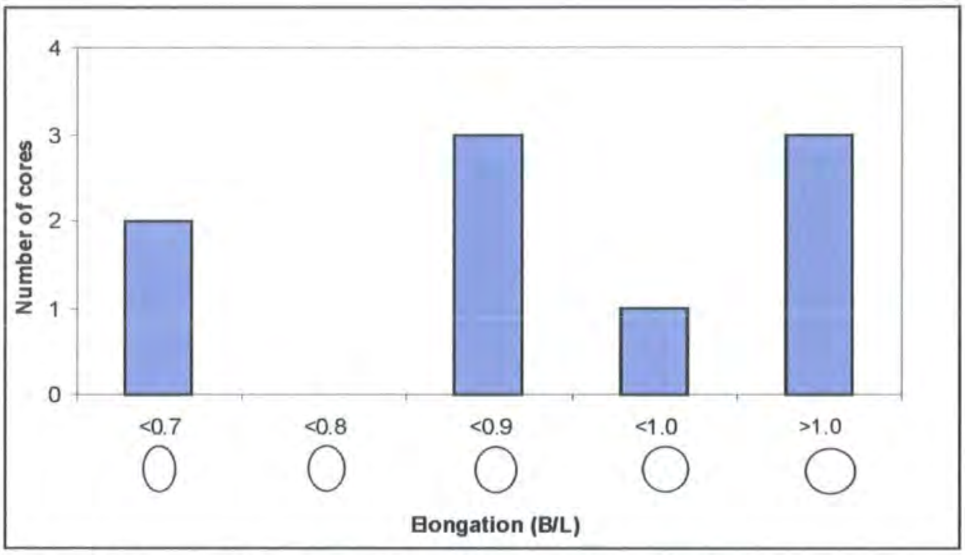

Figure 4.2.15 Elongation of Levallois cores from the St. Barnard's area of Creffield Road (n=10).

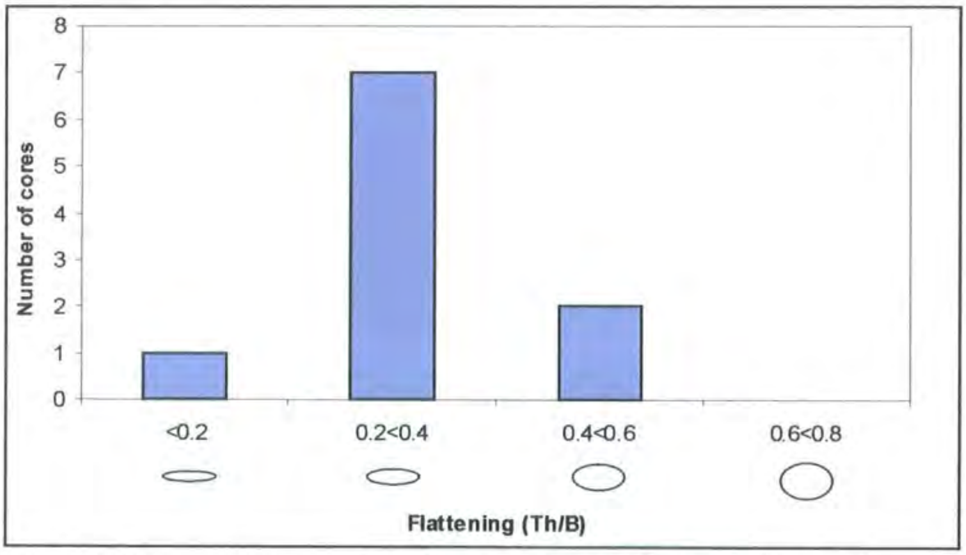

Figure 4.2.16 Flattening of Levallois cores from the St. Barnard's area of Creffield Road (n=10).

Overall, final preparation is not extensive and no core retains more than 9 preparatory scars. The surfaces are generally shaped continuously; only two cores retain evidence of the deliberate accentuation of the distal and lateral convexities, using a smaller series of semi-invasive removals. The striking platform surfaces are generally more extensively worked, some (3) retaining between 11 to 14 scars. Only three retain substantial (>50%) amounts of cortex (or relict ventral), and the fact that the scars that are retained are frequently merely the distal end of large flake scars seems to support the fact that these cores are very exhausted and have been subjected to a number of cycles of flaking surface re-preparation, the striking platform surface having been established early in the cores use-life and minimally worked since.

Of the five cores that were productive in their final phase of flaking, only one produced more than a single Levallois flake, attesting to unipolar recurrent exploitation (3 parallel removals). The productive remainder all reflect the removal of a single flake (linear exploitation of the final surface). The core which attests to unipolar recurrent exploitation of the final surface also appears to have been turned over (see Figure 4.2.17); large, flat scars interpreted as previous Levallois removals on the final striking platform surface are cut by small, steep peripheral scars concentrated at the distal and proximal ends. These convert this face to a striking platform surface, creating a striking platform and the increasing necessary distal convexity to allow the detachment of the final unipolar series of Levallois removals from the new flaking surface.

Effectively, the hierarchical relationship between the two surfaces has been reversed, but notably, between phases of exploitation. Boëda states that within "*a single production sequence of predetermined blanks, the role of the two planes cannot be reversed.*" (1990, 46), a statement which could imply that the roles are only non-interchangeable within a productive phase, but that they may change roles if the core is re-prepared in such a way that allows this between phases. However, it seems more usual for the functions of the flaking/striking platform surfaces to remain fixed throughout reduction – most Levallois cores retaining at least some cortex on the striking platform surface. Actual reversal of the striking/flaking surfaces does not appear to have been previously noted, although theoretically compatible with Boëda's (1986) volumetric definition of Levallois flaking, and probably relates to the intensive reduction of the cores from Creffield Road.

Two other cores also exhibit clear evidence for deliberate re-preparation of the final flaking surface, indicated by smaller, peripheral scars cutting invasive Levallois removals; neither of these were eventually used to produce a final Levallois flake. The small size of the single "unexploited" core from the St.Barnard's area suggests that it may also have been re-prepared but not exploited; if so, this final re-preparation has in this instance removed all traces of a previous Levallois removal. Given this visible evidence for re-preparation, it seems likely that the small, flat cores as a group may be the end result of similar recycling; this is supported by the truncated scars on the striking platform surfaces mentioned above.

The scars retained on the cores attest to the removal of a total of 10 Levallois products; three of these removals could be regarded as having failed, the flakes having overshot the distal end of the core. Such errors are the likely result of either insufficiently accentuated distal convexities or the application of excessive force to the removal of flakes from small cores, and reflect the problems inherent in trying to work such heavily reduced material. Other knapping errors are also apparent; attempted Levallois removals from two cores have terminated too soon, resulting in stepping. A single flake has taken the lateral core edge off during the single sequence of unipolar recurrent exploitation; the remainder comprise flakes and Levallois points.

There is clearly a marked disparity between the size of the final flakes removed from the cores (indeed, the cores themselves) and the Levallois flake assemblage. The final Levallois removals (5) retained on the cores range between 5-8 cm. in length; 28.1% of the whole Levallois flake assemblage does fall within this size range, but the remainder are too long (length invariably being the greater dimension for either Levallois flakes or flake scars in this instance). In terms of width, a similar pattern is apparent; flake scars retained on the cores range between 2-5 cm. in width, with only 6.3 % of the Levallois flake assemblages falling within this range. It therefore seems that although a proportion of the flake assemblage could have been produced from these cores, many are far too large; however, cores of this size were used to successfully produce Levallois products, and it seems likely, given the exhausted state of the cores and the likely large size of material available at this site, that some may have been produced earlier in their productive lives, progressive re-preparation eventually resulting in such exhaustion.

However, as noted above, it seems unusual that cores would be worked so intensively if raw material was easily available. Certainly, at other British sites of this period, where hominins are producing Levallois flakes and cores in immediate proximity to a flint source (Baker's Hole, Ebbsfleet; see Section 5.1), production tends of be maximised to a degree but not to excess – when the productive capabilities of cores are compromised, they are not re-prepared further, but discarded and reduction begun afresh. These cores are certainly on, if not beyond, the prosaic limits of exploitation – underlined by the cores which exhibit knapping errors when a final Levallois removal was attempted (overshooting, stepping). The large, cortical debitage from the St.Barnard's area does seem to suggest that material was available; this is supported by Allen Brown's observation of large flint nodules. This observation aside, the assemblage was recovered from the surface of a gravel from which material could presumably have been selected if necessary. Two possible explanations present themselves; firstly, that production was extended in order to produce a range of products with different properties and of different sizes (rather than the apparent concentration of large broad blanks apparent at other British sites of this date), or secondly, that these represent cores which have been extensively transported and used away from the

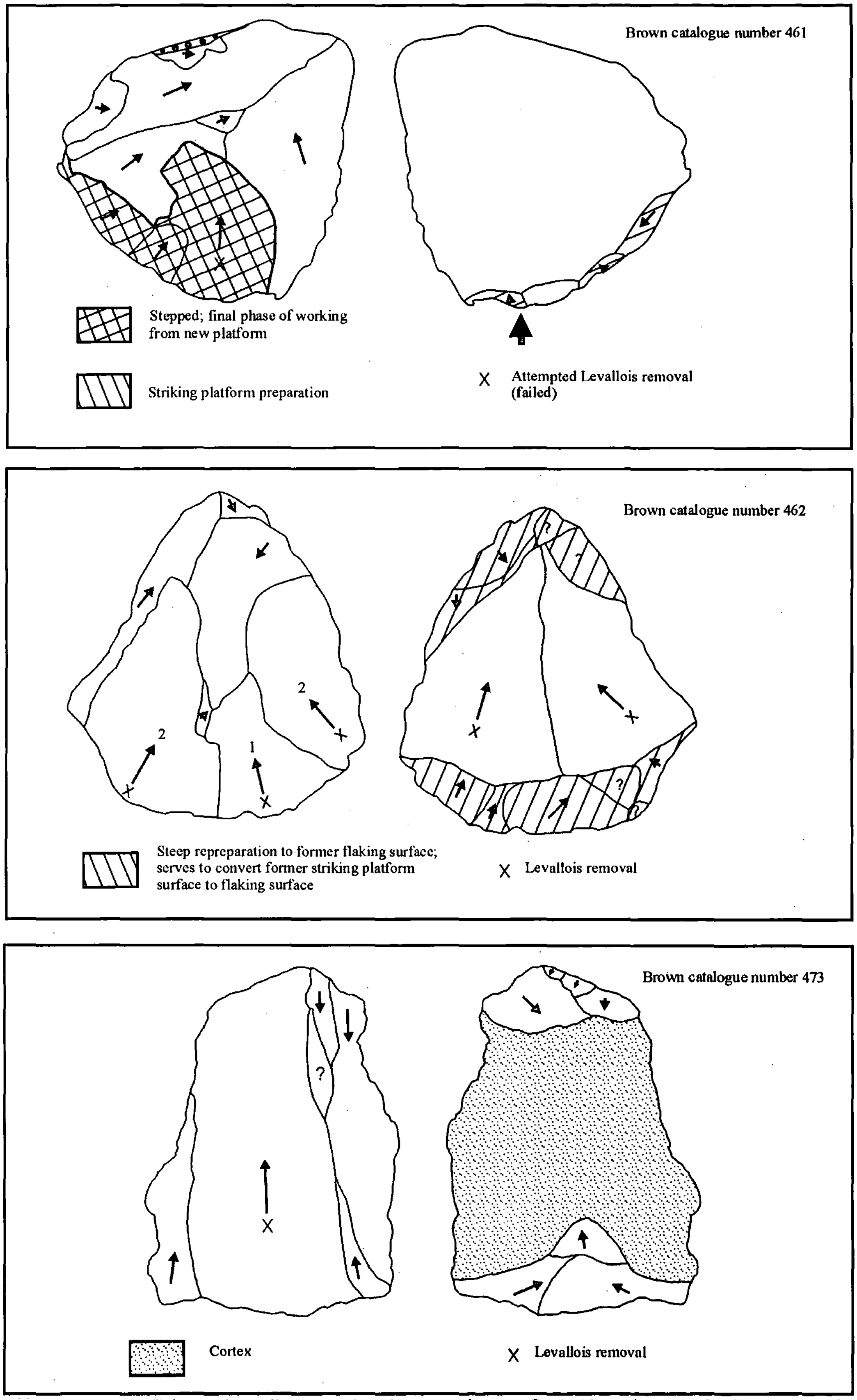

Figure 4.2.17 Exhausted Levallois cores from St. Barnard's area, Creffield Road. 461 = On flake; prepared as Levallois core but not successfully exploited. 462 = re-prepared; striking platform surface converted to flaking surface, final Levallois series unipolar recurrent. 473 = final lineal removal.

raw material available in the St. Barnard's area, only being discarded upon reaching the site when new material was once again immediately available.

Levallois flakes

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	91.12188	51.54375	12.45	0.587347
Median	91.5	50.8	12.2	0.54732
Min	46.6	36.1	7.9	0.39127
Max	140.9	70	19.1	0.922747
St.Dev	22.20867	8.151071	2.585318	0.121655

Table 4.2.8 (n=31) *Whole Levallois flakes from St. Barnard's area; summary statistics*

Seventy-nine definite Levallois flakes were recovered from the St.Barnard's area of Creffield Road. The majority of these are Levallois points (54.4%), although flakes are also present (21.5%). A typological distinction between flakes and points could not be made for many of the partial Levallois products present (see Table 4.2.9). A few metrical Levallois blades (2) and debordant flakes (2) were also collected. The flakes as a whole are of medium size, although some very large flakes were recovered (up to 14 cm. in length), and tend to be fairly elongated (43.8% where B/L= 0.5 – 0.6). Most retain no cortex (87.5%) and, as noted above, 71.9% of the whole Levallois flakes recovered from the area are too large to have come from the final surface of the cores; indeed, 19.5% of all the Levallois flakes, whole and broken (97) are larger in maximum dimension than any of the cores themselves. This suggests either that they were produced earlier in the use-life of the cores, or from other, larger cores that were not discarded in this area. However, given the intensity of reduction and obvious evidence of re-preparation of the cores outlined above, the former interpretation is favoured here.

The flakes as a whole retain relatively high numbers of dorsal scars (67.7% of whole flakes have 6-10 dorsal scars), comparable to the numbers retained on the surfaces of the exhausted cores, and reflecting fairly careful preparation of flaking surfaces. Convergent unipolar preparation strategies, indicated by dorsal scar patterns, dominate the flake assemblage (40.5%); this is clearly linked to the predominant pattern of point production, such a strategy favouring the removal of products that terminate where preparatory scars converge (Boëda 1982). Bipolar preparation is also strongly represented (34.2%), again closely related to point production in other contexts, where detachment of a pointed endproduct is encouraged by the deliberate creation of a guiding arête at the distal end of the flaking surface (Van Peer 1992, 41). Unipolar and centripetal preparatory methods are also represented (see Table 4.2.9).

Levallois flakes from the St.Barnard's area; technological observations (n=79)					
Type of endproduct			Butt type		
Flake	17	21.5%	*Plain*	11	13.9%
Point	43	54.4%	*Dihedral*	2	2.5%
Blade	2	2.5%	*Facetted*	35	44.3%
Debordant	2	2.5%	*Missing*	16	20.3%
Point or flake -			*Chapeau de gendarme*		
indeterminate	15	19.0%		11	13.9%
			Obscured	4	5.1%
Raw material			Cortex retention (n=31)		
Indeterminate	73	92.4%	*0%*	27	87.5%
Fresh	0	0%	*1 – 10%*	1	3.1%
Derived	6	7.6%	*11 – 25%*	3	9.4%
Bullhead	0	0%	*>25%*	0	0%
Method of exploitation			Direction of previous Levallois removal (n=2)		
Probably lineal	77	97.5%	*Proximal*	2	-
Unipolar recurrent	2	2.5%			
			Knapping errors (n=2), both siret fractures		
Number of preparatory scars (n=31)					
1-5	10	32.3%	2 Levallois flakes bear traces of previous Levallois		
6-10	21	67.7%	Removal		
Preparation method			Pattern of additional convexity working		
Unipolar	11	13.9%	*None*	70	88.6%
Bipolar	27	34.2%	*Distal*	2	2.5%
Convergent unipolar	32	40.5%	*Right*	4	5.1%
Centripetal	9	11.4%	*Left*	3	3.8%
Nature of convexity (n=9)			Portion		
Minimally invasive	4	-	*Whole*	31	39.2%
Semi-invasive	3	-	*Proximal*	29	36.7%
Cortical or natural	1	-	*Distal*	15	19.0%
Mixed	1	-	*Mesial*	2	2.5%
			Siret	2	2.5%

Table 4.2.9 Technological observations of Levallois flakes from the St.Barnard's area (n=79, except where otherwise stated).

Notably, a comparison of the maximum dimension (in this instance, invariably length) of whole Levallois flakes according to the preparatory method employed appears to suggest that larger flakes were more likely to be produced using a bipolar preparatory strategy; this was not used in the production of Levallois products smaller than 7 cm. in maximum dimension, where convergent unipolar preparation dominates (33.3% of whole flakes produced using this method are smaller than 7cm). Indeed, 71.4% of the flakes produced using a bipolar preparatory strategy are larger than 10 cm., in comparison with 40.5% of the flakes prepared using convergent unipolar removals. Furthermore, 14.3% bipolar flakes are larger than 12 cm, compared to none of the convergent unipolar ones. This suggests that, in this instance, unipolar convergent techniques are variably employed, but bipolar preparation is more likely to be used for the removal of larger flakes.

This could be related to the need to accentuate the distal convexity, and hence favour successful point detachment, earlier in the reduction history of the cores; convergent preparatory removals across a large initial flaking surface may not have been long enough to reach each other without removing excessive amounts of material. Deliberate working from the distal end would serve to correct this problem. Smaller flaking surfaces could more easily be worked using a convergent unipolar method without removing excessive amounts of material. This pattern could therefore be interpreted as reflecting a shift in the preparatory strategies employed to produce Levallois points throughout core reduction - from bipolar to convergent unipolar techniques – and is significant as it suggests that, of the variety of options available to produce quantities of variable Levallois products, methods were chosen throughout reduction to favour the removal of pointed endproducts. This suggests that, in this instance, points were deliberately produced and desired endproducts.

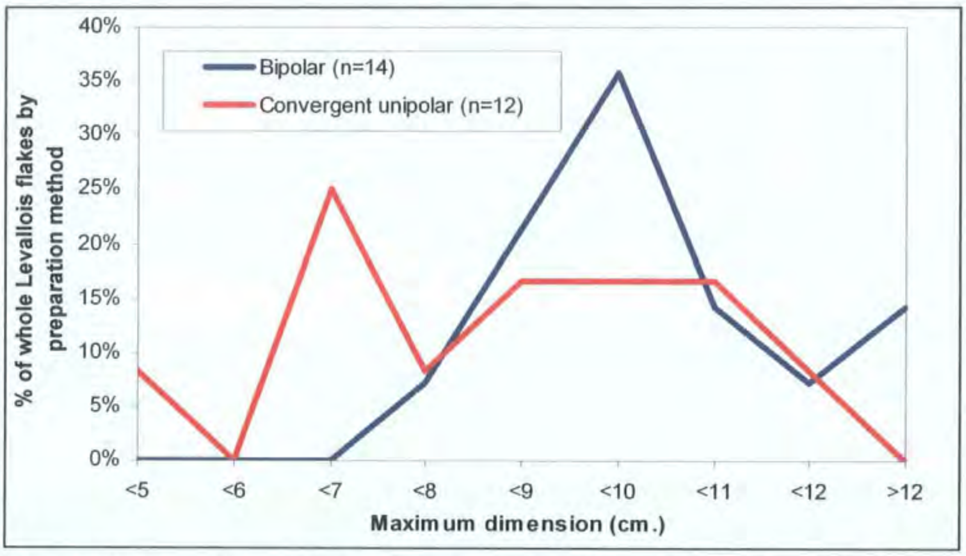

Figure 4.2.18 Comparison of maximum dimension of whole Levallois flakes by preparatory strategy (excluding centripetal and unipolar; n=30).

Many of the Levallois flakes have facetted butts (44.3%), together with a notable proportion with carefully prepared "*Chapeau de gendarme*" butts (13.9%); most flakes which retain their butts therefore attest to platform preparation, although this was not always employed. The use of "*Chapeau de gendarme*" preparation in particular reflects very deliberate preparation of an isolated area of the platform to receive the blow necessary to detach a Levallois product. Given that preparatory strategies geared towards point production dictate that a very specific flaking axis is exploited (to utilise the distal convexity emplaced either by previous convergent removals or working from the distal end), the choice of this form of platform preparation - favouring restricted placement of the percussor - could be seen as concomitant to using such techniques. The vast majority of the Levallois products show no evidence of having been preceded by another Levallois removal, and none can be said to have prevented the removal of a subsequent flake; they are therefore interpreted as resulting from probable lineal exploitation of the flaking surface.

However, as Levallois point production is frequently linked to recurrent exploitation of a given flaking surface – Levallois removals functioning in a predetermined and predetermining manner to continuously recreate the convexities necessary for further exploitation (Boëda 1982, 1986) – they cannot be stated to definitely represent the only products of a given flaking surface. However, given the under-representation of debordant flakes within the collection, a possible explanation presents itself: although removals that allow recurrent Levallois exploitation are both predetermining and predetermined, in this instance they are not desired endproducts – unlike the points which dominate the assemblage. Only two debordant flakes are present. That they would have been produced and should be present can be inferred from the frequent use of convergent unipolar preparation; the converging scars are the result of flakes taken off along the edges of the cores. These can therefore be regarded as "missing in action" – having been discarded away from the current area. Boëda regards such removals as Levallois removals because of their dual nature – predetermined/predetermining – in an attempt to circumvent the issue of what represents an intended product (Boëda 1986, 26). However, in this instance, and in combination with the use of preparatory methods favouring the removal of endproducts with convergent edges throughout reduction, it seems that at Creffield Road Levallois points can be regarded as the desired (if not the only) products of Levallois reduction, regardless of whether the intervening (missing) debordant flakes are viewed as Levallois products from a continually exploited flaking surface, or as serving to prepare the surface for the removal of a single, preferential Levallois point.

Levallois points have historically been identified as weapon armatures based on an analogy of form; Allen Brown himself (1889) described the flakes from Creffield Road as spear heads. However, simplistic correlations between perceived form and inferred function are difficult to sustain, and the relationship between the morphology of Levallois points and the methods used to produce them have also been debated – whether points represent intended endproducts, or whether they are one amongst a variety of intended and utilised products of the reduction strategy adopted (Boëda 1982). In this instance, given the lack of debordant flakes, which are utilised in other contexts (Beyries and Boëda 1983), it seems reasonable to infer that the points were intended endproducts, produced outside the St.Barnard's area, then transported into and discarded there.

The potential use of Levallois points as weapons heads has been extensively debated (Shea 1988, 1989, 1990, 1993, 1995, 1997; Shea *et al* 2001; Holdaway 1989, 1990; Solecki 1992; Plisson and Beyries 1998) and in some cases archaeologically demonstrated, notably through the discovery of a Levallois point embedded in the cervical vertebra of a wild ass from Um El Tlel, Syria (Boëda *et al.* 1999). A number of approaches have been adopted in order to interpret Levallois point function in variety of contexts (although few European studies have been undertaken), including the identification of impact and hafting wear (Shea 1993; the latter is obviously not uniquely referable to weapon heads, Plisson and Beyries 1998), ratios of points to tips in comparison with Paleo-Indian projectile point discard patterns (Holdaway 1989) and experimental work aimed at establishing the optimal configuration of Levallois point shape and size to function as the armature of a thrusting spear (Shea *et al.* 2001).

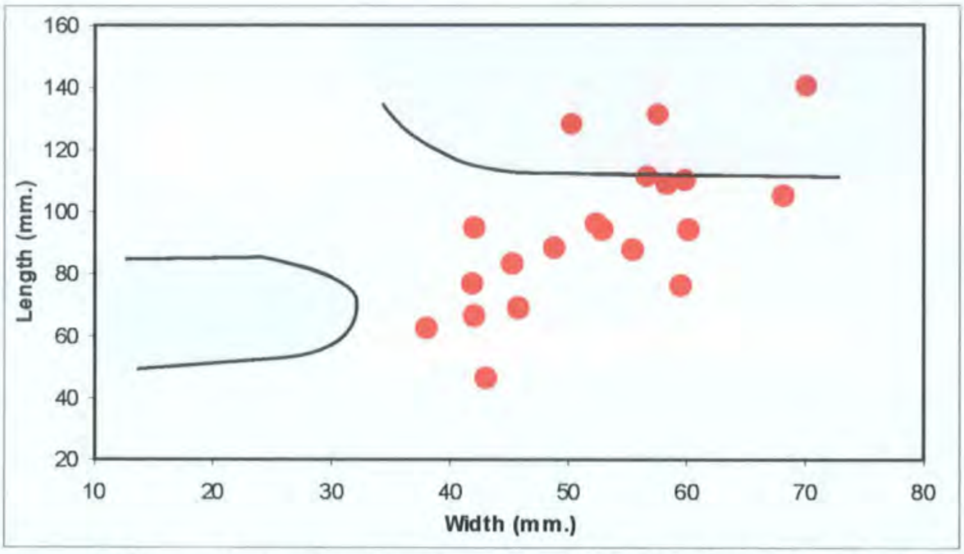

Figure 4.2.19 Scatterplot of the dimensions of whole Levallois points from the St. Barnard's area (n=20) plotted against the limits defined for optimal Levallois point size/shape configuration to avoid breakage during experimental use as a thrusting spear; shaded areas represent zones within which breakage is likely (Shea et al. 2001, 812).

Clearly, the edge damage sustained by the St.Barnard's material at two points in its taphonomic history militates against use-wear analysis as a possible means of investigating the function of the points recovered there. Moreover, the actual nature of damage uniquely referable to use as a weapon head is debated, even for better-preserved material (Shea 1989, Plisson and Beyries 1998). When the dimensions of the whole Levallois points from St. Barnard's were plotted against the experimentally defined limits for optimal function as the weapon-head of a thrusting spear (as defined by Shea *et al.* 2001), the majority (14) fall within the optimal zone (Figure 4.2.19). These are relatively broad, and when hafted, would provide a secure link between the point, the handle, and mastic used to bed it, thus resisting rolling and dispersing torsional forces into the haft (Shea *et al.* 2001, 812). A further 3 rest on the upper limit (towards flakes which are too large and therefore prone to break), and none tend to be small and narrow (a configuration also prone to breakage). Whole Levallois points from the St.Barnard's area could arguably have been used as weapon heads; however, whether this was their actual or only function remains unresolved.

Most of the Levallois points from the St.Barnard's area are broken (23); 16 of these have patinated breaks, the remainder having broken more recently (through excavation, collection practices and the renewed movement suggested for the entire St.Barnard's assemblage). Two of these have split along their long axis, and probably represent siret fractures during knapping, but it is impossible to state when the remaining flakes were broken. Points which have broken in the course of use as weapon heads tend to snap laterally (Holdaway 1989) and therefore lose their distal end; in ethnographic contexts, hafted projectiles are frequently re-sharpened or replaced following breakage (Flenniken and Raymond 1986), leading to an over-representation of proximal pieces at location where armature maintenance was undertaken (Keeley 1982). It has therefore been suggested that sites with more proximal than distal ends of points reflect the fact that such products had a projectile function (Holdaway 1989, 80). Of the 14 laterally snapped points with patinated breaks from the St. Barnard's area, 11 are distal fragments and only three proximal. However, as noted above, no typological distinction could be made between flakes and points for many of the partial Levallois products, this being particularly true of proximal ends. When all Levallois endproducts are included, (32 with patinated lateral breaks), there are 20 proximal pieces to 11 distal (together with a single mesial fragment). Arguably, this may reflect a situation where hafted products are being removed from their armatures and replaced.

All Levallois flakes with patinated lateral snaps	32
Distal	11
Proximal	20
Mesial	1
Levallois points with patinated lateral snaps	14
Distal	11
Proximal	3

Table 4.2.10 Proportions of Levallois products with patinated lateral snaps from the St. Barnard's area.

Flake Tools

Only 6 flakes from the St. Barnard's area have been retouched. Four of these are on Levallois flakes, two of which have thinned butts (see Figure 4.2.20). Platforms were prepared on the proximal end (obscuring whether this was on a break or not) to allow invasive flaking into either the dorsal or ventral surface, serving to thin the proximal end of the flake. Flakes that have been modified in this way have previously been described as "truncated-facetted" – the secondary working being located at any point around the perimeter of the flake (Nishiaki 1985), or have been explicitly compared with Kostienki truncations (Turq and Marcillaud 1976). A further non-Levallois flake has also been treated in a similar manner; this also has minimally invasive scaly retouch to its distal end and right edge (see Figure 4.2.21). The remainder retain variable amounts of scaly retouch, reflecting the transformation and strengthening of edges to accomplish a variety of unknown tasks.

Nature of retouch on modified flakes (n=6)			
Position		Location	
Direct	2	*Proximal*	2
Inverse	1	*Right*	1
Alternating	2	*Both edges*	1
Alternating and direct	1	*Proximal, distal and right*	1
		Proximal and left	1
Distribution		Edge form	
Continuous	3	*Rectilinear*	3
Partial	3	*Convex*	2
		Rectilinear and convex	1
Extent of retouch		Angle of retouched edge	
Minimally invasive	2	*Semi-abrupt*	2
Semi-invasive	2	*Low*	3
Invasive	1	*Abrupt, low and semi-abrupt*	1
Invasive and minimally invasive	1		
Regularity of retouched edge		Morphology of retouch	
Obscured by damage	2	*Scaly*	6
Regular	1		
Irregular	2	On Levallois flake?	4
Irregular and regular	1		
		Thinned butts	3

Table 4.2.11 Nature of retouch on modified flakes from the St. Barnard's area.

The three flakes with deliberately thinned proximal ends ("truncated-facetted) are significant. These may have been deliberately thinned to accommodate their fitting into a haft, either when originally mounted or during equipment maintenance (mounted armatures tending to become less securely fixed during use). However, whether they were hafted as weapon armatures or hafted tools – potentially knives (*cf.* Plisson and Beyries 1998) – remains debatable. The single non-Levallois flake that has been modified in this way is also significant; the end opposite the thinned area may have been transformed into a pointed form through retouch. However, whether any of these artefacts actually were hafted remains a matter of conjecture, the taphonomic processes undergone by the material having damaged the surfaces and removed any potential traces of hafting.

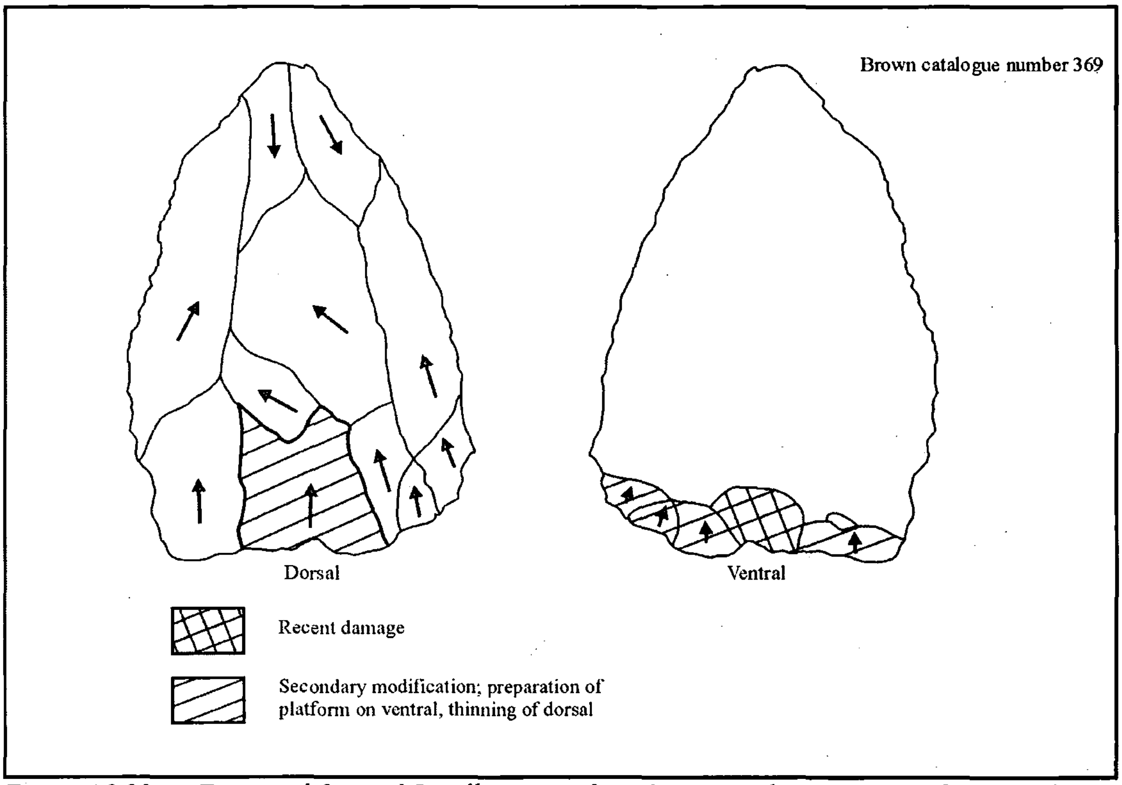

Figure 4.2.20 Truncated-facetted Levallois point from St. Barnard's area; a single removal into the dorsal surface from a platform prepared at the base serves to thin the proximal end.

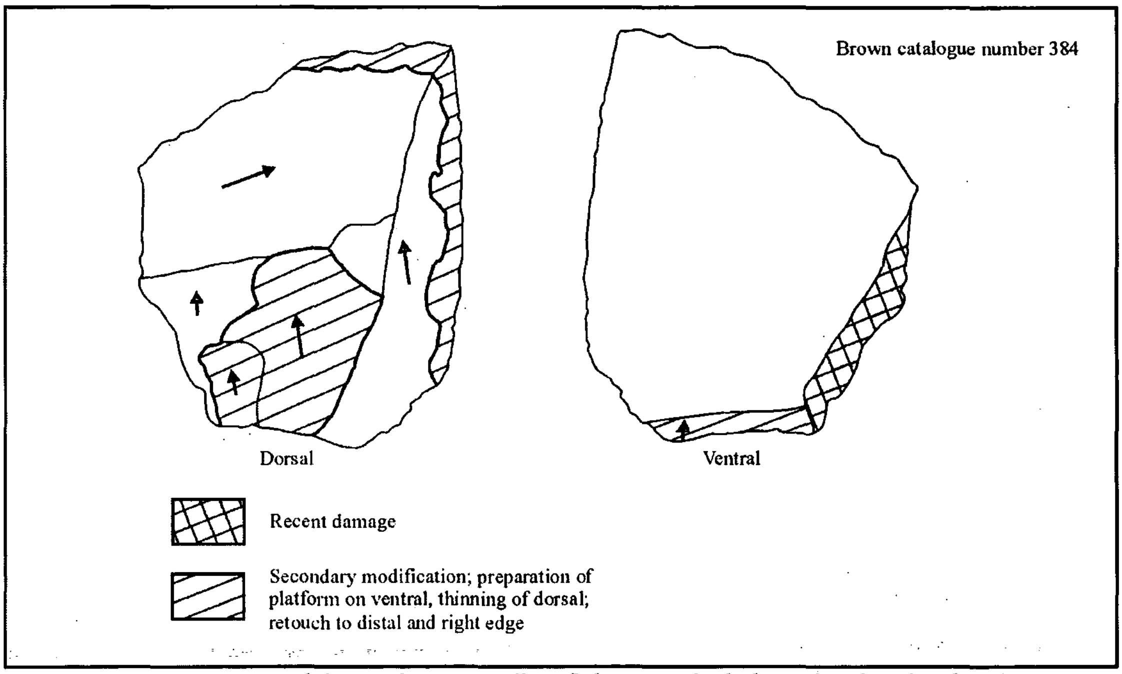

Figure 4.2.21 Truncated-facetted non-Levallois flake retouched along distal and right edge.

Non-Levallois cores

Two non-Levallois cores were recovered from the St. Barnard's area, both of which are on flakes. One (Brown number 454) has had a single flake removed from the dorsal surface, from a minimally prepared platform on the left edge, whilst the other (Brown number 468) is volumetrically discoidal in its discarded state, but approaches the Levallois form in the final configuration of its dorsal surface. Flaking into the ventral surface formed a platform for the removal of four small flakes from around the edges of the dorsal surface. Although not a Levallois core in volumetric terms, this could be interpreted an attempt to implement the criteria necessary for the removal of a Levallois flake, in a similar way to the Levallois core on a flake described above. However, although it is impossible to interpret intent in this way, both non-Levallois cores reflect the same concerns of raw material economy apparent from the Levallois core assemblage.

The School Site

As the School Site assemblage is technologically and taphonomically similar to that from the St.Barnard's area discussed above, and potentially less contextually secure, it has been treated in less detail. The technological characteristics for all objects are presented in tables hereafter, and the following discussion is intended to emphasise the similarities and differences between two parts of essentially the same assemblage for comparative purposes.

Raw material

Raw material	Levallois cores (n=5)	Debitage and all Levallois flakes (n=118)	% Debitage and all Levallois flakes
Fresh	2	17	14.4%
Derived	1	20	16.9%
Indeterminate	2	81	68.6%

Table 4.2.12 Raw material type for artefact from the School Site area.

Whilst again raw material cannot be determined for the majority of the School site collection, material from various sources is present, from flint fresh from the chalk to chatter marked pebbles (Table 4.2.12).

Levallois cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	64.78	57.1	23.22	0.915848	0.414084
Min	60	57.8	22.1	0.963333	0.382353
Max	51.8	46.7	20.6	0.572304	0.31307
St.Dev	81.6	65.8	26.6	1.15035	0.537473
Median	12.29114	6.82129	2.519325	0.235639	0.085405

Table 4.2.13 Levallois cores summary statistics (n=5).

The five small cores from the School Site are as heavily reduced as the material considered above from the St.Barnard's area, reflected in their small size and degree of flattening (Table 4.2.13), as well as technological indications of extreme reduction. This includes the re-preparation of small final flaking surfaces (unexploited in one case), and the failure of a final Levallois removal (Table 4.2.14). Again, the retention of the proximal ends of larger flake scars on the striking platform surface indicates shaping of the striking platform surface earlier in the productive history of the cores, the final phases of working being concentrated towards re-shaping the flaking surface.

Levallois cores from School Site; technological observations			
Preparation method (n=5)		Exploitation method (n=5)	
No indication	1	*Lineal*	3
Convergent unipolar	1	*Re-prepared but unexploited*	1
Centripetal	3	*Failed lineal*	1
Convexities (n=5)		Type of convexity working (n=1)	
Whole surface shaped as one	4	*Steep*	1
All edges	1		
Blank type (n=5)		Distribution of preparatory scars striking surface (n=5)	
Probably nodule	3	*All over*	4
Indeterminate	2	*Proximal and one edge*	1
Type of striking surface working (n=5)		Position of cortex on striking surface (n=5)	
Invasive	3	*None*	3
Semi-invasive	1	*Central and one edge*	1
Steep	1	*One edge*	1
% Cortex striking surface (n=5)		Total number Levallois products from cores (n=5)	
0	3	0	1
1-25%	1	1	4
26 – 50%	1		
Levallois products from final flaking surface (n=5)		Types of Levallois products from core (n=4)	
0	1	*Flake*	1
1	4	*Point*	1
		Debordant flake	1
		Debordant and overshot	1
Preparatory scars final flaking surface (n=5)		Preparatory scars striking surface (n=5)	
0	1	1-5	1
1-5	3	6-10	3
6-10	1	11-15	1

Table 4.2.14 Technological observations of Levallois cores from the School Site (n=5).

Two cores have been turned and the previous striking platform surface (indicated by very large, invasive removals running across the surface) converted into a flaking surface using steep peripheral flaking immediately prior to discard. Again, this effectively equates to the reversal of the hierarchical relationship between the striking platform and flaking surface. According to Boëda's formulation of the Levallois concept, these surfaces are functionally non-inter-changeable (Boëda 1986, 1995). Convergent unipolar or centripetal techniques were used to shape the flaking surfaces, to allow the removal of final single flakes, with varying amounts of success (see Table 4.2.14). As in the St. Barnard's area, therefore, the cores have been worked to (and in some cases beyond) the prosaic limits of reduction before discard.

Levallois flakes

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	74.59063	49.55938	11.95313	0.692411
Median	71.1	47.85	11.7	0.693734
Min	53.5	33.6	6.9	0.385353
Max	125.6	68.3	16.8	1.085386
St.Dev	17.35285	9.514026	2.241541	0.183649

Table 4.2.15 Whole Levallois flake from School site; summary statistics (n=32).

Similarly to the St. Barnard's assemblage, the Levallois flakes from the School Site also tend to be larger than any of the cores recovered, let alone the final Levallois flake scars retained on the flaking surfaces of the cores (see Table 4.2.15). Points again make up a large proportion of the flake assemblage, produced using a range of preparatory strategies similar to those employed to produce the St. Barnard's material (see Table 4.2.16), although unipolar preparation is more highly represented (29.5% rather than 13.9%). Plotting whole flakes by preparation method again indicates that convergent unipolar - and in this instance also unipolar - techniques are more likely to be employed when producing smaller flakes, with a slight suggestion that bipolar preparation is favoured for the largest flakes present (Figure 4.2.22). Given that the whole Levallois flakes from the St. Barnard's area include much larger examples than from the School Site, (31.3% of the St. Barnard's whole Levallois flakes being greater than 10 cm. in maximum dimension, in comparison to only 9.4% of whole Levallois flakes from the School Site; see Figures 4.2.11 and 4.1.12), the fact that bipolar preparation is less highly represented at the School Site could simply reflect the fact that fewer large flakes – the removal of which seem to be favoured by the use of this technique – are present.

Levallois flakes from School site; technological observations					
Type of endproduct (n=44)			Butt type (n=44)		
Flake	21	47.7%	*Plain*	10	22.7%
Point	15	34.1%	*Dihedral*	2	4.5%
Blade	6	13.6%	*Marginal*	1	2.3%
Debordant	1	2.3%	*Facetted*	20	45.5%
Point or flake –			*Chapeau de gendarme*		
indeterminate	1	2.3%		7	15.9%
			Obscured	1	2.3%
			Missing	3	6.8%
Raw material (n=44)			Cortex retention (n=32)		
Indeterminate	37	84.1%	*0%*	26	81.3%
Fresh	4	9.1%	*1 – 10%*	4	12.5%
Derived	3	6.8%	*11 – 25%*	2	6.3%
Bullhead	0	0.0%	*>25%*	0	0.0%
Method of exploitation (n=44)			1 knapping error – overshot and debordant flake		
Lineal	2	4.5%			
Probably lineal	42	95.5%			
Number of preparatory scars (n=32)			Preparation method (n=44)		
1-5	20	62.5%	*Unipolar*	13	29.5%
6-10	12	37.5%	*Bipolar*	9	20.5%
			Convergent unipolar	18	40.9%
			Centripetal	4	9.1%
Pattern of additional convexity working (n=44)			Nature of convexity (n=7)		
None	37	84.1%	*Minimally invasive*	1	-
Distal	3	6.8%	*Semi-invasive*	1	-
Right	4	9.1%	*Cortical or natural*	5	-
Portion (n=79)			7 have patinated breaks; all of these are proximal ends		
Whole	32	39.2%			
Proximal	11	36.7%			
Distal	1	19.0%			

Table 4.2.16 Technological observations of Levallois flakes from the School Site (n=44).

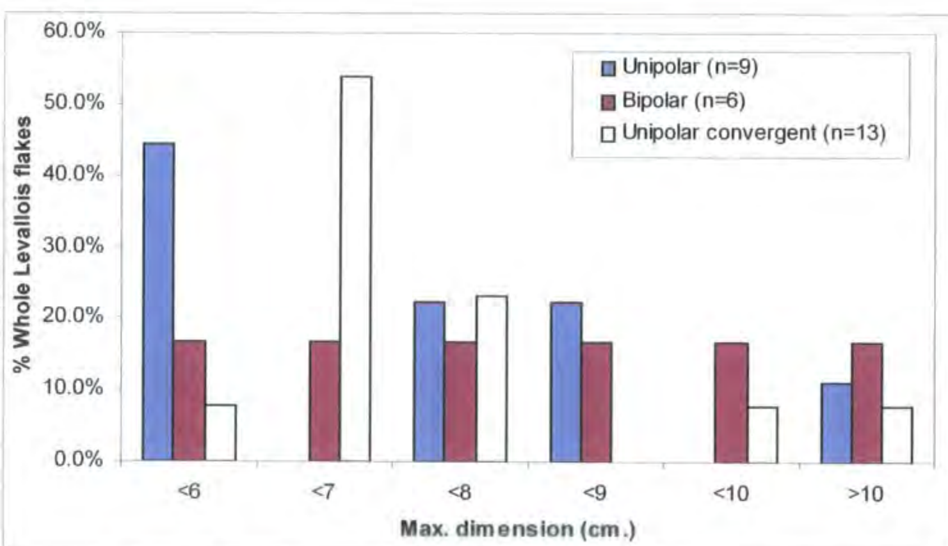

Figure 4.2.22 Maximum dimension of whole Levallois flakes grouped by preparation method (excluding centripetal; n=4).

Again, the platforms of most Levallois flakes have been carefully prepared (61.4%, Facetted or *Chapeau de Gendarme*; see Table 4.2.16) and none retain any indications of a previous Levallois flake being removed from the same flaking surface, probably therefore resulting from lineal exploitation of the flaking surfaces from which they were struck. Again, only a single debordant flake resulting from the preparation of such flaking surfaces is present, suggesting that this process may have taken place off-site, Levallois products having been subsequently imported into the School Site. As in the St. Barnard's area, most (13 of 15) whole points fall within experimentally-defined limits for optimal function as a thrusting spear (see Figure 4.2.23), and all the Levallois products present at the site with patinated breaks are proximal ends (See Table 4.2.16), again potentially suggesting the removal and replacement of hafted products from armatures.

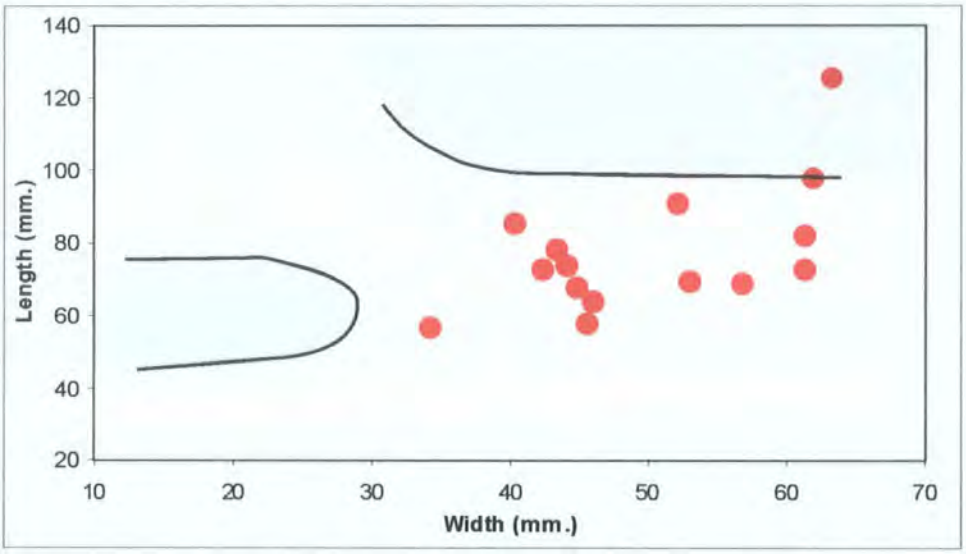

Figure 4.2.23 Scatterplot of the dimensions of whole Levallois points from the School Site (n=15) plotted against the limits defined for optimal Levallois point size/shape configuration to avoid breakage during experimental use as a thrusting spear; shaded areas represent zones within which breakage is likely (Shea et al. 2001, 812).

Flake tools

All the flake tools recovered from the School Site were on Levallois (or probable Levallois) flakes; five of these had thinned butts, and three exhibited additional modification of at least one edge, usually in the form of scaly scraper retouch. Fewer modified flakes were recovered from the St.Barnard's area, from which a larger assemblage was recovered. The modified flakes from the School Site amplify the patterns apparent from analysis of the St.Barnard's material; not only may deliberate thinning of the proximal end of Levallois products potentially reflect the fact that they were hafted, but the additional modification of other edges might imply they were also transformed and re-worked in the haft to accomplish a variety of tasks.

Nature of retouch on modified flakes (n=8)			
Position		Location	
Direct	3	*Proximal*	2
Alternating	2	*Right*	1
Alternating and inverse	2	*Both edges*	2
2 alternating sequences and direct	1	*Proximal, distal and right*	1
		Proximal and distal	2
Distribution		Edge form	
Continuous	3	*Rectilinear*	2
Partial	4	*Convex*	1
Partial and continuous	1	*Denticulated*	2
		Denticulated and convex	3
Extent of retouch		Angle of retouched edge	
Minimally invasive	3	*Semi-abrupt*	2
Minimally and semi-invasive	3	*Low*	1
Marginal and semi-invasive	1	*Semi-abrupt and low*	4
Invasive and minimally invasive	1	*Abrupt, semi-abrupt and low*	1
Regularity of retouched edge		Morphology of retouch	
Regular	3	*Scaly*	8
Irregular	2		
Irregular and regular	3	On Levallois flake?	8
		Thinned butts	5
		Thinned butts and other retouch	3

Table 4.2.17 Nature of retouch on modified flakes from School Site.

Handaxes

A single handaxe was recovered from the School Site; in contrast to the majority of the flake assemblage, this is very heavily patinated and unstained, with light surface scratching, though only lightly edge damaged. It is planoconvex and asymmetrical in form, having being shaped using an initial series of bold soft hammer removals, a single straight edge having been created through a second, less invasive episode of bifacial working (see Figure 4.2.24). It retains no markings indicating the depth from which it was recovered; given the problems of contextual integrity apparent for the School Site collection as a whole and that it contrasts with the Levallois material from this area in terms of surface condition, it may have been recovered from a different level.

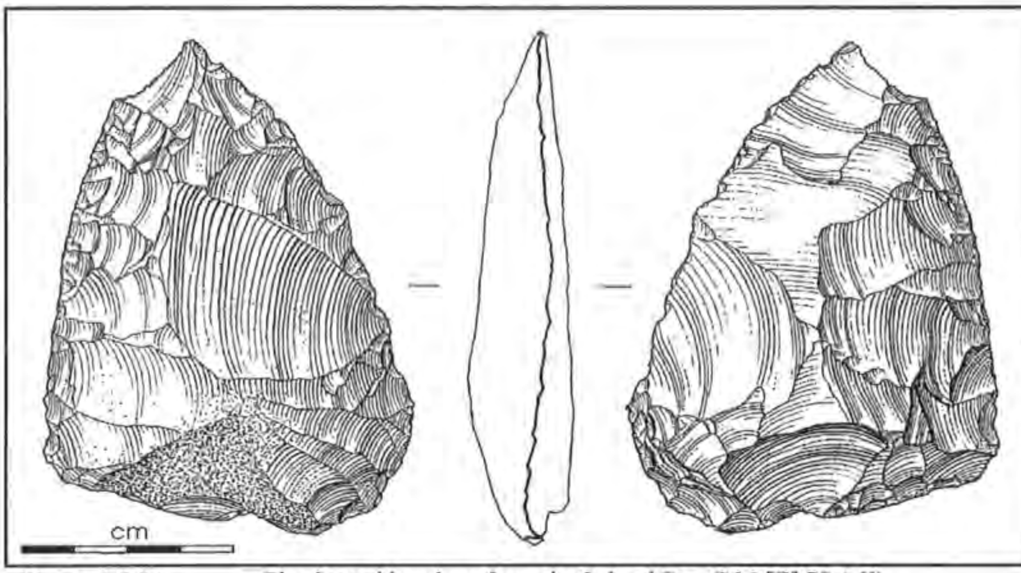

Figure 4.2.24 *Flat-butted handaxe from the School Site (BM [F]CRA II).*

Technology and hominin behaviour at Creffield Road

Given the immediate availability of large nodules of fresh flint at Creffield Road, as well as material available from the surface of the gravel itself, the technological activities undertaken at Creffield Road differ from those apparent at other early Middle Palaeolithic sites located on sources of raw material. Certainly, initial core working of very large, minimally abraded flint nodules was undertaken in the St. Barnard's area, suggested by the presence of very large debitage and the cortex it retains. This initial decortication does not seem to have been undertaken at the School Site, where such material is lacking, perhaps reflecting local variation in the immediate availability of such material and the activities undertaken in relation to it. However, both sites produced material from the opposite end of the reduction spectrum, in the form of very heavily reduced Levallois cores. Given the apparent availability of workable material, the state of the cores at discard is notable; at all other early Middle Palaeolithic sites situated on raw material sources, it seems that cores are abandoned once their ability to produce Levallois flakes is compromised, either by the reduction in size of potential products or the likelihood of knapping errors. In contrast, the Creffield Road cores have been worked at least to – if not beyond – the practical limits of reduction; some have been abandoned at the site re-prepared but unexploited, a final removal has been attempted from others – with varying degrees of success. Certainly, the potential products available from them differ markedly from the Levallois flake assemblage, which predominantly comprises large Levallois points.

It seems likely that these cores may have been abandoned at Creffield Road having been transported and used elsewhere; given that raw material was available at the site, such extreme reduction would not have been necessary, and was not prolonged in this way at similar locales. Other material is also missing which should be present had all stages of reduction been undertaken at the site; notably, the debordant flakes necessary for the production of Levallois points using convergent unipolar preparation. It is interesting that such products have been recovered from "off-site" contexts in fine-grained sediments; a small number of classic debordant flakes and probable core edge flakes were recovered Site N at Maastricht-Belvédère (Roebroeks *et al.* 1992). Given that these do not refit to any other material from the site, they have previously been interpreted as deliberately produced and utilised endproducts; however, it seems equally possible that they might represent the by-products of Levallois point production, the points themselves being the desired endproducts in this instance. The lack of debordant flakes at Creffield Road suggests that many of the Levallois points present also entered the site in finished form. The Levallois flake assemblage as a whole suggests that in this instance points were very much intended endproducts; preparatory strategies were used throughout core reduction which favoured the removal of such forms – bipolar preparation being used when working larger flaking surfaces, unipolar (especially convergent) strategies being used later on when flaking surfaces were reduced in size.

Modified flakes from Creffield Road suggest that at least a proportion of these endproducts may have been hafted; thinning of the butts of Levallois products may have been undertaken to allow them to be fixed into a shaft. Several Levallois flakes with such basal thinning additionally retain retouch around other edges, reflecting transformation of the flake blank to meet a variety of needs. Additionally, the over-representation of the proximal to distal ends of Levallois points could also be seen as suggesting that a number of Levallois products were actually entering the site already broken, but retained in the haft, being removed and replaced at Creffield Road. Whether these potentially-hafted Levallois points represent spear armatures or hafted knives remains a matter of conjecture; however, what is apparent is the transport and transformation of such blanks and their discard at this site, as well as the potential maintenance of a curated tool kit, if the over-represented proximal ends are viewed as having been removed from shafts and replaced.

Creffield Road can therefore be viewed primarily as a point at which elements of hominin toolkits were discarded – primarily endproducts, whether hafted and/or retouched or not, and exhausted cores – and at which the initial stages of core preparation were undertaken. Tool maintenance activities of two orders were potentially undertaken; the actual, physical maintenance of particular types of equipment – for instance, replacing damaged armatures – and the replacement of transported cores with the potential to produce a variety of products. The assemblage also reflects the co-occurrence of both Levallois core and flake transport, allowing flexibility on two levels – in terms of how endproducts are modified and what endproducts are produced in the context of movement. Therefore, although only representing a single point in a given landscape, it does allow some inferences to be drawn about approaches to exploiting this landscape. Clearly, hominins were moving around equipped to deal with future needs on an immediate level - as they appear to have been carrying functionally available products in the form of hafted points – and on a longer-term basis, being equipped to produce more such products easily when required.

Similar patterns have been suggested for sites located on the plateau edges of the Southern Limberg in the Netherlands; here material resulting from the primary preparation of cores co-occurs with extremely exhausted cores and a variety of retouched tools, the nature of which varies between sites (Kolen *et al.* 1998). These have been interpreted as locations where hominins may have provisioned themselves with raw material before venturing into the Maas valley below, where they primarily engaged in subsistence activities, for which a predictable strategy of Levallois core and flake transport was favoured. The contrast between the sites on the higher ground are viewed as reflecting different activities undertaken at the sites – which may have additionally functioned as monitoring points – such as tool maintenance.

Creffield Road can be viewed as similarly linked to the exploitation of the surrounding landscape, the structure and nature of which is in this instance unknown. It does, however, reflect the predominant strategies of point production, transport, modification and potentially hafting, as well as the transport of Levallois cores as a source of such points. These were only discarded at locations where raw material was available. It is also likely that, if the terrace surface was targeted as an exposed terrace flat on the valley side after downcutting during OIS 8, it would have overlooked the floodplain during OIS 7 and could therefore have allowed views out over the valley, from which prey movements could be monitored. Arguably, therefore, the technological strategies undertaken at Creffield Road reflect anticipatory behaviour on a threefold level; firstly, in being prepared to immediately respond to whatever opportunities present themselves (travelling equipped), provisioning with the material necessary to maintain this tool kit (transporting cores), and knowledge of the long-term availability of the material necessary to replace such material in the landscape.

4.3 West London; Yiewsley area.

Introduction

Levallois artefacts have been recovered from a number of localities on the Lynch Hill terrace of the Middle Thames throughout West London, extending east from Slough through to Creffield Road itself in Acton. Here the Lynch Hill gravels are surmounted by fine sediments, attributed to the polygenetic Langley Silt complex (Gibbard 1985). Whilst 28 individual findspots are recorded (TERPS 1996), four have produced the majority of the Levallois technology known from the area. These include Creffield Road itself (discussed separately; see Section 4.2), and three pits among a series located between Yiewsley, Dawley and West Drayton (hereafter Yiewsley area); Boyer's, Sabey's and Eastwood's Pits. Material was initially collected from this area by John Allen Brown, with later, larger collections being made by R. Garraway Rice. Intensive quarrying between 1890 and the present day, together with changing pit ownership, means that only the position of Eastwood's pit can be determined, whilst the context of much of the material recovered from the others is unknown. However, Eastwood's Pit and other, less archaeologically productive pits investigated by Allen Brown can be located, and the level from which at least some of the Levallois material was recovered determined, based on his publications (Allen Brown 1895a, 1895b) and artefact markings indicative of recovery depth. Unfortunately, no such information exists for the extensive collections amassed by Garraway Rice.

History of Investigations

John Allen Brown collected Levallois material from many pits located between Hanwell and Iver, and explicitly noted the similarity of some of the material he collected to that from Creffield Road (Allen Brown 1895b). He collected artefacts from the Yiewsley area between 1890 and 1901 (artefact markings), and Levallois material is present within extant collections (British Museum) from five pits (Odell's, Broad and Harris, Pipkin's, Eastwood's and Maynard's). His artefact markings indicate recovery depth in feet and he also published detailed sections of Pipkin's Pit (East facing; Allen Brown 1895b, 161; Figure 4.3.2) and Eastwood's Pit (West facing; *ibid.* 163; Figure 4.3.3). Four of these productive pits can be accurately relocated, using the descriptions of their position provided by Allen Brown (1895a, 1895b) and contemporary large scale OS maps (Middlesex Sheet XV, 1:2500 series, 1895; see Figure 4.3.1).

In his account of an excursion of the Geologists Association (Allen Brown 1895a), Allen Brown describes the route taken by the group through the Yiewsley area, beginning from Hayes railway station and walking along the canal to Dawley. At this point, three active

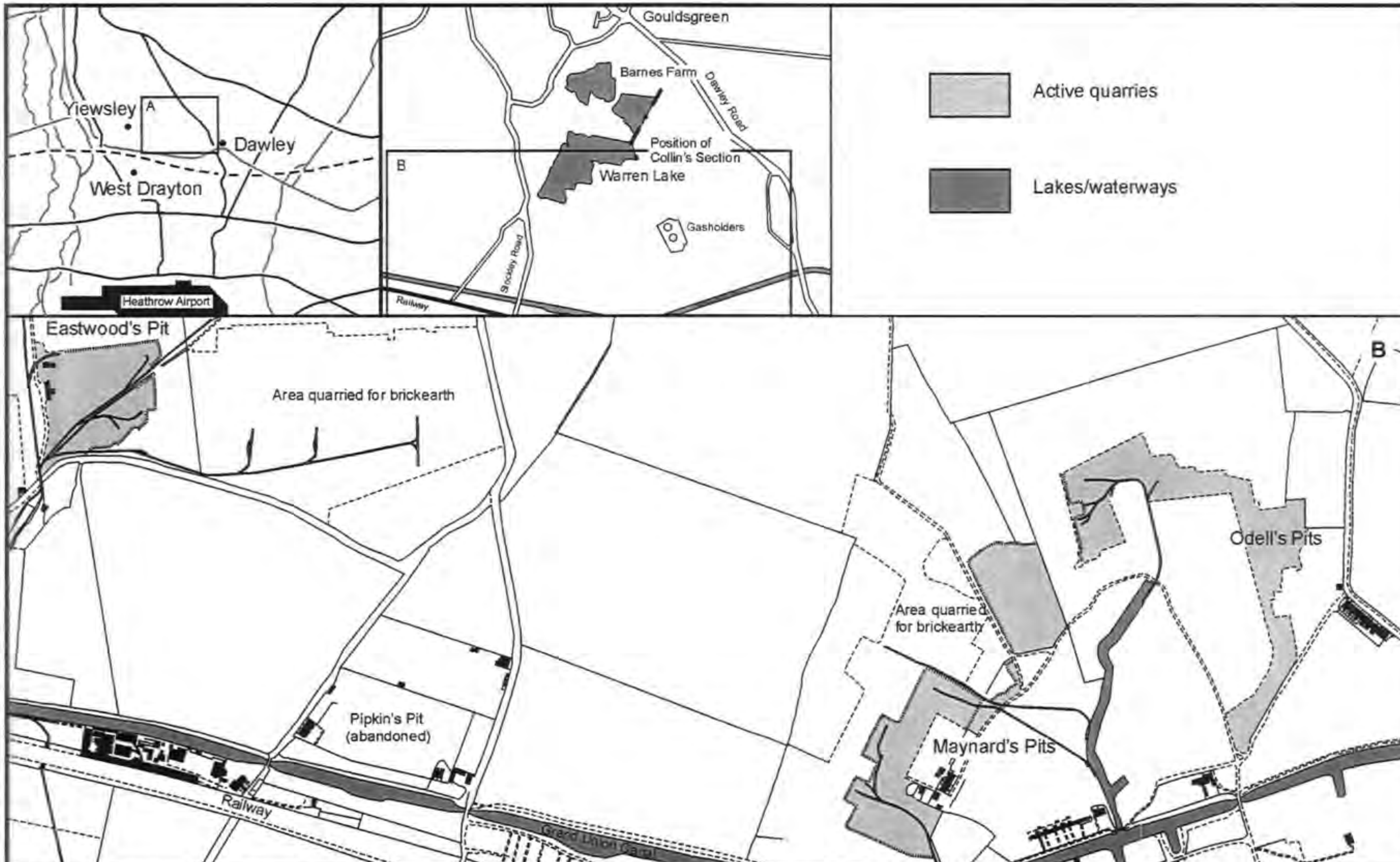

Figure 4.3.1 Position of pits in Yiewsley Area in 1895 from which John Allen Brown collected (based on OS 1:25000 series, Middlesex Sheet XV, 1895 revision).

gravel pits were open north of the canal, although large areas north and south were also being exploited purely for brickearth (see Figure 4.3.1). They visited the pits, walking along the canal from east to west, first visiting Odell's and Maynard's, which were located very close together. The group then walked west along the canal until they reached Pipkin's Pit. Given that the paper published to co-incide with the excursion describes this pit as no longer being worked (Allen Brown 1895b, 160), this must be the small "Old Gravel Pit" shown on the 1895 OS map. Continuing west, Eastwood's large gravel pit was reached; only a single pit north of the river is shown immediately to the east of Yiewsley itself, which is therefore assumed to be Eastwood's.

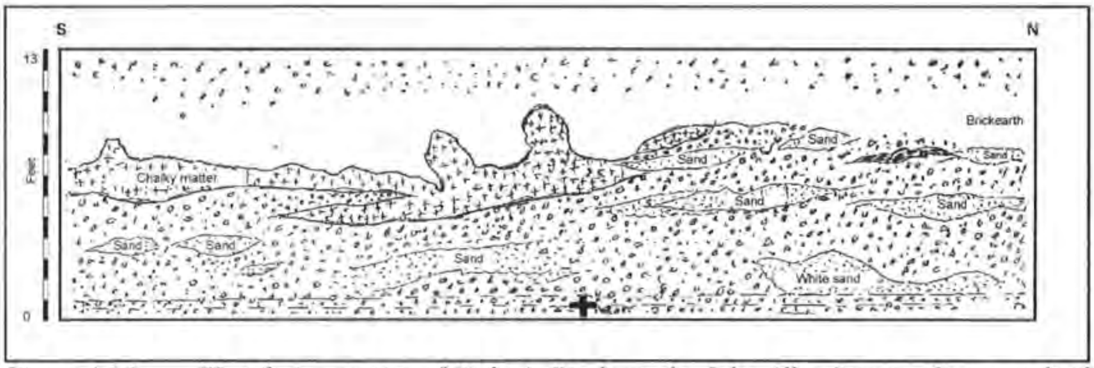

Figure 4.3.2 West-facing section of Pipkin's Pit drawn by John Allen Brown. Cross marks the position from which artefacts were recovered (Allen Brown 1895b, 161).

Allen Brown's publications indicate that in addition to handaxes recovered from within the stratified (Lynch Hill) gravels, Levallois material was recovered from the gravel surface, sealed beneath "the unstratified or ice-bourne deposit" (periglacial gravel; Allen Brown 1895b), which was surmounted by brickearth. Whilst he notes that that such artefacts are "generally" found at depths of 5-10 feet (*ibid*), only 3 Levallois artefacts (a flake from Maynard's, which is also annotated as coming from "under unstratified deposit", a core from Eastwood's, and a flake with no attribution to pit) are annotated as coming from this depth (7 ft, 10-11 ft, and 9 ft respectively). The remaining 11 extant Levallois artefacts collected by Allen Brown were variously recovered from between 11-18 ft. depths, with a single flake from Odell's Pit coming from only 3-3.5 ft down. A further 18 Levallois artefacts collected by Allen Brown from the Yiewsley area are not marked with any indications of depth.

The published section of Eastwood's Pit shows lenses of sand within the unstratified gravels (see Figure 4.3.3; Allen Brown 1895b, 163) and the base of the unstratified gravels resting at a depth of about 14.5-15 ft. Clearly, the depth of the unstratified gravel varied both within individual pits and throughout the Yiewsley area – as Allen Brown himself notes;

"Occasionally the bedded gravel reaches a higher level in the sections in these pits, as if it had not been invaded to the same extent by ice-bourne matter." (Allen Brown 1895b, 162).

It is therefore difficult to use artefact depth as an indication of relative position; however, Allen Brown does explicitly state that "implements of later age, consisting of long, sharp spear-heads, knives, etc." (i.e. similar descriptions to those he previously applied to the Levallois assemblage from Creffield Road) were recovered from higher up in the sections than the handaxes ("ordinary implements formed from nodules") and were always *under* (my emphasis) the unstratified deposit (Allen Brown 1895b, 163). This might therefore suggest that they were recovered on or near the top of the terrace gravels, variations in recovery depth reflecting undulations in the depth of the terrace surface; indeed, Allen Brown emphasises that;

"The different depths at which they are discovered may be accounted for in the varying thickness of the unstratified or ice-borne deposit, and its absence in some sections, or the stratified beds may not have suffered so much from erosion." (Allen Brown 1895b, 164)

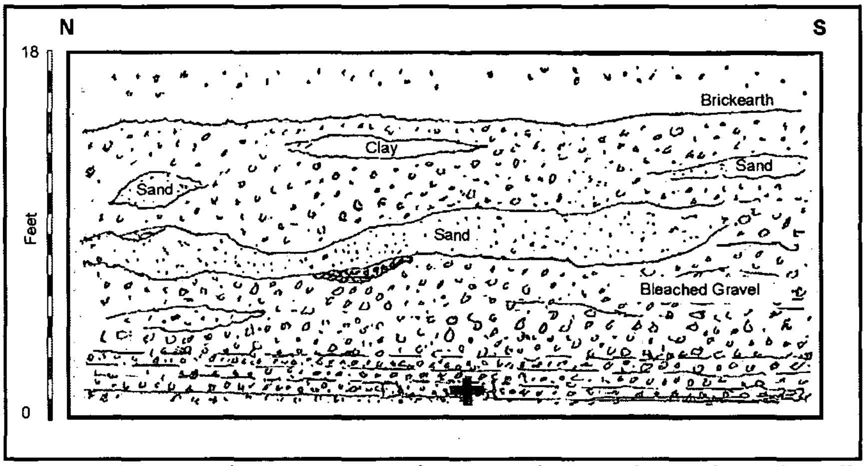

Figure 4.3.3 West-facing section of Eastwood's Pit drawn by John Allen Brown. Cross marks the position from which artefacts were recovered (stratified beneath unstratified drift; Allen Brown 1895b, 163).

Vast amounts of Levallois material were collected from the Yiewsley area between 1905 and 1929 by R. Garraway Rice, in addition to numerous handaxes from the same pits. However, although he dated his artefacts and marked them with the name of the pit they came from, he published nothing on the context of his finds and did not record the depth from which they were recovered. Garraway Rice collected from a variety of locations and eight separate names are mentioned on his artefact labels, though some of these might in fact refer to the same pit taken over by a different quarry operator later in time; for instance, material was collected from "Sabey's" and "Sabey's New" pits between 1925-1929; 1 artefact from

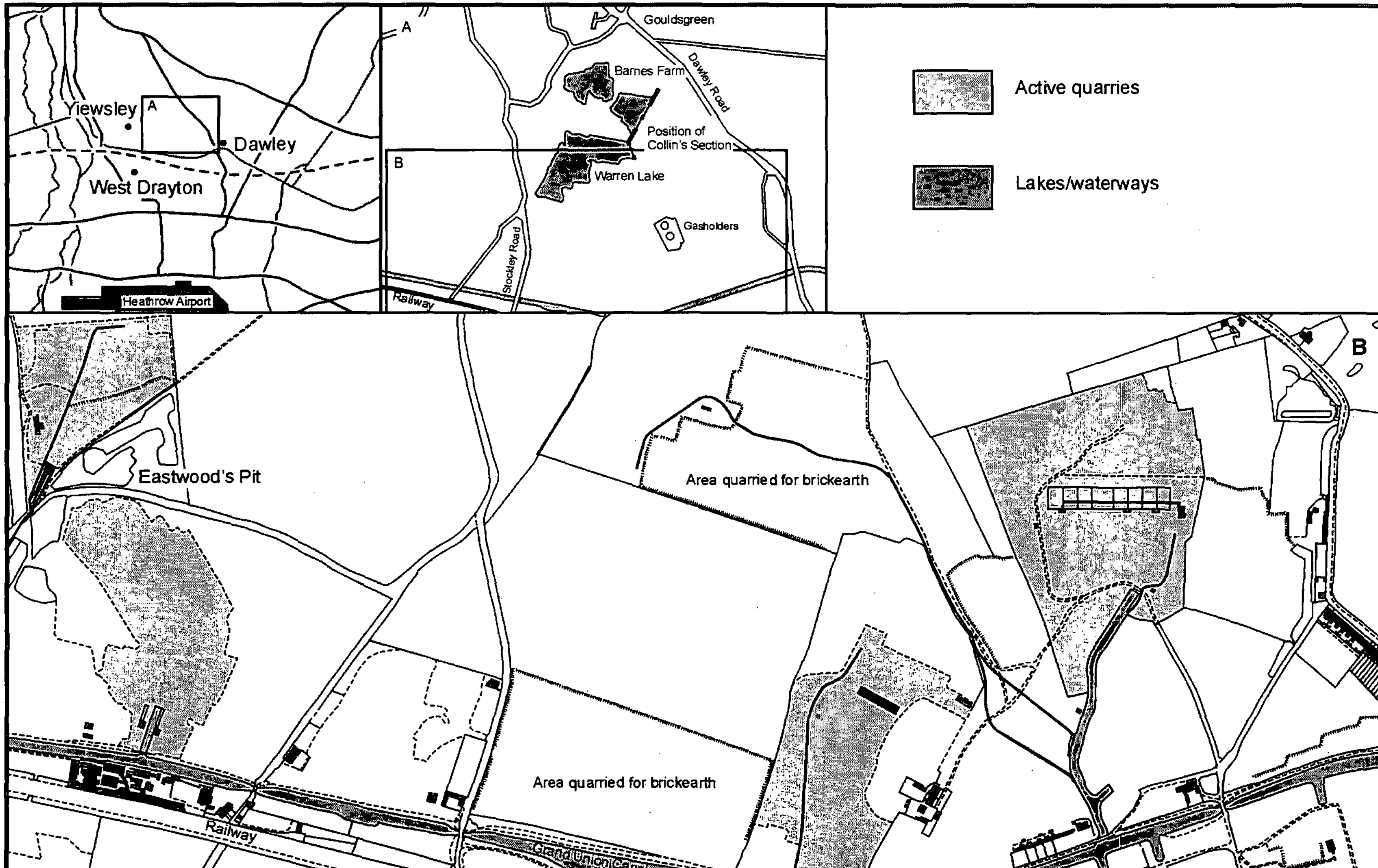

Figure 4.3.4. Position of pits in Yiewsley Area in 1914 from which Garraway Rice may have collected (based on OS 1:25000 series, Middlesex Sheet XV, 1914 revision).

"Sabey's" is marked "Late Maynard's", whilst 1 from "Sabey's New" is marked "Late Eastwood's". A further three artefacts from "Sabey's New" Pit are, in contrast, marked "Sabey's New Pit at Stockley" – clearly not the same place as the earlier Eastwood's Pit. Given that various quarry companies expanded to extract gravel from extensive pits throughout the area, it is frequently impossible to work out where he is referring to; one company may have owned several pits. Furthermore, only Eastwood's Pit can be accurately located if it is accepted that the "Eastwood's Pit" which can be identified from Allen Brown's description is that which was still active and had expanded notably by 1914 (see Figure 4.3.4).

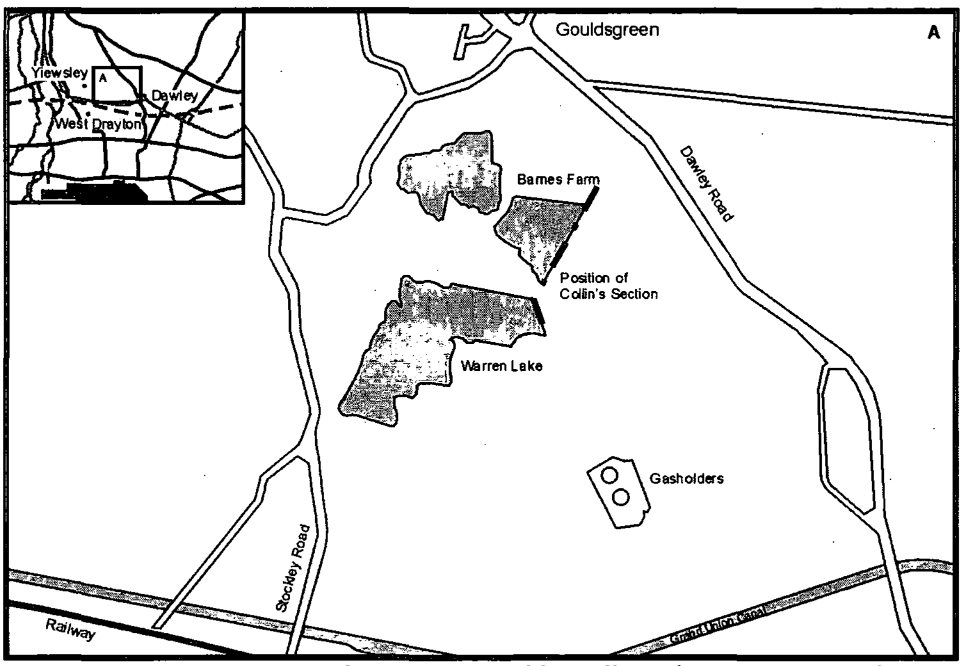

Figure 4.3.5 Location of pits investigated by Collins, showing position of section (after Collins 1978).

Further investigations in the Yiewsley area were undertaken by Desmond Collins in 1972, in and between pits then owned by Sabey's (Barnes Farm Pit and Warren Lake; see Figure 4.3.5) and north of the located pits investigated by John Allen Brown. Here a 323 m. section was recorded, interpreted as showing the relationship between the Lynch Hill terrace (Warrens loam/Warrens Gravel; Collins 1978) and the Boyn Hill terrace above (Gouldsgreen loam/Gouldsgreen gravel; Collins 1978). However, no lithological criteria support the division of the two aggradations, which are separated in the bluff area that divides them by a ridge of London Clay resembling a diapir (see Figure 4.3.6). Gibbard (1985, 34) suggests that the composition of the gravel north of the bluff (termed Gouldsgreen Gravel by Collins 1978) is indicative of a Colne influence of Lynch Hill age, this section being located close to its confluence with the Thames. No artefacts or faunal remains were recovered during these investigations, and although pollen samples were taken from throughout the gravels and overlying brickearths, these proved to be minimally productive (1.4 - 4.3 grains per gram; Hubbard 1978) and of little interpretative value.

Although clearly large amounts of material have been collected from the Yiewsley area, most cannot be located to pit, let alone to a contextually secure context, and so the interpretative value of the collections is somewhat limited. Only John Allen Brown's material is stated to come from a particular level, and such a situation cannot be assumed for the Garraway Rice collection. It is therefore impossible to discuss hominin activity in the Yiewsley area in any detail, beyond a broad characterisation of the technology represented, and care has been taken not to make any assumptions about the collections discussed below.

Geological Background

The Yiewsley area gravels have been attributed to the Lynch Hill Terrace (OIS 10-9-8) of the Middle Thames on the basis of altitude and composition (Gibbard 1985, 34). Although Collins (1978) suggested the presence of an earlier terrace in the northern part of the area investigated in 1972 (Barnes Farm Pit), lithologically the material shares characteristics with Colne Valley gravels. Given the position of this gravel close to the confluence of the Colne and Thames, downslope gradient and palaeocurrent direction, Gibbard suggests that it actually represents a Lynch Hill-age Colne equivalent (1985, 34).

Detailed descriptions and section drawings were published of some of the pits south of the section examined by Collins, closer to the river. John Allen Brown collected material from these (Pipkin's and Eastwood's; Allen Brown 1895b) and his descriptions of the main units are summarised below (Table 4.3.1; see Figures 4.3.2 and 4.3.3);

1.	Dense brown clay (brickearth) with trail
2.	Irregular deposit of chalk, rubble race and clay with few stones; irregular/lobate contact with brickearth above.
3.	Unstratified gravel, clay rich towards top but sandy towards base; contorted and containing thick lenses of sharp sand and gravel; shows stratification in places.
4.	Stratified gravel

Table 4.3.1 Summary of Allen Brown's description of the deposits exposed in Pipkin's and Eastwood's Pits, Yiewsley (Allen Brown 1895b, 160-163).

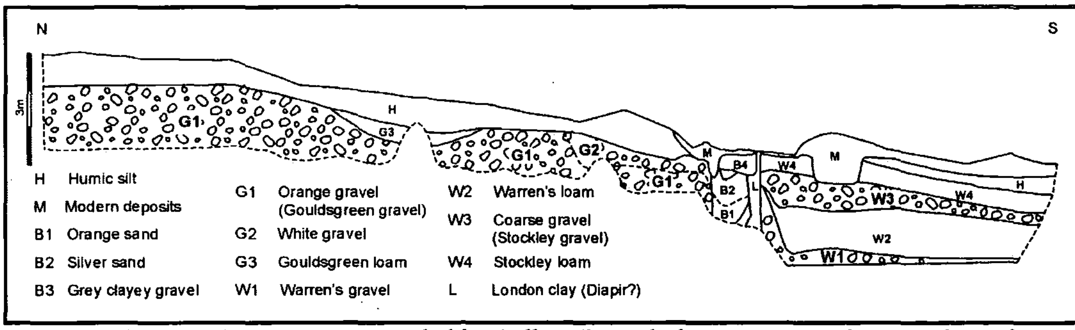

Figure 4.3.6 323 m. section recorded by Collins through deposits exposed in east face of Warren Lake and Barnes Farm Pit; horizontal scale is compressed (after Collins 1978, 13).

Allen Brown interpreted the deposits as fluvial gravel, capped by "glacio-fluvial" deposits resulting from the transport of frozen sediments within the river itself (Allen Brown 1895b, 153). Collins (1978,14) interpreted a similar deposit (his W3-Stockley Gravel) overlying the bedded Lynch Hill gravels at the southern end of the 1972 section as the result of solifluction; this consisted of unstratified clayey gravel with randomly orientated pebbles. The nature of the deposits overlying the fluvial gravels of the Lynch Hill terrace suggests that they are probably attributable to periglacial mass-movement. Notably, in the pits investigated by Collins (1978) and Gibbard *et al.* (1987), the exposed solifluction gravel (Stockley Gravel) is only c. 70 cm thick, in comparison with the 3 metres of solifluted material illustrated by Allen Brown in Eastwood's Pit 460 m. to the south (see Figures 4.3.3 and 4.3.6). Although not directly dated, the deposition of such material following the final fluvial aggradation of the Lynch Hill terrace could be viewed as reflecting periglacial processes during OIS 8 or early OIS 7. Although it is possible that such material may have been emplaced at a later date, the fresh condition of the artefacts recovered by Allen Brown is suggestive of swift burial. The Levallois material from the surface of the gravel in the Yiewsley area therefore post-dates the accumulation of the Lynch Hill gravels (OIS 10-9-8), but precedes the masking of the gravel surface by solifluction or soil formation during temperate conditions, potentially suggesting an OIS 8 or early OIS 7 date for the assemblage (Ashton *et al.* 2003). Given that there is no evidence for the occupation of Britain during fully glacial conditions, even during the Upper Palaeolithic (Jacobi 1999), a fully glacial OIS 8 date seems unlikely.

The brickearths overlying the Lynch Hill terrace at Yiewsley form part of the polygenetic Langley Silt complex, which overlies the Lynch Hill, Taplow and Kempton Park terraces of the Middle Thames and results from a variety of alluvial, fluvial and aeolian processes (Gibbard *et al.* 1987). Whilst Gibbard *et al.* (1987) suggest that where such material overlies the Lynch Hill and Taplow terrace, it primarily represents a locally-derived aeolian sediment, largely deposited during the Devensian, thermoluminescence dating of the sediments exposed in the pit investigated by Collins has produced dates in excess of 75 000 and 150 000 BP. This could reflect the deposition of fine sediment over the Lynch Hill terrace in this area during OIS 6, broadly supportive of the OIS 8 or early OIS 7 date suggested for the securely provenanced archaeological material.

Gibbard *et al.* (1987) observed the lower part of the fine sediments in the Barnes Farm/Warren Lake section to be weakly stratified, and viewed these as potentially resulting from colluvial or alluvial deposition forming part of the final phase of terrace aggradation in this area (*ibid.*, 7) – presumably a return to low-energy deposition following a mass movement event, possibly combined with the re-working of fine material from this deposit. It is unclear whether the TL samples taken from the Barnes Farm/Warren Lake section were taken from these basal, stratified brickearths, but a date of at least 150 000 BP is not incompatible with an OIS 8 or early OIS 7 date for the emplacement of the solifluction deposit and the fresh archaeological material sealed beneath.

Summary

- *Geographical situation*

  The contextually secure Levallois material from the Yiewsley area was recovered from the surface of a fluvial gravel.

- *Climate and environment*

  The favoured OIS 8 or early OIS 7 date for contextually secure hominin activity in the Yiewsley area could imply that a variety of environmental conditions could have prevailed whilst hominins were active in the area – from cool/cold to fully temperate. However, the only direct environmental evidence recovered during the investigation of the area is the pollen sampled during Collins' work further to the north (Hubbard 1978), which is of little interpretative value given the level of recovery.

- *Dating*

  These fluvial gravels are attributed to the Lynch Hill formation of the Middle Thames, based upon their altitude and composition (Collins 1978, Gibbard 1985). The position of the artefacts on the surface of the deposits suggests that they post-date the aggradation of these sediments (OIS 10-9-8). Although the interval of time separating the emplacement of the gravels and the deposition of the overlying solifluction deposits cannot be determined, the fresh condition of the artefacts indicates that they were not exposed for any appreciable period of time. An OIS 8 or early OIS 7 date is therefore favoured for the Levallois material for which context can be established (Ashton et al. 2003).

Analysis of the assemblages

Treatment and selection of collections

Although large amounts of Levallois material exist from the Yiewsley area (26 cores and 264 definite Levallois flakes within existing collections), very little of this can be located to pit, let alone a particular context. Much of the existing material therefore lacks the necessary chrono-stratigraphic integrity to allow detailed analysis. Even attribution to the Lynch Hill terrace, and therefore broad correlation with the OIS 10-9-8, is problematic, as it is possible that some of this material might derive from overlying deposits of later date. However, small collections of Levallois flakes and cores collected by John Allen Brown do come from pits which can be located spatially and from a known context on the surface of the Lynch Hill terrace, sealed beneath solifluction deposits (Table 4.3.2). This material was purchased by Sturge, and forms part of the collection from the area currently held at the British Museum (Smith 1931). The small collections from each of these pits (Eastwood's, Maynard's, Odell's and Pipkin's) are characterised separately below.

Pit Name	Collector (s)	Levallois Cores	Definite Levallois flakes	Located?
Boyer's	*Garraway Rice*	3	119	No
Clayton's	*Garraway Rice*	2	11	No
Eastwood's	*Allen Brown and Garraway Rice*	9	66	Yes
Pipkin's	*Allen Brown*	1	0	Yes
Sabey's	*Garraway Rice*	5	7	No
Sabey's New	*Garraway Rice*	0	9	No
Wallington's	*Garraway Rice*	1	4	No
Broad and Harris'	*Allen Brown*	0	5	No
Maynard's	*Allen Brown*	0	2	Yes
Odell's	*Allen Brown*	0	2	Yes
Western Cartage Company	*Garraway Rice*	0	9	No
Unattributed	*Allen Brown and Garraway Rice*	4	30	No
Total	*Allen Brown and Garraway Rice*	26	264	N/a

Table 4.3.2 Definite Levallois material from the Yiewsley area, by pit and collector.

Only one of the pits from which Garraway Rice collected can be located, if it is assumed that the Eastwood's Pit he targeted between 1905-1926 is the same pit as that which Allen Brown collected from – a distinct probability, given that this can be shown to have expanded notably by 1914 (see Figure 4.3.4). If this is accepted, then it is tempting to assume that the Levallois material he recovered from this pit came from an equivalent context on top of the terrace surface. However, this cannot be definitively stated, and the decision was made not to attempt to expand the sample from Eastwood's Pit through the inclusion of the Garraway

Rice material. Rather, Garraway Rice's collections from Eastwood's have been summarised separately, for comparative purposes, although it is acknowledged that this may of itself result in the conflation of material produced over a very broad period of time.

Similarly, all material from the Yiewsley area – predominantly comprising the material collected by Garraway Rice - has been summarised as a whole. This clearly represents a relatively spatially dispersed, and potentially temporally dispersed, sample from a particular landscape catchment of the Middle Thames. The possible affordances – in terms of available animal and lithic resources, and indeed environmental structure - of such an area could clearly have varied enormously, given that the period of time encompassed could feasibly extend from OIS 10 to the Holocene. However, the assumption has been self-consciously adopted here that Levallois technology in Britain currently seems to have been restricted to the period between OIS 9-Late OIS 7 (Ashton *et al.* 2002, Ashton and Lewis 2003, White and Jacobi 2002, White *et al.* forthcoming). Only Levallois flakes and cores are therefore included within this sample, and this material has been treated as if it was produced either throughout this period, and as reflecting the general drop-out of artefacts discarded throughout a restricted area of landscape (the Yiewsley area of the Lynch Hill terrace of the Middle Thames). It is therefore treated as representing the cumulative residues of a variety of spatially and temporally dispersed activities, which can be contrast with the specific actions undertaken at particular points within such landscapes elsewhere.

Analysis

Given the small totals of artefacts that can be accurately attributed to context (Tables 4.3.3 – 4.3.7), each is summarised separately in terms of technology, but no attempt is made to analyse the selected samples in any detail. Only a single Levallois core was recovered by John Allen Brown from Pipkin's Pit.

Artefact	No. of artefacts
All Levallois flakes	6
Definite Levallois flakes	5
Probable Levallois flakes	1
Possible Levallois flakes	0
Retouched Levallois flakes	1
Levallois cores	2
Total	8

Table 4.3.3 John Allen Brown's material from Eastwood's Pit.

Artefact	No. of artefacts
All Levallois flakes	2
Definite Levallois flakes	2
Probable Levallois flakes	3
Possible Levallois flakes	0
Levallois cores	0
Total	5

Table 4.3.4 John Allen Brown's material from Maynard's Pit.

Artefact	No. of artefacts
All Levallois flakes	2
Definite Levallois flakes	2
Probable Levallois flakes	3
Possible Levallois flakes	0
Levallois cores	0
Total	5

Table 4.3.5 John Allen Brown's material from Odell's Pit.

Artefact	No. of artefacts
All Levallois flakes	95
Definite Levallois flakes	59
Probable Levallois flakes	28
Possible Levallois flakes	8
Retouched Levallois flakes	2
Levallois cores	7
Total	102

Table 4.3.6 Garraway Rice's material from Eastwood's Pit.

Artefact	No. of artefacts
All Levallois flakes	429
Definite Levallois flakes	264
Probable Levallois flakes	131
Possible Levallois flakes	34
Retouched Levallois flakes	5
Levallois cores	26
Total	455

Table 4.3.7 All Levallois material examined from Yiewsley area (Allen-Brown material, including unattributed artefacts, and all Garraway Rice material combined).

Taphonomy

All definite Levallois material from the Yiewsley area (n=289)					
Unabraded	229	79.2%	*No original edge damage*	46	15.9%
Slightly abraded	49	17.0%	*Slight original edge damage*	166	57.4%
Moderately abraded	11	3.8%	*Moderate original edge damage*	76	26.3%
Heavily abraded	0	0.0%	*Heavy original edge damage*	1	0.3%
No modern edge damage	57	19.7%	*Unpatinated*	134	46.4%
Slight modern edge damage	188	65.1%	*Lightly patinated*	139	48.1%
Moderate modern edge damage	43	14.9%	*Moderately patinated*	15	5.2%
Heavy modern edge damage	1	0.3%	*Heavily patinated*	1	0.3%
Unstained	57	19.7%	*Unscratched*	285	98.6%
Lightly stained	132	45.7%	*Lightly scratched*	2	0.7%
Moderately stained	95	32.9%	*Moderately scratched*	1	0.3%
Heavily stained	5	1.7%	*Heavily scratched*	1	0.3%
No battering	265	91.7%			
Light battering	17	5.9%			
Moderate battering	6	2.1%			
Heavy battering	1	0.3%			

Table 4.3.8 Condition of all definite Levallois flakes and Levallois cores from the Yiewsley area (Garraway Rice and Allen Brown material combined, including unattributed Allen Brown material; n=289).

The material from the Yiewsley area as a whole is predominantly unabraded (79.2 %) or only minimally so (17.0 %), but does exhibit a degree of edge damage (see Table 4.3.8). As at Creffield Road (Section 4.2), the edges of some artefacts display two phases of edge damage – one stained and patinated in the same way as the artefact itself, and a further series of unpatinated spalls that cut this. These later scars are often slightly patinated themselves, and hence probably do not result from curation or collection practices.

All definite Levallois material collected from Eastwood's Pit (n=66)					
Unabraded	52	78.8 %	*No original edge damage*	5	7.6 %
Slightly abraded	13	19.7 %	*Slight original edge damage*	44	66.7 %
Moderately abraded	1	1.5%	*Moderate original edge damage*	17	25.8 %
Heavily abraded	0	0.0 %	*Heavy original edge damage*	0	0.0 %
No modern edge damage	16	24.2 %	*Unpatinated*	37	56.1 %
Slight modern edge damage	31	47.0 %	*Lightly patinated*	27	40.9 %
Moderate modern edge damage	19	28.8 %	*Moderately patinated*	2	3.0 %
Heavy modern edge damage	0	0.0 %	*Heavily patinated*	0	0.0 %
Unstained	14	21.2 %	*No battering*	60	90.9 %
Lightly stained	35	53.0 %	*Light battering*	6	9.1 %
Moderately stained	16	24.2 %	*Moderate battering*	0	0.0 %
Heavily stained	1	1.5 %	*Heavy battering*	0	0.0 %

Table 4.3.9 Condition of all definite Levallois flakes and Levallois cores collected from Eastwood's Pit (Garraway Rice and Allen Brown material combined; n=66).

Condition attribute	Pit	No. of artefacts			
		None	Light	Moderate	Heavy
Abrasion	*Eastwood's (n=7)*	4	2	1	0
	Maynard's (n=2)	1	1	0	0
	Pipkin's (n=1)	1	0	0	0
	Odell's (n=2)	0	2	0	0
Original edge damage	*Eastwood's (n=7)*	0	5	2	0
	Maynard's (n=2)	0	1	1	0
	Pipkin's (n=1)	0	1	0	0
	Odell's (n=2)	0	0	2	0
Modern edge damage	*Eastwood's (n=7)*	6	1	0	0
	Maynard's (n=2)	0	2	0	0
	Pipkin's (n=1)	1	0	0	0
	Odell's (n=2)	1	1	0	0
Patination	*Eastwood's (n=7)*	3	2	2	0
	Maynard's (n=2)	0	2	0	0
	Pipkin's (n=1)	0	1	0	0
	Odell's (n=2)	0	1	1	0
Staining	*Eastwood's (n=7)*	1	5	1	0
	Maynard's (n=2)	0	2	0	0
	Pipkin's (n=1)	0	0	1	0
	Odell's (n=2)	0	1	1	0

Table 4.3.10 Condition of contextually secure, definite Levallois material collected by John Allen Brown (n=12).

Most artefacts exhibit light-moderate original and later edge damage (Table 4.3.8). Such a pattern might reflect initial damage through trampling when exposed on the terrace surface, perhaps followed by further damage to the edges from the pressure of sediments accumulating above, but is difficult to interpret with any certainty. The 12 artefacts definitely from the surface of the gravel are certainly in fresh condition (see Table 4.3.10), suggesting that they were minimally exposed on the terrace surface prior to burial. In terms of chemical condition, most artefacts are unpatinated or only lightly so (46.4 % and 48.1 % respectively) and exhibit light-moderate staining (45.7 % and 32.9 %; see Table 4.3.8), and few exhibit either surface scratching (1.3 %) or battering (8.3 %); none of the 12 contextually secure artefacts exhibit such damage.

Technology

Eastwood's Pit; Allen Brown collection

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	95.9	60.44	15.24	0.632386
Median	96.2	65.2	16.5	0.591652
Min	83.4	48.8	10.4	0.51503
Max	110.2	70.8	20.8	0.735967
St.Dev	10.14938	9.722551	4.240637	0.098424

Table 4.3.11 Summary statistics for whole Levallois flakes collected by John Allen Brown from Eastwood's Pit (n=5).

Collector's Number	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
1285	81.4	94.5	30.1	1.160934	0.318519
2064	80.6	91.6	31	1.136476	0.338428

Table 4.3.12 Dimensions and indices of Levallois cores collected by John Allen Brown from Eastwood's Pit (n=2).

Five definite Levallois flakes exist within the extant collection made by John Allen Brown from Eastwood's Pit, all of which are whole, fairly elongated and of medium size; two Levallois points and three Levallois flakes are present (Table 4.3.11). Both points attest to unipolar convergent preparation, whilst two of the flakes reflect centripetal preparation, together with one reflecting unipolar preparation. None can be stated to have formed part of a recurrent exploitation sequence. Most have plain butts, apart from one Levallois point; this has been retouched along the left edge, and may also retain traces of retouch along the right edge, which is unfortunately obscured by patinated damage.

Two small centripetally-prepared Levallois cores (Table 4.3.12) attest to the removal of a single small flake (64.1 and 52.7 mm. in length) from their final flaking surface. The flaking surface of both has been shaped through deliberate accentuation of the convexities all around the core, using semi-invasive removals; this represents a separate phase of shaping to that which is attested by flatter, broader scars on the flaking surfaces. Additionally, both cores are very flat. This suggests that these cores were actually subjected to recurrent exploitation, and may have been discarded when their productive capacity was compromised; re-preparing the Levallois surface any further (as is possibly suggested by the separate convexity-shaping phase) would have resulted in any further flakes probably being too small to handle, if they could be removed at all. None of the flakes and only one core (1285) retained any cortex, this being indeterminate in nature. Notably, the other core (2064) appears to retain traces of burning on the striking platform surface.

Eastwood's Pit; Garraway Rice collection

Levallois flakes from Eastwood's Pit; technological observations					
Type of endproduct (n=59)			Butt type (n=59)		
Flake	42	71.2 %	*Plain*	17	28.8 %
Point	10	16.9 %	*Dihedral*	5	8.5 %
Blade	2	3.4 %	*Facetted*	33	55.9 %
Debordant	1	1.7 %	*Chapeau de gendarme*	1	3.4 %
Point or flake -	2	3.4 %	*Marginal*	1	1.7 %
Overshot	1	1.7 %	*Obscured*	1	1.7 %
Debordant and overshot	1	1.7 %			
Raw material (n=59)			Cortex retention (n=54)		
Indeterminate	48	81.4 %	*0%*	44	81.5 %
Fresh	2	3.4 %	*1 – 10%*	7	13.0 %
Derived	9	15.3 %	*11 – 25%*	2	3.7 %
			>25%	1	1.9 %
Method of exploitation (n=59)			Number of preparatory scars (n=54)		
Lineal	5	8.5 %	1-5	13	24.1 %
Probably lineal	51	86.4 %	6-10	33	61.1 %
Unipolar recurrent	1	1.7 %	11-15	6	11.1 %
Bipolar recurrent	1	1.7 %	>16	2	3.7 %
Indeterminate	1	1.7 %			
			Knapping errors (n=2), both overshot		
Preparation method (n=59)			Pattern of additional convexity working (n=54)		
Unipolar	13	24.1 %	*None*	49	90.7 %
Convergent unipolar	11	20.4 %	*Distal*	2	3.7 %
Centripetal	30	55.6 %	*Right*	1	1.9 %
			Left	1	1.9 %
			Proximal	1	1.9 %
Nature of convexity (n=5)			Portion (n=59)		
Minimally invasive	1	-	*Whole*	54	91.5 %
Semi-invasive	2	-	*Distal*	5	8.5 %
Cortical or natural	2	-			
Mixed	1	-			

Table 4.3.13 Technological observations of definite Levallois flakes collected by Garraway Rice from Eastwood's Pit (n=59).

The larger collection of material amassed by Garraway Rice from Eastwood's Pit is comprised mainly of whole Levallois flakes, together with some points (10; see Table 4.3.6), perhaps indicating that the collection has been subjected to a certain amount of weeding. Most of the flakes reflect probable or definite lineal exploitation, usually following recurrent preparation of the flaking surface – although unipolar (24.1%) and convergent unipolar

(20.4%) preparatory strategies are also represented. Most have facetted butts. One Levallois point has semi-invasive retouch along both edges.

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	89.0	61.9	16.5	0.700156
Median	85.8	61.2	14.9	0.697183
Min	68.2	33	8.3	0.357143
Max	131.5	93.4	112.8	1.073563
St.Dev	12.97956	14.15889	14.2633	0.155749

Table 4.3.14 Summary statistics for definite whole Levallois flakes collected by Garraway Rice from Eastwood's Pit (n=54).

Levallois cores from Eastwood's Pit; Technological observations (n=7)					
Preparation method			Exploitation method		
Centripetal	7	100 %	*Unexploited*	2	28.6 %
			Re-prepared but unexploited	1	14.3 %
			Unipolar recurrent	2	28.6 %
			Centripetal recurrent	2	28.6 %
Convexities			Type of convexity working (n=4)		
Whole surface shaped as one	3	42.9 %	*Semi-invasive*	2	50.0 %
Distal	2	28.6 %	*Minimally invasive*	1	25.0 %
Continuous	2	28.6 %	*Cortical/Natural*	1	25.0 %
Blank type			Distribution of preparatory scars striking surface		
Indeterminate	1	14.3 %	*All over*	6	85.7 %
Probably nodule	6	85.7 %	*Proximal and distal*	1	14.3 %
Type of striking surface working			Position of cortex on striking surface		
Semi-invasive	5	71.4 %	*None*	2	28.6 %
Steep	1	14.3 %	*Central*	4	57.1 %
Minimally invasive	1	14.3 %	*Butt only*	1	14.3 %
% Cortex striking surface			Levallois products from final flaking surface		
0	2	28.6 %	0	3	42.9 %
1-25%	0	0.0 %	2	3	42.9 %
26 – 50%	3	42.9 %	3	1	14.3 %
51 – 75%	2	28.6 %			
Types of Levallois products from core			3 cores have evidence of previous flaking surface		
Flake	9	100 %			
Preparatory scars final flaking surface			Preparatory scars striking surface		
1-5	0		1-5	1	14.3 %
6-10	5	71.4 %	6-10	3	42.9 %
11-15	2	28.6 %	11-15	2	28.6 %
Raw material					
Fresh	1	14.3 %			
Derived	5	71.4 %			
Indeterminate	1	14.3 %			

Table 4.3.15 Technological observations of Levallois cores collected by Garraway Rice from Eastwood's Pit (n=7 except where otherwise stated).

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	91.9	84.6	29.3	0.923442	0.345792
Median	89	86.8	30.3	0.945638	0.351261
Min	79.1	59.5	20.9	0.622385	0.273041
Max	107	109.1	40.2	1.061284	0.393782
St.Dev	10.30864	15.86818	7.004148	0.148731	0.042366

Table 4.3.16 Summary statistics for Levallois cores collected by Garraway Rice from Eastwood's Pit (n=7).

The seven cores are very flat and none has a flattening index where B/L = >0.4 (Table 4.3.15). Three retain evidence of re-preparation following exploitation of a previous flaking surface, apparent from small, peripheral scars cutting scars which have consumed the flaking surface, interpreted as previous Levallois removals; two of these were not exploited following re-preparation and an attempted Levallois flake failed to detach from the third. The cores which do retain final Levallois scars attest to recurrent exploitation immediately before discard; two reflect unipolar and two centripetal recurrent exploitation, potentially reflecting a final attempt to maximise production. The majority of the cores are made on flint derived from a fluvial gravel, and most are probably nodules.

Maynard's Pit; Allen Brown Collection

Type of endproduct	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Point	147.6	58.6	14.1	0.397019
Flake	64.7	62.6	13.6	-

Table 4.3.17 Dimensions and elongation of definite Levallois flakes collected by John Allen Brown from Maynard's Pit.

John Allen Brown collected a large, whole Levallois point with a facetted butt and the proximal end of a Levallois flake with a plain butt from Maynard's Pit. Both probably result from lineal exploitation, following bipolar preparation in the case of the point, and centripetal preparation in the case of the flake. Notably, the flake is clearly annotated as coming from 7 ft. down under the unstratified deposit.

Odell's Pit; Allen Brown Collection

Type of endproduct	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Point	105.7	54.7	14.5	0.517502
Flake	101.3	60.9	12.3	0.601185

Table 4.3.18 Dimensions and elongation of definite Levallois flakes collected by John Allen Brown from Maynard's Pit.

John Allen Brown collected a whole Levallois flake and point, both with plain butts, from Odell's Pit. Both probably result from lineal exploitation, following unipolar convergent preparation in the case of the point, and centripetal preparation in the case of the flake.

Pipkin's Pit; Allen Brown Collection

Sturge number	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
387	72.4	75.2	26.6	1.038674	0.353723

Table 4.3.19 Dimension and indices of core collected by John Allen Brown from Pipkin's Pit.

A single small, flattened Levallois core was recovered from Pipkin's Pit; this reflects the removal of a single flake from its surface following centripetal preparation.

Yiewsley area; all artefacts

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	94.4	94.1	34.8	1.006192	0.36378
Median	88.95	92.5	30.7	1.018986	0.352492
Min	67.5	59.5	20.9	0.622385	0.273041
Max	152.7	161.8	80.2	1.249307	0.522869
St.Dev	18.56177	19.34874	12.32995	0.139617	0.065451

Table 4.3.20 Summary statistics for all Levallois cores collected from the Yiewsley area (all Garraway Rice and John Allen Brown material combined, n=26).

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	90.1	59.6	14.4	0.677518
Median	88	59	13.65	0.672193
Min	51.9	19.3	7.7	0.215162
Max	156.7	93.4	112.8	1.138843
St.Dev	17.09871	12.17877	7.17701	0.157424

Table 4.3.21 Summary statistics for all definite whole Levallois flakes collected from the Yiewsley area (all Garraway Rice and John Allen Brown material combined, n=242).

A number of general statements can be made about the material collected from throughout the Yiewsley area; the cores are small and flat, only 4 having a flattening index of greater than Th/B = 0.4 (Table 4.3.20). Where raw material source can be determined, most are formed on flint from fluvial gravels (73.1 %) – presumably from the Lynch Hill terrace. All attest to centripetal preparation of the final flaking surface, usually followed by the removal of a single, small Levallois flake (lineal exploitation); however, unipolar and centripetal recurrent techniques are also represented (Table 4.3.22). The final flaking surfaces of 5 cores are unexploited; this includes the obviously re-prepared but unexploited core discussed previously from Eastwood's Pit. Given their small size, it is likely that these other "unexploited" cores had been subjected to a final phase of re-preparation, but that a Levallois flake had not been struck from them – perhaps because of the small size of the flaking surface once the Levallois convexities had been re-established.

Levallois cores from Yiewsley; Technological observations (n=26)					
Preparation method			Exploitation method		
Centripetal	26	100 %	*Unexploited*	4	15.4 %
			Re-prepared but unexploited	1	3.8 %
Raw material			*Unipolar recurrent*	4	15.4 %
Fresh	1	3.8 %	*Centripetal recurrent*	3	11.5 %
Derived	19	73.1 %	*Lineal*	14	53.8 %
Indeterminate	6	23.1 %			
Convexities			Type of convexity working (n=11)		
Whole surface shaped as one	15	57.7 %	*Semi-invasive*	6	54.5 %
Distal	3	11.5 %	*Minimally invasive*	3	27.3 %
Continuous	5	19.2 %	*Cortical/Natural*	1	9.1 %
1 lateral edge	2	7.7 %	*Steep*	1	9.1 %
Distal and 1 edge	1	3.8 %			
Blank type			Distribution of preparatory scars striking surface		
Indeterminate	10	38.5 %	*All over*	25	96.2 %
Probably nodule	13	50.0 %	*Proximal and distal*	1	3.8 %
Definite nodule	3	11.5 %			
Type of striking surface working			Position of cortex on striking surface		
Semi-invasive	13	50.0 %	*None*	6	23.1 %
Steep	1	3.8 %	*Central*	16	61.5 %
Minimally invasive	1	3.8 %	*Butt only*	1	3.8 %
Invasive	11	42.3 %	*One edge*	3	11.5 %
% Cortex striking surface			Levallois products from final flaking surface		
0	6	23.1 %	0	4	15.4 %
1-25%	9	34.6 %	1	15	57.7 %
26 – 50%	8	30.8 %	2	5	19.2 %
51 – 75%	3	11.5 %	3	2	7.7 %
Types of Levallois products from core (n=22)			4 cores have evidence of previous flaking surface		
Flake	22	100 %			
Preparatory scars final flaking surface			Preparatory scars striking surface		
1-5	1	3.8 %	1-5	2	7.7 %
6-10	15	57.7 %	6-10	5	19.2 %
11-15	7	26.9 %	11-15	12	46.2 %
>15	3	11.5 %	>15	7	26.9 %

Table 4.3.22 Technological observations of all Levallois cores from the Yiewsley area (Garraway Rice and John Allen Brown combined; n=26 except where otherwise stated).

Notably, many of the cores have evidence of a separate phase of flaking surface preparation that results in the accentuation of particular areas of the distal and lateral convexities. These comprise smaller, steeper, peripheral scars that cut larger removals running across the flaking surface. Although strictly speaking separate technological actions, the earlier, broader shaping of the surface, and the deliberate accentuation of the convexities could obviously form part of the same preparatory phase. However, given the small size and flat nature of most cores from the Yiewsley area, it is tempting to see this approach to shaping the

Levallois surface as evidence that these cores have been subjected to deliberate re-adjustment, and therefore as suggesting cyclical exploitation of subsequent flaking surfaces. Indeed, 4 cores from the Yiewsley area (including the 3 from Eastwood's noted above) retain evidence of a previous flaking surface; only one of these was exploited successfully.

Levallois flakes from Yiewsley; technological observations (n=263)					
Type of endproduct			Butt type		
Flake	201	76.4 %	*Plain*	90	34.2 %
Point	37	14.1 %	*Dihedral*	17	6.5 %
Blade	6	2.3 %	*Facetted*	129	49.0 %
Debordant	9	3.4 %	*Chapeau de gendarme*	18	6.8 %
Point or flake	6	2.3 %	*Marginal*	5	1.9 %
Overshot	3	1.1 %	*Obscured*	3	1.1 %
Debordant and overshot	1	0.4 %	*Missing*	1	0.4 %
Raw material			Cortex retention (n=242)		
Indeterminate	224	85.2 %	*0%*	209	86.4 %
Fresh	7	2.7 %	*1 – 10%*	23	9.5 %
Derived	32	12.2 %	*11 – 25%*	8	3.3 %
			>25%	2	0.8 %
Method of exploitation			Number of preparatory scars		
Lineal	22	8.4 %	1-5	60	24.8 %
Probably lineal	230	87.5 %	6-10	150	62.0 %
Unipolar recurrent	8	3.0 %	11-15	27	11.2 %
Bipolar recurrent	1	0.4 %	>16	5	2.1 %
Indeterminate	2	0.8 %			
			Knapping errors (n=6); 4 overshot		
Preparation method			Pattern of additional convexity working		
Unipolar	10	3.8 %	*None*	248	94.3 %
Convergent unipolar	34	12.9 %	*Distal*	6	2.3 %
Centripetal	171	65.0 %	*1 edge*	8	3.0 %
Bipolar	48	18.3 %	*Proximal*	1	0.4 %
Nature of convexity (n=16)			Portion		
Invasive	2	12.5 %	*Whole*	242	92.0 %
Minimally invasive	2	12.5 %	*Distal*	7	2.7 %
Semi-invasive	2	12.5 %	*Proximal*	9	3.4 %
Cortical or natural	6	37.5 %	*Siret*	5	1.9 %
Mixed	4	25.0 %			

Table 4.3.23 Technological observations of all Levallois flakes from the Yiewsley area (Garraway Rice and John Allen Brown combined; n=263 except where otherwise stated).

The Levallois flakes from the Yiewsley area are medium-sized and slightly elongated (mean B/L = 0.69882; Table 4.3.21). They are on the whole comparable in size to the cores from the area, and larger than the Levallois flake scars retained by the cores. Although a few Levallois points are represented (14.1 %), most are Levallois flakes (79.4 %), commonly with a facetted (49.0 %) or frequently a plain butt (34.2 %; Table 4.2.23). Most are the first Levallois flake to be removed from a particular surface and probably reflect lineal exploitation of a given core surface (87.5 %) although few can be definitively be viewed as the only Levallois flake produced (8.4 % definite lineal exploitation); a few flakes resulting from uni- or bipolar recurrent exploitation strategies are also present (3.0 % and 0.4 % respectively). Centripetal preparation of the flaking surface dominates (65.0 %), although bipolar and convergent unipolar strategies are also well-represented (18.3 % and 12.9 % respectively).

Technology and hominin behaviour in the Yiewsley/West Drayton area

Although the vast majority of the Levallois material from the Yiewsley area cannot be located spatially, let alone stratigraphically, certain observations can be made concerning the technological approach adopted to the production of Levallois material. The cores as a whole attest to the complete re-preparation of Levallois surfaces, and are discarded when completely exhausted. Indeed, several seem to be discarded without the attempt being made to remove a final Levallois flake, although they are re-prepared, and the vast majority are very flat. Centripetal preparation and the deliberate concentration of working around the convexities dominates the final phase of core working, although the Levallois flakes (which are on the whole of comparable size to the cores, and certainly larger than the final Levallois flake scars they retain) reflect the use of unipolar, bipolar and convergent unipolar preparatory strategies. Whilst the cores reflect only the production of one or more flakes, Levallois points make up a notable proportion of the flakes from the area. It therefore seems likely that a more varied range of larger Levallois products was produced from larger flaking surfaces earlier in the course of reduction, which were progressively re-prepared to allow further exploitation. The dominance of centripetal preparation and deliberate convexity accentuation immediately prior to discard may represent the only way of exploiting such flattened cores, suggesting that the productive capacity of Levallois cores in the Yiewsley area was extended as far as was practically possible.

Given that most cores and those flakes that retain cortex reflect the use of flint obtained from gravel – presumably the Lynch Hill terrace – this extension of the productive capacity of many cores is notable. British Levallois sites located directly on top of sources of raw material generally reflect the abandonment of cores once their ability to produce large, broad flakes is compromised (see sites in Chapter 5); it is unusual for cores to be worked to exhaustion as many are from the Yiewsley area. It cannot merely reflect the fact that when hominins were active in the Yiewsley area, large clasts of raw material were rarely encountered and therefore worked to exhaustion, as the amount of larger flakes from the area suggests that this was not the case. A similar pattern of core working to exhaustion is apparent at Creffield Road (Section 4.2), in tandem with the earliest stages of core working and flake production. This apparently results from a strategy of core and flake transport, cores only being discarded once hominins reached a situation in which they knew they would be able to re-provision themselves. Although the particular actions at Creffield Road can be delimited both in relation to the possibilities of the place itself (availability of large nodules of raw material) and strategies adopted in dealing with the surrounding landscape (transport of cores as a source of blanks; transport, modification and use of points, which may have been hafted), the Yiewsley material does not allow such conclusions to be drawn.

However, given that such material as can be accurately relocated to context can be regarded as produced during OIS 8 or early OIS 7, and that the rest of the Yiewsley artefacts are in similar condition and likely to come from an equivalent position, it is possible to consider the artefacts from this area as reflecting a broader pattern of landscape use and artefact discard. The recycling of cores to the point where they could not produce the larger flakes recovered from throughout the area does seem to suggest that they may have been transported. Creffield Road, also dated to OIS 8 or early OIS 7, reflects a particular situation in which cores were discarded following transport; particular areas of final discard cannot be delimited from amongst the Yiewsley material, but similar reasons for eventual discard (immediate raw material availability) may have been important. It could also be argued that the broad range of technological options exercised throughout the Yiewsley area, and the variable endproducts that result, emphasises the fact that the strategies which dominate at Creffield Road are specific to that particular place and the immediate area exploited in relation to it. Given the lack of spatial and contextual detail available for the vast majority of the Yiewsley material, it is impossible to delimit specific areas where particular endproducts, deliberately produced through the application of particular preparatory and exploitation strategies, were discarded. However, the more variable nature of the Yiewsley material as a whole emphasises that in other situations, different strategies could be and were adopted.

Chapter 5

Sites of the Taplow/Mucking Formation and Deposits of Equivalent Date

Introduction

The sites analysed in this chapter comprise material collected from deposits forming part of, or associated with, the Taplow/Mucking formation of the Thames, or from deposits away from the Thames dated to the same interval (OIS 8-7-6). Material from Northfleet (Baker's Hole and the Ebbsfleet Channel; Section 5.1), Lion Pit Tramway Cutting (Section 5.2) and Stoneham's Pit Crayford (Section 5.3) was collected or excavated from deposits correlated with the Taplow/Mucking terrace of the Thames and which are dated to throughout this interval; late OIS 8 (Lion Pit Tramway Cutting), OIS 8/7 (Baker's Hole), earlier OIS 7 (Ebbsfleet Channel) and later OIS 7 (Stoneham's Pit). Through considering the technological practices undertaken at these Lower Thames sites in the context of the specific nature of each locale, it is possible to evaluate changing hominin behaviour within a restricted landscape catchment over time. Away from the Thames, two further sites dated to the later part of OIS 7 are also considered; the Stoke Bone Bed, within deposits of the Gipping in Ipswich, and Brundon, on the south bank of the Suffolk Stour.

Each collection is dealt with independently and presented in terms of its chrono-stratigraphic, environmental and geographical context. A detailed taphonomic and technological analysis of each site is provided; different scales of analysis were considered appropriate to each assemblage, given different recovery conditions and collection practices. The approach adopted to deal with each assemblage is outlined in each section. On this basis, an interpretation of hominin activity at each site is presented; these are subsequently drawn together (Chapter 6) to provide a picture of emergent hominin technological practices and landscape use in Britain between OIS 9-7.

5.1 Northfleet; Baker's Hole and the Ebbsfleet Channel, Kent

Location

Prodigious quantities of Levallois material have been recovered from sediments infilling the Ebbsfleet valley, a south-bank tributary of the Thames. Here ongoing quarrying has merged a number of separate pits into two large, predominantly backfilled quarries, separated by a footpath - Bevan's Pit to the north and New Baker's Hole to the south. The latter encompasses the archaeologically productive sites (Figure 5.1.1). Correlation between the separate, unconnected exposures is frequently difficult (Bridgland 1994); however, the Levallois assemblages from the area were restricted to two separate units, and are treated individually here as a result.

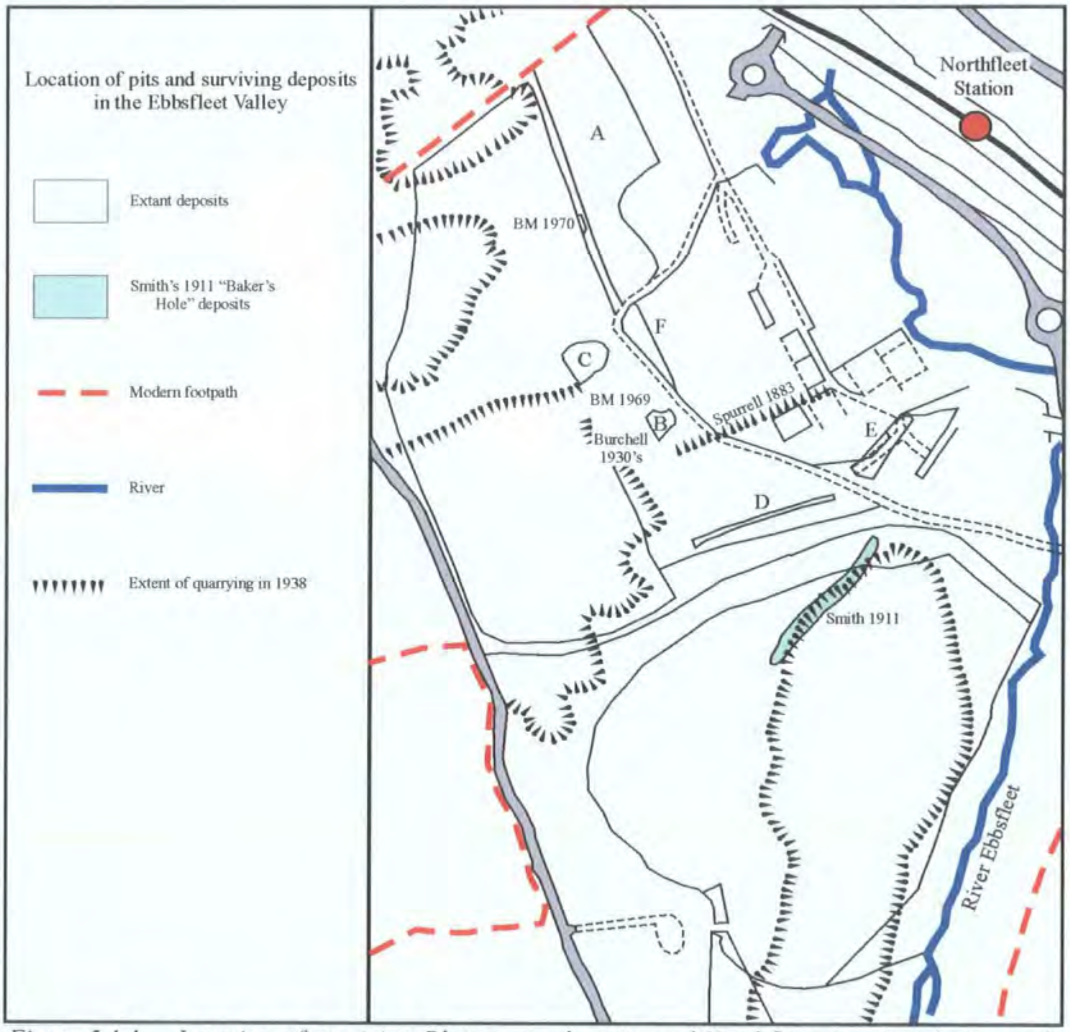

Figure 5.1.1 Location of surviving Pleistocene deposits and Northfleet sites in relation to the extent of quarrying, as mapped by the O.S. in 1938 (after Wenban-Smith 1995, 148, fig 28; Ordnance Survey 1:10560 Kent County Series 1938 and © Crown copyright/database right 2005. An Ordnance Survey/EDINA supplied service).

History of Investigations

The first recorded artefacts from the Northfleet area were discovered by Spurrell (1883, 1884), from a cutting south-west of Northfleet church. He recovered Levallois material, including flakes and cores, together with faunal remains from "a kind of beach" resting between 6-13.5 m O.D. (Spurrell 1883, 102). Although the section he recorded gives little indication of the precise context of his finds, his published description implies that they came from the surface of a gravel.

The most celebrated collection of Levallois material from the Ebbsfleet valley comprises that recovered from a contorted deposit of chalk debris ("Coombe Rock") in the north-west corner of Southfleet pit (Smith 1911). The locality has subsequently been referred to as "Baker's Hole", although this pit name in fact refers to an archaeologically sterile quarry to the north; the archaeologically productive pit was in fact known to the pit owners (The Associated Portland Cement Company) as Southfleet or New Barn Pit (Wenban-Smith 1990). Collections from the coombe rock in Southfleet Pit were described by Abbott (1911) and Smith (1911). Abbott described the material recovered by James Cross, a local collector, from the opening of the pit in 1907 onwards (Abbott 1911, 466). Smith published a description of artefacts held within a collection made by the Associated Portland Cement Company, but never excavated at the site; rather, he visited the company offices to view the collection upon which his paper was based (Keeper to White 1913; BM[F] Baker's Hole Correspondence) the material only being donated to the British Museum in 1915.

The means by which this material was amassed has implications for the integrity of the assemblage and estimates of the numbers of artefacts from the site vary enormously, some suggesting that hundreds of thousands of artefacts were present (Dewey 1932, 50). The collection passed from the Associated Portland Cement Company to the British Museum numbered approximately 750 artefacts (Wenban-Smith 1990); smaller reference collections were selected from this material and distributed to other regional museums. Equally, the position of the material within the coombe rock has been ascribed to different points over time; although both Abbott (1911, 467) and Smith (1911, 516) explicitly note that the artefacts were recovered from within the deposit, Dewey (1930, 148; 1932, 50) suggests that the material was recovered from a "working floor" underneath the coombe rock. Given that Dewey based his observation upon the opening of a new cutting within Southfleet Pit some 20 years after the original collection was made by the quarry company, and only a few "poor" artefacts are definitely noted as recovered from this situation, such a position cannot be confidently assumed for the entire assemblage, particularly given the nature of the deposit.

The earliest descriptions of the assemblage from the coombe rock also note an admixture of material in contrasting condition, suggesting that artefacts from further up the sequence and derived from the terrace above were also present (Abbott 1911, 468; Smith 1911, 521; Dewey 1930, 149; Haward unpublished notebook BM[F]). It is not entirely clear, however, whether this material was recovered from the coombe rock, or whether collections made by the quarry company conflated artefacts collected from the entire sequence (see below). As such, despite the international recognition and historical importance of the classic "Baker's Hole" assemblage, the integrity of the extant collections is certainly more complicated than frequently suggested; however, the recovery of the majority of the Levallois material from a mass-movement deposit indicative of cold climate can be confidently asserted. This material has been treated separately from that definitely recovered from other deposits within the Ebbsfleet Valley sequence, and despite problems of pit nomenclature, is referred to as the "Baker's Hole" assemblage below.

Excavations by Burchell within the Ebbsfleet valley from 1933 onwards represented the first systematic attempt to examine the deposits that had produced artefacts for over 50 years. Burchell's expressed purpose was understanding the relationship between the fills of the Ebbsfleet channel and the implementiferous coombe rock, the results of which he published in a series of papers until the late 1950's (Burchell 1933; 1935; 1936a; 1936b; 1936c; 1938; 1954; 1957). Throughout this period he progressively subdivided the main aggradational units and changed his mind concerning the relationship between the coombe rock and the incision of the channel, as well as describing a succession of industries from throughout the sequence. His publications appear to reflect the persistence of Levallois flaking throughout the period spanned by the deposition of the Ebbsfleet valley sequence, although re-analysis of the Burchell material held in the British Museum suggests that Levallois material is confined to the lower, fluvial units (Coulson 1990, 241).

Few of the sections Burchell examined can now be located, but appear to have been within an area several hundred metres west of the main "Baker's Hole" occurrence (Wenban-Smith 1995). Subsequent work has largely confirmed the sequence established by Burchell, further excavation being undertaken in the area of his main "Temperate Bed" site by Carreck (1972, in Wenban-Smith 1995), as well as a further exposure to the north-west beneath the Northfleet allotments 300 metres to the north-west, originally discovered by Marston (Wenban-Smith 1995, 150). Both these sites were re-investigated by the British Museum between 1965 – 1969, the "Temperate Bed" site designated site B and the allotment site A (see Figure 5.1.1; Kerney and Sieveking 1977). The full sequence recorded by Burchell was not exposed at either site, being truncated by later quarrying; notable quantities of faunal remains and artefacts, including Levallois material, were recovered. Recent re-investigation of five sections within the Ebbsfleet valley was undertaken by Wenban-Smith (1995), which produced both faunal and molluscan material. One of the sites investigated (E) had not previously been studied, but was located close to the probable position of the classic "Baker's Hole" site. No further artefacts were recovered from any of these exposures.

Geological Background

The sediments infilling the Ebbsfleet valley represent the fills of a channel occupying a sloping bench cut into chalk at 7.5 m. O.D. (Burchell 1933). Although located within the tributary valley of the Ebbsfleet, correlation with the Taplow/Mucking aggradation of the Thames (OIS 8-7-6) is suggested by the altitude of the sediments (Bridgland 1994, 272). This attribution is supported by the nature of the mammalian assemblage from throughout the Ebbsfleet deposits, for which Schreve proposed an OIS 7 date (Schreve 1997, 2001). In addition, amino acid analyses of *Lymnea peregra* from the upper part of the freshwater silts (see below; possibly bed 6, although correlation between exposures is difficult; Bridgland 1994, 269) re-exposed in the vicinity of the Marston's allotment site (British Museum site A) have produced ratios compatible with an OIS 7 date (0.182 $\pm$ 0.021 and 0.169 $\pm$ 0.038; Bowen and Sykes, in Wenban-Smith 1995). Mineralogical analyses of fluvially-bedded silts from the base of bed 5 suggest similarities to continental pre-Eemian loess (Catt and Weir, in Bridgland 1994), again supportive of such a date.

The composite sequence has been well summarised by Bridgland (1994), based upon Burchell's work (1933; 1935; 1936a; 1936b; 1936c; 1938; 1954; 1957) and the observations of other workers (Boswell 1940, Kerney and Sieveking 1977, Zeuner 1945; 1946; 1954; see Table 5.1.1 below). Burchell (1933) initially viewed the channel as downcutting through the coarse gravel of Bed 2 (his "Meltwater gravels" – Bed III), but later observed that it was actually incised prior to the deposition of the coombe rock (Burchell 1936b). The coombe rock was subsequently eroded and overlain by a variety of coarse gravels and sands. Although most workers have regarded these as fluvial, Burchell having recovered pike teeth from the lowest gravel unit (Carreck 1972, in Wenban-Smith 1995), Kerney and Sieveking saw them as resulting from solifluction (1977). Their section, located in the area of Burchell's main "Temperate Bed" site, records Beds 1, 2, 4 and 5 adjacent to the edge of the channel, cutting through frost-shattered chalk (Figure 5.1.2). Detailed versions of the published section and photographs of the excavations show the silts which make up the majority of the sequence in this area as parted by numerous seams of gravel and coombe rock eroding from the edges of the channel, with bedding indicative of colluvial deposition towards the top of the westernmost silts (Bed 5) underlying the buried soil (Bed 5a). Kerney and Sieveking (1977) interpreted the gravel resting on the channel edge and that contorted on the base of the channel as a single unit; the intervening Bed 3 ("Lowermost Loam") was not recorded in their section, making it difficult to separate the two (Bridgland 1994, 267).

12.	Trail; Gravelly "loam" with rafts of coombe rock, probably cryoturbated.
11.	Sandy "fluvial brickearth" (Uppermost Loam – Burchell 1936b)
10.	*"Cailloutis"*
9.	Trail; as bed 12, from which it was initially undifferentiated (Burchell 1935, 1936b)
8.	Silt, aeolian/colluvial brickearth, decalcified in its upper part with bands of ferruginous staining. Produced *Pupilla muscorum.*
7.	Upper coombe rock. Produced derived artefacts and land snails.
6.	Fossiliferous temperate silt (Temperate Bed/Upper Loam – Burchell 1936b, 1954)
5a.	Buried soil developed on the top of bed 5
5.	Silt (brickearth) interbedded with numerous minor lobes of "coombe rock" and/or gravel. Descriptions and photographic records of British Museum sections reveal clear indications of aqueous bedding and suggest interdigitation with (or incision through) beds 2 and 4. This encompasses both Burchell's "Lower Loam" (1936b) – of fluviatile origin – towards the base – and the "Middle Loam" overlying it, which he saw as of "sub-aerial" (probably colluvial) origin (1936b, 1954). Total thickness of over 6 m. Produced *Pupilla muscorum, Vallonia costata* and *Limax* sp. (Burchell 1954), as well as a small vertebrate assemblage (Carreck 1972, in Bridgland 1994)
4.	Gravel; produced artefacts and fauna. Potentially the gravel shown resting on the slope in the British Museum section (Figure 5.1.2), in which case its separation from bed 2 is unclear, the intervening sandy bed 3 being removed by quarrying. Carreck records reworked Palaeogene shells and flint pebbles from this bed (1972, in Bridgland 1994)
4a.	Artefact rich horizon at base of 4? No evidence for this, apparently spread throughout
3	Fossiliferous sand (Lowermost Loam – Burchell 1936b) yielding *Bithynia tentaculata.* Not present in British Museum excavations.
2.	Coarse gravel, cryoturbated into or filling scour/solution hollows in the top of Bed 1. Reaches a thickness of >2m. at the edge of the channel where it is interbedded with lenses of coombe rock, and appears to interdigitate with the lower part of 5 (Figure 5.1.2).
1.	Main coombe rock, thought to be equivalent to that at the Baker's Hole site.
	Frost shattered chalk

Table 5.1.1 Summary of the Ebbsfleet Valley sequence (after Bridgland 1994).

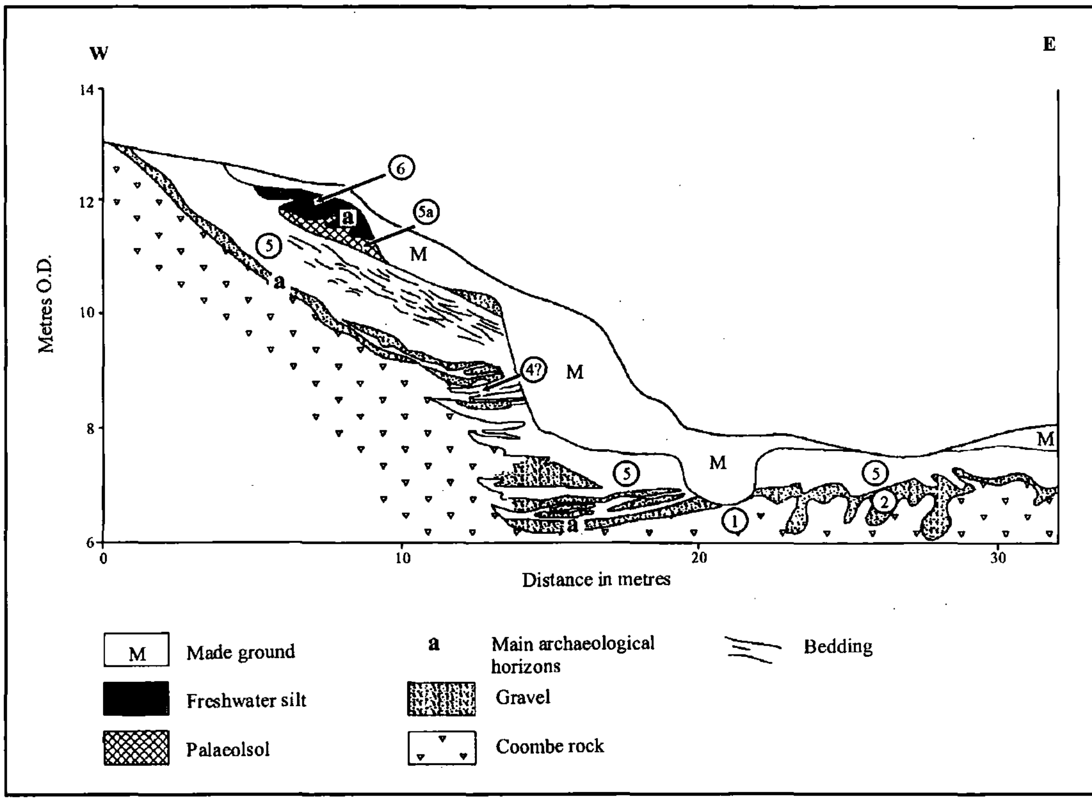

Figure 5.1.2 Deposits exposed in the British Museum (Site B) excavations (see Table 5.1.1 for explanation of bed numbers; modified from Bridgland 1994).

Bridgland (1994) suggests that Kerney and Sieveking's records indicate the infilling of the channel with a gravel lag followed by fluvial silts, which interdigitated with the continually eroding gravel and coombe rock near the channel edge. The channel then widened, and another gravel lag was deposited over a larger area; where observed by Burchell, presumably closer to the centre of the channel, this was of obvious fluvial origin (1936b), but closer to the edge cannot be differentiated from amongst the collapsed gravels and coombe rock interdigitating with the silts (Bridgland 1994, 267). The upper beds of the Ebbsfleet channel sequence predominantly comprise fine-grained sediments, and are spread over a wider area than the lower channel deposits. Problems again exist in relating the brickearths recorded in the British Museum excavations to the beds described by Burchell; Kerney and Sieveking (1977) treated all the fine-grained deposits between the gravels and the palaesol (5a) as a single unit, although clear differences in mode of deposition are apparent between upper, colluvial silts near the west end of the section and fluvial silts overlying the gravel to the east. The only means by which Burchell differentiated the Lower and Middle Loams (1935, 1936b) was on the basis of depositional environment, the Lower Loams being fluvially lain and the Middle Loams being "sub-aerial" (colluvially deposited) and containing land snails (Burchell 1954). This probably reflects the progressive incorporation of colluvially derived sediment into the Ebbsfleet and its fluvial redeposition away from the channel edge, and has implications for the treatment of the archaeological material from different investigations (see below).

A weathering horizon (Bed 5a) within the brickearths on top of the colluvial "Middle Loams" (upper part of Bed 5) was interpreted by Zeuner (1945, 1955) and Burchell (1954) as a rubified soil indicative of interglacial climate. However, Kemp (1991,1995) regards the soil as poorly developed, and the slumping and loading structures associated with the boundary between the Middle Loams (Bed 5) and the Upper Loam/Temperate Bed above (Bed 6) as indicative of cryoturbation and hence of cold conditions. Fully interglacial conditions and a return to fluvial deposition are attested by the overlying freshwater silts (Temperate Bed/Upper Loam – Bed 6), which produced a substantial molluscan assemblage, including both freshwater and land species indicative of a fully interglacial environment (Burchell 1954, 1957; Preece, in Bridgland 1994, 268). Burchell (1957) argued that the decline in both the total number of individuals and of species present throughout the Temperate Bed reflected a progressive deterioration in climate, a return to cold conditions being attested by the overlying deposit of coombe rock (Bed 7).

Baker's Hole Summary

- *Geographical situation*

  Although the precise context of the Baker's Hole assemblage within the coombe rock remains imprecisely established, the published descriptions describe the deposit as mantling a spur of chalk protruding along a north-east to south-west axis into the north-easternmost corner of the pit, adjacent to the fast-flowing river of which the coombe rock forms the basal fill (Reid, in Smith 1911, 516; Abbott 1911, 467).

- *Climate and environment*

  The nature of the chalk mass-movement deposit (coombe rock), reflective of ongoing solifluction, as well as the presence of *Coelodonta antiquitatis* within the coombe rock indicates that when hominins were exploiting the slope at Baker's Hole, the prevailing environment was cold and open in character (Bridgland 1994, Schreve 1997).

- *Dating*

  The coombe rock from which the Baker's Hole assemblage was collected represents the basal infilling of the Ebbsfleet channel, following its incision to a level of 7.5 m. O.D. Correlation of the Ebbsfleet valley sediments with the Taplow/Mucking formation of the Thames is suggested on the basis of similarity in height, allowing for the location of the site within the tributary valley of the Ebbsfleet (Bridgland 1994). The deposition of the coombe rock immediately following the downcutting of the channel indicates a late OIS 8 date for the Baker's Hole assemblage, supported by the attribution of the overlying interglacial sediments to OIS 7 (see below).

Analysis of the assemblage

Treatment and selection of collections

Although the Baker's Hole assemblage from the coombe rock at Northfleet represents the most substantial and best-known Levallois assemblage from Britain, clear problems exist with the integrity of the assemblage. The collection described by Smith and later donated to the British Museum by the Associated Portland Cement Company was not recovered in the context of a controlled excavation, but collected by the quarry company and stored in their offices at Northfleet, potentially at the instigation of Abbott (1911, 467). This represents the collection from Baker's Hole for which the best details of recovery are available and it is apparent that the majority of the assemblage was collected from within the coombe rock (Abbott 1911; Smith 1911). As suggested above, the coombe rock probably represents a continually aggrading cold-climate mass-movement deposit, artefacts both being incorporated into and reworked within the deposit to varying degrees. The assemblage as a whole is therefore likely to have a varied taphonomic and collection history.

Initial examination of the collections made it clear that material in very varied condition is present; stained and edge damaged handaxes being present in contrast to the largely fresh but lightly patinated Levallois assemblage. In addition, blade cores and endscrapers technologically comparable with Earlier Neolithic material are also represented. Given that this collection was amassed by the quarry company, it seems likely that material from throughout the exposed sequence was conflated, combining material from the coombe rock, the overlying gravels and silts, and even the surface soil above. Despite the fact that publications on the Baker's Hole material stress the association of large Levallois flakes and cores with the coombe rock, it is impossible to isolate these from within the existing collections.

The material included in the present sample therefore consists of only the larger available museum collections for which documentation or original artefact markings indicates recovery from Southfleet Pit; the Associated Portland Cement Company collection examined by Smith and later donated to the British Museum, of which a large collection subsequently passed to the Cambridge University Museum of Archaeology and Anthropology, the Cross collection held at the Oxford University Museum, and material donated to the British Museum (Natural History) by Hinton and Haward. Of this, only Levallois material is included in the analysis below; although the handaxes included with the Levallois material in these museum collections are more heavily abraded, stained and edge-damaged, a proportion of the Levallois material is in similar condition and given the continually aggrading nature of the deposit and the movement to which the material has clearly been subjected, a continuum of condition states exists between material which in other areas of the Ebbsfleet valley can be shown to have been derived from a higher terrace and that which was most probably deposited on and re-incorporated into the coombe rock.

There is, however, also the possibility that handaxes genuinely associated with the Levallois assemblage have been excluded, but given the nature of the collections and the context from which the material was recovered, material of more doubtful provenance has been deliberately excluded from the sample. It is also possible that Levallois material from the later exploitation of the gravels of the Ebbsfleet channel has also been included within the material examined here, but given the numerical dominance of the material from the coombe rock, a small number of such artefacts is unlikely to significantly affect the results. Given the apparent size of the original assemblage and the clear assertions of the position from which it was recovered re-iterated in the published sources (Abbott 1911; Smith 1911) it can confidently be stated that the majority of the material discussed below was recovered from the coombe rock, and reflects hominin technological activity on or adjacent to the active slope.

Analysis

The selected sample consists of 156 Levallois artefacts, summarised in Table 5.1.2.

Nature of artefacts	No.	% of assemblage
Levallois flakes	137	87.8%
Definite	108	69.2%
Probable	20	12.8%
Possible	9	5.8%
Retouched Levallois flakes	19	12.2%
Definite	17	10.9%
Probable	2	1.3%
Levallois cores	19	12.2%

Table 5.1.2 Levallois material from Baker's Hole (n=156).

Only definite Levallois flakes have been considered in the following analysis, the more ambiguous remainder largely comprising broken pieces.

Taphonomy

The condition of the material recorded is indicative of the processes which have affected the material as a whole (see Table 5.1.3). The artefacts show varying degrees of patination and staining, most being lightly to moderately patinated (73.2% of flakes, 94.7% of cores) and unstained or only lightly so (97.2% of flakes, 94.7% of cores). The interpretation of such chemical surface alteration is debatable, but contrasts markedly with the more pronounced staining exhibited by most handaxes within the collections and which have been excluded from the current analysis, being likely to derive from the iron-rich gravel deposits of the terrace above.

Definite Levallois flakes (n=108)			Levallois cores (n=19)		
Unabraded	80	74.1%	*Unabraded*	9	47.4%
Slightly abraded	24	22.2%	*Slightly abraded*	7	36.8%
Moderately abraded	4	3.7%	*Moderately abraded*	3	15.8%
No edge damage	7	6.5%	*No edge damage*	1	5.3%
Slight edge damage	69	63.9%	*Slight edge damage*	9	47.4%
Moderate edge damage	30	27.8%	*Moderate edge damage*	9	47.4%
Heavy edge damage	2	1.9%	*Heavy edge damage*	0	0%
Unpatinated	29	26.9%	*Unpatinated*	1	5.3%
Lightly patinated	61	56.5%	*Lightly patinated*	10	52.6%
Moderately patinated	18	16.7%	*Moderately patinated*	8	42.1%
Unstained	94	87%	*Unstained*	10	52.6%
Lightly stained	11	10.2%	*Lightly stained*	8	42.1%
Moderately stained	3	2.8%	*Moderately stained*	1	5.3%
No battering	81	75%	*No battering*	9	47.4%
Light battering	12	11.1%	*Light battering*	5	26.3%
Moderate battering	11	10.2%	*Moderate battering*	4	21.1%
Heavy battering	4	3.7%	*Heavy battering*	1	5.3%

Table 5.1.3 Condition of Levallois material comprising selected sample from Baker's Hole.

The flakes predominantly show little evidence of abrasion of the arêtes between flake scars (74.1% showing no abrasion), but varying degrees of light to moderate edge damage (63.9% and 27.8% respectively), reflecting mechanical pressure upon the more fragile areas of the artefacts, both in the context of movement of the artefacts themselves and the pressure of the mobile deposit upon them. The edges of the cores are similarly damaged (47.4% lightly so, 47.4% moderately), and the slightly elevated degree of abrasion (36.8% slight, 15.8% moderate) might potentially reflect a tendency for these heavier artefacts to sink into the saturated solifluctate and be subjected to the harsh pressure of subsequently mobile material moving across them. This suggestion is potentially supported by the elevated proportion of cores with incipient cones on humanly flaked surfaces (battering), reflective of repeated impact upon the artefacts by other hard, mobile clasts (52.7% of cores showing some evidence of battering, in contrast to only 25% of flakes).

The assemblage as a whole has thus clearly been subjected to varying degrees of movement and mechanical damage following its discard upon and incorporation into the continually aggrading deposit, but has probably not been substantially reworked. Refitting artefacts have apparently been noted between dispersed museum collections (Wenban-Smith 1995; although these are not recorded here), again supporting the assertion that the assemblage from the coombe rock, although by no means an *in situ* occurrence, can be regarded as re-organised but in primary context, reflecting hominin exploitation of the active slope.

Technology

Raw material

Only five of the nineteen cores within the current sample lack cortex, most (12; 63.2%) retaining cortex on at least 25% of the striking platform surface; none retain any on the flaking surface. Of these, a proportion (3 cores; 15.8%) exhibit fresh, unabraded chalky cortex, whilst most are worn in places (11; 57.9%) but retain the amorphous form of minimally transported nodules from the chalk. Thirteen cores are on whole or split nodules (68.4%), with a single example of an extensively frost-fractured blank being used. The size of the cores necessarily reflects the large size of the available raw material (see Table 5.1.4 below). Few flakes within the sample retain cortex (74.1% non-cortical), but those that do reflect a similar pattern of raw material use (3.7% fresh, 21.3% derived). One flake indicates the use of Bullhead flint from the Thanet Beds. It appears, therefore, that at Baker's Hole hominins were predominantly exploiting large flint nodules exposed by the ongoing erosion of the chalk slope and redeposited as part of the soliflucted talus at its base.

Levallois Cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	132.4	119.3	46.163	0.910097	0.388662
Min	84.7	72.2	26.8	0.73363	0.247406
Max	195.6	174.5	81.7	1.176871	0.556919
St.Dev	32.364	27.830	15.400	0.117505	0.090787
Median	133.2	115.4	38.9	0.893603	0.351798

Table 5.1.4 *Levallois cores summary statistics (n=19).*

The cores from Baker's Hole attest to the use of a variety of preparatory and exploitation strategies to produce large Levallois flakes. As repeatedly noted, most reflect the removal of a single flake (10 cores; 52.6%) following centripetal preparation (17 cores; 89.5%) of a single flaking surface (Smith 1911, Wymer 1968, Roe 1981 Coulson 1990, 380). However, variation within both the preparatory and exploitation phases of particular cores surfaces is also apparent, with single examples of bipolar and convergent unipolar preparatory strategies.

Levallois cores; technological observations (n=19)					
Preparation method			Exploitation method		
Bipolar	1	5.3%	*Unexploited*	3	15.8%
Convergent unipolar	1	5.3%	*Lineal*	10	52.6%
Centripetal	17	89.5%	*Unipolar recurrent*	2	10.5%
			Centripetal recurrent	2	10.5%
			Re-prepared but unexploited	2	10.5%
Convexities			Type of convexity working (n=16)		
Whole surface shaped as one	3	15.8%	*Invasive*	4	25.0%
Distal	1	5.3%	*Minimally invasive*	2	12.5%
Right	2	10.5%	*Steep*	3	18.8%
Left	1	5.3%	*Semi-invasive*	7	43.8%
Continuous	11	57.9%			
Distal and one edge	1	5.3%			
Blank type			Distribution of preparatory scars striking surface		
Definitely nodule	5	26.3%	*All over*	14	73.7%
Frost flake	1	5.3%	*Distal and one edge*	1	5.3%
Indeterminate	5	26.3%	*Proximal and distal*	3	15.8%
Probably nodule	8	42.1%	*Proximal and both edges*	1	5.3%
Type of striking surface working			Position of cortex on striking surface		
Invasive	9	47.4%	*None*	5	26.3%
Semi-invasive	5	26.3%	*All over*	1	5.3%
Steep	2	10.5%	*Central*	7	36.8%
Minimally invasive	3	15.8%	*Central and one edge*	5	26.3%
			One edge only	1	5.3%
% Cortex striking surface			Total number Levallois products from cores		
0	5	26.3%	0	3	15.8%
0-25%	2	10.5%	1	12	63.2%
26 – 50%	3	15.8%	2	2	10.5%
51 – 75%	6	31.6%	3	2	10.5%
>75%	3	15.8%			
Levallois products from final flaking surface			Types of Levallois products from core (n=22)		
0	5	26.3%	*Flake*	19	86.4%
1	10	52.6%	*Debordant flake*	3	13.6%
2	2	10.5%			
3	2	10.5%			
Preparatory scars final flaking surface			Preparatory scars striking surface		
1-5	2	10.5%	1-5	0	0.0%
6-10	6	31.6%	6-10	8	42.1%
11-15	7	36.8%	11-15	8	42.1%
16-20	3	15.8%	16-20	3	15.8%
>20	1	5.3%	>20	0	0.0%

Table 5.1.5 Technological observations of cores from Baker's Hole (n=19 except where otherwise stated).

The dominance of centripetal preparation probably reflects the fact the large, broad flakes produced from the final flaking surfaces of these cores required accentuation of the distal and lateral convexities to ensure successful detachment. Most cores retain high numbers of preparatory scars on the flaking surface, even though much of the surface is obviously removed by Levallois flake scars (57.9% retaining 11 or more preparatory scars). In comparison, the striking platform surfaces are less intensively worked, 47.4% retaining at least 50% cortex with comparable numbers of preparatory scars (57.9% have 11 or more preparatory scars) to the upper, flaking surfaces. The striking surfaces are simply prepared using invasive or semi-invasive removals (73.7%) all around the core circumference. The majority of the cores (16 cores; 84.2%) exhibit a separate, less invasive series of removals located around the margins which serve to increase the distal and lateral convexities of the flaking surface; these are generally continuous (57.9%) but can also be preferentially located on particular portions of the edge (26.3%). This presumably reflects the fact that detaching a large, broad flake from these flaking surfaces required careful accentuation of the distal and lateral convexities.

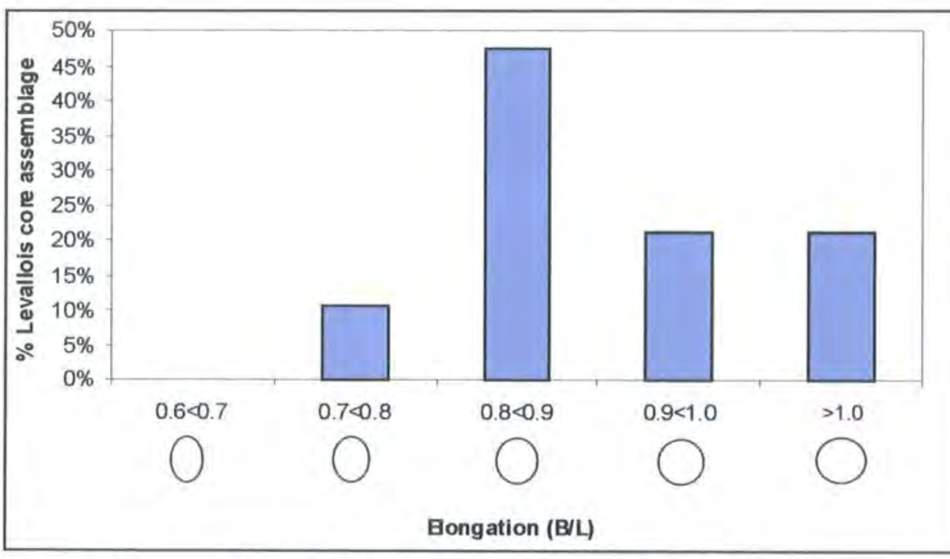

Figure 5.1.3 *Elongation of Levallois cores from Baker's Hole (n=19).*

The cores are predominantly round in planform (89.5% with elongation values of 0.8 and above; Figure 5.1.3) and tend to be relatively flat for their size, the flattening index of none exceeding 0.6 and most being between 0.2 and 0.4 (57.9 %; Figure 5.1.4). They are all large in size (see Table 5.1.4), and almost all could have been easily re-prepared and further reduced, being comparable in size, if not larger, than the available clasts of raw material at several other British sites. This apparently wasteful approach has been commented on by several previous workers (Wymer 1968, Roe 1981, Coulson 1990, 380). However, although most core surfaces (12) can only be shown to have produced a single flake, four attest to the recurrent exploitation of a given surface; two reflecting a unipolar recurrent strategy where two flakes were removed from one platform, and two a centripetal recurrent strategy, three Levallois flakes being removed from different striking platforms around the circumference of the core. Two of these also show further working of the lateral convexities before the final Levallois flake was removed.

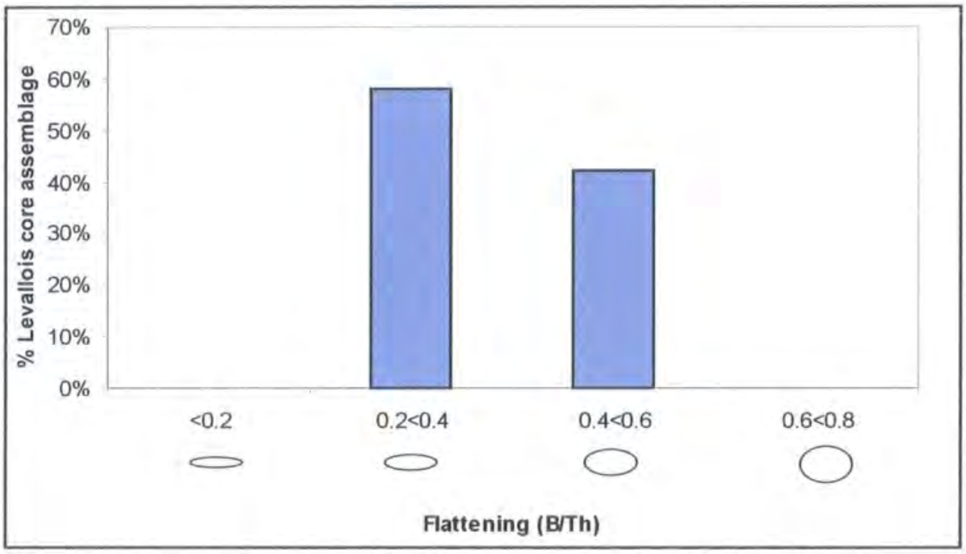

Figure 5.1.4 *Flattening of Levallois cores from Baker's Hole (n=19).*

The Levallois flake scars on the surfaces of the exploited cores indicate that the majority of endproducts removed consisted of Levallois flakes (86.4%), together with a small number of debordant flakes (13.6%; 3) resulting from the removal of flakes along the core edge in the context of recurrent exploitation of the flaking surface. Whilst most of the cores reflect the preparation of the core surface to allow the removal of a single flake, production was obviously also continued when a particular flaking surface allowed it, and sometimes deliberately extended through convexity adjustment. This illustrates a flexible approach to the extraction of several flakes, in contrast to the classic characterisation of the technological approach at Baker's Hole as solely linear and uneconomic in terms of the potential use-life of the discarded cores.

In addition to recurrent exploitation techniques, the complete, cyclical re-preparation of flaking surfaces is also apparent within the Baker's Hole sample. Five cores exhibit clear evidence of the re-preparation of the surface after the removal of a previous Levallois flake – smaller flake scars around the periphery cutting the large Levallois flake scar. Two of these were not subsequently exploited any further – in one case because the re-preparation of one edge rendered the core too thin for the easy removal of a flake, in the other for no obvious reason. Given that examination of Levallois cores in most instances only imparts information concerning the final flaking surface, all traces of previous surfaces being removed by later working, other cores within the sample may also be the result of such strategies.

Supporting evidence for this assertion is potentially provided by both the number of Levallois flakes present in comparison with the number of flake scars on cores resulting from the removal of a definite Levallois flake. Many more flakes are present within the sample than could be produced from the cores present, which between them (3 having unexploited final flaking surfaces) retain traces of the removal of 19 Levallois flakes. This may in large part relate to the collection and curation history of the extant assemblage; the quarry workers may not have collected and retained all of the large cores, which were presumably heavy and required storage space. In addition, at least two cores (one exploited, together with a second "unstruck" example) were sent with a variety of flakes to all local museums which asked for "duplicates" – representative examples of the material presented to the British Museum by the Associated Portland Cement Company (BM[F] Baker's Hole Correspondence). However, the ratio of Levallois flakes to cores (1:3; 2 cores and a minimum of 6 flakes in each "set") represented by these duplicate kits still suggests that more than a single flake may have been produced from each core.

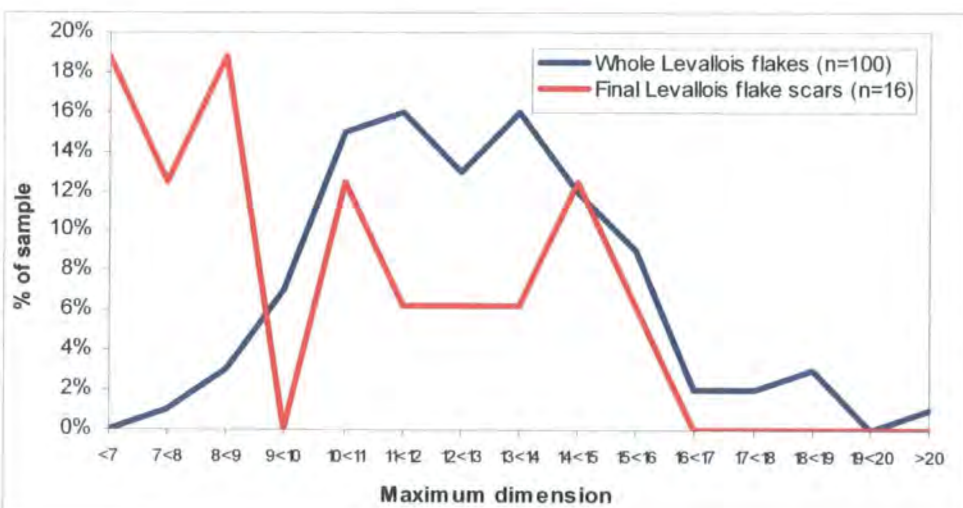

Figure 5.1.5 Comparison of maximum dimension (cm.) of final flake scars on Levallois cores with maximum dimension of Levallois flakes.

A comparison of the maximum dimension of final Levallois flake scars from the core surfaces with the maximum dimension of the Levallois flakes from the present sample potentially also indicates that several Levallois surfaces may have been prepared within the use-life of a given core (see Figure 5.1.5). 50.1% of the 16 untruncated Levallois flake scars are less than 9 cm. in maximum dimension, in comparison to only 4% of the unbroken

Levallois flakes, whilst some 8% of the flake assemblage is greater than 16 cm. in maximum dimension. None of the flake scars retained upon the cores in the present sample are large enough to represent flakes of such size. On the basis of the available sample, it could arguably be asserted that the majority of the flake assemblage was potentially produced from previous flaking surfaces which were then reworked to emplace the necessary convexities for further exploitation.

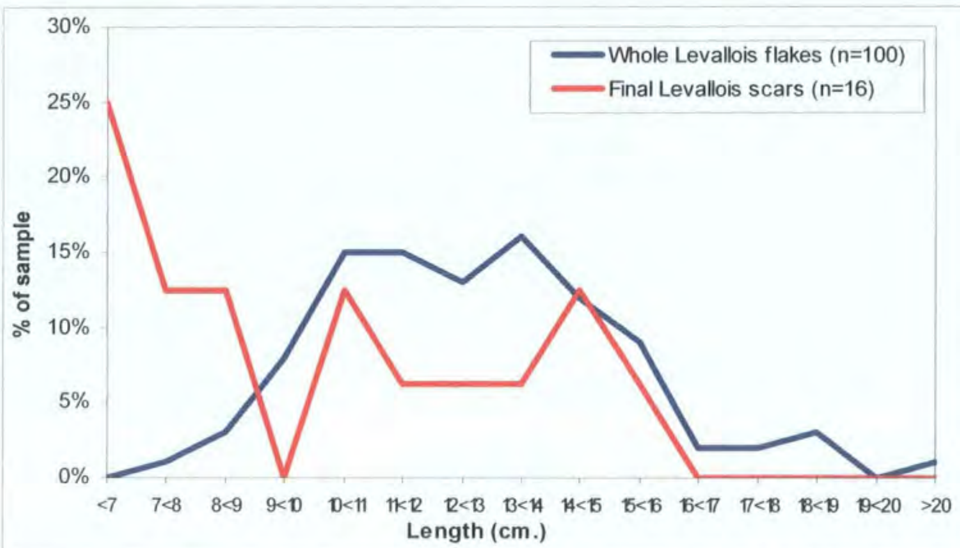

Figure 5.1.6 *Comparison of length (cm.) of final flake scars on Levallois cores and Levallois flakes.*

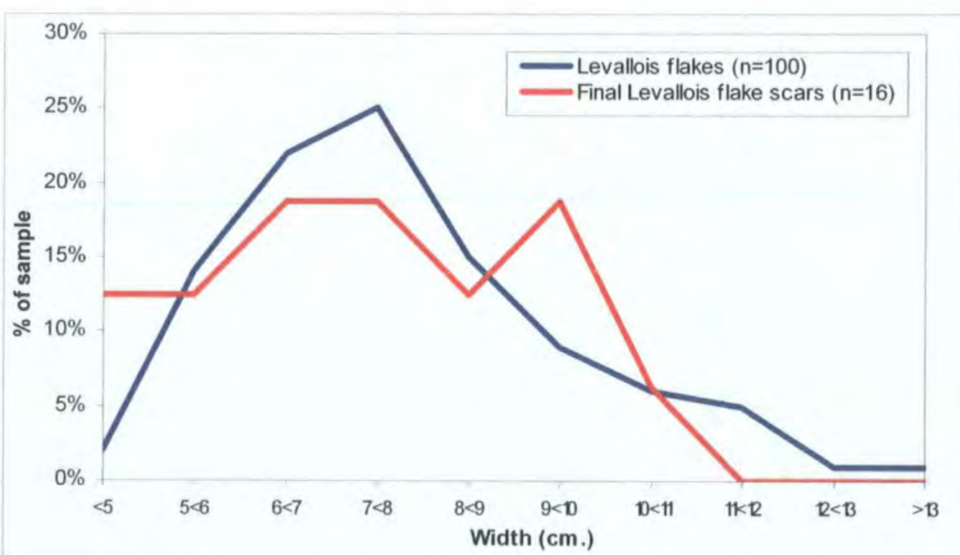

Figure 5.1.7 *Comparison of width (cm.) of final flake scars on Levallois cores and Levallois flakes.*

As a result of this, the exploitable area of the final flaking surfaces of the cores and subsequently of the flakes which could be produced was reduced, reflected in the fact that the final flake scars retained on cores are smaller than the majority of the extant flake assemblage. Interestingly, this pattern is more clearly marked for length of Levallois flakes compared with final flake scars than for width (see Figures 5.1.6 and 5.1.7). Both flakes and cores reflect a similar distribution in terms of width, 85% of the flake assemblage and 81.4% of the flake scars being 5-10 cm. wide. This might suggest, if we accept that Levallois surfaces were being cyclically re-prepared after initial flake extraction, that earlier in their exploitation history, Levallois flakes were removed only from the central area of the productive surface. Broader flakes would necessarily have required notable force for successful detachment, and are likely to have been very thick. Manageable broad flakes were produced later on in the reduction history of the cores, when the area of the flaking surface was reduced, using a centripetal preparatory strategy and deliberate accentuation of the convexities to favour the successful detachment of final Levallois flakes.

Levallois flakes

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	127.43	77.53	20.46	0.623444
Median	124.7	74.95	18.9	0.617097
Min	78	43.4	4.5	0.308904
Max	218.5	134.4	64.9	1.11279
St.Dev	25.222032	18.34506	8.288073	0.162178

Table 5.1.6 Summary statistics whole Levallois flake dimensions (n=100).

The majority of the 108 definite Levallois products from the current sample are large flakes (74.1%), together with a single Levallois point, a small number of metrical Levallois blades (16.7%) and flakes which have taken either the lateral or distal core edge off (8.4% debordant and overshot; see Table 5.1.7). Few of these retain any cortex (74%), though some do retain a minimal amount. Whilst the sample includes a relatively elevated number of Levallois flakes in relation to cores, most are unbroken (92.6% whole) and few (11; 10.2%) result from knapping accidents. The decision to include only definite Levallois flakes in this analysis certainly contributes to the high proportion of whole flakes in the assemblage, partial flakes being harder to confidently state to have been produced using this technique.

The Levallois flakes are large in size – a substantial proportion (see above) being too big to have been produced from the surface of any of the cores present within the sample. The scar patterns retained upon the dorsal surfaces of the Levallois flakes reflect the preparatory strategies attested by the cores themselves, 69% having being prepared centripetally, 4% using a convergent unipolar strategy and a marked proportion reflecting bipolar preparation (17%).

Levallois flake summary table					
Type of endproduct (n=108)			Butt type (n=108)		
Flake	80	74.1%	*Plain*	31	28.7%
Point	1	0.9%	*Dihedral*	6	5.6%
Blade	18	16.7%	*Natural*	1	0.9%
Debordant	3	2.8%	*Marginal*	3	2.8%
Overshot	3	2.8%	*Facetted*	58	53.7%
Overshot and debordant	3	2.8%	*Missing*	1	0.9%
			Chapeau de gendarme	4	3.7%
			Shattered	1	0.9%
			Obscured	3	2.8%
Raw material (n=108)			Cortex retention (n=100)		
Indeterminate	80	74.1%	*0%*	74	74%
Fresh	4	3.7%	*1 – 10%*	20	20%
Derived	23	21.3%	*11 – 25%*	6	6%
Bullhead	1	0.9%	*>25%*	0	0%
Method of exploitation (n=108)			Direction of previous Levallois removal (n=9)		
Definitely preferential	14	13%	*Proximal*	6	55.6%
Probably preferential	85	78.7%	*Distal*	1	11.1%
Unipolar recurrent	6	5.6%	*Right*	1	11.1%
Bipolar recurrent	1	0.9%	*Left*	2	22.2%
Centripetal recurrent	2	1.9%			
Position previous Levallois removals (n=9)			Knapping errors (n=11)		
Left lateral	5	55.6%	*Hinged*	1	9.1%
Right lateral	1	11.1%	*Overshot*	5	45.5%
Across	1	11.1%	*Step fracture*	4	36.4%
Diagonal	2	22.2%	*Other*	1	9.1%
Number of preparatory scars (n=100)					
1-5	14	14%	2 Levallois flakes exhibit possible evidence of previous flaking surface		
6-10	48	48%			
11-15	26	26%			
16-20	11	11%	9 Levallois flakes bear traces of previous Levallois removal		
>20	1	1%			
Preparation method (n=100)			Pattern of additional convexity working (n=100)		
Unipolar (proximal)	8	8%	*None*	72	72%
Bipolar	17	17%	*Distal*	72	72%
Convergent unipolar	4	4%	*Right*	7	7%
Centripetal	69	69%	*Left*	12	12%
Unidirectional lateral	1	1%	*Continuous*	3	3%
Unipolar (distal)	1	1%	*Distal and right*	4	4%
			Distal and left	1	1%
			Both edges	0	0%
				1	1%
Nature of convexity (n=28)			Portion (n=108)		
Minimally invasive	5	17.9%	*Whole*	100	92.6%
Semi-invasive	11	39.3%	*Proximal*	7	6.5%
Steep	1	3.6%	*Distal*	1	0.9%
Invasive	8	28.6%	*Mesial*	0	0%
Cortical or natural	3	10.7%			

Table 5.1.7 Technological observations of Levallois flakes from Baker's Hole (n=108).

Other patterns are also attested by scar patterns on the flakes which are not shown by the cores themselves; unipolar preparation from the same platform as that from which the Levallois flake itself was removed (8%) and single examples of preparation solely from the distal or one edge. Whilst these may well represent methods of preparation not visible upon the surfaces of the discarded cores, it is also possible, since the flake usually does not remove the entire flaking surface of the core (except accidentally), that the scar pattern retained upon the flake does not fully reflect the method employed to shape the entire core. There is a slight indication that bipolar preparation was favoured for the removal of the largest Levallois flakes; 30% of whole Levallois flakes greater than 15cm. in maximum dimension are prepared using such a strategy, in comparison with only 12% of centripetally prepared whole Levallois flakes (see Figure 5.1.8). Similar shifts in preparatory strategy from uni/bipolar to centripetal throughout reduction have previously been noted (Dibble 1995, Meignen 1995). At Baker's Hole, the use of bipolar preparation to produce very large flakes might reflect the fact that guiding longitudinal removals favour the removal of the flake from the centre of the core, opposed scars at the distal end encouraging successful detachment without overshooting. A broader flake – such as is encouraged by centripetal preparation – of this size would require the application of extreme force in order to detach it, and would probably be very thick. Without further reworking, such a flake may have been too unwieldy to be practically useful; strategies therefore seem to have been deliberately adopted to produce longer, thinner flakes from very large core surfaces.

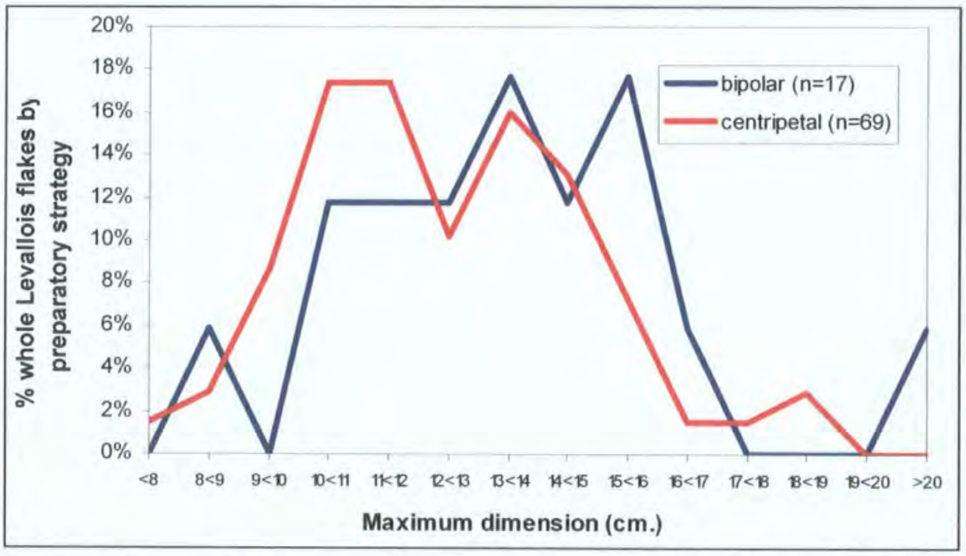

Figure 5.1.8 *Comparison of maximum dimension of whole Levallois flakes prepared using a bipolar or centripetal strategy.*

The Levallois flakes retain high numbers of preparatory dorsal scars (38% retaining more than 11), which when taken in tandem with the high numbers of preparatory scars remaining on the exploited core surfaces again emphasises the extended shaping of the volume of the flaking surfaces to produce such large flakes. Additionally, 25% of the flake assemblage retains invasive or minimally invasive scars (67.9% of those which retain such working) around the edges cutting broader preparatory flakes, possibly representing deliberate adjustment of the distal and lateral flaking surface convexities, these frequently being located along the right edge (40% of those flakes with convexity working). A notable proportion retain such working at the distal end (28%), reflecting the presence of 6 flakes within the sample which have overshot the distal end of the core and retain scars from the preparation of the core edge on the portion of it they have removed. As such, the preparatory patterns attested by the flakes support the evidence derived from the cores, reflecting either an initial phase of overall shaping of the surface, then adjustment of the convexities, or readjustment of the convexities in order to establish a new flaking surface.

The majority of the flakes have facetted butts (53.7%), although a notable proportion are plain (28.7%) and other types are minimally represented (see Table 5.1.7). Clearly, although particular platforms were frequently deliberately prepared in order to remove large flakes, this was not always necessary. In terms of exploitation method, the flakes again largely support the evidence provided by the cores; 13% definitely resulting from lineal exploitation, removing a large portion of the surface volume or the core edge in such a way that complete reconfiguration of the flaking surface would have been necessary to exploit it further. Most of the flakes, although not bearing the traces of previous Levallois removals, could potentially have been followed by a further removal but are *probably* the result of lineal exploitation (78.7%). Significantly, a small number of flakes again attest to recurrent strategies, retaining large, biting scars cutting shallower, preparatory removals on their dorsal face which could be interpreted as previous Levallois removals. These indicate that unipolar (5.6%), bipolar (0.9%) and centripetal recurrent (1.0%) exploitation methods were also employed, underlining the evidence from the cores for a certain amount of recurrent exploitation of particular flaking surfaces. Additionally, two flakes reflect the fact that limited re-preparation of the convexities was undertaken between Levallois flake removals.

When grouped into size classes by length, it is apparent that the largest flakes in the sample are the most elongated (see Figure 5.1.9). 19% of the most elongated flakes (B/L <0.4) are longer than 15 cm, whilst 33% of the near-circular flakes (B/L >0.8) are less than 10 cm long. As noted above, these larger, more elongated flakes are more likely to be produced following bipolar preparation of the flaking surface. Smaller, broader flakes are more likely to have been produced from a surface prepared using a centripetal method. In combination with the similarity between final Levallois flake scars on cores in terms of width, but not length, and the fact that a proportion of the Levallois flake assemblage is too long to have been produced from any of the cores present, this does seem to support the suggestion that core surfaces were cyclically re-prepared and that particular preparatory strategies were applied at particular stages in core reduction. Bipolar preparation was initially favoured in order to successfully remove elongated flakes from the centre of the large cores. At this stage, centripetal preparation would have encouraged the detachment of very large, broad flakes, which would have been difficult to control – such flakes require the application of great force to detach and proportionally would be rather thick and potentially heavy and unwieldy. Centripetal preparation and the removal of broader Levallois flakes was undertaken later on; not only did the reduction in the flaking surface allow such flakes to be struck more easily, but the re-creation of the distal and lateral convexities would be easily imposed through a continuous series of removals around the core edge. It therefore seem that throughout core reduction, particular strategies were selected from amongst a range of options in response to the evolving possibilities of the cores being reduced.

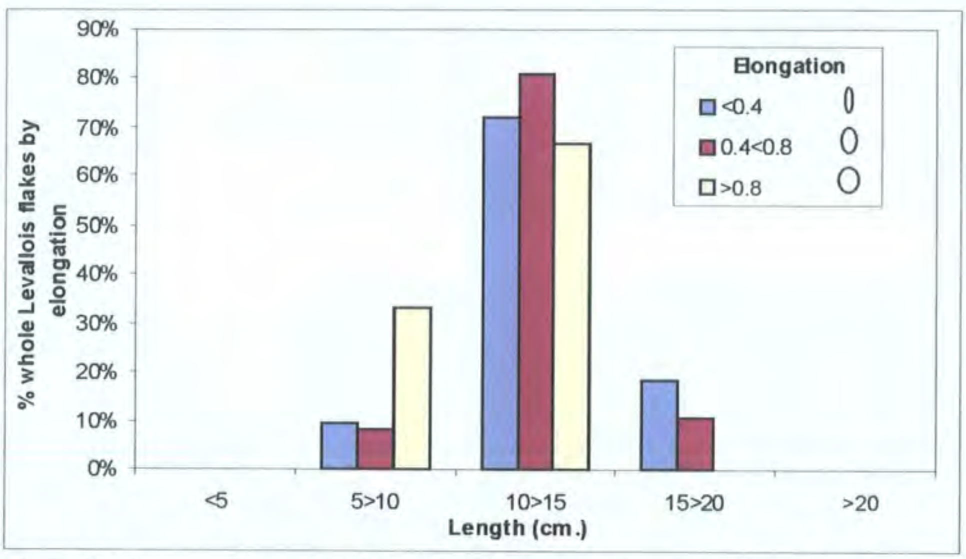

Figure 5.1.9 *Elongation of Levallois flakes (B/L) grouped by length (cm.); (n=100).*

Retouched Levallois flakes

Seventeen of the definite Levallois flakes within the selected sample have been retouched in a variety of ways. Although some (3) are notched, one or several times, most exhibit different degrees of semi-invasive or invasive retouch to a single convex edge (see Table 5.1.8), several show more intensive working of both edges (double sidescrapers), and a notable proportion reflect working of the ventral surface (5) or bifacial working (3).

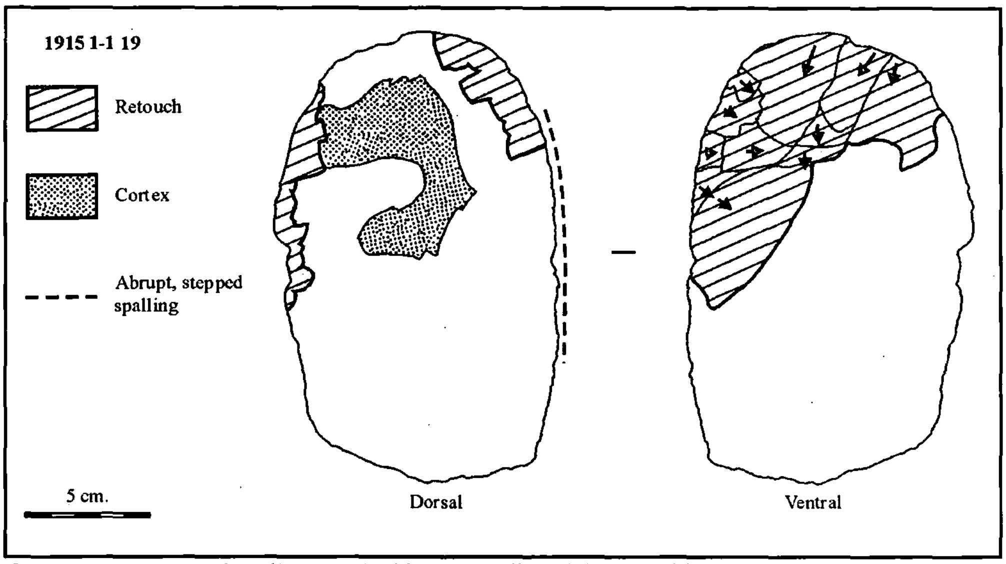

Figure 5.1.10 Bifacially retouched large Levallois flake resembling handaxe. (British Museum Registration number 1915 1-1 19)

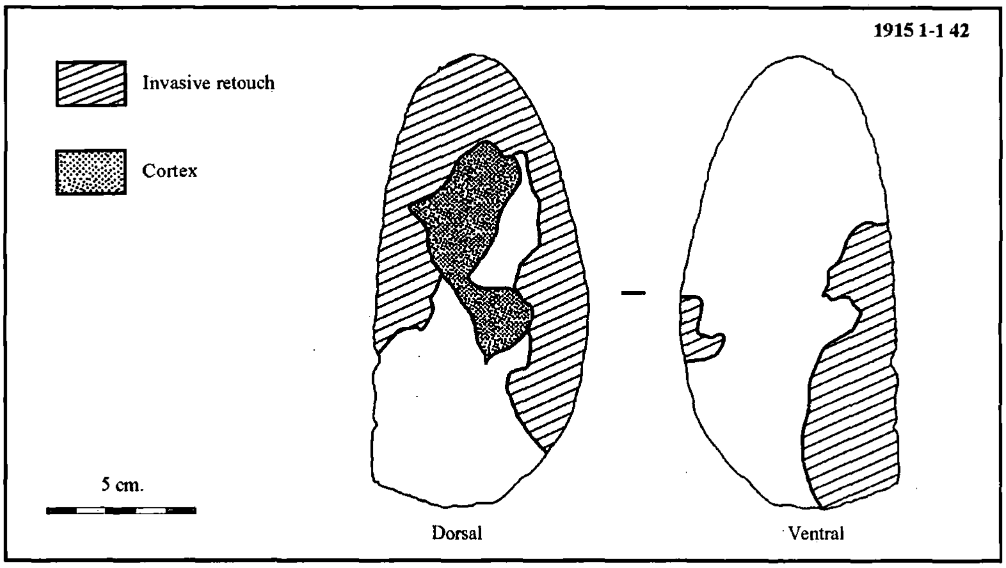

Figure 5.1.11 Bifacially retouched large Levallois flake resembling handaxe. (British Museum Registration number 1915 1-1 42)

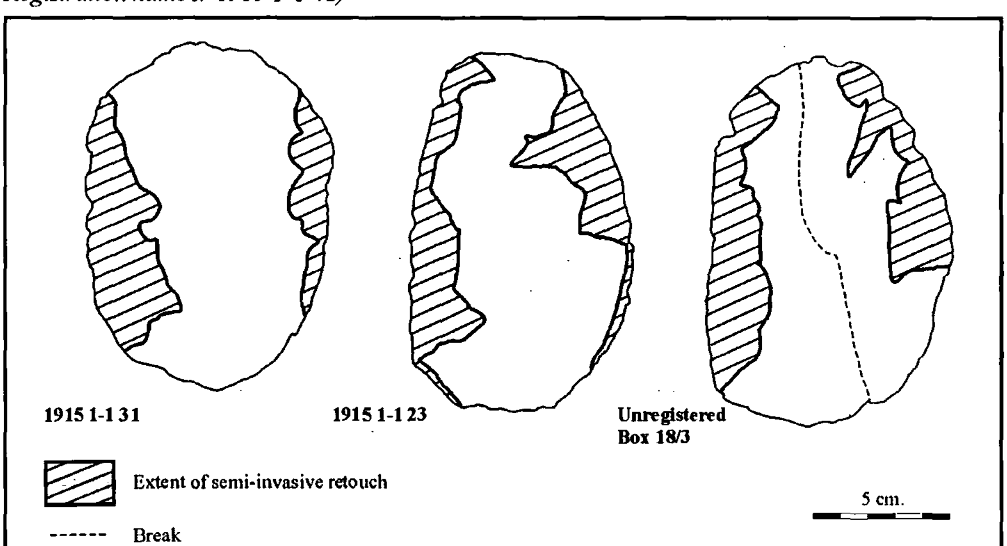

Figure 5.1.12 Large Levallois flakes with semi-invasive flat retouch resembling handaxes. (British Museum registration numbers 1915 1-1 23 and 31, unregistered 18/3).

Interestingly, 5 of the retouched flakes resemble handaxes in their discarded form; 2 of these are worked bifacially (Figures 5.1.10 and 5.1.11) whilst the others could be classified as double side-scrapers, with flat semi-invasive or invasive working of the dorsal surface (Figure 5.1.12). One very large handaxe-like retouched Levallois flake (BM 1915 1-1 19; see Figure 5.1.10) shows an initial phase of ventral thinning concentrated at the distal end (perhaps because this large flake had overshot, taking the core end off, and did not have a sharp distal edge) and subsequent less regular, semi-invasive working of the dorsal surface. A series of very abrupt, stepped scars along the right edge could be interpreted as backing, perhaps reflecting the transformation of different edges of the same tool to serve different functions – the creation or rejuvenation of a sharp cutting edge through thinning, opposed to a dull edge which may have aided prehension. Similar patterns have been noted in the application of retouch to handaxes from Later Middle Palaeolithic contexts (Boëda 2001, Cliquet 2001), the handaxe acting as a support for the transformation of edges in different ways, presumably to meet various functional needs.

Location of retouch on Levallois flakes					
Position			Location		
Direct	9	52.9%	*Distal*	4	23.5%
Inverse	5	29.4%	*Mesial*	1	5.9%
Bifacial	3	17.7%	*Right*	5	29.4%
			Left	1	5.9%
			Continuous except butt	1	5.9%
			Both edges	5	29.4%
Distribution			Edge form		
Continuous	5	29.4%	*Rectilinear*	2	11.8%
Discontinuous	6	35.3%	*Convex*	12	70.6%
Partial	6	35.3%	*Notched*	2	11.8%
			Denticulate	1	5.9%
Extent of retouch			Angle of retouched edge		
Marginal	1	5.9%	*Abrupt*	1	5.9%
Minimally invasive	6	35.3%	*Semi-abrupt*	11	64.7%
Semi-invasive	8	47.1%	*Low*	5	29.4%
Invasive	4	11.8%			
Regularity of retouched edge			Morphology of retouch		
Regular	11	64.7%	*Scaly*	17	100%
Irregular	6	35.3%			

Table 5.1.8 Location and type of retouch on Levallois flakes (n=17)

The dominance of flat, invasive or semi-invasive retouch to the edges of the large Levallois flakes from Baker's Hole can be inferred (through comparison with the non-retouched portions of retouched flake edges) not to have notably changed the angle or nature of the retouched edge. Such retouch could, therefore, be viewed as either strengthening or re-sharpening cutting edges, rather than changing the possible function or prehensile demands of tools. Although three are notched or denticulated, most have been retouched in order that they preserve the existing functional possibilities of an unmodified, large Levallois flake.

Technology and hominin behaviour at Baker's Hole

Together with the evidence for recurrent exploitation of core surfaces attested by both the flakes and cores, it seems that the technological approach undertaken at Baker's Hole is neither as straightforward nor as "uneconomical" as it has sometimes been characterised. Rather, several large Levallois flakes could be and, indeed, were produced from the large nodules of flint available from the slope. The fact that the cores were not worked to exhaustion is probably a reflection of the ubiquity of such material in this situation, and perhaps also suggests that flakes of large size were a desired endproduct. Further reworking of the core surfaces would have led to the production of increasingly small flakes, when merely beginning another would allow similarly large examples to be removed. Cores may simply have been discarded once the desired endproducts had already been extracted. Effectively, the large Levallois flakes produced at Baker's Hole are functionally analogous to handaxes, possessing a continuous cutting edge, whilst the recurrent exploitation of the cores allowed several such blanks to be produced at any one time. Notably, when retouched, such large flakes do not appear to be transformed – through the creation of steep or irregular retouched edges – so much as re-sharpened. Although Levallois flakes potentially offer flexibility as transformable tool supports, in this situation it appears that a continuous cutting edge- whether already present or imposed/re-created through retouch – was favoured. Baker's Hole therefore appears to represent a situation were hominins were deliberately provisioning themselves with large, sharp, flake blanks, potentially several at a time, but leaving cores with a potentially extendable use-life simply because once they had obtained the flakes required, the cores still remained too large to easily transport.

Ebbsfleet Channel Summary

- *Geographical situation*

  The Levallois material from the Ebbsfleet channel is restricted to the basal fluvial gravels and silts immediately overlying them, representing the banks and bars of a river adjacent to an eroding slope.

- *Climate and environment*

  The fluvial gravels and silts from which the assemblages considered below were recovered attest to a temperate climate (indicated by the presence of *Neomys* sp. and *Bithynia tentaculata* within the gravels themselves; Wenban-Smith 1995; 155, 158; Schreve 1997; 337). Both large and small mammals indicate nearby open grassland (e.g. *Mammuthus primigenius, Equus ferus, Cervus elephas*; *Microtus oeconomus, Microtus agrestis*; Wenban-Smith 1995, 159; Schreve 1997, 337), with the presence of *Clethrionomys glareolus* suggesting that woodland was also present nearby.

- *Dating*

The Ebbsfleet valley sediments are correlated with the Taplow/Mucking aggradation of the Lower Thames (OIS 8-7-6; Bridgland 1994), and amino acid analyses of molluscs from the interglacial silts (probably Bed 6) have also produced ratios indicative of an OIS 7 date (d/l = 0.182 $\pm$ 0.021 and 0.169 $\pm$ 0.038; Bowen and Sykes, in Wenban-Smith 1995). The mammalian assemblage from throughout the interglacial deposits, of which the archaeologically productive lower gravels and fluvial silts are part, supports this attribution, arguably being analogous to the upper sequence at Aveley (Schreve 2001). On this basis, Schreve advocates a later OIS 7 (7a) date for the whole interglacial sequence (Schreve 1997).

Given the apparent reversion to cold conditions (Kemp 1991, 1995) indicated by the cryoturbated weathering horizon on top of the Middle Loam (5a), followed by a return to full interglacial conditions and fluvial deposition throughout the temperate freshwater silts (6), it seems possible that at least two temperate and one cold sub-stage events are recorded within the Ebbsfleet sediments. Wenban-Smith advocates correlation of the Ebbsfleet sediments with the later part of OIS 7, suggesting that the erosional unconformity represented by Bed 5a is analogous to substage 7b, with the temperate sediments either side reflecting the two warmest substage within the interglacial (7c and 7a respectively; Wenban-Smith 1995, 159). However, this cold episode could arguably also represent 7d, this being the coldest substage within OIS 7. Leaving aside speculation as to which cold substage might be represented, it is worth keeping in mind that Levallois material was only recovered from the basal fluvial sediments (Beds 1 – 4). Although the period of time over which the basal, fluvial gravels accumulated cannot be speculated upon, their aggradation can be assigned to the interglacial phase 3 of Bridgland's model, suggesting an early-mid OIS 7 date for the archaeologically productive units.

Analysis of the assemblage

Treatment and selection of collections

Burchell

Burchell's investigations of the Ebbsfleet valley produced prodigious amounts of archaeological material, which his publications suggest reflects a persistent human presence throughout the aggradation of the Ebbsfleet channel sediments. The logic underlying the industrial designations he ascribes are unclear - a progression throughout the sequence from "Early Mousterian (Levallois B)" in the Lower Gravels (Beds 2-4) to an "Upper Mousterian (Levallois E)" (Latterly "Micoquian" – Burchell 1957) assemblage in the overlying Freshwater Bed (Bed 6). Additionally, Burchell changed his mind concerning the relationship between the coombe rock and the incision and infilling of the channel throughout his work (e.g. compare Burchell 1935 and 1936b). However, the terms he used to designate particular units remain constant – the possible exception being the "Middle Moustier Floor" – initially used to refer to artefacts from the base of the Lower Gravel (Burchell 1935; Beds 2-4) and later to material from beneath the coombe rock (Burchell 1936b) – a position potentially equivalent to the substantial Baker's Hole assemblage considered previously. Burchell distributed his collections between several museums; small amounts have ended up in a variety of provincial museums, with the largest such collections being those held at the British Museum, Pitt-Rivers Museum (originally held by Ipswich) and the Cambridge Museum of Archaeology and Anthropology. The following analysis is based upon these collections.

Burchell marked a large proportion of the material he collected with details of the unit from which it came; only artefacts bearing these markings have been recorded, allowing extensive resorting of material from the entire Ebbsfleet channel sequence held at the British Museum. The selected sample consists of material from a variety of levels within the basal fluvial sediments, as these were the only levels to produce Levallois material. This predominantly came from the Lower Gravel (Bed 2, variously referred to by Burchell as the Lower Gravel, Basal Gravel, *in situ* Gravel capping coombe rock, Between Lowermost and Lower Loams or Meltwater Gravel capping coombe rock), together with small amounts from the Lowermost Loam or the base of the Lowermost Loam (Bed 3; fluvial silt within the gravel).

Four Levallois flakes and a Levallois core have also been included in this sample from the "Factory site beneath coombe rock"; although these could be ascribed to the same position as the Baker's Hole assemblage, they are few in number and have been included here as they do come from the basal channel fill. Similarly, material from the "Middle Moustier Floor" has also been included, deriving as it does from either the base of the gravel, or a position equivalent to the "Factory site beneath coombe rock". Taken together, this material all comes from the lowermost units of the Ebbsfleet Channel (Beds 1-3); given its relative homogeneity in terms of condition and depositional context (especially in contrast to the overlying units; see below), as well as the restriction of Levallois technology at Ebbsfleet to these basal fluvial units, Beds 1-3 have been treated as producing a single assemblage, and are hereafter referred to as the "Lower Gravels".

British Museum Excavations; Site B

The excavations undertaken by Kerney and Sieveking (1977) included a section located close to the channel edge in the area of Burchell's main "Temperate Bed" site (British Museum Site B), and primarily exposed the silts of Bed 5 interdigitating with coombe rock and gravel. Bed 5 encompasses both the Lower and Middle Loams, the distinction made between the two by Burchell being one of depositional facies. The silts at the west end of the section exhibit bedding indicative of supply from the valley side, whilst those to the east (closer to the channel centre) are fluvially deposited (Bridgland 1994), reflecting the colluvial supply of silt and its progressive incorporation into the sediment load of the Ebbsfleet channel, concomitant with erosion of the channel edge. Although 488 artefacts were excavated, very few of these are Levallois, and the assemblage as a whole appeared to be in notably more mixed condition than the Burchell material. The primary value of the British Museum collection is therefore taphonomic; analysis was directed towards establishing whether lithic industries with different depositional histories had been conflated, and if so, whether these could be separated in order to understand the processes undergone by the technologically more informative material collected by Burchell.

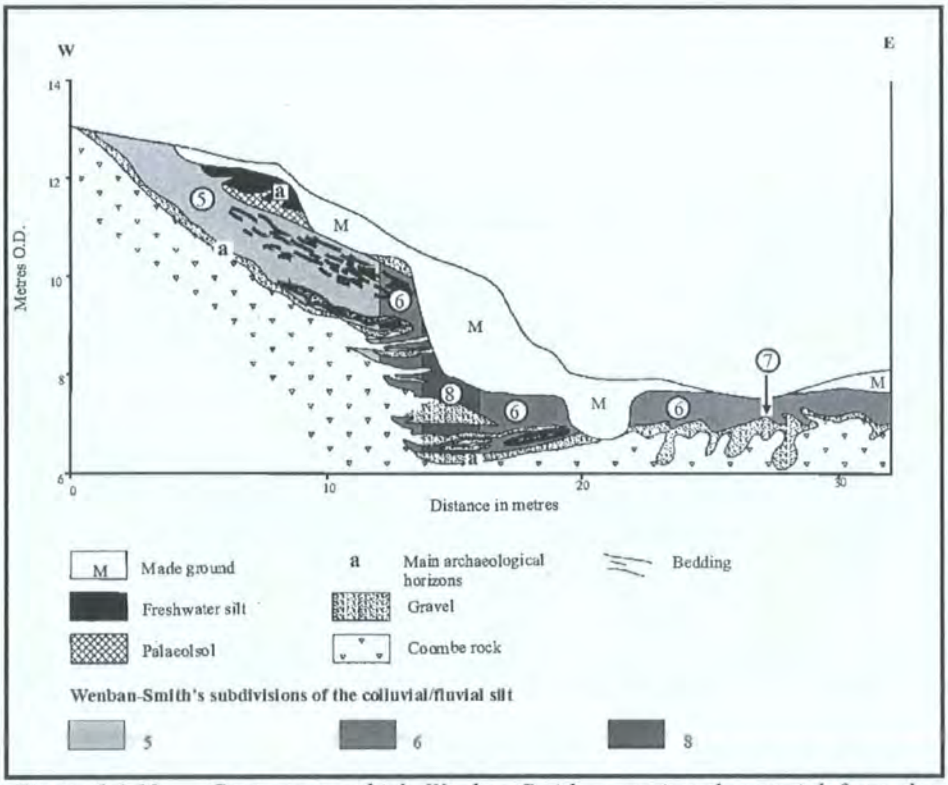

Figure 5.1.13 Contexts to which Wenban-Smith re-assigned material from the British Museum Site B excavations.

Following previous work by Wenban-Smith, the collection was re-sorted. Grid measurements along the bottom of a detailed version of the published section from Site B (Kerney and Sieveking 1977, fig. 14; see Figure 5.1.2) allow finds to be relocated horizontally to metre square, whilst context descriptions in the accession register (Site I, 1970 1-1) allow, in some cases, their reattribution to vertical context. However, this is more difficult in the central part of the section, where a variety of lenses of gravel and coombe rock interdigitate with Brickearth. Here Wenban-Smith had assigned all finds from the Brickearth up to 13 m. along the section to context 5 (colluvial brickearth), those from between 14-15m. to context 8, and those from 15 m. to the east end of the section to context 6 (both fluvial). Confusingly, he also assigns material from the "Loam" at 13 m. to context 6 rather than 5. All three of these contexts overlap in the central portion of the section (Figure 5.1.13).

New archaeological context number	Bridgland's Geological bed number	Description	Kerney and Sieveking	Wenban -Smith	Metre square	Mixed condition ?	Recorded?
0	1	*Coombe rock*	4 or 0	4 or 9	1-32	No	Yes
1a	4	*Gravel on channel edge*	1 or 2	2	1-13	Yes	No
1b	2	*Basal gravel*	1	3	14-30	No	Yes
2a	5	*Brickearth at west end of section*	2	5	1-12	Yes	No
2b	5	*Brickearth in interdigitating zone*	2 or 2b	5, 6 or 8	13-20	Yes	Levallois only
2c	5	*Base of chalky brickearth at junction with coombe rock in interdigitating zone*	2b	8	14-15	Yes	Levallois only
2d	5	*Brickearth directly over gravel east of modern intrusion*	2	6	21-32	No	Yes
2e	N/a	*Interface between coombe rock and brickearth*	2	7	21-31	No	Yes

Table 5.1.9 Archaeological contexts to which British Museum Site B material has been re-assigned, with earlier (Kerney and Sieveking and Wenban-Smith) context attributions and geological bed numbers (Bridgland 1994; see Table 5.1.1).

In order to disentangle the material from the brickearths, the assemblage was broadly re-sorted into three main groups, according to whether artefacts were recovered from fluvially deposited brickearth, colluvially deposited brickearth, or the brickearths in the centre of the section which interdigitate with the channel edge. (Figure 5.1.14, Table 5.1.9). To avoid confusion, the original context numbers assigned by Kerney and Sieveking were re-assigned, new subdivisions being indicated by a letter suffix. Following Wenban-Smith, artefacts from the gravel were assigned to two separate contexts depending on location; either the channel edge (1a) or base (1b). All artefacts from the coombe rock are reassigned to Kerney and Sieveking's context 0.

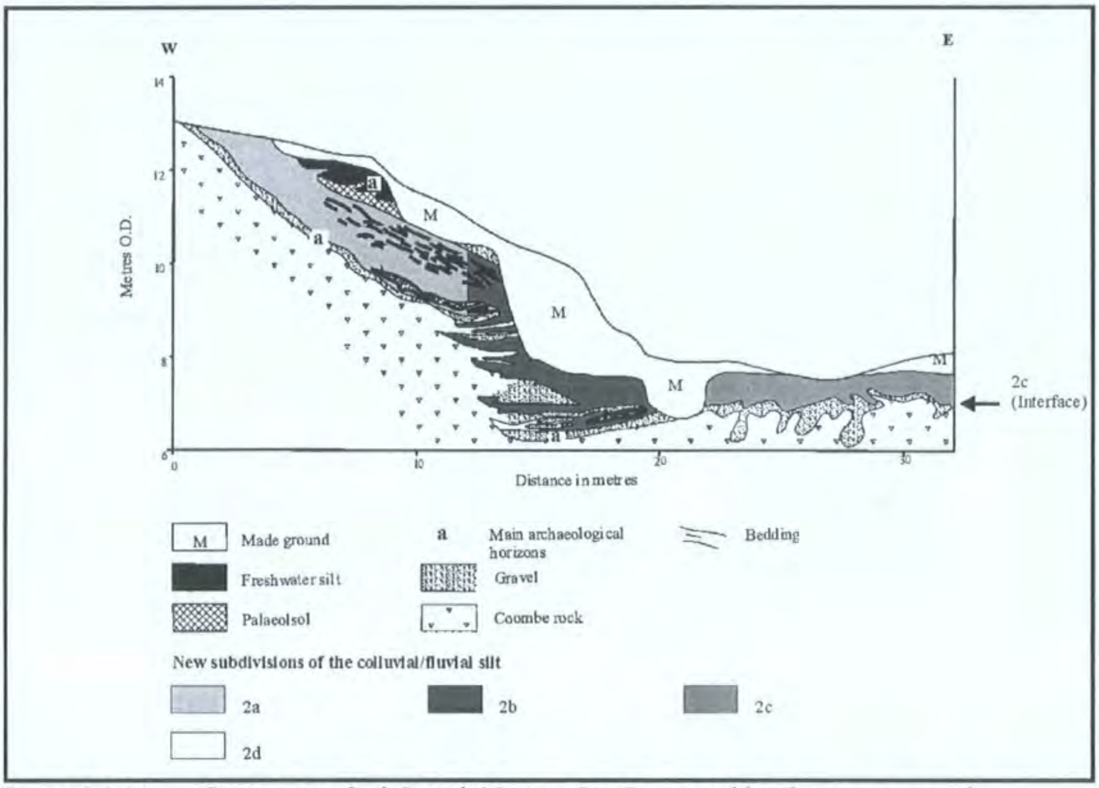

Figure 5.1.14 Contexts to which British Museum Site B material has been re-assigned.

When resorted in this way, it is apparent that material from the basal gravel (1b), the coombe rock (0) and the fluvial brickearth east of the interdigitating zone (2d-e) is predominantly in fresh condition and contains some Levallois material, but does not contain rolled and stained material as is present in other contexts. In contrast, although the other units do include fresh material, including some Levallois flakes and cores, they also encompass a high proportion of stained and rolled material, including small, pointed handaxes. This suggests that the brickearth and gravel from the slope (2a and 1a respectively) and the brickearth from the interdigitating zone (2b), where the various lenses provide an obvious mechanism for the introduction of material from upslope, represent a mixed assemblage, conflating artefacts possibly deposited contemporarily with the sediments and others derived from further up the slope. As such, the sample considered further below represents only the material from the basal gravel (1b – Bed 2), the fluvial brickearth (2d-e; fluvial facies of Bed 5) and the coombe rock (0 – Bed 1).

Analysis

Artefact	No. of artefacts	% of assemblage
Flakes	163	61.3%
All Levallois flakes	76	28.6%
Definite Levallois flakes	47	17.7%
Probable Levallois flakes	22	8.3%
Possible Levallois flakes	7	2.6%
Levallois cores	16	6.0%
Non-Levallois cores	4	1.5%
Retouched flakes	9	3.4%
Retouched Levallois flakes	5	1.9%
Retouched non-Levallois flakes	4	1.5%
Handaxes	3	1.1%
Total	266	100%

Table 5.1.10 Material collected by Burchell from the Lower Gravels

The selected sample from Burchell's collection consisted of 266 artefacts from the Lower Gravels, mostly unretouched debitage (61.3%) but also a large proportion of definite Levallois flakes (17.7%; see Table 5.1.10). In contrast, the material from the British Museum excavations includes very little Levallois material, but a high proportion of unretouched debitage (Table 5.1.11).

Artefact	No. of artefacts	% of assemblage
Flakes	144	91.7%
All Levallois flakes	4	2.5%
Definite Levallois flakes	1	0.6%
Probable Levallois flakes	1	0.6%
Possible Levallois flakes	2	1.3%
Levallois cores	2	1.3%
Non-Levallois cores	2	1.3%
Retouched flakes	4	2.5%
Retouched Levallois flakes	0	0.0%
Retouched non-Levallois flakes	4	2.5%
Handaxes	1	0.6%
Total	157	100%

Table 5.1.11 Material from contexts 0, 1b, 2d and 2e of the British Museum excavations (Site B).

Taphonomy

Following resorting of all material collected by Burchell from the entire Ebbsfleet Channel sequence, clear contrasts in both condition and technology are apparent between the assemblage from the Lower Gravels and the overlying units. Levallois technology is only present within Beds 1-4; in contrast, the material from the upper units (Beds 5 – 12) includes no Levallois material, but large numbers of small, pointed handaxes, which are minimally represented amongst the Lower Gravel assemblage (3 handaxes; see Tables 5.1.10 and 5.1.11). Clear differences in both surface condition and mechanical damage are also apparent, material from the Lower Gravels tending to be unpatinated or only lightly so, and minimally stained. Conversely, artefacts from the upper units on the whole exhibit deeper patination and staining (see Figure 5.1.15). Similar patterns are apparent when one compares mechanical damage, the assemblage from the Lower Gravels being comparatively less abraded and showing proportionally less edge damage than that from the upper units (Figure 5.1.16).

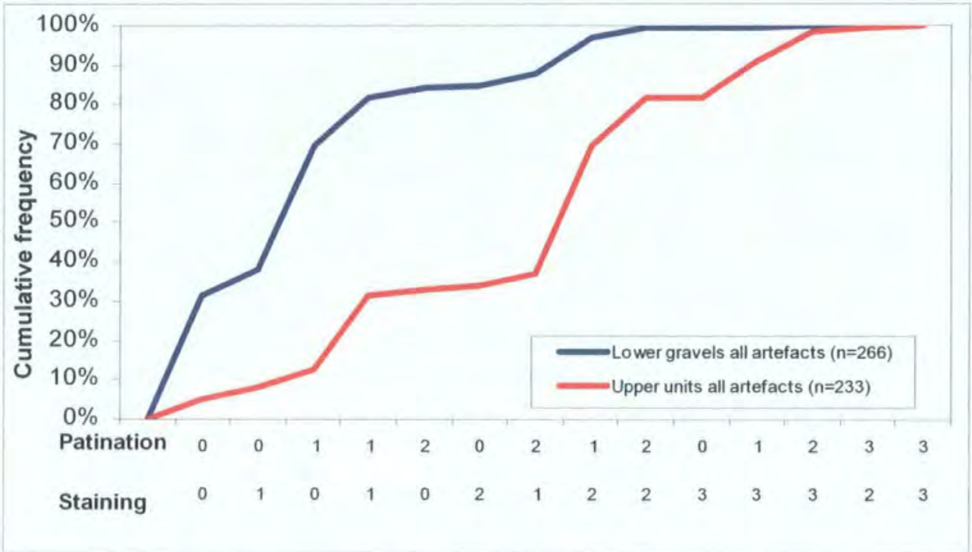

Figure 5.1.15 Comparison of surface alteration of artefacts collected by Burchell from the Lower Gravels (all collections studied) and Beds 5-12 (British Museum only).

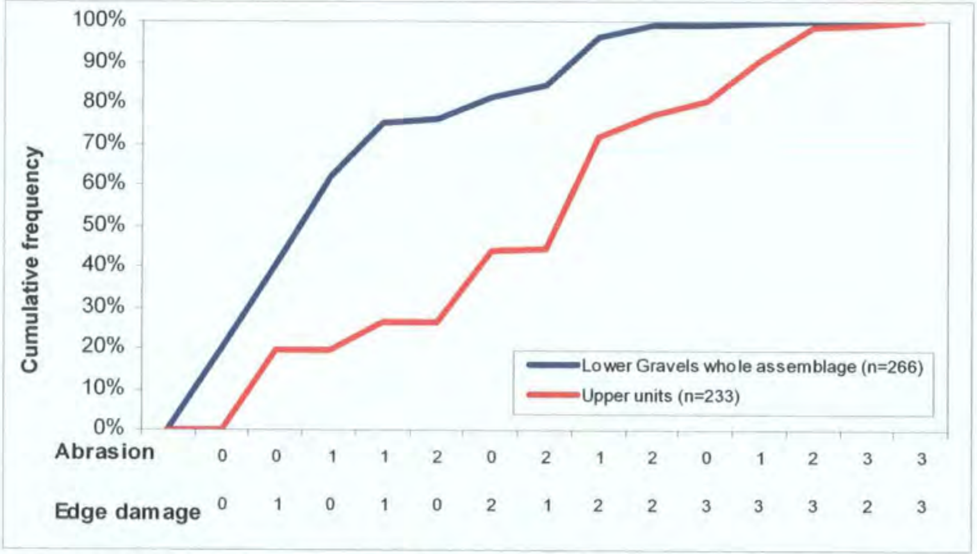

Figure 5.1.16 Comparison of mechanical damage to artefacts collected by Burchell from the Lower Gravels (all collections studied) and Beds 5-12 (British Museum only).

Although obviously a continuum of condition states exists between the two samples - some relatively fresh, unpatinated material being minimally represented within the material from the Beds 5-12, and some rolled, stained and patinated material being present within the sample from the lower gravels - as assemblages, they are markedly different. This suggests that the taphonomic processes undergone by the material from the Lower Gravels differs, on the whole, from those responsible for the accumulation of the material from further up the sequence.

The elevated levels of mechanical damage (abrasion of the arêtes, edge damage) apparent for the material from the upper levels might indicate that they have at some point undergone longer transport – or transport within a more energetically active regime - than that from the Lower Gravels. Alteration of the flint surface through patination and staining is hard to interpret and frequently difficult to disentangle, given that staining often overlies patination, but can broadly be viewed as resulting from differences in either degree of sub-aerial exposure or the chemical nature of the burial environment. Clearly, such differences are apparent between the material from the Upper Units and the Lower Gravel. In general terms, it can therefore be suggested that the material from Beds 5-12 has been moved further – or with greater force – than that from the Lower Gravels, and either that the burial environments from which they were retrieved differ in terms of their chemical effect upon flint, or that one or other of the assemblages has been derived from an exogenous source. Given that material from the Upper units was primarily recovered from fine-grained sediments (predominantly the Temperate Bed/Upper Loam – Bed 6; 68.2%, but also associated lenses of coombe rock), but is *more* abraded than the assemblage from the coarser, basal gravels, it seems likely that this material may have been reworked into the upper units of the Ebbsfleet channel from elsewhere.

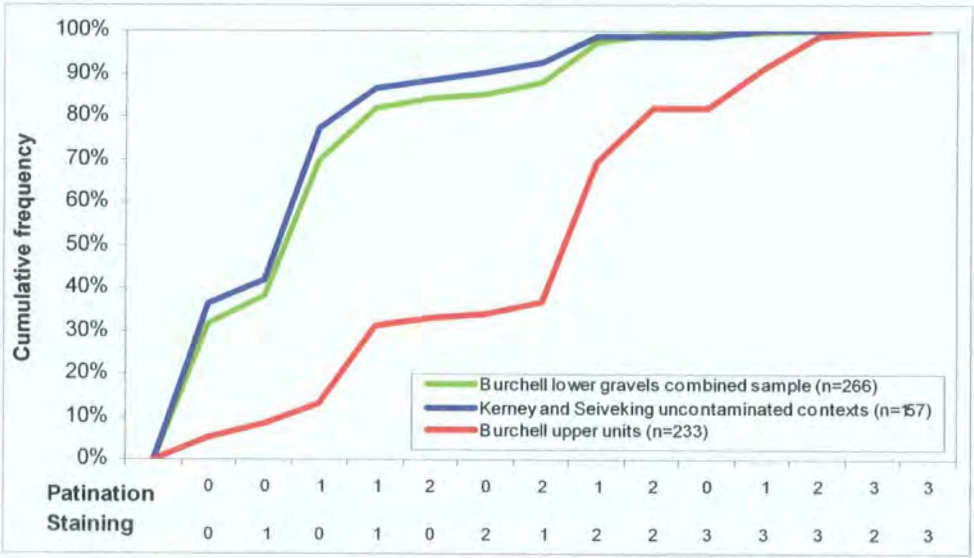

Figure 5.1.17 Comparison of surface alteration of artefacts collected by Burchell from the Lower Gravels (all collections studied), Beds 5-12 (Burchell collection, British Museum only), and contexts 0, 1b, 2d and 2e from Kerney and Sieveking's Site B excavation.

Examination of the Site B section from the British Museum excavations and the excavated assemblage suggests a mechanism by which the material may have become incorporated into the upper units. Numerous lenses of gravel and coombe rock part the colluvial/fluvial silts at the channel edge (see Figure 5.1.2), which contains both rolled and stained, as well as some fresh, material. The gravel on the slope (1a = Bed 4), in contrast to that excavated by Burchell, and indeed the basal gravel of this section (1b = Bed 2) contains notable quantities of abraded and stained material, equivalent to that recovered from the upper units by Burchell. Such material is minimally present within the basal gravel and almost entirely absent from the fluvial brickearths to the east. This suggests that patinated, stained and abraded material was predominantly being incorporated into the Ebbsfleet valley sediments from the slope; certainly, bedding indicative of colluvial deposition is present within the upper, western part of the brickearths.

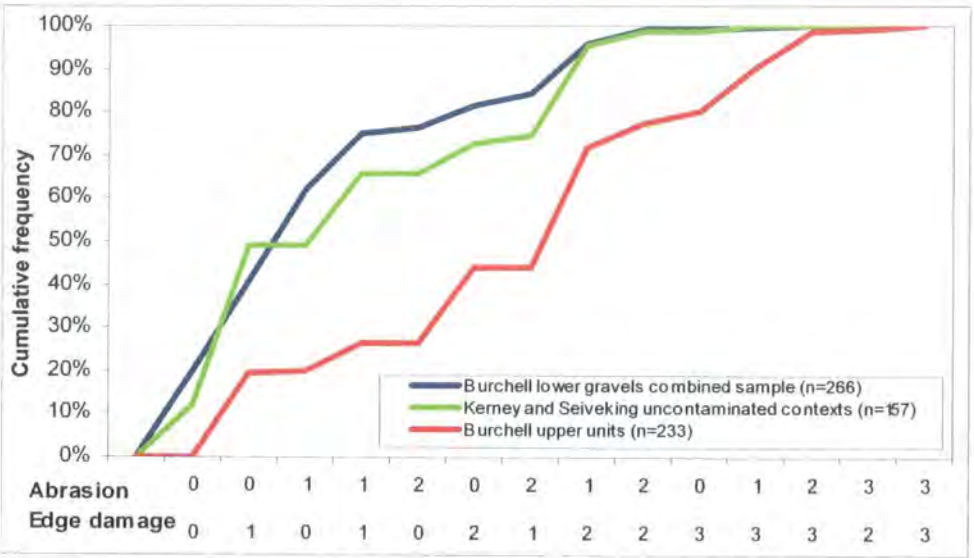

Figure 5.1.18 Comparison of mechanical damage to artefacts collected by Burchell from the Lower Gravels (all collections studied), Beds 5-12 (Burchell collection, British Museum only), and contexts 0, 1b, 2d and 2e from Kerney and Sieveking's Site B excavation.

Given the ongoing erosion of the channel edge, the gravel and coombe rock partings may represent the coarse remnant of a previously more homogenous colluvial deposit, from which fine material has been preferentially removed and incorporated into the sediment load of the channel; a comparison of the material from contexts away from the edge of the channel with the material collected by Burchell indicates that it also lacks a significant rolled, patinated and stained component (Figures 5.1.17 and 5.1.18) and is very similar to his material from the Lower Gravels in terms of condition. It therefore seems likely that rolled, patinated and stained material has predominantly been derived into the Ebbsfleet channel by the erosion of material from further up the slope; given the presence of small, pointed handaxes in relatively large numbers – handaxes only being minimally present within the Lower Gravels – this allochthonous source may have been an earlier, previously eroded, terrace deposit.

Burchell					
Abrasion			Edge damage		
Unabraded	146	54.9%	*None*	6	2.3%
Lightly abraded	105	39.5%	*Light*	125	47.0%
Moderately abraded	15	5.6%	*Moderate*	130	48.9%
			Heavy	5	1.9%
Patination			Staining		
Unpatinated	103	38.7%	*Unstained*	174	65.4%
Lightly patinated	142	53.4%	*Lightly stained*	58	21.8%
Moderately patinated	21	7.9%	*Moderately stained*	32	12.0%
			Heavily stained	2	0.8%
Scratching			Battering		
None	265	99.6%	*None*	191	71.8%
Light	1	0.4%	*Light*	62	23.3%
			Moderate	13	4.9%

Table 5.1.12 Condition of material collected by Burchell from the Lower Gravels (n=266).

Kerney and Sieveking (BM excavations)					
Abrasion			Edge damage		
Unabraded	88	56.1%	*None*	19	12.1%
Lightly abraded	61	38.9%	*Light*	87	55.4%
Moderately abraded	8	5.1%	*Moderate*	49	31.2%
			Heavy	2	1.3%
Patination			Staining		
Unpatinated	68	43.3%	*Unstained*	115	73.2%
Lightly patinated	82	52.2%	*Lightly stained*	28	17.8%
Moderately patinated	7	4.5%	*Moderately stained*	12	7.6%
			Heavily stained	2	1.3%
Scratching			Battering		
None	157	100%	*None*	152	96.8%
Light	0	0%	*Light*	5	3.2%

Table 5.1.13 Condition of material excavated by Kerney and Sieveking from lower fluvial contexts 0, 1b, 2d and 2e (n=157).

Given that the non-Levallois material from the upper units can be disregarded as predominantly derived from an earlier deposit, it is worth considering the processes which may have led to the formation of the assemblages considered here. The Burchell material (Table 5.1.12) from the Lower Gravels predominantly exhibits light (47.0%) or moderate edge damage (48.9%), reflecting at least a degree of movement within the gravels. Most artefacts are unabraded (54.9%) or only lightly so (39.5%) and very few exhibit surface scratching; mechanical damage has therefore largely affected the more delicate edges of the artefacts, militating against prolonged transport of the assemblage as part of the bedload of the channel, but suggesting at least a limited degree of transport within the gravels themselves. A proportion of the artefacts – preferentially those with at least moderate edge damage - exhibit light to moderate (28.2%) battering. Very similar patterns are apparent for the material from probably equivalent contexts collected by Kerney and Sieveking (Table 5.1.13), again suggesting that both collections have undergone similar degrees of fluvial rearrangement.

Given that both collections have undergone at least some degree of movement within the gravels, an attempt was made to determine whether the artefacts present reflect the full range of material produced within the context of flint reduction, and if not, whether this is due to taphonomic or technological factors. Clearly, many more non-Levallois flakes are present within the Kerney and Sieveking collection than Burchell's material. When all flakes were plotted against Schick's (1987) data for the size distribution of material resulting from experimental core reduction, both assemblages diverge markedly from her predicted distribution, even if the <2cm size range is excluded (since samples were collected from gravel, within which "real" chips and those merely resulting from clast collision are unlikely to be differentiable).

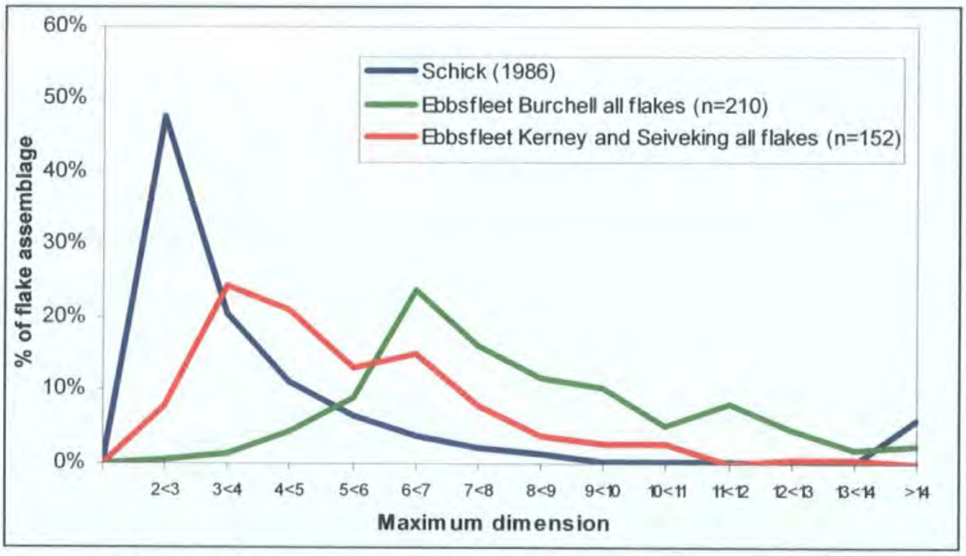

Figure 5.1.19 Comparison of maximum dimension of debitage from Burchell and Kerney and Sieveking excavations with size range of material produced during experimental core reduction (Schick 1987, adjusted to exclude material <2 cm.).

Given that neither assemblage was sieved, this may reflect the fact that a proportion of both collections was not recovered, but may also a reflect the fact that the smaller debitage has been selectively removed from both samples through fluvial action (winnowing), smaller material being preferentially transported away. The Burchell assemblage diverges more markedly from the predicted distribution than the Kerney and Sieveking material, with notably fewer flakes <6cm. in maximum dimension being present (15.2%, as opposed to 66.4% for the Kerney and Sieveking material, or the expected distribution of 95.3%; Figure 5.1.19). This may be explicable in several ways; potentially it might reflect different energetic regimes within different parts of the channel – material recovered from contexts close to the bank potentially having been subject to less intensive winnowing – or simply differences in the recovery rates of different investigators. However, it is apparent that neither the material from the British Museum excavations, nor that recovered by Burchell, reflects a complete knapping sequence in terms of size representation.

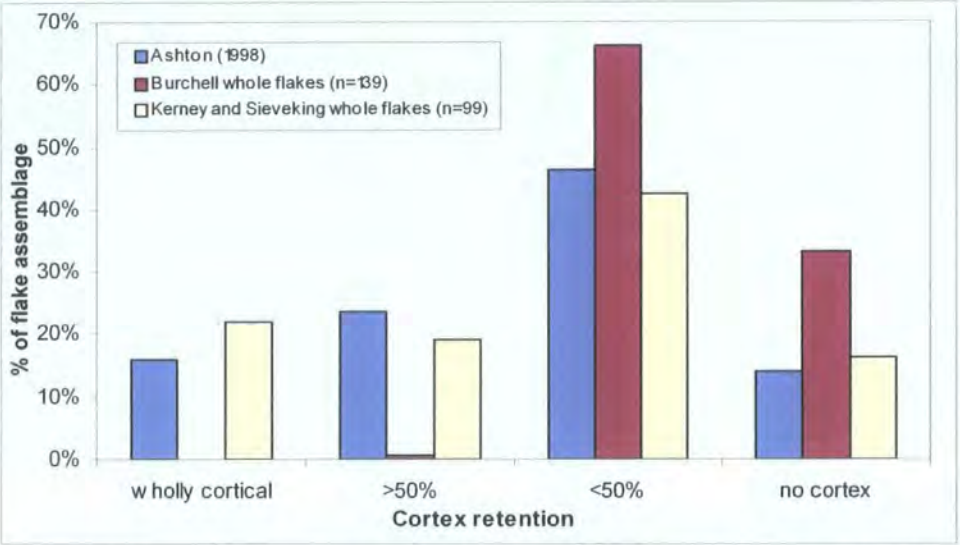

Figure 5.1.20 Comparison of dorsal cortex retention on whole non-Levallois flakes from Burchell and Kerney and Sieveking excavations with experimental data from hard-hammer core reduction (Ashton 1998a).

Comparison of cortex retention on whole, non-Levallois flakes from both samples (reflective of knapping stage within a given episode of core reduction) suggests some significant differences between the two samples; when compared with data from experimental hard hammer core reduction (Ashton 1998a, 211), the Burchell collection diverges markedly, only 10.8 % of the assemblage retaining more than 50% dorsal cortex. In contrast, the Kerney and Sieveking material reflects the representation of different cortex classes in proportions closely comparable to that expected for a complete knapping sequence (Figure 5.1.20). Clearly, whilst smaller flakes are missing from both samples, the range of material from the Kerney and Sieveking excavations does appear to reflect the fact that all stages of reduction may have been undertaken in the area. The lack of more cortical debitage within the Burchell collection is likely to reflect the potential visibility to the collector of such material amongst a gravel, especially when considered alongside the apparent over-representation of larger flakes. However, given the similarities in both condition and depositional context between the samples, it seems justified to consider the material from the "uncontaminated" contexts of the British Museum excavation (0, 1b, 2d and 2e) as part of the sample from the Lower Gravels. The material as whole has clearly undergone movement and fluvial modification within the gravels, and the British Museum material can be seen as perhaps less affected by collector bias than that assembled by Burchell.

Obviously, even when combined, the material from the Lower Gravels does not form a pristine assemblage, but combining the samples in this way allows two separate technological issues to be addressed. Firstly, the quantity of Levallois artefacts within the Burchell collection allow the specific Levallois techniques employed to produce the assemblage to be examined, since in the absence of complete refitting sequences, only Levallois cores and flakes yield any information reflective of the latter stages of the reduction process. Secondly, less selectively affected material from the British Museum excavations allows inferences to be drawn concerning the whole reduction process, attesting to the fact that complete reduction - from blank selection and decortication to Levallois flake production and discard – was undertaken by hominins exploiting the Ebbsfleet channel. The British Museum and Burchell collections have therefore been combined hereafter.

Technology

Raw material

Only one of the eighteen Levallois cores within the current sample retains no cortex, the majority (11; 61.1%) retaining rolled cortex on at least 25% of the striking platform surface, predominantly either in the centre of (44.4%) or all over (33.3%) this face. Five (27.8%) also retain cortex on the flaking surface, along either one (4) or both (1) lateral edges. Seven cores directly reflect the working of medium sized flint pebbles, the remaining cortex entirely defining the volume of the original clast. Four of these are amongst the most elongated cores from the site (B/L between 0.63 – 0.72), resulting, therefore, from the unprotracted working of broadly cylindrical flint pebbles. The cores resulting from minimal modification of the original blank are similar in overall dimensions to the remainder of the cores, of which a further 9 (50%) also probably reflect the working of nodules or split cobbles. In addition, a single large flake has been used as a Levallois core and five of the six non-Levallois cores also use similar flint cobbles.

A proportion of the flakes within the sample retain no cortex (34.9 %), but those which do also reflect a similar pattern of raw material use (51.6% from a derived source), only 3% retaining fresh chalky cortex and 1.5% reflecting the fact that Bullhead flint from the Thanet Beds was also minimally used. It appears, therefore, that the material incorporated into the

Lower Gravels results from hominin exploitation of the gravels themselves, large cobbles being selected and reduced adjacent to the channel and the products of reduction subsequently being re-incorporated into and re-arranged by the fluvially active gravel bed. Notably, following the transition to a more gentle fluvial regime, the gravels become progressively masked by the colluvial and fluvial deposition of fine sediments. No hominin activity contemporary with the deposition of these sediments is apparent.

Levallois Cores

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)	Flattening (Th/B)
Mean	96.62	84.09	42.11	0.909299	0.501434
Min	61.6	51.7	20	0.61758	0.27972
Max	135.7	134	72	2.175325	0.689655
St.Dev	21.07783	19.07291	14.17147	0.344139	0.119698
Median	96.7	83.75	39.7	0.835278	0.486695

Table 5.1.14 Levallois cores summary statistics (n=18).

The Levallois cores from the Lower Gravels vary in planform, 66.7% being fairly round (elongation values of 0.8 and above; Figure 5.1.21) in their discarded state, although a proportion are more elongated, particularly those cores which retain the dimensions of the original flint nodule. Most were discarded at a point when further reduction was arguably possible and tend to be relatively thick, with a flattening index of between 0.4 and 0.6 (61.6 %; Figure 5.1.22), and a notable proportion within the 0.6<0.8 range (27.8%). Given the fact that a proportion of the cores are fairly elongated, abandonment of relatively thick cores might reflect the fact that given such cylindrical nodules of raw material, repeated re-establishment of the flaking surface convexities would involve significant reductions in the size of the exploitable surface, leading to markedly smaller flake production.

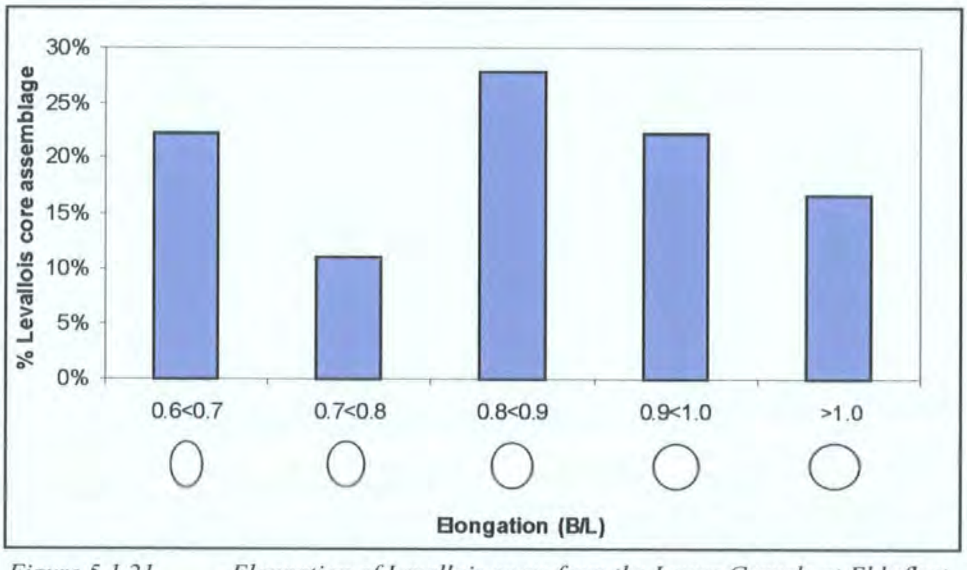

Figure 5.1.21 Elongation of Levallois cores from the Lower Gravels at Ebbsfleet (n=18).

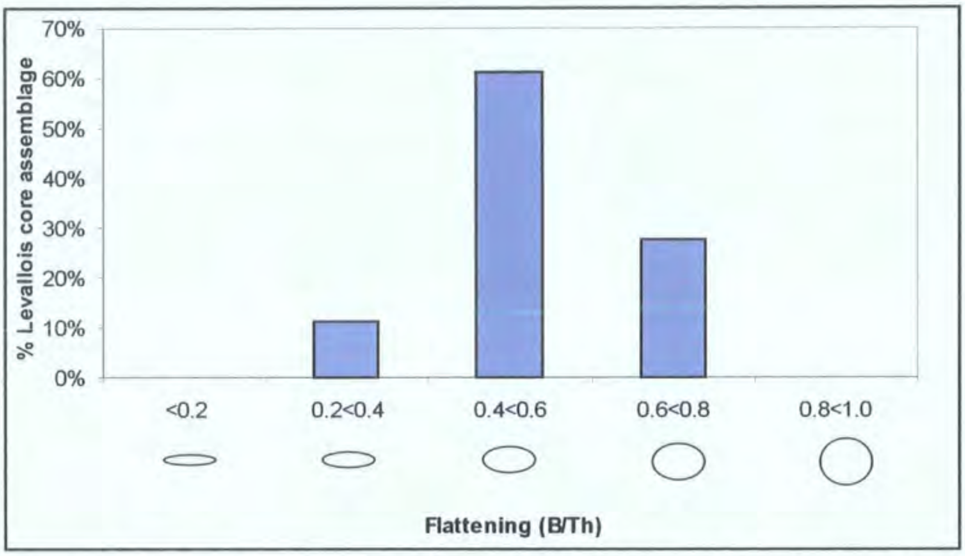

Figure 5.1.22 Flattening of Levallois cores from the Lower Gravels at Ebbsfleet (n=18).

The cores reflect the use of a several preparatory and exploitation strategies to produce a variety of Levallois flakes occupying the majority of the flaking surface of the cores. Most retain scars indicative of centripetal preparation of the flaking surface (11; 61.1%), together with 3 reflecting bipolar preparation, a single example prepared using convergent unipolar flaking, and one which only retains preparatory scars running in from the lateral edges but which may originally have been centripetally worked, the final flake scar removing any scars which might have been present at the distal and lateral extremities (Table 5.1.15). Preparation method could not be determined for two cores, the final flake scar having removed the majority of the flaking surface. Preparation prior to the removal of final flakes seems to have been minimal; most of the cores (88.8%) retain less than 10 preparatory scars on their flaking surface, and, as mentioned above, 7 retain the dimensions of the original nodule. The necessary distal and lateral convexities have predominantly been imposed on the flaking surface using an initial series of bold removals, frequently followed (10 of the cores) by smaller, less invasive removals serving to adjust the upper surface volume of the core; these are usually located on the distal end of the core (4) or continuously around all edges (3). The striking platform surfaces have been prepared using invasive or semi-invasive removals (14, 77.8%) around the circumference (12; 66.7%) or one or more edge, cortex generally being retained in the centre (8; 44.4%) or all over this face (6; 33.3%), to provide a platform for the shaping of the upper, flaking surface.

Levallois cores from Lower Gravel (n=18)					
Preparation method			Exploitation method		
Bipolar	3	16.7%	*Unexploited*	1	5.6%
Convergent unipolar	1	5.6%	*Lineal*	11	61.1%
Centripetal	11	61.1%	*Unipolar recurrent*	2	11.1%
Bipolar lateral	1	5.6%	*Bipolar recurrent*	1	5.6%
Indeterminate	2	11.1%	*Centripetal recurrent*	2	11.1%
			Re-prepared but unexploited	1	5.6%
Convexities			Type of convexity working (n=11)		
Whole surface shaped as one	7	38.9%	*Invasive*	1	9.1%
Distal	4	22.2%	*Minimally invasive*	0	0.0%
Right	0	0.0%	*Steep*	1	9.1%
Left	2	11.1%	*Semi-invasive*	7	63.6%
Continuous	4	22.2%	*Cortical/ natural*	1	9.1%
Distal and one edge	0	0.0%	*Mixed*	1	9.1%
Both edges	1	5.6%			
Blank type			Distribution of preparatory scars striking surface		
Definitely nodule	7	38.9%	*All over*	12	66.7%
Frost flake	0	0.0%	*One edge only*	3	16.7%
Indeterminate	1	5.6%	*Two edges*	3	16.7%
Probably nodule	9	50.0%			
Flake	1	5.6%			
Type of striking surface working			Position of cortex on striking surface		
Invasive	7	38.9%	*None*	1	5.6%
Semi-invasive	7	38.9%	*Central*	8	44.4%
Steep	4	22.2%	*One edge only*	1	5.6%
Minimally invasive	0	0.0%	*All over*	6	33.3%
			Two edges	2	11.1%
% Cortex striking surface			Total number Levallois products from cores (30 products)		
0	1	5.6%	0	1	3.2%
0-25%	8	44.4%	1	9	29.0%
26 – 50%	5	27.8%	2	3	19.4%
51 – 75%	3	16.7%	3	5	48.4%
>75%	1	5.6%			
Levallois products from final flaking surface (24 products)			Types of Levallois products from core; final only (n=17)		
0	2	11.1%	*Flake*	13	76.5%
1	11	61.1%	*Debordant flake*	3	17.6%
2	2	11.1%	*Debordant and overshot*	1	5.9%
3	3	16.7%			
Preparatory scars final flaking surface			Preparatory scars striking surface		
1-5	8	44.4%	1-5	5	27.8%
6-10	8	44.4%	6-10	6	33.3%
11-15	2	11.1%	11-15	5	27.8%
			>16	2	11.1%
Earlier flaking surface = 4 cores					

Table 5.1.15 Technological observations on Levallois cores from Lower Gravel (n=18 except where otherwise stated).

Whilst most of the cores have produced only a single Levallois flake from their final flaking surface (11), five reflect recurrent exploitation – unipolar recurrent in two instances, two cores resulting from centripetal recurrent exploitation and one from bipolar recurrent exploitation. Significantly, three of the five cores from which several Levallois flakes have been removed completely retain the dimensions of the original flint nodule and reflect the use of each recurrent strategy mentioned above (unipolar, centripetal and bipolar). It seems likely that these have only been subject to a single phase of preparation and exploitation, production being maximised from this one surface. In contrast, 4 cores reflect the complete re-preparation of the core surface between episodes of exploitation, retaining smaller peripheral re-prepartory scars which cut previous, large Levallois removals. These include a further core which retains the dimensions of the original nodule, the surface of which has been re-prepared but not exploited further, and the single core on a large flake, from which a final preferential flake was removed after re-preparation. A single core has had a Levallois surface prepared but no flake removed, potentially following prior exploitation. Given that four of the seven cores which retain the dimensions of the original flint nodule visibly attest to multiple flake production either within a given productive sequence or through complete re-preparation of the flaking surface, it seems likely that other more intensively worked cores present at the site might also result from such a pattern, the traces of previous working being obscured by later flake scars.

The scars retained upon the Levallois cores attest to the removal of 24 Levallois products; these are predominantly flakes (13 of the final removals), together with 3 debordant flakes and a debordant flake which has also overshot the distal end of the core. A comparison of the maximum dimension of the Levallois flakes in the current sample and the final flakes removed from the surface of the cores also potentially indicates that some cores may have undergone the re-preparation of several core surfaces within their reduction. 50% of the whole Levallois flakes are greater than 10 cm. in maximum dimension, whilst none of the cores bear scars of this size (see Figure 5.1.23). It could therefore be argued, particularly given that even minimally worked Levallois cores present at the site directly reflect surface re-preparation, that a proportion of the flake assemblage was produced from earlier flaking surfaces which were subsequently reworked to re-establish the necessary lateral and distal convexities, resulting in the ongoing reduction of the exploitable area of the flaking surface and hence of the flakes produced from it.

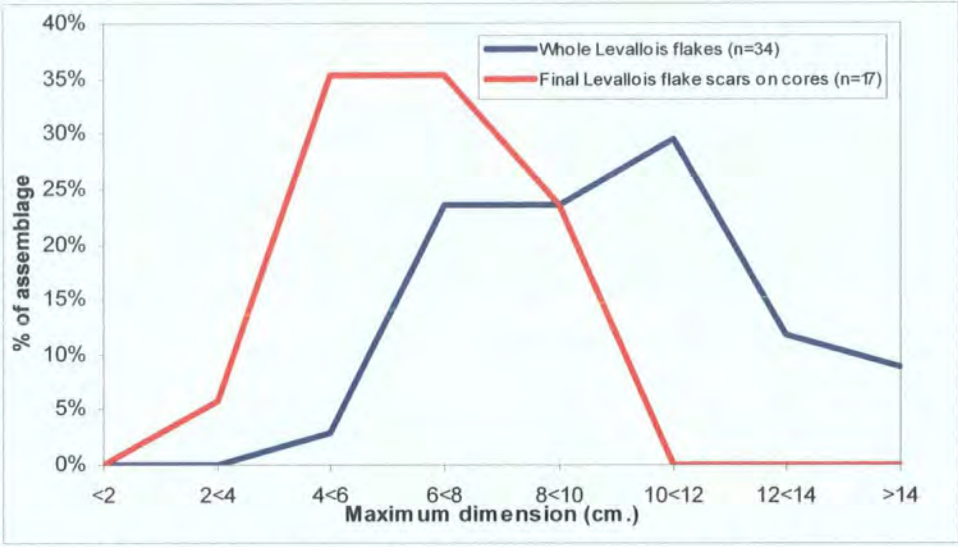

Figure 5.1.23 Comparison of maximum dimension (cm.) of final flake scars on Levallois cores with maximum dimension of Levallois flakes.

Similar distributions are apparent for both length and width (see Figures 5.1.24 and 5.1.25), Levallois flakes being notably larger than the scars retained on cores in both dimensions, 50% of the flakes present being longer than any of the flake scars (>10cm) and 26.5% being wider (>8cm.). This pattern could therefore be argued to reflect the reduction of exploitable flaking area through complete surface re-preparation. Although shorter flakes and flakes scars are slightly more likely to be wider than they are long, there does not seem to be a marked change in elongation with decreasing Levallois flake or Levallois flake scar size – if this pattern does reflect earlier phases of flake production, flakes retain constant proportions (in terms of elongation) throughout reduction.

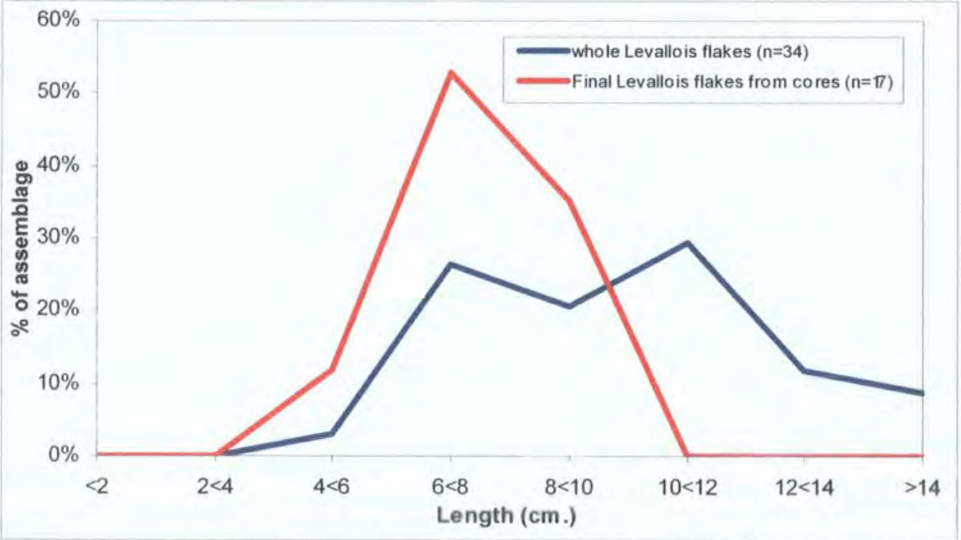

Figure 5.1.24 Comparison of length (cm.) of final flake scars on Levallois cores with length of whole Levallois flakes.

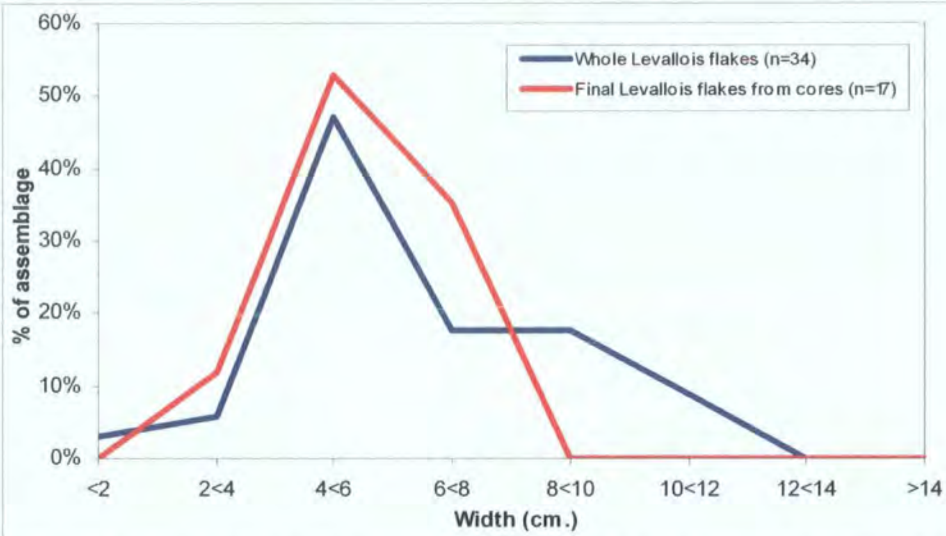

Figure 5.1.25 Comparison of width (cm.) of final flake scars on Levallois cores with width of whole Levallois flakes.

Levallois flakes

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	99.43	64.65	16.90	0.680874
Min	49.6	9.1	5.4	0.077778
Max	152.8	111.3	31.1	1.169689
St.Dev	25.83499	23.07258	6.043576	0.249028
Median	100.1	57.2	16.6	0.660306

Table 5.1.16 Summary statistics of whole Levallois flake dimensions (n=34) from the Lower Gravels

The Levallois flake assemblage from the Lower Gravels comprises 48 definite Levallois flakes, the majority of which are medium-sized flakes (68.8%) together with small numbers of points and metrical blades (See Table 5.1.17). Also represented are some debordant flakes (6; 12.5%) and a single flake which overshot both the lateral and distal core edges. As many of the flakes present are too big to have been produced from the surface of the cores (Table 5.1.16) and although most do not retain dorsal cortex (58%), a notable proportion exhibit a minimal amount (41% 0<10% dorsal cortex). This could be seen as reflecting minimal initial preparation of flaking surfaces prior to the removal of the first Levallois flakes. Whilst whole Levallois flakes retaining cortex are on average only 4.7 mm longer than those which do not, 57.1% of the whole Levallois flakes which retain cortex are larger than the final flake scars on any of the cores (>10cm.) in contrast to those which do not retain any cortex (45%; Figure 5.1.26). However, only minimal amounts of cortex are ever retained on the Levallois flakes (overwhelmingly less than 10%) and could remain on the flaking surface even following surface re-preparation (as exemplified by the re-prepared but unexploited core from the site which retains the dimensions of the original nodule).

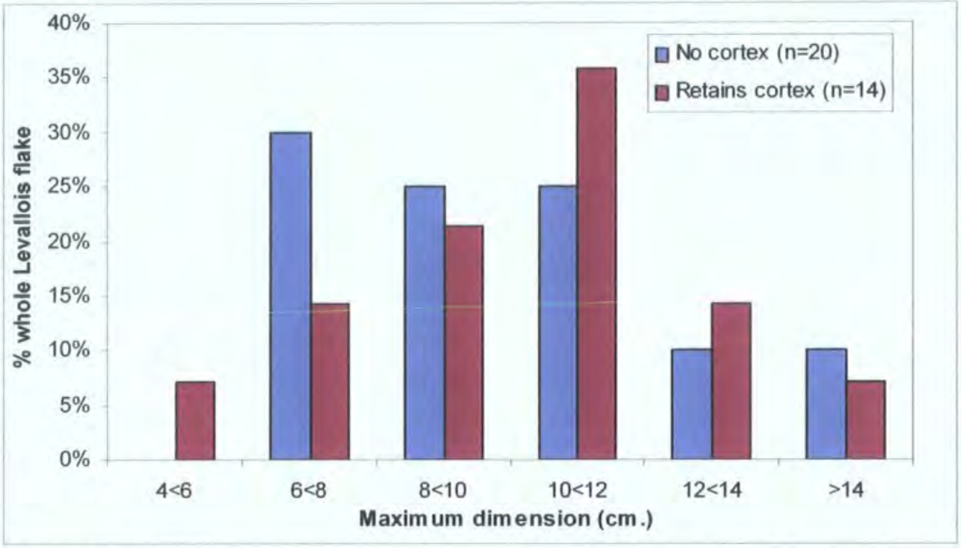

Figure 5.1.26 Comparison of maximum dimension of whole Levallois flakes according to presence of dorsal cortex.

The scar patterns retained upon the dorsal surfaces of the Levallois flakes reflect the preparatory strategies attested by the cores themselves. Centripetal preparation dominates (76.5%), together with occasional examples of unipolar (1 flake), bipolar (2 flakes) and convergent unipolar (5 flakes) preparation. The Levallois flakes generally retain relatively high numbers of preparatory dorsal scars (52% retaining 6-10); generally fewer than retained on the core surfaces and probably reflecting the fact that few flakes appear to have removed areas of the core surface close to the margins which have been more intensively worked in order to create the convexities necessary for their detachment; only 6 flakes retain such semi-invasive or steep scars cutting broader preparatory flake scars. Where core edges (either natural or deliberately accentuated) have been removed these are generally one or other of the lateral edges (7); as previously noted, one flake has both taken the left edge off and overshot the distal margin.

Many of the flakes do have facetted butts (43.8%), but other types are also present, notably plain (25%); clearly, platform preparation was not always necessary to detach large Levallois flakes. The exploitation methods indicated by the flakes again conform broadly with those suggested by analysis of the cores; although only 3 can be categorically stated to be lineal (the scar pattern not attesting to a previous Levallois removal and the flake itself removing enough of the core surface to prevent the removal of a further flake), the majority probably result from such a strategy (83.3%). Five flakes result from recurrent strategies; unipolar (4) and bipolar (1), underlining the stronger evidence provided by examination of the cores of both recurrent exploitation of individual flaking surfaces and complete re-preparation of the productive face.

Levallois flakes from Lower Gravel					
Type of endproduct (n=48)			Butt type (n=48)		
Flake	33	68.8%	*Plain*	12	25.0%
Point	3	6.3%	*Dihedral*	5	10.4%
Blade	4	8.3%	*Natural*	0	0.0%
Blade/point	1	2.1%	*Marginal*	1	2.1%
Debordant	6	12.5%	*Facetted*	21	43.8%
Overshot	0	0.0%	*Missing*	2	4.2%
Overshot and debordant	1	2.1%	*Chapeau de gendarme*	2	4.2%
			Shattered	1	2.1%
			Obscured	4	8.3%
Raw material (n=48)			Cortex retention (n=34)		
Indeterminate	35	72.9%	*0%*	20	58.8%
Fresh	0	0.0%	*1 – 10%*	14	41.2%
Derived	13	27.1%	*11 – 25%*	0	0%
Bullhead	0	0.0%	*>25%*	0	0%
Method of exploitation (n=48)			Knapping accidents (n=15)		
Definitely preferential	3	6.3%	*Hinged*	2	13.3%
Probably preferential	40	83.3%	*Overshot*	2	13.3%
Unipolar recurrent	4	8.3%	*Step fracture*	8	53.3%
Bipolar recurrent	1	2.1%	*Other*	3	20.0%
Centripetal recurrent	0	0.0%			
Portion (n=48)			Nature of convexity (n=8)		
Whole	34	70.8%	*Minimally invasive*	0	0
Proximal	12	25.0%	*Semi-invasive*	4	50.0%
Distal	2	4.2%	*Steep*	2	25.5%
Mesial	0	0.0%	*Invasive*	0	0
			Cortical or natural	1	12.5%
			Mixed	1	12.5%
Number of preparatory scars (n=34)			Pattern of additional convexity working (n=34)		
1-5	10	29.4%	*None*	26	76.5%
6-10	18	52.9%	*Distal*	0	0
11-15	6	17.6%	*Right*	4	11.8%
			Left	3	8.8%
			Continuous	0	0
			Distal and right	0	0
			Distal and left	1	2.9%
			Both edges	0	0
Preparation method (n=34)			No. of previous Levallois removals (n=48)		
Unipolar (proximal)	1	2.9%	0	43	89.6%
Bipolar	2	5.9%	1	4	8.3%
Convergent unipolar	5	14.7%	2	1	2.1%
Centripetal	26	76.5%			
Unidirectional lateral	0	0.0%			
Unipolar (distal)	0	0.0%			

Table 5.1.17 Technological observation of Levallois flakes from the Lower Gravel (n=48).

Relatively few of the definite Levallois flakes included in this analysis are broken (68.8% are whole), largely because partial flakes are harder to confidently ascribe to Levallois production, but some 18.8% (9) reflect knapping errors which could account for their discard in the immediate vicinity of the production location. It is more difficult to account for those flakes which may have been taken away from the site for use elsewhere, but given that examination of the cores and flakes provides minimal information on earlier stages of core reduction, it is likely that the cores present were capable of producing more Levallois flakes than are present and that some of these may have been taken away.

Given the apparently complete knapping sequence indicated by cortex retention on non-Levallois flakes from the Lower Gravel (See Figure 5.1.20), and the fact that Levallois flakes, tending to be relatively large, are unlikely to have been selectively winnowed from the site, it is worth considering whether the methods adopted during the exploitation of the Lower Gravels might be expected to produce the quantities of Levallois flakes recovered. To produce the 48 definite Levallois flakes within the sample requires each of the 18 cores to produce 2.7 flakes, although it is likely that other flakes less confidently attributed to this technique (and therefore not included in this analysis) would increase the expected amount. Given that 5 cores produced 3 flakes and a further 3 at least 2, such productivity seems plausible. This is not to suggest that the actual flakes present were produced from the cores themselves, but that the cores and Levallois flakes recovered from the gravel represent a reasonable reflection of the technological approaches adopted by hominins exploiting the banks and bars of the Ebbsfleet channel.

The proportion of Levallois flakes larger than any of the final flake scars on the cores from the site indicates either that these were produced from larger cores which are not present in the sample – potentially having been removed from the site - or that many of the cores present may have been subjected to flaking surface rejuventation which consequently reduced the exploitable area of the core surface, resulting in smaller flakes being produced. In contrast to Baker's Hole, the most elongated Levallois flakes are not the largest (See Figure 5.1.27); none exceed 12 cm. in length, whereas notable proportions of broader flakes do (25% $0.4<0.8$, 16.7% >0.8). One might expect, given the demonstrably cylindrical nature of at least a proportion of the raw material used, that the first (and predictably larger) flakes removed would tend to be the most elongated; without a preparatory stage dedicated towards the removal of material from the longitudinal centre of the flaking surface, the natural lateral convexities of such nodules would be steep and reduce the exploitable width of the flaking surface. However, the flakes overwhelming reflect centripetal preparation – a strategy which would act to lower the lateral convexities – including the most elongated (9 of 10 whole Levallois flakes where $B/L <0.5$). It therefore seems that regardless of the form of the raw material, broad flakes were deliberately produced. The elongated Levallois flakes within the sample are more likely to result from recurrent exploitation strategies; 4 of the 6 whole

Levallois flakes where B/L <0.5 resulted from recurrent unipolar (3) or recurrent bipolar exploitation (1), in comparison with only one whole Levallois flake where B/L >0.5.

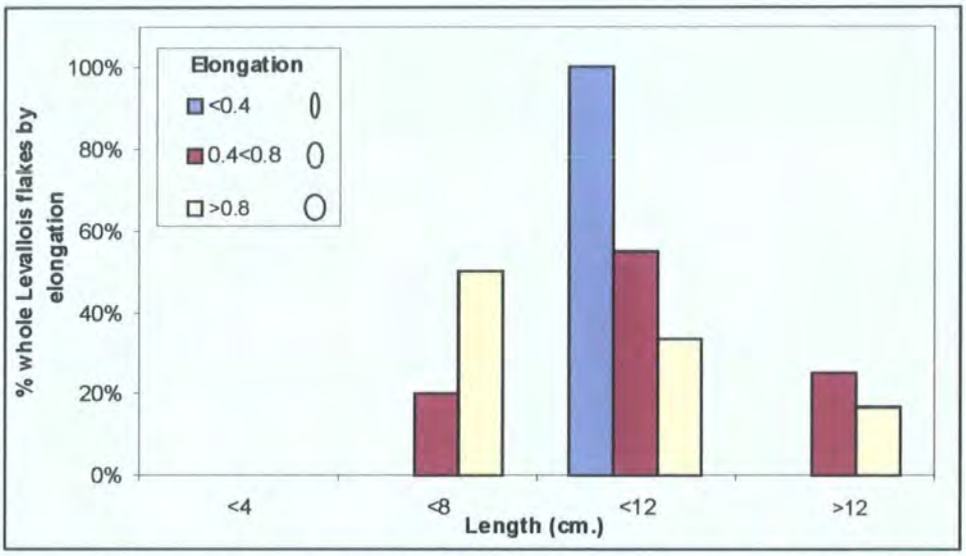

Figure 5.1.27 Elongation of whole Levallois flakes (B/L) grouped by length (cm.); (n=34).

It therefore seems that Levallois technology from the Ebbsfleet Lower Gravels was geared towards the imposition of a flaking surface allowing the removal of large, broad flakes; these were frequently exploited in a linear fashion, although recurrent exploitation of particular core surfaces is also apparent. The complete recreation of flaking surfaces is apparent both from examination of the cores themselves and the fact that half the Levallois flakes present are too large to have been produced from any of the extant cores. Both the largest flakes and final surfaces reflect a dominant pattern of centripetal preparation and lineal exploitation, suggesting the recurrent application of these methods, as they are represented both earlier in (the largest flakes) and at the end of the general reduction sequence (the discarded cores). Potentially, the abandonment of the cores at this stage might reflect the fact that prolonging the cores exploitative potential would require either a shift in strategy (perhaps towards a recurrent technique, presumably resulting in more elongated endproducts) or increasingly small endproducts – centripetally re-preparing the flaking surface results in smaller flakes, though without a notable change in proportions. That this was not done might suggest that the desired products in this situation were large, broad Levallois flake; sufficient material was available in the gravels that when the potential of a given core to produce such flakes was comprised, flaking could easily be begun again.

Flake Tools

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	90.34	72.11	24.5	0.861804
Min	57.5	57.2	14.1	0.44661
Max	128.3	108.1	34.4	1.349565
St.Dev	27.74744	15.95441	8.150256	0.282331
Median	84.15	67.6	24.9	0.866426

Table 5.1.18 Summary statistics for retouched flakes from the Ebbsfleet Lower Gravels (n=13).

Thirteen retouched fakes were recovered from the Lower Gravels at Ebbsfleet, of which 5 were Levallois flakes. Three are broken, but the remaining 10 flakes are broad and relatively large in size. Most (6) exhibit a single retouched edge, whilst some flakes (all non-Levallois) retain a single removal (notched and flaked flakes; 3) or the application of less regular, semi-invasive retouch to several points around the edge. Two flakes are bifacially worked; one non-Levallois flake being bifacially worked at the distal end, whilst one very large Levallois flake has been extensively bifacially worked and essentially resembles a cleaver in its discarded form (1947 5-2 84; Figure 5.1.28). Notably, one elongated Levallois flake with a steeply retouched edge also exhibits thinning of the butt on the ventral face, in a manner suggestive of the reduction of the bulb to facilitate hafting (1947 5-2 98; see Figure 5.1.29). The retouched flakes as a group vary notably in terms of how they have been worked. It seems likely that retouch was applied in an undirected manner as appeared immediately necessary to meet particular functional needs. Some edge angles were increased through the application of retouch – either in order to deliberately strengthen the edge or as a result of progressive resharpening – whilst the cutting edge of others was preserved through bifacial retouch or low, invasive removals, into either face.

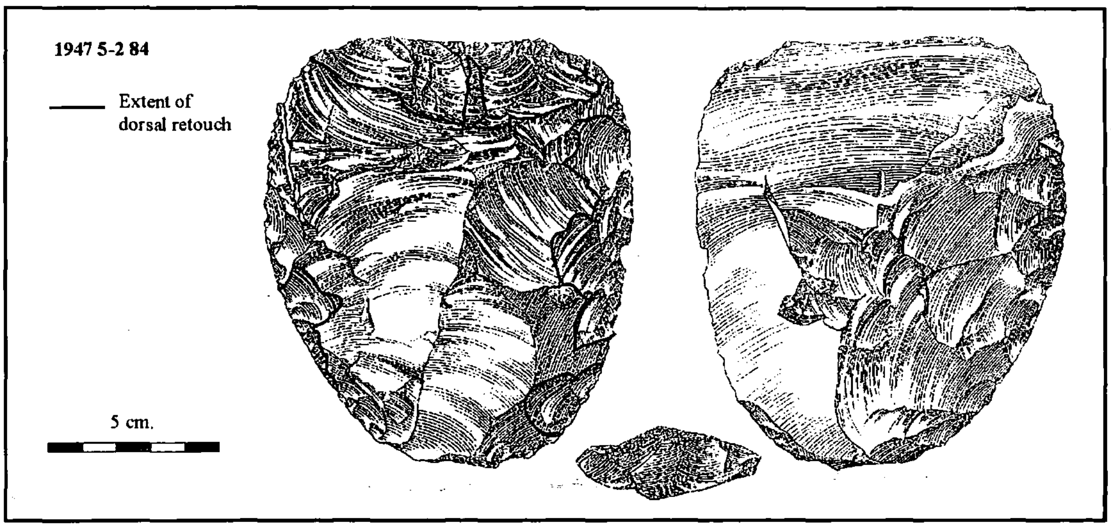

Figure 5.1.28 Bifacially-retouched Levallois flake from the Ebbsfleet Lower Gravels (British Museum registration number 1947 5-2 84; BM[F] Ebbsfleet Archive drawing).

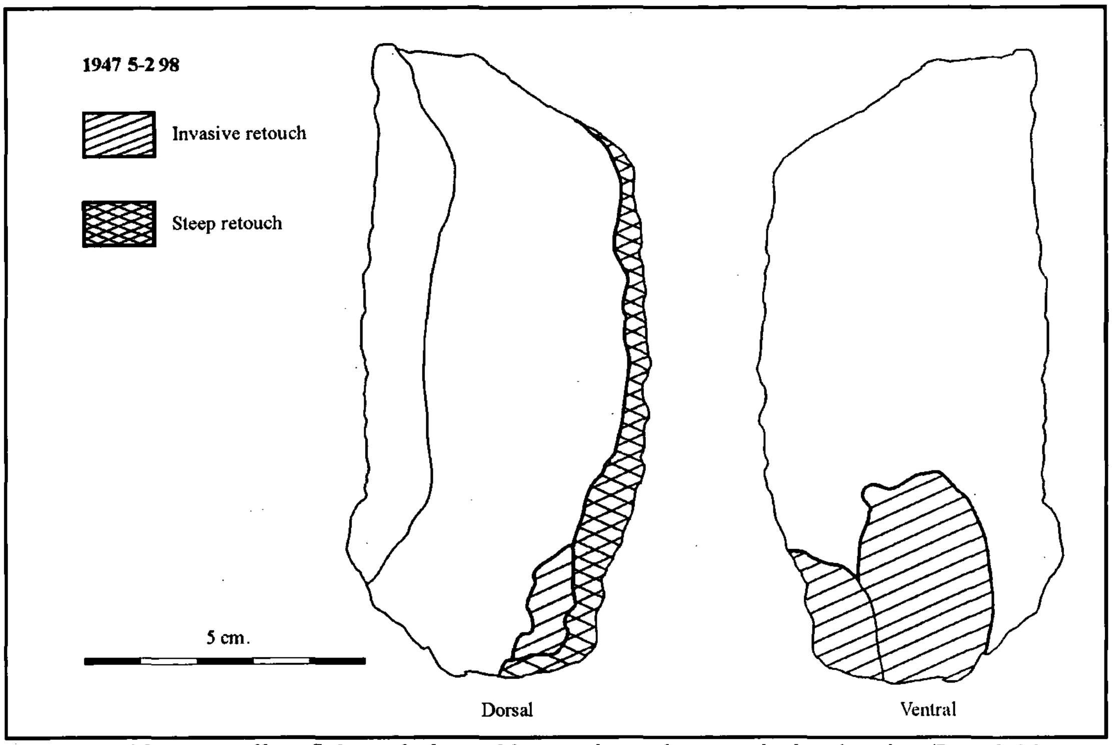

Figure 5.1.29 Levallois flake with thinned butt and steeply retouched right edge (British Museum registration number 1947 5-2 98).

Location of retouch on flakes					
Position			Location		
Direct	7	53.8%	*Distal*	3	23.1%
Inverse	3	23.1%	*Right*	4	30.8%
Bifacial	2	15.4%	*Left*	2	15.4%
Alternate	1	7.7%	*Continuous except butt*	1	7.7%
			Butt only	2	15.4%
On Levallois flake	5		*Continuous except one edge*	1	7.7%
On non-Levallois flake	8				
Distribution			Edge form		
Continuous	5	38.5%	*Convex*	9	69.2%
Discontinuous	1	7.7%	*Notched*	3	23.1%
Partial	5	38.5%	*Concave*	1	7.7%
Obscured	2	15.4%			
Extent of retouch			Angle of retouched edge		
Minimally invasive	5	38.5%	*Abrupt*	3	23.1%
Semi-invasive	5	38.5%	*Semi-abrupt*	4	30.8%
Invasive	3	23.1%	*Low*	6	46.2%
Regularity of retouched edge			Morphology of retouch		
Regular	9	69.2%	*Scaly*	11	84.6%
Irregular	2	15.4%	*Single removal*	2	15.4%
Obscured	2	15.4%			

Table 5.1.19 Location and nature of retouch on flakes from the Ebbsfleet Lower Gravels (n=13).

It is impossible to generalise as to what tasks required the variable retouch of Levallois and non-Levallois flakes from the Ebbsfleet Lower Gravels. However, the fact that such a varied approach was taken may indicate that a variety of activities were undertaken either at the site itself or in its immediate surroundings, and that flake blanks were retouched in response to these in a variety of ways, underlining the flexibility offered through the production of such large transformable blanks.

Handaxes

Figure 5.1.30 Handaxes from the Ebbsfleet Lower Gravels; thick, asymmetrical handaxe (British Museum registration number 1947 5-2 83) and partial roughout (British Museum registration number 1961 7-5 456).

Four handaxes were recovered from the Lower Gravels, three by Burchell and one from the basal gravel of the British Museum excavations (1b). One small, moderately rolled and edge-damaged pointed handaxes was illustrated by Burchell (1947 5-2 95; Burchell 1936c) and is described as coming from a position not given for any of the other artefacts – "unsorted gravel underlying lower loam and resting on unstratified gravel" (Burchell 1936c). This would represent the top of the Lower Gravel in a position which may be equivalent to the gravel resting on the slope (1a, Bridgland's Bed 4 – see Table 5.1.1) and that could represent the coarse remnant of a slope deposit from which fine material has been removed and redeposited within the sediment load of the channel. Potentially supporting evidence for this comes from Burchell's emphasis on this gravel being "unsorted", a description he does not apply to the main, implementiferous Lower Gravels. Additionally, the condition of the handaxe is more similar to the derived material from the upper units (moderately abraded, edge-damaged, patinated and stained). As such, this individual artefact is regarded as reworked from elsewhere.

The remaining two handaxes recovered by Burchell are identical in terms of condition to the majority of the Levallois material and are likely to have been produced during exploitation of the gravels. These comprise a portion of a large pointed ovate roughout (BM 1961 7-5 456); this retains rolled cortex on one face and has split during working along an existing coarse flaw in the flint. The second is unusual, being a thick, blunt ended biface with steeper working along the left edge (BM 1947 5-2 83). This could also potentially represent a non-Levallois core which has been later used as a scraper (Figure 5.1.30). The single handaxe recovered during the Kerney and Sieveking excavations is small, pointed and comparable in condition to the material from the Upper Units for which an allochthonous origin has been proposed. As such, only two handaxes were recovered from the Lower Gravels in similar condition to the Levallois assemblage; one is partial and the other entirely non-classic. These demonstrate that in individual instances artefacts which could be described as handaxes were made by hominids exploiting the Lower Gravels; however, over the period represented by the aggradation of the gravels as a whole, the dominant pattern is overwhelmingly one of Levallois flake production.

Non-Levallois Cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	92.95	78	58.86	0.9242229	0.7104321
Median	75.25	76.85	46.5	0.945452191	0.606701283
Min	57.1	54.4	26.1	0.498912255	0.424705882
Max	152.8	117.6	145.7	1.429292929	1.238945578
St.Dev	42.6876446	23.387433	43.679087	0.303953127	0.307900338

Table 5.1.20 Summary statistics for non-Levallois cores from the Ebbsfleet Lower Gravels (n=6)

Only six cores recorded as non-Levallois were recovered from the Ebbsfleet Lower Gravels. These are similar in size to the discarded Levallois cores from the site, and all retain the dimensions of the original selected clast – predominantly nodules from the gravel (5) but also a single, extensively naturally shattered block. Most are minimally worked, with the exception of one core which was subjected to a prolonged sequence of alternate flaking (see Table 5.1.21), through the preparation of a simple platform and preferential flaking of one face (5 cores). The face of another has been exploited without the preparation of a platform.

As at Purfleet, these cores essentially conform to Boëda's (1986) formulations of the defining volumetric characteristics of Levallois, although again, the preparatory phase is fulfilled through the orientation of the flaking surface axis with the natural convexities of the selected nodule.

Although they have been treated separately here, the distinction is purely one of degree of preparation, and all but one (extended alternate flaking from a single platform) could be described as reflecting unipolar recurrent exploitation of an unprepared flaking surface. Such cores were not extensively exploited, whilst the Levallois cores described above reflect the fact that recurrent exploitation and re-preparation of particular flaking surfaces was undertaken, the small size of the cores described here would militate against such an approach being adopted without resulting in miniaturisation of the flakes thus obtained. These cores underline the fact that a flexible approach was undertaken to producing flakes using the material available from the gravels, which may not always have permitted prolonged control of the products of flaking through deliberate preparation, but that an approach centred upon the flaking of a particular surface was still employed.

Non-Levallois cores (n=6); technological observations			
Core episodes (n=13)		Flake scars/core episode	
Type A; Single removal	3	*Min*	1
Type B; parallel flaking	0	*Max*	17
Type C; Alternate flaking	7	*Mean*	4.64
Type D; Unattributed removal	6		
Flake scars/core		Core episodes/core	
1-5	1	*Min*	1
6-10	3	*Max*	4
11-15	1	*Mean*	2.16
>15	1		
Max	17	All retain original blank form	
Mean	8.5		
% Cortex		Cortex position	
0	0	*More than one face*	1
1-25%	1	*All over*	5
26 – 50%	3		
51 – 75%	2	Type	
>75%	0	*Simple prepared*	5
		Migrating platform	1

Table 5.1.21 Technological observations of non-Levallois cores from the Lower Gravels at Ebbsfleet (n=6).

Technology and hominin behaviour in the Ebbsfleet Valley

The assemblage from the Lower Gravels at Ebbsfleet attests to a continued hominin presence in the area during a temperate phase of OIS 7, and reflects apparent shifts in technological practice in response to changes in the material possibilities of the locale. Whereas the earlier

OIS 8/7 occupation represented by the material from Baker's Hole indicates that hominins were using very large flint nodules obtained from the eroding chalk slope, this source was at least partially masked with the aggradation of the interglacial gravels. The banks and bars of the Ebbsfleet Channel therefore formed the focus of hominin activity. Large pebbles were selected from the gravels, and worked at the site in order to produce large, broad Levallois flakes. That such products were favoured is suggested by the use of centripetal preparation throughout reduction – acting to reduce the volume of elongated flint nodules from the earliest stages of Levallois flake production and produce broad flakes. Production was maximised to a degree through recurrent exploitation of particular flaking surfaces, as well as the complete re-preparation of the productive face, but cores were not worked to exhaustion; flint was immediately ubiquitous, and given the apparent emphasis upon the production of large, broad flake-blanks, the miniaturised products of such an approach may not have been desired. Notably, although two handaxes may well have been produced at the same time as the Levallois flake assemblage, Levallois flaking entirely dominates the Ebbsfleet assemblage; in addition, smaller flint pebbles were worked using a procedurally-reduced approach to flaking one particular surface, without a separate preparatory phase – effectively, Levallois flaking in volumetric terms.

Some of the large Levallois flakes were retouched in a variety of ways – as were other non-Levallois blanks of comparable size. This might reflect the fact that various other tasks, apart from Levallois flake production, were undertaken either at the site itself or in the immediate area; certainly, a large collection of faunal material has been recovered from the Lower Gravels, but this has never been examined for direct evidence of human involvement. Equally, it is possible that such blanks represent those discarded at the site following use and transformation by hominins exploiting the wider landscape – being discarded once they returned to a source of available raw material. Given the nature of recovery and context of the material examined, it is impossible to determine either the nature of the activities requiring that flakes were retouched, or the landscape-scale within which they were undertaken. However, a notable contrast with the retouched Levallois flakes from the earlier occupation of the area apparent at Baker's Hole is the variety of retouch. At Baker's Hole, flakes were predominantly retouched in a manner which re-created or accentuated the existing cutting edge of the flake blanks, whereas at Ebbsfleet, although individual artefacts are retouched in this way, edges are also transformed – some are backed, some thinned (potentially to facilitate hafting), and most reflect a definite increase in edge-angle.

This contrast could be interpreted in a number of ways; the variety of tasks undertaken by hominins in the immediate area may have changed, demanding a more varied approach to the treatment of flake blanks, rather than simply a demand for continuous cutting edges. In connection, it may also reflect a conceptual shift in the possibilities afforded by Levallois flakes; at Baker's Hole, both the unretouched flake blanks and many of the retouched flakes could be viewed as functionally analogous to handaxes, being similar in form and possessing a continuous cutting edge. The manner in which many were retouched suggests that the emphasis was upon *preserving* these properties, whereas in the later occupation of the Ebbsfleet Valley, the functional properties of some flakes were *altered* through the application of retouch. Such a shift may reflect a change in the technological possibilities of Levallois flaking; rather than a means of producing several "handaxes" from any one core, flakes may have come to be treated as blanks with transformative potential, increasing the options available to hominins equipping themselves in anticipation of a variety of future needs.

5.2 Lion Pit Tramway Cutting, West Thurrock, Essex

Introduction

Levallois material has been recovered from the side of a disused tramway cutting connected to the Lion Pit chalk quarry since the early years of the last century (Dibley and Kennard 1916, Warren 1923a, 1923b). Lion Pit is located on the north bank of the Thames, 1 km. from the modern river, within terrace gravels ascribed to the lower part of the Mucking formation of the Lower Thames (OIS 8-7-6; Bridgland and Harding 1994). The site remained largely unexamined in comparison with better-known Lower Thames Middle Palaeolithic sites, until recent excavations both re-exposed the primary archaeological deposits and allowed the re-assessment of the geological sequence (Bridgland 1985, Bridgland and Harding 1994, 1995, Schreve *et al.* in press). The Levallois material was restricted to the lowermost gravel at the base of a chalk cliff forming an embayment in the northern edge of the river valley, and was overlain by a thick Quaternary sequence. Although the site also produced mammalian and molluscan faunas, together within some pollen, little direct environmental evidence was recovered from the lowermost, archaeologically productive, gravels.

History of Investigations

Prodigious amounts of faunal and molluscan material were recovered from West Thurrock from the late 1880's onwards (Whitaker 1889). However, prior to the discovery of a "working floor" within Lion Pit itself by Kennard (Dibley and Kennard 1916), the area was primarily known as a source of mammalian material, although Abbott (1890) did note the presence of flakes within the lower gravels of a section he examined west of Lion Pit (Tunnel Cement Works). Fauna was recovered from fine-grained deposits exposed in various chalk pits in the West Thurrock area, including immediately south of the Lion Pit Tramway cutting (Gibb's chalk pit, London Road; Hinton and Kennard 1901, Whitaker 1889) and 500 m. to the west of Lion Pit (Thames Works Quarry/Tunnel Cement Works; Hinton 1901). Notably, many early workers emphasised significant differences between the faunal assemblages from brickearth exposures in the West Thurrock area and material collected from similar deposits to the east, around Grays and Little Thurrock (e.g. Hinton 1910, Kennard 1916), subsequently shown to relate to different terrace aggradations (Bridgland and Harding 1994).

Kennard was the first worker to recover Levallois material from the West Thurrock area, noting the presence of a "working floor" within "Middle Thames deposits against a chalk cliff" in the pit belonging to Wouldham Cement Company (Dibley and Kennard 1916).

Warren accredits the discovery of this site to Kennard and undertook further work at the site (Warren 1923a, 1923b), amassing a substantial artefact collection from the basal gravel exposed in the Tramway Cutting. He initially described these artefacts as the products of a "tortoise-core industry" (Warren 1923a, 42) or "proto-Mousterian" (Warren 1923b) in character, but later described them as coming from a "Mid-Levallois working site" (Warren 1942, 175). There appears to be little logic underlying this shifting application of industrial labels; Warren never published his work at Lion Pit in any detail, but notes the existence of the site when discussing the natural pressure flaking he observed there (Warren 1923a) or in relation to his interpretation of the industrial succession of south-western Essex (Warren 1923b, 1942).

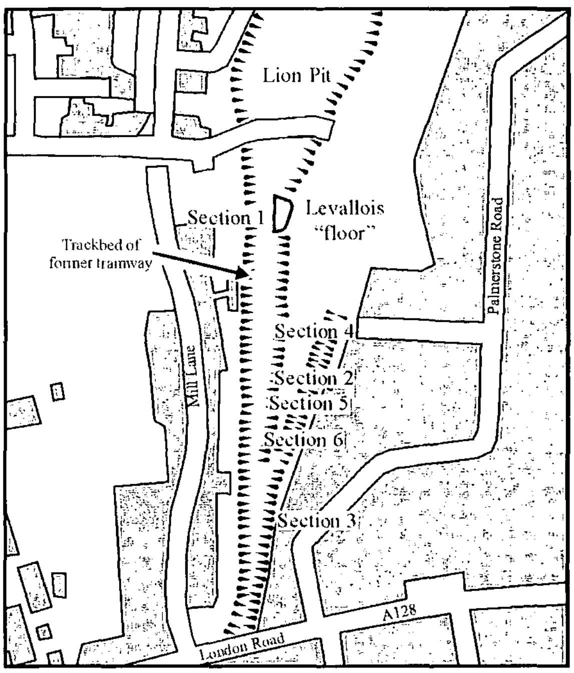

Figure 5.2.1 Position of sections exposing sediments in east side of the Lion Pit Tramway Cutting (adapted from Bridgland and Harding 1995, 222; fig.50 and © Crown copyright/database right 2005. An Ordnance Survey/EDINA supplied service).

Three sections through the deposits exposed in the Tramway Cutting were excavated by Hollin (1977), although further archaeological material was not recovered. Hollin's work confirmed that the terrace deposits exposed in the West Thurrock area were banked against a chalk cliff rising from 6 – 16 m. O.D., diving to well below O.D. under the fluvial deposits to the south (Hollin 1977). He noted three basic sub-divisions of the overlying terrace deposits in the vicinity of the cliff; 9 m. of sand at the bottom of the sequence, overlain by 2 m. of clayey brickearth, the base of which produced both freshwater molluscs and ostracods. These brickearths were sealed by a further sand layer rising to 15 m. O.D., and the deposits as a whole are capped by colluvial deposits. Hollin interpreted the West Thurrock sediments as Ipswichian in date, having obtained a single pollen sample rich in *Carpinus* from the clay-rich layer at the base of the brickearths (Hollin 1977, Bridgland and Harding 1994, 239).

Hollin's sequence was broadly confirmed when a new road cutting opened in 1983/84 allowed recording of a 100 m. section, located 900 m. west of Lion Pit, through the interglacial sediments (Bridgland and Harding 1994). Three sections were subsequently cleared in the sides of the Tramway Cutting itself (Figure 5.2.1), the first of these located in the immediate vicinity of Warren's "working floor" towards the northern end of the cutting where the Pleistocene deposits abut the chalk cliff. Warren provided detailed notes of the site position to W.A. Macfadyen, the first geologist appointed by the Nature Conservancy, which are still held within the archives of the Nature Conservancy Council (Schreve *et al.* in press). These allowed Warren's "working floor" to be accurately re-located and controlled excavation of the archaeological levels to be undertaken, in conjunction with sampling and recording of the Quaternary sequence. The two smaller sections were cleared further to the south, again exposing a sequence similar to that recorded by Hollin (Bridgland and Harding 1994, sections 2 and 3; see Figure 5.2.1).

The main site was again re-opened in October 1995, in advance of a Quaternary Research Association excursion, allowing further archaeological excavation of the artefact horizon, together with the clearing of three new exposures further to the south (sections 4,5 and 6; see Figure 5.2.1; Schreve *et al.* in press). Most recently, work to stabilise the surviving exposures allowed the investigation of a further section (section 7) in 2003 (*ibid*). The excavations at the main site in 1984 and 1995 produced 144 artefacts, including refitting material, all of which were recovered from the basal (Crayford) gravel. Given the thickness of the Quaternary sequence, only small areas of the Crayford gravel could be exposed for excavation, by cutting back the base of the eastern end of the section. This allowed access to an area of 1 x 4 m in 1984, whilst a 1.2 x 1.4 m. extension to the south-east of the 1984 investigations was excavated in 1995. Environmental samples were taken from throughout the sequence during all recent phases of excavation, and a wide variety of environmental proxies were recovered from the main interglacial beds (see below).

Geological Background

The terrace deposits exposed at West Thurrock have been attributed to the Mucking aggradation of the Lower Thames (OIS 8-7-6; Bridgland and Harding 1994), on the basis of altitude and stratigraphical position within the Thames sequence. The deposits comprise a sequence of fossiliferous sands and silty clays sandwiched between gravels and banked up against a chalk cliff, which in the Lion Pit area is cut back slightly into the northern side of the ancient river-valley. The full West Thurrock sequence (see Figure 5.2.2) has proved comparable between the various exposures investigated, and is summarised in Table 5.2.1 below.

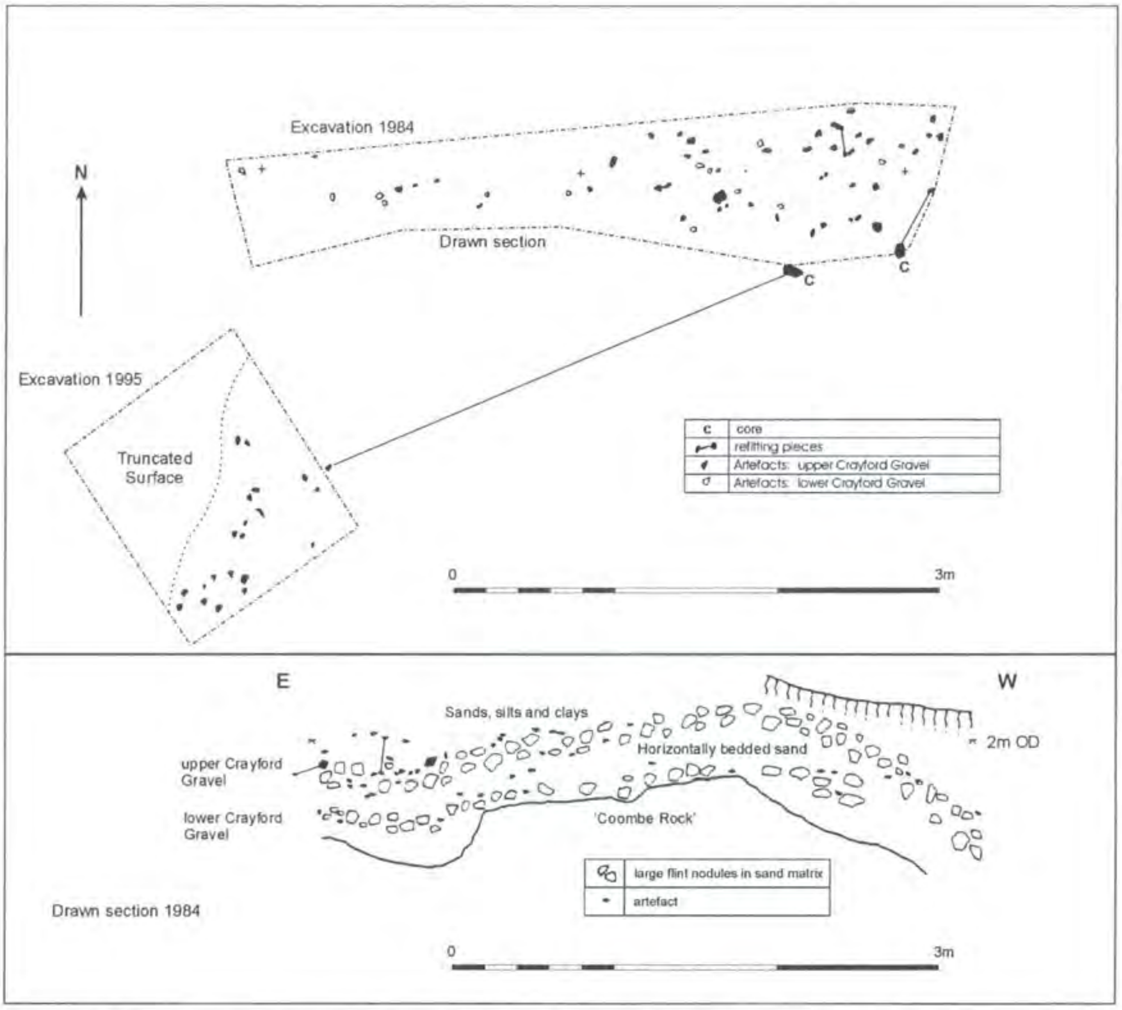

Figure 5.2.2 Section through deposits exposed at Lion Pit Tramway Cutting, West Thurrock and plan showing position of artefacts and distance between conjoining groups in Bridgland and Harding excavations (1984/1995; after Bridgland and Harding 1994).

Beds 0 and 1 (chalk rubble and Crayford Gravel) have been interpreted as deposited during cold conditions, on the basis of sedimentological characteristics; no environmental proxies were recovered from the lowermost 2 beds. The basal "coombe rock" was only observed in the most recent phase of excavations, and is interpreted as the result of periglacial slope processes (Schreve *et al.* in press). The presence of this slope deposit immediately over the chalk into which the Mucking terrace level is incised reflects the fact that glacial conditions still prevailed during this downcutting phase. The basal Crayford Gravel (Bed 1) is coarse and fluvial in origin, again reflecting deposition during a period of high discharge, before the landscape had stabilised through soil formation and vegetation growth during interglacial conditions. Two separate gravel units can be distinguished within Bed 1, separated by a thin seam of gravel (Schreve *et al.* in press).

6.	Colluvial overburden	
	Unbedded gravelly, clayey sand with Palaeosol	
West Thurrock Member		
5.	West Thurrock Gravel	< 2.00 m.
	Only present towards southern end of Tramway Cutting; poorly-developed horizontal bedding and occasional sand lenses, periglacially disturbed in places (Section 2).	
Aveley (Silts and Sands) Member		
4.	Upper Sand	> 2.00 m.
	Interbedded fine silts and sands, including cross-stratified and ripple laminated horizons	
3.	Clayey silt (Brickearth)	> 3.00 m.
	Unbedded, oxidised moderately-sorted clayey silt to poorly-sorted sandy clayey silt; unoxidised and shelly lower part further to south.	
2.	Lower Sand	8.5 m.
	Horizontally-bedded sand becoming silt and clay-enriched with occasional pebble stringers towards top. Upper metre clay-impregnated and capped with pebbles.	
Crayford Member		
1.	Crayford Gravel	< 1.0 m.
	Large, minimally-abraded flint nodules and smaller gravel clasts in sand.	
0.	Angular chalk rubble ("coombe rock")	Unbottomed

Table 5.2.1. Deposits of the Mucking formation exposed at Lion Pit Tramway cutting (after Bridgland and Harding 1994, Schreve et al. in press)

Beds 2-4 reflect relatively quiescent interglacial sedimentation, representing phase 3 of Bridgland's terrace model and therefore correlated with OIS 7 (Bridgland and Harding 1994, Schreve *et al.* in press). The sandy deposits of Beds 2 and 4 both reflect gentle sedimentation within the minor embayment formed by the cliff recess and are argued to be estuarine in origin (Schreve *et al.* in press). However, although some of Abbott's faunal material may have come from the sands of Bed 2 (Abbott 1890; Schreve *et al.* in press) no environmental evidence can be definitively stated to have come from these deposits.

In contrast, the fluvial silts and clays of Bed 3 have been interpreted as fully temperate on the basis of various environmental proxies (vertebrates, molluscs and pollen), deposited within a mudflat or quiet backwater which occasionally dried out for prolonged periods of time (Schreve *et al.* in press). Although no brackish indicators have been recovered, it is suggested that the thickness of Bed 3 might also indicate deposition in an estuarine environment *(ibid).* Molluscs recovered from this bed are overwhelmingly freshwater in character, but can be found in estuarine environments, whilst the fish recovered from Bed 3 are characteristic of stagnant or very slow-moving water, and include species tolerant of estuarine conditions (*Gasterosteus aculeatus, Tinca tinca; ibid).* The interglacial deposits (Beds 2-4) are capped by the West Thurrock Gravel (Bed 5), which reflects a return to cold-climate fluvial deposition, although an interglacial soil formed at the top of Bed 4 before periglacial conditions prevailed.

Correlation of the mammalian fauna from Bed 3 with OIS 7 is suggested, as it is similar in composition to faunas from this interglacial at Uphall Pit, Ilford and Crayford (Schreve *et al.* in press). In addition, the extensive molluscan assemblage from these deposits can be no younger than OIS 7, given the presence of *Corbicula fluminalis* and *Pisidium clessini* (*ibid*), and have produced amino acid ratios on *Bithynia* opercula consistent with an OIS 7 attribution (Schreve *et al.* in press, Penkman 2004). The entire West Thurrock sequence therefore reflects incision and "coombe rock" emplacement during the OIS 8/7 interglacial transition, followed by coarse gravel deposition; interglacial conditions prevailed during the deposition of the estuarine silts and sands during OIS 7, before cooling conditions at the OIS 7/6 transition resulted in a reversion to coarse gravel deposition (Schreve *et al.* in press). The main archaeological occupation of the site, as attested by the assemblage from Bed 1, therefore reflects exploitation of the coarse gravel banks and bars during the OIS8/7 transition. This date is comparable with other large sites in immediate association with raw material sources in the Lower Thames. However, it is also worth noting the presence of a narrow-nosed rhinoceros (*Stephanorhinus* hemitoechus) pelvis collected by Abbott from the interglacial deposits (possibly Bed 2). This preserves several series of cutmarks, in positions consistent with butchery and detachment of the main muscle blocks (Schreve *et al.* in press). No artefacts have been recovered from the interglacial deposits, although, if the pelvis can be definitively be stated to have come from these layers, humans must clearly have been active in the West Thurrock area during later OIS 7.

Summary

- *Geographical situation*

  The lithic assemblage from Lion Pit was recovered from the banks and bars of a fast-flowing river, immediately adjacent to a chalk cliff and within a slight embayment in the valley side.

- *Climate and environment*

  Although no direct environmental proxies were recovered from the archaeologically-productive gravels of Bed 1, the coarse nature of the gravels probably reflects a cool and open landscape prior to the establishment of extensive interglacial vegetation.

- *Dating*

  The West Thurrock sediments as whole are correlated with the Taplow/Mucking formation of the Lower Thames on the basis of altitude. The basal implementiferous gravels underlie interglacial sediments attributed to OIS 7 on the basis of biostratigraphy, terrace stratigraphy and amino acid analyses (Bridgland and Harding 1994; Schreve *et al.* in press). Given that the basal gravels (Bed 1) were deposited during a period of cold climate, immediately after an episode of incision, they are attributed to phase 2 of Bridgland's (1994) terrace model, and an OIS 8/7 date is advocated for these deposits.

Analysis of the Assemblage

Treatment and selection of collections

Artefacts recovered from Lion Pit during the recent phases of excavation (1984/5, 1994) were predominantly recovered from the small area (c. 5.25 m^2) of Crayford Gravel excavated at the base of the section at the main site. Artefacts were plotted in three dimensions and their position was additionally recorded on a 1:10 plan. Orientation, angle and direction of rest were also noted where possible (Schreve *et al.* in press). The assemblage was preferentially recovered from the upper part of the Crayford Gravel, where 63 artefacts were recovered in association with a layer of large flint nodules. Fourteen were recovered from either within or below the sand layer that separates the Upper from the Lower Crayford Gravels. The controlled excavation conditions and detailed level of recording mean that this sample can be used to assess the taphonomic integrity of the assemblage. The remaining 67 artefacts were recovered during section cleaning, or were collected from the sections during the QRA field visits to the site. Although these artefacts are not stratigraphically provenanced, they can only have been recovered from the Crayford Gravel, but cannot, however, be assigned to specifically to the upper or lower portion (Schreve *et al.* in press).

Material collected by Warren and Kennard from Lion Pit (Warren Collection, British Museum) can also be argued to have come from the Crayford Gravel, on the basis of the description Warren provided to MacFadyen at the Nature Conservancy (Schreve *et al.* in press) and the fact that it is in identical condition to the Bridgland and Harding assemblage. Given that Warren and Kennard's artefacts were collected, rather than recovered during controlled excavation, it is possible that certain elements (e.g. smaller debitage) might be under-represented in this collection. However, debitage is actually relatively uninformative when investigating how particular Levallois reduction methods were applied. Levallois flakes and cores from both the recent excavations and the Warren collection (British Museum) have therefore been combined in order to assess the Levallois methods employed at the site throughout the aggradation of the Crayford Gravels. A single handaxe from the Warren collection has been excluded from the current analysis, as it is abraded, with a lustrous surface, in marked contrast to any other artefacts from the Lion Pit Tramway Cutting. Only debitage from the Bridgland and Harding excavations has been used to assess the taphonomy of the whole archaeological assemblage. This material was recorded in collaboration with Mark White, the data already having been used in his discussion of the assemblage in Schreve *et al.* (in press).

Analysis

The selected sample comprises 229 artefacts, summarised in Table 5.2.2.

Artefact	Bridgland and Harding (1984-1995)	Warren and Kennard	Whole assemblage	% of whole assemblage
Flakes (including chips)	126	58	184	80.3%
All Levallois flakes	12	18	30	13.1%
Definite Levallois flakes	5	6	11	4.8%
Probable Levallois flakes	0	6	6	2.6%
Possible Levallois flakes	7	6	13	5.7%
Levallois cores	4	5	9	3.9%
Non-Levallois cores	0	3	3	1.3%
Retouched flakes	2	0	2	0.9%
Retouched Levallois flakes	0	0	0	0.0%
Retouched non-Levallois flakes	2	0	2	0.9%
Handaxes	0	1	1	0.4%
Total	144	85	229	100.0%

Table 5.2.2 Selected sample from Lion Pit Tramway Cutting, West Thurrock (Bridgland and Harding and Warren collections combined).

Taphonomy

Given the attention paid to artefact recording during the Bridgland and Harding excavations at Lion Pit, it is possible to draw some inferences from their plotted sample concerning the taphonomic processes affecting the entire assemblage. The artefacts as a whole show no preferential orientation or inclination, and are therefore unlikely to have been profoundly re-arranged by fluvial action (Schreve *et al.* in press). The larger trench, excavated in 1984/5, shows a concentration of material in the upper Crayford Gravel towards its eastern extent, with much lower numbers from the western end, whilst the 1995 extension does seem to indicate further artefact occurrences concentrated towards the south-west (see Figure 5.2.2).

However, when the horizontal distribution of artefacts from the upper and lower Crayford gravels is examined together, material appears to be distributed evenly over the entire area.

Examination of the vertical relationships between both horizons indicates that artefacts from the upper gravel are never vertically superimposed above those from the lower level, whilst refits within the upper gravel indicate vertical displacement by up to 20 cm. Finds from the upper gravel are distributed throughout the gravel, whereas those from the lower gravel are distributed below gaps between nodules in the upper layer and rest on top of the lower layer of nodules. This pattern, taken together with the evidence for vertical displacement *within* the upper gravel of distances *greater* than the distance between the two horizons, suggests that material from the upper gravel has worked down between gaps in the upper layer of nodules and through the bedded sands, coming to rest on top of the basal layer of nodules. It therefore seems apparent that the material from both horizons represents a single, vertically dispersed assemblage, and has been combined as a single sample hereafter.

Condition of material from Bridgland and Harding excavations (n=130)					
Unabraded	116	89.2%	*No edge damage*	2	1.5%
Slightly abraded	14	10.8%	*Slight edge damage*	109	83.8%
Moderately abraded	0	0.0%	*Moderate edge damage*	18	13.8%
Heavily abraded	0	0.0%	*Heavy edge damage*	1	0.8%
Unstained	120	92.3%	*Unpatinated*	7	5.4%
Lightly stained	7	5.4%	*Lightly patinated*	108	83.1%
Moderately stained	3	2.3%	*Moderately patinated*	13	10.0%
Heavily stained	0	0.0%	*Heavily patinated*	2	1.5%

Table 5.2.3 Condition of material from Bridgland and Harding excavations at Lion Pit Tramway Cutting, West Thurrock (excluding chips <2 cm.; n=130).

Condition of material from Warren collection (n=84)					
Unabraded	76	90.5%	*No edge damage*	12	14.3%
Slightly abraded	8	9.5%	*Slight edge damage*	60	71.4%
Moderately abraded	0	0%	*Moderate edge damage*	9	10.7%
Heavily abraded	0	0%	*Heavy edge damage*	3	3.6%
Unstained	71	84.5%	*Unpatinated*	16	19.0%
Lightly stained	11	13.1%	*Lightly patinated*	45	53.6%
Moderately stained	2	2.4%	*Moderately patinated*	22	26.2%
Heavily stained	0	0.0%	*Heavily patinated*	1	1.2%

Table 5.2.4 Condition of material forming Warren Collection, British Museum (excluding handaxe; n=84)

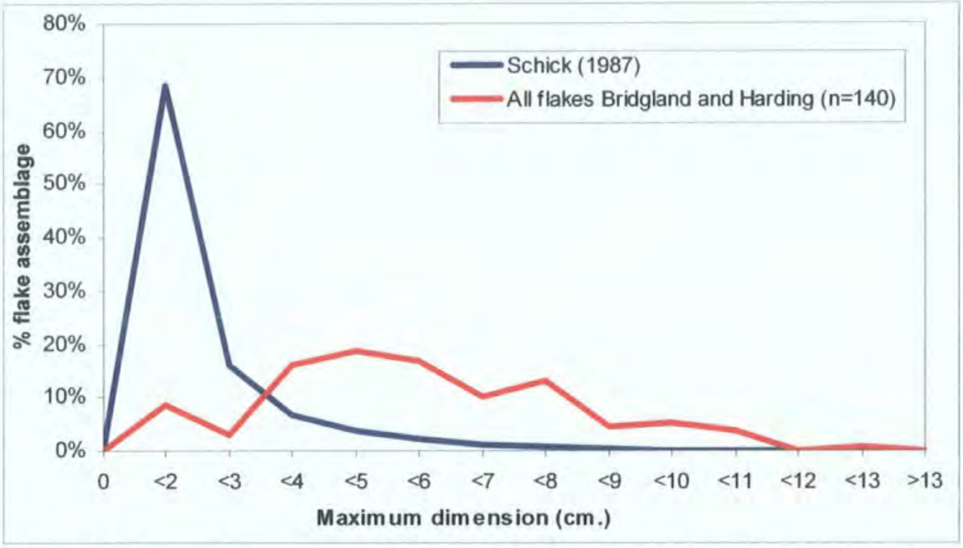

Figure 5.2.3 Comparison of maximum dimension of debitage from Bridgland and Harding excavations with experimentally-generated size distribution (Schick 1987).

The excavated material from Lion Pit Tramway cutting is predominantly unabraded (89.2 %) or only minimally so (10.8%), but most does exhibit a degree of edge damage (see Table 5.2.3). In terms of chemical condition, most artefacts are lightly patinated (83.1%) but unstained (92.3%); none exhibit surface scratching or battering. This appears to indicate that the assemblage as a whole has undergone minimal fluvial re-arrangement, whilst the slight edge damage affecting the majority of the material may relate to sediment pressure, potentially incurred in the context of vertical translocation. There are no notable contrasts between the condition of the excavated material and that collected by Warren and Kennard (compare Table 5.2.3 and 5.2.4 above), suggesting that the Warren collection can be regarded as forming part of the same assemblage.

However, although mechanical damage to artefacts is minimal, the excavated assemblage clearly has been subject to some degree of fluvial re-arrangement. Comparison of the size distribution of all debitage with experimentally-generated data (Schick 1987) demonstrates that small material is clearly under-represented, most especially, debitage under 3 cm, which dominates the experimental data (Figure 5.2.3). Very few chips were observed or recovered during careful hand excavation; an additional gravel sample was also processed through a 10 mm. sieve, confirming that micro-debitage is actually absent (Schreve *et al.* in press). This indicates probable winnowing of the extant assemblage; however, given that such small debitage, whilst taphonomically useful, is of minimal technological interest, this process is unlikely to have significantly altered the conclusions that can be drawn from the assemblage.

Conjoining artefacts were recovered from the upper Crayford gravel, reflective of the minimal re-arrangement undergone by the assemblage as a whole; these comprise three groups of 2-4 artefacts (see Figure 5.2.2). Group 1 is a pair of conjoining flakes (LTC84/12; flake in three pieces, facetted butt) which refits to broken cortical flake LTC84/78. Both artefacts were separated by 0.17 m. horizontally and 0.22 m. vertically. Group 2 comprises 3 flakes which refit to core LTC84/96; this includes flakes LTC84/94 (separated by 0.41 m. horizontally and 0.06 m. vertically), one unplotted broken flake (LTC84/101) and Levallois point LTC84/123, which was discovered in a gravel sample after excavation. Group 3 comprises 2 flakes which refit to core LTC/97, one of which is broken and unplotted (LTC84/3), together with LTC95/1022, found in the 1995 excavation and separated from the core by 3.10 m. horizontally and 0.20 m. vertically (Schreve *et al.* in press). In addition to these small groups of technological refits, several broken flakes could also be refitted. The presence of such material amongst the excavated assemblage demonstrates that although it has undergone some re-arrangement and winnowing, the material as a whole can be viewed as in primary context, if not, strictly speaking, *in situ*.

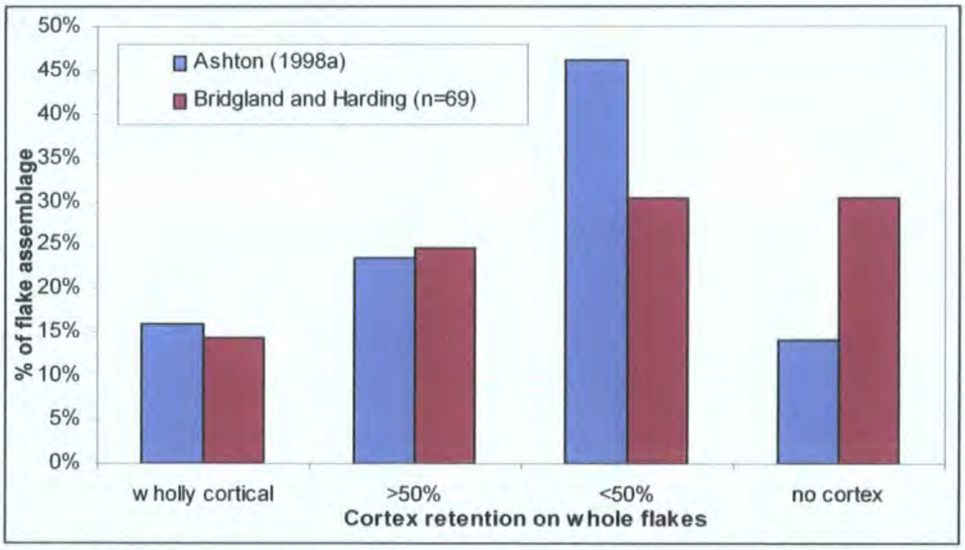

Figure 5.2.4 Comparison of cortex retention on whole non-Levallois flakes from Lion Pit Tramway Cutting with proportions resulting from experimental non-Levallois core reduction (Ashton 1998a).

The majority of the non-Levallois flakes from the excavation at Lion Pit Tramway cutting retain at least some cortex (69.5%), although less than would be expected for a complete non-Levallois knapping sequence; concomitantly, non-cortical flakes are over-represented when compared with experimentally generated data (30.4 %, as opposed to 14.2%; see Figure 5.2.4). Arguably, this pattern might relate to the large size of the available flint nodules (see below); following decortication, much of the volume of the nodule was available for reduction, particularly if a single flaking face was concentrated on through the application of a Levallois reduction strategy. Given that many flakes do retain large amounts of residual cortex, it does seem likely that all stages of reduction – raw material acquisition, preparation and exploitation – were undertaken in the locality.

Technology

Raw material

All of the cores from the Lion Pit Tramway cutting retain at least some cortex; two of the nine Levallois cores (both on lenticular flint nodules) retain cortex on the flaking, as well as the striking platform surface, whilst the remainder retain variable amounts on the striking platform surface alone. Such cortex as is retained is chalky, though often worn in places, indicating that the nodules selected had potentially been subject to minimal fluvial movement since eroded out of the chalk. Such nodules are common in the Crayford gravels, having been eroded from the underlying chalk. Three Levallois cores were definitely formed on nodules, whilst most others probably were, although blank form could not be determined for two of the Levallois cores; two non-Levallois cores were also formed on nodules and completely retained the form of the blank, whilst the third - which could be described as a small Kombewa core – is formed on a flake. A large proportion of the flake assemblage (including the Warren collection) does not retain any cortex (40.1% - largely because Levallois flakes have been included). Some bullhead flint was also used, but most flakes that do retain cortex also reflect the selection of large, fairly fresh nodules from the Crayford gravel.

Levallois cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Mean	124.6667	125.2111	50.7	1.023967	0.409681
Median	133.1	135	47	1.033809	0.388539
Min	57.5	56.3	22.3	0.668979	0.229321
Max	201.8	175.3	89.4	1.327801	0.662222
St.Dev	38.96768	38.16905	19.96071	0.225788	0.113791

Table 5.2.5 Summary statistics for Levallois cores from Lion Pit Tramway Cutting (n=9)

The Levallois cores from the Lion Pit Tramway Cutting are large in size (see Table 5.2.5); Most are equally proportioned (7 with elongation values of >0.8; Figure 5.2.5) and relatively thick when discarded, the flattening index of most being between 0.4-0.6 (7; Figure 5.2.6). Arguably, therefore, most of the cores could potentially be reduced further if reworked, as they are comparable in size to available clasts of raw material at several other British sites. Moreover, in other situations, cores could be and were much more intensively reduced (see Section 4.2, Creffield Road).

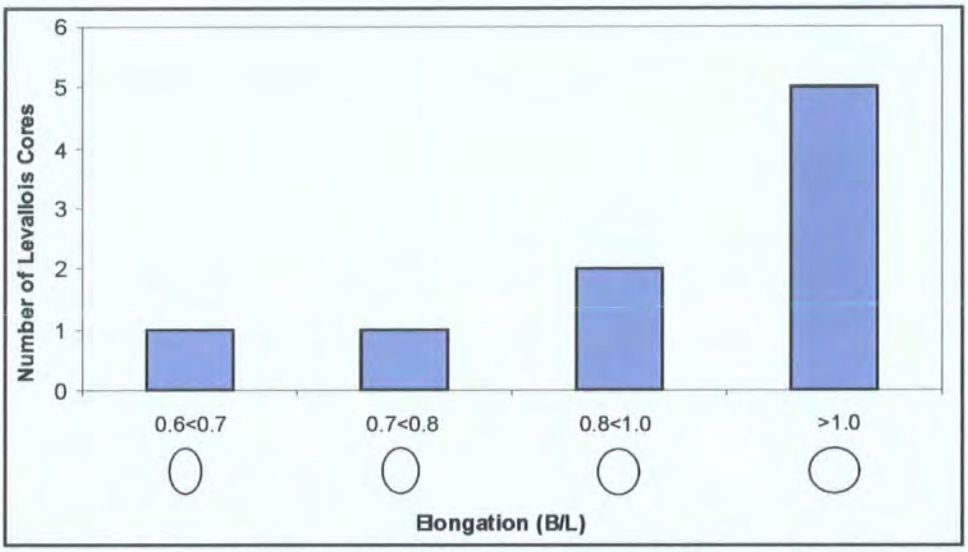

Figure 5.2.5 *Elongation of Levallois cores from Lion Pit Tramway Cutting (n=9)*

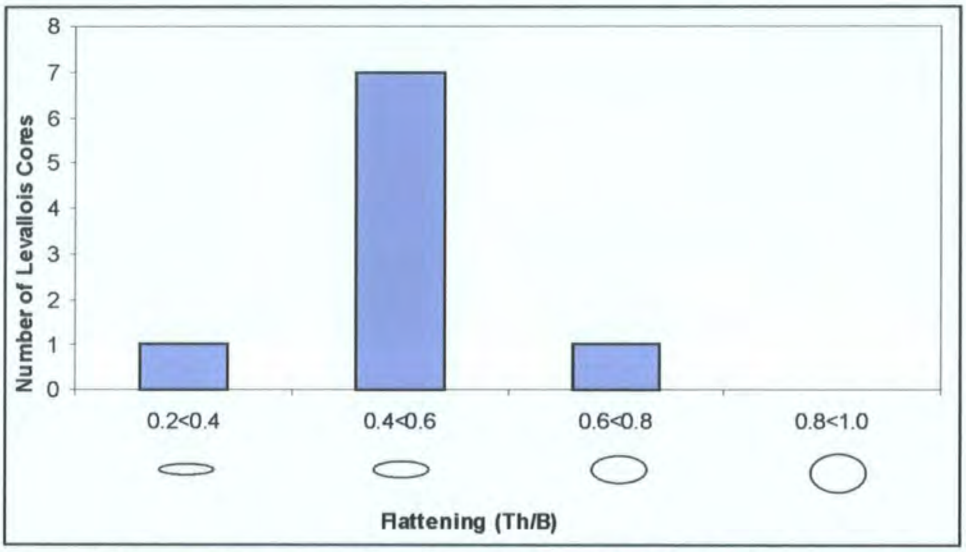

Figure 5.2.6 *Flattening of Levallois cores from Lion Pit Tramway Cutting (n=9)*

The cores reflect the use of a several preparatory and exploitation strategies to produce a variety of Levallois flakes, occupying most of their flaking surfaces. Most retain scars indicative of centripetal preparation of the flaking surface (6), together with two single examples attesting to the use of unipolar and convergent unipolar preparatory strategies. Method of preparation could not be determined for one core, as the Levallois flake itself removed the entire flaking surface. Preparation prior to the removal of final flakes seems to have been minimal; most of the cores (7) retain less than 10 preparatory scars on their flaking surface; 3 cores retain the form of the original nodule, two of which were lenticular in shape. The necessary distal and lateral convexities have been imposed on the flaking surfaces of the cores using a series of bold removals. The striking platform surfaces have been prepared using invasive (4) or semi-invasive removals (5) around the circumference (5) or one or more edge (4), cortex generally being retained in the centre (4) or all over this face (2) to provide a platform for the shaping of the upper, flaking surface.

Levallois cores from Lion Pit Tramway Cutting; technological observations (n=9)					
Preparation method			Exploitation method		
Unipolar	1	11.1%	*Unipolar recurrent*	5	55.6%
Convergent unipolar	1	11.1%	*Lineal*	2	22.2%
Centripetal	6	66.7%	*Centripetal recurrent*	2	22.2%
Indeterminate	1	11.1%			
Convexities			Type of convexity (n=1)		
One edge	1	-	*Cortical*	1	-
Blank type			Distribution of preparatory scars striking surface		
Nodule	3	33.3%	*All over*	5	55.6%
Indeterminate	2	22.2%	*Proximal and distal*	1	11.1%
Probably nodule	4	44.4%	*Proximal and one edge*	1	11.1%
			Distal and one edge	1	11.1%
			One edge	1	11.1%
Type of striking surface working			Position of cortex on striking surface		
Invasive	4	44.4%	*Central*	4	44.4%
Semi-invasive	5	55.6%	*All over*	2	22.2%
			One edge	1	11.1%
			More than one edge	2	22.2%
% cortex striking surface			Total number Levallois products from cores		
0	0	0	1	2	22.2%
1-25%	2	22.2%	2	5	55.6%
26 – 50%	2	22.2%	3	1	11.1%
51 – 75%	4	44.4%	5	1	11.1%
>75%	1	11.1%			
Levallois products from final flaking surface			Types of Levallois products from core (n=20)		
1	2	22.2%	*Flake*	8	40.0%
2	5	55.6%	*Point*	1	5.0%
3	1	11.1%	*Indeterminate*	11	55.0%
5	1	11.1%			
Preparatory scars final flaking surface			Preparatory scars striking surface		
1-5	4	44.4%	1-5	3	33.3%
6-10	3	33.3%	6-10	5	55.6%
>11	1	11.1%	>11	1	11.1%
N/A	1	11.1%			

Table 5.2.6 Technological observation on Levallois cores from the Lion Pit Tramway cutting (n=9 except where otherwise stated).

Most of the cores attest to recurrent exploitation of the final flaking surface; predominantly unipolar (5), as well as centripetal (2) recurrent techniques. The scars retained upon the Levallois cores attest to the removal of a minimum of 20 Levallois products; these are predominantly flakes (8 of the final removals), together with one point. The form of 11 of the Levallois products could not be determined, as they are obscured by previous removals within the recurrent exploitation phases which produced them. Only 6 whole Levallois flakes are present within the selected sample (see below), in comparison to the 20 whole flake scars retained on the cores; when compared in terms of maximum dimension, notable overlap is apparent (Figure 5.2.7). 36.4 % of whole flake scars and 33.3% of whole flakes are smaller than 8 cm. in maximum dimension; 45.5% of flake scars and 33.3% of whole flakes are larger than 10 cm. in maximum dimension.

Whilst it is difficult to hypothesise on the basis of such a small sample, the size range of whole Levallois flakes seems to accord with that which could be produced from the final flaking surface of these cores. Given that no cores from the site attest to repreparation or adjustment of a previous flaking surface, it could be argued that in this situation, hominins were maximising production from a single flaking surface using recurrent techniques. Given that most of the cores are large and thick, they could certainly have been reprepared and exploited further; that there is no evidence that this was done in this situation might relate to the ubiquity of large flint nodules eroded directly from the chalk, or simply that enough flakes for whatever purposes were produced in a single exploitation phase.

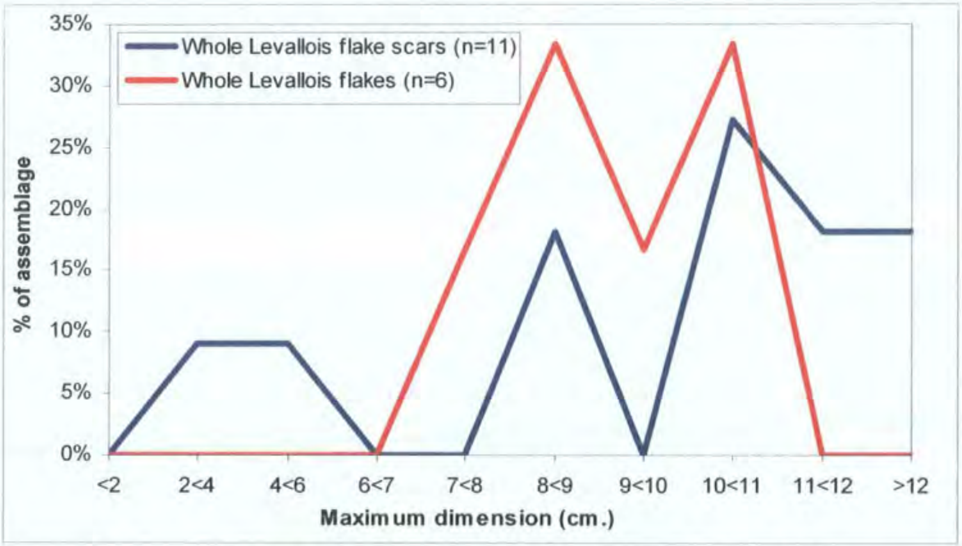

Figure 5.2.7 Comparison of maximum dimension (cm.) of final flake scars on Levallois cores with maximum dimension of Levallois flakes.

Levallois Flakes

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	92.3	56.56667	14.98333	0.6113
Median	91.9	47.25	11.7	0.508511
Min	74	31.5	9	0.393528
Max	109.7	91.5	25.6	0.956818
St.Dev	13.17452	25.09754	6.8814	0.251907

Table 5.2.7 Summary statistics of whole Levallois flake dimensions (n=6) from the Lion Pit Tramway Cutting

The Levallois flake assemblage from the Lion Pit Tramway Cutting comprises 11 definite Levallois flakes, the majority of which are of medium size and relatively elongated (Table 5.2.7). Most flakes retain plain butts (7), although two are facetted. They are variable in form; points (5), flakes (3) and blades (2) are present, together with a single debordant flake which has removed the cortical edge of a core. The scar patterns retained upon the dorsal surfaces of the Levallois flakes reflect the preparatory strategies attested by the cores themselves. Centripetal (4) and convergent unipolar (4) preparatory methods predominate; unipolar and bipolar strategies are also represented. It is impossible to attribute the majority of the flakes to any particular exploitation method; most do not reflect the removal of a preceding Levallois flake scar, and probably result from lineal exploitation (9). However, it is worth noting that most of the cores from the site in fact attest to the application of recurrent methods, and most retain large, frequently untruncated, flake scars. It is therefore likely that many of the Levallois flakes interpreted here as probably resulting from lineal exploitation may actually have formed part of a recurrent sequence. Two flakes do, in fact, attest to recurrent unipolar exploitation.

Levallois flakes from the Lion Pit Tramway Cutting (n=11)					
Type of endproduct			Butt type		
Flake	3	27.3%	*Plain*	7	63.6%
Point	5	45.5%	*Facetted*	2	18.2%
Blade	2	18.2%	*Missing*	2	18.2%
Debordant	1	9.1%			
Raw material			Cortex retention		
Indeterminate	9	81.8%	*0%*	9	81.8%
Fresh	2	18.2%	*1 – 10%*	1	9.1%
			11 – 25%	1	9.1%
Method of exploitation			Knapping accidents (n=3)		
Probably preferential	9	81.8%			
Unipolar recurrent	2	18.2%			
Portion			Position of convexity		
Whole	6	54.5%	*None*	10	90.9%
Proximal	3	27.3%	*Distal and right*	1	9.1%
Distal	2	18.2%			
Number of preparatory scars (n=6)			Type of convexity (n=1)		
1-5	3	50%	*Cortical*	1	-
6-10	3	50%			
Preparation method			No. of previous Levallois removals		
Unipolar (proximal)	2	18.2%	0	9	81.8%
Bipolar	1	9.1%	1	1	9.1%
Convergent unipolar	4	36.4%	2	1	9.2%
Centripetal	4	36.4%			

Table 5.2.8 Technological observations on Levallois flakes from the Lion Pit Tramway Cutting (n=11).

Five of the 11 definite Levallois flakes included within the current sample are broken; it is possible that other partial flakes present within the non-Levallois flake assemblage also represent Levallois endproducts, but cannot be definitively identified as such. Three of the partial flakes appear to have broken when struck, which may account for their discard in this location. Given the paucity of Levallois flakes – and especially whole Levallois flakes – at the site, it seems likely that many may have been transported from the site for use elsewhere; the 9 Levallois cores attest to the removal of a minimum of 20 Levallois flakes, of comparable size to the Levallois flakes recovered. The Levallois flakes that are present do reflect the range of strategies apparent from analysis of the cores, although the full range of methods used – and especially the recurrent exploitation of particular flaking surfaces – is only apparent from examination of the cores themselves.

Flake Tools

Artefact number (Bridgland and Harding)	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
90	64	71	26	1.109375
120	89	69	36	0.775281

Table 5.2.9 Dimensions of retouched flakes from Lion Pit Tramway Cutting.

Two retouched non-Levallois flakes were present within the selected sample from the Lion Pit Tramway cutting; both were recovered during the Bridgland and Harding excavations at the site. LTC84/90 is a single sidescraper, with irregular retouch towards the distal end, whilst LTC84/120 is bifacially worked, with regular alternating retouch along either edge.

Non-Levallois Cores

	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
Core 1	106.9	56.9	39	0.532273	0.685413
Core 2	84.4	59.4	36.8	0.703791	0.619529
Core 3 "Kombewa"	109.4	69.1	44.8	0.631627	0.648336

Table 5.2.10 Summary statistics for non-Levallois cores from Lion Pit Tramway Cutting

Only three cores recorded as non-Levallois were present within the selected sample, all from the Warren Collection. They are smaller than most of the Levallois cores from the site (compare Table 5.2.10 and 5.2.5), and all retain the dimensions of the original nodule – one on a bullhead pebble, one on a pebble from the gravel, and one on a flake. Cores 1 and 2 are minimally worked; platforms have been prepared on either end of the nodules using a single bold removal, from which parallel flaking has then proceeded, preferentially exploiting one surface. One platform on both cores was rejuvenated in order to prolong exploitation. Essentially, these cores conform to Boëda's (1986) formulation of the defining volumetric characteristics of Levallois, although, as at Purfleet and Ebbsfleet, the preparatory phase is fulfilled through the orientation of the flaking surface axis with the natural convexities of the selected nodule. Again, although recorded as a separate type of core, the distinction is purely one of degree; both could be described as reflecting bipolar exploitation of an unprepared flaking surface. Given the small size of these cores, it is likely that a deliberate preparatory phase would actually have acted to reduce the size of flakes that could be obtained from their surfaces; neither was extensively worked, since both retain the dimensions of the nodules on which they are formed

Core 3 could also be described as a flaked flake and is essentially a very small "Kombewa" core; a platform has been prepared on the butt end of a large cortical flake, from which a flake has been removed into the ventral surface. Essentially, the volumetric relationship between the prepared striking platform and the curved, ventral surface of the flake, which already possessed sufficient distal and lateral convexities for successful flake detachment, also equates to the volumetric definition of Levallois (Boëda 1986). Arguably, this is lineal exploitation; producing a single flake from the ventral surface of a flake blank. The few "non-Levallois" cores known from the Lion Pit Tramway Cutting are interesting, given that they reflect the application of the organisational principles through which Levallois flake production is achieved at the site on large fresh flint nodules to smaller pebbles and a flake.

Non-Levallois cores from Lion Pit Tramway Cutting (n=3)			
Core episodes (n=6)		Flake scars/core episode	
Type A; Single removal	1	*Min*	1
Type B; Parallel flaking	0	*Max*	9
Type C; Alternate flaking	5	*Mean*	5.33
Type D; Unattributed removal	0		
Flake scars/core		All retain original blank form	
6-10	2		
11-15	0	All 2 episodes per core	
>15	1		
Min	6		
Max	16		
% Cortex		Cortex position	
0	0	*One face*	1
1-25%	0	*All over*	2
26 – 50%	2		
51 – 75%	1	Type	
>75%	0	*Simple prepared*	5
		Migrating platform	1

Table 5.2.11 Technological observations of non-Levallois cores from Lion Pit Tramway Cutting.

Technology and hominin behaviour at Lion Pit Tramway Cutting, West Thurrock

The assemblage from the Lion Pit Tramway Cutting reflects a hominin presence at the site during late OIS 8/early OIS 7. During this period, large nodules of flint eroded directly from the adjacent chalk cliff were present in and on the Crayford gravels; hominins selected these from the gravel banks and bars upon which they were active and worked them at the site to produce a variety of Levallois flakes. Although all stages of reduction are represented, core working does not seem to have been prolonged; individual flaking surfaces were prepared using a variety of methods, and then were subject to recurrent exploitation. There is no evidence for the re-preparation of individual flaking surfaces, and the Levallois cores were still thick, and capable of further reworking, once discarded. Given that flint was plentiful in the immediate area, exploitation may have begun again on a new nodule following flake production, in order to ensure the production of large flake blanks. It is also notable that far fewer Levallois flakes are present at the site than would have been produced from the cores recovered, and it is suggested that the majority of these may have been transported from the site for use elsewhere. It is notable that at least three – and possibly others – of the Levallois flakes from the site were probably broken when struck, which arguably explains their presence when most endproducts are missing.

The Lion Pit Tramway cutting may therefore represent a location in which hominins were equipping themselves with a variety of transformable flake blanks, which were carried away from the site to be used elsewhere. The recurrent exploitation of the cores produced a variety of such blanks, and exploitation may simply not have been prolonged once the desired equipment had been produced. It is also notable that there is little evidence for hominin exploitation of the site later in OIS 7; no artefacts have been recovered from the interglacial estuarine silts and sands of the Aveley Member. However it is worth noting the rhinoceros pelvis (*Stephanorhinus hemitoechus*) collected by Abbott from the interglacial deposits (possibly Bed 2), which retains cutmarks consistent with butchery and muscle block detachment (Schreve *et al.* in press). If the pelvis can be definitively stated to have come from these layers, then hominins must have been active – and equipped with stone tools – in the West Thurrock area during later OIS 7. The deposition of these fine-grained deposits arguably served to mask the Crayford gravels, which were therefore no longer exploited as a source of raw materials.

5.3 Stoneham's Pit, Crayford, Kent

Introduction

The large collection of refitting artefacts recovered by F.J.C. Spurrell from Stoneham's Pit, Crayford is the most complete, and only definite *in situ*, British Middle Palaeolithic flint assemblage known. Levallois material has been recovered from throughout brickearth exposed in a variety of pits in the Crayford area on the south bank of the Thames, which have also produced extensive faunal and molluscan remains. The Crayford brickearths extend south-eastwards from Erith to Crayford itself, and form part of the Taplow/Mucking formation of the Lower Thames (OIS 8-7-6; Bridgland 1994). The peculiar laminar nature of the material recovered by Spurrell has lead to some debate concerning the technological nature of the Crayford assemblage; recent examinations of Spurrell's collections have suggested that it is non-Levallois, and represents an *ad hoc* response to available raw material (Cook 1986, 17), taking advantage of the form of the available nodules in order to produce laminar products (Révillion 1995).

History of Investigations

Faunal material was collected from the Crayford brickearths from 1838 onwards, when an article by John Morris attracted collectors to the area (Morris 1838, Kennard 1944). Few of the minimally-provenanced remains collected during this period can be located even to pit, given changes in pit-ownership over time and the confusion of collectors themselves as to where they actually were (Kennard 1944). Eight pits from the Crayford/Erith area can be re-located, having been mapped by Kennard (1944; see Figure 5.3.1); from north to south these are Norris' Brickyard, Furner's Old Pit (Later Murray's), Norris' Brickearth Pit, Furner's New, Rutter's New West, Rutter's New East, Talbot's and Stoneham's. Boyd-Dawkins (1867) suggests that much of the faunal material collected by Mr. Grantham, who lived in Crayford, and Dr. F. Spurrell (father of F.J.C.) was obtained from Stoneham's Pit, the southernmost pit of the group. The first artefact from the brickearths was recovered by the Reverend O. Fisher (accompanied by Boyd-Dawkins) from a "pebbly band" within the brickearths, at a depth of 11 ft. (Fisher 1872), and a further flake from Erith was illustrated by Cheadle and Woodward (1876). Although Fisher states that his artefact came from "Slades Green Pit", it is possible that it actually came from Stoneham's (Kennard 1944); he describes the deposits as banked against chalk rubble immediately south of the Tunnel running under the railway, which can only be Stoneham's (see Figure 5.3.1).

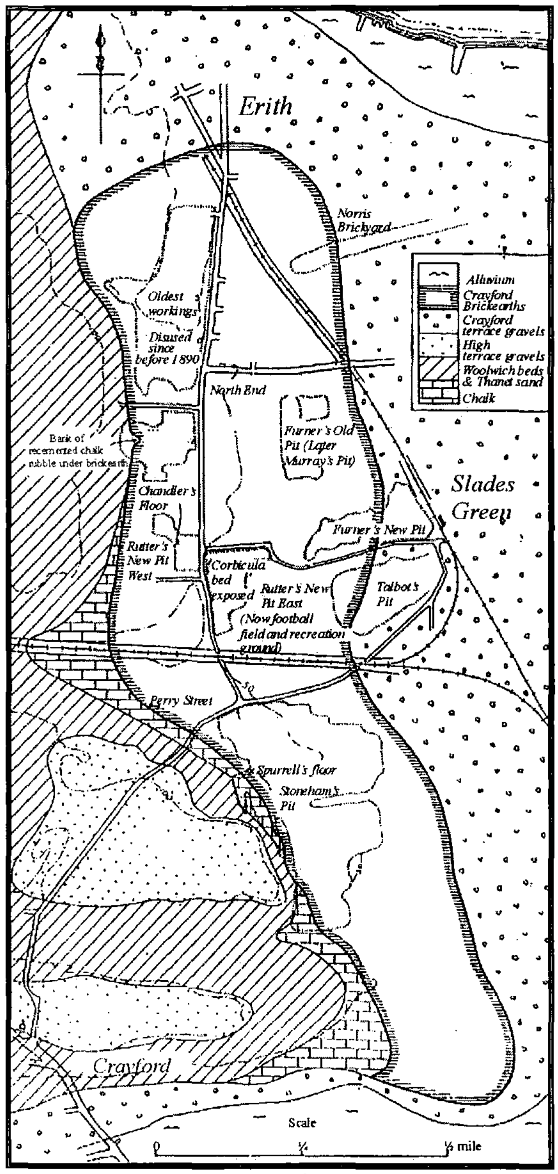

Figure 5.3.1 Kennard's plan of the Crayford/Erith area, showing the location of the various pits and exposures (Kennard 1944, 123; Fig. 12).

In 1880 F.J.C. Spurrell discovered a layer of flint flakes within the brickearths in Stoneham's Pit, where fine-grained deposits were banked up against an eroded chalk cliff mantled by chalk rubble (see Figure 5.3.2). Spurrell noted that the angle of the chalk slope here was more gentle than elsewhere, allowing access to the channel margin from the cliff above (Spurrell 1880b). Towards the steeper base of the cliff a line of flints was exposed; adjacent to this, occupying a sloping horizon between 36 and 42 ft from the surface (c. 9-12 m. O.D.) and an area of at least 3 by 5 m., was a dense band of flint flakes (Spurrell 1880b). The flint band was several inches thick in places; not only could much of the material be extensively refitted (Spurrell 1880a), indicating the *in situ* nature of the assemblage, but gaps devoid of sediment between the flakes indicate that it had been gently buried. Spurrell suggested that the spatial distribution of the flakes suggested knapping had been undertaken in a sitting position, as indicated by "heaps of flakes, which lay divided by two slight lines and other signs" (Spurrell 1884, 112). Fossil mammals were also recovered from the same level and in contact with the artefacts themselves, including a juvenile *C. antiquitatis* jaw held at the Natural History Museum with flakes still adhering, as well as mollusca (Kennard 1944).

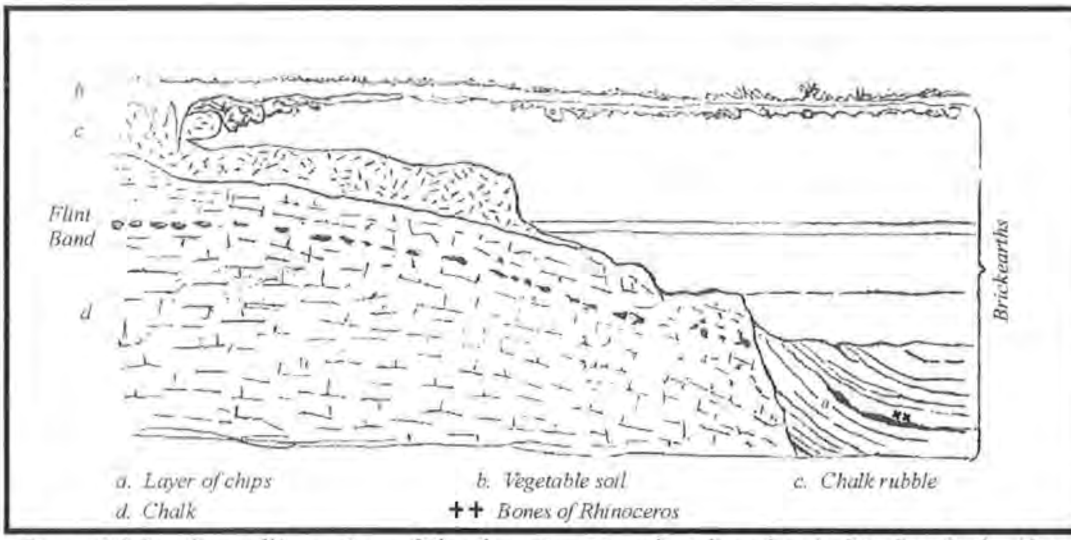

Figure 5.3.2 Spurrell's section of the deposits exposed at Stoneham's Pit Crayford. Note position of artefact layer immediately adjacent to the exposed flint band (Spurrell 1880b, 544, Fig. 1).

Spurrell initially viewed the material he collected as relating to handaxe manufacture, interpreting a broken core that he recovered as the two halves of a "hâche", and refitting a further core ("hâche") to the centre of a large refitting nodule (Spurrell 1880b). Hinton and Kennard (1905) described the material as "Le Moustier" in character, a designation endorsed by Smith (in Brice-Higgins 1914), who explicitly compared the material to that from Baker's Hole. Kennard collected from Crayford between 1892 and 1900, concentrating his work between Rutter's New Pits (East and West) and Stoneham's Pit (Kennard 1944, 122), but only recovered a single flake from 8 ft above the base of the brickearth. Chandler collected further refitting material from Rutter's New West Pit between 1905 and 1913, including refitting flakes, at least one core, and flakes which he viewed as coming from one nodule, though they could not actually be refitted. His material came from near to the base of the lower brickearths, below the *Corbicula* bed, at around 25-30 ft. O.D. (c. 7.5 – 9 m. O.D.), and he viewed it as a continuation of Spurrell's "working floor" ½ mile to the south (Chandler 1916). Chandler emphatically states that his artefacts were not recovered from the surface of the basal gravel, as frequently supposed (e.g. Bridgland 1994) and actually contrasts the position of his material with earlier finds from this position (Chandler 1916, 242). Given the comparative paucity of material in this location, Chandler's finds might better be viewed as further evidence for hominin activity during the aggradation of the Lower Brickearths, rather than necessarily an extension of the same scatter. Although

Chandler initially accepted the "Le Moustier" description of the Crayford artefacts, claiming that no "St. Acheul implements" were known (Chandler 1914, 64), he later claimed that neither his own nor Spurrell's finds had anything "characteristic of Le Moustier about them" (Chandler 1916, 242), though the reasons for either assertion or this change of heart are not made explicit.

Despite such statements, the Crayford material has generally been regarded as produced using a Levallois technique; Roe (1981) regards it as an "evolved Levalloisian" industry, viewing the production of "flake-blades" here, as at Ebbsfleet, as a later, technical refinement of the technique. However, more recently, others have questioned whether the Crayford material does reflect Levallois flaking or another non-Levallois method of reduction. Mellars (1974) describes it as being more similar to an Upper Palaeolithic than Middle Palaeolithic assemblage, presumably because of the laminar nature of many of the products, but does not elaborate further. Cook (1986) undertook an extensive refitting study of the Spurrell material, dismantling his original "Reassemblies" and refitting them again. On this basis she suggests that although some of products might typologically be described as Levallois flakes and blades, in technological terms they cannot be seen as the predetermined products of prepared cores, and are therefore not Levallois. An examination of Cook's work by Révillion (1995), applying Boëda's volumetric conception of Levallois, supported this suggestion; he describes the material as reflecting "convergent direct non-Levallois flaking" and argues that the reduction sequences reflect "almost accidental", uncontrolled laminar flake production. This he argues is conditioned by the cylindrical form of the nodules and is entirely opportunistic.

Levallois flakes and cores have been found at various points throughout the Brickearths, although more typically towards the base, (e.g. Chandler's recurrent bipolar core from Rutter's West New Pit; personal observation; Chandler 1916). However, these are generally single finds, potentially reflecting the occasional drop-out of Levallois products in the context of use. Handaxes are also known from the Crayford/Erith brickearths; although Kennard (1944) suggests these may be contemporary with the Levallois material, the position of none is clearly established and extant examples exhibit staining and patination not observed on any of the Levallois artefacts, suggesting that they may derive from a different situation (Cook 1986; Personal observation). Despite the wealth of material known from throughout the Crayford area, Spurrell's collection from Stoneham's Pit is focussed on here, since the material was clearly in primary context, and its stratigraphic position and location is well-established.

Geological Background

For many years the Crayford Brickearths were a favourite venue for Geologist's Association excursions, and a variety of statements and descriptions of the sequence were produced from 1899 onwards. (e.g. Spurrell 1899, Leach 1905, Chandler and Leach 1912, 1916, Chandler 1916). By 1944 brickearth extraction in the area had ceased (Kennard 1944) and no further exposures were available to collectors. A thorough review of the sequence represented at Crayford was published by Kennard (1944), drawing upon both a wealth of previous work and his own earlier observations (see Figure 5.3.3).

The Crayford deposits occupy a bench cut into chalk or Thanet Sand to well below 0 m. O.D. (Bridgland 1994, 249) and are banked against a chalk/Thanet Sand cliff along their western margin. Although descriptions of the sequence vary, three marked divisions have generally been recognised by all workers – between an upper and lower brickearth (including the *Corbicula* bed – see below) and the underlying Crayford Gravel (Kennard 1944). The overall sequence can be summarised as follows (see also Figure 5.3.3);

		Thickness of bed
1.	Trail. Involuted, clay-rich sandy gravel with large flints and Tertiary pebbles	<2.1 m.
2.	Upper Brickearth. Clay-rich and thinly bedded, colluvial in origin.	< 6 m., including Trail
3.	*Corbicula* bed. Sandy, frequent small mammalian and molluscan remains.	0.25 – 1.5 m.
4.	Lower Brickearth. Fine yellow sand with occasional pebble lenses. Fluvial in origin. Frequent mammalian and molluscan remains.	< 9 m.
5.	Crayford Gravel. Coarse fluvial gravel, some fauna.	< 4.5 m.
6.	Chalk/Thanet Sand. Chalk mantled by soliflucted material in places.	

Table 5.3.1 Summary of sequence in Crayford/Erith area.

Recent investigations have only exposed the uppermost, colluvial brickearths present in the Crayford area (Sutcliffe and Kowalski 1976), which is restricted to the westernmost edge of the brickearths (Bull 1942) where the deposits are thickest. Leach (1905) noted the elevated clay content and laminated nature of these deposits, whilst Kennard noted pebble partings in Stoneham's Pit consistent with sediment supply from the cliff side, suggesting a colluvial mode of deposition (Kennard 1944, 129). Few molluscs have been recovered from these sediments, although Kennard (1944) suggests that the presence of *Pisidium* (sp.) might reflect the cessation of deposition and the formation of a small, vegetated pool during a temperate period. Chandler (1914) suggests that fauna was recovered from the Upper Brickearth and that many individual specimens formed the nuclei of "race" nodules, listing the presence mammoth, rhinoceros, deer and horse. However, recent re-examination of the fauna has failed to locate specimens attributable to this bed (Schreve 1997). The entire sequence is overlain by contorted "Trail", profoundly involuted where it overlies the Brickearths, and attesting a return to cold conditions (Chandler 1914; Kennard 1944).

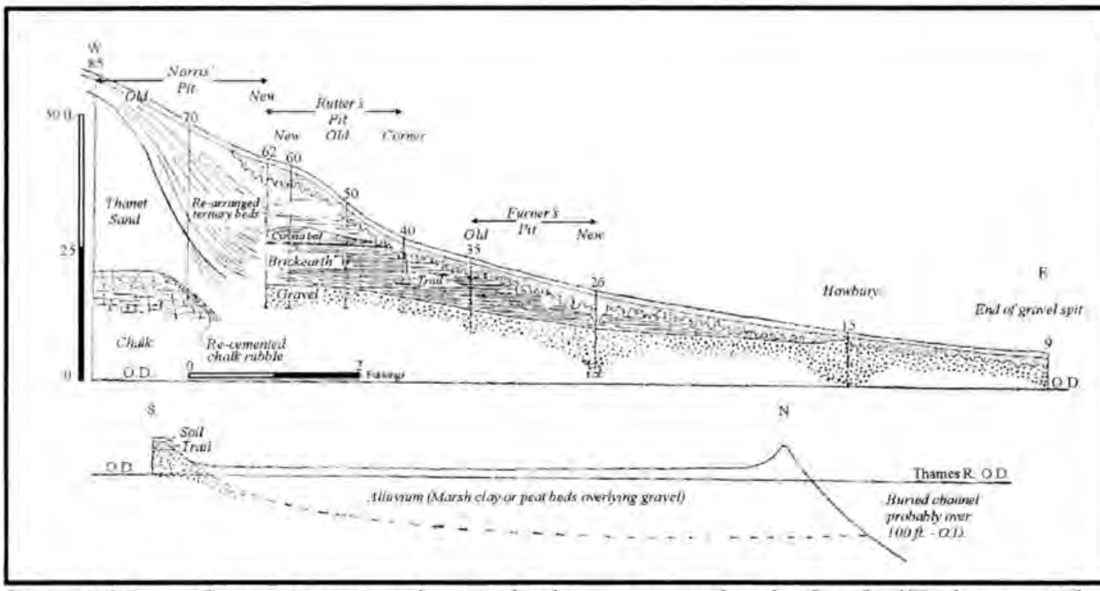

Figure 5.3.3 Composite section showing the deposits exposed in the Crayford/Erith area. (After Chandler 1914, 63, Fig. 33).

The *Corbicula* bed has variously been treated as either part of the Lower Brickearths or a separate deposit, and although variable in thickness does seem to have occurred at a constant depth (c. 10.5 m. O.D.) over a wide area. In Rutter's New West Pit, it is described as a fine yellow sand with pebbles and occasional clay patches, and frequent mollusca and small mammal remains (Chandler 1914, 67). The latter were apparently preferentially recovered from this bed because it was easy to sieve; Bull (1942, 44) suggested that many of the small mammals may in fact merely have burrowed in from higher deposits, following Spurrell's (1880a, 298) suggestion that the "marmots" he recovered from Crayford were found collected together in a nest. However, this suggestion was refuted by Kennard, who pointed out that many small mammal bones from the site were fragmented and rolled (Kennard 1944, 127). The molluscan assemblage consisted predominantly of stream-dwelling species, including *Corbicula* in articulation. Kennard points out that the *Corbicula* from Crayford are large in size, suggesting that this indicates warmer conditions than the present (Kennard 1944, 153).

The Lower Brickearths are fluvially deposited, with frequent sand and occasional pebble lenses. They produced the majority of the large mammalian and archaeological material from the Crayford/Erith area. Molluscs in articulation are present, though less common than in the overlying *Corbicula* bed, and include *Anodonta, Corbicula* and *Psilunio* in articulation

(Kennard 1944, 128). Kennard suggests that the presence of *Psiluno* and *Anodonta* within the Lower Brickearths and their absence from the overlying *Corbicula* bed may relate, on one hand, to their scouring from the stream-bed during the faster flowing conditions under which it was deposited (*Psilunio,* which can live where the bottom is gravelly), and on the other, to the location of particular sections in relation to the channel edge (1944, 128). *Anodonta* and *Psilunio* live close to the river bank and most specimens were recovered from Rutter's New West Pit, close to the cliff, rather than the East Pit, which would have been further from the bank (Kennard 1944). Additionally, Anodons require a firm, muddy bottom (Kennard 1944, 151); their restriction to the Lower Brickearths may therefore reflect the gentle fluvial conditions under which these sediments were deposited. The molluscs as a whole reflect an absence of aquatic vegetation; the land species reflect a dry, open grassland situation, with little evidence for near-by woodland (Kennard 1944).

The majority of the faunal material from Crayford/Erith was recovered from the Lower Brickearths – usually isolated bones, but articulated remains were also recovered on occasion (Kennard 1944, 126). Re-analysis of faunal material from the Crayford/Erith deposits has shown that it is in fact difficult to relate particular remains to different beds, but most are assumed to have come from the Lower Brickearths (Schreve 1997). The fauna as a whole reflects open grassland conditions; ground squirrel (*Citellus citellus*) is common, and the large mammals include *Equus ferus, Stephanorhinus hemitoechus* and *Coelodonta antiquitatis* (Schreve 1997). The apparent co-occurrence of cold and warm climate species at Crayford has been interpreted as supporting an OIS 6 date (Currant 1986, 51) – notably the presence of lemming (*Lemmus lemmus*) and Musk sheep (*Ovibos moschatus* – from the same gravel band within the Lower Brickearths as the flake collected by the Reverend Fisher; Dawkins 1872, Fisher 1872). However, the presence of large *Corbicula* and *Psilunio* within the same deposits might militate against this, as such specimens were clearly not at the limit of their environmental tolerance (Kennard 1944).

The basal Crayford Gravel overlies a bench cut locally into the chalk or Thanet Sand to a depth in excess of 0 m. O.D., and comprises a coarse sandy gravel, containing some derived artefacts (Spurrell 1880b) and mammalian fossils, also regarded as derived (Kennard 1994). However, Schreve (1997) suggests that there is no reason to suppose that any of the fauna from the gravels has been incorporated from elsewhere. The coarse nature of the gravel suggests fast-flowing fluvial deposition; all published description of the area describe it continuing east of the Crayford Brickearths, where it is mapped as floodplain gravel (Chandler 1914, Kennard 1944, Bridgland 1994). Bridgland (1994) suggests correlation of the entire Crayford interglacial sequence with the Mucking formation of the Lower Thames, on the basis of altitude, indicative of an OIS 8-7-6 date. This attribution is supported by an amino acid ratio of 0.170 ± on *Bythinia tentaculata* from the *Corbicula* bed (Bowen *et* al. 1989). Bridgland remained circumspect as to where the OIS 8-7 transition might be represented within the Crayford deposits, in response to the apparently cold-adapted fauna, suggesting that the fluvial deposits from below the *Corbicula* bed (Lower Brickearths and Crayford Gravel) could be referable to OIS 8 (Bridgland 1994, 250).

Schreve (1997) suggests that the combined fauna from the Crayford/Erith deposits, including the basal Crayford gravels, may in fact date to the later part of OIS 7. The gravels themselves contain a fauna almost identical to that from the upper sequence at Aveley, correlated with OIS 7a, whilst the overlying Lower Brickearths and the *Corbicula* bed are argued to present fauna reflective of an increasingly continental climate. Notably, a large form of northern vole (*Microtus oeconomus*) is present; large numbers were recovered from the *Corbicula* bed in particular. *Microtus* shows a progressive increase in size throughout the Middle Pleistocene, peaking in OIS 6 (*ibid*, 429); Schreve suggests that the Crayford *Microtus* are smaller than those from most sites dated to OIS 6, but larger than those from the Lower Channel at Marsworth (*ibid*, 430), suggesting that Crayford might be slightly later in date. The apparent co-occurrence of warm and cold fauna might therefore be explicable in terms of the deposits as a whole dating to terminal OIS 7 (Schreve 1997). However, given the difficulties in assigning particular fossils to particular points in the sequence, some degree of mixing between units cannot be ruled out.

Summary

- *Geographical situation*

  Spurrell's material was recovered from the banks of a slow-moving stream adjacent to an eroding chalk cliff. A line of flint nodules exposed in the cliff was exploited as a raw material source, whilst the eroded cliff itself would have provided access between the river bank and cliff top above.

- *Climate and environment*

  The substantial molluscan assemblage from the Lower Brickearth reflects fully temperate conditions, and militates against a continental climate, since the large *Corbicula* present are argued to reflect both warm summers and mild winters. The river itself was slow-moving at this time, with a firm muddy bottom, and lacked vegetation, whilst land snails swept in from the surrounding landscape reflect an open environment lacking trees (Kennard 1944). The open nature of the environment is also reflected by the fauna from the sequence (Schreve 1997), the majority of which probably comes from the Lower Brickearths.

- *Dating*

  The Crayford deposits have been correlated with the Mucking formation of the Lower Thames, on the basis of altitude, suggesting an OIS 8-7-6 date for the deposits (Bridgland 1994). This correlation is supported by amino acid ratios (Bowen *et al.* 1989), as well as mammalian and molluscan biostratigraphy. The similarity of faunal material from the gravels with the upper sequence at Aveley is interpreted as suggesting a late OIS 7 date for this deposit, whilst the size of northern voles (predominantly recovered from the *Corbicula* bed, overlying the Lower Brickearth) are suggested to indicate a terminal OIS 7 attribution for these deposits. The presence of *Corbicula* militates against a post-OIS 7 attribution for the interglacial sediments. A late OIS 7 attribution is therefore favoured here for the Lower Brickearths at Crayford and the *in situ* archaeological assemblage recovered from them by Spurrell.

Analysis of the Assemblage

Treatment and selection of collections

Although a variety of Levallois products have been recovered from a several points throughout the Crayford/Erith sequence, that recovered by Spurrell from Stoneham's Pit (1880a, 1880b) represents the most complete and contextually secure collection. Although Chandler collected his artefacts from what he viewed as an extension of Spurrell's floor (Chandler 1916), some ½ mile to the north and at a similar level above O.D. (within the Lower Brickearth and below the *Corbicula* bed), this location is not as easily characterised as Spurrell's. However, it does reflect further activity in the area during the aggradation of the Lower Brickearths. Given the *in situ* nature and completeness of Spurrell's material, as well as the extent to which the location it was recovered from can be reconstructed, this collection was concentrated on here. Although the majority of the material collected by Spurrell was donated to the Natural History Museum, small collections are spread throughout a variety of museums in Britain; the largest collection from BM(NH) is concentrated on here, in addition to a refitting sequence previously described by Cook ("L") which is currently stored at the British Museum, but which forms part of the BM(NH) Spurrell collection.

The Spurrell collection was mislaid for over 18 months during the period when data was being collected for this study, following the re-organisation of the Palaeontology stores at the

Natural History Museum. It was re-located at the end of August 2005 and was recorded soon after this point. However, time constraints and the current state of the material precluded the detailed study necessary to fully describe the technological approach undertaken at Stoneham's Pit. The material wholly refitted by Spurrell has been unglued and refitted again (Cook 1986); no documentation of this process is available. Many of the refitted sequences are incomplete, although they were previously completely refitted by Spurrell, and are currently split between several boxes and cannot be mixed. Several sequences are sometimes stored within one box, frequently poorly packed, and labels have become confused, meaning that it is sometimes difficult to work out which sequences have been referred to in previous published work (Cook 1986, Révillion 1995). The fact that all sequences are refitted to some degree means that it is sometimes difficult to interpret phases of flaking sealed within the blocks. It was therefore impossible either to apply the methodology adopted throughout this study, or to examine the refitting material in any detail (*cf.* Van Peer 1992).

A narrative approach has therefore been adopted here; the refitting sequences are described in terms of which parts of the reduction sequence are represented, what function the actions undertaken represent in terms of overall approach to core reduction, what parts are missing and what this might mean in behavioural terms. The Levallois/non-Levallois nature of the material has been explicitly examined, in the light of existing statements about the technological nature of the material (*cf.* Cook 1986, Révillion 1995). The material from Stoneham's Pit clearly requires more detailed future study; however, this preliminary examination both allows statements to be made concerning the nature of hominin behaviour at Stoneham's Pit and a re-examination of previous interpretations to be undertaken.

Analysis

The available sample comprises a minimum of 120 artefacts forming part of 19 refitting sequences, of which at least 2 (13 – ?Kundry and 17 – ?Tristan) represent a single sequence split between more than one box. At least 7 cores and 113 flakes could be distinguished. The following table (Table 5.3.2) presents the minimum number of artefacts from each sequence and the possible name given to them by Jill Cook; where this is unclear, it is indicated by a question mark. A further box of lithic material from the Crayford area was also present, but unlabelled, and the material was in varied condition. These artefacts have not been included in the current sample. Cook states that the entire assemblage comprises over 500 flakes and 10 cores (Cook 1986, 16); it is not clear whether she is referring to the material which she herself examined (implying that much has been lost recently, given the totals below), or whether this figure represents an estimate of all material from the

Crayford/Erith area held in British Museums. Spurrell does not give figures for the material he recovered from Stoneham's Pit.

Sequence number	Cook's description	Minimum number of cores	Minimum number of flakes	Minimum number of artefacts
1	*?L*	3	13	16
2	*Parsifal*	0	2	2
3	*?*	0	3	3
4	*?*	0	6	6
5	*?*	0	33	33
6	*Q*	0	2	2
7	*Ortlinde*	0	2	2
8	*Hagen*	1	2	3
9	*Erda*	1	1	2
10	*David*	1	6	7
11	*? Fricka*	0	9	9
12	*? Nothung*	0	2	2
13	*Kundry*	1	6	7
14	*Alberich*	0	4	4
15	*Isolde*	0	2	2
16	*? Gurnemanz*	0	9	9
17	*? Beckmesser*	0	5	5
18	*? Carmen*	0	6	6
19	*? Tristan*	0	?	0
Artefact total		7	113	120

Table 5.3.2 Minimum numbers of artefacts (present) making up the refitting sequences examined from Stoneham's Pit, Crayford (Spurrell collection).

Taphonomy

The material as a whole is in mint condition and unpatinated; some artefacts exhibit a minimal degree of edge damage, which, given the current state of storage, is probably recent. Much of the material refits, indicating that the assemblage was in primary context and *in situ.* Although Spurrell did not illustrate the scatters he apparently observed, the refitting sequences do support the suggestion that individual scatters were represented. The gentle sedimentation which sealed the artefacts – to the extent that artefacts within the layer of flint lay directly on top of each other and were not separated by sediment – suggests that they had not been swept into piles along the river bank by gentle wave action, but were covered where they fell.

Although smaller material was not represented amongst the refitting clusters examined – presumably due to the difficulty of refitting such material - Spurrell also recovered "most minute splinters" from Stoneham's Pit, and states that he actually preserved the spatial relationship between some of these by treating the chips and the sediment upon which they lay with "gumwater" (Spurrell 1880a, 296). Again, the presence of such small material is indicative that the assemblage has been minimally winnowed, if at all. However, because of the partial refitting of the assemblage, it is currently impossible to assess the size distribution of the material and to what extent this represents a full knapping sequence. Spurrell's material from Stoneham's Pit can therefore be regarded as an *in situ* knapping horizon. Given the position of the horizon in relation to the available band of flint in the chalk cliff, which suggests that this source was directly exploited by hominins (see Figure 5.3.2), the assemblage therefore allows the specific technological acts undertaken in this locale to be investigated.

Technology

Raw material

All the refitting sequences that retain cortex (17) reflect the use of flint freshly eroded from the chalk, supporting the assertion that hominins were probably exploiting the immediately proximal flint band exposed in the chalk cliff. Nodule form cannot be determined for most refitting sequences, as these only reflect the partial working of large cores of indeterminate shape (8), but broad/amorphous (2) and cylindrical (3) nodules were also used, in addition to individual examples of spherical, oval and lenticular nodules (see Table 5.3.3), most of which are large in size. This probably reflects the natural variety of available nodule forms.

Sequence number	Raw material	Blank form	Total % cortex
1	Fresh	Cylindrical	40%
2	-	Indeterminate	-
3	Fresh	Indeterminate	40%
4	Fresh	Lenticular	50%
5	Fresh	Cylindrical	30%
6	Fresh	Broad/amorphous	30%
7	-	Indeterminate	-
8	Fresh	Broad/amorphous	30%
9	Fresh	Indeterminate	10%
10	Fresh	Cylindrical	30%
11	Fresh	Broad/amorphous	30%
12	Fresh	Indeterminate	30%
13	Fresh	Spherical	30%
14	Fresh	Indeterminate	20%
15	Fresh	Indeterminate	30%
16	Fresh	Oval	20%
17	Fresh	Indeterminate	45%
18	Fresh	Oval	40%
19	Fresh	Oval	? >80%

Table 5.3.3 Raw material source, inferred blank form and cortex retention as a percentage of total surface area (ie. all surfaces) for refitting sequences from Stoneham's Pit.

Significantly, those cores on cylindrical nodules present the most complete knapping sequences (see below), potentially reflecting the fact that these imposed the greatest constraints upon the reduction trajectory adopted and could not be extensively reduced. In contrast, sequences for which nodule form cannot be determined predominantly result only from the initial working (decortication) of part of a large or very large nodule, or those representing the Levallois reduction of a core from which cortex had already been removed. This may reflect the fact that cores "dressed" at the site may have been further reduced elsewhere, but it is worth bearing in mind that large cortical flakes are more easily refitted than those produced later in the reduction sequence. As noted by Cook (1986), much of the material exhibits coarse inclusions and thermal fracture was relatively common. Since the adjacent cliff is heavily eroded and overlain a chalky solifluction deposit, the natural processes responsible for the erosion of the chalk may also have affected the available flint, flaws resulting from clast-collision as nodules fell from the cliff, and thermal fracture resulting from frost-action.

Levallois reduction

Seven of the extant refitting sequences do reflect the use of the Levallois flaking to produce predetermined elongated products; a further sequence (8 – "Hagen") could be viewed as a preparatory, as the refitting flakes would have served to create a core surface with the volumetric convexities necessary for Levallois exploitation. However, as the subsequent core is missing, it is impossible to definitely describe this sequence as relating to Levallois core preparation. Refitting sequences which reflect Levallois flaking (*sensu* Boëda 1986, 1995) are described below.

- ***Bipolar recurrent Levallois; Sequence 1; "L"***
- *Actions/events*

  Decortication; unipolar preparation (lowering lateral convexities); bipolar preparation (continued lowering of the lateral convexities following the shattering of the nodule); bipolar recurrent exploitation (Levallois); core discard.

Sequence 1 comprises a minimum of 16 artefacts (13 flakes and 3 cores; according to Cook (1986, 17), 4 cores are present) reflecting the working of an elongated cylindrical nodule c. 75 mm. in diameter and a minimum of 220.1 mm. long (Figure 5.3.4). Laminar cortical flakes were initially removed from one end of the nodule, the platform being adjusted several times; specifically, following the initial decortication sequence, a single blow was struck across the platform towards the productive face. After the platform had been prepared in this way, a single, large, relatively broad flake (missing from the refitting sequence) was removed. Flaking continued from this platform, which was carefully rejuvenated at various points, giving the refitted cluster a "stepped" profile; a series of laminar products was produced, many of which have cortical edges.

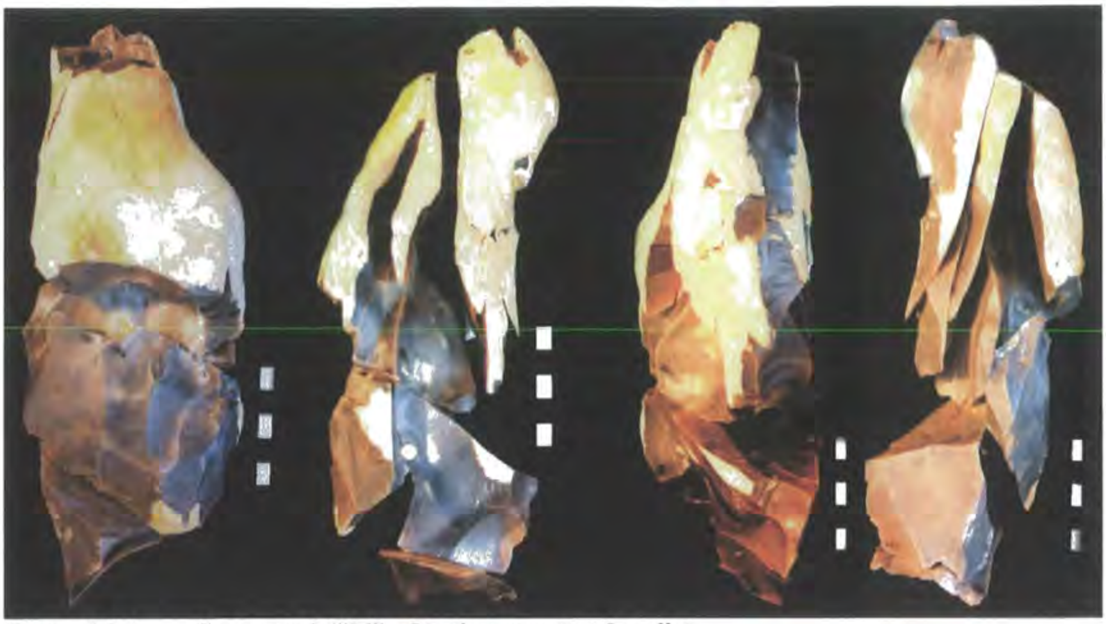

Figure 5.3.4 Sequence I ("L"). Bipolar recurrent Levallois.

The nodule then shattered around a coarse inclusion; this presented a platform naturally opposed to that concentrated on previously and a bipolar reductive strategy was adopted. The products of this sequence are again laminar in nature, frequently with cortical backs, reflecting the restricted volume of the cylindrical nodule. This flaking strategy served to alter the productive face from a cylindrical form – where the productive face extended around the sides of the nodule – to a flatter productive face. Notably, broader flakes frequently proved difficult to remove – especially earlier in the flaking sequence – resulting in hinge fractures at their distal end. At this point, the lateral convexities of the cylindrical flaking surface were too pronounced to allow the removal of broad products that were not too thick for easy detachment. Later, as the lateral convexities were lowered, they became easier to remove; many of these broader products are missing from the refitting sequence – particularly those which immediately preceded the abandonment of flaking and discard of the core resulting from this sequence. The core itself conforms fully to the volumetric conception of Levallois (Boëda 1896, 1995), and the final flake removed from its surface is missing. The remaining core fragments were expediently worked to produce several non-Levallois flakes.

This nodule is the mostly completely worked of the available sample; notably, those flakes which are missing from the sequence (as far as can be determined) are broader than those which can be refitted, perhaps suggesting that these – rather than the laminar removals – may have been intended endproducts. The laminar products which make up the majority of the cluster are viewed as primarily preparatory, serving to create an exploitable Levallois surface rather than productive flaking being continued around the core circumference. The reduction strategy adopted was not conceived from the beginning of reduction, but was flexible in response to the evolving form of the core (platform adjustment, lowering of convexities) and unforeseen accidents (shattering).

Although the "function" of particular flaking episodes are delimited here for analytic purposes, there are no clear-cut divisions between these various stages in terms of the gestures used to accomplish them. The techniques adopted to prepare the surface using laminar removals are as careful and controlled as those used to produce the broader, missing flakes. Preparation is here delimited as working prior to the point when it was possible to detach a broader product; the majority of the material forming this sequence is therefore preparatory, as most of the broader flakes are not present. The complete reduction of this nodule seems to be occasioned by its cylindrical form, which did not allow a Levallois surface to be easily established without product miniaturisation – particularly given the flaws apparent in the material.

- ***Unipolar recurrent Levallois; Sequence 5; ?"G"***
- *Actions/events*

  Partial decortication/unipolar preparation (lowering lateral convexities); platform preparation; convergent unipolar recurrent exploitation (Levallois). Core missing.

Figure 5.3.5 Sequence 5 ("G"). Unipolar recurrent Levallois.

Sequence 5 is a series of 33 refitting flakes removed from a single platform, and was illustrated by Spurrell (1880b, Plate II, 2). The sequence as a whole retains 30% cortex (60% of dorsal surface) and reflects the partial decortication of one area of a large, cylindrical flint nodule (estimated diameter minimum 10 cm., minimum length 153 mm), followed by a second phase of working from the same platform (Figure 5.3.5). The initial phase of working comprises a short sequence of elongated, volumetrically consumptive, partly cortical flakes from an unprepared platform, extending to just below a marked protuberance on the dorsal surface, which serves both to remove cortex and reduce the angle of the lateral convexities of the cylindrical nodule. Once the core surface had been configured, the platform was adjusted using a single tangential removal, and a second sequence of more carefully controlled laminar products was removed from the core surface. Many have facetted or *chapeau de gendarme* butts, reflecting the careful control exerted during this phase of flaking. The removals which comprise this second phase of reduction are slightly convergent, and function in both a predetermined and predetermining manner, preserving the convexities of the surface as they were removed. This surface was volumetrically Levallois in its arrangement, and judging by the inferred size of the core which would have produced this sequence, could have been reduced further. However, the core itself is not present, perhaps suggesting that it was transported away from the cliff.

Very few products (c. 2) are actually missing from this refitting sequence, but, again, those that are missing can be inferred to be larger and broader than those which are present. This might reflect the fact that these products possessed the perceived functional properties desired by hominins, and that they were transported from the site for use elsewhere. The sequence as a whole reflects convergent unipolar recurrent exploitation of a Levallois surface following unipolar preparation. There is a notable contrast between the methods used to control the detachment of the initial series of preparatory flakes and the careful control exerted throughout the second series (platform adjustment in relation to lowered surface convexities, individual butt facetting).

The fact that so few of these products were missing from the site is intriguing given the care with which reduction was carried out, each removal of the second series functioning in a predetermined and predetermining fashion in a manner which seems, to certain degree, productively redundant. If the many laminar products (at least 33, including the initial preparatory sequence) rarely possessed the qualities desired, then it is hard to understand why hominins did not adopt different preparatory strategies that would control the detachment of flakes of different form. It is possible that many may have been used within the site; no spatial patterning can be inferred, the edges of the artefacts cannot be examined as the cluster is refitted (although no retouched artefacts are present; Cook 1986), and use-wear analyses, even if possible, are unlikely to be productive given the curation history of the assemblage. However, the strategy adopted is not merely the result of the cylindrical raw material used; following the initial preparatory phase, the Levallois surface could have been prepared centripetally, allowing a broad flake to be detached. It is tempting to speculate that the actual act of careful, controlled flintworking may, in this instance, have been deliberately prolonged. This could either represent a "dead-time" activity, undertaken by an individual by way of practice, or it might perhaps have been some sort of demonstration of individual skill in a group situation. Clearly, such speculation is difficult to sustain, but these do represent possibilities suggested by the extended, apparently productively redundant, working of this nodule.

- ***Probable unipolar recurrent Levallois; Sequence 7; "Ortlinde"***
- *Actions/events*

  Unipolar preparation; Single Levallois removal from same platform.

Figure 5.3.6 Sequence 7 ("Ortlinde"). Probable unipolar recurrent Levallois flake production.

This sequence comprises only two flakes; the proximal end of an elongated Levallois flake with a complex unipolar scar pattern (length 49.3 mm; width 31.5 mm.), to which refits a preparatory removal from the same platform (Figure 5.3.6). The predetermining flake scars attest to unipolar recurrent preparation; these may or may not have been solely preparatory, and it is likely that this flake formed part of a recurrent unipolar Levallois sequence.

- ***Unipolar convergent hard hammer flaking - probable preparation of Levallois surface; Sequence 8; "Hagen"***
- *Actions/events*

  Partial decortication/unipolar convergent preparation (extension of flaking surface); Core missing.

The broad nodule used for producing these 8 flakes was already partially decorticated when this sequence began and retained 30% cortex, predominantly within a hollow on the dorsal surface (Figure 5.3.7). The left edge of the block was a natural fracture surface; these flakes represent a convergent unipolar sequence which was first directed towards removing the remaining cortex, and then towards modifying the angle between the flaking surface and the natural fracture surface along the left edge. By removing a flake along the junction between the two surfaces, the flaking surface is extended and an exploitable lateral convexity created.

Figure 5.3.7 Sequence 8 ("Hagen"). Unipolar convergent preparation, probably of Levallois surface.

Révillion (1995) views this sequence as illustrating that the technological approach adopted at Crayford is non-Levallois and follows from the form of the nodule. However, the removal along the junction between the fracture surface and core surface actually changes the organisation of the surface as a whole; the flaking surface created by this series of removals would have possessed the lateral convexities necessary for Levallois flaking. The nature of the distal core surface convexity cannot be inferred, and whilst convergent, this particular refitting sequence could form part of a centripetal preparatory phase. It cannot be definitively stated whether this sequence did form part of a Levallois reduction strategy; however, these flakes did impose the lateral convexities necessary to establish a Levallois flaking surface. In the light of the rest of the assemblage, they are here interpreted as reflecting a unipolar convergent preparatory phase within a Levallois core reduction sequence. Regardless of the nature of the core working that followed, the core itself is not present and could arguably have been transported for use elsewhere following initial preparation adjacent to the chalk cliff.

- ***Bipolar recurrent Levallois; Sequence 9; "Erda"***
- *Actions/events*

  Final centripetal repreparation and bipolar recurrent exploitation of Levallois core; core discard.

Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
121.6	82.8	50.8	0.680921	0.613527

Table 5.3.4 Dimensions of Bipolar recurrent Levallois core from Sequence 9; "Erda".

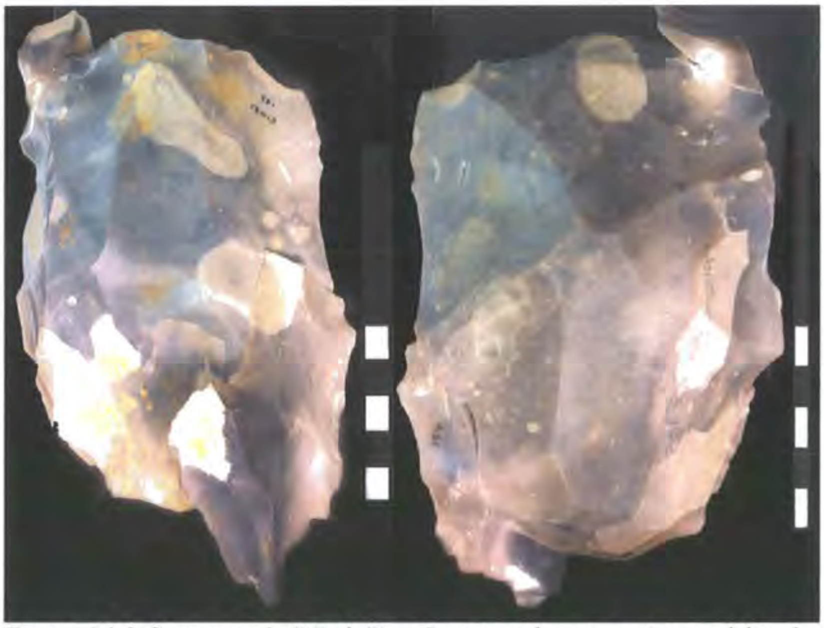

Figure 5.3.8 Sequence 9 ("Erda"). Centripetal preparation and bipolar recurrent exploitation of Levallois core.

This "sequence" comprises two flakes which refit to one of the only extant Levallois cores from the site; the core itself retains 9 scars on its flaking surface, three of which are Levallois removals resulting from bipolar recurrent exploitation (Figure 5.3.8). This core may represent the "Hâche" illustrated by Spurrell as refitting within his large, near completely refitted nodule (Spurrell 1880a, 294; plate 1; see Figure 5.3.9). However, the state in which the material is currently stored precluded checking whether this was in fact the case. The striking platform surface has been shaped all around using a series of 13 bold removals from all directions. The lateral core edges have been deliberately accentuated; one refitting flake was struck from the striking platform surface near to the distal end and serves to increase this convexity. Two small removals from the right edge near the proximal end are very flat and do not serve to reduce the angle between the striking and flaking surfaces, which is very steep in this area; they might either reflect a failed attempt to finally reconfigure the flaking surface, as they succeed the final Levallois removal, or merely a final attempt to exploit this core in some way. The other flake, which refits to the flaking surface and preceded the exploitation phase, was struck from the right, indicating that a centripetal preparatory method was used. The scar pattern retained by this flake is complex and multidirectional, again reflecting centripetal preparation.

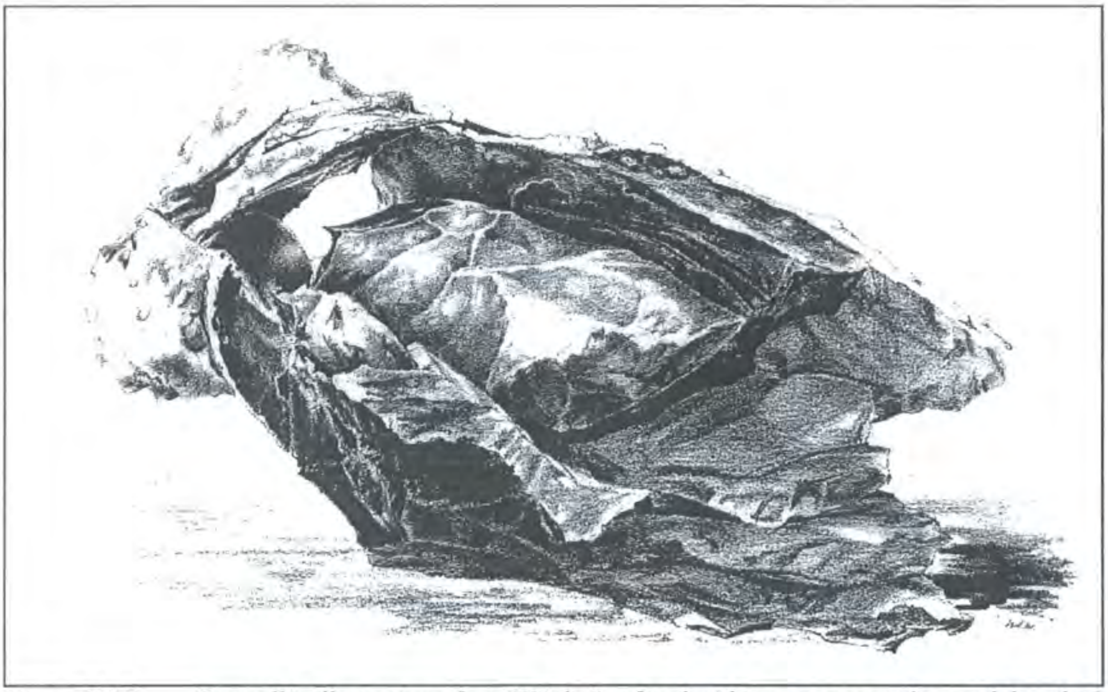

Figure 5.3.9 Spurrell's illustration of an "Hâche" refitted within a near-complete nodule, which might be a Levallois core (Sequence 9, "Erda"). (Spurrell 1880a, 294; Plate 1).

- ***Bipolar recurrent Levallois; Sequence 10; "David"***
- *Actions/events*

  Partial decortication; Bipolar preparation; platform adjustment; bipolar recurrent exploitation; unipolar preparation; platform adjustment; unipolar recurrent exploitation (Levallois), core discard.

Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
74.2	61.9	31.6	0.83423181	0.510500808

Table 5.3.5 Dimensions of Bipolar recurrent Levallois core from Sequence 10; "David".

Sequence 10 (Figure 5.3.10) comprises a minimum of 7 refitting artefacts, including a Levallois core and a minimum of 6 flakes, and reflects the partial decortication and working of a section of cylindrical nodule (approximate diameter 85 mm., minimum length 115.5 mm). The discarded Levallois core is very small in size (see Table 5.3.5) but fully conforms to the volumetric conception of Levallois. The sequence was partially decorticated before this phase of reduction began, but retained 30% fresh cortex, which defined the cylindrical form of the selected block. The first two removals are opposed and consume the decorticated surface, acting to reduce the upper volume of the cylindrical nodule as well as removing cortex; these were followed by two flatter removals from the distal end (in relation to the orientation of the discarded core), one of which also removed further cortex from the right edge. This striking platform was then adjusted using a single alternate removal, and a single large, flat flake removed from the surface so established; this is missing from the refitted sequence, but was at least 111.8 mm. long. A further large, flat flake was then struck from the opposite platform; this is also not present. These opposed removals left a steeply angled arête in the centre of the flaking surface, which was exploited and removed using a sequence of narrow laminar removals, all of which are present, resulting in the recreation of the reduced lateral convexities exploited previously, as well as removing further cortex from the right edge of the core. The same platform was again adjusted using a single alternate removal; the attempt was then made to strike a single large flake from the re-established Levallois surface. This hinged but is present; however, the broad flake which was struck from the same platform immediately afterwards is missing. The core itself was then discarded.

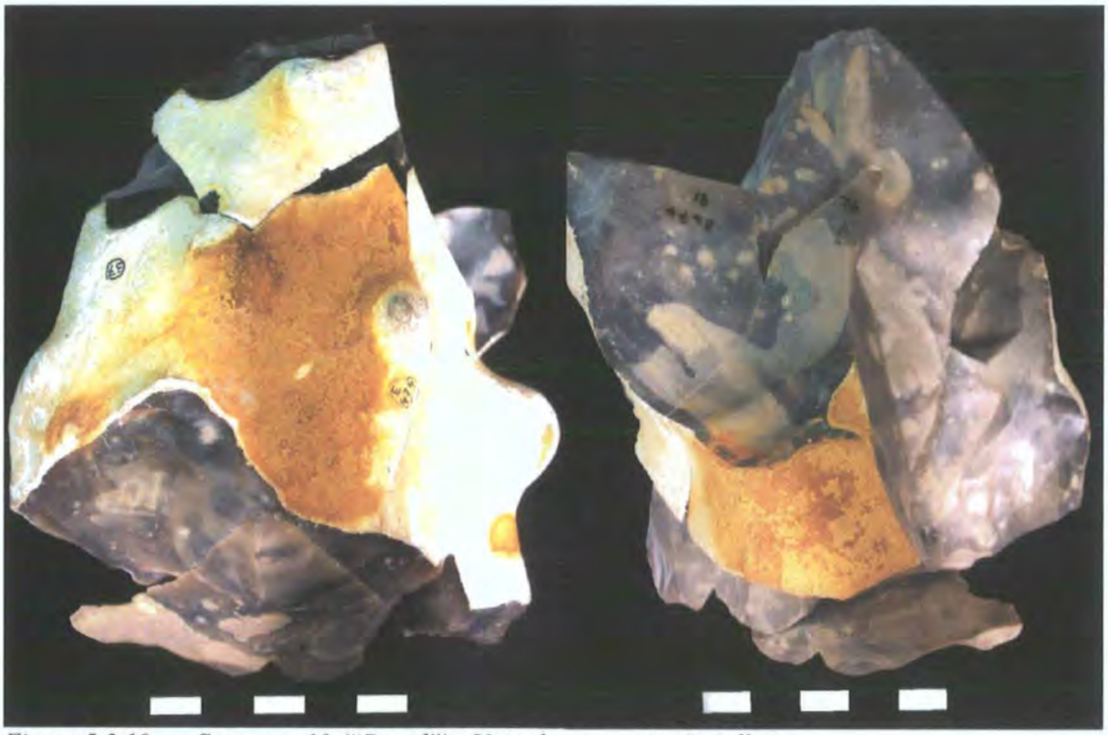

Figure 5.3.10 Sequence 10 ("David"). Unipolar recurrent Levallois.

Given that flatter, broader flakes are again missing from this refitting sequence, it does seem possible that they were a desired endproduct, selected from amongst the products of core reduction and carried elsewhere by the individual who produced them. Initial working seems to have been directed towards reducing the volume of the cylindrical nodule to allow flaking from a Levallois surface; deliberate platform adjustment precedes the attempt to produce broad flat flakes, which are missing. The necessary distal and lateral convexities are then recreated, and further platform adjustment again precedes the removal of broad, flat flakes from a surface. This core reflects two cycles of surface preparation and exploitation (initially bipolar, then unipolar), again reflecting the fact that analytically-defined techniques were shifted between throughout reduction, in response to the initial and evolving form of the core. As with sequence 1, the complete reduction of this nodule seems to be occasioned by its cylindrical form; given that just under half the upper core volume had to be removed before the flaking surface was established, only two cycles of rejuvenation and exploitation were possible without the resulting products becoming extremely small.

- ***Unipolar recurrent Levallois; Sequence 14; "Alberich"***
- *Actions/events*

  Unipolar convergent preparation; unipolar recurrent exploitation (Levallois).

Figure 5.3.11 Sequence 14 ("Alberich"). Unipolar recurrent Levallois.

This sequence retains only 20% dorsal cortex and consists of four flakes removed from the same platform (Figure 5.3.11); the first is volumetrically consumptive and retains a thick cortical margin; the subsequent three flakes are flat and were struck from a surface with the lateral and distal convexities necessary for Levallois flake removal. Two are fairly elongated, whilst the final flake is short; one has a facetted platform. These are regarded as

Levallois flakes produced using a unipolar recurrent technique; the arrangement of scars formed by the initial volumetrically-consumptive removal and the flakes themselves reflects unipolar convergent preparation. The core is not present.

- ***Unipolar recurrent Levallois; Sequence 16; "Gurnemanz"***
- *Actions/events*

Partial decortication; unipolar convergent preparation; unipolar recurrent exploitation (Levallois).

This sequence reflects the partial decortication and working of a broad flint nodule; although some cortex had been removed before this phase of flaking began (20% cortex), the selected block also retained naturally fractured surfaces (c. 10% cortex). The sequence comprises 9 refitting flakes, the first two of which were removed along the pronounced junction between these natural surfaces and flake scars reflecting decortication from the left; these initial flakes are fairly prismatic and remove much of the remaining cortex, as well as the projection from the core surface. Flaking then shifted to just right of this platform, producing broader, flatter and more irregular flakes, removing the last of the cortex and resulting in a convergent scar pattern. Flaking then shifts back to the same position as the initial prismatic preparatory blows and a sequence of four laminar Levallois products was removed, including a broad debordant flake (the last in this sequence). Although these flakes are elongated, they reflect the flaking of a surface rather than the prismatic volume utilised in blade production (*cf.* Boëda 1995), and are therefore regarded as Levallois flakes produced using a unipolar recurrent technique. The core is not present

Non-Levallois reduction

The following 11 refitting groups cannot be described as representing Levallois reduction sequences; all but one (sequence 2, "Parsifal") reflect only the initial decortication of flint nodules obtained from the chalk cliff. The dressed cores may subsequently have been transported away from the site and worked elsewhere, or they may actually form part of the earlier working of other nodules from the site, but there is no way of inferring whether or not a Levallois reduction strategy was pursued.

- ***Bipolar hard hammer flaking; Sequence 2; "Parsifal"***
- *Actions/events*

  Bipolar hard-hammer flaking.

Figure 5.3.12 Sequence 2 ("Parsifal"). Non-Levallois bipolar hard hammer flaking.

Two refitting non-Levallois flakes removed from the dominant platform of a predominantly bipolar flaking episode of at least 7 removals (Figure 5.3.12).

- ***Decortication; Sequence 3; ?***
- *Actions/events*

  Decortication; parallel flaking

Figure 5.3.13 Sequence 3. Decortication; parallel flaking.

Three refitting flakes; first flake removes a cortical lump, and is followed by a further two flakes from the same platform (Figure 5.3.13).

- ***Decortication; Sequence 4; ?***
- *Actions/events*

  Decortication; bipolar flaking

Figure 5.3.14 Sequence 4. Decortication; parallel flaking.

This sequence of 6 refitting flakes reflects the removal of very thick cortex from the edge of a lenticular nodule (Figure 5.3.14). The first 4 removals work along the prominent edge – the first removal is completely cortical, whilst the subsequent three retain cortex at their dorsal ends – then the core was rotated through 90° and two flakes with cortical ends and margins removed.

- ***Decortication; Sequence 6; "Q"***
- *Actions/events*

  Decortication; parallel flaking

Figure 5.3.15 Sequence 6 ("Q"). Decortication; parallel flaking

Two flakes (one wholly and one partially cortical) struck from same platform (Figure 5.3.15).

- ***Partial decortication; Sequence 11; ? "Fricka"***
- *Actions/events*

  Partial decortication; hard hammer flaking

Sequence of 9 refitting flakes which define the outer surface of part of a large, broad nodule (c. 30% total cortex); some cortical flakes removed before this sequence commenced (Figure 5.3.16). One platform dominates, but opposed and tangential platforms also used; all flakes are volumetrically consumptive and result in the decortication of this area of the nodule.

Figure 5.3.16 Sequence 11 (? "Fricka"). Partial decortication; hard hammer flaking.

- ***Partial decortication; Sequence 12; ? "Nothung"***
- *Actions/events*

  Partial decortication; hard hammer flaking

Figure 5.3.17 Sequence 12 (? "Nothung"). Partial decortication; hard hammer flaking.

Two refitting, partially cortical flakes struck from same platform (Figure 5.3.17).

- ***Partial decortication; hard hammer flaking; Sequence 13; "Kundry"***
- *Actions/events*

  Platform preparation; hard hammer flaking/partial decortication

This sequence proved very difficult to deal with, as it is partially refitted but split between two boxes. It reflects the working of a large, round flint nodule, defined by cortex retained on all but one face. A single non-cortical flake was removed across this surface, which then formed the platform for an extended sequence of parallel flaking; this removed a single cortical flake, followed by a sequence of flakes with cortical margins and cortical bases, as they overshot the flaking face to remove material from the rounded nodule surface below. The core is not present.

- ***Decortication; Sequence 17; ? "Beckmesser"***
- *Actions/events*

  Decortication

Figure 5.3.18 Sequence 17 ("Beckmesser"). Decortication.

Eight refitting hard hammer flakes converging from three directions which removed the cortex from part of the surface of a large core of indeterminate shape. The dorsal face of this refitting sequence is almost completely cortical (Figure 5.3.18).

- ***Partial decortication; Sequence 15; "Isolde"***
- *Actions/events*

  Decortication; difficult to tell what actions followed because of state of sequence.

Two large refitting flakes struck from the same platform, each retaining c.30% dorsal cortex on their distal end (Figure 5.3.19). Comparison of the photographs taken of the sequence with Spurrell's (1880b, 549; Plate XXII) illustration of the near-complete nodule which he refitted showed that it in fact forms part of the same sequence (see Figure 5.3.22)

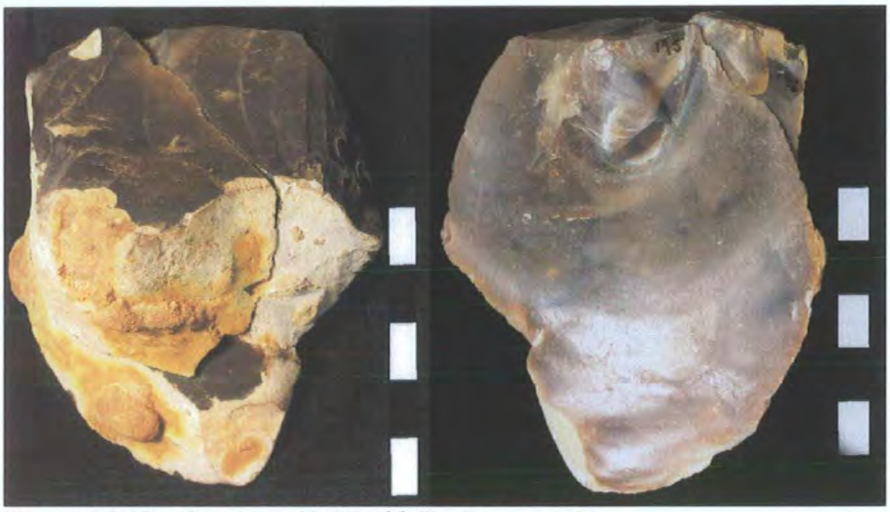

Figure 5.3.19 Sequence 15 ("Isolde"). Decortication.

- ***Decortication; Sequence 18; ? "Carmen"***
- *Actions/events*

  Decortication; difficult to tell what actions followed because of state of sequence.

Figure 5.3.20 Sequence 18 (?"Carmen"). Decortication; hard hammer flaking.

Figure 5.3.21 Sequence 19 ("?Tristan"). 5 of the refitting flake sequences which probably form part of Spurrell's completely refitted nodule. Decortication, other actions difficult to determine.

Six refitting hard hammer flakes converging from slightly opposed platforms which removed the cortex from part of the surface of a large oval nodule (Figure 5.3.20). The dorsal face of this refitting sequence is almost completely cortical. Again, this was shown to actually form part of the near-complete refitted nodule illustrated by Spurrell (1880b, 549; Plate XXII), through examination of the photographs taken of the sequence (see Figure 5.3.22).

- ***Decortication; Sequence 19; ? "Tristan"***
- *Actions/events*

  Decortication; difficult to tell what actions followed because of state of sequence.

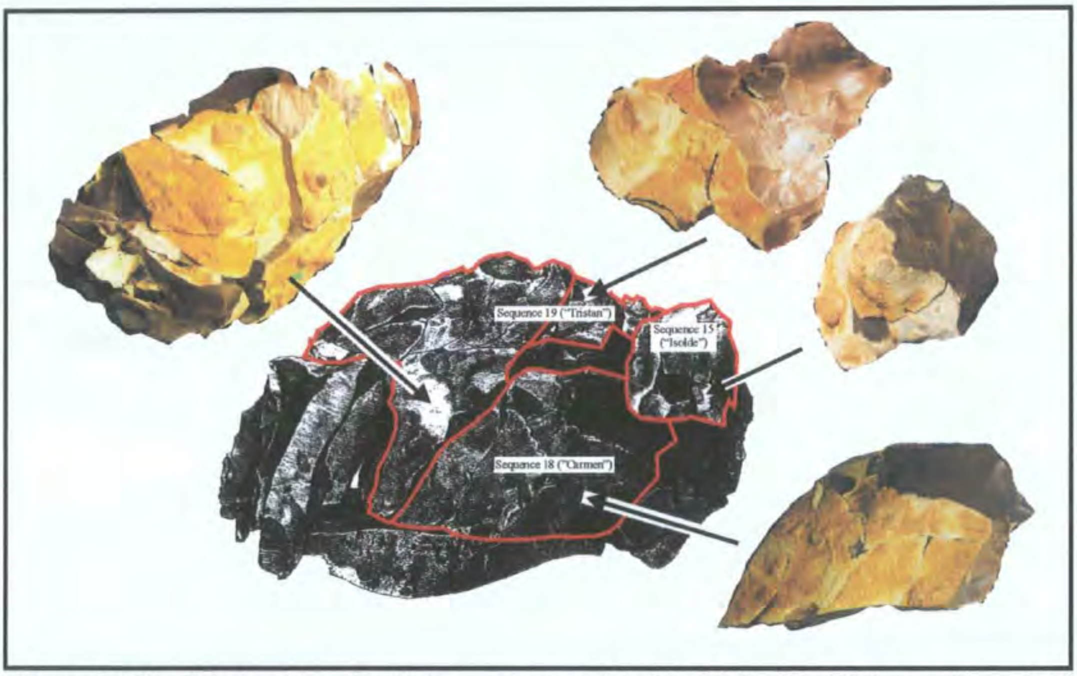

Figure 5.3.22 Relationship of refitting sequences 15 ("Isolde"), 18 (?"Carmen") and 19 ("Tristan") which actually form part of the same refitting sequence illustrated by Spurrell (1880b, 549; Plate XXII).

This sequence was split between three boxes, comprising 5 series of refitting flakes (mostly cortical) and others (Figure 5.3.21). It was therefore very difficult to work with, although the material was identified as part, if not all, of the completely refitted nodule re-assembled by Spurrell (1880b, plate XXII). Comparison of photographs taken of the refitting sequences with this illustration also showed sequences 15 ("Isolde") and 18 (?"Carmen") to form part of the same sequence. Certainly much of the currently refitted material does reflect the decortication of a large, oval nodule. However, Spurrell's illustration gives the impression that the core (described by him as an "Hâche"; Spurrell 1880a) was also present; this could not be located, despite the fact that other researchers suggest that they have seen it, and that it is in fact a core, not a handaxe (Cook 1986). Sequence 9 (Bipolar recurrent Levallois core with refitting flakes) can be inferred to be approximately the right size, but it is not currently possible to check whether this actually is the refitting core. At the very least, this sequence reflects the decortication of a large, oval flint block; Spurrell's drawing suggests that although the core refitted to the decortication flakes, many of the non-cortical flakes which overlay its surface are not present. This might suggest that many of the products from its surface had been transported for use elsewhere; however, this cannot currently be confirmed.

Technology and hominin behaviour at Stoneham's Pit, Crayford

The reduction sequences represented at Crayford have been suggested to be non-Levallois in character, and to reflect situational responses to the available raw material (Cook 1986, Révillion 1995). The laminar nature of much of the debitage has been viewed as resulting purely from the cylindrical form of the available nodules; the flaking surfaces of the cores have been interpreted as unprepared, and not deliberately maintained throughout reduction (Révillion 1995). However, both individual Levallois reduction sequences from Crayford and the nature of the refitting assemblage as a whole suggest that this is not the case. Particular sequences reflect both deliberate Levallois surface preparation and exploitation at specific points, whilst, more generally, most of the refitting sequences actually only reflect the process of decortication. Privileging only the most complete sequences from the site in fact presents a somewhat skewed picture; these are actually somewhat unusual in character (sequence 1, and sequence 10), since reduction was constrained by the cylindrical form of these particular nodules. Although clearly only the individual refitting groups currently delimited can provided evidence of immediately contemporaneous technological action, it is actually necessary to consider the assemblage as whole to appreciate the whole suite of technological strategies adopted at Crayford.

There are more indeterminate than Levallois refitting sequences from Stoneham's Pit (8 indeterminate, 7 Levallois and 4 probable Levallois; see Table 5.3.6). However, most of indeterminate sequences reflect only the decortication of particular portions of large nodules – the form of most of which cannot be determined. Since decortication itself cannot be linked to a particular reduction strategy, it is impossible to say whether Levallois preparation and exploitation would have followed if the material resulting from the subsequent phase of flintworking is not present. Further work might show that these sequences refit others from the site; it is also possible that at least some of the cores may have been transported away from the immediate area following decortication. The presence of this material at Stoneham's Pit reflects the fact that fresh flint was immediately available from the eroding chalk cliff, and that initial working was undertaken in the area.

Sequence number	Levallois?	Actions
1	Yes	Decortication; unipolar preparation; core shatters; bipolar preparation; bipolar recurrent exploitation; Non-Levallois flaking
5	Yes	Partial decortication/unipolar preparation; convergent unipolar recurrent exploitation
7	Yes	Unipolar preparation; single Levallois removal
8	Probably	Partial decortication; convergent unipolar preparation
9	Yes	Centripetal preparation; bipolar recurrent exploitation
10	Yes	Partial decortication; bipolar preparation; bipolar recurrent exploitation unipolar preparation; unipolar recurrent exploitation
14	Yes	Convergent unipolar preparation; Unipolar recurrent exploitation
16	Yes	Partial decortication; convergent unipolar preparation; unipolar recurrent exploitation
2	Indeterminate	Bipolar flaking
3	Indeterminate	Decortication
4	Indeterminate	Decortication
6	Indeterminate	Decortication
11	Indeterminate	Decortication
12	Indeterminate	Partial decortication
13	Indeterminate	Partial decortication
15	Probably	Decortication
17	Indeterminate	Decortication
18	Probably	Decortication
19	Probably	Decortication

Table 5.3.6 Summary table showing technological actions reflected by Levallois and non-Levallois refitting sequences from Stoneham's Pit, Crayford. Note that indeterminate sequences almost exclusively reflect decortication, and that 5 of 7 Levallois reduction sequences include a decortication phase.

Only two sequences from Stoneham's Pit - sequence 1 "L" and sequence 10 "David" - attest to relatively complete reduction, from decortication to core discard; both of these are on cylindrical nodules, and their working is constrained by the material selected. Both have been prepared using laminar removals which consume raw material and alter the volume of the flaking surface, changing it from a cylindrical form, where flaking extended around a large portion of the core surface, to an asymmetrical volume in which the flaking surface is separated from the under-surface by a plane of intersection (Boëda's first technological criterion of the volumetric definition of Levallois; 1986, 1994). The adoption of a convergent (sequence 1) or bipolar (sequence 10) preparatory strategy served to impose the necessary distal convexity for successful detachment, the lateral convexities having been established through the reduction of the cylinder volume (Criterion 3). These surfaces are hierarchically related throughout the subsequent exploitation episode and are non-interchangeable - only the upper, flaking surface is exploited (Criterion 2). Flakes are removed parallel to the plane of intersection (Criterion 4) using a hard hammer (Criterion 6); the striking platform and flaking surface intersect at a point perpendicular to the flaking surface (Criterion 5). Following preparation, the exploited surfaces therefore conform fully to the volumetric definition of Levallois (*cf.* Boëda 1986; 1994)

The flaking surfaces are maintained throughout exploitation, recurrent Levallois removals from the surfaces functioning in a predetermined and predetermining manner to recreate the convexities imposed through the reduction of the cylinder volume. Indeed, sequence 10 was deliberately re-prepared after the initial bipolar exploitation phase had altered the convexities of the exploited surface. These cores fully reflect the deliberate implementation and exploitation of Levallois flaking surfaces on cylindrical nodules. The methods of preparation are situational responses to the form of these particular cylindrical nodules, but the entire process of reduction is not dictated by raw material form, as implied by Révillion (1995). Flaking does shift to the exploitation of a surface, rather than a volume; in the case of sequence 10, the shift to exploitation is immediately preceded by deliberate platform preparation, suggesting that in this instance preparation and exploitation can be recognised as conceptually distinct phases, and not simply analytical categories. However, as noted above, these two sequences are the most complete from Stoneham's Pit precisely because of their cylindrical morphology; only one (sequence 1) or two (sequence 10) episodes of exploitation are represented, and the cores themselves were very small when discarded on site. Given that preparation reduced much of the volume of these cores, little was available once the necessary surface configuration had been achieved, and exploitation seems to have been curtailed as a result.

Whilst none of the other refitting Levallois sequences from Stoneham's Pit are as complete as sequences 1 and 10, they do reflect a similar pattern of partial decortication using elongated flakes which alter the volume of the upper flaking surface, frequently from polarised platforms (e.g. sequences 8 and 16) and the preparation of an exploitation surface which conforms fully to the volumetric definition of Levallois. Some reflect the deliberate reduction of upper surface volume (e.g. sequence 5 – also a cylindrical nodule) or the active imposition of Levallois surface convexities. For instance, the removal of a prismatic flake from the junction between the exploited face and natural fracture surface on the left edge of sequence 8 created the left lateral convexity of the underlying surface. Unipolar and bipolar exploitation sequences dominate (sequences 1, 5, 9, 10, 14 and 16), a technique which both maximises production without the need for separate phases of surface repreparation and produces a variety of elongated products. Notably, very few Levallois cores are present amongst the available sample – the exhausted cores which refit within sequences 1 and 10 (where reduction could not be prolonged due to nodule form) and the core to which the flakes of sequence 9 refit. The "missing" cores arguably all had productive potential, judging from the size and configuration of the surfaces which would have underlain the refitting sequences; they may therefore have been transported from the site as sources of future blanks.

Particular sorts of products do appear to be missing from the exploitation phases of the Levallois refitting sequences; as far as can be determined, "missing" flakes were often wider than many of the other products, perhaps suggesting that large, broad blanks were a desired flake form. Such products may have been transported from the site for further modification and use elsewhere; it is also possible that they may have been discarded immediately outside the area from which Spurrell collected, or that they might be present within the un-refitted material from the site. However, the fact that the missing products all tend to be large and broad might indicate that a particular type of product was being selected. Given that such flakes seem to have been "preferred", it is difficult to see why another Levallois method was not adopted which would have predetermined the production of such products –centripetal preparation, for example. Such options were available, since this technique was used in the preparation of the core from refitting sequence 9.

Most refitting sequences from the site reflect polarised decortication and preparation; such preparatory strategies represent the "easiest way in" to an elongated nodule, and although only three sequences can be definitely said to reflect the working of cylindrical nodules, others - whose form cannot be currently determined - may have been of similar shape, and hence required a similar approach. Whilst a centripetal preparatory phase could, of course, follow initial, polarised preparation, polarised exploitation would take advantage of the existing guiding ridges of the core surface, without requiring a conceptually separate, extra preparatory phase that would consume much of the available core volume. Whilst Boëda (1986; 1994) originally formulated the various Levallois reduction schemes as conceptually separate guiding plans of action, most archaeological evidence suggests that hominins actually adopted different methods flexibly throughout core reduction (see Section 4.2 Creffield Road; *cf.* Schlanger 1996). However, the distinct imposition of a new preparatory scheme independent of previous action seems to represent a conceptual leap that is not represented in the archaeological record; reduction trajectories more commonly evolve "in hand", in response to the evolving form and possibilities offered by the core. If such a scenario is accepted for the approaches to flint reduction at Crayford, then the practices undertaken may have evolved in response to the necessary method of decortication. The techniques adopted by hominins were not prescriptive, but responsive and reflexive to changing conditions and possibilities. A switch to centripetal preparation could have represented a conceptual disjunction; in preference, reduction continued in response to previous actions, and particular products were selected from amongst the material thus produced.

Sequence 5 is particularly notable, given the intensity of exploitation and how few products are missing. Following initial decortication and Levallois surface preparation, an extended convergent unipolar recurrent exploitation phase was undertaken, preceded by the deliberate preparation of a platform – again, an action marking a deliberate shift from preparation to exploitation. Exploitation was undertaken in an extremely controlled and technologically adept manner; most butts are individually prepared, either through facetting, or are isolated and facetted, using the *chapeau de gendarme* method. A minimum of two flakes is missing from the sequence; these would again have been larger and broader than most others. This sequence is interpreted here as "functionally redundant"; whilst recurrent laminar reduction is frequently argued to represent an economical approach to blank production, very few products are actually missing from this sequence, arguably having been selected for transport elsewhere. In this instance, the process of reduction may have been privileged over the actual products, perhaps in order to fill time, to practice technical skills, as a deliberate act of display, or a combination of all three possibilities. Were this meticulous and repetitive sequence of actions to be undertaken in the presence of others, it would arguably draw attention to the knapper and their skills, whether this was done intentionally – as an overt demonstration of ability or a form of deliberate instruction – or not.

Taken as a whole, the assemblage from Stoneham's Pit primarily reflects the selection of nodules immediately available from the chalk cliff and on-site decortication. Some cores were further prepared within the area from which Spurrell collected, their volumetric properties being deliberately adjusted to create a Levallois flaking surface, and some Levallois products were produced on site. Some of these are missing – generally the larger and broader products – which have arguably been transported away from this site for use and transformation in the wider landscape. Most of the Levallois cores prepared and partially exploited at the site are also missing, also suggesting that they may have been taken on for further exploitation elsewhere, arguably as a source for future blanks.

Whilst it is impossible to speculate as to the scale of these movements, it is worth noting the peculiar geographical situation of the Stoneham's exposure in comparison to geologically contemporary sediments exposed in other sections; the site is located immediately adjacent to a flint band, and the chalk cliff itself is eroded, providing easy access to the channel margin and associated raw material from the downland above. In contrast, exposed sections of equivalent date in the area reflect only gentle fluvial deposition and no associated raw material exposures have been noted. Given that the Crayford lower brickearths date to late OIS 7, progressive sedimentation throughout the interglacial may have masked previously available sources of raw material – such as the Crayford Gravel. In such a situation, particular outcrops like the base of the cliff at Stoneham's may have become increasingly important places, deliberately targeted as sources of raw material that was becoming less ubiquitous in the landscape. Low numbers of artefacts have been found throughout the Crayford brickearths, potentially reflecting the drop-out of material discarded in the context of use – a "veil of stones" (*cf.* Roebroeks *et al.* 1992) – in contrast to the specialised nature of the dense scatter at Stoneham's. Not only does the Crayford assemblage therefore reflect a human presence during late OIS 7, but also the same patterning of behaviour in response to landscape affordances observed earlier in the interglacial.

5.4 Stoke Bone Bed, Ipswich, Suffolk

Introduction

Although largely known as a palaeontological site, some artefacts have been found in association with faunal remains from the silts and clays of the "Stoke Bone Bed", Ipswich. Here Pleistocene fluvial sediments are banked against an elevated ridge of eroded tertiary deposits (London clay/Reading Beds) which rise to around 38 m. OD in the Stoke Hills area of Ipswich, around which the Gipping/Orwell loops to the north-east. A thick bed of organic silts and clays rests at about 8 m. OD. This is rich in fauna and has been investigated several times since material was first recovered from here in 1846, notably when excavated by Nina Frances Layard in 1908 and 1919 (Wymer 1985, 228). More recent excavations (Wymer 1985, West 1977) have confirmed the continuation of the deposits some 400 m. to the south, but few artefacts have actually been found within the bone bed itself.

History of Investigations

Faunal remains were first recovered from the Bone Bed around 1846, when a tunnel was opened by the Eastern Union Railway through the Stoke area of Ipswich. Material was recovered from immediately south of the tunnel entrance and exhibited in Ipswich Museum; Whitaker records that Prestwich visited the cutting whilst it was open and collected extensive faunal remains (Whitaker 1885). In 1908 Nina Frances Layard decided to try and relocate the source of material, which she found to the south of the tunnel entrance with the aid of an umbrella (Layard 1912, 60; Figure 5.4.1). Permission was granted to clear a seven-foot section of the cutting; this produced copious faunal remains, and also apparently three artefacts; a scraper, and two flakes which she gave to Lancaster and his niece (Layard 1912, 64). She described the "bone bed" as marked by a "distinct black line", and also recorded the deposits exposed in the cutting on at the north and south ends of the tunnel.

No further work was undertaken in this area, as permission to excavate had been restricted to this small section to prevent the collapse of the cutting. However, construction of new railway sidings in 1919 entailed the removal of a large portion of deposits east of Layard's original section and she was again granted permission to excavate (Layard 1920). This exposed a long, approximately south-facing section running east from the position of the 1908 investigations (Figure 5.4.1) and providing a long section through the bone-bed itself, which dipped in the centre of the section and towards the north-west. Layard also opened a deeper pit in order to examine the underlying beds, recording a section some 35 ft in depth. Again, copious faunal remains were recovered, together with freshwater molluscs (Layard 1920, 219). Layard lists only three artefacts recovered from the bone bed during these excavations; one is described as a "double racloir and hollow scraper" on a thermally fractured pebble, whilst another (illustrated; Layard 1920, 218; Figure 50) is a small, classic Levallois core, which she viewed as having been retouched after exploitation.

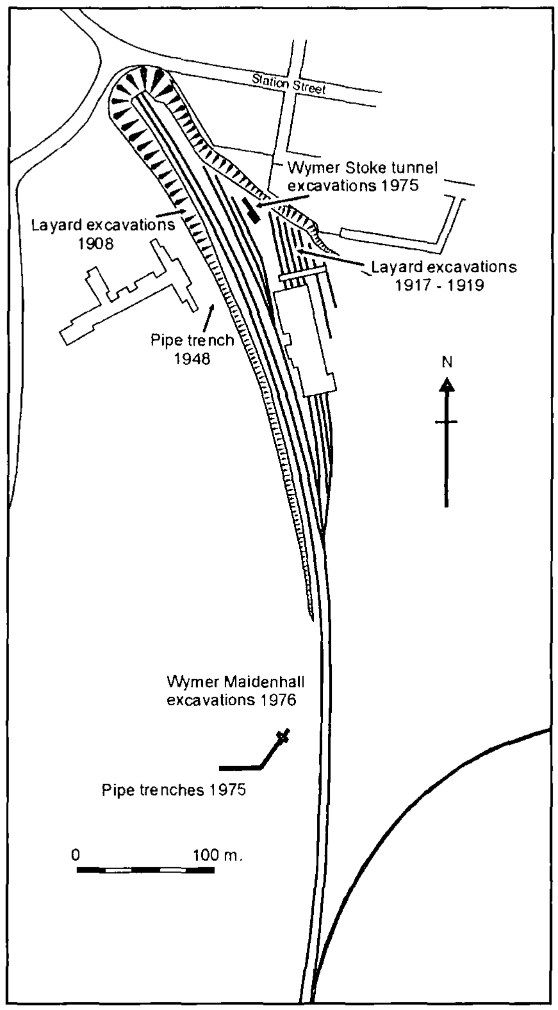

Figure 5.4.1 Location of excavations through the Stoke Bone Bed, Ipswich (after Wymer 1985, 229, Fig. 75).

Faunal material was again recovered from the Bone Bed in 1948 when a tunnel was opened in the grounds of Luther Road school on the south-western side of the railway, running parallel to the track. At the same time, bones and a Levallois core were recovered during the construction of the Maidenhall estate to the south, together with a retouched Levallois flake from fine sediments (Wymer 1985, 228). Further controlled excavation was undertaken by John Wymer in 1975 immediately to the north of Layard's 1919 excavations, exposing 60 m^2 of the Bone Bed (Figure 5.4.1). No definite artefacts were recovered from the Bone Bed in this location, although two flakes with facetted striking platforms were recovered from stony clay towards the north end of the section and two flakes were recovered from a gravel seam within silts some 1 m. above the Bone Bed. Part of this section was re-opened in 1977 in advance of an INQUA field visit. During the 1975 tunnel excavations, faunal material was also exposed during the construction of a new school in Maidenhall 400 m. to the south, and further excavations were undertaken in this area in 1976 (Wymer 1985). Faunal material was here recovered from a brown clay or mottled grey-brown silt encountered at a similar depth to the organic bed nearer the tunnel (c. 8 m. OD.). Notably, a near-complete mammoth skeleton was recovered during this phase of investigations, and it is suggested that the articulated state of its front feet might suggest that it may have perished after becoming mired (Wymer 1985, 231). A single unambiguous flake fragment was recovered from the bone-bed at Maidenhall. Sections opened close to Wymer's 1976 Maidenhall excavations in 2002 failed to expose the Bone Bed, although a deep geological sequence was observed (Mark White personal communication).

Geological Background

Although the fossiliferous levels near the Tunnel and in the Maidenhall area were encountered at similar levels (c. 8 m. OD.), differences were apparent between the observed sections and especially in the composition of the Bone Bed itself. Whilst in the Tunnel area fauna was recovered from a black organic deposit or purple clays (Layard 1920), micro-faunal remains being concentrated within dark, sandy patches (Wymer 1985), equivalent deposits in the Maidenhall area were brown clays and mottled grey-brown silts (Wymer 1985). Wymer (1985) also recorded a metre-thick solifluction deposit capping the sediments at Maidenhall which was not observed in the Tunnel area. The sequences recorded by Wymer (1985) and Layard (1920) at the Tunnel site are summarised in Table 5.4.1 below, and that recorded at Maidenhall in Table 5.4.2 (see also Figures 5.4.2 – 5.4.4).

Layard (1920)		Wymer (1985)	
Humus	0.6 m	Ash and clinker	
Coarse red gravel	2.4 m		
Laminated loams and brickearths	1.8 m	Cross-bedded sands	1.0 m
Iron-stained sandy clay with very poorly preserved mammal bones and thin gravel band containing artefacts	0.45 m	Buff to grey silty clay	1.5 m
Clay; white (and boneless) to purple (and rich in fragile bones)	1.8 m	Black organic clay with bones Purple clay with bones	0.15 – 0.2 m 1.0 m
Chalky Boulder clay	c. 15 cm		
Middle glacial sands	1.8 m		
Red gravel with re-worked Crag marine shells	0.9 m	Shelly sands and silts, contorted in places	
Red Sand ?Crag			

Table 5.4.1 Summary of deposits recorded by Layard (1920) and Wymer (1985) in the Tunnel area.

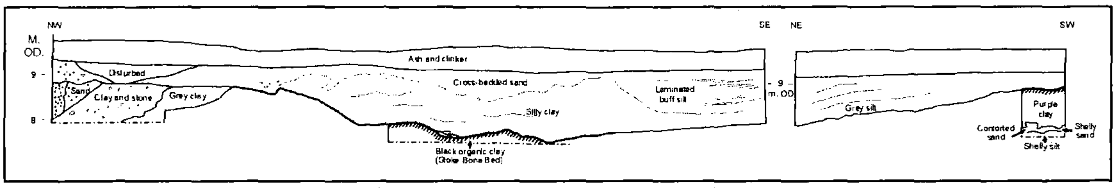

Figure 5.4.2 Section recorded by Wymer in the Tunnel area (after Wymer 1985, 232, Fig. 76).

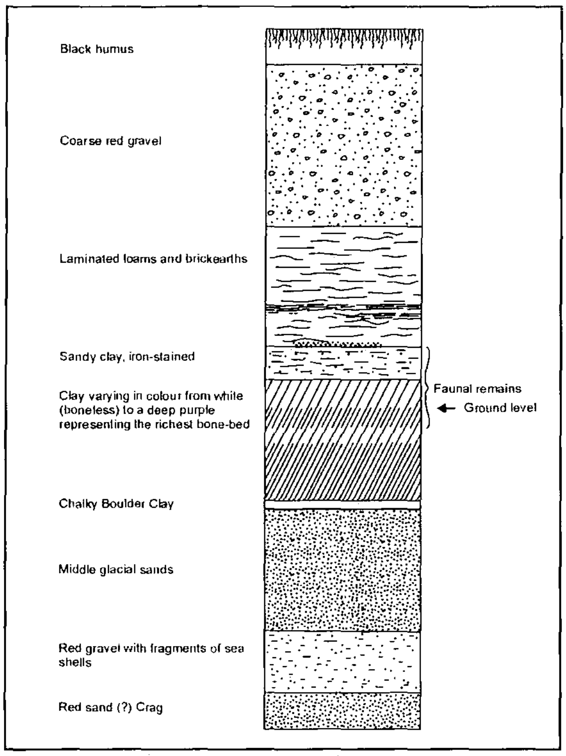

Figure 5.4.3 Section recorded by Layard during her 1919 excavations at Stoke Tunnel (after Layard 1920).

No trace of the thin layer of "Boulder Clay" recorded by Layard was observed during the excavations undertaken by Wymer (1985), who also suggests that the basal deposits ("Middle glacial sand" and below) are actually fluvial in origin, as similar fine, matrix-supported gravels were recorded in the Maidenhall area and produced fish bones. Wymer also observed that fine-grained fluvial deposits in the Tunnel area were originally overlain by coarse, unbedded gravel (since removed), as recorded by Layard; this probably represents a solifluction deposit equivalent to that recorded in the Maidenhall area. The entire sequence is banked against London Clay and Reading Beds to the west, and reflects the gentle infilling of a channel during an interglacial period, the overlying colluvial/solifluction deposits probably having been emplaced during the subsequent cold period.

Wymer (1985)	
1. Truncated by machine in places; glacial/solifluction deposit of mixed loam, gravel, chalky matter and lumps of Crag	1.0 m.
2. Loam, with some stones	2.0 m.
3. Mottled grey-brown silt	0.7 m.
4. Brown clay and mottled grey-brown silts with well-preserved bones	1.0 m.
5. Gravel and sand	0.8 m.
6. White sand	

Table 5.4.2 Summary of deposits recorded at Maidenhall by Wymer (1985).

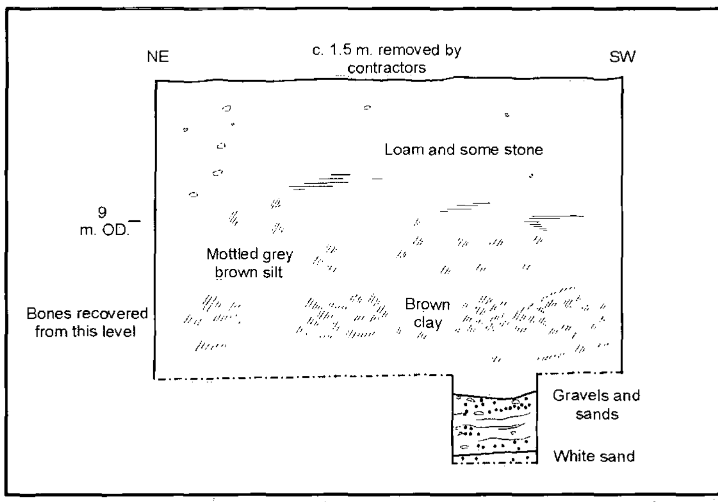

Figure 5.4.4 Section through deposits at Maidenhall excavated by Wymer in 1976 (after Wymer 1985, 233, Fig. 76).

A remarkable number of single individuals are represented amongst the mammalian assemblage, particularly lion, wolf and mammoth (Schreve 1997), suggesting that at least a proportion of the animals died on the site. In particular, the front feet of a near-complete mammoth skeleton excavated in the Maidenhall area were articulated, suggesting that the animal may have become mired and drowned (Wymer 1985). It seems possible that the site may have represented a location where animals tended to become trapped as a result of flooding, the steep cliff of London clay preventing escape as the floodwaters rose.

The clear interglacial character of the deposits is attested by multiple environmental proxies, as well as sedimentary characteristics. Pollen recovered from the Bone Bed at the tunnel site was fragmentary but reflected an open, interglacial environment (Turner, in West 1977; Wymer 1985). The extensive faunal assemblage is dominated by large, grassland mammals, although some indications of nearby woodland are also apparent (e.g. *A. sylvaticus*, *U. arctos*; Schreve 1997). The fluvial origin of the bone bed itself is confirmed by the recovery of fish and amphibian remains, and Layard also reported that Corner identified freshwater molluscs from the deposit (*Lymnaea* and *Planorbis*; Layard 1920, 219). Of particular note is the presence of pond tortoise (*Emys obicularis*), which requires summer temperatures in excess of 17-18° C and long daylight hours in order to hatch its eggs.

Notably, the bench level of the Gipping terrace within which the Bone Bed was encountered has aggraded to a level of 12-14 m. OD – some 10 m. above the surface height of the Ipswichian stratotype at Bobbitshole, only 2 km. south in the Belstead Brook Valley (Wymer 1988, 1999; West 1977). This indicates that the Stoke Bone Bed belongs to a higher and older aggradational stage. Schreve advocates a later OIS 7 date for the Stoke Tunnel interglacial deposits, based upon the similarity of the mammalian assemblage to that from the upper part of the Aveley sequence (Schreve 1997, 2001).

Summary

- *Geographical situation*

  The Bone Bed represents a gentle, fluvial deposit adjacent to a steep cliff of London clay/Reading Beds to the west. The underlying gravels are relatively fine and matrix-supported.

- *Climate and environment*

  Both pollen and vertebrate remains reflect the fully interglacial character of the deposits, as well as the open nature of the landscape, although some nearby woodland is also apparent. The fluvial character of the deposits is confirmed by both vertebrate remains (fish, amphibian, water vole) and freshwater molluscs.

- *Dating*

  The height of the deposits militates against an Ipswichian attribution. Schreve advocates correlation of the mammalian assemblage with the upper part of the sequence at Aveley, and hence a later OIS 7 (possibly substage 7a) date (Schreve 1997, 2001). A later OIS 7 attribution is therefore favoured here.

Analysis of the Assemblage

Treatment and selection of collection

Throughout the period in which it has been investigated, only seven artefacts have been definitively stated to come from the Bone Bed; a scraper and two flakes which Layard found in 1908 (the flakes given to Lancaster and his niece), two artefacts (one undescribed, one which sounds somewhat dubious) and a Levallois core found by Layard in 1919, and a flake fragment found by Wymer at Maidenhall (Layard 1912, 1920; Wymer 1985). Other Levallois artefacts have been recovered from the Stoke/Maidenhall area of Ipswich, but are either from higher up the sequence or of uncertain provenance (see Wymer 1985, 232-4). 11 flakes – one with a facetted platform – accessioned in 1948 are also present within the collection held at Ipswich Museum. One of these is marked as coming from Maidenhall, and they were presumably collected during groundworks when the estate was first built in 1948 (see above). The label on the bag indicates that a Levallois core should also have been present, but this is now missing. A bag of natural flint collected by Layard, accessioned in 1920 and with varying indications of stratigraphic context, was also encountered. Only a single Levallois core – that recovered from the Bone Bed by Layard in 1919 – can therefore be attributed to context and was available for study.

Analysis

Accession Number	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
1920-73A-1	67.6	59.9	19.9	0.88609467	0.33222037

Table 5.4.3 Dimensions and indices of Levallois core from the Stoke Bone Bed.

Figure 5.4.5 Exhausted Levallois core from the Stoke Bone Bed (Ipswich Museum accession number 1920-73A-1).

A single small, flat Levallois core was recovered from the Stoke Bone Bed by Nina Layard in 1919. This is in mint condition, though lightly patinated, and attests to centripetal preparation of the final flaking surface prior to the removal of a single flake. Contrary to Layard's (1920) suggestion, it has not been retouched. It retains some rolled cortex in the centre of the striking platform surface. The small size and flattening of the core might suggest that it has been subject to recurrent exploitation, discarded once it could not be worked any further.

Technology and hominin behaviour at Stoke Tunnel/Maidenhall

Although only a single, exhausted Levallois core was available for study, occasional artefacts have been recovered from throughout the Stoke Bone Bed, attesting to hominid presence in the area during the later part of OIS 7. No direct association between this hominin presence and the substantial vertebrate assemblage can be established. However, given the representation of single individuals amongst the fauna, probable death by miring for at least one of the mammoths, and the proximity of the steep clay cliff, it is tempting to speculate that this represented a location where animals were periodically trapped and drowned by rising floodwaters. Hominins may have visited the site in order to exploit trapped animals or drowned carcases; however, this cannot be established and the presence of their artefacts may merely reflect the fact that they were active in the vicinity at particular times.

What is significant, however, is the geological context of the site. The sediments as a whole are deposited over and banked up against tertiary clays, and the gravels immediately underlying the Bone Bed are relatively fine and predominantly matrix supported (see Figure 5.4.3). Clearly, in such a situation, raw material would be at a premium. Only a few non-Levallois flakes have been reported from the Bone Bed, and the only Levallois core examined is exhausted. It therefore seems likely that, regardless of the actual activities undertaken by hominins at the site, artefacts were rarely discarded there. The artefacts from the Stoke Bone Bed could be regarded as a sparse scatter discarded in the context of hominin activity (potentially subsistence) away from an immediate source of exploitable material. This contrasts markedly with larger assemblages from toolkit-maintenance and extraction locations discussed previously (see especially Section 5.1 Baker's Hole and the Ebbsfleet Valley, Section 5.2 Creffield Road).

5.5 Jordan's Pit, Brundon, Suffolk

Introduction

Jordan's Pit, Brundon, is located on the south bank of the River Stour in Suffolk. Terraces of the Stour have no geomorphological expression in the present landscape above 8-10 m. OD, and the pit is located on the slope between the flood-plain and the dissected till plain 30 m. above the modern river, at about 61 m. OD (Wymer 1985, 198). The Sudbury area, and particularly Ballingdon on the north bank of the Stour, produced fauna and artefacts from the mid-nineteenth century onwards, but no controlled excavation or collection was then undertaken. Finds by P.H. Jordan following the expansion of the pit in the early 1930's prompted the formation of an excavation committee, headed by J. Reid Moir (Moir and Hopwood 1939), and excavations undertaken at Jordan's Pit between 1935-1937 produced Levallois material in association with faunal and molluscan remains.

History of Investigations

No Levallois material from the area around Brundon was recovered until the 1935-1937 excavations, although flint artefacts from gravel somewhere near Sudbury were noted by Evans (1897; Wymer 1985), and the 1878 geological survey memoir mentions that flint artefacts were recovered from somewhere around Brundon by J.S. Holden (Whitaker *et al.* 1878, Moir and Hopwood 1939). P.H. Jordan, owner of the pit, had apparently recovered mammal bones, which he donated to Ipswich Museum for a number of years. Reid Moir visited the pit following its expansion in the early 1930's, and noted both extensive faunal remains and the occasional flint artefacts in a stratified gravel sandwiched between glacial deposits. An excavation committee was formed, and excavations, led by Reid Moir, were undertaken between 1935-1937 (Moir and Hopwood 1939).

Moir and Hopwood recorded a sequence of fluvial interglacial deposits overlying glacial deposits (including meltwater outwash) and surmounted by solifluction deposits attesting to a return to cold conditions (Moir and Hopwood 1939). At no one point was the entire sequence exposed, but it was pieced together from a variety of sections cut around the pit. A mixed lithic assemblage was recovered from the interglacial gravel (Bed 3; see Figure 5.5.1 and Table 5.5.1), especially towards its base, where it surmounted compact, mollusc-rich grey clay (Bed 4; Figure 5.5.1, Table 5.5.1). Reid Moir viewed the junction between the gravel and clay as representing an ancient landsurface, and described it as a black-stained gravel, "practically devoid of matrix" (Moir and Hopwood 1939, 3). Mammalian and molluscan remains (freshwater and land varieties) were recovered from the same deposit.

Reid Moir records only a few artefacts from the black-stained layer at the base of the Bed 3 gravel (Moir and Hopwood 1939, 5); these are described as unabraded and unpatinated, and include a classic, centripetally prepared Levallois core from which the final preferential flake failed to detach and two definite Levallois flakes, together with other debitage. He explicitly compared the Levallois material with Baker's Hole. Slightly abraded and patinated Levallois artefacts, some scratched, were also recovered from the same level and from throughout the gravels. Reid Moir also recovered handaxes, which he describes as abraded, from the gravels, but does not state any to have come from the black-stained horizon at the base. Re-examination of the material from Brundon by Wymer indicated that very little fresh material was recovered (7 flakes and 1 core from amongst the 68 artefacts available to him) and that the material as a whole, Levallois and handaxes alike, is in a variety of condition states (Wymer 1985, 201). In fact, given the state of the available collection (see below), only artefacts illustrated by Moir and Hopwood and stated explicitly to have come from the black band can be attributed to this position (1939, figs. 2-5); the majority may form part of the mixed assemblage from throughout the gravels. It therefore seems likely that at least some primary context Levallois artefacts were recovered, but that most material from the site cannot be stated to have come from a particular stratigraphic level and may have been derived from a variety of sources.

Geological Background

The Stour valley formed the focus of much work by Boswell between 1913 and 1929; he established the existence of the valley system prior to the Anglian glaciation, noting the presence of Boulder Clay on the valley sides and surrounding high ground (Boswell 1913, 1925, 1929; Wymer 1985). The investigations at Jordan's Pit indicated the presence of boulder clay on the southern side of the pit (Unit 6 – see below); this was patchy and eroded, though apparently not re-deposited (Moir and Hopwood 1939, 3). The sequence recorded by Moir and Hopwood (1939) is summarised below (Table 5.5.1), based on a number of exposures around the pit. Although the areas investigated by Moir and Hopwood were later obliterated by quarry expansion, the sequence has been broadly confirmed by later investigations (Rose *et al.* 1978, Wymer 1985).

The sequence as a whole overlies a chalky solifluction deposit containing fractured flints (Rose *et al.* 1978; Wymer 1985). The coarse gravels of Beds 5-7 have been previously been interpreted as glacial deposits, but are probably fluvial in origin. The fine clay of Bed 4 yielded abundant temperate freshwater molluscs, including unworn *Corbicula fluminalis* in articulation, suggesting a slow-moving fluvial environment (Baden-Powell, in Moir and Hopwood 1939, 32); Moir suggests that the fine material may have been deposited through gentle erosion of an adjacent cliff of boulder clay through which the river cut (*ibid*, 3). The overlying fluvial gravels attest to higher-energy deposition, and produced numerous mammal bones, together with freshwater and land molluscs, these being concentrated particularly towards the base ("landsurface"). Beds 2 and 2a represent a solifluction deposit, reflecting a return to cold conditions.

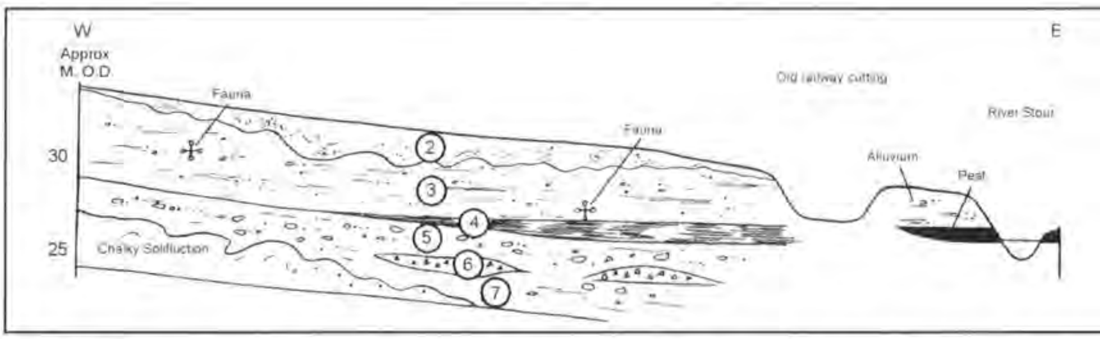

Figure 5.5.1 Composite sections through deposits exposed at Jordan's Pit, Brundon. Numbers indicate beds recorded by Moir and Hopwood (1939; see Table 5.5.1). Modified after Wymer (1985, 199; Fig. 66).

1.	Surface humus.	0.23 m.
2.	Unstratified sandy clay.	2.44 m.
2a.	Reddish, contorted, tumbled gravel (Solifluction deposit).	1.52 m.
3.	Yellowish, horizontally stratified gravel. Basal deposit c. 30 cm. in thickness comprising black-stained stones with little or no fine material. Numerous mammalian and molluscan remains.	4.57 m.
4.	Grey, compact unstratified clay with stones; abundant freshwater molluscs, including *Corbicula fluminalis* in articulation.	0.61 m.
5.	Coarse, red stratified gravel with thin streaks of manganese.	0.91 m.
6.	Chalky Boulder Clay in patches.	1.22 m.
7.	Stratified chalky sandy gravel or sand.	2.44 m.

Table 5.5.1 Summary of geological sequence recorded at Jordan's Pi, Brundon, by Moir and Hopwood (1939).

Both the mammalian and molluscan material from Beds 4 and 3 are fully temperate in character. Kennard identified 30 terrestrial and freshwater molluscs, assumed to come predominantly from the "landsurface" at the base of Bed 3 and throughout Bed 4, but potentially collected from throughout the gravels. The dominance of terrestrial molluscs within fluvial deposits suggested to him incorporation of material from the surrounding landscape, reflecting open grassland with some scrubland (Kennard, in Moir and Hopwood 1939, 31). The presence of *C. fluminalis* and *Belgrandia marginata* attest to the fully temperate character of these deposits, having a southerly present-day distribution, whilst *C. fluminalis* is unknown in Britain after OIS 7.

The mammalian fauna also attests to an open grassland environment, *Equus ferus* being particularly highly represented (45% of the faunal assemblage; Schreve 1997). Also present are the small "Ilford type" mammoth (*M. primigenius)*, and other open grassland species including *Megaloceros giganteus* and *Stephanorhinus hemitoechus*. Schreve proposes a late OIS 7 (potentially substage 7a) date for the interglacial deposits exposed in Jordan's Pit, based upon the similarity of the faunal assemblage (in terms of both species present and relative proportions) to that from the upper part of the sequence at Aveley (Schreve 1997, 2001). Uranium-series dating of faunal material from Jordan's Pit has produced dates of 230 000 $\pm$ 30 000 and 174 $\pm$ 30 000 BP. (Szabo and Collins 1975), supportive of a broad OIS 7 attribution. The presence of fully temperate mollusca in articulation from Bed 4 immediately below the lowest archaeological level indicates that fully interglacial conditions prevailed even before the first human presence at the site. A later OIS 7 date is therefore accepted here; Jordan's Pit clearly cannot be correlated with the earliest, wooded cool-temperate period of OIS 7, and at the very least shows human presence extending into OIS 7.

Summary

- *Geographical situation*

  Levallois artefacts were recovered from the surface of a coarse gravel beach, adjacent to a fast-flowing stream through an open landscape. Raw material was immediately available from both the beach itself and exposed chalky solifluction deposit, and large flints are visible in current exposures at the pit (Mark White, personal communication). Artefacts were also distributed throughout the overlying fluvial gravels.

- *Climate and environment*

  The substantial molluscan and faunal assemblages from the interglacial deposits (Beds 4-3) at Brundon indicate fully temperate conditions. Mammals typical of open grassland conditions dominate (Schreve 1997), whilst the land snails swept into the fluvial deposits by local flooding also reflect open conditions with only a little scrub vegetation present, and an absence of marshy conditions (Kennard, in Moir and Hopwood 1939).

- *Dating*

  Faunal and molluscan material, as well as U-series dates, suggest an OIS 7 attribution for the interglacial deposits at Jordan's Pit. The fully temperate molluscs from Bed 4, as well as the nature of deposit itself, definitely suggests that full interglacial conditions prevailed even before humans were active at the site, militating against an earlier OIS 7 date. Schreve correlates the faunal assemblage with the upper part of the sequence at Aveley and suggests a substage 7a attribution (Schreve 1997, 2001), and a later OIS 7 date is therefore favoured here for the interglacial deposits at Brundon and the primary context archaeological material contained therein.

Analysis of the Assemblage

Treatment and selection of collections

Although Moir and Hopwood (1939) state that some unabraded and unpatinated artefacts were recovered from the "landsurface" at the base of the Bed 3 over the grey clay, only three definite Levallois pieces (two flakes and a core) can be stated to have come from this position. None of the artefacts are marked with anything more than the name "Brundon" and a date between 1935-1937, and although some debitage examined at Ipswich Museum was contained within a (recently) sealed bag with a label which read "Brundon interglacial gravels of the upper valley of the Stour", this also included the butt end of a Neolithic polished axe – marked in the same way as Levallois material. Clearly, problems exist with the integrity of the extant collection, and it is likely that material from the entire sequence, including the surface soil, may have been combined. It is also clear from the 1939 article that material from the spoil heaps was also collected and retained – indeed, one is illustrated and assumed to come from Bed 3 (Moir and Hopwood 1939, 6 and fig. 10). The only artefacts which can be attributed to either the gravel or the "landsurface" are those which are illustrated and stated to have been excavated from such a position.

Given these difficulties, only the Levallois material from Brundon is considered in detail below, of which only the artefacts noted above and a single Levallois flake from the gravel can be attributed to position. The Levallois material as a whole is therefore combined and treated as a single collection from throughout Bed 3, including the "landsurface" towards the base. The handaxes from the site were also recorded, to allow comparison of their condition state with the Levallois material; again, several of these are definitely stated to come from the gravel.

Analysis

The selected sample therefore comprises 34 artefacts, in contrast to the 60 Levallois artefacts and handaxes from Ipswich museum recorded by Wymer (1985, 395). This may relate to losses since his examination of the collection, although similar numbers of whole handaxes and Levallois cores are present.

Artefact	No. of artefacts
All Levallois flakes	21
Definite Levallois flakes	9
Probable Levallois flakes	6
Possible Levallois flakes	6
Levallois cores	3
Handaxes (whole)	9
Handaxes (partial)	4
Total	37

Table 5.5.2 Material examined from Jordan's Pit, Brundon.

Taphonomy

All definite Levallois material from Jordan's Pit (n=12)					
Unabraded	10	83.3%	*No edge damage*	1	8.3%
Slightly abraded	2	16.7%	*Slight edge damage*	5	41.7%
Moderately abraded	0	0.0%	*Moderate edge damage*	5	41.7%
Heavily abraded	0	0.0%	*Heavy edge damage*	1	8.3%
Unstained	4	33.3%	*Unpatinated*	4	33.3%
Lightly stained	4	33.3%	*Lightly patinated*	5	41.7%
Moderately stained	4	33.3%	*Moderately patinated*	3	25.0%
Heavily stained	0	0.0%	*Heavily patinated*	0	0.0%
No battering	9	75.0%	*Unscratched*	10	83.3%
Light battering	1	8.3%	*Lightly scratched*	1	8.3%
Moderate battering	2	16.7%	*Moderately scratched*	1	8.3%
Heavy battering	0	0.0%	*Heavily scratched*	0	0.0%

Table 5.5.3 Condition of all definite Levallois flakes (n=9) and Levallois cores (n=3) from Jordan's Pit, Brundon (n=12).

All handaxes from Jordan's Pit (n=13)					
Unabraded	1	7.7%	*No edge damage*	0	0.0%
Slightly abraded	4	30.8%	*Slight edge damage*	3	23.1%
Moderately abraded	7	53.8%	*Moderate edge damage*	4	30.8%
Heavily abraded	1	7.7%	*Heavy edge damage*	6	46.2%
Unstained	3	23.1%	*Unpatinated*	2	15.4%
Lightly stained	2	15.4%	*Lightly patinated*	3	23.1%
Moderately stained	5	38.5%	*Moderately patinated*	7	53.8%
Heavily stained	3	23.1%	*Heavily patinated*	1	7.7%
No battering	3	23.1%	*Unscratched*	5	38.5%
Light battering	3	23.1%	*Lightly scratched*	5	38.5%
Moderate battering	4	30.8%	*Moderately scratched*	2	15.4%
Heavy battering	3	23.1%	*Heavily scratched*	1	7.7%

Table 5.5.4 Condition of all handaxes from Jordan's Pit, Brundon (n=13).

Clear contrasts in condition are apparent between the Levallois material and handaxes from Jordan's Pit, in terms of both chemical alteration and, more notably, mechanical damage (see Tables 5.5.3 and 5.5.4; Figure 5.5.2). The Levallois material tends to be unabraded with slight-moderate edge damage, and none is heavily stained or patinated; all but one handaxe are abraded and all are edge damaged, some (5) heavily so, and tend to be battered and scratched. Some handaxes are also heavily stained (3) and patinated. Although broadly speaking a continuum of condition states exists between the two technologies at Jordan's Pit (*cf.* Wymer 1985, 201), examination of the extant collection would support Moir's observation that the handaxes and Levallois material are in different condition, and that the handaxes are derived (Moir and Hopwood 1939, 6; see Figure 5.5.2). The mechanical damage incurred by the handaxes (abrasion of arêtes, edge damage, scratching and battering) may indicate that they have either been transported further or for a longer period of time than the Levallois material, or within a more energetically active regime. The elevated battering and scratching on handaxes might indicate previous cold-climate re-arrangement, potentially within a mass-movement deposit, although such an assertion cannot be substantiated. It therefore seems likely that the majority of the handaxe assemblage may have been reworked from elsewhere, potentially from an earlier deposit.

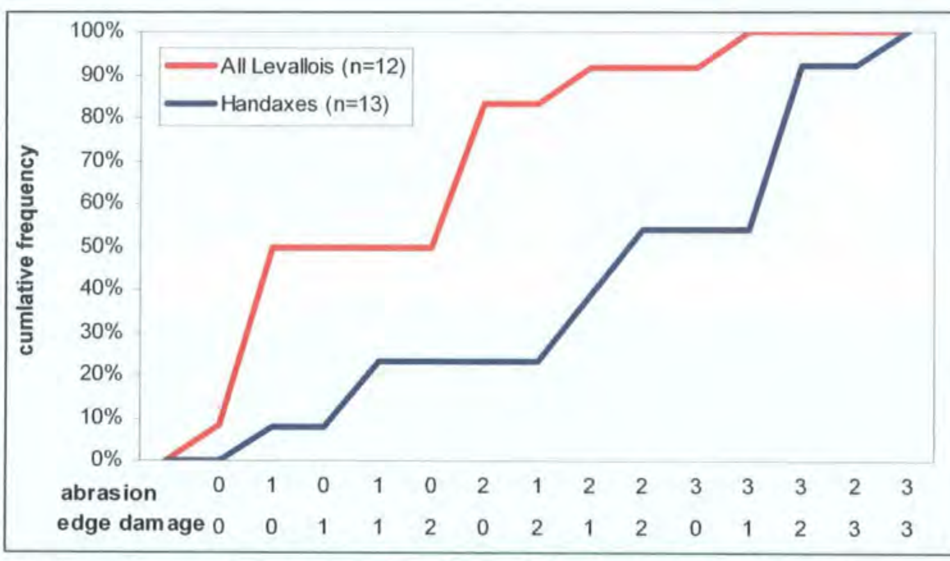

Figure 5.5.2 Comparison of mechanical damage to definite Levallois material and handaxes from Jordan's Pit, Brundon.

Most of the Levallois material from Brundon does exhibit at least some edge damage, indicating a degree of re-arrangement. Only three Levallois artefacts can definitely be stated to come from the "Landsurface" towards the base of the gravel; these too, although unabraded, exhibit light edge damage, and have probably been moved to some degree, or have incurred damage through the aggradation of gravels above them. The Levallois assemblage as a whole therefore appears to have been subjected to varying degrees of mechanical damage as a result of movement and re-arrangement, subsequent to discard and incorporation into the gravels. However, the condition of the assemblage indicates that such movement was not protracted or particularly violent. Although few artefacts can be directly related to Moir and Hopwood's posited "landsurface", the concentration of molluscan material within these levels could reflect a period of relative quiescence during which hominids were active on a stable bank or bar of the Stour. With a return to a more active fluvial regime, artefacts discarded during this period may have been re-worked within the gravels, but have probably not been transported far from the point at which they were originally discarded.

Technology

	Length (mm)	Breadth (mm)	Thickness (mm)	Elongation (B/L)
Mean	118.85	70.3875	20.2	0.619629
Median	108.1	70.3	19.7	0.671191
Min	68.2	45.7	12.4	0.371328
Max	170.2	88.2	26.8	0.777778
St.Dev	34.80045	13.061	5.486607	0.13229

Table 5.5.5 Summary statistics for whole Levallois flakes from Jordan's Pit, Brundon (n=8).

Accession Number	Length (mm.)	Breadth (mm.)	Thickness (mm.)	Elongation (B/L)	Flattening (Th/B)
938-197	147.3	150.3	51.7	1.020367	0.343979
938-197 (71)	120.7	101.3	56.7	0.839271	0.559724
1936-70	84.8	64.1	24.5	0.755896	0.382215

Table 5.5.6 Dimensions and indices of Levallois cores from Jordan's Pit, Brundon (n=3).

Nine definite Levallois flakes exist within the extant collection from Jordan's Pit, Brundon held at Ipswich Museum, all but one of which are whole, fairly elongated and of medium size (Table 5.5.5). Most are flakes, together with a single blade, a debordant flake, and a flake which is both debordant and overshot (Table 5.5.7). Most attest to centripetal preparation, with a single example of unipolar preparation and none can be stated to have formed part of a recurrent exploitation sequence (although it is possible that the debordant/debordant and overshot flakes did, but retain no traces of a previous Levallois removal). Most have facetted (5) or plain butts (3); of the three Levallois flakes that retain any cortex, two reflect the use of fresh flint and one derived. Rose *et al* (1978) noted the chalky composition of, and fractured flints evident within, a solifluction deposit immediately under the gravels at Jordan's Pit, emphasising that such material was immediately available.

Levallois flakes from Jordan's Pit, Brundon; technological observations			
Type of endproduct		Butt type	
Flake	6	*Plain*	3
Blade	1	*Facetted*	5
Debordant	1	*Obscured*	1
Debordant and overshot	1		
Raw material		Cortex retention (n=8)	
Indeterminate	6	*0%*	5
Fresh	2	*1 – 10%*	3
Derived	1		
Method of exploitation		Number of preparatory scars (n=8)	
Lineal	3	*1-5*	1
Probably lineal	6	*6-10*	2
		11-15	3
		>16	2
Preparation method		Pattern of additional convexity working (n=8)	
Bipolar	1	*None*	6
Centripetal	8	*Right*	1
		Left	1
Nature of convexity (n=2)		Portion	
Cortical or natural	2	*Whole*	8
Semi-invasive		*Proximal*	1

Table 5.5.7 Technological observations of definite Levallois flakes from Jordan's Pit, Brundon (n=9, except where otherwise stated).

Three Levallois cores from Brundon were recorded; these are of moderate size (Table 5.5.6) and reflect a wider range of exploitation strategies than are suggested by the Levallois flakes (Table 5.5.8). Two have been prepared centripetally (Cores 938-197 and 938 197 (71)), whilst a unipolar method has been used to shape a third (Core 1936-70). Core 1936-70 reflects the removal of a single Levallois flake which removed most of the flaking surface; an attempt was made to remove a single flake from the surface of Core 938-197 (71), but this failed to detach. Core 938-197 attests to centripetal recurrent exploitation; this additionally reflects deliberate accentuation of the convexities, whilst the surface of Cores 938-197 (71) and 1936-70 were shaped in a single phase. The two successfully exploited cores (Cores 938-197 and 1936-70) are very flat in their discarded state, potentially suggesting that they were actually subjected to recurrent exploitation, and may have been discarded when their productive capacity was compromised. All retain some cortex on their striking platform surface, two fresh (938-197 and 938-197(71)) and one derived (1926-70). The largest flakes scars retained on the cores are of a similar size to the smallest flakes within the extant collection (c.68 mm. long); this might again suggest that at least some degree of surface re-preparation and cyclical exploitation was being undertaken, although it is difficult to speculate on the basis of a such a small sample.

Levallois cores from Jordan's Pit, Brundon; Technological observations			
Preparation method		Exploitation method	
Centripetal	2	*Lineal*	1
Unipolar	1	*Centripetal recurrent*	1
		Attempted Lineal	1
Convexities		Type of convexity working (n=1)	
Whole surface shaped as one	2	*Invasive*	1
Continuous	1		
Blank type		Distribution of preparatory scars striking surface	
Indeterminate	2	*Proximal and distal*	1
Probably nodule	1	*Distal and both edge*	1
		Distal	1
Type of striking surface working		Position of cortex on striking surface	
Invasive	1	*Central*	1
Semi-invasive	2	*Central and one edge*	1
		All over	1
% Cortex striking surface		Levallois products from final flaking surface	
0	0	0	1
1-25%	0	1	1
26 – 50%	1	2	1
51 – 75%	2		
Types of Levallois products from core		Preparatory scars final flaking surface	
Flake	3	1-5	0
		6-10	2
		11-15	1
Preparatory scars striking surface		Raw material	
1-5	1	*Fresh*	2
6-10	1	*Derived*	1
11-15	1		

Table 5.5.8 Technological observations of Levallois cores from Jordan's Pit, Brundon. (n=3).

Technology and hominin behaviour at Jordan's Pit, Brundon

The small size of the surviving collection from Brundon, together with difficulties of contextual integrity, makes it hard to discuss the actual nature of hominin activity at Jordan's Pit with any certainty. However, it does seem clear that the handaxes and Levallois material collected from throughout the gravels are in different condition, and given the elevated degree of abrasion and edge damage to the handaxes, that the handaxe assemblage may be re-worked from an earlier deposit. Some handaxes in fresher condition – and a couple of more abraded Levallois flakes – are present, but they clearly separate as groups, and it seems reasonable to suggest that handaxes are not part of the Levallois assemblage; handaxes were manufactured infrequently, if at all, when Levallois technology was used at Brundon. However, it is difficult to argue for the co-occurrence of these technological options at Brundon, given the obviously mixed nature of the collection.

Although Wymer records over 55 Levallois flakes from the site, only 9 definite Levallois flakes can now be located within the collection held at Ipswich Museum. Over 130 non-Levallois flakes attributed to Brundon are still held at Ipswich, but are of minimal analytical value, given the likelihood that material from throughout the entire sequence has been conflated (witness the presence of a polished axe fragment, presumably from the surface soil) and the presence of reworked handaxes within the gravel. However, it could be argued that the original number of Levallois flakes from the site (compare with the 80 from Ebbsfleet – see Section 5.1) reflects the fact that Brundon was a major locale, and therefore may have formed the focus for prolonged or frequent hominin activity. Raw material was immediately available, both in the form of relatively fresh flint from the soliflucted material over which the gravels are emplaced, and from the gravels themselves. Levallois cores from the site (and potentially the size of the Levallois flakes in relation to final Levallois flake scars on the cores) attest to at least some recurrent exploitation. Notably, two of the cores are very flat and would have been difficult to rework without resulting in the production of Levallois flakes much smaller than others within the sample, whilst the other was discarded after a large Levallois flake failed to detach.

Brundon could, therefore, be viewed as an extraction site; a situation in which hominins were provisioning themselves with relatively large, broad transformable Levallois flake blanks – and potentially cores as the sources of such blanks – but leaving those cores which could no longer be usefully exploited. Similar provisioning at extraction locations and transport are apparent for other, earlier Levallois sites located where raw material was immediately available (see especially Sections 4.2 Creffield Road, and 5.1 Baker's Hole and the Ebbsfleet Valley). Brundon therefore not only reflects a hominid presence in Britain during later OIS 7, but also reflects technological patterns apparent in the earlier part of the interglacial.

Chapter 6
Discussion

6.1 Introduction

The British Middle Palaeolithic record has long been perceived as a rather peripheral phenomenon. Located on the north-westernmost edge of Europe, Britain in the Middle Palaeolithic appears to have been less intensively occupied than its continental counterparts; not only do there appear to be fewer sites and artefacts (especially when contrast with the "classic" sequence of south-west France), but Britain also witnessed a prolonged period of hominin absence between the end of OIS 7 and late OIS 4/3 (Ashton 2002, Boismier *et* al. 2003, Currant and Jacobi 2001, 2002, Ashton and Lewis 2003). Moreover, only three artefactually-productive excavations of Middle Palaeolithic sites have been undertaken in the last 20 years (Lion Pit Tramway Cutting; Bridgland and Harding 1994, Schreve *et al.* in press, Pontnewydd Cave; Green 1984, Aldhouse-Green 1988, Aldhouse-Green 1993, and Lynford, Boismier *et al.* 2003), and sites yielding detailed behavioural information from fine-grained deposits are rare. However, it is becoming increasingly clear that although Middle Palaeolithic Britain is located on the edge of Europe, it is by no means peripheral to reconstructing hominin behaviour during this period.

The British Middle Palaeolithic sequence as a whole provides the opportunity to examine the emergence of Middle Palaeolithic behaviours within a geographically-circumscribed entity. In common with other areas of similar latitude, there is no evidence for occupation in Britain during fully glacial periods. Moreover, given the alternating island-peninsula nature of Britain, access was necessarily constrained by rising interglacial sea-levels during warming periods, and Britain was completely inaccessible by any route during fully interglacial periods following the breach of the Straits of Dover (White and Schreve 2000; see also Ashton and Lewis 2003). In combination with the complete abandonment of Britain between OIS 6 and late OIS 4/3 (Currant 1986, Ashton 2002, Currant and Jacobi 2002, Ashton and Lewis 2003), the Middle Palaeolithic British record is therefore punctuated by a series of occupational hiatuses, some of which are longer than others. Arguably, this actually allows the British Middle Palaeolithic record to be investigated as a series of discrete time units, in a manner that may not be possible in areas more continuously occupied.

The chronostratigraphic framework of the British Palaeolithic record is central to the interrogation of emergent Middle Palaeolithic behaviours. The correlation of the terrestrial sequence with the oxygen isotope curve (Wymer 1988), together with advances in lithostratigraphy (e.g. Bridgland 1994), biostratigraphy (Schreve 1997, 2001a, 2001b) and geochronology (e.g. Penkman 2004), has allowed increasing differentiation between sites dating to OIS 9 and 7. The sites discussed during the preceding chapters represent the best of the British sample which can be assigned to these periods, and which also represent significant archaeological assemblages for which secure geographical and ecological contexts can be established. These sites therefore provide a basis upon which to investigate particular aspects of developing Middle Palaeolithic behaviours within British Pleistocene landscapes.

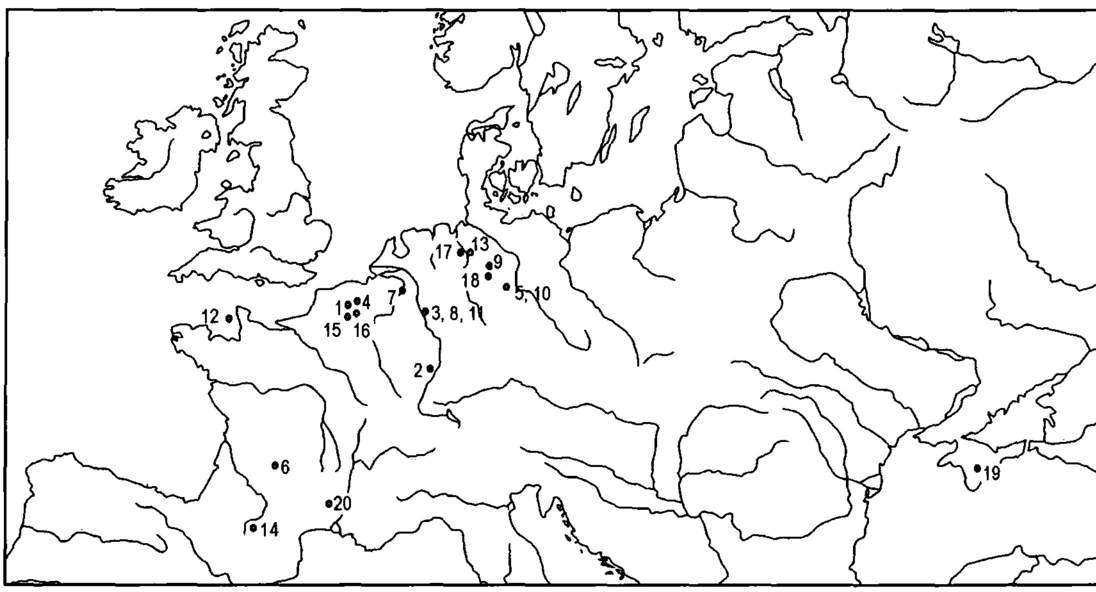

Figure 6.1 *Location of main European sites mentioned in Chapter 6.*

1	*Biache-Saint-Vaast*	*11*	*Tönchesburg*
2	*Achenheim*	*12*	*La Cotte de St. Brelade*
3	*Ariendorf 1*	*13*	*Lehringen*
4	*Mesvin IV*	*14*	*Mauran*
5	*Markleeberg*	*15*	*Cagny-La-Garenne*
6	*La Micoque*	*16*	*Rue Marcellin Berthelot*
7	*Maastricht-Belvédère*	*17*	*Meisenheim*
8	*In Den Wannen*	*18*	*Schöningen*
9	*Salzgitter-Lebenstedt*	*19*	*Starosele*
10	*Neumark-Nord*	*20*	*Orgnac III*

Aspects of these behaviours have been presented in the context of the individual sites examined in this thesis (Chapters 4 and 5); the following discussion therefore aims to place the patterns apparent from this examination of the British sequence within a broader European context. Several key issues are therefore explored below; firstly, how the Middle Palaeolithic is defined and whether it justifies investigation in its own right, and secondly, given that the period is widely regarded as beginning with the lasting adoption of Levallois flaking around OIS 9/8, how the technique developed and became widely practiced in Europe. Evidence from the sites examined in this study for behavioural changes apparent throughout the Middle Palaeolithic are subsequently explored, as well as the settlement history of the British Isles during OIS 9-3, in order examine the extent to which the British sequence can contribute to emerging pictures of early Middle Palaeolithic behaviours in Europe.

6.2 Becoming Neanderthals; defining the origins of the Middle Palaeolithic

The Lower-Middle Palaeolithic transition has only emerged as a research-worthy period relatively recently, historical definitions revolving around whether chronological or typo-technological criteria be invoked as defining the period anterior to the Upper Palaeolithic (Gamble and Roebroeks 1999). Bordes (1950), in particular, employed complex arguments to account for pre-Saalian Levallois occurrences, contrasting the Middle Palaeolithic with the Lower Palaeolithic in typo-technological terms, and viewing it as occurring temporally from the Rissian/Saalian (OIS 8-6) until the arrival of modern humans. Currently, a more heuristic definition of the Middle Palaeolithic has evolved; given the suite of broader behavioural changes apparent throughout this period, no single technological criterion can be invoked as defining the Middle Palaeolithic. Following various attempts to explore how the period might be defined (Ronen 1982, and papers therein), the Middle Palaeolithic is treated here as preceding the Upper Palaeolithic, and as a period within which particular contrasts with the Lower Palaeolithic can be delimited, but which cannot be characterised as a single behavioural package from the outset.

Considering the Middle Palaeolithic as a whole, it is possible to delimit differences in several facets of behaviour; during this period a variety of specialised flaking techniques – in particular, though not exclusively, Levallois technology – were employed to produce transformable flake blanks and tools, and geographical and temporal variation in flintworking traditions become widespread, in marked contrast to the preceding monotony of the Acheulean (White and Pettitt 1995, Gamble 1999). The widespread appearance of Levallois flaking in Europe around 300-250 KBP can be viewed as the first of the suite of "Middle Palaeolithic" behaviours to be archaeologically visible, but does not represent the entire "Middle Palaeolithic" package. For instance, throughout the period, changes are apparent in hunting strategies (Gaudzinski 1999), and use of landscape as evidenced by, on one hand, technological behaviour between sites (Geneste 1985, Turq 1988) and on the other, raw material transfer distances (Féblot-Augstins 1999). These do not represent synchronous behavioural changes, but an emerging suite of increasingly complex adaptations, leading one to question the validity of defining the beginning of the Middle Palaeolithic by the emergence of any one particular behaviour at all.

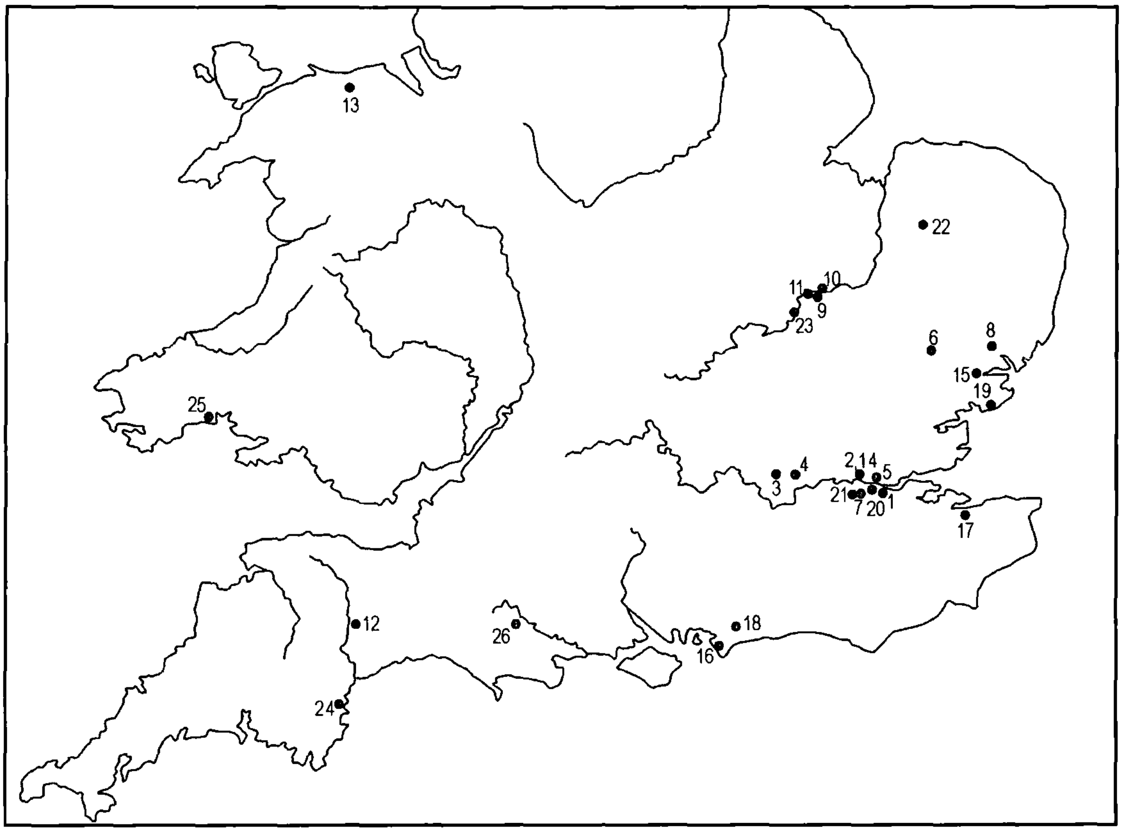

Figure 6.2 *Location of British sites mentioned in Chapter 6.*

1 Baker's Hole and the Ebbsfleet Channel
2 Botany Pit, Purfleet
3 West London (Yiewsley area)
4 Creffield Road, Acton
5 Lion Pit, West Thurrock
6 Jordan's Pit, Brundon
7 Stoneham's Pit, Crayford
8 Stoke Bone Bed, Ipswich
9 Fenstanton
10 Meadow Lane, St.Ives
11 Hemingford Grey
12 Broome
13 Pontnewydd
14 Aveley
15 Stutton and Harkstead
16 Selsey
17 Ospringe
18 Boxgrove
19 Clacton
20 Rickson's Pit
21 Bowman's Lodge
22 Lynford
23 Little Paxton
24 Kent's Cavern
25 Coygan
26 Harnham

Arguably, however, the key technological development that underwrites many of these behavioural changes is the lasting adoption of Levallois technology. Not only is this the first of this suite of behaviours to become widespread, but it is also intrinsically linked to fundamental changes in how hominins organised themselves technologically in their landscapes (*cf.* Pettitt 2003). Several lines of evidence suggest Levallois products were more intensively curated and transported than Lower Palaeolithic tools; Geneste (1985) has shown that Levallois products were generally moved further than other products during the Middle Palaeolithic, being comparatively over-represented amongst non-local raw material at sites in the Aquitaine basin. Both flakes and cores were transported, either as transformable blanks which could form supports for a variety of tools, or in order to produce various types of blanks. Roebroeks (Roebroeks and Henniken 1987, Roebroeks *et al.* 1988) interpreted such patterns apparent from refitting studies at Maastricht-Belvédère as underlining the inherent flexibility of Levallois flaking; either option – core or flake transport, or a combination of both – representing a possible solution to anticipated future needs.

The lasting adoption of Levallois flaking therefore both allows and occasions greater technological variability on several levels; choice of what sort of products are produced and/or transported (cores or flakes, type of flake), how these are retouched or used, and when the decision is made to use or transform endproducts in particular ways. As a technological system, Levallois flaking allows the extension of the *chaîne opératoire* in time and space (White and Pettitt 1995); whereas a handaxe represents a single tool form manufactured at a single point in time, Levallois products can be altered at many different points between core preparation and discard. The relationship between Levallois technology and several aspects of Middle Palaeolithic behaviour are, therefore, intimately related. It could be argued that it is only with the emergence of a flexible flaking system like Levallois that particular Middle Palaeolithic behaviours could develop; this extension of the *chaîne opératoire* means that behaviour need not be tethered to immediate raw material availability, as seems the case during the Lower Palaeolithic. A single handaxe broken in the context of use can only be recycled to a limited extent, if the material to manufacture a new one is not available on the spot. The transport of a Levallois core allows particular elements of an individual toolkit to be replaced where material is not immediately available, opening up areas of the landscape which may not previously have been exploited (e.g. away from outcropping lithic sources, such as river gravels).

In connection, larger ranging patterns could arguably rely upon an adaptable technology; exploiting larger landscapes might involve being less able to precisely predict what opportunities might present themselves and when. The adaptability of Levallois technology means that equipment can be modified to take advantage of situations and opportunities as they present themselves. This is not to say that such patterns could only have emerged in connection with Levallois flaking; later Middle Palaeolithic handaxes are similarly treated as transformable and transported tool supports (Turq 2001, Soressi and Hays 2003, White and Jacobi 2002). However, within the European Middle Palaeolithic, the emergence of such behaviours is chronologically linked to the widespread adoption of Levallois flaking. Although problems do exist in defining an archaeological entity on the basis of a single technological innovation, Levallois does appear to be inextricably linked to, and the first archaeologically visible manifestation of, the behavioural package that comes to represent the Middle Palaeolithic.

6.3 The origins of Levallois technology

The development of Levallois technology can therefore be viewed as central to understanding the origins of the Middle Palaeolithic, and has certainly formed the focus of considerable debate. The apparent sophistication of Levallois is frequently described as procedurally complex, in contrast to earlier lithic technologies (*cf.* Mellars 1996, Foley and Lahr 1997), and explicitly or implicitly linked to the cognitive capacities of its makers. For some, this demands biological separation from preceding hominin groups in Europe, and has been linked to the incursion of a hominin species from Africa ancestral to both modern humans and Neanderthals (*Homo helmei*; Foley and Lahr 1997, Lahr and Foley 1998). Certainly, the African sequence does show early evidence for the use of core preparation techniques, and particular developmental trajectories for the development of such techniques within the continent have been proposed from the early 1930's onwards (Riet Lowe 1932, 1936, 1945).

Although dating is problematic, there is evidence for the sporadic use of preparatory techniques in Africa to produce flake blanks for handaxe manufacture from large boulders (Kombewa technique) from c. 1 MYA onwards (Clark 1982). Such techniques are argued to represent deep antecedents to the development of Levallois flaking, and it has been suggested that the African Later Acheulean as a whole (c. 300-200 KBP) shows increasing variability, particularly in terms of techniques termed "proto-Levallois" (Clark 2001). Three separate regions of the continent are argued to show the ongoing development of prepared core technologies; north-west Africa and the Sahara, where techniques termed Tachengit and Tabala were used to produce preformed cleavers (sidestruck and endstruck respectively), East Africa, and South Africa, where the classic "Victoria West" succession was outlined on the basis of the undated Vaal basin succession (Rolland 1995).

However, few dates exist for the appearance of such technologies; K/Ar and Ar/Ar determinations in excess of 230 and 280 KBP (respectively) have been obtained on lava underlying the Kapthurin formation at Lake Baringo (East Africa), where half the cores from the site are described as radial or proto-Levallois (Clark 1982; McBrearty and Brooks 2000). Much earlier dates have also been proposed; the lower part of Stratum 2a at Canteen Koppie has been suggested to be earlier than 787 KBP, based upon typological and faunal correlation (Beaumont, quoted in McNabb 2001). This level produced evidence for a variety of "Victoria West" (essentially Levallois) core preparation techniques, including the deliberate manufacture of visually distinctive "henbeak" flakes, potentially for use as knives (McNabb 2001). The fact that this distinctive form, previously invoked as a type-fossil within the unilinear Vaal Basin succession (*cf.* Rolland 1995), may in fact have had a specialised functional and/or social role underlines the fact that a simple developmental trajectory cannot be assumed. Concomitantly, dated occurrences of Levallois technology in North Africa are no older than in Europe (Vermeersch 1995). Despite these problems, however, methods of core preparation which, although visually distinctive, do conform to the volumetric conception of Levallois, are present in Africa by at least 230 KBP, and potentially much earlier, and there are some suggestions that they may have arisen in different ways in different areas of the continent.

Foley and Lahr (1997, Lahr and Foley 1998) place a great deal of emphasis upon the evidence for the development of prepared core technologies within Africa. They see the geographical distribution of prepared core technology in Africa as reflecting the emergence of such technologies prior to OIS 8, when the Sahara became a barrier between the north and the rest of the continent, and continual development within these isolated regions during this glacial period. In contrast, they argue that European evidence for Levallois flake production is minimal during this period, but that during the earlier part of OIS 7, African hominins dispersed rapidly into Europe and Levallois flaking became widespread. Leaving aside the obvious problems of viewing all methods of core preparation as behaviourally analogous and treating stone tools as equivalent to biological species, a number of problems exist with this hypothesis.

Firstly, although obviously sparsely populated, the fossil record provides no evidence for an African invader at this time, and many workers would actually see Neanderthals as having evolved in Europe from earlier European hominins; derived features regarded as increasingly "Neanderthal" are arguably present on European hominin material from the middle part of the Middle Pleistocene onwards (Stringer and Hublin 1999, Stringer 2002). In archaeological terms, there is strong evidence for the emergence of local technological traditions commensurate with the volumetric definition of Levallois flaking at around the same time as such strategies evolved within Africa (c. 300-250 KBP), whilst some classic European Levallois occurrences have been shown to date to before the OIS 7 interglacial (e.g. Mesvin IV, Markleeberg, Orgnac 3, Ariendorf 1, Achenheim). Several British sites are dated to this period, including the classic Baker's Hole site (Late OIS 8/early 7; see Section 5.1), and, arguably, the West London sites (Late OIS 8, Creffield Road and the Yiewsley area; Sections 4.2 and 4.3). There appears to be no logical reason for characterising Levallois as an intrusive African phenomenon, regardless of posited fossil affiliations, and it is difficult to see how it might have become widely spread across Europe before the climatic conditions deemed necessary to allow hominins to leave Africa (Foley and Lahr 1997) had actually prevailed.

In contrast, individual examples of Levallois flakes and cores have been argued to suggest a long developmental trajectory for the appearance of Levallois in Europe, directly routed in preceding handaxe-making traditions. Tuffreau (1982, 1995) has argued that material from Cagny-La-Garenne in the Somme Valley (OIS 12) suggests the direct emergence of Levallois flaking from handaxe manufacture; the site has produced a number of Levallois cores, represented by the removal of a single preferential flake from a handaxe surface. Handaxes in all stages of manufacture have been treated in this way at the site; broken handaxes have been co-opted for use as cores, whilst handaxes with secondary retouch have had a striking platform prepared on their butt, and have been used to produce preferential flakes. One core from the site has also been interpreted as reflecting bipolar recurrent exploitation. Although several of these handaxes seem to have been co-opted for flake extraction after having broken during manufacture, or merely to represent thick handaxes from which large (or mis-struck) thinning flakes have been removed (Pseudo-Levallois flakes; Callow 1986), Tuffreau (1995) argues that flintworking at Cagny-La-Garenne underlines a conceptual link between handaxe manufacture and the emergence of Levallois flaking. Small numbers of handaxe treated in the same way are also known from outside Europe, and have been noted at several sites in Israel (Tabun Ed (7), Ma'ayan Barukh (13) and Gesher Benot Ya'aqov; DeBono and Goren-Inbar 2001).

Cores which conform volumetrically to the Levallois concept are also known in small numbers from a variety of northern European sites, including rue Marcellin Berthelot in Saint Acheul, where two preferential flake cores were collected from the outer part of the Fréville terrace (argued to date to OIS 14; Tuffreau 1995). Within Britain, individual cores reflecting the dedicated flaking of one surface are known from the top of the Boyn Hill/Orsett Heath formation (OIS 11; Bridgland 1994) at Rickson's Pit, Swanscombe (Roe 1981), and Bowman's Lodge (Tester 1951). However, these only represent individual examples within sites dominated by other technological modes, and few sites actually produce material approaching the Levallois concept prior to OIS 9. However, these individual examples are, taken together, significant, emphasising as they do the fact that conceptually, the elements necessary for Levallois technology were already present within existing Acheulean handaxe and core-working practices (White and Pettitt 1995, White and Ashton 2003). Moreover, they also emphasise the fact that these elements can be combined in different ways to arrive at the Levallois concept; either through the "tacking on" of a *débitage* episode after a dedicated period of *façonnage* (removing a privileged flake from a handaxe surface), or by combining the principles in a more organic fashion, to organise flaking in relation to existing core convexities (White and Pettitt 1995, White and Ashton 2003).

For White and Ashton (2003), the imminence of Levallois within existing technological systems accounts for a pattern whereby it becomes meaningless to try and pinpoint a single origin-point for Levallois. Rather, they emphasise particular local trajectories within Europe and beyond that suggest several unrelated, polyphyletic origins for the technique – that it emerges in different ways, in different places, at different times (*cf.* Otte 1995). A striking illustration of this is the Orgnac 3 aven in the Rhone valley (Moncel and Combier 1992; Moncel *et al.* 2005). The sequence at the site attests to the occupation of a receding cave/rockshelter throughout OIS 9/8. Flakes were produced from cores on flint plaques or flakes throughout the occupation of the site; discoidal techniques dominate the core working in the lower layers, flakes being removed from a continuous platform around the tabular material into both faces. However, from the middle of the sequence onwards (c. 350 KBP), flakes were produced preferentially from one dedicated flaking surface – essentially, Levallois flaking. By the final occupation of the site (298 $\pm$55 KBP; ash within level 2 has been correlated with the eruption of Mont-Dove-Sancy around 300 KBP), core working techniques are dominated by Levallois flaking, which is applied to pebbles, as well as the plaques and flakes used previously. Moreover, a variety of Levallois techniques were used, including recurrent centripetal, unipolar and bipolar methods, as well as the complete-re-preparation of Levallois surfaces between exploitation phases (Moncel *et al.* 2005). Levallois flakes form blanks for a variety of flake tools present in the upper levels. Essentially, Orgnac 3 reflects a fusion of the principles of *façonnage* and *débitage* in an entirely localised – potentially raw material-based – manner (the attempt to remove large, broad flakes for tool blanks from such raw material requiring a shift to flaking a surface). A variety of Levallois techniques are already present at Orgnac by 300 KBP; the inherent flexibility of Levallois flaking seems to be immediately released once the concept is adopted.

A similar pattern has also been suggested for material recovered from a series of loess quarries at Achenheim, near Strasbourg. Here fluvial sediments deposited by the Rhine and its tributary, the Bruche, are surmounted by a deep loess sequence subdivided by four soil horizons (Vollbrecht 1995). Cores showing evidence for the deliberate preparation and exploitation of a dedicated flaking surface were recovered from throughout loess deposits correlated with the onset of Saalian glacial conditions, and are argued to gradually increase up the sequence, again reflecting the gradual local emergence of Levallois technology in this context (Junkmanns 1991, 1995). Levallois flaking first appears in layer 20a of the site (dated to between 278$\pm$36 and 244$\pm$31 KBP; TL determinations on overlying and underlying sediments; Buraczynski and Butrym 1987) and represents the dominant mode of flake production by Levels 20-18 (TL determination of 222±29 KBP on sediments from Level 20; Buracynski and Butrym 1987). Notably, the use of finer grained raw material increases with the adoption of Levallois flaking, as does the proportion of retouched tools (predominantly scrapers and points), whilst pebble tools are produced less frequently (Junkmanns 1991, 1995). The Achenheim sequence not only attests to the local emergence of Levallois flaking at the onset of OIS 8, but also to other related changes in technological behaviour; it could be argued that in this instance the increasing dominance of retouched Levallois products on better-quality raw material was related to the progressive masking of the Rhine gravels, which had previously acted as a source of raw material. Such a situation could be seen as either leading to or requiring a more logistical technological approach – provisioning at sources outside the immediate area, and the transport and retouch of particular products – in order to continue exploiting the environs of Achenheim.

Whilst Orgnac, and potentially Achenheim, represent sequences within which a particular developmental trajectory can be traced, other European sites also reflect the application of the Levallois concept in different ways prior to OIS 7. At Purfleet (Section 4.1; White and Ashton 2003) flaking was deliberately orientated on particular, hierarchically organised core surfaces, through preparing a platform (and hence orientating the flaking axis) in relation to pre-existing convexities. The production of flakes from a surface at Purfleet contrasts notably with the core-working techniques apparent in the lower units (Purfleet and Little Thurrock Members), despite the fact that similar raw material was available throughout the aggradation of these sediments. The intention appears to be the production of larger, broader flakes than could be obtained through the flaking of a volume; when such convexities were not already present on a selected nodule, they were occasionally imposed - either through deliberate surface preparation – classic Levallois flaking - or once an initial attempt to exploit the core using another flaking technique (i.e. discoidal) had resulted in the creation of the convexities necessary to adopt such an approach.

A similar co-occurrence of fully prepared and minimally prepared cores is also represented by the site of Markleeberg, south of Leipzig in Germany, where a large collection of artefacts (>4500) – some in near primary context - was recovered from sandy gravel at the base of the Main Terrace of the Pleiße/Gösel river. The Main Terrace complex of the Leipzig lowlands separates the fully interglacial deposits of the Holsteinian from Saalian glacial deposits, and attests to a period of marked valley widening and extensive gravel deposition (Eissmann 2002, 1305). At Markleeberg, the terrace is surmounted by older Saalian till containing a characteristic suite of Scandinavian erratics (Eissmann 2002, 1314), indicating a pre-OIS 8 date for the archaeological material; the gravels themselves appear to have been targeted as a raw material source. Very few handaxes are present, and the assemblage as a whole predominantly comprises cores and flakes, amongst which are a number of fully-prepared Levallois cores (*Volkerne)* together with some *Abbaukerne*, or partially prepared cores (Baumann and Mania 1983). Illustrations of the latter closely resemble the simple prepared cores from Purfleet, whilst the former do not appear to have been subjected to a protracted phase of surface preparation; rather, the convexities appear to be simply emplaced using a series of bold removals. A variety of exploitation methods seem to have been employed, including unipolar and centripetal recurrent techniques. Notably, the few handaxes from the site (< 2.5% of the combined assemblage; Baumann and Mania 1983) are on small pebbles, in contrast to the larger clasts which are used as sources of flakes.

As at Markleeberg, Mesvin IV, Belgium, also exhibits evidence not only for Levallois flaking during early OIS 8, but also the application of recurrent exploitation methods (centripetal). The site produced fluvially re-arranged but minimally disturbed refitting material associated with an early Saalian fauna from the Mesvin terrace (Roebroeks and Tuffreau 1999, Tuffreau 1995), again indicating not only the emergence of Levallois flaking in Europe by OIS 8, but also that several Levallois methods were variably applied by this point. Similarly, Tuffreau (1995) suggests that uni- and bipolar recurrent techniques were used at Argouves, (Lower terrace complex of the Somme; OIS 8). Within northern Europe, therefore, there not only appears to be widespread evidence for the emergence of Levallois flaking prior to OIS 8 (perhaps from 350 KBP onwards at Orgnac 3), but also of immediate local variation in the specific methods used.

Given this almost immediate diversification in the use of specific Levallois methods, it could be suggested that once the volumetric principles underwriting the Levallois concept were in place, then the potential of organising flaking in this way (particularly in terms of economy, as evidenced by recurrent exploitation) was immediately apparent. Notably, instances of more than one flake being removed from a co-opted handaxe are extremely rare (e.g. a single example from Cagny-La-Garenne; Tuffreau 1995). This could suggests that although such precocious examples do, strictly speaking, represent exploitation of a handaxe surface utilising the volumetric principles which define the Levallois concept, the actual potential of combining the principles of *façonnage* and *débitage* was not realised. Such instances could be viewed as "non-reflexive"; just as producing a handaxe on a flake blank can be viewed as the sequential employment of these operational systems (*débitage* followed by *façonnage*; White and Ashton 2003), then removing a flake from a handaxe in this way could be interpreted as the sequential application of *façonnage* followed by *débitage*.

Arguably, the emergence of discoidal flaking techniques as a deliberate strategy, rather than merely the end result of prolonged alternate flaking, could be argued to reflect the fusion of principles of *façonnage* and *débitage*, equivalent to the recombination necessary for Levallois flaking. Both Levallois flaking – either in terms of simple prepared cores, or "classic" Levallois cores attesting to surface preparation - and discoidal flaking were practiced at Purfleet by late OIS 9, attesting to a notable change in flintworking behaviour by this point. On a European scale, there are also suggestions that Levallois flaking does emerge as one of several key changes in approaches to coreworking; for instance, at La Micoque in the Aquitaine Basin, levels 3 and 4 (>300 KBP; ESR-US; Falguères *et al.* 1997) are also argued to attest to the apparent co-emergence of several flaking methods; in Bed 4, techniques which reflect the removal of side-struck flakes from prepared cores (once termed "Tayacian"; Rolland 1986) dominate, whilst in the overlying Bed 3 discoidal, simple Levallois and Quina techniques become more important (Rolland 1986, 1995). Arguably, therefore, concentrating on the emergence of Levallois alone rather misses the point of what is happening at this time; through the bringing together of aspects of *façonnage* and *débitage* in an integrated manner, a variety of novel methods become possible.

The widespread emergence and diversification of Levallois techniques within Europe is significant in several ways. Most obviously, the evidence for a variety of Levallois flaking techniques being applied at the same time as such techniques may have been emerging in Africa, suggests that it cannot be viewed as an intrusive and biologically-driven phenomenon. Secondly, the manner in which Levallois appears in Europe is not suggestive of the adoption of a fully developed technology; not only can particular developmental sequences be observed, as at Orgnac 3, and potentially La Micoque and Achenheim, but other instances of early Levallois also seem to be closely embedded in their local circumstances. For instance, at Purfleet, most simple prepared cores take advantage of the existing convexities of the selected nodules; similar raw material was available when hominins were active at the site during earlier periods, but the choice was not made to orientate flaking in this way, marking a conceptual difference in the way flakes were produced. Given the fluvial context of the Purfleet site, this might represent a situation in which chronological resolution of the scale apparent at Orgnac is simply not accessible (White and Ashton 2003).

Not only is the emergence of Levallois closely linked to immediate diversification, but also, in many instances, the technique actually emerges in close association with other novel methods of core working, reflecting the application of different volumetric principles. These can be argued to also suggest the integration and application of the concepts of *façonnage* and *débitage* in different ways. However, although such techniques are variably applied throughout the Middle Palaeolithic, the dominance of Levallois perhaps reflects more strongly its inherent links to other changes in behaviour. For Foley and Lahr (1997), the lasting adoption of Levallois reflects the success of incoming African hominins bearing such technology, whilst the sporadic manufacture of handaxes throughout the Middle Palaeolithic is argued to reflect the co-presence of an existing, potentially *heidelbergensis*-derived, local group. However, accepting an autochthonous origin for Levallois flaking leads one to question why it became so widely practiced in Europe after OIS 8.

As suggested above, the early diversification of Levallois techniques, and in particular, the application of recurrent exploitation methods, suggests that once the concept had arisen, then the inherent possibilities of the system were immediately apparent. Recurrent exploitation allows the production of several flakes with similar morphometric properties from one core; such blanks are relatively thin and light for their size, and lend themselves to transport and subsequent transformation. Such a system could be argued to "release" hominins from their immediate environment, allowing exploitation of wider landscapes away from the prosaic constraints of immediately available raw material. Arguably, this "release from proximity" (Roebroeks 2001, 451) was a significant facet of hominin behavioural adaptation to temperate latitudes from the earliest occupation of Europe onwards, successful hunting requiring complex information exchange and teaching/learning practices which transcended the immediate environment. However, it is not until the Middle Palaeolithic and the changes in technological organisation associated with the advent of Levallois technology that such practices become archaeologically visible, reflecting a marked intensification of such behaviours.

Achenheim is potentially significant in this respect; a total of only 618 artefacts were recovered from the early Middle Palaeolithic levels (late OIS 9 - 7) throughout 50 years of collection (Vollbrecht 1995). Many of the artefacts are retouched tools or points; although it is difficult to account for collection bias, one could argue that any lithic artefact would be visible to the collector in such fine-grained sediments, and therefore that this represents the actual proportion of retouched artefacts present at the site – particularly given that when the Lower Palaeolithic fluvial levels were exposed, many more unretouched artefacts were recovered from a situation in which visibility is reduced. Moreover, it is also notable that many more of these artefacts are produced using fine-grained raw materials than in lower levels at the site (Junkmanns 1991, 1995). Given the very low recovery rate of predominantly retouched artefacts, from a situation in which the favoured raw material may not have been immediately available, one could interpret the Achenheim loess sequence as attesting to the occasional discard of curated tools by early Middle Palaeolithic hominins engaged in the wider exploitation of their landscapes. That such behaviour is apparent from the point at which Levallois emerges onwards emphasises the close relationship between Levallois technology and extended provisioning and planning practices, allowing early Middle Palaeolithic hominins to engage with their landscapes on a wider scale.

The sedimentation of Levallois flaking practices in connection to technological patterns suggestive of extended curation and exploitation of wider landscapes is perhaps particularly significant considering that OIS 8 is widely accepted as the period in which the highly specific "Mammoth steppe" biotope (Guthrie 1984, 1990) spread into the west of the continent. This period witnesses the first appearance in the region of species such as *Mammuthus primigenius* and *Coelodonta antiquitatis* (Gamble and Roebroeks 1999). A variety of early Middle Palaeolithic sites attest to hominin exploitation of these cool-cold, open environments, including Baker's Hole (Late OIS 8; Section 5.1), Markleeberg (early OIS 8; Baumann and Mania 1983, Eissmann 2002) and Mesvin IV (OIS 8; Cahen and Michel 1986). Whilst the rich, steppic environments posited for such areas are characterised as highly productive, with diverse gregarious faunas (Guthrie 1984, 1990), their successful exploitation may have demanded tracking these animals over increasingly long distances, particularly in the context of seasonal migrations. Given the expansion of the mammoth steppe to the west, technology that released hominins from the need for continual access to raw material may therefore have become essential, allowing them to successfully exploit such environments.

However, it does not follow that a technological system that, with the benefit of archaeological hindsight, can be described as "better", should necessarily become widespread. Hosfield (2005) emphasises that particular demographic conditions may encourage the lasting adoption of innovative technological practices; small populations are argued not to favour imitation and adoption, since individuals within larger populations are, in general terms, biologically fitter and more likely to be successfully imitated (Shennan 2001). Moreover, within small groups, mechanisms of social learning and transmission are reduced and any innovations, even if adopted, will swiftly pass out of practice (*cf.* Mithen 1994). Within larger populations, transmission of technological practice can occur both vertically (parent-offspring) or horizontally (between peers), meaning that once adopted, new practices are more likely to be retained and re-enforced within the apparently extended body of social knowledge available to a large group. Using artefacts from separate terrace formations of the Solent as a proxy for population size, Hosfield (2005) suggests that hominin populations in the region were small during OIS 13 and 11, but increased significantly during OIS 9 – the period within which Levallois emerges, both locally and on a European scale. He therefore suggests that elevated population size during OIS 9 may have resulted in larger group sizes, providing the social framework necessary for the lasting adoption and transmission of this technological innovation.

However, not only do significant difficulties obviously exist with using artefacts as proxies for population numbers, but one might also question whether elevated population numbers need necessarily result in extended group size. Moreover, it is unclear whether the Solent results can be extrapolated to infer increased population and group size on wider scale; similar estimates of population size for the Middle Thames (Ashton and Lewis 2002) are argued to suggest a decline in population from OIS 9 onwards (although re-analysis of their suggested figures actually indicates an increase in artefact numbers, analogous to the Solent pattern; White 2004). It is also possible that this apparent increase in artefact numbers over time may reflect a pattern of derivation from overlying terraces (White 2004).

However, it does seem possible that elevated population size during OIS 9 on a European scale could represent one mechanism whereby the apparent innovation in technological practice represented by the recombination of the principles of *façonnage* and *débitage* might have become widely-adopted. In contrast, innovations approaching the Levallois technique during earlier periods (e.g. Cagny-La-Garenne) neither became fixed nor widespread; given smaller group sizes, such techniques may not have been maintained and quickly faded from archaeological view. Concomitantly, such innovative practices may not have been maintained for a sufficient period to allow them to be utilised within the context of other emerging behaviours within which they may have proved advantageous. The spread into western Europe of environments within which increasing reliance on predictable prey availability may have become increasingly important – the mammoth steppe – may represent a situation within which exploitation of landscape on a wider scale and technological provisioning became more important. Such patterns clearly demand investigation on a European scale, but it does appear that the British pattern might suggest a demographic setting within which innovative practices may have become widely practiced.

6.4 Changing technological practice; exploiting Levallois technology

An almost immediate diversification in the manner in which the Levallois concept was applied is apparent from the earliest Middle Palaeolithic onwards. Taken as a whole, the early British Middle Palaeolithic is dominated by the use of the Levallois technique, and from late OIS 8 onwards, variation is apparent not only in terms of the static endproducts present at various sites (points, blades, flakes etc.), but also in the particular methods used to produce them. Notably, handaxes were rarely manufactured during this period in Britain, and most of the sites examined during this study which were previously claimed to attest to the co-occurrence of Levallois flaking and handaxe manufacture actually reflect a situation in which material of different ages has been conflated.

Handaxes from the Yiewsley area of West London are generally rolled, in contrast to the fresher Levallois material from the area. Where recovery context can be established (from annotations of depth and sediment descriptions on artefacts collected by John Allen Brown), it seems clear that handaxes were recovered from within the gravels of the Lynch Hill terrace, whereas Levallois material was collected from the terrace surface beneath the periglacial deposits (Ashton *et al.* 2003 and personal observation; see Section 4.3). Similarly, a single handaxe from Creffield Road is in different condition to the main Levallois assemblage; this retains no details of recovery context and may have come from a different level (Section 4.2). At Jordan's Pit, Brundon, clear contrasts in condition are apparent between the Levallois material and handaxes from the gravels, suggesting that the latter may have been derived from an earlier deposit (*contra.* Wymer 1985; see Section 5.5); the same is true of Baker's Hole (Section 5.1), where, given recovery methods, abraded handaxes have been regarded as derived from a higher terrace since the earliest investigations of the site onwards (Abbott 1911, 468; Smith 1911, 521; Dewey 1930, 149; Haward unpublished notebook, British Museum Archive). Similar contrasts in condition are also apparent between Levallois material and handaxes from particular sites in the Ouse Valley (e.g. Fenstanton, Meadow Lane, St. Ives, Hemingford Grey). At these sites, Levallois material is frequently abraded, whilst handaxes are less rolled (personal observation July 2004).

The two handaxes recovered from the Ebbsfleet Lower Gravels reflect the fact that handaxes were occasionally manufactured during the early Middle Palaeolithic in Britain, although it is perhaps worth noting that one is partial and the other thick and asymmetrical. The atypical (in contrast to Acheulean and later Middle Palaeolithic handaxe forms) handaxes from Ebbsfleet could be argued to represent individual tools produced to fulfil specific tasks at a particular time; however, the overwhelming dominance of Levallois flaking, both at the site itself and British earlier Middle Palaeolithic sites as a whole, suggests that although hominins were fully capable of making handaxes, their manufacture does not appear to have formed a significant part of technological practice during this period. Notably, only two British sites currently dated to this period are dominated by handaxes. At Harnham, Wiltshire, handaxes and refitting material resulting from their manufacture were recovered in mint condition from gravels and sands deposited by a tributary of the Avon, as well as overlying soliflucted chalk. OSL and amino acid determinations suggest that the sand/silt which overlies the gravels and is sealed by the solifluction deposit dates to around 250 000 BP (early OIS 8; Whitaker *et al.* 2004). However, the site is as yet minimally published and the reliability of the dating cannot currently be established; this particularly applies to the AAR analyses. At Broome, in the Axe valley, handaxes were recovered from throughout a tripartite fluvial sequence; these are predominantly ovate in planform, and OSL determinations suggest that the sediments may have accumulated between 250-270 KBP (Hosfield 2005). However, the assemblage as a whole is fairly rolled (Hosfield 2005, 233), in marked contrast to the near primary context sites upon which this study has concentrated.

A significant exception to the pattern of dominant Levallois flaking is Pontnewydd Cave, situated 50 m. above the modern river cutting through the limestone valley of the Elwy. Deposits within the cave are predominantly allochthonous in origin and attest to deposition and erosion over a period of some 300 000 years (Green 1984, Aldhouse-Green 1993). Over 600 artefacts, including both handaxes and Levallois material, have been recovered from the site, mostly from the Lower Breccia; their condition suggests exposure during cold conditions outside the cave before they were swept in (Aldhouse-Green 1988). TL and U-series dates on the Lower Breccia suggest an age in excess of 220 KBP, in agreement with the OIS 7 affinities of the mammalian assemblage (Schreve 1997). A variety of local raw materials, predominantly of volcanic origin, have been used to manufacture the artefacts (Aldhouse-Green 1988) and the Levallois methods practiced at the site are described by the excavator as "crude" and "inept" (Green 1983). Given the coarse-grained nature of the available material, it is possible that this represents a situation in which Levallois flaking simply could not be reliably practiced; handaxe manufacture may therefore have been locally adopted in order to produce large tools with cuttings edges (White *et al.* in press). However, given the allochthonous origin of the material within the Lower Breccias, it is also possible that artefacts resulting from separate occupations may have been combined within the debris flow.

It therefore seems apparent that in Britain, once Levallois technology became widely practiced, handaxes were rarely manufactured and did not represent a significant part of the technological repertoire of earlier Middle Palaeolithic hominins. This apparent inverse relationship between handaxe production and Levallois flaking is also evident within Europe, as well as further afield. Few primary context *western* European sites dominated by Levallois have produced any evidence for handaxe manufacture. A similar pattern is apparent within the African Middle Stone Age; once fully-developed prepared core techniques become widespread, handaxes disappear from the archaeological record (with the exception of sites in the Congo; Rolland 1995, Foley and Lahr 1997). However, in Central and Eastern Europe, handaxes are only present following the adoption of prepared core technology during OIS 8, after which point both elements are present within particular assemblages (Conard and Fischer 2000, Conard and Prindiville 2000)

The apparent inverse relationship between either technological option (Levallois flake production or handaxe manufacture) seems to suggest that Levallois products may have been used in a similar way to handaxes. Levallois products – particular those produced using a lineal technique – share many morphometric properties with handaxes; they are relatively broad and large, with a long, continuous cutting edge. Given that handaxes are generally interpreted as cutting tools (Mitchell 1995, Austin and Roberts 1999), it seems reasonable to assume that a Levallois flake with similar properties could have been used in the same way. Concomitantly, Levallois flakes are relatively thin in comparison to their size; whilst this is a property which many well-made, Lower Palaeolithic handaxes exhibit following extensive thinning, a large Levallois flake is necessarily configured in this way, as it is removed from the lesser volume of the upper, flaking surface of an asymmetrically-configured Levallois core. However, producing a large, lineal Levallois flake only involves a single shaping phase in order to configure the upper flaking surface of the core. Accidents may occur (overpassing, flexion) when the flake is removed (usually when producing very large flakes – see Baker's Hole and Lion Pit Tramway Cutting; Sections 5.1 and 5.2), but successful Levallois flake removal produces a "ready-shaped", unifacial, "handaxe" (a point made by Smith in 1911, in his discussion of the material from Baker's Hole). In contrast, the extended thinning phase necessary to produce a handaxe as thin as most Levallois flakes represents a period within which knapping errors (i.e. endshock) are increasingly likely to occur. Levallois flaking could therefore be viewed as a means of producing reduced-weight blanks with the functional properties of handaxes, using a method less likely to result in irreversible mistakes.

Evidence from several British sites indicates both the production and maintenance of handaxe-like blanks, as well as the deliberate selection of broader, larger products from amongst the range resulting from various recurrent techniques. At Baker's Hole (Section 5.1) large nodules of fresh flint were immediately available, and recurrent techniques were employed to produce several large products from each core. Cores were not exhaustively worked, potentially suggesting that large flakes were a desired endproduct; instead new cores were prepared using the ubiquitous large nodules of raw material, allowing more large flakes to be produced. Not only are most of the Levallois flakes from Baker's Hole morphologically similar to handaxes, but most retouched flakes retain flat, invasive to semi-invasive retouch – frequently amounting to bifacial or ventral thinning. This would have changed neither the angle nor form of the modified edge, and is therefore interpreted here as deliberately applied in order to strengthen or re-sharpen the existing cutting edges, rather than changing the possible functional or prehensile affordances of the tool. Effectively, most have been retouched in order to preserve the existing functional possibilities of the unmodified Levallois flakes from the site.

Although a very different approach to Levallois flake production was undertaken at Crayford, a similar emphasis upon large, broad blanks is also apparent (see Section 5.3). The endproducts missing from the exploitation phases of the refitting Levallois sequences are often wider than the majority of the debitage, which is laminar in nature, suggesting that although a reduction method was necessarily adopted that resulted in the production of elongated material, large, broad blanks were a desired flake form. It is also notable that all the larger British Middle Palaeolithic assemblages attest to the use of various recurrent techniques, whereby several large flakes can be produced during any given exploitation phase. If, as suggested above, Levallois flaking can be viewed as a means of producing "handaxe" blanks of around half the weight of a normal, biconvex handaxe of the same dimensions, which could rarely be so extensively thinned without breakage, then recurrent methods allow the production of several such blanks from a single core surface. These are arguably replaceable toolkit elements but do not notably increase the weight of equipment carried; the shift towards multiple blank production represents a more maintainable technological strategy (*cf.* Bleed 1986) than individual handaxe manufacture, potentially allowing hominins equipped in this way to exploit situations in which resources can be less reliably predicted.

The production of several blank forms not only represents a maintainable technological strategy, but also introduces greater potential flexibility. Not only can several blanks be produced from a single Levallois core, but these products can be retouched in a variety of ways; Levallois flake blanks, once produced, were not treated as fixed tool forms, but could function as supports for a variety of tools. For instance, during the early OIS 7 interglacial exploitation of the Ebbsfleet gravels, blank forms were retouched in a variety of ways (see Section 5.1), both transforming (i.e. notching, blunting) and preserving the properties of existing flake blanks. Concomitantly, through the sequential application of retouch, the use-life of such tools can be prolonged (*cf.* Dibble 1987), again emphasising their maintainable aspect as individual pieces. Landscape studies within fine-grained sediments indicate the maintenance and transformation of Levallois products away from production locations, as reflected by elevated proportions of retouched tools and tools fragments (e.g. Site N, Maastricht-Belvédère; Roebroeks *et al.* 1992). Obviously, flake tools were also retouched in a transformative fashion throughout the Lower Palaeolithic, and handaxes were rejuvenated in order to preserve their cutting edges (e.g. tranchet removals on handaxes from Boxgrove; Pope and Roberts 2005). However, these practices of tool maintenance and transformation are magnified with the widespread adoption of Levallois technology; rather than being optional solutions to particular problems, flexibility (through transformation) and maintainability (either through element replacement or tool rejuvenation) become integral parts of the entire technological project.

6.5 Flexibility and technological practice; the variable selection of different Levallois methods.

The widespread acceptance of Boëda's volumetric definition of the Levallois reduction strategy has allowed researchers to recognise variability in the particular methods employed to achieve Levallois flake production. Methods may vary both in terms of how the working of a particular core is initialised (preparation) and how flakes are produced (exploitation), but methods themselves are defined as conceptually separate guiding plans of action, reflecting the precise ways in which the abstract representation of the Levallois concept were materially realised (Boëda 1986; 1994). Given that most archaeological evidence reflects the fact that several methods are actually employed flexibly throughout core reduction (Dibble 1995, Meignen 1995, Schlanger 1996), and for the sake of clarity, this study has treated methods of preparation and exploitation as separate but intimately related stages of working each Levallois surface. Within these, variability can be delimited which is explicable in terms of different situational demands – for instance, preparation/initialisation is most closely related to raw material at the beginning of reduction, but may change throughout exploitation in order to successfully produce particular sorts of product. Although individual Levallois products have been described in terms of the specific preparation and exploitation strategies employed, an attempt has been made to relate these to the reduction stage at which specific methods were used, and to examine why this might be so in given situations. This study therefore emphasises the specific local conditions within which variability is apparent, whilst exploring the extent to which particular techniques may represent knowledgeable plans of technological action.

The early British Middle Palaeolithic record reflects enormous variability in the application of particular preparatory and exploitation techniques. The first level upon which such variation is apparent obviously relates to immediate local conditions, and, in particular, raw material size and form. Nowhere is this more obvious than at Crayford, where at least a proportion of the extant Levallois sequences were undertaken using elongated cylinders of locally available fresh flint. Initial preparation was frequently undertaken using elongated flakes from polarised platforms, deliberately reducing the upper surface volume of the cores in order to actively impose Levallois surface convexities (see Section 5.3). In contrast, at Baker's Hole, available raw material was extremely large, and it appears that bipolar preparatory techniques were favoured early in reduction, from the largest core surfaces, with a shift to centripetal preparation later in reduction, when flaking surfaces were smaller. This might relate to the fact that a broad flake – such as is encouraged by centripetal preparation – from a very large core surface would require the controlled application of extreme force for successful detachment, and may then have been too unwieldy to use if not reworked further. The use of bipolar preparation early in reduction to produce very large flakes might relate to the fact that guiding longitudinal removals favour the removal of flakes from the centre of the core, opposed scars at the distal end encouraging successful detachment without overshooting. In this instance, preparatory strategies may have been deliberately adopted to successfully produce longer, thinner flakes from very large core surfaces (see Section 5.1).

Evidence for the application of preparatory strategies deliberately geared towards the production of particular types of Levallois product is also apparent within the British sequence. At Creffield Road (Section 4.2) preparatory strategies were used throughout core reduction which favoured the removal of pointed endproducts; bipolar preparation would favour the removal of large pointed products from large core surface (Van Peer 1992) and was used during the earliest stages of reduction; unipolar (and especially convergent) strategies favour the detachment of pointed products from smaller flaking surfaces (Boëda 1982) and were used later on, when flaking surfaces were reduced in size. The frequent application of "*Chapeau de gendarme*" platform preparation arguably also suggests deliberate point production, as these strategies demand the exploitation of a very specific flaking axis (to utilise the distal convexity emplaced either by previous convergent removals or working from the distal end). "*Chapeau de gendarme*" platform preparation encourages restricted placement of the percussor in relation to the necessary flaking axis, suggesting deliberate point production. Concomitantly, debordant flakes - which must necessarily have been produced in the course of unipolar convergent recurrent reduction – are not present; these have elsewhere been suggested to represent deliberately produced and utilised endproducts (Beyries and Boëda 1983). However, their absence at Creffield Road suggests that points *were* a desired endproduct, and methods deliberately applied in order to produce them. The deliberate adoption of particular preparatory strategies throughout reduction favouring the production of particular types of endproduct – as at Creffield Road (Section 4.2) and Baker's Hole (Section 5.1) - clearly demonstrates that Levallois reduction does represent a distinct technological strategy geared towards the production of predetermined endproducts, and cannot be characterised as simply another method of core reduction (*contra* Dibble 1995, Davidson 2002; *cf.* Van Peer 1992).

Preparatory methods can therefore be shown to vary on one hand, in response to immediate material constraints, and on the other, in response to specific technological objectives. As already stated, for purely practical analytical purposes, (Section 2.3.4, Section 3.3.4) preparatory techniques have been treated here as a separate stage of core working. However, in particular instances technological actions do suggest that these stages actually were conceptually separated. For instance, at Crayford, individual reduction sequences reflect deliberate platform preparation once Levallois surface convexities had been established, before actual exploitation of this surface commenced (see Section 5.3). However, even when such separation can be suggested, preparatory techniques and exploitation methods remain intimately related. Variation in exploitation strategies revolves around two main factors; firstly, whether a recurrent or lineal approach was undertaken, and secondly, the deliberate production of specific types of endproduct, both of which depend directly upon the method of preparation adopted. Frequently, recurrent strategies produce a number of variable, transformable and transportable flake blanks, from amongst which the most suitable for a particular task can be selected; the material from the Yiewsley sites exemplifies the diverse array of material resulting from a variety of recurrent strategies (Section 4.3).

Recurrent exploitation primarily relates to the maximisation of production from a given core surface, but also affects the morphology of resultant products. For instance, polarised recurrent exploitation produces fairly elongated flakes, as with the Levallois material from the Ebbsfleet Lower Gravels (Section 5.1). Similarly, unipolar convergent preparation cannot be fully disassociated from recurrent exploitation – Levallois removals (debordant flakes and Levallois points) functioning in a predetermined and predetermining manner to continuously recreate the convexities necessary for further exploitation (Boëda 1982, 1986). In such cases (as at Creffield Road) the choice of exploitation strategy relates to both deliberate endproduct shaping and the desire for continuous blank production, underlining the fact that preparation and exploitation are part of the same process. Significantly, when particular sorts of endproducts do appear to be favoured (e.g. the apparent selection and transport of larger, broader flakes at Crayford), hominins do not appear to deliberately switch to strategies which would produce flakes with these apparently desirable properties – for instance, in this case, centripetal preparation would have encouraged the detachment of broader products.

The fact that there seems to be no evidence for the interchangeable application of conceptually distinct preparatory schemes has implications for how active technological choices were made by Middle Palaeolithic hominins. Whilst a vast array of possible options were open to them, once a particular reductive path had been embarked upon, the subsequent choices made appear to be at least partially directed by previous technological strategies. Innovative leaps between particular strategies do not appear to have been made; where reduction trajectories can be traced, they appear to evolve in response to the modified form and possibilities of the core, rather than as deliberately imposed, conceptually distinct plans of actions. This approach can be characterised as both responsive and reflexive, being informed and influenced by preceding choices, but innovative transformation within reduction does not appear to have been an available option.

Although separate Levallois methods can be delimited in analytical terms, there seems little evidence that they were conceived of by hominins as proscriptive formulas for working flint. Rather, particular strategies seem to be worked out in the context of action through ongoing engagement with material; Levallois methods represent structuring principles through which particular outcomes (maximisation of number of products, basic morphometric properties of products) can be achieved in a number of ways. Hominins did not set out "to do" unipolar recurrent reduction; instead, such methods represent the particular ways in which knapping evolved throughout flint reduction in given situations. Where refitting material allows such statement to be made, there is further good evidence for the fluidity with which particular Levallois methods emerged throughout the process of flintworking. A single refitting core from Site C, Maastricht-Belvédère (Schlanger 1996) attests to the repeated, variable application of diverse recurrent and lineal techniques, resulting in endproducts of relatively standardised size and shape. The core was re-prepared several times throughout reduction, following the recognition of a sufficient distal convexity and preparation of the Levallois surface in respect to this. In the course of Levallois reduction, flakes (Levallois and preparatory) were removed from core surfaces in a manner which allowed the generalised goals of flint working to be achieved, whilst responding to the changing form of the core itself (Schlanger 1996); particular trajectories never appear to have been conceived at the outset and imposed upon the material.

The privileging of Levallois methods as conceptually separate entities actually implies technological inflexibility on the part of Middle Palaeolithic hominins; that they acted as technological automata once a particular strategy had been adopted. In fact, the variety of Levallois techniques employed within the reduction of individual cores, and the manner in which particular trajectories can be shown to evolve "in hand", suggest a knowledgeable and skilful engagement with the material world in which action was continually constructed in respect to probable outcomes and previous action. This is not to suggest that each act was consciously evaluated, but that hominins possessed both the conceptual knowledge of possible options, and practical know-how of how to achieve them, necessary to make such choices. What they do not appear to have done is make innovative leaps between available options; if a path was not already suggested by actions already undertaken and their material effects, it was not followed. In their approach to lithic reduction, Middle Palaeolithic hominins are neither obligately reactive nor entirely free to undertake innovative acts independent of previous action. Rather, the application of the Levallois concept as a plan-like principle (Schlanger 1996) for undertaking technological projects both constrained and provided a structure for individual action.

6.6 Variability between sites; Levallois technology and the logistical organisation of Middle Palaeolithic landscapes

Detailed examination of the technological practices represented by particular British Middle Palaeolithic assemblages reflects the diverse range of Levallois preparatory and exploitation methods employed, as well as situational factors which may have influenced such variability. However, moving from observations of individual technological actions undertaken within sites to a characterisation of how hominins were actually exploiting the landscapes within which they were active entails the integration of a several scales of analysis. As noted above, material from particular, chronostratigraphically secure European sites suggest that Levallois was a highly mobile and curated technology. Within individual sedimentary envelopes, refitting material reflects the selective transport and transformation of Levallois endproducts (e.g. Maastricht-Belvédère; Roebroeks and Henniken 1987, Roebroeks *et al.* 1988). Similarly, within Middle Palaeolithic assemblages from sites in areas with a variety of well-characterised raw-material types – in particular, the Aquitaine Basin (Geneste 1985) - Levallois products are over-represented amongst the non-local component of lithic assemblages, suggesting preferential transport of Levallois flakes and cores. This pattern is apparent from OIS 7 onwards in Western Europe; from the earliest Middle Palaeolithic, material transported over distances greater than 4-10 km was preferentially carried in the shape of pre-formed cores and finished tools, and especially Levallois products (Féblot-Augustins 1999). However, there are few changes in the absolute distances over which material was transported between the Lower, and earlier Middle, Palaeolithic.

Site	Probable Date	Assemblage Size	Context and Integrity	Environment	RM	Probable RM Source
Botany Pit, Purfleet, Essex	Early 8	108 (3 flakes, 105 cores)	Within fluviatile sands and gravels of Lynch Hill Terrace. Primary & secondary context	Riverine, cool-cold.	I	Chalk flint eroding directly from channel edges
West London; Yiewsley area	Late OIS 8/7	290 (264 flakes, 26 cores)	On top of Lynch Hill Gravel, below solifluction gravel and brickearth. Integrity unclear, minimally reworked	Riverine/valley side.	I	From local gravel
Creffield Road, Acton	Late OIS8/7	186 (171 flakes, 15 cores)	On top of Lynch Hill Gravel, below brickearth and periglacial gravel. Primary context	Riverine/valley side.	I	From local gravel
Lion Pit, West Thurrock Essex,	Late 8/Early 7	156 (137 flakes, 19 cores)	In situ on top of Crayford Gravel of Mucking Terrace Formation. Primary context	Riverine. Fully temperate; open environment, adjacent woodland and marshy areas.	I	Chalk flint eroding from channel edge and a lag gravel composed of large minimally weathered nodules
Baker's Hole, Kent	Late 8	> 227	Within chalk rubble. Primary context	Riverine. Cold, open	I	Chalk flint accessible at channel edge
Ebbsfleet Channel, Kent	Early 7	90 (80 flakes, 18 cores)	Within gravel. Primary & secondary context	Riverine. Fully temperate; open grassland, woodland nearby.	I	Large clasts from banks and bars of river
Crayford, Kent	Later 7	> 120 (> 113 flakes, > 7 cores)	Within Lower brickearth. Other occurrences throughout brickearths of area. *In situ.*	Slow-moving clear-bedded river, non-marshy banks. Fully temperate; open grassland.	I	Bullhead and Chalk flint eroding from channel edges.
Brundon, Suffolk	Later 7	24 (21 flakes, 3 cores)	Surface of coarse gravel beach and minimally reworked within overlying gravels. Primary & secondary context?	Riverine. Fully temperate; open grassland, adjacent woodland	I	Large clasts available in gravel beds at site.
Stoke Bone Bed, Ipswich Suffolk	Later 7	1 core	Within 'bone bed' and underlying purple clays/ primary context	Riverine. Fully temperate; open grassland, woodland present.	L	Range of local glacial/fluvial gravels; Chalk possibly outcropping within 5-10km to north

Table 6.1 *Inferred environment, context, available raw material and assemblage size of selected sites (I=immediate, L=local).*

Site	Probable Date	Levallois Sample Size	On RM source?	Technological actions	Nature of endproducts	General state of cores at discard
Botany Pit, Purfleet, Essex	Early 8	108 (3 flakes, 105 cores)	Yes	Nodule selection; variable preparation; predominantly recurrent exploitation; core discard	Large, broad flakes	Exploitable
West London; Yiewsley area	OIS 8/7	290 (264 flakes, 26 cores)	Yes	Core preparation; some evidence for recurrent exploitation; discard of exhausted cores	Elongated flakes; notable proportion of points	Exhausted
Creffield Road, Acton	OIS8/7	186 (171 flakes, 15 cores)	Yes	Nodule selection; variable preparation (bipolar/ unipolar convergent); recurrent exploitation (on and off site); import of exhausted cores and endproducts; rehafting?; discard of exhausted cores	Point-dominated; elongated flakes	Exhausted
Baker's Hole, Kent	Late 8	156 (137 flakes, 19 cores)	Yes	Nodule selection; core preparation; lineal and recurrent exploitation; limited surface rejuvenation; discard of cores with reductive potential	Very large, broad flakes	Exploitable
Lion Pit, West Thurrock Essex,	Late 8/Early 7	> 227	Yes	Nodule selection; core preparation; lineal and recurrent exploitation; discard of cores with reductive potential	Large, broad flakes	Exploitable
Ebbsfleet Channel, Kent	Early 7	90 (80 flakes, 18 cores)	Yes	Nodule selection; core preparation; lineal and recurrent exploitation; limited surface rejuvenation; discard of cores with reductive potential	Large flakes, some elongated	Potentially exploitable
Crayford, Kent	Later 7	> 120 (> 113 flakes, > 7 cores)	Yes	Nodule selection; polarised core preparation; recurrent polarised exploitation; selection of broader, larger endproducts; export of most cores	Larger, broader flakes	Missing
Brundon, Suffolk	Later 7	24 (21 flakes, 3 cores)	Yes	Nodule selection; core preparation; some evidence for recurrent exploitation; limited surface rejuvenation; discard of exhausted cores and cores with reductive potential	Medium-large, broad flakes	Exploitable and exhausted
Stoke Bone Bed, Ipswich Suffolk	Later 7	1 core	No	Lineal exploitation and discard of single core, previously subjected to recurrent surface rejuvenation	Small -medium broad flake	Exhausted

Table 6.2 Technological actions undertaken at sites considered in this study, together with dominant type of endproduct and state of cores at discard (if present).

The selective transport of Levallois endproducts has been argued to reflect the spatial and temporal disaggregation of the Levallois *chaîne opèratoire* (White and Pettitt 1995). However, reconstructing the spatial structure of technological patterning throughout reduction – rather than solely as reflected by the drop-out of select products – has been complicated by the fact that the sites invoked in such studies are usually open air occurrences, lacking chronological resolution. Classic studies of open air sites in south-west France, (and more recently, the southern Limburg Plateau; Kolen *et al.* 1999) reveal clear patterns between sites in terms of assemblage size, raw material proximity and the particular technological acts undertaken at individual sites. Most notably, within the Northern and Southern Perigord, the largest assemblages are located either directly on top of, or very close to, abundant sources of raw material (Duchadeau-Kervazo 1984, 1986, Turq 1989).

In these areas, such sites are also generally located high up, in exposed locations between interfluves; in contrast, smaller sites tend to be concentrated at lower elevations, closer to the valley bottoms, and also appear to be made up of a higher proportion of retouched tools or debitage relating to particular stages of reduction, reflecting at least some degree of specialisation (Duchadeau-Kervazo 1984, 1986, Turq 1989). Arguably, this patterning might in part relate to the temporally and spatially restricted nature of such occurrences; they may comprise material discarded in the context of a single activity, rather than material resulting from repeated occupation of a place offering access to raw material and good views of the surrounding landscape. Certainly, when area excavation and intensive survey allows such patterns to be discerned, particular large scatters can be broken up into a series of discrete concentrations, potentially suggesting that hominins were exploiting such locales over a period of time (e.g., La Croix-Guérmard, Deux-Sèrvres; Mellars 1996).

A similar pattern is apparent from survey of sites on the Southern Limburg plateau in the Netherlands (Kolen *et al.* 1999); here a variety of assemblages have been collected from valley-side situations in immediate association with raw material. Whilst most activities undertaken at these sites primarily reflect raw material extraction, the discard of heavily retouched tools and exhausted cores has been argued to suggest a cyclical relationship between the Limberg plateau and Maastricht-Belvédère in the valley below (Kolen *et al.* 1999, Roebroeks *et al.* 1992), hominins "gearing up" on the higher ground, in situations which both afforded access to raw materials and monitoring of the open valley, before venturing into the valley bottoms for primarily subsistence activities (Kolen *et al.* 1999), discarding their exhausted tool kits again when they returned. In general terms, therefore, evidence from both South-West France and the Netherlands suggests a dichotomy between higher-level sites on raw material sources – at which hominins extracted material and undertook other tasks in the context of monitoring the valley below – and low-level sites away from available raw material, at which particular Levallois products were employed and discarded in the context of a variety of other activities.

Turq (1988, 1989) proposed that this distinction can actually be further refined, and suggested that four broad types of open air site can be distinguished within the Southern Perigord, on the basis of which stages of reduction were undertaken at particular sites, as well as, to a lesser degree, the tools discarded at particular locations. "Extraction and exploitation" sites comprise occurrences located immediately adjacent to or on top of raw material sources, and are dominated by cortical debitage, in associations with "tested" nodules bearing a restricted number of removals, or which have been deliberately scratched in order to assess quality. "Extraction and production" sites are also located near available raw material, but reflect all stages of artefact manufacture from raw material acquisition to Levallois flake production. Such assemblages are made up of large quantities of debitage, including much cortical material, but are argued to contain few retouched tools or Levallois endproducts – these being assumed to have been transported for use elsewhere. "Mixed strategy sites" contain evidence for all stages of lithic reduction, but are distinguished from "extraction and production" sites by high frequencies of retouched tools and heavily reduced cores. Notably, these are the sites which are preferentially located on the highest points of interfluves and provide commanding views of the surrounding landscape. In terms of assemblage composition, Turq (1988) notes these sites contain a range of material equivalent to that obtained from cave sites, and which might in that context be regarded as resulting from a wide range of domestic or residential activities. It is tempting to speculate that such locales may in fact represent open-air residential sites, but perhaps more likely that, similarly to cave sites, their composite character at least partly relates to their palimpsest nature.

The final group of sites proposed by Turq (1988) are characterised as "episodic" occupations; these are smaller occurrences, reflecting brief, specialised activities resulting in particular types of debris, such as few retouched tools or unretouched flakes, or the debitage resulting from the working of a few select cores. Most open-air sites in the Dordogne (c. 80%; Turq 1988, 99) actually equate to this type of occurrence, but few are adequately excavated to the extent that the actual activities undertaken can be characterised with any confidence (Mellars 1996). Broad patterns of Middle Palaeolithic landscape use documented from studies in the south-west of France therefore imply an apparent separation between a large number of small, specialised sites, and fewer large accumulations, where cores were actually prepared and endproducts produced, located immediately adjacent to raw material sources. It is worth noting that these sites are undated and few means exist to disentangle the landscape palimpsests which they represent. A similar point could be made in relation to the Southern Limburg sites, for which only a generalised "Middle Palaeolithic" date can be proposed on the basis of site location in relation to deflated Saalian loess, patination and technology (Kolen *et al.* 1999, 179). However, the logistical separation between sites where hominins provisioned themselves on the higher ground, and sites in the valley to which hominins transported material, including Levallois products, to employ in the context of other activities, has been widely accepted as a classic facet of Middle Palaeolithic behaviour.

The British Middle Palaeolithic sites discussed in this study have predominantly been recovered from fluvial contexts, and all can be placed within a secure chrono-stratigraphic framework. This dataset therefore comprises a series of well-dated and environmentally characterised open-air occurrences, allowing the temporal scale upon which the complex treatment of landscape suggested by the continental evidence to be examined. A prosaic correlation between assemblage size and raw material proximity is immediately apparent within the British data set. All the larger sites (Purfleet, Creffield Road, Baker's Hole, Ebbsfleet, Lion Tramway Cutting, Crayford, and arguably Brundon) are located immediately adjacent to raw material sources (see Table 6.1). The technological practices apparent at such sites overwhelming reflect relatively complete reduction sequences, from raw material extraction and Levallois core preparation to Levallois flake production, using a variety of techniques (see Table 6.2). Using the definitions proposed by Turq (1988), almost all of these sites could be characterised as "Extraction and Production" locations (although Creffield Road better fits his definition of a "Mixed Strategy Site"; see below). Frequently, cores are abandoned at these sites that could have been exploited further – most notably at Baker's Hole, but also at Ebbsfleet, Purfleet, Lion Pit Tramway Cutting and Brundon. That such cores did have exploitable potential is underlined by the efforts made to prolong flaking in other situations – particularly at Creffield Road, where a number of methods have been employed to prolong flaking, including peripheral working of the convexities to remove a very small final flake, or complete reversal of the hierarchical relationship between surfaces (see Section 4.2).

At most sites located directly on top of raw material sources, the primary objective appears to be the production of several blanks from any one core – even where scar patterns do not attest to recurrent exploitation, a comparison of Levallois flake and Levallois flake scar dimensions does suggest that surfaces were cyclically re-prepared and re-exploited. This cyclical pattern of exploitation was not prolonged indefinitely; extended reduction would have resulted in the progressive miniaturisation of resultant products, lacking the morphometric and prehensile qualities of the larger, broad blanks which appear to be favoured at most sites. Once such qualities were compromised, new material was selected from the immediate source and flaking begun again. Such sites therefore appear to represent situations in which Middle Palaeolithic hominins were provisioning themselves with a selection of large, transformable blanks, some of which may have been used and abandoned at the site, but others of which may have been transported for use and discard in the context of wider subsistence activities elsewhere in the landscape. This prosaic working of available material once apparently desired blank qualities were compromised raises questions concerning suggestions that Levallois flaking represents an "uneconomical" use of lithic resources (e.g. Callow 1986), since to prolong flaking when an embarrassment of riches in terms of workable material was immediately available would seem to represent a waste of time and effort.

Most larger British sites therefore appear to represent situations in which hominins were provisioning themselves with large, transformable Levallois flake blanks. However, a different pattern is apparent at Crayford; whilst particular blanks do appear to be missing from the refitting sequences, most of the Levallois cores also appear to be missing. This is particularly notable given that many of the individual refitting sequences reflect the decortication and preparation of Levallois cores. In this instance, therefore, there also appears to be good evidence for the transport of cores as a future source of flake blanks. Aside from broad characterisations of most British sites as "Extraction and Production" locations, variation is therefore apparent in exactly how hominins were equipping themselves to deal with future needs. At Creffield Road, core transport can also be inferred, from the co-occurrence of material resulting from opposite ends of the reduction spectrum; on one hand, large, cortical debitage reflecting nodule selection and preparation is present, whilst on the other, extremely exhausted cores and broken endproducts were discarded at the site (Table 6.2). The fact that such intense reduction may have been undertaken away from Creffield Road itself is indicated by the lack of debordant flakes which would necessarily have been produced using the unipolar convergent method which dominates the material resulting from latter stages of exploitation.

Whilst most larger British artefact accumulations can be interpreted as places in the landscape to which Middle Palaeolithic hominins repeatedly returned to provision themselves with either flakes or cores, at Creffield Road it is possible to make some inferences concerning wider behaviour away from the immediate locale. Although it is impossible to speculate as to the likely structure and nature of the surrounding landscape within which hominins were active, one can outline the particular technological strategies through which they engaged with it. These include the use of particular Levallois methods favouring successful point production, the transport, modification and potentially hafting of these points, and the transport of cores themselves as sources of Levallois points. The material resulting from such a strategy was only discarded once hominins reached a location in which raw material was immediately available. Not only can it therefore be inferred that hominins possessed the knowledge necessary to organise their behaviour in relation to the long-term availability of raw material in their landscape, but also that they provisioned themselves in such away as to respond immediately to whatever opportunities presented themselves – travelling equipped – as well as provisioning themselves with the means to maintain this equipment in the context of action – cores as a source of points. Given the co-occurrence of exhausted cores, debitage from initial core preparation, and the residues of tool maintenance, in Turq's (1988) terms, Creffield Road best fits with his definition of a "Mixed Strategy" site, whilst most large British sites represent "Extraction and Production" locations.

It is unsurprising that ephemeral artefact accumulations resulting from the actual use of these transported tool kits are under-represented in Britain, in comparison with the large and well-contextualised assemblages which have formed the basis of this study. Such instances are less likely to be archaeologically visible than larger occurrences, not only because of reduced artefact numbers, but also the likelihood of material discarded away from classic "capture points" (for instance, fluvial, lacustrine, loessic or karstic envelopes; *cf.* Roebroeks and Tuffreau 1999) actually entering the archaeological record at all, let alone being adequately preserved throughout subsequent glacial cycles. A concomitant difficulty relates to collection issues; historically, British collectors not only focussed almost exclusively on coarse-grained fluvial sediments, but also upon those pits which had already proved archaeologically productive. A good example of this problem is the situation in the Aylesford area of the Medway, where handaxes sold to collectors by workmen at the Aylesford pits may in fact have been imported to the site for sale, potentially from New Hythe Lane, the Aylesford quarries being known as "productive" pits, whilst the latter was not (Paul Ashbee, quoted in Wymer 1999, 91). It is highly unlikely, therefore, that at the turn of the last century, when most British Middle Palaeolithic sites were discovered, archaeologically "unproductive" fine-grained sediments would have been systematically searched for artefacts on anything approaching the scale necessary to detect occasional artefacts discarded in the context of use.

Individual examples of British sites which might represent ephemeral use-sites are known; the single exhausted Levallois core from the Stoke Bone Bed (Section 5.4) may represent a curated core abandoned in the context of use, and individual non-Levallois flakes have also been reported from the same fine-grained deposits. In this situation, raw material would have been scarce; the Bone Bed itself is banked against a cliff of tertiary clays and overlies fine, matrix-supported gravels. Similarly, artefacts, and particularly Levallois material, have also been recorded in small numbers from throughout the Crayford brickearths, including the fine-grained fluvial sediments that accumulated at the same time as the Lower Brickearths at Stoneham's Pit. Whilst at Stoneham's Pit the exposed flint band was targeted as a source of raw material, progressive sedimentation throughout the rest of the Crayford-Erith area actually served to mask available raw material (e.g. the Crayford Gravels); the few products recovered throughout the brickearths may well reflect the low-level drop-out of artefacts discarded in the context of use away from the situation in which cores were produced.

Other low-density British sites also reflect a similar pattern of occasional artefact discard away from sources of raw material; at Aveley, small collections of artefacts from the Lower Sands (n=5) and Upper Silts (n=3) reflect a human presence during the early and later part of OIS 7 (Schreve *et al.* in prep). The exposed deposits represent part of the Taplow/Mucking aggradation of the Lower Thames; whilst it is difficult to estimate whether raw material was locally available during the aggradation of both units of fine material, due to the small exposures examined, at other sites examined in this study, fine-sediment deposition often serves to mask previously exploited exposures (e.g. the basal gravels at Ebbsfleet, the flint band at Crayford). It is also notable that the single Levallois core from the upper silts is small and reduced to exhaustion (Mark White personal communication), in a similar manner to the single example from the Stoke Bone Bed.

Sparse artefacts have also been recovered from later OIS 7 interglacial brickearths at Stutton and Harkstead in Suffolk (Schreve 1997), including Levallois material, as well as a single broken handaxe on a flake (Wymer 1985). At Selsey Lifeboat Station channel, West Sussex, organic detrital muds infilling a channel incised into Eocene clays have produced 5 artefacts, including a Levallois core (Wymer 1999). The deposits are surmounted by beach gravels and have been correlated with OIS 7 using biostratigraphy and aminostratigraphy (Bowen *et al.* 1989, Keen 1995, Sutcliffe 1995), the mammalian assemblage suggesting a later OIS 7 age (Schreve 1997). At both sites, raw material would not have been available in the immediate locale; at Selsey, the fine-grained deposits infill a channel incised into Eocene clays, whilst the majority of the sands and silts exposed at Stutton and Harkstead overlie London Clay. In both situations, artefacts are scarce but do indicate a hominin presence, arguably reflecting the discard of transported products – especially Levallois flakes and cores – with which hominins provisioned themselves to deal with their wider landscapes. It is notable that Levallois cores recovered from low density sites in fine grained deposits are frequently small and worked to exhaustion (e.g. Stone Bone Bed, Aveley upper silts), suggesting that they have been subject to recurrent exploitation as a source of flakes.

The Early British Middle Palaeolithic as a whole therefore reflects a logistical approach to the organisation of technology in the landscape; particular sites are targeted as sources of raw material and were repeatedly visited by hominins in order to provision themselves with Levallois flakes and cores, which were carried into the wider landscape and used in the context of other activities; "Extraction and Production" locations (Turq 1988). This treatment of landscape has been regarded as one facet of classic Middle Palaeolithic behaviours, although, significantly, the vast majority of the south-west French open air sites are undated (Duchadeau-Kervazo 1984, 1986, Turq 1988,1989), as are the higher level sites in the Limberg Plateau of the Netherlands (Kolen *et al.* 1999). In contrast, the chronologically-constrained British Middle Palaeolithic data-set indicates a logistical exploitation of landscape emerged by at least late OIS 8/early OIS 7, again supporting the assertion that this approach is closely associated with the widespread adoption of Levallois flaking as a transported toolkit.

It is notable that particular "Extraction and Production" locations were targeted over a prolonged period of time (although not necessarily continuously), and that the practices undertaken varied in response to the changing material affordances of such places. For instance, the assemblages from Northfleet reflect two phases of occupation of the same valley, one exploiting material from the soliflucting slope during late OIS 8/early OIS 7 (Baker's Hole), the other reflecting the exploitation of the banks and bars of the Ebbsfleet channel during the OIS 7 interglacial phase. The very large nodules obtained from the slope and the clasts obtained from the gravels required the employment of different techniques in order to successfully exploit them; on the one hand, to successfully remove very large yet manageable flakes successfully, whilst on the other, to maximise production from smaller flint nodules. During both phases, however, the Northfleet area was targeted as an "Extraction and Production" location.

Similar "Extraction and Production" locations are also present during the later part of OIS 7; arguably at Jordan's Pit, Brundon, as well as the *in situ* occurrence from Stoneham's Pit, Crayford. Markedly fewer ephemeral sites are known from Britain (see above), although those there are broadly reflect a pattern of endproduct and exhausted core discard in low numbers in areas where raw material was not immediately available. Few structured attempts have been made to examine such ephemeral "off-site" occurrences, either in Britain or on the continent. The significant exception is Site N, Maastricht-Belvédère (Mid-late OIS

7) where some 765 m^2 of fine-grained deposits were excavated, resulting in the recovery of 450 artefacts (Roebroeks *et al.* 1992). The larger material (>2 cm) only comprises 25% of the assemblage, and mostly consists of broken artefacts, tools and tool fragments; typical debordant flakes and core edge flakes are also present (n=11), arguably resulting from ongoing core re-preparation. The low-density artefact assemblage from Site N (0.6 artefacts per m^2) therefore broadly reflects the discard of individual utilised or retouched artefacts, presumably in the context of use. The decalcified nature of the sediments precludes an assessment of what subsistence or other practices may have been undertaken. Low-density British sites could arguably represent similar, more restricted samples of material from the landscapes exploited by Middle Palaeolithic hominins.

Given that the current sample of well-contextualised and age-constrained British early Middle Palaeolithic sites is dominated by larger extraction and production locations, controlled sampling and excavation of fine-grained sediments dated to this period (e.g. the Crayford-Erith Brickearths) is necessary before any firmer conclusions can be offered concerning the actual nature of behaviour away from these magnet locations. The particular nature of the Creffield Road assemblage does provide some indication of how hominins were equipping themselves for activity "off-site" – transporting cores as sources for points, and potentially carrying hafted points as thrusting spears or knives. It seems reasonable to assume that such equipment was used in the context of active hunting, although the specific nature of early Middle Palaeolithic meat-acquisition practices in Britain remains open to speculation whilst such sites remain uninvestigated.

6.7 Ephemeral sites, invisible sites; the exploitation of British Middle Palaeolithic landscapes

The early British Middle Palaeolithic dataset clearly reflects a logistical organisation of behaviour in the landscape, characterised by a contrast between the technological patterns apparent at larger extraction and production/mixed strategy sites, on one hand, and ephemeral sites, on the other. However, for the reasons outline above, a broader reconstruction of the ways in which hominins exploited the landscapes within which they were active remains elusive. In particular, although substantial faunal assemblages have been collected from many early British Middle Palaeolithic sites, none have been recovered using modern excavation and recovery techniques. No detailed taphonomic studies of this material have been undertaken, whilst the recovery bias affecting the extant samples arguably precludes such work yielding significant results (*cf.* Marean 1998, Bratlund 1999). Given that patterns of hominin land-use are clearly structured by subsistence strategies, as well as broader technological behaviours, any attempt to reconstruct the "projects for living"

(Ingold 1986, Hopkinson and White 2005) in which British early Middle Palaeolithic hominins were engaged remains partial at best.

A growing body of research actually indicates that throughout the Middle Palaeolithic, hominin subsistence practices became increasingly specialised, and influenced regional land-use patterns in a complex and dynamic fashion, varying both between areas as well as over time. Factors that impact upon patterns of landscape use include local environmental structure, topography and prey ecology, as well as active choices by hominin groups to exploit prime and/or seasonally available animals. From OIS 7 onwards, evidence for an intensification of hunting behaviours is widespread in Europe (Gaudzinski 1999). Cutmarks are increasingly common on faunal assemblages from OIS 7 onwards, reflecting either an increase in hominin animal exploitation or an intensification or change in processing practices (Gamble 1999, 237), and single carcase sites indicating primary hominin access are known from a number of locales (e.g. single adult aurochs from Neumark-Nord, Germany OIS 7; Mania *et al.* 1990; complete adult woolly rhino from In den Wannen layer VI, Germany; Late OIS 7; Conard and Prindiville 2000). Additionally, restricted species and monospecific faunal assemblages become commonplace, primarily concentrating upon 2-3 species (Gaudzinski and Turner 1996, Patou-Mathis 2000); examples include the dominance (70%) of adult aurochs at Biache-Saint-Vaast (early OIS 6; Auguste 1995) and horse, red deer and bovids (89%) from Tönchesburg horizon 1A (Saalian; Conard and Prindiville 2000).

Other evidence from this period also implies an intensification of hunting practices; the bones of bears and other carnivores indicate deliberate and careful skinning, presumably reflecting fur acquisition (e.g. Biache-Saint-Vaast; Auguste 1988), as well as meat and marrow extraction (intensive green bone fracture at Biache-Saint-Vaast; *ibid.*). Increasingly specialised hunting behaviours such as these are likely to have influenced the structuration of early Middle Palaeolithic landscapes – concentration upon specific prey resources demanding that hominins be in particular places (biotopes, topographical traps) at particular times (seasonally). The impact of such practice upon landscape use is clearly apparent by the later Middle Palaeolithic (OIS 5d onwards), when there is clear evidence for monospecific, prime age prey selection, using repeated strategies at specific points in the landscape (Gaudzinski and Roebroeks 2000). For instance, prime-age monospecific faunal accumulations often occur in situations that may have been utilised as topographic traps (Mauran, France, Salzgitter Lebenstedt, Germany, Starosele, Western Crimea; Gaudzinski 1996, 1999, Gaudzinski and Roebroeks 2000, Burke 2000).

Such patterns are currently more difficult to discern earlier in the Middle Palaeolithic, although active hominin hunting is apparent from the Lower Palaeolithic onwards, as attested by particular high resolution signatures from sites such as Boxgrove (Roberts and Parfitt 1999), Schöningen (Thieme 1997, 2005) and, arguably, Meisenheim I (Turner 2000). The latter two examples are argued to represent situations in which hominins may have been deliberately miring and dispatching prey on boggy lake margins, and might therefore reflect repeated hominin exploitation of particular landscape settings during the Lower Palaeolithic. Given the likely indigenous evolution of Neanderthals from preceding European hominins (Stringer and Hublin 1999, Stringer 2001), the specialised and selective hunting behaviours evident by the later Middle Palaeolithic arguably represent the cumulative outcome of a long period in which hominins were actively exploiting animal resources in Europe (Gaudzinski and Roebroeks 2000). During the early Middle Palaeolithic, the repeated use of particular areas for specific subsistence behaviours is sometimes evident; Levels 3 and 6 at La Cotte de St. Brelade (OIS 6) reflect the repeated use of the headland as a topographic trap (Scott 1986).

Within Britain, whilst it is currently impossible to use extant faunal collections to consider how specific subsistence behaviours influenced patterns of hominin landuse, it is possible to offer some more speculative comments on the nature of hominin activity in the wider landscape, in the light of the patterns apparent for the earlier European Middle Palaeolithic as a whole. Although no direct association between hominin presence and the substantial vertebrate assemblage can be definitively established, single individuals are present amongst the fauna from the Stoke Bone Bed and probable death by miring seems likely for at least one of the mammoths (see Section 5.4). Given the proximity of the steep clay cliff, it is tempting to speculate that this may have represented a situation which animals were periodically trapped and drowned. Hominins may have visited the locale in order to exploit animals already dying there, or may actually have used the local topography in order to isolate and dispatch particular animals. Whatever the nature of the actual activities undertaken, hominins entering this locale were already technologically equipped to deal with future contingencies, carrying at least one core as a source of flakes with them and abandoning it once exhausted.

The assemblage from Creffield Road has been interpreted here as reflecting the deliberate use of preparatory strategies that would favour successful point detachment throughout reduction. Cores were prepared, and some endproducts produced, at the site, whilst others were produced away from Creffield Road. Given that some of points from the site retain evidence for deliberate thinning of the proximal end, it has been suggested that they were retouched in this way to ensure their accommodation within a haft. Most whole Levallois points from Creffield Road fall within the experimentally-defined optimal configuration limits for use as a thrusting spear (Shea *et al.* 2001), although use-wear analyses have shown that Levallois points may be used as either spear armatures (Shea 1993), hafted knives (Plisson and Beyries 1998), or both (Shea 1997). The broken Levallois products from the site show a preponderance of proximal over distal elements; it has been suggested that points which break whilst being used as weapon armatures are prone to lateral breakage and lose their distal ends (Holdaway 1989). In ethnographic contexts, hafted projectiles are frequently resharpened or replaced following breakage (Flenniken and Raymond 1986), leading to an over-representation of proximal pieces at locations where armature maintenance was undertaken (Keeley 1982). It has therefore been suggested here that the presence of more proximal than distal point fragments at Creffield Road might indicate that these points were hafted as weapon heads (Holdaway 1989, 80).

The Creffield Road assemblage therefore provides some limited information about the specific activities undertaken away from the site itself. If the points present were used as hafted weapon armatures, then a mode of hunting may have been practiced based around close contact with herbivore prey. Ethnographic survey suggests that stone-tipped thrusting spears are often deployed in the hunting of gregarious large game or dangerous prey (Ellis 1997). Broad stone points cause large wounds, and when hafted to thick shafts can be driven into prey with considerable force. It has been suggested that such points are prone to breakage on a single use and therefore represent an "unreliable" technological strategy, recent hunter-gatherer groups countering this tendency either by carrying several re-attachable, pre-hafted foreshaft elements, or using stone-tipped thrusting spears to deliver fatal wounds to prey already incapacitated through the use of untipped javelins thrown from distance (*ibid.*) – perhaps of the sort known from the Lower Palaeolithic sites of Schöningen (Thieme 1997, 2005) and Clacton (Oakley *et al.* 1977), as well as the last interglacial site of Lehringen, Germany (Thieme and Veil 1985). It is, however, also worth noting that experimental analysis has shown that hafted Levallois points can actually be thrust into carcases many times before breakage (Shea *et al.* 2001). Given the minimally-known organic component of Middle Palaeolithic technological systems, either option could potentially have been practiced; the notion of hominins equipped with several foreshaft elements is intriguing given that such elements frequently also function as hafted knives (Ellis 1997) – the use most frequently inferred for European Levallois points subjected to microwear analysis (Plisson and Beyries 1998).

However, it is impossible to know precisely how hominins may have been engaged in hunting such prey in the environs of Creffield Road. Is it impossible even to reconstruct the probable environmental structure of the surrounding landscape in even the broadest terms; given the stratigraphic context of the material, the site may date to between the final aggradation of the Lynch Hill terrace (the beginning of OIS 8) and any point within the OIS 7 interglacial. The absence of evidence for a hominin presence within any full glacial period in Britain implies that a mid-OIS 8 date is unlikely, but a variety of environmental conditions could have prevailed whilst hominins were active at the site – from cold, open late glacial to fully forested interglacial structures. Clearly, such a varied range of environments have very different implications for the ecological structure of the immediate area and the prey species available, and hominin hunting practices are, accordingly, likely to have been very different.

One notable possibility is worth delimiting, if an OIS 7 interglacial attribution is accepted for this material. Following downcutting to Taplow bench-level during OIS 8, the terrace surface exploited at Creffield Road would have remained as an elevated flat on the valley side. Throughout OIS 7 it is likely that progressive colluviation and soil formation on the terrace surface would have masked the immediately available raw material, implying that hominins may have been exploiting the surface during the earlier part of OIS 7. The terrace surface at this time may have acted both as a source of raw material, as well as a higher-level site on the valley side, from which hominins were able to monitor prey movements in the valley below. An earlier OIS 7 date implies that conditions would have been relatively cool and open, ecological conditions favoured by herd animals such as horse and bovids; species which may have been deliberately targeted in the valley bottom.

Lacking the "invisible" sites in the valley bottom, and especially faunal remains, including from Creffield Road itself, it is difficult to speculate as to exactly what subsistence practices were undertaken in the surrounding landscape, beyond likely engagement with gregarious herbivore prey, potentially using hafted thrusting spears. Ephemeral sites on the valley bottom are less likely to survive than larger accumulations on raw material sources anyway, especially if deposited during periods of higher energy aggradation and reworking (early interglacial). However, the manner in which hunting was actually undertaken remains elusive. This exemplifies one of the current problems when trying to reconstruct hominin land-use patterns in Britain; not only are many fewer "ephemeral" sites known and well-contextualised, but many are actually likely to be absent, and the record we are left with only represents a partial reflection of how early Middle Palaeolithic hominins actually made a living in Britain. Clearly, the location and investigation of such locales in "off-site" contexts represents a pressing research objective. However, anecdotal aspects of the current record suggest some ways in which subsistence practices may have impacted upon the structuration of landscape use; the topographic context of the Stoke Bone Bed being suggestive of a natural trap, whether deliberately used by hominins as such or not, whilst the possible use of Creffield Road as a monitoring and maintenance locale implies the observation and exploitation of large gregarious prey in an open environment.

6.8 The Middle Palaeolithic settlement history of the British Isles

The emergence and ongoing refinement of a chrono-stratigraphic framework for the British Middle Palaeolithic has re-awakened interest in questions of hominin settlement history. In particular, the re-attribution of many sites previously interpreted as Ipswichian in date (OIS 5e) to a previously unrecognised intra-Saalian warm episode (OIS 7) suggested a probable absence of hominins from Britain during the last interglacial (Stuart 1976, Currant 1986, Wymer 1998). More recently, a longer period of abandonment has been suggested; no traces of a human presence are apparent from sites dated to the later part of OIS 5 (5d-5a), or most of OIS 4 (Currant and Jacobi 1997, 2001), hominins first re-occupying Britain towards the end of OIS 4/early OIS 3 (Currant and Jacobi 2001, White and Jacobi 2002; see Table 6.3 below). Hominin absence during the OIS 6 glaciation is unsurprising, Britain never having been occupied during an equivalent glacial period, even by modern humans (Jacobi 1999). However, it has also been suggested that OIS 7 populations in Britain may well have been reduced or intermittent, in comparison to preceding interglacials (Ashton 2002, Ashton and Lewis 2002).

6.8.1 Abandonment and "declining populations"

Ashton and Lewis (2002) suggest that the paucity of artefacts from the Taplow terrace of the Middle Thames (OIS 8-7-6; Bridgland 1994), in comparison to earlier terrace formations in the same area, reflects a smaller British hominin population than was present during previous interglacials. Additionally, they suggest that artefacts are not abundant at British OIS 7 sites as a whole, and that sites dated to this period are few in number (Ashton 2002, 94), whilst elsewhere Ashton (Ashton *et al.* 2003) suggests that most British Levallois sites date to late OIS 8/early OIS 7, and that populations therefore declined rapidly throughout OIS 7. They argue that this pattern is explicable in two ways; firstly, insularity from mainland Europe allowing only a narrow window of opportunity for colonising hominin groups following a late breach of the Wealden-Artois ridge (potentially OIS 8, in contrast to the more commonly suggested OIS 12; see papers in Preece (ed.) 1995a), and secondly, progressive adaptation to the cool, open but highly productive environments of the mammoth steppe, best represented in the continental east, leading to lower populations in north-west of Europe as a whole (Ashton and Lewis 2002, Ashton 2002).

A number of problems exist with this model; firstly, it remains questionable whether artefact numbers can be reliably used as a proxy for hominin population size, particularly given a marked change in technological practice between the aggradation of the Lynch Hill and Taplow terraces. Re-analysis of artefact densities from the same area of the Middle Thames actually suggests a progressive increase in artefact numbers over time between the aggradation of the Boyn Hill and Lynch Hill terraces (T. White 2004). A similar pattern has also been observed for the Solent, and interpreted as reflecting elevated populations during OIS 9 (Hosfield 2005), although White suggests that a likely explanation for the same pattern in Thames region to actually be the reworking of material between terrace levels (T. White 2004). A marked reduction in artefact density is apparent between the Lynch Hill and Taplow terraces in both the Middle and Lower Thames (Ashton and Lewis 2003, T. White 2004); given that handaxes appear to be minimally represented at the primary context sites upon which this study has focussed, it is argued here that handaxes were rarely produced during the period in which these terraces aggraded. Their under-representation is therefore unsurprising and probably reflects reworking from the Lynch Hill terrace above. Such processes are actually also archaeologically evident at Northfleet, especially within the Ebbsfleet Channel (Section 5.1), where rolled and stained material, including handaxes, was introduced into the channel from an allochthonous source – arguably a now-eroded remnant of a higher terrace.

Ashton and Lewis (2003) point out that historically, handaxes were more likely to be retained by collectors than other artefact types, but suggest that the inclusion of Levallois flakes and cores within their artefact counts compensates for this apparent bias. However, merely in terms of collection practices, it is worth noting that although many early collectors did retain such material (e.g. Spurrell, John Allen Brown), the Levallois technique was not explicitly described in a British context until the publication of the Baker's Hole assemblage (Smith 1911). Many collectors may not have retained or recognised such material prior to this publication, and handaxes are therefore likely to have been collected over a much longer period, and thus to be comparatively over-represented in the record.

A further complicating factor relates to the period over which the Taplow formation aggraded (OIS 8-6; Bridgland 1994). Most primary context British Middle Palaeolithic sites date to the earlier part of this aggradational cycle (OIS 8/7), whilst some are known from later in the interglacial (OIS 7; see table 6.1). However, none are known from subsequent cold-stage deposits (OIS 6), either within the Taplow/Mucking formation itself or the Kempton Park deposits below; there is no current evidence for a hominin presence in Britain during this period. The majority of the extant Taplow deposits aggraded during the latter part of the OIS 8-7-6 cycle of terrace formation; phase 4 of Bridgland's terrace model (David Bridgland personal communication 2005; White *et al.* in press). If this does truly represent a period in which hominins were absent from Britain, then clearly only artefacts reworked from extant deposits or the pre-existing landscape were available for incorporation into the Taplow gravel. The Taplow/Mucking formation will obviously contain fewer artefacts than earlier deposits where hominins are present throughout the whole aggradational cycle. If artefact density is averaged out for the entire period of deposition, as advocated by Ashton and Lewis (2003, 389), this amplifies the impression of a reduced population during OIS 8-6.

Quite apart from issues of collection visibility, however, a more fundamental difficulty in comparing handaxes and Levallois products as proxies for hominin population size relates to changes in hominin technological organisation. With the widespread adoption of Levallois flaking, technological behaviour clearly becomes organised in a more logistical fashion. Within the British dataset, this pattern is characterised as a contrast between the types of activities undertaken at extraction and production/mixed strategy sites, at which large assemblages attest to raw material selection, Levallois core preparation and flake production from immediately available raw material sources, and smaller sites away from sources of raw material, where occasional endproducts are discarded. Increased curation of Levallois flakes and cores appears to have had a profound effect upon patterns of artefact discard, material either being discarded in low numbers in the context of use, or upon return to available raw material sources. As noted previously, the former situations (ephemeral sites) are poorly represented in the current record, being less archaeologically visible, less likely to enter the archaeological record at all, and less attractive to collectors than larger sites. In contrast, throughout the British Lower Palaeolithic hominin behaviour appears to be largely concentrated within river valleys, acting as open conduits through forested interglacial landscapes (Ashton *et al.* in press), and elevating the likelihood of discarded artefacts being incorporated within fluvial sediments. The discard of artefacts in low numbers away from contexts likely to enter the Quaternary record, as well as the reduced likelihood of recovery from fine-grained sediments, arguably results in lower overall numbers of Levallois artefacts, again giving the impression of a reduced hominin presence in Britain during OIS 8-6.

This observation is particularly pertinent to Ashton's suggestion that hominin populations also declined *throughout* OIS 7 (Ashton *et al.* 2003). Certainly, most of the larger extraction and production/mixed strategy sites date to the earlier part of OIS 7 or late OIS 8 (see table 6.1); during the subsequent interglacial phase, fewer such sites are apparent (Stoneham's Pit, Crayford; Jordan's Pit, Brundon) and most occurrences consist of only a few artefacts from fine-grained sediments (see above, Section 6.6). This pattern may in part relate to how hominin behaviour was necessarily adapted to the changing material affordances of post-glacial landscapes. During colder periods, incision through and erosion of chalk bedrock and the deposition of coarse gravels exposed a variety of large flint clasts; these were frequently targeted by hominins active within such environments as sources of raw material. With the transition to lower energy deposition and the stabilisation of landscapes during the subsequent interglacial period, fewer such exposures may have been available (see also Wenban-Smith 1998). Indeed, several large sites indicate that hominins abandoned particular locales once raw material outcrops were masked by progressive sedimentation; this is most particularly evident at Ebbsfleet (Section 5.1). Where equivalent exposures were more rarely available during later OIS 7, they were targeted in the same way, reflecting the fact that hominins clearly were still present throughout the interglacial and structuring their exploitation of these changing landscapes in a similar way. It is likely that curation tactics may have increased with a reduction in overall flint availability, though this is not a pattern which can be discerned on the basis of the extant record.

It is therefore difficult to argue for a reduced British hominin population during OIS 7 on the basis of artefact density, without taking account of the factors outlined above. Technological logistics, curation and discard rates, artefact visibility and collection issues, as well as terrace aggradation have all had an effect upon the extant record. This is not to suggest that hominin populations may not have been low during OIS 7, but rather that hominin populations were neither so dramatically depressed nor subject to such a severe crash as Ashton and Lewis (2002) suggest. Most particularly, the intensification of artefact curation practices concomitant with the lasting adoption of Levallois flaking complicates the matter, to the extent that modelling past demographics on the basis of comparative artefact densities could be argued to be a fruitless exercise.

Regardless of whether one accepts a reduced hominin presence during OIS 7, there is no evidence that Britain was occupied during OIS 6 – unsurprising considering the extreme climatic conditions inferred for this period – and was not re-occupied during the last interglacial (OIS 5e; Stuart 1976, Currant 1986, Wymer 1998, Ashton 2002; see Table 6.3 below). One possible explanation relates to the island status of Britain; regardless of whether an early (OIS 12) or late (OIS 8 or 6) breach of the strait of Dover is favoured, climatic amelioration at the beginning of OIS 5e resulted in a dramatic rise in sea level, from – 50 m. OD to current levels in less than 3000 years (Shackleton 1987). This arguably allowed only a short period within which hominins could recolonise the north-westernmost edge of the European peninsula before separation from the rest of the landmass.

	Archaeology Present	Reason for rejection (see key)
OIS6		
Taplow Gravel	Stone artefacts	1
Stanton Harcourt Gravel	Stone artefacts	1
Warwickshire Avon Terrace 4	Stone artefacts	1
River Trent, Egginton Common Sands & Gravels	Stone artefacts	1
OIS 5e		
Barrington, Cambridgeshire	Small flint core	2
Cardo's Pit, Barrington	Flake	2
Lavenham, Suffolk	Stone artefacts	2
Newmarket Railway Station, Cambs	Flints	3
East Mersea	Flake	2
Victoria Cave	Biface	4
Milton Hill Fissure	Butchered & burnt bone	5
OIS 5d-a		
Kempton Park Gravel	Stone artefacts	1
Cassington, Unit 1	Stone artefacts	1
Bacon Hole, grey clay, silts and sands	Split & polished bone	3
OIS 4		
Banwell Bone Cave	Modified bone & antler	3
Banwell Bone Cave	Human tooth	2 (modern)
Bosco's Den	Split pebble	3
Steetley Wood Cave	Human mandible	2 (modern)
Tornewton Cave, Reindeer Strata	Stone hammer	3
Windy Knoll	Stone artefacts	4 (from Creswell)
River Trent, Beeston Gravel	Stone artefacts	1
Kempton Park Gravel	Stone artefacts	1

Table 6.3 Some Late Middle and Upper Pleistocene occurrences apparently showing evidence for human activity, with reasons for their rejection (data principally taken from Ashton 2002 and Currant and Jacobi 2002, with additions). The list is not exhaustive, but to date no convincing evidence of primary context archaeology has been forthcoming for any of these periods in Britain.

Key *1) Derived, abraded artefacts clearly not contemporary with deposits in which they were found and likely to have originated from older deposits in the region*
2) Finds of late or post-Pleistocene type and/or other evidence that they came from deposits of different age
3) Non-anthropogenic
4) Do not actually belong at the site to which they have been attributed (based on preservational state, archival records etc)
5) Re-examination failed to verify

Given the prolonged cold and extreme conditions inferred for OIS 6 (Dansgaard *et al.* 1993), European populations may have been dramatically lowered during the preceding glacial period, and/or pushed back to distant southerly refugia (*cf.* Gamble 1986). Repopulation and range expansion may only have brought hominins to the northwestern edge of Europe once Britain was already separated as an island. However, there are indications that hominins were active within adjacent areas of north-west Europe towards the end of OIS 6, as evidenced by the sites of la Cotte de St. Brelade (Scott 1986), Biache-Saint-Vaast (Auguste 1995) and Rheindahlen (Gamble 1999). It is also worth noting that whilst there is no evidence for a hominin presence in Britain during the last interglacial, there is also very little from immediately adjacent areas of north-west Europe; Roebroeks and Speelers (2002) consider only 11 sites dated to this interval as adequately characterised in palaeoenvironmental and contextual terms, most of which are located on the southern edge of the German lowlands. In this context, the preceding suggestion that reduced opportunity after OIS 6 for access to Britain may in fact relate more to the absence of humans from north-west Europe than to potential access to Britain itself. This absence has been explained several ways; in terms of hominin inability to cope with the ecological or social difficulties presented by surviving in climax forest (Gamble 1987, 1992, 1999), habitat preference and progressive adaptation towards the conditions of the mammoth steppe (Ashton 2002, Ashton and Lewis 2002). However, it has also been suggested that this apparent absence might simply reflect a lack of sedimentary capture points dated to this interval (Gamble and Roebroeks 1999, Roebroeks and Speelers 2002).

6.8.2 Re-occupation and technological practice in the later British Middle Palaeolithic

Unambiguous artefacts associated with "Pin Hole" type mammalian faunas reflect a return to Britain by hominins during OIS 3 (Currant and Jacobi 2001, 2002). Recent C14 dates obtained on material from Lynford, Norfolk, where a substantial handaxe assemblage was recovered in association with a mammoth-dominated vertebrate fauna, suggest that recolonisation actually took place towards the end of OIS 4, c. 64-67 000 (± 5000) BP (Boismier *et al.* 2003). Unhindered access was certainly possible across the northern European plain, the North Sea bed being exposed as a fluvially dissected landscape while sea levels were depressed. Significant elements of the Pin Hole MAZ (Mammalian assemblage zone) include hyaena, mammoth, horse and woolly rhinoceros, faunal associations comparable with later Quaternary assemblages from central Asia, and are interpreted as reflecting the extension the "mammoth steppe" into Britain and its nearest neighbours during a period of extreme continentality (Currant and Jacobi 2001). The reappearance of hominins in Britain during this period reflects their ability to exploit equivalent conditions prevailing over much of Europe (see above; Section 6.8.1). OIS 3 environments are distinguished from earlier interglacials by rapidly oscillating changes of climate (Dansgaard *et al.* 1993), often over periods of less than 50 years, conditions which are argued to have prevented the establishment of substantial tree cover over much of north-west Europe (Van Andel and Tzedakis 1996). With the expansion of open environments, hominins may have again adopted strategies involving extended mobility and the specialised hunting of specific prey. The range expansion associated with such behaviours may again have brought them into

Britain at the north-westernmost corner of the European landmass, through exploitation of the open environments of the northern European plain.

Well-dated and contextualised sites are rare during this period in Britain, Lynford being a notable and recent exception. However, particular technological patterns are apparent. Levallois flaking appears to have been rarely, if ever, practiced from late OIS 4 onwards in Britain; rather, finds securely dated to this period indicate that Neanderthals predominantly practiced a technology based upon handaxe production (White and Jacobi 2002). Assemblages of this date at which a co-occurrence of Levallois elements and handaxes have been claimed are typically in mixed condition (e.g. poorly provenanced collections from Terraces 1 and 2 of the Ouse – Fenstanton; Meadow Lane, St. Ives; Hemingford Grey; Personal observation) or actually include misidentified handaxe manufacture flakes (Little Paxton; Wymer 1999, White and Jacobi 2002 and personal observation). Of particular interest is the fact that handaxes termed *bout coupés* (as defined by Tyldesley 1987; White and Jacobi 2002) are restricted to this period (Late OIS 4/3), and are extremely rare (if indeed present) within continental Middle Palaeolithic assemblages. They have long been argued to represent a regionally specific local technological tradition (Roe 1968, 1981; Mellars 1974; Shackley 1977; Tyldesley 1987).

Typo-technological differences between different areas within time-bracketed intervals are widely documented in the Europe Middle Palaeolithic, particularly during the later Middle Palaeolithic, and are regarded as reflecting the emergence of a complex "cultural geography" (Gamble 1999, Gamble and Roebroeks 1999), particular groups transmitting particular ways of doing things within specific local settings, potentially equivalent to territory. Examples of such "regional-scale time-space-units" (White and Jacobi 2002) include the MTA in France and Belgium (Mellars 1996), and the Altmühlian, characterised by distinctive leaf points and centred upon Southern Germany (Kozlowski 2003). Given the temporal and spatial restriction of the *bout coupé* to Britain between late OIS 4/3, the assertion that they do represent a specific regional toolmaking tradition seems justified. Specifically, it could be argued that the British *bout coupé* phenomenon represents a particular cultural modality within the MTA; continental researchers have advocated that the MTA designation be reserved only for assemblages containing triangular handaxes (Cliquet *et al.* 2001) and that other cordiform-dominated later Middle Palaeolithic assemblages be described as a bifacial facies of the Mousterian.

Bout coupé handaxes form a small but persistent component of cordiform-dominated handaxe assemblages from late Middle Palaeolithic Britain. Assemblages dated to this period are generally small in size (e.g. Little Paxton; Paterson and Tebbutt 1947, Kent's Cavern; Tyldesley 1987, White and Jacobi 2002), although Lynford represents a notable exception (1619 artefacts, including 41 complete and 6 broken handaxes from the main palaeochannel deposits; Mark White, unpublished data); many represent isolated discards. Large assemblages attesting to raw material procurement, handaxe manufacture and discard within a limited area are unknown in Britain, although the small assemblage from Little Paxton (extant assemblage n=116, including 4 complete handaxes, one of which is a "true" *bout coupe*; *cf.* Tyldesley 1987) does reflect handaxe manufacture using immediately available small gravel clasts (personal observation). In contrast to the earlier Middle Palaeolithic, "extraction and production" locations are therefore largely absent. However, several lines of evidence suggest that late Middle Palaeolithic handaxes, like Levallois products, do represent a curated and transported technology.

The contexts from which *bout coupé* and other late British Middle Palaeolithic handaxes have been recovered are suggestive of isolated discard in the context of use; additionally, more intriguing examples have been recovered from situations interpreted as suggestive of deliberate caching – two "true" *bout coupés* from close to the cave wall at Coygan, and one from an uninhabitable part (Wolf's Den) of Kent's Cavern (White and Jacobi 2002). Incidence of retouch and resharpening of later Middle Palaeolithic handaxes in France has been interpreted as evidence for extended curation, handaxes being treated as curated blanks with transformative potential (Turq 2001, Depaepe 2001, Lhomme and Connet 2001), frequently transported as "finished" artefacts but retouched – sometimes several times, in several ways - in the context of use (Soressi and Hays 2003). Notably, the position of particular areas of deliberate retouch – sometimes "scraper-type", sometimes notching or deliberate blunting – has been suggested to relate to prehensile function; deliberately resharpened or retouched edges being opposed to those which would aid handling, often changing several times with the application of successive retouch (Boëda 2001, Soressi and Hays 2003).

Such treatment of late British Middle Palaeolithic handaxes is also apparent, most especially amongst the assemblage from Lynford (Mark White personal communication and unpublished data). The Lynford assemblage also reflects the import and final working of non-Levallois flake blanks into handaxes, albeit potentially over fairly short distances, as well as their subsequent retouch and resharpening (*ibid.*). Despite obvious technological contrasts – a technology based around the transformation of bifacial, rather than Levallois flake, blanks – a number of similarities between technological organisation in the earlier and later Middle Palaeolithic are therefore apparent. Disaggregation of the *chaîne opératoire* can be observed during both phases, not only in terms of the treatment of objects themselves (transformative potential of Levallois flake blanks or handaxes) but also the technological signatures of sites themselves. The earlier Middle Palaeolithic is dominated by extraction and production locations, more ephemeral occurrences being largely absent for a number of taphonomic reasons (Section 6.6); the later Middle Palaeolithic is dominated individual find-spots or specialised task sites (e.g. Lynford). The lack of extraction sites during the later phase might perhaps relate to increased spatial and temporal disaggregation of technical acts - extraction and minimal preparation in one locale, finishing and retouch in others - reducing the incidence of concentrations of artefactual material entering the archaeological record through discard in a suitable depositional environment. Concomitantly, it might also be suggested that the material at such sites might comprise technologically undistinctive cortical debitage, and that resulting from initial roughing out; historically, the sort of material least likely to be retained by collectors.

Middle Palaeolithic handaxes can therefore be viewed as employed within a similar technological system of provisioning for future needs as Levallois flakes and cores during the earlier period in Britain. The manner in which this was done – through retouch and transformation of a handaxe serving as a blank support - underlines the fact that Middle Palaeolithic technological systems – whether dominated by episodes of *façonnage* or *débitage* – reflect the integration of both principles (*cf.* White and Pettitt 1995). It has been suggested that the highly specific, deliberately imposed, form of the *bout coupé* might additionally hint at otherwise invisible social relations in which Neanderthals were engaged, representing a shared idea of what a particular tool "should" look like to those inhabiting a particular region at a particular time (White and Jacobi 2002). The existence of a shared idea can be viewed as structuring individual actions in a similar way to material constraints, and which can be transformed in its material expression by such factors as individual skill (ability to make such a tool), availability of suitable material, the social role of particular individuals and so forth (Hopkinson and White 2005). The absence of such similarly conceptually-bounded tool forms in the earlier Middle Palaeolithic obviously does not indicate that similar, shared and transmitted technological concepts did not exist. As discussed previously, the application of the Levallois concept acted as a structuring "plan-like principle" (Schlanger 1996), reflecting both the transmission of conceptual knowledge - of a restricted range of possible options – and practical know-how, taught and learnt by individuals and shared amongst groups.

Chapter 7
Conclusion

7.1 Introduction

This thesis has sought to relocate the early British Middle Palaeolithic record at the centre of Europe. Long regarded as a parochial outpost of mainland Europe, the history of interdisciplinary research through which the British record was amassed, together with the re-emergence and ongoing refinement of the chrono-stratigraphic framework through which individual sites are related, are arguably its greatest strengths. Through the detailed technological analysis of material from key locales dated to the interval OIS 9-7, this study has demonstrated that not only does the early British Middle Palaeolithic record reflect the complex, logistical exploitation of hominin landscapes during this period, but that the British record is actually central to investigating the development of such behaviours in Europe.

Research into the early British Middle Palaeolithic has previously focussed upon the investigation of broad scale patterns of industrial variability and settlement history (White and Ashton 2003, White and Jacobi 2002, Ashton and Lewis 2002). Re-examination of the artefact assemblages themselves has allowed these questions to be re-examined in a more dynamic fashion. The methodology employed in order to achieve these stated aims has combined innovative continental observations (e.g. Boëda 1986, 1995) with approaches developed in order to understand the taphonomy and technology of Lower Palaeolithic core working practices from similar preservational contexts (e.g. Ashton 1992, Ashton and McNabb 1996a, Ashton 1998b). The flexible and considered combination of these analyses has permitted the variability apparent within the early British Middle Palaeolithic to be addressed, in terms of what technological acts were undertaken by hominins in particular landscape settings and how such variability can be related to the material affordances of specific locales. On this basis, is has been possible to reconstruct how hominins were exploiting the Middle Palaeolithic landscapes within which they were active in Britain. The implications of this study for understanding hominin technology and landscape use during the early Middle Palaeolithic in Britain, and the significance of these results for understanding the development of Middle Palaeolithic behaviours in Europe as a whole, are summarised below.

7.2 Hominin behaviour in British early Middle Palaeolithic

White and Jacobi's (2002) assertion that a clear distinction can be drawn between an early British Middle Palaeolithic dominated by Levallois flaking (OIS 9-7), and a later phase (late OIS 4/3), within which Levallois flaking was not practiced but during which handaxes, and especially *bout coupés,* were typically manufactured, is supported by this study. Such handaxes as can be related to contextually secure early Middle Palaeolithic assemblages are frequently in a different preservational state to the dominant Levallois assemblages (e.g. Jordan's Pit, Brundon, Section 5.5) or are only sporadically manufactured and atypical in form, if present at all (e.g. Ebbsfleet Lower Gravels, Section 5.1). It does appear that handaxes did not, therefore, form a regular component of the problem-solving repertoire of early Middle Palaeolithic hominins in Britain. In contrast, the Levallois-dominated assemblages examined in this study have been shown to reflect immense technological variation, in terms of the specific Levallois techniques (preparatory and exploitative) adopted in particular situations.

This variation has been argued to relate to several factors; most prosaically, the raw material immediately available at the selected sites has an obvious impact upon the strategies adopted. Thus elongated nodules, such as some that were worked at Stoneham's Pit, Crayford (Section 5.3), required the adoption of a polarised preparatory strategy to impose the necessary lateral and distal convexities upon the Levallois flaking surface, encouraging the continuation of a polarised exploitation strategy once the surface was emplaced. Very large raw material, such as that available at Baker's Hole, posed its own problems, in that very large, broad flakes are prone to breakage; the adoption of bipolar preparatory strategies may have encouraged successful endproduct detachment (Section 5.1). Moving away from immediate material constraints, particular methods also appear to have been adopted in order to produce specific types of endproduct, and changes in techniques are apparent throughout core reduction, to favour the ongoing production of flakes with particular morphometric properties. For instance, at Creffield Road (Section 4.2), pointed endproducts were deliberately produced – initially using a bipolar preparatory strategy, to favour the removal of points from large core surfaces, whereas unipolar and especially convergent preparatory strategies were favoured later on in reduction, when flaking surfaces were reduced in size.

All the assemblages analysed in this study reflect multiple endproduct production; both recurrent exploitation of particular Levallois core surfaces, and the cyclical re-preparation/re-exploitation of Levallois cores. The particular ways in which production was maximised have been argued to relate to the logistical flexibility of Levallois technology, and particularly, the choice between provisioning with one or more transformable flake blanks (i.e. Baker's Hole and Ebbsfleet, Section 5.1) or a core as the source of such blanks (i.e. Creffield Road, Section 4.2; Crayford, Section 5.3). It has been suggested that several sites reflect the deliberate production of large, broad products, possessing similar morphometric properties to handaxes in terms of continuous cutting edge, whilst being lighter and thinner.

The production of several such products from a single Levallois core allows for greater technological flexibility; not only can such products be transformed through the application of retouch, but several products could also be produced and transported at any one time, at no extra cost in terms of weight. Arguably, this represents a maintainable technology – if one flake should break, another could be brought into play by way of a replacement. The alternative strategy – core transport and continuous exploitation – similarly represents a maintainable technological option, whilst also allowing for even greater flexibility, as several different types of endproduct could potentially be produced.

The British record provides good evidence that such technological choices were closely linked to a more logistical approach to exploiting Middle Palaeolithic landscapes from at least late OIS 8/early OIS 7 onwards. Clear patterning is apparent between the sites examined, particularly in terms of assemblage size and raw material proximity – all the largest assemblages examined (Purfleet, Creffield Road, Baker's Hole, Lion Pit Tramway Cutting, Crayford and Brundon) were recovered from positions immediately adjacent to raw material sources, and overwhelmingly reflect complete lithic reduction sequences following raw material acquisition, and the production of several Levallois flake blanks from each core. Most large British early Middle Palaeolithic sites have been interpreted here as situations within which hominins were provisioning themselves with the equipment necessary to exploit landscapes away from such exposures; either with a series of large, transformable Levallois flake blanks, or cores from which such blanks could be produced.

In general terms, most early British Middle Palaeolithic sites can therefore be characterised as "Extraction and Production" locations, using the terminology proposed by Turq (1988). In contrast, low density artefact occurrences (see Section 6.6; examples include Stoke Tunnel, the Crayford-Erith Brickearths and the Aveley Upper Silts) reflect occasional artefact discard away from proximal sources of raw material, and the probable discard of transported toolkit elements in the context of use. Whilst it is difficult to speculate as to exactly what activities may have been undertaken at such episodic sites, there are some indications that subsistence practices are represented – for instance, it has been suggested that the Stoke Bone Bed may have represented a situation in which animals may have become mired (Section 5.4). It is particularly notable that Levallois cores recovered from such situations are frequently exhausted (e.g. Stoke Tunnel, Section 5.4; Aveley Upper Silts), and several ephemeral sites represent situations in which raw material was not immediately available (e.g. Stoke Tunnel, Selsey).

Beyond this broad contrast between "Extraction and Production" locations, on one hand, and "Episodic" sites, on the other, more complex patterns are also apparent. The assemblage from Creffield Road (Section 4.2) reflects a wide range of technological practices which have been interpreted here as reflecting a cyclical relationship between the terrace surface (from which raw material was obtained) and the surrounding landscape. Creffield Road acted as a location to which hominins would return in order to re-provision themselves with new point cores, as well as repairing the hafted Levallois points that they carried with them; exhausted cores and broken points were discarded on the terrace surface. Depending on the particular interval between OIS 8/early OIS 7 within which hominins were active at Creffield Road, it is also possible that the terrace surface was an exposed flat on the valley side above the floodplain, following downcutting to Taplow bench level after OIS 8. Such a location would have provided an excellent platform from which prey movements in the valley bottom could be monitored. Clearly, it is necessary to more precisely establish the date at which hominins were active at Creffield Road, as well as the possible structure of the surrounding landscape at this time.

The early British Middle Palaeolithic record therefore provides good evidence for a marked change in technological behaviour from late OIS 8/early OIS 7 onwards; not only do novel techniques come to dominate the technological repertoire (various Levallois methods) but it is also apparent that hominins were equipping themselves to exploit their landscapes in an increasingly logistical fashion – "gearing up" at specific places where raw material was easily accessible, then travelling equipped in order to deal with whatever opportunities may have presented themselves.

This change in provisioning behaviour has profound implications for any attempt to model hominin demography during this period on the basis of artefact density (as advocated by Ashton and Lewis 2002). Increased curation of Levallois flakes and cores appears to have had a profound effect upon patterns of artefact discard, material either being discarded in low numbers where used, or only upon return to situations in which they could be replaced. The discard of low numbers of artefacts away from contexts likely to enter the Quaternary record, as well as the reduced likelihood of recovery from fine-grained sediments, arguably results in lower overall numbers of Levallois artefacts, in comparison to the Lower Palaeolithic record. It is additionally suggested that there is little evidence for a dramatic decrease in hominin population throughout OIS 7 (*contra* Ashton and Lewis 2002); rather, the fact that most of the largest early Middle Palaeolithic sites examined in this thesis date to the earlier part of OIS 7 is argued to relate to changes in raw material availability – many sources being masked by progressive sedimentation later in the interglacial (e.g. Ebbsfleet), and therefore no longer targeted as extraction sites.

7.3 Implications of this study for understanding the development of Middle Palaeolithic behaviours in Europe

The British early Middle Palaeolithic record is key to understanding the development of classic Middle Palaeolithic behaviours in several ways. Re-analysis of the core assemblage from Botany Pit, Purfleet supports White and Ashton's (2003) interpretation of the material as representing one of several European sequences which reflects the indigenous development of Levallois technology in Europe from existing technological principles. It is further suggested here that the development of such practices might be related to the expansion of the Mammoth steppe biotope into Western Europe during OIS 8. Although such environments have been interpreted as highly productive (Guthrie 1984, 1990), exploiting them may have required tracking gregarious prey over increasingly long distances, especially in the context of seasonal migrations. A technological strategy that allowed hominins to move away from situations in which material was predictably available, and to equip themselves to deal with a variety of possible contingencies, may have been favoured by the development of such landscapes in Western Europe.

This study additionally supports recent attempts to build upon the work of Eric Boëda, but move beyond the simple cataloguing of material as Levallois/Non-Levallois, or classification of Levallois material according to the specific methods employed (e.g. Schlanger 1996, Guette 2002, White and Ashton 2003). Rather, it is necessary to evaluate technological action in response to specific local conditions and affordances, in order to determine how and why particular strategies were adopted at particular times. Any understanding of hominin "projects for living" (*cf.* Hopkinson and White 2005) requires investigation of the entire context of behaviour in as broad a sense as possible; subsistence behaviours, landscape structure and environment, as well as the socially-transmitted technological principles which were knowledgably employed in particular situations. Concentrating upon lithic artefacts obviously only provides a partial glimpse of how hominins engaged with the world within which they were active; however, attempting to do so through situating flintworking practices within a holistic behavioural context allows us to move beyond static classification of endproducts and methods, and towards a more dynamic reconstruction of the development of Middle Palaeolithic behaviours in Europe.

The complex patterns of landscape use apparent within Britain from late OIS 8 onwards are of central importance to understanding the development of Middle Palaeolithic behaviours in

Europe. Continental studies have previously suggested that the differential treatment of particular points in the landscape is a classic facet of the Middle Palaeolithic "behavioural package" (e.g. south-west France, southern Limburg Plateau; Duchadeau-Kervazo 1984, 1986, Turq 1988, 1989, Kolen *et al.* 1999). However, such landscape studies are largely undated and based upon the analysis of material collected during surface survey, for which no more than a generalised Middle Palaeolithic date can be proposed. In contrast, the early British Middle Palaeolithic record comprises a chronologically constrained corpus of sites, well characterised in terms of local environment and climate. The British record also supports almost immediate diversification in Levallois techniques during the early Middle Palaeolithic, and the knowledgeable selection of particular strategies in order to obtain particular desired endproducts. On this basis, it is therefore possible to demonstrate that the logistical organisation of technological behaviour within Middle Palaeolithic landscapes is apparent in Britain by at least late OIS 8, providing a time depth to at least some of the increasingly complex suite of behavioural adaptations apparent during the European Middle Palaeolithic.

7.4 Directions for future research

By necessity, the majority of the sites examined in this study comprise larger assemblages from fluvial contexts, and the selected sample is dominated by larger extraction and production locations. As outlined previously, more ephemeral occurrences away from such magnet locations are less likely to enter the record, or to be recovered at all. In order to offer any firmer conclusions concerning the specific nature of hominin behaviour away from these locales, it is necessary to deliberately target these "off-site" locations, as well as to re-examine faunal material from such situations for cutmarks. The mammalian faunas from known sites such as Stoke Tunnel, Selsey and the Crayford brickearths would almost certainly repay re-analysis. Similarly, controlled sampling and excavation of fine-grained sediments is necessary to locate and examine the residues of hominin behaviour away from immediate raw material sources. Such investigations are rarely undertaken either in Britain or on the continent, Site N at Maastricht-Belvédère being a notable exception (Roebroeks *et al.* 1992). It is possible that the extant brickearths surviving in the Crayford-Erith area would repay equivalent investigation. Similarly, whilst material from Creffield Road and sites in the Yiewsley area is suggested to date to between OIS 8-Mid OIS 7, clarification of the date at which the archaeological material was sealed on the terrace surface would allow the relationship of the site to the exploitation of the wider landscape to be more closely established.

Given that this study clearly shows that the logistical organisation of technology within the landscape is fundamental to Middle Palaeolithic practices by late OIS 8 in Britain, similar investigation of such patterns on the basis of chronologically constrained continental assemblages is also required. This is particularly important given increasing evidence for the indigenous, local development of Levallois technology in Europe and almost immediate diversification in technological practices. Levallois technology appears to underwrite many of the behavioural changes apparent throughout the Middle Palaeolithic; moving beyond the question of how Levallois technology emerged, it is now necessary to examine why it became so widespread so quickly. Specifically, it is necessary to examine the relationship of novel European core-working techniques to pre-existing technologies, and to examine the relationship between such practices and other changes in technological behaviour – for instance, the apparently immediate adoption of recurrent methods apparent at Argouves (north France, OIS 8) and Mesvin VI (Belgium, early OIS 8), and the apparent transport of select products away from an immediate source of raw material at Achenheim (Germany, early OIS 8). It is particularly important to consider the landscapes within which such sites were situated, and to examine the relationship of such changes in technological behaviour to the apparent spread of the mammoth steppe into western Europe, and whether such strategies were favoured given the development of increasingly open environments.

The strength of the British early Middle Palaeolithic record is the result of a long history of interdisciplinary research, through which a substantial corpus of well contextualised assemblages have been amassed and a secure chrono-stratigraphic framework established. It is only on this basis that a study such as this is possible. The early British Middle Palaeolithic attests to ongoing, dynamic hominin engagement with changing Pleistocene landscapes from Late OIS 8 onwards, and suggests that such dynamism may have had deep roots. For the first time, it is therefore possible to investigate the Middle Palaeolithic in archaeological terms and to attempt to document the process by which the Palaeolithic inhabitants of Europe "became" Neanderthals. The challenge now is to move away from traditional archaeological preoccupations with recording novel behaviours, and to embark upon contextualised reconstructions of hominin practices on a European scale. The inhabitants of early Middle Palaeolithic Britain did, indeed, live in interesting times.

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