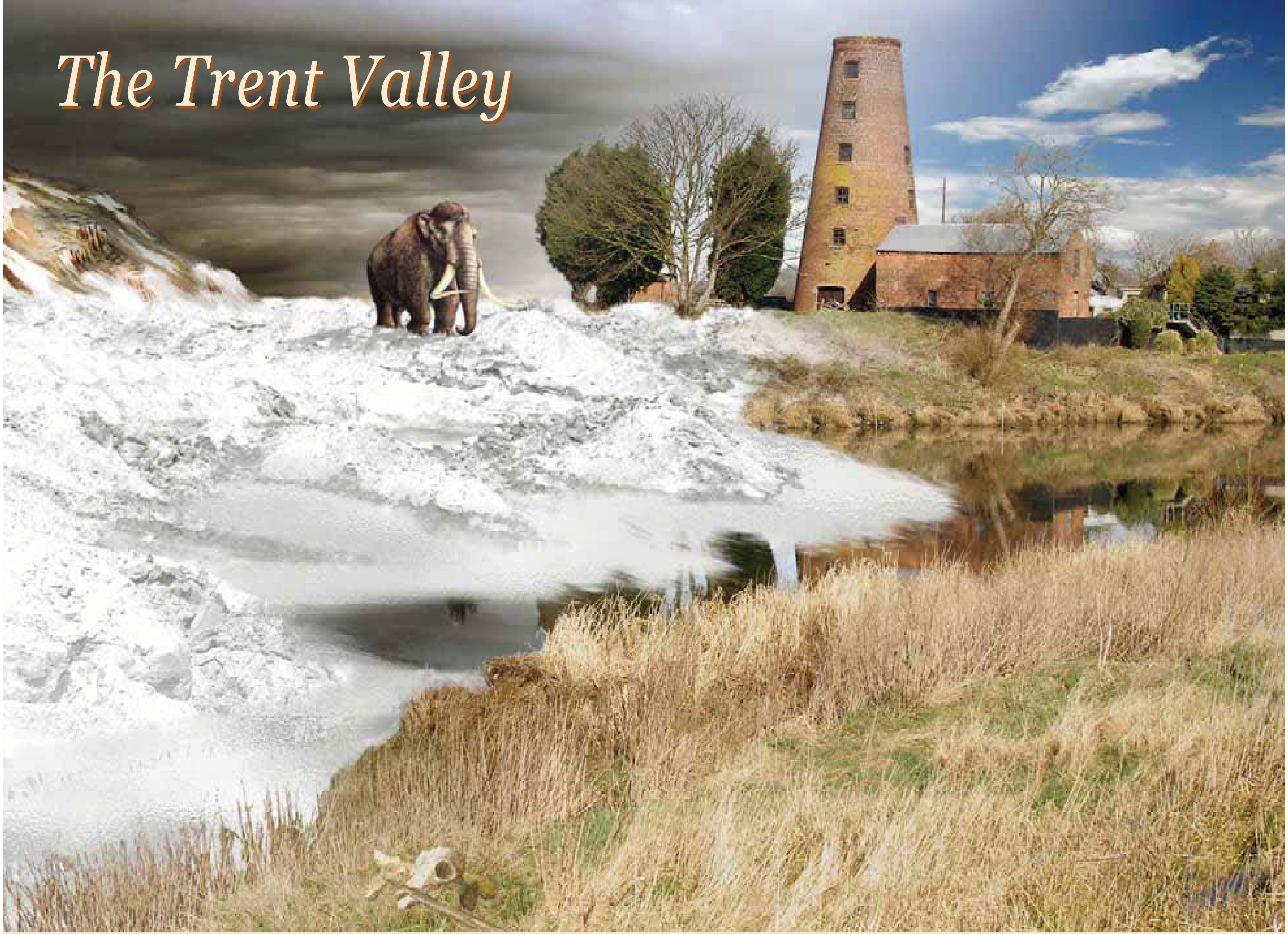
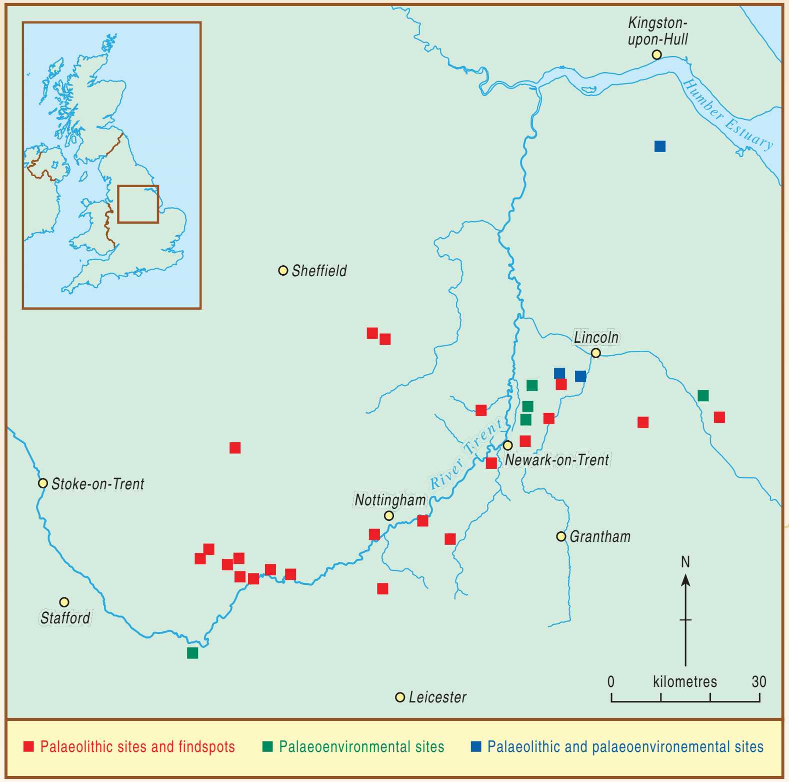
The Trent Valley



Archaeology and Landscape of the Ice Age

A Hidden Landscape

The River Trent is the third longest river in England, rising on Biddulph Moor in Staffordshire, at an altitude of 250m OD, and flowing approximately 210km to the east coast. It is the major fluvial artery of the English Midlands, flowing in a great arc through the counties of Staffordshire, Derbyshire, Leicestershire and Nottinghamshire, before turning northward through Lincolnshire to Trent Falls and into the Humber Estuary, draining into the North Sea.



The Trent Valley catchment showing important sites studied in this project

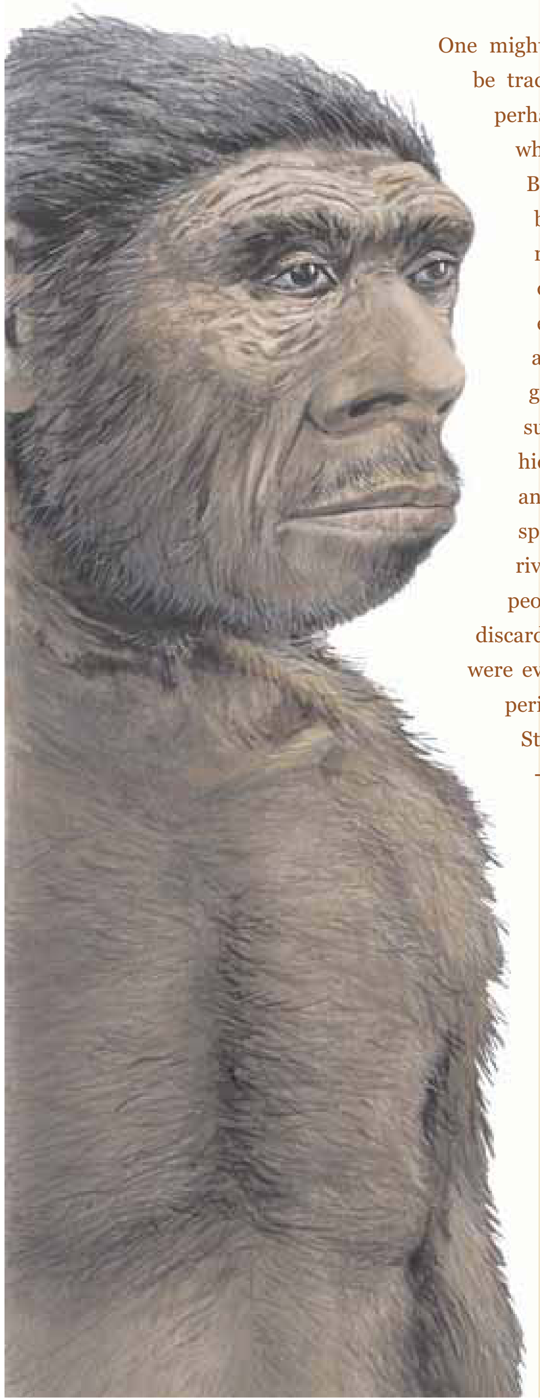
The modern landscape of the Trent Valley is littered with conspicuous traces of a rich and continually changing human history. The remains of Roman villas and ancient field systems lie close to great castles, rich manor houses and sleepy stone-built villages, and in the towns medieval churches and cathedrals rub shoulders with the towering chimneys of industry, testament to their long history since foundation. The river itself has played a vital role in the creation of this landscape, as a source of nourishment, a transport route for people and resources, and as a provider of power.

The Trent was one of the earliest routes into the heart of the Midlands for Anglo-Saxon invaders in the 4th and 5th centuries AD, settlements being founded along both the river and existing Roman roads such as Ermine Street. Subsequent invasions in the 9th century AD by the Danes led to the East Midlands becoming the most heavily 'Scandinavianized' part of the country and subject to the ***Danelaw***. Evidence of these earlier origins for settlements can be found in place-names throughout the Trent Valley, such as those that end in *–ingham*, which have Anglo-Saxon heritage, and in *–by* or *–thorpe*, denoting a Viking origin.

Following the Industrial Revolution, the waters from the Trent and its tributaries powered mills and factories and, together with the burgeoning network of canals, provided a highway to transport goods to market. Even today, the Trent plays a key role in Britain's power generation, symbolized by iconic cooling towers rising dramatically from the valley and visible for miles around from the uplands of the Peak District, Charnwood Forest and the Lincolnshire Wolds.

Place names can be clues to the origins of settlements

Neanderthals: ancient residents of the Ice Age Valley
© The Natural History Museum, London

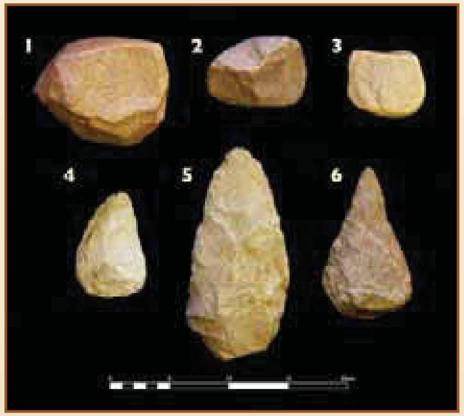


One might assume that this rich tapestry can be traced back only a few thousand years, perhaps to the earliest Neolithic farmers who settled in the valley around 4000 BC, growing crops and grazing animals by the river. In fact, far more ancient remains of Ice Age human activity exist, dating back over 500,000 years. The evidence for this lies very deeply buried and virtually invisible in the sands and gravels beneath our modern towns, suburbs and countryside. This is the hidden landscape of the **Neanderthals** and their immediate ancestors, ancient species of humans who frequented the river long before the arrival of modern people, leaving behind nothing more than discarded stone tools as evidence that they were ever there. Archaeologists refer to this period as the Palaeolithic (literally Old Stone Age, taken from the Greek *Palaeos* - old + *Lithos* - stone).

The Trent Valley is the northernmost British region with significant evidence for occupation by these ancient humans during the Palaeolithic. In recognition of this, a major research project, the **Trent Valley Palaeolithic Project (TVPP)**, funded by English Heritage as part of the Aggregates Levy Sustainability Fund, has examined the archaeological and geological histories of the river between c.500,000 and 35,000 years ago.

Records of the Trent in flood, carved into the wall of Collingham Church, Nottinghamshire

Willington power station viewed across the Trent (Dave Harris)



Some examples of stone tools from the gravels of the River Trent. 1: Quartzite core, East Leake, Nottinghamshire. 2: Quartzite chopper-core, East Leake, Nottinghamshire. 3: Quartzite flake, East Leake, Nottinghamshire. 4: Flint handaxe, unknown provenance. 4: Flint handaxe, Willington, Derbyshire. 6: Quartzite handaxe, Willington, Derbyshire.

Work has been conducted by a research team from the Departments of Archaeology and Geography at Durham University and the Institute of Archaeology and Antiquity at the University of Birmingham, working in close collaboration with local quarry companies, museums and a range of other specialists. Using a variety of scientific techniques, the project has begun to reconstruct the natural landscapes of the region including the types of climate, vegetation and animals that would have been encountered by early humans, and to explore their settlement history and behaviour through the stone tools they left behind.

Organic channel fill near the base of the Balderton Sand and gravel sequence in Lincolnshire. This is an important new discovery made during the Trent Project and promises to be the best preserved interglacial evidence thus far found in the Trent Valley. It is believed that the episode represented is the penultimate interglacial (MIS 7) - see Page 15.

Members of the TVPP team at work in a gravel quarry

Lithic recording and analysis

A view of the gravel exposures at Norton Bottoms

In Search of the Ice Age Trent

It has taken many decades of research to reach our current state of understanding of the complex changes to our climate and landscape that have occurred over long expanses of time. This has involved archaeologists, geologists, geographers, palaeoecologists, physicists and astronomers, to name but a few of the disciplines that overlap when considering the history of the Earth.

This booklet is about the people of the Ice Age Trent and their activities, and explains some of the techniques that have been used to reconstruct the evolution of the natural landscape of the river and its valley over the last half million years. It begins by outlining the evidence for early human occupation and lifestyles recovered from the Trent Valley, and goes on to describe how plants and animals living on the Earth have been forced to adapt to changing environments, as landscape features such as rivers responded to repetitively changing climates. It also celebrates the pioneering work of those scholars who, over the last century, have studied the sediments laid-down by the River Trent and collected stone tools. Their efforts provide the foundations for current research on ancient human occupation.

We hope that this booklet provides an interesting introduction to the distant prehistory of the Trent Valley and its ancient inhabitants, and to the geological and archaeological research being undertaken to unravel it. It has been produced as part of our commitment to raising local awareness of the value and importance of the hidden Ice Age Valley.

A reconstruction of hominids hunting a specimen of the extinct Clacton fallow deer with wooden spears c.400,000 years ago. © The Natural History Museum, London

The Role of the Aggregates Industry

Our knowledge of the Palaeolithic period is derived almost exclusively from artefacts, animal bones, pollen, insects and other fossilized remains preserved within sand and gravel deposits exposed during aggregate extraction.

Representing one of the most important industries to flourish in the Trent Valley, a large number of gravel pits have come and gone in the last 200 years, exploiting the various sand and gravel deposits laid down by the river in the past. In the early part of the 20th century gravel workings were small and hand-excavated, allowing sharp-eyed workmen to collect stone tools as they toiled. Today, the industry is highly mechanized, and far fewer artefacts are recovered. It is estimated that between 1984 and 1993 some 140 million tonnes of sand and gravel were extracted in the East Midlands. In some parts of the valley, these aggregate deposits have been completely exhausted, and the land has been redeveloped as important nature reserves and recreational centres, whilst some has been returned to agriculture.

Research has relied heavily upon the goodwill of numerous aggregates companies to access the deeply-buried deposits containing Palaeolithic evidence, which can be many metres below the present ground surface. Indeed, without the information yielded by these dwindling resources, most of the evidence for archaic humans and their activities would have remained undiscovered and our understanding of the distant past much poorer as a consequence. The central irony of the Palaeolithic, then, is that the industry responsible for revealing the evidence of ancient human occupation may also be responsible for its destruction, and it is only through projects like the TVPP that this evidence can be recovered and preserved for the benefit of future generations.

Bygone era: Mr George 'Deffy' Carter sieving gravel by hand in 1913. Mr Carter, who worked at Maidenhead in the Thames Valley, gained his nickname from his love of gramophone records, which he bought with the money he made by selling stone tools to collectors. (Photo: L. Treacher, reproduced by courtesy of J.J. Wymer)

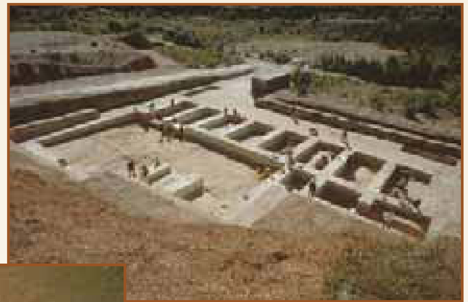
Modern times: A mechanical excavator at work in Lincolnshire

Sunset over Attenborough Nature Reserve, Notts (© Graham Gamble)

Archaeology of the Quaternary: The Lower and Middle Palaeolithic Periods

The period of geological time spanning the last 2.6 million years or so is called the Quaternary. It is subdivided into two **epochs**: the **Pleistocene** (2.6 million – 10,000 years ago); and the **Holocene** (10,000 years ago to present). The **Palaeolithic** describes the earliest archaeological period, which in Britain spans the time from the earliest human occupation, perhaps as early as 750,000 years ago (as represented by the site of Pakefield, Suffolk) down to the end of the last ice age 10,000 years ago. In the Trent Valley, the earliest evidence of human activity is currently about 500,000 years old.

The evidence from Palaeolithic sites usually consists of little more than concentrations of stone tools and animal bones preserved in large numbers within the ancient silts, sands and gravels. Ideally, archaeologists hope to find horizons within these ancient sediments where the depositional environment was sufficiently low energy to preserve the surface upon which stone tools were manufactured and have remained unmoved for tens or possibly hundreds of thousands of years. Such sites are extremely rare, most having been disturbed by a number of later natural processes such as river erosion. Two notable examples are Boxgrove, in Sussex, and Crayford, in Kent, where extremely well preserved '**knapping floors**' have been found.

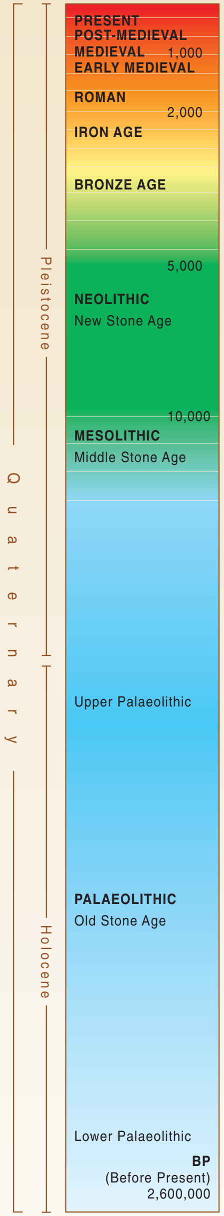


A view of the archaeological excavation at Boxgrove, West Sussex. The site yielded the fossil remains of a c.500,000 year old Homo heidelbergensis, *along with a great many beautifully preserved stone tools.*

© Simon Parfitt, Boxgrove Project

Skulls of early humans. Left: Homo sapiens *from Predmosti, Czech Republic. Right:* Homo neanderthalensis *from La Fereassie, Dordogne, France. © Natural History Museum*

Professor Chris Stringer of the Natural History Museum with four hominid skulls. Top left: Modern Human (Europe). Top right: Modern Human (Africa). Bottom Left: Gibraltar Neanderthal, Forbes Quarry. Bottom Right: Broken Hill Skull, Zambia. © Natural History Museum



The Palaeolithic is divided, on the basis of changes in the technology and form of stone tools, into three smaller sub-periods:

- **The Upper Palaeolithic**, 35,000-10,000 (generally associated with modern humans, ***Homo sapiens***)
- **The Middle Palaeolithic**, 300,000-35,000 years ago (generally associated with the Neanderthals, ***Homo neanderthalensis***)
- **The Lower Palaeolithic**, 750-300,000 years ago (generally associated with the archaic human species ***Homo heidelbergensis***

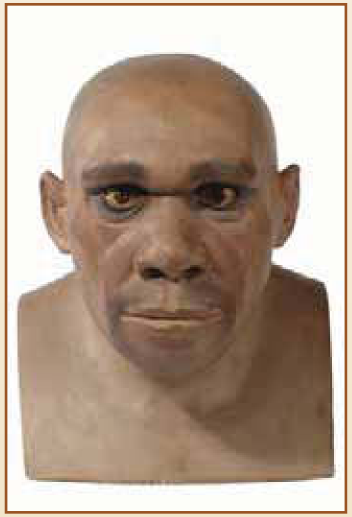
In Britain we have evidence of human occupation during all three periods, but the populations were not large and occupation was definitely not continuous. As we shall see later, over the past half million years the climate has fluctuated on a number of occasions between warm temperate periods similar to the present and extremely cold periods when sheets of ice covered the land.

Humans probably abandoned Britain for the warmer parts of mainland Europe during the extremes of each glaciation, returning as the climate once again began to warm up. There was also a very long period of total absence lasting some 120,000 years between 180,000 and 60,000 years ago. We suspect that a combination of high sea-levels during the warmer phases and hostile climate during the colder phases kept people away during this climatic cycle.

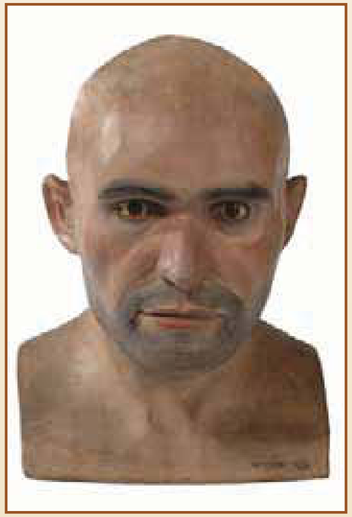
The project has focussed on the evidence from the Lower and Middle Palaeolithic, representing the Neanderthals and their immediate ancestors (*Homo heidelbergensis*). Anatomically modern humans did not appear in Europe until the Upper Palaeolithic Period. Here the nature of the archaeological record changed in dramatic and far-reaching ways, including the appearance of pictorial cave art as recently discovered at Church Hole, Creswell Crags, on the Nottinghamshire - Derbyshire border (Britain's only example).

Homo heidelbergensis

Homo neanderthalensis



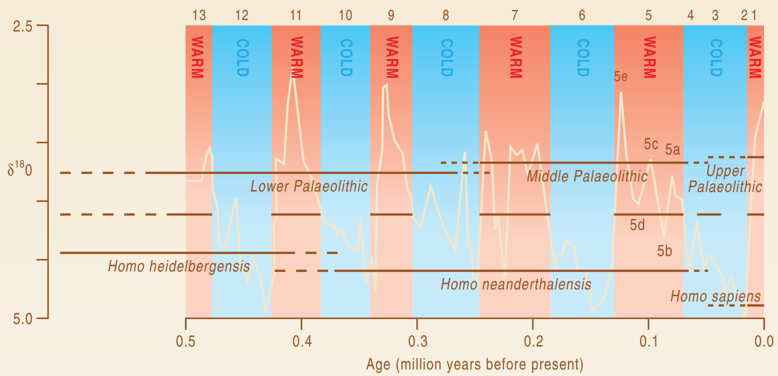
Homo sapiens



Images © Natural History Museum

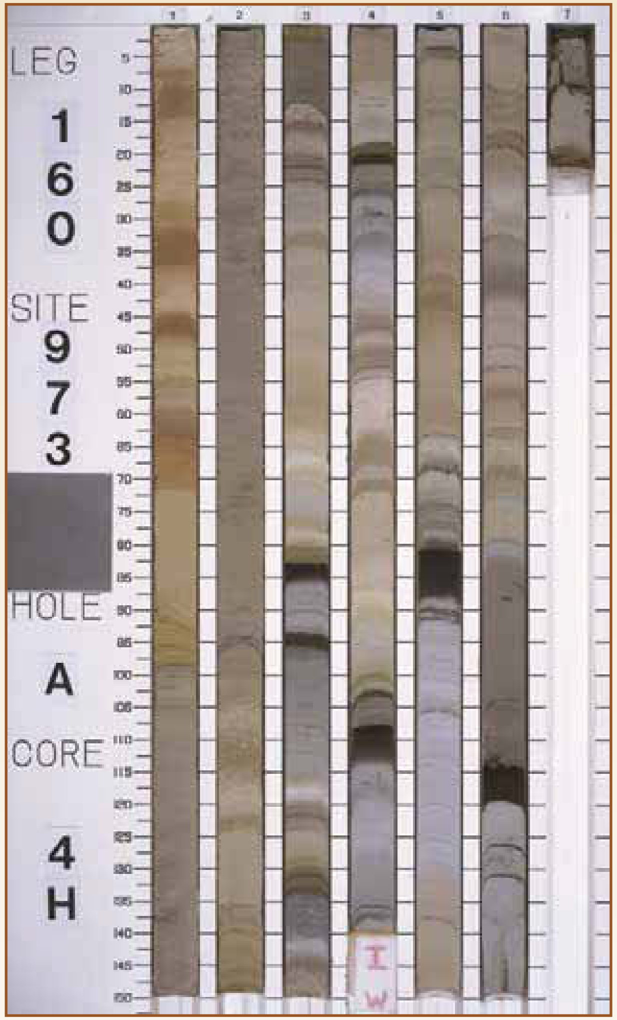
The Climate of the Quaternary Period: Past, Present and Future

Although often referred to as simply 'the Ice Age', the Pleistocene was not continuously characterized by extreme cold. There have in fact been many 'ice ages', known as **glacials**, separated by periods of warm climate called **interglacials**. The Holocene, in which we are living at present, is in fact the most recent interglacial. The alternations between glacials and interglacials have been controlled by cyclic variations in the Earth's orbit around the sun and the tilt of its axis. If the global warming caused by human activities does not permanently alter the natural chemical balance of the atmosphere, these cycles will cause the world to enter another glacial a few thousand years in the future.



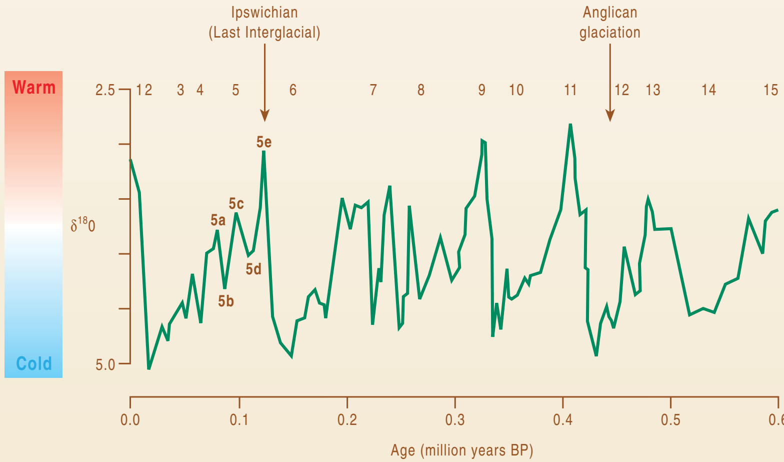
Unravelling the geological record has been likened to doing a jig-saw puzzle with most of the pieces missing. This is particularly true for the Quaternary, as every time an ice sheet advanced across the landscape during the intense cold of a glacial, earlier records were mostly destroyed. Piecing together the information on the past climates of the Quaternary is far from straightforward, as the evidence that survives on land is now scattered and fragmentary. The record for the Trent Valley has been badly damaged by ice sheets in comparison with those of southern British rivers, which have not been covered by ice during glaciations. Indeed, the Trent is the most northerly of our river systems in which any significant multi-cyclic record survives.

Since the 1950s, scientists have been able to reconstruct a more complete history of Quaternary climate change than previously by examining the information contained in sediments drilled from the ocean-floors. These sediments have accumulated continuously and can fill in the gaps in the fragmentary records on land. This is



Cross-section of a deep sea sediment core (Image courtesy of the Integrated Ocean Drilling Program) possible because the proportion of different isotopes of oxygen in sea-water varies according to climate or, more precisely, according to the amount of ice that exists on the planet. Water evaporating from the oceans contains more of the lighter oxygen isotope (O^{16}), which means that the same is true of ice (the snow and rain that go to make up the ice come from the evaporation of sea-water); the oceans therefore contain a higher proportion of the heavier isotope (O^{18}) during glacials when large ice sheets exist. These variations are recorded in the shells of tiny single-celled animals called **foraminifera**, which take oxygen into their shells from the sea-water in which they live. By analyzing the ratios of the isotopes in these shells within different layers of ocean sediments, the amount of global ice can be calculated for different periods of the Quaternary. From these types of record, around five glacial-interglacial climatic cycles have been recognized within the last half million years, each cycle lasting about 100,000 years. The warm interglacial part of each cycle only accounts for about 10-20,000 years of this time.

Recently these ocean records have been supplemented by evidence from the ice sheets of Greenland and Antarctica, which have accumulated in layers just like sediments. The lowest and oldest ice layers, sampled by drilling and retrieving ice cores, provide a history that extends back over half a million years. Ice cores show oxygen isotope variations, like ocean sediments, as well as containing air bubbles that represent tiny samples of the atmosphere at the time of ice formation. From these we know that the carbon dioxide content of the air has varied naturally in the past before modern human actions caused it to increase alarmingly.



Oxygen Isotope Curve for marine sediments, after Bridgland et al, *1994*

The result of this research has been the **oxygen isotope curve**. This illustrates the record of cold and warm climatic conditions throughout the Quaternary, and provides a way of comparing the age of sediments on a global scale. The curve is divided into a series of stages, each of which is numbered; each glacial period is assigned an even number, and each interglacial an odd number.

On land, the various glacial and interglacial periods are often referred to by a series of names, reflecting important local sites and sequences. One of the key developments of recent years has been the correlation of land and ocean sequences. For example, the last interglacial, known in Britain as the Ipswichian, has been identified as equivalent to the early warmest part of Oxygen Isotope Stage 5, sub-stage 5e (approximately 125,000 years ago). Ipswichian deposits can thus be compared to other OIS5e deposits throughout the world.

The build up of huge ice-sheets during the severest periods of glaciation also lowers sea level. Ice-sheets have covered northern Britain several times, even reaching as far south as the Thames Valley on one occasion (known as the **Anglian glaciation**) about half a million years ago. Global sea level would have been around 150 metres lower than now at the height of the Anglian glaciation, and Britain would not have been an island, as the shallow basins that are today the North Sea and English Channel would have been dry land connecting it to mainland Europe. These 'land bridges', as they are often referred to, were important routeways for the migration of both humans and animals. Indeed, this was very much the normal Quaternary situation. See level was only high enough to separate Britain from the continental mainland during the very warmest periods, i.e. for less than 20% of Quaternary time.

The Formation of the Sand and Gravel Deposits

Deposits of material formed by rivers are termed **fluvial** sediments. Some deposits are coarse sands and gravels, mostly formed during colder periods when the Trent was more powerful; other deposits are fine sands and silts that were laid down when the climate was warmer and the river more sluggish. The dramatic changes in the character of the river and the types of sediments it deposited were thus controlled by the climatic cycles.

As the climate began to warm after a glacial maximum, the huge quantities of water released from melting snow and ice (including the permanently frozen ground or **permafrost**) gave the river the ability to erode and transport vast quantities of material. Rivers flowing under these glacial conditions, known as **braided rivers**, have many channels separated by islands of eroded gravels. Although the climate was warming, the temperatures were still very cold, and only a limited range of vegetation could survive. The landscape was therefore very bleak, consisting of wide expanses of gravel colonized by occasional mosses and hardy tundra plants. Braided river systems can be seen today in the glacial and **periglacial** landscapes of Iceland, New Zealand, Greenland, Alaska and the Canadian Arctic, which give an impression of how the Trent Valley might have looked as recently as only 13,000 years ago.

During interglacial periods, rivers were less powerful, usually flowing in single meandering channels. The valley-sides were stabilized by plant growth, and so coarser sediments were not as easily eroded and transported. Instead, interglacial rivers carried a combination of fine sands and silts, which were usually laid down in abandoned channel sections (cut-off **meanders**, known as **oxbow lakes**) or on the wider floodplain, during times of flood. If preserved, such fine-grained deposits represent the interglacial part of the Quaternary record, and often contain organic remains and fossils. Records of this sort were often destroyed, however, by subsequent ice-sheet advances and erosion by the river in its higher-energy glacial form.

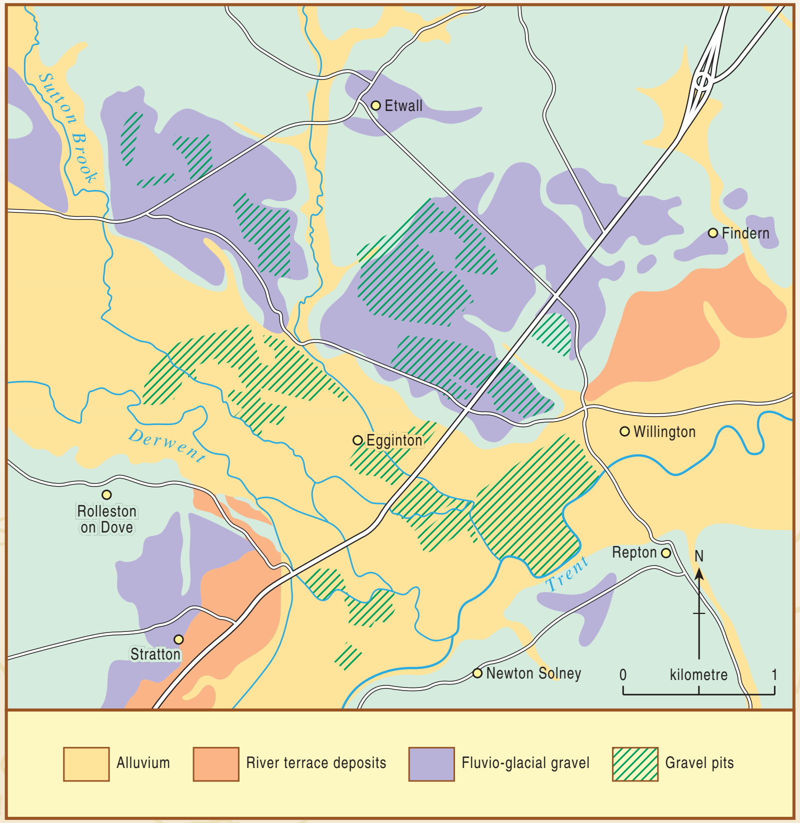
The rich natural resources of these interglacial river valleys made them extremely attractive to early human communities, and they became a focus of activity, as is indicated by finds of stone tools. However, although life may have been easier during interglacials, early humans were able to adapt to a variety of warm and cold conditions, probably only leaving Britain altogether when the climate was at its coldest.

Small patches of ancient fluvial sand and gravel deposits can be found scattered across the Trent Valley. Their tops often form relatively flat surfaces known as **terraces**, which represent fragments of former floodplains. Rivers such as the Trent usually form terraces once in a 100,000 year cycle, during which changing climatic and geological conditions cause the river to erode into its valley floor (a process known as **downcutting**) and deposit large amounts of coarse fluvial sediment (a

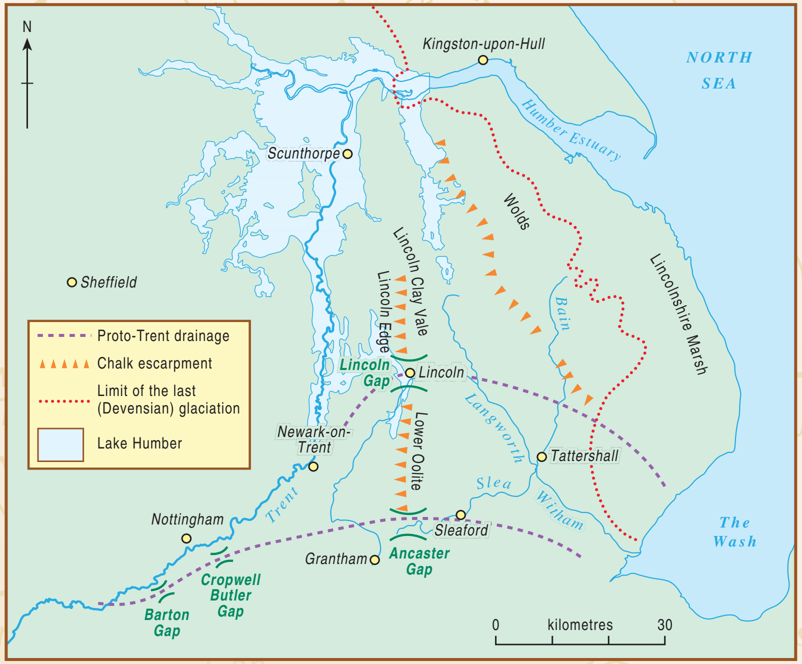
A typical braided river: the Tasman River (New Zealand) with Aoraki / Mt. Cook in the background (© Mike Hambrey, glaciers-online.net)

process known as **aggradation**). The older river deposits are therefore left 'high and dry' when the river deepens its valley. Repeated downcutting and aggradation events in approximate synchrony with the glacial-interglacial climatic cycles, have created a 'staircase' of river terraces, fragments of the oldest being preserved at the top with each terrace becoming progressively younger until the present course of the river is reached (see diagram on Page 15).

It is possible to group terrace fragments together by comparing features such as height above the current valley floor, and the distinctive types of rocks contained within the gravels. Even if two patches of sediment are many miles apart, they can be matched to the same continuous river terrace. If sufficient fragments survive, the former floodplain can be mapped. The evolution of the river during the Quaternary, with minor and sometimes major course changes, can thus be pieced together. we know the River Trent experienced three major course changes in the last half-million years, as distinctive gravel deposits occur across Lincolnshire to the east of Newark. Some of the rivers that still drain Lincolnshire, such as the Bain, were probably once tributaries of an extinct and very different course of the Trent.

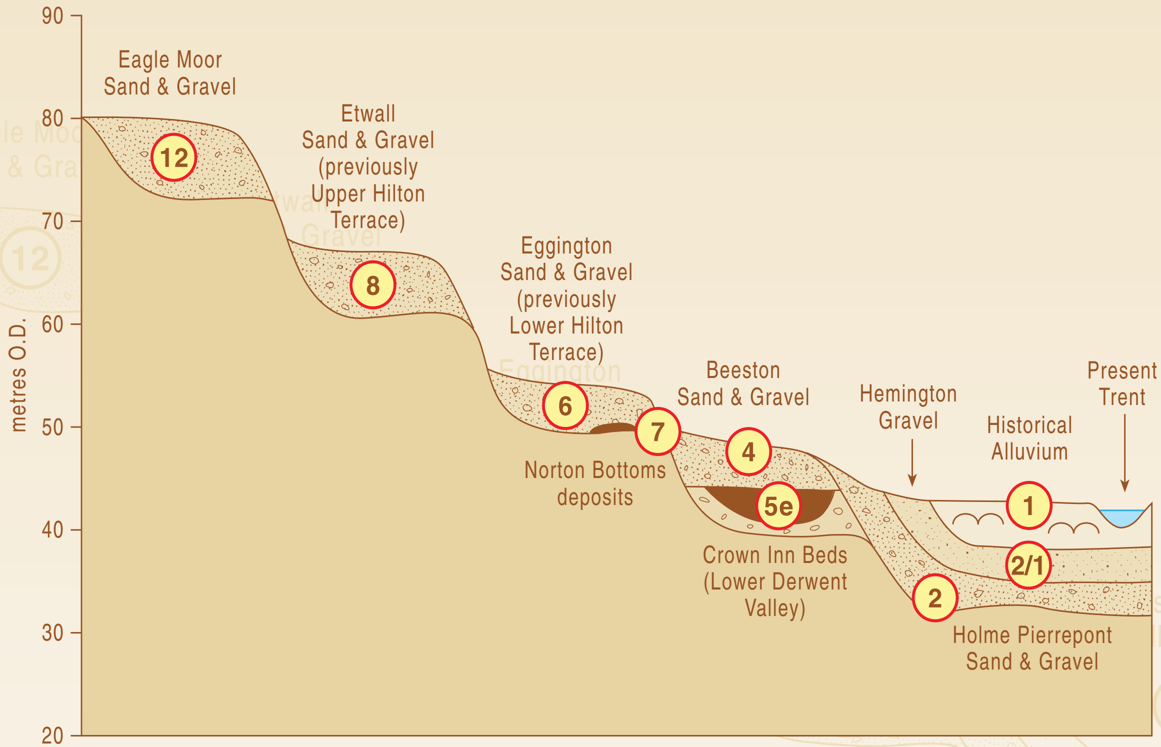


Section of geological map from the Trent in Derbyshire with fragmentary terrace deposits highlighted (after The English Rivers Palaeolithic Project)



Map of the lower part of the Trent catchment showing supposed earlier courses of the river via the Lincoln and Ancaster gaps and the approximate area covered by Glacial Lake Humber (see Clark et al, 2004), which formed when the lower Trent was dammed by the Devensian ice sheet.

The formation of Lake Humber was probably instrumental in diverting the Trent into its modern estuary shared with the Yorkshire Ouse.



An idealized section through the Middle Trent terrace 'staircase'

Circled numbers refer to oxygen isotope stages from the deep ocean record, with which all land-based sequences are compared wherever possible (see also Page 12 for an explanation of the Oxygen Isotope Curve). Thus Stage 2 is the coldest part of the last glacial, when ice covered much of northern England and disrupted the lower part of the Trent (c.25,000 years ago - 10,000 years ago). Substage 5e is the last interglacial, whereas stage 7 is the penultimate interglacial. The oxygen isotope stage assignments become less certain in the higher, older parts of the staircase. Stage 12 equates with the severe Anglian Glaciation, about 450,000 years ago, during which ice sheets reached their most southerly point in Britain and diverted the River Thames into its valley through London (see Bridgland, 1994). Any previous River Trent would have been completely obliterated by this glaciation, with the terrace attributed to Stage 12 forming as the ice sheets melted, late during the glacial, and the river system became established. There is a possibility, however, that this terrace dates from Stage 10, which is otherwise unrepresented within the sequence. Interglacial remnants are rare, but older ones (older than Stage 7) might be found in the future, in the higher part of the terrace sequence.

Lower and Middle Palaeolithic Stone Tools

Lower and Middle Palaeolithic stone tool working is referred to as **knapping**. This is based on the principle of **conchoidal fracture**, which is the way in which certain types of brittle stone break very cleanly and with an extremely sharp edge when struck with a hammer or **percussor**. Two types of percussor were used, hard-hammers, usually another piece of stone, and soft hammers, usually antler or bone or perhaps wood.

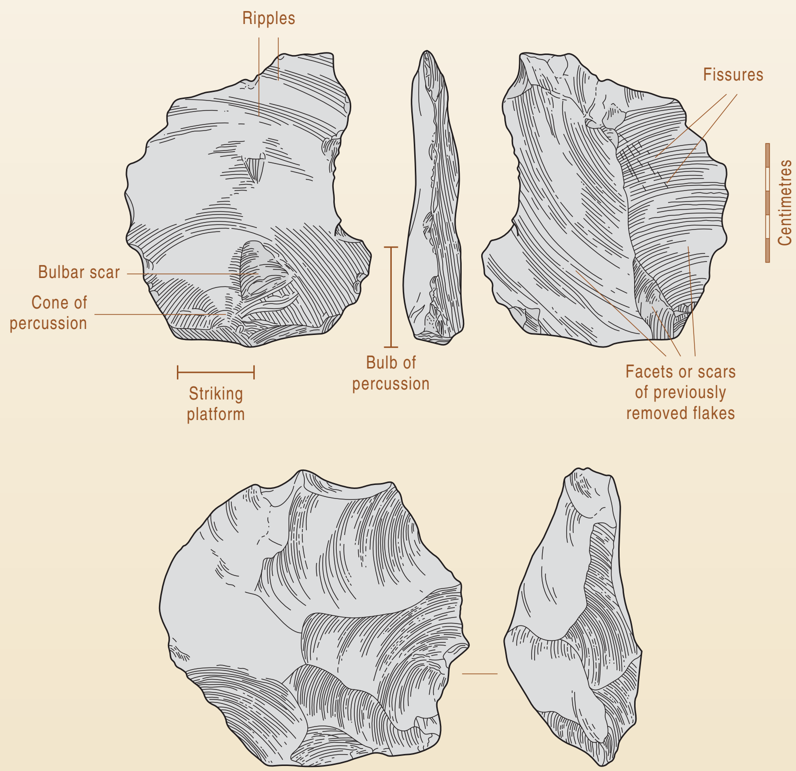
Over much of Britain the stone most often used by Palaeolithic knappers was **flint**, which forms nodules and more extensive beds in the chalklands stretching from the south coast to the east Yorkshire coast. The Trent Valley is well beyond the nearest flint outcrops, however, and flint is relatively rare there. The scarce natural flint has been transported into the area by either glaciers or rivers. As a result, other types of rock, including **quartzite**, and **chert** replaced flint for toolmaking as they could be found locally.

Stone tools of any kind are relatively rare the Trent Valley system, when compared to more southerly rivers such as the Thames and Solent. This may give the impression that humans themselves didn't venture this far north very often and preferred to live in the warmer southeast. However, our research suggests that a number of other factors may be contributing to the apparent rarity of evidence for human activity in the Trent Valley and Midlands more generally. First, both andesite and quartzite are much softer than flint and more susceptible to weathering and abrasion. As a result they can quickly lose the distinctive features of human workmanship if subjected to transport by the river prior to inclusion in its sands and gravels. Additionally, as most British stone tools are made of flint, collectors may not have their 'eye in' for quartzites, and so fewer are picked up.

Lower Palaeolithic stone tools are dominated by four classes of artefact: cores, flakes, handaxes and flake tools.

Cores and flakes

Here a stone nucleus, or core, was struck with a hard hammer to remove flakes. Whilst not entirely random, this form of knapping was relatively unplanned and both the cores and flakes are highly variable in both size and shape. Being worked by heavy blows from a hard-hammer, the knapping features on such objects are very pronounced. Sharp edged flakes suitable for cutting are generally assumed to have been the end goal of this technology, the cores being the waste by-product. However, some, referred to as choppers or chopper-cores, have a sharp zig-zag edge opposite an unworked area and it is unclear whether these were specially created to be used in heavy-duty chopping activities or whether their shape is just coincidental.



Above: A flake, showing the important diagnostic features, and, below: a core, showing multiple scars from which flakes have been detatched

Core and flake diagnostics:

Bulb of Percussion: When a flake is struck from a core, the force of the blow produces a conical bulb next to the striking platform. The bulb is one of the first things to look for when determining whether a stone has been worked by people, as they rarely occur in a natural break.

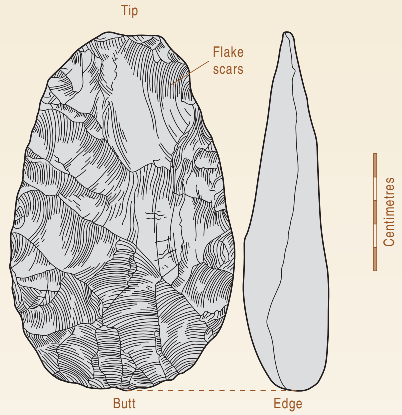
Striking Platform: The flat surface from which a flake is struck from a core.

Bulbar Scar: A small secondary flake detached as the bulb of percussion forms.

Ripples: These radiate out from the bulb of percussion, indicating the direction of the blow that detached the flake.

Handaxes

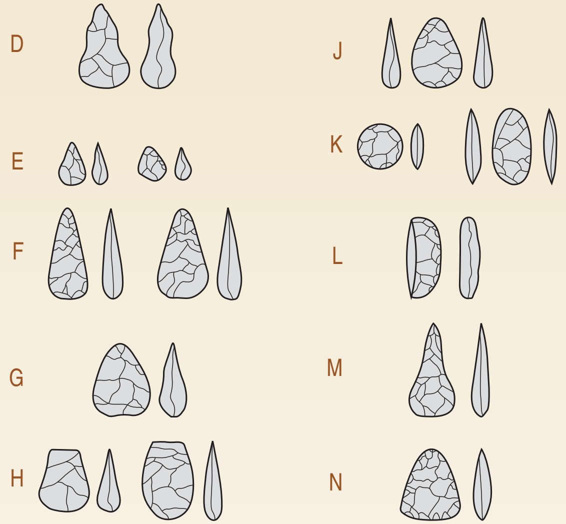
The quintessential and most distinctive of all Lower Palaeolithic tools is the handaxe. These are symmetrical, pear-shaped implements possessing a sharp **bifacially-worked** edge around all or part of the circumference. Unlike cores, handaxes are clearly deliberately shaped objects. Many are highly refined and delicately flaked using a soft hammer, leaving a complex pattern of **scars** on both surfaces. Handaxes were made from nodules, pebbles or flakes of different stone types and may be found in a number of different forms around the basic blueprint. These implements are often found in large numbers and have been described as the Palaeolithic equivalent of the Swiss Army Knife, having a wide variety of potential uses, although microscopic studies of their edges have shown that they were most often used in butchery.



Cordate handaxe showing diagnostic features

Handaxe types and diagnostics

Handaxes come in many shapes and sizes, ranging from small ovate forms to very large pointed examples. The great Palaeolithic archaeologist John Wymer developed a typology of handaxes which demonstrates the variation in shape.



John Wymer's handaxe typology:

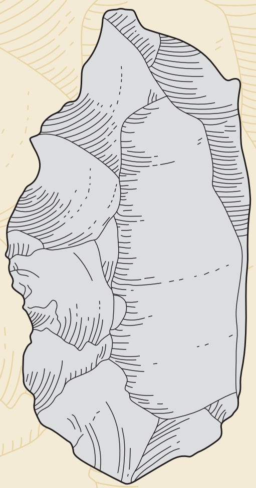
D: Stone struck, crude handaxe
E: Small (<10cm) irregular handaxes
F: Pointed handaxe
G: Sub-cordate handaxe
H: Cleaver
J: Cordate handaxe
K: Ovate handaxe
L: Segmental 'chopping tool'
M: Ficron handaxe
N: Flat butted cordate handaxe or 'bout coupé'

Flake tools

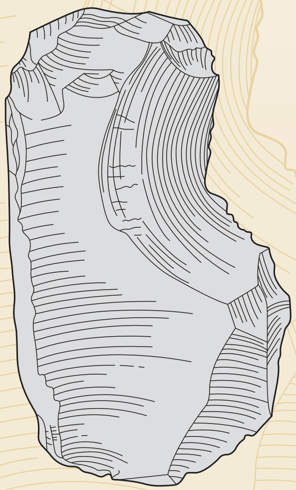
Lower Palaeolithic flake tools are usually fairly simple, often no more than a flake with minimum edge modification or **retouch**. Several different types are recognised, depending on the nature of the edge produced: scrapers, notches, denticulates and flaked flakes. Flake tools are not particularly rare, although it is sometimes difficult to differentiate between man-made and naturally altered edges in sand and gravel deposits. They were probably used in a variety of wood and hide working activities.

The handaxe: to have or have not?

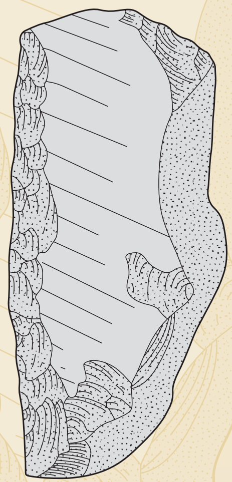
Different combinations of these tool forms are used by archaeologists to define different stone tool **industries**. In Britain, two Lower Palaeolithic industries are recognized: the **Clactonian** (named after the type site at Clacton-on-Sea) and the **Acheulean** (named after a French village in the Somme Valley). The Clactonian is a simple core and flake industry, which may also contain a variety of flake tools and chopper cores but by definition lacks handaxes. The Acheulean is defined by the presence of handaxes, but may equally contain a number of flake-tools and cores identical to those found in the Clactonian. The significance of the presence and absence of handaxes within these two industries, whether the result of different populations each with their own distinctive tool kit, different toolkits used by the same groups of people for different purposes, or a response to local raw material suitability, is the subject of heated debate. At present, no examples of a Clactonian industry have been found in the Trent.



Denticulate



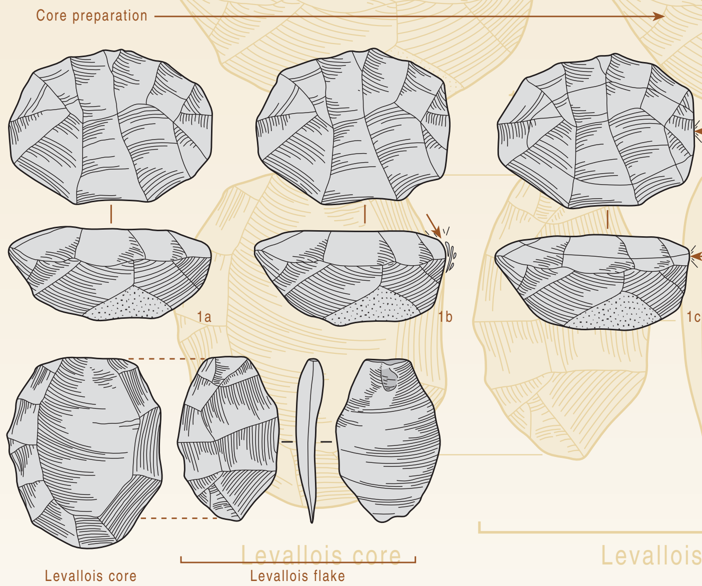
Notch



Scraper

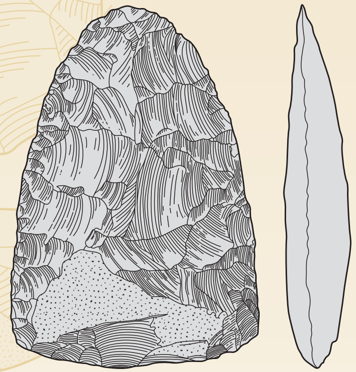
Middle Palaeolithic technology and Levallois technique

The Middle Palaeolithic tool kit shows a number of technological advances over the Lower Palaeolithic. Most notable is the introduction of a new form of core working referred to as the **Levallois technique**, which appears in Britain around 300,000 years ago. Levallois is a form of 'prepared core technology', in which the core is carefully shaped by removing a series of preparatory flakes to enable the production of a final flake or series of flakes of predetermined shape and size (See Levallois method). In its classic form Levallois cores are often referred to as tortoise cores (for obvious reasons - see illustration), but a number of other variations exist. The Middle Palaeolithic also shows a much wider range of more sophisticated flake tools, including a large number of different forms of scrapers with elaborately retouched edges. Levallois material has been recorded in the Trent Valley around Nottingham.



Levallois technique: stages in the preparation of a 'tortoise core' in order to remove a Levallois flake

At about the same time as Levallois appears in Britain handaxes disappear from the record, Levallois flakes perhaps taking their place as the main cutting implement. However, the handaxe reappears some 200,000 years later at the very end of the Middle Palaeolithic. These later examples are frequently small and cordiform (heart-shaped). One peculiar form of late Middle Palaeolithic handaxe the '*bout coupé*' is believed to be unique to this period in Britain. This is an elongated D-shaped handaxe with a markedly flat butt and a broad tongue-shaped tip. *Bout coupé* handaxes often occur as individual finds on or just beneath the surface. This may indicate they were carried around the landscape as a multipurpose tool, thrown away when they were no longer useful or accidentally lost. Although we remain hopeful, at present no classic *bout coupé* handaxes have been identified in the Trent Valley. However, other evidence of Middle Palaeolithic occupation has been found at several well dated sites in the Midlands, most notable from Creswell Crags on the Nottinghamshire-Derbyshire Border.



bout coupé *handaxe*

An History of Archaeological Research in the Trent Valley

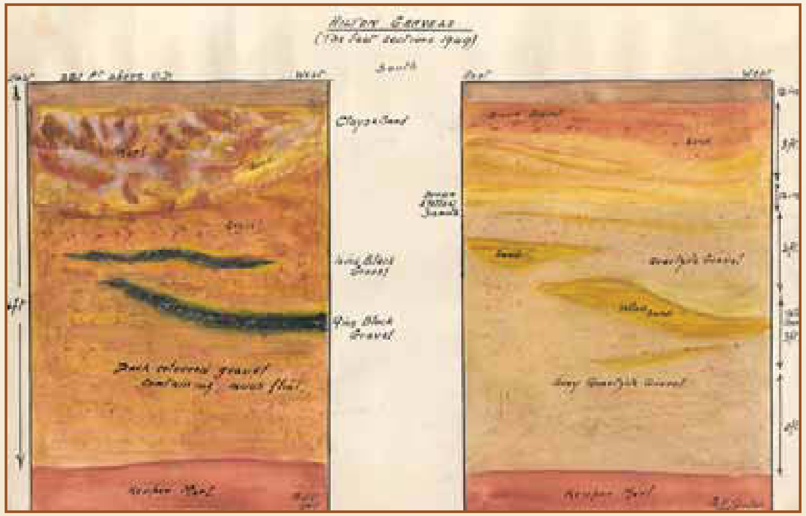
The first Palaeolithic artefact found in the English Midlands was a handaxe discovered in 1890 at Saltley in Birmingham. Made on a quartzite pebble, it was published by Sir John Evans in his landmark book of 1897 entitled *The Ancient Stone Implements of Great Britain*. It is important because it stimulated the first real interest in the Palaeolithic of the Midlands. Until then our study area had largely been considered sterile and beyond the realms of Palaeolithic human habitation.

Some of the artefacts discovered by F.W.G. Davey in Beeston, Nottinghamshire (Photo T. White) Reproduced courtesy of Nottingham City Museum

Inspired by Evans and other prehistorians of the day, Mr. Fred W. G. Davey, began searching the gravel pits around Beeston, Nottinghamshire, for stone tools. He was the first of three collectors to make a significant contribution to Palaeolithic archaeology in the region. Davey actively searched the gravel pits in Beeston from 1897 until 1909, but his finds went unnoticed by the archaeological establishment for many years. He eventually amassed a large collection from the Tottle Brook and Stoney Street pits in Beeston, including a great many flakes and several non-flint implements, artefacts that were often overlooked at the time in favour of more easily recognizable and desirable handaxes.

During the 1930s, Mr. A. Leslie Armstrong assembled another significant collection from the gravels pits around Hilton and Willington in Derbyshire. He frequented these pits with his friend W. H. Hanbury, a geologist, and together they made the first detailed descriptions of the gravel exposures and the location of artefact finds. This contrasted with the collecting by Davey, who was given many of his artefacts by workmen. From the latter years of the Second World War until the early 1970s, the principal collector in the Trent Valley was Mr. George F. Turton, who visited pits in both Nottinghamshire and Derbyshire.

The work of these three collectors is typical of early Palaeolithic enthusiasts, whose patient searching over many years has provided the vast majority of the archaeological material now in our local museums. Rivers far richer in Palaeolithic material, such as the Thames, have naturally attracted more attention from antiquarians, although the quality of the work was variable. To collect large numbers of artefacts, beautiful



Mr George Turton's section drawing of the gravel deposits at Hilton, Derbyshire (Reproduced courtesy of Derby Museum and Art Gallery)

and intriguing as they are, is of little use without making detailed notes on the geological and archaeological context in which they were found. Thankfully, the antiquarians working in the Trent Valley did just that, and superb archives of notes and diagrams are preserved in local museums together with the artefact collections. George Turton even produced some wonderful watercolours illustrating the geology at certain localities (see illustration above).

The last major study of the Lower and Middle Palaeolithic material collected from the Trent Valley was by Merrick Posnansky, a student at Nottingham University, who in 1963 wrote a summary of our knowledge of the Palaeolithic of the Trent up to that date. He noted that a large number of artefacts were still in private hands, some of which have since been acquired by local museums, but many more of which may still be lying unknown to archaeologists. They could be in your attic.

The Trent Valley Project and the Importance of Local Knowledge

One of the main aims of the Trent Valley Palaeolithic Project was to catalogue, inspect and analyse the existing archive of Lower and Middle Palaeolithic stone tools held by various museums around the country and to raise awareness of this resource. The project has now recorded all of the major collections, comprising some 400 handaxes, cores, flakes and other artefacts. Another aim was to try to identify potential new sites, which we have done by a number of organised field studies by trained personnel.

Aside from the three main antiquarian collectors (all amateurs), a considerable number of stone tools have been discovered individually, often by chance, on the surface or in small excavations dug for mundane everyday purposes. Sites which only reveal the odd artefact are known as 'findspots', and include casual finds made by people in virtually every walk of life, from engineers digging foundations for telegraph poles, to walkers rambling across ploughed fields and even gardeners digging their vegetable plots. Such finds require the artefact to catch the eye of the discoverer, who may know nothing about the antiquity of the strange object. Having survived hundreds of thousands of years buried beneath the surface, their fate is still determined by the curiosity of those who encounter them. Raising awareness of the types of artefacts that may be found in your own back garden is therefore a key aim of this booklet, as such finds may lead to the discovery of important new sites.

Times have changed dramatically since Turton, Davey and Armstrong were actively collecting. They often collected from spoil heaps themselves or asked eagle-eyed workmen to save artefacts for them. This was when gravels were hand-dug using shovels and handcarts, and latterly draglines, but those days are long since past. Quarries are now massive, highly mechanised production centres where the health and safety of employees and visitors is taken extremely seriously. Access to quarry areas to inspect spoil heaps, exposures and quarry floors is only granted to appropriately trained personnel, such as those of the TVPP, following lengthy induction training. Unfortunately this also means that the chances of finding artefacts are much reduced.

Mr George F. Turton, a collector passionate about local history and archaeology

However, that is not to say that Lower and Middle Palaeolithic artefacts can no longer be found by the enthusiast. Any find should be reported to your local Historical Environment Record Office, and members of this project would also love to be informed. Contacts for reporting potential discoveries are published at the back of this booklet.

Reconstructing Environment and Landscape

When sediments are laid down in any geological environment, be it a desert, a lake, a river valley or beneath an ice sheet, the deposits and associated features provide a distinctive record of that environment. Experienced geologists can read the features of exposed sediments and identify the processes that created them, reconstructing the physical appearance of the landscape. Sediments can also be sampled for organic and inorganic remains, which can be used in a variety of ways. Some are analysed by environmental specialists to determine what species of plants and animals were living at the time of deposition. Others can be dated, allowing us to match geological deposits to the oxygen isotope curve.

Some of the methods used for reconstructing the environment and landscape of the Trent are outlined here. Individually, these analyses can only tell us about the particular site at which the samples were collected, a snapshot of the Trent at a particular time. By combining the information from a wide range of different samples collected from several sites, however, we can begin to reconstruct a continuous history for the river.

Stone Counting and Gravel Analysis

By studying and identifying the different stones that make up gravel deposits, it is possible to determine where the component rock types originated. Changes in the course of the river can be mapped by matching distinctive stones in river gravel deposits to the sources from which they were eroded. Events such as glaciations can also transport 'exotic' rock types from far afield and introduce them into river systems, each event leading to the introduction of new rock types into the sand and gravel deposits.

The gravels of the river Trent are rich in **quartzite** pebbles and **chert**, both derived relatively locally within the catchment. Occasionally, more exotic rock types are encountered, such as **flint** from east Yorkshire and volcanic rocks such as **andesite** from the Lake District, all brought into the area by ice during glaciation

Examples of some of the rocks found in gravels of the River Trent:

1. *Conglomerate pebble from the Triassic ("Bunter")*
2. *Well cemented orthoquartzite*
3. *Poorly cemented orthoquartzite*
4. *Metaquartzite*
5. *Vein quartz*
6. *Schorl*
7. *Flint*
8. *Carboniferous chert*
9. *Rhaxella chert*

Reconstructing Palaeoclimate

Palaeoclimate means 'ancient climate'. A number of features and structures found in sand and gravel deposits are records of the nature of the climate both during and after sediment deposition.

Under cold climates, the freezing and contraction of the ground causes the formation of vertical bodies of ice (ice wedges) within the deposits, their thickness tapering downwards in a distinctive V-shape. These structures often penetrate through the entire sequence of sediments. When the ice melts, the gap is filled by material that tumbles in from above, creating features known as 'ice wedge casts'. Research on ice wedges forming today in the Canadian Arctic suggests that annual air temperatures of around –6°C are needed for them to form. Ice wedge casts recorded in the East Midlands therefore illustrate the severity of the climate in the Trent Valley during the glacial periods.

An exposed ice wedge in the modern arctic region. The wedge is approximately 3m long

Although at times climate was harsh, the upper levels of some of the sand and gravel deposits show signs of warm-climate soil development. This type of feature is known as a palaeolsol (ancient soil), and indicates an interglacial climate similar to (or even warmer than) the present day.

Finding distinctive features such as these in a sand and gravel deposit enables geologists to determine whether the sediments were deposited during a cold or warm climate

Gravel pit section in Essex showing warm-climate soil formed at the top of a river gravel buried beneath till. The warm climate soil is indicated by the dark red coloured areas. It has been disrupted by frost activity including the formation of an ice-wedge cast (fossil ice-wedge) seen in the centre. Compare with photograph of a modern ice-wedge to the left.

Environmental Evidence From Terrestrial Deposits

Fine-grained clays and silts rich in organic material have been discovered in several quarries throughout the Trent Valley. The remains of plants and animals, both large and small, preserved within these sediments can help us reconstruct the environments and habitats of the past. Such deposits are often waterlogged, which enhances preservation of organic materials

Plant remains

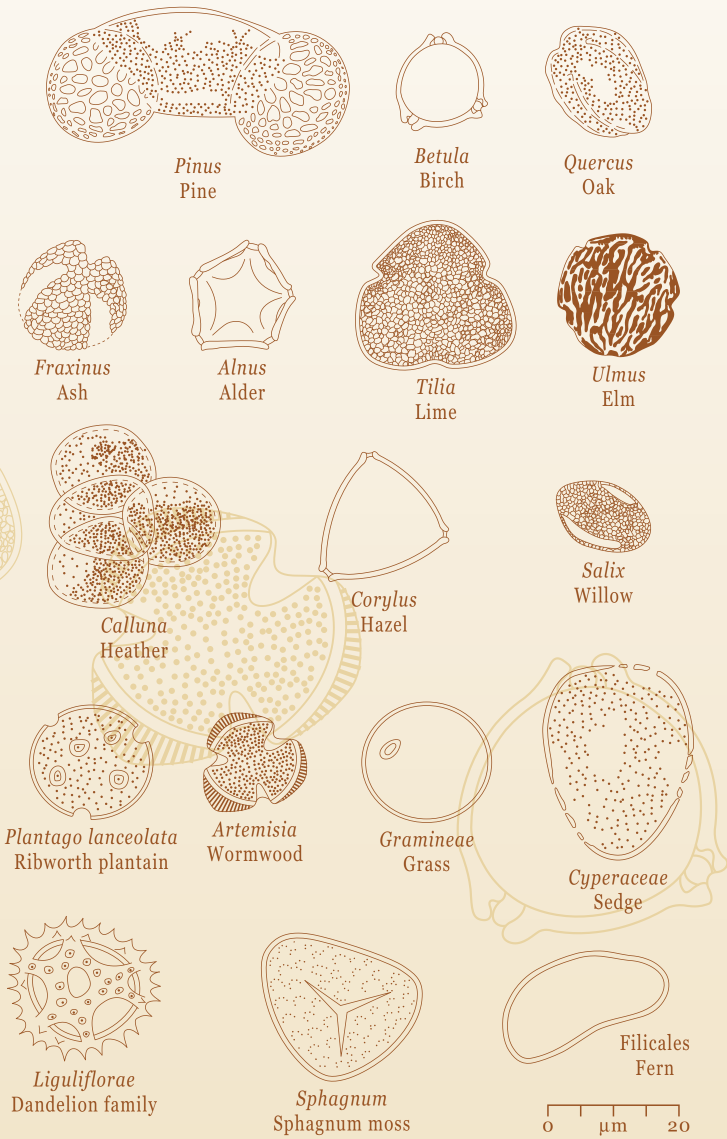
Pollen grains are the microscopic reproductive material of flowering plants. Often produced in vast quantities by wind-pollenated species, which are therefore the best represented in sediments, pollen can be transported over considerable distances. It is highly resistent to destruction and can survive under the right conditions for millions of years.

Pollen specialists (Palynologists) can identify plant types from preserved pollen, as different groups of flora produce characteristic forms of pollen grains. It is therefore possible to determine the types of trees, shrubs and grasses that grew in a particular environment during a specific part of the Quaternary. Furthermore, because pollen is widely distributed in the air (as anyone with hayfever will tell you), it can provide a regional picture of the vegetation growing in the landscape.

As well as pollen, larger fragments of plant material, including tree trunks, twigs, leaves and seeds, can be preserved and their species identified. In contrast to pollen, these remains tend to be deposited relatively locally and therefore provide an idea of the plants growing at a specific site.

A blackberry pip (Rubus fruticosus agg.)

Seeds of Najas Flexilis, the Slender Naiad, a lake-dwelling aqautic plant



Pollen grains, magnified several thousand times (1 μm = one millionth of a metre)

Birch fruit

Carex seed

Animal remains

Remains of animals from Quaternary deposits consist mainly of bones and shells, with the soft parts of the body only surviving in exceptional cases, such as the mammoth carcasses frozen in Siberia. In Britain, animal bones are often found in river gravels, and can be used to determine the prevailing climate when the deposit was formed. Remains of smaller animals can also be found, predominantly in the fine-grained organic sediments of interglacials. They can be used to determine how warm an interglacial period was, as well as giving an indication of the types of habitats that would have existed, such as woodland, grassland, and tundra. As some animal lineages evolved significantly during the Quaternary, they can be a useful indication of age and can help identify particular interglacials.

Fragments of insect **exoskeleton** are often found in organic sediments. Wing cases are very common, although other remains are more useful for identifying species, especially the reproductive parts. By identifying the different species of fossil insects preserved in a deposit, it is possible to reconstruct their environment by looking at the habitats of their modern descendents. Most insects live in very specific habitats, and many are very intolerant to change in climate and environment. One advantage insects have over other environmental indicators, such as vegetation, is that they respond very rapidly to changes in their environment and are therefore very sensitive indicators of climate change. Combinations of insect species of known environmental distribution can reveal very precise temperature ranges for past climates.

Under specific conditions, the shells of snails and other molluscs, living on land and in water, may be preserved. As with other environmental indicators, individual species have particular ecological preferences, and can be identified and used to reconstruct the local environment.

Snails preserved in Quaternary sediments:
1) Planorbis corneus
2) Bithynia tentaculata
3) Discus rotundatus
4) Theodoxus fluviatilis
5) Aneylus fluviatilis

Irridescent beetle wing cases washed from Quaternary sediment

Fossil elephant tooth from River Trent deposits in Lincolnshire

From Glacial Wasteland...

During glacial periods the temperatures in the Trent Valley probably averaged between -10 and -30°C and, as already noted, the glaciers and more extensive ice sheets that developed across what is now northern Britain sometimes reached the English Midlands. At such times, beyond the ice, the environment was characterized by arctic tundra vegetation and was extremely hostile to human occupation. Only specialized cold-adapted animals such as mammoth, musk ox, bison, arctic fox, arctic hare and reindeer would have roamed the landscape, some migrating from mainland Europe across land-bridges created by low global sea levels. There were long periods in between the most severe glacials and the warm interglacials when such conditions prevailed; the climate was generally cold, with permanently frozen ground and limited vegetation. Combined with the extreme glacial maxima, at least 80% of Quaternary time has been cold. During the extremes of these cold periods people probably abandoned Britain altogether.

Outflow glacier, Gigjökull, South Iceland (© Dr. Mike Church)

... to Interglacial Paradise

In contrast, interglacial climates were similar to those of the present day and sometimes warmer. With the rise in temperatures, vegetation flourished and dense, mixed deciduous forests of oak, elm, hazel, alder and birch spread across the landscape, interspersed with more open grasslands where large herbivores grazed. We know from fossils that during pre-Holocene interglacials, Britain was home to a wide range of animals, some familiar and others quite exotic compared with those we know today. For example, during the Hoxnian interglacial (approximately 400,000 years ago), archaic species of bear and rhinoceros roamed East Anglia and southern Britain, together with a large but now extinct relative of the beaver and a very large fallow deer.

During the last interglacial, the Ipswichian (approximately 125,000 years ago), hippopotamus wallowed in British rivers, including the River Derwent where its remains have been found in old Trent sediments, beneath what are now the Derby suburbs of Allenton and Boulton. Hippopotamus fossils, which are commonly preserved in river deposits (unsurprisingly, since hippos live and die in rivers), are important markers for the Ipswichian, as that animal did not live in Britain during any other interglacial of the last half million years. A huge temperate-climate elephant, the now-extinct 'straight tusked elephant (pictured here)', was also an inhabitant of Britain during at least five of the last five interglacials. Finding its remains provides excellent evidence that the climate was warm, but unlike the hippopotamus, it cannot be used to identify a specific interglacial. The use of fossils as a method of dating is called **biostratigraphy**. Much of what we know of human life during the Pleistocene comes either from these interglacial periods or from the cooling or warming phases at either end of them.

Dating the Sediments

When considering the age of deposits, geologists talk about two types of dating; **relative** and **absolute** dating.

Relative dating does not involve any numerical dates. It is often based on no more than the relationships observed between deposits. When examining a geological section, it can usually be assumed that the oldest deposits are at the bottom of the sequence, with progressively younger ones stacked above. Deposits within individual river terraces conform to this principle, but the terraces themselves show the opposite, in that the higher terraces are older than those further down the 'staircase'. This is because rivers deepen their valleys progressively.

In recent years, however, advances have been made in correlating some of the relative dating sequences to the oxygen isotope curve, thereby providing a means of locating these sequences within Quaternary timescales. One way in which this has been done is through the different terrace formations of British rivers (principally the Thames), where a model of terrace formation based on climate and uplift has suggested that a terrace was produced during each climatic cycle.

The remains of many different mollusc and mammal species can also be used to obtain relative dates for geological deposits, especially where these can be anchored to a well-known series of terrace deposits. Deposits may contain the fossilised remains of animals that have clearly evolved from an earlier form found in other deposits, contain groups of mammals or molluscs that only existed together in the British Isles during certain periods, or contain individual species unique to a certain deposit. The last decade has seen significant advances in tying these specific mollusc and mammalian groups to the oxygen isotope curve, along with the terrace deposits in which they are found, using biostratigraphy. Taking the last interglacial as an example, this uniquely contains hippopotamus, but not horse, humans or the mollusc species *Corbicula fluminalis*. Finding hippopotamus within a deposit can be sufficient to assign it to the Ipswichian, even if an absolute date is not available.

Since the 1950s a number of scientific dating techniques have been developed, allowing precise age estimates to be calculated. This type of dating, known as **absolute dating**, includes methods that can date a variety of mineral and fossil remains found in sediments.

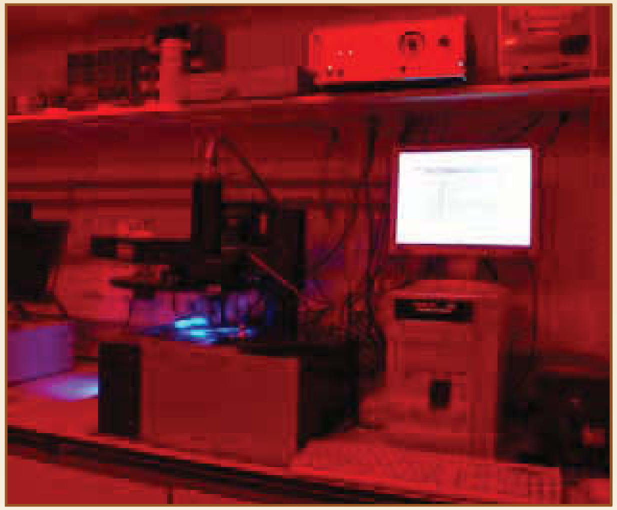
Radiocarbon dating is one of the best-known techniques, but can only be used for materials that are less than 30,000 years old. Because the TVPP is dealing with deposits that are sometimes almost 20 times older than this, two comparatively new absolute dating techniques, both developed in the last few years, have been used to date the sands and gravels.

Optically Stimulated Luminescence Dating (OSL) measures the natural radiation that builds up in geological deposits over time. All sediments contain tiny amounts of natural radioactive isotopes, and the radiation from these elements is absorbed by quartz or feldspar grains in the surrounding sediment. Exposure to sunlight resets the radioactive signal stored in grains to zero, and so samples are collected in light-proof tubes. In a laboratory darkroom, grains taken from the centre of the sample can be made to emit their stored radiation in the form of light (luminescence), which can be measured and used to estimate the amount of time that has elapsed since they were buried. An OSL date therefore represents the date at which the deposit was laid down, not the age of the grain itself.

OSl field technique: a gamma spectrometer measuring the natural radiation present in a Quaternary sediment

OSL has been most successfully used to date aeolian (wind-blown) sediments, which have generally been zeroed by exposure to light before burial. In the last few years, however, scientists have attempted to use OSL to date both glacial and fluvial sediments, in which the grains are less likely to have always been zeroed. The Trent

Project is working with luminescence specialists from Oxford University to develop an OSL dating framework for the sands and gravels of the River Trent, and thus far over 30 OSL samples have been taken from key deposits.



Analysing OSL samples in the lab: A TL/OSL DA-15 Risø reader equipped with blue LEDs in the Luminescence Dating Laboratory, University of Oxford (Photo © Jean-Luc Schwenninger)

Amino Acid Racemization Dating (AAR) works by analyzing the **amino acids** that form proteins. Protein is an essential part of life: every cell of every organism contains proteins in different amounts. However, proteins decompose very rapidly when an organism dies, and so the newly developed version of the AAR technique relies on protein preserved within single crystals of the calcium carbonate shells of snails, which has been preserved from the moment the animal died.

The amino acids can exist in two forms, which are chemically the same, but mirror images of each other in terms of molecular structure. Amino acids in living organisms are all left-handed (L) molecules, but when the organism dies, a gradual reaction occurs until there are an equal number of left-handed molecules, and right-handed (D) amino acids. The ratio of right-handed to left-handed molecules, or D to L, therefore increases with time and the measurement of this ratio of amino acids (the D–L ratio) is used to date the shell.

AAR can be used to provide age estimates for individual mollusc shells preserved in organic sediments within sand and gravel deposits. It cannot be used to date all sites, of course, as mollusc shells are often not preserved and some are unsuitable for this type of dating. The opercula of *Bithynia tentaculata* have been most successfully used for AAR dating. The TVPP is working with AAR specialists from the University of York and has so far obtained 20 dates from suitable sediments.

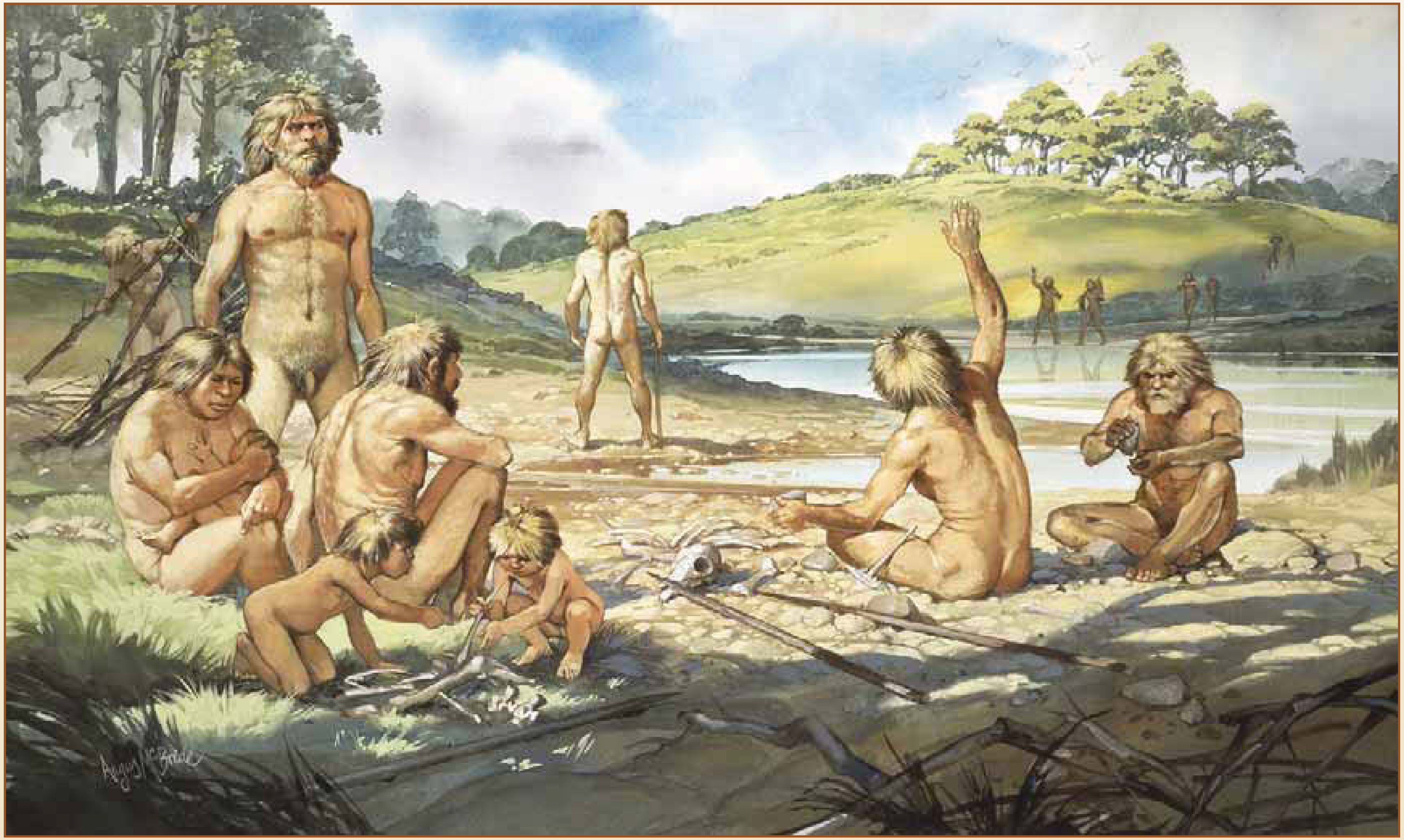
Members of the team collecting samples for analysis

Operculum of Bithynia tentaculata. *The operculum (from the Latin for 'little lid') is a tiny plate at the opening of the snail shell, attached to the snail's foot. It serves as a cover to protect against the predators when the snail's body is retracted inside the shell (Image © Kirsty Penkman)*

Combining the Evidence: Creating a Portrait of Palaeolithic Life

As we have seen, the archaeology and landscape of the Palaeolithic can only be reconstructed by connecting many lines of inquiry. Every new strand of evidence adds to the picture of Britain during the Palaeolithic, and as new sites are discovered and scientific techniques are improved our understanding of prehistoric life continues to expand.

In some respects Lower and Middle Palaeolithic archaeology has more in common with **palaeontology** than with later archaeological periods. We have remarkably little from which to reconstruct the lives of ancient humans, often no more than stone tools and the bones of wild animals accompanying them in the same sediments. These early people left no monuments, recognizable architecture or complex settlements, and their effects on the natural landscape were minimal.



© Natural History Museum

Image © Natural History Museum

The evidence we have suggests that they lived as simple hunter-gatherers who adapted their lifestyles to meet the challenges of surviving in the harsh natural environments around them. Their lifestyle was probably highly mobile but at the same time very local. Archaeologists believe that they moved between a number of well known places in search of food and other raw materials, foraging for vegetable foodstuffs and hunting and butchering the animals that roamed the landscape. They had no true homes as such, but many temporary camps; they rarely moved resources further than an hour or two's walk and made most of their tools where suitable raw materials naturally occurred.

Their stone tool kits tell us much about their level of technological sophistication, the decisions they took in making their implements and the skill and intelligence that this required. The shape and edges of the tools also allow us to infer the range of materials on which they were used, including meat, hides, wood and other plants. Many tools were involved in butchery, but others were probably used to make other vital equipment such as animal skin clothing and wooden tools and weapons. Amazingly, 450,000 year-old examples of wooden spears have been found at Clacton-on-Sea in Essex and at the German site of Schöningen, preserved under exceptional circumstances. These just hint at the potential range of tools, manufactured from perishable materials such as wood and bone, that are now lost to the Palaeolithic archaeologist.

Hunting was probably based around frequent visits to places where animals were known to congregate, such as riverbanks, or where they could be easily ambushed, such as the limestone gorge at Creswell Crags on the Nottinghamshire - Derbyshire border.

We hope that our research will ultimately help unravel the mysteries surrounding the ancient history of the Trent and its first human occupants, and perhaps inspire similar work along the Trent Valley and other places.

The Clacton Spear, discovered in 1911 in interglacial sediments at Clacton-on-Sea, dates back 450,000 years, making it the oldest wooden spear to have been discovered in the British Isles. Image © Natural History Museum

Glossary

Acheulean – a Lower Palaeolithic stone tool industry characterized by handaxes, named after the site at St. Acheul, in the Somme Valley, France.

alluvium – a term used most frequently for finer sediments deposited by rivers, sometimes spread over quite large areas during flooding.

amino acid – an organic compound, the main component of proteins. There are over 100 amino acids, but only 20 are commonly found in living organisms.

andesite – volcanic, igneous rock named after the Andes mountains of South America where it is commonly found. British examples of andesite occur in the Lake District and the Charnwood Forest.

Anglian glaciation – a period when much of Britain was covered in ice, extending from about 480,000 until about 425,000 years ago.

biface – a stone artefact, commonly a handaxe, that has been flaked on both faces.

braided river – a river overloaded with sediment and forced to divide into many channels separated by shifting bars or islands.

chert – a very hard sedimentary rock commonly found as nodules in limestone as well as in beds as a primary deposit. **Flint** is a very fine-grained form of chert..

Clactonian – Lower Palaeolithic stone tool industry made distinct from the Acheulean by the complete absence of handaxes.

conchoidal fracture – (literally, shell-like) - the manner in which materials such as flint or glass fracture with a smooth curved surface.

Danelaw – a region of England conquered and administered by the Vikings in the 9th century.

Devensian – the last glacial period of the **Pleistocene** in Britain, between about 80,000 years ago and 10,000 years ago. The main period of glaciation was between 23,000 years ago and 15,000 years ago..

epoch – the smallest unit of geological time, being a subdivision of a geological period (e.g. the Pleistocene is an epoch of the Quaternary period).

exoskeleton – the hard outer covering of invertebrate organisms such as insects.

flint – a very hard sedimentary silica-based rock that occurs mainly as nodules or thin beds in chalk. It breaks to form thin, sharp splinters when struck with another object, making it a perfect raw material for stone tool manufacture. See also, **Chert**.

flintknapping – see knapping

fluvial sediments – material deposited by the action of a stream or river, often sands and gravels.

foraminifera – tiny, single-celled marine animals with a hard shell composed of calcium carbonates that can be analysed to determine the oxygen isotope ratio in sea water.

glacial period, glaciation – a period of intense cold, lasting centuries or millennia, during which ice-sheets and glaciers formed.

glaciofluvial sediments – material deposited by the action of a stream or river fed by meltwater from a glacier or ice sheet.

Holocene - the warm period in which we now live, which began about 10,000 years ago. It is now thought of as the latest interglacial.

Homo heidelbergensis – the Latin name given to a human species that appears to have flourished from about 750,000 years ago; in Britain its remains have been found at Boxgrove in Sussex dating from around 500,000 years ago.

Homo neanderthalensis – the Latin name for a species closely related to, but distinct from, modern humans; popularly known as 'Neanderthal man', Neanderthals seem to have co-existed with our own species for about 170,000 years, before apparently becoming extinct about 30,000 years ago.

Homo sapiens – the Latin species-name for modern humans (Homo = man, sapiens = wise); we appear to have been around for about 200,000 years.

Industry – a group of archaeological assemblages found over a specific region or corresponding to a certain period of time containing similar artefacts, e.g. the Clactonian industry.

interglacial period – a warm episode between two glacial periods or 'Ice Ages'.

isotope – one of two or more forms of an element, chemically identical but with different atomic weights.

knapping – a technique for making stone tools by striking flakes from a core of stone with various types of percussor.

Levallois technique – knapping technique in which a core is carefully prepared in order to produce flakes of a predetermined size and shape.

meander – a loop-like bend in a stream or river channel.

megafauna – large animals, often – as in the cases of the mammoth and woolly rhinoceros – more massive equivalents of species which survive today, which roamed the landscapes of the Lower and Middle Palaeolithic and were hunted by their human inhabitants.

molecule – the smallest unit of a substance that can exist alone and retain the character of that substance.

Neanderthal – see **Homo neanderthalensis**.

outwash deposits – gravels, sands, silts and clays deposited by meltwater flowing outwards from a glacier.

oxbow lake - a lake formed in the abandoned channel of a river meander.

palaeo- - from the Greek *palaios* meaning ancient, of ancient times. For example, Palaeoclimate = ancient climate.

Palaeolithic period – The Old Stone Age (Greek palaios = 'old', lithos = 'stone'); covers the period from when the earliest ancestral human species began to manufacture tools (about 2.5 million years ago, but what is now Europe effectively begins, as far as we know at present, about 800,000 years ago), extending until about 10,000 years ago. The period is usually subdivided into 'Lower' (before 300,000 BP), 'Middle' (300,000 – 35,000 BP) and 'Upper' (35,000 – 10,000 BP).

palaeontology – the study of the fossil remains of plants and animals.

percussor – a hammer or striking object used in flint knapping, which can be made of stone (for 'hard-hammer' techniques) or antler or bone (for 'soft-hammer' techniques).

periglacial – conditions prevailing close to an ice sheet, but not covered in ice. The ground is often permanently frozen save the active layer, resulting in waterlogging of the surface during summer as downward drainage is impossible. Such areas support only tundra vegetation.

permafrost – a layer of soil that has remained 'permanently' frozen from a few to several thousand years.

Pleistocene – the most recent major geological epoch (dating from c. 2.6 million – 10,000 years ago), colloquially known as the 'Ice Age' due to the cyclical expansion and contraction of glaciers during this epoch.

quartzite – a highly cemented form of pure quartz sandstone, Some quartzites are metamorphic in origin, however, having been altered by heat and pressure.

Quaternary – the geological period which extends from about 2,000,000 years ago until the present, subdivided into two epochs, the Pleistocene (2 million – 10,000 years ago) and the Holocene (10,000 years ago – present).

retouch – further intentional modification of the sharp edge of a stone tool to suit certain jobs or to re-sharpen the implement.

river terrace – fragments of ancient river floodplain surfaces preserved as distinctive flat steps in the valley side after the river channel has cut downwards, deepening the valley.

scar – distinctive concave feature on the surface of stone tool where a flake has been removed.

terrace – see river terrace.

till – material deposited by the movement of glaciers; typically stiff clay containing boulders and therefore sometimes referred to as 'boulder clay'.

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Quarry Products Association (QPA): **www.qpa.org**

Quaternary Research Association (QRA): **www.qra.org.uk**

Trent Valley Palaeolithic Project: **www.tvpp.org**

Trent Valley Geoarchaeology: **www.tvg.org**

Young Archaeologists Club (YAC): **www.britarch.ac.uk/yac**

Cresswell Crags: **www.creswell-crags.org.uk**

IGCP 449/518: **www.dur.ac.uk/geography/research/researchprojects**

Glaciers on-line: **www.swisseduc.ch/glaciers**

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Acknowledgments

The Trent Valley Palaeolithic Project and this publication were funded with a grant from the Aggregates Levy Sustainability Fund (ALSF) through DEFRA and administered by English Heritage (Project Number 3495). Our thanks go to Dr Pete Wilson of English Heritage for project management and a number of his colleagues for additional support (Dr Jonathan Last, Dr Alex Bayliss, Dr Derek Hamilton, Dr Peter Marshall, Dr Jim Williams and Dr Jim Leary).

However, critically, this work could not have been undertaken without the generous provision of access to active and worked out quarries and private land.

We would therefore like to offer our sincere thanks to the following companies and individuals:

Bardon Aggregates (notably Mr Chris Stone)

Cemex (notably Mr Andrew Hindmarsh, Mr Alan Smith and Mr Stephen Woods)

C&G (notably Mr. Andrew Moseley)

Hanson Aggregates-central (notably Mr Roy Bishop)

Lafarge Aggregates Ltd (notably Mr Ian Adcock, Mr Richard Allott, Mr Ross Halley & Mr Len Mudd)

Tarmac Ltd. (notably Mr Neil Beards, Mr Dave Coote and Mr Steve Hill)

Woodhall Spa Sand & Gravel (notably Mr Peter Gray)

Mr. Ken Atkin

Mr. Michael Chennells

Geoff and Jean Laughton

Mr. C. T. and Mr. J. J. Sheldon

Mr. David Stretton

Mr. Chris Waddington

Mr. Keith Wright

Thanks are also due to the curators of the museums visited during the project to record Palaeolithic artefacts from the Trent Valley, and the staff at the Derbyshire and Nottinghamshire SMR for their help with local records:

Nick Ashton and Debbie Slatford (British Museum)

Ann Insker (Nottingham City Museum)

Lloyd Laing (Nottingham University Museum)

Jonathan Wallis (Derby Museum and Art Gallery)

Gill Woolrich (Sheffield Museum and Art Gallery)

Gill Stroud, Andy Myers and Dave Barrett (Derbyshire SMR)

Virginia Baddeley, Ursula Spence and Mike Bishop (Nottinghamshire SMR)

We would also like to thank Mr. John Turton for access to his late father's private collection of Palaeolithic artefacts.

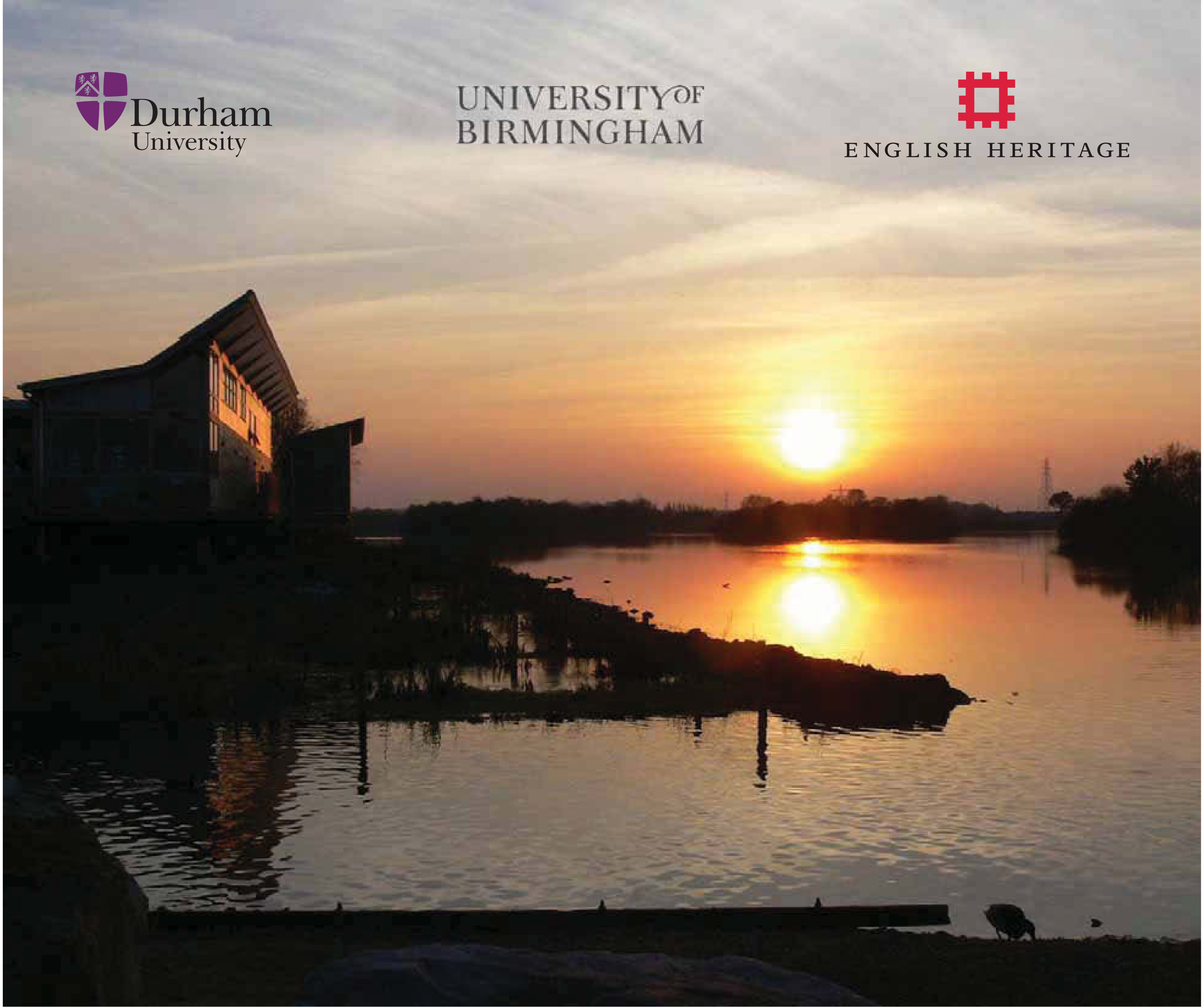
Lastly, thanks to Chris Orton and David Hume of the Durham Design and Imaging Unit for their care and patience in the design and production of this publication.

This book is dedicated to the memory of Professor David Keen, an inspirational mentor to Quaternary Researchers

Bibliographic details of this booklet:

Bridgland, D.R., Howard, A.J., White, M.J. and White T.S. (2006).
The Trent Valley: Archaeology and Landscapes of the Ice Age. Durham University

ISBN: 0900974761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