

Royal Holloway, University of London

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London before London: Reconstructing a Palaeolithic Landscape



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Declaration of Authorship

This thesis presents the results of original research undertaken by the author. Where the work of others has been consulted it is clearly specified and acknowledged.

Signed:

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Abstract: London before London: Reconstructing a Palaeolithic Landscape

Central London and its suburbs have produced a spectacular diversity of Palaeolithic artefacts in association with some of the most important palaeoenvironmental information in western Europe for the Pleistocene period. During the 19th and 20th centuries, London's rapid urban development coincided with the beginnings of Palaeolithic research and a new-found interest in the antiquity of humans and ancient landscapes. Contemporary antiquarians amassed extensive collections of artefacts and fossils as gravel extraction and construction occurred on an unprecedented scale. Nevertheless, in recent times, London has experienced a significant decline in research into its Palaeolithic heritage, at the expense of other parts of the Thames valley and southern England. However, thanks to the extraordinarily rich repository of antiquarian artefacts and faunal remains, new interpretations are now possible and these collections form the basis for the work presented here. Through the re-evaluation of over 16,400 artefacts and 4700 faunal remains from multiple localities (ranging from individual findspots to 'super sites'), the thesis explores the timing and nature of Palaeolithic occupation of London and its suburbs from the very earliest evidence in the Middle Pleistocene to the end of the last glaciation through a series of discrete time slices. The work further investigates the spatial patterning of the lithic resources through the application of GIS and, for the first time, fully integrates the archaeology with the Pleistocene palaeogeographical, stratigraphical, faunal and floral records of London, thereby allowing a dynamic palaeoenvironmental picture to be created. Finally, the research draws upon the activities of the antiquarians and collectors themselves at the time of these discoveries through publications, letters and other archival sources and situates these within the contemporary scientific knowledge.

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Chapter 1: Introduction

1.1 Rationale: London as a Palaeolithic and Pleistocene research area

The London area and its primary natural resource, the River Thames, have experienced dramatic changes in climate and environment over the last half a million years, including the southerly diversion of the Thames into its current course by the Anglian glaciation and periodic connection to and severance from the rest of Europe *via* a terrestrial connection or 'landbridge'. Superimposed upon this physical change is a constantly fluctuating climate, oscillating from glacial to interglacial, which forced Britain's earliest inhabitants to advance and retreat across the land, to adapt to changing ecological settings, to encounter new plants and animals and to seek out new resources. The virtually-unexplored Palaeolithic archaeological and palaeontological records from London are therefore eminently suitable proxies for the reconstructing and interpreting London's past climates and landscapes and establishing patterns of early prehistoric occupation.

The presence of the River Thames flowing through what is now the centre of London is of paramount importance in understanding the Palaeolithic history of London for two key reasons. Firstly, the river would have acted as a vital resource and focal point for hominins and other vertebrate fauna, offering a source of water, riparian vegetation and potentially, aquatic food resources. Its eroding banks and gravel bars would have provided hominins with a source of raw material (notably flint nodules) from which they could produce stone tools, whereas certain sites beside the river would have provided a clear view of the valley, useful for following herd movements, locating carcasses or identifying danger. Secondly, the river has responded to climatic oscillations and uplift by aggrading a staircase of terraces, which not only provides a depositional context for the remains but also acts as a stratigraphical framework for their interpretation. Often, fluvial sediments will be the final resting place for evidence of hominin and faunal occupation or activity (artefacts and fossils), which then become buried and preserved by later deposits. Consequently, the fluvial archive of London is a significant repository for Palaeolithic artefacts and also large numbers of mammalian fossils.

The research presented here was inspired by the recognition of two specific problems in the London area. The first is that in sharp contrast to other areas of the UK, including adjacent areas such as the Sussex coastal plain and southern East Anglia, there has been a virtual absence of directed research on the Palaeolithic and wider Pleistocene environment of London for more than half a century, despite the richness of the material available for study. This has created a significant gap (both in knowledge and in geographical terms) in the area. The River Thames itself has provided one of the most important natural corridors for the migration and dispersal of Palaeolithic hunter-gatherers and Pleistocene fauna and yet, no corpus of knowledge from the central stretch of its course currently links the rich sites in the upper reaches around Oxford with the renowned Lower Thames localities in north Kent and Essex. The situation is further exacerbated by the extensive excavation and construction that London has witnessed, which has all but obliterated, in the central part of the city, the traces of former river terraces and overlying brickearths that have yielded the artefact and fossil remains. This has perhaps led to a negative perception that few research opportunities exist.

The second problem relates more specifically to the nature of the material, since almost all of it was collected at a time during the 18th and early 19th centuries when the acquisition of specimens was generally of more interest than the geological context from which they came. This is particularly the case for material casually collected by enthusiasts and quarry workmen, prior to the mechanisation of aggregates extraction, although diligent antiquarians such as Worthington George Smith and John Allen Brown are notable exceptions. As a result, much of the scientific value of the artefactual and fossil specimens currently held in museums is potentially diminished, unless they can be re-evaluated in the light of newly-developed chronologies, stratigraphies and interpretations. It was therefore recognised that a significant opportunity existed, to situate these large artefact and fossil collections from London within contemporary scientific knowledge, particularly comparing with the well-established Upper and Lower Thames chronologies.

The Greater London Historic Environment Record (GLHER) was consulted during this research. However, it was not used as a primary resource for locating Palaeolithic artefacts in London, since the contained records often lack fundamental information on

where the artefacts are currently held. Many of the artefacts eventually seen during this study do appear in the GLHER, however this study has identified many additional objects, particularly from the antiquarian collections, which have never been recorded in the GLHER. Equally, there are also artefacts listed in the GLHER that were not revisited in this study, either because no location was given or because the objects remained in private collections. Currently, the Palaeolithic GLHER entries only record basic information on location of site and the broad time period the artefacts have been assigned to (although even this cannot be confidently ascertained for some lithics). Occasionally, the number or type of artefacts or some interpretative information on the nature of the site is also given. The specific information held on each artefact or collection in the GLHER is therefore not consistent and this is certainly an area that could be substantially improved in terms of level of detail. However, this would entail the revisiting of each listed object in order to update the GLHER, which would prove to be an insurmountable task. It is also difficult to ensure that all new finds are recorded on the GLHER. Any catalogue produced from this thesis could, however, assist in at least updating the existing Palaeolithic material records and increasing the level of detail the GLHER holds. This may ultimately help in identifying locations with potential for the analysis of Pleistocene deposits and possibly the recovery of artefacts and fossils during the future development of London.

1.2 The diversity of evidence in London

Although widely unappreciated until now, central London and its suburbs have produced a spectacular diversity of Palaeolithic remains, in association with some of the most important palaeoenvironmental information in western Europe for the Pleistocene period. From the oldest-known record in 1715 of a flint handaxe near the Grays Inn Road (Leland, 1716; Evans, 1872), to the iconic 1950s discovery of fossilised remains of hippopotamus, straight-tusked elephant and lion in Last Interglacial Thames gravels underneath Trafalgar Square (Franks *et al.* 1958), London itself provides a superb repository of materials for the interpretation of ancient human occupation of the area and the shifting landscape and environments over approximately the last 500 000 years. When taken together, the artefactual and faunal assemblages from London represent all the key stages of the Palaeolithic and cover most (if not all) of the various climatic episodes of the Middle and Late Pleistocene, although some significant periods remain very poorly known.

Although various gazetteers (eg. Roe, 1968a; Wymer, 1968, Wessex Archaeology, 1996) have previously attempted to catalogue and describe Lower and Middle Palaeolithic artefacts from various sites in the London area, these studies were not comprehensive. In addition, the Upper Palaeolithic has frequently been excluded from previous assessments and the full corpus of palaeoenvironmental evidence has never before been properly documented nor fully integrated. This study has revisited and analysed over 21000 artefacts and mammalian fossils spanning the period from the Anglian glaciation until the start of the Holocene, thereby making it the first occasion that an integrated review and reinterpretation has been undertaken. As well as first-hand study of the mammals, all available published evidence from other palaeoenvironmental proxies, such as pollen, plant macrofossils, molluscs, beetles, ostracods, and herpetofauna, have been integrated with this research in order to fully reconstruct the landscapes and climates of Pleistocene London.

1.3 The role of antiquarians in Palaeolithic and Pleistocene research in London

London was extensively developed during the 18th and 19th centuries, providing amateur collectors with an unprecedented opportunity to observe the prehistoric sediments in gravel pits, brick pits, during the excavations of house foundations and the installation of utility pipes. This period of urbanisation occurred at a time when natural sciences, in particular geology and palaeontology and the associated fledgling discipline of archaeology, were rapidly developing and antiquarians were first recognising the antiquity of hominins (for example Lyell (1880-1883), Darwin (1859), Evans (1872)). These developments inspired many antiquarians to acquire large collections of artefacts and fossils, which were often sufficiently large and impressive to be later acquired or purchased by museums. London supported a strong archaeological community during this time, since it was home to many archaeological societies and museums, which encouraged the sharing of knowledge, the publication of research and the ultimate advancement of the science. A large proportion of our knowledge of the Palaeolithic of London can be credited to the antiquarians and their collections, upon which this thesis is largely based.

Many of the late 19th and early 20th century antiquarians recorded their finds and the site stratigraphies in great detail, despite this not being widespread standard practice at the

time. However, the use of antiquarian collections is not without its problems. Some collections lack stratigraphical and geographical provenance detail, making it difficult to draw firm conclusions about their significance. Another concern with research of this nature is that many of the artefacts were originally found by workmen and then passed onto the antiquarian collectors later. This practice occasionally encouraged forgeries or misattributed finds, as workmen were frequently paid for their efforts and were keen to 'deliver the goods'. Furthermore, antiquarians frequently found artefacts *ex situ*, for example in gravel heaps and on newly lain roads. Nevertheless, by basing key interpretations only on well-provenanced material, maintaining vigilance for any suspect artefacts (usually revealed by preservation or condition) and integrating the historical material with more recent observations and up-to-date recording of sections, it is still possible to unravel London's Palaeolithic past (Juby, 2008).

1.4 Aims and objectives of the project

The aims of the research can be categorised as follows:

1. *Changing peoples.* To investigate the timing and nature of Palaeolithic occupation of London and its suburbs from the very earliest evidence of hominin presence in the Middle Pleistocene to the end of the last glaciation; to identify evidence of changing populations (and species) of early hominins, technologies and interaction with the environment; to identify key 'hotspots' for Palaeolithic activity and to use this information to complement and update existing resources such as the Historic Environment Record for Greater London.
2. *Changing landscapes.* To establish the dynamic environmental context for Palaeolithic occupation by investigation of the palaeogeographical, stratigraphical, faunal and floral records of London; to assess evidence for environmental change through time, thereby providing the backdrop for understanding changing availability of natural resources and implications for hominin subsistence behaviour.
3. *Changing knowledges.* To establish the nature of the activities of antiquarians and collectors at the time of these discoveries through publications, letters and

other archival sources and to situate these within the modern scientific knowledge.

These aims will be achieved through the following objectives:

1. To compile the most comprehensive record of Lower, Middle and Upper Palaeolithic stone tools and humanly-modified objects from London, including first-hand observations on technology, raw material and condition, and to integrate those with published records where available.
2. To display the spatial and chronological distribution of key technological periods using basic GIS mapping.
3. To undertake a full-scale appraisal of the mammalian assemblages from London and its boroughs, based on first-hand re-examination of fossil material together with integration of published records, in order to assess relative ages of the different assemblages through biostratigraphical analysis, to reconstruct palaeoenvironments and to understand hominin interactions with the mammal fauna.
4. To establish the stratigraphical origins of the specimens analysed by comparing recorded provenance information with geological mapping and integrating any information from absolute or relative dating in order to establish an age for each assemblage or locality.
5. To integrate the archaeological and mammalian palaeontological evidence with published records of other biological proxies and non-biological evidence in order to reconstruct the palaeoenvironment and palaeoclimate.
6. To examine publications, obituaries, newspaper articles and personal notebooks, artefact catalogues and photographs of notable antiquarians from the 19th and 20th centuries in order to document their interest in the Palaeolithic, their collecting practises and explore the significance of their discoveries at the time in which they made them.

The research will therefore provide the first comprehensive, integrated overview of the earliest prehistoric occupation of London and will place that information within an up-to-date Quaternary landscape and palaeoenvironmental context.

Chapter 2: Methodology

2.1 Identification of relevant collections

The collections in all the major archaeological and natural history museums in central London were analysed first, chiefly the Museum of London, the Natural History Museum and the British Museum. Sixteen other institutions were visited, including local London Borough museums and some outside London, namely the British Geological Survey Museum at Keyworth, Bromley Museum, Dartford Museum, the Wymer Collection held in the Department of Geography, Royal Holloway, Elmbridge Museum in Weybridge, Gunnersbury Park Museum, Hillingdon Museum, the Institute of Archaeology (University College London), the Museum of Archaeology and Anthropology and the Sedgwick Museum of Earth Sciences at the University of Cambridge, Reading Museum, Redbridge Museum, Richmond Museum, Vestry House Museum, Walthamstow, Wandsworth Museum and Wardown Park Museum in Luton. Consultation of previous gazetteers such as those by Roe (1968a), Wymer (1968) and Wessex Archaeology (1996) aided in identifying collections outside the London boundary that hold Palaeolithic artefacts from London. Archival research into antiquarian activities also led to the identification of further museums outside London with relevant assemblages, such as Wardown Park Museum in Luton, which holds a large proportion of Worthington George Smith's collections due to his connections with Bedfordshire. A list of all museums visited can be seen in the Appendix.

2.2 Analysis of Palaeolithic artefacts

Each artefact had the following information recorded:

1. Museum
2. Artefact number
3. Location within the museum
4. Collection name or original collector
5. Location from which the artefact was found
6. Tool type. Debitage (flakes measuring <20mm) were not recorded in this study due to time constraints. The categories of tools identified in this study are listed below. Broken flakes and handaxes were included and their fragmentary nature was acknowledged.

- Handaxe
- Flake
- Flake (modified)
- Core
- Unclassifiable worked flint

7. Handaxe shape. The categories used for handaxe shape followed the broad classifications by Wymer (1968) (Figure 2.1):

- Pointed
- Cordate
- Sub-cordate
- Flat-butted cordate (or *bout coupé*)
- Ovate
- Ficron
- Cleaver
- Crude

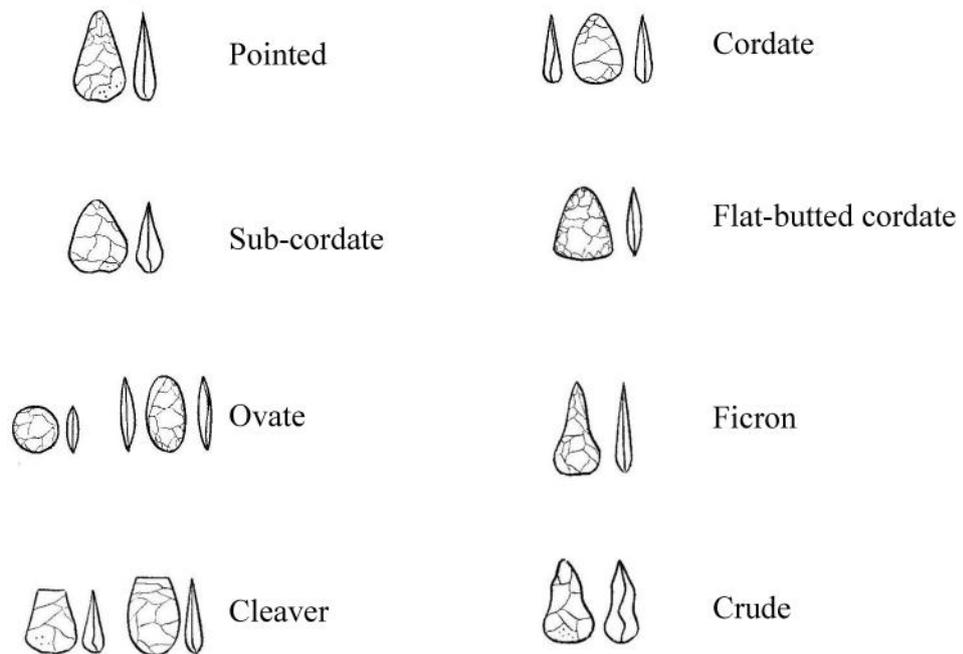


Figure 2.1: Handaxe shape classifications. Adapted from Wymer (1968).

8. Tool measurements. All tools were measured for their maximum length (L), breadth (B) and thickness (T) using callipers (in mm). For handaxes, four additional measurements were also recorded, B1 (breadth at 1/5 of the distance from the handaxe point), B2 (breadth at 1/5 of the distance from the handaxe butt), T1 (thickness at 1/5 of the handaxe length from the point) and L1 (the distance from the butt end to the position of the maximum breadth) (Figure 2.2), following the method proposed by Roe (1964, 1968b). This series of measurements allow the morphology of the handaxe to be reconstructed when a photograph or drawing of the implement is not available.

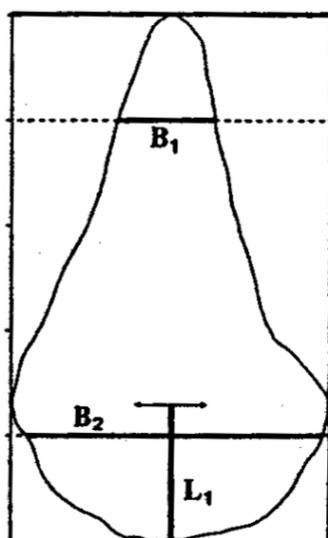


Figure 2.2: Handaxe measurements recorded, following the method proposed by Roe (1964, 1968b). Figure adapted from Roe (1968b)

The taking of measurements may assist in future identification of a particular tool if it lacks a museum accession or other individual identification number and it is possible to roughly recognise the overall shape of a tool by these measurements.

8. Levallois cores and flakes. Flakes were recorded as either a definite Levallois flake or a probable Levallois flake. Definite Levallois flakes were recognised by their faceted butt, which is a direct result of the prepared core technological method used to create Levallois flakes (Chapter 5). Probable Levallois flakes lacked the clear presence of faceting but otherwise resembled a Levallois flake.

9. Percentage of tool covered by cortex. For flakes, this refers to the percentage of cortex on the dorsal side.
10. Level of abrasion. Abrasion of the tool is present when the ridges left on the tool from the removal of flakes are rounded from water-action or battering against other material and stones. This usually occurs during transportation in fluvial or marine environments, or during overland transport (e.g. in colluvial or solifluction deposits). Many flint implements from fluvial sand or gravel deposits will exhibit significant abrasion (Wymer, 1968). Generally the greater the degree of surficial abrasion, the further the tool has been transported, although other factors such as stone type need to be considered (Shackley, 1974, 1978). Categories for this are listed below and are illustrated in Figure 2.3.
- Unabraded
 - Slightly abraded
 - Moderately abraded
 - Heavily abraded



Unabraded

Slightly abraded

Moderately abraded

Heavily abraded

Figure 2.3: Artefacts illustrating the four abrasion categories used in this study.

Photographs by C. Juby.

Recording the degree of abrasion may help in differentiating *in situ* artefacts and surface discards from those from the gravel body or reworked artefacts found in younger deposits.

11. Degree of patination.

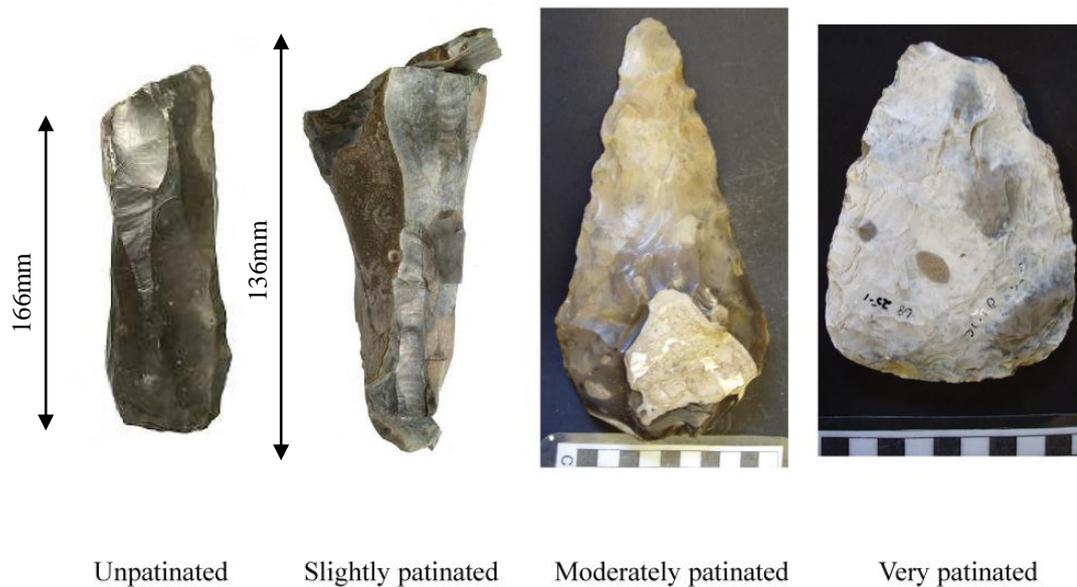
Patination is a result of extended exposure to moisture, very basic solutions (Schmalz, 1960) or very acidic solutions that which dissolve the silica in flint, although the rate of patination may vary depending on the chemical composition of the flint (Burroni *et al.*, 2002). Therefore, in archaeological contexts, patination may occur when the tool is exposed to rainfall on the land surface or by leaching of moisture through sediment. Patination increases in strong localised concentrations of acids such as those arising from the decay of organic matter. If the flint has mineral impurities that dissolve easily, patination is also increased because water will penetrate more freely (Burroni *et al.*, 2002). Patination can be used as a broad indication of relative age, as the longer a tool is exposed to patina-forming conditions, the stronger the patina (Wymer, 1968). However, as patination depends on a variety of factors, such as flint composition and the localised presence of acids or alkalis, it is not always a reliable characteristic for dating implements.

Patination of flint can often be very assemblage-specific and so recording the degree and nature of patination of a flint lacking some details of provenance may help in attributing it to a particular assemblage with a similar patina and may also help identify a particular tool if it lacks an artefact number.

Artefacts were assigned to one of four categories (Figure 2.4):

- Unpatinated
- Slightly patinated
- Moderately patinated
- Very patinated

The colour of the patination was also recorded, for example, 'light grey' or 'bluish-grey'.



**Figure 2.4: Artefacts illustrating the four patination categories used in this study.
Photographs by Museum of London and C. Juby.**

12. Degree of staining.

The colour of the implement staining was also described. Flint becomes stained when the gravel body contains iron and is exposed to water for a significant period of time. The colour is often caused by minerals, for example the common orange/brown staining of many of the Thames gravels is caused by iron oxide. As with patination, the presence of characteristic staining on a tool may help to indicate its stratigraphical provenance.

Much like the level of abrasion and patination, the degree of staining was recorded by one of four categories:

- Unstained
- Slightly stained
- Moderately stained
- Heavily stained

2.3 Analysis of Palaeontological collections

All large mammal fossils were recorded with the following categories:

1. Museum

2. Specimen number
3. Location within the museum
4. Collection name or original collector
5. Location in which the specimen was found
6. Identification of skeletal element. In this thesis teeth are depicted by the following abbreviations; 'C' (upper tooth) or 'c' (lower tooth) for canine, I/i for incisor, M/m for molar.
7. Left or right body side (abbreviated to L and R in tables in this thesis)
8. Species (or to Genus, Family, Order or Class level depending on presence of diagnostic characters)
9. Completeness of the specimen
10. Degree of abrasion
11. Degree and colour of staining
12. Modifications, such as gnaw marks, modification by humans, root marks, and repairs to the specimen

Many of the criteria are the same as for the artefacts, which help with future identifications of a specimen, and understanding its stratigraphical provenance.

During collecting data for this project it became increasingly apparent that it was not always suitable to assign the degree of staining, abrasion and patination of artefacts and fossils to one of four categories. The method used to describe artefacts and fossils was subjective and thus it could be difficult to differentiate between the intermediate two categories ('slightly' and moderately'). Therefore it would have been much more consistent and simplistic, although no less useful, to only use three categories (e.g. unstained/unabraded/unpatinated, moderate and heavy).

2.4 Archival Research

Local history archives, museum archives and libraries were visited, where personal artefact catalogues, field notebooks and photographs were consulted to obtain information on the antiquarians and their collections. Obituary journal and newspaper articles were also studied.

The Greater London Historic Environment Record (GLHER) was consulted for information on Palaeolithic finds in London and 589 find spots were identified. Many records were from sites yielding implements that were observed in museum collections but there are substantial difficulties in using the GLHER as a key resource for information on the Palaeolithic. This is because the database lacks artefact identification numbers, notification of the museum in which particular artefacts are held and many basic details, including critical technological or typological information. It is therefore unfortunately not possible to establish which of the finds logged in the GLHER were actually seen during this study. One of the key objectives (see Chapter 1) was to improve the potential level of information available in the GLHER for the Palaeolithic and it is hoped that the level of detail recorded during this study, such as artefact measurements, individual implement numbers, the collector and details from antiquarian labels may eventually supplement the information presently available.

2.5 Palaeoenvironmental information

Details on environmental and climatic proxies other than the mammalian evidence studied here, such as pollen, plant macrofossils, molluscs, beetles, and ostracods were included from published sources, such as journal articles, books and field guides.

2.6 Geographical Information System (GIS) maps

To create maps showing the distribution of Palaeolithic implements and faunal specimens in London, ArcGIS software was used. Each artefact or specimen was assigned an individual identification number and Eastings and Northings relevant to their find spot. If an artefact or specimen lacked a detailed geographic provenance, coordinates corresponding to the centre point of that location were used for illustration purposes. Although it had originally been intended to deploy the GIS much more widely throughout this study, this ultimately proved impossible because of time constraints and problems obtaining a Digital Elevation Map at a high-enough resolution so as to enable querying of the databases. However, the information collated during this study can be utilised subsequently for GIS-based studies as part of a programme of future research, for example in identifying ‘hot spots’ for Palaeolithic activity or occupation, determining the proximity of sites to resources such as rivers or raw material sources, and assessing the influence of slope, aspect or bedrock in choice of site location.

The key for the deposits represented in the GIS maps throughout this thesis are listed in Figure 2.5.



Figure 2.5: Key for deposits represented in the GIS maps

Chapter 3: Geology of the London Region and the History of the Thames

The following chapter presents a brief overview of the bedrock geology of the London region and overlying superficial deposits. Particular attention is paid to the evolution and diversion of the River Thames as a context for interpreting the artefactual and palaeontological datasets.

3.1 Pre-Quaternary bedrock in the London region

The oldest bedrocks in the Thames region are volcanic deposits of Precambrian age (600-700 million years BP). Overlying these are shallow marine early Palaeozoic rocks, calcareous Silurian deposits (443-418 million years BP) and Devonian sandstones and mudstones (416-374 million years BP), creating a block known as the London Platform. The area was again submerged by a marine transgression at the beginning of the Upper Palaeozoic (Carboniferous, 370-299 million years BP), depositing mudstones, limestones and sandstones. During the Permian (299-252 million years BP), the region became a desert and there is no evidence to suggest any rocks were formed at this time (Pharaoh *et al.*, 1996). During the Triassic (251-203 million years BP), the London Platform was eroded heavily and sediments accumulated in neighbouring basins (Pharaoh *et al.*, 1996). Jurassic rocks (200-150 million years BP), which are predominantly marine in origin, are largely absent in the Greater London area due to the London Platform being mostly dry land at that time. However, there were some Lias Group rocks and Inferior and Great Oolite rocks deposited on the outskirts of the London Platform, directly overlying Devonian rocks (Ivimey-Cook, 1996; Wyatt, 1996) (Figure 3.1). Subsequent uplift during the Early Cretaceous (c. 140 million years BP) caused elevation and erosion, depositing the Lower Greensand and the Gault Formation mudstones that were laid down the southern margins of the London Platform (Owen *et al.*, 1996) (Figure 3.1).

Chalk bedrock is present in outcrops along the Chiltern Hills and the North Downs but is also present at depth in between these two outcrops, through most of Berkshire, Essex, Kent, southern Suffolk and out into the North Sea. The Chalk formed during the Late Cretaceous (c. 97-65 million years BP), when sea levels were much higher than at present. Calcareous pelagic sediments were laid down; while evidence from corals,

brachiopods and echinoderms indicates that the sea was significantly warmer than at the present day (also supported by stable isotope studies (Wood, 1996)). The Chalk reaches a maximum depth of 200-600 m (Wood, 1996) (Figure 3.1).

The Palaeogene was a time of intense sedimentation in the London area of shallow marine, coastal, and fluvial deposits, as the London Platform subsided to form the London Basin in response to tectonic movements, notably the Alpine orogeny. The oldest Palaeogene deposit infilling the London Basin is the **Thanet Sand Formation** (58-56 million years BP), which can be found in south-east London and which reaches depths of 32m. **The Lambeth Group**, of Lower Eocene age, 56-55 million years BP, is the next oldest Palaeogene deposit, represented (in the London area) by the **Reading Beds** to the north and west of London and the **Woolwich Beds** in central and south-eastern London. These were both deposited in lagoonal or estuarine environments. A deep water marine environment subsequently developed across south east England, which resulted in the deposition of the **Thames Group** of deposits. This Group consists of the **Harwich Formation** in the south-eastern and eastern parts of the London Basin and the richly-fossiliferous **London Clay Formation**, which represents the majority of the London area Palaeogene deposits, and reaches 150m in depth on the eastern side of Greater London (Ellison and Zalasiewicz, 1996).

After the London Clay Formation was deposited, a series of shallow marine sediments of the **Bracklesham Group** (c. 50 million years BP) was deposited, consisting of the **Bagshot Formation**, the **Windleham Formation** and the **Camberley Sand Formation**. In Greater London, these sediments were deposited to the north in the Hampstead area (Ellison and Zalasiewicz, 1996). During the early Neogene, there was a further rise in sea level and marine sediments were again deposited, however there are no deposits of this age known in the Thames Valley or London Basin (Ellison and Zalasiewicz, 1996).

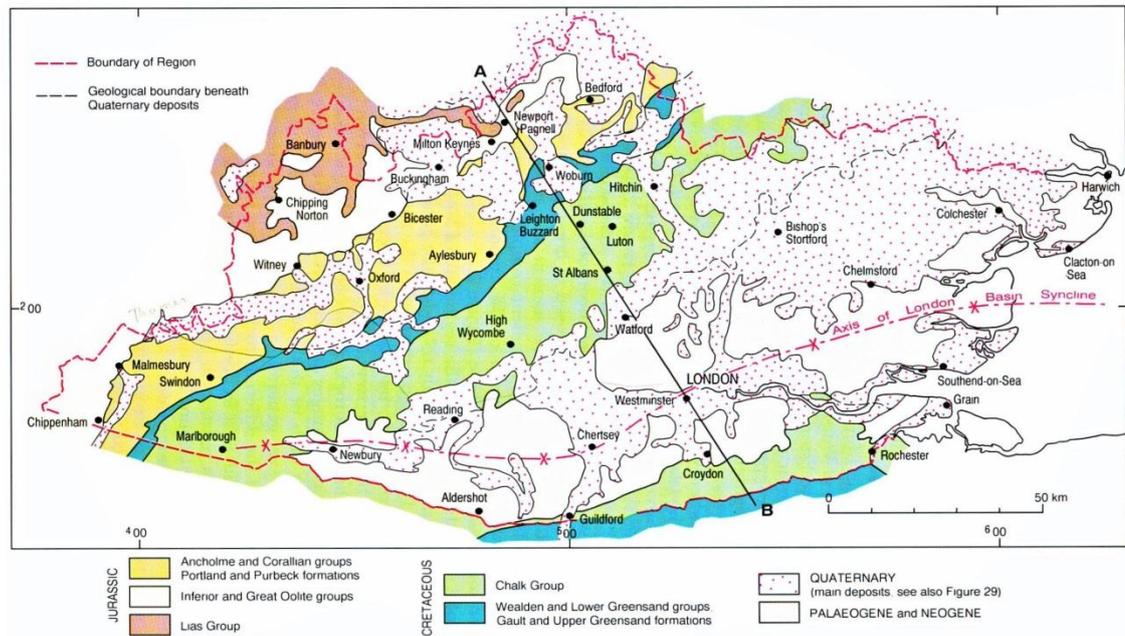


Figure 3.1: Geology map of the Thames basin. From Sumbler (1996).

3.2 The formation of the Thames terraces

During the Quaternary, the proto-Thames (which flowed to the north of its current course) and its successor created a ‘staircase’ of terraces due to a combination of climate change and uplift of the region. River terrace development occurs through a combination of climatic triggers on fluvial activity and gradual isostatic adjustment to the removal and redistribution of surface material and bedrock from glaciations and river activity. As a result, the river responds by incising, in an effort to re-establish its previous equilibrium (Leopold and Bull, 1979; Maddy, 1997; Bridgland, 2000; Westaway *et al.*, 2002). Zeuner (1945, 1959) first suggested that incision occurs in cold-climates as a response to lowered sea levels. It was also put forward that downcutting and aggradation can be both triggered by hydrological changes as well as changes in the base level in the Thames valley (Green and McGregor, 1980). However, it is not clear which forcing mechanism triggered the downcutting in the case of the Thames, as a lowering of sea level would not cause incision but instead would just extend the river valley further beyond the interglacial coastline (Bridgland, 1994). Furthermore, research on the North Sea floor has indicated that fluvial valleys and terraces continue offshore beneath the Holocene marine sediments, thus illustrating the existence of extended river valleys in periods of low sea level (D’Olier, 1975; Bridgland and D’Olier, 1987, 1989).

Evans (1971) attempted to correlate the Thames terraces system with deep sea records, by comparing raised beach deposits found in Britain and abroad with the terrace aggradations. He demonstrated that fluvial systems have progressively lowered their base level throughout the Pleistocene. This may reflect an isostatic adjustment due to the removal of material from the terrestrial areas and deposition in marine areas, leading to uplift of the terrestrial areas and depression of the marine floors (Bridgland, 1994).

However, it is clear from the extensive and well-dated fluvial record in the Thames that the river was acting in synchrony with the large-scale climatic changes witnessed during the Pleistocene. Bridgland (1994, 2000, 2006), Bridgland and Maddy (1995), and Bridgland and Allen (1996), have accordingly developed a schematic model that represents terrace development in rivers such as the Thames in response to climate change (Figure 3.2).

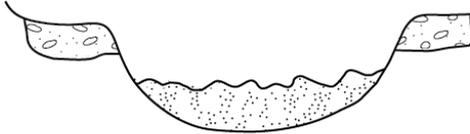
Phase 1: Downcutting of single thread river



**Cold/
Warming**

Phase 1: During climatic warming, vegetation stabilises slopes, therefore limiting accumulation of slope on the floodplain. River incises but with lack of sediment to transport.

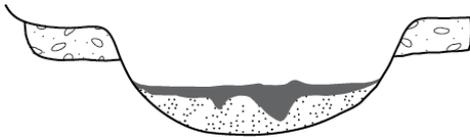
Phase 2: Aggradation by single thread river



Warming

Phase 2: Instabilities in the climate as it adjusts result in depressions across the UK and high rainfall events. Previously stored water in frozen ground melts and increases aquifers. Flow increases in the river, leading to erosion. Eroded sediment is deposited.

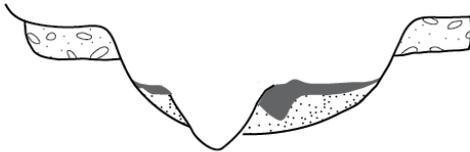
Phase 3: Stable. Small changes only.



Interglacial

Phase 3: As the warming completes, climatic conditions stabilise. Changes within the river course are small, with low-energy sediment being deposited in the floodplain in small volumes.

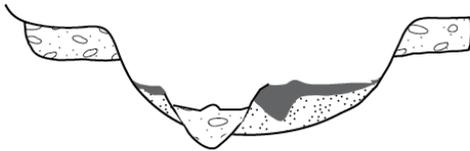
Phase 4: Minor downcutting



**Cooling/
cold**

Phase 4: As the climate cools, climate instability leads to floods and so may lead to increased erosion. Narrow terrace formation.

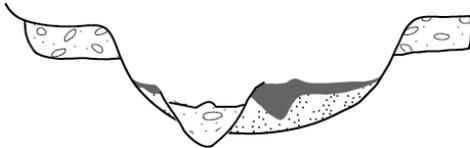
Phase 5: Aggradation in multichannel river with basal scour



**Cooling/
cold**

Phase 5: As cooling continues, vegetation reduces on slopes. This along with freeze-thaw processes increases mass slope movement. Rainfall intensity and magnitude increases due to instabilities in the North Atlantic atmospheric and oceanic circulations. This results in increased aggradation of sediment on the valley floor.

Phase 6: Stable. Small changes only



**Glacial-
cold and
stable**

Phase 6: In complete glacial conditions, the thermo-haline circulation shuts down and polar front pushes south, resulting in less rainfall over the UK. General flow of the river reduces and is dominated by an annual flood. This results in only small scale changes occurring within the valley.

Figure 3.2: Model to illustrate the cycles of incision and aggradation of the River Thames terraces over a climatic cycle. Adapted from, and descriptions based on Maddy *et al.* (2001) and Bridgland (2006).

The model suggests that incision prior to the formation of a new terrace occurs on the warming limb of each climatic cycle and that aggradation occurs in two stages in the cycle, first in the warming phase and with the major aggradation occurring in the cooling stage (Phases 2 and 5 Figure 3.2). The model allows for the observation that more than one cold-climate stage can be represented in a single terrace aggradation, for example, interglacial deposits are usually found ‘sandwiched’ with underlying and overlying cold-climate gravels. A revision to Phase 4 of the standard model was added by Bridgland (2006) to suggest that uplift taking place in the stage is sufficient to enable deep incision and base-level lowering. It was estimated that the rate of uplift every 100 years may be as much as 7cm in the Upper Thames Valley (calculated using a simple linear model) (Maddy, 1997). Bridgland (2006) noted that the incision in Phase 4 would be 10-20ka following the downcutting in Phase 1. In contrast the time between Phase 4 and back to 1 would be a minimum of 80ka, suggesting that widely- and narrowly-spaced terraces may form, and that Phase 4 would be responsible for the narrow-spaced terrace. A further modification to the original model was proposed by Bridgland and Westaway (2008), which allowed for areas where the warming transition incision failed to occur and instead had the major phase of incision at the cooling transition. It was suggested that this occurred more frequently in systems that were inundated with sediment from destabilized landscapes, thus cancelling the effect of increased discharge from the melting permafrost. However, in the Lower Thames, the interglacial deposits are positioned low in the terrace, suggesting that the main incision occurred during the warming transition (Bridgland, 2000). The Middle Thames also reflects this trend with interglacial deposits at Redlands Pit, Reading, occurring above the basal Taplow Gravel and the interglacial deposits at Brentford and Trafalgar Square lying above the basal Kempton Park Gravel.

3.2.1 Terrace Formations and Members

There is some debate over whether the terrace aggradations should be assigned ‘Formation’ or ‘Member’ status. Gibbard (1985, 1986), using a lithological content approach and associated statistical analyses, assigned the terraces ‘Member’ status and then grouped all the terraces into the ‘Middle Thames Valley Gravel Formation’. However, Bridgland (1988a, 1988b, 1990, 1994) assigned the terraces primary ‘Formation’ status. He argued that when assigning ‘Formation’ status, the deposits should be looked at on a much larger scale and identifications should be based on

morphology and gross lithological content. Bridgland reasoned that this allows for small changes within the same unit and unconformity due to erosion and breaks in sedimentation, whilst still recognising the deposits as the same. In practice, the latter approach allows much greater flexibility and allows for climatic complexity within individual temperate-climate and cold-climate stages (eg. Schreve *et al.*, 2002). Accordingly, the terraces are recognised as Formations in the present work.

3.3 The Quaternary Deposits

3.3.1 Pliocene/ Early Pleistocene Deposits and ancestral Thames deposits (pre-diversion)

Early Pleistocene deposits are generally very poorly preserved in Britain, except in East Anglia and even then sequences frequently contain substantial hiatuses. The London area is no exception, with the only hint of deposits of this age being found just outside the study area, in the form of beds found on the hills of the North Downs in Surrey at Netley and Headley Heath (Whitaker, 1862; French, 1888; Stebbing, 1900; Davies, 1917; Chatwin, 1927; Dines and Edmunds, 1929; John and Fisher, 1984). The fossils and the ferruginous nature of the beds led to these beds being correlated with the **Red Crag** of East Anglia (Bridgland, 1994), the date of which remains controversial (Late Pliocene or Early Pleistocene) (Reid, 1890; Harmer, 1902; Baden-Powell, 1950; Boswell, 1952). More recent research suggested that the Red Crag could span the end of the Pliocene into the Early Pleistocene (Cambridge, 1977; West, 1977), although Zalasiewicz and Gibbard (1988) most recently assigned it an age between 3.5 and 2 million years based on correlation with deposits in the Netherlands, therefore making it at least a partially Pliocene deposit.

To the north of London, around Hertfordshire, there are deposits that are mainly composed of rounded flint pebbles, similar to the flints in the Palaeogene deposits that they overlie. These have long been thought of as very ancient deposits, possibly as old as the Pliocene, with many authors attributing the rounded nature of the pebbles to marine deposition (Hughes, 1868; Wood, 1868; Prestwich, 1881, 1890a, 1890b; Whitaker, 1889). Whitaker (1864) was the first to name the deposits as '**Pebble Gravel**'. He distinguished these Pebble Gravels from the fossiliferous Pliocene deposits found on comparable high-level ground in the area, regarding the Pebble Gravel as a 'drift' deposit.

There are also some sub-angular flints found in the **Pebble Beds**, which have led to conclusions that it contains reworked Palaeogene flints, although some are derived directly from the Chalk (Hughes, 1868; Whitaker, 1889). Prestwich (1881, 1890b) correlated the Pebble Gravel with the Westleton Beds in East Anglia. He interpreted these beds as the result of the London Basin being flooded by the sea, later attributing the marine incursion to the end of the Pliocene and early Pleistocene, declaring them ‘the base of the Quaternary Series’ (Prestwich, 1890a, p. 85).

Salter (1896) recognised four distinct groups of Pebble Gravels based on their differing lithological components, particularly their relative flint and quartzose components. He named these, from the highest altitudinally and in descending flint content; the Barnet Gate type, Hampstead type, High Barnet type, and the Bell Bar type. The last is the lowest altitudinally but with the most far-travelled lithologies. He later noted that the deposits decline towards to the east, causing him to reject the marine deposition theory and propose fluvial deposition driven by the onset of glacial conditions. His new theory suggested that the higher deposits of Pebble Gravel with lower percentages of far travelled clasts were deposited before the rivers were strongly affected by glacial conditions, whereas the lower altitude gravels with high proportions of quartzose material were deposited by high energy fluvial systems under glacial conditions (Salter, 1898, 1901, 1905). Despite this new theory, many workers continued to favour marine deposition for the Pebble Gravels. For example, Barrow (1919) divided the Pebble Gravels into two separate height levels and described the lower 400ft (120m) O.D. on the Chilterns, known as the **Northaw Pebble Gravel**, as marine gravel and the higher 500ft (155m) O.D. beds found at Harrow Weald, known as the **Stanmore Pebble Gravel** as a beach deposit. Barrow also contested a theory proposed by White (1906), which correlated the large percentage of quartz in the Pebble Gravels to a facies of the Reading Beds at Lane End in Buckinghamshire, believing that the gravels there were overlain by Eocene London Clay. Barrow (1919) refuted this correlation and reaffirmed a Pliocene age for the Pebble Gravels. An alternative interpretation, although not one that was subsequently developed, was that the Pebble Beds were formed by local glaciers which reworked the Tertiary deposits (Sherlock, 1924).

Wooldridge (1927, 1957, 1960) and Wooldridge and Linton (1939, 1955) redefined the term Pebble Gravel to apply only to the lower deposit found at 400ft (120m) on the basis that the 500ft (155m) deposits had a lower far-travelled lithological component. This confirmed the observations by Salter approximately 25 years previously where he explained the different altitudes and lithological contents of the deposits as the effect of glacial conditions on river activity. Wooldridge attributed the higher gravels to deposition by a Late Pliocene marine incursion (as recognised at Netley Heath), whereas he suggested that the lower gravels were fluvial in nature.

Hey (1965) re-examined the Pebble Gravels and found they could be sub-divided on the basis of lithological content, similar to Salter's approach at the beginning of the century. He re-named Salter's lower division of Pebble Gravels (the Bell Bar Group) as the **Westland Green Gravels**. Hey *et al.* (1971) examined the surface textures of the sand grains in the different 'Pebble Gravels' and found that the grain surface features indicating a marine or beach depositional environment decreased between the higher Stanmore Pebble Gravels and the lower Westland Green Gravels. Hey *et al.* (1971) further suggested that the highest level gravels, the Stanmore Pebble Gravels (Barrow's 500ft Pebble Gravel) should be regarded as truly marine and the Westland Green Gravels should be interpreted as fluvial, hence explaining the source of some of the Midland lithologies such as Bunter quartzite, and upholding Wooldridge's interpretation. Hey *et al.* (1971) proposed that the marine Stanmore Pebble Gravels were deposited during an Early Pleistocene transgression. The grain-surface results on Barrow's 400ft Pebble Gravels (Northaw Pebble Gravels) were more equivocal, although overall they seemed to indicate a similar fluvial environment. The sand surface grain textures that might indicate deposition in a beach could have been derived from the Palaeogene deposits (Bridgland, 1994).

Moffat (1980, 1986) re-investigated the deposits at Lane End and Little Heath and found that they had similar elevations to the Red Crag deposits at Rothamsted in Hertfordshire and the fossiliferous outliers at Netley Heath and Headley Heath. Moffat and Catt (1983) suggested that the particle size distributions of Little Heath and Lane End were similar to the marine deposits of Rothamsted, Headley Heath and Netley Heath. However the clast lithological content was comparable to that of a fluvial system and consistent with what might be expected from an early Thames deposit.

Horton (1977, 1983) and Gibbard (1983, 1985) reinterpreted two levels of Pebble Gravels, both older than the Westland Green Gravels and both of fluvial origin. The oldest was the 'Westleton Beds' previously described by Prestwich (1890a and b). Gibbard (1983, 1985) recognised them as a Thames deposit and re-named them the **Nettlebed Gravels** (Figure 3.3). They are the oldest known Thames gravels to be preserved. They have low percentages of far-travelled lithologies and represent a small catchment area of the early Thames (Horton, 1977; Green and McGregor, 1983; Moffat, 1986; Moffat and Catt, 1986). At Priest's Hill in Nettlebed, an Early Pleistocene interglacial organic deposit was found in association with the Nettlebed Gravels, which represents an Early Pleistocene temperate stage previously unrecognised in Britain (Horton, 1977, 1983; Turner, 1983; Gibbard, 1985; Bridgland, 1994). The younger gravel deposit was named the **Stoke Row Gravels**. These, along with the Westland Green Gravels, form part of the **Kesgrave Group** (see below), first defined from deposits in East Anglia (Rose *et al.*, 1976 and Rose and Allen, 1977) (Table 3.1 and Figure 3.3).

Recent work (Bridgland, 1994) has suggested that the gradient, composition and position of the Northaw and Stanmore Pebble Gravels (together known as the North London Pebble Gravels) indicate deposition by a tributary of the early Thames, since they are found further south than the lowest early Thames course along the Chiltern dip slope. The distribution of the gravels suggests a north-eastward trending river course from the northern Weald area, which would also be supported by the Greensand chert content of the gravels (Bridgland, 1994). A similar quartz and Greensand chert content as the Northaw Pebble Gravels has been found in early Mole-Wey tributary deposits found in Finchley, such as the Dollis Hill Gravel (Gibbard, 1979). Therefore the Northaw Gravels could be part of the same terrace of the Mole-Wey tributary between the Lower Lea valley and the north London Pebble Gravels. The higher Stanmore Pebble Gravels do have some Greensand chert recorded (Wooldridge, 1927; Moffat, 1980; Moffat and Catt, 1986), but at smaller percentages. Therefore, these gravels could credibly represent an earlier stage in the Mole-Wey tributary system (Bridgland, 1994).

On the basis of altitude and gradient, Bridgland (1994) correlated the Stanmore Pebble Gravels with the Stoke Row Gravels of the Thames and the Northaw Pebble Gravels with the Westland Green Gravels. Bridgland therefore rejected the correlation made by

Gibbard (1985) and Moffat and Catt (1986) between the Northaw Pebble Gravel and the Nettlebed Gravels, on the basis that the Nettlebed Gravels are located at a higher level than the Northaw or Stanmore Pebble Gravels (Table 3.1).

Estimated Age	Bridgland (1994)			Gibbard (1985; 1999)		Environment
	Group/ Formation	Middle Thames Deposits	Tributary de- posits	Formation	Members	
Cromerian Complex Pre-MIS 12 (Gibbard, 1999) MIS 13-21 (Bridgland, 1994)	Kesgrave Group	Rassler Gravel		MIDDLE THAMES FORMATION (also includes Win- ter Hill Member as upper fluvial sections were deposited prior to ice)	Rassler Gravel?	Increasing en- ergy fluvial sys- tem as become younger
		Gerrards Cross Gravel			Gerrards Cross Gravel	
Early Pleistocene Pre-MIS 21 (Bridgland, 1994)		Beaconsfield Gravel			Beaconsfield Gravel	
		Satwell Gravel			Satwell Gravel	
		?Chorleywood Gravel?			Chorleywood Gravel	
		Westland Green Gravel	Northaw Pebble Gravel		Westland Green Gravel	
Late Pliocene/Early Pleistocene	Nettlebed For- mation	Stoke Row Gravel	Stannore Pebble Gravel	PEBBLE GRAVEL FORMATION:	Stoke Row Gravel	Fluvial. Low energy, small catchment
		Nettlebed Gravels and Nettlebed Inter- glacial deposits			Priest's Hill and Nettlebed Members. Little Heath Bed. Northaw and Stannore Pebble Gravels may be correlated to the Westland Green and Stoke Row Gravels respectively if attribution to the Mole-Wey tributary is correct).	
		Red Crag equivalent outliers			Rothamsted Formation	Shallow Marine deposition

Table 3.1: Summary of the Pre-diversion Middle Thames deposits and differing models

The Kesgrave Group

The Kesgrave Group of the proto-Thames can be further sub-divided into the **Sudbury** (or the High-Level Kesgrave Group) and **Colchester Formations** (or the Low-Level Kesgrave Group). These represent sands and gravels deposited by the ancestral River Thames and are defined by their high quartz and quartzite contents, with the Sudbury Formation containing a significantly higher percentage compared to the Colchester Formation (Whiteman and Rose, 1992). These are ‘pre-glacial’ gravels, thought to have been deposited by periglacial river activity during the late Early Pleistocene and the early Middle Pleistocene between about 1.8 and 0.46 million years BP (Rose *et al.*, 1999). The Kesgrave Group of gravels can be differentiated from the Nettlebed Group by its relative higher quartz and quartzite content compared to the flint component (Figure 3.3).

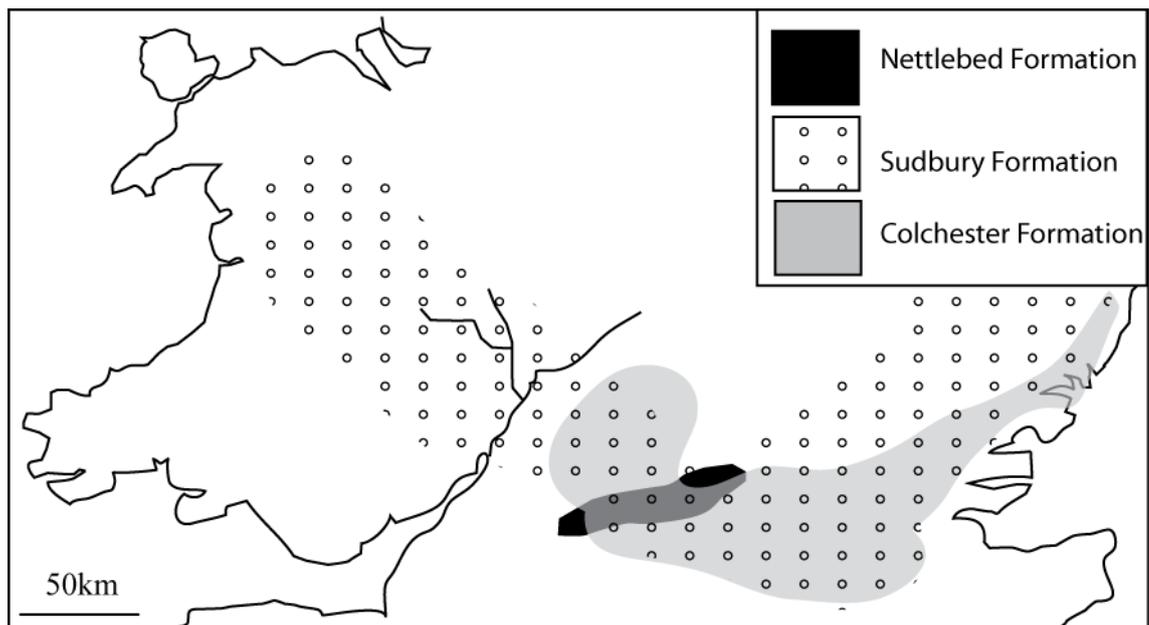


Figure 3.3: Map of the distribution of the Nettlebed and Kesgrave Groups.

Adapted from Whiteman and Rose (1992).

The Sudbury Formation

The Sudbury Formation was laid down when the River Thames catchment extended into the West Midlands and Wales. The larger catchment resulted in the erosion of lithologies such as quartz and quartzite, Carboniferous and Devonian rocks, which are not found in the present day Thames catchment. A significant amount of these erratics is

found in the Sudbury Formation, and along with the presence of glacially fractured sand grains, it has been suggested that these deposits have been derived from glacial erosion in the head of the catchment (Whiteman and Rose, 1992) (Figure 3.3).

Wooldridge (1928, 1938) first identified separate terraces within the Thames gravels, including two that he termed the 'Higher' and 'Lower Gravel Trains'. Hare (1947) renamed the 'Lower Gravel Train' as the Harefield Terrace after geomorphological mapping of the Slough and Beaconsfield areas. Sealy and Sealy (1956), Thomas (1961) and Allen (1978) extended Hare's mapping west and eastwards. Gibbard (1985) then replaced the term 'Harefield Terrace' with **Gerrards Cross Gravel** and 'Higher Gravel Train' with **Beaconsfield Gravel** and recognised an intermediate terrace that he termed the **Satwell Gravel**.

Moffat and Catt (1986) described gravels at Chorleywood, which they attributed to the Westland Green Gravels. The gravels were recorded as being 10m below the expected level of the Westland Green Gravels and contained a higher level of quartzose material and lower percentages of flint than other Westland Green deposits. It has subsequently been suggested by Bridgland (1994) that these gravels could represent a previously unidentified separate aggradation of the early Thames (**Chorleywood Gravels**). It is also possible that another outlier of the Westland Green Gravels described by Green and McGregor (1978) on the opposite side of the River Chess from Chorleywood represents the Chorleywood Gravels. This deposit was equally at a lower level than the Westland Green Gravel and contained higher levels of quartzose material and lower percentages of flint. However due to the difficulty in projecting altitude of deposits on the Chilterns dip slope, this has not been fully investigated (Bridgland, 1994).

Currently the Sudbury Formation can be split into six sediment aggradations known as, with the oldest and highest first: the **Stoke Row** (Gibbard, 1985), **Waterman's Lodge** (Hey, 1980), **Westland Green** (Hey, 1965), **Satwell**, **Beaconsfield**, and **Gerrards Cross** members (Gibbard, 1985). If the Chorleywood and Rasserl Gravels are accepted, then the latter is placed between the Beaconsfield and Gerrards Cross Gravel and the former lies between the Westland Green and Satwell Gravel (Table 3.1 and Figure 3.3).

The Colchester Formation

The Colchester Formation represents a later and less extensive River Thames catchment. The head of the catchment is proposed to have extended to the Cotswold escarpment but with the course of the river still flowing through the Vale of St. Albans, as opposed to following the modern, more southerly route. There are lower percentages of erratic, far-travelled rock lithologies when compared to the Sudbury Formation (Whiteman and Rose, 1992) (Figure 3.3).

Whiteman and Rose (1992) and Bridgland (1994) also recognised another aggradation, grouped with the Colchester Formation, the **Rassler Gravels**. Sealy and Sealy (1956) first described these gravels morphologically and altitudinally. Gibbard (1985) could not find evidence at the stratotype for fluvial gravels and so abandoned the name. However Bridgland (1994) proposed that there is a separate aggradation in the Reading area, which is the only place where this aggradation is preserved in the Middle Thames. The Winter Hill and Westmill Gravels are also included in the Colchester Formation. These gravels are discussed in section 3.3.2 with reference to the diversion of the Thames by the Anglian Glaciation.

3.3.2 Diversion of the Thames by Anglian Ice and Anglian age deposits

‘Glacial Gravels’ were first recognised in the Thames area in the 1860s by Wood as part of his ‘Glacial Series’ (Wood, 1867, 1870; Wood and Harmer, 1868, 1872). The gravels were referred to as ‘Middle Glacial’ and the overlying till was referred to as ‘Upper Glacial’ (now recognised as the Anglian Lowestoft Till). The term ‘Lower Glacial’ referred to what was later identified as part of the North Sea Drift (Wood and Harmer, 1868, 1872). The Geological Survey also used Wood’s ‘Glacial Series’ in their mapping of the London Basin (for example, Whitaker, 1875, 1889; Sherlock and Noble, 1922; Bristow, 1985), but the term has been confused, with Thames terrace gravels also referred to as ‘Glacial Gravels’, and the term ‘glacial’ was used to refer to the Pleistocene period in general (Bridgland, 1994).

At the end of the early Middle Pleistocene, the arrival of Anglian ice in the Thames basin diverted the course of the proto-Thames southwards, from its more northerly position flowing through the Vale of St. Albans. The diversion of the Thames was first suggested by White (1895) and Salter (1905) and later supported by Sherlock and Noble (1912), who traced the gravels from the Goring Gap to Watford and suggested that the

glaciation of the Vale of St. Albans had diverted the Thames from its course through Beaconsfield and Watford. Sherlock (1924), Sherlock and Pocock (1924) and Clayton and Brown (1958) further described lacustrine deposits in the Vale of St. Albans leading them to suggest that at this time, the route of the Thames had been blocked by ice. These authors also suggested that catastrophic overspill from the resulting proglacial lake contributed to the diversion of the Thames. Hare (1947) also described how the Winter Hill Terrace gradient greatly reduces in the area directly west of the Colne confluence, the result of Thames being blocked by ice and creating a proglacial lake.

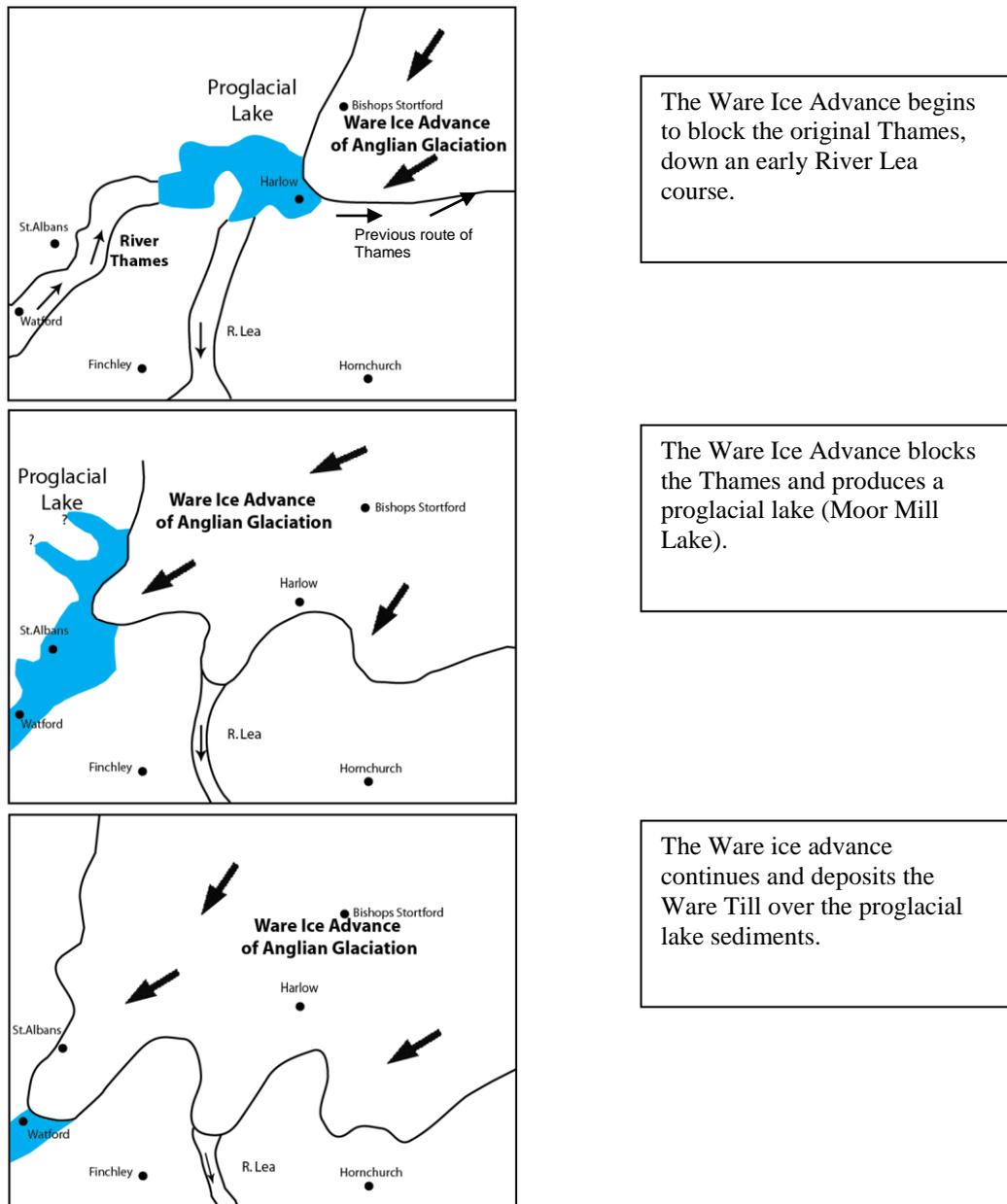
Saner and Wooldridge (1929) were the first to describe early Thames terrace deposits within Wood's 'Glacial Gravels' in the lower Chiltern dip slope, defining the **Winter Hill Terrace**. Wooldridge (1938) further proposed that there had previously been two drainage routes for the Thames, an older one through the Vale of St. Albans and a later route through Finchley, thereby suggesting that separate glacial advances had shifted the route of the Thames south in two stages. Wooldridge suggested that the initial diversion was a result of 'Chiltern Drift' ice entering the area, with the second phase caused by the Anglian ice sheet, denoted by the presence of the 'Chalky Boulder Clay'. He also considered the Winter Hill Terrace to continue eastwards through the Finchley route.

Other authors have investigated Wooldridge's theory of there being a two-phase diversion of the Thames but found there to be no supporting evidence (Moffat and Catt, 1982; Avery and Catt, 1983; Green and McGregor, 1983), possibly because the Anglian ice advance removed all traces of it. Hey (1965) later mapped the Winter Hill Terrace from the Goring Gap, along the Chiltern dip slope to Hertfordshire along with the Beaconsfield and Gerrards Cross Gravels, thus disproving Wooldridge's Finchley route.

Gibbard (1977, 1985) later demonstrated that the Winter Hill Terrace deposits in the Watford area are overlain by proglacial lake deposits, which are then overlain by Anglian till. He considered the Winter Hill Gravels to have been deposited during the Anglian glaciation, when the river was still flowing in the upper parts of the Middle Thames valley. Downstream of Burnham, supposed deltaic sediments were deposited, which Gibbard concluded were laid down when the river was dammed by the advancing ice. Gibbard (1979) also suggested that the Thames was diverted on one single event from its position on the Vale of St. Albans to the current position by the overspilling of

the proglacial lake. He further proposed that the intermediate position recognised by Wooldridge is instead a pre-Anglian valley of a Mole-Wey tributary.

Gibbard (1974, 1977, 1978a, 1978b) was the first to identify two gravel units and two till units at Westmill Quarry, Hertfordshire, which reveal a detailed glacial succession in the Vale of St. Albans. Gibbard considered the lower two gravel units (**Westmill Upper and Lower Gravels**) to be equivalent to the Winter Hill Gravels of the Middle Thames on the basis of elevation and composition. However, it was later shown that only the Westmill Lower Gravels were a continuation of the Winter Hill Formation. The Westmill Upper Gravels can be mapped into the Lea basin, where the Thames has never previously flowed and is probably therefore equivalent to the Black Park Formation of the Thames (Cheshire, 1981, 1983a, 1983b, 1986; Bridgland, 1994). Cheshire (1986) demonstrated that the first ice advance deposited the Ware Till, which was widespread throughout the Vale of St. Albans. Since the Ware Till overlies the proglacial lake deposits in the Watford area, it is likely that the Ware ice sheet was responsible for blocking the proto-Thames route and creating a proglacial lake. The ice had then extended over where the lake had been formed and deposited the Ware Till and effectively diverted the Thames into its present day position (Figure 3.4). To the southwest of Hatfield, there are no subsequent tills overlying the Ware Till, therefore suggesting that dead ice blocked the second ice advance (the Stortford Till advance). However the Stortford ice advance did extend further south than the Ware Till in some areas, reaching as far south as Finchley and Hornchurch, depositing the **Hornchurch Till** in the lower Thames region. The last two ice advances, those that deposited the Ugley Till and Westmill Till did not extend as far as the first two; the Ugley Till is found as far south as Hertford and the Westmill Till at Hatfield and Waltham Cross (Cheshire, 1986).



The Ware Ice Advance begins to block the original Thames, down an early River Lea course.

The Ware Ice Advance blocks the Thames and produces a proglacial lake (Moor Mill Lake).

The Ware ice advance continues and deposits the Ware Till over the proglacial lake sediments.

Figure 3.4: Diagram of the first ice advance of the Anglian Glaciation that diverted the River Thames to a more southerly route. Adapted from Bridgland (1994).

The Hornchurch till occurs at significantly lower altitude than other Anglian deposits in southern East Anglia. It was suggested that this could be due to a valley already being present in the area before the glaciation (Holmes, 1892, 1893; Woodward, 1909; Woodward *et al.*, 1922; Dines and Edmunds, 1925; Warren, 1942; Wooldridge, 1957). Bridgland (1980, 1983a, 1988a) indicated that this could have been a tributary of the Medway between Southend and Dartford. It has also been proposed that the lowland is an example of ‘inverted relief’ where the soft London Clay was not protected by

previously deposited gravels and so was eroded by the Thames upon its diversion (Bridgland, 1986). This uncertainty has caused problems when trying to correlate terraces but it is possible that the glacier eroded sediments, especially as the Hornchurch Till was deposited in the second advance of Anglian ice, whereas the Thames had already been diverted in the first advance (Cheshire, 1986; Bridgland, 1994).

The first post-diversion Thames deposit in the Middle Thames region is now known to be the **Black Park Gravel** (Hare, 1947; Wooldridge and Linton, 1955; Gibbard, 1979) (Figure 3.6). The **Black Park Terrace** was deposited late in the Anglian Glaciation and it has been suggested that deposition occurred while some ice was still present in the London Basin (Gibbard, 1983, 1985; Cheshire, 1986a, Bridgland, 1994). In the Caversham to Henley area, the Black Park Gravel makes up the floor of an abandoned valley of the Thames after its diversion, where it flowed just north of the current course. At Highlands Farm Pit in Oxfordshire, abundant Palaeolithic artefacts have been found. Their presence was first noted by White (1895) and the assemblage represents the earliest Thames human occupation site known.

The Anglian Glaciation has been correlated with Marine Oxygen Isotope Stage 12 and is considered to be one of the most severe glaciations in the Middle Pleistocene (Shackleton and Opdyke, 1973; Shackleton, 1987; Bowen *et al.*, 1986a, 1986b; Bowen and Sykes, 1988; Campbell and Bowen, 1989). The correlation with MIS 12 has been upheld by the well-dated terrace sequence in the Lower Thames valley, where four pre-Holocene interglacials are preserved (MIS 11, 9, 7 and 5e), thereby implying a minimum age of MIS 12 for the Anglian Hornchurch till that underlies the highest and oldest terrace (Bridgland, 1994; Schreve, 2001a).

3.4 Post-Anglian River Thames deposits in the London Area

The significance of the diversion of the River Thames in MIS 12 is that the valley axis was finally brought into the present study area of London and its modern day course. The river can be divided into the Upper Thames (Cotswolds to Goring Gap), Middle Thames (Goring Gap to Central London) and the Lower Thames (Central London to the North Sea) (Figure 3.5). As this research is focussed on Central and Greater London, only parts of the Middle Thames and Lower Thames will be discussed in more detail.

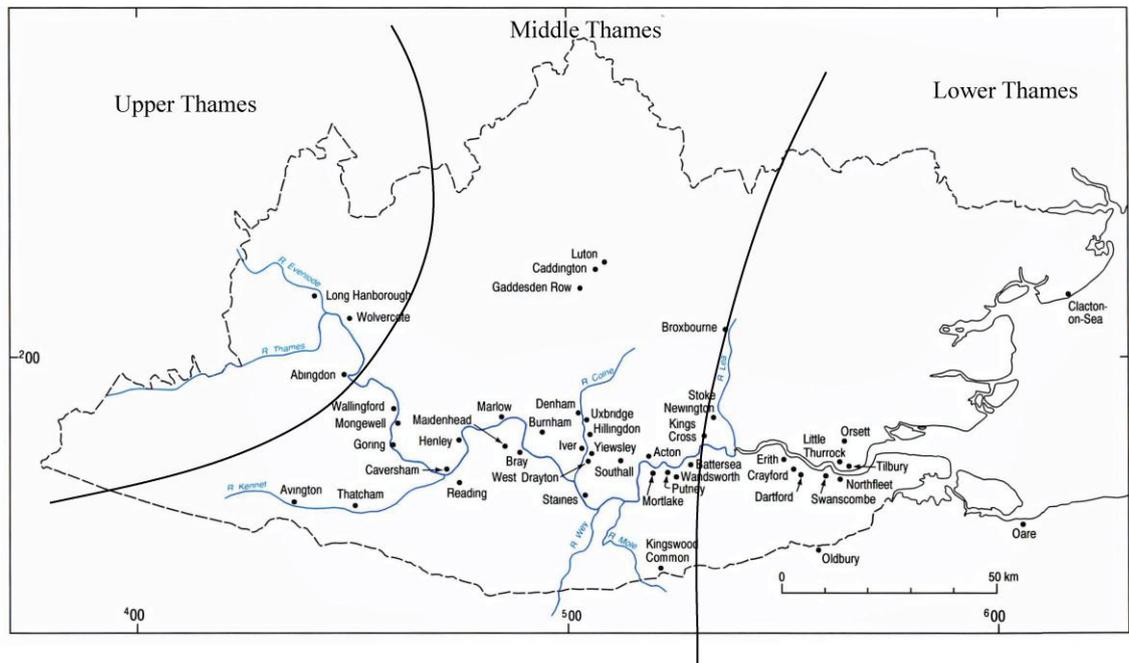


Figure 3.5: Map of the Upper, Middle and Lower Thames areas (adapted from Sumbler, Bridgland, Wymer and Balson, 1996)

3.4.1 Middle Thames Terraces

Research History

The Middle Thames terraces were first described by Prestwich (1855a), who recognised a series of high-level and low-level terraces. Whitaker (1864, 1889) and later Pocock (1903) identified three fluvial terraces in the Maidenhead area, which together became known as the ‘tripartite terrace system’, with a ‘high’, ‘middle’ and ‘lower’ terrace. It was not until the Geological Survey mapped the same area in 1911, that these terraces become known as the **Boyn Hill Terrace**, **Taplow Terrace** and the **Floodplain Terrace** in descending age order (Bromehead, 1912) (Table 3.2). Dewey and Bromehead (1921) further sub-divided the Floodplain Terrace into upper and lower levels, based upon observation of an erosional horizon in the gravels at Brentford, but acknowledged that the two facets were not always recognisable. Zeuner (1959) later observed that the ‘Upper Floodplain’ could also be recognised upstream as far as Chertsey, which was confirmed by Gibbard *et al.* (1982).

The Winter Hill Terrace was later added to the Middle Thames sequence (Saner and Wooldridge, 1929; Wooldridge, 1938; Wooldridge and Linton, 1939). However, what was originally defined as the Winter Hill Terrace was later discovered to be much more complex and was partially redefined as the Black Park Terrace (Hare, 1947), the first aggradation of the modern Thames (Wooldridge and Linton, 1955; Gibbard, 1979). Both the originally-defined Winter Hill Terrace and the Black Park Terrace were found to be deposited in the Anglian (Section 3.3).

Hare (1947) later added the **Lynch Hill Terrace** between the Boyn Hill and Taplow Terraces, recognising it as a completely separate aggradation (Figure 3.6, Table 3.2). This terrace had previously been observed locally and subsequently named at several locations. Treacher (1909) observed it at Furze Platt, Maidenhead, where Warren (1926, 1933) named it the Furze Platt Stage. Other names include the Furze Platt Terrace (Wright, 1937); Taplow Terrace No.1 (Burchell, 1934a), the Iver Stage (King and Oakley, 1936) and the lower Boyn Hill Terrace (Lacaille, 1940). Hare's work was extended downstream into the London region by Allen (1978), whereas Sealy and Sealy (1956) and Thomas (1961) extended the scheme upstream.

Hare (1947) also subdivided the Taplow Terrace into an Upper and Lower Taplow Terrace, a position later followed by Sealy and Sealy (1956), Thomas (1961) and Evans (1971). Gibbard (1985) observed that the Upper Taplow Terrace around Slough was overlain by a wind-blown silt (loess). He therefore proposed that localised erosion of the silt had resulted in the lower division, described by Hare. Gibbard defined the loess deposit as the **Langley Silt Complex** (Gibbard, 1985) (Figure 3.6, Table 3.2 and Section 3.4.2).

Gibbard (1985) used detailed content analyses of the deposits to update and clarify the research on Middle Thames terraces. He used methods such as clast lithological counts, palaeocurrents, pebble fabric and sediment grain size analyses alongside borehole data and biological data such as palynology. Using clast lithological analysis, Gibbard (1985) found that there were fewer far-travelled lithologies as the terraces get younger, thus indicating that the Thames catchment area had become less extensive as time progressed.

The youngest two terraces of the Middle Thames are the **Kempton Park** and **Shepperton Gravels** (Figure 3.6, Table 3.2), the most recent terminology attributed to the Upper and Lower Floodplain Terraces (Gibbard *et al.* 1982; Gibbard, 1985). The fluvial gravels observed at Kempton Park were braided, indicating deposition under cold-climate conditions, which Gibbard has attributed to the Devensian. The Shepperton Gravels consisted of almost exclusively flint, with little in the way of far-travelled lithologies and also representing a braided river channel. Gibbard interpreted this as being deposited in a periglacial environment between 15,000 and 10,000 years ago, thus representing the last major aggradation of the Thames (Gibbard, 1985).

Evans (1971) had previously attempted to correlate the Thames terrace (both Middle and Lower) sequence with seven successive interglacial sea levels, thus introducing the theory that the formation of river terraces was caused by climatic fluctuations. Bridgland (1994) continued and updated Evans' work to correlate the formation of river terraces with the marine isotope record and clarify that terrace aggradations are deposited during cold-climate episodes (Bridgland, 1994) (see Tables 3.2, 3.3).

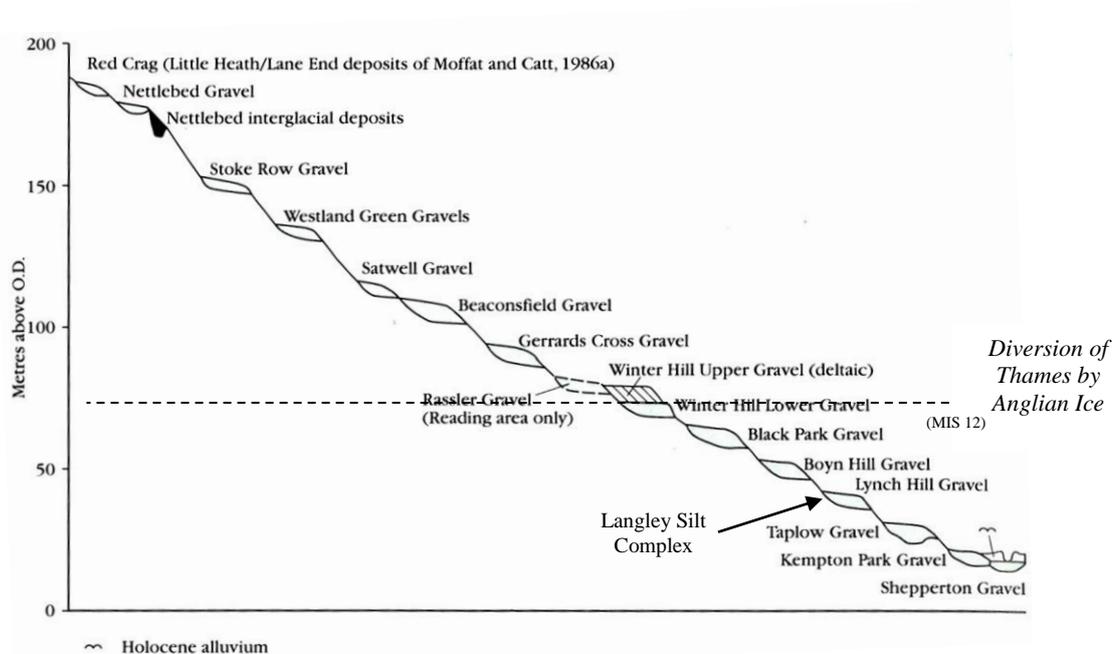


Figure 3.6: The terraces of the Middle Thames from the higher Pre-Pleistocene deposits through to the lower modern Thames alluvium. Adapted from Bridgland (1994).

Age	Middle Thames		Lower Thames		Age	Middle Thames		Lower Thames		
	Bridgland (1980, 1983a, 1983b, 1988a, 1994, 2006)					Gibbard (1985, 1999)				
MIS 2 (Devensian)	Shepperton Gravel	Shepperton Gravel	Shepperton Gravel	Shepperton Gravel	Devensian	Shepperton Member Langley Member Kempton Park Gravel Reading Town Member	Shepperton Member Langley Member East Tilbury Marshes Gravel West Thurrock Member			
MIS 5d-2 (Devensian)	Kempton Park Gravel	Kempton Park Gravel	East Tilbury Marshes Gravel	East Tilbury Marshes Gravel	Ipswichian	Trafalgar Square/Brentford Member	Aveley Member			
MIS 5e (Ipswichian)	Brentford and Trafalgar Square interglacial deposits	Brentford and Trafalgar Square interglacial deposits	Below Floodplain	Below Floodplain	'Wolstonian'					
MIS 6	Taplow Gravel and Basal Kempton Park Gravel	Taplow Gravel and Basal Kempton Park Gravel	Mucking Gravel and Basal East Tilbury Marshes Gravel	Mucking Gravel and Basal East Tilbury Marshes Gravel						
MIS 7	Interglacial deposits at Redlands Pit, Reading	Interglacial deposits at Redlands Pit, Reading	Aveley and West Thurrock interglacial deposits	Aveley and West Thurrock interglacial deposits						
MIS 8	Lynch Hill Gravel and Basal Taplow Gravel	Lynch Hill Gravel and Basal Taplow Gravel	Corbets Tey Gravel and Basal Mucking Gravels	Corbets Tey Gravel and Basal Mucking Gravels						
MIS 9	None known	None known	Purfleet and Grays interglacial deposits	Purfleet and Grays interglacial deposits						
MIS 10	Boyn Hill Gravel and Basal Lynch Hill Gravel	Boyn Hill Gravel and Basal Lynch Hill Gravel	Orsett Heath Gravel and Basal Corbets Tey Gravel	Orsett Heath Gravel and Basal Corbets Tey Gravel						
MIS 11 (Hoxnian)	None known	None known	Swanscombe interglacial deposits and Dartford Heath Gravels	Swanscombe interglacial deposits and Dartford Heath Gravels	Hoxnian	Slade Oak Lane Beds Hatfield Member	Swanscombe Member			
MIS 12 (Anglian)	Basal Boyn Hill Gravel Black Park Gravel	Basal Boyn Hill Gravel Black Park Gravel	Basal Orsett Heath Gravel and Hornchurch Till	Basal Orsett Heath Gravel and Hornchurch Till	Anglian-Late Anglian	Black Park Member	Dartford Heath Member Hornchurch Member			

Table 3.2: The Middle and Lower Thames deposits and their correlation

3.4.2 The Langley Silt Complex

The Langley Silt Complex is a term applied by Gibbard (1985) to the red, orange and brown fine grained deposits found throughout the Thames Valley, often referred to as 'brickearth'. These deposits are polygenetic in origin and the term 'brickearth' has been referred to loessic, solifluction, colluvial and estuarine deposits.

The type site proposed by Gibbard (1985), at Langley, contained silt rich deposits capping Taplow Gravel. In West London, the Langley Silt Complex overlies Lynch Hill Gravel. The upper unit of Langley Silt has been dated by thermo-luminescence to 17.8 ± 1.5 and 14.3 ± 1.2 ka BP (no laboratory codes given in publication) (Gibbard *et al.*, 1987).

Further work, including micromorphology and sedimentary analyses of the Langley Silt Complex, was conducted at Prospect Park, Heathrow. Here the Complex overlies Taplow Gravels (correlated in Bridgland's 1994 scheme with MIS 6) and an argillic soil correlated with MIS 5e. The Langley Silt Complex was characterised by 3 units (from Rose *et al.*, 2000):

3) *Unit iii (25.4-27.7m OD)*. The upper unit of the Langley Silt Complex was homogenous and consisted predominantly of silt. The average particle size within this unit was typical of western European loess (Catt *et al.*, 1974; Gibbard *et al.*, 1987). The deposition of this unit was correlated with MIS 2 by Rose *et al.* (2000) based on the thermo-luminescence dates undertaken by Gibbard (1985) and Gibbard *et al.* (1987). During late MIS 2 (the Lateglacial Windermere Interstadial ca. 14.5-12.0 ka BP), this unit developed a soil characterised by CaCO₃ mobilisation, and clay translocation. The soil development was disrupted during the Younger Dryas (ca. 12.0-11.5 ka BP) witnessed by ice lens growth and cryoturbation fragmenting the soil structure. Finally, during MIS 1 (<11.5 ka BP), a temperate soil developed within the unit characterised by CaCO₃, iron and manganese mobilisation and clay translocation.

2) *Unit ii (24.4-25.4m OD)*. The second horizon of the Langley Silt Complex was characterised by laminated silts and sands suggested to have been deposited by aeolian and sheetwash processes. This unit was correlated with MIS 3 based on its

stratigraphical position overlying the warm MIS 5e soil and the preceding cold climate horizon of the Langley Silt Complex (Rose *et al.*, 2000).

1) *Unit i (23.7-24.4m OD)*. This basal unit was sandy silt with occasional pebbles was suggested to represent a former periglacial land surface. The gravel was incorporated into the horizon by frequent cryoturbation with the underlying soil. The silt was deposited by suspension from the atmosphere and the sand was deposited by saltation and winds affecting the land surface. The unit was correlated with the early Devensian (MIS 5d-4) based on its stratigraphical position overlying the warm MIS 5e argillic soil (Rose *et al.*, 2000).

Langley Silt Complex at Yiewsley

The basal 1.2m of the Langley Silt Complex comprises of upwardly fining cross-bedded sand at the base overlain by alternating silty sand and silt bands up to 10cm thick. Grain size analysis of this lower section of the Langley Silt Complex suggests it was mainly waterlain, probably colluvial. Above the stratified horizon at Yiewlsey, a massive brown clayey silt with occasional pebbles was recorded often displaying cold-climate features such as ice wedge casts. Gibbard *et al.* (1987) and White and Jacobi (2002) suggested that this lower section of the ‘brickearth’ at Yiewsley may correlate with the final stage of the Lynch Hill Terrace aggradation and does not represent deposition during the Devensian.

3.4.3 Lower Thames Terraces

Research History

The Lower Thames Terrace sequence has been the focus of more intensive research compared to the Upper and Middle Thames sequences, largely on account of the presence of better exposures and more richly-fossiliferous sediments.

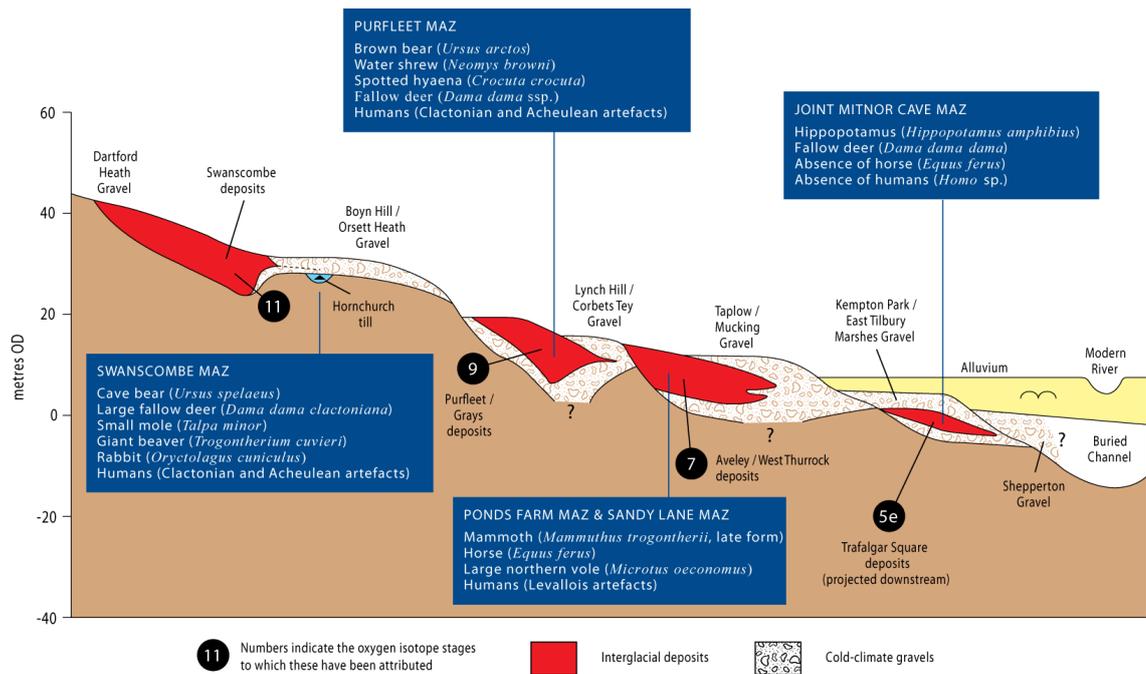


Figure 3.7: Diagram illustrating the deposits and terraces of the Lower Thames, including the location of the interglacial deposits. The significance of the mammal assemblage zones (MAZs) are discussed in Chapters 6-8. From Schreve (2004a)

Research History

Hinton and Kennard (1900, 1905, 1907) were the first to identify four gravel terraces in the Lower Thames valley, which they numbered in a declining sequence. However in the 1920s, the Geological Survey mapped just three Thames terraces, continuing the Boyn Hill, Taplow and Floodplain terraces from the Middle Thames into the Lower Thames (Dewey *et al.*, 1924; Dines and Edmunds, 1925) (Table 3.2). They did not differentiate between Hinton and Kennard’s first and second terraces, and instead recognised a single terrace, which they called the **Boyn Hill Gravel** (Bridgland, 1994).

King and Oakley (1936) proposed a complex sequence for the Lower Thames that was based on palaeontological and archaeological evidence. Each deposit with similar archaeological assemblages was thought to be laid down in sequential order and deposits now known to be in the same terrace were separated in time due to their differences in archaeology. This approach was problematic when applied to unfossiliferous deposits, but was still widely accepted at the time.

Further research was infrequent in the area until the late 1980s and Middle Thames terminology for the terraces was widely applied in the Lower Thames. However, there were problems in tracing fluvial deposits from the Middle Thames into the Lower Thames and each Geological Survey sheet in the Lower Thames region had a different version of the Middle Thames tripartite terraces system. For instance on the Chatham sheet (272), the terraces were numbered 1-4, and this system continued onto the Southend/Foulness (1976) map, whereas the North London sheet had the three terrace names but also an upper and lower floodplain terrace (Smith and Ellison, 1995).

In recognition of the problems associated with mapping from the Middle to the Lower Thames, a new terminology was developed for the mapping of the Lower Thames based on local names by Bridgland (1983a, 1983b, 1988a, 1994), Gibbard *et al.* (1988) and Gibbard (1994). The new terminology resulted in the terraces being named the **Orsett Heath**, **Corbets Tey** and **Mucking** terraces (Figure 3.7, Table 3.2). Bridgland (1983a, 1988a) additionally recognised a lower aggradation of the Thames beneath the modern floodplain which he called the **East Tilbury Marshes Gravel** (Figure 3.7, Table 3.2). This revised nomenclature was adopted by the 'S.W. Essex – M25 Corridor Applied Geology Project' of the British Geological Survey was carried out by Moorlock and Smith (1991) between 1987 and 1990.

There are differing opinions on the ages of Lower Thames terraces due to contrasting interpretations of their contained interglacial sediments. For example Gibbard (1985, 1989) has added the West Thurrock Gravel to apply to gravel overlying the interglacial deposits at West Thurrock, whereas Bridgland (1994) regarded these gravels as a post-interglacial division of the Mucking Gravel and so suggested that no separate name is needed. Gibbard has also named the Spring Gardens Gravel to represent the pre-interglacial gravels at Ipswichian sites, whereas Bridgland again regards these as a pre-interglacial division of the Kempton Park Gravel (Table 3.2). The problem with introducing these new terms for the gravels is that they can only be formally identified at sites where there are interglacial deposits to separate the two divisions of the terrace gravel. Where there are no interglacial deposits, it is not possible to use the separate terms (Table 3.2).

3.5 Correlating the Middle Thames and Lower Thames terraces

Figure 3.7 and Table 3.2 show the most recent attempts to correlate the terraces of the Middle Thames and Lower Thames. There has been controversy over some of these correlations, especially for the high level gravels found on Dartford Heath in the Lower Thames. The Dartford Heath Gravel was first named in 1979 by Gibbard, however it has been investigated since the 1800s (Trimmer, 1853). It is notable for containing artefacts, including Lower Palaeolithic handaxes (Evans, 1872, 1897; Spurrell, 1880). There is still debate over whether the Dartford Heath Gravels are part of the Orsett Heath Terrace of the Lower Thames and therefore in the same terrace as the Swanscombe deposits (e.g. Bridgland, 1994), or whether they are the Lower Thames equivalent of the Black Park terrace of the Middle Thames (e.g. Gibbard, 1979, 1988, 1989).

Hinton and Kennard (1905) first suggested the Dartford Heath gravels were older than the deposits found at Swanscombe and compared them with high-level gravels in Richmond Hill and Kingston in the Middle Thames. They consequently correlated the Dartford Heath Gravels with their 135ft O.D. terrace and the Swanscombe deposits with the terrace below (at 100ft.). This was later supported by Woodward (1909). However, disagreements arose when Chandler and Leach (1912b) proposed that the Dartford Heath gravels and the deposits at Swanscombe formed part of the same aggradation at Wansunt Pit on Dartford Heath. The Dartford Heath Gravels were subsequently mapped by the Geological Survey as part of the Boyn Hill/Orsett Heath Terrace (Dewey *et al.*, 1924). Smith and Dewey (1914), Burchell (1933), King and Oakley (1936) and Marston (1937) all agreed, believing that the Dartford Heath gravels and Swanscombe deposits were coeval but had been separated by later erosion in the Darent Valley. Leach (1913) published details of the mammal remains recovered from the base of the Dartford Heath Gravel, including straight-tusked elephant, red deer, aurochs, horse, an unidentified deer, and rhinoceros. Zeuner (1945, 1959) later published that the downstream gradient of the Lower Thames indicated the Dartford Heath gravels pre-dated the Boyn Hill Terrace.

In contrast, Gibbard (1979, 1988, 1989) suggested that the Dartford Heath Gravels represented the highest and oldest deposits of the Lower Thames, therefore adding a new aggradation to the stratigraphy in the area. He demonstrated that the surface of the

gravels at 42m O.D. is approximately 8m higher than the deposits at Swanscombe, reinforcing what Hinton and Kennard (1905) had previously noted. He correlated the Dartford Gravel with the Black Park Gravels of the Middle Thames. However, Evans (1971) and later, Bridgland (1980, 1994; White *et al.*, 1995) suggested that the Black Park Gravels in the Middle Thames have a steeper downstream gradient than the Boyn Hill Gravels and so, if extended downstream east of London, the Black Park Gravels would fall below the level of the Boyn Hill Gravels. Bridgland also referred to buried channels below the Dartford Gravels that have been recorded in the past, including one found incised into the Thanet Sands beneath the Dartford Heath Gravels at Pearson's Pit on Dartford Heath. (Dewey *et al.*, 1924; Dewey, 1959). Bridgland thus correlated the gravels associated with the buried channel with the Boyn Hill/Orsett Heath Gravels (Table 3.2). Suggested correlations between the Middle and Lower Thames and inferred ages, based on comparisons with the oxygen isotope stratigraphy, are presented in Table 3.2.

Chapter 4: The role of antiquarians in establishing our understanding of the Palaeolithic in London

4.1 Introduction

Many of the early discoveries in London and its boroughs are preserved thanks to the diligent activities of antiquarian collectors and were made at a fascinating and pivotal point for the history of science. The following chapter is not intended to be an exhaustive gazetteer of the activities of all collectors but rather an attempt to highlight some of the key players in the antiquarian community and to situate their important findings within contemporary scientific understanding. The following information was collected from the antiquarians' private artefact catalogues, notebooks and photographs found in museums and local history archives, in addition to published obituaries and journal articles celebrating their work.

In fact, the beginning of Palaeolithic research in London occurred serendipitously at a time when the majority of people still relied on religious writings as a source for early history, not yet realising the antiquity of the Earth and humanity. In 1715, the antiquarian John Bagford reported how an antique dealer, Mr Conyers, found a handaxe in Gray's Inn Road and the tooth of an elephant (Figure 4.1) (Leland, 1716; Evans, 1872). The artefact was imagined to be a weapon that was used by an ancient Briton to kill one of the Roman emperor Claudius's elephants during the Roman invasion and became the first description of an ancient *human-made* tool (Daniel, 1975). Antiquarians began to make huge advances in the study of geology, palaeontology and archaeology, in a time that is known as the 'The Age of Enlightenment' between 1750 and 1820. During this time professionals and amateurs studied the natural environment and sought to offer theories on how and when it developed (Roe, 1981). They also began collecting ancient implements, rocks and fossils not only to build up comparative collections, but also to illustrate and increase their standing within the antiquarian community. The collectors were inspired by the likes of John Frere, who presented his revolutionary findings concerning the antiquity of early humans from the site of Hoxne, Suffolk, to the Society of Antiquaries at the end of the 18th century. He recognised the tools and the animal bones with which they were found to be from a 'very remote period indeed' (Frere, 1800). In 1815, the geologist William Smith published the first geological map of Britain, pioneering the study of modern geology and stratigraphy.

Later, in 1822, William Buckland, who became a colleague of John Gibson, a collector in the brickpits at Ilford, pioneered scientific study of caves and their contents, at sites such as Kirkdale Cave, Yorkshire, and Banwell Bone Cave, Somerset. The latter is a site that is still particularly significant in present fossil mammal research as its name gives rise to the early Devensian Banwell Bone Cave Mammal Assemblage-Zone (MAZ), characterised by Carrant and Jacobi (2001) and Gilmour *et al.*, (2007) as discussed in Chapter 9.

From the 1820s onwards, research into the inter-related disciplines of archaeology, palaeontology and geology increased in pace and fervour. Charles Lyell published the first edition of *Principles of Geology* in three volumes (1830-1833). This was a seminal work in which he presented his observations in geology and his interpretations using a systematic approach. The premise of his theories was based on interpreting ancient deposits using geological processes that could be observed in the modern day. Later in the decade, geologist John Morris began publishing his work in a similar systematic fashion on the fossiliferous deposits of the Thames Valley, including sites at Brentford, Ilford, Crayford and Erith in London (Morris, 1836, 1838). He recognised the significance of mammals and molluscs that are now extinct in Britain and was concerned with the taphonomy of the deposits. He also observed that some of the sites were situated at different heights in the river valleys and therefore might represent varying ages. The century progressed with other seminal works on natural history and archaeology emerging, not least Charles Darwin's *On the Origin of Species* (1859) and Sir John Evans' *The Ancient Stone Implements, Weapons and Ornaments of Great Britain* (1872), which brought the relatively new discipline of archaeology into the foreground.

The late 19th and early 20th centuries were significant periods for the advancement of scientific knowledge of geology, archaeology and palaeontology in London. London, as the capital, experienced huge and rapid urban development, which required much quarrying and excavation for building foundations. During these activities, antiquarians had the unique opportunity to observe Pleistocene sediments and to collect the fossils and artefacts contained within. It was predominantly during this time that the antiquarians amassed the large collections of Palaeolithic tools and fossils that this study is largely based upon. Some antiquarians actively collected their own material

when possible, but often artefacts and fossils would be acquired or bought from workmen in the pits, who were instructed by the antiquarians to look out for suitable material. Unfortunately, this practise of buying implements also led to occasional handaxe forgeries being made and false provenances being given. The practise of collecting artefacts from workmen also frequently reduced the provenance information that the antiquarian could attribute to each artefact, sometimes limiting the locality to just a town or borough name. Artefacts lacking provenance information were frequently encountered in this study. In some cases, antiquarians were interested only in obtaining large collections of ‘cabinet specimens’ and were not at all concerned with stratigraphical provenance. However, such collections rarely survive in museum collections since they are virtually archaeologically worthless. More often the lack of detailed provenance information encountered in this study was due to antiquarians collecting from workmen or possibly because the label or catalogue had since been lost.

Despite the lack of provenance information being recorded by some collectors, the meticulous recording of stratigraphic sequences, and the tools and fossils they found, has ensured further research into the Palaeolithic of London is possible almost 300 years since the Gray’s Inn Road handaxe was discovered.



Figure 4.1: The handaxe found in Gray’s Inn Road, London, the first stone implement to have been recognised as human-made. Photograph reproduced courtesy of the British Museum.

4.2 Robert Garraway Rice (1852-1933)



Figure 4.2: Robert Garraway Rice (from Contemporary Biographies, 1910)

Rice lived in Pulborough, West Sussex. He was a barrister and became a member of the Honourable Society of the Middle Temple, based near the Royal Courts of Justice in the City of London, in 1887, although he did not practise. He eventually became a magistrate in Petworth in 1906 (Contemporary Biographies, 1910; West Sussex Gazette, 19/1/1933). It is not known whether he was employed prior to this date or whether he devoted his time to his many archaeological interests.

Rice was the principle collector at Yiewsley in West London, amassing almost 3000 artefacts but astonishingly, very little information is known about the man himself or how and why he collected. From his artefact labels, it is clear that Rice bought artefacts from the workmen in the pits, as he records the date he purchased some of the specimens. It is probable that he acquired all of his Palaeolithic implements in this way, since his collection includes a wide variety of archaeological items such as armorial bookplates and Sussex ironwork, in addition to the flint tools (The Antiquaries Journal, 1933 p.357).

It is clear from the many learned societies that Rice joined and from the positions of responsibility he held within them, that he attended very diligently and had a keen interest in archaeology and history. He became a fellow of the Society of Antiquaries in

1891, held the position of vice-President between 1924 and 1926 and served on the council of the society from 1901-1903 and 1908-1910. He was described as virtually never missing the weekly meeting at the Society of Antiquaries and always being the first member to sign the attendance book. On his death he left a large sum of money (£5420) to the society to be used solely on research. Rice was also a member of the Council of the Royal Archaeological Institute and the Sussex and Surrey Archaeological Societies amongst many other local societies (Comtemporary Biographies, 1910; The Antiquaries Journal, 1933 p.357).

According to Comtemporary Biographies (1910), Rice was a contributor to papers of the Proceedings of the Antiquaries, the Archaeological Journal and Sussex Archaeological Collections. Unfortunately, none relating to Palaeolithic subjects have been traced during this study.

4.3 Frederick Sadler (1873-1953)



Figure 4.3: Frederick Sadler (from Blake, 1988)

Frederick Sadler became the Borough Engineer and Surveyor for Acton when he moved there from his home county of Lancashire in 1903 (Blake, 1988). It was his arrival in Acton that sparked his interest in archaeology, since John Allen Brown was then excavating in Creffield Road and Acton had also recently been the site of excavations by General Pitt-Rivers (previously known as Col. Lane-Fox) (Chapter 8.6). His position in the council allowed him to visit gravel pits and building sites in the area and it was on

these visits that he began purchasing implements from the workmen. At the beginning of the First World War, he exhibited his collection in Acton Public Library and in 1916 he joined the Army and was stationed in the Somme Valley. Here he continued collecting artefacts and he also developed an interest in using aerial photographs to identify potential archaeological sites. As Captain, and later Acting Major in the Army, he received aerial photographs of enemy territory in order to prepare for the terrain they would encounter on invasions, and it was from these that he realised the potential of aerial surveys (Blake, 1988).

Sadler also found objects in the gravel pits himself, since he recorded finding several artefacts in pits in Hanwell in his personal notebook (now held in Gunnersbury Park Museum). Sadler purchased the Loydell Collection to add to his own around 1908, which contained many items given to Loydell from other notable collectors such as John Allen Brown, Alfred Santer Kennard, and Peter Crooke. Sadler's collection was highly regarded by his contemporaries, since it was sold to Acton borough for £510.13s by Sadler. The funds were raised by 112 people pledging money to the borough to allow it to buy the collection (Blake, 1988).

Despite Sadler's dedication to collecting and personally recording his finds and purchases, he published nothing on the sites he had visited or on the implements, much like Robert Garraway Rice. However he was keen to spread his knowledge by lecturing and by exhibiting his collection (Blake, 1988).

4.4 John Gibson (1778-1840)

John Gibson was a manufacturing chemist originally from Yorkshire, who later resided in Plaistow, London. He was also an amateur collector of fossils from two Pleistocene sites, Kirkdale Cave in Yorkshire and Ilford (Chapter 6 and 7). He became a Fellow of the Geological Society in 1824, sponsored by several notable geologists. One of these sponsors was the eminent geologist and palaeontologist William Buckland, who helped Gibson excavate some of the mammal bones from the Ilford brick pits. Gibson's collection was donated to the Yorkshire Museum as well as the Royal College of Surgeons, which were catalogued by Richard Owen (George, 1998).

4.5 Dr. Richard Payne Cotton (1820-1877)

Cotton was a doctor at Brompton Hospital, although his hobby was geology and palaeontology, which began when he began personally collecting mammal bones from brick pits in Ilford in 1839. It is thought that he probably purchased the majority of his collection from workmen in the brick pits (George, 2000). Cotton's publication in 1847 of the stratigraphy and finds from the two sites in Ilford (Cauliflower Pit and Uphall Pit, see Chapters 6 and 7) was the first detailed account of the two locations in Ilford since the original descriptions by Morris (1838) and has proved to be immensely useful in understanding the Ilford stratigraphy during this study. Like Gibson, Cotton became a Fellow of the Geological Society in 1861, sponsored by two eminent palaeontologists, Richard Owen and John Morris (George, 2000), reflecting the respect other antiquarians had for Cotton and his contribution to palaeontology.

Cotton's collection contained 246 specimens and was deemed a significant contribution to the Ilford assemblage, so much so that many specimens were displayed in the Geological Survey Museum in South Kensington from 1878, and have been illustrated or mentioned in many publications (George, 2000). They are now held at the British Geological Survey Museum at Keyworth, Nottingham.

4.6 Sir Antonio Brady (1811-1881)

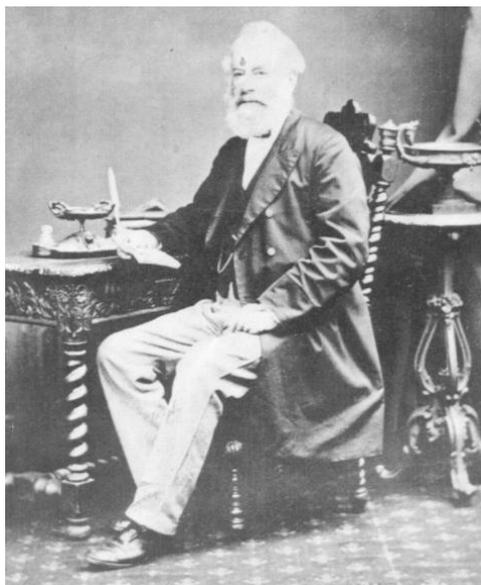


Figure 4.4: Sir Antonio Brady. Reproduced with the permission of Redbridge Local Studies and Archives.

Brady, of Stratford, was a civil servant in the Navy, who had an interest in geology. He was a member of the Geological and Palaeontological Societies, among many others. Brady collected flint implements and had visited celebrated Palaeolithic sites such as Amiens and Abbeville. He began collecting the large mammal fossils from the Ilford brick pits, around 1844, after the widow of Mr Curtis, the owner of one of the brickpits, notified him of new discoveries by workmen and asked him to look after the assemblage (Brady and Woodward, 1882; Davies, 1874). It is suggested that Brady's interest in palaeontology began when he worked in Admiralty, which also houses the Geological Society, or possibly when he and the Curtises became neighbours in Stratford (George, 1999). The most famous and impressive specimen from Brady's collection, an intact mammoth cranium and tusks from Uphall Pit, was acquired by the Natural History Museum in 1857 (Chapter 7, Figure 7.3). It is still on display in the entrance hall there today and represents one of only a few Pleistocene mammals from London on display in the museum. Brady sold his collection to the Natural History Museum in 1874 for £525 (George, 1999).

Brady excavated and restored some of the Ilford mammal bones himself with the help of William Davies from the Natural History Museum. However, workmen are likely to have given him some, if not the majority, of the specimens as they excavated the 'brickearth'. Brady also published a catalogue of his finds. His collection and careful conservation of the specimens has ensured that the unique and impressive assemblage is available for future research.

4.7 Samuel Hazzledine Warren (1872-1958)

Warren lived in Loughton, Essex and began working in the family business of wholesale provision merchants. He is an example of an antiquarian who was not formally trained in geology but who became so involved with the discipline that he eventually devoted his whole life to it and left the family business in the early 19th century. Warren was President of the Geologists' Association (1922-24), and later a trustee and Honorary Member. He was also on the councils for the Geological Society of London and the Royal Anthropological Institute, and a member of the Prehistoric Society. His early work centred on the 'Eolith' controversy, and he became a key figure in persuading archaeologists that these lithics were of natural origin. He worked on sites in Essex, such as Clacton, where he found the 'Clacton spear', but he also collected

implements in north-east London and the Lea Valley (Oakley, 1957). For example, he collected nearly 500 of the artefacts from Stoke Newington (Chapter 6). Warren published his research extensively and his contributions were rewarded with the Prestwich Medal of the Geological Society (1939) and the Henry Stopes Medal of the Geologists' Association (1949) (Oakley, 1957). His published work is still pertinent today and his collections are now preserved for future research in the British Museum and the Natural History Museum.

4.8 Flaxman Charles John Spurrell (1842-1915)

Spurrell, of Belvedere south-east London (then in Kent), inherited his interest in geology and archaeology from his father, Dr Flaxman Spurrell, who collected many fossils from Crayford and Erith. F. C. J. Spurrell's closest friend was Flinders Petrie, the eminent Egyptologist, who further encouraged Spurrell's interest in the Palaeolithic, and whose archaeological techniques Spurrell tried to imitate (Caiger, 1992; Scott and Shaw, 2009).

Spurrell appears to have been officially unemployed, although he inherited enough private wealth to pursue his archaeological interests, particularly excavating the local sites of Erith and Crayford (Chapter 7) and collecting implements from the 'working floor'. Spurrell also discovered the Palaeolithic site at Ebbsfleet in Kent, later known as Baker's Hole. He practised flint knapping to understand how the implements from Crayford and Ebbsfleet were produced (Caiger, 1992; Scott and Shaw, 2009).

Whilst Spurrell's contemporaries, such as John Evans and Worthington Smith, were attempting to categorise flint implements from river gravels such the Thames terraces into different age groups, Spurrell was concentrating on the taphonomy. He focussed his attention on the unabraded finds, those that he was confident could be relatively dated. He was concerned that the younger terraces contained implements of a variety of ages, and therefore greater issues arose when trying to assign them to an age (O'Connor, 2007; Scott and Shaw, 2009).

Spurrell was one of the first antiquarians in the UK to attempt refitting flakes from a 'working floor' at Crayford, which inspired Smith to do the same at Caddington in Bedfordshire and Brown at Creffield Road, although Brown was not as successful with his site (Scott and Shaw, 2009). Smith said of Spurrell's refits, '*I shall never forget*

reading for the first time of this remarkable achievement' (Smith, 1887 p.83). Like his father, Spurrell was a member of the Kent Archaeological Society, to which he regularly lectured on his finds, and he was also a member of the West Kent Natural History, Microscopical and Photographic Society, of which he became the President between 1864 and 1866 (Caiger, 1992).

It appears that Spurrell had to be cajoled into publishing much of his work by his colleagues and when he did, the reports were short and to the point, with little expansion on the facts (Kennard, 1944). Fortunately what he did publish has enabled future researchers to understand the stratigraphy of some of these key sites and the provenance of the implements in great detail. His research on two of the most celebrated Levallois sites in Britain, and his interest in understanding the activities of hominins, has ensured his position as one of the most diligent and notable local collectors and archaeologists.

4.9 Worthington George Smith (1835-1917)

Smith was an architect and botanical illustrator from Shoreditch. His interest in illustrating mycology and botany brought Smith into contact with institutions such as the Natural History Museum and natural history societies. It was through these connections, in conjunction with the exciting time in which he worked, during which massive advancements in geology and archaeology occurred, that Smith became interested in Palaeolithic archaeology (Dyer, 1978). It was Evans' book (1872) that alerted Smith to the implementiferous deposits in his local area, around Stoke Newington (Smith, 1894), from which he made many discoveries (Chapter 6). The area of Stoke Newington was being heavily suburbanised during the last 19th century and so provided Smith with the opportunity to collect implements from the gravels being excavated for the foundations of houses and road building. He spent much of his spare time walking the newly laid roads, visiting the gravel pits, examining drainage ditches and house foundation excavations collecting artefacts. He also bought artefacts from workmen that he spoke to at the sites. Smith discovered a horizon in the stratigraphy that he believed was a buried ancient land-surface, from which he found fresh implements and organic remains. He called this horizon his Palaeolithic 'working floor', after the work of Spurrell in Crayford. He later traced his 'floor' to Bedfordshire, specifically to the site of Caddington near Whipsnade. He published his discoveries in his book *Man the Primeval Savage* (1894), in which he not only presented the

stratigraphies, implements and other findings in great detail but also offered his view of the broader Palaeolithic, even producing illustrations depicting activities of Palaeolithic life (Figure 4.5). These plates illustrating Palaeolithic life were also used by John Allen Brown in his books and papers (Brown, 1887). They included pictures of women who are fully involved in Palaeolithic activities, such as flint knapping, which was progressive for the time the publications and illustrations were prepared (Roe, 2009).



Figure 4.5: An example of Smith's illustrations depicting Palaeolithic activities (Smith, 1894 p. 198).

Smith is also credited with being one of the first antiquarians to use photographs to record archaeological sites on a regular basis. Although the art of photography was still fairly new, Smith's son, Arthur Edgar, was one of the first commercial photographers in London, who also worked with archaeologist Sir Mortimer Wheeler, former keeper of the London Museum (now Museum of London) (Dyer, 1978).



Figure 4.6: Photograph of Smith inspecting a gravel pit in Bedfordshire with workmen. From Smith's personal notebook held in Wardown Park Museum, Luton. Photograph reproduced with permission from Luton Museum Services.

In his own words, Smith described looking for Palaeolithic artefacts as requiring '*a vast amount of walking, great patience, and the power of throwing off disappointment*' because artefacts of this age were rarely found (Smith, 1888a p. 7). It is clear that Smith invested much time in walking newly-laid roads and investigating gravel pits in order to accumulate his collection. Unsurprisingly he became well known to workmen and locals in his regular haunts, such as Clapton near Stoke Newington. He described once looking at a gravel heap there and overhearing two workmen who had spotted him inspecting the gravel. They said of Smith, '*if you ever sees a heap of gravel anywhere, it don't matter where, if you keep your eye on that heap of gravel long enough you will be bound to see that gent come and walk about on top of it*' (Smith, 1888a p. 10). It is this dedication to finding Palaeolithic implements and his meticulous recording of sites,

stratigraphies and implements that ensures Smith is one of the celebrated antiquarians in London.

4.10 John Allen Brown (1831-1903)



Figure 4.7: John Allen Brown. Reproduced with the permission of the London Borough of Ealing Library Service.

John Allen Brown, from Ealing, was the Justice of the Peace for Middlesex. He is renowned for his discovery of fresh Levallois implements from a horizon he termed the Palaeolithic ‘floor’ at Creffield Road, Acton. It is believed that Brown was inspired by natural history by his father’s publications on the Arctic and Antarctic. After his father’s

death he was his duty to finish the publications (Kettle, 1903). However, it was the discovery of fossils and artefacts by Col. Lane-Fox in Acton, which specifically inspired Brown to observe Palaeolithic deposits of his local area during development in the latter half of the 19th century (Rudler, 1903).

John Allen Brown was a contemporary of Smith and Spurrell, and as described above, their individual work often inspired each other. Parallels between Smith and Brown are frequent, with both publishing detailed books on their discoveries and interpretation of the Palaeolithic. All three men attempted to refit flakes from Palaeolithic ‘floors’ at their respective sites with varying degrees of success. Unfortunately for Brown, the assemblage from Creffield Road did not contain many refitting flakes and the collection includes several broken Levallois points that have been glued and taped to the butts of other Levallois implements, illustrating Brown’s attempts at refitting (Scott and Shaw, 2009).

Brown was known to enjoy displaying his vast collection of implements (Rudler, 1903), and he was actively involved in the archaeological community, since he was a member of the Royal Geographic Society, Anthropological Institute and the Geological Society (Kettle, 1903; Rudler, 1903). Brown’s major contribution to archaeology are his publications on his discoveries in West London, including his book *Palaeolithic Man in North West Middlesex* (1887), in which he recorded detailed stratigraphies and descriptions of the sites in addition to the huge collection of artefacts from London he accumulated from various locations.

Chapter 5: The Earliest Palaeolithic Sites in London MIS 12-11-10

5.1 Introduction

As discussed in Chapter 1, the River Thames terraces are a significant archive of Palaeolithic artefacts and fossils in central London and the boroughs. As a result, since the Thames did not run through this region prior to the Anglian glaciation, there is an absence of knowledge concerning the Palaeolithic and palaeoenvironmental records for the early Middle Pleistocene, the first period for which human occupation can be confidently detected in Britain (Parfitt *et al.* 2005, but see Parfitt *et al.* (2010) for an alternative view). The Anglian Glaciation, widely attributed to MIS 12 (Shackleton, 1987; Bowen *et al.*, 1989; Ehlers *et al.*, 1991; Bowen, 1992; Bridgland, 1994; Rowe *et al.*, 1999; Scourse *et al.*, 1999), destroyed the original course of the Thames and diverted it south into its current valley through central London. This diversion of the Thames ensured that the vast majority of pre-Anglian deposits in the London basin were destroyed or reworked into younger Thames terraces. This chapter deals with the last remaining pre-Anglian deposits in Greater London and to the north of London and also the deposits left behind by the Anglian ice sheet. Unfortunately, very little of the first terrace to be created by the newly-diverted Thames, the Boyn Hill/Orsett Heath Gravel Formation remains in London, as much of it has been destroyed by later fluvial erosion. The last remaining patches of this terrace and any artefacts that may be associated with the deposits are discussed in Section 5.4. Although much more information is known about the timing of the emplacement of the Boyn Hill/Orsett Heath Gravel and its associated environmental and archaeological context from the Lower Thames, it is important to identify the remaining pockets of this deposit in the Middle Thames should further development be planned in these locations.

5.2 Pre-diversion Thames deposits

The British Geological Survey (2006) mapped the **Stanmore Gravel** as a pre-Anglian deposit in North London, on Stanmore Common, Harrow Weald Common, Monken Hadley, and north of Borehamwood, just outside the Greater London boundary in Hertfordshire. It is suggested that this gravel was deposited by a tributary of the pre-diversion Thames, since it has a steeper gradient than Middle Thames deposits in the area (Bridgland, 1994). It also contains Greensand Chert, suggesting that it represents

an early deposit of the Mole-Wey tributary, flowing from the south (Wooldridge, 1927; Moffat, 1980; Moffat and Catt, 1986).

The British Geological Survey (2006) also mapped **Gerrards Cross Gravel** north of Borehamwood in Hertfordshire, which they suggested to be pre-Anglian or Anglian in age. Although this is outside the Greater London boundary, it is possible that these deposits represent early Pleistocene Thames sediments very close to London. It has been recognised that the Gerrards Cross Gravel contains high percentages of exotic lithologies from North Wales, and north-west England (Hey and Brenchley, 1977; McGregor and Green, 1978, 1983a, 1983b, 1986; Green *et al.*, 1980; Whiteman, 1983; Gibbard, 1985), suggesting that the gravel was deposited by an ice advance from North Wales. It was also found that the igneous pebbles were concentrated in certain areas, perhaps suggesting that larger blocks of these rocks had been deposited by ice and had subsequently fragmented over time (McGregor and Green, 1983a). Gibbard (1983, 1985) proposed that the Gerrards Cross Gravel represented deposition during the early Anglian, due to its position below the Westmill Gravel, which is itself found underlying chalky till of the Anglian Glaciation maximum in the Vale of St. Albans (Gibbard, 1974, 1977). However, reinterpretation of the pre-diversion Thames deposits in East Anglia suggests the Gerrards Cross Gravel is older than previously believed.

Whiteman (1990) correlated the high levels of volcanic lithologies from North Wales in the Gerrards Cross Gravel with the Westland Green Gravels of the pre-diversion Thames (Hey, 1980; Allen, 1983, 1984) in Suffolk and Norfolk. The Westland Green Gravel is part of the High-level Kesgrave sub-group, which represents an early Thames with a large catchment that extended beyond the Cotswolds. The High-level Kesgrave sub-group is separated from the post-diversion Thames terraces by the Low-level Kesgrave sub-group, which reflects deposition by a Thames with a much-reduced catchment. Whiteman (1990) suggested that the Low-level Kesgrave sub-group is poorly represented in the Middle Thames, implying that terrace formation at this time is preserved only in East Anglia. However the correlation of the Gerrards Cross Gravel with the Westland Green Gravels of the High-level Kesgrave sub-group indicates that the Gerrards Cross Gravel, just north of London, substantially pre-dates the Winter Hill Gravel, and must represent a period prior to the Anglian in the early Pleistocene. Bridgland (1994) attributes the Gerrards Cross Gravel to the period prior to MIS 21.

A number of other gravel deposits in and around north London are thought to have been laid down during the immediately pre-Anglian period. The **Westmill Gravel** is mapped by the British Geological Survey to the north of Watford. Again, although not in Greater London, the Westmill Lower Gravel (the Westmill Upper Gravel is a post-diversion River Lea deposit) represents the final aggradation of the Thames before the diversion (Bridgland, 1994). The Westmill Lower Gravel was observed underlying chalky till of the Anglian Glaciation in the Vale of St. Albans (Gibbard, 1974, 1977) and is considered to be a downstream continuation of the Winter Hill Gravel of the Middle Thames (Bridgland, 1994).

A further pre-diversion Thames deposit in North London is the **Dollis Hill Gravel** mapped in Finchley, Hendon, Dollis Hill, Southgate, and Enfield (British Geological Survey, 2006). It is thought to be the Mole-Wey tributary equivalent of the Winter Hill Gravel of the Middle Thames (Gibbard, 1985; Bridgland, 1994), and therefore immediately pre-dates the Anglian Glaciation.

The **Woodford Gravel** (British Geological Survey, 2006) or the **Woodford Green Gravel** (Gibbard, 1994) in north-east London, is suggested to be a pre-diversion Wandle deposit, equivalent to the Westmill Lower Gravel, Winter Hill Gravel of the Middle Thames and the Dollis Hill Gravel of the Mole-Wey tributary (Gibbard, 1994).

There appear to be no pre-diversion deposits preserved in South London, with the exception of two small patches of sand and gravel of uncertain origin, thought to be of possible pre-Anglian age near Streatham and Norwood (British Geological Survey, 1998).

As demonstrated above, very little of the pre-diversion Thames or its tributary deposits survive today, since most were destroyed during the diversion of the river into its current position by the Anglian ice. Unfortunately no Palaeolithic artefacts have thus far been attributed to these gravels. Whether this reflects the genuine rarity of hominin occupation in the area during the early Middle Pleistocene or is simply a factor of preservation cannot be determined.

5.3 Anglian-age deposits

Chalky Till

The Anglian glacial maximum reached Finchley, Enfield and Hornchurch in London (Figure 5.1) and the deposit at Hornchurch represents the most southerly location where the Anglian till has been recognised.

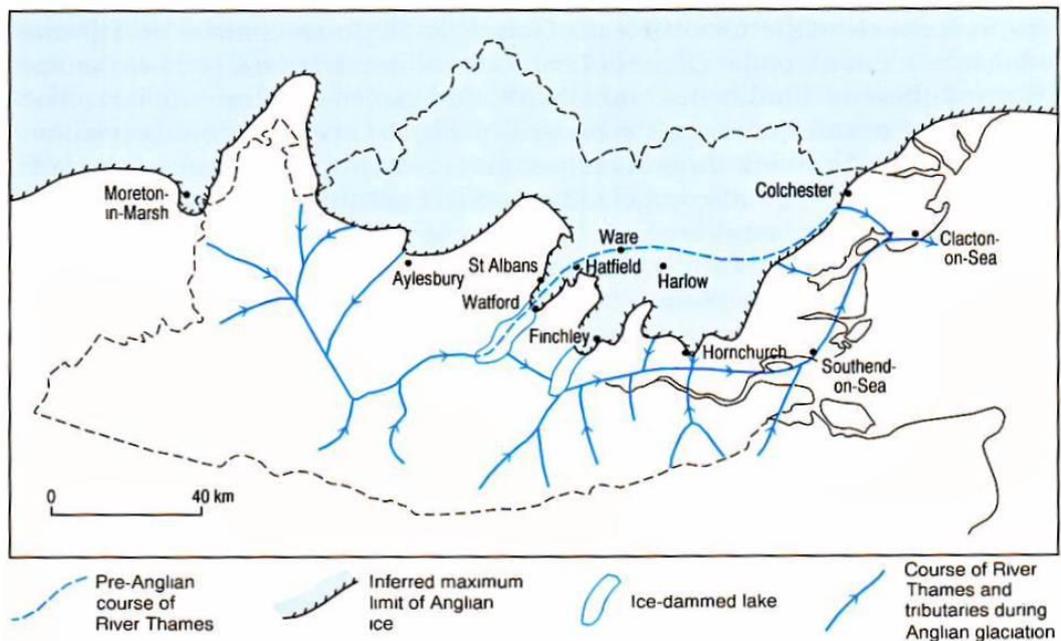


Figure 5.1: The extent of the Anglian Glaciation in London. From Sumbler *et al.* (1996).

The Anglian till in Hornchurch is overlain by the oldest deposit of the post-diversion River Thames, the Orsett Heath Gravel Formation (Figure 3.7). The chalky till at Hornchurch was first described by Holmes (1892a, 1892b, 1892c), and was a significant development in the recognition that all the terraces in the Lower Thames valley are younger in age than the Anglian.

Black Park Gravel

The Black Park Gravel of the Middle Thames is recognised as the oldest deposit of the newly-occupied Thames Valley system following the Anglian glacial maximum (Gibbard, 1979). The gravel is suggested to have been laid down as melt-water deposits

of the late Anglian ice that was carrying detritus in the Vale of St Albans (Gibbard, 1977; Sumbler *et al.*, 1996).

A number of Palaeolithic artefacts have been attributed to the Black Park Gravel of the Middle Thames. These include (Figure 5.2):

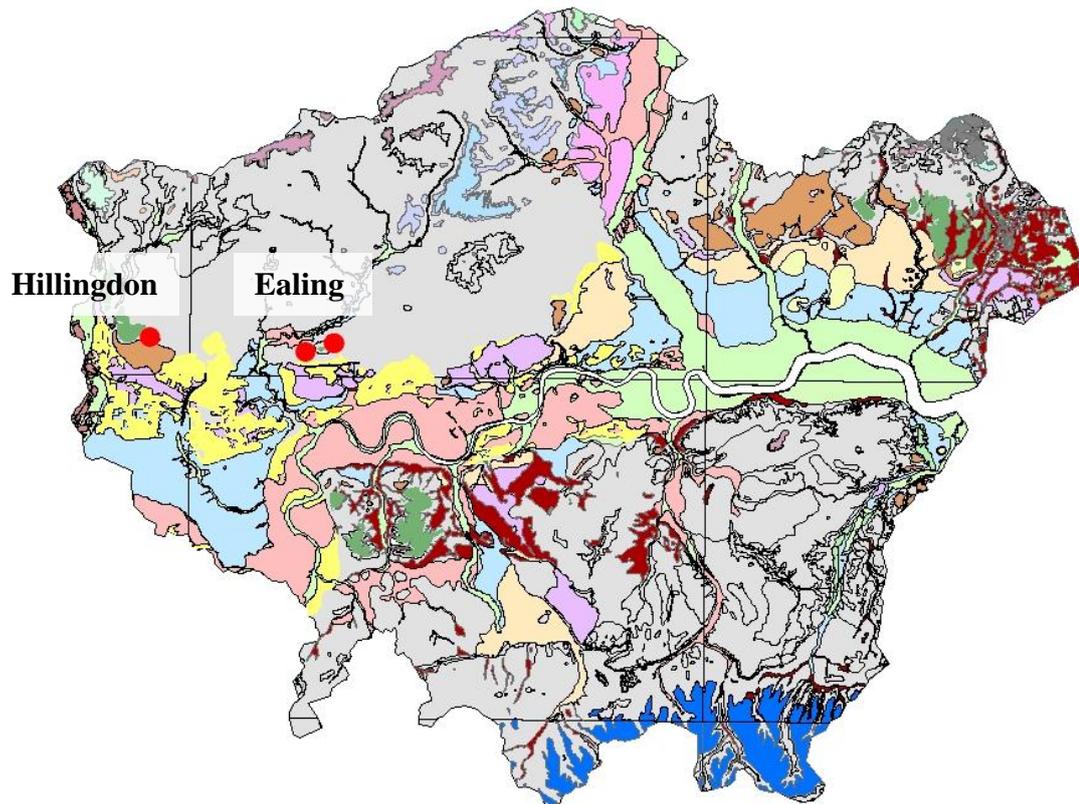


Figure 5.2: Map of implements thought to belong to the Black Park Terrace. Black Park Gravel is denoted by dark green. Each artefact is represented by a red spot.

1. Wimbledon Common is largely mapped as containing Black Park Gravel (British Geological Survey, 1998). Two handaxes are registered on the Greater London Historical Environment Record (GLHER) from Glen Albyn Road held at the Museum of London. However, these implements have not been relocated by Wessex Archaeology (1996) or this study.
2. The implements from Hillingdon Town Pits described by Brown (1895b), which are attributed to the small patch of Black Park Gravel mapped in the area (Wessex Archaeology, 1996). Unfortunately these implements could not be relocated by

Wymer (1968) but two handaxes were identified in the British Museum by Wessex Archaeology (1996). Only one of these could be located in this study (J. A. Brown no. 2057) and the artefact label confirms that the implement was found at 180ft OD (55m OD), which is comparable to the height of the Black Park Gravels in Wimbledon (approximately 52-55m OD). However, a flake attributed to a gravel pit in Hillingdon was also found on high gravels at 177ft OD (54m OD) was identified in this study in the British Museum (no artefact number). Both artefacts are heavily abraded, suggesting that they have been transported by the Thames and are not *in situ*, and possibly indicate the implements pre-date the Anglian.

3. Hanger Hill, in north Ealing, also contains a small patch of Black Park Gravel. John Allen Brown found artefacts in Hill Crest Road during excavations for a reservoir and water tower (Brown, 1886). Two handaxes in the British Museum were identified from this site by Wessex Archaeology (1996), and were also identified during this study (J. A. Brown no. 23 and 59), with another four implements also provenanced to Hanger Hill at Gunnersbury Park Museum and the British Museum.

All of the artefacts from Hillingdon and Hanger Hill described above are heavily abraded, suggesting they have been reworked from older gravels and may represent pre-Anglian hominin occupation. There is also Black Park Gravel mapped in areas of Richmond Park and Streatham Hill, although no artefacts could be attributed to these gravels.

5.4 Boyn Hill/Orsett Heath Gravels

The Boyn Hill and Orsett Heath Gravels of the Middle and Lower Thames are attributed to the 'Wolstonian' by Gibbard (1985, 1994, 1995) and to MIS 12-11-10 by Bridgland (1994). These gravels contain deposits of the first interglacial in the post-Anglian Thames valley. Much like the immediately pre-Anglian and Anglian deposits in London, the Boyn Hill/Orsett Heath Gravels survive only in small patches and the majority of the aggradation must have been eroded and reworked subsequently by the river. Artefacts that have been attributed to areas of Boyn Hill/Orsett Heath Gravels are presented below (Figure 5.3):

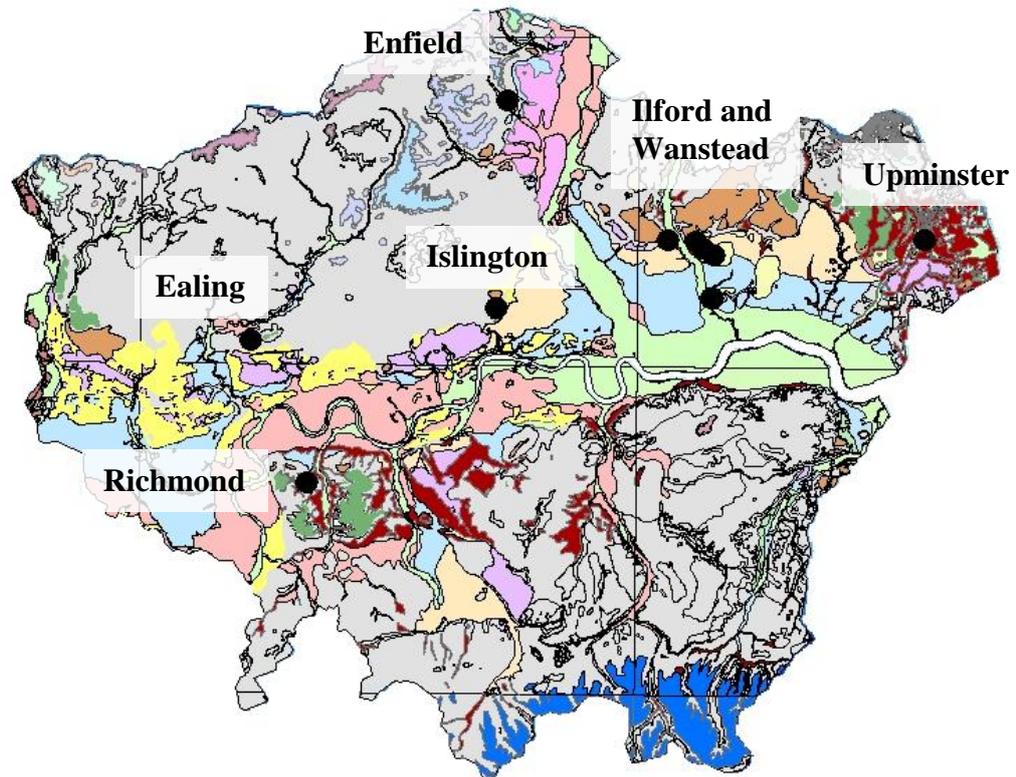


Figure 5.3: Map of the artefacts listed below thought to be from the Boyn Hill/Orsett Heath Gravel. Boyn Hill/Orsett Heath Gravel is denoted by tan brown. Artefacts are represented by black spots.

1. A handaxe from Richmond Park near White Lodge was found by Mr. C. H. Watson in 1949 on a gravelly field (Wymer, 1968). The artefact is now in the Wymer Collection held at the Geography Department, Royal Holloway (artefact no. 2011) (Figure 5.4). Another implement from the same collection, from Richmond provenanced by Wymer to the Boyn Hill Gravel on its label (artefact no. W242) is also included in Figure 5.4.



Figure 5.4: Photographs of the artefacts from Richmond Park. Wymer Collection no. 2011 and W242. Photographs by C. Juby.

2. Two handaxes were recorded from Castle Bar Hill, Ealing (Brown, 1886). Unfortunately they were not relocated in the survey by Wessex Archaeology (1996), however one from Castle Bar Hill from the Sturge Collection (ex. W.G. Smith Collection) was found in the British Museum (Smith no. 193). The implement was recorded from gravels at 164ft OD (50m OD), suggesting that it could have come from the Boyn Hill Gravels, which are situated between approximately 30-50m OD in this part of London (Bridgland, 1994). Twenty-six other handaxes and flakes from Castle Hill have also been identified during this study from Gunnersbury Park Museum and the British Museum. However, they cannot be definitely associated with the Boyn Hill Gravels, particularly as they are predominantly heavily abraded.
3. Fourteen handaxes and one flake were found in Pentonville, Islington, where Boyn Hill Gravel covers most of the area (Roe, 1968a; Wymer, 1968; Wessex Archaeology, 1996). The handaxes and two flakes were all relocated in this study in the British Museum.
4. Wanstead Park in north-east London is almost entirely situated on Boyn Hill Gravel. One handaxe from the area held in the Cambridge Museum of Archaeology and

Anthropology was identified by Roe (1968a), Wymer (1985) and Wessex Archaeology (1996) and was also seen during this study (artefact no. 24.1327/2065).

5. Sixteen handaxes, three retouched flakes, and eight flakes, were identified from St. Swithins Pit, Ilford held in the British Museum (Roe, 1968a; Wymer, 1968, 1985; Wessex Archaeology, 1996) was attributed to a high terrace of gravel (around 27m OD by Wymer (1968, 1985) and the Boyn Hill Terrace by Wessex Archaeology (1996). The pit was described by Hinton (1900b) and is likely to be on the east side of Roding Lane. During this study, thirteen handaxes, 18 flakes, and one retouched flake were relocated in the British Museum.
6. One handaxe, one retouched flake and two non-retouched flakes were found in Ilford, at the top of Cranbrook Road, near Gants Hill underground station (Roe, 1968a; Wymer, 1985; Wessex Archaeology, 1996). These were all relocated in the British Museum in this study.
7. One handaxe was found in the garden of 24 Globe Rd. Hornchurch, after 1945. The artefact was apparently found at the junction of the Orsett Heath and Corbets Tey Gravels (GLHER; Wessex Archaeology, 1996). The artefact remained with the finder and was not seen during this study.
8. Twenty handaxes and three flakes were found in the Stonehall Farm Pits, Gants Hill and the Griggs Estate, which now covers the site (Roe, 1968a; Wymer, 1968; Wessex Archaeology, 1996). Twenty one handaxes, in addition to four flakes from these locations were identified during this study, all held in the British Museum.
9. The point of a broken handaxe from Moor Hall Farm in Rainham was found on Orsett Heath Gravel and held in the British Museum (Wymer, 1985; Wessex Archaeology, 1996), although it was not analysed during this study.
10. Three handaxes were recovered from the excavations for the building of the A127, in Upminster in 1924. They were found in 'brickearth' overlying Boyn Hill Gravel (Warren, 1942; Dewey, 1932; Dines and Edmunds, 1925; Wymer, 1985; Bridgland,

1994). Four handaxes and one piece of modified flint from this locality were identified during this study in the British Museum.

11. Four flakes in the Smith collection held at Wardown Park Museum are provenanced to Bush Hill in Enfield in addition to one handaxe from the Christy collection (Ex Smith) and one flake and one handaxe from the Warren Collection, all in the British Museum. The top of the hill is mapped as Boyn Hill Gravel (British Geological Survey, 2006) and the flake may have been collected from this gravel. It is particularly interesting as the flake is slightly abraded and may suggest it was found *in situ* in these gravels. Wymer (1968) stated that a few handaxes from the 148ft OD. (45m OD, Boyn Hill Gravel) gravel were found by Warren and Smith; however, none were re-identified by Wymer with any certainty.

Unfortunately, all the objects listed above were abraded to some degree, with the majority displaying high levels of abrasion, indicating that all objects were not in primary context. It is therefore not possible to associate many of the implements with confidence to the Boyn Hill/Orsett Heath Gravels, although those with associated height data can be attributed to the Boyn Hill/Orsett Heath Gravel with greater assurance. This is not surprising considering the age of the terrace (ca. 440-350k BP) (Bridgland, 1994), and the poor provenance information recorded for many of the objects, especially those found on the surface, suggesting that some may not actually originate from the Boyn Hill/Orsett Heath Formation.

Further pockets of Boyn Hill Gravel are also mapped on Richmond Hill, Bush Hill in north London and near Palmers Green (British Geological Survey (1998, 2006), although no artefacts are known these deposits.

5.5 The significance of twisted ovate handaxes

Variations in handaxe shape are widely perceived to be a result of the different raw materials used (Evans, 1863; Flower, 1868; Jones, 1979; Villa, 1983; Isaac, 1984; Ashton and McNabb, 1994; White, 1995, 1996). It was suggested that rounded ovate handaxes were produced when the raw material was large and robust enough to support the reduction needed to produce the handaxe, whereas pointed handaxes were generated from smaller and narrower raw flint nodules (White, 1998). However, there is one form

of early Palaeolithic handaxe where the shape is also of chronological significance, namely the twisted ovate. These deliberately-fashioned handaxes, which display a reverse 'S' twist when viewed from the side (Figure 5.5), are temporally restricted to late MIS 11 and early MIS 10, particularly when they are frequent in an assemblage (White, 1998).

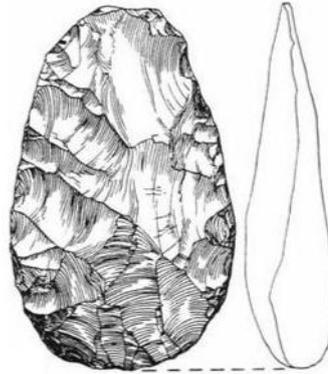


Figure 5.5: Illustration of a twisted ovate handaxe. From Wymer (1968 p. 63).

Examples of sites with large numbers of twisted ovates are Bowman's Lodge, Wansunt Pit and Swanscombe, all in Kent, and Elveden in Suffolk (White, 1998). Although none of the assemblages with large proportions of twisted ovates are from London itself, the presence of twisted ovates in the archaeological record might therefore indicate the presence of late MIS 11 and/or early MIS 10 assemblages. A number of twisted ovate handaxes have been identified in the London area and are listed in Table 5.1 and illustrated in Figure 5.6. The deposit that each handaxe is associated with based on its find location is listed in Table 5.1. However the great variation in the deposits reflects the poor provenances recorded for most artefacts and that most of the handaxes have experienced reworking.

Location	Museum	Collection	Deposit
Barkingside, Stonehall Pit	British Museum	Warren	Boyn Hill Gravel
Becontree Heath, Romford	British Museum	Warren	Hackney Gravel
Chelsfield, from surface	British Museum	R. G. Rice	
Clapton Common, west side	British Museum	Sturge Coll. Ex. W.G.Smith	Langley Silt
Clerkenwell, near Sessions House.	British Museum	Christy Coll. Ex W. G. Smith	Hackney Gravel
Crayford	British Museum	Jones Bequest	Alluvium/Taplow Gravel
Crayford	British Museum	Jones Bequest	Alluvium/Taplow Gravel
Crayford. From 'brickearths' above sand and gravel.	British Museum	Kemp	Alluvium/Taplow Gravel
Dagenham, Gale Street, found by workmen	British Museum	Warren	Taplow Gravel
Dawley	British Museum	Sturge Coll. Ex J.A.B	Lynch Hill Gravel
Dawley	British Museum	Sturge	Lynch Hill Gravel
Dawley	British Museum	Sturge Coll. Ex J.A.B	Lynch Hill Gravel
Dawley, Maynard's Pit	British Museum	Sturge Coll. Ex J.A.B	Lynch Hill Gravel
Dawley, Maynard's Pit	British Museum	Sturge Coll. Ex J.A.B	Lynch Hill Gravel
Dawley, Maynard's Pit	British Museum	Sturge Coll. Ex J.A.B	Lynch Hill Gravel
Earlsfield	British Museum	Wellcome	Kempton Park/Taplow Gravel
Hanwell	Institute of Archaeology, Uni. Of London	Unknown coll.	Taplow Gravel
Hanwell, Boston Road Pit	British Museum	W.G.Smith	Taplow Gravel/Langley Silt
Hanwell, Boston Road Pit	British Museum	W.G.Smith	Taplow Gravel/Langley Silt
Hanwell, Seward's Pit, Boston Road	British Museum	Dewey	Taplow Gravel/Langley Silt
Leytonstone	British Museum	Christy Coll, Ex. A. W. Franks	Lynch Hill Gravel/London Clay
Leytonstone	British Museum	I.O.A. Coll. Ex. Corner	Lynch Hill Gravel/London Clay
Leytonstone, Bents Farm	British Museum	Warren	Lynch Hill Gravel/London Clay
Lower Clapton	British Museum	Sturge Coll. Ex. W.G.Smith	Taplow Gravel/Hackney Gravel

Table 5.1 continued

Location	Museum	Collection	Deposit
Lower Clapton	British Museum	Sturge Coll. Ex. W.G.Smith	Taplow Gravel/Hackney Gravel
Lower Clapton, Newick Road	British Museum	Sturge Coll. Ex. W.G.Smith	Taplow Gravel/Hackney Gravel
Norwood, Lambeth, from sewer excavations	Museum of London	Unknown coll.	London Clay
Pentonville	British Museum	Sturge	Boyn Hill Gravel
Pentonville	British Museum	Sturge	Boyn Hill Gravel
South Hornchurch	British Museum	Warren	Taplow Gravel
Stamford Hill	British Museum	Sturge Coll. Ex. W.G.Smith	London Clay
Stamford Hill, Kyverdale Road, north of Cazenove Road	British Museum	Sturge Coll. Ex. W.G.Smith	London Clay
Stamford Hill, north of and close to Grove Road	British Museum	Sturge Coll. Ex. W.G.Smith	London Clay
Stamford Hill, north side of Cazenove Road, S.W. corner of Alkham Road	British Museum	Sturge Coll. Ex. W.G.Smith	Langley Silt
Stoke Newington Common, between Kyverdale and Osbaldeston Roads	British Museum	Sturge Coll. Ex. W.G.Smith	Langley Silt
Stoke Newington, Geldeston Road	British Museum	Warren	Langley Silt/Hackney Gravel
Stoke Newington, Sovereign Lane, a short distance south of Northwold Road	British Museum	Warren	Hackney Gravel
Upper Clapton	British Museum	Sturge Coll. Ex. W.G.Smith	Langley Silt/Hackney Gravel
Upper Clapton, close to railway station	British Museum	Sturge Coll. Ex. W.G.Smith	Langley Silt/Hackney Gravel
Wanstead	British Museum	Sturge	Boyn Hill Gravel/London Clay
Wanstead, found 1/2 mile south-east of Low Leyton Railway station. Gravel dug close by	British Museum	Sturge Coll. Ex W.G.Smith	Boyn Hill Gravel/London Clay
West Drayton, Eastwood's Pit	British Museum	J. A. Brown	Lynch Hill Gravel
West Drayton, Eastwood's Pit	British Museum	J. A. Brown	Lynch Hill Gravel
West Drayton, Eastwood's Pit	British Museum	J. A. Brown	Lynch Hill Gravel

Table 5.1 continued

Location	Museum	Collection	Deposit
Yiewsley, Boyer's Pit	Museum of London	R.G. Rice	Lynch Hill Gravel
Yiewsley, Eastwood's Pit	Museum of London	R.G. Rice	Lynch Hill Gravel
Yiewsley, Wallington's Pit	British Museum	Unknown coll.	Lynch Hill Gravel

Table 5.1: Twisted ovate handaxes from London

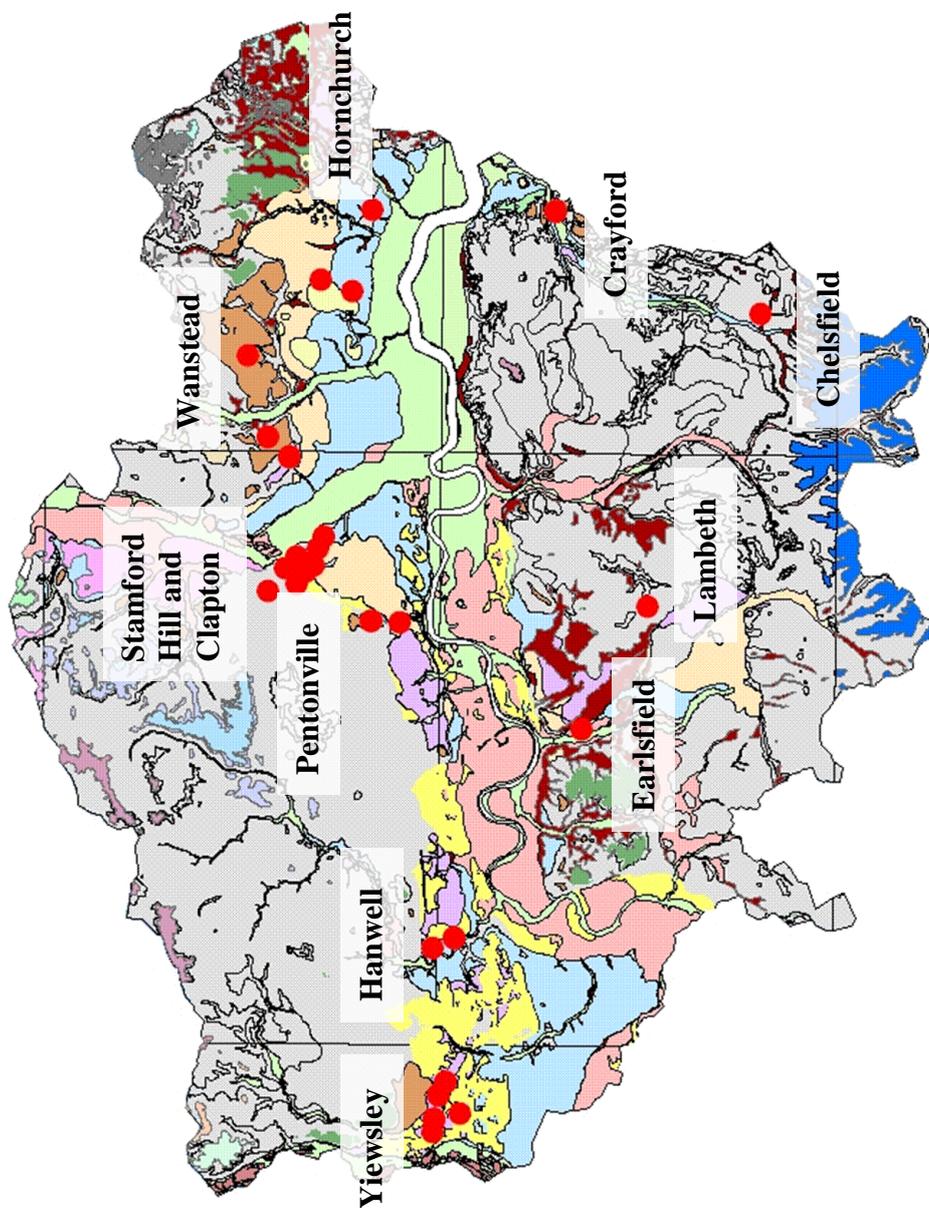


Figure 5.6: Map of twisted ovate handaxes found in London. Twisted ovate handaxes represented by red circle.

Boyn Hill/Orsett Heath Gravel is denoted by tan brown.

Only a small proportion of the twisted ovate handaxes are situated on Boyn Hill Gravel (Figure 5.6), specifically those from Wanstead, Barkingside (Stonehall Pit), and Pentonville, although the Leytonstone implement is found very near to a Boyn Hill Gravel outcrop. Of the twisted ovates found, these might conceivably be *in situ*, since their inferred age significance is consistent with the age of the deposits. The others are situated on Hackney Gravel (beige on map) (Romford, Lower Clapton, Stoke Newington, Clerkenwell), Taplow Gravel (pale blue) (Dagenham, South Hornchurch, Lower Clapton and Hanwell), Kempton Park Gravel (pale coral) (Earlsfield), and Langley Silt (yellow) (Clapton Common), suggesting they are reworked from older deposits. Two are mapped on London Clay (grey) (Lambeth and Chelsfield), which are not easily provenanced. Artefacts from Yiewsley and Dawley are mapped on Lynch Hill Gravel, suggesting they may be reworked from Boyn Hill Gravel outcrops to the north as many of them are moderately to heavily abraded. Four handaxes from Yiewsley and Dawley are slightly abraded, suggesting that they may come from the earliest aggradation of the Lynch Hill Gravel which is associated with MIS 10, or be a less rolled reworked component from the Boyn Hill Gravels.

Level of Abrasion	No. of Implements	% of Assemblage
Unabraded	0	0
Slightly abraded	3	6.38
Moderately abraded	18	38.30
Heavily abraded	26	55.32
Total	47	

Table 5.2: Levels of abrasion exhibited by the twisted ovate handaxes from London

As the twisted ovate handaxes in London are not known to be from assemblages containing significant numbers of this tool type, they can only be tentatively attributed to late MIS 11 or early MIS 10.

5.6 Summary of Chapter 5

This chapter has demonstrated that although very few artefacts can be attributed to the earliest deposits in the Thames Valley, evidence exists for occupation by hominins from the time of the retreat of the Anglian Ice (in the Black Park Terrace) and from the first terrace deposited by the Thames, the Boyn Hill/Orsett Heath Terrace.

Complementary to the evidence discussed in this chapter is Wansunt Pit, an important site that represents a MIS 11 occupation in the Lower Thames Valley. The pit overlaps the boundary of Greater London in Crayford and Dartford, Kent. Fresh bifaces, flakes, cores and scrapers were discovered in the Wansunt Loam, overlying the Dartford Heath Gravel and details were published by Chandler and Leach (1912b), Smith and Dewey (1914), Leach (1913), Wymer (1968) and Roe (1968a). At a recently excavated site at nearby Sweyne County Primary School in Swanscombe, Kent, the Swanscombe Upper Loam was recorded extending to 39m OD and therefore allowed correlation with the Wansunt Loam at Dartford Heath, which occupies a similar height (White *et al.*, 1995). This would imply both sites correlate with the latter half of MIS 11 and the Dartford Gravel corresponds to MIS 12 or early MIS 11. Therefore it has been suggested that the correlation of the Dartford Heath Gravel may represent the earliest fluvial deposit of the Lower Thames Valley and be equivalent to the Black Park Gravel of the Middle Thames as previously believed by Gibbard (1979, 1994) whilst still being part of the Boyn Hill/Orsett Heath Formation as proposed by Chandler and Leach (1911, 1912b), Smith and Dewey (1914), Dewey *et al.* (1924), King and Oakley (1936), Bridgland (1994) and White *et al.* (1995).

Chapter 6: Lynch Hill/Corbets Tey Terrace Sites (MIS 10-9-8)

The Lynch Hill Gravel stratotype is located near Slough, Berkshire, in the Middle Thames (Gibbard, 1985, 1989). The downstream equivalent was first recognised as the Barvills Gravel by Bridgland (1983) and later redefined as the Corbets Tey Member by Gibbard (1985, 1994) and Gibbard *et al.* (1988).

6.1 The chronology and significance of Levallois material in the Thames archaeological record

It has long been recognised that the Middle and Lower Thames gravels contain an abundance of Levallois (prepared core) material (Wymer, 1968). The Middle Palaeolithic saw a wide range of behavioural changes in hominins, with the emergence of Levallois technology considered to mark the beginning of this period, around 350-300k BP, broadly coincident with the emergence of Neanderthals (*cf.* Gamble and Roebroeks 1999). Levallois implements were named after the Palaeolithic site of Levallois-Perret, a suburb of Paris. The site was discovered by Reboux in 1879 and contained abundant prepared core material. Historically, the Middle Palaeolithic was considered to encompass only the last interglacial and last cold stage, with assemblages referred to as Mousterian industries (see Bordes, 1950). However, research into the Middle Palaeolithic has subsequently concentrated on attempts to redefine it typologically and technologically, leading to an extension of the definition, with the European Middle Palaeolithic now recognised as the period dating from the emergence of the Levallois technique in the late Middle Pleistocene to the appearance of the very different typologies of the Upper Palaeolithic at the end of the late Pleistocene.

Levallois implements are distinctive and are created by preparing a core until it has very little cortex and one face is fairly flat. The desired flake is then detached from the flat face of the core with one final strike to the core (Figure 6.1).

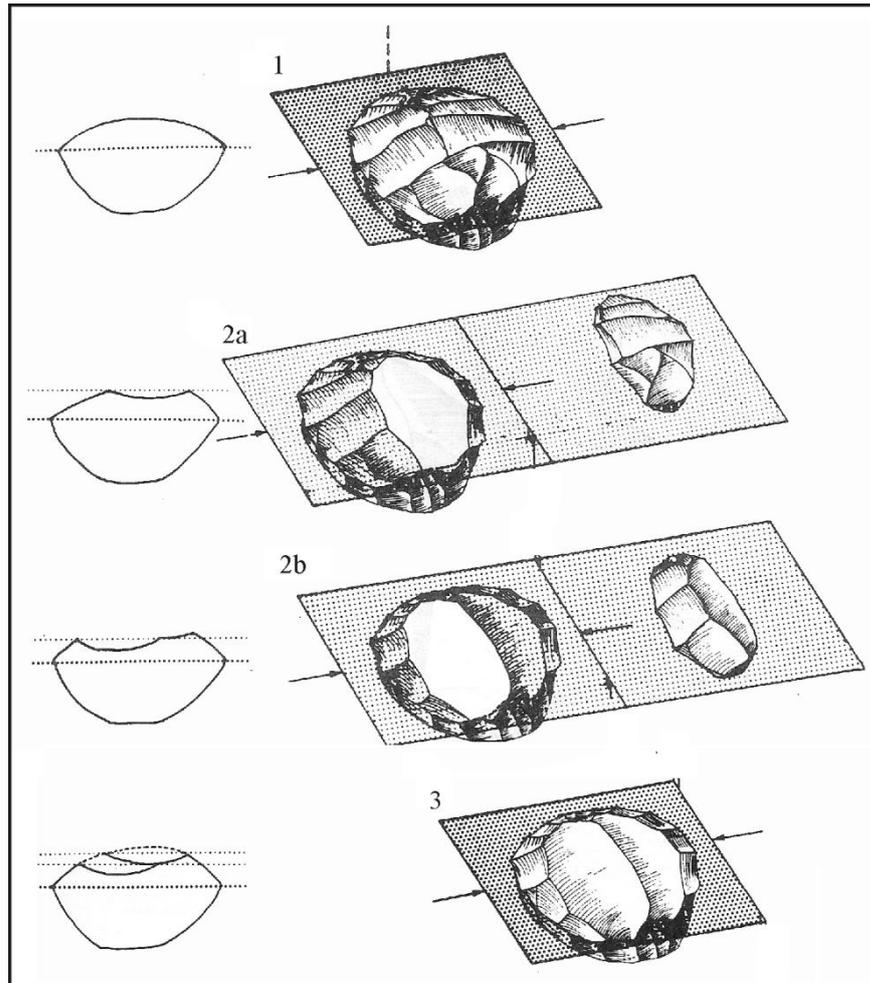


Figure 6.1: The Levallois concept as outlined by Böeda. 1. represents preparing the core by flake removals, 2a and 2b illustrate the removal of 1 or more predetermined flake tools (From Böeda, 1988).

Böeda (1986, 1988, 1995) went on to list a number of criteria (now widely accepted) for identifying Levallois implements (see Figure 6.2).

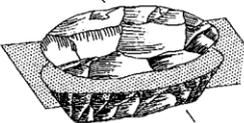
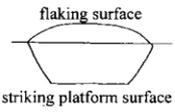
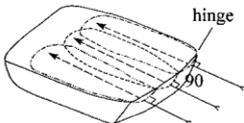
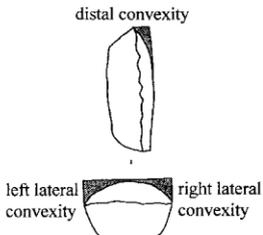
<p>Criterion 1: The volume of the core is conceived as two surfaces separated by a plane of intersection</p>		<p>Criterion 4: The fracture plane for the removal of predetermined blanks is parallel to plane of intersection</p>	
<p>Criterion 2: The two surfaces are hierarchically related and non-interchangeable, one being a dedicated surface of striking platforms, the other a dedicated flaking surface</p>		<p>Criterion 5: The line created by the intersection of the striking platform surface and the flaking surface (the hinge) is perpendicular to the flaking axis of the predetermined blanks</p>	
<p>Criterion 3: The flaking surface is configured in a fashion that predetermines the morphology of the products. This predetermination is controlled by the management of lateral and distal convexities</p>		<p>Criterion 6: Hard-hammer percussion</p>	

Figure 6.2: Böeda's criteria for identifying Levallois products. From White and Ashton (2003), drawings originally from Böeda (1995).

The Levallois technique is considered to be both an efficient method for producing a wide range of tools such as flakes and blades, and also a method requiring a large amount of skill to ensure the cores are prepared correctly and the desired final removal is made. This practice gives the distinctive 'faceted' butt to Levallois flakes and blades. When an assemblage is dominated by Levallois tools, rather than handaxes, it can be called a Levalloisian industry (Wymer, 1968). It had been suggested that the products of Levallois reduction have desirable qualities not seen in other tools such as bifaces, for example the Levallois implements have a high number of usable edges per flake and more tools can be produced from one piece of flint. The technique may thus be beneficial when access is restricted to sources of raw material (e.g. Sandgathe, 2005).

There have been claims for proto-Levallois industries in the Thames Valley from Rickson's Pit, Swanscombe (Roe, 1981), and Bowman's Lodge, Dartford Heath (Tester, 1950), both from the surface of the Boyn Hill/Orsett Heath Gravel dated to late MIS 11-early MIS 10 (Bridgland, 1994). However, it is not until late MIS 9, within the Lynch Hill/Corbets Tey Terrace, that examples of Levallois production consistently appear in the archaeological record in the Thames region. Botany Pit, Purfleet contains a well-

stratified Levallois technology from the Lynch Hill/Corbets Tey Terrace, dated to late MIS 9 or early MIS 8 (Schreve *et al.*, 2002). Examples of Levallois become more common after the final aggradation of the Lynch Hill/Corbets Tey Terrace at sites in West London, such as Creffield Road in Acton. At this site, the Levallois material rests on top of the Lynch Hill/Corbets Tey Terrace and so dates to late MIS 8 or early MIS 7 (Section 6.4). In the Lower Thames, the Levallois record continues with abundance *within* the Taplow/Mucking Terrace at sites such as Crayford (Section 7.2), the Lion Pit Tramway Cutting (Schreve *et al.* 2006) and Aveley that have Levallois archaeology attributed to later MIS 7 (Schreve, 2004c; White *et al.*, 2006).

Levallois implements from sites not already included in Chapters 6 and 7 are shown in Figure 6.3 (artefacts are shown by black dots).

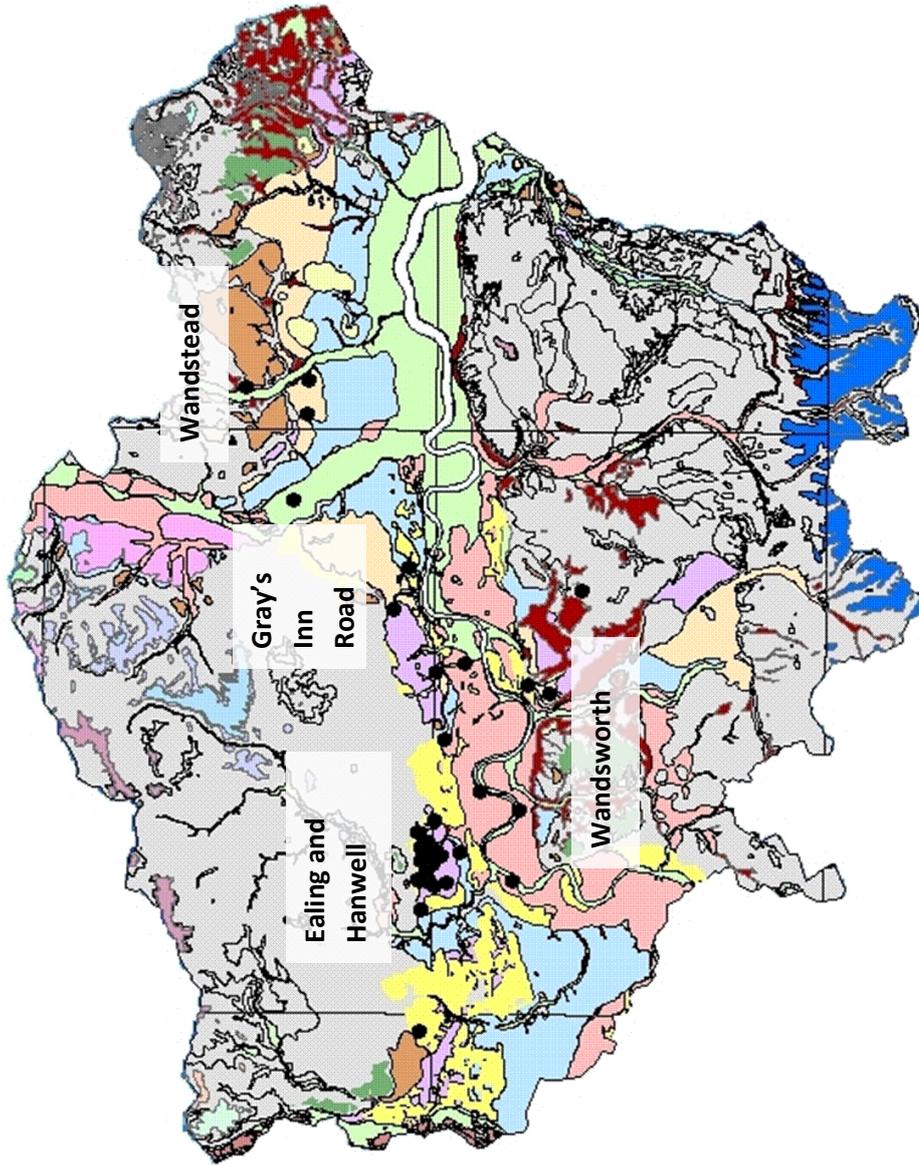


Figure 6.3: Levallois implements from sites within London that are not specified in detailed site analyses in Chapters 6 and 7 (only implements with a suitably detailed provenance were included)

The implements in Figure 6.3 were mainly found in areas attributed to the Lynch Hill and Taplow Terraces (represented by light purple and light blue respectively), already identified above as the terraces encompassing the time period during which Levallois technologies were being produced. A smaller number were found in areas of alluvium (light green), the Thames river bed, and the Hackney Gravel (pale beige). The implements from the alluvium and river bed represent artefacts reworked by the modern River Thames. Implements from the Hackney Gravel, a deposit recognised by the British Geological Survey between the Lynch Hill and Taplow Terraces, also fall within the time period during which Levallois technology was prevalent. The Hackney Gravel is separated from the Lynch Hill Gravel on the BGS maps because the two gravels occupy slightly different heights. The Hackney Gravels is marked as occupying the Stoke Newington and Shoreditch areas, whereas the Lynch Hill Gravel appears adjacent to the Hackney Gravel to the south-west in the Bloomsbury and Marylebone areas. However, it remains possible that the Hackney Gravel is a continuation of the Lynch Hill Terrace, since they are so closely juxtaposed and the Hackney Gravel appears to follow the same geographical spread as the Lynch Hill Gravel. The area mapped as Hackney Gravel by the British Geological Survey is recognised as Lynch Hill Gravel by Bridgland (1994).

The following sites have been identified as being within or on top of the Lynch Hill/Corbets Tey Terrace in the Greater London area; Stoke Newington and neighbouring areas (6.2), Cauliflower Pit in Ilford (6.3), Creffield Road in Acton (6.4), Yiewsley and West Drayton (6.5), and Hanwell in West London (6.6).

6.2 Stoke Newington, Abney Park Cemetery, Upper and Lower Clapton, Shacklewell and Hackney Downs

6.2.1 Introduction

From the mid 19th century, over 3000 Palaeolithic artefacts were discovered in the north London locations of Stoke Newington, Abney Park Cemetery, Upper and Lower Clapton, Shacklewell and Hackney Downs. The most notable of the antiquarian collectors in the area was Worthington George Smith, who accumulated a large proportion of these artefacts and meticulously recorded the local stratigraphy in available exposures between 1877 and 1909. Smith discovered his most celebrated finds

in a horizon that he termed a Palaeolithic ‘working floor’, which was thought to represent a palaeo-landsurface and from which fresh, *in situ* tools were prolific (Smith, 1882a; 1894). The ‘floor’ was most famously discovered in the area surrounding Stoke Newington Common at depths of approximately 1.2m from the ground surface, however due to the varying stratigraphy in the area, it differed in depth elsewhere and was absent in some locations. The Quaternary deposits in Stoke Newington and Hackney Downs have been assigned to the Lynch Hill Terrace (Bridgland, 1994) or attributed the Langley Silt Complex and the Hackney Gravel (a separate deposit intermediate between the Taplow and Lynch Hill terraces) (British Geological Survey, 2006).

Several researchers attempted to relocate Smith’s Palaeolithic ‘floor’, although all were unsuccessful due to the extensive urban development Stoke Newington has experienced since Smith’s discoveries. Recent research has focussed on the Devensian Hackney Brook deposits (Harding and Gibbard, 1983) and the late Middle Pleistocene interglacial (MIS 9) deposits at Hackney Downs, from which a comprehensive multi-proxy study (Green *et al.*, 2006) has led to a greater understanding of the complex stratigraphy in the area. The locality is of paramount importance, since not only does it contain one of the richest Palaeolithic archaeological assemblages in southern England, but also rich palaeoenvironmental evidence for a relatively poorly-known interglacial in western Europe.

6.2.2 Location of Collections

Artefacts were recorded from the Worthington George Smith and Bagshawe (ex. Smith) Collections at Wardown Park Museum, Luton, the Sturge (including ex. Smith and John Allen Brown Collection), Christy (ex. Smith collection), Warren (including ex. Greenhill Collection), and Wellcome Collections held in the British Museum, London, the Smith Collection in Bromley Museum and unnamed collections in the Museum of London, Natural History Museum and Vestry House Museum, Walthamstow.

Faunal material was seen from the H. Lewis collection in Natural History Museum, London and the Worthington Smith collection in Wardown Park Museum, Luton.

6.2.3 History of Research

The first palaeontological discovery in Stoke Newington was made in 1853 when large mammalian bones (suggested to be Bovidae sp.) were found by Beeke in a gravel pit (Prestwich, 1855). They were recovered from a mollusc-rich clay deposit between two gravel horizons in Shacklewell Lane, directly east of Hackney Downs (Figure 6.4). Prestwich recorded the stratigraphy as ‘brickearth’ (silty clay) underlain by ochreous flint gravel, the former including fossils and yellow sand and gravel (Prestwich, 1855b).

The first Palaeolithic implement from the gravels of North-East London was found by Mr G. H. Gaviller in Hackney Downs in 1866, although it was found in a newly-gravelled road and was not *in situ* (Smith, 1879; Evans, 1897) (artefact now in the Sturge Collection, British Museum). The first *in situ* implement followed in 1869 from Highbury New Park, where a handaxe was discovered in a mollusc-rich sandy bed (Evans, 1897). Worthington George Smith later suggested that this implement originated from the Palaeolithic ‘working floor’, which he had recorded in parts of Highbury, based on its colour and lack of abrasion (Smith, 1884a). The molluscs from this section were analysed by Tylor (1868).

Mammalian fossils were also recorded from the Hackney Downs vicinity. Details of species were not recorded, instead they were simply noted as ‘bones and tusks of large size’ from various locations and times (Smith, 1879, p. 275).

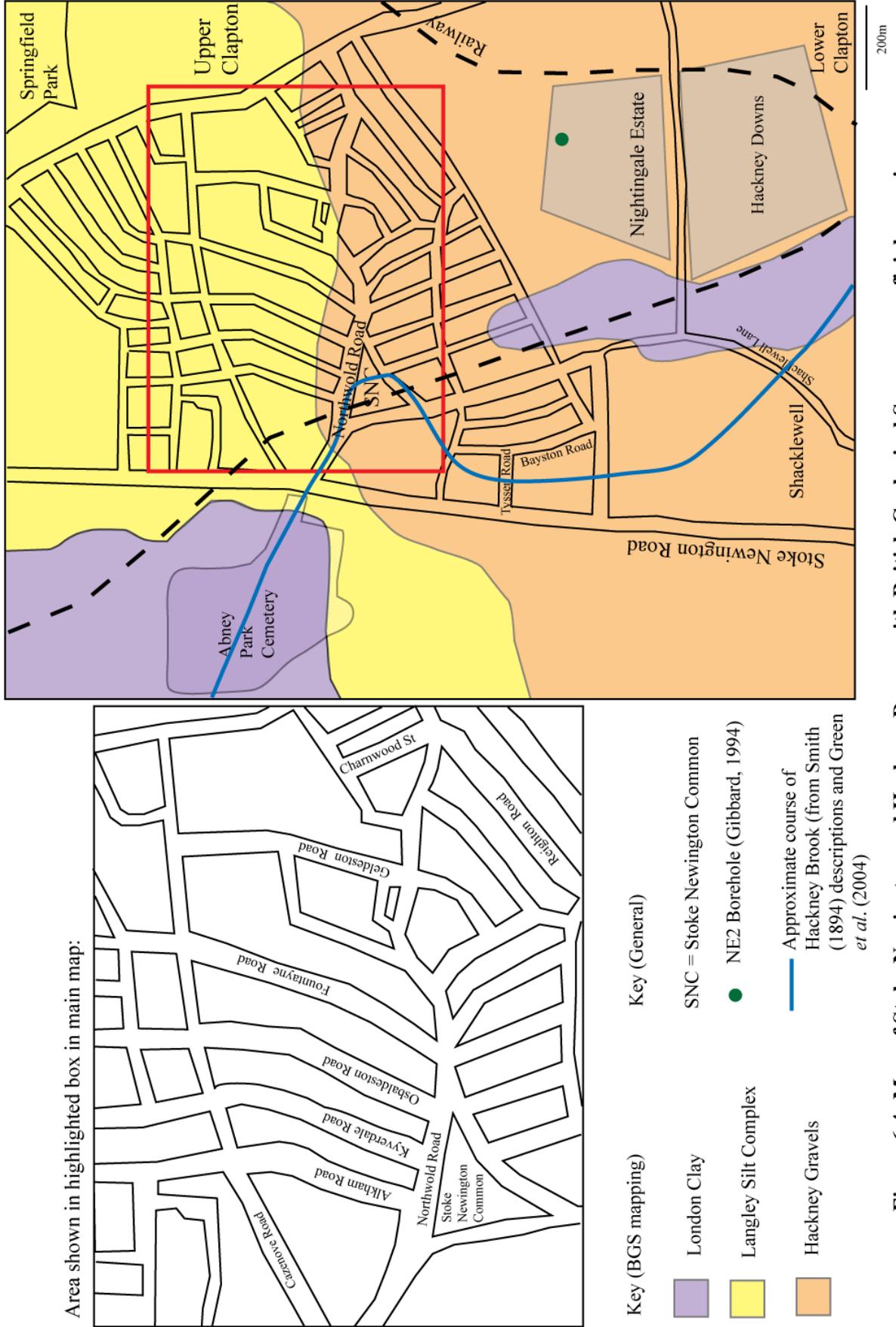


Figure 6.4: Map of Stoke Newington and Hackney Downs with British Geological Survey superficial mapping

Smith first discovered the Palaeolithic 'working floor' when Alkham, Geldeston, Kyverdale, Osbaldeston and Fountayne Roads were being developed north of Stoke Newington Common between 1878 and 1883 (See Figure 6. 4) (Smith, 1879, 1882a, 1882b, 1883a, 1883b, 1884a, 1884b, 1887a, 1887b, 1887c, 1888b, 1894). Smith traced the 'working floor' to other locations in the area by observing the stratigraphy seen during the building of house foundations and in dug graves in Abney Park Cemetery to the west of Stoke Newington High Street (see Figure 6.4) (Smith, 1884a). S. H. Warren also collected artefacts from this area between 1893 and 1899 (pers. obs. evidence from artefact labels).

Greenhill (1884) recorded the stratigraphy in the area and suggested that the stratified sands dipping towards the south had been deposited by the Thames rather than the Hackney Brook or the River Lea.

Many attempts were subsequently made to relocate Smith's Palaeolithic 'working floor'. The first occurred in 1971 when the south side of Northwold Road was excavated by Roe, Sampson and Campbell (Roe, 1981). Few details were published, although Palaeolithic and Mesolithic implements were found. It was later suggested that the gravels observed here related to the Devensian Lateglacial and early Holocene sediments of the Hackney Brook, after a second excavation in Northwold Road by Harding and Gibbard (1983). They recorded gravel and sand, overlain by silty clay, which was comparable with the stratigraphy recorded by Roe, Sampson and Campbell, and described the sedimentology as characteristic of cold climate fluvial deposition. The silty clay at the top of the stratigraphy was proposed to be Holocene alluvium containing Mesolithic artefacts. One handaxe and a broken handaxe tip were also found *ex situ*, suggesting they were derived from older deposits (Harding and Gibbard, 1983; Green *et al.* 2004).

Five trenches at 63 Cazenove Road were excavated in 1976 by the North London Archaeological Unit. London Clay was found within a metre of the ground surface in some places. In the southern end of the excavation, yellow sand (Stoke Newington Sand) was present above the London Clay, which was in turn overlain by 'brickearth'. In the centre of the excavation site, a 2m deep channel was found cutting into the London Clay, which was filled with coarse red and grey gravel (unpublished report by

North London Archaeological Unit). No artefacts were found. A further excavation later in 1976 by the Inner London Archaeological Unit at 66-76 Northwold Road revealed only disturbed sediments from a brick pit (Harding and Gibbard, 1983; Green *et al.* 2004). A more recent excavation at 15-21 Northwold Road (TQ 3380 8666), opposite the northern end of Rectory Lane, found very similar deposits to those described by Harding and Gibbard (1983). Implements typical of a Mesolithic or Early Neolithic industry were found in alluvium. Boreholes confirmed the stratigraphy recorded by Smith in the Kyverdale Road and Alkham Roads vicinity (Green *et al.*, 2004).

Gibbard (1994) cored the deposits in Stoke Newington and on the Nightingale Estate in Hackney Downs. He correlated the gravels on Stamford Hill, to the north of Stoke Newington, with the Lynch Hill Gravel, and the Leytonstone Gravel at Stoke Newington with the Taplow Gravel. The age of the Stoke Newington deposits has been the subject of considerable controversy. Under Gibbard's chronostratigraphical model of the Thames terraces (see Chapter 3, Table 3.2) the sands overlying the gravel at Stoke Newington (Highbury Silts and Sands/Stoke Newington Sands) were attributed by him to the Last Interglacial. The organic deposits observed at Hackney Downs (Highbury Silts and Sands) were also assigned to the Last Interglacial, on the basis of the pollen being comparable with Sub-stage Ip IIb of the Ipswichian Interglacial (*cf.* Philips, 1974; West, 1980).

In contrast, Bridgland (1994) interpreted the whole complex of sediments from Stamford Hill down to Hackney Downs as part of the late Middle Pleistocene Lynch Hill Terrace (MIS 10-9-8). Finally, the British Geological Survey (2006) mapped London Clay, Hackney Gravel (which they recognise as a distinct deposit between the Lynch Hill Terrace and Taplow Terrace) and Langley Silt Complex.

The most recent excavation in the area occurred in Hackney Downs (Figure 6.4) (Green *et al.*, 2006). A full account of the stratigraphy and analysis of fossil plant, insect, mollusc and vertebrate remains from the interglacial deposits gave rise to a detailed palaeoenvironmental reconstruction, elements of which are highlighted below. Optically Stimulated Luminescence (OSL) dates and biostratigraphical evidence suggested an MIS 9 date for the interglacial silts and sands, thus supporting the terrace stratigraphy proposed by Bridgland (1994). Five trenches were also opened in Geldeston Road by

Archaeology South East in 2006, however they revealed only evidence of 19th century sand quarrying overlain by made ground (Greater London Historical Environment Record ELO7313).

Roe (1968a, 1981), Wymer (1968, 1985) and Wymer in *Wessex Archaeology* (1996) summarised and discussed the artefact find spots and collections. Wymer (1968) suggested that the lower gravels were Wolstonian in age and considered the overlying finer deposits, including the Palaeolithic ‘floor’, to be of Ipswichian age. Roe (1981) believed that the complicated stratigraphy and the time lapsed since the site’s discovery made it impossible to attribute a definite age to the assemblage and suggested that it could have been laid down during any temperate period between the Hoxnian and the Devensian.

6.2.4 Stratigraphy

Smith (1894) recorded varying stratigraphies in the Stoke Newington area. He observed the Palaeolithic ‘working floor’ in house foundations in Alkham, Kyverdale, Osbaldeston and Fountayne Roads and in graves in the southern part of Abney Park Cemetery (See Figure 6.4). In locations where the Palaeolithic ‘working floor’ was absent, a different series of deposits were recorded. The different stratigraphies observed in Stoke Newington are detailed below and possible correlations proposed.

Palaeolithic ‘working floor’ and associated stratigraphy

In locations where the ‘floor’ was observed, the following stratigraphy was recorded (Figure 6.5):

5. Soil
4. Sandy loam/’contorted drift’
3. Palaeolithic ‘working floor’ (D)
2. Fine sand with molluscs (C)
1. Gravel with (rolled) implements and bones (B)

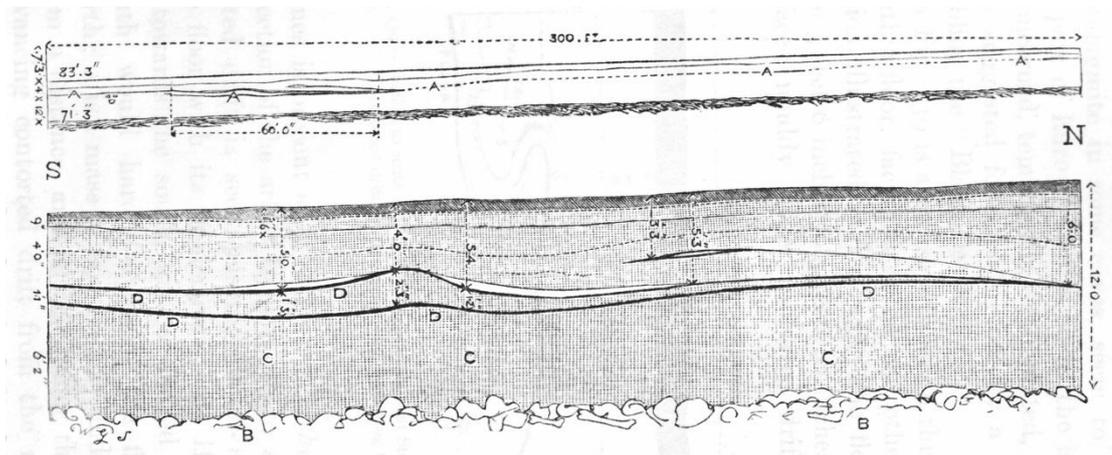


Figure 6.5: Section showing the ‘Palaeolithic floor’ in Stoke Newington. B is the implementiferous gravels at the base; C – fine sand with shells; D – ‘Palaeolithic floor’. From Smith (1894, p206).

1. Lower gravel

The gravel at the base of the sections was found at 12 feet in depth (3.66m) and extended to 20 or 30 feet deep (6.1-9.1m) in some locations. At its deepest, it contained very abraded and ochreous implements, and moderately-abraded, less stained implements in the upper parts. Rolled and abraded fossils, such as bones, teeth and elephant tusks were also found. The gravel contained large sandstone blocks and white quartz and was thought to be a high energy fluvial deposit characteristic of a cold climate (Prestwich, 1855b; Smith, 1882b, 1894).

Gibbard (1994) correlated this deposit with the Leytonstone Gravel, which was deposited by the River Lea. This is equivalent to the Middle Thames Taplow Gravel (Gibbard, 1994, 1999). However in a contrasting scheme, Bridgland (1994) attributed all of the deposits in the area to the Lynch Hill Terrace (MIS 10-9-8) of the Middle Thames, thereby equating these basal gravels with MIS 10.

For simplicity, the lower gravels in the following stratigraphic descriptions will be referred to as the Leytonstone Gravel.

2. *Fine sand with molluscs*

Beneath the Palaeolithic ‘floor’, a fine buff coloured sand containing freshwater and land molluscs was present.

The sands were named the Stoke Newington Sands by Harding and Gibbard (1983). However, Green *et al.* (2004) proposed that the organic silts and sands at Hackney Downs (described below) are a separate and distinct deposit from the sands near Stoke Newington Common. These authors applied the name ‘Highbury Silts and Sands’ to the organic silts and sands in Hackney Downs, reserving the Stoke Newington Sands exclusively for the stratified (non-organic) sands seen in Smith’s Charnwood Street and Reighton Road excavations (see Figure 4.4). The Highbury Silts and Sands were found to occupy a height range largely below that of the Stoke Newington Sands. It was therefore proposed that the Stoke Newington Sands represented the first aggradation in the late Middle Pleistocene (including the occupation of the ‘floor’) and that the Highbury Silts and Sands represent a second, later aggradation. Both were attributed to MIS 9 (Green *et al.*, 2004, 2006). However, Gibbard (1994, 1999) only acknowledged the Highbury Silts and Sands (or Highbury Member), which he attributed to the Last Interglacial. The controversy indicates that there remains considerable complexity associated with the terminology and chronology of the deposits.

In this study, sands overlying the Leytonstone Gravel will be attributed to the Highbury Silts and Sands if they contain molluscs, whereas the (non-organic) stratified sands seen by Smith in Charnwood Street and Reighton Road will be referred to as the Stoke Newington Sands.

3. *The Palaeolithic ‘working floor’*

North of Northwold Road, near Stoke Newington Common, the Palaeolithic ‘working floor’ was observed approximately 4 feet (1.2m) from the surface (approximately 27.2 - 24.1m O.D.). This is the level at which the numerous celebrated fresh, black and lustrous implements were apparently found, with Greenhill estimating that between Smith and himself, around 200-300 implements were collected (Greenhill, 1884). The ‘floor’ was generally between 12.7cm and 15.2cm thick and was recognisable by a sub-angular ochreous or grey gravel. Occasionally the ‘floor’ was thinner and only recognisable by a thin band of ochreous colour (Smith, 1882a, 1894). Amongst the

implements and flint, some 'exotic' lithologies including sandstone, Chalk, Cretaceous fossils, quartzite, white quartz and Hertfordshire conglomerate were found along with broken bones, antler, teeth and wood and rolled river gravel pebbles (Smith, 1882b, 1894). Molluscs were mainly found underlying the 'floor' in sand; however they were also found directly above the implements and sometimes within the 'floor', in direct contact with the implements and bones (Smith, 1882b). Figure 6.5 records the stratigraphy seen in association with the Palaeolithic 'working floor'.

Where the 'floor' was present in Abney Park Cemetery, it was found at a deeper level in the stratigraphy compared to the roads north of Stoke Newington Common, at 12 feet (3.66m) from the surface (Smith, 1894). The 'floor' was also located at the same depth by Warren who collected artefacts from Geldeston Road (see Figure 4.1) between 1893 and 1899. Warren recorded that the 'floor' was higher in the stratigraphy towards Cazenove Road, although his observations post-date the discoveries of Smith. It is possible that building in the Geldeston Road area had not begun when Smith was active in the area, especially as Smith did not record any artefacts from Geldeston Road.

In some areas the Palaeolithic 'floor' was found to consist of two separate layers (Figure 6.5) in direct superposition and separated by sand. Smith (1882b, 1894) suggested that this might represent an event in which a small flood covered the lower section of the 'floor' with sand, after which further tools were made once the flood waters had subsided.

Green *et al.* (2004) suggested that, rather than there being a single 'floor', Palaeolithic occupation occurred at different episodes during the deposition of the Stoke Newington Sands. This would explain the varying heights and positions where the 'floor' has been found. Green *et al.* (2004) also proposed that the period of occupation that produced the fresh artefacts may have occurred at only one level in the aggradation of the Stoke Newington Sands and that the other abraded artefacts are derived from slope processes. Gibbard (1994) also proposed that all the artefacts in the 'floor' were all derived from slope processes, however this does not account for why some artefacts were fresh and could be refitted (Green *et al.*, 2004).

4. Sandy loam and 'contorted drift'

The majority of the tools from the 'floor' were found covered with 1.22-1.52m of sandy loam or 'brickearth' and slightly undulating 'contorted drift' (Smith, 1882a). The 'contorted drift' often consisted of pebbles orientated at diverse angles; it had disturbed the underlying 'floor' and in places disturbed the 'floor' sufficiently so as to actually underlie it (Figure 6.6). Some implements were consequently slightly abraded where the 'floor' had been disturbed by the 'contorted drift' (Smith, 1882b, 1894).

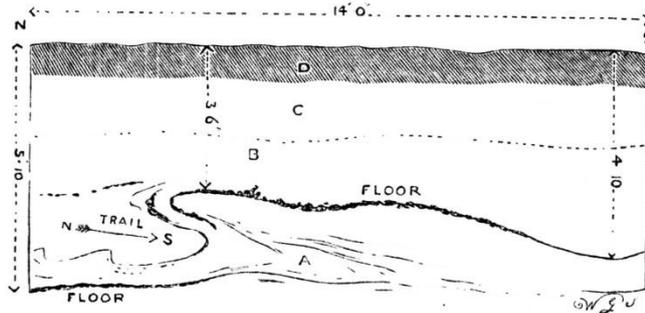


Figure 6.6: Section showing the 'contorted drift' undercutting underlying Palaeolithic 'working floor'. From Smith (1894, p 208)

Smith suggested that the sandy loam and the 'contorted drift' were not deposited by fluvial processes but were more likely to be due to periglacial action (Smith, 1882b, 1894). Later Wymer (1968), attributed the deposit as cryoturbated fluvial sediments. The 'contorted drift' contained very abraded and patinated Palaeolithic implements, which were suggested to be reworked from older deposits. Green *et al.* (2004) suggested the 'contorted drift' represented a colluvial slope deposit. The age of the 'contorted drift' is not firmly established but it is likely to be of Devensian age, since it overlies Devensian Hackney Brook sediments and clearly contains cold-climate structures (Harding and Gibbard, 1983) (see Hackney Brook stratigraphy description below).

5. Soil

Overlying the full Palaeolithic stratigraphy was a soil containing Neolithic or Mesolithic and younger implements (Smith, 1894).

Deposits lacking the Palaeolithic ‘working floor’

In some parts of Stoke Newington, such as in Upper Clapton, Reighton Road and Charnwood Street (Figure 6.4), the Palaeolithic ‘working floor’ was not present and a slightly different stratigraphy was recorded (Figure 6.7) (Smith, 1894). The ‘floor’ was absent in these locations due to the more prominent presence of periglacial ‘contorted drift’, which Smith suggested had removed any evidence of the ‘floor’. The stratigraphy recorded by Smith in an excavation near Charnwood Street and Reighton Road is summarised below:

6. Soil

5. Mud associated with the ‘contorted drift’

4. Sandy loam and ‘contorted drift’

3. Stratified sands or Stoke Newington Sands

2. Sand with molluscs

1. Gravel with some (rolled) implements and bones (attributed to the Leytonstone Gravel)

With the exception of the absent Palaeolithic ‘floor’, the deposits are largely the same, such as the lower implementiferous gravel (attributed to the Leytonstone Gravel), the overlying mollusc-rich sand and the sandy loam and ‘contorted drift’.

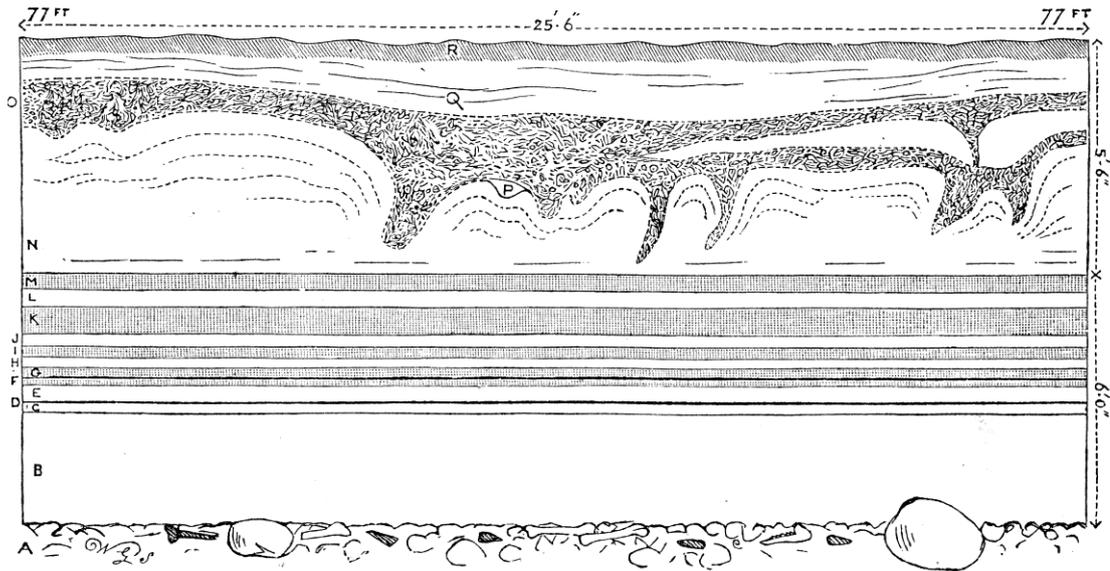


Figure 6.7: Deposits seen at the sites north of Clapton Railway Station and south of Charnwood Street and Reighton Road. No ‘Palaeolithic Floor’ present (Smith 1894). R – humus, Q – mud belonging to the ‘trail’, P- pocket of London Clay, O- ‘trail’ (which Smith called ‘warp and trail’ in his writing, N- Palaeolithic Sand and loam, crumpled and disturbed by trail, M-dark sand and clay, L- light sand and clay, K – dark sand and clay, J- yellow sand, I-red sand, H-light sand and clay, G - dark sand and clay, F- red sand , E – yellow sand, D – red sand, C-sand, almost white, B- buff sand sometimes full of land and fluvial shells, A – gravel containing abraded implements

Leytonstone Gravel (1) and sand with molluscs (2) are the same as the above descriptions.

3. Stratified sands

This deposit comprised of horizontally stratified layers of varying colour and texture (see description in Figure 6.7) (Smith, 1894).

Although Smith’s illustration of the stratified sands did not include the Palaeolithic ‘floor’ (Figure 6.7), the sands were recorded directly underneath the ‘working floor’ near Stoke Newington Common, where the ‘floor’ had not been disturbed or removed by the ‘contorted drift’ (see Figure 6.8) in which horizons F-K are the stratified sands, ‘L’ is the Palaeolithic ‘floor’ and ‘B’ is the ‘contorted drift’). It was suggested the sands

were deposited by the River Thames on account of their southerly dip, and not by the River Lea or the Hackney Brook (Greenhill, 1884; Smith, 1894). These sands were named the Stoke Newington Sands by Harding and Gibbard (1983).

4. *Sandy loam and 'contorted drift'*

The sandy loam and 'contorted drift' in areas lacking the Palaeolithic 'working floor' were more prominent than in areas where the 'floor' was present. The absence of the 'floor' and the presence of the contorted drift were thought to be linked (Smith, 1884a, 1894). The deposition of the sandy loam and 'contorted drift' under periglacial conditions (as discussed above) was further confirmed by probable ice-wedge casts in sections seen in Reighton Road (see Figure 6.8) (Smith, 1894). Many of the artefacts from the area also display frost pitting, indicating that they had been exposed to severely cold conditions in the past.

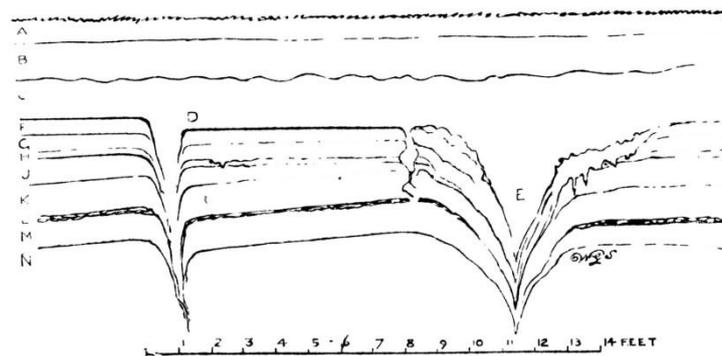


Figure 6.8: Section in Reighton Road with ice wedge cast within the overlaying 'contorted drift'. A- humus, B – 'contorted drift', C- buff coloured sand, D – possible ice wedge, E – clay and sand, F-K – sand and loam horizons, L – Palaeolithic 'floor', M – sand and loam, N – sand. From Smith (1894, p213)

Stratigraphy associated with the Hackney Brook

The palaeo-channel of the Hackney Brook has been mapped from Hampstead in north west London to where it joined the River Lea south east of Hackney (Green *et al.*, 2004) (Figure 6.4). The stratigraphy of the Hackney Brook was recorded from Bayston and Tyssen Roads (Figure 6.4) in Stoke Newington by Smith (Smith, 1894) (Figure 6.9).

The bed of the brook was found to be filled with fine horizontally bedded sand with the 'contorted drift' positioned above (Smith, 1894).

When the deposits of the Hackney Brook were originally discovered, they were thought to be directly associated with the sediments of the Palaeolithic 'floor' (Smith 1879; Evans, 1897). However as more excavations were made in the area, it was revealed that the Hackney Brook deposits were inset into the underlying Palaeolithic 'floor' and that they were therefore younger than the 'floor' (Smith, 1894).

Smith's illustration of the stratigraphy associated with the Hackney Brook (Figure 6.9) is significant in establishing the position of the principal deposits in Stoke Newington and Hackney Downs. At the base of Figure 6.9, stratum 'A' represents gravels that are the same as the lower gravels described by Smith below the Palaeolithic 'floor' (Leytonstone Gravel). This is overlain by sands ('B'), which were also described by Smith in association with the 'floor' (Stoke Newington Sands/Highbury Silts and Sands) and a second deposit of gravel ('C'). These upper gravels were described by Smith as being visible in areas 'a short distance south' of Stoke Newington Common.. The gravels were presumed by Smith to be deposited by the Thames (Smith, 1894 p.205). It is likely that these gravels are the Hackney Downs Gravel described at the Nightingale Estate (Gibbard, 1994; Green *et al.*, 2006).

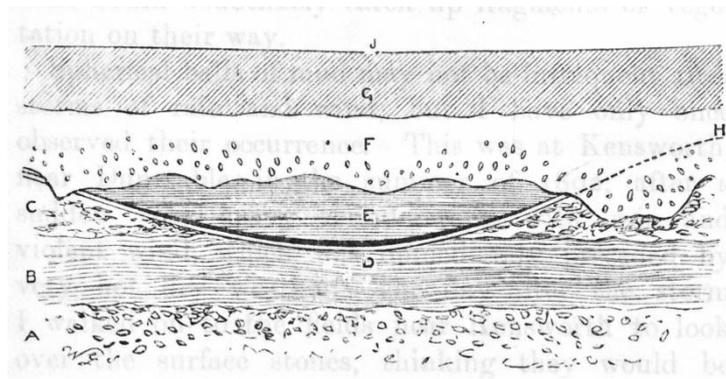


Figure 6.9: Section through the Hackney Brook sediments in 1883, south of Tyssen Road and west of Bayston Road. From Smith (1894, p 200). The bed of the Hackney Brook is indicated by 'H'. 'E' denotes the fine sand of the Hackney Brook sediments and 'F' represents 'contorted drift' which has incised into the Hackney Brook sands. 'G' represents modern soil. A, B and C represent the lower gravels (Leytonstone Gravel), the stratified sands (Stoke Newington Sands) and upper fluvial gravels (Hackney Downs Gravel).

Harding and Gibbard (1983) recorded a similar stratigraphy to Smith from an excavation at 55 Northwold Road (TQ 33988663). London Clay was overlain by gravel and sand and finally a brown/black clayey silt or 'brickearth'. It was proposed that the two deposits overlying the London Clay were deposited by the Hackney Brook, under two different climates.

1. Gravels and Sands

The deposit consisted of 0.2-1.1m of yellow/brown, fine to medium gravel with occasional larger clasts and sand lenses. However, the deposit varied considerably in thickness. The matrix consisted of sand with increasing clay towards the top. The gravels were massive, whereas the sand lenses were stratified and reached 0.60m in thickness. Cross-bedding indicated a palaeocurrent to the east. The gravel and sand represented deposition in a braided river environment where some areas experienced high energy flow that eroded the channels and scour hollows in the bedrock, as well as areas of gentle flow that allowed the sand to be deposited (Harding and Gibbard, 1983). This type of river flow is typical of lowland Britain in cold climates (Castleden, 1980; Bryant, 1982). It was suggested that the east-flowing Hackney Brook could have

deposited the gravel and sand, having previously reworked local gravel that could have partly entered the Brook by solifluction, incorporating Stoke Newington Sands from an area north of the site. The upper surface of the gravel occasionally displayed folding or overturning, although it was generally undisturbed. Some polygon features were noted and were proposed to have been formed after or during the deposition of the overlying clayey silt during the freezing and thawing of the ground under periglacial conditions (Harding and Gibbard, 1983).

2. Clayey silt

This deposit consisted of unbedded clayey silt reaching 0.8-1.5m in thickness. Towards the base of this deposit, the clayey silt was strong brown or yellow/brown in colour, with occasional flint clasts, and lacking archaeology. This lower section of the clayey silt was identified as a solifluction deposit, with remobilised loess, which was thought by Harding and Gibbard (1983) to date towards the end of the cold-climate period during which the underlying braided river sediments were deposited. In the middle of the deposit, the clayey silt became increasingly grey due to the deposition of manganese dioxide and, towards the top of the deposit, the colour changed to yellow brown. The upper part of the clayey silt was increasingly sandy in texture and was interpreted as alluvium, aggraded by low-energy overbank flooding, most likely by the Hackney Brook. The upper section of the clayey silt contained a Mesolithic industry and consequently the underlying gravel and sands and lower clayey silt were attributed to the late Devensian. This age was upheld by the silt mineral composition of the lower clayey silt and underlying gravel, which was comparable with known Devensian signatures. The alluvium was suggested to have been deposited in the early Post glacial/Holocene period due to the soil micromorphology revealing development of a land surface under warm-climate conditions, and the presence of Mesolithic artefacts (Harding and Gibbard, 1983).

One large handaxe was found along with the tip of second handaxe and some waste flakes in the gravel. It has not been possible to locate the complete handaxe within the assemblage during the present study. Due to the inferred age of the sediments and rolled nature of the artefacts found within it, it was suggested that many of the Lower Palaeolithic implements must be derived from older deposits (Harding and Gibbard, 1983).

Similar deposits were found in an excavation at 15-21 Northwold Road (TQ 3380 8666) by Green *et al.* (2004). Mesolithic or Early Neolithic artefacts were again found in the alluvium, confirming its post-glacial age. Boreholes confirmed the sediments recorded by Smith in the Kyverdale and Alkham Roads vicinity (Green *et al.*, 2004).

The stratigraphies described by Smith (1894) and Harding and Gibbard (1983) differ slightly in that Smith's Hackney Brook bed is filled at the base by fine, horizontally-bedded sands, clearly deposited under gentle temperate-climate conditions. These are absent in the description by Harding and Gibbard (1983), which noted only high-energy braided river gravels and sands. This suggests that the Hackney Brook eroded a new course as the climate cooled and increased its flow, thereby abandoning the fine-grained bed and depositing coarse gravels in the new course. Harding and Gibbard (1983) recorded a solifluction deposit, which must be the equivalent of Smith's 'contorted drift'. It is likely that the 'contorted drift' or colluvial slope deposit would have accumulated at the same time as the braided river gravels of the Hackney Brook, since it was found overlying the temperate bedded sands of the Hackney Brook by Smith (1894). The stratigraphies recorded by Smith (1894) and Harding and Gibbard (1983) thus suggest the Hackney Brook was depositing sediments at least throughout the Devensian (represented by Smith's bedded sands and the cold climate gravels recorded by Harding and Gibbard), although it cannot be established whether the temperate-climate sands relate to an earlier interglacial or to one of the numerous Devensian interstadials, and during the early Holocene (represented by the Mesolithic artefacts in the alluvium). The alluvium recorded by Harding and Gibbard (1983) must equate to the 'soil' recorded by Smith (1894). The Hackney Brook now exists as a subterranean river.

The British Geological Survey (2006) has attributed the fine-grained deposits in Stoke Newington to the 'Langley Silt Complex' (see Figure 6.4). The Langley Silt Complex is attributed to the Last Glaciation and in particular to the Late Devensian/Last Glacial Maximum on account of TL dates of $17.8 \pm 1.5 - 14.3 \pm 1.2$ ka (Gibbard, 1985; Gibbard *et al.*, 1987). The solifluction deposit recorded by Harding and Gibbard (1983) contained remobilised loess, suggesting possible accumulation during the Younger Dryas, following deposition of the loess at the Last Glacial Maximum (MIS 2, Dimlington Stadial) (Rose *et al.*, 2000).

Stratigraphy at Hackney Downs

The following description of the stratigraphy recorded at Nightingale Estate is based on the publication by Green *et al.* (2006) unless otherwise referenced. The stratigraphy observed was summarised as (see Figure 6.13):

4. Made ground
3. Hackney Downs Gravel
2. Highbury Silts and Sands
1. Leytonstone Gravel

Prestwich (1855b) recorded the same stratigraphy as above just east of Hackney Downs in a gravel pit in Shacklewell Lane with sand and gravel at the base (Leytonstone Gravel), 0.76m of dark grey sandy clay with organic matter including bones and shells (Highbury Silts and Sands), overlain by ochreous flint gravel and sand (Hackney Downs Gravel). Finally, Prestwich recorded ‘brickearth’ at the top of the section, which presumably was later removed for building material. The sediments are as follows:-

1. Leytonstone Gravel

Only 0.16 m of the lower gravel was observed. It contained large bivalve shells and therefore was thought to relate to the overlying organic deposits as there appeared to be no significant unconformity. The top of the gravel was recorded at 13m O.D.

In boreholes recorded by Gibbard (1994), the gravel was shown to have eroded contours on the bedrock suggesting that it was deposited by the southward-flowing River Lea. However, clast lithological analysis of all the deposits at Hackney Downs was inconclusive in suggesting a River Thames or River Lea deposition (Green *et al.*, 2006).

2. Highbury Silts and Sands

The Highbury Silts and Sands were found to become increasingly fine towards the top of the deposit. They also record many changes in sedimentation, with over fifty beds being observed in laboratory examinations, alternating between sand-rich and silt-rich horizons. Within the beds, evidence of plant debris and freshwater molluscs was present. In some layers the shells were well preserved and in others they were broken into sand-sized particles.

The Highbury Silts and Sands were sub-divided into four sub-units:

- 1) **12.84 - 4.09m OD.** The lowest sub-unit contained gravel and coarse sand with some thin silty clay layers. The upper boundary of this bed was sharp, characterised by clasts of gravel and reworked sediment; the overlying sub-unit mainly consisted of medium sand and some thin silty clay horizons in the upper part.
- 2) **14.09 - 15.49m OD.** The second sub-unit generally consisted of horizontally-bedded, medium, stoneless sand. The upper boundary of sub-unit 2 was sharp and irregular and was draped in a thin silty clay layer.
- 3) **15.49 - 16.20m OD.** The next sub-unit comprised of medium sand with silty clay and occasional gravel increasing towards the top. The beds dipped from west to east.
- 4) **16.20 - 16.93m OD.** The fourth sub-unit was stoneless and silty with increasing clay towards the top.

The contact between the Highbury Silts and Sands and the Hackney Downs Gravel was sharp and horizontal.

Gibbard (1994) recorded the Highbury Silts and Sands in a series of boreholes from Stoke Newington in the north and Hackney Downs towards the south. The deposit appeared to be complex, including a number of stratified green, grey or brown silts bands. Each band was no more than a few centimetres in thickness. Occasionally thicker bands were found up to 20cm or thin bands of small pebbles were recorded. No fossils were recovered.

3. Hackney Downs Gravel

The Hackney Downs Gravel was interpreted as characteristic of a braided river deposit with alternating horizontal beds of sand and fine and medium gravel. Clast lithological analysis of the Hackney Downs Gravel was comparable with that of the Corbets Tey gravels (Bridgland, 1994) of the Lower Thames. However, since the Lower Thames gravels were also found to be lithologically similar to the Hackney Brook gravel (Bridgland in Harding and Gibbard, 1983), the river which deposited the Hackney Downs Gravels cannot be confidently identified.

In contrast, Gibbard (1994) suggested that the southerly dip of the Highbury Silts and Sands and Hackney Downs Gravel indicated deposition by the River Lea rather than the Thames and a change in position of the River Lea allowed the accumulation of the ‘contorted drift’ or solifluction deposit (called ‘brickearth’ by Gibbard (1994)) and the development of the Hackney Brook tributary.

6.2.5 Palaeontology and Palaeobotany

The flora and fauna recorded from the deposits in Stoke Newington and Hackney Downs are detailed below.

Stoke Newington, no specific deposit

Several indeterminate bone fragments from Stoke Newington are in the W. G. Smith collection held at Wardown Park Museum, Luton. An atlas vertebra of *Coelodonta antiquitatis* (woolly rhino) is held in the Natural History Museum, unfortunately unprovenanced. It is moderately abraded with slight brown iron staining, suggesting it is from a gravel deposit in the area. The Hackney Downs Gravel was described as this colour and Smith (1894) specifically stated that the ‘floor’ gravel and the Leytonstone Gravel were not ochreous unless derived. Therefore it is most likely that the woolly rhinoceros fossil was found in the Hackney Downs Gravel, which was attributed to MIS 8 (Green *et al.*, 2006).

The Smith collection in Wardown Park Museum, Luton contains nine unprovenanced mammalian fossils from Abney Park Cemetery along with some indeterminate bone fragments. The fossils were identified are listed in Table 6.1.

Species	
Carnivora	
<i>Canis</i> sp. undetermined wolf	Rm1 and p3(fragments)
Perissodactyla	
<i>Equus ferus</i> Boddaert, horse	RM1-M3 and cranium fragment and RM1 or M2
Rhinocerotidae sp. undetermined rhinoceros	Left humerus (fragment)
Artiodactyla	
<i>Cervus</i> sp. undetermined deer	Ri1, Lm3 (juvenile), right metacarpal (fragment)
Bovidae sp. undetermined large bovid	Rm3 and right calcaneum

Table 6.1: List of mammal fossils from Stoke Newington

All fossils from Abney Park Cemetery were abraded and stained orange to some degree indicating they were probably from the gravel deposits in the Stoke Newington area, rather than the ‘floor’. The small size of the assemblage, the lack of stratigraphic provenance and the fact that most of the fossils can only be attributed to genus level mean that the assemblage is not characteristic of a specific climatic period. Horse, the only fossil identifiable to species level, is an indicator of open, grassland environments (Kurtén, 1968). However, the co-occurrence of horse and humans (*Homo* sp., from the presence of artefacts) suggests that this assemblage is not of Late Interglacial age, a time when both species were apparently absent (Currant, 1989; Sutcliffe, 1995; Currant and Jacobi, 2001). This would argue against the Ipswichian age for the Highbury Silts and Sands proposed by Gibbard (1994).

Smith (1883b) described a Geologists’ Association excursion in Upper Clapton in which the group visited a brick pit rich in mammalian fossils from a level 44 feet (13.4m) above the River Lea. These finds were studied by a Mr Cooke and ‘many examples’ were then housed in the Natural History Museum. However, no fossils directly attributed the Upper Clapton area can today be identified in the Natural History Museum Collections, although seven fossils from Upper Clapton are held in Wardown Park Museum along with 14 fragments of indeterminate bone. Unfortunately all specimens were stratigraphically unprovenanced. The specimens identified are shown in Table 6.2.

Species	
Carnivora	
<i>Panthera leo</i> (L.), lion	right ulna (fragment)
Perissodactyla	
Cf. <i>Equus ferus</i> Boddaert, horse	Mandible fragment
Rhinocerotidae sp. undetermined rhinoceros	left radius (fragment), right femur (fragment), 3rd right metatarsal (fragment), left ulna fragment x2

Table 6.2: List of mammals from Upper Clapton

The Rhinocerotidae fragments were previously identified as *Coelodonta antiquitatis* (from label on specimens); however, on account of their fragmentary nature they were not attributed to species level in this study.

Leytonstone Gravel

Smith (1884b, 1894) often observed mammal fossils in the Leytonstone Gravel, specifically mentioning mammoth tusks alongside wood fragments. No further identifications were made due to the often fragmentary nature of the fossils. No surviving fossils have been identified in extant collections from this bed.

Palaeolithic 'floor'

Smith (1894) found 4ft long birch stakes with what he described as artificially pointed ends at the end of Baystock Road (probably now Bayston Road) in association with a stone tool (artefact no. 1312) (Smith, 1894) (Figure 6.10).

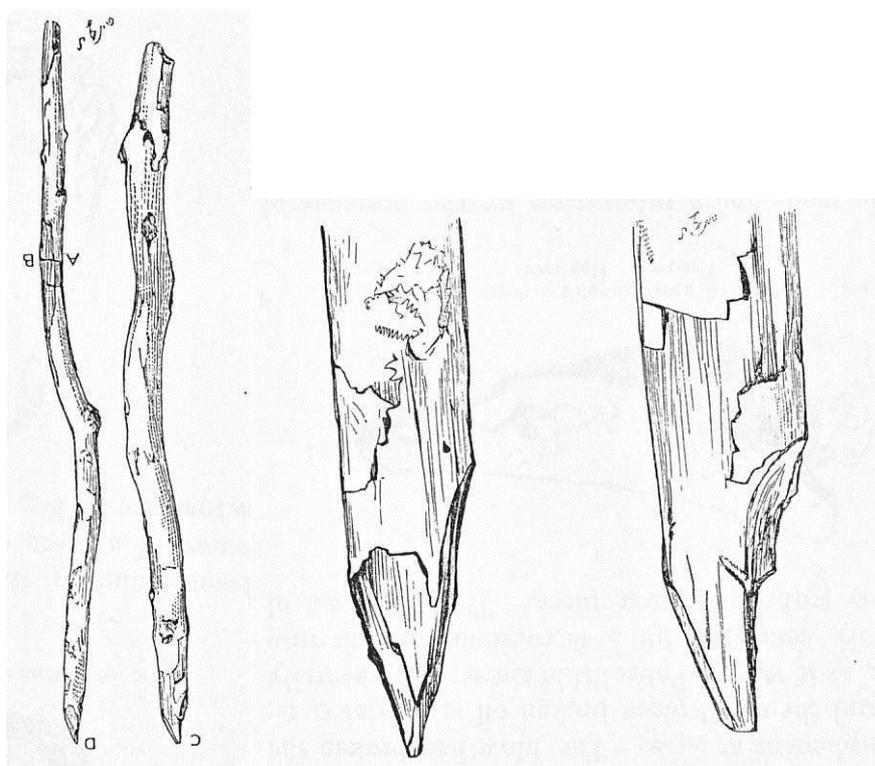


Figure 6.10: Illustrations of the modified birch stakes found by Smith. From Smith (1894 p268 and 269).

Wymer (1968) was unable to locate the stone artefact; however in the present study, it has been possible to identify the item concerned as a fresh, modified flake in the Christy Collection held at the British Museum. Unfortunately, the birch stakes have not been

identified in extant collections. Despite this, the stakes may represent a form of hominin tool made from organic materials that is extremely rarely recorded in the Palaeolithic archaeological record. The possible function of the stakes can only be guessed at but given their length and pointed tip, a possible role as a spear or jabbing stick is plausible. A comparable record is that of a yew spear tip found in the assemblage from Clacton-on-Sea in Essex (Warren, 1911), which has been correlated with the Hoxnian interglacial (MIS 11) (Bridgland *et al.*, 1999). Further evidence for spear usage by hominins in Britain is from an inferred spear wound in a horse scapula at the early Middle Pleistocene site of Boxgrove in West Sussex. Other bones from the assemblage exhibited cut marks from tools used during butchery (Roberts, 1996). More recently, several wooden spears approximately 2m long, together with a shorter jabbing stick, have been discovered from Schöningen, Germany, dated to between 400,000 and 350,000 years ago (Thieme, 1997). The spear evidence from Clacton, Boxgrove and Schöningen clearly indicates that hominins were using wooden spears to hunt in northern Europe from nearly half a million years ago. The wooden artefacts from Stoke Newington may have been part of this behavioural repertoire, although other uses (for example as stakes for shelter) cannot be ruled out. If the latter were the case, this would represent the earliest established use of organic building materials for the NW European Lower Palaeolithic. Another plausible explanation for the modification of the birch stakes could be beaver gnawing (Wymer, 1999), particularly as beaver is a known component of MIS 9 faunal assemblages at sites such as Cudmore Grove (Roe *et al.*, 2009).

Smith collected smaller yew wood fragments from Stoke Newington, which are now part of his collection held at Wardown Museum. It is possible that these are from the 'floor', since Smith described wood as often being discovered from there. The fossils exhibit a low degree of abrasion, which would also suggest they originate from a deposit similar to the 'floor' from which fresh or slightly abraded artefacts were found.

During a Geologists' Association excursion in 1883, in which the party visited Smith's home in Highbury, he displayed a mammoth scapula (*Mammuthus primigenius*) in contact with an unabraded implement (Smith, 1883b). A photograph of this can be seen in Smith's notebooks (now in Wardown Park Museum, Luton) (Figure 6.11). Unfortunately, neither the scapula nor the implement can be found in collections today.



Figure 6.11: Photograph of Mammoth scapula in contact with unabraded implement found in Stoke Newington (no specific location) in the ‘Palaeolithic Floor’. From W. G. Smith’s notebooks in Wardown Park Museum, Luton. Photo courtesy of Luton Museum Service.

The presence of mammoth during the deposition of the ‘floor’ suggests that the landscape was dominated by open grassland although there must have been some non-deciduous forests nearby as suggested by the yew wood. Mammoth is not known from MIS 9 sites, and unfortunately the mammal fauna of MIS 10 is poor, however there is a record of *Mammuthus primigenius fraasi* (a sub-species of woolly mammoth) from Steinheim-an-der-Murr, Germany in Neckar fluvial deposits. This record marks the first appearance of woolly mammoth and has been dated to MIS 10 (Schreve and Bridgland, 2002). Therefore it is not impossible for woolly mammoth to have entered Britain around this time.

Highbury Silts and Sands

Molluscs

Molluscs from the sands above the basal gravel in the excavation south of Charnwood Street (Figure 6.4) were analysed by Jeffreys (in Smith, 1882b). The taxonomy has been

updated here according to most recent systematic determinations and the species found comprised:

Corbicula fluminalis

Hydrobia marginata (or *Belgrandia marginata*)

Sphaerium corneum

Pisidium fontinale var. *henslowana* (or *P. henslowanum*)

Pisidium amnicum

Unio tumidus

Bithynia tentaculata

Valvata piscinalis

Planorbis albus (now *Gyraulus albus*)

Planorbis complanatus (or *Hippeutis complanatus*)

Lymnaea auricularia

Lymnaea truncatula (now *Galba truncatula*)

Lymnaea peregra (now *Radix balthica*)

Ancylus fluviatilis

Helix concinna (now *Trochulus hispidus*)

Helix nemoralis (or *Cepaea nemoralis*)

Jeffreys suggested that the molluscs, particularly *Pisidium fontinale* var. *henslowana* reflected deposition by a flood or a large river such as the Thames (Smith, 1882b). The species observed by Smith and Jeffreys were all recorded within the Highbury Silts and Sands at Nightingale Estate, Hackney Downs (Green *et al.*, 2006) with the exception of *Lymnaea auricularia*, *Helix concinna* and *Cepaea nemoralis*, suggesting that the sands observed south of Charnwood Street and the Highbury Silts and Sands were deposited under similar conditions. The assemblage is indicative of a large body of well oxygenated slow-flowing water, with some faster flowing areas (Kerney, 1999).

Wardown Park Museum, Luton, holds freshwater molluscs from Lower Clapton from Smith's collection. The species identified by J. Cooper and P. Jeffrey from the Natural History Museum in 1996 were *Bythinia tentaculata*, *Corbicula fluminalis* and *Valvata piscinalis*. Unfortunately the provenance of these molluscs was not recorded, although it is likely that they were found in the Highbury Silts and Sands following other records of

molluscs from this deposit (Smith, 1882b, 1894; Green *et al.*, 2006). Although only three species were identified, they suggest the water body was large, slowly flowing and well oxygenated.

Molluscs were also recorded in Shacklewell, west of Hackney Downs, from a dark-grey sandy clay deposit which contained abundant organic remains (Prestwich, 1855b). This sandy clay resembles the Highbury Silts and Sands and was associated with an overlying and underlying gravel deposit, reminiscent of the stratigraphy seen at the Nightingale Estate. The species recorded were:

Freshwater

Bithynia tentaculata (now *Bithynia tentaculata*)

Valvata piscinalis

Limnaeus palustris (now *Stagnicola palustris* agg.)

Limnaeus truncatula (now *Galba truncatula*)

Limnaeus glaber (now *Lymnaea glabra*)

Limnaeus stagnalis (now *Lymnaea stagnalis*)

Planorbis marginatus (now *Planorbis planorbis*)

Planorbis spirorbis (now *Anisus leucostoma*)

Planorbis nautilus (now *Gyraulus crista*)

Pisidium pulchellum

Pisidium obtusale

Pisidium pusillum (could relate to several different species (R. Preece, pers. comm.))

Terrestrial

Carychium minimum

Succinea putris

Zua lubrica (now *Cochlicopa lubrica*)

Helix pulchella (now *Vallonia pulchella*?)

Helix aculeate (now *Acanthinula aculeata*?)

Zonitea crystallinus (now *Vitrea crystallina*?)

Zonites radiatulus (now *Nesovitrea hammonis*?)

Zonites nitidus (now *Zonitoides nitidus*)

Clausilia sp.

Helix hispida (now *Trochulus hispidus*)

The freshwater assemblage is typical of large, slow-flowing water bodies and the land species suggest well-vegetated wet environments (Kerney, 1999).

An excavation at Highbury New Park, a mile to the west of Hackney Downs, in 1868 also revealed fluvial deposits containing land and freshwater molluscs. The pits lay at 31.09m O.D. with clay containing molluscs and wood 6.71m below the surface. At 24.38m O.D, molluscs were also found in a reddish loam or brickearth immediately above the clay (Tylor, 1868; Evans, 1897). Due to the close proximity to Hackney Downs, these fluvial deposits are almost certainly the Highbury Silts and Sands. Terrestrial species found included *Helix rufescens* var. *depressa* (now *Trichia striolata*), *Zua lubrica* (now *Cochlicopa lubrica*), *Clausilia biplicata*, *Succinea putris*, and *Carychium minimum*; and freshwater species, *Lymnaea palustris* (now *Stagnicola palustris* agg.), *Planorbis marginata* (now *Planorbis planorbis*), *Planorbis spirorbis* (now *Anisus leucostoma*), *Valvata cristata*, *Valvata piscinalis*, *Pisidium obtusale*, *Pisidium pusillum*, and *Cyclas cornea* (now *Sphaerium corneum*). Later *Achatina*, *Bythinia*, *Pupa* and *Velletia* were added to this list (Wood Mason, 1869). The molluscan evidence combined with the sedimentology from Highbury was suggested to represent a shallow pool or a slow flowing stream with some marshy areas on the banks (Tylor, 1868).

The Highbury Silts and Sands from Nightingale Estate, Hackney Downs

The following information relates exclusively to the palaeontology and palaeoecology from the Highbury Silts and Sands at the Nightingale Estate, Hackney Downs, and is from Green *et al.* (2006) unless otherwise referenced.

Pollen

The NE2 borehole taken from Nightingale Estate reached London Clay at 6.10m in depth. The pollen extracted from the grey silty clay was represented one pollen assemblage biozone, which reflected diverse temperate woodlands dominated by *Quercus* (oak), and *Pinus* (pine), and increased *Alnus* (alder) towards the top of the sequence (Figure 6.12). Other species such as *Betula* (birch), *Acer* (maple), *Tilia* (lime) and *Ulmus* (elm) were also present in smaller numbers with *Carpinus* (hornbeam) and

Fraxinus (ash) arriving in the upper part of the sequence. *Corylus* (hazel) and *Salix* (willow) were present throughout. The increase of *Alnus* pollen towards the top in addition to a reduction of tall herbs and *Pinus* suggests that the floodplain became wetter (Gibbard, 1994).

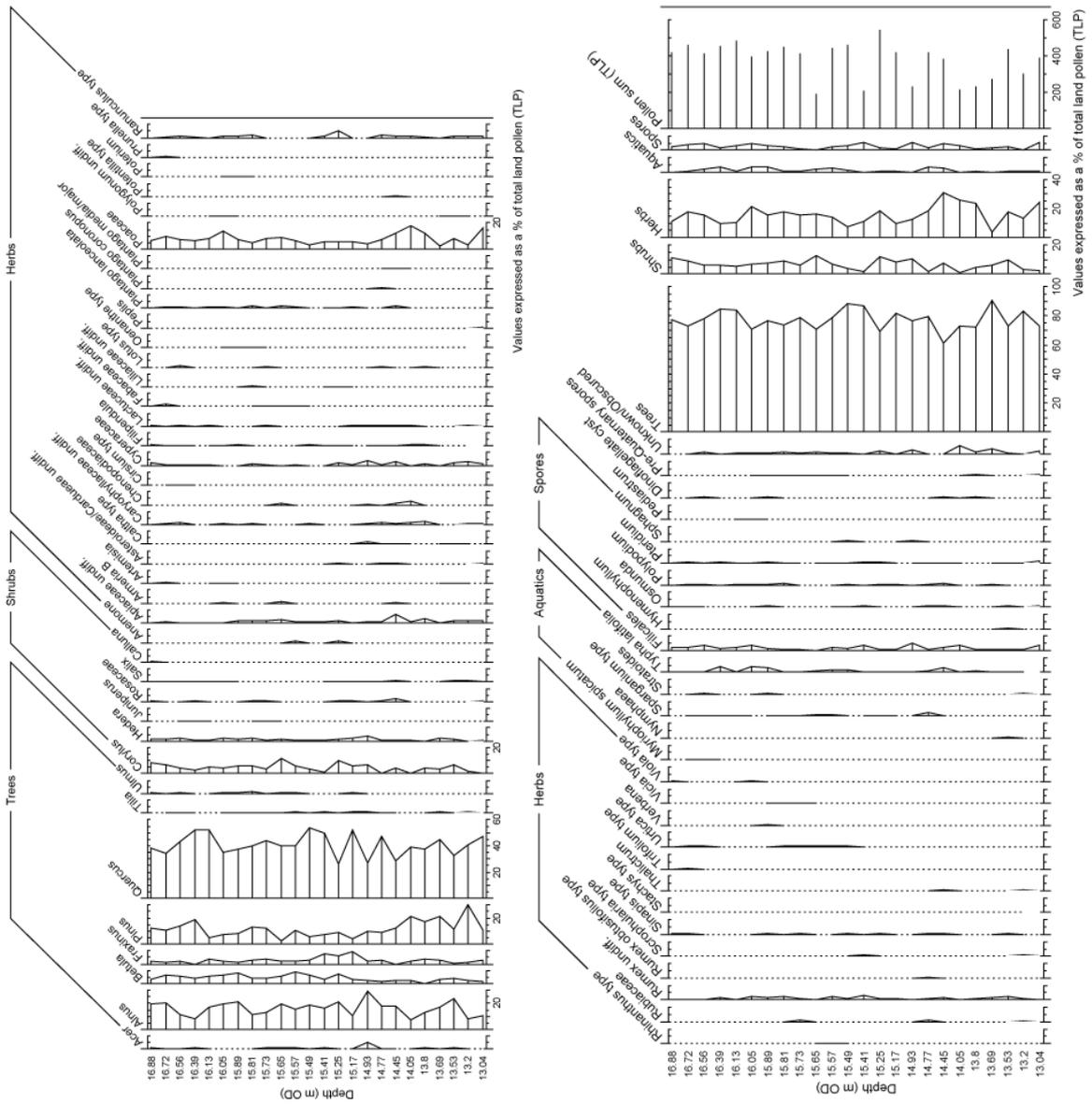


Figure 6.12: Pollen diagram from Nightingale Estate, Hackney. From Green *et al.* (2006).

The presence of thermophilous species such as *Quercus*, *Tilia* and *Ulmus* indicated deposition within an interglacial. The presence of taxa preferring a damp environment such as *Alnus*, *Fraxinus*, *Salix* and *Corylus* suggested that these taxa contributed to a shrub layer probably growing near or on the floodplain of a river. *Hedera helix* (common ivy) also indicated a damp woodland environment along with the field layer containing *Ranunculus* (buttercup), *Filipendula* (meadowsweet), *Cirsium* (thistles), *Urtica* (nettles), *Stachys sylvatica* (hedge woundwort), *Vicia* (vetches), *Ajuga reptans* (bugle), *Galium* (bedstraw), *Scrophularia* (figwort), Cyperaceae (sedges) and *Dryopteris filix-mas* (fern). Drier areas of the site were indicated by *Acer campestre* (field maple), *Ulmus*, *Tilia* and *Betula*. *Pteridium* (bracken) suggests some areas of the woodland were less shady and Caryophyllaceae (carnation family), Apiaceae (hollow stemmed plant family such as parsley, carrot, celery), *Plantago lanceolata* (plantain) and *Chenopodium* (goosefoots) also indicated areas of tall herbs and grasses were present.

A freshwater reedswamp near slow-flowing open water was indicated by *Typha latifolia* (bulrush), *Sparganium* (Bur-reed), *Myriophyllum spicatum* (water milfoil), Poaceae (grasses), Cyperaceae and *Pediastrum* (algae). The presence of common ivy suggested average winter temperatures were above -1.5°C (Iversen, 1944).

Plant macrofossils

Six taxa were identified as being exotic to Britain in the present day: *Azolla filiculoides* (water fern), *Pyracantha clactonensis* (firethorn), *Elatine triandra* (threestamen waterwort), *Najas minor* (brittle waternymph), *Salvinia natans* (floating fern) and *Trapa natans* (water chestnut). The last four have continental distributions (Meusel and Jäger, 1965, 1978; Jalas and Suominen, 1972; Hultén and Fries, 1986) indicating that the climate was warmer than the present day during the deposition of the Hackney Downs sequence. The assemblage contained species tolerant of both drier and wetter environments. *Alnus glutinosa* (European alder) and the herb *Moehringia trinervia* (three-nerved sandwort) represented wetter conditions near the river whereas *A. campestre* reflects drier calcareous soils further away from the river. At the onset of deposition, *Cyperus fuscus* (brown flatsedge) and *E. triandra* were dominant, again indicating the presence of wet and muddy environments such as the margins of a river or beside ponds and lakes. Rose (1989) noted that *C. fuscus* usually only survives in

areas where grazing animals maintain short vegetation. Green *et al.* (2006) considered that the extinct *P. clactonensis* was comparable to the extant *Pyracantha coccinea*, which favours the margins of woodland or scrub land. Grassland and open ground species were present throughout the sequence and most are tolerant of relatively dry, disturbed and bare soil conditions. It was suggested that the disturbed land indicators could represent areas of bank collapse or trampling by large mammals.

In the latter part of the sequence the assemblage revealed environments with deeper water in comparison to the beginning of the sequence. The presence of taller species increased, such as *Epilobium cf. hirsutum* (great willowherb), *Eupatorium cannabinum* (hemp agrimony), *Filipendula ulmaria* (meadowsweet) and *Typha* (bulrush), together with herbs such as *Lycopus europaeus* (gypsywort), *Mentha cf. aquatica* (water mint) and *Myosoton aquaticum* (water chickweed), which indicated the establishment of a reed swamp. This, along with the large increase in *Urtica dioica* (nettle) achenes towards the top of the sequence, indicated a decline in ground disturbance in order for plants to establish themselves and not be removed by trampling animals or flood events. Obligate aquatics were present throughout the sequence indicating that water up to 2m in depth was present. Floating aquatics such as *A. filiculoides*, *S. natans* and *T. natans* suggested the water was slow-flowing or still. The presence of damp grassland nearby the site is indicated by the persistent presence of *Ranunculus sceleratus* (celery-leaved buttercup) and *Veronica cf. beccabunga* (brooklime).

Vertebrates

Very few vertebrate bones were recorded in the sequence. As molluscan fossils were abundant, the lack of vertebrate bones is not due to decalcification and the presence of dung beetles suggests that large mammals were nearby. Terrestrial fauna generally becomes incorporated within fluvial sediments by overbank flooding, subsequently becoming trapped against obstructions in shallow or slack water. However, this was clearly not the case at the Nightingale Estate, perhaps due to the sampling point being too far in the centre of the channel (Green *et al.*, 2006).

Three-spined stickleback (*Gasterosteus aculeatus*) and *cf.* perch (*Perca fluviatilis*) were recorded. Perch favours ponds and lakes or slow to moderately flowing rivers with water temperatures higher than 7-8°C in order to breed (Muus and Dahlstrom, 1971). The three-spined stickleback is common in most water bodies but is less likely to be

found in stagnant and densely weedy areas. The presence of fragile fish fossils indicated little post-depositional disturbance.

Fossils of palmate newt (*Triturus helveticus*) and slow worm (*Anguis fragilis*) were found in addition to indeterminate frog and toad remains. At the present day, slow worms are found all over Europe and palmate newt extends to northern Scotland and western Czech Republic (Gleed-Owen, 1999), indicating that a temperate climate existed in Hackney Downs.

Coleoptera

254 beetle taxa were recovered, with 181 identified to species level. Twenty one species are exotic to Britain at the present time. The coleopteran species remained fairly constant throughout the sequence indicating either little change in the local environment during the time of deposition or that deposition occurred over a short period of time.

A large proportion of the assemblage consisted of dryopid species such as *Oulimnius troglodytes*, *Normandia nitens*, *Limnius volckmari* and *Oulimnius tuberculatus*, which prefer shallow running water amongst the stones and mosses. There was evidence for standing water with hydrophilid species such as *Hydrochus elongatus*, *Helophorus* sp. and *Coleostoma orbiculare*. The adults of such species are known to feed on decaying plant debris in stagnant water (Hansen, 1987). Beetles and weevils such as *Macrolea appendiculata* and *Bagous* sp. are known to feed on sub-aquatic plants and prefer still or slowly flowing water, indicating the presence of well vegetated pools, ponds or backwaters. Obligate still-water species were relatively rare in comparison to species preferring flowing water within the assemblage. Certain genera such as *Longitarsus*, *Haltica* and *Chaetocnema* feed on weeds in open habitats thereby indicating the presence of nearby grasslands. Many species (eg. *Nebria brevicollis*, *Notiophilus palustris*) and those from the *Bembidion* genus are common in woodland habitats as well as meadows and, along with the presence of coleopteran species directly dependant on deciduous trees such as the weevil *Rhynchaenus quercus*, it is clear that woodlands were present near the site. Species preferring dry habitats were rarer in the assemblage but were represented by species like *Trechus quadristriatus* and *Ryssemus germanus*. The assemblage contained large numbers of dung beetles, providing evidence for large herbivorous mammalian species in the area despite no direct evidence being recorded.

Most of the coleopteran species found in Hackney Downs are now found in central Europe. Only a small proportion of the species now live in Britain and the assemblage contained no exclusively northern species. It was therefore suggested that the climate at Hackney Downs during deposition of the Highbury Silts and Sands was warmer than southern Britain in the present day.

Mutual Climatic Range (MCR) analysis of the assemblage indicates that mean warmest month temperatures were approximately 18 or 19°C and the mean coldest month temperatures were between -4 and +1°C. This suggests that summers were warmer than the present day although the winters were similar.

Mollusca

Overall, the molluscan assemblage from Nightingale Estate, Hackney Downs, indicated a change in the environment from the base of the sequence, where fluvial species dominated, and the top where terrestrial species became more significant. This implied that the site became dominated by marshland near the top, which could have occurred through the river becoming shallower or by a floodplain pond infilling.

In the lower section of the sequence, there were large numbers of species with preferences for flowing water such as *Ancylus fluviatilis* and *Pisidium henslowanum*. *Valvata piscinalis* was abundant and this species, in addition to the unionid bivalves present, suggested that the water must have been deeper than 2m. There were similar numbers of *Bithynia tentaculata* opercula and shells found in the sequence indicating that there was little disturbance or winnowing after deposition and that water velocity was therefore not high. The sequence contained many Planorbidae, and in particular *Gyraulus crista*, which indicated the presence of aquatic vegetation at the site.

The upper part of the section was dominated by land and marshy grassland species although the continued presence of species such as *A. fluviatilis* and *P. henslowanum* indicated that water flow at the site was still occurring. The assemblage contained high numbers of Succineidae, *Carychium minimum* and *Vallonia pulchella*, which suggested the importance of marshy grasslands. However, species such as *Pupilla muscorum* and *Truncatellina cylindrica* indicated that drier grasslands were present near the floodplain along with shaded scrub and woodland highlighted by smaller numbers of *Discus rotundatus*, *Discus ruderatus* and Clausiliidae (Green *et al.*, 2006).

Molluscs were also analysed by Green *et al.* (2006) from borehole (NE2) described by Gibbard (1994) (see Figure 6.4). The assemblage from the NE2 borehole contained fewer fluvial taxa than found in the 1999/2000 investigations by Green *et al.* (2006), suggesting that these molluscs inhabited pools on the floodplain that were not affected by flooding from the main river. The borehole assemblage also contained at least two thermophiles, *Segmentina nitida* and *Anisus vorticulus*, again indicating a temperate climate.

The molluscan assemblage reflects interglacial climatic conditions with many species now occupying a range south of Britain. *Belgrandia marginata* now lives in Catalonia and south-east France and *Unio crassus* occurs in the Upper Rhine and the Danube basin (Turner *et al.*, 1998). *Corbicula fluminalis* today ranges from Egypt to China and *D. ruderatus* inhabits the forests of Sweden, Switzerland and the Balkans (Kerney, 1977; Keen, 2001). *T. cylindrica* and *Vertigo angustior* are found in Britain today but their main distribution is in southern Europe (Kerney and Cameron, 1979). The persistence of southern species within the sequence suggested that the climate must have been warmer than the present day, thereby echoing the coleopteran evidence.

Ostracoda

Preservation of the ostracod fossils at the Nightingale Estate was good with 15 species recorded. Where the sediments indicated a slower rate of river flow, the numbers of ostracod remains were higher and vice-versa. Slight salinity of the river was indicated by *Cyprideis torosa*, which tolerates the moderate salinity levels found in the heads of estuaries (Henderson, 1990; Schreve *et al.*, 2002). Both male and female *Limnocythere inopinata* were found throughout most levels of the sequence, thought to indicate higher temperatures than at present. In north-west Europe today the species is parthenogenic and both male and females are only found in the Balkans, Anatolia and the Caucasus, whereas in past interglacials males and females reached as far north as Britain (Griffiths and Holmes, 2000; Schreve *et al.*, 2002). The sexual dimorphism can be caused by the higher temperatures during interglacials or by higher solute content in the water (Löffler, 1990; Schreve *et al.*, 2002). The Mutual Ostracod Temperature Range (MOTR) calculated from the assemblage was comparable with the MCR from the coleopteran assemblage, with +15 to +19°C calculated for the summer temperature range and -4 to +3°C calculated for the winter average temperatures (Horne, 2007).

However, in contrast to Green *et al.* (2006), Horne suggests that the MOTR indicated the climate at Hackney during the deposition of the interglacial sediments, the climate was similar to the present day. This was based on comparison to the WorldClim dataset used to compare fossil data against modern temperature ranges, which gives slightly higher values for Hackney today than those used by Green *et al.* (2006) as 18°C in the summer and about 4°C in the winter. Therefore, Horne (2007) proposed that the temperatures indicated by the ostracod and coleopteran assemblages suggest that summer temperatures were similar to the present day, but with slightly colder winters. This contrasts with the coleopteran research that suggested warmer summers (Green *et al.*, 2006). Combined, the two temperature range estimates may indicate a continental climate at the time the sediments were deposited. The site could have experienced more continental climates than today due to the presence of the connection to continental Europe or ‘land-bridge’, which would have dramatically increased the area of land surrounding Hackney Downs and the present day south-east England.

Summary of the stratigraphy seen in Stoke Newington with palaeoenvironmental inferences

Figure 6.13 summarises the stratigraphies recorded by Smith (1894) near Stoke Newington Common and Charnwood Street and that from the Nightingale Estate, Hackney Downs (Green *et al.*, 2006). Included in Figure 6.13 is an amalgamation of all Smith’s descriptions of the deposits in the Stoke Newington area before the deposition of the ‘contorted drift’. Descriptions of associated deposits in Stoke Newington that have been included in Figure 6.13, but which were not included in previously discussed published stratigraphies by Smith, are:

- 1) the Palaeolithic ‘floor’ overlying the stratified sands and clay (Stoke Newington Sands) (Smith, 1894 p. 210).
- 2) the presence of an upper stratum of gravel overlying the stratified sands and clays (see Figure 4.6, stratigraphy observed at Tyssen and Bayston Roads). This gravel was removed, most likely before or during the deposition of the ‘contorted drift’.

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**Summary of the stratigraphy and palaeoenvironments near Stoke Newington
Common based on Smith's descriptions (Smith, 1894)**

Table 6.3

Lithostratigraphy	Lithology	Palaeoenvironment	Climate
'Contorted drift'	undulating gravels	periglacial deposit	cold climate
Palaeolithic 'floor'	fresh artefacts, bones, sub-angular gravel narrow horizon	palaeo-landsurface with occasional flood events	temperate
Sand and molluscs	buff-coloured sand, with freshwater and terrestrial molluscs	Fluvial	temperate
Gravel	gravel with fossils, exotic lithologies	large river	Possibly cold?

**Summary of the stratigraphy and palaeoenvironments south of Stoke Newington
Common (lacking Palaeolithic 'floor') (Smith, 1894)**

Table 6.4

Lithostratigraphy	Lithology	Palaeoenvironment	Climate
'Contorted drift'	undulating gravels	periglacial deposit	cold climate
Stratified sands	horizontally bedded sands, varying colours and textures	large river floodplain	Temperate
Sand with molluscs	buff-coloured sand, with freshwater and terrestrial molluscs	Fluvial	Temperate
Gravel	Gravel	large river	Possibly cold?

Summary of the stratigraphy and palaeoenvironments at Hackney Downs
(adapted from Green *et al.*, 2006)

Table 6.5

Lithostratigraphy	Lithology	Palaeoenvironment	Climate
Hackney Downs Gravel	horizontally bedded sandy gravel and sands	braided river	Cold
Highbury Silts and Sands	horizontally bedded silt, sand and clay, occasional stones, abundant organic remains	large river floodplain	Warm
Leytonstone Gravel	sandy gravel and some molluscs	large river floodplain, main channel	Warm

6.2.6 Archaeology

There are four types of stone tool assemblages recorded in published sources:

- 1) Heavily abraded, ochreous implements in the deepest gravel pits from the lower half of the gravel. No specific location was given for these deep pits. Smith indicated that the gravels were found 6-9m from the surface. It is likely that this deep deposit represents the lower sections of the Leytonstone Gravel (Smith, 1894).
- 2) Moderately abraded implements from the Leytonstone Gravel (Smith, 1894), found at around 3m from the surface. Handaxes were larger than from the overlying ‘floor’ and side-scrapers were rarer.
- 3) Fresh and unstained implements from the Palaeolithic ‘floor’ (Smith, 1894).
- 4) Neolithic and Mesolithic artefacts from the alluvium of the Hackney Brook (Smith, 1894; Harding and Gibbard, 1983).

In the following analyses, artefacts from Stoke Newington Common, Abney Park Cemetery, Upper Clapton and Stamford Hill are dealt with collectively on account of their close proximity and similar stratigraphies. Artefacts that can be directly attributed to the Palaeolithic ‘floor’ (from antiquarian labelling), have been grouped together in a separate analysis.

The stratigraphy seen in Hackney Downs, Lower Clapton and Shacklewell is often considered different to that near Stoke Newington Common (as described above) and

therefore all artefacts from the first three locations are analysed together in the following sections.

Artefacts that were omitted from the analyses are:

1. Campbell's artefacts in the British Museum, due to the mixed nature of the assemblage, which included Mesolithic material and debitage. Specific find locations within the stratigraphy were not recorded.
2. H. G. Mantle collection in the British Museum (ex Geological Museum Collection) as the artefacts are suspiciously fresh and many are suspected to be forgeries (R. Jacobi pers. comm.).
3. Many artefacts from Wardown Park Museum lacked Smith's location notations and so although they were in boxes allegedly from Stoke Newington, there is a possibility that they were from elsewhere.
4. Any objects thought to be later prehistoric in age.

Archaeology from Stoke Newington Common, Upper Clapton, Abney Park Cemetery and Stamford Hill

Artefact	Number of artefacts	% of assemblage
Handaxe	551	22.95
Flake	1763	73.43
<i>of which modified</i>	205	11.63
Core	35	1.46
unclassifiable worked flint	52	2.17
Total artefacts	2401	

Table 6.6: Summary of artefacts from Stoke Newington Common, Upper Clapton, Abney Park Cemetery and Stamford Hill

The assemblage from Stoke Newington consists predominantly of flakes (73.43%) (Table 6.6). Almost half the handaxes are pointed (46%) supporting the observations of Wymer, 1968) and Roe (1968a). The majority of the handaxes are slightly abraded (36%) and moderately abraded (34%), in contrast to over half the flake assemblage that exhibits slight abrasion (51.34%) (Table 6.7).

Level of Abrasion	No. of Handaxes	%	No. of Flakes	%
Heavily abraded	136	24.68	239	13.56
Moderately abraded	186	33.76	529	30.01
Slightly abraded	199	36.12	906	51.39
Fresh	30	5.44	89	5.05
Total	551		1763	

Table 6.7: Summary of handaxe and flake level of abrasion from Stoke Newington Common, Upper Clapton, Abney Park Cemetery and Stamford Hill

Following Smith's (1894) description of the fresh condition of artefacts from the 'floor' in Stoke Newington, it is reasonable to assume that the majority of fresh (and slightly abraded to account for those disturbed by the overlying contorted drift) artefacts from extant collections represent tools from the Palaeolithic 'floor'. Artefacts exhibiting higher degrees of abrasion are almost certainly from the gravels (both the lower gravel and the contorted drift) in Stoke Newington or derived from these deposits.

A very small number of artefacts were made using the Levallois technique (14). They were found in Stoke Newington Common and Stamford Hill. None were fresh and in addition to the very small number of specimens, it is likely the Levallois artefacts are reworked in some of the younger deposits such as the 'contorted drift' or the Hackney Brook sediments.

Archaeology from the Palaeolithic 'floor'

The artefacts from the Palaeolithic 'working floor' were described as sharp, black and lustrous, but occasionally the implements were slightly abraded where the contorted drift had disturbed the 'floor' (Smith, 1894).

Gibbard (1994) suggested that the 'floor' material may be derived from the downward slope movement of gravels around Stamford Hill. However this does not account for the fresh and refitting material Smith found. Mark White (in Green *et al.*, 2004) also noted that the implements from Stamford Hill are more abraded than those from the Stoke

Newington 'floor', suggesting that the implements from the 'floor' and the Stamford Hill gravels are not the same age.

Wymer (1968) identified 19 artefacts from Smith's catalogue that were provenanced to the Palaeolithic 'floor'. In this study it has been possible to locate 28 artefacts from Smith's catalogue attributable to the 'floor' and an additional three mentioned in the catalogue that were untraceable in extant collections. The artefacts are predominantly from Stoke Newington Common, the most celebrated location for the presence of the Palaeolithic 'floor'; however, a small number are from Stamford Hill, South Hornsey and Shacklewell. All these locations were documented by Smith as having the Palaeolithic 'floor' present, although Prestwich (1855b) and Green *et al.* (2006) have described a different stratigraphy in the Shacklewell and Hackney Downs area to that associated with the Palaeolithic 'floor'. The record of the Palaeolithic 'floor' in Shacklewell (two artefacts, Smith catalogue numbers 1010 and 522) appears on artefact labels, in his catalogue and in his publications, suggesting that Shacklewell has yielded evidence for both variants of the stratigraphy. Artefacts from Shacklewell have been included in the Lower Clapton and Hackney Downs analyses, rather than the Stoke Newington assemblage, on the basis of their close proximity to each other, the common stratigraphy descriptions given by Prestwich (1855b), Green *et al.*, (2006) and the British Geological Survey mapping, which depicts Shacklewell as the same as Hackney Downs. Unusually the majority of the artefacts are handaxes (75%) (Table 6.8) despite flakes being the most common artefact type in the Stoke Newington Common area (Table 6.6). This could be a result of collections bias, with some collectors favouring the more recognisable and impressive handaxe, especially as the discovery of the Palaeolithic 'floor' was celebrated at the time and may have attracted less experienced collectors. Although the predominant degree of abrasion of these artefacts is slight (36%) and fresh (32%), as would be expected, there is also a significant proportion of the artefacts that displays higher abrasion levels (27%) (Table 6.9), as noted by Wymer (1968). This suggests that either not all artefacts from the 'floor' were fresh (and that there was more disturbance to the 'floor' than previously recorded) or that the Smith's catalogue location descriptions were inaccurate.

Artefact Type	Number of artefacts	%
Handaxe	21	75.00
Flake	6	21.43
<i>of which modified</i>	6	100.0
Core	0	0.00
unclassifiable worked flint	1	3.57
Total artefacts	28	

Table 6.8: Summary of artefacts attributed to the Palaeolithic ‘floor’ by Smith (from his personal catalogue)

Level of abrasion	Number of artefacts	%
Fresh	9	32.14
Slightly abraded	10	35.71
Moderately abraded	7	25.00
Heavily abraded	2	7.14
Total	28	

Table 6.9: Summary of degree of abrasion of artefacts attributed to the Palaeolithic ‘floor’ by Smith (from his personal catalogue)

Smith also described artefacts from the ‘floor’ as black and lustrous (Smith, 1894), which indicates that a low level of staining is as significant in identifying artefacts from the ‘floor’ as a low degree of abrasion. Significantly, all fresh or slightly abraded artefacts from the 28 objects attributed to the ‘floor’ were unstained or slightly stained. Using the combination of low abrasion and staining, it can be suggested that 1200 artefacts seen during this research that have been classified as fresh/slightly abraded, unstained/slightly stained are almost certainly from the floor, especially 54 that are both fresh and unstained.

Archaeology from Hackney Downs, Shacklewell and Lower Clapton

The first Palaeolithic artefact from Lower Clapton was found in Dunlace Road (artefact now in the British Museum, Ex. J. Anscombe and Ex. Geological Museum Collections) (Smith, 1879). All implements recorded from Hackney Downs, Shacklewell and Lower Clapton are summarised below.

Artefact Type	Number of artefacts	% of assemblage
Handaxe	188	27.81
Flake	453	67.01
<i>of which modified</i>	25	3.70
Core	15	2.22
unclassifiable worked flint	20	2.96
Total artefacts	676	

Table 6.10: Summary of tool types from Lower Clapton, Hackney Downs and Shacklewell

The majority of the assemblage consists of flakes (67%), with 22.95% comprising of handaxes (Table 6.10). These proportions are very similar to the assemblage from Stoke Newington Common assemblage described above. However, artefacts displayed higher levels of abrasion than those from Stoke Newington, with the majority exhibiting moderate abrasion (handaxes, 38.83% and flakes 43.71%), in contrast to the Stoke Newington Common assemblage in which more artefacts displayed slight abrasion (Table 6.11). The Lower Clapton, Hackney Downs and Shacklewell assemblages also contained less fresh artefacts. This is to be expected, considering that the Palaeolithic ‘floor’ was more prominent in Stoke Newington Common and surrounding locations compared to the Hackney Downs, Lower Clapton and Shacklewell area.

Level of Abrasion	No. of Handaxes	%	No. of Flakes	%
Heavily abraded	56	29.79	100	22.08
Moderately abraded	73	38.83	198	43.71
Slightly abraded	52	27.66	148	32.67
Fresh	7	3.72	7	1.55
Total	188		453	

Table 6.11: Summary of handaxe and flake level of abrasion from Lower Clapton, Hackney Downs and Shacklewell

It is likely the artefacts displaying the heavier degrees of abrasion are derived from the Leytonstone Gravel or the Hackney Downs Gravel. Fresher artefacts may be from the

Highbury Silts and Sands, although not many have been recorded from this deposit. Although the Palaeolithic ‘floor’ was described less frequently in these locations than in the Stoke Newington Common area, it was still observed and therefore the fresher artefacts may still be attributable to the ‘floor’.

Archaeology from the Hackney Brook

Six artefacts in the Sturge (Ex Smith) and Smith collection in the British Museum are listed as originating from the Hackney Brook deposits in Shacklewell and Stoke Newington Common. In the Shacklewell area the deposits were at a depth of 3.04m, whereas in Stoke Newington Common the deposits were found higher in the stratigraphy at 1.22m below the surface. They vary in their condition with two slightly abraded, three moderately abraded and one heavily abraded.

Artefacts excavated by Roe, Sampson and Campbell in 1971 (Harding and Gibbard, 1983; Green *et al.* 2004) are not included in the following analyses due to the mixed nature of the assemblage.

The assemblage collected by Harding and Gibbard (1983) appeared to contain Palaeolithic specimens as well as later prehistoric artefacts. Only those considered to be Palaeolithic have been included in the following analysis (six artefacts).

Artefact Type	Number of artefacts	% of assemblage
Handaxe	3	25.00
Flake	9	75.00
<i>of which modified</i>	<i>1</i>	<i>8.33</i>
Core	0	0.00
unclassifiable worked flint	0	0.00
Total artefacts	12	

Table 6.12: Artefact types from the Hackney Brook deposits

Level of abrasion	Number of artefacts	%
Fresh	0	0.00
Slightly abraded	3	25.00
Moderately abraded	6	50.00
Heavily abraded	3	25.00
Total	12	

Table 6.13: Artefact degree of abrasion from the Hackney Brook deposits.

The most common artefact types in the assemblage were flakes (75%) (Table 6.12) and the most common condition of the Hackney Brook artefacts was moderately abraded (Table 6.13), suggesting that the Brook transported the implements from other sites and deposits.

6.2.7 Age of Deposits

Biostratigraphy

Nightingale Estate, Hackney Downs

Flora

The pollen from borehole NE2 (Gibbard , 1994) was correlated with Ipswichian sub-stage Ip IIb on the dominance of *Quercus* and *Pinus* together with the appearance of *Carpinus* at the top of the sequence. However, many of the sites attributed to the Ipswichian on account of their pollen sequences are now believed to be older (eg. Sutcliffe, 1975; Jones and Keen, 1993; Bridgland, 1994, Schreve, 2001a).

It was originally thought that the presence of *A. filiculoides* indicated an age within the Hoxnian Interglacial or older, as evidence suggested that this species became extinct at the end of the Hoxnian in Britain (Godwin, 1975). However it is now clear that many ‘Hoxnian’ sites include younger deposits of MIS 9 age (Thomas, 2001; Green *et al.*, 2006) thereby presenting the possibility that the Hackney deposits represent an unnamed late Middle Pleistocene interglacial. The condition of the megaspores of *A. filiculoides* in the assemblage was consistent with that of other species and so they are not considered to be reworked. Recently, many *Pyracantha* fossils in Britain have been attributed to the extinct species, *P. clactonensis*. However, this species was also

identified at Clacton-on-Sea (MIS 11), Barling (MIS 9) and West Wittering (MIS 7) (Reid and Chandler, 1923; Bridgland *et al.*, 1999, 2001) and so cannot be considered a biostratigraphical marker species.

Vertebrates

The record of woolly rhinoceros at Stoke Newington, most likely from the Hackney Downs Gravel (attributed to MIS 8), is biostratigraphically significant as the species has been recorded from cold climate gravel at Northfleet, thought to be of equivalent age, suggesting its first appearance in Britain was during MIS 8 (Schreve, 1997, 2001a).

Palmate newt has been found in Barnham, Suffolk which has been attributed to MIS 11 (Ashton *et al.*, 1994). *T. cf. helveticus* has also been found in Aveley, Essex which is MIS 7. Slow worm is known in assemblages attributed to MIS 11, 9 (Gleed-Owen, 1999) and most recently MIS 7 at Aveley (Juby, 2005). From the limited herpetofaunal evidence, the Nightingale Estate assemblage can be attributed to MIS 7 or earlier.

Coleoptera

The assemblage from Hackney was originally considered to be similar to Ipswichian coleopteran faunas on the account of the high numbers of thermophilous exotics (Coope, 1974; Keen *et al.*, 1999; Gao *et al.*, 2000). However the Nightingale Estate assemblage includes fewer southern species than Ipswichian faunas. Assemblages attributed to MIS 7 characteristically contain different and less southern species compared to MIS 9 sites, such as abundant *Oxytelus (Anotylus) gibbulus* and *Stomodes gyrosicollis* (Green *et al.*, 2006). Hoxnian assemblages were also considered to be very different when compared to the Nightingale Estate assemblage, as the MCR from the latter suggested the climate was warmer than the present day, whereas the Hoxnian is considered to be no warmer than today (Green *et al.*, 2006; Coope, 2010). The coleopteran fauna at Barling, attributed to MIS 9 (Bridgland *et al.*, 2001), and that from Cudmore Grove, which is also correlated with MIS 9 (Roe *et al.*, 2009), were considered to be very similar to the Nightingale Estate assemblage, therefore also suggesting a comparable age for the Nightingale Estate fauna.

Molluscs

The occurrence of *B. marginata* alongside *C. fluminalis* indicates an age within MIS 7, MIS 9 or a later part of MIS 11 (Preece, 1999), or just MIS 9 (Keen, 2001). *U. crassus*

has only been recorded in the Thames region at Swanscombe (MIS 11) and Purfleet (MIS 9) (Kerney, 1971; Bridgland, 1994; Schreve *et al.*, 2002). It was recognised that the Nightingale Estate assemblage did not closely match that from Swanscombe and that the occurrence of *B. marginata* alongside *C. fluminalis* was common at both Purfleet and the Nightingale Estate. The molluscan assemblage from Barling was also noted to be similar to that from the Nightingale Estate, thereby implying an MIS 9 age.

Ostracods

Assemblages containing significant numbers of *Fabaeformiscandona* sp. are known only in Britain during the MIS 11 and MIS 9 interglacials (Keen *et al.*, 1997; Schreve *et al.*, 2002). The ostracod faunas recorded at Barling (Bridgland *et al.*, 2001) and Purfleet (Schreve *et al.*, 2002) (both MIS 9) have comparable assemblages to that at Nightingale Estate, therefore making a correlation with MIS 9 based on the ostracods the most probable (Green *et al.*, 2006).

Biostratigraphical Summary

It was suggested that many of the biological assemblages were consistently indicative of MIS 9 and were comparable with other MIS 9 sites in the Thames valley such as Purfleet, for the molluscs and ostracods (Schreve *et al.*, 2002) and Barling for the insects (Bridgland *et al.*, 2001). The key non-mammalian features indicative of MIS 9 are the co-occurrence of *Azolla* and molluscs *B. marginata*, *C. fluminalis* and *U. crassus* in the same assemblage. This is consistent with the topographical position of the Hackney deposits, which are found at a lower level (between 20-21m OD) than the MIS 11/Hoxnian Boyn Hill/Orsett Heath Terrace (between 23 and 34m OD at Swanscombe (Bridgland, 1994)). In addition, neither the molluscan nor insect faunas closely resemble those recorded from MIS 11 sites (Green *et al.*, 2006).

The warmer-than-present mean summer temperatures imply that the assemblage does not compare well with palaeotemperature reconstructions from MIS 7, which is thought to be cooler or similar to the present interglacial (Green *et al.*, 2006). However, this does not take into consideration the warmest substage of MIS 7 (MIS 7e), which is poorly represented in the British terrestrial record. Close correspondence with the Hoxnian does appear to be definitely ruled out, since the Hoxnian invertebrate fauna indicates a climate only as warm as the present day and no warmer (Schreve, 2004a;

Coope, 2010). The only other British late Middle or Late Pleistocene episode with palaeotemperatures warmer than present is the Ipswichian, with summer temperatures approximately 4°C higher than southern Britain today (Sparks and West, 1972; Keen *et al.*, 1999; Keen, 2001; Gao *et al.*, 2000), thus in excess of the 18-19°C implied at Hackney Downs. In summary, the combined biostratigraphical evidence indicates a late Middle Pleistocene interglacial post-dating the Hoxnian but pre-dating the Last Interglacial and most likely older than MIS 7. This would be consistent with the MIS 9 age inferred from other recent evaluations based upon terrace stratigraphy and absolute dating.

Age of Archaeology

Levallois artefacts first appear in Britain in the upper part of the Lynch Hill/Corbets Tey terrace (from late MIS 9) (Moncel and Combier, 1992; Bridgland, 1994, 1998; Rolland, 1995; Wymer, 1999; Schreve *et al.*, 2002; Westaway *et al.*, 2006; White *et al.*, 2006), and as Levallois artefacts were virtually absent and and/or not *in situ*, it offers further support to a pre-late MIS 9 date for the majority of deposits.

Dating and Age

OSL dating placed the Highbury Sands and Silts between 328,000-201,000 years BP. The sample that produced the 328,000 years BP was obtained using the preferred field sampling method, and therefore was considered to be most reliable. This placed the Highbury Silts and Sands within MIS 9 (Green *et al.*, 2006). In contrast the Amino Acid Racemisation (AAR) results based on *Valvata piscinalis* shells placed the sands and silts within MIS 7. Miller *et al.* (1979) previously correlated *Corbicula* from Stoke Newington with that from Grays (now widely considered to be of MIS 9 (Bridgland, 1994; Schreve, 1997, 2001a; Schreve *et al.*, 2002)) on the basis of AAR, however the same study also grouped these samples with others from Swanscombe, now widely accepted to represent the first post-Anglian (Hoxnian/MIS 11) interglacial. The OSL dates for the overlying Hackney Downs Gravel indicated a MIS 6 age, which would be equivalent to the Mucking Gravel of the Taplow Terrace of the Thames, suggesting there is some conflict in the age of deposits suggested by the dating and the biostratigraphy.

There remain problems in fitting the Hackney deposits into the established staircase terrace sequence of the Thames. The deposits are not easily placed within the scheme proposed by Bridgland (1994) as here, MIS 9 age sediments are immediately followed by the aggradation of the upper part of the Lynch Hill/Corbets Tey gravels. In Bridgland's model, this aggradation is shown to be up to 12m above the surface of the Hackney Downs Gravel in the Hackney area. Therefore it was suggested by Green *et al.* (2006) that the Stoke Newington deposits may indicate a more complex Thames stratigraphy here than is recognised elsewhere by Bridgland (1994). With the greatly varying heights of deposits in the Lea Valley area, it is not unusual that certain definitions of terraces do not incorporate all deposits. This highlights the need for new multi-proxy investigations including geochronological dating techniques to assign ages to the different deposits and to incorporate them fully within the terrace stratigraphy.

Relationship between the stratigraphy at Stoke Newington and Nightingale Estate, Hackney Downs

Smith (1894) believed that all the deposits in the Stoke Newington and Hackney Downs area could be inter-related. Wymer (1968) also suggested that the deposits in Lower and Upper Clapton were continuations of the Stoke Newington deposits. Furthermore, Bridgland (1994) proposed that all the deposits from Stamford Hill in the north to Hackney Downs in the south belong to the same terrace, the Lynch Hill terrace, suggesting that the deposits are similar in age and are closely related.

The deposits observed at Nightingale Estate apparently did not contain the Palaeolithic 'floor' nor did they resemble the deposits associated with the 'floor' seen by Smith in the 19th century (Green *et al.*, 2006). These authors also noted that the 'floor' described by Smith was found around 24 m OD, which is 3m above the level of the ground seen at Nightingale Estate. Therefore it was suggested that although the Stoke Newington 'floor' deposits may form part of the Lynch Hill/Corbets Tey complex, they could represent an earlier and separate phase of deposition compared to the Nightingale Estate deposits (Green *et al.*, 2004; 2006). The biological proxies from the Highbury Silts and Sands at the Nightingale Estate suggest that the interglacial was warmer than present and may represent the climatic optimum of MIS 9: MIS 9e (Green *et al.*, 2006). If the suggestion is correct that the 'floor' represents an earlier aggradation than the Highbury Silts and Sands in Hackney Downs, it must represent a period prior to the climatic

optimum peak of MIS 9e. As the floor was deposited in a fine-grained, low-energy deposit, it must consequently represent a temperate period at the very beginning of MIS 9e or even earlier, possibly within MIS 10. The presence of the mammoth scapula, apparently from the 'floor' could be consistent with a late MIS 10/early MIS 9 date, as mammoth has been recorded from Germany in MIS 10 (Schreve and Bridgland, 2002). The open conditions that would have been likely at this time would have suited mammoth and hominins.

There are some similarities between the Hackney Downs stratigraphy (Green *et al.*, 2006) and the Stoke Newington area. For example both locations include a lower gravel unit that is overlain by sands, silts and clays (often stratified and organic) and finally an upper gravel unit. However, Figure 6.13 illustrates the significant height difference between the two locations, which supports the notion that although the sequences appear to represent similar environments and conditions, they may reflect different periods of deposition.

The Highbury Silts and Sands at Hackney Downs were attributed to MIS 9e (Green *et al.*, 2006) due to the fully temperate climate reflected by many of the biological proxies. The higher stratigraphical position of the sands, archaeology and Palaeolithic 'floor' at Stoke Newington must therefore represent an earlier period of deposition to the Hackney Downs organic deposits. Four possible ages for the sands at Stoke Newington are suggested:

- 1) The sands at Stoke Newington may represent a temperate period prior to MIS 9. It is unlikely the temperate deposits at Stoke Newington belong to an older terrace than the Lynch Hill/Corbets Tey terrace (MIS 10-9-8). The base of the Boyn Hill/Orsett Heath gravel in Central London is around 28m OD (Bridgland, 1994) and the Stoke Newington temperate deposits are at 20-27m OD indicating they are too low to belong to the higher terrace (Green *et al.*, 2004, 2006). The interglacial deposits at Purfleet in the Lower Thames, are also assigned to MIS 9 and are situated between 7 and c. 15m OD (Schreve *et al.*, 2002), however this site is further downstream than Stoke Newington, thereby explaining its lower position. It is possible that the human occupation may relate to the early aggradation of the Lynch Hill Terrace, during the warming limb of MIS 10

when the climate would have been cool but still suitable for hominins. Furthermore twisted ovate handaxes have been attributed to late MIS 11/early MIS 10, suggesting that hominins were present during parts of MIS 10 (White, 1998).

- 2) The fossiliferous Highbury Silts and Sands may not represent MIS 9e, but instead a younger sub-stage within MIS 9, such as the next warmest sub-stage, MIS 9c. Although the climatic optimum of the interglacial is shown to be during MIS 9e in ice and marine isotope records (e.g. Petit *et al.*, 1999; Jouzel *et al.*, 2007; Toucanne *et al.*, 2009), the climate may have been warm enough in another of the MIS 9 sub-stages to support the biological assemblage recorded at Hackney Downs. Consequently the higher (and older) sands at Stoke Newington may represent MIS 9e.
- 3) The temperate deposits at Stoke Newington may represent a slightly earlier period within MIS 9e than the Highbury Silts and Sands. The Leytonstone Gravel at Hackney Downs was also attributed to MIS 9e based on the molluscan evidence, and it is possible the sands at Stoke Newington are another facies of the MIS 9e deposits. The forest stage of MIS 9e is suggested to have lasted approximately 3.6kyr in south-west Portugal from a marine core benthic $d^{18}O$ curve; however, French (Reille and Beaulieu, 1995; Reille *et al.*, 1998) and Greek records (Wijmstra and Smit, 1976) suggest the sub-stage lasted for approximately 12 kyr (Tzedakis *et al.*, 2004), suggesting there was a suitably long period during which two separate temperate deposits could accumulate.
- 4) The deposits at Stoke Newington and Hackney Downs were deposited by different rivers/tributaries. There is confusion over the provenance of the deposits in the two locations, with the study area covering the confluence of the River Lea with the River Thames. Clast lithological analyses by Green *et al.*, (2006) were inconclusive in establishing whether the deposits in Hackney Downs were deposited by the Thames or its tributary, the River Lea. Gibbard (1994, 1999) suggested that many deposits in the Hackney Downs area were accumulated by the River Lea, whereas Bridgland (1994) attributed the deposits in both locations to the Thames Lynch Hill/Corbets Tey terrace. The two rivers

would incise and deposit sediment at different rates and depths, therefore their respective terraces would occupy different heights. This could account for the slightly different positions that the comparable deposits in Stoke Newington and Hackney Downs occupy, with the former potentially laid down by the Lea and the latter by the main Thames.

6.3 Cauliflower Pit, Ilford

6.3.1 Introduction

Pits in the Ilford area were commercially exploited in the 19th century for brick-making and it was whilst these were being excavated that local amateur collectors and geologists became aware of the fossiliferous nature of the ‘brickearths’. Uphall Pit, located within the younger Mucking Gravel Formation (Bridgland, 1994) (Chapter 7.1), was the most prolific and celebrated of the sites in Ilford, however there were a further two pits that yielded fossils to the north of Uphall Pit. Following mistaken conflation with Uphall Pit for many years, the deposits in this area were only recently definitively assigned to the Corbets Tey Formation (Bridgland, 1994), based on the higher elevation of the gravels, thereby differentiating them from the lower and separate Mucking Formation (MIS 8-7-6). During this research, only 19 mammal specimens and 22 artefacts were identified from the Cauliflower Pit area, in contrast to the much richer faunal assemblage from Uphall Pit. Nevertheless, this study represents the first analysis of all artefacts and mammals from the Corbets Tey Formation sites in London and its boroughs since the original excavations in the 19th and early 20th Centuries.

6.3.2 Location of Collections

Fossils were analysed from the Hinton and White collections in the Natural History Museum. Artefacts from Ilford were seen in the Christy (Ex. Franks), Sturge, Todd-White, Lawrence, Warren, Geological Museum, Corner, and W. G. Smith collections at the Museum of London, Natural History Museum, British Museum, Cambridge Museum of Archaeology and Anthropology, and Wardown Park Museum, Luton.

6.3.3 History of Research

Morris (1836, 1838) was the first to record the discovery of bones in Ilford brickpits. He described a composite sedimentology from three brickfields in Ilford; two were located in the Uphall area (Chapter 7) and one, belonging to a Mr Curtis, was further north and

separate from the Uphall location. Cotton (1847) published a detailed account of the stratigraphy from Curtis' Pit, and confirmed its location to the north of Ilford and the railway. Hinton (1900a, 1900b (the latter in more detail)) described sections in the same location as Cotton (1847) although this time referring to the pit as 'Sam's Green', 'Cauliflower' or 'Page's'. The molluscs from this pit were listed by Kennard and Woodward (1900), and Johnson and White (1900), Hinton (1900a,b) and Johnson (1900) confirmed that Palaeolithic artefacts had been recovered from Cauliflower Pit, but not in Uphall Pit as of the turn of last century. The subsequent discovery of remains of *Stephanorhinus hemitoechus* (narrow-nosed rhinoceros) and *Stephanorhinus kirchbergensis* (Merck's rhinoceros) from Cauliflower Pit was described by Hinton (1902). Half a century later, the deposits under Ilford were temporarily exposed when excavations for a sewer trench began (Rolfe, 1957). Although it had already been suggested by Kennard and Woodward (1900) that the Uphall and Cauliflower sites might represent different ages, three sections published from Rolfe's excavations in a north to south transect through Ilford proved to be of paramount importance in identifying two river terrace deposits situated at different elevations.

The lithostratigraphy and pollen from a borehole near Seven Kings Station was published by West *et al.* (1964) and Gibbard (1994), and the pollen from the Richmond Road excavations (Rednap and Currant, 1985) was published by Gibbard (1994). He attributed both sites to the newly termed 'Ilford Sands and Silt' and correlated the deposits with the Ipswichian Interglacial. In contrast, the river terrace deposits around Cauliflower Pit were attributed to the Corbets Tey Formation (MIS 10-9-8) by Bridgland (1994) and to the Hackney Gravel Formation, an intermediate terrace between the Lynch Hill and Taplow Formations, by the British Geological Survey (2006).

A gazetteer of artefacts from Ilford was compiled by Roe (1968a) and Wymer (1968) compiled a summary of the fossils and artefacts that were reported from Ilford.

6.3.4 Location of Sites

Curtis's Pit was situated 'beyond the town on the left hand side of the road' (Morris, 1838 p. 540) and on the north side of London Road (now Ilford High Road) (Cotton, 1847). Hinton (1900b) also placed Curtis' Pit/Cauliflower Pit north of Ilford High Road

and on the northern side of the railway, on the left hand side of the footbridge that led to an iron-bridge. This places Cauliflower Pit in the approximate position shown in Figure 6.14. A brick pit is shown in the same location as the above descriptions on the 1875 OS map and fossil remains are recorded as being found in this pit (Figure 6.15).

The first of the three sections described by Rolfe (1957) was situated in Gordon Road, south of Green Lane and approximately 400m to the east of the Uphall brickfields (TQ 447865). The second was 7.6m north of the first, and the third was situated in Connaught Road, south of Ilford High Road at approximately TQ 446868 (Figure 6.14).

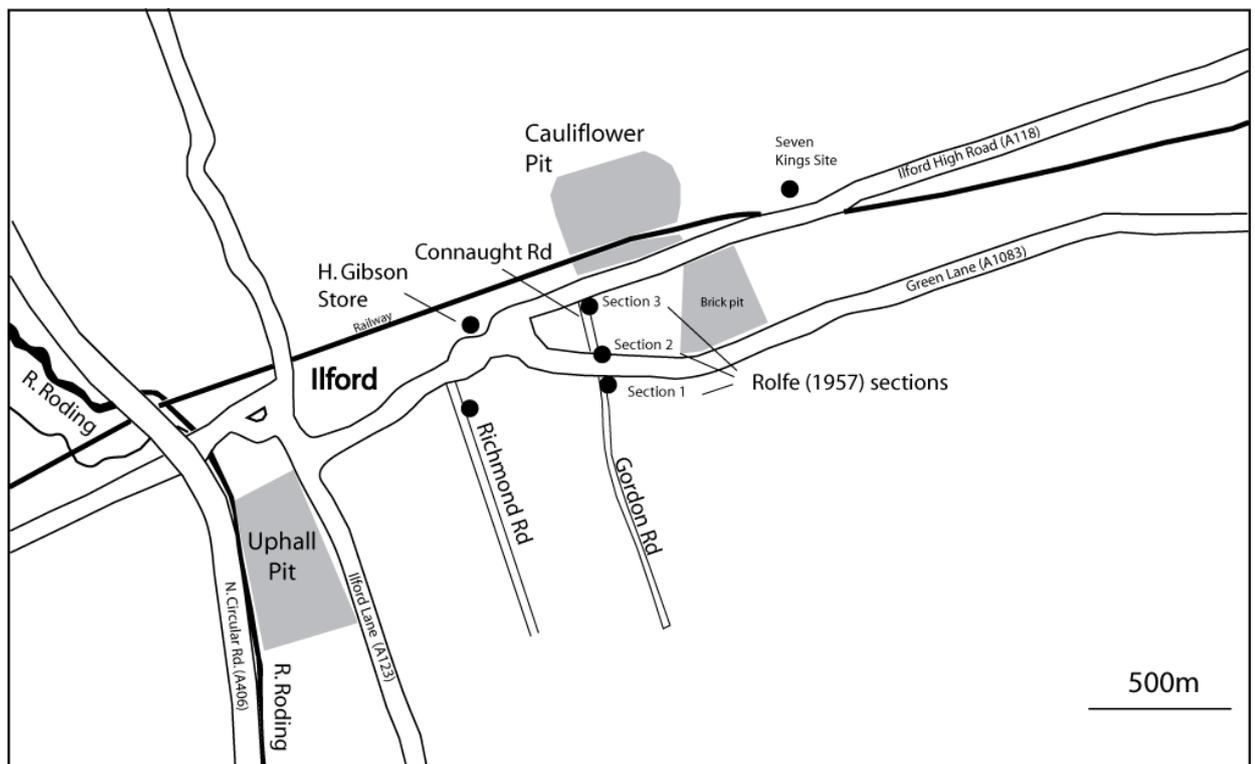


Figure 6.14: Map of sites in Ilford

Fossil remains
were found in
this pit

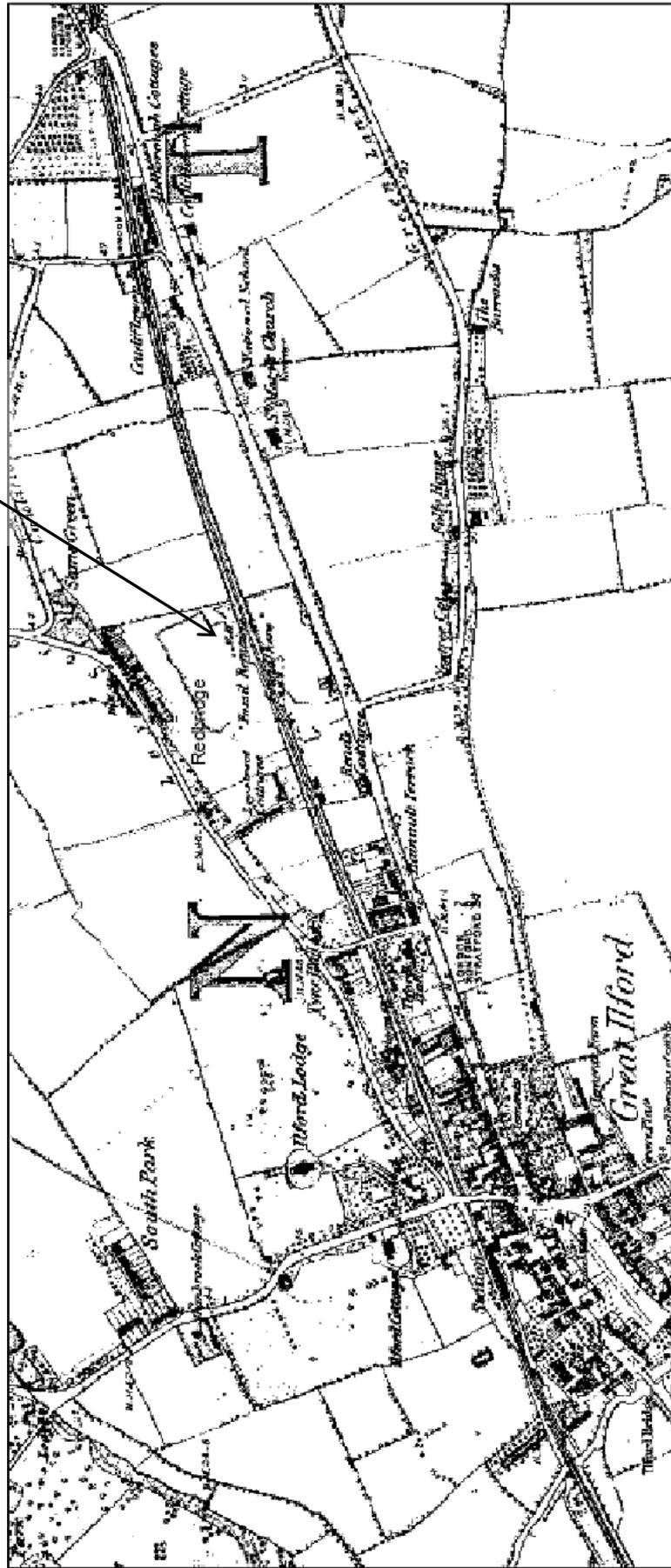


Figure 6.15: Approximate location of Cauliflower Pit as shown on 1875 OS map. 'Fossil remains' in a brick pit outline can be seen indicated above the railway.

6.3.5 Stratigraphy

The stratigraphy recorded at Cauliflower Pit by Cotton (1847) and Hinton (1900a, 1900b) are illustrated in Figure 6.16 and can be summarised as:

4. Upper gravel
3. 'Brickearth' with mammal fossils and molluscs
2. Stratified sand with molluscs
1. Gravel

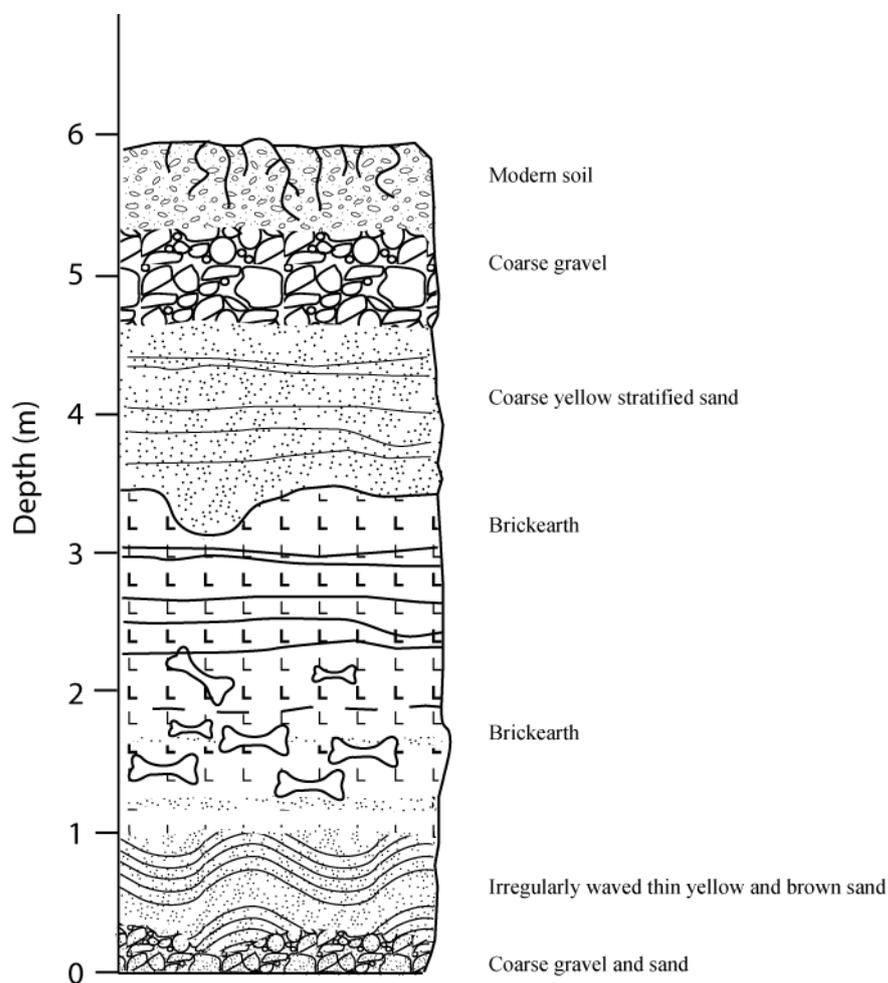


Figure 6.16: Stratigraphy recorded from Cauliflower Pit (from description by Cotton, 1847)

1. Gravel

The gravel deposit was coarse and contained sand (Cotton, 1847). Hinton (1900b) did not observe or record the basal gravels.

Hinton (1900b) noted the deposits in Cauliflower Pit reached 13.41m O.D, in contrast to the deposits at Uphall, which lay at approximately 9.14m O.D (Dawkins, 1867a). This difference in height was later upheld by Rolfe (1957) who described the gravels significantly increasing in height towards the north of Ilford. Three sections in a north-south transect were studied. Section 3, the furthest north, contained a thick section of gravels that extended almost to 11m O.D. At the site furthest south, Section 1, the gravels were only found to reach 6-7m O.D (Figure 6.18). This provided the first definitive indication that there were two different gravel aggradations of the Thames represented in the area. The junction of the two aggradations appears to centre on the area between Ilford High Road and Green Lane (approximately TQ 446867). Cauliflower Pit is located north of this boundary and so must lie within the higher aggradation recorded by Rolfe. It was not until much later that Bridgland (1994) attributed these gravels to the Corbets Tey Formation of the Lower Thames.

2. Sand and molluscs

The sand horizon consisted of thin undulating brown and yellow layers (Cotton, 1847).

3. 'Brickearth'

Cotton (1847) described the lower portion of the 'brickearth' as stratified, including layers of sand and abundant mammalian and molluscan remains. The upper parts of the 'brickearth' were also stratified, but with fewer bones. Cotton (1847) also recorded a coarse, stratified sand horizon above the 'brickearth'.

4. Upper gravel

The pebbles within this deposit were almost all orientated with their long axis vertical and the contact with the underlying bed was contorted (Hinton, 1900b), suggesting periglacial processes had been active on the deposit. Hinton (1900b) also recorded long furrow-like features protruding into the underlying deposit, up to 2.4m long (Figure 6.17). These are now recognised as periglacial wedges, which have been infilled by a solifluction deposit.

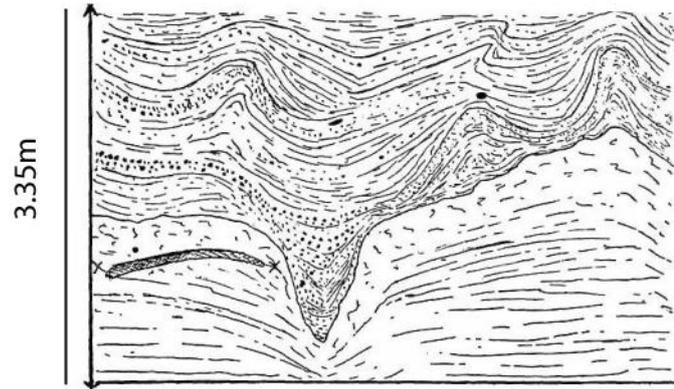
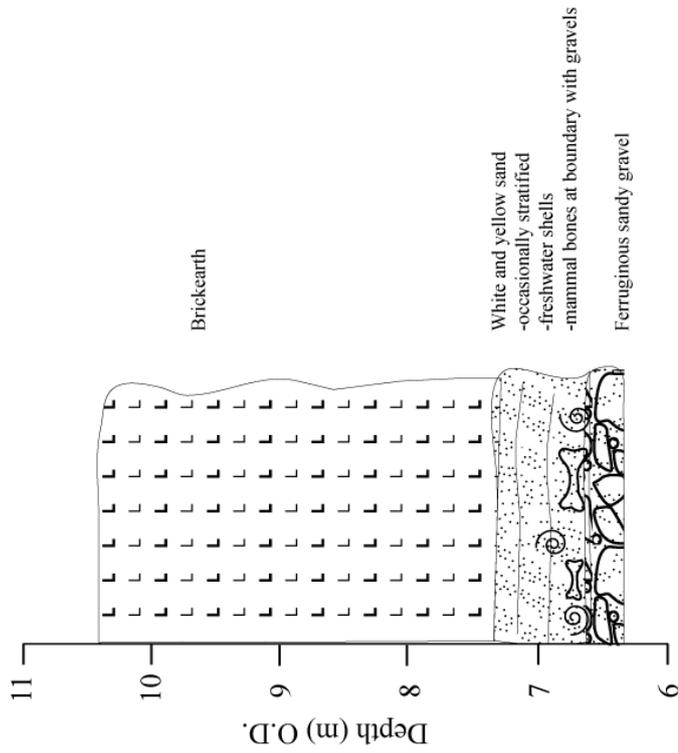
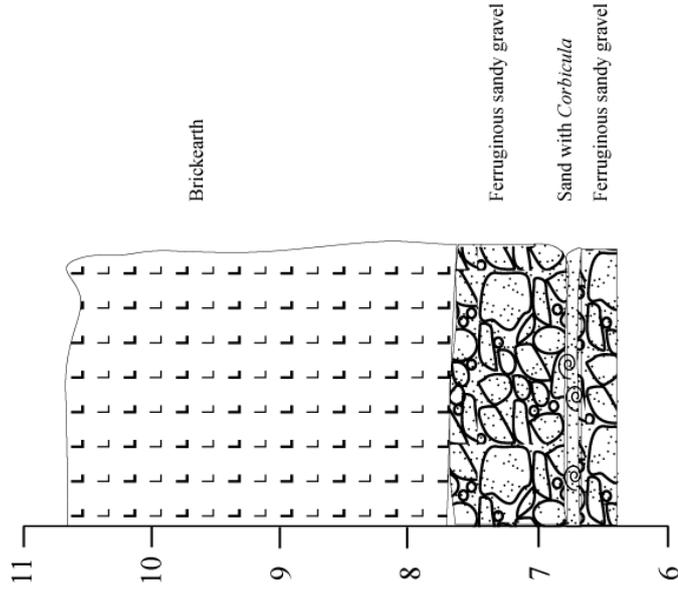


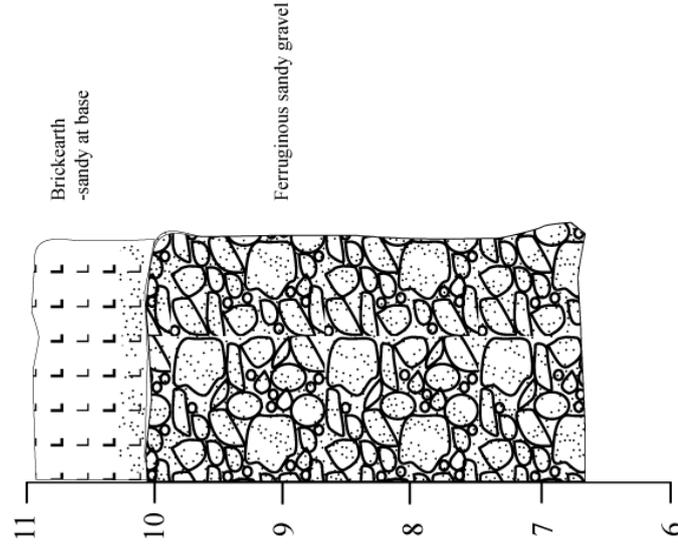
Figure 6.17: Stratigraphy recorded from Cauliflower Pit, illustrating the periglacial wedges and contorted solifluction gravel (adapted from Hinton, 1900b)



Rolfe (1957) Section 1 Gordon Rd



Rolfe (1957) Section 2



Rolfe (1957) Section 3 Connaught Rd

Figure 6.18: Stratigraphy recorded by Rolfe (1957) in three locations in Ilford in a south to north transect, illustrating the different heights of deposits. From descriptions by Rolfe (1957).

* O.D. heights inferred from modern OS maps

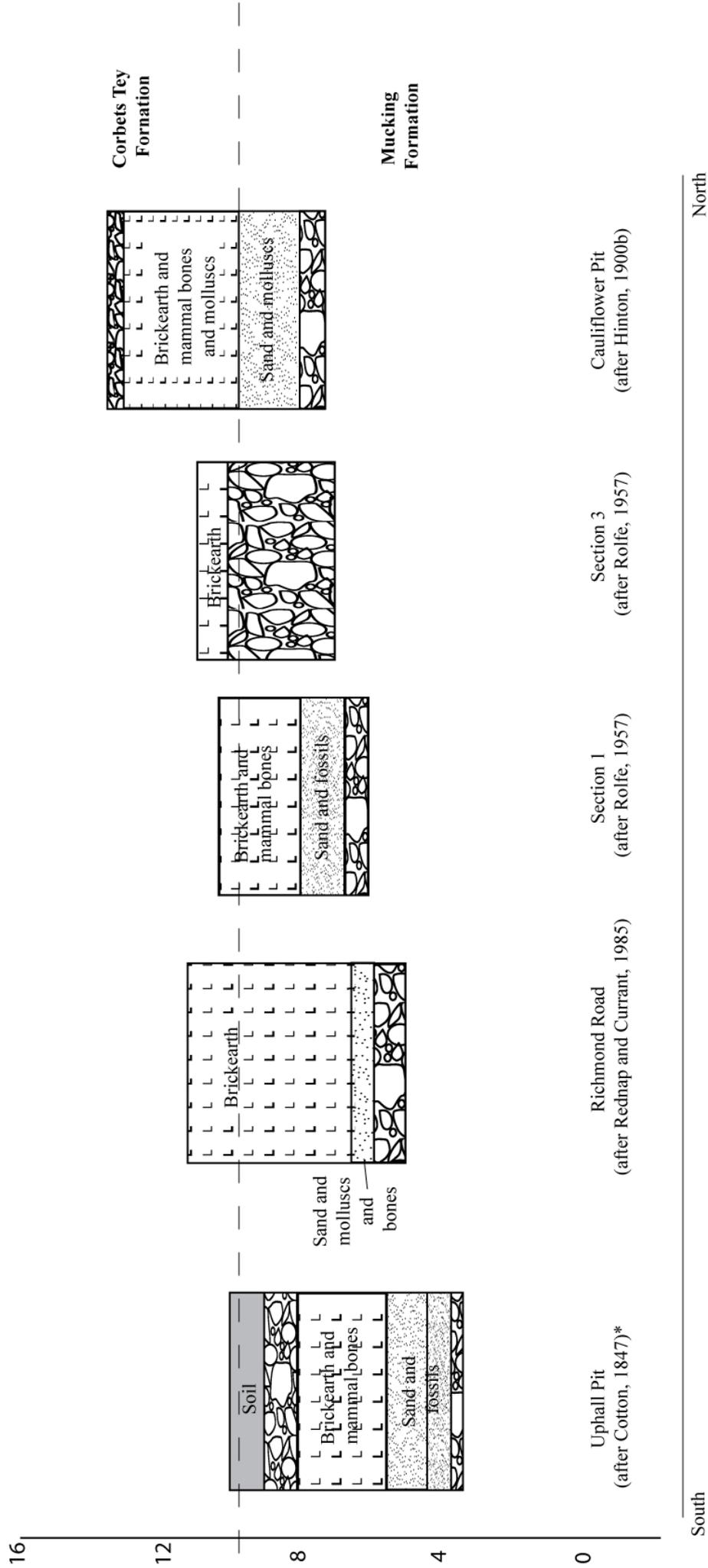


Figure 6.19: Sedimentology of various sites in Ilford illustrating the varying height of gravel in the area and the position of the Mucking and Corbets Tey Terrace Formations.

Rolfe (1957), and Redknap and Currant (1985) (see Chapter 7 for more details) illustrate the varying height in gravels in the Ilford area. Section 3 of Rolfe (1957) and the Cauliflower Pit stratigraphy recorded by Hinton (1900b) represent gravels that are at a significantly higher elevation than the other three sequences, which all represent Uphall locations within the lower and younger Mucking Formation deposits.

6.3.6 Palaeontology and environmental reconstruction

Palynology

Pollen was analysed from a borehole located in the Seven Kings area of Ilford (West *et al.*, 1964) (Figure 6.14). The location of the site is north-east of the Uphall site and almost level with the Cauliflower Pit. The upper part of the borehole was logged at 12.8m O.D., which would correlate well with the height of the sections seen by Hinton (1900b) and the Connaught Road (Section 3) described by Rolfe (1957). The tree pollen recorded is illustrated in Figure 6.20 (it was not possible to reproduce the non-tree pollen diagram in this thesis due to the format).

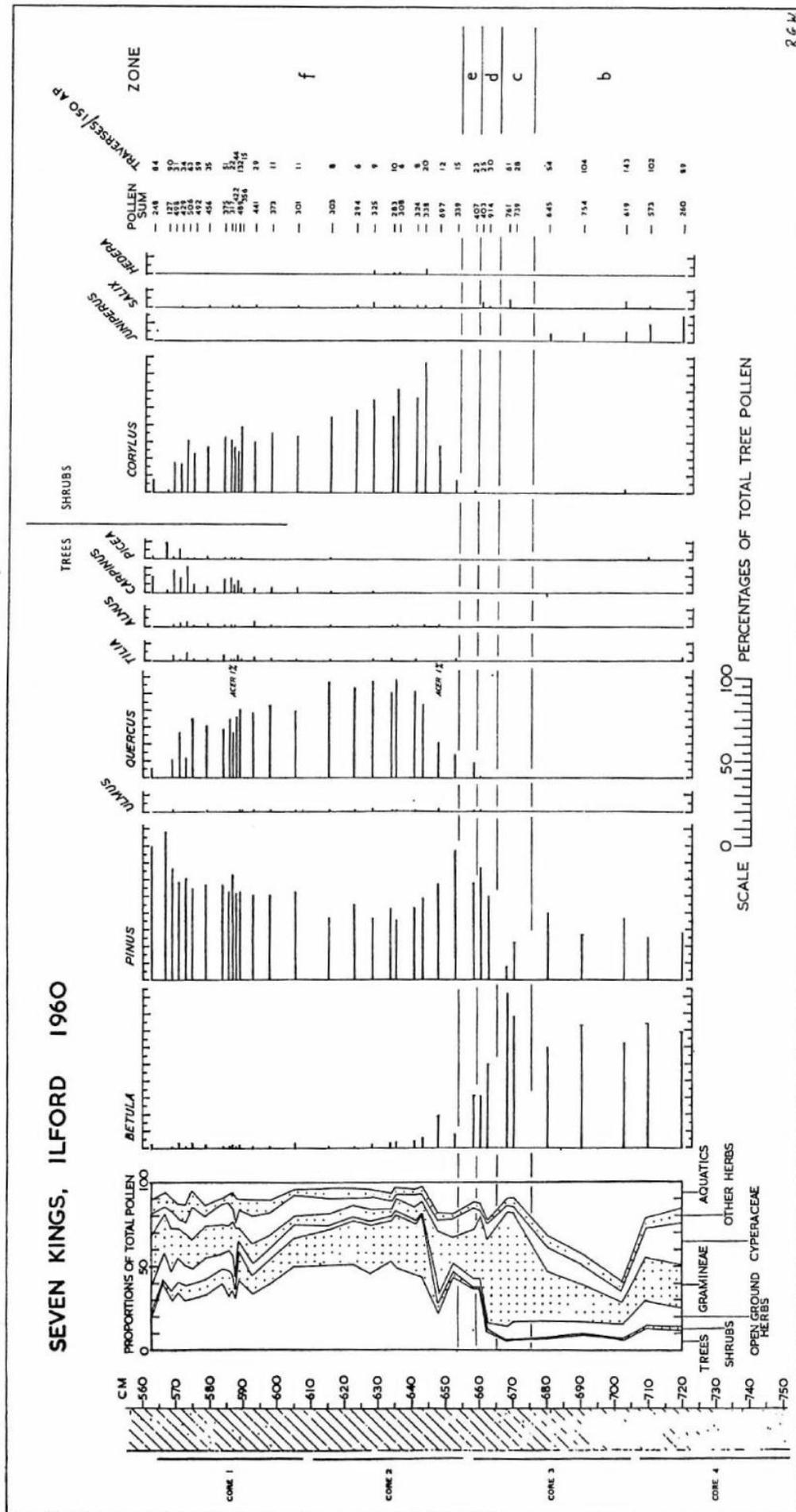


Figure 6.20: Tree pollen diagram from Seven Kings, Ilford. From West *et al.* (1964).

Pollen zone b of the sequence suggested open environments were present, with low tree pollen and high levels of grasses and sedges. Marsh and aquatic habitats were well represented, suggesting the presence of a small pond or slowly flowing water. The species in zone b represented a temperate climate despite the lack of tree pollen.

During Zone c, *Betula* (birch) increased and *Juniperus* (juniper) disappeared. Herbs reduced in number, possibly due to the increase in *Betula*. The sequence indicated a spread of reed swamp, a result of fluctuating water levels, suggested by the alternating organic and inorganic layers. The presence of *Hydrocharis morsus-ranae* (frogbit) seeds suggested warm summers, as the species rarely fruits in Britain today.

Zone d saw a rise in *Pinus* pollen, and grasses, sedges, Chenopodiaceae (flowering plants), Compositae (aster, daisy or sunflower plants) and *Typha latifolia* (common bulrush) were all well represented. The pollen suggested the climate was similar to that during zone c.

During zone e, oak increased, pine remained at high levels and *Betula* became reduced. *Eupatorium cannabinum* (hemp agrimony) and *Carex strigosa* (thin spiked wood sedge) both have southern distributions today, although no change in climate was indicated by West *et al.* (1964) from zone d.

At the beginning of zone f, herbaceous pollen dropped to its lowest level and tree pollen increased, suggesting forest habitats had become widespread. By the end of zone f, pine had increased whilst oak and hazel reduced, suggesting that pine favoured the dry sandy soils. In the upper part of the zone, values for herbaceous pollen also rose, indicating that open environments were present in the area. There was an increase in the more thermophilous plants, such as *Aphanes arvensis* agg. (parsley-piert), *Carpinus betulus* (European or common hornbeam), *Carex riparia* (great pond sedge), and *Ranunculus sardous* (hairy buttercup), however, it was suggested the climate was not greatly different from that of the previous zone.

Mollusca

The molluscs recorded by Kennard and Woodward (1900) from the Cauliflower Pit and by West *et al.* (1964) from Seven Kings are listed in Table 6.14.

Species	Current name	Kennard and Woodward (1900)	West <i>et al.</i> , (1964)
Freshwater			
<i>Valvata piscinalis</i>			*
<i>Valvata cristata</i>		*	*
<i>Bithynia tentaculata</i>		*	*
<i>Lymnaea palustris</i>	<i>Stagnicola palustris</i> agg.	*	*
<i>Lymnaea pereger</i>	<i>Radix balthica</i>	*	
<i>Lymnaea truncatula</i>	<i>Galba truncatula</i>	*	
<i>Lymnaea stagnalis</i>		*	
<i>Lymnaea glabra</i>	<i>Omphiscola glabra</i>	*	
<i>Lymnaea</i> sp.			*
<i>Planorbis planorbis</i>		* (as <i>Planorbis marginatus</i>)	*
<i>Planorbis glaber</i>	<i>Gyraulus laevis</i>	*	
<i>Planorbis carinatus</i>		*	
<i>Planorbis vortex</i>	<i>Anisus vortex</i>	*	
<i>Planorbis vorticulus</i>	<i>Anisus vorticulus</i>		*
<i>Planorbis leucostoma</i>	<i>Anisus leucostoma</i>	* (as <i>P. spirorbis</i>)	*
<i>Planorbis crista</i>	<i>Gyraulus crista</i>		*
<i>Planorbis contortus</i>	<i>Bathyomphalus contortus</i>	*	*
<i>Planorbis</i> sp.			*
<i>Segmentina nitida</i>		* (as <i>P. lineatus</i>)	*
<i>Acroluxus lacustris</i>			*
<i>Vertigo antivertigo</i>		*	
<i>Corbicula fluminalis</i>		*	
<i>Anodonta cygnea</i>		*	
<i>Sphaerium corneum</i>		*	
<i>Sphaerium lacustre</i>	<i>Musculium lacustre</i>		*
<i>Pisidium obtusale</i>			*
<i>Pisidium amnicum</i>		*	
<i>Pisidium astartoides</i>	<i>Pisidium clessini</i>	*	
<i>Pisidium pusillum</i>	Could relate to several different species (Preece, pers. comm.)	*	
<i>Pisidium nitidum</i>			*
<i>Pisidium</i> sp.			*
Terrestrial			
<i>Succinea</i> sp.			*
<i>Succinea putris</i>		*	
<i>Succinea elegans</i>	<i>Oxyloma pfeifferi</i> of British authors; <i>S. elegans</i> of continental authors	*	
<i>Zointoides nitidus</i>		* (as <i>Vitrea nitida</i>)	*
<i>Vitrea nitidula</i>	<i>Aegopinella nitidula</i>	*	
<i>Agriolimax</i> cf. <i>agrestis</i>	<i>Deroceras</i> sp.		*
<i>Agriolimax</i> sp.	<i>Deroceras</i> sp.		*
<i>Vallonia pulchella</i>		*	

Table 6.14 continued...

Species	Current name	Kennard and Woodward (1900)	West <i>et al.</i> , (1964)
<i>Hygromia hispida</i>	<i>Trochulus hispidus</i>	*	
<i>Helicigona arbustorum</i>	<i>Arianta arbustorum</i>	*	
<i>Helix nemoralis</i>	<i>Cepaea nemoralis</i>	*	
<i>Hellicella virgata</i>	<i>Ceriuella virgata</i>	*	
<i>Helicella caperata</i>	<i>Candidula crayfordensis</i>	*	
<i>Pupa cylindracea</i>	<i>Lauria cylindracea</i>	*	
<i>Pupa muscorum</i>	<i>Pupilla muscorum</i>	*	

Table 6.14: Mollusc species recorded from Cauliflower Pit

The assemblage published by West *et al.* (1964) is dominated by *Bithynia tentaculata* and significantly lacked *Corbicula fluminalis* in contrast to the assemblage recorded by Kennard and Woodward (1900), where *Corbicula* was present. West *et al.* (1964) noted that the Seven Kings molluscan assemblage reflected slow flowing water, as opposed to the faster flow indicated by the species recorded from Uphall Pit. This, they proposed, was due to the Seven Kings sediments being deposited by a tributary river, rather than the larger River Thames aggrading sediments in the Uphall location. The species listed by West *et al.* (1964) and Kennard and Woodward (1900) largely indicate well vegetated, slow flowing or still water (Table 6.15).

Inferred habitats and climates	Species
Warm temperatures/southern species	<i>Corbicula fluminalis</i>
Shallow	<i>Galba truncatula</i> , <i>Planorbis carinatus</i>
Still water	<i>Stagnicola palustris</i> agg., <i>Planorbis planorbis</i> , <i>Valvata cristata</i> , <i>Bithynia tentaculata</i> , <i>Planorbis carinatus</i> , <i>Anisus vorticulus</i> , <i>Bathyomphalus contortus</i> , <i>Segmentina nitida</i> , <i>Acroluxus lacustris</i> , <i>Musculium lacustre</i> , <i>Sphaerium corneum</i> , <i>Pisidium obtusale</i>
Slowly flowing water	<i>Anodonta cygnea</i> , <i>Stagnicola palustris</i> agg., <i>Lymnaea stagnalis</i> , <i>Valvata cristata</i> , <i>Bithynia tentaculata</i> , <i>Planorbis carinatus</i> , <i>Acroluxus lacustris</i> , <i>Vertigo antivertigo</i> , <i>Pisidium clessini</i>
Moderately-fast flowing water	<i>Pisidium amnicum</i> , <i>Valvata piscinalis</i> , <i>Corbicula fluminalis</i>
Muddy substrate	<i>Anodonta cygnea</i>
Hard bed for attachment	<i>Ancylus fluviatilis</i>
Aquatic vegetation	<i>Stagnicola palustris</i> agg., <i>Lymnaea stagnalis</i> , <i>Valvata cristata</i> , <i>Gyraulus laevis</i> , <i>Planorbis carinatus</i> , <i>Anisus vortex</i> , <i>Gyraulus crista</i> , <i>Bathyomphalus contortus</i> , <i>Segmentina nitida</i> , <i>Vertigo antivertigo</i> , <i>Pisidium obtusale</i>
Hard water	<i>Lymnaea stagnalis</i> , <i>Bithynia tentaculata</i>
Terrestrial	
Shaded	<i>Clausilia bidentata</i> , <i>Discus rotundatus</i> , <i>Vitrea crystallina</i> , <i>Cochlicopa lubrica</i> , <i>Aegopinella nitidula</i>
Unshaded	<i>Trochulus hispidus</i>
Alkaline soils	<i>Candidula crayfordensis</i> , <i>Pupilla muscorum</i>
Damp	<i>Discus rotundatus</i> , <i>Vallonia pulchella</i> , <i>Cochlicopa lubrica</i> , <i>Carychium minimum</i> , <i>Arianta arbustorum</i> , <i>Aegopinella nitidula</i> , <i>Oxyloma pfeifferi</i>
Dry	<i>Hellicella itala</i> , <i>Candidula crayfordensis</i> , <i>Pupilla muscorum</i> , <i>Ceruella virgata</i>
Grasslands	<i>Candidula crayfordensis</i> , <i>Deroceras</i> sp., <i>Vallonia pulchella</i> , <i>Cepaea nemoralis</i>
Woodlands	<i>Cochlodina laminata</i> , <i>Discus rotundatus</i> , <i>Vitrea crystallina</i> , <i>Cepaea nemoralis</i>

Table 6.15: The environments inferred from the mollusc species recorded from Cauliflower Pit and Seven Kings. Habitat references from Ellis (1926, 1978), Quick (1933), Macan (1949), Bishop (1976), Kerney and Cameron (1979), Kerney (1999).

Mammals

Table 6.16 lists the species recorded from Cauliflower Pit during this study. All of Hinton's and a 'large part' of Corner's collection were recovered from the Cauliflower Pit (Hinton, 1900b). The specimens from Hinton's collection were included in the

following analyses (Table 6.16), however Corner's collection was not included due to the difficulty in indentifying the specimens that could definitely be provenanced to the Cauliflower Pit. Only 19 specimens from Corner's collection were recognised and they included *U. arctos* (brown bear), *M. trogontherii*, (steppe mammoth, late form) *P. leo* (lion), *S. hemitoechus*, *C. elaphus* (red deer), and Bovidae sp. (large bovid). The specimen of *M. trogontherii* strongly suggests that at least this specimen from the Corner collection came from the Mucking Terrace in Uphall, as this species is unknown from other late Middle Pleistocene interglacials (Schreve, 2001a; Lister and Sher, 2001).

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Carnivora			
<i>Panthera leo</i> (L.), lion	1	5.26	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	9	47.37	4
<i>Stephanorhinus hemitoechus</i> (Falconer), narrow-nosed rhinoceros	1	5.26	1
<i>Stephanorhinus kirchbergensis</i> (Jäger), Merck's rhinoceros	1	5.26	1
Rhinocerotidae sp. undetermined rhinoceros	1	5.26	1
Artiodactyla			
<i>Cervus elaphus</i> L., red deer	2	10.53	1
cf. <i>Cervus elaphus</i>	1	5.26	1
Bovidae sp. undetermined large bovid	3	15.79	1
Total	19		

Table 6.16: Species recorded from Cauliflower Pit

Hinton (1900b) recorded several species that were not identified during this study including *Canis lupus* (wolf), *Ursus arctos*, *Palaeoloxodon antiquus* (straight-tusked elephant), *Mammuthus primigenius* (woolly mammoth), *Megaloceros giganteus* (giant deer), *Capreolus capreolus*, (roe deer), *Bos primigenius* (aurochs), and *Bison priscus* (bison). Only *Equus ferus* (horse), *Cervus elaphus*, *Stephanorhinus hemitoechus*, *Stephanorhinus kirchbergensis* were identified during this study from the Hinton collection.

Although small, the assemblage is generally representative of open environments, with *S. hemitoechus*, *E. ferus*, Bovidae sp., all predominantly being grazers and inhabiting

grasslands. Woodland environments are also indicated by the presence of *S. kirchbergensis*. The significance of lion is discussed in section 6.3.8.

6.3.7 Archaeology

Wymer (1968) and Roe (1968a) refer to one artefact from Cauliflower Pit, which was also analysed in this study (British Museum, no. 592), although many more were described from the pit by Hinton (1900b) and Johnson (1900), including two flakes from the ‘lowest shell-bed’, suggesting that it was found in the sand overlying the fluvial basal gravels (Hinton, 1900b p.275). An additional 22 artefacts from near the Cauliflower Pit, north of Ilford High Road and the railway, have been located in this study (Table 6.17). Wymer (1985) listed a handaxe found in the Seven Kings area of Ilford, held at the British Museum, although this has not been identified during this study.

Implement	Number of artefacts	% of assemblage
Handaxes	8	36.36
Flakes (total)	13	59.09
Levallois flakes	5	22.73
Probable Levallois flakes	0	0.00
Retouched Levallois flakes	0	0.00
Retouched non-Levallois flakes	2	9.09
Cores (total)	1	4.55
Levallois cores	0	0.00
Unidentified worked flint	0	0.00
Total implements	22	

Table 6.17: Implements identified from near Cauliflower Pit, Ilford

No artefacts from the assemblage were unabraded, suggesting none were *in situ*, despite the description of at least two flakes being found in the sands overlying the fluvial gravels (Table 6.18). These flakes have not been identified in the present study.

Level of abrasion	Number of artefacts	% of assemblage
Fresh	0	0.00
Slightly abraded	1	4.55
Moderately abraded	12	54.55
Heavily abraded	9	40.91
Total	22	

Table 6.18: Level of abrasion exhibited by the implements from in and around Cauliflower Pit, Ilford

6.3.8 Age of Deposits

Lithostratigraphy

The Cauliflower Pit deposits lay at 13.41m OD (Hinton, 1900b), clearly at a higher elevation than the Uphall Pit deposits at 9.14m OD (Dawkins, 1867a) and around 6-7m OD (Rolfe, 1957), suggesting that the two sites represent separate terraces and are therefore of different ages. This was first noted by Kennard and Woodward (1900) and later followed by Rolfe (1957). The Uphall deposits are widely attributed to Mucking Formation, on the basis of their elevation and faunal assemblages (see Chapter 7.1) (Bridgland, 1994; Schreve, 1997, Schreve, 2001a, 2001b). The interglacial deposits at Purfleet, further downstream in the Lower Thames and a site now widely accepted as belonging to the Corbets Tey Formation and MIS 9 (Schreve *et al.*, 2002; Schreve, 2004b) range from 7-15m OD and occupy a similar height range to those at Cauliflower Pit. However, the interglacial deposits at the Lion Pit Tramway cutting, West Thurrock and Aveley, both considered to relate to MIS 7 (Schreve, 2004c; Schreve *et al.*, 2006) are also recorded up to 15m OD. The similar height ranges occupied by Purfleet and Aveley are thought to result from Purfleet's position downstream of Aveley (Schreve *et al.*, 2002). During the period when the deposits at Purfleet were aggraded, the Thames flowed through a loop near South Ockendon, thereby extending the distance between Purfleet and Aveley by several kilometres, despite their present close geographic proximity (Schreve, 2004b). The difference in elevation between the Mucking and Corbets Tey Formations in Ilford is not large, due to the Mucking Gravel at the site representing the back edge of the lower terrace and the Corbets Tey Gravel representing the leading edge of the upper terrace (Bridgland, 1994). This may also explain that modest difference in height between the Cauliflower Pit and Uphall Pit deposits in the Ilford area. Significantly, the Cauliflower Pit deposits are clearly separate from the

Boyn Hill/Orsett Heath deposits at Swanscombe, which occupy a height range of 22.5-35.5m OD.

The interglacial deposits at Cauliflower Pit occupy a similar height range to those observed at Hackney Downs in the Nightingale Estate, which lie between 13 and 17m OD (Section 6.2). These deposits have also been attributed to the Lynch Hill/Corbets Tey Formation and are geographically closer to the Ilford Cauliflower Pit site than the other Lower Thames sites discussed above. This interpretation is at odds with that of Gibbard (1994), who proposed these sediments as the stratotype for the newly characterised, 'Ilford Sands and Silts'. He proposed that these post-dated the underlying Mucking Gravel and pre-dated the 'brickearth', which he correlated with the Langley Silt Complex, assigning an age within the Ipswichian interglacial to the temperate-climate sediments.

Biostratigraphy

Pollen

The pollen assemblage at Seven Kings was considered similar to the sequences from Bobbitshole, Ipswich, the type site for the Ipswichian interglacial (West, 1957) and Selsey (West and Sparks, 1960). It was consequently correlated with Grays, Erith and Crayford, on the basis of the similar pollen sequences at these sites (West *et al.*, 1964). However, the close proximity of Seven Kings to the location of Cauliflower Pit, could imply that they contain sediments deposited by the same river, and thus may both correlate with the Corbets Tey Formation (MIS 10-9-8).

Molluscs

Corbicula fluminalis shells, apparently from the Uphall area of Ilford, were analysed by Miller *et al.* (1979). An average amino acid ratio of 0.23 ± 0.038 was obtained, although one as high as 0.28 and one as low as 0.19 were also recorded. In the same study, ratios were obtained from Crayford (0.19 ± 0.024) and Aveley (0.19 ± 0.023). It is therefore likely from the range of ratios obtained that the shells tested were not all from the Uphall Pit, particularly when the spread of ratios is compared with the most consistent ones from well-established MIS 7 sites such as Crayford and Aveley. It is thus possible that the higher ratios came from shells obtained from the Corbets Tey Formation. The shells tested were taken from the Kennard collection in the Natural History Museum

and it is known that he looked at assemblages from both terraces, possibly leading to conflation of Ilford samples (Kennard and Woodward, 1900).

Bowen *et al.* (1989) analysed *Bithynia tentaculata* shells from a 'shelly bed' in Ilford. These shells produced an amino acid ratio of 0.23 ± 0.02 , almost identical to the average calculated by Miller *et al.* (1979). This is a much higher ratio compared to the ratios obtained from *B. tentaculata* shells from Aveley (0.148 ± 0.016) and Crayford (0.170 ± 0.02), again suggesting that the 'shelly bed' sampled represented a pre-MIS 7 age deposit, most likely within the Corbets Tey Formation.

Keen (2001) identified abundant specimens of *B. marginata* and *C. fluminalis* at MIS 9 sites, including Purfleet, Belhus Park (Bridgland, 1994; Schreve, *et al.*, 2002; Schreve, 2001a, 2004b, 2004c) and Hackney Downs (Bridgland, 1994; Green *et al.*, 2006). The assemblages from Purfleet and Hackney Downs also contained smaller numbers of *Pisidium clessini* and *Unio crassus*, both of which became extinct after MIS 9 (Preece, 1999). Although these species were found in the above MIS 9 sites and are considered significant components of the assemblages, it was not possible to characterize MIS 9 molluscan assemblages in more detail due to the few MIS 9 sites available for study. The assemblages from Cauliflower Pit did not contain either *B. marginata* or *U. crassus*, and *P. clessini* and *C. fluminalis* were only recorded by Kennard and Woodward (1900), and not by West *et al.* (1964). This suggests that some of the components of MIS 9 mollusc assemblages were present in Cauliflower Pit, but unfortunately some of the molluscan characteristics of MIS 9 sites are not understood sufficiently to use as biostratigraphic markers. However, the absence of *B. marginata* and presence of *C. fluminalis* contradict an MIS 5e date (Keen, 1990, 2001; Bridgland, 1994; Meijer and Preece, 1995).

Mammals

Unfortunately the limited mammal assemblage that can be confidently attributed to the Cauliflower Pit does not contain enough biostratigraphical marker species to differentiate between MIS 9 or MIS 7. Significantly, the small assemblage does not contain the indicator species from MIS 11, such as *Ursus spelaeus* (cave bear) or *Dama dama clactoniana* (large fallow deer). Several factors suggest against a Last Interglacial age, namely an absence of hippopotamus and the presence of Merck's rhinoceros, horse

and humans (indicated by artefacts) (Currant, 1989; Sutcliffe, 1995; Schreve, 2001a; Currant and Jacobi, 2001). The assemblage also does not appear to represent the early part of MIS 7, as characterised in the Ponds Farm MAZ in Aveley, where *S. kirchbergensis*, and *S. hemitoechus* are absent (Schreve, 2001a).

E. ferus, *S. kirchbergensis*, *S. hemitoechus*, *C. elaphus*, and Bovidae sp. are all present during both MIS 9 in the Purfleet MAZ and the Sandy Lane MAZ in Aveley representing the latter part of MIS 7 (Schreve, 2001a), and so do not help in identifying the age of Cauliflower Pit. Lion is a significant component of the Sandy Lane MAZ, however, it is only tentatively indicated in MIS 9 from this single specimen from Cauliflower Pit from the Hinton Collection (Schreve, 2001a). Generally, the specimens included in this study were assigned to Cauliflower Pit based on putative provenance information, and therefore this is not a suitable, or large enough dataset, to use biostratigraphically.

Archaeology

The archaeology cannot be used to suggest an age for the deposits seen in Cauliflower Pit, as none were unabraded and clearly *in situ*, despite two flakes being described from the sands overlying the fluvial gravels (Hinton, 1900b).

6.4 Creffield Road, Acton

6.4.1 Introduction

Creffield Road, Acton, became a renowned Palaeolithic site in the late 19th century when excavations during house building revealed hundreds of stone tools, including Levallois material. The site was discovered by the antiquarian John Allen Brown, who published extensive details of the site and finds. Due to the large number of finds and their frequently fresh condition, Brown called the site a ‘Palaeolithic workshop’ or a Palaeolithic ‘working floor’, a popular term at the time used to describe a palaeo-landsurface used by hominins (Brown 1886, 1887a, 1889a). The ‘floor’ lies on top of the Lynch Hill Gravels at *ca.* 28m O.D. The gravels and the ‘floor’ archaeology are overlain by the Langley Silt Complex (Gibbard, 1985). Brown’s meticulous recording of the finds, site locations and stratigraphies can be credited for the great detail revealed by the site today and its reputation as one of the most notable Levallois sites in Britain.

6.4.2 Location of collections

Artefacts were observed from the Sturge (ex. Brown), Hayward and Marsden Collections in the British Museum, the Brown and Lloyd collections in the Museum of London and the Sadler collection in Gunnersbury Park Museum.

6.4.3 History of Research

The discovery of Palaeolithic artefacts was first recorded from Creffield Road in 1884 by J.A. Brown and he continued cataloguing finds until 1905. Brown mainly collected artefacts from four pits located on the corner of Masons Green Lane (now Twyford Avenue) and Creffield Road. He identified an artefact-rich horizon approximately 1.8m from the ground surface that he called the Palaeolithic 'working floor'. Brown published extensively on the site, including the stratigraphy and the finds (Brown, 1886, 1887a, 1889a). Antiquarians continued to study the area with Hayward collecting between 1900-1910 at the school site Haberdashers' Aske Girls' School, now The Japanese School (see Figure 6.20) (one artefact dated to 1910 and an archived sketch in the British Museum of the site dated to 1900) and Marsden recording finds in 1927-28. Both Hayward and Marsden collected at approximately the same stratigraphic horizon as Brown, ca. 1.8m (6 feet) (pit location sketch by Haward in the British Museum; Marsden, 1927).

Further excavations by the London and Middlesex Archaeological Society and G. de G. Sieveking in the area took place in 1974-1975 when the Haberdashers' school vacated the Acton building (Figure 6.21). Resistivity surveying and trenching revealed the area excavated by Brown, which had since been infilled with late nineteenth century glass and other refuse from the period. The main trench revealed archaeology similar to that recorded by Brown in undisturbed material (Burleigh, 1976). The results of the excavation were not fully published and no evidence for pollen, molluscan or other faunal remains was found. Most of the finds were later prehistoric and only a small amount of Levallois material was recovered.

Demolition of an annexe on the school site in 1988 led to excavations by the Museum of London's Department of Greater London Archaeology (now Museum of London Archaeology/MOLA) (Bazely *et al.*, 1991) (Figure 6.21). Although a similar

stratigraphy was recorded compared to Brown's, only one Levallois flake was discovered along with several flint pieces characteristic of the Mesolithic. It was suggested that the surface of the Lynch Hill Terrace was not stable and therefore identifying the exact position of Brown's 'working floor' was complex (Bazely *et al.*, 1991).

Wymer (1968), Roe (1968a), and the Southern Rivers Project (Wessex Archaeology, 1996), summarised the location of the excavations at Creffield Road and the number and type of artefacts provenanced to the site. The most recent research on the material from Creffield Road, including detailed analyses of the Levallois material recovered, was carried out by Scott (2006) and summarised by White *et al.* (2006).

6.4.4 Location of Sites

Brown collected from four pits on the corner of Creffield Road and Mason's Green Lane (now Twyford Avenue) from the mid-1880s. Brown stated that the four pits were excavated in the gardens of the house next to St. Barnard's Vicarage (the house on the corner) (Brown, 1889a) (Figure 6.21). Pits 2 and 3, which produced the vast majority of the artefacts in Brown's collection, were 6.10m to the west of Pit 1 and merged together to create a pit 9.14 x 3.66m in size. Pit 4 was 1.83m south of Pit 3 (Brown, 1887a).

Brown (1887a) described preparing a ground plan of the area but unfortunately it is not included in his publications, although he stated that the area where the pits were excavated is 'to a large extent included in the gardens of the two villas, St. Barnard's and the adjoining house on the west' (Brown, 1899a). Hayward sketched a map of the locations he collected from during the early 1900s, and included the pit locations visited by Brown (sketch map held in the Sturge Collection, British Museum). Between 1899 and 1901 construction began on the new site for Haberdashers' Aske Girls' School (now The Japanese School) that exposed the same deposits and more artefacts (Figure 6.21).

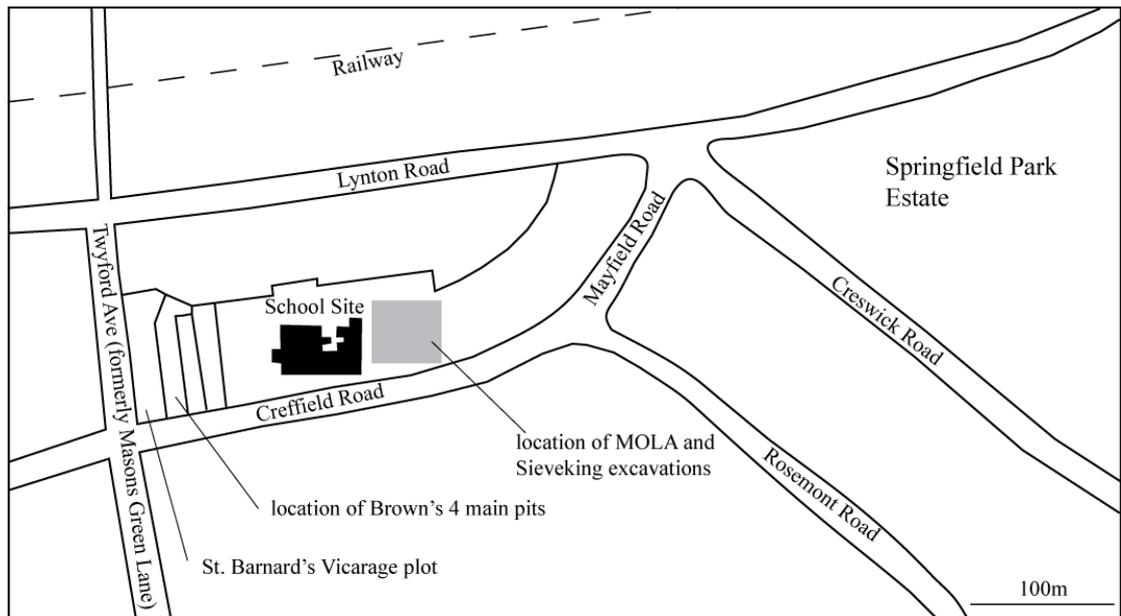


Figure 6.21: Location of excavations in Creffield Road. Based on OS 1:10560 London 1896-97 and 1920 versions

Artefact notation by Brown shows that he also collected from other sites in the immediate area. Several artefacts were attributed to a fifth pit and four artefacts were found in the foundation of a house 18.29m south of this pit. Brown also referred on artefact labels to 'E Pit'. Other, mostly unlocated, find sites mentioned on artefact notations are 'Pit 8', 'public library extension', 'Springfield, Creffield Road' (this is probably close to the Haberdashers' Aske School location as it was built on the Springfield Estate), 'Collins Brickfield, Green Lane', 'C.E.P. Pool site, Springfield'. The last site was described as 30.48-36.58m south of the pits. It is likely that the Creffield Road implements labelled by Brown with no fixed location are probably from the original house foundation excavations in the St. Barnard's area, particularly as the dates recorded are around 1885-1886, consistent with the major period of construction.

6.4.5 Stratigraphy

Brown (1886, 1887a) recorded the following stratigraphy from Pit no. 2 (Figure 6.22):

- 6) Modern soil
- 5) Gravel or 'Trail'
- 4) 'Brickearth'

- 3) Sandy loam
- 2) Palaeolithic 'working floor' in bleached pebbles at 1.83m from surface (Majority of archaeology collected from this horizon).
- 1) Series of thin seams of sand, gravel and 'black' seams. Palaeolithic artefacts found 3.35-3.66m and 2.44m from surface.

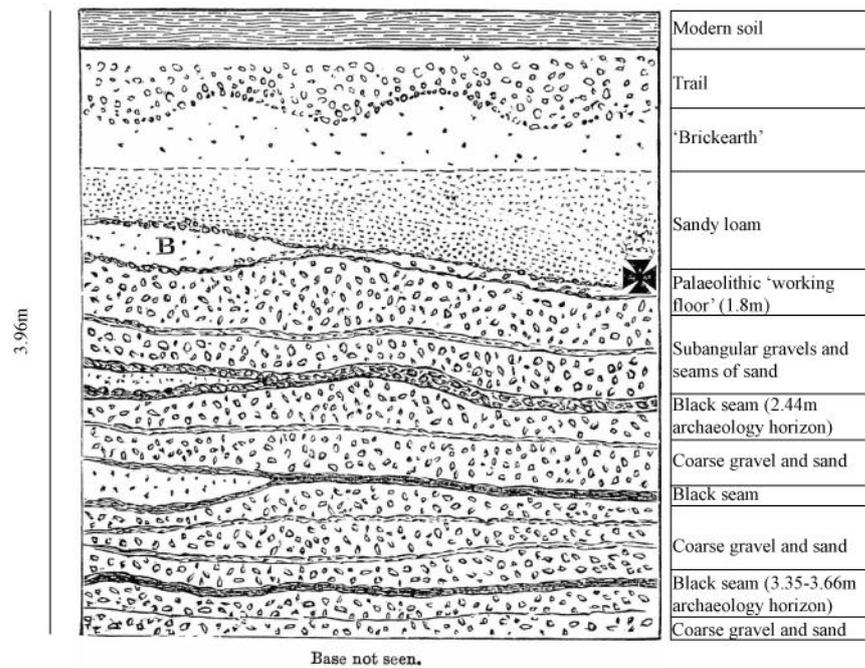


Figure 6.22: Stratigraphy recorded at Creffield Road (Pit no. 2) (adapted from Brown, 1886)

A similar stratigraphy was recorded by Bazely *et al.* (1991) at the School Site with 4 units (A-D) recognised (Figure 6.23).

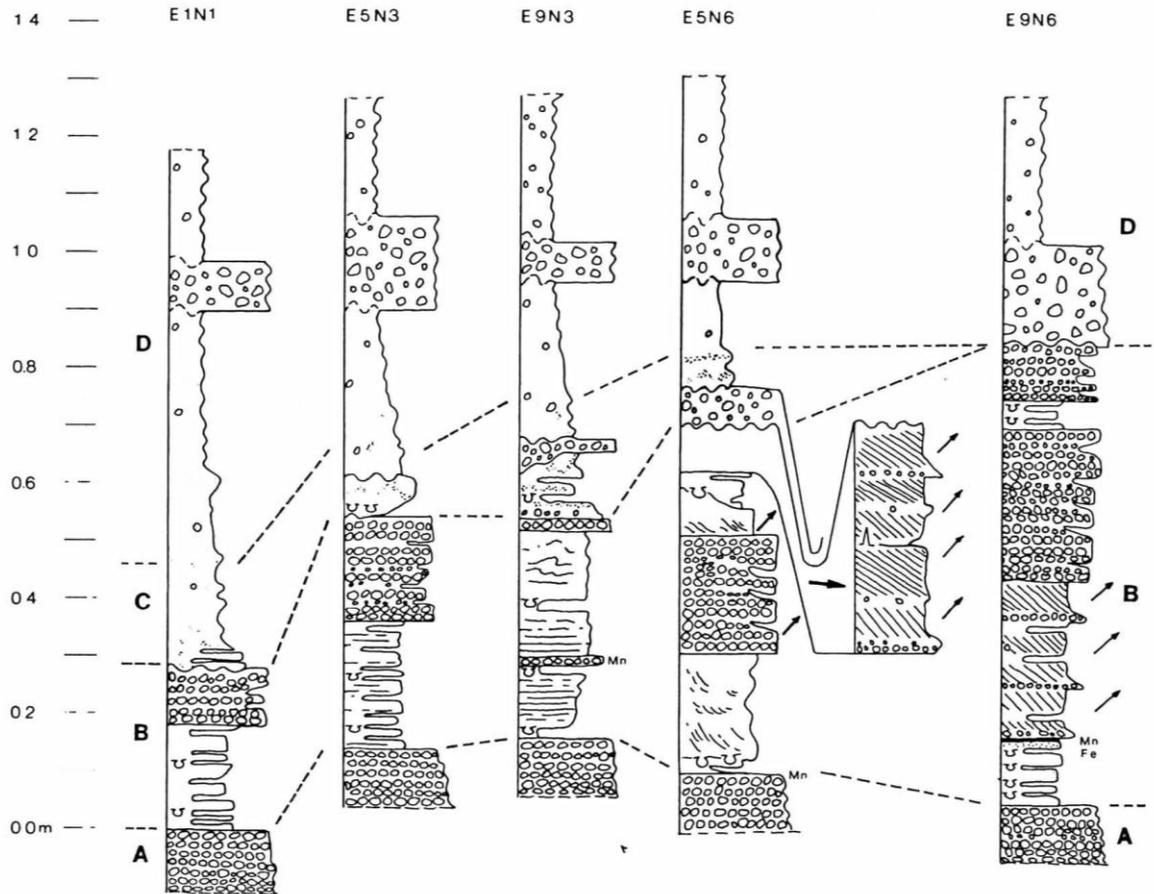


Figure 6.23: Stratigraphy recorded at the School Site at each excavation pit, showing palaeocurrents (Bazely *et al.*, 1991)

A) **Lynch Hill Gravels** (<28m OD). The gravels were well-bedded with occasional sand sub-units.

B) **Continuation of Lynch Hill Gravels** (ca. 0.3m thick). Poorly sorted gravel, sand and clay, rapidly deposited under cool climate conditions. The horizon contained frequent erosional features and fluctuations in flow with rapidly changing sediment textures. Cross-bedding towards the NNE was recorded. In the upper part of this horizon there is evidence for a channel cutting into the underlying sediments with stronger cross-bedding indicating flow towards the east. A manganese and iron pan was recorded in one pit at the School Site that was suggested to be a diagenetic replacement of a calcareous or organic lag in the channel bottom.

C) **Gravels, sands, clays and silts** (ca. 0.2m thick). This horizon contained fluvial sediments that were occasionally laminated. The bed was disturbed by cold climate mass movement and cryoturbation. The base of the deposit sloped into the underlying

horizon in a SSW direction. Gibbard (1985) suggested that a cryoturbated horizon is common in West London overlying the Lynch Hill Gravel and underlying the subaerial deposits. The slope towards the SSW is consistent with the regional pattern of the Thames incising the valley to the south of the site.

D) **Langley Silt Complex** (ca. 0.6m thick). The Langley Silt Complex is predominantly composed of silts with some gravel and sand. This deposit is the equivalent of Brown's sandy loam and 'brickearth' horizons, which reflect the upward reduction in sand in the unit. The silt is largely aerial in origin but with some evidence of mass movement and slope wash. A gravelly diamicton (ca. 0.1m thick) was recorded within this horizon, reflecting the 'trail' observed by Brown and interpreted as a solifluction deposit (Bazely *et al.*, 1991)

6.4.6 Archaeology

Brown's Palaeolithic 'working floor' was the most prolific archaeological horizon. It was recorded by Brown at 6 feet (1.8m) from the surface just below the 'brickearth' with artefacts resting on the surface of the gravels and often with residue of the silts from the Langley Silt Complex on their upper surface. Two other levels produced archaeology but to a much lesser degree; 'eight or ten worked unabraded flakes' were found 8 feet (2.44m) below the surface (Brown, 1887a p57), and two implements were found at 11-12 feet (3.35-3.66m) from the surface (Brown, 1887a). Artefacts from the Palaeolithic 'working floor' were fresh, indicating they had experienced no disturbance since they were discarded. It was their fresh condition that led Brown to name the horizon a 'Palaeolithic working floor' or 'Palaeolithic workshop', suggesting the implements had been produced or used at the exact site at which they were discovered (Brown, 1886, 1887a, 1889a).

The three horizons containing implements, particularly the Palaeolithic 'working floor', contained 'black matter', which Brown recorded as manganese staining and attributed to the decay of vegetation, although it is likely that this was precipitated in rising groundwater. In some areas, the manganese was not always visible but instead the archaeological horizon could be identified by pebbles whitened on their upper surface and coated in clay at the equivalent depth. Brown (1886, 1887a, 1889a) suggested that these seams represented old land surfaces due to the length of exposure required to bleach the pebbles on their upper surface.

The analyses carried out by Scott (2006) indicated that the site of Creffield Road was used differently to other early Middle Palaeolithic sites with local sources of raw material. It was clear that initial core working occurred in some areas, as represented by the presence of very large cortical debitage, particularly in the St. Barnard's site, although the School Site lacked the large debitage. However, it was found that both sites contained heavily-reduced Levallois cores, which is highly unusual wherever raw material is readily available. Other early Middle Palaeolithic sites that also have abundant of raw material do not contain these heavily-reduced cores, since cores are discarded once their ability to produce Levallois flakes is compromised. Significantly, the Creffield Road assemblage predominantly consisted of large Levallois flakes that clearly could not have been produced from these heavily-reduced cores. Therefore it was concluded that the cores discarded at Creffield Road must have been transported from elsewhere. Scott also noted that other implements produced during the complete knapping process were missing at Creffield Road, such as débordant flakes that result from the production of Levallois points using convergent unipolar preparation. The lack of these knapping products reflects the fact that the Levallois points from Creffield Road must have been produced elsewhere. Scott (2006) also highlighted a proportion of the modified flakes from Creffield Road with thinned butts, suggesting that they had been hafted. It was concluded that the hominins were moving cores around the landscape in order to make new tools at further sites that might not have had local raw material sources. Hominins were also carrying finished Levallois points and hafted points to be prepared at the future activity sites for the purpose of food procurement and preparation. Scott (2006) further suggested that the terrace surface would have been exposed after downcutting during MIS 8, providing a suitable observation post across the Thames valley from which prey movements could be tracked and implying a high degree of anticipatory behaviour.

During this study, 888 artefacts from Creffield Road were recorded (Table 6.19). The assemblage analysed includes all artefacts collected by Brown and labelled from Creffield Road. Haward's collection containing nine flakes, eight of them Levallois and one non-Levallois from Montague Gardens (road adjoining Creffield Road) have also been included, since Haward was actively collecting in the area at the same time as Brown and the two collections are similar in condition. The artefacts from the Marsden,

Sadler, Lloyd and Sieveking (the later prehistoric artefacts excluded) collection are also included based on the similar preservation and tool types as Brown's collection.

Implement	Number of artefacts	% of assemblage
Handaxes	3	0.34
Flakes (total)	859	96.73
Levallois flakes	324	36.49
Probable Levallois flakes	146	16.44
Retouched Levallois flakes	5	0.56
Retouched non-Levallois flakes	4	0.45
Cores (total)	24	2.70
Levallois cores	23	2.59
Hammerstones	2	0.23
Total implements	888	

Table 6.19: Artefacts from Creffield Road, Acton

The work of Scott (2006) indicated that, when compared with experimentally-generated data (eg. Schick, 1987), much of the smaller material such as debitage is under-represented at both the St. Barnard's and the School Site. This reflects the collecting by workmen who may not have recognised or gathered the smaller material.

The whole assemblage was predominantly moderately abraded (48.31%) and slightly abraded (36.37%) (Table 6.20). The mixed nature of the degrees of abrasion exhibited by the assemblage reflects the variety of sediments in which the objects were discovered. A detailed account of the artefacts from the Lynch Hill Gravel, the Palaeolithic 'working floor' and the Langley Silt Complex follows.

Level of abrasion	Number of artefacts	% of assemblage
Fresh	80	9.01
Slightly abraded	323	36.37
Moderately abraded	429	48.31
Heavily abraded	56	6.31
Total	888	

Table 6.20: Degree of abrasion exhibited by the artefacts from Creffield Road, Acton

Artefacts from the Lynch Hill Gravel

Sixteen implements can be attributed to the 3.35-3.66m (11-12ft) horizon described by Brown from the artefact annotations. Two of these are handaxes and the remainder are flakes, including five Levallois flakes. They exhibit a range of abrasion levels from slight to heavy and most exhibit orange and brown staining and patination.

Five artefacts can be directly linked to the 2.44m (8ft) horizon in the Lynch Hill Gravels that Brown recorded as containing archaeology. All are identified as flakes, slightly stained with an orange and brown colour and are moderately-heavily patinated. They exhibit slight-heavy levels of abrasion and four are Levallois flakes with faceted butts. Scott (2006) suggested that this seam may represent a local, lower continuation of the Palaeolithic ‘working floor’ based on the similarity of the artefacts found at both depths such as definite Levallois flakes. It is also possible that these implements represent a slightly earlier Levallois activity at a site elsewhere, after which they were transported to Creffield Road in the river gravels. Wymer (1968) suggested that the rolled Levallois implements must come from these two lower levels identified by Brown.

The orange and brown staining in this deposit is consistent with Brown’s description of finding ochreous implements from the gravels (Brown, 1886, 1887a). The varying degrees of abrasion are also consistent with gravel deposited under cool conditions, depending on how far each implement had been transported.

Artefacts from the Palaeolithic ‘working floor’

It was possible to attribute 248 artefacts to the Palaeolithic ‘working floor’ based on their labels directly stating the ‘floor’ or a depth of 5-6ft. The vast majority of the assemblage consisted of flakes (95.16%) which included 97 definite Levallois flakes with a faceted butt (Table 6.21 and Figure 6.24).

Implement	Number of artefacts	% of assemblage
Handaxes	0	0.00
Flakes (total)	236	95.16
Levallois flakes	97	39.11
Probable Levallois flakes	54	21.77
Retouched Levallois flakes	3	1.21
Retouched non-Levallois flakes	1	0.40
Cores (total)	12	4.84
Levallois cores	12	4.84
Hammerstones	0	0.00
Total implements	248	

Table 6.21: Artefact types definitely attributed to the Palaeolithic ‘working floor’, Creffield Road, Acton

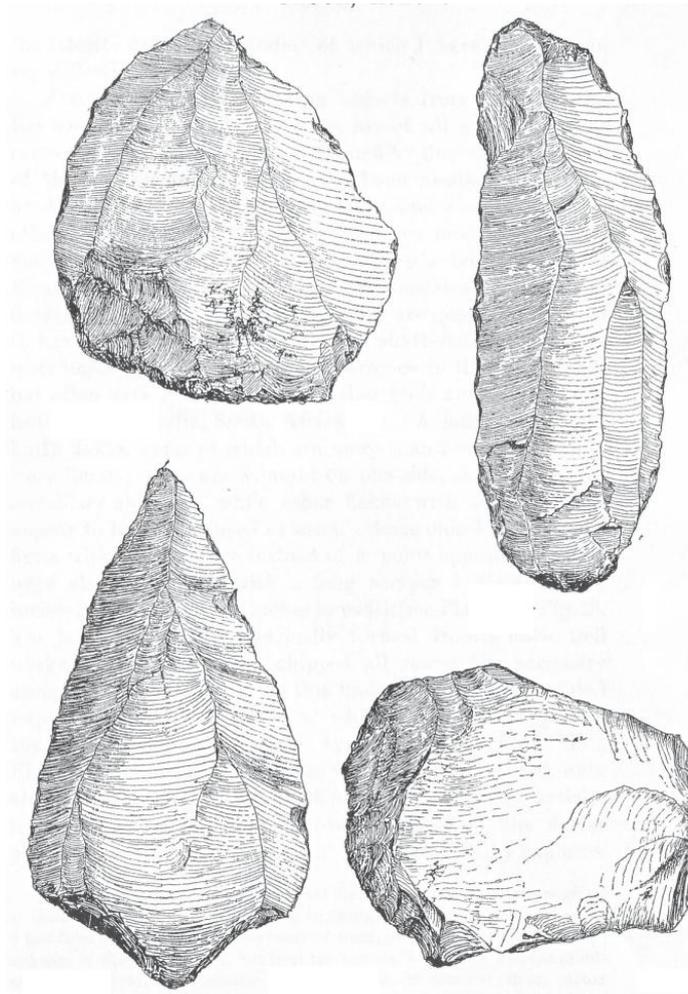


Figure 6.24: Examples of artefacts from the Palaeolithic ‘working floor’, Creffield Road, Acton (From Brown, 1889a)

The majority of implements from the Palaeolithic ‘working floor’ exhibited low levels of abrasion with 68.55% of the assemblage exhibiting slight abrasion and 27.42% remaining unabraded (Table 6.22). This is consistent with Brown’s description of the unabraded and sharp finds within the Palaeolithic ‘working floor’ (Brown, 1886, 1887a, 1889a) and echoed by Scott (2006) who also found that the assemblages were predominantly unabraded. No heavily abraded artefacts from the Palaeolithic ‘working floor’ have been identified in this study or in previous studies (Brown, 1885, 1886, 1887a, 1889a; Burleigh, 1976; Bazely *et al.*, 1991; Scott, 2006). The presence of slightly and moderately abraded artefacts from the Palaeolithic ‘floor’ does suggest that the material has been moved slightly since it was abandoned. Only two implements have been found to refit with each other suggesting that there must have been some movement or mixing of the assemblage. The lack of refitting examples may also be a

result of some stages of the production process not being carried out at Creffield Road (Scott, 2006). However, mixing and movement of the implements is considered to be limited as Brown described finding the artefacts ‘in little heaps’ (Brown, 1887a, 60). Unless these are natural taphonomic accumulation, this would perhaps argue against the heaps containing much derived material (Bazely *et al.*, 1991). Bazely *et al.* (1991) also drew attention to Brown’s rolled material from the gravel and its typological similarity to the fresher ‘floor’ assemblage. These authors argued that this reflects the complex nature of the Palaeolithic ‘floor’ and that distinguishing its exact position within the underlying gravel body can be problematic. They suggested that the material was originally discarded at the site but in a braided stream system, thereby explaining the abraded nature of some implements from the assemblage, some of which were displaced further by erosional processes.

Level of abrasion	Number of artefacts	% of assemblage
Fresh	68	27.42
Slightly abraded	170	68.55
Moderately abraded	10	4.03
Heavily abraded	0	0.00
Total	248	

Table 6.22: Degree of abrasion exhibited by artefacts from the Palaeolithic ‘working floor’, Creffield Road, Acton

Brown (1887a) recorded artefacts from the Palaeolithic ‘working floor’ as varied in their patination. Some were fully patinated and white, some were stained brown and orange from the Langley Silt Complex above and some were still black or grey like the original flint. Within this study, no unpatinated artefacts were recorded directly from the ‘floor’ but there was a wide variation in the level of patination and colour, which ranged from a grey white to fully white (Table 6.23). Brown suggested that the different patination levels and staining reflected the position that the individual artefacts were buried in and not varying ages. He believed that the patinated lithics had been exposed and bleached on a palaeo-landsurface (Brown, 1887a).

Level of Patination	Number of artefacts	% of assemblage
Heavily patinated	84	9.46
Moderately patinated	133	14.98
Slightly patinated	31	3.49
Unpatinated	0	0.00
Total	248	

Table 6.23: Level of patination exhibited by the artefacts from the Palaeolithic ‘working floor’, Creffield Road, Acton

Artefacts from the Langley Silt Complex

It was possible to attribute 16 abraded flakes to the Langley Silt Complex or near the surface, based on their artefact labels (Table 6.24 and 6.25). Six were identified as Levallois flakes, echoing the research by Wymer (1968) who also identified rolled Levallois flakes from this horizon. He suggested that the three horizons containing Levallois implements (gravel, the ‘floor’ and the Langley Silt Complex) were unlikely to be widely separated in time. However, due to the abraded nature of the flakes within the Langley Silt Complex, it is possible that the artefacts were derived from older deposits, particularly when considering the Langley Silt Complex is Devensian in age (Gibbard, 1985; Gibbard *et al.*, 1987; Rose *et al.*, 2000).

Implement	Number of artefacts	% of assemblage
Handaxes	0	0.00
Flakes (total)	16	100.00
Levallois flakes	6	37.50
Probable Levallois flakes	0	0.00
Retouched Levallois flakes	0	0.00
Retouched non-Levallois flakes	1	6.25
Cores (total)	0	0.00
Levallois cores	0	0.00
Hammerstones	0	0.00
Total implements	16	

Table 6.24: Artefacts found within the Langley Silt Complex, Creffield Road, Acton

Level of abrasion	Number of artefacts	% of assemblage
Fresh	0	0.00
Slightly abraded	6	37.50
Moderately abraded	9	56.25
Heavily abraded	1	6.25
Total	16	

Table 6.25: Degrees of abrasion exhibited by the artefacts found within the Langley Silt Complex, Creffield Road, Acton

6.4.7 Age of Site

The area is mapped as Lynch Hill gravels (MIS 10-9-8) (British Geological Survey, 1998; 2006; Gibbard, 1985; Bazely *et al.*, 1991). According to Brown (1886, 1887a, 1889a), the Palaeolithic ‘working floor’ rests on top of the gravels and underlies the ‘brickearth’, suggesting that the artefacts post-date the final accumulation of the Lynch Hill Terrace. Ashton *et al.* (2003) proposed that since the artefactual material rested directly on the surface of the gravel and was not overlain by a temperate soil on the terrace surface, an age within late MIS 8 or early MIS 7 is indicated. Since no

palaeoenvironmental proxy information was recorded from any excavation, it is impossible to say whether they were buried under a cool or temperate climate (Scott, 2006; White *et al.*, 2006).

The more abraded artefacts found lower down in the stratigraphy within the gravels are at least the age of the Lynch Hill Gravels, if not older, particularly the more heavily abraded implements. The gravels contained Levallois artefacts which are thought to date from as early as MIS 8 at Purfleet within the Corbets Tey Gravel, the Lower Thames equivalent of the Lynch Hill Gravel (Schreve *et al.*, 2002).

The artefacts found within the Langley Silt Complex are younger than the Palaeolithic ‘working floor’ material. The deposit is largely considered to date from the Devensian (Gibbard, 1985; Gibbard *et al.*, 1987; Rose *et al.*, 2000), whereas nearly 38% of the assemblage comprises abraded Levallois flakes that must pre-date the Ipswichian Interglacial. One ‘bout coupé’ or ‘flat butted cordate’ was found within the ‘brickearth’, which is characteristic of the late Middle Palaeolithic/MIS 3 (Jacobi *et al.*, 1998; White and Jacobi, 2002; Jacobi *et al.*, 2006). This is consistent with the Devensian age attributed to the Langley Silt Complex.

6.5 Yiewsley (incorporating West Drayton and Dawley)

6.5.1 Introduction

Yiewsley and the neighbouring areas of West Drayton and Dawley were prolific gravel extraction and brick making locations in the late 1800s and early 1900s, and attracted the attention of several antiquarians, most notably Robert Garraway Rice and John Allen Brown. During the re-evaluation of all artefacts in museum collections from Yiewsley as part of this research, 4447 artefacts from these localities have been recorded and analysed, representing the first detailed analysis of all Yiewsley Palaeolithic implements since the 1970s. The large number of artefacts found highlights Yiewsley as a significant Palaeolithic occupation site.

6.5.2 Location of Collections

Artefactual collections were seen from the J. A. Brown, Sturge, R. G. Rice, H. W. Seton-Karr, S. H. Warren, Maj. F. Sadler, P. Crooke, W. G. Smith, W. G. Haynes, Col.

Lane-Fox, George Smith, L. Treacher, Department of Greater London Archaeology and Wymer collections at the Museum of London, British Museum, Gunnersbury Park Museum, Wardown Park Museum, Luton, Natural History Museum, Museum of Archaeology and Anthropology, University of Cambridge, Reading Museum, Department of Geography, Royal Holloway University of London, and Hillingdon Museum, Uxbridge.

6.5.3 History of Research

The first record of Palaeolithic artefact collection in Yiewsley is by John Allen Brown in 1882 (from artefact notations). He continued collecting in the area until 1909 and, during this period, published the most detailed account of the stratigraphy from three of the pits in the area; Maynard's, Pipkin's and Eastwood's (Brown, 1895a). He also described a Geologists' Association excursion to the above three pits, as well as Odell's Pit (Brown, 1895b). Brown (1887a) stated their location and provided illustrations of some artefacts collected in Yiewsley. A second Geologists' Association excursion to the pits was reported by Monckton (1904).

Robert Garraway Rice collected in Yiewsley between 1905 and 1929 (from artefact annotations). A small number of artefacts from the Rice collection are marked 1934; however these are labels attached by staff the Museum of London after they received Rice's collection following his death in 1933, presumably labelling previously unmarked artefacts collected after 1929. Unfortunately, Rice did not publish or record any information on the pits he collected from, although each artefact is annotated with the name of the pit from which it was collected from, but only one object has a depth recorded (Clayton's Pit, 18 feet, LAARC Garraway Rice Collection, Artefact number 80.41/2460). It is clear from the labels written by Rice that he acquired artefacts from workmen in the pits with many early labels recording the date he bought the object concerned.

One factor contributing to the end of artefact collection on the scale conducted by both Rice and Brown from the late 1920s was the increasing use of mechanical diggers in gravel pits, which made it more difficult to identify individual stone tools as they emerged from the deposits (Vulliamy, 1930). Brown and Rice were the principal collectors in Yiewsley, although other antiquarians also accumulated implements from

the area. Major Frederick Sadler (the Acton Borough Engineer and Surveyor) collected in Dawley and West Drayton from 1893 until 1911. Thirteen artefacts from the area are held at Gunnersbury Park Museum, which also holds twelve artefacts from Dawley accumulated by local collector Peter Crooke. Crooke often seemed to collect alongside Brown or to donate artefacts to him, as often Brown's artefact labels indicate that Crooke had discovered that particular implement. Brown (1887 p.76) also mentioned that Crooke had allowed him 'free use of his collection'. The artefacts in Crooke's collection from Dawley are undated and lack provenance details, with the exception of one that was found in Odell's Pit.

Lacaille collected in the Yiewsley area in 1934 and 41 artefacts (including some ex-Marsden artefacts) from his collection are now in the British Museum's Sturge Collection. Lacaille collected in Sabey's Pit and also at less prolific sites: Little Wonder Pit, Chapel Lane, and De Salis Pit (see section 6.4.4 for location details). Lacaille published descriptions of Levallois artefacts and the stratigraphy of Yiewsley and noted its similarity to the stratigraphy at Iver, Buckinghamshire (Lacaille, 1936, 1938, 1940). Worthington George Smith collected a small number of artefacts in 1880 and 1881 from gravel used during road building in Willesden that was extracted from Yiewsley (from artefact labels). An undated Levallois core in the Sturge Collection in the British Museum from 'Yiewsley, Boyn Hill Terrace or 100ft terrace' is labelled as 'Ex. Burchell Collection'. This is presumably J.P.T. Burchell, who published work on the Palaeolithic including sites in London in the early 20th century (e.g. Burchell, 1934b, in which he describes the deposits between Acton and West Drayton). Wymer (1968), Collins (1978) and Wessex Archaeology (1996) all list F. N. Haward as a collector in Yiewsley, however it has not been possible to attribute any objects from this area to Haward.

Roe (1968a), Wymer (1968), and Wessex Archaeology (1996) have all published detailed gazetteers on the implements from Yiewsley and the location of the pits. Collins (1972) published the most exhaustive re-analysis of the Yiewsley sites and implements found there. He excavated a new section in what is now Stockley Park Golf Course (See Figure 6.25) and included a detailed stratigraphical description and recorded the first pollen sequence from Yiewsley. Further new excavations were conducted by the Museum of London in 1985 in Stockley Park, Dawley. An Iron Age

site was discovered with Palaeolithic flakes resting on the surface of the gravel terrace (Cotton, 1986). The most recent analysis of the Yiewsley material was undertaken by Scott (2006) and described by White *et al.* (2006), specifically concerning the Levallois material.

Gibbard (1985) attributed the gravels at Yiewsley to the Lynch Hill Terrace of the Middle Thames and this was reaffirmed by the British Geological Survey (1999, 2005).

6.5.4 Location of sites

Yiewsley, West Drayton and Dawley are neighbouring localities and are frequently used interchangeably on artefact labels to describe the same pits. Figure 6.24 shows the location of the pits described in this section. The OS map from 1897 shown in Figure 6.26 shows the location of many of the brick pits labelled in Figure 6.25.

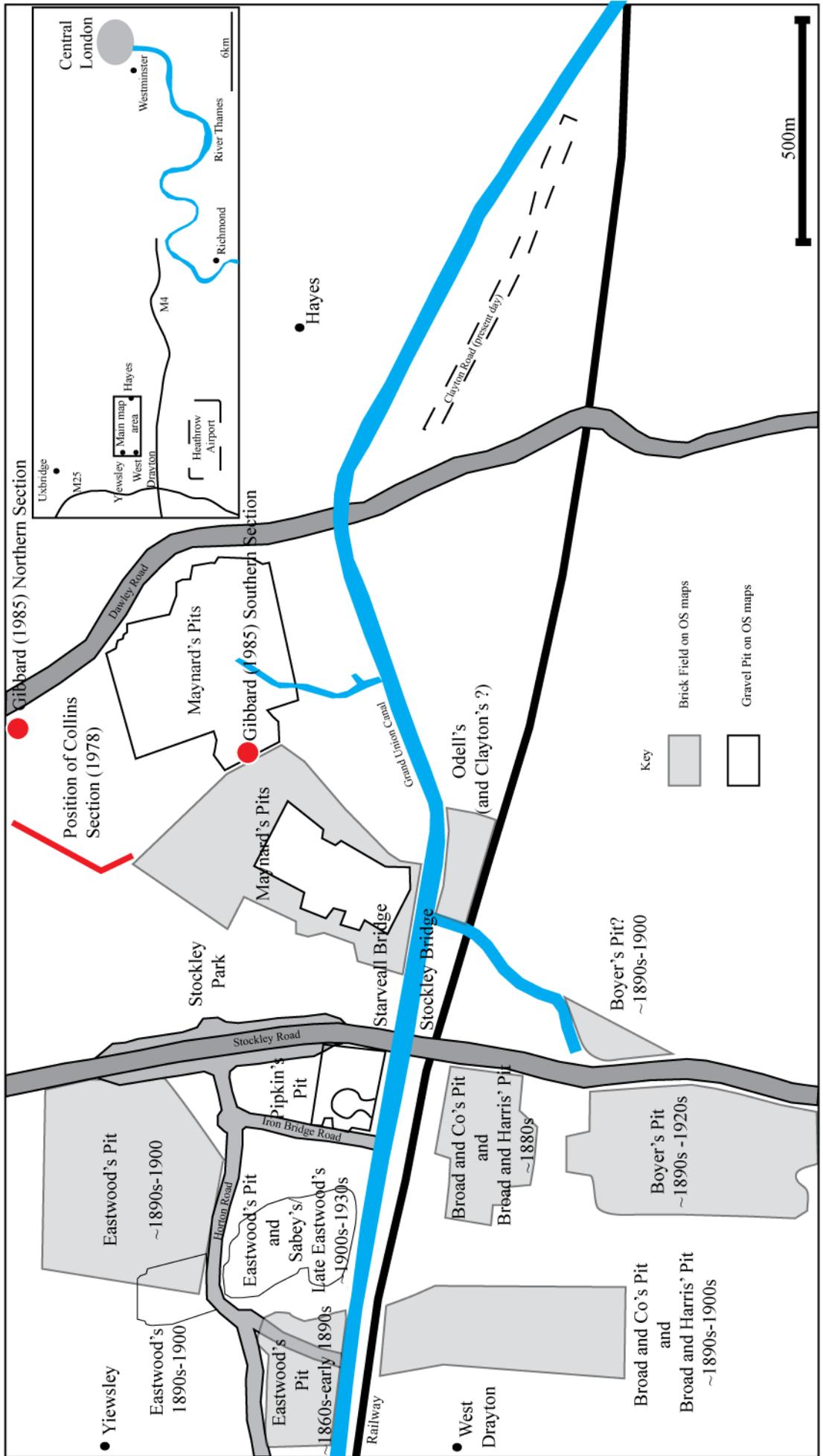


Figure 6.25: Map of site locations in Yiewsley

Odell's and Clayton's Pits

Brown (1895b) described that a Geologists' Association party reached Odell's Pit by walking from Hayes station along the canal. On one artefact label written by Brown (Sturge Collection, Ex J.A. Brown Coll. no 1260, British Museum), Odell's Pit is noted as being south of the canal. There is only one brick pit continuously labelled on old Ordnance survey maps south of the canal and north of the railway for the period between 1895 and 1900. There were two other brick pits recorded very close to this on OS maps for 1881, west of Dawley Road, although they are not recorded for the duration that artefacts were being collected from Odell's up to 1909. The English Rivers Palaeolithic Survey also placed Odell's Pit in the same location as this study (Wessex Archaeology, 1996).

Rice did not record artefacts from Odell's Pit, although it was said to be one of Brown's most prolific pits, as Clayton's Pit was apparently for Rice (Collins, 1978). It was proposed by Collins (1978) that Brown and Rice often collected from the same locations, and that these pits were in the same place but known by different names. The presence of the nearby Clayton's Road (Figure 6.25) further suggests that Clayton's Pit must have been located in that vicinity. There were no pits recorded in the exact location of Clayton's Road during the period over which the objects were collected (until the 1920s). It appears that Odell's Pit may therefore be the same locality as Clayton's Pit. There is a two year overlap of implements collected from Clayton's and Odell's Pits, between 1907 and 1909. However, the overlap is only created by a single artefact collected by Brown in Odell's Pit in 1909. Prior to 1909, the closest date Brown recorded an artefact from Odell's was 1903. Therefore it can be suggested that this label may have been produced using the former, historical name for the pit.

Maynard's and Pipkin's Pits

Brown (1895a) described Maynard's and Pipkin's pits as being near the northern banks of the canal. Maynard's Pits (*sic*) was the second pit to be visited on the Geologists' Association excursion, following Odell's Pit (described above). It might be inferred that Maynard's Pit was not located particularly close to the canal, as Brown stated that the party had to return to the canal to reach Pipkin's Pit, the third site visited on the trip (Brown, 1895b). Maynard's Pits was described as being extensive and referred to in the

plural (Brown, 1895a). On OS maps dating to between 1895 and 1920, there are two pits labelled to the north of the canal and west of Dawley Road, which are the most probable locations for Maynard's Pits (shown in Figures 6.25 and 6.26). These two pits also cover an extensive area of land. The English Rivers Palaeolithic Survey situated Maynard's Pit approximately in this area (Wessex Archaeology, 1996).

Brown (1895a) described Pipkin's Pit as lying a short distance to the west of Maynard's Pits and abandoned at the time of his publication. This led Scott (2006) to correlate Pipkin's Pit with the 'Old Gravel Pit' shown on the 1895 OS map, which on previous maps was depicted as active (shown on map, Figure 6.25). Brown continued labelling artefacts from Pipkin's Pit up to 1906, demonstrating that he was still collecting from the pit after its abandonment as a working quarry. Four artefacts are labelled as 'Sabey's, late Maynard's' by Rice in 1927, suggesting it changed names at this time.

Roe (1968a) commented that a note in the Lacaille collection in the British Museum states that Pipkin's Pit was the same as Sabey's Pit. It has not been possible to locate the note, nor has it been possible to find any other source of information that suggests the same. However, with Pipkin's Pit clearly becoming disused in the late 1880s, it seems unlikely that it is the same pit as depicted in Figure 6.25. Often the pits changed names, so it may be referring to a second Pipkin's Pit.

Eastwood's and Sabey's Pits

The last pits visited on the Geologists' Association excursion were Eastwood's Pits in West Drayton, lying further west from the others and within the West Drayton boundary.

Artefacts were collected from Eastwood's Pits between 1884 and March 1926 and referred to by Brown in the plural (Brown, 1895a). On the 1881 OS map there is only one pit near Horton Bridge north of the canal. By the 1895 map, this one is no longer labelled but there are two further brick and gravel pits labelled north-east of the previous one, both north of Horton Road. This is the same location where Scott (2006) situated Eastwood's Pit. These two pits continue to be labelled on OS maps until 1900. After this time there is another large pit directly south of Horton Road and west of Iron Bridge Road on both the 1920 and 1932 maps.

After March 1926 it is clear from the artefact labels written by Rice that at least one Eastwood's pit becomes known as Sabey's Pit (or Sabery's on some artefacts) with labels such as 'Yiewsley, Eastwood's now Sabey's', 'Sabey's, Late Eastwood's' or 'Sabey's New Pit'. Rice's artefact labels describe a few artefacts as 'Sabey's Pit, Stockley' which would place at least one Sabey's pit somewhere around Stockley Road or Stockley Bridge. Stockley Bridge is directly south of Iron Bridge Road and adjacent to the brick pit identified as Eastwood's after 1900 (see above and Figure 6.25). This is further supported by an artefact label from the Wellcome Collection (Ex J. Hancock Collection) in the British Museum, which places Sabey's Pit on Horton Road. Another artefact from an unknown collector within the British Museum collection also labels Eastwood's Pit as situated near Colham Green. The area of Colham Green is approximately a mile directly north of the area west of Ironbridge Road, again suggesting this is the most likely location for Eastwood's and Sabey's Pits. However, it is not clear whether these labels describe the same pit, or a combination of renamed Eastwood's Pits and completely new pits acquired by Sabey.

Collins (1978) placed Eastwood's in the area east of Stockley Road because it would have faced the Foresters public house and apparently was known to the gravel diggers as 'Sabey's Foresters pit'. Presumably this information came from the former operators, H Sabey and Co., whom Collins had contacted for his publication. They were able to locate all their old pits north of the canal, consistent with the possible locations described above for Eastwood's and Sabey's pits. However it seems most likely from the artefact annotations and the persistent location of a brick pit on Ordnance Survey maps that Eastwood's/Sabey's pits were in the area west of Ironbridge Road. Scott (2006) also correlated Eastwood's with the brick pit west of Ironbridge Road. The English Rivers Palaeolithic Survey placed Eastwood's and Sabey's in the approximate area, but the exact location is not clear due to the large scale of the map co-ordinates suggested for the pit (Wessex Archaeology, 1996).

Boyer's Pit

An artefact from an unknown collection held in the British Museum has a label detailing 'Yiewsley, Starvall (or Starveall), Boyer's Pit'. This suggests that Boyer's Pit was near the area with Starvall Farm (south of the canal) and Starvall Bridge (still present today as Starveall Bridge) which can both be seen on the 1895 OS Map.

Artefacts were collected from Boyer's pit between 1902 and 1926 and OS maps for 1897 and 1900 reveal a large brick pit to the south of Starvall Farm and a smaller one to the east of the farm. It seems likely that these brick pits, particularly the larger one (on account of the large numbers of artefacts from the pit), must represent Boyer's. On the 1920 OS map, the area to the south of the farm was still being exploited and is labelled as 'Stockley Brick Works' with no other pits being identified in the neighbouring areas. Collins (1978) also located Boyer's Pit in this area, mainly west of Stockley Road, where the same company still owned land in the 1970s. The English Rivers Palaeolithic Survey also placed Boyer's Pit west of Stockley Road (Wessex Archaeology, 1996).

Broad and Co.'s and Broad and Harris's Pits

Broad and Co. and Broad and Harris are one and the same company, as it is known that Clement Burgess Broad and George Harris from Paddington rented the field prior to purchasing it in 1935 (Reynolds, 1962). These pits appear to have been less prolific than the others in the area. Only two artefacts were collected from Broad and Co.'s pit by Rice in 1905 and 1921. A larger number were collected from Broad and Harris's pit by Brown between 1889 and 1893. One artefact in the Rice collection in the British Museum describes Broad and Co.'s pit to be near Starvall, West Drayton. This would place this pit near those of Boyer's, south of the canal and near Starvall Farm and Bridge. On the 1881 OS map there is a brick pit identified to the west of Starvall Farm and directly south of the railway, making this a likely position for Broad and Harris's pit. The pit is no longer identified on the 1895 OS map, although at this point there is another brick pit to the west directly adjacent to the previous, therefore suggesting that the brick making had moved to the west to exploit further deposits of silty clay. This new pit continued to be labelled on the 1900 OS map. These two brick pits to the west of Starvall Farm seem the most likely locations for Broad and Harris'/Broad and Co.'s pits as the mapping of the pits is consistent with the dates the artefacts were collected, with the exception of one artefact collected in 1921 by Rice. It is possible that the artefact labelled in 1921 could have been erroneously attributed to the Broad and Co.'s pit or the wrong date could have been recorded on the label.

Wallington's/Warrington's Pit and Western Cartage Pit

It has not been possible to locate these pits in this study nor in previous investigations (Roe, 1968a; Wymer, 1968; Collins, 1978; Scott, 2006).

Chapel Lane

Chapel Lane is just north of Stockley Road. Lacaille collected 22 artefacts from this location.

Little Wonder Pit

It has not been possible to identify the location of Little Wonder Pit.

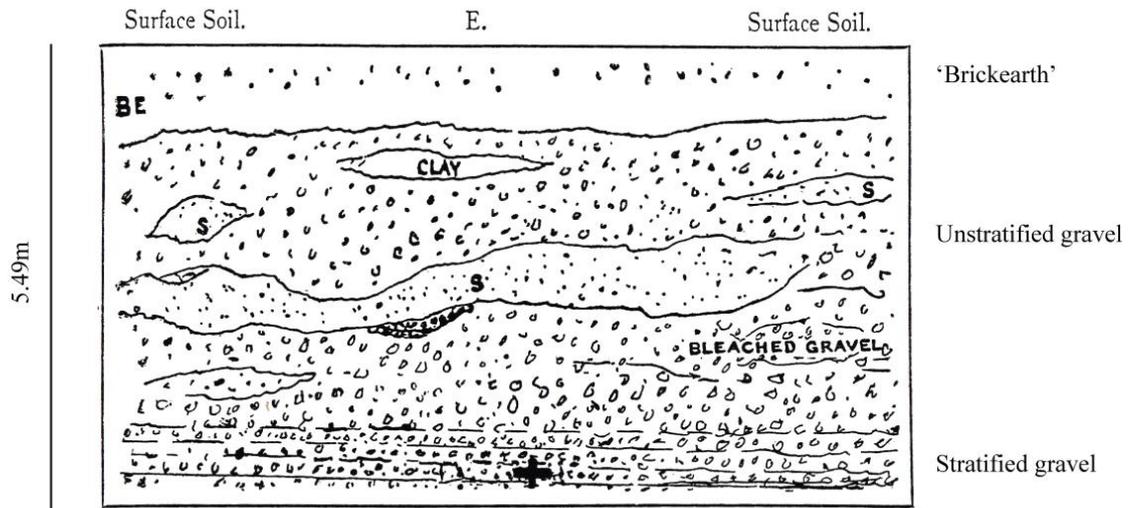
De Salis' Pit

The De Salis family lived in Dawley House in the 1800s and leased land to brickmakers. Dawley House was situated in the area between the canal and the railway to the west of Dawley Road and it is possible that one of the temporary pits described near Odell's Pit (see above) may have been De Salis' Pit. However no further information regarding the location of the pit has been recorded. R. Fane De Salis was a leader on a Geologists' Association excursion to Dawley and a Fellow of the Geological Society (Monckton, 1904).

6.5.5 Stratigraphy

Brown was the only collector to describe the stratigraphy seen in the pits at the time of the extensive discoveries. Figure 6.27 represents the stratigraphy observed from Eastwood's, Pipkin's, Odell's and Maynard's Pits (Brown, 1895a,b). The stratigraphy recorded can be summarised as:

3. 'Brickearth'
2. Unstratified gravel deposit
1. Stratified gravels



**Figure 6.27: Section seen at Eastwood’s Pit. ‘+’ depicts location of implements.
From Brown (1895a).**

3. *‘Brickearth’*

This was recorded as containing brown clay and occasional gravel and was attributed to the Langley Silt Complex (Gibbard, 1985; Scott, 2006).

2. *Unstratified gravel deposit*

Within this deposit, Chalk, gravel, and clay were recorded. The deposit extended into the overlying ‘brickearth’ in lobes. Parts of this deposit were stratified, whilst the rest remained unstratified. Large boulders of quartz, quartzite and other erratic lithologies and lenticular patches of sharp sand and gravel were recorded. Brown suggested the deposit accumulated in a ‘glacio-fluvial’ environment in which frozen sediments were transported and deposited by the river (Brown, 1895a). Collins (1978) and Gibbard *et al.* (1987) later attributed this to the Stockley Gravel and identified it as a solifluction gravel that may relate to the cold-climate following the final aggradation of the underlying fluvial terrace (Lynch Hill Gravel), around late MIS 8 or early MIS 7, although this deposit remains undated.

1. *Stratified gravels*

The underlying gravel was separated from the overlying deposit by a distinct boundary. Brown (1895a) suggested that the eroded upper surface of the gravels must have been above water in the past and provided a surface for hominins to inhabit. It was proposed

that it was deposited under temperate fluvial conditions. These deposits have been attributed to the Lynch Hill Gravels (Gibbard, 1985) (see discussion below).

Collins (1978) observed a 323m long section exposed in a pit operated by H Sabey and Co. in 1972, slightly further to the north of the pits visited by Brown and Rice (TQ 082803-083807) (see Figure 6.25 and 6.28).

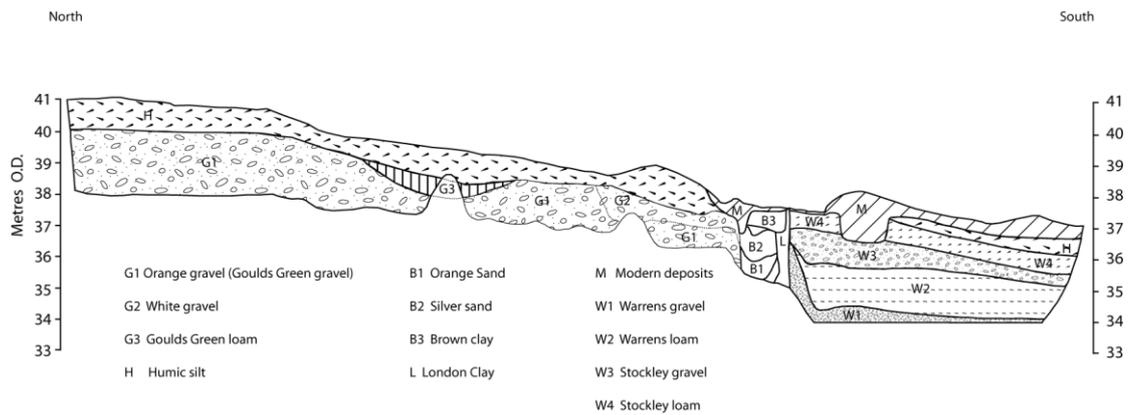


Figure 6.28: Stratigraphy as observed by Collins (Adapted from Collins, 1978)

Collins mapped the section as showing two terrace levels: the ‘Stoke Park Terrace’ (represented by his Goulds Green gravel and loam) and the Lynch Hill Terrace (represented by his Warrens Gravel and Loam) (Figure 6.28). The Stockley gravel (W3) was interpreted as a solifluction gravel separating the two. Collins considered the stratigraphy to be similar to the sections recorded by Brown, leading him to correlate his Warrens Gravel (W1) with the stratified fluvial gravels at the base of Brown’s sequence. Collins also correlated his Stockley Gravel (W3) with Brown’s unstratified gravel, and the Stockley Loam (W4) with the ‘brickearth’.

The ‘Stoke Park Terrace’ was considered by Collins to be an additional, older terrace in the Yiewsley area between the Boyn Hill and the Lynch Hill terraces, due to gravel being present at a slightly higher elevation than the more expansive Lynch Hill Terrace to the south, nearer the modern Thames (Allen, 1978; Collins, 1978).

Further excavations by Gibbard (1985) (Figure 6.25) reinterpreted the stratigraphy at Yiewsley whilst confirming many of Collins's observations. Gibbard's re-interpretation of two sections was based on lithological analyses and palaeocurrent measurements. The first section, at the northern end of Collins' section (TQ 084807), (Figure 6.25) revealed gravels (equivalent to Collins' Goulds Green Gravel) with palaeocurrents trending towards the south-south-east. Lithologically, Greensand chert was scarce, whereas vein quartz was more common, suggesting a correlation with the Colne Valley Gravels (Gibbard and Hall, 1982; Gibbard, 1985). Gibbard (1985) retained the name of the Goulds Green Gravel as used by Collins to describe deposits of the River Colne, equivalent to the Middle Thames' Lynch Hill gravel.

The second, more southerly section (TQ 083803) (Figure 6.25) revealed horizontally bedded gravel, with occasional current-bedded coarse sand bands, all with an easterwards palaeocurrent flow. This was considered to be the equivalent of Collins' Warrens Gravel and was found to be lithologically similar to the Lynch Hill Gravel, on the account of its higher levels of Greensand Chert and less vein quartz.

In summary, Gibbard (1985) was able to demonstrate that all the gravels described by Collins were of Lynch Hill terrace age, with one deposited by the River Colne (northern section) and the other deposited by the River Thames (southern section). Brown's sections only included the River Thames gravels. Gibbard (1985) suggested that the gravel assigned to the Stoke Park Terrace by Allen (1978) and Collins (1978) was probably the northern edge of the Lynch Hill Terrace, separated from the bulk of the Lynch Hill Terrace to the south, by diapirically uplifted London Clay.

Gibbard (1985) further identified areas in West London where the upper part of the Lynch Hill Gravel was cryoturbated to varying depths. In the area south of Iver, to the west of Yiewsley, 1-1.5 m of the terrace top was cryoturbated, whereas in Yiewsley itself, only 60cm were affected. Evidence for cryoturbation included frost-shattered pebbles, mostly flint, orientated vertically. Gibbard (1985) considered the cryoturbated upper portion of the Lynch Hill Gravels to be similar to the solifluction evidence described by Brown and Collins (their Stockley Gravel). It is most likely that this occurred during MIS 6 or possibly even in the early part of the Devensian, prior to deposition of the overlying Langley Silt Complex (see Chapter 3 Geology).

Gibbard *et al.* (1987) recognised that the basal 1.2m of the ‘brickearth’ at Yiewsley was stratified, becoming upwardly finer in texture, and containing small-scale ripple structures. This, they proposed, reflected the alluvial or colluvial nature of the basal ‘brickearths’.

6.5.6 Palaeoenvironmental Evidence

Five columns within the Collins (1978) section were analysed for pollen by R. N. L. B. Hubbard. Low concentrations of pollen were found in the samples (1.4-4.3 pollen grains per gram) and most of the pollen was thought to be derived, as there were species of both cold and warm-climate affinity represented. However, cold-climate species were dominant, thereby suggesting that the warm-climate component may have been older and derived. Differential preservation of pollen grains was dismissed as an explanation, as no species was considered to be under-represented. It was considered likely by Hubbard that alkaline conditions may have resulted in poor preservation, which could account for the general low concentrations of grains, although poor pollen preservation is a common feature of many fluvial sites. The samples with over 100 pollen grains counted (number of pollen grains per sample ranged from 53-169) are likely to be more representative of the climate/environment at the time of deposition. However, the overall low concentration of pollen, and the potential derived nature of the samples, makes climatic and environmental interpretations unconvincing. Overall, tree species such as birch, oak and elm were recorded throughout the sequence along with higher concentrations of shrub species such as hazel. The pollen was interpreted as either representing an open environment in a temperate period or a series of brief temperate episodes within a cold period.

6.5.7 Archaeology

Very few of the artefacts collected by the antiquarians can be linked to the *in situ* deposits such as the stratified gravels at the base of the sections or the brickearth at the top.

There are many complicating factors in attempting to use recorded depths as an indication of relative position within the stratigraphy. Brown often labelled his artefacts with depths either including the brickearth deposits (e.g. ‘20F inc BE’), discounting the brickearth (presumably because it had been removed for brick making), or with no

indication of either. Also it is clear that Brown did not always collect the artefacts himself and that he received them from other collectors or workmen. For example Brown recorded a handaxe from Pipkin's Pit and mentioned how he 'visited the pit soon after it was found and carefully noted the site of the find' (Brown, 1895a, p.162), thereby indicating that he did not have first-hand knowledge of the findspot. The depths of the deposits have also been shown to vary throughout the area. This can be seen in the differences between the two published sketches of sections by Brown and also in his descriptions (Figures 6.27). Brown (1895a) specifically described the stratified gravels as occurring at higher levels in some areas where the overlying solifluction gravels were less extensive. These issues render most of the artefacts collected in the Yiewsley area as stratigraphically unprovenanced.

Overall 4447 implements were recorded from Yiewsley (Table 6.26), with the majority comprising of handaxes (50.33%), and flakes making up almost half of the assemblage (46.26%).

Implement	Number of artefacts	% of assemblage
Handaxes	2238	50.33
Flakes (total)	2057	46.26
Levallois flakes	556	12.50
Probable Levallois flakes	334	7.51
Retouched Levallois flakes	10	0.22
Retouched non-Levallois flakes	95	2.14
Cores (total)	113	2.54
Levallois cores	55	1.24
Unidentified worked flint	39	0.88
Total implements	4447	

Table 6.26: Implements recorded from Yiewlsey

It is common for handaxes to be the dominant tool type in antiquarian collections as they are the most recognisable Palaeolithic implements, especially to the workmen who passed on many artefacts to the antiquarians. It was also common for antiquarians to select the more impressive artefacts for their collection, sometimes leading to the under-representation of flakes, particularly the smaller examples. These factors may explain the apparent biases in the collections seen above.

Artefacts from the basal stratified gravels/Lynch Hill Gravels

Brown found unabraded “Palaeolithic implements of later age, consisting of long, sharp spear-heads, knives” at 1.5-3m from the surface and ‘beneath the unstratified gravels’ (Brown, 1895a, p.163). These tools were specifically identified as Levallois by Marsden (1927), who noted that Levallois implements were confined to the top 2.5-2.7m of the stratified gravels at Yiewsley. This was not based on the discovery of *in situ* artefacts but due to the reported ‘two or three months’ in which he found Levallois material when he knew only the top section of the pits was being worked. Nevertheless, this information provides a useful insight into the restricted stratigraphical distribution of the Levallois artefacts. Later, when extraction went deeper in the pits, the Levallois material ceased to be found (Marsden, 1927). Despite this, the unabraded condition of the tools suggests that they were *in situ*. Scott (2006) echoed these observations, and found the majority of definite Levallois implements from Yiewsley were unabraded (79.2%) and a further 17% were found to be slightly abraded.

The non-Levallois handaxes and flakes discovered by Brown were found deeper in the river terrace than the Levallois implements. Brown (1895a p. 162-3) described finding several large handaxes in almost fresh condition between 3.96 and 6.10m from the surface in Maynard’s and Pipkin’s Pits. However, Brown stressed that these fresher handaxes were unusual in their good condition and that it was more common to find abraded Palaeolithic tools deeper in the stratified gravels. Some of the fresher tools found deep in the gravels were found in a thin bed of laminated clay at approximately 5.79-6.09m from the surface (Brown, 1895a). Some artefact annotations refer to this clay band.

Only 27 implements could accurately be attributed to the stratified fluvial gravels, with the majority displaying high levels of abrasion (51.85% were heavily abraded and another 33.3% were moderately abraded). Although these artefacts have clearly been found in the stratified gravels, the high levels of abrasion suggest a history of transportation, supporting the observations by Brown (1895a), who highlighted that fresh Palaeolithic artefacts from deep in the gravels were rare. These implements exhibiting high levels of abrasion suggest they have been derived from older deposits by the Thames, or had travelled from further upstream.

Following the description by Brown (1895a p.163) of finding virtually unabraded ‘later age’ implements from the stratified gravels and the recognition of these fresh artefacts as Levallois tools by Marsden (1927) and Lacaille (1936), all artefacts analysed during this research exhibiting slight or no abrasion were grouped in a separate assemblage. The predominant tools displaying low levels of abrasion were flakes (67.11%), with 26.98% of the whole assemblage being definite Levallois flakes (Table 6.27). This indicates that 79.67% of *all* definite Levallois implements from Yiewsley exhibited low levels of abrasion, supporting the observations of Marsden (1927) and comparable to the high numbers of fresh and slightly abraded Levallois specimens recorded by Scott (2006).

All tools displaying low levels of abrasion are likely to have been *in situ* within the stratified gravels, as they had experienced very little movement after deposition and so are unlikely to have been derived from the solifluction deposit. They are also unlikely to be from the overlying ‘brickearth’ or Langley Silt Complex, because a large part of the assemblage consisted of Levallois and pre-Late Middle Palaeolithic handaxes, which were not being produced in the Devensian, the period from which dated sections of Langley Silt Complex appears to date (Gibbard *et al.*, 1987; Rose *et al.*, 2000).

Implement	Number of artefacts	% of assemblage
Handaxes	490	29.84
Flakes (total)	1102	67.11
Levallois flakes	443	26.98
Probable Levallois flakes	273	16.63
Retouched Levallois flakes	9	0.55
Retouched non-Levallois flakes	16	0.97
Cores (total)	44	2.68
Levallois cores	29	1.77
Unidentified worked flint	6	0.37
Total implements	1642	

Table 6.27: All implements displaying low levels of abrasion (unabraded and slightly abraded) from Yiewsley

Technologically, the Levallois cores are all notably small and re-prepared (*ie.* prepared for more flake removals without the final flake being actually removed, presumably because the resulting flake would have been too small to use effectively) or completely

flattened and exhausted (Scott, 2006). This pattern was similar to that seen at Creffield Road (Section 6.3), and at both the sites, the exhausted cores were considered to be unusual. The smaller exhausted cores at Yiewsley and Creffield Road are therefore suggested to reflect the transport of cores between sites in the area in order to ensure hominins had sufficient raw materials at new sites before they discarded the cores carried from the previous site (Scott, 2006).

Twelve twisted ovate handaxes have been recorded from Yiewsley in this study. One was found 3.35m from the surface and second was recorded from very deep in the stratigraphy, at 5.79-6.09m from the surface close to a 'black seam'. Brown (1895a) described this black, carbonated matter horizon as lying within the laminated clay bed deep within the stratified gravels, from which an unabraded implement was recovered. The twisted ovate handaxes were predominantly heavily and moderately abraded, with the exception of two that displayed slight abrasion. They were all stained orange and brown to varying degrees and were all patinated varying from a light patination to strong patination. Their abrasion levels suggest they are reworked from an older deposit.

Artefacts from the solifluction gravel

Due the nature of the solifluction deposits, any artefacts found in them may represent a variety of ages. Only one moderately abraded artefact can be attributed to the solifluction deposit, as it was described as being found immediately underneath the 'brickearth'. No artefacts can be directly associated with the solifluction gravels based on the artefact labels.

Artefacts from the 'brickearth'

Eight flakes and one handaxe can be confidently attributed to the 'brickearth' from the artefact labels. The handaxe is a 'bout coupé' or a 'flat-butted cordate', characteristic of the late Mousterian or the late Middle Palaeolithic (see Chapter 8). Seven of the flakes are Levallois flakes, all unabraded (2 implements), slightly abraded (4 implements) or moderately abraded (1 implement). For Levallois artefacts and a late Middle Palaeolithic handaxe to be found within the same deposit, it suggests the artefacts are derived, particularly the older Levallois implements. Since two artefacts in the

'brickearth' were unabraded, it may suggest that the deposit accumulated over more than one cold stage.

6.5.8 Age of Site

Age of 'brickearth'

Thermoluminescence dating from the 'brickearth' at Yiewsley gave dates in excess of 150 ka and 75 years BP (Gibbard *et al.*, 1987), although it was not clear whether these dates were taken from the lower section of the 'brickearth' that exhibits some stratification, as opposed to the overlying massive 'brickearth' at Yiewsley. It has been suggested that at Yiewsley the lower horizons of the 'brickearth' have been partly water sorted and therefore may be alluvial or colluvial, following the final aggradation of the underlying river terrace gravels (Lynch Hill Gravels) (Gibbard *et al.*, 1987). Scott (2006) noted that the thermoluminescence date of >150k years BP is in the range for deposition during MIS 6, which would be consistent with a late MIS 8 or early or late MIS 7 age for the underlying Levallois material. The 'brickearth' or Langley Silt Complex throughout West London has otherwise been attributed to the Devensian based on thermoluminescence dating (Gibbard *et al.*, 1987; Rose *et al.*, 2000). As the 'brickearth' contained a 'bout coupé' or a 'flat-buttet cordate', characteristic of the late Middle Palaeolithic, it would suggest a minimum age of MIS 3 (Jacobi *et al.*, 1998; White and Jacobi, 2002; Jacobi *et al.*, 2006).

Age of stratified gravels

The gravels have been attributed to the Lynch Hill Formation of the Middle Thames (Gibbard, 1985; British Geological Survey 1999, 2005). The Levallois implements were frequently found near the surface of the stratified gravels (Brown, 1895a; Marsden, 1927; Lacaille, 1938), which suggests an MIS 8 or MIS 7 age.

The Palaeolithic artefacts from deeper in the gravels reflect an older period of occupation. However, the frequently abraded nature of the implements strongly suggests that the implements have been reworked from older deposits by the River Thames. The twisted ovate handaxes within these gravels may also be derived, particularly since they appear to be restricted to late MIS 11 and early MIS 10 in Britain, when recorded in significant numbers (White, 1998). Consequently they are likely to have been reworked from Boyn Hill Formation gravels (MIS 12-11-10).

6.6 Hanwell, Southall, Norwood Green and Osterley

6.6.1 Introduction

In the late 19th and early 20th centuries, over 800 Palaeolithic implements were found in Hanwell and neighbouring areas by antiquarians including J. A. Brown and W. G. Smith. However, despite the large number of artefacts found in several gravel pits, the majority of the assemblage appears to be reworked from older deposits.

6.6.2 Location of collections

Artefacts from the Crooke, Sadler, Loydell, Bagshawe, C. King, J. A. Brown, R. G. Rice, W. G. Smith, Dewey, Fleming, Lacaille, Seward, Sturge, Trechmann, and Warren collections in the Museum of London, Cambridge Museum of Archaeology and Anthropology, British Museum, Wardown Park Museum, Gunnersbury Park Museum, Luton, Institute of Archaeology, University of London, Hillingdon Museum, and Reading Museum.

6.6.3 History of Research

Smith (1880, 1881) was the first described the location of the two largest gravel pits in Hanwell; Gibson's Pit and Seward's Pit. Some drawings of the tools from Hanwell were published by Brown (1887a) and Smith (1894). In the neighbouring area of Southall, Brown (1889b) published the discovery of remains of *Mammuthus primigenius* and flint implements in Norwood Lane and then later published the most detailed descriptions known of the stratigraphy in Hanwell, along with details of the provenance of implements from the Hanwell pits (Brown, 1895a). A Geologists' Association excursion to two pits in Hanwell was described by Brown (1895b), who included further details on the location of the pits. Later, Burchell (1934b) published a sketch of a Levallois implement from Hanwell. Detailed gazetteers of the Hanwell sites and the implement types have been produced by Roe (1968a), Wymer (1968) and Wessex Archaeology (1996).

There has been controversy over which of the River Thames terrace deposits the Hanwell sites relate to. Dewey (1930) attributed the deposits to the Taplow Terrace (as the Lynch Hill Terrace had not yet be recognised), as did the British Geological Survey (1998, 2006). In contrast, Gibbard (1985) attributed the deposits to the Lynch Hill

Gravel based on the height of the gravel (approximately 20-26m OD), which was consistent with the distribution of Lynch Hill Gravels analysed during the construction of the M4. Gibbard stated that the gravel is continuous beneath the Brent Valley, including Hanwell, although no new exposures were located for study. Bridgland (1994) and Wessex Archaeology (1996) have also attributed the Hanwell deposits to the Lynch Hill Gravel.

6.6.4 Location of sites

The locations described in this section are shown in Figure 6.29.

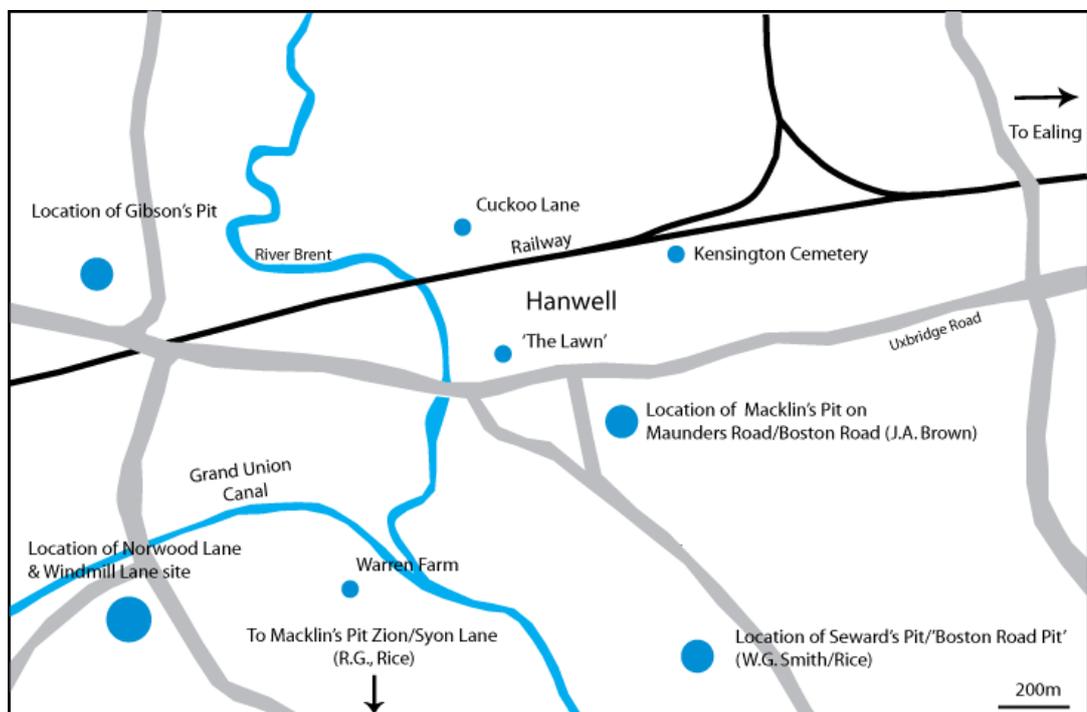


Figure 6.29: Map of Palaeolithic locations in Hanwell

Gibson's Pit, Hanwell

Brown (1895) describes Gibson's Pit as being north of Uxbridge Road and a short distance south-east of the 'Mill Ponds', which is now the West Middlesex Golf Club, west of Greenford Road. This places the pit in the area that is north of the railway and west of the River Brent, where gravel pits are situated on the Middlesex Ordnance Survey Map from 1877. Wessex Archaeology (1996) also attributed Gibson's Pit to this location. Worthington George Smith (1880, 1881) described this as being the largest of

two pits in the area (the other being Seward's Pit), covering a total of 20 acres. Smith (1881) also stated how the pit had been exploited in the years previously, with the top 2.4m already removed. During this period of excavation at Gibson's Pit, about 6.7m of sediments were removed, making the original depth of the pit approximately 9.1m, however the base of the pit was rarely reached. The gravel from this pit was used in building roads to the west of Hanwell, as far as Southall (Smith, 1881). An artefact in the Sturge Collection (Ex J.A. Brown) is attributed to the 'Iron Bridge Pits'. It is possible that this is the same as Gibson's Pit, as Brown (1895a) and Brown (1895b) described crossing Uxbridge Road via an iron bridge to reach Gibson's Pit.

Macklin's Pit, Hanwell

Macklin's Pit was described by Brown as being located in Maunders Road near the High Street, Hanwell, about a mile east of Gibson's Pit (Brown, 1895a). This would place it just south of the railway, consistent with the location of the present day Maunders Road. However, many of Brown's artefact inscriptions contain 'Macklin's Pit, Maunders Road' or 'Boston Road, Macklin's Pit', and as Maunders Road adjoins Boston Road, it is not surprising that Brown used the two roads interchangeably to describe the same pit. Ordnance Survey maps of this period do not show a gravel pit in this location, although they do have apparently empty fields at the end of Maunders Road, which are likely locations of gravel extraction.

There are 16 implements from the Robert Garraway Rice collection in the Museum of London with their provenance described as Macklin's Pit, Zion (or Syon) Lane, Hanwell. Two of the labels also mention Wyke Green. This could indicate that the owner of the Macklin's Pit described by Brown had another brickfield further south on the opposite side of the river near where the modern Syon Lane is situated in the Wyke Green area. Wymer (1968) also described Macklin's Pit at this more southerly location as did Wessex Archaeology (1996). However, it would seem that the main Macklin's Pit was in the location Brown described, particularly with the large number of objects that have the Boston Lane/Maunders Road connection. It appears there was another pit with the same name further south but which yielded fewer artefacts.

There are also some inscriptions on implements in the Museum of London which indicate that there was a pit near Boston Manor or Boston Manor Station, for example,

‘Perhaps gravel pit nr. Boston Manor Ealing’ and ‘Gravel pit near Boston Manor Station’.

Seward’s Pit, Hanwell

Seward’s Pit is described as being east of the River Brent, half a mile south of Hanwell and ‘on the east side of Boston Road, towards Brentford’ by Smith (1880 p. 317). No gravel pits are located on the east side of Boston Road on maps from the late 1880s, although there is a large gravel pit on the *west* side of the road. It is possible that Smith was referring to this pit as he used ‘east’ in reference to the position of Brentford (to the south). The location of the pit between the river and Boston Road was also identified by Wymer (1968) and Wessex Archaeology (1996).

Smith (1880) also referred to this pit as ‘Boston Road Pit’, suggesting that his artefact annotations of ‘Hanwell, Boston Road Pit’ also refer to Seward’s Pit. Smith never referred to the other pit near Boston Road (Macklin’s Pit) in his publications or artefact annotations, further indicating that his Boston Road Pit was located in a different position to Brown’s Boston Road Pit.

Robert Garraway Rice also labelled objects from Hanwell between 1900 and 1917, as ‘Boston Road Pit’, although he did not specify where in Boston Road the pit was situated. Rice may have been referring to the same pit as Smith, since the gravel pit present on the west side of Boston Road during the 1880s and 1890s is still labelled on the Middlesex OS 1:2500 map of 1914. However there is an additional smaller gravel pit also situated on the west of Boston Road, a short distance to the south, which he may equally have visited.

Dowell’s Pit, Hanwell

On one artefact annotation by Brown places Dowell’s Pit in East Hanwell. On OS maps of the area from the 1890s, there is a gravel pit a few hundred metres to the east of Seward’s Pit. It is possible that this is the location of Dowell’s Pit, although no further information on the specific position of the pit is recorded.

Mantell's Pit, Hanwell

'Boston Road, Mantell's Pit' was detailed on one object annotation by Brown and another mentioned 'Sewage Work near canal and Mantell Pit'. The sewage works appears on OS maps from the mid-1880s and are in between Seward's Pit and the Grand Union Canal, suggesting Mantell's Pit may be the same as Seward's Pit and that it experienced a name change. The location of this pit was not identified by Wymer (1968).

Bristow's Pit

One artefact annotation in Gunnersbury Park Museum (in the Crooke collection) describes this pit in north Hanwell Station, near the 'G.W.R' or the railway, and was attributed to a modern residential area (Wessex Archaeology, 1996). The exact location of this pit is not known.

Kensington Cemetery, Hanwell

Two items in the Brown collection were labelled as being found at the back of Kensington Cemetery, which is still present to the east of Hanwell Railway Station.

St. George's Cemetery, Hanwell

This cemetery is now known as Hanwell Cemetery, on the south side of Uxbridge Road.

Warren Farm, Southall

On the London OS Map of 1896, Warren Farm was located at the same site as Warren Farm Sports Centre is today on Windmill Lane. This is the same location attributed to Warren Farm by Wessex Archaeology (1996).

'The Lawn', Hanwell

An asylum called 'The Lawn' can be found on the 1868 OS map just south of Hanwell Station, where Conolly Road and Lawn Gardens are today (Conolly Road having been named after Dr John Conolly the physician of the hospital at the time). It is probable that the hospital location was the area where these objects were collected. Wessex Archaeology (1996) also attributed this site to this location.

Cuckoo Lane, Hanwell

Cuckoo Lane is to the east of Gibson' Pit and to the north of Hanwell Station (TQ 153808) today and is probably the same 'Cuckoo Lane' mentioned by the collector Crooke on the objects from Gunnersbury Park Museum.

Norwood Lane, Southall

Between Norwood Lane (now Tentelow Lane) and Windmill Lane, artefacts and mammoth fossils were excavated, when drainage works were taking place 503 metres from the junction of the two roads. Artefacts from Windmill Lane are also recorded under Osterley Park adjacent to Southall.

6.6.5 Stratigraphy

The stratigraphy from Macklin's Pits was published in detail by Brown (1895a) (Figures 6.30) and can be summarised as:

3. 'Brickearth' (not shown in Figures 6.30 and 6.31, as it had already been removed)
2. Unstratified gravel with inclusions of sand and clay
1. Stratified gravel and sand

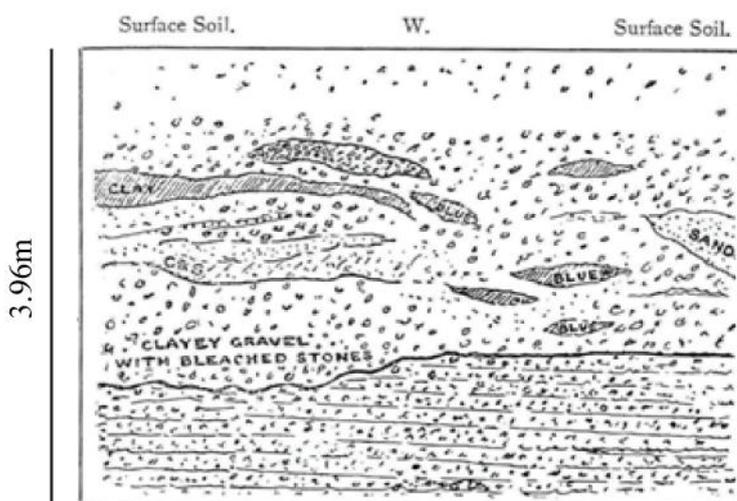


Figure 6.30: Stratigraphy recorded in Macklin's Pit, Hanwell. From Brown (1895a)

1. Stratified gravel

The stratification suggests fluvial deposition and is attributed to either the Lynch Hill Gravel (Gibbard, 1985; Bridgland, 1994; Wessex Archaeology, 1996) or the Taplow Gravel Formation (Dewey, 1930; British Geological Survey, 1998).

2. Unstratified gravel

Brown (1895a) stated that the unstratified gravel irregularly overlay the river gravels, often protruding into the stratified gravels in large furrows (Figure 6.31).

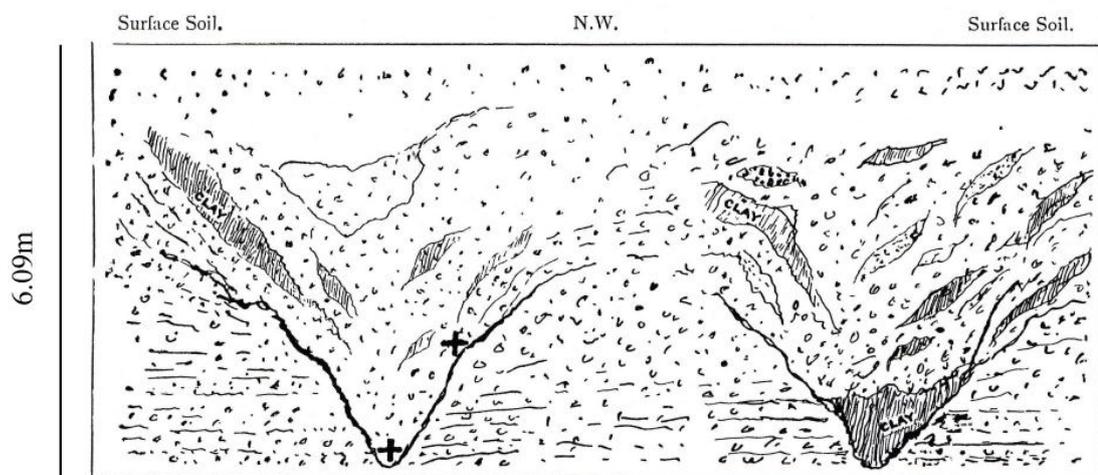


Figure 6.31: Section from Gibson's Pit showing the furrows incised into underlying stratified gravels. '+' indicates location of implements. From Brown (1895a).

Given the shape of the furrows and the contorted nature of the gravels within and surrounding them (Brown, 1895a), it is likely that they were created by periglacial processes, and subsequently were filled with solifluction gravel. The artefacts were found within the furrows, suggesting that they are reworked from older deposits.

3. 'Brickearth'

This deposit is attributed to the Langley Silt Complex, which is mapped on a large area to the east of Hanwell.

The *M. primigenius* remains in Norwood Lane, Southall, were found in a sandy loam bed within stratified gravels, underlying 'brickearth'. This site lacks the periglacial unstratified gravel.

6.6.6 Palaeontology

Brown (1889b) stated that the *M. primigenius* remains were found by workmen 3.96m below the surface in Norwood Lane. He visited the site a few days after the initial discovery and found bones discarded in the pit, from which he was able to identify broken pieces of leg, mandible, three molars, and some tusk fragments. The remains were highly weathered and crumbled when picked up, although Brown noted that the bones were unabraded. The lack of abrasion suggests that the mammoth had not been transported prior to deposition and was probably found in a fine-grained horizon within the Thames gravels at the site. Brown also reported that some other bones, probably of *Bos* sp., were recovered from near by. Neither the mammoth nor the bovid bones have been relocated in the current study and have probably not survived to the present day. Of particular interest is the notation of one ‘well-formed spear-head’, which was reportedly found in contact with the mammoth remains according to the workmen, but unfortunately this cannot be identified today (Brown, 1889b p. 363).

6.6.7 Archaeology

During this study, 885 implements have been identified from Hanwell, Norwood Green, Southall, and Osterley (Table 6.28).

Implement	Number of artefacts	% of assemblage
Handaxes	371	41.92
Flakes (total)	494	55.82
Levallois flakes	17	1.92
Probable Levallois flakes	2	0.23
Retouched Levallois flakes	31	3.50
Retouched non-Levallois flakes	3	0.34
Cores (total)	6	0.68
Levallois cores	1	0.11
Unidentified worked flint	14	1.58
Total implements	885	

Table 6.28: Implements from Hanwell and the surrounding area

The majority of implements were heavily abraded (48.81%) (Table 6.29), which is consistent with the descriptions of implements being found in contorted (periglacial) gravels in Gibson’s and Macklin’s Pits by Brown (1895a). The solifluction gravel

would probably have contained reworked implements from older deposits. The few fresher implements may have originated from the stratified gravels, the low level of abrasion suggesting they have not been disturbed since their deposition.

Level of abrasion	Number of artefacts	% of assemblage
Fresh	22	2.49
Slightly abraded	119	13.45
Moderately abraded	312	35.25
Heavily abraded	432	48.81
Total	885	

Table 6.29: Abrasion levels exhibited by the implements from Hanwell

An abraded quartzite handaxe from Southall, approximately 165mm long, was described by Brown (1895a). Two handaxes from the area seen in the current study are made on quartzite and it is likely that one from Southall gas works from the Brown collection in the British Museum (J.A. Brown no. 1429) is the same implement as described above, although it is slightly shorter at 138mm. It was also recorded as heavily abraded, consistent with Brown's description. The second pointed quartzite handaxe was found at 'The Lawn', Hanwell, and was mentioned in Wymer (1968) as curated in the Museum of London. This handaxe has now been rediscovered in Gunnersbury Park Museum, with a different artefact number (76.20/216) but found in the same year, 1897, and in the same condition

Four implements were identified from the mammoth excavation (from their labels), three were moderately abraded and one was heavily abraded, suggesting they were not *in situ*.

6.6.8 Age of Deposits

The deposits in Hanwell have been attributed to both the Taplow and Lynch Hill Gravels; however the Lynch Hill (MIS 10-9-8) correlation is based on more recent lithological comparisons with the M4 section by Gibbard (1985), suggesting that this may be the more reliable attribution. The less abraded specimens, although few in number, may have been found in the stratified gravel, giving them a maximum age of

MIS 8. However, the vast majority of implements were heavily abraded, suggesting they were not *in situ* and may represent various ages prior to MIS 8.

6.7 Summary of Chapter 6

The Lynch Hill/Corbets Tey Terrace has proven to be a key depository for evidence of human activity and variations in climate, fauna and landscapes in London, including significant evidence for late Middle Pleistocene interglacial environments and the onset of the Middle Palaeolithic. Celebrated Palaeolithic ‘super-sites’ such as Stoke Newington, Yiewsley and Creffield Road are all situated on the Lynch Hill/Corbets Tey Terrace and offer some intriguing illustrations of London during MIS 10-8.

Hackney Downs offered a comprehensive suite of proxies that depict the landscapes and climates in MIS 9 and greatly furthers our knowledge of palaeoenvironmental and palaeoclimatic conditions in southern Britain during the period. Damp woodland habitats and open grasslands were both present, and the beetles and ostracods suggested the climate ranged from -4 to 19°C (Green *et al.*, 2006; Horne, 2007). The relationship between the deposits at Stoke Newington and Hackney Downs was re-evaluated and it seems likely that the archaeology from Stoke Newington is closely related to those at Hackney Downs and may even date from the same interglacial. In addition, it has been possible to consider the stratigraphic sequences at higher resolution than previously achieved and it is tentatively suggested that both of the aforementioned sites might even date to the same part of the interglacial, potentially MIS 9e. For the first time the mammalian assemblage recorded at Cauliflower Pit was re-evaluated and this research represents the first time the mammal assemblage had fully been separated from the younger Uphall assemblage (See Chapter 7). The palaeontology from Cauliflower Pit in Ilford offers additional palaeoenvironmental evidence for the period during which the Lynch Hill/Corbets Tey Terrace was deposited.

Levallois material is first recorded in the Lynch Hill/Corbets Tey Terrace in London, particularly in Creffield Road as well as Yiewsley, Hanwell and Stoke Newington. This change in technology suggests that fully-fledged Neanderthals were now occupying the London area and illustrates the shift from industries with high numbers of handaxes (as seen at Stoke Newington), to flake-based assemblages. The exhausted Levallois cores found at Creffield Road hint at details of the hominin activity, suggesting they were transporting tools to use elsewhere, but were discarding used tools when they discovered new raw materials (Scott, 2006; White *et al.*, 2006).

A small assemblage of handaxes only displaying slight abrasion were observed from Glasshouse Street, Westminster (held at the Museum of London, see Appendix 1) (Figure 6.32). They were said to be found on the site of the Regent Palace Hotel. It has not been possible in this study to discuss these separately due to the lack of provenance; however their unabraded nature suggests they have experienced very little transportation and therefore they may have been manufactured and used in the Westminster area. During this study it was unusual to record a relatively unabraded assemblage of lithics in the Central London area, and so it was felt this particular assemblage should be highlighted briefly here. Glasshouse Street is mapped by the British Geological Survey (2006) as Lynch Hill Gravel, suggesting this assemblage dates from the period of MIS 10-9-8.



Figure 6.32: A handaxe from Glasshouse Street, Westminster (artefact A11922)

Chapter 7: Taplow/Mucking Terrace Sites

Introduction

Gravels representing an intermediate terrace in the Middle Thames were first recognised by Whitaker (1864, 1889), in addition to a ‘high’ and ‘lower’ terrace. The middle terrace was later named the Taplow Terrace by the Geological Survey (Bromehead, 1912; Dewey and Bromehead, 1915), with an exposure of gravels at Taplow Station, Buckinghamshire, designated the stratotype for the Taplow Member (Gibbard, 1985, 1989). The equivalent Mucking Gravel in the Lower Thames was first characterised by Bridgland (1983) and was subsequently correlated with the Taplow Terrace by Gibbard (1985, 1994), Gibbard *et al.* (1988) and Bridgland (1988a, 1988b, 1994).

Within Greater London., two principal sites lie on the Taplow/Mucking Terrace: Uphall Pit at Ilford (Section 7.1) and Crayford in the London Borough of Bexley (Section 7.2). Several more minor sites, also attributed to the Taplow/Mucking Gravel Formation, contain Levallois implements that are typical of this period (Chapter 6.6), thereby highlighting the substantial presence of Neanderthals in the area during the early part of the Middle Palaeolithic.

7.1 Uphall Pit, Ilford

7.1.1 Introduction

During the nineteenth and early twentieth centuries, Ilford was the site of several commercial brick-making pits (see Chapter 6) and it was during the exploitation of the ‘brickearth’ (silty clay) that numerous, well preserved, large mammal remains were recovered. The most fossiliferous and celebrated of these brick pits, Uphall Pit, 6.4km to the north of the River Thames today, was the location of the vast majority of the discoveries in Ilford. Other pits in the Ilford area, such as the Cauliflower Pit, have proved to belong to the higher and older Lynch Hill/Corbets Tey terrace so a reappraisal of the mammalian fossils from all sites in the Ilford area on the Taplow terrace is undertaken here, comprising the analysis of 1606 specimens. The Taplow Terrace is considered to span MIS 8-7-6 (Bridgland, 1994; British Geological Survey, 2006).

7.1.2 Location of Collections

Faunal assemblages acquired by Sir Antonio Brady, J. Brown, R. Cotton, J. Morris, C. Westendarp, C. Falconer, A. Bell, J. Mason, Lady Prestwich, J. E. Lee, Mann, W. Ball, W. Thompson, Rawkins, C. Lyell, J. Liefe, Charlesworth, Enniskillen, Warburton, Sowerby, Cheadle, Appleton, the Harrison Gibson Store and the ex-Wellcome collection were observed in the collections at the Natural History Museum (and some on loan to Museum of London and Redbridge Museum) and the British Geological Survey Museum at Keyworth. The Redknap and Currant Richmond Road collection was seen at Redbridge Borough Museum, Ilford and one specimen was recorded at the Horniman Museum.

Specimen identifications made Dr. Danielle Schreve at Yorkshire Museum, Oxford University Museum, Lapworth Museum at Birmingham University and Manchester Museum, including the collections of J. Wickham Flower, Rolfe, W. Reed, W. B. Dawkins, R. D. Darbishire and Dixon were kindly offered for inclusion in this study due to time limitations making first-hand analyses at these locations difficult.

Artefactual collections from Ilford were seen from the Christy (Ex. Franks), Sturge, Todd-White, Lawrence, Warren, Geological Museum Collection, Corner, and W. G. Smith collections at the Museum of London, Natural History Museum, British Museum, Cambridge Museum of Archaeology and Anthropology, and Wardown Park Museum, Luton.

7.1.3 History of Research

The discovery of mammalian fossils in Ilford extends back to 1824 when a local collector, John Gibson, discovered an almost entire mammoth skeleton amongst other fossils in clay that was being exploited for commercial brick making (Morris, 1836, 1838). It was not specified from which pit the discoveries were made, although Morris (1838) detailed the stratigraphy from three principal brick pits that antiquarian collectors were frequenting in Ilford at the time. The first of these was Kilberton's Pit beside the River Roding and was later referred to as Kilverton's by Cotton (1847) and Uphall Pit by Dawkins (1867a). The second nearby pit was called Thomson's (Figure 7.1) and the third was Curtis' Pit discussed in Chapter 6 in relation to the Corbets Tey deposits.

Cotton (1847), Owen (1848), Davies (1865) and Wood jun. (1866), published further details of the stratigraphy and discoveries from Kilverton's/Uphall Pit. Dawkins (1867a) described the stratigraphy seen at Uphall Pit and the excavation of a complete skull of *Stephanorhinus hemitoechus* in 1865, which was acquired by Sir Antonio Brady, whose extensive collection is now held by the Natural History Museum. Brady's collection was catalogued by William Davies in 1874, in which 888 mammal bones were identified and listed (Davies, 1874). By the 1880s the Uphall brickpits had become well known for their abundant fossils and Walker (1880) described an excursion made by many eminent collectors and geologists to the Uphall site. The Uphall brickfield was enlarged in 1899 and revealed further fossils and abundant molluscan remains (Johnson and White, 1900; Johnson, 1900; Hinton, 1902). Whitaker (1889) also provided a description of the stratigraphy at Uphall Pit.

The work by Rolfe (1957) (previously detailed in Chapter 6), proved to be important in differentiating two separate river terrace deposits in the Ilford area. He illustrated the presence of two distinct aggradations of river gravels, one reaching as high as 10m O.D. and the other reaching only as far as 6-7m above O.D. The location at which the two aggradations meet seems to centre on the area between Ilford High Road and Green Lane (approximately TQ 446867), with the higher terraces being north of this boundary (Figure 6.14). The Uphall Pit lies south of this boundary and so represents the lower of the two aggradations, ie. the Taplow/Mucking Gravel Formation (Bridgland, 1994). In recent years, there have been few opportunities to examine these important deposits. The last investigations took place in 1984 in a pit north west of Uphall Pit in Richmond Road, during the redevelopment of Ilford town centre (Redknap and Currant, 1985; Gibbard, 1994) (Figure 6.14). Mammalian fossils were also discovered at the site of the Harrison Gibson Store (Figure 6.14). It is believed that the late Dr A. J. Sutcliffe, formerly of the Natural History Museum, was present at the excavations, however no records exist on the site, and the assemblage remains unpublished. The collection is now held in the Natural History Museum.

Equally, there have been few publications on the mammalian assemblages from the site in recent years. During a reappraisal of the mammal remains from the Ilford area, Schreve (1997) correlated the assemblage with that from Aveley, her type site for the MIS 7 interglacial, and subsequently attributed the Ilford fauna and that from the upper

part of the Aveley sequence to the Sandy Land Mammal Assemblage-Zone, characteristic of the mid-late part of the MIS 7 interglacial (Schreve, 2001a,b).

7.1.4 Location of sites

Uphall Pit was located south of Ilford High Road, to the west of Ilford Lane and on the eastern banks of the River Roding. Thomson's Pit was near Uphall Pit, approximately 450m from the River Roding, although the precise location of this pit is not known (Morris, 1838; Dawkins, 1867a) (Figure 6.14). The deposits mapped by Rolfe (1957) ran from Green Lane in the south to Ilford High Road in the north, 0.4km to the east of the Uphall site. He described three sections between Ilford High Road and Gordon Lane (approximately 400m to the east of the Uphall site), from which he also recovered several specimens. Further mammalian fossils were recorded from Richmond Road and the Harrison Gibson Store (Figure 6.14).

7.1.5 Stratigraphy

The stratigraphy recorded at Uphall Pit can be summarised as follows (based on the detailed descriptions by Cotton (1847) and Dawkins (1867a) (Figure 7.1):

- 4) Modern soil
- 3) Stratified 'brickearth' (fossils absent), with some sand and gravel horizons
- 2) Stratified sands and brown 'brickearth' with numerous fossils and freshwater molluscs
- 1) Sands and gravels

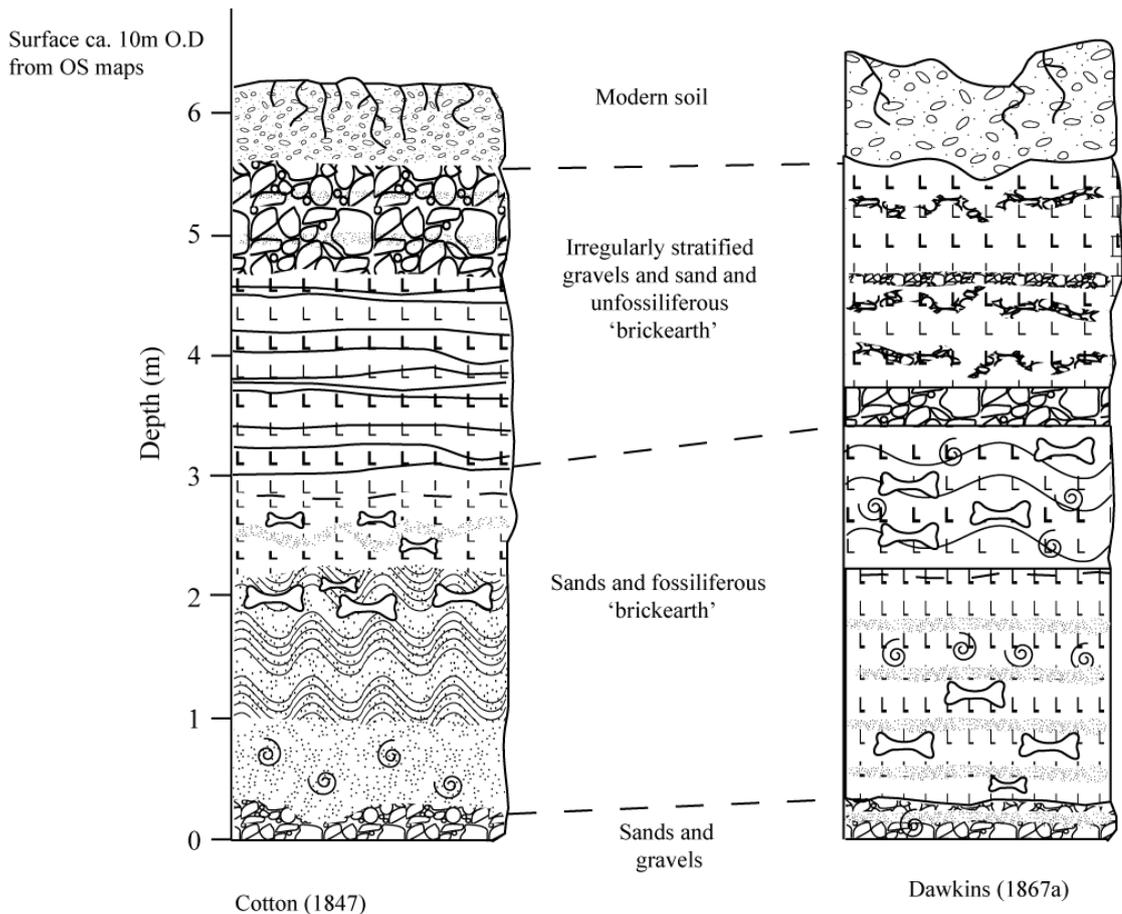


Figure 7.1: Stratigraphy from Uphall Pit, Ilford, redrawn as recorded by Cotton (1847) and Dawkins (1867a)

Similar sequences were recorded by Philips (1871), Walker (1880), Hinton (1900a,b), Rolfe (1957) in his Section 1 (See Chapter 6) and from the Richmond Road excavation by Redknapp and Currant (1985), all at similar ordnance datum heights (see Figure 6.18). The deposits will be considered in more detail below.

3) Stratified 'brickearths' lacking fossils, 'Upper Brickearths'

The 'brickearth' was irregularly stratified and highly contorted, and contained gravel horizons (Cotton, 1847; Dawkins, 1867a). The contortion observed in the upper 'brickearths' and the presence of vertically-positioned pebbles (Dawkins, 1867a) suggests that the deposit has been exposed to periglacial processes.

2) Fossiliferous ‘brickearths’ and sand

Cotton (1847) stated that the ‘brickearth’ and sand horizons at Uphall Pit were often discontinuous and varied greatly within a few feet, thus reflecting the differences recorded. Cotton (1847) also observed that the fossils occurred in both the ‘brickearth’ and the sand horizons but were more abundant at the horizon between the two, although it is clear from the descriptions published by Dawkins (1867a) and Redknap and Carrant (1985) that the fossils occurred throughout the lower ‘brickearth’ and sand horizons in other sections. It was in the Uphall Pit section, near the base of the ‘brickearths’, resting on a bed of pebbles, that the large cranium and tusks of a late form of steppe mammoth (*Mammuthus trogontherii*), now on display in the Natural History Museum, was discovered by workmen (Figure 7.2) (Dawkins, 1867a).



Figure 7.2: Cranium of *Mammuthus trogontherii* from Uphall Pit, Ilford on display in the Natural History Museum (Photo courtesy of the Natural History Museum)

The fossiliferous deposits observed in Uphall Pit, were laid down under temperate-climate conditions and their fine-grained nature indicates fluvial deposition under very calm conditions, so as not to disturb the often-articulated mammal bones (Cotton, 1847; Dawkins, 1867a). The bones were well preserved suggesting they were rapidly deposited, possibly by a flood (Schreve, 1997). Changing flow conditions are reflected in the varying textures present throughout the bed, with alternations between sand, gravel and silty clay.

1) Sand and Gravels

The sands and gravels were yellow in colour and mostly composed of flint, with some quartz and freshwater molluscs such as *Anodonta* and *Corbicula* (Dawkins, 1867a). This gravel is considered to be part of the Taplow/Mucking Gravel of the Thames (Bridgland, 1994; British Geological Survey, 2006).

7.1.6 Palaeontology and environmental reconstruction

Pollen

Pollen was also recovered from the Richmond Road excavations, from the silt beneath the 'brickearth' (Gibbard, 1994). Two samples were taken, but pollen preservation was poor in both. Tree pollen was dominated by *Pinus*, and low frequencies of *Quercus*, *Alnus* (birch), *Carpinus* (common hornbeam) and *Picea* (spruce) were also recorded. It was suggested that the sequence indicated that woodland was present, possibly some distance away from the fluvial site, nearer dry ground. Grasses and other herbaceous pollen was well represented, particularly of species indicative of disturbed ground (Gibbard, 1994).

Molluscs

Morris (1838), Cotton (1847), Dawkins (1867a) and Kennard and Woodward (1900) recorded molluscs from Uphall Pit, which are presented in Table 7.1. Cotton (1847) recorded only one species in addition to the genera, *Helix*, *Unio*, *Planorbis*, *Belgrandia*, *Valvata* and *Lymnaea*, although he did record that the molluscs were obtained from the sands overlying the bottom gravels at Uphall Pit. In some instances the shells were commingled with the bones in the lowest sections of the brickearth. The most common species recorded were *Corbicula fluminalis* and *Helix nemoralis* according to Johnson

and White (1899). Current taxonomic names were provided by Dr. Richard Preece at the University of Cambridge.

Species (in publications)	Current species name	Morris (1838)	Cotton (1847)	Dawkins (1867a)	Johnson and White (1900)	Kennard and Woodward (1900)
Freshwater						
<i>Corbicula fluminalis</i>		*	*	*	*	*
<i>Sphaerium mainanum</i>	<i>S. moenanum</i> was synonymised with <i>S. dickinii</i> which in turn may be <i>S. subsolidum</i> . The specimens need to be re-examined				*	
<i>Vitrea nitida</i>	<i>Zonitoides nitidus</i>				*	*
<i>Eulota fruticum</i>	<i>Fruticicola fruticum</i> (= <i>Bradybaena fruticum</i>)				*	*
<i>Paludestrina marginata</i>	<i>Belgrandia marginata</i>				*	
<i>Paludestrina ventrosa</i>	<i>Ventrosia ventrosa</i>				*	
<i>Cyclas cornea</i>	<i>Sphaerium corneum</i>			*		
<i>Pisidium amnicum</i>		*		*	*	*
<i>Pisidium fontinale</i>	Likely be a mix of several species				*	*
<i>Unio pictorum</i>		*		*		*
<i>Unio tumidus</i>					*	*
<i>Unio littoralis</i>	<i>Potomida littoralis</i>			*		
<i>Anodon cygneus</i>	<i>Anodonta cygnea</i>			*		
<i>Lymnaea peregra</i>	<i>Radix balthica</i>	*		*	*	*
<i>Lymnaea auricularia</i>	<i>Radix auricularia</i>	*		*	*	
<i>Lymnaea palustris</i>	<i>Stagnicola palustris</i> agg.				*	*
<i>Lymnaea truncatula</i>	<i>Galba truncatula</i>				*	*
<i>Lymnaea stagnalis</i>				*		
<i>Planorbis albus</i>	<i>Gyraulus albus</i>					*
<i>Planorbis carinatus</i>				*		
<i>Planorbis marginatus</i>	<i>Planorbis planorbis</i>				*	*
<i>Planorbis lineatus</i>	<i>Segmentina nitida</i>					*
<i>Planorbis glaber</i>	<i>Gyraulus laevis</i>				*	
<i>Planorbis spirorbis</i>	<i>Anisus leucostoma</i>				*	
<i>Planorbis corneus</i>	<i>Planorbarius corneus</i>	*		*		
<i>Hydrobia marginata</i>	<i>Belgrandia marginata</i>			*		

Table 7.1 continued...

Species (in publications)	Current species name	Morris (1838)	Cotton (1847)	Dawkins (1867a)	Johnson and White (1900)	Kennard and Woodward (1900)
<i>Paludina vivipara</i>	<i>Viviparus viviparus</i>			*		
<i>Paludina impura</i>	<i>Bithynia tentaculata</i>	*				
<i>Bythinia tentaculata</i>	<i>Bithynia tentaculata</i>			*	*	*
<i>Bythinia leachii</i>	<i>Bithynia leachii</i> (probably refers to <i>B. troschelii</i> at Ilford)					*
<i>Ancylus fluviatilis</i>				*	*	
<i>Vertigo antivertigo</i>					*	
<i>Valvata piscinalis</i>				*	*	*
<i>Valvata cristata</i>					*	
Terrestrial						
<i>Succinea oblonga</i>	<i>Succinea oblonga</i>	*				
<i>Succinea putris</i>						*
<i>Succinea elegans</i>	= <i>Oxyloma pfeifferi</i>				*	
<i>Helix hispida</i>	<i>Trochulus hispidus</i>	*		*		
<i>Hygromia hispida</i>	<i>Trochulus hispidus</i>					*
<i>Helix hortensis</i>	<i>Cepaea hortensis</i>	*			*	
<i>Helix nemoralis</i>	<i>Cepaea nemoralis</i>			*	*	*
<i>Helix caperata</i>	<i>Candidula crayfordensis</i>			*		
<i>Hellicella caperata</i>	<i>Candidula crayfordensis</i>				*	*
<i>Pupa marginata</i>	<i>Pupilla muscorum</i>			*		
<i>Pupa muscorum</i>	<i>Pupilla muscorum</i>				*	
<i>Carychium minimum</i>				*	*	
<i>Cochlicopa lubrica</i>					*	*
<i>Vallonia pulchella</i>					*	*
<i>Agriolimax agrestis</i>	<i>Deroceras</i> sp. (in this context)				*	
<i>Vitrea crystalline</i>					*	
<i>Arion ater</i>	Almost certainly earthworm granules				*	
<i>Punctum pygmaeum</i>					*	
<i>Pyramidula rotundata</i>	<i>Discus rotundatus</i>				*	
<i>Hellicella itala</i>					*	
<i>Clausilia laminate</i>	<i>Cochlodina laminate</i>				*	
<i>Clausilia bidentata</i>					*	

Table 7.1: Mollusc species recorded from Uphall Pit, Ilford

These species predominantly represent slowly-flowing water with plenty of vegetation. Areas of still and faster flowing water are also represented, with areas of deep water. The terrestrial species suggested areas of open grasslands and shaded woodlands, with alkaline soils. Drier habitats, presumably further away from the water-body are also indicated (Table 7. 2).

Inferred habitats and climates	Species
Warm temperatures/southern species	<i>Corbicula fluminalis</i> , <i>Belgrandia marginata</i>
Deep water	<i>Planorbarius corneus</i> , <i>Viviparus viviparus</i>
Still water	<i>Ventrosia ventrosa</i> , <i>Stagnicola palustris</i> agg., <i>Galba truncatula</i> , <i>Planorbis planorbis</i>
Slowly flowing water	<i>Unio pictorum</i> , <i>Potomida littoralis</i> , <i>Anodonta cygnea</i> , <i>Stagnicola palustris</i> agg., <i>Lymnaea stagnalis</i> , <i>Gyraulus albus</i> , <i>Planorbarius corneus</i> , <i>Viviparus viviparus</i> , <i>Valvata cristata</i>
Moderately-fast flowing water	<i>Pisidium amnicum</i> , <i>Ancylus fluviatilis</i>
Muddy substrate	<i>Ventrosia ventrosa</i> , <i>Anodonta cygnea</i> , <i>Viviparus viviparus</i>
Hard bed for attachment	<i>Ancylus fluviatilis</i>
Aquatic vegetation	<i>Ventrosia ventrosa</i> , <i>Radix auricularia</i> , <i>Stagnicola palustris</i> agg., <i>Lymnaea stagnalis</i> , <i>Gyraulus albus</i> , <i>Planorbarius corneus</i> , <i>Valvata cristata</i> , <i>Gyraulus laevis</i>
Hard water	<i>Unio pictorum</i> , <i>Potomida littoralis</i> , <i>Radix auricularia</i> , <i>Lymnaea stagnalis</i>
Terrestrial	
Shaded	<i>Clausilia bidentata</i> , <i>Discus rotundatus</i> , <i>Vitrea crystallina</i> , <i>Cochlicopa lubrica</i>
Unshaded	<i>Hellicella itala</i> , <i>Succinella oblonga</i> , <i>Trochulus hispidus</i>
Alkaline soils	<i>Cochlodina laminata</i> , <i>Hellicella itala</i> , <i>Candidula crayfordensis</i> , <i>Punctum pygmaeum</i> , <i>Vitrea crystallina</i> , <i>Pupilla muscorum</i>
Damp	<i>Discus rotundatus</i> , <i>Vallonia pulchella</i> , <i>Cochlicopa lubrica</i> , <i>Carychium minimum</i>
Dry	<i>Hellicella itala</i> , <i>Candidula crayfordensis</i> , <i>Pupilla muscorum</i>
Grasslands	<i>Candidula crayfordensis</i> , <i>Deroceras</i> sp., <i>Vallonia pulchella</i>
Woodlands	<i>Cochlodina laminata</i> , <i>Discus rotundatus</i> , <i>Vitrea crystallina</i>

Table 7.2: Environments inferred by the molluscs from Uphall Pit, Ilford.
References from Ellis (1926, 1978), Quick (1933), Macan (1949), Bishop (1976),
Kerney and Cameron (1979), Kerney (1999).

Mammals

Schreve (1997) reassessed the mammals from Uphall Pit and the Harrison Gibson Stores site and produced a revised species list, including the significant dismissal of *Hippopotamus* at the site. This species was originally recorded based on one specimen (Davies, 1874) and was also mentioned in (Walker, 1880). During the present study, which included the assemblages from Uphall Pit, Richmond Road and the Harrison Gibson Store, no new species were recorded, although some specimens formerly attributed to the 'Ilford type' mammoth (previously described as a 'primitive' form of woolly mammoth, *Mammuthus primigenius*) were reattributed to a late form of *M. trogontherii*, following the taxonomic revisions of Lister and Sher (2001).

Mammoth molars analysed in this study displayed the characteristics of *M. trogontherii*, such as reduced size, lower numbers of plates (ca. 18-20 on M3 compared to ca. 24 in *M. primigenius* (Lister and Sher, 2001)), reduced lamellar frequency (ie. wider spacing between plates), thicker enamel, a pronounced oval occlusal surface in upper molars, a pronounced lozenge shape to the lower molars and finally pronounced enamel islets in occlusal view (A. Currant, pers. comm.). The last feature is not unique to the 'Ilford type' mammoth but does appear to be an exceptionally common character. The mean plate count calculated from nine M3 specimens recorded in this study was 19.3, and therefore is consistent with the range observed in *M. trogontherii*. Specimens that were considered impossible to identify to species level, such as post-cranial bones, were identified as *Mammuthus* sp. to indicate that the specimen may be either *M. primigenius* or *M. trogontherii* (late form). The earlier taxonomic confusion had arisen because mammoths of post-Anglian age had relatively high lamellar frequencies compared to early Middle Pleistocene representatives of *M. trogontherii*, thereby leading to an attribution of these specimens to *M. primigenius*. However, it has been observed that mammoths from 500k to 200k years (including Ilford) BP exhibit higher lamellar frequencies because mammoths during this period experience a reduction in overall body size, resulting in compressed molar plates and resembling *M. primigenius* (Lister and Sher, 2001). Therefore, lamellar frequency is not regarded as a reliable tool to identify mammoth species during this time, and instead the total number of plates is the significant characteristic when identifying mammoth species (Lister and Sher, 2001).

Therefore, only plate count has been used in this study to identify the presence of *M. trogontherii* at sites in London.

During the late parts of MIS 7, some sites apparently had both *M. trogontherii* and *M. primigenius* present (Schreve, 1997; Lister and Sher, 2001). Since the latter is firmly established in the UK from MIS 6 onwards, a combination of forms might therefore indicate an age towards the closing phases of the interglacial (Schreve 1997). However, a bimodal distribution of the M3 plates was not recorded at Ilford in the present study. Almost 40% of mammoth specimens were identifiable to species level and all were characteristic of the late form of *M. trogontherii*, perhaps indicating that the fossiliferous brickearths lie well within MIS 7a as opposed to at the transition to MIS 6. The species recorded in this study, following those published by Schreve (1997) and are listed in Table 7.3.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Rodentia			
<i>Castor fiber</i> L., beaver	10	0.62	2
Carnivora			
<i>Canis lupus</i> L., wolf	2	0.12	1
<i>Ursus arctos</i> L., brown bear	19	1.18	2
<i>Panthera leo</i> (L.), lion	9	0.56	2
Proboscidea			
<i>Palaeoloxodon antiquus</i> (Falconer and Cautley), straight-tusked elephant	26	1.62	4
<i>Mammuthus primigenius</i> (Blumenbach), woolly mammoth	27	1.68	2
cf. <i>Mammuthus primigenius</i>	4	0.25	1
<i>Mammuthus trogontherii</i> (Pohlig), steppe mammoth (late form)	145	9.03	5
cf. <i>Mammuthus trogontherii</i>	15	0.93	15
<i>Mammuthus</i> sp. undetermined mammoth	253	15.75	11
Elephantidae sp. undetermined elephant	15	0.93	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	68	4.23	4
<i>Stephanorhinus hemitoechus</i> (Falconer), narrow-nosed rhinoceros	143	8.90	6
cf. <i>Stephanorhinus hemitoechus</i>	7	0.44	1
<i>Stephanorhinus kirchbergensis</i> (Jäger), Merck's rhinoceros	12	0.75	3
<i>Coelodonta antiqunitatis</i> (Blumenbach), woolly rhinoceros	4	0.25	1
Rhinocerotidae sp. undetermined rhinoceros	19	1.18	2
Artiodactyla			
<i>Megaloceros giganteus</i> (Blumenbach), giant deer	15	0.93	2
<i>Cervus elaphus</i> L., red deer	72	4.48	12
cf. <i>Cervus elaphus</i>	16	1.00	2
<i>Capreolus capreolus</i> (L.), roe deer	1	0.06	1
Cervidae sp. undetermined cervid	2	0.12	1
<i>Bos primigenius</i> Bojanus, aurochs	45	2.80	14
cf. <i>Bos primigenius</i>	3	0.19	1
<i>Bison priscus</i> Bojanus, bison	7	0.44	4
cf. <i>Bison priscus</i>	1	0.06	1
Bovidae sp. undetermined large bovid	655	40.78	20
cf. Bovidae sp.	10	0.62	1
unidentified Artiodactyla sp.	1	0.06	
Total	1606		

Table 7.3: Species recorded from Uphall Pit, Ilford

The dominant components of the assemblage, Bovidae sp. (40.78%), *Mammuthus* sp. (15.75%), *Mammuthus trogontherii* (9.03%), and *Stephanorhinus hemitoechus* (8.90%)

are all indicative of open grassland habitats (Kurtén, 1968), supported by smaller number of *E. ferus* (4.23%), *B. primigenius* (2.80%), *P. leo* (0.56%), *B. priscus* (0.44%), and *C. antiquitatis* (0.25%). Although the predominant palaeoenvironmental signature is one of grassland, the presence of at least some woodland is highlighted by *P. antiquus* (1.62%), *S. kirchbergensis* (0.75%), *C. fiber* (0.62%) (Figure 7.3), and *C. capreolus* (0.06%). Much like the molluscan evidence, the presence of beaver also suggests the predominance of slow flowing water, since they require relatively slow water to build their dams, in which they store their winter food (Corbett, 1966).



Figure 7.3: *Castor fiber* mandible from Ilford (Specimen 23767, Natural History Museum) (Photo courtesy of D. Schreve)

The presence of *C. fiber*, *B. primigenius*, *P. antiquus*, *S. kirchbergensis* and *C. capreolus* indicate the climate was fully temperate, as these species are exclusively known from warm periods during the Pleistocene (Stuart, 1982). The Harrison Gibson Store and Richmond Road assemblages were both included with the Uphall fauna because both had several mammoth specimens. Although mammoth has been tentatively suggested from MIS 10/9 at Stoke Newington in Chapter 6.2, it is not a known from interglacial periods prior to the latter half of MIS 7 (Schreve, 2001a). However, the Richmond Road site was recorded at c. 13m OD (Rednap and Currant, 1985), and the Harrison Gibson Store site was nearby, further to the north, suggesting it was also situated at a similar height range. This is a higher height compared to the Uphall Pit site, which was recorded at around 6-7m OD (Cotton, 1847; Dawkins,

1867a), and is more comparable with the height range associated with Cauliflower Pit (Chapter 6.3). Therefore there remains some uncertainty as to which terrace these assemblages belong to.

Cotton (1847) stated that many bones in the ‘brickearth’ were still in articulated position and showed little evidence of attrition or abrasion, suggesting they had not been disturbed since their original deposition. This again suggests the assemblage was deposited quickly, possibly by a flood. The majority of specimens analysed in this study displayed moderate levels of abrasion (41.54%) and another 38.05% were heavily abraded (Table 7.4) suggesting that there is a possibility that not all specimens were from the same deposit as described by Cotton (1847) and that some specimens may have degraded pre- and post-excavation. Despite this, 20.41% of the assemblage did display low levels of abrasion (unabraded and slight abrasion), reflecting the description of the fossils from Cotton (1847), Dawkins (1867a) and Walker (1880). The frequent large, intact specimens, such as a *Bos* skull, with the fragile nasal bones intact, suggests that burial occurred extremely rapidly as well as under gentle depositional conditions.

Condition	No. of specimens	%
Heavily abraded	535	38.05
Moderately abraded	584	41.54
Slightly abraded	285	20.27
Unabraded	2	0.14
Total	1406	

Table 7.4: Level of abrasion exhibited by fossils from Ilford (* not all specimens from assemblage were analysed for this criteria)

The degree of staining exhibited by the specimens was varied, although they were predominantly stained orange or brown. When comparing the staining of the unabraded and slightly abraded fossils, the degree of staining remained variable (Table 7.5).

Level of Staining	No. of specimens
Strong	49
Moderate	96
Slight	127
Unstained	15
Total	287

Table 7.5: Level of staining of the unabraded and slightly abraded fossils from Ilford

A large number of specimens from Ilford were not directly provenanced to Uphall Pit or to specific deposits within the area, which might accordingly explain the varied abrasion exhibited by the fossils.

7.1.7 Archaeology

Seven implements have been recognised from locations attributed to the Taplow Terrace in Ilford (Table 7.6). Four handaxes are specifically provenanced to Uphall Pit and the others are provenanced to Little Ilford and Barking Lane.

Implement	Number of artefacts	% of assemblage
Handaxes	5	71.43
Flakes (total)	2	28.57
Levallois flakes	1	14.29
Probable Levallois flakes	0	0.00
Retouched Levallois flakes	0	0.00
Retouched non-Levallois flakes	0	0.00
Cores (total)	0	0.00
Levallois cores	0	0.00
Unidentified worked flint	0	0.00
Total implements	7	

Table 7.6: Implements recorded from Ilford, from Taplow Terrace locations

No artefacts were unabraded and therefore were presumably not *in situ* (Table 7.7). The paucity of artefacts is rather unusual in such extensively-worked deposits, which might imply that hominins were not particularly active at the site and utilisation of the large mammal carcasses was not occurring. This observation may be upheld by the apparent lack of cutmarks, breakage or other modification on the bones, although it should be noted that collector bias probably discriminated against the recovery of incomplete,

‘damaged’ specimens and the levels of abrasion noted on the surface of many bones may have been sufficient to obscure any cutmarks. Nevertheless, the low numbers of artefacts appears consistent with the interpretation that the assemblage is a natural accumulation, possibly the result of an extensive flood.

Level of abrasion	Number of artefacts	% of assemblage
Fresh	0	0.00
Slightly abraded	2	28.57
Moderately abraded	3	42.86
Heavily abraded	2	28.57
Total	7	

Table 7.7: Level of abrasion exhibited by the Ilford implements

Two of the Uphall Estate artefacts are recorded as found 6ft (1.8m) from the surface, which, when compared to the stratigraphies recorded by Cotton (1847) and Dawkins (1867a), would correlate with the ‘Upper Brickearths’ and not with the older, lower, fossiliferous deposits. The two artefacts described by Hinton (1900b p.275), Johnson (1900), and Johnson and White (1900), were found in the Cauliflower Pit by Corner and are therefore from the higher Corbets Tey Gravel Formation, however no artefacts from Cauliflower Pit in Corner’s collection could be relocated in this study. Johnson (1900, 1902) also referred to flakes from the sand and gravel above the ‘brickarth’ in Uphall Pit. Kennard (1916) referred to Levalloisian implements from Ilford, possibly found by Corner, although neither the Kennard nor Johnson artefacts were relocated by Wymer (1968), or during this study.

7.1.8 Age of Deposits

Lithostratigraphy

Bridgland (1994, 1995) reinterpreted the deposits in the Ilford area and recognised two terrace levels based on the elevations of the gravels, supporting the work of Rolfe (1957) (see Chapter 6.2). Bridgland correlated the deposits at Uphall with the Mucking Gravel Formation of the Lower Thames, which he proposed represented MIS 8-6 inclusive and incorporated interglacial sediments correlated with MIS 7. In contrast, Gibbard (1994, 1995) correlated the Ilford Uphall deposits with the Aveley Silts and

Sands Member, which he regarded as part of a complex Ipswichian interglacial (see Chapter 3).

Dating

C. fluminalis shells, believed to be from the Uphall area of Ilford, were analysed by Miller *et al.* (1979) for amino acid racemization. As described in Chapter 6, the amino acid ratios obtained indicated that some shells were likely to have originated from the older Corbets Tey Terrace and others from Uphall site, as the ratios clearly indicated a mixture of ages. However, the ratios obtained from Ilford were all higher than those from Bobbitshole, the type site of the Ipswichian interglacial (0.09 ± 0.015), thereby supporting a pre-Ipswichian date.

Biostratigraphy

The interglacial deposits at Ilford were originally assigned to the Ipswichian Interglacial (MIS 5e) by Stuart (1976) who correlated the Ilford mammalian assemblage with those from other sites in the same terrace (Aveley and the Lower Brickearths, Crayford), previously considered to be Ipswichian in age. Since the mid-1970s however, there has been radical reinterpretation of many of these localities, principally through a widespread reappraisal of the new lithostratigraphy, mammalian and molluscan biostratigraphy and the application of other dating techniques. The Seven Kings site to the north of Ilford is now attributed to the Corbets Tey Gravel Formation (see Chapter 6) but had originally been assigned to the Last Interglacial (West *et al.*, 1964), along with Aveley and Trafalgar Square, on the basis of their temperate-climate pollen records (West, 1969; Mitchell *et al.*, 1973; Hollin, 1977), considered comparable to that from the Ipswichian stratotype at Bobbitshole, Suffolk (Spencer, 1953; West, 1957). However, it was later recognised that the deposits at Trafalgar Square were situated just below ordnance datum, whereas those at Aveley, Crayford and Ilford were found at substantially higher levels (c. 15m O.D.) and therefore the three sites could not represent the same interglacial if they were all the product of deposition by the Thames (Sutcliffe, 1975, 1976; Bridgland, 1994).

Sutcliffe (1975, 1976) and Sutcliffe and Kowalski (1976) suggested that the Uphall site pre-dated the Ipswichian interglacial and assigned an age within the penultimate interglacial on the basis of its faunal assemblage and also its higher elevation compared

to *bona fide* Ipswichian deposits at Trafalgar Square. In contrast, Stuart (1976) recognised differences between the faunal assemblages of Ilford and Aveley (also part of the Mucking Terrace) compared to Trafalgar Square, but attributed these to different biozones within the Ipswichian. He also did not recognise the presence of the distinctive ‘Ilford type’ mammoth (a late morphotype of *Mammuthus trogontherii*) and *Stephanorhinus kirchbergensis*, species which Sutcliffe (1975, 1976) recognised as pre-Ipswichian.

In a review of the Ilford mammalian assemblage, Schreve (1997) re-identified the single vertebra previously misidentified as *Hippopotamus major* (Davies, 1874) as belonging to *Bos primigenius*. This removed one crucial piece of supporting evidence for an Ipswichian age, since *Hippopotamus* is a key biostratigraphical indicator species for MIS 5e. The presence of *S. kirchbergensis* was also confirmed within the Uphall Ilford assemblage by Schreve (1997). Stuart (1976) had based his dismissal of *S. kirchbergensis* at Ilford on the absence of upper third molars in the assemblage. However, Schreve (1997) identified 23 other elements of this species in the assemblage, including complete lower jaws with dentition *in situ*. *S. kirchbergensis* is unknown in Britain after the penultimate interglacial (Schreve, 2001a) and its presence at Ilford is therefore consistent with a pre-MIS 5e age.

Additionally, Schreve (1997), Lister and Sher (2001), and this study have identified 100% of the *Mammuthus* M3s as the primitive ‘Ilford type’ or *M. trogontherii* (late morphotype). As explained previously, *M. trogontherii* molars are generally smaller and have a relatively lower plate count when compared to *M. primigenius* (Lister and Sher, 2001) and are only found in sites that are now considered to be MIS 7 interglacial sites such as Northfleet and Crayford in Kent, Marsworth in Buckinghamshire and Stanton Harcourt in Oxfordshire (Sutcliffe, 1995; Schreve, 1997; Lister and Sher, 2001). In the molluscan record, the occurrence of *C. fluminalis* is highly significant, since it is unknown in Britain from Last Interglacial deposits (Meijer and Preece, 2000; Keen, 2001).

The mammalian assemblages from sites within the Lower Thames correlated with MIS 7 were grouped into two Mammal Assemblage Zones (MAZ), reflecting a difference in age and environment and attributable to different sub-stages within the interglacial: the

Ponds Farm and the Sandy Lane MAZs (Schreve, 2001a,b). The Ponds Farm MAZ is characterised by a fully temperate interglacial fauna dominated by woodland inhabitants, such as *Crocidura* sp. (white-toothed shrew), *P. antiquus*, *C. elaphus*, *Bos* sp. and *B. priscus* and was originally established for the assemblage in the lower sands and silts at Aveley (Schreve, 2001a, b). This assemblage was considered to reflect deposition during an early isotopic sub-stage within MIS 7, namely MIS 7e (Schreve, 2001a,b). The younger the Sandy Lane MAZ was originally based on the fauna from the upper beds at Aveley and is characterised by temperate species that are predominantly grassland dwelling, such as *S. hemitoechus*, *P. leo*, *E. ferus* and significantly, mammoth. *Mammuthus trogontherii* (late form) is a component of the assemblage, appearing in exclusivity in some sites and in association with *M. primigenius* at others, presumed to be very late on in the interglacial. Fallow deer is an important absentee from the Sandy Lane MAZ but other woodland indicator species such as *P. antiquus* and *S. kirchbergensis* are present in very low numbers.

The isotopic sub-stage ages attributed to the faunal assemblages at Aveley and consequently comparable sites such as Uphall Pit, Ilford and Crayford, have been upheld by high precision ICP-MS Uranium-series dating on tufa deposits at Marsworth (Candy and Schreve, 2007). The chronology for MIS 7 proposed by these authors illustrated the presence of fully temperate conditions during the two oldest (and warmest, as indicated by the marine and ice core records) sub-stages MIS 7e and 7c. The Ponds Farm MAZ observed at Aveley is attributed to this early part of MIS 7. This was followed by a significant climatic deterioration (MIS 7b) after which a fully temperate grassland fauna occurred in MIS 7a (the Sandy Lane MAZ). Species adapted to continental climates such as *C. antiquitatis*, *Ovibos moschatus* (musk-ox), *Dicrostonyx torquatus* (collared lemming), *Lemmus lemmus* (Norway lemming) and *Citellus citellus* (European ground squirrel) are recorded in the Sandy Lane MAZ and could only have entered Britain if there was some form of terrestrial connection to the continent. If the Straits of Dover had already been created before or during MIS 7 (most likely during the Anglian Gibbard, 1995), then a fall in sea level under cold-climate conditions would be required to permit the movement into Britain of the cool-adapted fauna. The necessary fall in sea level could have occurred during MIS 7b, the intervening cool sub-stage between the fully temperate woodland environment and the fully temperate grassland environment of MIS 7a (Candy and Schreve, 2007). If, on the

other hand, the breaching of the landbridge connecting Britain to the continent did not occur until MIS 6 (see Gupta *et al.* 2007), the immigration would not require a lowering of sea level but would simply occur in response to deteriorating climatic conditions as the interglacial progressed.

The combined presence of the late morphotype of *M. trogontherii* with *S. kirchbergensis* and the bivalve *C. fluminalis* recorded at Uphall Pit is therefore diagnostic of a pre-Ipswichian age as none are known from MIS 5e (Currant, 1989; Sutcliffe, 1995; Schreve, 1997; Keen, 2001; Schreve, 2001a,b; Bridgland *et al.*, 2004). Schreve (2001a,b, 2004c) subsequently attributed the Uphall site to the Sandy Lane MAZ, which represents a temperate open grassland environment in late MIS 7.

The pollen sequence from Richmond Road was correlated with the Seven Kings assemblage (Chapter 6.3) and both were consequently attributed to Ip IIB of the Ipswichian Interglacial. As discussed above, the terrace positions in the Ilford area oppose an Ipswichian correlation of these sites. In Chapter 6.3 the Seven Kings site is suggested to belong to the Lynch Hill Terrace and as discussed above the Richmond Road site (and the Harrison Gibson Store site) are both located in height ranged higher than the Uphall Pit area. Therefore the Harrison Gibson Store and Richmond Road assemblages cannot be definitely attributed to either the Lynch Hill/Corbets Tey Terrace or the Taplow/Mucking Terrace in this study.

Archaeology

The archaeological assemblage is small, and suggests for some reason the site was not significantly occupied by hominins. One implement was identified as a Levallois flake, which is a common typology seen during MIS 7, and is recorded from sites such as Crayford (Scott, 2006; White *et al.*, 2006; this chapter), Lion Pit Tramway Cutting, West Thurrock (Schreve 2004c; Schreve *et al.*, 2006), and Aveley (Schreve, 2004c).

7.2 Crayford, Erith and Slade Green

7.2.1 Introduction

Crayford and the neighbouring areas of Erith and Slade Green (Figure 7.4) became celebrated in the 19th century for the many fossils and flint artefacts that were found there, particularly in the deposits of the Lower Brickearths and *Corbicula* bed. F. C. J. Spurrell was a key collector in the area and made the discovery of numerous fresh associated flint tools from the famous Palaeolithic ‘working floor’ (Spurrell, 1880a,b, 1884, 1886, 1898). The condition and abundance of the artefacts from Crayford, in addition to the substantial fossil record from the site, distinguishes Crayford as one of the most renowned Palaeolithic sites in Britain. The deposits are part of the Taplow Terrace (Bridgland, 1994; British Geological Survey, 1998) with the basal Crayford Gravels, Lower Brickearths and *Corbicula* Bed generally being correlated with the penultimate (MIS 7) interglacial (Bridgland, 1994; Schreve, 1997, 2001a). Similar deposits were observed nearby at East and West Wickham and Plumstead (discussed in section 7.3).

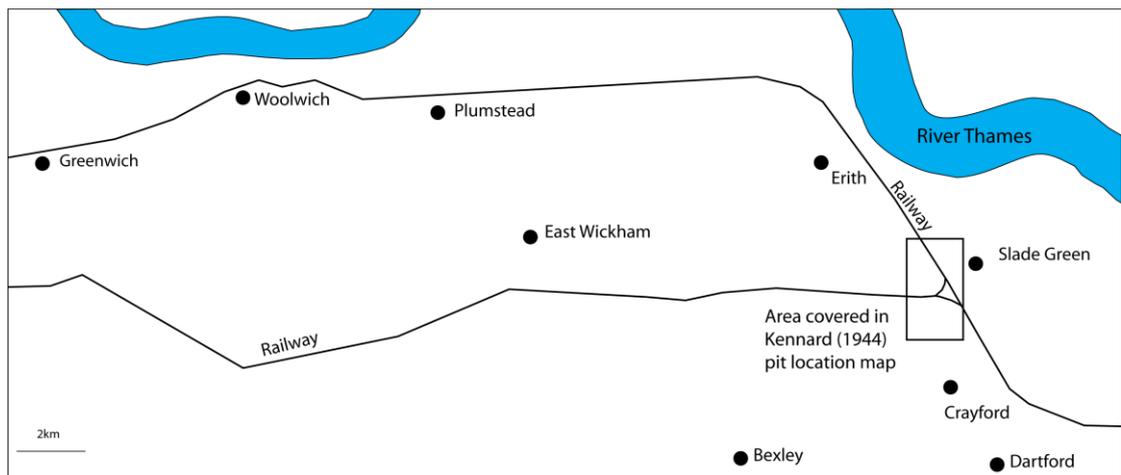


Figure 7.4: Location of Crayford, Erith, Slade Green, Plumstead and East Wickham (West Wickham no longer exists as a separate locality and is unmarked)

7.2.2 Location of Collections

The faunal collections acquired by F. C. J. Spurrell, Warburton, F. Corner, M. A. C. Hinton, J. E. Lee, Butler, A. Bell, Dr. Exton, W. Ball, Charlesworth, C. M. Doughty, J. Prestwich, Kennard, Morris, H. Warren, D. Sharpe and Griffiths and a small number of Palaeolithic artefacts (one from the H. Dewey Collection) were seen at the Natural History Museum, London.

The artefact collections made by Burchell, Chandler, Christy (Ex. W. Franks), Dewey, Ex. Guildhall Museum, Brice-Higgins, Jones, Kemp, Marston, Newton, R. G. Rice, Trechmann, Warren (including some Ex. Kennard), Wellcome, Lord Avebury, Ex. Institute of Archaeology and Sturge (including some Ex. J. A. Brown) were all seen at the British Museum, London.

Other faunal and artefactual material from E. C. Youens, F. C. J. Spurrell, K. J. Andrews, Furner, Chandler, J. S. J. Pearson, S. Priest, Lord Glenesk, W. T. Bartlett, Ex. Norwich Castle Museum, Lewis Abbott, and R. Miles was seen at Dartford Museum, Kent.

Faunal material from the Kennard, Dr. F. Spurrell, W. M. Newton, M. S. Johnson, Cheadle, W. H. Penning, A. L. Leach and Francis Whitehead collections was seen at the British Geological Survey Museum in Keyworth, Nottingham.

Artefacts from Erith, including one from the Layton Collection were seen in the Museum of London.

One Palaeolithic artefact from the Rev. O. Fisher Collection and the C. M. Doughty faunal Collection were seen at the Sedgwick Museum of Earth Sciences, Cambridge.

A small collection of artefacts (unidentified collector) were seen in the Museum of Archaeology and Anthropology in Cambridge.

An additional collection of mammalian fossils from an unidentified collector were seen at the Horniman Museum, London.

Information on tool type, size, and condition recently recorded by Dr. Beccy Scott from 264 artefacts from the Spurrell collection in the Natural History Museum and 134 faunal identifications by Professor Danielle Schreve from the Reed Collection at the Yorkshire Museum, the Wallis Collection at the Lapworth Museum of Birmingham University, the J. W. Jackson Collection at Buxton Museum, the J. W. Flower Collection at University Museum, Oxford and the W. B. Dawkins Collection at Manchester Museum were kindly offered for inclusion in this study.

7.2.3 History of Research

The first detailed description of fossiliferous deposits at Erith and Crayford was made by Morris (1838), although he refrained from placing the sites into a chronology until further research offered more evidence. He described deposits present in four brick pits: Stoneham's, Francis and White's Pit, Hutchon's, and Clarke's Pits. Unfortunately the location of the latter two pits is now unknown due to the pits often changing ownership and name, although the other two have been located by previous researchers (e.g. Kennard, 1944). Stoneham's Pit, in particular, continued to be the most frequented and prolific pit in the area throughout the 19th and early 20th centuries. Wood jun. (1866) attempted to place the deposits at Crayford (along with other fossiliferous sites in the Thames valley such as Ilford and Grays) into the Pleistocene chronology as it was understood at the time. He proposed that the Lower Brickearths in the Crayford area, along with similar deposits at Ilford and Wickham, were deposited after the 'Boulder Clay glacial event' (now accepted as the Anglian Glaciation, MIS 12), which he believed had completely excavated the Thames valley. He also suggested that these deposits were contemporaneous in age but that they were *older* compared to the deposits at Grays (now attributed to MIS 9) (Bridgland, 1994; Schreve, 2001a).

Dawkins (1867a) discussed the deposits seen at Erith, Crayford and Ilford and published more stratigraphical details. He suggested that the various 'Lower Brickearths' throughout the Thames such as those at Crayford, Ilford, Erith and Grays all represented the same period of time due to their similar sedimentological characteristics and mammalian fossils. Morris also subsequently supported this grouping (in Dawkins, 1867b).

Fisher (1872) recorded the first Palaeolithic artefact to be found in the Crayford area at Slades Green Pit in brickearth deposits. This artefact is now in the Sedgwick Museum, Cambridge. As Kennard (1944) first noticed, the location of 'Slades Green Pit' as described by Fisher actually referred to the famous Stoneham's Pit.

F. C. J. Spurrell was the most prolific collector of Palaeolithic artefacts in the Crayford pits. He had observed the excavations at Crayford for some time but it was not until 1880 that he was able to associate artefacts and fossils with the specific deposits from which they had been excavated (Spurrell, 1880a). He consequently published several

papers (1880a and b, 1884, 1886, 1898) on his discoveries in the Crayford area. His most famous discovery was a Palaeolithic ‘working floor’, in which he found a concentration of flakes that he was able to re-fit into the original core that they had been struck from. He also found a flake resting upon a mandible of a woolly rhinoceros (Spurrell, 1880a), thereby demonstrating a clear association between the artefacts and fauna.

F.C.J Spurrell’s father, Dr. F. Spurrell, and Mr. Grantham, both local residents, were responsible for collecting the majority of the mammalian fossils from Crayford. Spurrell’s collection later went to the Natural History Museum and the British Geological Survey Museum. Grantham’s collection was not located in a later review by Kennard (1944) and no specimens bearing his name have been found during this study. These collections were considered to be entirely from Stoneham’s Pit (Dawkins, 1867a) although Kennard (1944) suggested that a small proportion of the specimens may have come from elsewhere in the Crayford area. Detailed summaries of the history of collecting and research, stratigraphy and the chronology in the Crayford area were compiled by Whitaker (1889) and Kennard (1944).

More recent work on Crayford has included a revision of the rodent fossils and the inferred age of the deposits by Sutcliffe and Kowalski (1976). It was suggested by these authors that the Crayford interglacial deposits could be correlated with the interglacial sediments at Grays, Ilford and Aveley, ie. assigning them a broad late Middle Pleistocene age but then unable to differentiate between MIS 9 and 7. A commercial report by Wessex Archaeology (1996) summarised the pit locations and the artefacts discovered in the area and also reviewed the stratigraphy and the future potential of the deposits in their Crayford Silt Complex Archaeological Deposit Survey (1999). Wymer (1968) and Roe (1968a, 1981) both compiled detailed gazetteers of the archaeology from the Crayford area.

In an attempt to place the sediments within a well-constrained stratigraphical context, Bridgland (1994) correlated the interglacial deposits at Crayford with the Taplow/Mucking Terrace and proposed a subsequent age of MIS 7 based on the stratigraphical succession seen in the Lower Thames. Bridgland recognised that the interglacial deposits seen at West Thurrock, Aveley, Northfleet and Crayford were

separated from those at Grays by the post-interglacial gravel aggradation of the Lynch Hill/Corbets Tey Formation and the down-cutting event that preceded the deposition of the Crayford/West Thurrock/Northfleet/Aveley interglacial sediments. This suggested that the Crayford Lower Brickearths represented a separate and younger interglacial from MIS 9, but older than MIS 5e, deposits of which are preserved in a lower terrace, the Kempton Park terrace, lying below the modern floodplain (Bridgland, 1994, see Chapter 3 Figure 3.7).

Schreve (1997, 2001a,b) analysed all mammalian fossils from the Crayford area and attributed the faunal assemblage from the Lower Brickearths to the Sandy Lane Mammal Assemblage Zone (MIS 7a). Finally Scott (2006) re-investigated all archaeology from Crayford and upheld the sometimes disputed Levallois status of the Palaeolithic artefacts.

7.2.4 Location of sites

Kennard (1944) produced a map of the pits in the Crayford and Erith area (Figure 7.5). As he collected in two pits for eight years between 1892 and 1900, he had first-hand knowledge of where the pits were located. Kennard was able to locate Stoneham's, Rutter's, Norris', Furner's Old, Furner's New and Talbot's Pits.

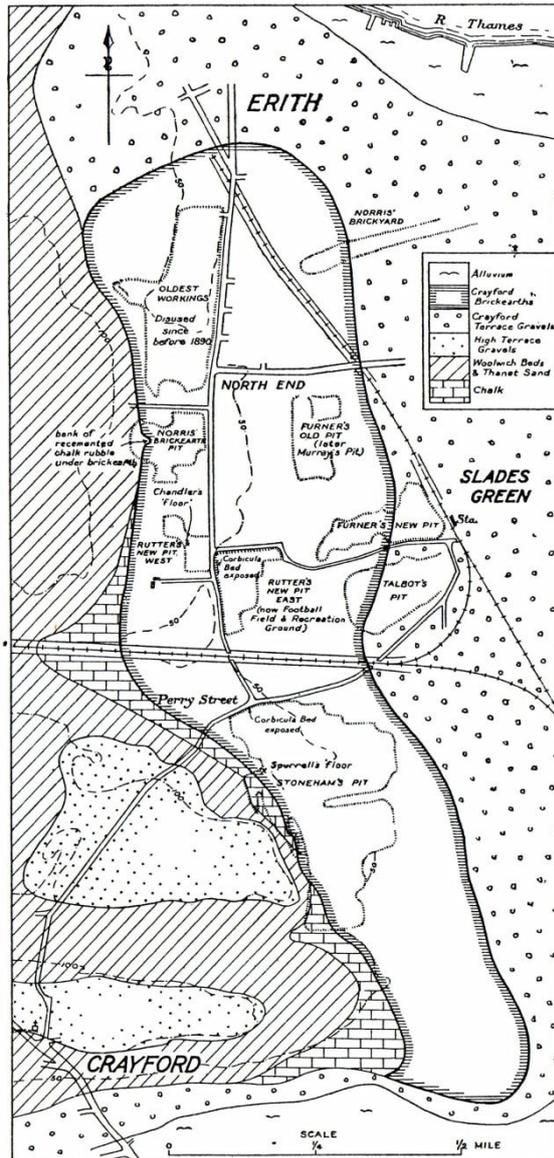


Figure 7.5: Location of many of the brick pits in the Crayford area. From Kennard (1944)

As mentioned previously, it has not been possible to locate some of the pits referred to in the older publications such as Clarke's and Hutchon's Pits described by Morris (1838), although Kennard (1944) suggested these two pits may have been located in Slade Green. Morris' Francis and White's Pit was later identified by Dawkins (1867a) as White's Pit. Spurrell (1886) described White's Pit as almost abandoned, which is likely to be the pit labelled 'Oldest Workings, disused since before 1890' by Kennard on his 1944 map. Dawkins' account of the pit being 'on the right hand side of the road

from Erith to Crayford, immediately after it has crossed the North Kent Railway' (Dawkins, 1867a p.97), supports this location.

7.2.5 Stratigraphy

The Thanet Sands and Chalk bedrock have been eroded below 0m O.D. (Bridgland, 1994) to create a 'cliff' against which the Pleistocene deposits have accumulated. The following horizons were recognised (Morris, 1938; Dawkins, 1867a; Tylor, 1869; Whitaker, 1889; Leach, 1905; Chandler and Leach, 1912a, 1912b; Chandler, 1914; Kennard, 1944; Schreve, 1997; Scott, 2006):

5. 'Trail' (<2.1m)
4. The Upper Brickearth (< 6m)
3. *Corbicula* Bed (<1.5m)
- 2 The Lower Brickearth (<9 m)
1. Crayford Gravel (<4.5 m)

The most frequently published stratigraphy was from Stoneham's Pit, which appears to be the site where the majority of collecting occurred. Chandler (1914, 1916) summarised the general stratigraphy at Crayford, illustrating how the deposits differed from east to west (Figure 7.6):

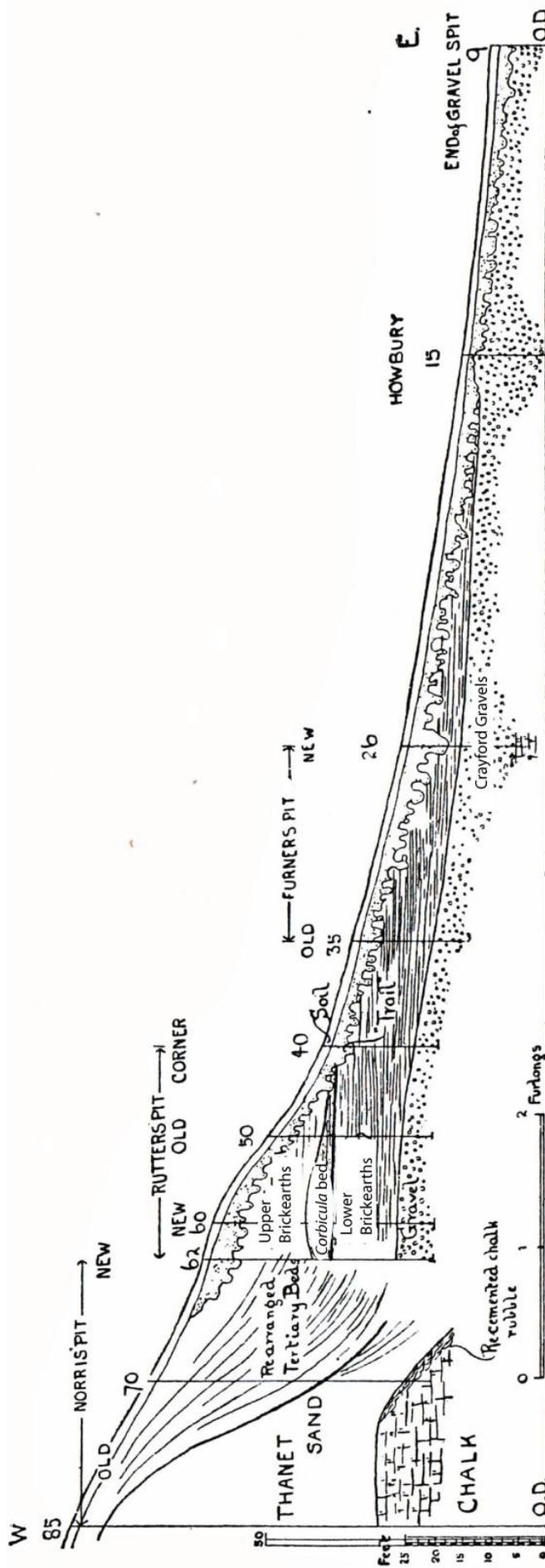


Figure 7.6: Stratigraphic cross-section of the site at Crayford. Adapted from Chandler (1914).

Published accounts of the stratigraphy in the Crayford area have been consistent. Where differences have been described (Morris, 1838; Dawkins, 1867a; Whitaker, 1889) they are accounted for by the transient and lenticular nature of fluvial sands and gravels (Whitaker, 1889; Kennard, 1944).

The Crayford Gravel

The gravel consists of coarse sand and gravel, mainly composed of flints with smaller percentages of granite, quartz, quartzites and sandstones (Dawkins, 1867a; Spurrell, 1886). Towards the east, the thickness of the overlying deposits decrease resulting in the Crayford Gravels being the only exposed deposit (see Figure 7.6). Whitaker (1889) recorded that in the Howbury area (in the east of the area, near Slade Green), the gravels reached 10 to 15 feet thick (3.0 - 4.6m). It was suggested by Kennard (1944) that the deposition of the gravel probably occurred directly after the cutting of the chalk 'cliff' and represented a large river with fast currents due to the coarse nature of the gravels (Figure 7.6). The Crayford Gravels have yielded abraded and derived artefacts of an older age than the fresh artefacts from Spurrell's 'working floor', in addition to a small number of faunal remains (Spurrell, 1886).

The Lower Brickearths

The Lower Brickearths have yielded the majority of the vertebrate remains and flint artefacts from Crayford, which were both reportedly found throughout the deposit. Accounts of the brickearths recorded lenses of sand and pebbles indicating transient currents during its deposition (Kennard, 1944). The remains of large molluscs such as *Anodonta*, *Corbicula* and *Unio* were rare but when found, were often in life-position reflecting the rapid conditions under which the sediments were deposited (Kennard, 1944). Spurrell's Palaeolithic 'working floor' was discovered at the base of the Lower Brickearths.

The fresh implements of the Palaeolithic 'working floor' were discovered in a narrow band within the Lower Brickearths (Spurrell, 1880a). Chandler (1916) reported finding several associated artefacts towards the base of the Lower Brickearths and believed them to come from to be the same 'floor' as described by Spurrell. Kennard (1944) suggested that a 'great interval' of time occurred between the deposition of the gravels and the overlying Lower Brickearths, during which the gravels were eroded to 20ft OD

(p. 160). The surface of the new terrace thus became a palaeo-landsurface upon which hominins operated and manufactured the lithic material. Kennard further suggested that the Thames which deposited the Lower Brickearths had already covered the discarded implements whilst hominins were still using the site during this time.

The *Corbicula* Bed

The *Corbicula* Bed, consisting of fine yellow sand and pebbles with some clay, varied in thickness throughout the area. In Stoneham's Pit near the base of the chalk 'cliff', it was described as being present only as a lenticular patch, whereas in Rutter's Pit it was 1 foot deep at the south and 6-8 feet (1.8 – 2.4m) deep in the northern end of the pit (Chandler and Leach, 1912a, 1912b). It contained abundant large bivalves, as its name suggests, and small mammal bones. Bull (1942) suggested that the small mammals might have burrowed into this layer after it was originally deposited, however this was opposed by Kennard (1944) and Hinton (1910) due to the rolled condition of the bones, thereby suggesting some degree of fluvial transportation. It has been noted that the remains of *Citellus citellus* were largely complete (Schreve, 1997) suggesting they had been buried whilst in their burrows (D. Schreve, pers. comm.). Kennard (1944) further believed that the *Corbicula* Bed was a sandy facies of the Lower Brickearths but deposited under higher energy conditions by the same.

The Upper Brickearths

Unlike the Lower Brickearths, the upper deposit contained very few fossils, and consequently less research has concentrated upon them. They were first noted to be different in nature from the Lower Brickearths by Tylor (1869), who described them as being deposited by high energy land floods or 'sludging'. He also noted that they contained fewer contemporary fossils and many derived Eocene shells. Leach (1905) also recognised them as different when compared to the Lower Brickearths when he described the thin bedding and higher clay content of the former. Kennard (1944) supported Tylor's hypothesis of the Upper Brickearths being a colluvial deposit, produced under periods of heavy rainfall from the higher deposits on the chalk 'cliff'. He noted that the 'cliff' in Stoneham's Pit was well exposed and had therefore experienced some form of denudation and that a line of pebbles could be traced following the contour of the 'cliff', which increasingly descended towards the east. This observation explains why the Upper Brickearths are only recognised in the west of the

Crayford area on higher ground, unlike the Lower Brickearths, which are apparently continuous in the area (Bull, 1942; Chandler, 1914).

The Upper Brickearths are overlain by 'trail' (a solifluction deposit) consisting of clayey gravel with large flints and many derived components from neighbouring deposits such as Tertiary pebbles. The contact between the Upper Brickearths and the 'trail' was uneven, with the 'trail' cutting into the brickearth (Dawkins, 1867a; Kennard, 1994).

7.2.6 Palaeontology

Details of the fauna recorded from the Crayford Gravels, Lower Brickearths, *Corbicula* bed and Upper Brickearths are described below.

Fauna from the Crayford Gravels

Whitaker (1889) recorded *Canis cf. lupus*, *Ursus arctos*, *Panthera leo*, *Palaeoloxodon antiquus*, *Mammuthus primigenius*, *Equus ferus*, *Stephanorhinus cf. hemitoechus*, *Coelodonta antiquitatis*, *Megaloceros giganteus*, *Cervus elaphus*, *Bos primigenius*, and *Bison priscus* from the Crayford Gravels, although very few of these species were confidently attributed to the gravels in other publications.

It was suggested that the *Palaeoloxodon antiquus* molars came exclusively from the Crayford Gravels at the base of the sequence and that they may be reworked from older deposits (Whitaker, 1889; Kennard, 1944). This is possible, since all fossils of *P. antiquus* were observed to be heavily abraded in this study, making it more likely that they came from the gravels, rather than the lower-energy brickearths. However it was highlighted by Schreve (1997) that this species is a genuine component of MIS 7 assemblages although not common, thus making it possible that the fossils were from the interglacial deposits. Fossils of other species thought to be from the Lower Brickearths also exhibit high degrees of abrasion and so abrasion may not be suitable for determining stratigraphical provenance at Crayford (See next section). Within this study, 22 specimens of Bovidae sp. were provenanced to the Crayford Gravels. It is possible that one specimen of mammoth was also found in the gravels, however the label was unclear and also said it may have been found in the Lower Brickearths (Table 7.8). No molluscs were recorded from the Crayford Gravels.

Fauna from the Lower Brickearths and *Corbicula* bed

Most of the faunal remains from Crayford are thought to originate from the Lower Brickearths (Kennard, 1944).

Mammals

Sutcliffe and Kowalski (1976) recorded the following rodent species from the *Corbicula* bed: *Spermophilus primigenius* (ground squirrel), *Microtus oeconomus* (northern vole), *Microtus nivalis* (snow vole), *Microtus agrestis* (field vole), *Arvicola* sp. (water vole), *Lemmus lemmus* and *Dicrostonyx torquatus*. Schreve (1997) reattributed the ground squirrel to *Citellus citellus* and re-assigned all specimens formerly attributed to *Microtus nivalis* and *Microtus malei* (snow voles) to *Microtus oeconomus* (northern vole). The specimens of northern vole were notably large, the significance of which is discussed later in section 7.2.9. The record of *Citellus citellus* marks the first known presence of this species after the Anglian Glaciation in Britain (Schreve, 1997).

According to F. C. J. Spurrell (1880a,b), remains of *Rhinoceros tichorhinus* (*Coelodonta antiquitatis*) were found in the Lower Brickearths adjacent to the Palaeolithic flakes he was collecting. Cheadle (1876) also recorded the discovery of a 2m long mammoth tusk within the *Corbicula* Bed.

A re-appraisal of the entire mammalian assemblage from the Crayford area by Schreve (1997), identified virtually the same species as Kennard (1944) although the specimens of *Vulpes vulpes* (red fox) and *Lepus* sp. (hare) were not re-located during the more recent study. The new record of *Sorex* cf. *araneus* (common shrew) was the first identification of this species at Crayford and the previous identification of *Cuon alpinus* (alpine dhole) by Kurtén (Stuart, 1982; Sutcliffe, 1985) was re-identified as *Canis* sp. (small canid).

Table 7.8 combines the microtine rodents identified by Schreve (not analysed in this study) and the reattribution of some specimens formerly attributed to *M. primigenius* to *M. trogontherii* (late form) made during this research, following Lister and Sher (2001) (See 7.1.6 for more information). Only three complete upper third molars of mammoth were seen in this study, with all other molars being incomplete. Although only a small

assemblage, the mean plate count of these was 18.6, which is lower than the average plate count for Devensian *M. primigenius* specimens (average 24 plates) (Lister and Sher, 2001). The low plate count at Crayford is comparable with those observed in other MIS 7 assemblages such as 19-22 plates at Aveley (Schreve, 2004c), 16.5-20.5 plates at Ilford (19.3 was recorded in this study) and 17.5-20.5 at Marsworth (Lister and Sher, 2001) and is consistent with the late morphotype of *M. trogontherii*. Specimens that were considered impossible to identify to species level, such as post-cranial bones, were identified as *Mammuthus* sp.

Species	No. of specimens	% of total assemblage	Minimum Number of Individuals (MNI)	Crayford Gravels	Lower Brick-earths	Upper Brickearths
Insectivora						
<i>Sorex cf. araneus</i> L., common shrew						
Rodentia						
<i>Citellus citellus</i> L., ground squirrel						
<i>Dicrostonyx cf. torquatus</i> (Pallas), collared lemming						
<i>Lemmus lemmus</i> (L.), Norwegian lemming						
<i>Microtus oeconomus</i> (Pallas), northern vole						
<i>Microtus</i> sp. indet. vole.						
Carnivora						
<i>Canis lupus</i> L., wolf	21	2.04	1			
<i>Canis</i> sp. Small undetermined canid	8	0.78	1			
<i>Ursus arctos</i> L., brown bear	14	1.36	2			
<i>Crocuta crocuta</i> Erxleben, spotted hyaena	2	0.19	1			
<i>Panthera leo</i> (L.), lion	27	2.62	3		*	
Carnivora sp. Indeterminate carnivore	1	0.10	1			
Proboscidea						
<i>Palaeoloxodon antiquus</i> (Falconer and Cautley), straight-tusked elephant	8	0.78	2			
<i>Mammuthus primigenius</i> (Blumenbach), woolly mammoth	71	6.89	4	*?	*	
<i>Mammuthus trogontherii</i> (Pohlig), steppe mammoth (late form)	58	5.63	5		*	
<i>Mammuthus</i> sp. undetermined mammoth	102	9.90	4			
Elephantidae sp. undetermined elephant	6	0.58	1			
Perissodactyla						
<i>Equus ferus</i> Boddaert, horse	247	23.98	8		*	
<i>Stephanorhinus hemitoechus</i> (Falconer), narrow-nosed rhinoceros	23	2.23	3			
<i>Stephanorhinus kirchbergensis</i> (Jäger), Merck's rhinoceros	14	1.36	2		*	
<i>Coelodonta antiquitatis</i> (Blumenbach), woolly rhinoceros	54	5.24	5		*	
Rhinocerotidae sp. undetermined rhinoceros	51	4.95	4		*	
Artiodactyla						
<i>Megaloceros giganteus</i> (Blumenbach), giant deer	2	0.19	1			
<i>Cervus elaphus</i> L., red deer	72	6.99	6		*	
<i>Bos primigenius</i> Bojanus, aurochs	11	1.07	3			
<i>Bison priscus</i> Bojanus, bison	2	0.19	2			
Bovidae sp. undetermined large bovid	230	22.33	8	*	*	
<i>Ovibos moschatus</i> Zimmerman, musk ox	6	0.58	2		*	
Total	1030					

Table 7.8: Species List for Crayford, Erith and Slade Green. Species list compiled by Schreve (1997) and numbers of specimens and minimum number of individuals from this research (C. Juby). Presence of the species in each deposit is based on the specimen labels. Presence of the species within each horizon are indicated by asterisks.

A small collection from the Royal College of Surgeons seen in the Natural History Museum, London was ambiguously labelled from Crayford or Ilford and was not included in the analyses. However, it is suggested here that this collection may well originate from Crayford as it was presented by Charles Rutter in 1854, the owner of a brick pit in the local area. In addition, Dawkins (1867a) mentioned collections from Crayford from the Royal College of Surgeons, which have otherwise not been re-located. The orange and brown staining of the fossils in this collection is consistent with a large proportion of the Crayford and Ilford assemblages (although Crayford fossils sometimes displayed a paler, more grey-hued stain compared to the Ilford fossils). Unfortunately, the condition of the specimens does not therefore definitively indicate their provenance.

The condition of all fossils that can be confidently associated with either the Crayford Gravels or the Lower Brickearths seen in this study is summarised in Tables 7.9 and 7.10.

Crayford Gravels			Lower Brickearths		
Abrasion	No. of fossils	%	Abrasion	No. of fossils	%
Heavy	5	22.73	Heavy	44	89.80
Moderate	13	59.09	Moderate	2	4.08
Slight	4	18.18	Slight	3	6.12
Total	22		Total	49	

Table 7.9: Summary of the degree of abrasion exhibited by all fossils from the Crayford Gravels and the Lower Brickearths

All fossils labelled from the Lower Brickearths and the Crayford Gravels were analysed for abrasion levels. A higher proportion of fossils from the brickearths was heavily abraded (79.4%) compared to the Crayford Gravels, in which the majority of fossils displayed moderate abrasion levels (59.0%). This is surprising, since one would anticipate that material from gravels would be more rolled than from fine-grained deposits, particularly since the artefacts from the brickearths found *in situ* in Spurrell's 'floor' were predominantly in fresh condition. Also 'brickearths' are generally

deposited under lower energy conditions compared to the fluvial gravels. This suggests that some of the fossils attributed to the ‘brickearths’ may have been reworked by the river, presumably from the lower gravels, prior to deposition. It is also likely that the fossils exhibiting higher degrees of abrasion from the Crayford Gravels are also derived, which would be expected in high energy fluvial gravels.

Crayford Gravels			Lower Brickearths		
Staining	No. of fossils	%	Staining	No. of fossils	%
Strong	1	4.55	Strong	10	20.41
Moderate	3	13.64	Moderate	13	26.53
Slight	18	81.82	Slight	26	53.06
Colour of Staining	No. of fossils	%	Colour of Staining	No. of fossils	%
Orange/brown only	6	27.27	Orange/brown only	40	81.63
includes grey	16	72.73	Includes grey	9	18.37
Total	22		Total	49	

Table 7.10: Summary of the colour and degree of staining exhibited by all fossils from the Crayford Gravels and the Lower Brickearths

There appears to be no significant difference between the gravel and brickearth fossils in terms of their degree of staining, with the majority of fossils from both deposits exhibiting slight staining. However the predominant stain colour is slightly different for the two deposits, with 72.7% of the Crayford Gravel fossils displaying a grey hue compared to only 18.4% of the fossils from the Lower Brickearths.

The condition of the fossils discussed above from the Crayford Gravels and the Lower Brickearths is thus not distinctive enough to allocate all fossils to specific deposits as they display some common characteristics.

Molluscs

Kennard (1944) recorded the following freshwater mollusc species from the *Corbicula* bed, based on the studies by Morris (1838), Dawkins (1867a), Tylor (1869), Cheadle and Woodward (1876), Dolffus (1884), Woodward (1890), Kennard and Woodward (1905), Woodward (1913) and Stelfox (1918). Species highlighted in bold were recorded by Kennard in the Lower Brickearths in addition to the *Corbicula* bed. The modern nomenclature was provided by Dr. R. Preece:

***Bithynia tentaculata* (Linné)**

Bithynia inflata Hansen (junior synonym of *B troschelii*)

Viviparus fasciatus (Müll) (now *Viviparus contectus* (Millet))

***Valvata piscinalis* (Müll)**

Valvata cristata (Müll)

Paladilhia radigueli (Bourguignat) (currently considered a problematic hydrobiid, R. Preece, pers. comm.)

***Lymnaea peregra* (Müll)** (now *Radix balthica*)

***Lymnaea palustris* (Müll)** (now *Stagnicola palustris* agg.)

***Lymnaea truncatula* (Müll)** (now *Galba truncatula*)

Lymnaea stagnalis (Linné)

***Planorbis corneus* (Linné)** (now *Planorbarius corneus*)

Planorbis albus Müll. (now *Gyraulus albus*)

Planorbis laevis Alder (now *Gyraulus laevis*)

Planorbis crista (Linné) (now *Gyraulus crista*)

***Planorbis planorbis* (Linné)**

Planorbis vortex (Linné) (now *Anisus vortex*)

***Planorbis leucostoma* Millet** (now *Anisus leucostoma*)

Planorbis vorticulus Troschel (now *Anisus vorticulus*)

Planorbis contortus (Linné) (now *Bathyomphalus contortus*)

Segmentina complanata (Linné) (now *Hippeutis complanatus*)

Segmentina nitida (Müll.)

Ancylastrum fluviatile (Müll.) (now *Ancylus fluviatilis*)

Ancylus lacustris (Linné) (now *Acroloxus lacustris*)

Psilunio littoralis (Cuvier) (now sometimes referred to as *Potomida littoralis*)

Anodonta cygnea (Linné)

Anodonta anatina (Linné)

Anodonta minima Millet. (now *Pseudanodonta complanata*)

***Sphaerium corneum* (Linné)**

***Sphaerium dickinii* Clessin** (currently disputed as a species)

***Corbicula fluminalis* (Müll)**

***Pisidium amnicum* (Müll)**

Pisidium sulcatum S. V. Wood (now *Pisidium clessini*)

Pisidium cinereum Alder. (now *Pisidium casertanum* (Poli, 1791) but may also include other species, R. Preece pers. comm.)

Pisidium nitidum Jenyns.

Pisidium milium Held.

***Pisidium subtruncatum* Malm**

Pisidium henslowanum (Sheppard)
Pisidium lilljeborgi Clessin. (doubtful record, R. Preece pers. comm.)
Pisidium supinum A. Schmidt
Pisidium moitessierianum Paladilhe

Land species recorded in Kennard (1944):

***Pupilla muscorum* (Linné)**
Vallonia pulchella (Müll.)
Vallonia excentrica Sterki.
Vallonia costata (Müll.)
Zua lubrica (Müll.) (now *Cochlicopa lubrica*)
Limax sp.
Candidula radigeuli (Bourguignat) (now *Candidula crayfordensis*)
Trochulus hispidus (Linné)
***Cepaea nemoralis* (Linné)**
Cecilioides acicula (Müll.)
Succinea pfeifferi Rossmässler (now *Oxyloma pfeifferi*)
Succinea oblonga Draparnaud (now *Succinella oblonga*)

Fauna from the Upper Brickearths

The Upper Brickearths were reported to contain *Mammuthus primigenius*, *Coelodonta antiquitatis* and *Equus ferus* (Kennard, 1944). No fossils seen in this study can be directly attributed to the Upper Brickearths. A. L. Leach found the only record of molluscan remains in the Upper Brickearths. It was possible to identify these only as *Pisidium* sp. (Kennard, 1944).

Palaeobotanical Evidence

No pollen has been reported from Crayford. Only one macrofossil of *Castanea sativa* (sweet chestnut) from the basal part of the Lower Brickearths has been recorded (Ridley, 1885).

7.2.7 Palaeoclimate and Palaeoenvironment Interpretation

Crayford Gravels

Although only Bovidae sp. specimens and a mammoth specimen could be attributed to the Crayford Gravels in this study, the mammals listed by Whitaker (1889) apparently from the gravels indicate a generally open and temperate environment (Schreve, 1997). The presence of *P. antiquus* and particularly *Bos primigenius* indicate temperate conditions as they are only known from interglacial deposits in Britain (Stuart, 1982).

The presence of grazers such as *E. ferus*, *M. primigenius*, *S. cf. hemitoechus* and *C. antiquitatis* are also indicative of open conditions (Stuart, 1982; Schreve, 1997).

It is possible that some of the fossils from the Crayford Gravels were derived from earlier deposits, particularly considering the high energy fluvial regime required to deposit the gravels. The mixed nature of the assemblage, which contains species such as *C. antiquitatis* (generally associated with continental and cooler climates), alongside species associated with temperate climates such as *B. primigenius* (Stuart, 1982), could indicate a derived component from older deposits. However, the mixed assemblage could equally reflect a continental climate with warm summers and colder winters than the present interglacial (Kennard, 1944; Schreve, 1997).

Lower Brickearths and Corbicula Bed

C. citellus, *M. oeconomus* and *Microtus* sp. are all indicators of grassland habitats. Their presence represents a continental climate with cold winters as they are today distributed in the northern Palaearctic, with both *Citellus citellus* and *M. oeconomus* inhabiting the Eurasian steppe, the coniferous forests of Siberia and the tundras and prairies of North America. *M. oeconomus* also extends into northern Germany and the Netherlands, northern Norway and Siberia (Corbet, 1978; Stuart, 1982) but both are today absent from Britain.

The most common taxa from the Lower Brickearths are *E. ferus*, large bovids, *C. elaphus*, *M. primigenius*, *M. trogontherii* (late form), *C. antiquitatis*, Rhinocerotidae sp. and *P. leo*. Apart from *P. leo*, these are all predominantly grazers and indicate open grassland environments. Lion is today also generally associated with grasslands and open habitats (Stuart, 1982). Lower frequencies of *S. kirchbergensis*, *P. antiquus* and *U. arctos* suggest that woodland habitats were present in the area but not dominant.

As with the Crayford Gravels, the Lower Brickearths contained fossils reflecting both temperate and cool climates. *B. primigenius*, *S. kirchbergensis* and *P. antiquus* are known only from interglacials in the Pleistocene and so reflect a temperate climate, whereas *C. antiquitatis*, *O. moschatus*, *L. lemmus* and *D. torquatus* imply cool climates, with the latter three species living only in northern Palaearctic or tundra environments today (Stuart, 1982). In particular, *O. moschatus* lives exclusively on arctic tundra,

today restricted to an introduced population on Greenland, the northern and western islands of the Canadian Arctic, and from northern Alaska to Hudson Bay (Hall, 1981). It may also have lived in Siberia and Mongolia until 200 years ago (Tener, 1965; Corbet, 1978; Spassov, 1991). Musk ox feed on grasses and sedges in the summer and browse in the winter. It has been suggested that this disharmonious assemblage indicates a continental climate with warm summers and cold winters (Kennard, 1944; Schreve, 1997), towards the end of an interglacial. The appearance of cold-climate indicators in Britain at this time could have been facilitated by a preceding short-lived cold period (or sub-stage) within the interglacial, during which lowered sea levels created a land bridge to allow the movement of these animals into Britain (Schreve, 1997, 2001a, 2001b). This has been upheld by the work of Candy and Schreve (2007) who used high-precision Uranium-series dating of tufa at Marsworth (Green *et al.*, 1984; Murton *et al.*, 2001), to propose that this period of lowered sea levels occurred during MIS 7b, thereby implying that the faunal assemblages from the Lower Brickearths and *Corbicula* bed Crayford most likely date to MIS 7a.

The molluscan evidence suggests that the *Corbicula* Bed and the Lower Brickearths were both deposited by slow-moving water with little aquatic vegetation. The greater number and larger size of species found in the *Corbicula* bed suggests a more rapidly-flowing water body compared to the Lower Brickearths (Kennard, 1944). Species such as *C. fluminalis*, *Pisidium amnicum*, and *Pisidium clessini*, which were common in the *Corbicula* bed, all prefer flowing clean water and reflect the higher energy conditions during the deposition of the *Corbicula* bed. The large bivalves represented by *Anodonta*, *Psilunio* and *Corbicula* were often in life position within the brickearth and therefore indicate that the deposition of the brickearth was rapid (Chandler and Leach, 1912b; Kennard, 1944). The molluscan land species are exclusively grassland dwellers, reflecting the dominance of open environments over woodland at this time (Kennard, 1944; Sutcliffe and Kowalski, 1976) and supporting the mammalian evidence. The presence of species currently found in Southern Europe, such as *C. fluminalis* and large specimens of *Cepaea nemoralis*, indicate higher summer temperatures than present (Kennard, 1944).

A single record of sweet chestnut was recorded from the Lower Brickearths. This species is common in Spain in the present day and does not tolerate very cold conditions (Kennard, 1944).

Upper Brickearths

There were no mammalian specimens that could be confidently associated with the Upper Brickearths and there was only one record of Mollusca (*Pisidium* sp.), which suggests the river continued to be slow-flowing with some vegetation (Kennard, 1944).

Possible evidence of human modification

A first phalanx of *E. ferus* from Crayford (no further stratigraphical information recorded) in the Natural History Museum (M5063) exhibits an unusually flat posterior surface that has apparently been created by rubbing (Figure 7.7). This is a possible indication of human modification, as it cannot be readily attributed to any natural process and no other specimens display the same feature.



Figure 7.7: Modified horse phalanx from Crayford, showing the unusually flattened posterior of the bone (left) and distal view showing the flattened posterior side at the base of the photograph (right) (Photograph courtesy of the Natural History Museum)

7.2.8 Palaeolithic Artefacts

Artefacts were generally described as being found in two locations in the stratigraphical sequence at Crayford; abraded from the Crayford Gravels, and in a fresh condition in the Lower Brickearths and the Palaeolithic ‘floor’. Overall, 476 artefacts from Crayford, Erith and Slade Green have been identified and analysed during this research, with the majority of those in an unabraded condition (Tables 7.11 and 7.12).

Implement	Number of artefacts	% of assemblage
Handaxes	11	2.31
Flakes (total)	207	43.49
Levallois flakes	103	21.64
Probable Levallois flakes	17	3.57
Retouched Levallois flakes	3	0.63
Retouched non-Levallois flakes	4	0.84
Debitage	243	51.05
Cores (total)	15	3.15
Levallois cores	6	1.26
Hammerstones	0	0.00
Total implements	476	

Table 7.11: All artefacts from Crayford

Level of abrasion	Number of artefacts	% of assemblage
Unabraded	336	70.74
Slightly abraded	91	19.16
Moderately abraded	38	8.00
Heavily abraded	10	2.11
Total	475*	

Table 7.12: Degree of abrasion displayed by all Crayford artefacts (*one artefact was not recorded to this level)

Artefacts from the Crayford Gravel

Spurrell (1886) stated that many artefacts found in the gravel, exhibited greater degrees of abrasion compared to the Palaeolithic ‘floor’ and Lower Brickearth implements. From the artefact labels, it can be seen that one artefact provenanced to the ‘Thames drift’ could be assumed to come from the Crayford Gravel or the ‘trail’ deposits higher in the stratigraphy. However, the flake was fresh and so did not match Spurrell’s description of the Crayford Gravel artefacts, thus suggesting the implement may have originated from another deposit. If attributed to the ‘trail’, the artefact would also have

been reworked from an older deposit or be contemporary with the cold-stage during which the gravel accumulated. From the 185 unstratified artefacts recorded from the Crayford area, ten exhibited heavy abrasion and 38 displayed moderate abrasion (Table 7.12). It is possible that these are from the Crayford Gravels, however it is perhaps more likely that they originate from the 'trail' or the Upper Brickearths, which are likely to produce objects with higher degrees of abrasion. It is unlikely they could originate from the Lower Brickearths since they exhibit high levels of abrasion, which is not characteristic of the artefacts from this deposit.

Artefacts from the Lower Brickearths and Palaeolithic 'floor'

Within the Palaeolithic 'floor' at the base of the Lower Brickearths, worked flakes were occasionally found resting upon each other, with some flakes attached to fragments of bone with iron oxide. Spurrell (1880b, 1884) suggested that this concentration of fresh flakes represented 'Palaeolithic workshop', where hominins were knapping tools. The tools were found in 'heaps' that were *'divided by two slight lines and other signs, that the operator sat on the sand with his legs but slightly apart'* (Spurrell, 1884 p. 112). Smaller numbers of flakes were found above and below the 'floor', which was taken to represent a continuous occupation at the site by hominins (Spurrell, 1880b).

Spurrell (1880a and b) proposed that the hominins who occupied Crayford used the flint nodules from the chalk bedrock cliff at the site (Figure 7.6) to make their tools. He further suggested that the often-flawed flint nodules found at Crayford would have caused difficulty for the hominins in obtaining suitable pieces of raw material to work with. Spurrell recognised that the artefacts from the 'floor' overlapped each other and were clearly in their original position after the knapping episode. This enabled him to reconstruct the nodules from the flakes and cores found in the 'floor' (Spurrell, 1880a) and subsequently refitting exercises were undertaken by Cook (1986) and Scott (2006) (See Figure 7.8).



Figure 7.8: Example of refitting implements from the Palaeolithic ‘floor’ at Stoneham’s Pit. Refitted by Dr. Beccy Scott (Photo: B. Scott)

Spurrell named one of his refitted nodules an ‘hâche’ or axe (Figure 7.9). He believed that the ultimate product of the knapping from this nodule was a handaxe that had been broken and discarded by the maker (Spurrell, 1880a). It is now recognised that the Spurrell’s ‘hâche’ is a broken Levallois core (Cook, 1986; Scott, 2006).

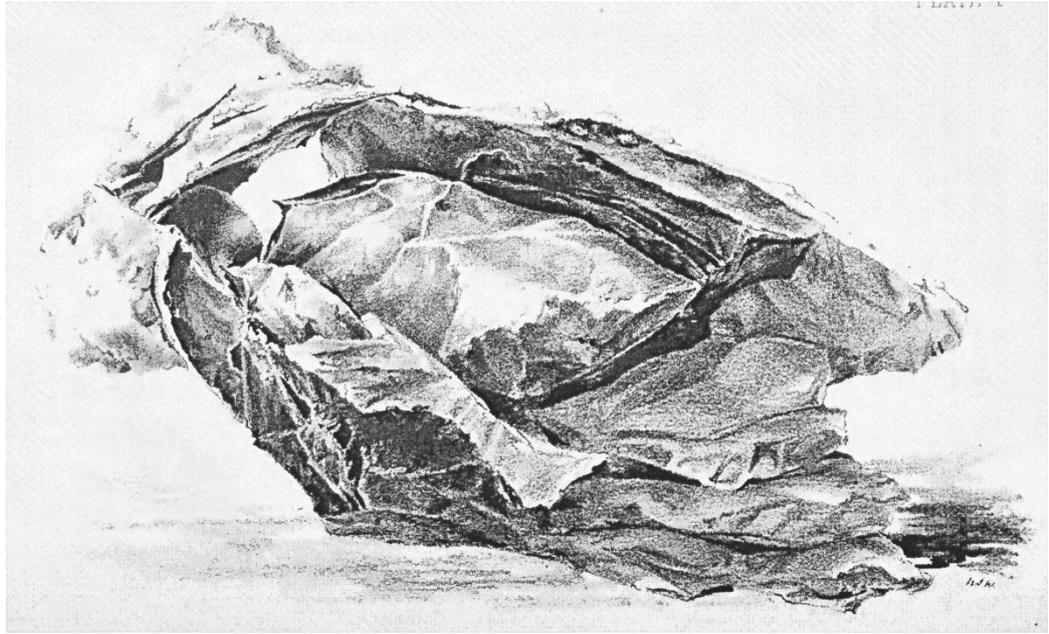


Figure 7.9: ‘The Hâche’. An example of Spurrell’s refitted implements from the Palaeolithic ‘floor’ (From Spurrell, 1880a)

Further reconstructions by Spurrell illustrated that hominins were using the flint nodules solely to make smaller tools such as blades and flakes, as opposed to handaxes. Recent research has found that many of the missing products from the refits were large and broad Levallois flakes and blades, which suggests that the hominins were making these types of tool and transporting them elsewhere for a specific purpose. Most of the Levallois cores were also missing, equally suggesting these had also been transported elsewhere and used as a source for future blanks (Scott, 2006).

Within this study only 11 artefacts were analysed that can be confidently attributed to the Palaeolithic ‘floor’ or the Lower Brickearths from Crayford, Erith or Slade Green (from artefact labels) (Table 7.13).

Implement	Number of artefacts	% of assemblage
Handaxe	0	0
Flake	11	100
<i>of which modified</i>	<i>1</i>	<i>9.09</i>
Core	0	0
unclassifiable worked flint	0	0
Total implements	11	

Table 7.13: Artefact types from the Palaeolithic ‘floor’ and Lower Brickearths from Crayford, Erith and Slade Green

Only three of the above artefacts were unabraded, a further seven were slightly abraded, and the remaining lithic piece was moderately abraded. The low levels of abrasion of these artefacts is consistent with the descriptions of Spurrell (1880a,b, 1884, 1886, 1898). However, the low abrasion levels exhibited by many of the other artefacts are consistent with those from the Lower Brickearths and the ‘floor’, particularly including those from the Stoneham’s Pit collection held by the British Museum and the Natural History Museum, the majority of which can be incorporated into refitting nodules from Spurrell’s floor (Scott, 2006). At the time of this research, the refitted examples were under re-examination by Dr Beccy Scott and were therefore not accessible for analysis during. However, descriptions of 264 specimens were provided by Dr Scott for inclusion in this discussion. Table 7.14 summarises the artefacts that exhibit low levels of abrasion, specifically unabraded and slight abrasion, which strongly suggests that they were from the Palaeolithic ‘floor’ and the Lower Brickearths.

Implement	Number of artefacts	% of assemblage
Handaxes	2	0.47
Flakes (total)	169	39.58
Levallois flakes	99	23.19
Probable Levallois flakes	12	2.81
Retouched Levallois flakes	2	0.47
Retouched non-Levallois flakes	1	0.23
Debitage	242	56.67
Cores (total)	14	3.28
Levallois cores	6	1.41
Hammerstones	0	0.00
Total implements	427	

Table 7.14: Crayford artefacts displaying low levels of abrasion and probable provenance from the Palaeolithic ‘floor’ and Lower Brickearths

There are 23 artefacts labelled from unspecified brickearths, of which 14 are slightly abraded and another eight are unabraded (Table 7.15). This strongly suggests they originated from the Lower Brickearths.

Level of abrasion	Number of artefacts	%
Fresh	8	34.78
Slightly abraded	14	60.87
Moderately abraded	0	0.00
Heavily abraded	1	4.35
Total	23	

Table 7.15: Artefact abrasion levels from unspecified ‘brickearths’ at Crayford

One artefact from an unspecified brickearth is a slightly abraded, unstained and heavily patinated twisted ovate handaxe (Kemp Collection, British Museum). It is assumed to be from the base of brickearth, but its exact provenance is not known due to it being found with a mechanical shovel by a pit worker. A note with the object describes how it was found as the last of the brickearth was being removed, approximately 4.2m from the surface, possibly at the base of the Lower Brickearth or within the upper parts of the Crayford Gravel. Twisted ovate handaxes are restricted to late MIS 11 and MIS 10 in Britain (White, 1998), suggesting that the handaxe may be reworked from an older deposit. Orsett Heath Gravel (MIS 12-10, Bridgland, 1994, 1995) exists to the east of

the River Cray around Dartford, offering a possible gravel source for the twisted ovate handaxe prior to it being reworked into the Crayford Gravel. However, the slight abrasion exhibited by the handaxe does not reflect the long period of time and consequent transportation the handaxe would have experienced to have been reworked from the Orsett Heath Gravel and the object consequently remains enigmatic.

Artefacts from the Upper Brickearths

Only one slightly abraded flake can be attributed to the Upper Brickearths (Burchell Collection, British Museum). This artefact was clearly not significantly transported during the deposition of the Upper Brickearths and may have been discarded nearby at the time.

Artefacts from the ‘trail’

One slightly abraded flake from Furner’s Pit is recorded from the ‘trail’. Due to the ‘trail’ being a solifluction deposit, it is likely this implement is reworked from higher sediments.

Artefact Typology/Technology

Hinton and Kennard (1905), Smith (in Higgins, 1914) and Chandler (1914) described the material as ‘Le Moustier’ in character, although this was later refuted by Chandler (1916). It is now accepted that the Mousterian culture is associated with Neanderthal occupation during the late Middle Palaeolithic (MIS 3) (see Chapter 9). Subsequently, the artefacts from Crayford were recognised to have been produced using the Levallois technique, typical of the early Middle Palaeolithic (Roe, 1981; Wymer, 1968). However, the assemblage has also been attributed to alternative techniques and industries, with Mellars (1974) suggesting the material at Crayford had affinities with the Upper Palaeolithic and not Middle Palaeolithic archaeology. Cook (1986) concluded that some flakes and blades were *typologically* Levallois following Bordes (1980). However, *technologically* Cook demonstrated that although some flakes and blades appeared to be Levallois, they were not produced in the prepared core fashion nor were the final products predetermined as they would be if prepared using the standard Levallois technique. Cook (1986) based her analysis on artefacts from Stoneham’s Pit and compared the assemblage with those from Rutter’s Pit and Saint-Valéry-sur-Somme (de Heinzelin and Haesaerts, 1983), which is dated to early MIS 7. At the time of

Cook's analysis, Crayford was considered to represent MIS 5e (Ipswichian Interglacial) and she suggested that a re-evaluation of the stratigraphy and age of the site should be considered to ascertain if a pre-Ipswichian date were possible. Révillion (1995) endorsed Cook's analysis after re-examining the refitted cores.

Handaxes have been found from Crayford, although their exact stratigraphical provenance has not previously been known. Kennard (1944) suggested that they might be associated with the Levallois material, however Cook (1986) and Scott (2006) recognised that the handaxes are stained and patinated differently to the Levallois material. Wymer (1968) believed the greater abrasion and patination displayed by the handaxes therefore suggested that they must have been found in the Crayford Gravel and be older than the Levallois material.

During this study it has been confirmed that all the handaxes from the Crayford area are either unstratified or reworked due to the high levels of abrasion they exhibit. The majority of handaxes display moderate (54.6 %) and 27.3% are heavily abraded, suggesting they have been transported and are not *in situ*. All specimens were patinated, with the 63.6% displaying heavy patination, suggesting they had been exposed on the land surface in their history (Table 7.16).

Level of abrasion	Number of artefacts	%	Level of Patination	Number of artefacts	%
Fresh	0	0.00	Unpatinated	0	0.00
Slightly abraded	2	18.18	Slightly patinated	2	18.18
Moderately abraded	6	54.55	Moderately patinated	2	18.18
Heavily abraded	3	27.27	Heavily patinated	7	63.64
Total	11		Total	11	

Table 7.16: Abrasion and patination levels of handaxes from Crayford, Erith and Slade Green

7.2.9 Age of the deposits

Biostratigraphy

As with Ilford (see above), the Lower Brickearths at Crayford were correlated with the Ipswichian Interglacial on the basis of palynostratigraphy (Stuart, 1976), and the overlying Upper Brickearths attributed to the Devensian Glaciation. However, in the light of Sutcliffe's revisions of the likely age of the Taplow Terrace assemblages (1964, 1976), it seemed plausible that Crayford might also represent a pre-Ipswichian episode. Carrant (1986) further suggested that the cold climate fauna seen at Crayford, including *Mammuthus*, *Coelodonta*, *Ovibos*, *Citellus*, *Lemmus* and *Dicrostonyx* represented the cold stage immediately prior to the Ipswichian, which would now be widely correlated with MIS 6. Sutcliffe (1995) also investigated the cold climate fauna from Crayford and supported the correlation with MIS 6.

The re-investigation into the mammalian assemblage at Crayford area by Schreve (1997) proposed that Crayford Gravels and the Lower Brickearths relate to a temperate period prior to the Ipswichian, which she correlated with MIS 7. This was based firstly on the similar stratigraphic positions of the Crayford Gravels and the Lower Brickearths and the deposits at Aveley, Ilford and Northfleet, all of which had been attributed to MIS 7 (Bridgland, 1994). Secondly, the unique faunal assemblages found in the Crayford Gravels and the Lower Brickearths (including the *Corbicula* Bed) were notably different to Ipswichian age faunas. In particular the assemblages at Crayford, Aveley, Ilford and Northfleet lack hippopotamus, a diagnostic component of Ipswichian assemblages, and contain horse and the late morphotype of steppe mammoth, which are both absent in the Ipswichian (Stuart, 1976).

Several taxa recorded at Crayford are of biostratigraphical significance. The Lower Brickearth microtine rodent assemblage contained *M. oeconomus*, the dominance of which is considered characteristic of MIS 7 (Carrant, in Green *et al.*, 1996). Additionally, the relatively large size of the first lower molars of *M. oeconomus* at Crayford were recognised to be larger than those from the MIS 7 Lower Channel at Marsworth but significantly smaller than specimens from MIS 6 sites (Schreve, 1997). The first lower molar of *M. oeconomus* is known to progressively increase in length throughout the late Middle Pleistocene until it reaches its maximum size in the Last

Interglacial. Therefore Schreve (1997) proposed that the specimens from Crayford must be older than MIS 6 but younger than the fully interglacial specimens from Marsworth.

The presence of other species in the Lower Brickearths such as *C. fluminalis*, *E. ferus*, *S. kirchbergensis*, the late morphotype of *M. trogontherii*, and *Homo* sp. (presence of artefacts) contradicts an MIS 5e age as all these taxa appear to be absent from Britain during the Last Interglacial, thereby reinforcing the notion that Crayford represents an older interglacial (Currant, 1989; Bridgland, 1994; Sutcliffe, 1995; Schreve, 1997; Keen, 2001; Schreve, 2001a, 2001b). Schreve (2001a,b, 2004c) subsequently attributed the Lower Brickearths (in addition to Uphall Pit, Ilford, as discussed in Section 7.1.8) to the Sandy Lane MAZ, which represents a temperate open grassland environment in late MIS 7. This age was later upheld by high precision U-series dating on tufa deposits at Marsworth, another MIS 7 site (Candy and Schreve, 2007), which correlated the Sandy Lane MAZ with MIS 7a.

Finally, the mammalian assemblage recognised from the Upper Brickearths as Crayford which includes *M. primigenius*, *E. ferus* and *C. antiquitatis*, reflects a period of colder climate and open conditions and was therefore attributed to MIS 6 based on its stratigraphical position above the Lower Brickearths (Schreve, 1997).

The molluscan assemblages from the Lower Brickearths and *Corbicula* bed support the MIS 7 age suggested by the mammalian evidence. In particular, MIS 7 represents the last appearance of *P. clessini* in Britain and the species is present in MIS 7 assemblages in smaller numbers than preceding interglacials (Keen, 2001). This is consistent with the modest levels of *P. clessini* in the Crayford molluscan assemblage (Kennard, 1944; Keen, 2001). Another significant biostratigraphical indicator is the abundance of *C. fluminalis*, which is known to be absent during the Ipswichian interglacial and therefore opposes a correlation with MIS 5e (Preece, 1999; Keen, 2001).

Dating

The MIS 7 age suggested by the faunal assemblages is supported by amino acid racemisation (AAR) dating on *Bithynia*, *Corbicula*, and *Valvata* shells (most likely collected from the *Corbicula* bed or Lower Brickearths), which placed Crayford in MIS 7 (Bowen *et al.*, 1989). Further support comes from *Bithynia tentaculata* opercula from

Norris' Pit, (again most likely collected from the *Corbicula* bed or Lower Brickearths), which yielded AAR values greater than those from Ipswichian sites, but less than those from the lower silts (Ponds Farm MAZ) at Aveley. This placed the Lower Brickearths and *Corbicula* bed between MIS 7 and late MIS 6 (Penkman *et al.*, 2008).

Age of archaeology

Levallois artefacts first appear in Britain in the upper part of the Lynch Hill/Corbets Tey terrace (attributed to late MIS 8) and became prevalent through MIS 7 (Bridgland, 1994, 1998; Schreve *et al.*, 2002; White and Ashton, 2003; White *et al.*, 2006). The confirmation of Levallois material from Crayford (Scott, 2006) is therefore consistent with an MIS 7 age for the Lower Brickearths. The flakes were described by Spurrell (1880a) as virtually contemporaneous with the mammal bones in the deposits. Bone fragments were described below the layer of archaeology and the finer fossil specimens were recorded above the 'floor'. In addition, smaller implements were 'cemented by iron oxide to the bones' (Spurrell, 1880a p. 545) and some were found in direct contact, such as the flake associated with the woolly rhinoceros mandible. This would suggest that the tools are of the same age as the mammalian bones, which have been attributed to MIS 7a (Schreve, 1997; Candy and Schreve, 2007). The late MIS 7 age for the archaeology, based on mammalian biostratigraphical evidence, has also been favoured by Scott (2006) and White *et al.* (2006)

7.3 Plumstead and Wickham

7.3.1 Introduction and Location of sites

Mammalian fossils were collected in the areas of Plumstead (London Borough of Greenwich) and neighbouring East and West Wickham (London Borough of Bexley) during the time when Crayford first became famous for its archaeological discoveries. Fewer fossils were recorded from the Plumstead and Wickham compared to Crayford and consequently much less attention was directed to the area. The known stratigraphy and location of the fossils found are also much less detailed than at Crayford, although good collections of material still exist.

Plumstead and East Wickham are located 10km to the north west of Crayford and Erith, and east of Charlton and Woolwich (See Figure 7.4). West Wickham no longer exists as a separate location and has been absorbed into neighbouring areas.

7.3.2 History of Research

Very few publications have mentioned East or West Wickham and even fewer have detailed the stratigraphy or palaeontology, thereby restricting current understanding of the sites. Morris (1838) was the first to describe Wickham when he compared the deposits there to those at Ilford. Morris recorded the stratigraphy as 25 feet (7.6m) of brickearth, sand and gravel containing horse, ox and deer fossils. Later Wood jun. (1866) mentioned the Wickham Lower Brickearth in his description of the superficial deposits in the Thames Valley and suggested that the brickearths at Wickham could be correlated with those at Crayford, Erith and Ilford. He further proposed that the brickearth was younger than the boulder clay but older than the deposits at Grays.

Dawkins (1867a) described the deposits in Wickham in the greatest detail after visiting a brick pit 'about half a mile' north of East Wickham church, on the left side of the road leading to Plumstead. Fossils from Dr Spurrell's and the Royal Artillery collection (not located during this research) were discovered in a sand and gravel horizon within the brickearths found in the area. Dawkins supported Wood's correlation of the brickearths at Wickham with those at Ilford, Crayford and Erith, but also included the brickearths at Grays. He further described two bison metacarpals from Dr Spurrell's collection, which retained two articulated phalanges, thus illustrating the rapid accumulation of the sediments and lack of disturbance of the faunal material. One metacarpal with two associated phalanges of Bovidae sp. was located in the Natural History Museum (M5076) from Spurrell's collection and is likely to be one of those mentioned by Dawkins. Kennard (1944) suggested that the East Wickham brickearth was colluvial and deposited by a similar process to the Upper Brickearths at Crayford, although he referred to a microtine assemblage that resembled the microtine fauna from the Crayford Lower Brickearths. No artefacts have been recorded from the deposits at Plumstead and Wickham.

7.3.3 Stratigraphy

The area is currently mapped as undifferentiated river terrace deposits (British Geological Survey, 1998). Most publications simply describe the presence of brickearth and gravel at the site with no further details. However, Kennard (1944) proposed that the brickearth was colluvial, which suggests that the faunal remains may be reworked from higher deposits.

7.3.4 Palaeontology and environmental interpretation

Very few palaeontological records from East/West Wickham exist. Dawkins (1867a) recorded the only description of molluscs from the site, stating that *C. fluminalis* was identified; suggesting that the water-body was rapidly flowing and summer temperatures were higher than at present, on the basis of its current distribution in southern Europe (Dawkins, 1867a; Kennard, 1944). Dawkins (1867a) recorded mammalian fossils from Wickham including bear, bison, mammoth, Merck's and narrow-nosed rhinoceroses. With the exception of the bison and mammoth fossils, these species have not been recorded from extant collections during the current research, although additional species including woolly rhinoceros, horse and red deer have been noted.

Table 7.17 lists the species recorded from Plumstead, East and West Wickham during this study.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Proboscidea			
<i>Mammuthus primigenius</i> (Blumenbach), woolly mammoth	1	3.45	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	5	17.24	1
<i>Coelodonta antiquitatis</i> (Blumenbach), woolly rhinoceros	1	3.45	1
Artiodactyla			
<i>Cervus elaphus</i> L., red deer	3	10.34	1
<i>Bison priscus</i> Bojanus, bison	2	6.90	2
Bovidae sp. indet. large bovid	15	51.72	2
<i>Ovibos moschatus</i> Zimmerman, musk ox	2	6.90	1
Total	29		

Table 7.17: Species list and minimum number of individuals from fossils recorded from Plumstead, East and West Wickham.

The *M. primigenius* specimen was a left m3 and a fragment of mandible. The molar was considered to resemble *M. primigenius* rather than *M. trogontherii*. Although the number of specimens from Plumstead and Wickham is limited, some indications of the climate and environment are suggested by the assemblage. The presence of species such as *C. antiquitatis* and *O. moschatus* represent cold climates, with *O. moschatus* living exclusively on arctic tundra in the present day (see Section 7.2.7 for more details). *M. primigenius*, *E. ferus* and *C. antiquitatis* are all indicative of open grassland landscapes. If the record of *S. kirchbergensis* made by Dawkins (1867a) is correct, it suggests the climate was fully temperate and that at least some woodland was present in the vicinity. All fossils exhibit high levels of abrasion (moderate to heavy) suggesting that they had undergone transportation since initial deposition and supporting the proposal that the brickearths are colluvial.

Kennard (1944) suggested the microtine faunal assemblage from the Plumstead and Wickham ‘brickearths’ was similar to the assemblage recorded from the Lower Brickeraths at Crayford. The species recorded at Crayford by Kennard (1944) were re-

assessed by Schreve (1997) and are listed in Table 7.3. However, without re-analysing the assemblage from Plumstead and Wickham, the species list cannot be confirmed.

7.3.5 Age of Deposits

All publications correlate the Plumstead and Wickham brickearths with the celebrated Lower Brickearths at Crayford, with the exception of Kennard (1944) who suggested that the East Wickham brickearth is a colluvial deposit and therefore compared it to the colluvial Upper Brickearths at Crayford. Despite this, he highlighted that the microtine rodent assemblage from the Plumstead and Wickham brickearths was similar to that from the Lower Brickearths at Crayford (Kennard, 1944) and also noted the presence of *C. antiquitatis*, *M. primigenius*, *E. ferus*, and *C. fluminalis* at both locations.

The presence of species such as *C. fluminalis*, *E. ferus* and *S. kirchbergensis* suggest a pre-MIS 5e date as both have last appearances in Britain during MIS 7 (Currant, 1989; Sutcliffe, 1995; Keen, 2001; Schreve, 2001a; Bridgland *et al.*, 2004).

The mammalian and microtine rodent assemblages from Plumstead and Wickham suggest a correlation with the Lower Brickearths at Crayford and thus a MIS 7a age can be assigned (Schreve, 1997; Candy and Schreve, 2007). If the deposits are colluvial, as Kennard (1944) suggested, they may have accumulated during a period of cooler climate when high rainfall is more common in order to instigate movement of material downslope. If the correlation of the fauna with MIS 7a is correct, the subsequent cooling in MIS 6 is a possible period during which the colluvium may have been deposited.

7.4 Summary of Chapter 7

The assemblages discussed in this chapter have all been recently re-investigated (see Schreve, 1997, 2001a; Scott, 2006) and all offer a relatively detailed picture of landscapes, mammal populations and hominin behaviour during MIS 8-7-6. This study has therefore attempted to integrate the evidence from the complete archaeological assemblages with the palaeontology as well as the palaeobotanical and lithostratigraphical data from each site for the first time since their discoveries in the late 19th and early 20th centuries. The sites of Plumstead, East and West Wickham have also been revisited during this study for the first time since the work of Kennard (1944).

The assemblages from both sites contained *M. trogontherii*, *Stephanorhinus kirchbergensis*, *Stephanorhinus hemitoechus*, *Panthera leo*, *Equus ferus* and *Coelodonta antiquitatis*, thus allowing correlation with the Sandy Lane Mammal Assemblage Zone (MAZ) (Schreve, 2001a,b, 2004c). This MAZ is characteristic of late MIS 7 environments, which consist predominantly of temperate open grasslands and which have been correlated with MIS 7a based on high precision U-series dating at the MIS 7 site of Marsworth (Candy and Schreve, 2007).

Despite the similarity of the palaeontology at the two sites and their inferred ages, Ilford (Uphall Pit) lacks any significant lithic archaeology, whereas Crayford has a rich assemblage of fresh Levallois tools and older derived implements. The extensive Levallois assemblage, its fresh condition and the many refitting pieces ensure that Crayford is a celebrated Levallois site in Britain. Furthermore, the faunal assemblage contains an unusual specimen; a horse phalanx with an artificially smoothed posterior side, most likely produced by hominins and again representing a very rare organic artefact. The fauna from the 'brickearths' at Plumstead and East and West Wickham were found to be similar to the Crayford Lower Brickearth assemblages.

Chapter 8: Last (Ipswichian, MIS 5e) Interglacial Sites

Nine Ipswichian sites, with assemblages containing the biostratigraphically diagnostic fossils of *Hippopotamus amphibius*, have been identified in London during this research, thereby complementing and amplifying the information from Trafalgar Square (Section 8.1) in Central London, which remains the most famous and comprehensive locality in terms of multiproxy evidence. The other reported sites are Brown's Orchard, Acton (Section 8.2), Brentford (Section 8.3), Peckham (Section 8.4), Greenwich (Section 8.5), Cane Hill, Croydon (Section 8.6), Camden (Section 8.7), Wembley Park (Section 8.8), and Leadenhall Street (Section 8.9). This chapter represents the first time that comprehensive species lists have been compiled for most of the sites described here and the first time that some localities have been identified as being of Ipswichian age, thus making a considerable novel contribution to the corpus of known Last Interglacial sites in London.

8.1. Trafalgar Square

8.1.1 Introduction

Faunal remains have been recorded from Trafalgar Square and the surrounding roads since the early 18th century (Preece, 1999). The site was first attributed to the Last (Ipswichian) Interglacial in the 1950s based on the distinctive faunal assemblage that includes *Hippopotamus amphibius*, a species only recognised from MIS 5e in Britain (Sutcliffe, 1995; Currant and Jacobi, 2001). Other notable characteristics of the British Ipswichian faunal assemblage are the absence of *Equus ferus* and of *Mammuthus trogontherii*, both of which are known from the preceding (penultimate, MIS 7) interglacial (Schreve, 2001a) (see Chapter 7.1). Palaeolithic artefacts have never been confidently associated with the Trafalgar Square interglacial faunal remains, contributing to the widespread absence of evidence for human occupation during the Ipswichian interglacial in Britain (Ashton, 2002). During this study, over 250 faunal specimens have been located in extant collections and are analysed collectively for the first time. Despite the abundance of fossils discovered in and around Trafalgar Square, especially during the 1957/58 excavations, the discoveries often remain unpublished, particularly the vertebrate remains.

8.1.2 Location of Collections

Specimens from Trafalgar Square were seen in the Museum of London, Natural History Museum, London, and the British Geological Survey, Keyworth, Nottingham.

8.1.3 History of Research

Fossils from the Trafalgar Square vicinity were first recorded in St James's Square and St James's Place around 1712 and 1716 (Gentleman's Magazine, 1758). Later 'elephant' fossils were found during sewer digging near the 'King's Arms' tavern in Pall Mall (thought to be near the junction with Haymarket) at a depth of 22 feet (6.7m) in sand in 1730 or 1731 (Gentleman's Magazine, 1758). Occasional references to the discovery of mammalian fossils were subsequently made, however most lacked stratigraphical details (Buckland, 1823; *The English Mechanic*, 1882). Locations where fossils have been excavated include Drummond's Bank at Charing Cross (1879) (*The English Mechanic*, 1882), the Admiralty (Abbott, 1892), Lloyds Bank on Pall Mall (1922) (unpublished, mentioned in Preece (1999) and recorded on specimen labels), the Canada Sun Life Assurance Building, 2-4 Cockspur Street (1927) (Bate, 1937), Rex House, Lower Regent Street (1939) (unpublished, mentioned in Preece (1999)), Uganda House, Trafalgar Square (1957) (Franks *et al.*, 1958; Franks, 1960), New Zealand House, Haymarket (1958) (unpublished, mentioned in Preece (1999) and recorded on specimen labels), Laing's site in Cockspur Street (1971) (unpublished, mentioned in Preece (1999)), the Tennessee Pancake House, 7 Whitehall (Gibbard, 1985) and Canadian Pacific House, Cockspur Street (1980) (Gibbard, 1985) (Figure 8.1).

The first detailed account of the stratigraphy was published by Abbott (1892) after fossils were discovered in an excavation under the new Admiralty offices, Whitehall in 1890 (Figure 8.1). The stratigraphy observed at Trafalgar Square was briefly summarised by Franks *et al.* (1958), and a detailed analysis of the stratigraphy was published by Gibbard (1985), who formally named the gravel underlying the sequence at Trafalgar Square and the overlying interglacial silts and sands as the Spring Gardens Gravel and the Trafalgar Square Sands and Silts respectively. He also correlated the stratigraphy seen at Trafalgar Square with similar sequences at Brentford and Peckham. Gibbard analysed the pollen from the excavations beneath Canadian Pacific House and the Tennessee Pancake House.

Bridgland (1994) assigned the Trafalgar Square deposits to the Kempton Park/East Tilbury Marshes Formation, whereas Gibbard (1985, 1994) recognises the deposits as part of the Trafalgar Square Complex, which follows the Taplow/Mucking Terrace and precedes Kempton Park/East Tilbury Marshes Terrace. The Kempton Park/East Tilbury Marshes Terrace lies below the modern floodplain alluvium (see Chapter 3, Figure 3.6). The interglacial deposits at Trafalgar Square are underlain by a gravel sequence (the Spring Gardens Gravel Member of Gibbard (1985)), all attributed to the Ipswichian Interglacial and overlain by the Kempton Park Gravel (attributed to the Devensian) as described by Gibbard *et al.* (1982) and Gibbard (1985).

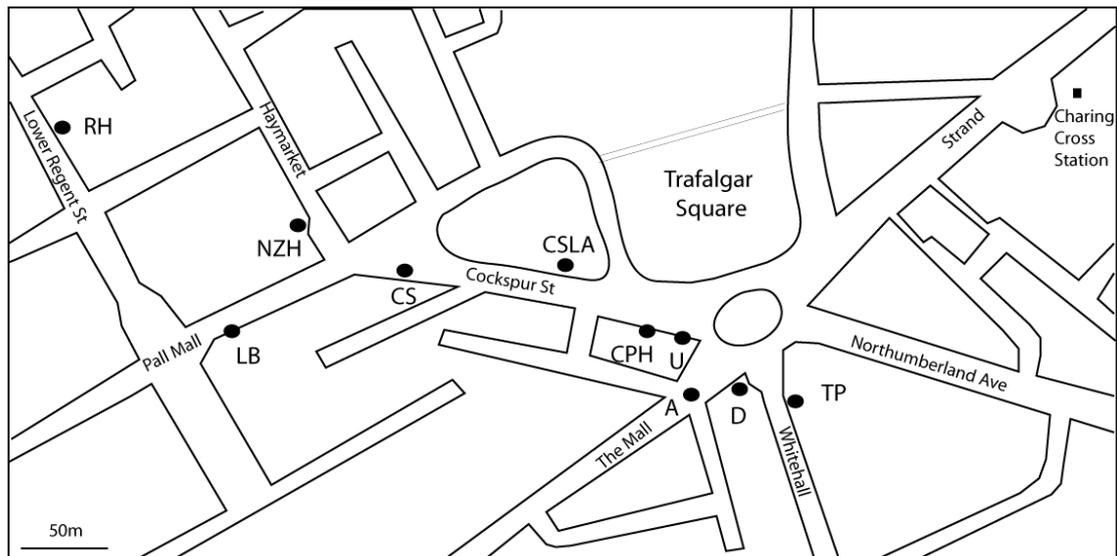
Franks *et al.* (1958) summarised the mammalian fossils, molluscs, pollen and plant remains, and coleoptera from Trafalgar Square. This was subsequently followed up by Franks (1960), who published a detailed record of the pollen and plant macrofossils from the same excavation. The pollen record was comparable to that from Bobbitshole, the Ipswichian type site (West, 1957), and the sequence was therefore considered to represent the Last Interglacial and specifically pollen zone Ip IIB (Franks *et al.*, 1958; Franks, 1960; West *et al.*, 1964; Stuart, 1976). Molluscan assemblages from several locations in the Trafalgar Square area were re-analysed by Preece (1999) and attributed to the Ipswichian interglacial. This was reinforced by Keen (2001) who summarised the common characteristics of the British Ipswichian molluscan assemblages, including those from Trafalgar Square.

Coope (1974) correlated the coleopteran assemblage from Trafalgar Square (which remains unpublished) with the sequence at Bobbitshole. All the species found in Bobbitshole were also found in the Trafalgar Square assemblage; however the latter contained some exotic species that were not recorded at Bobbitshole but was overall much larger (which may explain the greater diversity). The correlation between the coleopteran assemblages from Bobbitshole and Trafalgar Square was reiterated by Coope (2001). Coope (2000, 2001) further used the coleopteran assemblages from British sites, including Trafalgar Square, to identify indicator species that indicate an Ipswichian (MIS 5e) age deposit and to calculate the Mutual Climatic Range (MCR) of Ipswichian environments.

Stuart (1976) grouped the mammalian faunal and floral assemblages from Trafalgar Square with those from Crayford, Aveley and Ilford and attributed them all to the Last Interglacial, a position later adopted by Gibbard (1985) who also correlated the pollen sequence at Trafalgar Square with that from Aveley. In contrast, research by Sutcliffe (1964, 1976), Sutcliffe and Bowen (1973), Curren (1989), Bridgland (1994), Curren and Jacobi (2001) and Schreve (2001a) demonstrated that the Trafalgar Square sediments represent a separate and younger temperate episode than Aveley, Ilford and Crayford, based principally on the recognition of a distinctive Ipswichian mammalian assemblage and the position of Trafalgar Square on a lower terrace of the River Thames. Curren and Jacobi (2001) proposed that on the basis of common vertebrate species, stratigraphic positions and absolute dating, British sites of MIS 5e age including Trafalgar Square could be grouped in the Joint Mitnor Cave Mammal Assemblage Zone (MAZ).

8.1.4 Location of Sites

All sites within the Trafalgar Square locality are shown in Figure 8.1.



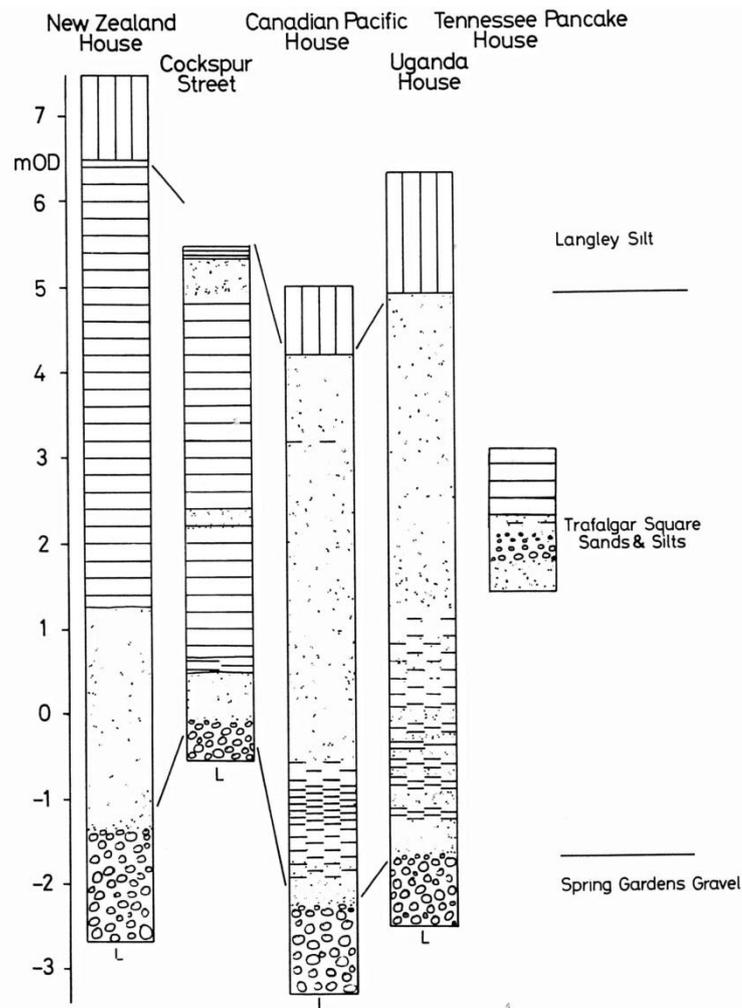
A - Admiralty
CPH - Canadian Pacific House
CS - Cockspur Street
CSLA - Canada Sun Life Assurance Building
D - Drummond's Bank
LB - Lloyds Bank
NZH - New Zealand House
RH - Rex House
TP- Tennessee Pancake House

Figure 8.1: Map of excavation sites in the Trafalgar Square area

8.1.5 Stratigraphy

Although the stratigraphy in the area is variable and several facies of the deposits are present, all accounts generally describe London Clay at the base, overlain by a series of gravels, variable horizons of sands and silts and finally by ‘brickearth’ (Abbott, 1892; Franks *et al.*, 1958; Kerney, 1959). Gibbard (1985) identified four main stratigraphical units in the Trafalgar Square area and assigned the following stratigraphic names:

4. Langley Silts
3. Trafalgar Square Sands and Silts
2. Spring Gardens Gravel
1. London Clay



**Figure 8.2: Stratigraphy recorded at the main excavations in Trafalgar Square
(From Gibbard, 1985, p.52)**

London Clay

In the Trafalgar Square area, London Clay bedrock is generally found at a depth of -2.3 to -3.3m OD. However, the surface of the London Clay is undulating and has been found as deep as 12.2m and as high as 5.2m below the surface (Bate, 1937; Gibbard, 1985).

Spring Gardens Gravel

The Spring Gardens Gravel (Gibbard, 1985) is found under the entire St. James's – Trafalgar Square area and is recorded at a maximum depth of 4.5m at New Zealand House. It was composed of stratified red-brown coarse to fine subangular gravel and sand. The northern limit of the gravel has been mapped under Haymarket where the

London Clay rises to 1.8m OD and the Spring Gardens Gravel is absent on the higher ground.

Trafalgar Square Sands and Silts

At the Uganda House and Canadian Pacific House excavations, the Trafalgar Square Sands and Silts consisted of the following succession (from Gibbard, 1985):

6. Shelly sand, 1m
5. Silt, 0.15m
4. Greenish-grey well sorted shelly sand containing several vertebrate fossils, 0.3m
3. Sandy gravel, 0.2m
2. Brown sand, silty at the base, cross-bedded and containing occasional horizons containing molluscs. The lower silty section was rich in plant remains, 3.3m
1. Alternating grey clayey silt and brown sand bands (0.15-0.3m thick) at the base of the unit, 1.5m. Some horizons within this lower section were rich in molluscs and plant remains

The basal horizon containing the grey silt and brown sand, suggested the sediments were deposited under conditions of variable energy. The overlying deposits are dominated by sands and gravel horizons indicating the presence of fast water flow (Gibbard, 1985).

At the Tennessee Pancake House excavation, a different sequence of the Trafalgar Square Sands and Silts was recorded by Gibbard (1985). The increasingly fine sediments towards the top of this section were proposed to be the infill of a channel, which had excavated a path within the sands observed at the top of the Uganda House and Canadian Pacific House excavation. The stratigraphy at Tennessee Pancake House was recorded as (Gibbard, 1985):

3. Grey to pale buff clay rich silts in molluscs, 0.6m
2. Coarse shelly gravel, 0.2m
1. Erosional surface of creamy-yellow sand at 1.75m OD

Langley Silt Complex

At both the Uganda House and Canadian Pacific House excavations, one metre of mottled grey brown clayey silt, or ‘brickearth’ was recorded with an erosional base, suggesting that it is separated from the Trafalgar Square Sands and Silts by a hiatus, possibly representing a significant period of time (Gibbard, 1985).

8.1.6 Palaeontology and Palaeoecology

The palaeobotanical and faunal assemblages from excavations in and around Trafalgar Square are detailed below, together with descriptions of the inferred palaeoclimates and palaeoenvironments that these represent.

Palynology

The palynological profiles recorded by Franks (1960) from the Trafalgar Square Sands and Silts Uganda House and Gibbard (1985) from Canadian Pacific House were comparable, although the latter apparently represented a more complete sequence. Gibbard (1985) divided the pollen sequence into three local biozones, (described from the base upwards):

A - This biozone indicates the dominance of temperate forest, with abundant *Quercus* in addition to *Acer*, *Fraxinus* and *Corylus*. The presence of *Hedera* and *Ilex* (holly) pollen suggests that winters were mild, as these genera do not tolerate frost (Iversen, 1944). Grasslands were present in the area as indicated by the abundant herb and grass pollen.

B – *Corylus* pollen dominated the sequence with *Acer*, *Fraxinus*, *Quercus*, *Taxus* (yew) and *Ulmus* all present in significant amounts. The occurrence of local wet woodland was indicated by *Alnus* pollen, in addition to Filicales (ferns) spores. In addition to *Hedera* and *Ilex*, the presence of *Viscum* (mistletoe) also suggests the winters were mild (Iversen, 1944). Dry grasslands were also present in the area, represented by pollen from the herb and grass families. The record of *Plantago major/media* (plantain), *Trifolium* (clover) and Compositae (aster, daisy and sunflower family) at the site suggest disturbance of the ground, probably by the large mammals. A slight brackish influence (indicative of a high sea level stand) was recognised by the presence of *Armeria maritima* (sea thrift) and *Plantago maritima* (sea plantain).

C – Low levels of *Corylus* were recorded whilst *Quercus*, *Acer*, *Fraxinus*, and *Pinus* were common, suggesting the presence of deciduous forest. A brief rise in *Salix* at the beginning of the sequence was proposed to represent an interval in which deciduous woodland developed. Throughout the sequence, an increase in herbaceous pollen suggests a retreat of forest vegetation in the immediate area. As with biozone B, a brackish influence was suggested by the presence of *Armeria maritima*, *Plantago maritima* and members of the Chenopodiaceae.

The pollen spectra from the excavations beneath the Tennessee Pancake House, Whitehall, were found to be a continuation of the sequence recorded from the Canadian Pacific House excavation (Gibbard, 1985). The sequence from the Tennessee Pancake House contained decreasing levels of tree pollen towards the top of the section, suggesting increasingly open (and perhaps cooler) conditions. Conversely, the molluscs from the same sequence indicated temperate conditions (M. P. Kerney in Gibbard, 1985; Preece, 1999), although it was recognised that reworking of older specimens from underlying horizons could have occurred. However, the sediments from the Tennessee Pancake House excavation appeared to be slightly younger than those from the Uganda and Canadian Pacific House sections, since the silts at the first locality filled a channel cut into the sands at the last two locations. Thus, it is plausible that the decrease in thermophilous tree pollen observed at the Tennessee Pancake House genuinely reflects a deterioration in the climate towards the end of the interglacial. The pollen sequence also suggests large mammals were trampling the site with the disturbed ground indicators in pollen zone b, and the retreat of forest habitats in the immediate area at the top of the sequence (pollen zone c).

Plant macrofossils

Abbott (1892) recorded four species of moss, *Amblystegium riparium*, *Hypnum stramineum* (now *Calliergon stramineum*), *H. fluitans* (now *Warnstorfia fluitans*) in addition to *Potamogeton* (pondweed), *Lemna polyrhiza?* (duckweed), *Ceratophyllum demersum* (hornwort), *Polygonum* (buckwheat), *Rumex* sp. (docks and sorrels), *Carex* sp. (sedges), *Scirpus* sp. (aquatic grasses), and *Betula nana* (dwarf birch). Many of these species were later recorded by Franks (1960) alongside the climatically-significant species *Trapa natans* and *Acer monspessulanum* (water chestnut and Montpellier maple) from the gravels at Trafalgar Square. Both are currently southern species living

in Mediterranean regions, Africa and Asia and indicate summer temperatures up to 4°C warmer than southern Britain at present (Sparks and West, 1972; Keen *et al.*, 1999; Gao *et al.*, 2000). Edwards (in Bate, 1937) further recorded wood fragments from either willow (*Salix* sp.) or poplar (*Populus* sp.).

Coleoptera

Coleoptera were recovered during the excavations at Uganda House in 1957/58; however the assemblage was not described in detail (Franks *et al.*, 1958). Coope (2000, 2001) analysed fossil beetles from Trafalgar Square and other British Ipswichian sites in order to calculate the collective Mutual Climatic Range (MCR) for the Last Interglacial, which suggested the T_{\max} (mean temperature of the warmest month) was 18 to 24 °C and T_{\min} (mean temperature of the coldest month) was -6 to +6 °C. The most climatically significant genus within the Trafalgar Square assemblage was *Drepanocerus*, which is not found in Europe today but occupies Central and Southern Africa, eastern Asia and oriental regions (Balthasar, 1963). The nearest relative of this genus lives in northern India today (Coope, 2001). Other exotic species from the assemblage included *Bembidion elongatum*, *Bembidion octomaculatum*, *Oodes gracilis*, *Rhysodes sulcatus*, *Cybister lateralimarginalis*, *Hydrophilus caraboides* and *Hydrous piceus*. These species suggested that small pools, areas of stagnant water and a well-vegetated water body were present in the vicinity of the site, together with some areas of woodland (Coope, 2000, 2001).

Molluscs

Molluscs were first recorded in the area by Abbott (1892) who identified the following taxa from the 'peat' exposed in the foundations of the New Admiralty Offices, the same horizon as the mammal fossils (modern taxonomic names from Kerney (1999) and R. Preece (pers. comm.) unless otherwise stated; *Limax laevis*, *Hyalina nitidula* (re-identified as *Zonitoides nitidus* (Kerney, 1959), *H. nitida* (*Segmentina nitida*), *Helix pulchella* (*Vallonia pulchella*), *H. concinna* (*Trochulus hispidus*), *H. nemoralis* (*Cepaea nemoralis*), *H. caperata* (re-identified as *Candidula crayfordensis* (Kennard, 1944) and later as a mixture of *Trichia hispida* and *Helicella itala* (Kerney, 1959)), *Zua lubrica* (*Cochlicopa lubrica*), *Pupa muscorum* (*Pupilla muscorum*), *Vertigo minutissima* (*Truncatellina cylindrical*), *V. antivertigo*, *Clausilia rugosa* (more likely to be *C. pumila* (Kerney, 1959)), *Succinea elegans* (*Oxyloma pfeifferi*), *Carychium minimum*,

Lymnaea peregra (*Radix balthica*), *L. palustris* (*Stagnicola palustris* agg.), *L. truncatula* (*Galba truncatula*), *Planorbis nautilus* (*Gyraulus crista*), *P. carinatus*, *P. marginatus* (*Planorbis planorbis*), *P. vortex* (*Anisus vortex*), *P. spirorbis* *Anisus leucostoma*), *P. fontanus* (*Hippeutis complanatus*), *Paludestrina marginata* (*Belgrandia marginata*), *Bithynia tentaculata*, *Valvata piscinalis*, *V. cristata*, *Unio littoralis*, *Sphaerium corneum*, *Pisidium pusillum*, and *P. fontinale*.

More recently, Preece (1999) re-analysed molluscan assemblages from Canadian Pacific House (originally collected 1980), Uganda House (collected 1957-8), New Zealand House (1958), Cockspur Street (1971) and Tennessee Pancake House (1978). He considered Abbott's molluscan assemblage to be comparable with those from other Trafalgar Square locations, with the only significant difference being the abundance of *Cepaea* shells described by Abbott, which apparently formed beds 'several inches thick' (Abbott, 1892 p.350).

The assemblage from the excavation at Uganda House included species now extinct in Britain such as the freshwater pearl mussel *Margaritifera auricularia*, which is currently found in France, northern Italy, Spain, Portugal and Morocco and cannot tolerate soft water (Ellis, 1978; Kerney, 1999; Preece, 1999). The assemblage also included *Belgrandia marginata*, which currently inhabits clear springs in southwest France, Spain and the western foothills of the Alps (Germain, 1931). Therefore it was suggested that the assemblage was deposited in a swiftly-flowing, highly calcareous and well vegetated river that experienced summers warmer than those in Britain today (Franks *et al.*, 1958).

The assemblage from the same excavation at Uganda House was re-analysed by Preece (1999), who concluded that the Spring Gardens Gravel and the Trafalgar Square Sands and Silts were all deposited under temperate conditions. The sequence was dominated by species characteristic of flowing water, such as *Valvata piscinalis*, *Bithynia tentaculata*, *Pisidium henslowanum*, *P. moistessierianum*, *Potomida littoralis*, and in some samples, *Margaritifera auricularia*. There were very few specimens of *Ancylus fluviatilis* (river limpet) noted, which implied that the stones on the bed were too muddy for the mollusc to attach itself to. *Belgrandia marginata* was abundant, supporting the record made by Franks *et al.*, (1958). Very few changes were identified in the faunal

composition upwards through the Spring Gardens Gravel and the Trafalgar Square Sands and Silts, suggesting rapid aggradation, although some slight variations were recorded in the assemblage (Preece, 1999). In the lower parts of the Sands and Silts, a higher proportion of species suggesting sheltered, vegetated conditions were recorded, such as *Valvata cristata*, *Armiger crista* and *Acroloxus lacustris*, whereas in the upper horizons, species such as *Pisidium henslowanum*, *P. casertanum* and *P. moitessierianum* were more abundant, suggesting an increase in water flow. In the upper parts of the Sands and Silts, land snails were well represented and reflected the palaeobotanical inferences made by Franks (1960), namely the presence of damp marshy ground as well as areas of dry open calcareous grassland. Woodland environments were rare. The assemblage from the excavation at Canadian Pacific House was comparable to that from Uganda House (Preece, 1999).

The excavations at New Zealand House produced a fluvial assemblage including *M. auricularia*, which was dominated (81% of the assemblage) by species characteristic of moving water. The assemblage from beneath Tennessee Pancake House was also dominated by moving-water taxa (Preece, 1999). The molluscan assemblage from Cockspur Street reflected a slightly more complex sequence of deposition. The taxa from the lower section of the Silts reflected a combination of stagnant and moving water (over 20%, and 25% of the assemblage respectively). Towards the top of the Silts and contained organic deposits, the number of terrestrial species representing areas of marshland and dry calcareous grasslands increased, as at Uganda House. However, as with the other assemblages, woodland species were surprisingly scarce, which is in direct contrast to the palaeobotanical evidence. An apparent absence of woodland in the local area is surprising in the context of the palaeoclimatic evidence, since one would normally expect a high proportion of trees to be present during the climatic optimum.

One explanation for the scarcity of trees suggested by the molluscan evidence may be the contrasting highly-localised signature provided by the molluscs living in the immediate area of the river, and that provided by the pollen record, which often contains further-travelled components and can thus represent a much wider environment with woodland at some distance. In addition, the grazing and trampling activities of megafauna may also explain the local paucity of trees. Modern hippopotami in Africa trample the banks of rivers, creating areas of short grassland environments with patches

of bare ground up to 1km wide on each side of the river (Lock, 1972). Therefore the scarcity of trees indicated by the molluscan fauna may suggest large mammals such as *H. amphibius* trampling and grazing the site near to the river, a feature that has also been noted at other Ipswichian sites with abundant hippopotamus, such as Barrington in Cambridgeshire (Stuart, 1976). Here, the sediments had a notably high minerogenic content, suggesting that soil from bare, trampled ground had been washed in, and arboreal pollen levels were only at 10%, implying that the woodland had been opened up by the megaherbivores (Gibbard and Stuart, 1975). Modern elephants are known to uproot trees at an unusually high rate in areas where their population is high (Laws, Parker and Johnstone, 1970).

Kennard (in Bate, 1937) recorded a molluscan assemblage from beneath the Canada Sun Life Assurance House site in Cockspur Street, which included *Valvata piscinalis*, *Succinea* sp., *Pisidium* sp., and *Lymnaea peregra* (now *Radix balthica*). All these taxa were identified at adjacent sites by Franks *et al.* (1958) and Preece (1999), thereby reinforcing the notion that the stratigraphy is broadly continuous throughout the area.

Ostracods

Ostracods were recovered from sands (presumably the Trafalgar Square Sands and Silts) during the Admiralty section excavation (Abbott, 1892), including *Cypridopsis vidua*, *Cypria laevis* (now *Cyclocypris laevis* or *Trajancypris laevis?*), *C. serena* (now *Cyclocypris serena?*), *Cypris virens* (now *Eucypris virens?*), *C. incongruens* (now *Heterocypris incongruens?*), *C. fusca* (unclear which species this is now taxonomically recognised as), *Candona candida*, *C. pubescens* (unclear which species this is now taxonomically recognised as), *C. lactea* (no longer a recognised species, see Griffiths and Holmes, 2000), and *Herpetocypris reptans*.

Despite the small collection recorded by Abbott (1892), the assemblage indicated a predominance of shallow and vegetated water with a muddy river substrate (Griffiths and Holmes, 2000). For example, genera including *Cypridopsis*, *Herpetocypris* and *Eucypris* are known to live in shallow pools, ponds and well vegetated areas, with *Cypridopsis vidua* specifically preferring water with plenty of submerged vegetation, often *Chara* (stonewort). The genus *Heterocypris* is also recorded from shallow water (2-3m). However, *Candona candida*, a common species from Northern Europe,

suggests that deep water was also present. Members of the genus *Candona* are often associated with fine organic rich mud and *Herpetocypris* is also known to prefer firm mud substrates (Griffiths and Holmes, 2000).

Two species, *Candona candida* and *Cypridopsis vidua*, were recorded living in Canada at the present day between mean annual temperatures of -11.5 to 9.6°C and -9.7 to 9.9°C respectively (Delorme and Zoltai, 1984).

Preece (1999) noted that *Cyprideis torosa*, an ostracod species characteristic of brackish-water habitats, was common throughout the sediments at Canadian Pacific House. However, he suggested that as the molluscan assemblage indicated an exclusively freshwater environment, it was unlikely that brackish and freshwater species inhabited the same area, Therefore he considered it probable that the brackish elements were carried upstream by tidal action (cf. Kilenyi, 1969). However, in addition to the brackish ostracod species found throughout the sequence, the pollen assemblage also indicated that a brackish influence existed, thus suggesting that the Thames at this location may have been in the upper ranges of the tidal influence. Ostracod samples were taken from the excavation beneath the Tennessee Pancake House (Gibbard, 1985), however they have not been described in any subsequent publication.

Vertebrates

From the published accounts, it appears the vertebrate fossils from the various Trafalgar Square localities were found from both the Spring Gardens Gravel and the overlying Trafalgar Square Sands and Silts. Bate (1937) recorded fossils from the gravels, whereas the fossils mentioned in the Gentleman's Magazine (1758) were described from sands. Abbot (1892) and Franks *et al.* (1958) described faunal remains from both sands and gravels.

Herpetofauna

Abbott (1892) recorded specimens of *Emys* sp., although it was not reported from Trafalgar Square by Stuart (1976). If verified, it is probable that Abbott's finds refer to *Emys orbicularis* (European pond tortoise), which is known from the Ipswichian type site assemblage of Bobbitshole, Ipswich (Stuart, 1976, 1979), *Emys orbicularis* currently occupies areas in eastern Europe and the Mediterranean where it requires

warm dry summers reaching at least a mean July temperature of 18°C in order to breed successfully, thus suggesting Last Interglacial summers were approximately 2°C warmer than the present day (Stuart, 1976, 1979; Hallock *et al.*, 1990).

Mammals

The species recorded during this study are summarised in Table 8.1.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Carnivora			
<i>Ursus arctos</i> L., brown bear	1	0.40	1
<i>Crocota crocuta</i> Erxleben, spotted hyaena	1	0.40	1
<i>Panthera leo</i> (L.), lion	1	0.40	1
Proboscidea			
<i>Palaeoloxodon antiquus</i> (Falconer and Cautley), straight-tusked elephant	12	4.74	2
<i>Mammuthus primigenius</i> (Blumenbach), woolly mammoth	8	3.16	2
Elephantidae sp. indet elephant	7	2.77	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	1	0.40	1
Rhinocerotidae sp. indet rhinoceros	3	1.19	1
Artiodactyla			
<i>Hippopotamus amphibius</i> L., hippopotamus	20	7.91	2
<i>Megaloceros giganteus</i> (Blumenbach), giant deer	6	2.37	2
<i>Cervus elaphus</i> L., red deer	15	5.93	6
cf. <i>Cervus elaphus</i> L., red deer	2	0.79	1
<i>Dama dama</i> (L.), fallow deer	4	1.58	1
<i>Bos primigenius</i> Bojanus, aurochs	1	0.40	1
cf. <i>Bos primigenius</i> Bojanus, aurochs	3	1.19	1
<i>Bison priscus</i> Bojanus, bison	8	3.16	5
Bovidae sp. indet. Large bovid	129	50.99	12
cf. Bovidae sp. indet large bovid	16	6.32	2
Indet. Bone fragment	15	5.93	~
Total	253		

Table 8.1: Species recorded from the Trafalgar Square area

The taxa recorded during this study are generally consistent with previously published assemblages from Trafalgar Square, which detailed fossils of ‘Elephant’, *Panthera leo* (lion), *Bos primigenius* (aurochs), *Bison priscus* (bison), *Palaeoloxodon antiquus* (straight tusked elephant), *Dama dama clactoniana* (a large-bodied subspecies of fallow deer, now re-identified as *Dama dama* (fallow deer)), *Cervus elaphus* (red deer), *Cervus* sp. (a small indeterminate deer), *Mammuthus primigenius* (woolly mammoth), *Equus caballus* (horse, now re-identified as *Equus ferus*), *Hippopotamus amphibius* (*H. amphibius*), *Rhinoceros* sp. (an indeterminate rhinoceros) and a small *Microtus* sp. (indeterminate vole) (Gentleman’s Magazine, 1758; Abbott, 1892; Bate, 1937; Franks *et al.*, 1958).

All the taxa recorded, with the exception of *Equus ferus* and *Mammuthus primigenius*, are established members of the Joint Mitnor Cave Mammal Assemblage-Zone (MAZ) as described by Curren and Jacobi (2001) and correlated with MIS 5e. Of these, the most diagnostic element is *H. amphibius*, which is known only from this interglacial in the British Middle and Late Pleistocene (Curren and Jacobi, 2001). Horse and mammoth are believed to be absent during the Ipswichian and have never been found in British assemblages containing *Hippopotamus* (Curren, 1989; Sutcliffe, 1995). While this may appear a circular argument, the fact that these observations are based on very large assemblages of many hundreds of specimens across the UK and from different types of depositional environment (fluvial, lacustrine, raised beach, cave) underpinned by independent geochronology, would add considerable credence to the view that horse and mammoth are genuine absentees at this time. Accordingly, the small number of horse and mammoth found here (0.4 and 3.16 % of the assemblage respectively) may be reworked elements of the assemblage. Both species are known from the preceding, pre-Ipswichian cold stage (Schreve, 1997) and mammoth is also recorded from the ensuing parts of the early Devensian (MIS 5c) by Curren and Jacobi (2001). The horse and mammoth fossils observed in the present study displayed moderate to heavy abrasion levels, however other species including some *Hippopotamus* fossils exhibited equally high levels of abrasion, thus offering limited insight into their provenance.

A climatically significant species of the assemblage, *Hippopotamus amphibius*, suggests summers were warm with mild winters, during which time rivers remained unfrozen. *H. amphibius* is currently confined to sub-Saharan Africa, again reflecting the warm

climate experienced in Trafalgar Square during the Ipswichian (Stuart, 1976), although it was more widespread in the past, occupying the broader circum-Mediterranean region (Schreve, 2009). Hippopotami today occupy rivers with adjacent grasslands in order to graze on grasses and aquatic plants (Stuart, 1982).

Further evidence for temperate conditions is given by the presence of *P. antiquus* and particularly *Bos primigenius*, which are only known from temperate episodes in Britain. Species such as *Panthera leo*, *Bison priscus* and *Bos primigenius* suggest that open herbaceous vegetation was present, whereas wooded areas are indicated by *Ursus arctos*, *P. antiquus*, *Cervus elaphus*, *Dama dama* and *Megaloceros giganteus*. *Crocota crocuta* would have occupied both habitats (Stuart, 1982).

The record of an indeterminate rhinoceros most probably relates to *Stephanorhinus hemitoechus* (narrow-nosed rhinoceros), which is an established component at other British Ipswichian sites (Currant and Jacobi, 2001) and, indeed, is the only species of rhinoceros known from this period in Britain. The cranial and dental morphology of *S. hemitoechus* suggests that it fed on low growing vegetation and therefore occupied open grassland habitats (Stuart, 1982).

8.1.7 Archaeology

Abbott (1892) described 12 flakes, an indeterminate number of worked flakes and cores from the Spring Gardens Gravel. They were all recorded as strongly patinated and some of the cores were considered to be water-worn. Their patination and abraded condition suggests that the artefacts were reworked from older deposits. This is consistent with the widespread view that hominins were absent in Britain during the Ipswichian (MIS 5e) (Currant and Jacobi, 2001; Schreve, 2001a).

Only one artefact from the Admiralty has been located in this study, reportedly from the 'lower bed', presumably referring to the Spring Gardens Gravel (Flake 46.2/23, unnamed collection, Museum of London). It has not been identified as one of the flakes described by Abbott (1892) and was observed here to have only slight patination and abrasion. Nevertheless, the degree of abrasion suggests that the artefact experienced some post-depositional transportation and was therefore not found *in situ*. The rest of the artefacts described by Abbott (1892) have not been re-located during the current

research and therefore their status as artefacts cannot be substantiated. Currant and Jacobi (1997) analysed a range of artefacts claimed to be from British MIS 5e deposits and none were found to be convincing. This might cast further doubt on the presence of genuine artefacts contemporary with the interglacial deposits at Trafalgar Square.

8.1.8 Age of Deposits

Lithostratigraphy and dating

Gibbard (1985) attributed the Spring Gardens Gravel to a cold climate episode pre-dating the Last Interglacial in the ‘Wolstonian’ and the overlying Trafalgar Square Sands and Silts to the Ipswichian Interglacial. Bridgland (1994, 2006) included the Trafalgar Square deposits within his Kempton Park Formation, which spans the equivalent of MIS 6-5a in the Middle Thames. The interglacial deposits at Trafalgar Square are situated at a lower position compared to the Taplow/Mucking Terrace (MIS 8-7-6), for example they are 10m below the level of the West Thurrock ‘brickearth’ (attributed to MIS 7) and yet Trafalgar Square is 30km *upstream* from West Thurrock (Bridgland, 1994). Therefore the Trafalgar Square interglacial deposits must be younger than the Taplow/Mucking Terrace deposits. Furthermore the position of the Kempton Park Gravel also suggests that the Lower Thames Valley was excavated significantly below the level of the Taplow/Mucking Gravel by the beginning of the Ipswichian since its Lower Thames equivalent, the East Tilbury Marshes Gravel actually underlies the modern Thames floodplain.

In contrast to Gibbard (1985), Preece (1999) proposed that the Spring Gardens Gravel should equally be considered as part of the interglacial sequence, since characteristic temperate Mollusca occur throughout the Spring Gardens Gravel and overlying the Trafalgar Square Silts and Sands. The Kempton Park Gravel, which is found to overlie the interglacial deposits in some areas, has been attributed to the Middle Devensian on the basis of a radiocarbon date of 43140 +1520/-1280 BP from Isleworth (Birmingham - 319) (Shotton and Williams, 1973) (49618-44685 cal BP, 94.5%) and another at Kempton Park of 35230 ± 185 BP (Q-2019) (Gibbard *et al.*, 1982) (41061 – 39645 cal BP, 95.4%). Penkman *et al.* (2007) demonstrated, using the Amino Acid Racemization (AAR) technique of dating mollusc shells, that the Trafalgar Square assemblage was

younger than sites such as Aveley, and comparable with other Ipswichian sites such as Shropham (Walkling, 1996) and Deeping St. James (Keen *et al.*, 1999).

Biostratigraphy

Pollen

The pollen sequence from Uganda House was correlated with zone IpIIb of the Ipswichian Interglacial by Franks (1960). This was followed by Gibbard (1985), who correlated the assemblage from Canadian Pacific House to the same Ipswichian sub-stage, however he also conflated the sequence with that from Aveley, now well-established as a pre-Ipswichian (MIS 7) site (Sutcliffe, 1975; Bridgland, 1994; Schreve, 1997, 2001a).

Coleoptera

The coleopteran assemblage from Trafalgar Square has been confidently attributed to the Ipswichian interglacial (Coope, 2000, 2001) on the basis of the robust stratigraphical context and the similarity to other well-established Ipswichian beetle assemblages such as those from Bobbitshole, Suffolk (West, 1957; Coope, 1974), Deeping St James, Lincolnshire (Keen *et al.*, 1999), Elsing, Norfolk (Taylor and Coope, 1985; Coope, 2000), Itteringham, Norfolk (Beesley, 1988), Shropham, Norfolk (Walkling, 1996) and Woolpack Farm, Cambridgeshire (Gao *et al.*, 2000).

Molluscs

The molluscan assemblages recorded from the Spring Gardens Gravel at Canadian Pacific House, Uganda House, New Zealand House, Cockspur Street and the Tennessee Pancake House sites were correlated with the Ipswichian Interglacial (Franks *et al.*, 1958; Preece, 1999). None of the species recovered were unique to MIS 5e, but the co-occurrence of molluscs such as *Belgrandia marginata*, *Potomida littoralis* and *Margaritifera auricularia*, combined with the absence of species such as *Pisidium clessini*, *Corbicula fluminalis* and *Unio crassus*, is distinctive of British MIS 5e assemblages (Preece, 1999). *Corbicula fluminalis* has never been recorded alongside *Hippopotamus* fossils, even though it is an invasive coloniser and, if present during the Last Interglacial, would be expected to have been widespread in the Thames catchment. This offers an important distinction between Ipswichian sites and those of the

penultimate (MIS 7) interglacial, since *Corbicula* is abundant in the latter (Sutcliffe, 1975, 1976; Keen, 1990; Bridgland, 1994; Preece, 1999; Meijer and Preece, 2000).

Ostracods

Currently there few species recognised that can be used unequivocally to assign ages to assemblages or sediments and none from the small assemblage recorded from Trafalgar Square are suitable for this purpose (Griffiths and Holmes, 2000).

Mammals

British faunal assemblages including *H. amphibius* have long been attributed to the Last Interglacial (King, 1955; Sutcliffe, 1959). Other species associated with *H. amphibius*, such as fallow deer, straight-tusked elephant and narrow-nosed rhinoceros, were also recognised to be characteristic elements of the Ipswichian (Stuart, 1976; Curren, 1989). Previously, assemblages including *Hippopotamus*, such as that from Trafalgar Square, were often erroneously grouped with sites now known to be from the preceding interglacial, such as Ilford and Aveley. Subsequently, Sutcliffe (1964, 1976), Sutcliffe and Bowen (1973), Curren (1989), Bridgland (1994) and Schreve (2001a) suggested that they represented separate temperate periods, based on their relative stratigraphical positions and clear differences between their mammal assemblages.

Curren and Jacobi (1997, 2001) proposed a biozonation scheme in which all British Ipswichian mammal assemblages were grouped within the Joint Mitnor Cave Mammal Assemblage-Zone (MAZ). Absence of horses and hominins are considered significant characteristics of the Last Interglacial, in conjunction with the presence of *H. amphibius* and fallow deer (Sutcliffe, 1960, 1995; Curren and Jacobi, 2001). Other species noted by Curren and Jacobi (2001) as common elements of the Joint Mitnor Cave MAZ include giant deer, straight-tusked elephant, brown bear, spotted hyaena, narrow-nosed rhinoceros, red deer, bank vole, water vole, field vole and wood mouse. The Joint Mitnor Cave MAZ was correlated with MIS 5e on the Uranium series age determinations conducted on a stalagmite which encompassed a *Hippopotamus* fossil from Victoria Cave, North Yorkshire which dated the fauna to 120 ± 6 ka (Gascoyne *et al.*, 1981). An additional date on flowstone enclosing a tooth of narrow-nosed rhinoceros at Victoria Cave was obtained, dating the deposit to 104 ± 6 to 135 ± 9 kyr (Gilmour *et al.*, 2007). Similar dates have been obtained from two sites attributed to the

Joint Mitnor Cave MAZ; Kirkdale Cave, North Yorkshire (Uranium-thorium) (McFarlane and Ford, 1998) and Sewerby Cliff, East Yorkshire (thermoluminescence (TL) and optically stimulated luminescence (OSL)) (Bateman and Catt, 1996).

With respect to the controversy over the climatic interpretation of the Spring Gardens gravel, it is clear that a faunal assemblage of clear temperate-climate affinity, including *Hippopotamus* specimens, was found within the Trafalgar Square Silts and Sands and in underlying the Spring Garden Gravels (Abbott, 1892; Bate, 1937). The assemblages recorded from the Spring Gardens Gravel also included species such as *Bos primigenius* and *Palaeoloxodon antiquus*, which are only known from interglacial or interstadial deposits in Britain (Stuart, 1982). This offers further support to the molluscan evidence, which identified the Spring Gardens Gravel as an interglacial deposit (MIS 5e) (Preece, 1999) and not the cold climate gravel as previously believed (Gibbard, 1985).

8.2 Acton and Turnham Green

8.2.1 Introduction

Faunal remains, including hippopotamus, were first discovered in Acton and Turnham Green in the early 1870s. The stratigraphy at both sites was recorded in detail, although not all the fossils available for analysis today can be directly associated with individual horizons. The analyses in this chapter represent the first time the collection has been described in detail since its discovery.

8.2.2 History of Research

Lane Fox (1872) described the excavations at Brown's Orchard in Acton Green during which many fossils including *Hippopotamus amphibius* were collected. An additional nearby section described from a house foundation in the same publication from a location in Turnham Green (the site was described as in 'Chiswick Road' and 'Chiswick Row, Turnham Green Road') also yielded a small number of fossils. These assemblages have not been re-analysed since the original publication.

8.2.3 Location of collections

Specimens were recorded from the Busk Collection held in the Natural History Museum, London.

8.2.4 Stratigraphy

The following stratigraphy was recorded by Lane Fox (1872) in Brown's Orchard (Figure 8.3):

6. Surface soil
5. 'Mixed earth'
4. Gravel
3. Sand with some clay
2. Black seam (Iron or manganese oxide)
1. Gravel (fossils found within this horizon)

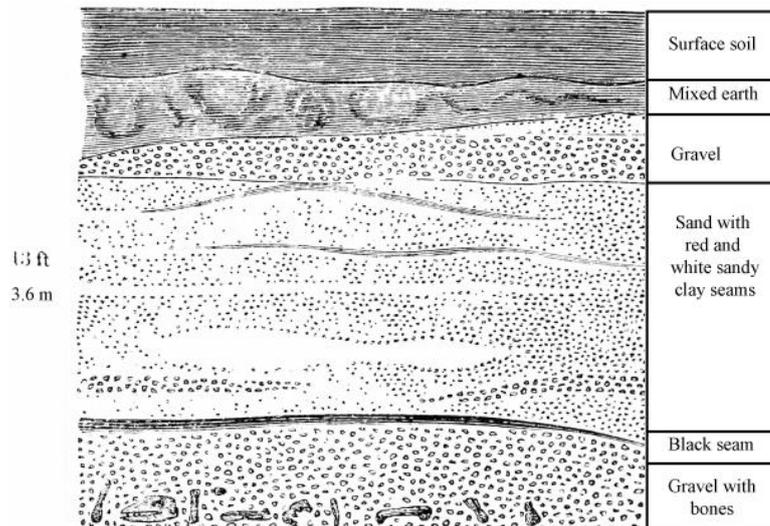


Figure 8.3: Stratigraphy observed at Brown's Orchard, Acton. Adapted from Lane Fox (1872)

A similar stratigraphy was recorded from the Turnham Green Road excavation (Lane Fox, 1872) however this time with brickearth underlying the surface soil and the bones were found in sand with pebbles.

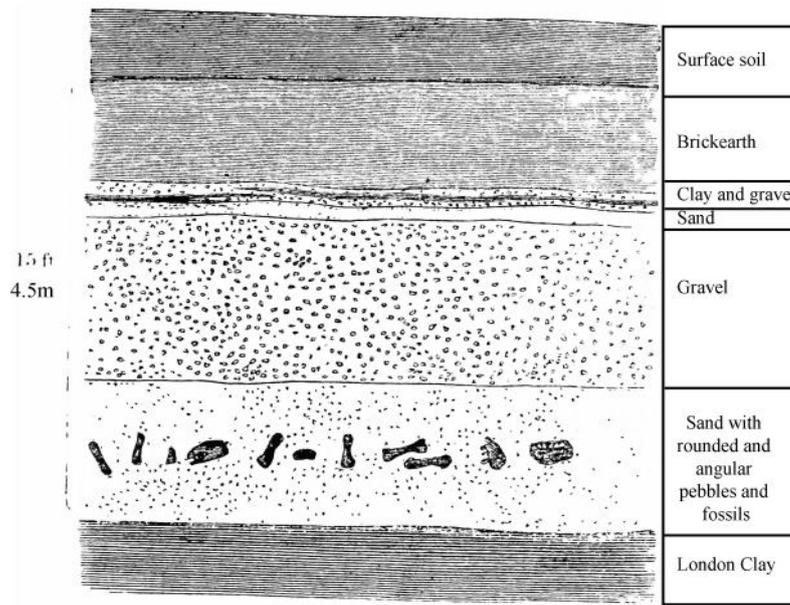


Figure 8.4: Stratigraphy observed from Turnham Green Road. Adapted from Lane Fox (1872)

8.2.5 Palaeontology and interpretation

Although Lane Fox (1872) did not record the species found in Turnham Green Road, he did record the following species from Brown's Orchard; *Stephanorhinus hemitoechus* (narrow-nosed rhinoceros), *Equus ferus* (horse), *Hippopotamus amphibius* (hippopotamus), *Bos primigenius* (aurochs), *Bison priscus?* (bison), *Dama dama* (fallow deer), *Cervus elaphus* (red deer), *Rangifer tarandus* (reindeer), *Ursus arctos* (brown bear), *Mammuthus primigenius* (woolly mammoth).

The specimens from Brown's Orchard, Acton and Turnham Green Road have been grouped together in the following analyses on the basis of their close proximity and comparable faunal assemblages. The species recorded in the present study from Brown's Orchard and Turnham Green Road are listed in Table 8.2).

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Carnivora			
<i>Ursus arctos</i> L., brown bear	1	2.22	1
Proboscidea			
<i>Palaeoloxodon antiquus</i> (Falconer and Cautley), straight-tusked elephant	1	2.22	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	4	8.89	1
Artiodactyla			
<i>Hippopotamus amphibius</i> L., Hippopotamus	4	8.89	1
<i>Megaloceros giganteus</i> (Blumenbach), giant deer	2	4.44	1
<i>Cervus elaphus</i> L., red deer	7	15.56	2
cf. <i>Cervus elaphus</i> L., red deer	4	8.89	1
<i>Dama dama</i> (L.), fallow deer	4	8.89	1
<i>Rangifer tarandus</i> (L.), reindeer	1	2.22	1
Bovidae sp. indet. large bovid	14	31.11	5
cf. Bovidae sp., indet large bovid	1	2.22	1
Indet. bone fragment	2	4.44	~
Total	45		

Table 8.2: Species list and minimum number of individuals from Brown's Orchard, Acton and Turnham Green Road

The other species within the assemblage correspond to those recorded from Trafalgar Square (Section 8.1.6), reflecting the palaeoenvironments and climate previously described.

8.2.6 Age of Deposits

As with the Trafalgar Square assemblage, there appears to be either a small amount of reworking on the basis of the presence of horse and woolly mammoth, or a simple lack of provenance information may be to blame, especially as woolly mammoth was not recorded during this study. The horse fossils were recorded as slightly to moderately abraded whereas the hippopotamus specimens were all heavily abraded, suggesting they may have been found in different deposits. In addition, *Rangifer tarandus* is not a recognised component of Ipswichian age deposits and is exclusively restricted to cold

periods in Britain during the Pleistocene (Stuart, 1982), therefore making it incompatible with a Last Interglacial age. The positions of the horse and reindeer remains within the stratigraphy are unknown and therefore may well come from elsewhere within the succession, such as the basal section of the gravel (associated with the cold-climates of MIS 6) or the upper gravel, which is attributed to a post-interglacial episode.

The similarity of the assemblage to that from Trafalgar Square and the Joint Mitnor Cave MAZ (Currant and Jacobi, 2001), in particular the presence of *Hippopotamus amphibius*, suggests a correlation with MIS 5e (Sutcliffe and Bowen, 1973; Stuart, 1976; Currant, 1989; Sutcliffe, 1960, 1995; Currant and Jacobi, 2001).

8.3 Brentford

8.3.1 Introduction

Faunal remains were found at various locations in Brentford from 1813 up to the 1950s when molluscan and palaeobotanical evidence was also recorded. The Ipswichian ‘indicator’, hippopotamus, was recorded at these sites, suggesting they were deposited during MIS 5e.

8.3.2 History of Research

Trimmer (1813) first described the stratigraphy and the discovery of faunal material in Brentford from two brickfields. Further research in Brentford was undertaken by Morris (1838) at Brentford Water works near Kew Bridge, in which ‘elephant’, ox and deer fossils were recorded. However these may not be related to the Brentford assemblage containing *Hippopotamus* fossils, as a cold-climate Devensian assemblage has also been recorded from this location (see Chapter 9).

Zeuner (1959) and Kerney (1959) described the molluscs and palaeobotanical evidence from excavations at Beecham’s House, on Great West Road (A4) and proposed correlation of the two sequences from Brentford and Trafalgar Square. During an extension of Beecham’s House, Sutcliffe collected further stratigraphical information (Gibbard, 1985), although it is not clear whether fossils were found and none have been identified during this study. The details of this excavation remain unpublished. Gibbard

(1985) also considered the stratigraphies at Brentford and Trafalgar Square to be comparable and correlated the two sites accordingly and produced a species list for the site.

The assemblage recorded during this research has been collected from several locations in Brentford:

- a) The foundations of the Simmonds Aerocessories A. R. P. Shelter (on Great West Road/A4) at a depth of 14-16 feet in Pleistocene Gravel. Presented to the Natural History Museum in 1938.
- b) A trench along Great West Road near the Lucozade factory in 1961 (now GlaxoSmithKline building on Great West Road).
- c) Avenue Road (not traceable on current maps).

Brentford is mapped as the Langley Silt Complex and Kempton Park Gravel (British Geological Survey, 1998).

8.3.3 Location of collections

Specimens were recorded from the Natural History Museum, London, the British Geological Survey, Keyworth, Nottingham (including items from the Trimmer and the Geological Society Collections) and Museum of London.

8.3.4 Stratigraphy

Deposits near Brentford containing *Hippopotamus* fossils were first described by Trimmer (1813) from Boston Manor Road, near Brentford and Gunnersbury Park. The stratigraphy at Boston Manor Road was described as:

- 5) sandy loam (1.8 – 2.1m)
- 4) sandy gravel with molluscs (thin layer)
- 3) calcareous loam with bovid, deer and molluscan remains (0.3 – 0.5m)
- 2) layer of peat
- 1) basal gravel with sand and clay with ‘elephant’, *Hippopotamus* and bovid bones (0.6-3 m)

The second brickfield at Gunnersbury Park was described as containing:

4) sandy loam (2.4m)

3) sand, becoming coarser at the base with *Hippopotamus*, 'elephant' , deer, bovid and mollusc fossils (0.9 – 2.4m)

2) sandy calcareous loam with bovid, deer and mollusc fossils (0.3-2.1m)

1) basal gravel and London Clay not observed

8.3.5 Palaeontology

The species recorded at Brentford are listed in Table 8.3.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Carnivora			
<i>Ursus arctos</i> L., brown bear	3	1.23	1
<i>Crocuta crocuta</i> Erxleben, spotted hyaena	4	1.65	1
Carnivora indet.	1	0.41	1
Proboscidea			
<i>Mammuthus primigenius</i> (Blumenbach), woolly mammoth	6	2.47	1
Elephantidae sp. indet elephant	2	0.82	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	13	5.35	1
Rhinocerotidae sp. indet rhinoceros	2	0.82	1
Artiodactyla			
<i>Hippopotamus amphibius</i> L., hippopotamus	5	2.06	1
<i>Megaloceros giganteus</i> (Blumenbach), giant deer	3	1.23	1
<i>Cervus elaphus</i> L., red deer	18	7.41	4
cf. <i>Cervus elaphus</i> L., red deer	9	3.70	3
<i>Dama dama</i> (L.), fallow deer	5	2.06	2
Cervidae indet.	2	0.82	1
<i>Bos primigenius</i> Bojanus, aurochs	2	0.82	2
<i>Bison priscus</i> Bojanus, bison	2	0.82	2
Bovidae sp. indet. Large bovid	161	66.26	17
cf. Bovidae sp. indet large bovid	1	0.41	1
Indet. bone fragment	4	1.65	
Total	243		

Table 8.3: Species recorded from excavations in Brentford

8.2.6 Age of Deposits

As with the Trafalgar Square assemblage, it is likely the mammoth and horse fossils are reworked from an older or younger deposits as they are known ‘absentees’ from the British Ipswichian fauna (Currant, 1989; Sutcliffe, 1995). The mammoth specimens, in particular, were all heavily abraded and appear to have suffered considerable reworking. As described above, the horse specimens recorded from Brentford during this study displayed slightly lower levels of abrasion than the *H. amphibius* fossils, suggesting they may be from younger deposits. The remaining species fully reflect the

palaeoenvironmental and climatic inferences previously described for Trafalgar Square (Section 8.1.6) and support previous correlations with the Trafalgar Square assemblage and the Ipswichian (MIS 5e) (Zeuner, 1959; Kerney, 1959; Gibbard, 1985).

8.4 Peckham

8.4.1 Introduction

Deposits yielding hippopotamus fossils were first discovered in the early 1860s. The site has been correlated with the Ipswichian in previous studies such as those by Gibbard (1994, 1995) and Bridgland (1995).

8.4.2 History of Research

Four fossils are provenanced to a brickfield in Peckham, with one specifically in Park Road. Most of the specimens were collected in the early 1860s. Unfortunately it is not known who collected the fossils. Some of the specimens are attributed to the Spurrell collection and others were purchased by J. Ruthven and Sowerby. The discovery of hippopotamus fossils from Peckham were mentioned in Woodward (1886). Gibbard (1994, 1995) correlated the interglacial deposits at Peckham with the sub-stage IpIIIb of the Ipswichian Interglacial, based on the similarity of the sequence to that from Trafalgar Square. Both sites contain temperate-climate sediments accumulated under still- or slow-flowing water and overlain by clays reflecting the increased inwash of inorganic sediments and the expansion of local meadow on the floodplain (the Trafalgar Square Sands and Silts). Bridgland (1995) also correlated the deposits at Peckham with the Trafalgar Square sequence.

The area is mapped as Langley Silt Complex and a small pocket of Kempton Park Gravel (British Geological Survey, 1998).

8.4.3 Location of collections

Specimens were recorded in the Natural History Museum, London (including items from the Spurrell and Owen Collections), Museum of London, and the British Geological Survey, Keyworth, Nottingham.

8.2.4 Palaeontology and age of deposits

The species recorded at Peckham are listed in Table 8.4.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Carnivora			
<i>Canis lupus</i> L., wolf	1	2.56	1
Proboscidea			
<i>Palaeoloxodon antiquus</i> (Falconer and Cautley), straight-tusked elephant	1	2.56	1
cf. <i>Palaeoloxodon antiquus</i> (Falconer and Cautley), straight-tusked elephant	1	2.56	1
<i>Mammuthus primigenius</i> (Blumenbach), woolly mammoth	3	7.69	1
Perissodactyla		0.00	
<i>Coelodonta antiquitatis</i> (Blumenbach), woolly rhinoceros	5	12.82	1
Rhinocerotidae sp. indet rhinoceros	6	15.38	1
Artiodactyla		0.00	
<i>Hippopotamus amphibius</i> L., hippopotamus	11	28.21	2
<i>Cervus elaphus</i> L., red deer	3	7.69	1
<i>Bison priscus</i> Bojanus, bison	2	5.13	2
Bovidae sp. indet. large bovid	7	17.95	1
Total	39		

Table 8.4: Species recorded from Peckham

The presence of *Canis lupus* is novel, since it has not been recorded from Trafalgar Square, Acton or Brentford, although it is known elsewhere in Britain from the Ipswichian Joint Mitnor Cave MAZ (Currant and Jacobi 2001). Wolves are able to adapt to many climates and environments and are known from both interglacials and cold periods alike (Stuart, 1982). As with the records of horse and woolly mammoth, woolly rhinoceros has never been recorded from *bona fide* un-mixed British MIS 5e

assemblages (Carrant, 1989; Sutcliffe, 1995) and its remains are therefore they are likely to have been reworked from older deposits.

The other species within the assemblage correspond to those recorded from Trafalgar Square (Section 8.1.6), reflecting the palaeoenvironments and climate previously described. The similarity of the assemblage to that from Trafalgar Square and the Joint Mitnor Cave MAZ (Carrant and Jacobi, 2001), in particular the presence of *Hippopotamus amphibius*, strongly suggests correlation with MIS 5e (Sutcliffe and Bowen, 1973; Stuart, 1976; Carrant, 1989; Sutcliffe, 1960, 1995; Carrant and Jacobi, 2001).

The pollen analysed by Gibbard (1994, 1995) from Peckham indicated the expansion of local meadow on the floodplain, which may suggest that large mammals, particularly *H. amphibius*, were trampling the areas surrounding the river banks, much like modern hippopotami in Africa (Lock, 1972). The trampling of large mammals on the banks of the River Thames was also suggested by the molluscs recorded at Trafalgar Square (Section 8.1).

8.5 Greenwich

8.5.1 Introduction

An assemblage containing hippopotamus fossils was discovered around 1875. This study represents the first time the assemblage has been described and analysed.

8.5.2 History of Research

The majority of specimens were found during sewer work in St. Alfege Passage and Churchfields (both near Greenwich Market and the Cutty Sark), Greenwich, around 1875, although some fossils lack detailed provenance information. Churchfields and St. Alfege Passage are located within the Kempton Park Gravel Formation, overlying Thanet Sand (British Geological Survey, 1998). The discoveries in Greenwich have not been previously recorded and their inclusion here is therefore the first time that the faunal material has been identified and described.

8.5.3 Location of collections

Specimens were recorded in the Natural History Museum, London and the Museum of London.

8.5.4 Palaeontology

The species recorded from Greenwich are listed in Table 8.5.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Artiodactyla			
<i>Hippopotamus amphibius</i> L., hippopotamus	6	14.29	1
<i>Cervus elaphus</i> L., red deer	2	4.76	1
<i>Rangifer tarandus</i> (L.), reindeer	4	9.52	1
<i>Bison priscus</i> Bojanus, bison	1	2.38	1
Bovidae sp. indet. large bovid	29	69.05	4
Total	42		

Table 8.5: Species recorded from Greenwich

8.5.5 Age of deposits

All species are common components of the Joint Mitnor MAZ apart from reindeer. None of the material is provenanced to particular beds, thereby inviting the possibility that the reindeer material comes from either pre- or post-interglacial deposits. Reindeer is a particularly common component of later Devensian assemblages (Currant and Jacobi, 2001; Gilmour *et al.*, 2007). The presence of *Hippopotamus* specimens suggests that at least part of this small assemblage is referable to the Ipswichian (Sutcliffe and Bowen, 1973; Stuart, 1976; Currant, 1989; Sutcliffe, 1960, 1995; Currant and Jacobi, 2001).

8.6 Cane Hill, Croydon

8.6.1 Introduction

A small assemblage of bone fragments, including identifiable hippopotamus specimens, was recorded from the grounds of a hospital in Cane Hill, Croydon. Unfortunately very little information is known about the collection, and this study represents the first time the assemblage has been analysed and recorded.

8.6.2 History of Research

A small number of heavily degraded fossils including *Hippopotamus* specimens were discovered in a pit in the grounds of the Cane Hill Hospital, a Victorian asylum in Coulsdon (London Borough of Croydon) circa 1913 when they were received by the Horniman Museum (Figure 8.5).

The area is mapped as chalk with no Quaternary superficial deposits (British Geological Survey (2007)).

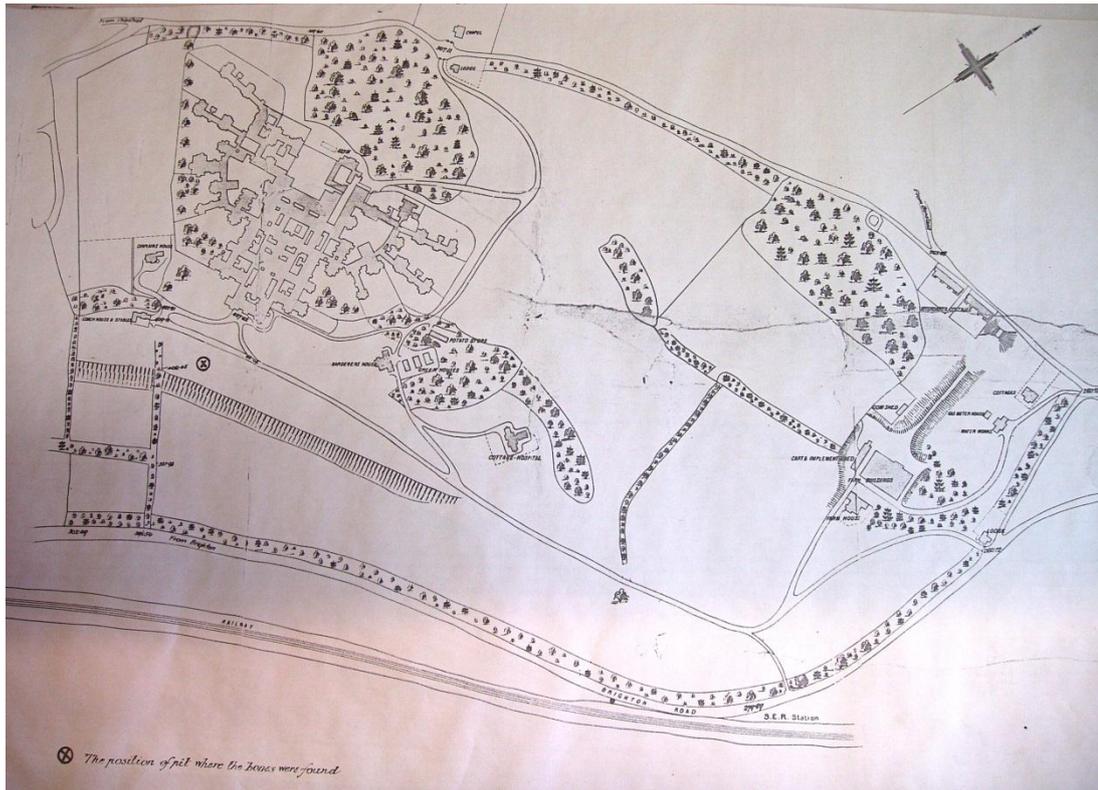


Figure 8.5: Map of Cane Hill Hospital grounds, the cross in the circle represents the location where the fossils were found (Map from archive in Horniman Museum).

8.6.3 Location of collections

All specimens from Cane Hill were seen at the Horniman Museum, London.

8.6.4 Palaeontology

59 highly fragmentary and mostly unidentifiable fossils were recorded. The most complete and recognisable specimen was a section of *Hippopotamus amphibius* maxilla with fragments of 2 molars and some fragments of canine *in situ* (Figure 8.6).



Figure 8.6: Fragment of *H. amphibius* maxilla and 2 molars (Photograph courtesy of Horniman Museum)

8.6.5 Age of deposits

Despite the fragmentary nature of the assemblage, the presence of *Hippopotamus amphibius* fossils suggests the assemblage relates to MIS 5e (Sutcliffe and Bowen, 1973; Stuart, 1976; Currant, 1989; Sutcliffe, 1960, 1995; Currant and Jacobi, 2001). The discovery of the assemblage suggests that either sediments equivalent to the Kempton Park/East Tilbury Marshes Terrace deposits exist in this location, or that Ipswichian sediments were locally reworked into younger deposits.

8.7 Camden

8.7.1 Introduction

A small collection of fossils was excavated from Camden around 1891. Unfortunately, as with the Cane Hill assemblage (8.6), very little stratigraphical information was

recorded about the site. Again, this study represents the first time this collection has been analysed and described.

8.7.2 History of Research

The assemblage was discovered in Brecknock Crescent near Camden Town around 1891. There is a Brecknock Road in the locality today, presumably near where the fossils were originally collected. The area around Brecknock Road was mapped as London Clay and there is no nearby mapped Kempton Park Formation. There are several zones of worked ground adjacent to Brecknock Road, reflecting the heavy development that has occurred in North London, however without further details on the stratigraphy it is not possible to suggest the deposit from which the assemblage was found (British Geological Survey, 2006).

8.7.3 Location of collections

Specimens were observed from the Wetherell Collection held in the Natural History Museum, London.

8.7.4 Palaeontology

The species discovered from Camden are listed in Table 8.67.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Proboscidea			
<i>Palaeoloxodon antiquus</i> (Falconer and Cautley), straight-tusked elephant	3	42.86	1
Elephantidae sp. indet elephant	1	14.29	1
Artiodactyla			
<i>Hippopotamus amphibius</i> L., hippopotamus	3	42.86	1
Total	7		

Table 8.6: Species recorded from Camden Town

8.7.5 Age of deposits

Both species are common components of the Joint Mitnor Cave MAZ, particularly the characteristic *Hippopotamus* fossils; therefore this small assemblage can be attributed to MIS 5e (Sutcliffe and Bowen, 1973; Stuart, 1976; Carrant, 1989; Sutcliffe, 1960, 1995; Carrant and Jacobi, 2001). However, with the lack of Kempton Park deposits currently identified in the area and no further knowledge of the source of this material, no further conclusions can be drawn at this point.

8.8 Wembley Park

8.8.1 Introduction

A small assemblage containing hippopotamus remains was recorded from Wembley Park in the early 1890s. This chapter represents the first time the collection has been analysed and recorded.

8.8.2 History of Research

The specimens were collected in the early 1890s from ‘rearranged London Clay’ (from specimen label). The Wembley Park area has been mapped as London Clay (British Geological Survey, 2006); however the River Brent flows nearby and may be responsible for laying down deposits of Ipswichian age here.

8.8.3 Location of collections

Specimens were recorded from the Maclure and Newton Collections in the British Geological Survey, Keyworth, Nottingham.

8.8.4 Palaeontology

The assemblage is small and consists of a complete left *H. amphibius* astragalus, an indeterminate *H. amphibius* molar fragment and an unidentifiable fragment of bone.

8.8.5 Age of deposits

The presence of *H. amphibius* fossils suggests correlation with MIS 5e (Sutcliffe and Bowen, 1973; Stuart, 1976; Carrant, 1989; Sutcliffe, 1960, 1995; Carrant and Jacobi, 2001), although no further comments can be made on the locality.

8.9 Leadenhall Street

8.9.1 Introduction

A small collection of faunal remains, including hippopotamus fossils, was collected from the Leadenhall Street area in the City of London around 1925. Unfortunately no stratigraphical information was recorded and it remains unclear from which deposit the bones were discovered and whether they were found *in situ*. Nevertheless, the analyses in this chapter represent the first time the collection has been recorded and described.

8.9.2 History of Research

One item in the assemblage was provenanced to Lloyd's in Leadenhall Street and was presented to the Natural History Museum in 1925, which suggests that the fossils were discovered during the building of the original Lloyd's premises, completed in 1928. The area around Leadenhall Street has been mapped as Langley Silt Complex overlying Taplow Gravel (British Geological Survey, 2006). This suggests that the *Hippopotamus* fossils present *may* have been reworked from Kempton Park Terrace deposits, which would have been present in the area prior to the deposition of the younger sediments noted by the BGS. Consequently, it is likely that the Leadenhall Street deposits are Devensian in age, since significant sections of the Langley Silt Complex cover this time period (Gibbard, 1985; Gibbard *et al.*, 1987; Rose *et al.*, 2000).

8.9.3 Location of collections

Specimens were housed in the Natural History Museum, London.

8.9.4 Palaeontology

The species recorded from Leadenhall Street are shown in Table 8.7.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Proboscidea			
<i>Mammuthus primigenius</i> (Blumenbach), woolly mammoth	1	10	1
Perissodactyla			
<i>Coelodonta antiquitatis</i> (Blumenbach), woolly rhinoceros	1	10	1
Artiodactyla			
<i>Hippopotamus amphibius</i> L., hippopotamus	3	30	1
cf. <i>Hippopotamus amphibius</i> L., hippopotamus	1	10	1
<i>Bos primigenius</i> Bojanus, aurochs	1	10	1
Bovidae sp. indet. large bovid	3	30	1
Total	10		

Table 8.7: Species recorded from Leadenhall Street

8.9.5 Age of deposits

Woolly rhinoceros and mammoth are not known from British Ipswichian faunas (Currant and Jacobi, 2001; Schreve, 2001a), therefore they are likely reworked components of the assemblage from older cold climate gravels. However as the remaining species are common components of the Joint Mitnor Cave MAZ, particularly the characteristic *Hippopotamus* fossils they suggest a correlation with MIS 5e (Sutcliffe and Bowen, 1973; Stuart, 1976; Currant, 1989; Sutcliffe, 1960, 1995; Currant and Jacobi, 2001). Fossils have also been recorded from the nearby locations of Whitefriars Street, Fleet Street, Salisbury Square, including one specimen of *P. leo* from Fleet Street. It is probable that many of these fossils can be attributed to the Ipswichian deposits in the area; however it is clear that others are not characteristic of the Ipswichian. Species such as horse, woolly mammoth, woolly rhinoceros and reindeer are also recorded in the Whitefriars Street, Fleet Street and Salisbury Square assemblages, suggesting they are not fully contemporaneous with the Trafalgar Square assemblage. For this reason they have not been included in the above analyses.

8.10 Summary of Chapter 8

This chapter has presented the full mammalian faunal list from Trafalgar Square for the first time and integrated it with the lithostratigraphy and the molluscan and coleopteran assemblages. The faunal assemblages from Acton and Brentford have also been fully described during this study and placed within the current chronology of the Late Pleistocene. Additional sites containing specimens of *Hippopotamus amphibius*, an Ipswichian indicator species, have been identified for the first time by this study, namely Peckham, Greenwich, Croydon, Camden, Wembley, and Leadenhall Street in the City of London.

In summary, the most complete and stratigraphically robust faunal assemblage analysed in this chapter, Trafalgar Square, contained remains of *Hippopotamus amphibius*, which is not known from any other interglacial in the late Middle and Late Pleistocene in Britain. This species is presently confined to sub-Saharan Africa and suggests that conditions at the site reflect warm summers and mild winters. The Coleoptera and plant macrofossil assemblages also reveal that the climate was warmer than the present day, perhaps up to 4°C warmer, based on the coleopteran MCR calculations of mean summer temperatures ranging from 18 to 24 °C and mean winter temperatures between -6 to +6 °C. Warmer summers are further indicated by the presence of *Trapa natans* and *Acer monspessulanum* (water chestnut and Montpellier maple) macrofossils, two southern plant species now found in Mediterranean regions, Africa and Asia (Sparks and West, 1972; Keen *et al.*, 1999; Gao *et al.*, 2000).

Other mammals found at Trafalgar Square include giant deer, straight-tusked elephant, brown bear, spotted hyaena, narrow-nosed rhinoceros, fallow deer and red deer, thus allowing confident correlation of the site with the Joint Mitnor Cave MAZ, identified by Carrant and Jacobi (1997, 2001) as the type assemblage for the British Ipswichian. Overall the fauna represents open grassland habitats with some areas of nearby woodlands.

A significant and testable characteristic of the Ipswichian interglacial sites is that they apparently lack evidence for both horses and hominin occupation (Stuart, 1976; Carrant, 1986; Wymer, 1988; Carrant and Jacobi, 1997, 2001; Schreve, 2001a). No evidence of human occupation was found at the sites described in this chapter, be it in the form of artefacts, cutmarks or other examples of modified bone. It is suggested that hominin absence during MIS 5e forms part of a much more extensive gap in the record, extending from MIS 6 through to MIS 4 (Jacobi *et al.*, 1998; Ashton and Lewis, 2002)).

Given that prevailing temperatures and environmental conditions were eminently suitable for human occupation, and there is evidence for human occupation during this time in Jersey at La Cotte de St Brelade (e.g. Scott, 1980; Callow and Cornford, 1986) and Caours, northern France (e.g. Antoine *et al.*, 2006). One possible explanation for the absence of hominins pre-est may be the final breach of the 'land bridge' (Gupta *et al.*, 2007) connecting Britain to continental Europe in MIS 6, which then may have subsequently prevented the migration of hominins into Britain.

It has been suggested that a megaflood from a large pro-glacial lake in the southern North Sea breached the Strait of Dover at some point prior to MIS 5e (Gupta *et al.*, 2007). Before the breach, humans would have been able to migrate between mainland Europe and Britain via the Dover Strait land bridge. Following the breach, high sea levels during temperate periods would have separated Britain from mainland Europe. However, the timing of the breach or breaches, is still under debate with recent research suggesting that rivers were prone to large-scale palaeo-floods at certain times in the Pleistocene and that the scale of these floods was so large that the volumes of water introduced into the Atlantic Ocean could have affected the thermohaline circulation and thus the climate (Westaway and Bridgland, 2010).

Chapter 9: Last Cold Stage Sites (excluding Upper Palaeolithic)

Six sites within London yielding palaeontological and palaeobotanical assemblages characteristic of Late Pleistocene cold climates have been identified: Isleworth (Section 9.1), Kew Bridge (Section 9.2), Twickenham (Section 9.3), Feltham (Section 9.4), Battersea (Section 9.6), South Kensington (Section 9.7) and the Lea Valley Arctic Bed sites in northwest London (Section 9.9). Kempton Park (Section 9.5), a site lying just outside the Greater London boundary and the type locality for the Kempton Park Gravel, the terrace on which these sites are located (Gibbard *et al.*, 1982; Gibbard, 1985), is also briefly discussed within this chapter in order to illustrate, together with the South Kensington deposits, the presence of early Devensian cold-climate deposits within the study area. Upper Palaeolithic sites are not included in this chapter but are discussed separately in Chapter 10.

Evidence from the last glaciation suggests considerable climatic complexity (Grootes *et al.*, 1993; Grootes and Stuiver, 1997; Tzedakis *et al.*, 2002), initially comprising a series of stadials and interstadials of the Early Devensian (correlated with MIS 5d-5a inclusive (c. 116-66,000 years BP) followed by a severe climatic deterioration (MIS 4 66-58,000 years BP) and then a period of relatively elevated temperatures (the Middle Devensian, MIS 3, c. 58-25,000 years ago) (Tzedakis *et al.*, 2002). MIS 3 has the largest number of recorded Dansgaard–Oeschger (DO), or millennial-scale, climatic oscillations, thus illustrating the complexity of climate variability within the Middle Devensian period. The Late Devensian, the period encompassing the Last Glacial Maximum (LGM) around 20,000 years ago, is correlated with MIS 2.

The climatic transitions throughout the Devensian glaciation are reflected in the mammalian records and the changes in faunal composition have been identified and incorporated into a formal biostratigraphy for the Late Pleistocene by Curren and Jacobi (1997, 2001). Within this scheme, similar mammal assemblages were recognised from several sites attributed to the same isotope stage, based on absolute dating, specifically thermal ionisation mass spectrometric (TIMS: uranium/thorium) age determinations for the Early Devensian and radiocarbon dating for the Middle and Late Devensian sites (MIS 3 and younger). The precision of the dating methods used to

attribute the Early Devensian sites to isotope stages was improved by new TIMS dates published in Gilmour *et al.* (2007).

Within the Early Devensian, the Bacon Hole mammal assemblage zone (MAZ) was proposed to represent the fauna of MIS 5c, which is dominated by temperate species but lacking the most thermophilous elements, such as hippopotamus and fallow deer, which are associated with the preceding interglacial, MIS 5e. The Banwell Bone Cave MAZ represents MIS 5a assemblages, which are dominated by bison and reindeer, two species that reflect cold-climate, maritime conditions. Finally, the Pin Hole MAZ was proposed for Middle Devensian MIS 3 faunas, represented by the re-immigration of woolly mammoth, horse and woolly rhinoceros, amongst other species (Currant and Jacobi, 1997, 2001; Gilmour *et al.*, 2007) as well as the return of hominin (Neanderthal and modern human) populations to Britain (Jacobi *et al.*, 2006).

Evidence for the very earliest parts of the last glaciation (MIS 5d to 5b) has not been identified in the study area, although these faunas are very poorly known in Britain generally. In contrast, sites representing the period from MIS 5a to MIS 3 have been noted here for the first time and include both interstadial and cold climate deposits. The mammalian assemblages from Isleworth, Battersea, Feltham, Twickenham and Kew Bridge have not been fully described since their discovery and this research is the first time that full species lists based on the extant collections have been compiled and analysis undertaken.

The Devensian also records a complex pattern of human presence and absence. Eighteen *bout coupé* tools, characteristic of the Middle Palaeolithic, have been discovered in London and reflect the return of Neanderthals to Britain during MIS 3, following a lengthy absence during MIS 5 and 4 (Tyldesley, 1987; White and Jacobi, 2002).

9.1 Isleworth

9.1.1 Site Location and History of Research

The fossils were discovered during gravel extraction from Willment's Pit, Isleworth (TQ 158746) during 1956. The location is now part of the Ivybridge Estate and Twickenham Trading Estate.

The locality yielded significant multiproxy palaeoenvironmental evidence. Coope and Angus (1975) published a coleopteran assemblage from the site, while Kerney *et al.* (1982) described the pollen, plant macrofossils, molluscs and ostracods, and Sutcliffe and Kowalski (1976) reported on the microtine rodent fauna. A comprehensive list of the mammalian species found at Isleworth has not been published previously although the assemblage was attributed to the Banwell Bone Cave MAZ by Currant and Jacobi (1997, 2001) and Gilmour *et al.* (2007) on account of its faunal composition.

The gravels at the site were attributed to the Kempton Park Gravel by Gibbard (1985) and Bridgland (1994). Most recently, the area has been mapped as Kempton Park Gravel with some areas of Langley Silt Complex by the British Geological Survey, (1998).

9.1.2 Location of Collections

Faunal remains were recorded from the J. W. Simons Collection in the Natural History Museum, London. Lithics were observed in the Museum of London, British Museum, Natural History Museum, Wardown Park Museum, Luton and Manchester Museum.

9.1.3 Stratigraphy

The following stratigraphy was recorded by Coope and Angus (1975) and Kerney *et al.* (1982) (Figure 9.1):

7. Sandy ‘brickearth’
6. Gravel, coarse, poorly sorted, with ice wedge casts
5. Sand and gravel, current bedded
4. Gravels and sands with thin silt horizons at base occasionally containing molluscan remains.
3. Organic laminated dark grey silty clay (approximately 1m)
2. Basal red gravel
1. London Clay (0-2m OD)

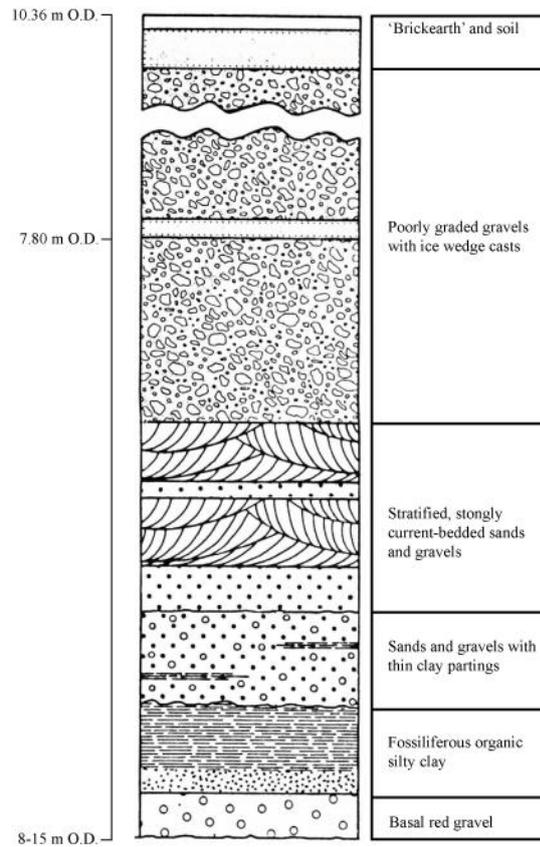


Figure 9.1: Willment's Pit Stratigraphy. Adapted from Coope and Angus (1975)

The deposits were interpreted as braided river sediments accumulating under a fluvial regime with variable flow. It was suggested the gravel and sand beds were laid down during periods of high seasonal flow, probably under a cold periglacial climate when snow melt is common and frost action and solifluction produce large amounts of debris. The presence of ice-wedge casts reflects periods when the surface of the gravel was exposed to permafrost processes. The organic silty clay horizon was deposited by slowly flowing, or still water in an abandoned channel or floodplain depression (Coope and Angus, 1975; Kerney *et al.*, 1982).

9.1.4 Palaeontology and Palaeoenvironmental reconstruction

Palynology

Pollen recovered from two samples within the organic silty clays was poorly preserved and the samples were contaminated with pre-Pleistocene palynomorphs. The

assemblages recovered from both samples were very similar and were dominated by Poaceae (grasses), Cyperaceae (sedges) and herbs (Table 9.1) (Kerney *et al.*, 1982).

Inferred habitats	Indicative plants
Shallow water, muddy pond or slow flowing water	<i>Typha angustifolia</i> , <i>Mananthes</i> and <i>Potamogeton</i>
Damp marshy ground	<i>Mentha</i> type, Ranunculaceae, <i>Thalictrum</i> , <i>Filipendula</i> , <i>Salix</i> and possibly <i>Valeriana officinalis</i>
Tall herb community on drier grasslands, probable sandy soils	Umbelliferae, Compositae, Caryophyllaceae, Chenopodiaceae, Rubiaceae, <i>Urtica</i>

Table 9.1: Habitats at Isleworth as inferred by the pollen assemblages (assembled from data in Kerney *et al.*, 1982).

Arboreal taxa were represented by very low percentages of *Pinus* and *Betula* pollen. It was suggested that the pine pollen had been transported from sites elsewhere and that the *Betula* pollen could represent the dwarf birch *Betula nana* (Kerney *et al.*, 1982).

Plant Macrofossils

The plant macrofossil assemblage was high in Umbellifereae remains that represent environments with little shade and moderate amounts of ground disturbance. Three plants, *Chenopodium ficifolium*, *Coronopus* sp. and *Medicago* sp. are known to be colonisers of bare ground, with the last being the first fossil record reported in Britain (Kerney *et al.*, 1982). Aquatic taxa were also present, reflecting the fluvial environments previously described. As with the pollen spectra, no tree species were noted.

Coleoptera

The inferred environments based on the beetle evidence are listed in Table 9.2 (assembled from Coope and Angus, 1975).

Inferred habitats	Indicative species
Aquatic Habitats	
Large pond, open water	<i>Dytiscus circumcinctus</i> , <i>Colymbetes</i> sp., <i>Rantus pulverosus</i>
Areas with no vegetation	<i>Gyrinus marinus</i> and <i>Gyrinus aerates</i>
Sandy or gravelly substrate	<i>Deronectes</i> sp.
Vegetated, marshy areas	<i>Hydrobius fuscipes</i> , <i>Enochrus quadripunctatus</i> , <i>Cymbiodyta marginella</i>
Riparian habitats	
Wet clay or muddy substrate	<i>Bembidion</i> species, <i>Georyssus crenulatus</i> , <i>Chaetarthria seminulum</i> , <i>Bledius</i> sp., <i>Stenus</i> sp., <i>Heterocerus</i> , <i>Aphodius niger</i> , <i>Aphodius plagiatus</i>
Vegetated banks	<i>Notaris acridulus</i> , <i>Notaris bimaculatus</i> , <i>Chaetocnema obesa</i> , <i>Limnobaris t-album</i> , <i>Stilbus oblongus</i>
Terrestrial Habitats	
Moist soils	<i>Carabus granulatus</i> , <i>Badister unipustulatus</i>
Dry soils, open heathland, sandy soils, low humus content, thin vegetation	<i>Calosoma reticulatum</i> , <i>Notiophilus aquaticus</i> , <i>Trechus quadristriatus</i> , <i>Agonum ericeti</i> , <i>Amara bifrons</i> , <i>Metabletus foveatus</i>
Presence of Ranunculaceae (buttercups)	<i>Hydrothassa aucta</i> , <i>Hydrothassa marginella</i>
Presence of oak	<i>Rhynchites pubescens</i>
Presence of Cruciferae (mustard and cabbage family)	<i>Phyllotreta</i>
Presence of Umbelliferae (hollow stemmed aromatic plants)	<i>Phaedon tumidulus</i> , <i>Phytonomus adspersus</i> , <i>Liparus coronatus</i> , <i>Lixus iridis</i>
Presence of Compositae (aster, daisy and sunflowers)	<i>Olibrus aeneus</i> , <i>Chrysolina marginata</i>
Presence of thistles	<i>Haltica carduorum</i> , <i>Psylliodes chalcomera</i> , <i>Longitarsus apicalis</i> , <i>Ceuthorhynchus litura</i> , <i>Cleonus piger</i>
Presence of heathland vegetation e.g. <i>Erica</i> and <i>Calluna</i> (heathers) and <i>Armeria maritima</i> (sea thrift)	<i>Haltica britteni</i> , <i>Strophosomus nebulosus</i> , <i>Sibinia sodalist</i>
Presence of Plantaginaceae (plantains)	<i>Ceuthorhynchus troglodytes</i> , <i>Gymnetron plantaginis</i>
Presence of Polygonaceae (knotweeds or smartweeds)	<i>Gastrophysa viridula</i> , <i>Phytonomus rumicis</i>
Presence of large herbivores (dung scavengers and dung inhabitants)	<i>Geotrupes</i> , <i>Onthophagus gibbulus</i> , all <i>Aphodius</i> species (except <i>A. niger</i> and <i>A. plagiatus</i>), all <i>Heptaulacus</i> species, <i>Sphaeridium scarabaeoides</i> , <i>Sphaeridium lunatum</i> , <i>Cryptopleurum minutum</i> , <i>Megasternum obscurum</i> , <i>Cercyon pygmaeus</i> , <i>C. melanocephalus</i> , <i>C. quisquillus</i>

Table 9.2: Inferred environments at Isleworth based on the coleopteran assemblage (assembled from Coope and Angus, 1975)

The majority of species represent the presence of still water, with only three species, namely *Brychius elevatus*, *Plantambus maculatus* and *Orectochilus villosus*, occasionally being recorded from channels with flowing water (Coope and Angus, 1975).

The Isleworth coleopteran assemblage reflects a temperate climate with 91% of the species still inhabiting Britain today. It was proposed that the mean July temperature at Isleworth was approximately 18°C and mean January temperatures were around 0°C, indicating that prevailing conditions in Isleworth were slightly warmer in the summer and colder in the winter than in the present day. Precipitation was suggested to be sufficient to maintain the pools throughout the year (Coope and Angus, 1975).

Molluscs

Two samples were analysed for molluscs by Kerney *et al.* (1982). Sample A was recovered from the organic silty clays and Sample B was taken from the silt band in the overlying gravel (Figure 9.1). The palaeoenvironments represented by the molluscan assemblages were considered to be similar and are detailed in Table 9.3.

Inferred habitats	Indicative species
Both Samples	
Large, freely flowing river	<i>Valvata piscinalis</i> , <i>Bithynia tentaculata</i> , <i>Ancylus fluviatilis</i> , <i>Pisidium amnicum</i> , <i>Pisidium henslowanum</i>
Treeless, adjacent calcareous terrestrial habitats	<i>Pupilla muscorum</i>
Sample A	
Quiet deposition environment	higher proportion of <i>Pisidium milium</i> , lower percentage of <i>Ancylus</i> compared to Sample B
Sample B	
Poorly vegetated aquatic habitats	<i>Gyraulus crista</i>

Table 9.3: Inferred habitats from the molluscan assemblage recovered from Isleworth (adapted from Kerney *et al.*, 1982).

The assemblages are dominated by Palaearctic and Holarctic taxa, suggesting that the climate was not excessively cold, with mean July temperatures greater than 15°C. However, all species recorded can withstand modern Siberian winters, implying a considerable tolerance of extremely cold conditions. Sample B lacked the southern species *Anisus vortex*, *Anodonta anatina* and *Pisidium moitessieranum* found in Sample A, suggesting that a slight climatic deterioration had occurred between the deposition of the two samples (Kerney *et al.*, 1982).

Ostracods

A limited assemblage of ostracods was sampled from the organic silty clays. Table 9.4 details the inferred habitats from the sequence.

Inferred habitats	Indicative species
Flowing water and rich vegetation	<i>Prionocypris zenkeri</i> , <i>Cycloocypris serena</i> , <i>Cypridopsis vidua</i>
Possible spring in the area	<i>Cycloocypris serena</i>
Soft sediment	<i>Limnocythere inopinata</i> , <i>Candona neglecta</i>

Table 9.4: Inferred palaeoecological preferences of the ostracod assemblage from Isleworth (adapted from Kerney *et al.*, 1982).

The presence of associated ostracod valves suggests that water flow was not vigorous (Kerney *et al.*, 1982).

Trichopteran Larvae

Many of the proto-clypeal apotomes of the larvae of *Hydropsyche contubernalis* (Caddis fly) were found. This species inhabits very slowly flowing water (Wilkinson, 1980) and is currently found all over Europe and some areas in the Arctic Circle and southwest Asia (Kerney *et al.*, 1982).

Mammals

Sutcliffe and Kowalski (1976) recorded remains of *Microtus oeconomus* (northern vole) and *M. gregalis* (narrow-skulled vole). The record of *M. gregalis* was suggested at the time to be the earliest record of the species in Britain (Sutcliffe and Kowalski, 1976),

although this has since been supplanted by the recovery of this species from early Middle Pleistocene sites such as Boxgrove (Roberts and Parfitt, 1999).

The mammals recorded during this study from Willment's Pit, Isleworth are listed in Table 9.5.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Carnivora			
<i>Canis lupus</i> L. wolf	1	0.15	1
<i>Ursus arctos</i> L. brown bear	5	0.75	2
Proboscidea			
<i>Palaeoloxodon antiquus</i> (Falconer and Cautley) straight-tusked elephant	1	0.15	1
cf. <i>Mammuthus primigenius</i> , mammoth	1	0.15	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	2	0.30	1
<i>Coelodonta antiquitatis</i> (Blumenbach) woolly rhinoceros	1	0.15	1
Artiodactyla			
<i>Megaloceros giganteus</i> (Blumenbach) giant deer	2	0.30	1
cf. <i>Megaloceros giganteus</i> , giant deer	1	0.15	1
<i>Rangifer tarandus</i> (L.) reindeer	193	28.94	26
cf. <i>Rangifer tarandus</i> , reindeer	1	0.15	1
<i>Bison priscus</i> Bojanus, bison	44	6.60	13
cf. <i>Bison priscus</i> , bison	26	3.90	13
Bovidae sp. indet. Large bovid	389	58.32	31
Total	667		

Table 9.5: Mammal species recorded from Willment's Pit, Isleworth

The assemblage is dominated by indeterminate large bovid (*Bison* or *Bos*, probably *Bison*) (58.32%), reindeer (28.94%) (Figure 9.2) and confirmed remains of bison (6.60%) (Figure 9.3). Reindeer and bison are both grazers and inhabit grasslands at the present day, while reindeer are particularly characteristic of tundra habitats (Nowak, 1999). Brown bear, although versatile, often inhabits forests in order to browse and

hibernate (Stuart, 1982). *Canis lupus* is gregarious and can inhabit a wide variety of habitats and climates (Kurtén, 1968). This low-diversity faunal assemblage is characteristic of the Banwell Bone Cave MAZ (see Section 9.1.6) of MIS 5a (Currant and Jacobi, 2001; Gilmour *et al.*, 2007). However, the presence of (albeit) rare remains of taxa that are not known from this MAZ (woolly mammoth woolly rhinoceros, horse and giant deer), combined with obligate temperate climate taxa such as straight-tusked elephant, indicates that there may be a small amount of mixing of faunal material from deposits of other ages.

During the Pleistocene in Britain, reindeer appear only during the cold stages, suggesting the climate was cool, in contrast to the evidence from the beetles (see previously). The majority of the shed reindeer antlers at Isleworth are from males and suggest the herds were present at the site in the winter (Stuart, 1982). The bison assemblage contained examples of juvenile remains. Five fossils were identified as juvenile *Bison priscus* specimens in this study, in addition to several more juvenile fossils from Bovidae sp. specimens. There is also evidence of clear sexual dimorphism in the bison remains. The presence of males, females and juveniles would therefore suggest that the bison herds were present during spring, when the calves are born.



Figure 9.2: Reindeer antler from Isleworth (specimen from the Natural History Museum)



Figure 9.3: Bison cranium and horn cores from Isleworth (specimen from the Natural History Museum)

Specimens of *Ursus arctos* from Isleworth (and correlated sites such as Kew Bridge, see later) are substantially larger than brown bear remains from other sites of different ages, although they are morphologically the same (Figure 9.4) (Currant and Jacobi, 2001). The significance of this very large-bodied bear is discussed further under Section 9.2.



Figure 9.4: *Ursus arctos* ulnas from Early Devensian deposits at Kew Bridge and Isleworth and Middle Devensian deposits at Kent's Cavern (left-right), illustrating the large size of the bear at the former.

9.1.5 Age of deposits

Lithostratigraphy and absolute dating

The position of the organic deposits at Isleworth is comparable with those at Kew Bridge and possibly Twickenham (Figure 9.12). Since the area is mapped as Kempton Park Gravel (Gibbard, 1985; Bridgland, 1994; British Geological Survey, 1998), the deposits must have been laid down the terminal late Middle Pleistocene or more likely during the Late Pleistocene, i.e. between MIS 6 and MIS 4 (Bridgland, 1994). However, further refining of the likely age is difficult to obtain from the lithostratigraphy alone, since the fluvial record may encompass many erosional hiatuses and evidence for high-resolution climatic change may not be visible.

A radiocarbon date of 43140 +1520/-1280 years BP (Birm-319) (49618 – 44685 cal BP, 95.4%) was obtained from plant debris within the organic silty clays (Shotton and Williams, 1973; Kerney *et al.*, 1982), placing the Isleworth organic horizon within MIS 3.

Biostratigraphy

Pollen

The pollen sequence at Isleworth was deemed comparable with sites attributed to the Middle Devensian and, in particular, with sites attributed to the 'Upton Warren Interstadial', based on the grassland-dominated habitats and virtual absence of trees (Kerney *et al.*, 1982). This was a term used to identify floral assemblages thought to represent the thermal maximum of the Middle Devensian and based on the organic deposits at Upton Warren, Worcestershire, which were radiocarbon-dated to between 41900 ± 800 (GRO 1245) (46787-44201 cal BP, 95.4%) and 41500 ± 1200 BP (GRO 495) (48002 – 43252 cal BP, 95.4%) (Coope *et al.*, 1961; Jones and Keen, 1993). However, Amino Acid Racemization (AAR) has subsequently placed the site within MIS 5a of the Early Devensian (ratio 0.066 ± 0.007) (Bowen *et al.*, 1989), 84-66 ka yr (Tzedakis *et al.*, 2002) and in addition, the climatic complexities of the last cold stage indicate the presence of many different stadials or interstadials, rather than the single 'thermal maximum' previously envisaged.

Mammals

The revised (older) age for the Upton Warren organic deposits implied by the AAR analyses, and the consequent correlation of Isleworth with MIS 5a, is upheld by the evidence from mammalian biostratigraphy. The dominance of reindeer, bison and indeterminate bovid, in addition to wolf and bear strongly suggests a correlation with the Banwell Bone Cave Mammal Assemblage Zone (MAZ) of the Early Devensian, proposed by Curren and Jacobi (1997, 2001, 2002). This diagnostic assemblage is typical of a cold maritime climate and is clearly different from the much more diverse faunal assemblages associated with the Middle Devensian MIS 3 (Pin Hole MAZ) (see Battersea, Section 9.6). The Banwell Bone Cave MAZ was re-assigned to MIS 5a from Curren and Jacobi's original attribution of MIS 4, based on new flowstone dates from Stump Cross Cavern, North Yorkshire. The oldest part of the flowstone was dated to 79.2 ± 2.4 kyr suggesting that the overlying faunal material, which is characteristic of the Banwell Bone Cave MAZ, originates from within MIS 5 (Baker *et al.*, 1996). Curren and Jacobi (2001) recognised a typical temperate fauna from MIS 5c (assigned to the Bacon Hole MAZ), thereby requiring the Banwell Bone Cave MAZ to occupy a later part of the Early Devensian. An additional high-precision TIMS (thermal

ionisation mass spectrometric, uranium/thorium) determination of $73.86 \pm 1.20/-1.19$ kyr on flowstone encasing wolverine fossils at Stump Cross Cavern was also consistent with the reassignment of this MAZ to MIS 5a (Gilmour *et al.*, 2007), the third and final temperate sub-stage of MIS 5. Furthermore, a mammal fauna dominated by bison-reindeer (with a smaller frequencies of wolf and brown bear) from Cassington, in the Upper Thames, was correlated with MIS 5a (Maddy *et al.*, 1998). The molluscan assemblage from Cassington was also comparable with the Isleworth fauna (Maddy *et al.*, 1999).

There is evidently conflict between the original (Middle Devensian) radiocarbon dates and the early Devensian age suggested by the mammalian biostratigraphy. It is proposed that the radiocarbon dates should be regarded with caution, since they lie close to the accepted reliable limit of the technique. The Banwell Bone Cave MAZ was dated using TIMS, a newer technique with increased precision that resulted in the reassignment of the MAZ from MIS 4 to MIS 5a. Furthermore, radiocarbon dating has been recently improved by the adoption of new methods of ultrafiltering bone collagen prior to using the technique (e.g. Jacobi *et al.*, 2006). Re-dating using the more rigorous methodology has demonstrated that previous radiocarbon dates are frequently consistently 'too young' in comparison to the new results. This may indicate many older radiocarbon dates are unreliable and that new dates for Isleworth might ultimately prove to be older. However, without additional dating of the site this cannot be confidently established.

The extremely low frequencies of mammoth, horse, woolly rhinoceros, giant deer and straight-tusked elephant strongly imply that these rare specimens may be mixed and/or reworked into a classic Early Devensian reindeer-bison assemblage. The specimens displaying low abrasion levels (Table 9.6) – and therefore more credibly contemporaneous – contain exclusively the characteristic components of the Banwell Bone Cave MAZ proposed by Carrant and Jacobi (1997, 2001, 2002), again suggesting the other non-Banwell Bone Cave taxa are more likely to be either reworked from older sediments or cover more recent time periods that cannot be separated in the fluvial record.

Level of abrasion						
Species	Heavy		Moderate		Slight	
	No. of specimens	%*	No. of specimens	%*	No. of specimens	%*
<i>Rangifer tarandus</i>	56	28.87	132	68.04	6	3.09
<i>Mammuthus primigenius</i>	1	100.00	0	0.00	0	0.00
<i>Coelodonta antiquitatis</i>	0	0.00	1	0.52	0	0.00
<i>Ursus arctos</i>	3	60.00	0	0.00	2	40.00
<i>Palaeoloxodon antiquus</i>	0	0.00	1	0.52	0	0.00
Bovidae	64	16.41	291	150.00	35	8.97
<i>Equus ferus</i>	0	0.00	2	1.03	0	0.00
<i>Bison priscus</i>	0	0.00	44	22.68	0	0.00
<i>Canis lupus</i>	0	0.00	0	0.00	1	100.00

Table 9.6: Abrasion levels displayed by the specimens from Isleworth

9.1.6 Archaeology from Isleworth

Two undiagnostic flakes in the Natural History Museum were recorded as collected in 1958, one definitely from the same excavation as the mammalian fauna from Willment's Pit. The other was found during excavations for the Mogden Sewage Works, a short distance to the north of where Willment's Pit was formerly located. Both flakes were found in sandy gravel, with the Willment's Pit artefact described from '2 feet below Prof Z or S's 'Land Surface'' and the Mogden flake from 'about 10 feet above London Clay'. It is not clear where the 'Land Surface' is located in the stratigraphy but 10 feet (3.05m) approximately correlates with the stratified, current-bedded sands and gravels (horizon 5 in Figure 9.1). As the Mogden flake was provenanced to a similar sandy gravel, it can be suggested that both flakes are younger than the Isleworth fauna, but older than the 'brickearth' that caps the stratigraphy. At nearby Heathrow, a 'brickearth' in a comparable stratigraphical position is correlated with the Late Devensian Langley Silt Complex that is thought to have been deposited during MIS 2 and 1 (Rose *et al.*, 2000). If the 'brickearth' capping the sequence at Isleworth is contemporaneous with the Heathrow deposit, a minimum age of MIS 2 can be applied to the archaeology found at Isleworth (Gibbard *et al.*, 1987; Rose *et al.*, 2000). The most likely age for the archaeology is therefore MIS 3, particularly

considering this is when humans are suggested to have re-entered Britain following an absence since MIS 6 (Currant and Jacobi, 1997, 2001, 2002; White and Jacobi, 2002; Jacobi *et al.* 1998).

The Mogden Sewage Works flake was recorded as slightly abraded and the Willment's Pit flake as moderately abraded, suggesting the Mogden flake, in particular, was found not far from where it was originally dropped.

Ten additional artefacts from Isleworth have been recorded in museum collections, unfortunately all lacking stratigraphical provenance:

1. Modified flake from the Thames (Museum of London, 49.107/51, found January 1894).
2. Flake from Springfield Grove (British Museum, Sturge Collection, found 18/11/1883).
3. Flake from Isleworth, no further location details (British Museum, Sturge Collection)
4. Pointed handaxe from the Thames (British Museum, Trechmann Collection)
5. *Bout coupé* from the Thames at Isleworth (Manchester Museum, 34075 R. D. Darbishire Collection). See Section 9.8 on the significance of *bout coupés* for additional information.
6. Flake from Isleworth Railway Cutting (Wardown Park Museum, Luton, W. G. Smith Collection, found April 1882)
7. Core from Isleworth Railway Cutting (Wardown Park Museum, Luton, W. G. Smith Collection, found March 1882)
8. Broken handaxe from Isleworth, no further location details (Wardown Park Museum, Luton, W. G. Smith Collection, found 25/5/1882)
9. Flake from Isleworth, no further location details (Wardown Park Museum, Luton, W. G. Smith Collection, found July 1882)
10. Large worked nodule found in gravel and 'brickearth' discarded from building the railway south of Osterley Park, near Isleworth (British Museum, W. G. Smith Collection, found December 1881). This item was figured in Smith (1894) and Brown (1887) (Figure 9.5).

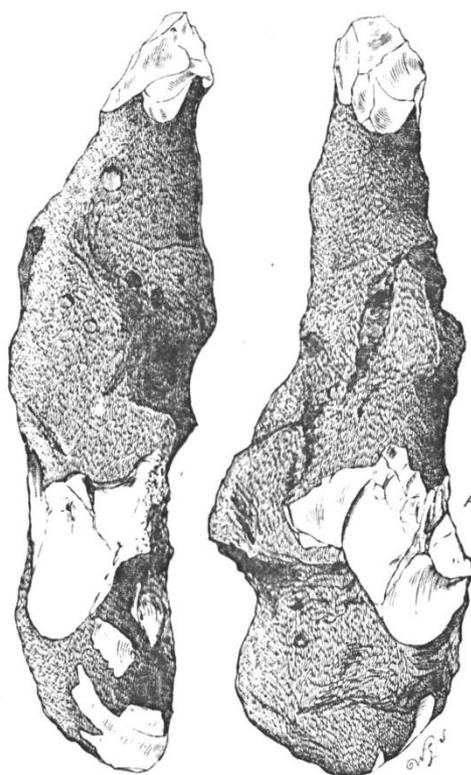


Figure 9.5: Large worked nodule from Isleworth (From Smith, 1894)

9.2 Kew Bridge

9.2.1 Site location and History of Research

Morris (1838) first recorded mammalian fossils from near Kew Bridge during works for the new water reservoir, reporting finds such as ‘elephant, ox, and deer’ (p. 540). In later observations on the railway excavation approximately 90m north of Kew Bridge, Morris (1850) reported more faunal remains including mammoth, bison, aurochs, red deer, reindeer, woolly rhinoceros, hippopotamus and lion. However the exact stratigraphical provenance of all faunal remains recovered in this excavation was not recorded and much, if not all, of this assemblage is no longer traceable. It is possible that some of these fossils may have later become part of the collection from nearby Turnham Green collection (Section 8.2), particularly considering the thermophilous aspect of key elements such as hippopotamus. Gibbard (1985) re-investigated the lithostratigraphy in the area through a series of boreholes and attributed the deposits to the Kempton Park Gravel, subsequently supported by British Geological Survey mapping (1998). Currant and Jacobi (1997, 2001) and Gilmour *et al.* (2007) assessed

the faunal remains from Kew Bridge and correlated the assemblage with their Banwell Bone Cave MAZ, attributed to MIS 5a.

9.2.2 Location of Collections

The faunal remains were observed in the Natural History Museum, London, presented by Thomas Layton in 1849, and in the British Geological Survey Museum, Keyworth, Nottingham.

Lithics were observed in the British Museum, Gunnersbury Park Museum, and the Museum of Archaeology and Anthropology, University of Cambridge.

9.2.3 Stratigraphy

Morris (1850) recorded London clay overlain by sands and gravels, fine sand, brickearth and finally, by modern soil. Within the sands and gravels, three horizons containing faunal remains were identified (Figure 9.6).

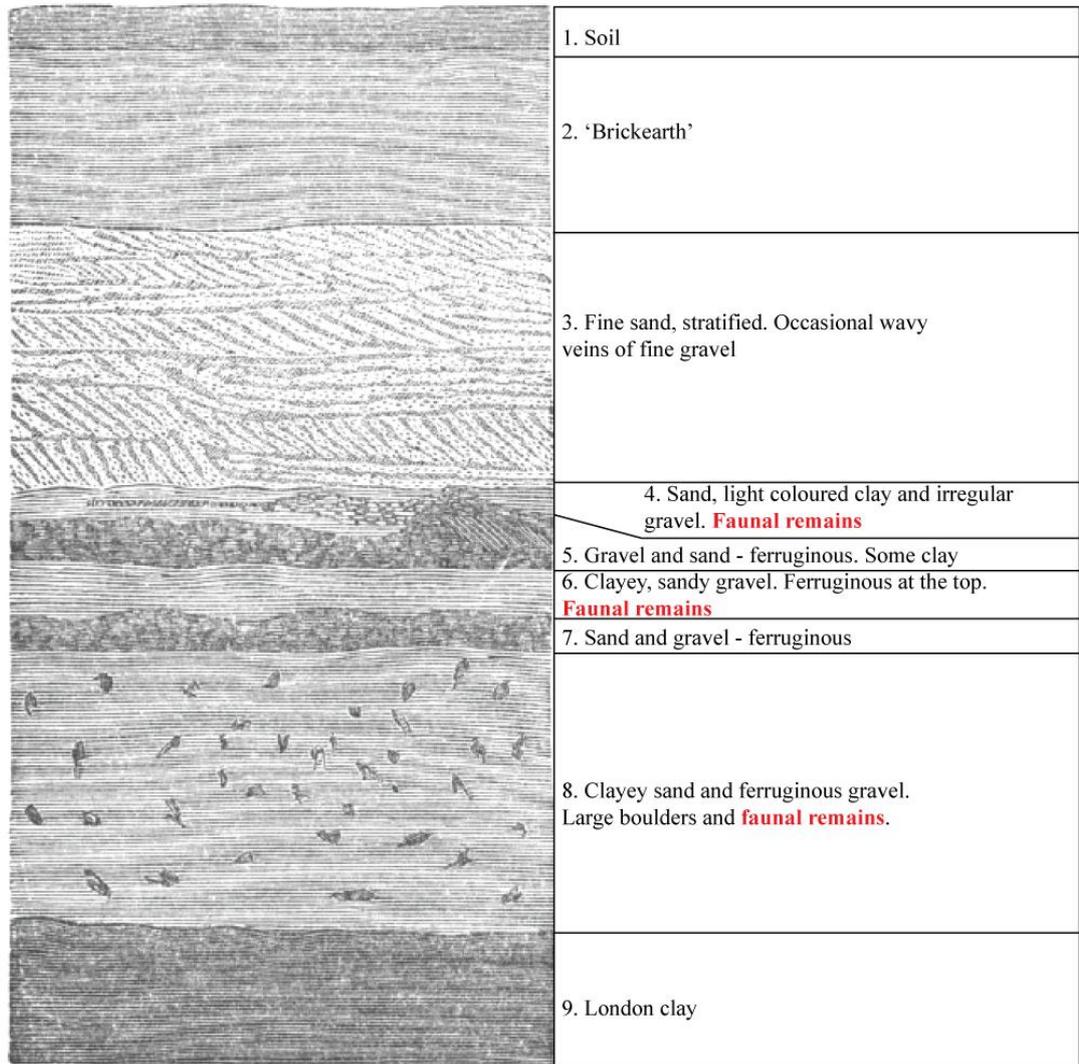


Figure 9.6: Stratigraphy recorded from 90m north of Kew Bridge during railway excavations. Adapted from Morris (1850). The presence of faunal remains is indicated in red type.

The deposits overlying the London Clay appear to have been laid down in a fluvial environment with varying channel flow. Horizons containing gravel and, in particular, the larger boulders represent higher energy flow or possibly flood events, whilst clay and sand deposits reflect slower flow or still water usually at the margins of a channel or in abandoned channels.

9.2.4 Palaeontology and Palaeoenvironmental reconstruction

The species recorded from the Kew Bridge assemblage are detailed in Table 9.7.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Carnivora			
<i>Ursus arctos</i> L. brown bear	1	4.17	1
Artiodactyla			
<i>Rangifer tarandus</i> (L.) reindeer	9	37.50	2
cf. <i>Cervus elaphus</i> L. red deer	1	4.17	1
Bovidae sp. indet. large bovid	14	58.33	2
Total	24		

Table 9.7: Species recorded from Kew Bridge (from fossils available in the Natural History Museum and the British Geological Museum, Keyworth, Nottingham)

The most abundant taxa found at Kew Bridge are indeterminate bovid (*Bos* or *Bison*) (58.33%) and reindeer (37.5%). These species are grazers and suggest that grasslands were dominant, whereas the presence of reindeer indicates a cool climate with steppe tundra habitats. Brown bear is known to inhabit forested areas in the Palaearctic regions in order to browse and hibernate, suggesting there may have been some areas of forest present in the area (Stuart, 1982).

As with the bear specimens from Isleworth, the Kew Bridge specimen (a left ulna) of *Ursus arctos* is larger than bear specimens from other time periods (see Section 9.1.4). Due to its exceptionally large size, the specimen from Kew Bridge shown in Figure 9.4 was originally attributed to *Ursus maritimus* (polar bear), despite it being even larger than modern polar bear specimens (Kurtén, 1964). The specimen was later re-identified as a very large form of *Ursus arctos* (Currant and Jacobi (2001). Kurtén (1968) recognised that *Ursus arctos* varied greatly in size depending on the climate in Europe and attributed it to Bergmann's rule, which states that body size is more likely to increase in size in cold climates in order to reduce the ratio between the surface area and volume of the body, so that the area from which heat is given off becomes smaller.

9.2.5 Age of deposits

Lithostratigraphy

As the area is mapped as Kempton Park Gravel (British Geological Survey, 1998), the deposits must date to between MIS 6 and MIS 4 (Bridgland, 1994). The position of the organic deposits at Kew Bridge is comparable with those from Isleworth and possibly Twickenham (Figure 9.12).

Biostratigraphy

From the railway excavations 90m north of Kew Bridge, Morris (1850) recorded a mixed assemblage of cold and warm-adapted mammals: *Mammuthus primigenius*, *Bison priscus*, *Bos primigenius*, *Cervus elaphus*, *Rangifer tarandus*, *Coelodonta antiquitatis*, *Hippopotamus amphibius* and *Panthera leo*, although there is unfortunately no provenance data to specific horizons. However, the hippopotamus and lion remains described by Morris (1850) were not seen in the Kew Bridge collection held at the Natural History Museum and these identifications therefore cannot be confirmed. Although lion is equally recorded from both cold-climate and temperate episodes in the Pleistocene, hippopotamus is an obligate thermophile and the appearance of the modern African species in Britain is restricted to the Last Interglacial (see Chapter 8). If these identifications were correct, the provenance may be doubtful, since it is not clear whether Morris found all these species within the same excavation or horizon in the area and Kew Bridge is adjacent to Brentford and Turnham Green where Ipswichian assemblages have been found.

As discussed in Chapter 8, *Hippopotamus amphibius* is an indicator species for MIS 5e in Britain (Stuart, 1982; Carrant, 1989; Sutcliffe, 1995) and its presence amid fauna characteristic of the Early Devensian, such as bison and reindeer (Carrant and Jacobi, 1997, 2001), suggest the fossils originated from different horizons at the site. If the hippopotamus specimens and the other fully temperate species recorded by Morris were definitely found at the Kew Bridge site, it is most likely that they were from the lowest fossiliferous horizon (bed 8 in Figure 9.6). This is based on the similarity of the stratigraphy to that recorded from Brown's Orchard, Acton and Turnham Green Road (Lane Fox, 1872), where an Ipswichian fauna was found in sand and gravel deposits directly overlying London Clay.

The cold-adapted species from Morris's assemblage and those recorded during this research most likely originate from one of the younger, upper fossiliferous deposits (beds 6 or 4 in Figure 9.6). All of the fossils in the Kew Bridge assemblage exhibit brown and/or orange staining, suggesting they were found in bed 6, the deposit that was described by Morris (1850) as ferruginous. In contrast, bed 4 was described as sand and light-coloured clay.

A borehole from Kew Bridge Station revealed two silt bands in the Kempton Park Gravel. Pollen spectra from the silts bands were similar to those from the Ismaili Centre (ICb p.a.z.), South Kensington, Isleworth and Twickenham, in that high percentages of grasses and sedges and a diverse herb assemblage were recorded (Gibbard, 1985). Unfortunately it is impossible to correlate the silt band containing pollen with the fossiliferous horizons in the Morris (1850) stratigraphy and the inherent complexity in the palaeoclimate record for this period means that multiple short-lived periods may have produced similar pollen records.

Based on the dominance of reindeer and the co-occurrence of very large brown bear, the assemblage from Kew Bridge was assigned to the Banwell Bone Cave MAZ and consequently attributed to MIS 5a (Currant and Jacobi, 1997, 2001, 2002; Gilmour *et al.*, 2007). The single red deer specimen is clearly not from the same horizon as the rest of the assemblage, as firstly, it is not from the railway cutting excavation and second, it is stained grey and brown instead of the orange and brown staining characteristic of the rest of the assemblage.

The position of the Kew Bridge sediments suggests a correlation with the organic deposits at Isleworth and possibly Twickenham (Figure 9.12).

9.2.6 Archaeology

Five artefacts have been located during this study from Kew and Kew Bridge (two handaxes and three flakes). All artefacts exhibit moderate to heavy abrasion levels, suggesting they have experienced significant transport from their source. This is especially true for four of the artefacts that were recovered from the River Thames. It is clear that none of the artefacts were discovered *in situ*, which adds further support to the

notion that humans were absent during the period that the mammals found at Kew Bridge inhabited the site.

A handaxe from Style Hall, Kew was recorded in Brown (1887), Wymer (1968) and Wessex Archaeology (1996); however this was not located during this research.

9.3 Twickenham

9.3.1 Site location and History of Research

The first fossil recorded from Twickenham was of *Saiga tatarica* (saiga antelope) by J. R. Leeson in Orleans Road (TQ 170735). Unfortunately no associated faunal assemblage was discovered (Woodward, 1890). This continued to be the only record of *Saiga tatarica* in Britain until the 1980s (Currant, 1987). Leeson and Laffan (1894) subsequently recorded a faunal assemblage found during excavations for a sewage culvert near Strawberry Hill station and the Thames in 1892 (approximately TQ160727). Other specimen labels list Twickenham Open (now Twickenham Green), collected in 1972 (TQ 154279), and a small number of fossils were dredged from the River Thames.

Leeson and Laffan (1894) recorded the stratigraphy at the sewage culvert site and the faunal and plant remains found. Gibbard (1985) recovered and analysed pollen from two *Bison* sp. specimens in the Geological Museum (GS5034 and GS5079, the latter now held in the British Geological Survey Museum, Nottingham) and considered the results to be comparable to the Isleworth and Kew Bridge sequences. The sewage culvert location described by Leeson and Laffan (1894) is currently mapped as Kempton Park Gravel with the overlying Langley Silt Complex to the north. Orleans Road is within the area containing Langley Silt Complex (British Geological Survey, 1998) and was attributed to Gibbard's Kempton Park Gravel (Gibbard, 1985).

9.3.2 Location of Collections

Faunal specimens were analysed at the British Geological Survey Museum, Keyworth, Nottingham, and the Natural History Museum, London.

Lithics were seen in the Museum of London collection

9.3.3 Stratigraphy

Leeson and Laffan (1894) recorded the following stratigraphy in Twickenham:

3. In some areas a 'dark loam' (3.4-5.5m from surface, 0.7-0.8m thick) was recorded (see Figure 9.7).
2. 'Reddish yellow gravels' (3.6- 5.8m from surface)
1. London Clay (≤ 1.5 m thick)

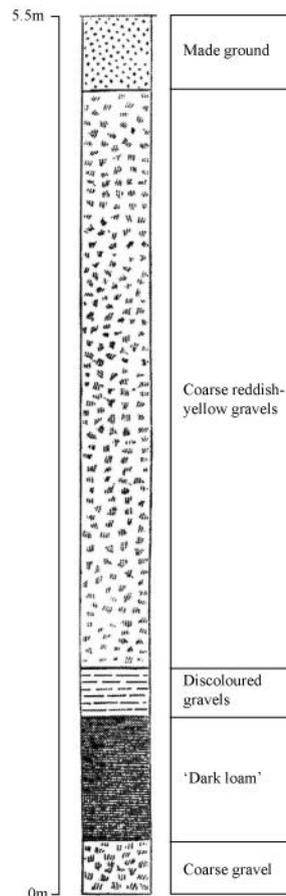


Figure 9.7: Example of the stratigraphy recorded from boreholes taken in Twickenham. Adapted from Leeson and Laffan (1894)

The 'dark loam' varied from silt-dominated to sand-dominated. Above the 'dark loam', a thin dark blue or greyish sand and gravel horizon was occasionally recorded, which was described as resembling material frequently dredged from the Thames. The sand and gravel horizon graded into the red and yellow gravels above it. All faunal and floral remains, including molluscs, plant macrofossils and mammal remains, were recovered

from the ‘dark loam’ and the thin layer of blue/grey gravel. The overlying gravels contained ‘generally no organic remains’ (Leeson and Laffan, 1894, p. 454).

9.3.4 Palaeontology and Palaeobotany

Palynology

Pollen sampled from adhered sediment on two *Bison* sp. specimens was considered comparable to the Isleworth, Kew Bridge and the Ismaili Centre (ICb) sequences, with no trees represented but dominated by grasses and sedges and a diverse herb population (Gibbard, 1985).

Plant Macrofossils

Stellaria media (chickweed), *Montia fontana* (blinks or water chickweed), *Heracleum sphondylium* (hogweed), *Galeopsis tetrahit* (common hemp-nettle), *Atriplex* sp. (saltbush and orach genus), *Persicaria maculosa* (redshank), *Rumex crispus* (curled dock), *Potamogeton alpinus* (red pondweed), *Zannichellia palustris* (horned pondweed), *Eleocharis palustris* (common spike-rush), *Scirpus lacustris* (bulrush), *Carex panicea* (carnation sedge) and *Phragmites* sp. (common reed) were all recorded from the ‘dark loam’. The species indicated the presence of dry ground as well as marshy areas with small pools or channels (C. Reid, in Leeson and Laffan, 1894).

Molluscs

The species and their preferred habitats, recorded by C. Reid in Leeson and Laffan (1894), are detailed in Table 9.8.

Inferred habitats	Species
Freely flowing water	<i>Ancylus fluviatilis</i> , <i>Bithynia tentaculata</i> , <i>Valvata piscinalis</i> , <i>Pisidium amnicum</i>
Slow moving water	<i>Radix balthica</i> , <i>Sphaerium corneum</i>
Aquatic habitat rich in vegetation and muddy substrate	<i>Gyraulus albus</i> , <i>Sphaerium corneum</i>

Table 9.8: Mollusc species and their preferred habitats recorded from Twickenham (Leeson and Laffan, 1894).

The molluscs recorded indicated the presence of a freely flowing river with a muddy and silty bed. Habitats containing still or slowly flowing water and denser vegetation were also present, possibly near the banks of the channel or in shallow pools.

Mammals

The species noted by Woodward in Leeson and Laffan (1894) included *Bos primigenius* (aurochs), *Rangifer tarandus* (reindeer), *Bison priscus* (bison), *Sus scrofa* (wild boar), *Cervus elaphus* (red deer), *Canis lupus* (wolf) and *Capreolus capreolus* (European roe deer). The authors mentioned that these species were all recorded 0.75 miles to the east of the site where the *Saiga tatarica* specimen was found. The last four species were not observed in the Twickenham assemblage during this research. The femur and humerus bones of *Bos primigenius* analysed by Dr. Günther (in Leeson and Laffan, 1894) were frequently broken, leading him to suggest that humans had extracted the bone marrow. Unfortunately no *Bos* humeri and femora were located in the current study.

The species recorded during the current research from Twickenham are listed in Table 9.9.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Perissodactyla			
Rhinocerotidae sp. indet rhinoceros	1	4.00	1
Artiodactyla			
<i>Rangifer tarandus</i> (L.) reindeer	9	36.00	2
cf. <i>Rangifer tarandus</i> (L.) reindeer	1	4.00	1
<i>Megaloceros giganteus</i> (Blumenbach) giant deer	1	4.00	1
<i>Bos primigenius</i> Bojanus, aurochs	3	12.00	3
<i>Bison priscus</i> Bojanus, bison	1	4.00	1
Bovidae sp. indet. large bovid	8	32.00	2
<i>Saiga tatarica</i> , (L.), saiga antelope	1	4.00	1
Total	25		

Table 9.9: Species recorded from Twickenham

The dominant species recorded in Twickenham are reindeer (36%), indeterminate bovid (*Bos* or *Bison*) (32%) and aurochs (12%). The issues surrounding the presence of *Bos* fossils in the Twickenham assemblage are discussed in Section 9.3.6 (biostratigraphy). Reindeer and bison are both grazers, indicating the presence of open environments. Reindeer are restricted to cold stages within the British Pleistocene, favouring a ‘steppe tundra’ environment and suggesting that the climate was colder than today. Saiga antelope inhabited the steppes and semi-desert regions of south-eastern Europe and Central Asia from the Precaspian steppes to Mongolia and western China, until recently, although it is only presently recorded on the plains of Kazakhstan and Russia in restricted pockets (Figure 9.8); again it indicates the dominance of grasslands at Twickenham (Kurtén, 1968; Stuart, 1982). The species has a large muzzle, and each nostril contains a sac lined with mucous membranes that allows it to adapt to arid environments. It is an unusual feature found in no other mammal except whales (Nowak, 1999). This species is extremely rare in British Pleistocene assemblages, but was present in northern Europe during the Late Pleistocene and was forced eastwards following the Devensian into its present range (Kurtén, 1968). Giant deer is a more

unusual component of a cold-climate assemblage; its presence further supports the dominance of grassland environments.

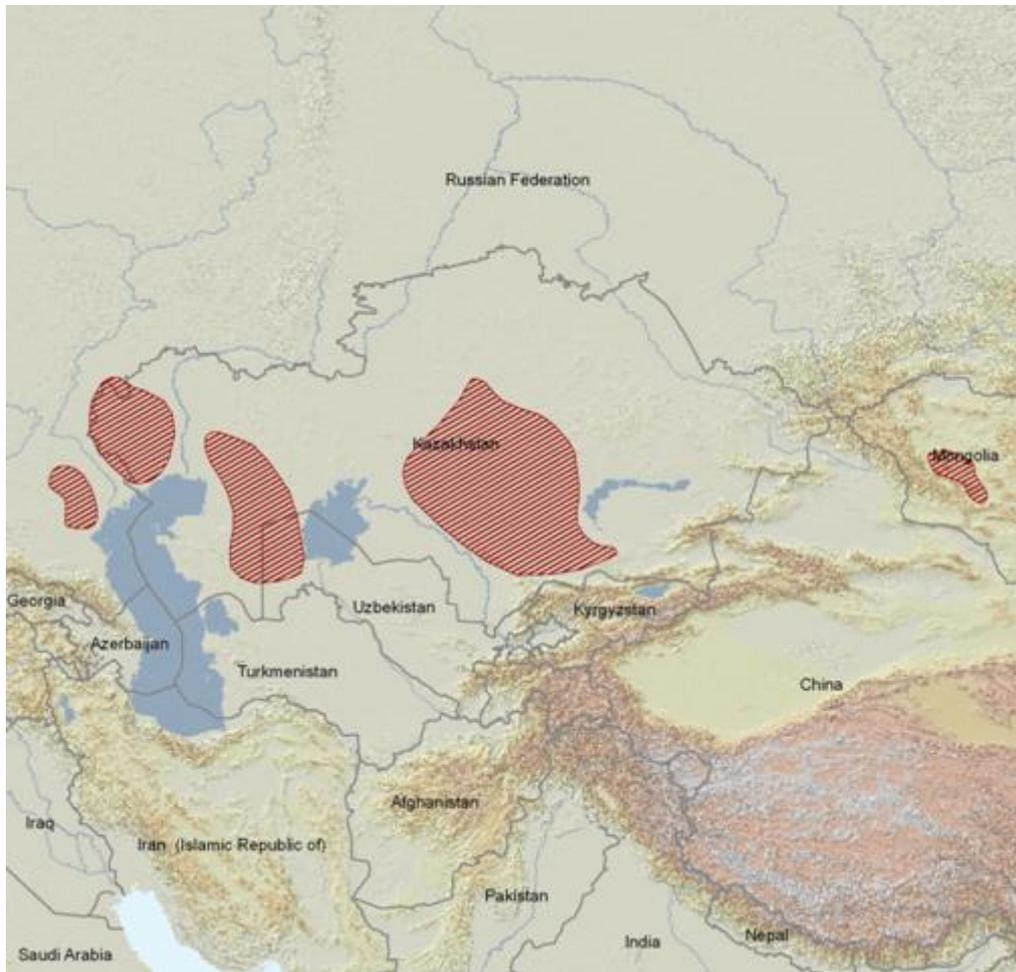


Figure 9.8: Current distribution of *Saiga tatarica* (Adapted from the IUCN Red List of Threatened Species, 2010)

9.3.5 Age of deposits

Lithostratigraphy

The position in the terrace of the organic deposits at Twickenham is broadly comparable with those at Isleworth and Kew Bridge (Figure 9.12). Although the Twickenham organic deposits occupy a lower position in comparison to those at Isleworth and Kew Bridge, the site is closer to the Thames, suggesting that the gravels are lower down due to the natural slope of a terrace. The three sites are all assigned to the Kempton Park Gravels and therefore, according to Bridgland (1994) must represent a period within MIS 6-4.

Biostratigraphy

Molluscs

Similarities were noted between the molluscan assemblage from the ‘dark loam’ and that from Isleworth (Kerney *et al.*, 1982)

Mammals

A major difficulty in the interpretation of this assemblage is that stratigraphical provenance to bed is rarely recorded. Leeson and Laffan (1894) described all mammal bones found during the sewage works excavation as being found in the ‘dark loam’ and the bluish grey gravels immediately overlying the loam. For example, both *Bos* and *Bison* fossils were found ‘lying on top of what proved to be our ‘dark loam’ layer’ (Lesson and Laffan, 1894, p. 456). However, the authors mention that the co-occurrence of *Bos* and *Bison* may not be contemporaneous as the bones were found by workmen, and the authors could not substantiate the position of their discovery.

Only two reindeer specimens within the extant Twickenham assemblage can be directly provenanced to the dark loam or the overlying bluish grey gravels (both specimens M12353, Natural History Museum). Both of these specimens are moderately abraded. Otherwise the specimens are described from ‘Thames gravels’ (*Bos*, indeterminate large bovid and reindeer) and sand (saiga antelope, indeterminate rhinoceros and giant deer). Two specimens were provenanced to the Thames (*Bos* and indeterminate large bovid), although it is not clear how they were collected from the river. It is not possible to differentiate the origin of each specimen from their staining or abrasion as all specimens displayed brown and orange-brown staining and moderate to heavy abrasion. The high abrasion level of all Twickenham specimens adds further evidence to the reworked and mixed nature of the assemblage.

It is clear from the dominance of reindeer in the assemblage that cold-climate tundra environments prevailed in the area at the time of deposition. However, the presence of aurochs is inconsistent with a cold-climate episode (Stuart, 1982), thereby suggesting that its co-occurrence with reindeer may be incorrect. The Twickenham faunal assemblage was assigned to the Banwell Bone Cave MAZ and correlated with MIS 5a by (Currant and Jacobi, 1997, 2001, 2002; Gilmour *et al.*, 2007) based on the

dominance of reindeer and the presence of bison. However other species found at Twickenham such as indeterminate rhinoceros, giant deer and aurochs are not known from the Banwell Bone Cave MAZ, again implying that the Twickenham assemblage is mixed. The predominance of reindeer at Twickenham, as verified in this study, does indeed support an Early Devensian age. However it is also clear that some components of the assemblage are reworked and represent separate time periods.

Saiga antelope is more commonly associated with the Gough's Cave MAZ, representative of the Lateglacial interstadial (c. 14,700 to 12,900 cal years BP (Jacobi and Higham, 2009)). As well as Gough's Cave (Carrant, 1986), the species has been recorded from Sun Hole (Colcutt *et al.*, 1981), Soldier's Hole and Wolf Den, all in the Mendip Hills of Somerset (Carrant, 1987), and all specimens are attributable to the Lateglacial (Carrant, 1987). A date of 12,380 \pm 160 yrs (OxA 463) (15086-13946 cal BP) was obtained from a saiga calcaneum from Gough's Cave (Carrant, 1987). Other dates more recently obtained on horse bones from Gough's Cave range from c. 15,000 and 14,100 cal BP, representing the end of Greenland Stadial 2 and throughout the Greenland Interstadial 1e (Bølling) (Jacobi and Higham, 2009). These dates are comparable to that on the saiga remains, suggesting that they were contemporaneous.

It was suggested by Carrant (1987) that the low sea levels during the Devensian would have facilitated the migration of saiga antelope into Britain prior to the Lateglacial interstadial (Verpoorte, 2003). On the continent, saiga has a longer chronological range, stretching back beyond the Lateglacial into the Late Pleistocene. The earliest records in Western and Central Europe are consistently from around the Last Glacial Maximum (20-18 ka BP). Remains of saiga were recorded in layer 6a of Kůlna Cave in the Czech Republic, dated to 21ka BP (Kahlke, 1992), but the layer also contains archaeology of an earlier period, suggesting the layer may be mixed. The first record of saiga in France dates to 18.5 ka BP in Laugerie-Haute Est (Delpech, 1989; Crégut-Bonnoure, 1991). These examples of saiga in northern Europe suggests it is possible that saiga entered Britain prior to the Lateglacial; however, there are no other saiga fossils dated to MIS 5a elsewhere in Europe, thereby making the Twickenham specimen an unusual record. The record from Twickenham may therefore suggest the presence of sediments of mixed age, including from the Lateglacial.

9.3.6 Archaeology from Twickenham

Only two handaxes and a single flake have been recorded from Twickenham (and neighbouring Teddington). Two were recovered from the River Thames and the other is unprovenanced, thereby clearly indicating that the archaeology is not associated with the faunal assemblage. The lack of *in situ* artefacts from Twickenham supports the suggestion that the deposits may be of Early Devensian age, a period when humans are thought to have been absent from Britain (Ashton and Lewis, 2002; Carrant and Jacobi, 1997, 2001, 2002; White and Jacobi, 2002; Jacobi *et al.*, 1998).

9.4 Feltham

9.4.1 Site location and history of research

The faunal remains from Feltham were recovered from Hall and Co.'s gravel pit in Clockhouse Lane (TQ 078729) during 1955-59 and Greenham's gravel pit in Chertsey Road (TQ 094716), presumably around the same time that a small number of fossils were collected (J. W. Simons Collection held in the Natural History Museum) presented in 1959 according to specimen labels). Pollen analyses were performed on silty sediments excavated in 1983 from Lower Feltham (TQ 107714) (Coope *et al.*, 1997). The Feltham faunal remains have never been previously published.

Coope *et al.* (1997) and the British Geological Survey (2007) recognised the gravels at the pollen site in Lower Feltham as Kempton Park Gravels.

9.4.2 Location of Collections

The faunal remains were observed in the Natural History Museum, Gunnersbury Park Museum and Horniman Museum, London.

9.4.3 Stratigraphy

The stratigraphies seen at the two Feltham faunal sites have not been recorded although the pollen from Lower Feltham was described as being collected from organic silts interbedded with sands (1.65m) that were found within 3m of gravel and sands (Kempton Park Gravels) (Coope *et al.*, 1997).

9.4.4 Palaeontology and Palaeobotany

Palynology

The pollen recorded by Coope *et al.* (1997) from the Lower Feltham site indicated a treeless, herb-dominated landscape with grasses and sedges and areas of damp ground. Marshland and aquatic habitats were also represented, in addition to *Plantago maritima* (sea plantain), Plumbaginaceae (leadwort family) and *Armeria* (thrift) that may suggest saline soils caused by continental and dry conditions.

Mammals

The specimens analysed during this study from Feltham are listed in Tables 9.10 and 9.11. The assemblages from the Hall and Co. Pit and Greenham's Pit have been analysed separately (see Biostratigraphy discussion for more information).

Species	No. of specimens	% of total assemblage	M.N.I
Carnivora			
<i>Ursus arctos</i> L. brown bear	3	1.65	3
Proboscidea			
<i>Palaeoloxodon antiquus</i> (Falconer and Cautley) straight-tusked elephant	3	1.65	1
cf. <i>Palaeoloxodon antiquus</i> (Falconer and Cautley) straight-tusked elephant	1	0.55	1
<i>Mammuthus primigenius</i> , mammoth	8	4.40	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	25	13.74	2
<i>Coelodonta antiquitatis</i> (Blumenbach) woolly rhinoceros	4	2.20	1
Artiodactyla			
cf. <i>Megaloceros giganteus</i> , giant deer	1	0.55	1
<i>Cervus elaphus</i> L. red deer	4	2.20	2
<i>Rangifer tarandus</i> (L.) reindeer	38	20.88	7
<i>Bison prisceus</i> Bojanus, bison	4	2.20	2
cf. <i>Bison prisceus</i> , bison	1	0.55	1
Bovidae sp. indet. large bovid	90	49.45	10
Total	182		

Table 9.10: Species from Hall and Co. Pit, Feltham

Species	No. of specimens	% of assemblage	M.N.I
Proboscidea			
<i>Mammuthus primigenius</i> , mammoth	5	20.83	1
Proboscidea indet.	1	4.17	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	4	16.67	1
<i>Coelodonta antiquitatis</i> (Blumenbach) woolly rhinoceros	9	37.50	2
Artiodactyla			
<i>Megaloceros giganteus</i> (Blumenbach) giant deer	1	4.17	1
Bovidae sp. indet. large bovid	4	16.67	1
Total	24		

Table 9.11: Species from Greenham's Pit, Feltham

The dominant taxa recorded from Feltham are indeterminate large bovid (*Bison* or *Bos* sp.), reindeer, horse, mammoth and woolly rhinoceros. These animals are predominantly grazers that inhabited open grasslands (Stuart, 1982). However, the assemblage is a composite from several locations and may well cover several time periods. Due to the specimens lacking any stratigraphical provenance, it has proved impossible to attribute species clearly to the individual deposits recorded in Feltham (see Biostratigraphy for more information).

9.4.5 Age of deposits

Lithostratigraphy

As the Feltham area is attributed to the Kempton Park Gravel (British Geological Survey, 2007; Coope *et al.*, 1997), the deposits must date between MIS 6 and MIS 4 (Bridgland, 1994). There has been no direct dating on the deposits or their contents.

Biostratigraphy

The specimens exhibit a range of abrasion levels, with only a very small proportion displaying low levels of abrasion, clearly highlighting the fact that very little (if any) of the assemblage is *in situ* (Table 9.12). The heavy abrasion and low frequency of *P. antiquus* and *C. elaphus* fossils (both from Hall and Co. Pit) suggest that they may have been reworked from older temperate-stage deposits, perhaps those laid down either in the Last Interglacial (MIS 5e) or a temperate sub-stage of the Early Devensian (MIS 5c) (respectively the Joint Mitnor Cave or Bacon Hole MAZs) (Carrant and Jacobi, 1997, 2001, 2002; Gilmour *et al.*, 2007). This is further upheld by the observation that the final appearance of *P. antiquus* in Britain is thought to be soon after the Ipswichian (Stuart, 1991, 1999, 2005) and more specifically in MIS 5c, the Bacon Hole MAZ (Carrant and Jacobi, 1997, 2001, 2002; Gilmour *et al.*, 2007). A small number of horse, bison and indeterminate large bovid specimens exhibited only minor abrasion, perhaps indicating that they have undergone less transportation since their deposition and may thus represent a slightly younger component of the assemblage. Otherwise all other fossils exhibited heavy and moderate abrasion.

Species	Level of abrasion					
	Heavy		Moderate		Slight	
	No. of specimens	%*	No. of specimens	%*	No. of specimens	%*
<i>Rangifer tarandus</i>	29	74.36	10	25.64	0	0
<i>Mammuthus primigenius</i>	10	71.43	4	28.57	0	0
<i>Coelodonta antiquitatis</i>	8	61.54	5	38.46	0	0
<i>Ursus arctos</i>	1	33.33	2	66.67	0	0
<i>Palaeoloxodon antiquus</i>	3	100.00	0	0.00	0	0
<i>Cervus elaphus</i>	4	100.00	0	0.00	0	0
<i>Equus ferus</i>	13	44.83	7	24.14	9	31.03
Bovidae	32	34.04	57	60.64	5	5.32
<i>Bison priscus</i>	1	25.00	2	50.00	1	25.00
* % of species specimens						

Table 9.12: Degree of abrasion exhibited by the Feltham faunal remains (of species with >1 specimen)

The colour and degree of staining exhibited by the assemblage is also complex (Table 9.13). Fossils are predominantly stained orange and/or brown, which would be consistent with observations of other material coming from the gravels in the local area; however a small proportion of the assemblage was slightly stained grey or a combination of grey and orange/brown, suggesting that the fossils do not all come from the same deposit. The brief stratigraphy described in Coope *et al.* (1997) did not refer to colour of the deposits and so the origin of the grey staining cannot be inferred.

Species	Colour of staining									Unstained
	Orange/brown			Grey			Orange/brown AND grey			
	Strong	Mod.	Slight	Strong	Mod.	Slight	Strong	Mod.	Slight	
<i>Rangifer tarandus</i>	1	7	17	0	0	7	0	2	4	1
<i>Mammuthus primigenius</i>	0	4	7	0	0	2	0	0	1	0
<i>Coelodonta antiquitatis</i>	2	2	6	0	0	0	0	2	1	0
<i>Ursus arctos</i>	0	0	2	0	0	1	0	0	0	0
<i>Palaeoloxodon antiquus</i>	0	2	0	0	0	0	0	1	0	0
<i>Cervus elaphus</i>	0	0	3	0	0	1	0	0	0	0
<i>Equus ferus</i>	1	7	12	0	0	4	0	3	2	0
Bovidae	4	21	49	0	0	7	0	0	12	1
<i>Bison priscus</i>	1	1	2	0	0	0	0	0	0	0

Table 9.13: Colour and degree exhibited by fossils from Feltham

The dominant species from the Hall and Co. Pit are indeterminate large bovid (*Bison* or *Bos*) (49.45%), followed by reindeer (20.88%). A co-abundance of reindeer and bison is a key feature of the Banwell Bone Cave MAZ of the Early Devensian (Currant and Jacobi, 1997, 2001, 2002). However, the presence of occasional remains of horse, straight-tusked elephant, giant deer, red deer, woolly rhino and mammoth, which are not recognised as part of this faunal suite, reinforces the mixed nature of the assemblage. As discussed above, the consistently high levels of abrasion of the straight-tusked elephant and red deer specimens suggest reworking from (at the latest) MIS 5c ages deposits as this is the last known appearance of *Palaeoloxodon antiquus* in Britain (Currant and Jacobi, 1997, 2001, 2002; Gilmour *et al.*, 2007).

In contrast, the dominant species at Greenham's Pit are woolly rhinoceros (37.5%), woolly mammoth (20.83%) and horse (16.67%). These are all identified as the dominant species of the Pin Hole MAZ (Currant and Jacobi, 1997, 2001, 2002)

attributed to MIS 3, the Middle Devensian. Giant deer, another component of the Pin Hole MAZ, was also recorded from Greenham's Pit. If the correlation of the Greenham's Pit assemblage with the Middle Devensian is correct, it could also explain the presence of these species in the Hall and Co. Pit assemblage. This may suggest the Hall and Co. Pit assemblage has reworked at least three different ages of faunal remains: from a temperate episode possibly equated with MIS 5c (*Palaeoloxodon antiquus* and possibly *Cervus elaphus*), MIS 5a (*Rangifer tarandus* and *Bison priscus*, possibly *Ursus arctos*), and MIS 3 (*Coelodonta antiquitatis*, *Mammuthus primigenius* and *Equus ferus*, possibly *Ursus arctos*). *Ursus arctos* is a component of both the Banwell Bone Cave and Pin Hole MAZs and so its origin may be from deposits of either age. Unfortunately no fossils were noted as being unusually large in size, which would be expected of Banwell Bone Cave MAZ specimens.

Further evidence for the identification of remains of Middle Devensian (MIS 3) age within the Kempton Park Gravels comes from recent research into rivers that lie beyond the LGM limits in the UK, such as the Trent. These display last glaciation gravels immediately beneath the modern floodplain deposits, therefore suggesting that the rivers experienced little or no post-LGM incision (Bridgland *et al.*, 2010). Consequently, incision must have occurred in MIS 2, prior to the aggradation of the Shepperton Gravels. This would imply that the Pin Hole MAZ fauna, attributed to MIS 3, fits within the period represented by the Kempton Park Terrace. This builds on the previous suggestions that the Shepperton Gravel spanned MIS 4-2 (e.g. Bridgland (1994)).

Summary of Feltham Biostratigraphy:

- The assemblage from Feltham is not *in situ*. The Hall and Co. Pit assemblage is particularly obviously reworked and mixed. .
- The dominance of reindeer from the Hall and Co. Pit assemblage would suggest a correlation with Banwell Bone Cave MAZ, and MIS 5a (Carrant and Jacobi, 1997, 2001, 2002; Gilmour *et al.*, 2007).
- Straight-tusked elephant specimens from the Hall and Co. Pit assemblage were heavily abraded and represent reworking from older deposits, at least of MIS 5c, Bacon Hole MAZ age (Carrant and Jacobi, 1997, 2001, 2002; Gilmour *et al.*, 2007), since this is the last known appearance of the species in Britain. The red

deer fossils from the Hall and Co. assemblage were also all strongly abraded, thereby suggesting they too were reworked from older deposits, possibly also of MIS 5c age as this was the last interstadial before MIS 3 when the species is known to be present in Britain.

- The Greenham's Pit assemblage is more consistent in its composition. All species are characteristic of the Pin Hole MAZ, MIS 3 (Currant and Jacobi, 1997, 2001, 2002).

9.4.6 Archaeology

No Palaeolithic artefacts have been recorded from Feltham in this study, either by Wymer (1968), or Wessex Archaeology (1996) in their regional surveys.

9.5 Kempton Park

The site of Kempton Park is close to the border of Greater London and is therefore briefly included in this chapter in order to highlight certain aspects of the next climatic episode following the interstadial represented at Isleworth, Twickenham and Kew Bridge.

9.5.1 Stratigraphy

A fossiliferous grey silt horizon was found within gravel and sands overlying London Clay. The grey silt horizon was interpreted as a channel-fill that accumulated under conditions of slow flow. The under- and overlying sands and gravels were thought to have accumulated in a braided river, characteristic of a strongly seasonal climate such as is found in periglacial conditions (Gibbard *et al.*, 1982).

9.5.2 Palaeontology and Palaeoecology

The plant macrofossil assemblage reported by Gibbard from the grey silt suggested that aquatic, marshy and well-drained habitats were all present. Only two tree species were recorded, *Salix herbacea* (dwarf willow) and *Betula nana* (dwarf birch), implying that a virtually treeless landscape, dominated by grasses, herbs and dwarfed trees existed. Slow flowing water and marshy environments were indicated by *Groenlandica densa* (opposite-leaved pondweed), *Potamogeton* sp. (pondweed), *Ranunculus* (buttercup genus) and *Zannichellia* (horned pondweed). Plant taxa tolerant of cold conditions were

also recorded. The coleopteran, ostracod and mollusc faunas suggested that the climate was temperate at the base and increasingly became cooler towards the top of the section (Gibbard *et al.*, 1982).

9.5.3 Age of deposits

Lithostratigraphy

A radiocarbon date of $35230 \pm 185\text{BP}$ (Q-2019) ($35230 - 39645$ cal BP, 95.4%) was taken from plant remains at the top of the silt. It was suggested that the silts accumulated in increasingly cool conditions that post-dated the thermal maximum of the interstadial represented at other sites in London, such as Isleworth, Twickenham and Kew Bridge (Gibbard *et al.*, 1982).

9.6 Battersea

9.6.1 Location of Site and History of Research

The majority of faunal remains were recovered during excavations at Battersea Power Station and Battersea Gas Works (Coombs, 1873). Gibbard (1985) mentioned that, at the time of his writing, much of the Battersea Gas Works fauna was no longer available for study. The assemblage observed during this research may therefore represent only a small fraction of the original assemblage. The gravels underneath Battersea Power Station were identified as probably belonging to the Shepperton Gravel, due to the depths at which the bedrock was located (-17.6 and -27.4m O.D.) (Gibbard, 1985). In the Middle Thames, the Shepperton Gravel was attributed to MIS 4-2 (Bridgland, 1994), however it may be more likely to belong to MIS 2 (see Bridgland *et al.*, 2010, and discussion in Section 9.4.5). The British Geological Survey (1998) mapped the site of the power station as Holocene alluvium, with Kempton Park Gravel found extremely close by to the south-west.

9.6.2 Location of collections

All faunal remains were observed in the Natural History Museum, London.

Lithics were recorded at the British Museum and from the W.G. Smith Collection in Wardown Park Museum, Luton.

9.6.3 Stratigraphy

The following stratigraphy was recorded by Coombs (1873):

4. Gravel and horizontally bedded and current-bedded sands, 7.6 m deep)
3. (in north-western corner of excavation) Blue/black clay containing angular pebbles, vertical roots (2.4 m above London Clay)
2. Gravel and horizontally bedded and current-bedded sands
1. London Clay

The faunal remains were apparently discovered in the bluish black clay deposit (Coombs, 1873).

9.6.4 Palaeontology and Palaeobotany

Table 9.14 lists the species recorded from Battersea during this study.

Species	No. of specimens	% of total assemblage	Minimum number of Individuals (M.N.I.)
Proboscidea			
<i>Mammuthus primigenius</i> (Blumenbach) woolly mammoth	2	15.38	1
cf. <i>Mammuthus primigenius</i>	1	7.69	1
Perissodactyla			
<i>Equus ferus</i> Boddaert, horse	1	7.69	1
<i>Coelodonta antiquitatis</i> (Blumenbach) woolly rhinoceros	5	38.46	1
Rhinocerotidae sp. indet rhinoceros	2	15.38	1
Artiodactyla			
<i>Rangifer tarandus</i> (L.) reindeer	1	7.69	1
Bovidae sp. indet. Large bovid	1	7.69	1
Total	13		

Table 9.14: Species recorded from Battersea

The assemblage is dominated by woolly rhinoceros (38.46%) (Figure 9.9) and woolly mammoth (15.38%). Other significant members of the assemblage are horse (7.69%), reindeer (7.69%) and indeterminate bovid (*Bos* or *Bison*) (7.69%). All species recorded are generally grazers and inhabit grasslands or steppe environments. Woolly rhinoceros and particularly reindeer are only recorded from cold climate periods (Stuart, 1982). The species recorded here mirror those listed by Coombs (1873) with the exception of the red deer specimen listed in his publication., which was not identified during this study.



Figure 9.9: Cranium of *Coelodonta antiquitatis*, woolly rhino from beneath Battersea Power Station (specimen M55175, Natural History Museum, London).

9.6.5 Age of deposits

Lithostratigraphy

The stratigraphical position of the sediments is considered to correlate with the temperate-climate radiocarbon-dated deposits at South Kensington (see Figure 9.12) suggesting that both sites may relate to MIS 3, particularly considering the coherent composition of the mammal assemblage at Battersea (see below). The gravels at the site have not yet been formally identified, with Gibbard (1985) suggesting that they may belong to the Shepperton Gravel. In contrast, the British Geological Survey (1998) have mapped Holocene alluvium with Kempton Park Gravel very close by, presumably based on borehole evidence. On the basis of the above evidence, including the biostratigraphical correlation with MIS 3, it is suggested that the deposits are most

likely to be Kempton Park Gravel, spanning MIS 6-2 (see discussion in Section 9.4.5 and Bridgland *et al.* (2010)).

Biostratigraphy

The small assemblage from Battersea is dominated by woolly rhinoceros and woolly mammoth in association with horse, indeterminate large bovid (*Bos* or *Bison*) and reindeer. All specimens display high levels of abrasion (moderately and heavily abraded) (Table 9.15) and brown and orange staining (with the exception of a horse metatarsal from beneath Battersea Power Station that was stained grey) suggesting that virtually all fossils may be contemporaneous and buried in the same deposit.

Level of Abrasion	No. of specimens	%
Unabraded	0	0
Slightly abraded	0	0
Moderately abraded	6	46.15
Heavily abraded	7	53.85
Total	13	

Table 9.15: Levels of abrasion exhibited by the Battersea faunal remains

All species are characteristic components of the Pin Hole MAZ (Carrant and Jacobi, 1997, 2001, 2002) and so could indicate that these mammals inhabited the Battersea area during the Middle Devensian, MIS 3. With the exception of woolly mammoth, which is noted from MIS 5c (Carrant and Jacobi, 2001), none of the species are known from the Early Devensian (Carrant and Jacobi, 1997, 2001, 2002; Gilmour *et al.*, 2007). Due to the small assemblage size, however, the proposed date of MIS 3 can be only tentatively attributed at this stage. No upper third molars of woolly mammoth were present in the assemblage in order to analyse the number of plates, which might have further assisted in refining the age.

9.6.6 Archaeology from Battersea

Eight artefacts (three handaxes and five flakes) have been recorded from Battersea during this research, including the handaxe from St John's Hill held in the British Museum recorded in Wymer (1968), Roe (1968) and Wessex Archaeology (1996). They

all exhibit moderate to heavy levels of abrasion indicating they have experienced transportation and all are reworked. One heavily abraded Levallois flake also suggests reworking from older deposits, since this technique is not known in Britain after MIS 7-6 (White *et al.*, 2006).

9.7 South Kensington

9.7.1 Site location and History of Research

Organic deposits were first discovered in South Kensington in 1980 during construction of the Ismaili Centre, located on the corner of Cromwell Gardens and Exhibition Road. Fossiliferous silty clay sediments were exposed, leading to a detailed multi-proxy investigation including sedimentology, pollen, plant macrofossils, molluscs, ostracods and beetles. Unfortunately only one mammal fossil was recovered, of *Bison* sp. (Coope *et al.*, 1997).

The location is mapped as Kempton Park Gravel (Gibbard, 1985; Coope *et al.*, 1997; British Geological Survey, 1998).

9.7.2 Location of Collections

Faunal remains from South Kensington were analysed in the Natural History Museum, London.

9.7.3 Stratigraphy

The general stratigraphy from the excavations was recorded as follows (all stratigraphy information from Coope *et al.*, 1997) (Figure 9.10):

- 5) Made ground (4.5m)
- 4) Upper gravel and sand (3.5m)
- 3) Interstratified silt, silty clay, sand and pebbly sand (2.6m)
- 2) Basal gravel and sands (2.2m)
- 1) London Clay

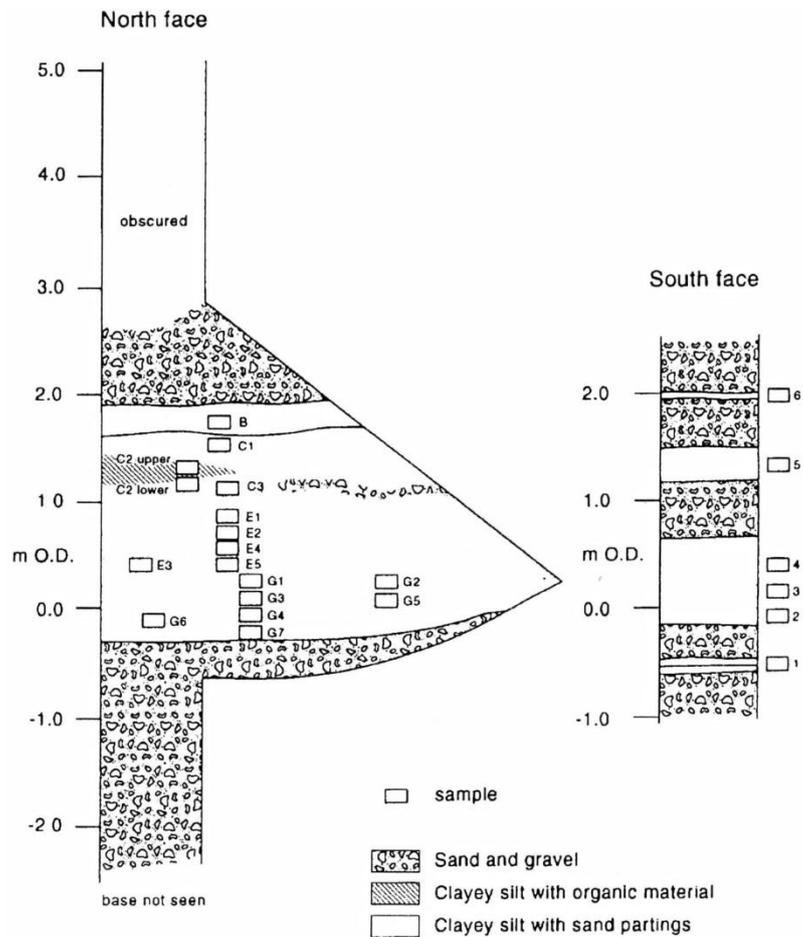


Figure 9.10: Stratigraphy recorded at the Ismaili Centre excavation in South Kensington. Samples E2 and C2 were dated by radiocarbon. From Coope *et al.* (1997)

1) London Clay

The surface of the London Clay was irregular and situated at -2.5m O.D (not seen in Figure 9.10).

2) Basal Gravel and Sands

This unit consisted of poorly-sorted medium gravel in a sand matrix. Lenticular beds of tabular cross-stratified sand were also recorded in the unit.

Clast lithological analysis on a sample of gravel 1m above the London Clay indicated that the gravel was comparable with the Kempton Park Member, with high percentages of angular flint (Gibbard, 1985).

3) Interstratified clay, silt and sand

This unit contained all fossils recovered and varied considerably between the northern and southern faces of the excavation. At the northern end of the excavation, the unit consisted mainly of grey silty clay with some thin blue horizons (approximately 10cm thick) in the upper half of the bed. Each of the beds had an erosional base and drapes of fine sediment, current-bedded sands and ripple structures were recorded. In the southern exposure, the silty clay horizons were interbedded with thick sandy gravel layers.

The fine sediments within this horizon were suggested to represent low-energy conditions such as those accumulated in braidplain depressions or channels with little or no flow. The coarser beds represent flood events within the channel.

4) Upper Gravel and Sand

The unit consisted of horizontally bedded sand and matrix supported gravel with occasional lenses of cross-bedded medium to fine sand in the uppermost 1.5m of the sequence, with some lenses reaching 40cm in thickness. Palaeocurrent measurements indicated a flow towards the north-east.

The horizontal bedding in the gravels were suggested to represent the aggradation of horizontally-migrating bars, whilst the facies variation observed at the site and the lack of predominant upward-fining sequences suggests deposition within a braided river.

Clast lithological analysis on a sample of gravel 1m above the fine sediment bed indicated that the gravel was comparable with the Kempton Park Member, with high percentages of angular flint (Gibbard, 1985).

9.7.4 Palaeontology and Palaeoecology

Palynology

Pollen was poorly preserved throughout the sequence and pre-Pleistocene and Pleistocene temperate-episode pollen grains derived from local interglacial deposits were also present in the sequence but not counted.

Within the pollen sequence from the Ismaili Centre site, two biozones were recognised (the lower ICa and upper biozone, ICb). The pollen assemblage recorded from the north

side of the excavation was longer and contained both pollen assemblage zones, whereas in the south face sequence only ICb was recorded. The two pollen assemblage zones were characterised by the following features:

1) ICa Gramineae – Cyperaceae – Plumbaginaceae (0-90cm above O.D.)

The lower half of the sequence was dominated by Gramineae (grasses) and Cyperaceae (sedges). Much of the grass pollen comes from common species in dry grassland habitats such as *Artemisia* (e.g. wormwood, sagebrush, sagewort, mugwort), Compositae (aster, daisy and sunflower family), Caryophyllaceae (carnations) and *Sanguisorba officinalis* (great burnet). The low percentages of arboreal pollen indicate that trees were absent in the area. Small amounts of *Betula* (birch) pollen were inferred to represent dwarf birch (*Betula nana*), which was also recorded in the macrofossil assemblage. Similarly, the *Salix* pollen was thought to represent dwarf willow, although this was not supported by the presence of macrofossils. Fully aquatic species were rare but marshy habitats were represented. *Saxifraga oppositifolia* (purple saxifrage) implies that areas of stony ground were present. It was suggested the ICa represented a treeless habitat and harsh climate (Coope *et al.*, 1997).

2) ICb Gramineae – Cyperaceae – Umbelliferae – Compositae and herbs (90-156cm above O.D.)

An increase in herb diversity is indicated the beginning of the pollen assemblage zone. Dry grassland species increased, as did Umbelliferae, which were virtually absent in the preceding zone. Tree species continued to be scarce, however the slight increase in *Pinus* was thought to be due to a greater long-distance transported component. ICb was suggested to reflect a slightly more favourable climate, due to the greater plant diversity in comparison with ICa, although trees continued to be absent (Coope *et al.*, 1997).

Plant Macrofossils

Within ICa, a significant species recorded is *Diploaxis tenuifolia* (perennial wall-rocket) (*sensu* Bell, 1969), a species native to south-eastern Europe and western Asia today. Very low frequencies of temperate genera such as *Carpinus* (hornbeam), *Trapa* (water chestnut), *Quercus* (oak) and *Alnus* (alder) were concluded to be reworked fossils from older temperate deposits. A richer aquatic floral community was

represented by *Eleocharis palustris* (common spike-rush), *Schoenoplectus* sp. (bulrush), and *Groenlandia densa* (opposite-leaved pond weed).

The plant macrofossil assemblage reflected the palaeoecological reconstruction indicated by the pollen, namely a treeless environment where the fine sediments were deposited in shallow pools under harsh climatic conditions. The upper part of the sequence (ICb) shows evidence of greater grassland diversity with more tall herbs that may represent a slight climatic amelioration (Coope *et al.*, 1997).

Coleoptera

Beetle remains were only recovered from the grey unoxidised silty clay horizons on the north side of the excavation, E2 and C2 and samples 2, 3, 4 and 5 from the southern side (see Figure 9.10). The assemblages recovered from the south side samples were comparable to the assemblage from horizon C2, and therefore were correlated with each other.

Coleoptera from sample E2

The species recorded from E2 indicate a sparse habitat of predominantly bare ground, with patchy vegetation surrounding small pools of standing water. The presence of ground beetles such as *Bembidion bipunctatum*, *B. dauricum* and *B. fellmanni* indicated that gravelly and sandy banks close to water were nearby, whereas *B. aeneum* indicated clayey banks were also present. There was a lack of phytophagous species, suggesting that vegetation cover was poor. Areas of disturbed ground at the site were indicated by the presence of *Galeruca tanaceti*, a Compositae feeder, and the abundance of dung beetles (in particular *Aphodius*), which likely fed on the dung of herbivorous animals. The presence of marshy habitats was suggested by weevils such as *Notaris aethiops* and *Notaris bimaculatus*, which feed on reedy vegetation. All aquatic species from the assemblage are characteristic of standing water, such as *Helophorus*, which inhabits small ponds and puddles.

Many of the beetles are cold-adapted with 15 species no longer found in Britain. Many of these are characteristic of high altitude and high latitude in Fennoscandia with the exception of; *Helophorus obscurellus*, now found in Russia, arctic Siberia and central Asia, *H. splendidus*, also found in Siberia as well as arctic Canada (Angus, 1992), and *Tachinus caelatus*, now found in Mongolia (Ullrich, 1975). Other species are still recorded in Britain today, but are equally present in arctic Europe and Siberia, such as

Bembidion virens, *Patrobus septentrionis*, *Amara quenseli* and *Agabus arcticus*. The Mutual Climatic Range (MCR) of the E2 assemblage resulted in the following temperature reconstructions (based on 90-99% of the species ranges overlapping):

a) Mean temperature of the warmest month = $9 \pm 2^{\circ}\text{C}$

b) Mean temperature of the coldest month = $-22 \pm 10^{\circ}\text{C}$

It was suggested that much of the precipitation would have fallen as snow, leading to spring snow-melt floods and the establishment of ephemeral water bodies (Coope *et al.*, 1997).

Coleoptera from samples C2, 2, 3, 4 and 5

The presence of both running and standing water was highlighted by the beetle assemblage. For example *Orectochilus villosus* is known to inhabit rivers and streams, *Riokus* and *Oulimnius tuberculatus* are found in shallow, well oxygenated and high-energy water bodies. The carnivorous diving beetles such as *Rhtus*, *Colymbetes* and *Dytiscus* that live in weedy backwaters suggest the presence of standing water habitats. Marshy areas are represented by phytophagous species such as *Donacia bicolora*, *Plateumaris sericea* and *Notaris aethiops* that feed on tall waterside vegetation. Wet meadow-like habitats were also near the site, as represented by *Carabus granulatus*, *Bembidion biguttatum*, *Bembidion clarki*, *Bembidion gilvipes* and *Agonum nigrum*. Species such as *Notiophilus aquaticus*, *Dyschirius globasus*, *Trechus secalis* and *Microlestes maurus* also suggest that areas of drier, gravelly soil with sparse vegetation was present further away from the water. As with the E2 assemblage, dung beetles were present, implying the presence of large herbivorous mammals in the vicinity.

The assemblage composition, and subsequently the climatic significance of the Coleoptera from horizon C2 and samples 2, 3, 4 and 5, is distinct from that of sample E2. The assemblage from C2 is largely composed of temperate species that can be found in Britain and Central Europe today. Only *Notaris aethiops* is an exception, due to its range extending to mountainous areas in Europe and the far north of Britain. The MCR was based on 100% of the species ranges overlapping and resulted in the following temperature ranges:

From sample C2

a) Mean temperature of the warmest month = $17 \pm 1^\circ\text{C}$

b) Mean temperature of the coldest month = $-4 \pm 6^\circ\text{C}$

From Sample 2

a) Mean temperature of the warmest month = $16.5 \pm 1.5^\circ\text{C}$

b) Mean temperature of the coldest month = $-3.5 \pm 2.5^\circ\text{C}$

It was suggested that precipitation was sufficiently high at this point to maintain a flowing stream throughout the year (Coope *et al.*, 1997).

Molluscs

Molluscs were recovered from both the north and south sides of the excavation. The preservation of the shells was significantly better in the southern section, where many of the bivalves were found intact, indicating very little post-mortem transport (Coope *et al.*, 1997).

Molluscs from the north side of the excavation

Molluscs were both scarce and poorly preserved in the lower part of the organic silts. Five species were recovered from the basal sample that are indicative of moderate stream flow: *Ancylus fluviatilis*, *Pisidium subtruncatum*, *P. henslowanum*, *Pupilla muscorum* and a probable record of *Anisus leucostoma*. Higher up in the sequence, a more diverse molluscan assemblage was recorded including *Gyraulus albus*, the first record of this species in the Devensian and *Anodonta cf. anatina* and *Pisidium supinum*, both of which have a relatively southern European modern distribution and only reach southern Scandinavia as their northern limit. The *Anodonta* bivalves were paired and adult, indicating that the individuals had lived in the channel for at least 20 years and had not experienced post-mortem transportation. This contrasts with the braidplain environments implied by the lithostratigraphy, which indicate that some parts of the channel had stabilised and ceased being ephemeral. *Pisidium henslowanum* was a common species at this point, suggesting that the stream was well-oxygenated and rich in vegetation. Samples from the top of the sequence contained similar species to the middle of the sequence however the shells were corroded and less common. A species

not found elsewhere in the sequence, *Oxyloma pfeifferi*, is common in emergent vegetation indicating that new habitats were forming at this stage (Coope *et al.*, 1997).

Molluscs from the south side of the excavation

The molluscan assemblage was broadly similar throughout the sequence, being dominated by species common in slow flowing water such as *Valvata piscinalis*, *Armiger crista* and *Pisidium nitidum*. In the uppermost part of the sequence, *V. piscinalis* was much less frequent, *A. crista* was absent and numbers of *Ancylus fluviatilis* had increased, suggesting that the stream flow had increased in strength. The sequences from both sides of the excavation were considered to be comparable and representative of the same environments (Coope *et al.*, 1997).

All species in from the southern side of the excavation are common Palaearctic or Holarctic molluscs and all live in Britain today. Some species such as *Physa fontinalis*, *Ancylus fluviatilis*, *Anodonta anatina*, *Pisidium henslowanum*, *Pisidium supinum* and *Pisidium moistessierianum* are all presently absent in the Arctic Circle, indicating that prevailing temperatures did not reach modern Arctic levels (Okland and Kuiper, 1982). However, research also suggests that the absence of hard water may be a limiting factor controlling the spread of many of these species.

Overall, the low mollusc diversity at the base of the two sequences, when compared to the top, reflected the contrasting environments they represent. It was suggested the lower section of the assemblage reflected a more severe climate, however there are no exclusively cold-water mollusc species known from fluvial environments to support the conclusion.

Ostracods

Ostracods from the north side of the excavation

The lowest four samples (H5, G5, G6 and G7 see Figure 9.10) lacked ostracod remains. In the first sample with ostracod fossils (G4), *Ilyocypris* was the principal genus, with one specimen provisionally referred to *I. schwarzbachi*. This species was originally described from the early Middle Pleistocene deposits at Kärlich in Germany (Kempf, 1967) and is believed to now be extinct. From the associated fauna at Kärlich, it was proposed that the species inhabited small shallow lakes that often dried up in the

summer. Higher up the sequence, in sample G1, ostracod remains were more common with *I. cf. schwarzbachi* and *Limnocythere falcata* the dominant species. *L. falcata*, another extinct species, was represented by males, females and juveniles suggesting that there had been little post-mortem modification of the once-living population. In samples E5 and E4, species diversity increased with *Ilyocypris bradyi* dominating the assemblage. *Candona candida*, *Candona lozeki* and *Dawinula stevensoni* suggested that the pools contained soft muddy substrates and marginal bank habitats. Open water was also indicated by the presence of *Cyclocypris* and *Cypridopsis*, which are both active swimmers. It is thought that *Candona lozeki* may be a cold stenothermic species (Absolon, 1973) and this species has also been recorded at Kempton Park (Gibbard *et al.*, 1982). Higher up in the sequence, samples C2 and C1 were dominated by *Prionocypris serrata*, which inhabits permanently flowing, shallow and plant rich streams at the present day (Klie, 1938; Diebel and Wolfschläger, 1975). The appearance of *P. serrata* suggests that the river had changed to more strongly-flowing, much like the situation at Isleworth (Siddiqui, 1971; Kerney *et al.*, 1982). The species was represented by fully grown adults, implying that the specimens had not experienced post-mortem transport and had lived near the site.

Ostracods from the south side of the excavation

Samples 2 contained the first ostracod remains on the south face of the excavation. Only five species were recorded, including *Herpetocypris* sp. and *Cypridopsis vidua* that are both non-swimming genera and represent plant-rich habitats with slow flowing streams or pools. Sample 4 contained significantly higher frequencies of *Dawinula stevensoni*, suggesting increased importance of calm water habitats. Sample 5, although depleted in ostracod remains compared to earlier samples, indicated that stream flow had increased with the dominance of *Prionocypris serrata* (Coope *et al.*, 1997).

Vertebrates

Fish

Remains of *Gasterosteus aculeatus* (three-spined stickleback) were common. The species inhabits most water bodies in the Northern Hemisphere (Coope *et al.*, 1997).

Mammals

An unstratified right mandible of *Bison* sp. (Natural History Museum M47033) was recovered during the excavations. Pollen from sediment adhering to the bone revealed a similar assemblage to ICb from the upper organic silts, with high percentages of Umbelliferae (Coope *et al.*, 1997).

In addition to the Ismaili Centre specimen, the following fossils have been discovered in South Kensington:

1. an indeterminate large bovid (*Bos* or *Bison*) right metacarpal collected in 1904 from an unspecified South Kensington location (Natural History Museum, Corner Collection).
2. Two *Mammuthus primigenius* molars from beneath the Natural History Museum, uncovered in 1874 (specimen no. 45870, Natural History Museum).
3. Two *Mammuthus primigenius* molars from an unspecified location in South Kensington, discovered in gravel, 6m from the surface in 1868 (specimen no. 5103, British Geological Survey Museum, Keyworth, Nottingham).

All the specimens, with the exception of the Ismaili Centre fossil, were highly abraded, suggesting that they had been reworked from older gravels.

The bison specimen from the Ismaili Centre suggests that grassland environments were present (Stuart, 1982).

Summary of the Ismaili Centre excavation palaeoecology and palaeontology

Two separate palaeoenvironmental and palaeoclimatic zones were represented by the assemblages collected.

1) Cold climate environment as represented by basal organic clayey silt samples on the northern side of excavation (Samples G and E, see Figure 9.10)

All proxies analysed either reflected cold climate environments by the presence of cold-adapted species or the absence of obligate thermophilous species. Pollen assemblage ICa represented a habitat dominated by grasses and sedges with local stands of dwarf birch. The molluscan and ostracod evidence indicated low species diversity, whilst the presence of the limpet *Ancylus fluviatilis* indicated moderate stream flow. The ostracod

assemblage, in contrast, suggested there were areas of still water. In addition, the Coleopteran assemblage contained many cold-adapted species.

2) *Early temperate environments as represented by the upper organic clayey silt samples from the north face of the excavation (samples C and B) and the south face samples (2, 3, 4 and 5) (see Figure 9.10)*

Samples from higher up in the stratigraphy on the northern side of the excavation and the samples taken from the southern end all suggested a shift in climate towards temperate environments. The pollen and plant macrofossil assemblages were more diverse, however trees were still absent. The lack of tree species was suggested by Coope *et al.* (1997) to be due to rapid climate change from the underlying cold-climate environments that would not have allowed time for the trees to colonise. Other factors influencing the absence of trees may be the impact of large grazing herbivores (such as those known from other well-established Middle Devensian sites, such as mammoth, woolly rhino and horse) and the lack of a developed soil following the preceding period of cold-climate conditions.

Mollusc remains were also richer and more diverse with some relatively southern species that have northern range limits reaching southern Scandinavia and Britain. The richer ostracod fauna reflected the presence of permanently flowing water, whereas the Coleoptera indicated the proximity of varied habitats, including flowing water, standing water areas and rich vegetation. The MCR also indicated raised temperatures in comparison with the lower samples (Coope *et al.*, 1997).

9.7.5 Age of deposits

Lithostratigraphy and absolute dating

Two radiocarbon dates were obtained from wood and plant debris from the organic units from the northern face of the excavation (See Figure 9.10 where dates were obtained from – horizons C2 and E2). The sample from C2 gave a date of 38,000±2000 years BP (Birm-1102) (47497-39214 cal BP, 95.4%) and the date obtained from E2 was >45,000 years BP (Birm-1101). The C2 date is comparable with the date from Isleworth (43,140±1520 years BP (Birm-319) or 49726-44650 cal BP, 95.4%) that contained similar palaeontological assemblages; however, the dates for all three sites were near the acceptable limits of radiocarbon dating techniques, making precise dating difficult

(Coope and Angus, 1975; Coope *et al.*, 1997) and would benefit from being re-done with modern collagen preparative techniques.

The gravels at the Ismaili Centre excavation were attributed to the Kempton Park Gravels, dated to MIS 6-4 within the Middle Thames sequence (Bridgland, 1994; Coope *et al.*, 1997). Bridgland (1994) thereby attributed the temperate deposits to MIS 5a and/or 5c. Figure 9.13 indicates the stratigraphies at South Kensington and Battersea are comparable. It is highly probable that the deposits at Battersea are part of the Kempton Park Gravel based on the British Geological Survey (1998) mapping (see Section 9.6.2) underlying Holocene alluvium. This and the mammalian fauna suggest an MIS 3 date for the temperate deposits. The equivalent deposits at South Kensington may also prove to be of MIS 3 age and form part of the Kempton Park Gravel. As stated above, Bridgland *et al.* (2010) have demonstrated that in other river terrace sequences beyond the ice limit of MIS 2 there is very little or no post-LGM incision, on account of the presence of last glacial sediments directly beneath the Holocene alluvium. In contrast, rivers within the limits of the last glaciation, exhibit later terrace incision occurring within the Holocene. The authors suggest that the main explanation for these differences is glacio-isostatic uplift occurring in areas glaciated during MIS 2.

This is possible when considering the Shepperton and Kempton Park Gravels are often found overlapping vertically (Bridgland, 1994). Furthermore there is considerable palaeoclimatic complexity during MIS 3, as discussed above, suggesting that the South Kensington deposits may not be exactly contemporaneous with Battersea.

Biostratigraphy

The temperate deposits from the Ismaili Centre excavation were correlated with the early phase of the 'Upton Warren Interstadial Complex'. As discussed in Section 9.1.6 (Isleworth), radiocarbon dating of sites attributed to this period may be problematic, often including both older material (eg. Bowen *et al.*, 1989) and younger material (e.g. radiocarbon dates of Middle Devensian age at Isleworth and Upton Warren). In addition, it is now widely accepted that the palaeoclimatic picture is substantially more complex than realised at the time when these authors were writing (Grootes *et al.*, 1993; Grootes and Stuiver, 1997; Tzedakis *et al.*, 2002), with rapid, often millennial-scale climatic oscillations. Coope *et al.* (1997) attributed the temperate deposits at the Ismaili Centre excavation to MIS 3 based on the following evidence:

- 1) In the Thames Valley and Midlands, deposits attributed to the Upton Warren Interstadial are separated by a clear erosional break from the underlying deposits that are usually associated with MIS 5e.
- 2) Comparable coleopteran assemblages have been recovered from sites spanning 40,000-25,000 years BP (MIS 3), previously attributed to the Upton Warren Interstadial (Coope *et al.*, 1971).
- 3) The molluscan assemblage contained *Trichia hispida*, a species that has only been found in Middle Devensian sites in assemblages assigned to the thermal maximum of the 'Upton Warren Interstadial Complex' (Holyoak, 1982). Sites attributed to this time period are suggested to belong to MIS 3 (see above).
- 4) Comparison with palaeobotanical and coleopteran evidence from continental sequences. Coope *et al.* (1997) noted that the pollen sequence at South Kensington was very different from the pollen assemblage from La Grande Pile, France (Woillard, 1978; Beaulieu and Reille, 1992), which spans MIS 5e-5a and represents a well developed oak forest environment. Additionally the pollen sequence from Watten, northern France (Emontspohl, 1995) indicated the site was dominated by pine, spruce, birch and hazel during MIS 5a, whereas South Kensington was virtually treeless. Furthermore these continental European sites yielded coleopteran assemblages that were also very different to those at South Kensington (Coope *et al.*, 1997). These sites are considered close to London (only 600km and 150km respectively) and it was anticipated by Coope *et al.* (1997) that the Thames Valley site assemblages would contain some of the tree pollen that existed in mainland Europe at the time, even if trees had not colonised Britain. However, the authors suggested that this could not be occurring at South Kensington as the pollen sequence showed a conspicuous absence of local tree pollen. Therefore Coope *et al.* (1997) suggested that the palaeobotanical and coleopteran assemblages at South Kensington were not comparable to other MIS 5 sites. However, it may also be considered that London would not be comparable with sites in France for many other reasons, such as the differences at the two locations in continentality of climate, and proximity to rivers, estuaries and seas. Thus, this may not provide suitable evidence alone to attribute South Kensington to MIS 3.

- 5) Comparison with British sites attributed to MIS 5a. Three sites in Britain, Chelford, Cheshire (Simpson and West, 1958), Four Ashes, Staffordshire, (Morgan, 1973) and Brimpton, Berkshire (Bryant *et al.*, 1983; Worsley and Collins, 1995) are all correlated with the Early Weichselian Brørup Interstadial, which in turn has been attributed to MIS 5a, but these sites also represent tree-rich habitats like the French sites and therefore are not comparable with the treeless sequence at the Ismaili Centre.
- 6) The cold-climate deposits at the base of the sequence at the Ismaili Centre excavation are suggested to correlate with a horizon from Cassington (D, where coleopteran sample B6 was obtained) (Maddy *et al.*, 1998) in the Upper Thames Valley. Horizon D at Cassington was attributed to MIS 4, and contained a similar coleopteran assemblage to the cold climate basal gravels at South Kensington. Thereby the overlying temperate horizon at South Kensington would correlate with MIS 3.

The temperate deposits at South Kensington were originally correlated with those at Isleworth (considered by Coope *et al.* (1997) as an MIS 3 site) based on radiocarbon dating, the molluscan and coleopteran assemblages. The Middle Devensian age proposed by Coope *et al.* (1997) is upheld here. Figure 9.13 suggests that the position of the deposits is comparable to those at Battersea and is supported by the evidence outlined by Coope *et al.* (1997). New dating using the improved radiocarbon dating techniques and further opportunities to recover more mammalian fauna from the temperate deposits at South Kensington would undoubtedly help clarify their age.

9.7.6 Archaeology from South Kensington

No artefacts have been found from South Kensington during this research. One very rolled handaxe was recorded in Guildhall Museum by Wymer (1968) from Pelham Street, but this has not been relocated in current collections. The heavily rolled nature of this handaxe suggests that it was reworked from older deposits and would not have been contemporary with the Middle Devensian organic deposits.

9.8 The significance of *bout coupé* handaxes (flat-buttet cordates) from London

The Late Pleistocene is characterised by distinctive patterns of ebb and flow, in terms of human occupation in Britain, to which the evidence from London and its boroughs can

make a contribution. Human absence from Britain during the Ipswichian Interglacial has long been suggested (Stuart, 1976; Gascoyne *et al.*, 1981; Bateman and Catt, 1996; McFarlane and Ford, 1998; Currant and Jacobi, 2001). It has been proposed that people were absent from as early as MIS 6 (Ashton and Lewis, 2002), lasting throughout MIS 5 (Currant and Jacobi, 2002), with re-colonisation occurring during MIS 3 (Currant and Jacobi, 1997, 2001, 2002; White and Jacobi, 2002; Jacobi *et al.*, 1998). The absence of humans from MIS 6 until MIS 3 may have been due to intolerably harsh conditions during MIS 6 (first causing Neanderthals to retreat to refugial areas), followed by a rapid climatic amelioration during MIS 5e leading to the separation of Britain from mainland Europe by high sea levels before Neanderthals could re-immigrate. As discussed in Chapter 8, this breach may have been caused by a megaflood from a large pro-glacial lake in the southern North Sea breached the Strait of Dover at some point prior to MIS 5e (Gupta *et al.*, 2007), which would have then prevented hominins from migrating from Continental Europe to Britain. However, the timing of the breach and the periods during which Britain was connected to mainland Europe, is still being investigated.

The timing of recolonisation of Britain during MIS 3 was upheld by Jacobi *et al.* (2006) through the re-dating of three Middle Palaeolithic sites using the ultrafiltration radiocarbon method: Pin Hole and Robin Hood Caves at Creswell Crags, Derbyshire and the Hyaena Den at Wookey Hole, Somerset. The dates obtained from all three sites exclusively correlated with MIS 3 (ca. 56-28ka (Tzedakis *et al.*, 2002). Sixteen dates from Pin Hole Cave placed the horizons containing Middle Palaeolithic technology between 40650 ± 500 (OxA 11797) (45331-43639 cal BP, 95.4%) and 58800 ± 3700 ka BP (OxA 11 979) (77703-53623 cal BP, 95.4%). The youngest two ages of 40,000 years BP were thought to be from bones that were subjected to mixing by hyaenas and to be from younger deposits than the rest of the assemblage. The five samples dated from Robin Hood Cave gave dates between > 52800 and >38500 years BP. The three infinite ages obtained were due to lack of extractable collagen in the samples. Previously, a single ESR date of 55 ± 4 ka BP was obtained from a *Coelodonta antiquitatis* tooth provenanced to red sand underlying the human occupation horizon, giving a maximum age of the occupation (Jacobi and Grün, 2003). The four samples associated with Late Middle Palaeolithic technology were dated from the Hyaena Den site, between 52700 ± 2000 years BP (OxA 13914) (58841-49251 cal BP, 95.4%) and 45100 ± 1000 year BP (OxA 13915) (no date given-46521 cal BP, 95.4%) (Jacobi *et al.*,

2006). The dates obtained from the three sites strongly suggest that people re-colonised Britain during MIS 3.

Bout coupé handaxes (also known as flat-butted cordates) are unknown from the Lower Palaeolithic and Early Middle Palaeolithic technocomplexes (Tyldesley, 1987; White and Jacobi, 2002). They are generally considered to be symmetrical cordiforms with a straight or slightly rounded butt and unambiguous angles at either end of the butt leading to the lateral edge. Both sides are slightly convex, with all areas refined often with soft hammer removals (Tyldesley, 1987) (see Figure 9.11 photo).



Figure 9.11: Photograph of bout coupé from Acton (Museum of London artefact number A13473) (Photo courtesy of Museum of London)

The approximate chronological range of *bout coupés* can be ascertained with reference to other well-dated Middle Pleistocene localities. At Kent's Cavern in Devon, faunal remains are directly associated with *bout coupés*, including spotted hyaena, mammoth, horse, woolly rhinoceros, and giant deer (Coulson, 1990), which are all characteristic of the Pin Hole MAZ, correlated with MIS 3. Additionally, radiocarbon dates of 34620 ± 820 BP (41512-37721 cal BP, 95.4%) to 30220 ± 460 BP (36265-33726 cal BP, 95.4%) (OxA 3449, 3450, 6108, 1621), from the horizon directly overlying the sediments containing the Kent's Cavern *bout coupés*, suggests that occupation at the cave occurred approximately before 30 ka years BP (White and Jacobi, 2002). The specimens from which the aforementioned Kent's Cavern radiocarbon dates were obtained were re-sampled using the ultrafiltration method and gave dates ranging from $37,200 \pm 550$

(42844-41248 cal BP, 95.4%) and 36,040±330 (41820-40530 cal BP, 95.4%) (OxA 13965, 13921 and 14210). It was also suggested that the cave earth that contained the faunal assemblage began accumulating sometime after 60 ka years BP, since no earlier Devensian faunal material is known from the cave (Jacobi, 1997, 2001; Gilmour *et al.*, 2007). Further support for the time-range for occupation associated with *bout coupés* was lent by a radiocarbon date of 38684 ±2713/-2024 years BP (BM-499) taken from red deer from Coygan Cave, Wales. Unfortunately the artefacts were not directly associated with the red deer sample, but the date was considered a minimum age limit for the occupation. A U-series date of 64,000 years BP from a flowstone thought to underlie the horizon with the fauna and artefacts offered a probable maximum date for the occupation (White and Jacobi, 2002).

Some *bout coupés* occur in discrete river terraces that can provide an age indication for their contained archaeology. For example, a *bout coupé* found at Berrymead Priory, Acton is from the Kempton Park Gravel (Wymer 1968, 1988, 1999) and was attributed to MIS 3 or 2 by White and Jacobi (2002). The discovery of this artefact from the Kempton Park Gravel is consistent with the MIS 3 age of *bout coupés*, as it is likely that the terrace spans MIS 6-2 (see earlier discussions).

Twenty one *bout coupés*/flat-buttred cordate handaxes were identified during this research and are listed in Table 9.16 and Figure 9.11 (handaxes are represented by black spots).

Location	Museum	Level of abrasion	Identified in:
Acton, Berrymead Priory Estate, 13 ft in fine gravel	British Museum	Moderate	Smith (1915), Wymer (1968), Tyldesley (1987), Roe (1981)
West Drayton, Eastwood's Pit B. E. in ?lense? Above gravel 7 F	British Museum	Moderate	Smith (1915), Collins (1978), Tyldesley (1987), Roe (1981)
Acton, brickearth	Museum of London	Slight	Smith (1915), Roe (1981), Tyldesley (1987)
Wandsworth, Thames	Museum of London	Moderate	Wymer (1968)
Sipson, Wall Garden Farm, Sipson Lane, Harlington	Museum of London	Slight	Cotton (1984), Tyldesley (1987)
Hammersmith, Thames	Museum of London	Moderate	Wymer (1968), Roe (1981)
Yiewsley, Clayton's Pit	Museum of London	Slight	Tyldesley (1987)
Yiewsley, Boyer's Pit	Museum of London	Slight	
Lower Edmoniton, Plevna Road	Museum of London	Slight	Bishop (2002)
Orpington, Tintagel Road, Ramsden Estate. Salvaged from excavation.	Bromley Museum	Slight	
Orpington, Tintagel Road, Ramsden Estate. Salvaged from excavation.	Bromley Museum	Moderate	
Orpington, Tintagel Road, Ramsden Estate. Salvaged from excavation.	Bromley Museum	Moderate	
Creefield Road, Acton, School site (1899-1901)	British Museum	Heavy	Smith (1915), Wymer (1968), Roe (1981)
Erith, London Gravels (in previous records from the Thames)	British Museum	Heavy	Roe (1981), Tyldesley (1987)
Erith, London Gravels	British Museum	Moderate	Wymer (1968), Roe (1981), Tyldesley (1987)
Erith, London Gravels	British Museum	Moderate	Wymer (1968), Roe (1981), Tyldesley (1987)
Yiewsley	British Museum	Slight	Smith (1915) recorded a handaxe from Yiewsley
Isleworth	Manchester Museum	Artefact not seen	Wymer (1968), Tyldesley (1987), Roe (1981)
Balham	Museum of London	Slight	Roe (1981), Tyldesley (1987)
Richmond, Thames	Museum of London	Heavy	Roe (1981), Tyldesley (1987)
Putney Bridge, Thames	Museum of London	Moderate	

Table 9.16: List of *bout coupés*/flat-butted cordates identified from London

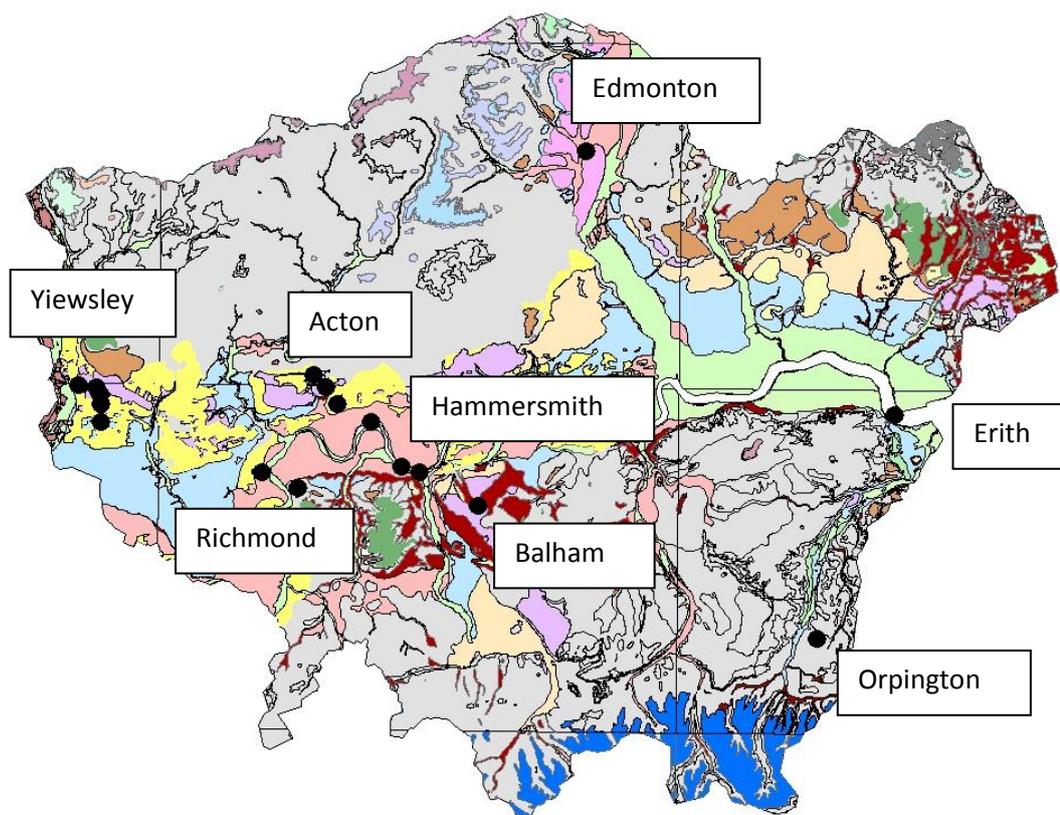


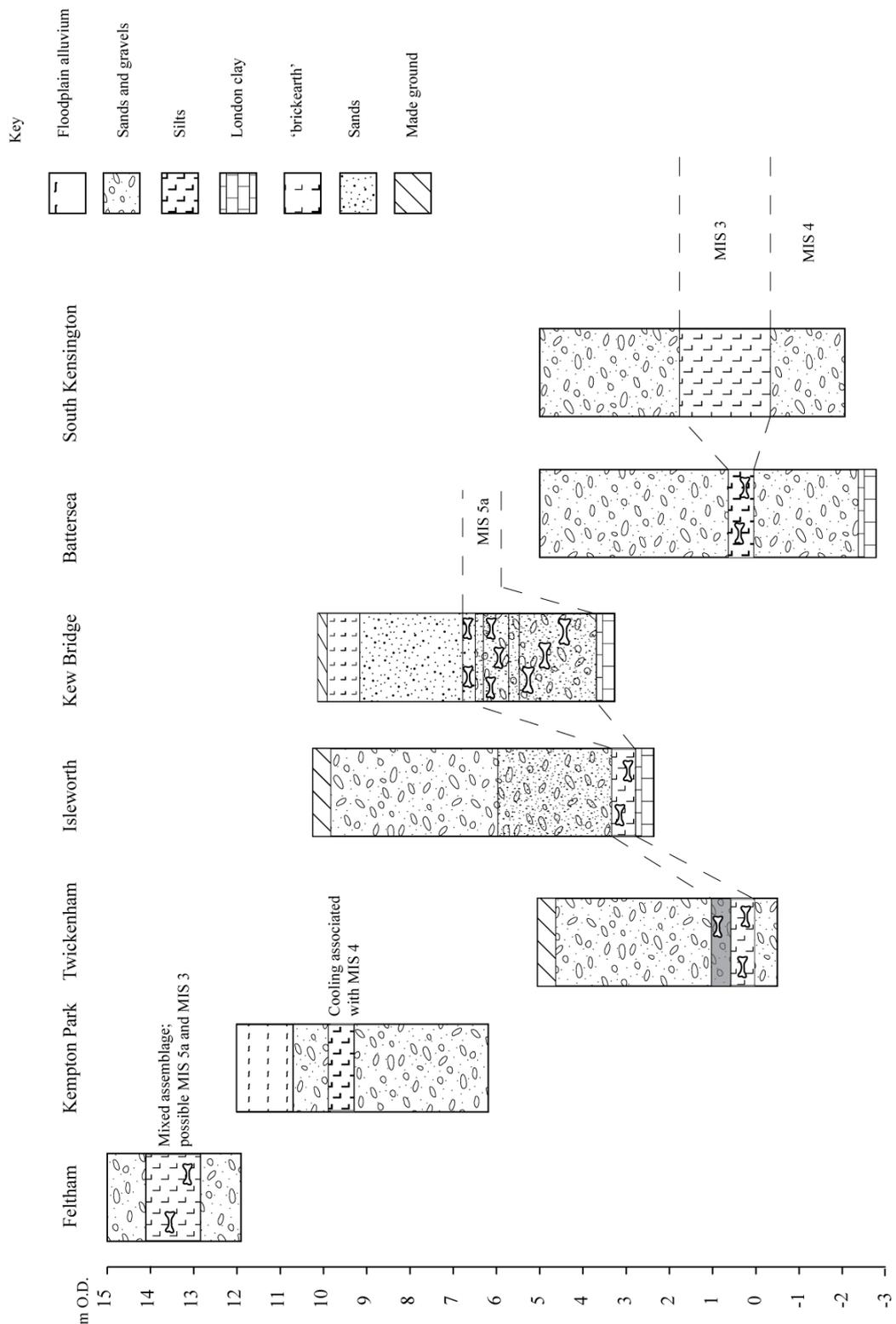
Figure 9.12: Find locations of *bout coupés*/flat-butted cordates from London

Bout coupés have also been recorded from Hoxton (Roe, 1981; Tyldesley, 1987), Putney and Beckton (mentioned in White and Jacobi, 2002), however these have not been relocated.

Tyldesley (1987) identified three *bout coupés* from ‘brickearth’ in the West London area, from Clayton’s Pit, Yiewsley, Eastwood’s Pit, West Drayton (Brown, 1887, 1895; Collins, 1978), and Sipson, Hillingdon (Cotton, 1984). All three were analysed during this study (Table 9.16). The ‘brickearth’ in London overlying the Lynch Hill and Taplow Gravels has been assigned by Gibbard (1985) to the Langley Silt Complex that he in turn attributed to the Devensian and was dated by thermo-luminescence, yielding dates of 17.8 ± 1.5 and 14.3 ± 1.2 ka BP by Gibbard *et al.* (1987). The Devensian age of the Langley Silt Complex was supported by work at Heathrow by Rose *et al.* (2000) (see Chapter 3).

The Eastwood's Pit *bout coupé* (British Museum, J. A. Brown Collection no. 2193) was recorded from brickearth above gravel, either 7m from the surface or 7m above the gravel (label unclear). The handaxe is moderately abraded suggesting that it has been transported to some degree. The other three *bout coupés* from Yiewsley and West Drayton lack stratigraphical information, however they are all slightly to moderately abraded. Part of the Langley Silt Complex is thought to have been deposited during MIS 3 (unit ii of Rose *et al.*, 2000) and is characterised by laminated silts and sands produced from aeolian rainout and sheetwash. As the *bout coupé* is associated with MIS 3 age deposits, in sites where organic remains are found alongside the handaxes, the sheetwash provides a process that may have resulted in abraded artefacts.

The Sipson *bout coupé* was found in 'brickearth' overlying Taplow Gravel. Micromorphology on the 'brickearth' and the abrasion by wind blown dust on one side of the handaxe all suggest a period of cold climate deposition within the Devensian (Cotton, 1984; Macphail in Wymer, 1988). It is probable that the heavily abraded surface of the handaxe was exposed on the land surface during late MIS 2 when cold-climate aeolian processes were in action (Rose *et al.*, 2000).



* Metres above O.D. calculated from modern Ordnance Survey maps for Feltham, Twickenham, Kew Bridge and Battersea. Not recorded in original publications.

Figure 9.13: Comparison of stratigraphies from Devensian sites in London

9.9 Lea Valley Arctic Bed Sites

9.9.1 Introduction and History of Research

The Lea Valley Arctic Bed was first identified during the early 20th century by S. H. Warren in the floodplain deposits in the lower Lea Valley at sites including Ponder's End, Angel Road, Hedge Lane and Borrowell Green in Edmonton, Temple Mills in Waltham Forest and Hackney Wick (Warren, 1912, 1916, 1923, 1940; Allison *et al.*, 1952). He recognised that there was a blue-black organic deposit beneath the floodplain that contained cold climate plant remains, beetles, shells and mammalian fossils, which varied from being predominantly composed of clay to being sandy in texture (Warren, 1912).

The deposit was traced in a series of boreholes by Gibbard (1994) and it was suggested that the Lea Valley Arctic bed represented a series of channel fills, rather than a single aggradation.

These sites overlap the time period covered by this chapter and Chapter 10, however, they are included here due to the dominance of palaeontological remains recorded in the assemblage. Only one lithic artefact could be associated with the sites (see section 9.9.6).

9.9.2 Location of Collections

Faunal remains from the Warren and Hinton Collections were seen in the Natural History Museum and an unidentified collection was observed at Reading Museum.

9.9.3 Stratigraphy

The following stratigraphy was recorded from Pickett's Lock near Ponder's End (Warren, 1912):

3. 'Brickearth' (1.2m depth)
2. Stratified gravel and sand with the Arctic bed (5.5m depth)
1. London Clay

9.9.4 Palaeontology

Table 9.17 lists the mammalian remains that were identified during this study from the Lea Valley Arctic Bed sites of Ponders End in Enfield, Temple Mills in Waltham Forest and Angel Road, Edmonton.

Species	No. of specimens	% of the assemblage	Minimum no. of individuals (MNI)
<i>Dicrostonyx</i> sp. undetermined lemming	33	47.14	1
<i>Microtus</i> sp. indet. vole.	1	1.43	1
<i>Mammuthus primigenius</i> (Blumenbach), woolly mammoth	6	8.57	3
<i>Mammuthus</i> sp. undetermined mammoth	4	5.71	1
<i>Equus ferus</i> Boddaert, horse	12	17.14	1
<i>Coelodonta antiquitatis</i> (Blumenbach) woolly rhinoceros	5	7.14	1
Rhinocerotidae sp. undetermined rhinoceros	5	7.14	1
<i>Rangifer tarandus</i> (L.), reindeer	2	2.86	1
<i>Ovibos moschatus</i> Zimmerman, musk ox	2	2.86	1
Total	70		

Table 9.17: Mammal species recorded from Lea Valley Arctic Bed Sites

Many of the species suggest the present of open grassland habitats, including *Microtus* sp., *E. ferus*, *M. primigenius*, *C. antiquitatis*, *Rangifer tarandus*, and Rhinocerotidae sp.. Reindeer and bison are both grazers and inhabit grasslands at the present day, while reindeer are particularly characteristic of tundra habitats (Nowak, 1999).

C. antiquitatis, *R. tarandus*, *O. moschatus*, and *Dicrostonyx* sp. imply cool climates, with musk ox and lemming living only in northern Palaeartic or tundra environments today (Stuart, 1982). In particular, as discussed in Chapter 7, *O. moschatus* lives exclusively on arctic tundra, today restricted to an introduced population on Greenland, the northern and western islands of the Canadian Arctic, and from northern Alaska to Hudson Bay (Hall, 1981).

9.9.5 Age of Sites

Absolute dating

Two radiocarbon dates of 28000 ± 1500 BP (Q-25) (36608-30235 cal years BP) from the fine silts in gravels in an unknown location in the Lea Valley (Godwin and Willis, 1964; Godwin, 1964) and 21530 ± 480 BP (Birm -238) (27530-24510 cal years BP)

from Deephams Sewage Works, Edmonton (Shotton and Williams, 1971) were obtained from the Lea Valley Arctic Bed deposits. These dates, if accurate, would suggest that the Lea Valley Arctic Bed deposits accumulated during the period prior to the Last Glacial Maximum.

Biostratigraphy

The dominance of cold-adapted species in the assemblage strongly suggests the presence of cold climates, thus reflecting the broad period during the Devensian suggested by the radiocarbon dates. The vast majority of the species in the Lea Valley assemblage are components of the Pin Hole MAZ associated with MIS 3, such as woolly mammoth, woolly rhinoceros, reindeer, lemming, and horse (Currant and Jacobi, 1997, 2001, 2002). Although not a specific component of the Pin Hole MAZ, musk ox was present in Britain during the Devensian (Stuart, 1977). This further suggests that the deposits accumulated immediately prior to the LGM. Furthermore, new research has suggested that woolly rhinoceros became extinct after 35,864–34,765 at 2s cal BP (Jacobi *et al.*, 2009), suggesting that if the remains of this species at these sites are *in situ*, that they represent one of the final appearances of the species in Britain.

9.9.6 Archaeology

No lithic implements were observed during this study that could be confidently associated with the Lea Valley Arctic Bed fauna. One handaxe from Hedge Lane, Edmonton (Warren Collection artefact number 4115, British Museum) was found above the Arctic Bed fauna, suggesting it is younger than the palaeontological assemblage. Other artefacts from the Lea Valley area were observed during this study (see Appendix 1) however, they could not be directly associated with the Lea Valley Arctic Bed sites and many lacked detailed provenances.

9.10 Summary of Chapter 9

It has been demonstrated by this study that the Devensian cold stage is well-represented in the London area. This study has also compiled the first complete species list for Devensian mammalian assemblages from Feltham and Isleworth and reanalysed the Kew Bridge and Twickenham assemblages, thus providing the first comprehensive appraisal since the original publications in the 1800s. Together, the Feltham, Isleworth,

Kew Bridge, Twickenham and the more recently published site at South Kensington (Coope *et al.*, 1997) are judged to span MIS 5a to MIS 3 (Early-Middle Devensian). The oldest of these, the mammal assemblages from Isleworth, Twickenham, and Kew Bridge, have been correlated with the Banwell Bone Cave MAZ and attributed to MIS 5a by Carrant and Jacobi (1997, 2001) and Gilmour *et al.* (2007). This MAZ is characterised by the dominance of reindeer and bison, in addition to wolf and very large brown bear. The faunal and palaeobotanical assemblages from these sites suggest a predominance of grassland environments, and significantly, the presence of reindeer implies the presence of tundra. The MCR calculated from the coleopteran assemblage suggest that colder winters than present were experienced at Isleworth with mean summer temperatures suggested to be 18°C and the mean January temperatures of 0°C, (Coope and Angus, 1975), also echoed by the palaeoclimatic evidence from the molluscan assemblage (Kerney *et al.*, 1982). Very similar coleopteran and molluscan assemblages were recorded from Cassington, near Oxford, although the site also yielded assemblages from higher in the sequence that reflected much colder conditions, suggesting that the site was deposited during the MIS 5-4 transition (Maddy *et al.*, 1998). Unfortunately, these much colder conditions from MIS 4 were not recorded from the sites in London.

A significant record in the Twickenham faunal assemblage is the discovery of *Saiga tatarica* (saiga antelope), a very rare species only otherwise associated with the Lateglacial interstadial in Britain. Saiga suggests that temperatures were both colder and drier than the present day as the modern species inhabited the steppes and semi-desert regions of south-eastern Europe and Central Asia from the Precaspian steppes to Mongolia and western China until recently.

The deposits at Kempton Park illustrate a period of extreme cold climate during MIS 4. The plant macrofossils suggest a virtually treeless landscape, dominated by grasses, herbs and dwarf trees (Gibbard *et al.*, 1982). Battersea and South Kensington also contain sediments previously suggested to relate to MIS 4 and 5a, although the fossil assemblage at Battersea has been reassigned to MIS 3 in this study. It has been demonstrated by this study that the stratigraphy at South Kensington is comparable with the deposits at Battersea and thus that the South Kensington assemblages may also be correlated with MIS 3. The mammal assemblage from Battersea is dominated by woolly rhinoceros and woolly mammoth with horse, reindeer and an undetermined large

bovid (*Bos* or *Bison*), suggesting the presence of grassland steppe environment and a relatively cold climate. The assemblage from Battersea is characteristic of the Pin Hole MAZ as proposed by Currant and Jacobi (1997, 2001, 2002) and correlated with the Middle Devensian, MIS 3. The other palaeoenvironmental proxies (pollen, plant macrofossils, Coleoptera, molluscs, ostracods) recorded at South Kensington corroborate the presence of cold climate conditions but also include evidence of subsequent climatic amelioration (Coope *et al.*, 1997).

The Kempton Park Terrace also yields the first evidence of hominin re-occupation of Britain since late MIS 7/early MIS 6, during MIS 3 (Currant and Jacobi, 1997, 2001, 2002; White and Jacobi, 2002; Jacobi *et al.* 1998). A diagnostic implement from this period is the *bout coupé* or flat-buttet cordate handaxe, which is considered to be characteristic of late Neanderthal manufacture. Twenty one flat-buttet cordate handaxes have been identified from London in this study.

Chapter 10: Upper Palaeolithic

Introduction

The British Early Upper Palaeolithic began ca. 45,000 years BP with the introduction of modern humans (*Homo sapiens*) and includes a hiatus of human occupation during the Last Glacial Maximum beginning approximately 26,000 years BP (Jacobi *et al.*, 2006). Re-colonisation of Britain occurred at approximately 14,700 calibrated years BP as illustrated by the archaeological industry from Gough's Cave, Somerset, attributed to the Creswellian, a local variant of the European Magdalenian (Jacobi and Higham, 2009). The period during which humans re-occupy Britain during the Lateglacial Interstadial (Greenland Interstadial 1/Bølling and Allerød interstadials) ca. 14,700-12,900 cal. years BP and the Younger Dryas or Loch Lomond Stadial (Greenland Stadial 1) ca. 12,900-11,700 cal. years BP (Jacobi and Higham, 2009) is identified as the Final Upper Palaeolithic. *Federmessengruppen* (or Azilian) industries appear ca. 12,000 BP and represent a complex technological shift from curved backed pieces that are bi-points to mono-pointed artefacts (pointed at one end only) (Bodu and Valentin, 1997; Célérier *et al.*, 1997; Pion *et al.*, 1990; Jacobi and Higham, 2009).

Assemblages representing human occupation during the Younger Dryas or Loch Lomond Stadial period are characterised by 'long blades' (>12cm in length) and 'bruised blades' (both discussed later in this section) (Barton, 1999). It was first proposed by Wymer and Rose (1976) that the Final Upper Palaeolithic assemblages be called 'long blade' assemblages, in order to distinguish them from the Late Upper Palaeolithic assemblages already recognised in Britain (Campbell, 1977; Jacobi, 1980) and early Mesolithic assemblages.

In addition to the large size of the long blades, there are other typological and technological characteristics that link the blades to the Upper Palaeolithic in southern Britain. These chiefly relate to the core preparation technique, which is typically Upper Palaeolithic in fashion, consisting of the utilisation of two opposing striking platforms and their continuing adjustment to produce blades with 'faceted' butts. It was recognised that in long blade sites in southern Britain, the occurrence of faceted butt blades was rarely lower than 20% of the assemblage (Barton, 1986a). The assemblages

also contain very low numbers of retouched tools and by-products common with Mesolithic assemblages, such as microburins (Barton, 1989).

More recently it has been recognised that long blades are usually found in association with ‘bruised’ flakes and blades in northern Europe (Britain, France and Germany) (Barton, 1986a, 1986b, 1989; Fagnart, 1992). Bruised tools, also called *lames mâchurées* (cf. Bordes, 1971) exhibit bruising on one or both lateral edges caused by ‘retouching’, crushing or rounding. This can give the appearance of heavy battering. It is believed that the bruising is a result of damage during use of the tool rather than intentional retouching (Barton, 1998). Notable British sites with assemblages that contain long blades in association with bruised blades include Sproughton in Suffolk, Avington VI, Berkshire, and Three Ways Wharf, Uxbridge – the last inside the study area (Section 10.4). It is important to note Barton’s (1998) comment that single long blades found without a provenance cannot be dated and should not be assumed to represent the Final Upper Palaeolithic. Long blades have been recorded from other archaeological periods, including the Middle Palaeolithic (Heinzelin and Haesaerts, 1983; Tuffreau, 1984), the early Upper Palaeolithic (Bordes, 1966, 1968, 1970), the Late Upper Palaeolithic (Brézillon, 1977), the Mesolithic (Bille-Henriksen, 1976; Andersen, 1973, 1978) and the Neolithic (Louwe Kooijmans, 1981). Therefore Barton (1998) suggested that assemblages containing long blades genuinely belonging to the Final Upper Palaeolithic should be reclassified as ‘bruised blade’ assemblages.

It is difficult to distinguish Upper Palaeolithic artefacts in London as many potential sites lack a robust chronology or provenance due to their historical discovery by antiquarians. Secondly, it is often challenging to identify Upper Palaeolithic finds as they show many similarities to Mesolithic artefacts. Additionally, many artefacts from London are from isolated spot-finds or surface finds and thus do not benefit from belonging to a larger assemblage, which might have more clearly-defined Final Upper Palaeolithic characteristics, as described above. Consequently it has been recognised that Late Upper Palaeolithic sites are rare in the Thames Valley (Jacobi, 1991). In this study, assemblages containing a combination of long blades and ‘bruised blades’ have been identified as representative of the Final Upper Palaeolithic occupation in London, namely Three Ways Wharf, Uxbridge (10.4), North Cray in Sidcup (10.5), Wandsworth (various locations) (10.6), Kingsway, Aldwych (10.7) and Hanger Hill, Ealing (10.8)

(Figure 10.1). In addition, single artefacts that exhibit at least one of the Final Upper Palaeolithic characteristics described above have been included as probable sites of this age. Four sites, namely the World Cargo Site in Heathrow (10.1), Syon Reach (10.2), Whitgift Street in Croydon (10.3), and Wandsworth (10.4), have artefacts that have been suggested to be older in age than the Final Upper Palaeolithic by various authors and are discussed in this chapter (Figure 10.1). The first site is attributed to the Early Upper Palaeolithic, whereas the others contain artefacts suggestive of Middle Upper Palaeolithic technologies.



Figure 10.1: Map of locations discussed in this chapter

10.1 Heathrow, World Cargo Site

10.1.1 Location of site and history of research

During excavations for a new cargo facility to the west of the aircraft stands at Terminal 4, Heathrow (TQ0714 7445), in 1995, six long blade artefacts characteristic of the Upper Palaeolithic were exposed. The site is approximately 3.5km east of the River Colne to the west and a similar distance to the River Crane to the east (J. S. C. Lewis, undated).

10.1.2 Location of Collections

The lithics were seen at the London Archaeological Archive and Research Centre (LAARC), part of the Museum of London. Two artefacts are on display in the Museum of London in the London before London gallery.

10.1.3 Stratigraphy

The surface at the site was recorded at approximately 23m OD. Taplow Gravels (Gibbard, 1985) were overlain by the Langley Silt Complex (Gibbard *et al.*, 1987).

The artefacts were recovered from the surface of the gravel, where silty clay ('brickearth') was absent. Some reworked Palaeolithic artefacts were also recovered (although not *in situ*) in Bronze Age features. No further artefacts were recovered during subsequent test pitting, suggesting the Bronze Age post-glacial human activity may have removed or dispersed further evidence for Upper Palaeolithic occupation (J. S. C. Lewis, undated).

10.1.4 Archaeology

Four of the six lithics from Heathrow are represented in Figure 10.2. The other two artefacts consist of a small dorsal fragment and a proximal end of a flake or blade.



Figure 10.2: Lithics from the World Cargo Site, Heathrow. Artefact in lower right has been called a ‘Kostenki knife’ (J. S. C. Lewis, undated). Photographs taken by Museum of London and C. Juby

All six flints had no remaining cortex, were slightly abraded, and displayed a heavy white patina and some rust spot staining. The breaks on the implements were all old and displayed the same patina as the rest of the artefact apart from one implement (shown in the top right photograph in Figure 10.2), which had broken presumably from frost, and displayed grey flint inside and had been refitted post-excavation.

The implement types from the World Cargo Site are summarised in Table 10.1.

Implement	Number of artefacts	% of assemblage
Blade	2	33.33
Blade (broken)	4	66.67
Total implements	6	

Table 10.1: Implement types from World Cargo Site, Heathrow

10.1.5 Age of Site

Although the size of the artefacts is similar to Final Upper Palaeolithic long blades, their typology was not considered to be exactly comparable (Lewis, undated). The artefacts from the World Cargo Site were considered similar to those from Beedings, near Pulborough, West Sussex by A. Roberts and R. Jacobi (in Lewis, undated). Although the most recent publication on Beedings (Jacobi, 2007), does not refer to the similarity of the assemblage with that from the World Cargo Site, Heathrow, the Beedings assemblage was described as containing Kostenki knives (knives with a truncated end used as a platform to make dorsal bladelet removals) and was attributed to the Lincombian-Ranisian-Jerzmanowichian technology characterised by blade-points. Like Beedings, the World Cargo site also contains ‘Kostenki knives’ and ‘Kostenki truncations’ (truncated, but with no dorsal bladelet removals), which are common in the Kostenki I, level I and Avdeevo assemblages in Russia. These Early Upper Palaeolithic sites were suggested to date to no earlier than 28,000 years BP and may be as young as 24,000 years BP (Jacobi, 1986); however, Jacobi (2007) compared the Beedings assemblage with sites with Lincombian-Ranisian-Jerzmanowichian technology, such as Badger Hole in the Mendip Hills, Somerset, Bench Quarry in Brixham, Devon, Pin Hole in Creswell Crags, Derbyshire, and Nietoperzowa in Jerzmanowice, north west of Cracow in southern Poland. These comparisons led Jacobi (2007) to suggest that, although the chronology of the Lincombian-Ranisian-Jerzmanowichian is poorly constrained, it is probably older than previously thought and dates to c. 45,558 -39,476 cal. BP (Jacobi, 2007) (original dates from Jacobi *et al.* (2006), Hedges *et al.* (1996) and Chmielewki (1961)). These dates suggest that, if the comparisons between the World Cargo Site and Beedings assemblages are correct, the World Cargo Site may represent one of the earliest occupation sites for the Upper Palaeolithic in Britain. A TL

(thermoluminescence) date of $31,100 \pm 5700$ BP from burnt flint from Beedings may suggest that the hominin occupation was slightly younger.

As stated above, the artefacts were found resting on the top of the Taplow Gravel and underlying the Langley Silt Complex. The bulk of the silts or loess in the Langley Silt Complex has given two TL dates of 17.8 ± 1.5 and 14.3 ± 1.2 ka BP (Gibbard, 1985; Gibbard *et al.*, 1987) within the Last Glacial Maximum, thereby offering an upper age limit to the World Cargo site occupation.

10.2 Syon Reach, Brentford

10.2.1 History of Research

The blade was found in the Thames. No further information is recorded. Syon Reach is mapped as modern alluvium by the British Geological Survey (1998).

10.2.2 Location of Collection

The artefact was seen in the British Museum, Sturge Collection.

10.2.3 Archaeology

The artefact is moderately abraded and patinated, suggesting a degree of transport and exposure prior to burial.

A second artefact from Syon Reach, Brentford, was identified as a long blade (broken proximally) by Barton (1986a) (Museum of London, Lloyd Collection, Acc. No. 49.107/37B). This accession number has not been relocated, although it is thought that it may be referring to a blade recorded from 'Old England' (a term attributed to an area of Brentford) with the accession number 49.107/375. This blade is also broken proximally.

10.2.4 Age of Site

The British Museum artefact may be described as a shouldered point (R. Jacobi, pers. comm.). Lithics of this type are believed to be slightly older in age than the curved backed points of the *Federmessergruppen* typology of the Late Upper Palaeolithic (Ellaby, 1987), which has been radiocarbon dated at Gough's Cave to between $12600 \pm$

80 (OxA-18035) (15194-14238 cal. BP 95.4%) and 12245 ± 55 (OxA-18067) (14796-13885 cal. BP 95.4%). It was suggested that the occupation associated with the *Federmessergruppen* lithics occurred towards the younger end of the date range at Gough's Cave (Jacobi and Higham, 2009), on the basis of a similar assemblage radiocarbon dated to between 12423±67 (AA-41881) (14994-14120 cal. BP 95.4%) and 12248 ± 66 (AA-41882) (14831-13873 cal. BP 95.4%) at Le Closeau in the Seine Valley (Bodu and Valentin, 1997; Bodu, 1998, 2000, 2004). Therefore it is likely that the shouldered point from Syon Reach pre-dates *Federmessergruppen* type lithics and is certainly older than ca. 13,885 cal BP, and possibly older than 14412 cal BP.

The long blade from Syon Reach can thus be broadly attributed to the Final Upper Palaeolithic due to its large size, one characteristic of assemblages of this age. However, this single find lacks the context of a larger assemblage to confirm other Final Upper Palaeolithic characteristics, such as bruised lateral edges (Wymer and Rose, 1976; Barton, 1986a, 1986b, 1989, 1999; Fagnart, 1992).

10.3 Whitgift Street, Croydon

10.3.1 Site Location and History of Research

The assemblage was recovered during excavations by Museum of London Archaeology (MOLA) in 2008 (Cotton, 2008).

10.3.2 Location of Collections

The assemblage is held at the London Archaeological Archive and Research Centre (LAARC), part of the Museum of London.

10.3.3 Stratigraphy

The artefact was found in colluvium or ploughed soil (Cotton, 2008). The area is mapped by the British Geological Survey (1998) as the Hackney Gravel and Thanet Sand.

10.3.4 Archaeology

A curved backed blade with steep retouching on the right lateral edge, in fresh condition and displaying slight patination, was recovered. Shallow scalar damage was recorded

along the left lateral distal edge. This was suggested to reflect use of the blade for a cutting or scraping function (Cotton, 2008).

10.3.5 Age of Site

The curved backed blade was suggested to be comparable with *Federmessergruppen* type pieces dated to ca. 14412-13885 cal. BP at Gough's Cave, as discussed above in relation to the Syon Reach finds (Section 10.2) (Cotton, unpublished MOLA lithics report). It is thought that the *Federmessergruppen* lithics date to the younger period in the range due to similar dates recorded at Le Closeau in the Seine Valley (Jacobi and Higham, 2009).

10.4 Three Ways Wharf, Uxbridge

10.4.1 Location of Site and History of Research

The site at Three Ways Wharf is located in the north-west of Uxbridge in the River Colne Valley (Figure 10.3).

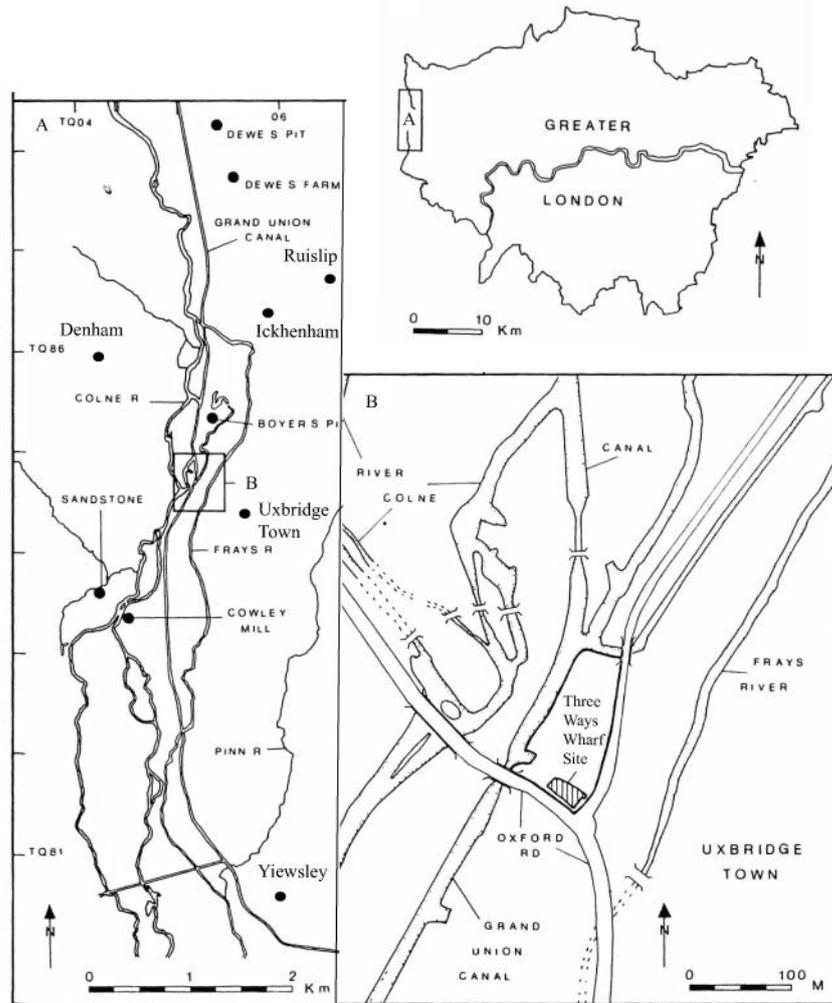


Figure 10.3: Location of the Three Ways Wharf Site, Uxbridge (Adapted from Lewis, 1991)

The River Colne Valley is a long-established area for Holocene Mesolithic occupation (Lacaille (1961, 1963). During research in 1986 by the Museum of London Archaeology department, the site of Three Ways Wharf was discovered, revealing *in situ* assemblages spanning the Upper Palaeolithic to the Mesolithic (Lewis, 1991; Lewis *et al.*, 1992). Soil micromorphology was described in Macphail (1990) and Macphail *et al.*, 2010), in addition to the interim publications by Lewis (1991) and Lewis *et al.* (1992) and recently, the site has been published in full (Lewis and Rackham, 2011 2010?).

During the excavation five artefact scatters were identified; A, B, C East, C West and D. Scatter A was recognised as Upper Palaeolithic and associated faunal material provided complementary radiocarbon dates (see below, Lewis, 1991; Lewis *et al.*, 1992). Scatter C East also contained an Upper Palaeolithic long blade assemblage but was not radiocarbon dated. Scatters B and D contained small lithic assemblages that proved difficult to date and Scatter C West contained early Mesolithic assemblages and a faunal assemblage dominated by red deer (Lewis and Rackham, 2011). Only the fauna and lithics from Scatters A and C East are therefore discussed in this study.

Three Ways Wharf illustrates the transition from the Lateglacial to the Holocene (Post Glacial), a period which is otherwise poorly represented in the British archaeological record.

10.4.2 Location of Collections

Both the faunal and lithic collections were observed in the London Archaeological Archive and Research Centre (LAARC), part of the Museum of London. A selection from the collection was on display in the Museum of London galleries at the time of writing.

10.4.3 Stratigraphy

The following stratigraphy was recorded (Lewis, 1991; Lewis *et al.*, 1992) (Figure 10.4):

6. Medieval and post-Medieval sediments
5. Calcareous tufa and grey/brown clay containing Late Neolithic/Early Bronze Age artefacts
4. Black clay containing charcoal and organic material
3. Grey clays including *in situ* lithics and faunal remains (Upper Palaeolithic and Early Mesolithic)
2. Argillaceous sediments accumulated from gentle overbank flooding
1. Colney Street Gravel

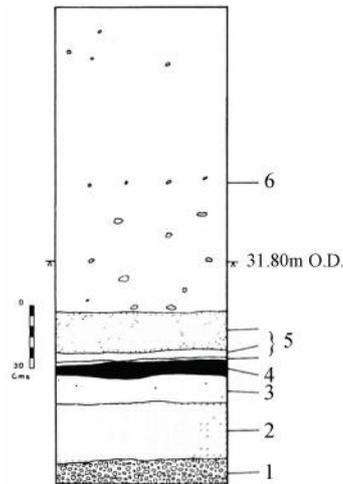


Figure 10.4: Stratigraphy recorded at Three Ways Wharf, Uxbridge (Adapted from Lewis *et al.*, 1992). Numbers correspond to the above stratigraphy description.

Colney Street Gravel was first identified on the floodplain of the River Colne in Hertfordshire, where it was found underlying post-glacial floodplain deposits (Gibbard, 1974, 1977). These deposits were later traced throughout the Colne Valley to West London, including in Uxbridge (Gibbard and Hall, 1982; Gibbard, 1985). They represent the Colne equivalent of the Shepperton Gravel of the Middle Thames valley (Gibbard, 1999).

The Upper Palaeolithic artefacts were recovered from within the grey clay horizon of Bed 3 in contrast to the Mesolithic artefacts that were recovered either from the surface of the grey clay or very near the surface. The grey clay horizon was recorded between ca. 100 and 107cm from the surface in Scatter A. In Scatter C the same horizon occurred between 24 and 32cm deep (Lewis *et al.*, 1992). Both Upper Palaeolithic and Mesolithic industries were sealed by the black clay of Bed 4 (Macphail *et al.*, 2010).

Sediment micromorphology analysis suggested that the Upper Palaeolithic occupation had occurred on braided stream sediments upon which soils had developed (Lewis *et al.*, 1992; Macphail *et al.*, 2010). The silts accumulated when the active stream abandoned its original channel, creating areas of low energy or still water, allowing the silts to fall out of suspension. Thin sections also showed evidence of calcium carbonate

depletion and flushing by calcium carbonate-enriched water within the sediments. These features are typical of Late Devensian sediments and could relate to rapid decalcification during periods of cold climate and high water flow conditions (Catt, 1979). No evidence for cryogenic processes or microfabric sedimentary structures remained, and biological activity has subsequently homogenised the sediments. It was therefore proposed that conditions were damp and the soils vegetated and containing biological activity during the occupation period.

A small portion of the fossils and lithics had worked downwards in the stratigraphy through bioturbation (Macphail *et al.*, 2010). Abandonment of the site probably occurred due to the inundation of fresh water and, following the rise in the water table, a sedge marshland developed. The thin sections revealed mottling and relict roots that were replaced by iron and manganese, suggesting gleying had occurred due to the inundation of fresh water (Macphail *et al.*, 2010). Similar micromorphological features were also recorded at the Lower Palaeolithic site at Swanscombe, Kent, where a rising water table was also inferred (Kemp, 1985).

10.4.4 Palaeoecology and Palaeontology

Palynology

Pollen preservation was poor at Three Ways Wharf, since only occasional grains of grasses and spores of ferns were recorded from the sediments underlying and overlying the black clay horizon. Only 22 taxa of pollen were recorded from the black clay horizon. Unfortunately this horizon overlies the Upper Palaeolithic and Early Mesolithic industries and therefore post-dates the Upper Palaeolithic occupation of interest here.

Mammals

Only two species were recorded from Three Ways Wharf, reindeer and horse. Numbers of specimens and MNIs are given below (Table 10.2).

Species	No. of specimens	% of the assemblage	Minimum no. of individuals (MNI)
<i>Equus ferus</i> Boddaert, horse	5	14.29	2
<i>Rangifer tarandus</i> (L.), reindeer	30	85.71	2
Total	35		

Table 10.2: Species recorded from Three Ways Wharf

Reindeer are grazing animals and naturally inhabit open arctic tundra and the surrounding boreal coniferous forests in Eurasia and North America (Novak, 1999; Stuart, 1982). Reindeer are only known from the cold stages in the British Pleistocene. Horses are also grazers and inhabit herb-dominated landscapes or open woodland. Horses are known from both interglacial and cold-climate environments (Stuart, 1982). The overall picture is therefore one of predominantly open grassland and cool conditions.

The faunal remains were found amongst burnt flint and some bone fragments also displayed evidence of burning, suggesting that the bones had been subjected to food processing by the humans (Lewis *et al.*, 1992).

10.4.5 Archaeology

The archaeological assemblage was dominated by flakes (55.5%) and blades (41.6%) although 21 ‘long blades’ were also recognised in addition to 48 cores (Table 10.3). Refitting implements were also recorded.

Implement	Number of artefacts	% of assemblage
Flake	1551	55.45
Blade	1163	41.58
Long blade	21	0.75
Core	48	1.72
Unclassified worked flint	14	0.50
Total implements	2797	

Table 10.3: Implement types from Three Ways Wharf, Uxbridge

The majority of the assemblage was recorded as unabraded (97.8%) with 2.18% exhibiting slight abrasion (Table 10.4). The low levels of abrasion and the presence of refitting artefacts indicates there was very little, if any, post-depositional movement (see figure 10.5 for example of refit). Macphail *et al.* (2010) suggested that although there was very little post depositional lateral movement, the refitting artefacts were distributed vertically within the clay suggesting they had experienced some sorting due to pedogenesis. This vertical sorting may account for the slight abrasion.

Level of abrasion	Number of artefacts	% of assemblage
Fresh	2736	97.82
Slightly abraded	61	2.18
Moderately abraded	0	0.00
Heavily abraded	0	0
Total	2797	

Table 10.4: Level of abrasion exhibited by the artefacts from Three Ways Wharf, Uxbridge



Figure 10.5: Example of refitting core and implements from Three Ways Wharf, Uxbridge. Scatter A, accession no. 10174 (Photo: Museum of London)

The artefacts varied in the degree of patination, with the majority of artefacts displaying a slight white/grey patina (Table 10.5). The implements exhibiting more extensive patinas (moderate = 13.09% of assemblage, heavy = 3.22%) may therefore have been exposed on the land surface for longer prior to burial compared to the less patinated flints, or been exposed to strong acid or alkaline conditions after burial (Burroni *et al.*, 2002).

Level of Patination	Number of artefacts	% of assemblage
Heavily patinated	90	3.22
Moderately patinated	366	13.09
Slightly patinated	1501	53.66
Unpatinated	840	30.03
Total	2797	

Table 10.5: Level of patination exhibited by the artefacts from Three Ways Wharf, Uxbridge

The assemblage contains 'bruised blades' (Barton, 1998, 1999; Lewis and Rackham, 2011) (Figure 10.6 blade with bruised lateral edges), typical of the Final Upper Palaeolithic.



Figure 10.6: Long blade from Three Ways Wharf displaying bruising on the lateral edges (Photograph: Museum of London)

Due to the presence of refitting flints in a distinct 150mm thick band, it was suggested that the occupation was a limited phase only rather than continuous (Lewis *et al.*, 1992). The scatters of artefacts were therefore interpreted as brief activity areas, the results of hunting and food processing on a bar or 'island' of a braided river (A. Boucher in Lewis *et al.*, 2002). Overall the assemblage was dominated by smaller blades and flakes, with only a small proportion of the implements (0.75%) identified as long blades. Other assemblages included in this chapter from the Final Upper Palaeolithic were collected by antiquarians or pit workers and contain a greater proportion of long blades. There is likely to be inherent bias in these collections, since long blades are more easily recognisable and were therefore more likely to have been spotted during antiquarian excavations, in comparison with the smaller blades and flakes recorded from Three Ways Wharf.

Activity of humans at Three Ways Wharf

Analysis of the assemblage at Scatter A detailed in Lewis and Rackham (2011) suggested that a small group of four to six humans occupied the site and that the occupation was probably brief. The close proximity of the flint tools and the faunal bones, suggested that the animal bones were being butchered at the site. At least one and a maximum of two reindeer, and possibly one horse were processed at the site but the initial butchery appeared to have occurred elsewhere, at the original kill site. Selected meat-bearing elements of the carcass were completely processed at the site. At Scatter C East, a similar occupation of four to six humans was suggested, who processed at least three reindeer. The analysis suggested that two of the reindeer carcasses were completely processed at the site, whereas parts of the third reindeer may have been removed from the site in order to provide food as the humans moved away. The main meat-bearing bones appeared to have been butchered and discarded adjacent to a hearth, while other bones were discarded at the edges of the site. The tools were produced from local river flint nodules at both scatters, although the assemblage at Scatter C East contained a wider range of retouched tools than Scatter A. A refitted assemblage of tools (Group 10) had many missing blade blanks, suggesting that tools were carried away from the site. Furthermore, as most of the activities occurred on the southern side of the hearth in Scatter C East, it was suggested that the smoke dispersed to the north and therefore that the prevailing wind came from the south. It was suggested that the site at Scatter C East was brief and the site was abandoned after only two or three weeks (Lewis and Rackham, 2011).

10.4.6 Age of site

Absolute dating

Two horse bones from Scatter A were radiocarbon dated to 10270 ± 100 BP (OxA-1778) or 11619 cal. years BP (94.7%) and 10010 ± 120 BP or 11226 cal. BP (95.4%) (OxA-1902) (Lewis, 1991; Lewis *et al.*, 1992). A further date of ca. 11500 cal. years BP (OxA-18702) on horse bone using the ultrafiltration method to increase precision was recorded by Jacobi and Higham (2009) (date from Fig. 10 p. 1907)). These dates place the assemblage at Three Ways Wharf within the final part of the Younger Dryas/Loch Lomond Stadial or the beginning of the Holocene (Jacobi and Higham, 2009).

Archaeology

The assemblage contains long blades and bruised blades, both considered to be significant characteristics of Final Upper Palaeolithic assemblages (Wymer and Rose, 1976; Barton, 1986a, 1986b, 1989, 1999; Fagnart, 1992). These features, in addition to the radiocarbon dating, strongly suggest that the site should be attributed to the Lateglacial and specifically (archaeologically) to the Final Upper Palaeolithic (Barton, 1999; Jacobi and Higham, 2009).

Biostratigraphy

The co-occurrence of horse and reindeer in Scatters A and C East at Three Ways Wharf may be comparable with that noted in the Lateglacial Interstadial Gough's Cave Mammal Assemblage Zone (MAZ) (Currant and Jacobi, 1997, 2001). However, it appears that Gough's Cave was abandoned around the middle part of the Allerød (Greenland Interstadial 1, ca. 13,500 cal years BP) (Jacobi, 2004) and dates obtained from Three Ways Wharf suggest a later occupation during the Younger Dryas (ca. 12,000 years BP) and the beginning of the Holocene (Jacobi and Higham, 2009). Although the mammal assemblage recovered from Three Ways Wharf is limited, none of the obligate woodland or more temperate climate taxa known from Gough's Cave (eg. European beaver, aurochs) were recorded from the former. In addition, reindeer is present at Gough's Cave only as a single archaeological artefact (the celebrated *bâton de commandement*), the lack of faunal remains implying that reindeer was not present in the landscape at the time of occupation of the cave (Currant, 2004). These factors, together with the disparate ages obtained from the two sites, mean that the assemblage from Three Ways Wharf cannot be considered directly comparable with the Gough's Cave MAZ. The increased precision of accelerated mass spectrometry (AMS) radiocarbon dating has revealed higher resolution faunal changes than previously recorded. Thus, interstadial faunas such as that from Gough's Cave and stadial faunas such as that from Three Ways Wharf can now be attributed to stages with very different climates within a relatively short period of time.

It is suggested from other sites from the Lateglacial in Britain that horses become scarce as birch woodland expanded during the Lateglacial Interstadial (Kaagan, 2000). Horses were present at Three Ways Wharf and this, in association with the lithostratigraphy and the presence of reindeer, all suggest that a cold climate prevailed at Three Ways Wharf,

thus supporting the assignment of the site to the Younger Dryas/Loch Lomond Stadial. The fauna and aspects of the sedimentary micromorphology, such as calcium carbonate depletion and flushing by calcium carbonate rich water (Catt, 1979; Lewis *et al.*, 1992) reflect cold-climatic conditions and although the radiocarbon dates span the end of the Younger Dryas/Loch Lomond Stadial and the beginning of the Holocene, the climate must still have been sufficiently cold and the landscape still open and tundra-like to support reindeer.

10.5 North Cray, Sidcup

10.5.1 Location of site and History of Research

The first implements collected in North Cray (London Borough of Bexley) were found by Mr. Arnold Vansittart in a pit on the east side of the River Cray around 1904-5. Apparently ‘thousands’ of implements were found *in situ* and many were refitted in groups of at least two implements (Chandler, 1915 p. 91). The archaeologist and then Keeper of British and Medieval Antiquities at the British Museum, R. A. Smith, mentioned to Chandler that flakes from the site had been presented to the British Museum in 1911 by Captain R. A. Vansittart, inspiring Chandler to monitor the site for further discoveries (Chandler, 1915). No further artefacts were found until 1912 when workmen found a long blade core and some flakes and passed them to Chandler who published the findings (Chandler, 1915). The pit was described as 100 yards (91.44m) to the south of ‘Foots Cray Church’ (All Saints Church) and on the west side of the River Cray (Figure 10.7) (Chandler, 1915 p. 81). Barton (1986a) described the assemblage as containing long blades, bruised blades and long blade cores.

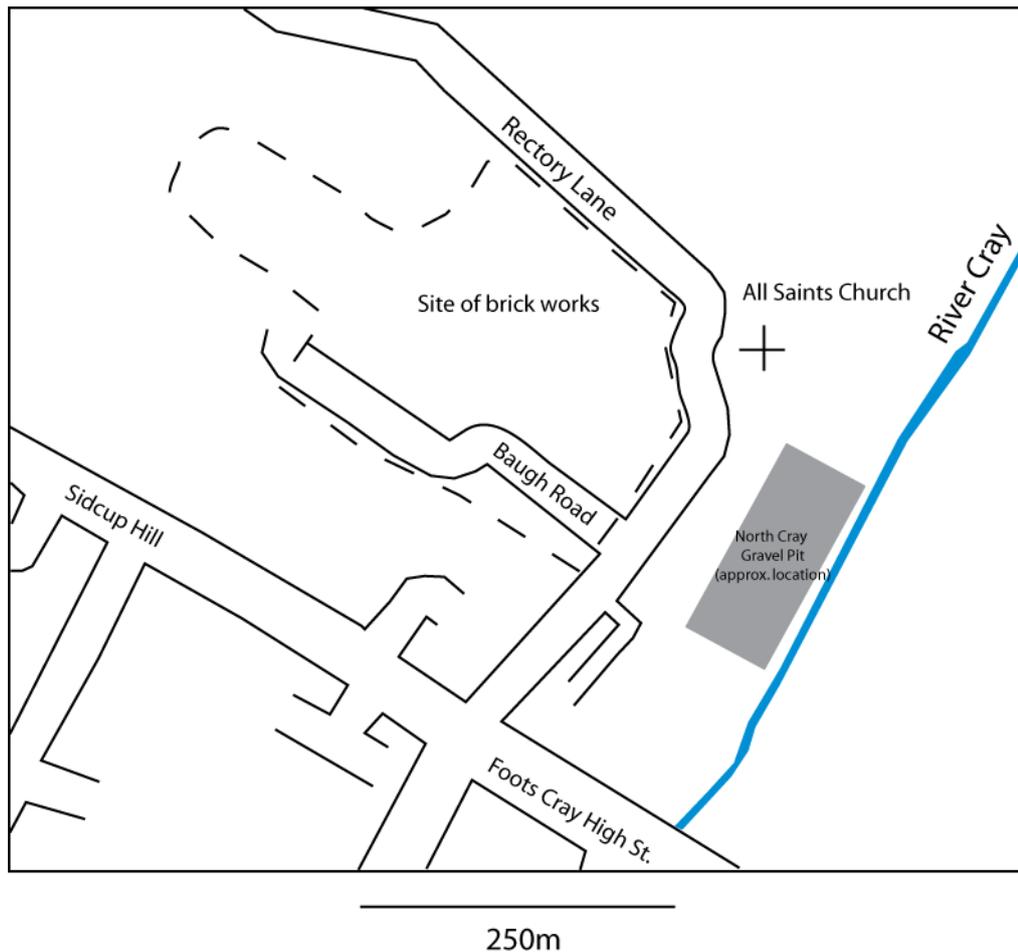


Figure 10.7: Location of the ‘North Cray Gravel Pit’ in Sidcup

10.5.2 Location of Collections

All lithics were seen at the British Museum.

10.5.3 Stratigraphy

The land surface was recorded at approximately 27m O.D and the following stratigraphy was observed at North Cray Gravel Pit (Chandler, 1915):

3. Alluvium, with shelly patches and sand lenses and occasional gravel (0.9m)
2. Gravel (2.4m)
1. Unexposed sediments hidden beneath water level

The alluvium appeared to be disturbed as it contained coal and tiles as deep as the junction with the gravel; however the flakes were found at the base of the alluvium and on top of the gravel and so were not thought to be associated with the disturbed sediments (Chandler, 1915).

The area is mapped as Taplow Gravel and alluvium (British Geological Survey, 1998).

10.5.4 Archaeology

Lithics from the Chandler Collection held in the British Museum are provenanced to the 'Foots Cray Gravel Pit' or 'Pit near Foots Cray', and not from North Cray as his publication suggested. There are another two refitting flakes collected by Chandler labelled from Crayford, but registered in his catalogue from North Cray. An additional 57 artefacts from the Vansittart, Warren (ex. Kennard), Trechmann (ex. Kennard), and Geological Museum Collections are all registered from North Cray. Two of these refitting flakes from the Trechmann Collection are also labelled from Crayford, but are remarkably similar to the other North Cray artefacts in length, typology and preservation, suggesting that they are genuinely associated with the North Cray assemblage (R. Jacobi, pers. comm.). It is considered here that all the artefacts from North Cray and Foots Cray and the four mistakenly associated with Crayford should be dealt with in the same assemblage on the basis of the similarity of the lithics and the close geographic proximity of Foots Cray and North Cray (the border is adjacent to All Saints Church mentioned in Chandler (1915). Overall there are 63 lithics from Foots Cray and North Cray analysed here (Table 10.6).

Implement	Number of artefacts	% of assemblage
Flake	25	39.68
Blade	6	9.52
Long blade	29	46.03
Core	3	4.76
Total implements	63	

Table 10.6: Implement types from North Cray

The assemblage is dominated by long blades (46.03%) and flakes (39.68%). These include refitting examples (Figure 10.8).

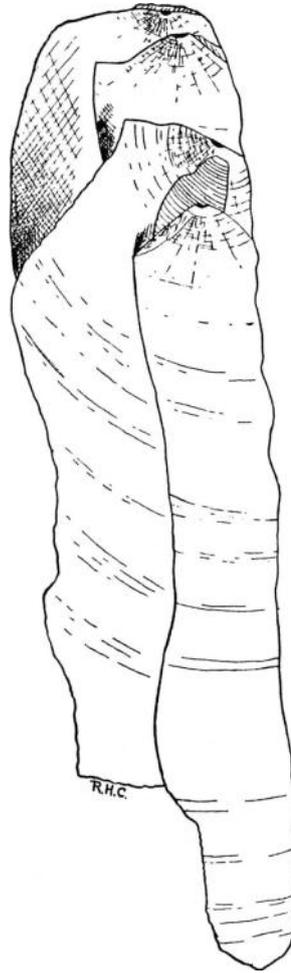


Figure 10.8: Refitting long blades from North Cray (Adapted from Chandler, 1915)

Although thousands of implements were reportedly found when the refitted pieces were discovered, only thirteen refitting groups were recorded from the assemblage during this study. All implements from North Cray displayed low levels of abrasion, with 12.7% of the assemblage exhibiting no abrasion and 87.3% demonstrating slight abrasion (Table 10.7). This suggests that they had hardly been disturbed since their original burial. All but one of the artefacts were patinated a light grey and white colour with the majority slightly patinated (61.9%) (Table 10.8). The exception to this was found in the ‘Footh Cray Gravel Pit’ specimen, suggesting that it may not be part of the same assemblage as the rest of the North Cray examples.

Level of abrasion	Number of artefacts	% of assemblage
Fresh	8	12.70
Slightly abraded	55	87.30
Moderately abraded	0	0.00
Heavily abraded	0	0
Total	63	

Table 10.7: Level of abrasion exhibited by the North Cray implements

Level of Patination	Number of artefacts	% of assemblage
Heavily patinated	7	11.11
Moderately patinated	16	25.40
Slightly patinated	39	61.90
Unpatinated	1	1.59
Total	63	

Table 10.8: Level of patination displayed by the North Cray implements

The higher degrees of patination may suggest the implements had been exposed on the land surface for a significant period of time or been exposed to acidic or alkaline conditions in the soil (Burroni *et al.*, 2002), in contrast to the artefacts displaying lower levels of patination.

Five artefacts from the assemblage were identified as bruised blades or flakes (Barton, 1986a).

10.5.5 Age of Site

The assemblage contains long blades and bruised blades, both of which are significant characteristics of Final Upper Palaeolithic assemblages (Wymer and Rose, 1976; Barton, 1986a, 1986b, 1989, 1999; Fagnart, 1992). These features, in addition to the radiocarbon dating, strongly suggest that the site can be attributed to the Lateglacial and

the archaeological assemblage specifically to the Final Upper Palaeolithic (Barton, 1999; Jacobi and Higham, 2009).

10.6 Wandsworth

10.6.1 Site Location and History of Research

The artefacts from Wandsworth are from a variety of locations:

- Unspecified (1 blade and 1 long blade)
- Thames (2 blades)
- West Hill (1 core and 1 blade)
- St. Anne's Hill (1 long blade)
- Wandsworth Road Station (long blade)
- Wandsworth Common (1 long blade)
- Watney's Estate (1 long blade)
- Waterside near Harley's Factory (1 long blade)

No publications detail the provenance of these artefacts or stratigraphy at the sites. The artefacts from St. Anne's Hill, Waterside, and the unspecified location long blade were all described by Barton (1986a), who also considered the artefact from Wandsworth Common to be of the same age.

The area contains various deposits including modern alluvium, London Clay, 'head' (silt, sand and clay with variable gravel), Hackney Gravel and Kempton Park Gravel (British Geological Survey, 1998). The most likely source for the artefacts are discussed below.

10.6.2 Location of Collections

The artefacts were observed from the Sturge Collection, held in the British Museum.

10.6.3 Archaeology

Eleven artefacts were seen from Wandsworth, with the majority of the assemblage comprising of blades (45.45%) and long blades (45.45%) (Table 10.9).

Implement	Number of artefacts	% of assemblage
Flake	0	0.00
Blade	5	45.45
Long blade	5	45.45
Core	1	9.09
Total implements	11	

Table 10.9: Implement types from Wandsworth

All artefacts exhibited low levels of abrasion and patination, suggesting they had experienced very little, if any, transportation since deposition and that they had not been exposed on the land surface for a long period of time (Tables 10.10 and 10.11).

Level of abrasion	Number of artefacts	% of assemblage
Fresh	3	27.27
Slightly abraded	8	72.73
Moderately abraded	0	0.00
Heavily abraded	0	0
Total	11	

Table 10.10: Level of abrasion exhibited by the Wandsworth artefacts

Level of Patination	Number of artefacts	% of assemblage
Heavily patinated	0	0.00
Moderately patinated	0	0.00
Slightly patinated	8	72.73
Unpatinated	3	27.27
Total	11	

Table 10.11: Patination levels exhibited by the Wandsworth artefacts

10.6.4 Age of Site

One of the blades from an unspecified location in Wandsworth is a shouldered point (no accession number, British Museum, Sturge Collection). With reference to previously-described shouldered point from Syon Reach, lithics of this type are believed to be slightly older in age than the curved backed points of the *Federmessergruppen* typology (Ellaby, 1987).

Bruising is not recorded on any of the Wandsworth artefacts, unlike the sites of Three Ways Wharf and North Cray. The lack of bruising may be explained by the small size of the assemblage and the fact that the objects were isolated finds from various localities in Wandsworth. Despite this, the style and size of the long blades and the presence of a long blade core still tentatively suggest a Final Upper Palaeolithic age for most of the objects from Wandsworth.

From the typology of the archaeology it is probable that most of the archaeology originates from the younger deposits mapped in the area such as alluvium and cold-climate ‘head’ deposits.

10.7 Kingsway, Aldwych

10.7.1 Location of site

No further details are known about the core, described as a long blade core by Barton (1986a). The road, which lies 400m to the north of the modern Thames, overlies

patches of Lynch Hill Gravel, Hackney Gravel and Langley Silt Complex (British Geological Survey, 2006).

10.7.2 Location of collections

A core was seen from the Robert Garraway Rice Collection in the Museum of London.

10.7.3 Archaeology

The core has many long blade removals from both ends, indicating that it belongs to a classic long blade assemblage (Figure 10.9) (Barton, 1986a). It is slightly abraded, suggesting it has experienced minor movement before its burial at the site. However, the core is unpatinated suggesting that it was buried relatively quickly and was not exposed on the land surface for long.



Figure 10.9: Long blade core from Kingsway, Aldwych (Photo: Museum of London)

10.7.4 Age of site

Long blade cores are one characteristic of the Final Upper Palaeolithic (Wymer and Rose, 1976; Barton, 1986a, 1986b, 1989, 1999; Fagnart, 1992) and a tentative attribution to this period can be made. However, without a large assemblage that exhibits the other characteristics of Upper Palaeolithic objects, this age cannot be completely confirmed.

It is likely that the core originated from the Langley Silt as this is dated to between the beginning of the Devensian and the Holocene, when soil formation occurred on the aeolian sediments of the Last Glacial Maximum (Rose *et al.*, 2000).

10.8 Ealing, Hanger Hill

10.8.1 History of Research

The artefact was identified by Barton (1986a) as a long blade. No further information is recorded on the artefact.

Hanger Hill mainly rests on London Clay with small patches of Black Park and Boyn Hill Gravel (British Geological Survey, 2006).

10.8.2 Location of Collection

A single artefact was seen in the Crooke Collection in Gunnersbury Park Museum.

10.8.3 Archaeology

The artefact is fresh, unstained and only slightly patinated, indicating that it was not moved from where it was discarded and it has only experienced minimal time exposed on the land surface.

10.8.4 Age of Site

The length of the blade and the fresh condition suggest the object can be attributed to the Final Upper Palaeolithic. However, the blade did not exhibit bruising, another important characteristic in recognising Final Upper Palaeolithic industries. However, bruising does not occur on all artefacts from long blade assemblages and therefore the lack of bruising may be an artefact of the absence of a larger assemblage (Wymer and Rose, 1976; Barton, 1986a, 1986b, 1989, 1999; Fagnart, 1992). Ealing predominantly contains deposits much older than the Late Pleistocene, however Hanger Hill is adjacent to the River Brent Valley and so the long blade from this location may have been found in terminal Pleistocene deposits reworked into the alluvium, or on younger superficial deposits overlying the London Clay, which outcrops in Hanger Hill.

10.9 West Drayton

10.9.1 Location of Site and History of Research

The site is a gravel pit situated to the north-west of West Drayton (TQ 053792) on the floodplain of the River Colne (Gibbard and Hall, 1982). The lithostratigraphy and plant macrofossils were recorded by Gibbard and Hall (1982) and the coleopteran assemblage was published by Coope (1982).

10.9.2 Stratigraphy

The following stratigraphy was recorded by Gibbard and Hall (1982):

4. Modern floodplain
3. Organic sediments consisting of 20cm of black detritus mud and 30cm of mottled grey and brown silty clay
2. Gravel and sand, poorly sorted and current bedded (3m)
1. London clay

The lithostratigraphy suggested the organic sediments accumulated in a shallow pool or channel of the river under slow-flowing or still conditions. Periodic flooding was suggested to have deposited the sand layers. The gravels and sands accumulated under variable energy conditions and the complexity of their geometrical arrangement suggested deposition in a braided river channel (Gibbard and Hall, 1982).

10.9.3 Palaeoenvironmental Evidence

Plant Macrofossils

The plant macrofossils from Bed 3 were found to represent cold-climatic conditions and a predominance of open ground with species such as *Armeria* (thrift), *Arenaria ciliata* (fringed sandwort), *Betula cf. nana* (dwarf birch), *Diploxys tenuifolia* (wall rocket), *Glaux maritima* (sea milkwort), *Linum cf. perenne* (perennial flax) and *Silene maritime/vulgaris* (sea/bladder campion). The only woody plant recorded was *Salix herbacea* (dwarf willow). There were also species recorded that suggested the presence of damp or marshy ground such as *Caltha palustris* (marsh marigold), *Carex* sp. (sedges), *Eleocharis palustris* (common spike-rush), *Schoenoplectus* (club-

rush/bulrush) in addition to fully aquatic environments indicated by *Myriophyllum* sp. (water milfoil), *Potamogeton* sp. (pond weed) and *Ranunculus* sp. (buttercups, spearworts and water crowfoots) (Gibbard and Hall, 1982).

Coleoptera

The assemblage, also from Bed 3, contained 21 species, all representative of cold climatic conditions, with ten species absent from Britain today: *Bembidion hasti*, *Oreodytes alpinus*, *Helophorus obscurellus*, *Helophorus glacialis*, *Olophrum boreale*, *Pycnoglypta lurida*, *Tachinus coelatus*, *Hypnoidus rivularis*, *Simplocaria metallica* and *Syncalypta cyclolepidia*. The current distribution for these species is predominantly Arctic or Siberian steppe habitats or above the present day tree line, such as for *Helophorus obscurellus*. The presence of this particular species also suggests that mean July temperatures were below 10°C (Coope *et al.*, 1971). Four more species, *Patrobis septentrionis*, *Bembidion virens*, *Arpedium brachypterum* and *Otiorhynchus nodosus* only reach as far south as northern Britain today. The record of *Tachinus coelatus* at West Drayton was a first for a Lateglacial assemblage in Britain. Today, this species inhabits the mountains of Mongolia, in birch woodlands, at altitudes of 1150-2000m above sea level (Ullrich, 1975). Together with *Helophorus jacutus* and *Tachinus jacuticus*, all three are found in Asia in the present day and are the most exotic components in the assemblage (Coope, 1982).

10.9.4 Age of Site

Absolute Dating

A radiocarbon date of 11230 ±120 BP (Q-2020) (13345-12782 cal BP, 95.4%) was determined from plant remains, placing it roughly contemporaneous with the Younger Dryas or Loch Lomond Stadial (Jacobi and Higham, 2009). This is consistent with the cold-climate flora and fauna recorded from the organic horizon.

Biostratigraphy

All coleopteran species reflect harsh climates and, in particular, *O. boreale*, *P. lurida* and *H. glacialis* suggest a Younger Dryas/Loch Lomond Stadial age, as these species are rare during other periods in the Devensian (Coope, 1982). Coope (1982) further considered *Trechus rivularis* to be a relic from the Early Devensian, since it is otherwise

unknown from the Middle and Late Devensian, whereas *Brychius elevatus* and *Anotylus nitidulus* were described as interstadial remnants since they are rare or absent from the extreme north of Europe in the present day.

10.10 Other sites and artefacts identified from the Upper Palaeolithic of London

Barton (1986a) identified the following additional artefacts to those described above (Table 10.12). Those in italics have not been viewed during this study. Unfortunately no further provenance information is known of these implements, but they demonstrate that Upper Palaeolithic occupation is well represented in London.

Site	Location of Artefact	Accession No.	Type of artefact
<i>Darenth</i>	Hythe Museum		Long Blade
<i>East Acton</i>	Pitt Rivers Museum	932	Long Blade
Erith	Museum of London	49.107/171	Long Blade
<i>Erith</i>	Gunnersbury Park Museum	725 (929)	Long Blade
<i>Erith, Long Reach</i>	F.S. Clark Private Collection		Long Blade and Bruised
Fulham, Thames	Museum of London	33.105/6	Long Blade
<i>Hackney, Brightwell</i>	Reading Museum	86.52/1	Long Blade
Ham	Museum of London	60.176/193	Long Blade
Ham	Museum of London	60.176/387	Long Blade
<i>Kingston</i>	Cambridge A and A Museum	z15147c	Long Blade
Between Ladywell and Catford	Museum of London	A16431	Long Blade
Between Ladywell and Catford	Museum of London	A16430	Long Blade
<i>Mortlake</i>	Cambridge A and A Museum		Long Blade
Teddington	Museum of London	A13701	Long Blade
<i>Woolwich</i>	Cambridge A and A Museum	z15147f (1486)	Long Blade
<i>Woolwich</i>	Cambridge A and A Museum	z15147f (1541)	Long Blade
<i>Chingford</i>	British Museum of Natural History	E1697	Probably similar age to the other Long Blade sites
<i>Dawley</i>	Gunnersbury Park Museum	76.20/258	Probably similar age to the other Long Blade sites
Ham Common, Earl of Dysart's Gravel Pit	Museum of London	A18990	Probably similar age to the other Long Blade sites
<i>Erith</i>	Manchester Museum		Probably similar age to the other Long Blade sites
<i>Erith</i>	Gunnersbury Park Museum		Probably similar age to the other Long Blade sites

Table 10.12 continued...

Site	Location of Artefact	Accession No.	Type of artefact
Ham, Thames?	Museum of London	60.176/168	Probably similar age to the other Long Blade sites
<i>Hanwell</i>	Gunnery Park Museum		Probably similar age to the other Long Blade sites
Mortlake	Museum of London	81.450/4 + 5	Probably similar age to the other Long Blade sites
Mortlake Reach	Museum of London	0777	Probably similar age to the other Long Blade sites
Petersham	Museum of London	49.107/174	Probably similar age to the other Long Blade sites
<i>Twickenham</i>	Cambridge A and A Museum	z15147c	Probably similar age to the other Long Blade sites
<i>Waltham Forest, Lockwood and Banbury Reservoirs</i>	Vestry House Museum		Probably similar age to the other Long Blade sites
<i>Wandsworth</i>	Museum of London	16.862	Probably similar age to the other Long Blade sites
<i>Wandsworth Rd</i>	Gunnery Park Museum		Probably similar age to the other Long Blade sites
<i>Wanstead</i>	British Museum	1965 2-9 71 B108	Probably similar age to the other Long Blade sites
<i>Whitton</i>	Museum of London		Probably similar age to the other Long Blade sites
Hammersmith	Museum of London	A13697	Bruised Blade
<i>Mortlake</i>	Cambridge A and A Museum	15147a	Bruised Blade
Barnes	Museum of London	0.767	Long Blade Core
<i>Brentford</i>	Cambridge A and A Museum	z31180	Long Blade Core
Brentford?	Museum of London	0.766	Long Blade Core
<i>Erith, Long Reach</i>	British Museum	93 3-13 3	Long Blade Core
<i>Richmond</i>	British Museum	2023 6796	Long Blade Core
Teddington, Thames	Museum of London	A13695	Long Blade Core

Table 10.12: Long blades, long blade cores and bruised blades identified by Barton (1986a).

10.11 Summary of Chapter 10

This study has analysed lithic assemblages made by modern humans from the Early Upper Palaeolithic site at the World Cargo Site in Heathrow, the Middle Upper Palaeolithic sites at Syon Reach, Whitgift Street in Croydon, and Wandsworth and the Final Upper Palaeolithic sites at Three Ways Wharf, Uxbridge, North Cray in Sidcup, Wandsworth, Kingsway, Aldwych, and Hanger Hill, Ealing. The assemblage from Heathrow contained 'Kostenki knives', comparable to other Early Upper Palaeolithic sites that have been dated 28-24 ka years BP (Jacobi, 1986). Assemblages attributed to the Middle Upper Palaeolithic contain shouldered points, attributed to technologies ca. 14,000 years BP, whereas long blades and bruised blades are both considered to be significant characteristics of Final Upper Palaeolithic, dated to around 11-12 ka years BP.

The site of Three Ways Wharf offers evidence of prevailing palaeoenvironmental conditions during the Final Upper Palaeolithic. It is suggested that braided stream environments were present in this part of London during the Lateglacial, with stabilisation of adjacent land surfaces (Lewis *et al.*, 1992; Macphail *et al.*, 2010). The mammal assemblage was dominated by reindeer and horse and indicates a cold climate with open grassland landscapes. The mammal bone remains from Three Ways Wharf also include some burnt pieces and were found with burnt flint specimens, suggesting that the bones had been processed for food (Lewis *et al.*, 1992; Lewis and Rackham, 2011). Furthermore the main meat-bearing bones were butchered beside the hearth, whereas the smaller bones were found scattered elsewhere, suggesting there was some transporting of food. Tools were also being transported, with some refitting groups missing large blade blanks, suggesting they had been removed from the site. The evidence from the site also suggested the prevailing wind came from the south, as the majority of the activity appeared to occur on the south side of the hearth, indicating the humans were avoiding the smoke dispersing to the north. It was suggested that the site was home to a small group of humans (maximum 6 people) for a short period of time, around 2-3 weeks (Lewis and Rackham, 2011).

Chapter 11: Discussion

11.1 Introduction

11.1.1 Aim: *Changing peoples*

This research has investigated the timing and nature of early human occupation in London from the Anglian glaciations through to the terminal Pleistocene, with archaeological assemblages reflecting changes in early human species and their technologies. These can be traced from the Lower Palaeolithic handaxe manufacture (presumed by *Homo heidelbergensis*), through the Middle Palaeolithic prepared-core Levallois technology and the later flat-buffed cordate handaxes associated with Neanderthals (*Homo neandertalensis*) to the blade-dominated assemblages associated with the emergence of modern humans (*Homo sapiens*). A comprehensive first-hand analysis of over 16400 lithic artefacts from London was performed during this study, on which the analyses and conclusions were based. This information was integrated with published records of the archaeology in order to compile a wide-ranging reconstruction of the context and use of the lithics and thus, the nature and timing of hominin occupation. Significantly, the archives from several large archaeological ‘super-sites’ have been reinvestigated, including Stoke Newington, Creffield Road in Ealing and Crayford, thus identifying ‘hot-spots’ of hominin occupation, and presumably episodes of significant population size in the London area at key times throughout the Palaeolithic. This was complemented by mapping of the key technological periods using GIS in order to explore their spatial and chronological distribution

11.1.2 Aim: *Changing landscapes*

The thesis has also placed those assemblages within a coherent yet dynamic palaeoenvironmental framework, thereby addressing the second aim of examining changing landscapes through time. This has been achieved by re-analysing in detail over 4700 fossilised mammal remains from London’s rich vertebrate assemblages. This first-hand research was integrated with available stratigraphical, sedimentological and palaeoenvironmental records, in order to evaluate the nature of different palaeoclimatic episodes and to provide a backdrop for interpreting patterns of hominin occupation. The habitat preferences of the mammal species recorded are significant indicators for the changing landscapes and climates London experienced during the Palaeolithic and the biostratigraphical composition of the assemblages can offer guidance on the ages of

individual sites. This study also attempted to establish the stratigraphical origins of each of the specimens where possible and combine this with the geological mapping and any absolute or relative dating in order to establish an age for each assemblage or locality. This research represents the first study to integrate detailed primary analysis of the Palaeolithic archaeology with the faunal evidence in order to reconstruct the environmental and climatic history of Palaeolithic London.

11.1.3 Aim: *Changing knowledges*

The third aim was to incorporate the physical evidence from the archaeological and fossil records with knowledge of the history of the collections, through study of the antiquarians and collectors that amassed this extraordinary repository. Written records such as obituaries, newspaper articles and personal notebooks, artefact catalogues and photographs of the main antiquarians from the 19th and 20th centuries were consulted in order to document their interest in the Palaeolithic, their collecting practices and explore the significance of their discoveries at the time in which they made them. It can be demonstrated that not only is there a significant value to be gained from reinterpreting old collections in the light of new chronostratigraphical and palaeoenvironmental knowledge but also that the work of these antiquarians in assembling the London archive was of major significance in driving forward the fledgling sciences of archaeology and palaeontology from the late eighteenth century onwards.

11.2 Interpreting the archive

Early human occupation is well-established in Britain from at least the early Middle Pleistocene onwards in areas adjacent to what is now London, both in East Anglia and on the Sussex Coastal Plain. However, evidence is all but absent in the London area, due in part to the (then) more northerly route of the Thames, which would have likely acted as a major corridor for the movements of people and animals, as well as a source for preservation of material. Furthermore, very little remains of deposits of potential early Middle Pleistocene age in the London area since the Thames terraces that formed post-diversion have reworked much of the existing sediment. Nevertheless, small patches of the Gerrards Cross, Stanmore, Westmill, Dollis Hill, and the Woodford/Woodford Green Gravels, previously attributed to the proto-Thames and its tributaries by various authors (see Chapters 3 and 5), do exist in north London. Although no lithics or fossil remains have to date been identified from these deposits,

such pockets of *in situ* sediment form an important resource for future investigation. In addition, the presence of rolled artefacts in the Black Park terrace (see below) may hint at the presence of early hominins in the area prior to the Anglian glaciation.

The earliest definitive evidence of hominin occupation in London has been traced to the Black Park Terrace, in gravel deposited by the River Thames as the Anglian ice retreated (Gibbard, 1979). Although the assemblages are sparse, one previously unidentified implement from Hillingdon and four new finds from Hanger Hill in Ealing were recorded during this research, in addition to previously-described implements from both these locations and from Wimbledon Common. These remnants therefore imply the presence of hominins from at least 420 000 years ago, although the palaeoenvironmental context for this occupation cannot be determined. Furthermore, since the artefacts exhibit high levels of abrasion they may, in fact, represent pre-Anglian hominin presence in London as opposed to occupation during the Anglian cold stage. As with deposits of early Middle Pleistocene age, much of the Black Park Gravel has been subsequently removed and reworked into younger Thames terraces by the process of erosion.

What may be said with certainty is that there is a sharp increase in the numbers of sites and amount of archaeology noted from the first post-Anglian interglacial. This study has significantly increased the known evidence for hominin occupation from this period, with implements from Castlebar Hill (Ealing), Ilford, Gants Hill and Enfield identified for the first time from Boyn Hill/Orsett Heath Gravels and artefacts from known Boyn Hill/Orsett Heath Gravel sites, namely Pentonville, Wanstead Park, Hornchurch, Upminster, and Rainham also reanalysed. This research has further drawn together all known twisted ovate handaxes from London for the first time, which may support evidence for hominin occupation extending into late MIS 11 and early MIS 10, since this tool type appears to be temporally restricted when recorded in significant numbers (cf. White, 1998). Unfortunately no fossils were identified from the Boyn Hill/Orsett Heath Gravels, leaving the Middle Thames in London relatively impoverished in this respect compared to the Lower Thames and East Anglia.

The next terrace in the sequence, that formed by the Lynch Hill Gravels, represents the first aggradation of the Thames for which faunal and palaeobotanical remains are

recorded in the London area. Focal points for early hominin activity are located in west and north-east London, with five key sites from the Lynch Hill/Corbets Tey Gravel re-analysed in this study: Creffield Road in Acton, Hanwell and Yiewsley, Stoke Newington and Hackney Downs, and Ilford (Cauliflower Pit). Levallois archaeology is first recognised in abundance in the Lynch Hill/Corbets Tey Terrace at Creffield Road, Yiewsley, Hanwell and in small numbers at Stoke Newington. The emergence of this technology represents an important change in hominin activity and an inferred change of species, moving from industries dominated by handaxes to the production of pre-prepared cores and flakes manufactured by Neanderthals. This development is thought to reflect a significant shift in hominin cognition and behaviour (Gamble, 1999; White and Ashton, 2003). The period correlated with MIS 10-8 inclusive remains one of the more poorly-known in terms of its archaeology and palaeoenvironmental setting. The present study has confirmed the evidence from London area as a significant contributor to the current state of knowledge.

The site at Nightingale Estate, Hackney (Green *et al.*, 2006) presents the evidence for the environments and climate present in London during MIS 9, currently a relatively poorly-known interglacial, and provides a context for hominin occupation in the area. Other sites of this age in the Thames valley, such as Purfleet (Schreve *et al.*, 2002) have proved too calcareous to preserve palaeobotanical or beetle evidence, both of which can provide significant information concerning local environment and climate. However, this is not the case at Hackney, which has yielded exceptional evidence from various biological proxies, contributing not only to understanding of the MIS 9 interglacial in southern England but also in western Europe. The coleopteran MCR estimated the mean summer temperatures as 18 or 19°C and the mean coldest month temperatures between -4 and +1°C (Green *et al.*, 2006). The ostracod assemblage suggested similar temperatures with the mean summer temperatures calculated at +15 to +19°C and the average winter temperatures ranging between -4 and +3°C (Horne, 2007). The pollen sequence from the interglacial deposits indicated the presence of damp woodland habitats in addition to open grassland areas and fluvial environments with areas of stagnant and flowing water and rich riparian vegetation.

The interglacial deposits at Nightingale Estate are underlain by probable warm climate gravels (Leytonstone Gravel) and are overlain by higher energy cold-climate gravels

(Hackney Downs Gravel) (Green *et al.*, 2006). To the north, the Stoke Newington area has yielded one of the largest lithic assemblages from London and contains unabraded tools from the 'working floor' discovered by Worthington George Smith in the late 1800s. Artificially sharpened yew stakes were discovered by Smith from the 'floor' and these have remained the only record of such artefacts in London (and indeed an exceptionally rare record of organic remains from the Middle Pleistocene of western Europe). Although now missing, these artefacts may reflect the use of spears or jabbing sticks by contemporary hominins, or may have served a different purpose, for example as construction material. The discovery of a woolly mammoth scapula on the Palaeolithic 'floor' by Smith may represent the first record of the species in Britain.

Establishing the relationship between the large Stoke Newington lithic assemblage and the interglacial deposits in Hackney Downs has been complicated by the different relative heights of the two sites, despite their close geographical proximity. This question was therefore examined at length in the present study and the findings may assist in shedding light on climatic variability *within* the MIS 9 interglacial and the Lynch Hill terrace. The Nightingale Estate interglacial deposits have been assigned to MIS 9e, indicated as the climatic optimum of MIS 9 in long terrestrial records such as EPICA (Petit *et al.*, 1999; Jouzel *et al.*, 2007; Toucanne *et al.*, 2009) and supported by the fully temperate climate indicated by the palaeobiological proxies at Hackney (Green *et al.*, 2006). It is suggested in this study that the Stoke Newington Palaeolithic 'floor' pre-dates the Hackney Downs interglacial deposits due to the higher position it occupies, although it is most likely still part of the same terrace aggradation (Lynch Hill/Corbets Tey MIS 10-9-8). The deposits at Stoke Newington are therefore suggested by this research to represent a period earlier in MIS 9e, or even a period within MIS 10. The complexity of the stratigraphy in the area has also led the British Geological Survey to map a separate and intermediate terrace between the Lynch Hill and Taplow Terraces, the Hackney Gravel. The areas mapped as Hackney Gravel by the British Geological Survey were previously recorded as Lynch Hill Gravel by Bridgland (1994) and, as discussed in Chapter 6.1, it seems likely that the Hackney Gravel deposits are a spatial continuation of the Lynch Hill Gravel. The height of the Hackney Gravel is also comparable with the height of the Lynch Hill/Corbets Tey Gravel in the Middle and Lower Thames. Therefore it is likely that the Hackney Gravel is not a separate gravel but is, in fact, the Lynch Hill Gravel. Despite the lack of mammal remains at Hackney

Downs, the multi-proxy analyses from the site have offered one of the most detailed palaeoenvironmental reconstructions for any MIS 9 site in Europe (Green *et al.*, 2006).

Although modest in terms of numbers of specimens, the mammal fauna identified during this research from Cauliflower Pit, Ilford, is the first time that the assemblage has been fully described, separately from the better-known and younger Ilford Uphall Pit assemblage. The Cauliflower Pit mammals included *Stephanorhinus hemitoechus*, *Stephanorhinus kirchbergensis*, *Cervus elaphus*, and *Panthera leo*, which complement the other palaeobiological proxies known from Hackney for this period. The assemblage broadly indicates the presence of open grasslands, with some deciduous or mixed forest at the site and the accompanying molluscan assemblage suggests the presence of well-vegetated, slowly flowing or still water. This study has located 22 previously unidentified artefacts from near the site of the Cauliflower Pit in Ilford, in addition to the single item previously described by Wymer (1968) and Roe (1968a).

The lithic analyses presented here of the archaeology from Hanwell and Cauliflower Pit represent the first research into these assemblages since their discovery in the late 19th and early 20th centuries. Levallois tools were also recorded from Hanwell, Yiewsley and Stoke Newington but unfortunately were not *in situ* as at Creffield Road. The present study has determined that the assemblages from Hanwell and Yiewsley (the latter being particularly substantial) are predominantly derived from older deposits and are therefore of more limited use for future research.

Unfortunately it has not so far been possible to discuss in any depth the likely age of the first recorded Palaeolithic implement from London, the Gray's Inn handaxe (introduced in Chapter 4). It is possible that this important object was found in the Lynch Hill Gravels mapped in this location by the British Geological Survey (2006). Therefore the artefact appears to date to some period between MIS 10-8, although it may have been reworked from older gravels since it exhibits some abrasion.

Lower Palaeolithic artefacts were also recovered from South Woodford, near Ilford in relatively undisturbed deposits in the Corbets Tey Gravel (White *et al.*, 1998) (collections were not seen during this study). Due to the gravel deposit this assemblage was discovered in, the assemblage was also correlated with MIS 10-9-8. The bifaces at

this site all displayed evidence of heavy wear and the majority had their tips damaged due to heavy percussions. Two handaxes also displayed reworking of the broken tips suggesting they had been re-used. Furthermore, traces of meat polish were detected on one handaxe suggesting the tool was used for butchery at the site. The damage exhibited on much of the collection was considered consistent with butchery activities such as joint breakage and bone splitting (cf. Keely, 1993). The site at South Woodford offers further evidence on the hominin behaviour in the London area during MIS 10-9-8.

The remarkably fresh nature of the Levallois tools at Creffield Road, from the Palaeolithic 'working floor' identified by John Allen Brown, emphasises the place of this locality as one of the most celebrated Levallois sites in Britain. In addition, this rich assemblage offers important insights into changing early human behaviour and activities. The Levallois cores found at Creffield Road are completely exhausted but are much smaller than the Levallois flakes discovered at the site, indicating that the hominins were discarding the used Levallois cores at the site, where presumably there were sufficient flint nodules to prepare new cores from which the large flakes were struck. Thus, Creffield Road gives an important insight into Neanderthal activity and behaviour, through the demonstration of raw material transportation and discard patterns. Additionally, many of the flakes at the site had thinned butts suggesting they may have been hafted (Scott, 2006; White et al., 2006), probably as spear tips. This adds to the growing body of evidence of the importance of hunting in Neanderthal societies. Although direct evidence of hunting is rare, such as cut-marks on bones, the body of indirect evidence is growing in Europe to suggest Neanderthals and other hominins were hunting in order to procure food. For example, the spears and shorter jabbing sticks discovered in Schöningen, Germany (Thieme, 1996, 1997), the spear from Lehringen, Germany (Adam, 1951) and the evidence suggesting hominins deliberately drove mammoths over the cliffs into mires to enhance their hunting success at La Cotte, Jersey (Scott, 1980). Furthermore, recent bone isotope-based research has suggested Neanderthal bones contained a substantially higher proportion of ^{15}N in comparison to other predators such as hyaenas, and therefore reflects diets based on prey with different ^{15}N enrichment (Bocherens *et al.*, 2005). Hyaena prey is predominantly large to medium ungulates, with smaller proportions of large mammals, such as woolly rhinoceros and woolly rhinoceros, whereas this evidence suggests the Neanderthals consumed significantly larger proportions of woolly rhinoceros and

woolly mammoth. The authors suggested that woolly mammoth and rhinoceros would have been rarer in the landscape and therefore the Neanderthals must have used hunting strategies in order to have access to significantly higher quantities of mammoth and rhinoceros meat. The Neanderthal hunting site of Salzgitter-Lebenstadt in Germany (Gaudzinski and Roebroeks, 2000), has also reflected that Neanderthals were selective in their hunting methods and chose the highest quality and largest reindeer of the herd. The faunal remains at the site are predominantly adult reindeer and are associated with stone tools, presumably used in the hunting and/or the butchery that took place post-kill.

Once in the Taplow/Mucking terrace of MIS 8-6, the mammalian faunal evidence becomes substantially richer. The assemblages from Crayford and Ilford (Uphall Pit) have recently been reinvestigated and placed within a biostratigraphical framework by Schreve (1997, 2001a). The renowned Levallois assemblage from the former has also been re-evaluated by Scott (2006). This study has therefore attempted to integrate the evidence from the complete archaeological assemblages with the palaeontology as well as the palaeobotanical and lithostratigraphical data from each site for the first time since their discoveries in the late 19th and early 20th centuries. The sites of Plumstead, East and West Wickham have also been revisited during this study for the first time since the work of Kennard (1944). Biostratigraphical analysis of the mammalian assemblages from the two key sites, in particular the presence of species such as *M. trogontherii*, *Stephanorhinus kirchbergensis*, *Stephanorhinus hemitoechus*, *Panthera leo*, *Equus ferus* and *Coelodonta antiquitatis*, allows correlation of Crayford and Ilford (Uphall Pit) with the Sandy Lane Mammal Assemblage Zone (MAZ) (Schreve, 2001a,b, 2004c). This MAZ is characteristic of late MIS 7 environments, which consist predominantly of temperate open grasslands and which have been correlated with MIS 7a based on high precision U-series dating at the MIS 7 site of Marsworth (Candy and Schreve, 2007).

The presence of *B. primigenius*, *P. antiquus* and *S. kirchbergensis* at both sites indicate the climate was fully temperate and the environments inferred from the fauna suggest the predominance of open grassland habitats, although woodlands were also represented. The Ilford (Uphall Pit) assemblage represents a site with a remarkable fossil assemblage, characterised by large, often articulated faunal fossils such as *Mammuthus trogontherii*. The Crayford faunal assemblage contains species that are typically disharmonious and representative of both cool and temperate climates. Cool

climate species include *Coelodonta antiquitatis*, *Ovibos moschatus*, *Lemmus lemmus* and *Dicrostonyx* cf. *torquatus*, with the latter three species living only in northern Palaeartic or tundra environments today (Stuart, 1982). The record of *O. moschatus* is unusual in London since it is only recorded from Crayford and the nearby site of Plumstead and West and East Wickham. This species lives exclusively on arctic tundra, today restricted to an introduced population on Greenland, the northern and western islands of the Canadian Arctic, and from northern Alaska to Hudson Bay (Hall, 1981). This species has also been recorded from Taplow, Buckinghamshire (Gibbard, 1985) from MIS 6 cold climate gravels, suggesting that the appearance of *O. moschatus* may have occurred in MIS 6 during the extremely cold conditions associated with a glacial period.

This part of MIS 7 is believed to reflect a continental climate with warm summers and cold winters (Kennard, 1944; Schreve, 1997), towards the end of the interglacial. The appearance of steppic or tundra species in Britain at this time could have been facilitated by a preceding brief period of cold-climate conditions within the interglacial, during which lowered sea levels created a land bridge to allow the immigration of these animals into Britain (Schreve, 1997, 2001a, 2001b; Candy and Schreve, 2007). The molluscan faunas at both sites suggested the fluvial environments were slowly flowing, with some areas of faster flow and some local differences; the Ilford molluscan fauna suggested the site was well vegetated, whereas Crayford was less rich.

Despite the similarity of the palaeontology at the two sites and their inferred ages, Ilford (Uphall Pit) lacks any significant lithic archaeology, whereas Crayford has a rich assemblage of fresh Levallois tools and older derived implements, suggesting either an extended period of hominin occupation or a large group size. The extensive Levallois assemblage, its fresh condition and the many refitting pieces ensure that Crayford should be regarded as arguably the premier Levallois site in Britain. An unusual component of the Crayford faunal assemblage is a horse phalanx with an artificially smoothed posterior side, most likely produced by hominins and again representing a very rare organic artefact. The fauna from the 'brickearths' at Plumstead and East and West Wickham were found to be similar to the Crayford Lower Brickearth assemblages. However, it was proposed by Kennard (1944) that the 'brickearths' at the first three sites were colluvial in origin. It is therefore suggested in this thesis that the deposits

accumulated during a period of cooling climate when increased rainfall instigated movement of material downslope, thereby reworking the older deposits containing faunal remains.

In terms of the Last Interglacial, this study has presented the full mammalian faunal list from the iconic site at Trafalgar Square for the first time and integrated it with the published molluscan and coleopteran assemblages and lithostratigraphy. The faunal assemblages from Acton and Brentford have also been fully reanalysed during this study and placed within the modern chronology of the Late Pleistocene. Additional sites yielding specimens of *Hippopotamus amphibius*, an Ipswichian indicator species, have been identified for the first time by this study, namely Greenwich, Croydon, Camden, Wembley, and the Leadenhall Street, City of London. The site of Peckham has previously been identified as containing Ipswichian sediments on the basis of the palynology (Gibbard, 1994), yet the fossil mammal assemblage was not identified. The re-examination of the assemblage in this study now offers further support to correlating the interglacial deposits at Peckham to the Ipswichian. The research in Chapter 8 has added substantially to the corpus of established Last Interglacial sites and has highlighted the potential of new areas for future investigation.

The most complete reconstruction of the landscapes and climate during the Ipswichian interglacial in London can be made from the Trafalgar Square assemblages. The molluscs predominantly indicate the presence of a fast flowing, well-vegetated river (Preece, 1999) and the Coleoptera and plant macrofossil assemblages reveal that the climate was warmer than the present day, perhaps up to 4°C warmer, based on the coleopteran MCR calculations of mean summer temperatures ranging from 18 to 24 °C and mean winter temperatures between -6 to +6 °C. Warmer summers were further indicated by the presence of *Trapa natans* and *Acer monspessulanum* (water chestnut and Montpellier maple), two southern plant species now found in Mediterranean regions, Africa and Asia (Sparks and West, 1972; Keen *et al.*, 1999; Gao *et al.*, 2000). The most significant component of Ipswichian mammalian assemblages is *Hippopotamus amphibius*, which is not known from any other interglacial in the late Middle and Late Pleistocene in Britain. This species is presently confined to sub-Saharan Africa and along the Nile, extending to the delta (Ansell in Meester and Setzer, 1977). This distribution supports the MCR and plant macrofossil evidence for warm

summers and mild winters. The assemblage from Trafalgar Square also includes giant deer, straight-tusked elephant, brown bear, spotted hyaena, narrow-nosed rhinoceros, fallow deer and red deer and thus allowed the site to be correlated with the Joint Mitnor Cave MAZ, identified by Carrant and Jacobi (1997, 2001) for the British Ipswichian faunas. Overall the fauna represented open grassland habitats with some areas of nearby woodlands.

A significant characteristic of the Ipswichian interglacial sites is that they lack evidence for both horses and hominin occupation (Stuart, 1976; Carrant, 1986; Wymer, 1988; Carrant and Jacobi, 1997, 2001; Schreve, 2001a). The absence of hominin occupation during MIS 5e in the London area was upheld by the findings of this study. It has been suggested that this absence of hominins during MIS 5e (and from MIS 6 through to MIS 4 (Jacobi *et al.*, 1998; Ashton and Lewis, 2002)), may be due to a breach of the land bridge connecting Britain to continental Europe in the preceding stage, thus preventing the migration of hominins into Britain. The timing of this breach is discussed in section 11.3.

As might be expected for the most recent part of the Pleistocene, assemblages representing the Devensian cold stage are relatively well represented in the London area. Indeed, the evidence from London provides important support for the mammalian biostratigraphical models recently proposed by Carrant and Jacobi (2001) for the Late Pleistocene. Deposits (and assemblages) of Early Devensian age appear particularly abundant in the study area. Notably, this research has compiled the first complete species list for Devensian assemblages from Feltham and Isleworth and reanalysis of the Kew Bridge and Twickenham assemblages has provided the first comprehensive appraisal since the original publications in the 19th century. Together, the Feltham, Isleworth, Kew Bridge, Twickenham and the recently published site at South Kensington (Coope *et al.*, 1997), span MIS 5a to MIS 3 (Early-Middle Devensian). The oldest of these, the mammal assemblages from Isleworth, Twickenham, and Kew Bridge were correlated with the Banwell Bone Cave MAZ and attributed to MIS 5a by Carrant and Jacobi (1997, 2001) and Gilmour *et al.* (2007). This MAZ is characterised by the dominance of reindeer and bison, in addition to wolf and very large brown bear. The faunal and palaeobotanical assemblages from these sites suggest a predominance of grassland environments, and significantly, the presence of reindeer implies the existence

of tundra. The MCR calculated from the coleopteran assemblage suggest that colder winters than present were experienced at Isleworth, with mean summer temperatures suggested to be 18°C and the mean January temperatures of 0°C (Coope and Angus, 1975), as also echoed by the palaeoclimatic evidence from the molluscan assemblage (Kerney *et al.*, 1982).

A significant record in the Twickenham faunal assemblage is *Saiga tatarica* (saiga antelope), a very rare species only otherwise associated with the Lateglacial interstadial in Britain. Saiga suggests that temperatures were both colder and drier than the present day as the modern species inhabited the steppes and semi-desert regions of south-eastern Europe and Central Asia from the Precaspian steppes to Mongolia and western China until recently. The antelope even has a specially-adapted muzzle to deal with arid conditions. The single, stratigraphically-unprovenanced record of saiga antelope from Twickenham may suggest that the site contains deposits of varying ages, including the Lateglacial, or may be a genuine Early Devensian record (thereby complementing the evidence from other parts of western Europe, where saiga has a longer stratigraphical range). Radiocarbon dating of this important specimen would appear to be the way forward to determine which of these scenarios is the more likely.

The deposits at Kempton Park illustrate a period of extreme cold climate during MIS 4. The plant macrofossils suggest a virtually treeless landscape, dominated by grasses, herbs and dwarf trees (Gibbard *et al.*, 1982). Battersea and South Kensington also contain sediments previously suggested to relate to MIS 4, although the fossil assemblages at these two sites have been assigned to MIS 3 in this study. The mammal assemblage from Battersea is dominated by woolly rhinoceros and woolly mammoth and also included horse, reindeer and an undetermined large bovid (*Bos* or *Bison*), suggesting the presence of grassland steppe environment and a relatively cold climate. All of the aforementioned species are characteristic components of the Pin Hole MAZ as proposed by Currant and Jacobi and correlated with the Middle Devensian, MIS 3 (1997, 2001, 2002). The other palaeoenvironmental proxies (pollen, plant macrofossils, Coleoptera, molluscs, ostracods) recorded at South Kensington corroborate the presence of cold climate conditions but also include evidence of subsequent climatic amelioration (Coope *et al.*, 1997).

Mapping and identifying the lower, younger, terraces of the Thames is not always possible, especially where they are located close to the modern river, as often they overlap or are submerged. Recent work by Bridgland *et al.* (2010) has shown that rivers beyond the ice limit of MIS 2, such as the Trent, show very little or no post-LGM incision and therefore it can be suggested that the final incision of the terrace sequence occurred during MIS 2. In these rivers, last glacial sediments are recorded directly beneath the Holocene alluvium. In contrast, rivers within the limits of the last glaciation exhibit later terrace incision occurring within the Holocene. The authors suggest that the key explanation for these differences is glacio-isostatic uplift occurring in areas glaciated during MIS 2. On the basis of this research, it is likely that the final aggradation of the Thames was produced during MIS 2, and therefore the penultimate aggradation (Kempton Park Gravel) was deposited during the glacial-interglacial cycle prior to this, MIS 5d-2.

It is significant that a Pin Hole MAZ assemblage, attributed to MIS 3, has been identified within Kempton Park Gravels at sites such as Feltham, since it offers further support to the Kempton Park Gravel occupying MIS 5d-2. The recent research by Bridgland *et al.* (2010) also suggests that at all sites in the Thames terraces that can be correlated with MIS 3, despite that the identification of the Kempton Park Terrace or Shepperton Terrace is not always clearly separated.

The first evidence of hominin re-occupation of Britain since late MIS 7/early MIS 6 coincides with MIS 3 (Currant and Jacobi, 1997, 2001, 2002; White and Jacobi, 2002; Jacobi *et al.* 1998). It has been suggested that following the breach of the land bridge to the continent, at some point prior to MIS 5e, the return of hominins was not possible until the climate became more hospitable during MIS 3 (Ashton and Lewis, 2002). A recent MCR inferred temperature range for this time period (based on the coleopteran assemblage from Lynford, Norfolk) suggests a mean July temperature of 12-14°C and a mean of -10°C or lower during the coldest month (Boismier, 2003). During this time the sea level would have been lower thus facilitating the movement of humans across the channel. A diagnostic implement from this period is the *bout coupé* or flat-buttet cordate handaxe, which is considered to be characteristic of late Neanderthal manufacture. Twenty one flat-buttet cordate handaxes have been identified from London in this study and therefore add to the list of sites where flat-buttet cordates have been found.

Finally, this research has analysed the assemblages from the Early Upper Palaeolithic site at the World Cargo Site in Heathrow, the Middle Upper Palaeolithic sites at Syon Reach, Whitgift Street in Croydon, and Wandsworth and the Final Upper Palaeolithic sites at Three Ways Wharf, Uxbridge, North Cray in Sidcup, Wandsworth, Kingsway, Aldwych, and Hanger Hill, Ealing. The assemblage from Heathrow contained ‘Kostenki knives’, comparable to other Early Upper Palaeolithic sites that have been dated 28-24 ka years BP (Jacobi, 1986). The Middle Upper Palaeolithic assemblages contain shouldered points, attributed to technologies ca. 14,000 years BP, whereas long blades and bruised blades are both considered to be significant characteristics of Final Upper Palaeolithic, dated to around 11-12 ka years BP.

Although there is good evidence from the archaeological record for these new technologies, exclusively produced by modern humans, only the Final Upper Palaeolithic site of Three Ways Wharf has any evidence of prevailing palaeoenvironmental conditions. In this case, it is proposed that braided stream environments prevailed in this part of London during the Lateglacial, with stabilisation of adjacent land surfaces (Lewis *et al.*, 1992; Macphail *et al.*, 2010). The mammal assemblage was dominated by reindeer and horse and indicates a cold climate with open grassland landscapes. Reindeer is only known from cold stages in the British Pleistocene and inhabits arctic steppe tundra and the surrounding boreal coniferous forests in Eurasia and North America (Novak, 1999). Although the evidence is limited, the composition of the mammal assemblage suggests that it may be slightly younger than the Lateglacial Interstadial Gough’s Cave MAZ of Currant and Jacobi (2001). This would reflect well the considerable palaeoclimatic complexity apparent at this time and assists in current attempts to refine the history of the mammal fauna in Britain during the terminal Pleistocene. The mammal bone remains from Three Ways Wharf also include some burnt pieces and were found with burnt flint specimens, suggesting that the bones had been processed for food (Lewis *et al.*, 1992; Lewis and Rackham, 2011).

The lithic assemblage from Three Ways Wharf reflected that a small group of four to six individuals occupied the site for just a few days. There was also evidence to suggest that tools were removed from the site and taken elsewhere, as several of the refitting nodules were missing blade blanks. Finally, the majority of the activities at Three Ways Wharf occurred on the southern side of the hearth in Scatter C East, suggesting that

either the prevailing wind came from the south or that there was a shelter in the north (Lewis and Rackham, 2011).

The evidence from Three Ways Wharf is reflected at three other sites in the Lower Colne Valley; Denham in Buckinghamshire, Church Lammas, Staines, Surrey and the Sanderson site in Uxbridge (Wessex Archaeology, 2002, 2005). A small assemblage of long blades, comparable with the Three Ways Wharf site was discovered at Denham. Two of the lithics refitted and suggested *in situ* occupation at the site. The archaeological deposits were overlain by peat, which was radiocarbon dated to 9300 ±50 BP (NZA – 19306) (10653-10296 cal BP, 95.4%), suggesting the occupation was broadly contemporaneous with that of Three Ways Wharf (Wessex Archaeology, 2002, 2005). The assemblage excavated from Church Lammas, Staines, contained long blades, also comparable with the larger Three Ways Wharf site. Due to the close proximity of the sites and the comparable assemblages and distribution of the tools, it was suggested that the group of humans responsible for the Three Ways Wharf were also responsible for the Church Lammas assemblage (Jones, undated). Remains of reindeer and horse were also associated with the long blade implements, enabling further comparisons with the Lateglacial mammal assemblage at Three Ways Wharf (Jones, undated).

11.3 The London evidence in the context of connections to the European mainland

Access for hominin and mammalian populations to Britain during the Palaeolithic is suggested to be controlled by the timing of the breach of the Weald-Artois ridge connecting Britain to mainland Europe and by subsequent changes in relative sea level that are climatically-driven. Prior to the Anglian glaciation, Britain was permanently connected to the continent by the Chalk ridge, thereby allowing free movement of animals and people. This connection is reflected in similarities between sites on either side of the English Channel. For example remarkable similarities have been recorded in mammal faunas at West Runton, Norfolk and Voigstedt, Germany (Stuart, 1981; Preece and Parfitt, 2000). This connection was brought to a halt possibly by a megaflood in the area of the English Channel, which drained a large pro-glacial lake in the southern North Sea basin and ultimately breached the terrestrial connection (Gibbard, 1988, 1995; Gupta *et al.*, 2007) or by a large-scale palaeoflow of the now submerged 'Channel River' (e.g. Toucanne *et al.*, 2009; Westaway and Bridgland, 2010). Establishing the timing and the cause of this breach is paramount to understanding

the presence or absence of mammal species and hominins in the London area at various times throughout the Pleistocene. The breach would have created a marine barrier that would have been impassable to hominins without boats and therefore the only time they could attempt to cross would have been during periods of lowered sea level (White and Schreve, 2000). However, even during lower sea levels, the Channel River system would still have been a significant barrier to migration. The fluviially eroded channels on the bed of the English Channel are up to 250m wide and up to 10m deep, suggesting that the rivers present during the low sea level periods were still substantial in size (Gupta *et al.*, 2007). Therefore if hominins wanted to cross the Channel River system from France, they would most probably have to travel further north to avoid the channels and enter Britain from the far east of Kent. It has further been proposed that Britain's hominin population peaked between MIS 13 and MIS 10, after which it steadily declined into MIS 8 and dramatically dropped after MIS 7 (Ashton and Lewis, 2002). Establishing the timing of periods when Britain was isolated from continental Europe may offer an explanation for these patterns.

Ashton and Lewis's (2002) model for declining hominin populations in Britain during the Middle and Late Pleistocene was based on a simplistic calculation of the number of handaxes and Levallois flakes and cores from each terrace of the Middle Thames. The choice of using handaxes as a proxy for human occupation attempted to minimise the antiquarian collector bias on tools, since handaxes are the most recognisable and attractive implements. However, this approach must itself be open to question, since one handaxe cannot be taken as a proxy for one individual. Levallois flakes and cores were included by these authors to increase the assemblage size used in the research. It is not possible to consider whether tool discard is a direct reflection of hominin populations and whether the effect of raw material availability or artefact function may also have an effect on the frequency of tool discard, irrespective of hominin numbers (Ashton and Lewis, 2002). Again, this admission creates a problem with understanding demographic patterns, since it is apparent that from the Middle Palaeolithic onwards, Neanderthals increasingly curated their tools (ie. they were not manufactured, used once and then discarded at the activity area, as often seems to be the case for the Lower Palaeolithic). This new behaviour is exemplified by the evidence from Creffield Road, where Neanderthals are clearly transporting and re-using Levallois cores.

Recent work on the bathymetry of the English Channel has revealed landforms that suggest two stages of the breach occurred, however it was not possible to establish the

exact timing of the two events (Gupta *et al.*, 2007). It has been suggested that an initial breach occurred during the Anglian Glaciation (MIS 12) (Gibbard, 1995), with a possible second breach much later, possibly in MIS 6 (Gupta *et al.*, 2007). The first significant difference between British and continental molluscan faunas is not recorded until MIS 5e (Meijer and Preece, 1995; Keen, 1995), when it is clear that the Strait of Dover was definitely open (Gupta *et al.*, 2007). However, Lusitanian molluscs are now known from deposits in the Netherlands that are dated to MIS 7 (Meijer and Cleveringa, 2009), suggesting the argument for a late breach of the Strait of Dover may be less likely. Furthermore evidence from marine boreholes in the Celtic Sea/Bay of Biscay, suggest that large volumes of sediment were deposited in the Channel River in MIS 10, MIS 8 and MIS 6 as well as MIS 2, thereby requiring the Strait of Dover to have already been breached and for the 'Channel River' to be developed, by MIS 10 (Toucanne *et al.*, 2009). Further evidence for suggesting breach of the Dover Strait occurred early, during MIS 12, is offered by the overall disposition of sediment within the North Sea. It has been noted that during the Pliocene, Early Pleistocene and early Middle Pleistocene the southern North Sea experienced continuous stacked deposition (e.g. Cameron *et al.* (1992)). However, since the Anglian, the North Sea has experienced only intermittent sedimentation. Thus it can be suggested that the sediment has been transported elsewhere, such as into the 'Channel River' and into the Atlantic Ocean (cf. Toucanne *et al.*, 2009).

The most recent large palaeoflow of the 'Channel River' was during MIS 2 and Westaway and Bridgland (2010) calculated that the discharge from the River Rhine was the main contributor to this outflow. These calculations were also consistent with the offshore stratigraphy and geomorphology emanating from the mouth of the Rhine. Despite the large volume of discharge, the authors also could not find any evidence for a catastrophic breach of the Strait of Dover. It was suggested that the large scale palaeoflows of the rivers entering the 'Channel River' were characteristic of these rivers during the Pleistocene (Westaway and Bridgland, 2010).

Ashton and Lewis (2002) proposed that if the land bridge was breached during deglaciation after MIS 12 (as it seems likely from the above discussion), then the population influx must have been sufficiently large to be sustained throughout MIS 11-MIS 7. In contrast to Ashton and Lewis (2002), this study has demonstrated that, following the Anglian Glaciation, evidence for hominin occupation in London (even

reworked) is relatively poor until the Lynch Hill/Corbets Tey Terrace. Clearly, if the assemblages from sites just outside London in the Thames Valley, such as Swanscombe were included as they are in Ashton and Lewis (2002), more artefacts would be associated with the Boyn Hill/Orsett Heath terrace. The pattern described by Ashton and Lewis (2002) is however, reflected in London from the Lynch Hill/Corbets Tey terrace onwards, as this terrace is richer in terms of hominin occupation (as measured by ‘super sites’ or hotspots for archaeology sites) than the subsequent terrace, the Taplow/Mucking Terrace. The former includes Stoke Newington and the surrounding sites of Lower and Upper Clapton, Stamford Hill and Hackney Downs and the sites in West London such as Yiewsley, Creffield Road and Hanwell. Together, these sites contained over 3600 unabraded or slightly abraded implements (all tool types were included in this calculation), suggested to be virtually *in situ*. In contrast, the Taplow/Mucking Terrace was found to host only 429 unabraded or slightly abraded implements. Only the implements from the ‘super sites’ discussed in this thesis have been included in these calculations, however lithics from single find spots or smaller assemblages would not affect the overall proportion of implements contained in each terrace. Therefore the evidence from London supports the theory proposed by Ashton and Lewis (2002) of declining populations from MIS 9 to MIS 7 in Britain. However, it still remains that the number of tools recorded may not truly reflect hominin populations, especially in the Middle Palaeolithic with the emergence of Neanderthals, as discussed above.

It was suggested by Ashton and Lewis (2002) that the decline in hominin populations may have partly occurred due to the changes in climatic and habitat preferences of hominins in the Middle Palaeolithic. Prior to this period it is suggested that hominins favoured warm climates and environments but their preferences changed towards more open and often cooler climates in the Middle Palaeolithic. However, this cannot explain a reduction in Middle Palaeolithic sites in MIS 7, since the interglacial was not as warm as the preceding MIS 9 and should therefore have suited Neanderthals better.

11.4 The importance of the antiquarian collections in studying the Palaeolithic period in London

This thesis has acknowledged the significant antiquarian collections acquired in the 19th and 20th centuries that the vast majority of this research is based upon. Although a more

detailed coverage of the individual collectors is beyond the scope of this research, it is evident that without the meticulous recording of stratigraphies and site discoveries by antiquarian such as John Allen Brown, Worthington George Smith and F. C. J. Spurrell, this study would not have been possible. Many of the fossils and lithics would still be buried under London (or indeed entirely lost) and an appreciation of the varied human occupation, climates, biodiversity and landscapes that London has witnessed would not be possible. The present study has therefore demonstrated that even when large excavation opportunities are not widely available (frequently the case in central London), the existing material, no matter how long ago it was collected, is still of enormous relevance for new interpretations.

Chapter 12: Conclusions

The research presented here has demonstrated that central London and its boroughs provide an excellent repository of Palaeolithic artefacts and associated multiproxy palaeoenvironmental evidence. During the course of this research, over 16400 artefacts and 4700 fossils have been re-evaluated in the light of current Pleistocene chronologies and stratigraphic interpretations, thereby forming the most comprehensive review of objects from the London area to date. In contrast to previous studies, the Upper Palaeolithic has also been included for the first time. The provenance and taphonomy of the assemblages have been thoroughly reviewed, in order to provide the most reliable assessment of the significance of the material and the artefacts and mammalian fossils studied here have been integrated with all available palaeoenvironmental evidence, in order to fully reconstruct the changing environments, climate and landscapes of the Palaeolithic.

Analysis of the Palaeolithic artefacts in this thesis has traced the timing and nature of Palaeolithic occupation of London from the earliest evidence of hominin presence in the Middle Pleistocene, immediately prior to or during the Anglian glaciation, up to the beginning of the Holocene, spanning a total period of around 440,000 years. The research has documented changing technologies, encompassing Lower and Middle Palaeolithic handaxes, Levallois implements, Mousterian flat-butted cordate handaxes and blade-dominated Upper Palaeolithic assemblages. These have reflected the presence and activity of three species of hominins, *Homo heidelbergensis*, *Homo neanderthalensis* and modern humans, thereby affirming the significance of the London archive for studying the Palaeolithic in Britain.

Previously well-known sites such as Crayford, Ilford (Uphall Pit), and Creffield Road in Ealing have been re-analysed here, however this research has equally revisited sites that have surprisingly been largely ignored since their discovery. Sites such as Stoke Newington, Cauliflower Pit (Ilford), Plumstead (and East and West Wickham), Trafalgar Square, Brown's Orchard (Acton), Brentford, Peckham, Kew Bridge, Feltham, Isleworth, Battersea and North Cray are all home to significant lithic or mammalian assemblages that have received scant attention and in some cases have never been published. Additionally, a large number of smaller assemblages or

individual find spots have been identified in this study, and together they significantly increase the current knowledge of the Palaeolithic in London.

Detailed analysis of the fossil mammalian remains from London has revealed a pattern of changing landscapes and climates throughout the Pleistocene and shed light on vertebrate responses to climate change and changing faunal composition. The London area provides evidence for past warm climates, sometimes warmer than the present day, notably during MIS 9 and MIS 5e. These have been inferred from exotic, typically 'southern' mammal species that no longer inhabit northern Europe today, including hippopotamus and the extinct straight-tusked elephant, narrow-nosed rhinoceros and Merck's rhinoceros. These taxa have been recorded from a diverse range of interglacial sites in London and reflect areas the presence of a mosaic of grasslands and deciduous or mixed woodland, developed under fully temperate climatic conditions. In contrast, cold climate periods are reflected by species such as reindeer, musk-ox, saiga antelope and woolly rhinoceros, which are characteristic of environments such as steppe tundra and semi arid grasslands that are alien to Britain today. Although less biologically diverse than the interglacial assemblages, these cold-climate faunas themselves are beginning to provide an important insight into different cold stages, since some are demonstrably of cold, maritime, high Arctic affinity with substantial snow cover, whereas others reflect cool temperatures and open, steppic grassland. The evidence provided by the mammal faunas is complimented by the rich mollusc, coleoptera, ostracods, pollen, plant macrofossils and herpetofaunal assemblages also reported from several of the sites. Together, these proxies allow a detailed reconstruction of the changing landscapes of London, providing not only a palaeoenvironmental context for understanding hominin occupation and adaptations but also shedding light on changing resources and subsistence patterns.

This research was almost entirely based on the antiquarian collections stored in museums in and around London. Frequently, the artefactual and faunal collections were complimented by detailed notes of site locations and stratigraphies, photographs and sketches recorded by many of the antiquarians. This important and relatively unexploited resource has further facilitated the interpretations described in this study almost two centuries after many specimens were originally collected. This thesis has demonstrated that existing collections often remain viable for new research – an

approach that may prove essential in very urbanised locations such as London where the opportunity for large-scale new excavations are rare.

Ultimately, it is hoped that the resource provided by this study may be useful not only to other researchers but also to professional archaeologists, planning departments and the construction industry. It is vital that the nature of the existing material from London becomes better-appreciated, in order to maximise the potential for future discoveries whenever and wherever the possibility arises. This is especially true of central London, where the opportunity for further excavations is greatly limited but where even 'keyhole' investigations may provide new information, or dateable specimens or deposits. The findings of this research also have a bearing on the GLHER, which is seen as a primary source of Palaeolithic information in London but, as this study has demonstrated, has great scope for improvement in terms of the number of entries and the level and quality of detail recorded. The archive compiled by this study may thus assist in updating the existing Palaeolithic and Pleistocene material records, thereby providing better information for desktop studies and archaeological mitigation during the future development of London.

Finally, this research has highlighted how the Palaeolithic is a largely ignored period in London's past and yet contains a huge diversity of information. This research project, which was set up in collaboration with the Museum of London, has therefore sought to bring some of this fascinating material into the public eye. Often, key Palaeolithic and Pleistocene sites are in celebrated locations, in particular the iconic finds from Trafalgar Square, thereby providing a ready stimulus to encourage public appreciation of this distant yet intriguing period. Three different species of hominin have been shown to inhabit Ice Age London, in addition to a bestiary of often unfamiliar yet impressive species of mammals that accompanied them, not least woolly mammoth, straight-tusked elephant, lion, hyaena and hippopotamus. These extraordinary finds, truly the stuff of legends, could not provide a better platform to promote a period of London's own prehistory.

Appendices

The data collected on each lithic artefact and mammal fossil analysed during this study is included on the CD included at the back of the thesis in spreadsheet form. Over 22000 lithics and mammal fossils are listed and the gazetteer was too large to include in a printed form.

Abbreviations of Museums Visited

The following abbreviations have been used in the spreadsheets to denote the museums and locations they were observed in:

Museum of London (MOL)

British Museum (BM)

Natural History Museum (NHM)

British Geological Survey Museum, Keyworth (BGS)

Bromley Museum (BROM)

Dartford Museum (DART)

Department of Geography, Royal Holloway, University of London, Wymer Collection (RHUL)

Elmbridge Museum, Weybridge (WEY)

Gunnorsbury Park Museum (GUNN)

Hillingdon Museum (HILL)

Horniman Museum (HORN)

Institute of Archaeology, University of London (IOA)

Manchester Museum (MAN) (not visited personally)

Museum of Archaeology and Anthropology, University of Cambridge (CAM MAA)

Reading Museum (READ)

Redbridge Museum (RED)

Richmond Museum (RICH)

Sedgwick Museum of Earth Sciences, University of Cambridge (SEDG)

Vestry House Museum, Walthamstow (VEST)

Wandsworth Museum (WANDS)

Wardown Park Museum, Luton (WARD)

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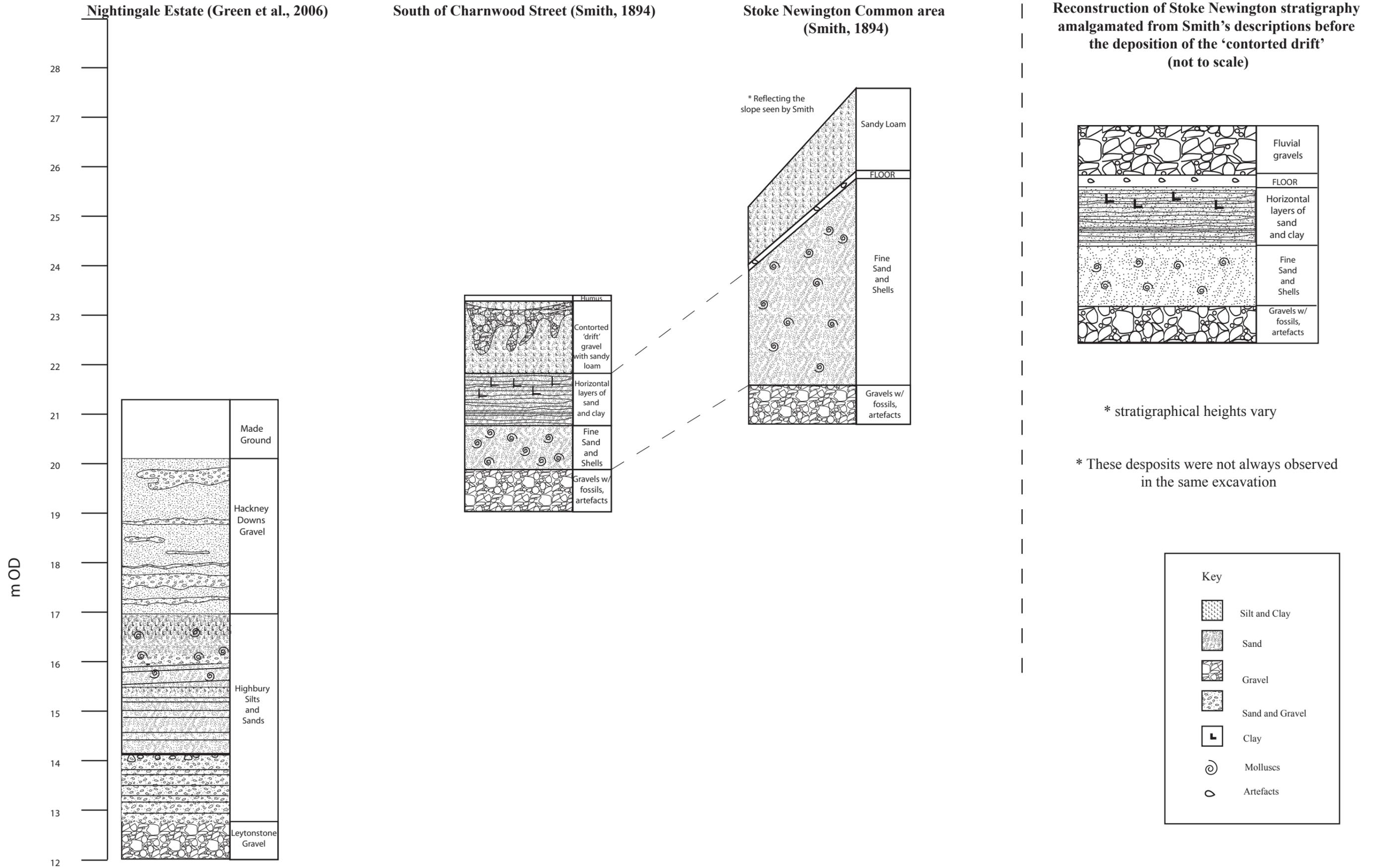


Figure 6.13: Relationship between Smith's discoveries in the Stoke Newington Common area and the recent Nightingale Estate excavations.

Locations included in this diagram are shown in Figure 6.4.