formation in the Axe may explain the large concentration of handaxes at Broom, although the long terrace sequences of the Exe and the Otter do not fully explain the paucity of artefacts in those valleys.

It is clear that the landscapes we see today are nothing like those which hominins would have encountered in the past. The rolling hills and valleys that characterise the area today may only have formed over the last 250,000–300,000 years (on the basis of the dates from Kilmington and terrace 7 of the River Otter). There would have been far less topographic relief during the Pleistocene, although high points like Dartmoor and the Blackdown Hills would still have stood out. Rivers would have fluctuated between braided (cold) and meandering (warm) types, both of which would have incorporated the artefacts discarded by the Palaeolithic hominins of the south-west.

Palaeolithic Resources
If you are interested in finding out more about the Palaeolithic period in the south-west region, try visiting the following Palaeolithic cave sites (all website addresses correct at the time of going to press):
• Kent’s Cavern, Torquay: http://www.kents-cavern.co.uk/
• The Cheddar Caves, Somerset: http://www.cheddarcaves.co.uk/

You’ll find interesting collections of Palaeolithic artefacts at the following museums:
• Royal Cornwall Museum, Truro: http://www.royalcornwallmuseum.org.uk/

The recent book Fairweather Eden (by Mike Pitts and Mark Roberts) also provides an excellent summary of British Palaeolithic archaeology and the key site of Boxgrove in particular.

Acknowledgements
This booklet was produced as part of the Palaeolithic Rivers of South-West Britain project, and all text and images are under project copyright. The project was funded by the Aggregates Levy Sustainability Fund, through English Heritage. OSL sampling and dating was undertaken by Dr Phil Toms. Full publication of the OSL dates is pending (please see the project website for further details).

The Palaeolithic Rivers of South-West Britain

Introduction
The Palaeolithic Rivers of South-West Britain (PRoSWeB) project was established to improve our understanding of the Palaeolithic archaeology of the south-west region, including the ages of the archaeology (which consists of stone artefacts, largely handaxes), the evolution of the region’s river valley landscapes during the Palaeolithic, and the scope and extent of the hominin occupation during the Lower (c. 700,000–250,000 years ago) and the Middle (c. 250,000–40,000 years ago) Palaeolithic.

There is a glossary of key terms (marked in bold italics) used in this booklet at the project website, where you can also find further information: http://www.rdg.ac.uk/palaeorivers

Background
River Terraces: The majority of Lower and Middle Palaeolithic stone artefacts in Britain are found in river deposits: gravels (which consist of
cobble and pebbles), sands, silts and clays. As well as being found on modern river floodplains, these deposits are also found on river terraces.

Terraces represent the ancient floodplains of rivers. They are located above the modern floodplains because over the course of the Pleistocene (the geological period often known as the Ice Ages) most of the rivers in southern Britain have progressively cut deeper and deeper floodplains, leaving only fragments of their old floodplains as terrace remnants on the valley sides. This happened as a result of sea level changes, which occurred in response to the climatic changes of the Pleistocene (cyclical periods of cold and warm conditions), and very gradual uplift of the land. Where river terraces occur at different heights above the same river, generally the higher the terrace, the older it is.

**Schematic model of river terraces**

![Schematic model of river terraces](image)

**Palaeolithic Artefacts and River Terraces:** Palaeolithic artefacts were left by hominins (early humans) on the banks and floodplains of rivers, and the artefacts were then washed into the rivers when they flooded. In this way, they became mixed in with the river deposits that make up the ancient river terraces and were eventually deposited along with the gravels and sands. One of the main problems that archaeologists must therefore address is that the artefacts are rarely found where they were originally left down gravels; others were very sluggish, laying down fine-grained sands, silts, and clays. At a larger scale however the deposits are all typical of those laid down by a braided river system. OSL samples from Chard Junction date the top of the fluvial material to c. 96,000 BP, while the base of the fluvial deposit has been dated to c. 274,000 BP.

**Summary**

There is clearly considerable inter-valley variation in the Palaeolithic rivers of the south-west (see the table below). A much better understanding of the causes of this variation has now been gained, showing that the Exe and the Otter are strath terrace systems, but that the Axe is a fill terrace system. This means that in the Exe and the Otter valleys the rivers incised over time, and in combination with uplift activity a series of altitudinally separate terraces formed.

<table>
<thead>
<tr>
<th>Site</th>
<th>River</th>
<th>Terrace</th>
<th>Dates (before present)</th>
<th>OIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Princesshay</td>
<td>Exe</td>
<td>6</td>
<td>43,000±5,000</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(re-worked)</td>
<td>44,000±4,000</td>
<td>3</td>
</tr>
<tr>
<td>Yellowford Farm</td>
<td>Exe</td>
<td>6</td>
<td>75,000±23,000</td>
<td>5a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(re-worked)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monkey Lane</td>
<td>Otter</td>
<td>7</td>
<td>140,000±20,000</td>
<td>6</td>
</tr>
<tr>
<td>Chard</td>
<td>Axe</td>
<td>U</td>
<td>94,000±9,000</td>
<td>5b</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>98,000±8,000</td>
<td>5c</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>174,000±18,000</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>274,000±74,000</td>
<td>8</td>
</tr>
<tr>
<td>Kilmington</td>
<td>Axe</td>
<td>U</td>
<td>154,000±19,000</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>179,000±18,000</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>273,000±26,000</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>309,000±26,000</td>
<td>9</td>
</tr>
</tbody>
</table>

**Summary of key Pleistocene terrace deposits and ages in the Exe, Axe and Otter rivers. U: Undifferentiated terrace**

By contrast, the gravels in the Axe are made up of different units which are vertically stacked (as recorded in our sedimentological logging). There is considerable variation in these deposits mapped as a single terrace, demonstrating that their evolution is multiphase. The nature of the terrace
represent a human presence in one of the preceding warm **interglacials** (probably Oxygen Isotope Stage 9: the OSL age of 309,000 BP dates to the very end of this stage). If the artefacts come from the higher unit, then they could again reflect a human presence in a warm interglacial (Oxygen Isotope Stage 7), as the dates of c. 179,000 BP and c. 154,000 BP also fall within a cold glacial stage (Oxygen Isotope Stage 6). In other words, in both cases the handaxes are likely to have been reworked from older, warm climate deposits.

The differences in the types of sediment within the exposed sections at Kilmington (for example the variability between gravel-dominated deposits and sand/silt deposits) reveal different channel and bar features, and reflect changing river types and drainage patterns.

![A cold climate, braided river system from modern day Iceland (© Dr J Chambers, University of Birmingham)](image)

**Chard Junction:** A similar range of analytical techniques were applied at Chard Junction, from which several handaxes have also been recovered (although again their exact context is unknown). Two main deposit units have been identified so far: the upper unit resembles a debris flow deposit (i.e. the downslope movement of muds, gravels and other materials), while the lower one is clearly a fluvial river deposit, with evidence of several large, sand-filled channels and, at the micro-scale, numerous different depositional environments. Some of the channels were fast flowing, laying

by hominins thousands of years ago. Instead the artefacts have usually been moved some distance down the river, and may even be considerably older than the sediments in which they are found.

![A Palaeolithic handaxe from Budleigh Salterton](image)

**Palaeolithic Rivers in the South-West:** Not all of the rivers of the south-west have clearly defined terraces (due to numerous factors including uplift rates, topography, geology and erosion), but two key rivers with distinct terrace features are the River Exe and the River Otter.

Prior to this project the ages of most of these rivers’ terrace deposits were unknown. Yet their ages are important for our understanding of the region’s Lower and Middle Palaeolithic archaeology because in the south-west there is a notable reduction in the numbers of Lower and Middle Palaeolithic artefacts to the west of the River Axe on the Devon/Dorset border.

**KEY QUESTION:** Does this reduction reflect a genuine absence of Palaeolithic hominins in the far west of Britain? Or were hominins regularly in the south-west, but has the nature of the river terrace deposits, and/or their age been unfavourable to the recovery of artefacts to the west of the River Axe?

A key goal of the PRoSWeB project was therefore to date the terrace deposits of the south-west’s rivers: this would improve our understanding of how the river landscapes of the south-west developed during the Pleistocene and help us assess the extent of the hominin occupation in the south-west during the Lower and Middle Palaeolithic periods.
Summary of Previous Knowledge: The Exe and the Otter have eight and nine terraces respectively. Handaxes have been found in direct association with terrace 5 in both river valleys. Unpublished work by Prof. A.G. Brown & Dr J. Bennett recently dated terrace 3 of the Exe to c. 27,000 BP (years before present) and c. 40,000 BP. The Axe however is rather different to the Exe and the Otter. It has a much higher number of artefacts, and only “Terrace 1” and “undifferentiated” deposits. OSL dates between c. 250,000 to c. 300,000 BP were sampled at the site of Broom (by Dr P. Toms & Dr R. Hosfield), which yielded hundreds of handaxes when the terrace deposits were being quarried by hand.

New Fieldwork

The Dating Method: PRoSWeB has focused particularly on the river terraces of the Exe, Axe and Otter rivers. The dating programme has used a technique called Optically Stimulated Luminescence (OSL). The method measures when the quartz grains found in sand were last exposed to light. The sand lenses found within river terrace deposits are therefore well suited to this method.

Results

River Exe: Dates on terrace 6 have concentrated around c. 44,000 BP and c. 75,000 BP respectively. These are far more recent than was expected given the dates on terrace 3 (see earlier comments). However, studies of the deposits show that terrace 6 is heavily cryoturbated. Cryoturbation means the deposit has undergone freeze–thaw processes, and in terrace 6 this is to a considerable depth. This suggests that the dates on terrace 6 reflect a later reworking of the deposits through cryoturbation, rather than the actual date of deposition by the river. The cryoturbation evidence may also indicate that these terraces have undergone more than one freeze–thaw cycle. Such reworking could potentially incorporate stone artefacts, animal bones, and other materials from the surface.

River Otter: OSL sampling of terrace 7 has provided an age of c. 140,000 BP, roughly halfway though the Middle Palaeolithic. No cryoturbation features were noted, suggesting that the OSL age is contemporary with the formation of the terrace. Palaeo-channels and a block of Mercian mudstone were recorded, and the mudstone seems to have been transported as a frozen block: this suggests cold climatic conditions very different to those of today. Channel features were also preserved within the deposits, showing that the course of the Pleistocene Otter at that time broadly followed the same route as the present river.

River Axe: In the Axe valley, two key sites were examined. Kilmington is now a disused quarry, but handaxes were found there when the pit was working. Chard Junction Quarry is active, and work was undertaken with kind permission from Bardon Aggregates Ltd. Unlike the shallower deposits of the Exe and the Otter valleys, the River Axe deposits are at least eight metres deep at Kilmington and up to 15 metres deep at Chard Junction (although exposures were only about eight metres thick during our fieldwork). The ages of, and relationships between, the deposits exposed at Kilmington and Chard Junction were not clear, and these were key areas of interest for the project.

Gravels of the River Axe at Chard Junction

Kilmington: The OSL dates fall into two groups and are related to two separate major units within the single terrace. The younger dates (for the upper unit) are c. 154,000 BP and c. 179,000 BP. The older dates (for the lower unit) are c. 273,000 BP and c. 309,000 BP. Unfortunately we do not know which unit the artefacts came from (this is a common problem with old quarry finds). If it was the lower unit, then this makes the Kilmington artefacts similar in age to those from Broom. The date of c. 273,000 BP falls into a cold glacial stage (Oxygen Isotope Stage (OIS) 8), but it would seem most likely that any artefacts are actually older than the gravels and