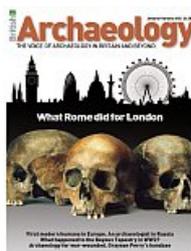


British Archaeology

THE VOICE OF ARCHAEOLOGY IN BRITAIN AND BEYOND



feature

Dating Europe's oldest modern humans

How long has Homo sapiens been in Europe, and for how long did they compete with neanderthals before that species died out? Working with archaeologists in Britain and Italy, the *Oxford Radiocarbon Accelerator Unit* has made the answer to both of those questions, "much longer than we thought". Tom Higham, Chris Stringer and Katerina Douka report.

Issue 122

Jan / Feb 2012

Contents

news

All the latest archaeology news from around the country

letters

Your views and responses

CBA Correspondent

Highlights of another year in listed building casework

Mick's Travels

Mick Aston explores less-visited sites in Brittany

science

Sebastian Payne looks at the reality of spotted horses

features

COVER STORY: Origins of London

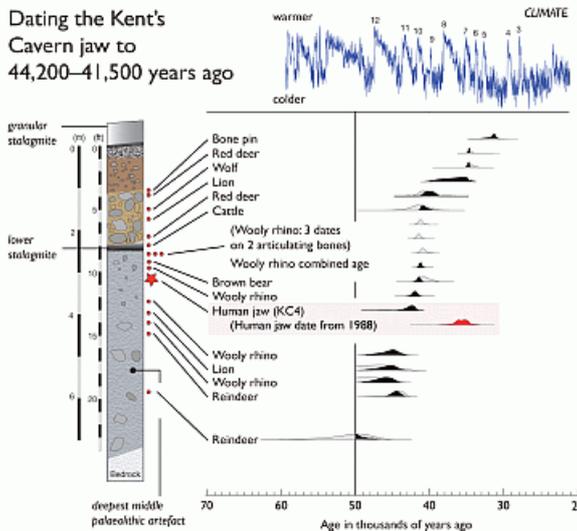
Around 45,000 years ago a new human appeared across much of the Old World. Flourishing in environments far removed from the African heartlands where this species had evolved – hot and dry in Australia, wet in Indonesia or temperate in northern Europe – groups of individuals would occasionally have come across similar beings.

Themselves long since having left Africa, these beings had evolved in their own separate ways. It is thought they occasionally interbred with the new arrivals, and they may

have passed on to each other ideas about technology or the worlds around them. But in time the aboriginal peoples – neanderthals in Europe, Denisovans in Asia, and perhaps others – all died out. We are still here.

This is a new vision of early modern humans. It owes much to archaeology and DNA studies, and will undoubtedly develop as research continues in the field and in labs around the world. But the key to fitting all the parts together is timing. When did the first modern-looking humans leave Africa and enter Asia, Europe and Australia? When, where and why did the neanderthals finally become extinct, and how much were modern humans responsible? And when and where did our species interbreed with neanderthals? We cannot answer such questions without a proper chronology.

Dating the Kent's Cavern jaw to 44,200–41,500 years ago



The early 20th century Kent's Cavern excavations were not published in detail, but were well recorded. Roger Jacobi matched remains preserved in Torquay Museum with specific cave levels. Dating the bones confirmed the integrity of the stratigraphic sequence, but showed the earlier date obtained from the human jaw – whose position in the sequence is known – was much too young, allowing a statistical estimate of its age to be made (numbers top right identify warm periods or interstadials during the last glacial stage)

CBA web:

British Archaeology

- Jan/Feb 2005
- Mar/Apr 2005
- May/June 2005
- July/Aug 2005
- Sep/Oct 2005
- Nov/Dec 2005
- Jan/Feb 2006
- Mar/Apr 2006
- May/June 2006
- July/Aug 2006
- Sep/Oct 2006
- Nov/Dec 2006
- Jan/Feb 2007
- Mar/Apr 2007
- May/June 2007
- July/Aug 2007
- Sep/Oct 2007
- Nov/Dec 2007
- Jan/Feb 2008
- Mar/Apr 2008
- May/June 2008
- July/Aug 2008
- Sep/Oct 2008
- Nov/Dec 2008
- Jan/Feb 2009
- Mar/Apr 2009
- May/June 2009
- July/Aug 2009
- Sep/Oct 2009
- Nov/Dec 2009
- Jan/Feb 2010
- Mar/Apr 2010
- May/June 2010
- July/Aug 2010
- Sep/Oct 2010
- Nov/Dec 2010
- Jan/Feb 2011
- Mar/Apr 2011
- May/June 2011
- July/Aug 2011
- Sep/Oct 2011
- Nov/Dec 2011
- Jan/Feb 2012
- Mar/Apr 2012

CBA Briefing

- Fieldwork
- Conferences
- Noticeboard
- Courses & lectures
- CBA Network
- Grants & awards

The city reveals its chilling Roman past

Local Authority cuts and EH protection

The latest problems and policies of procting our heritage

Dating Europe's oldest modern humans

Each team from Somerset and Italy thought they had it

Archaeology in Russia

Heinrich Härke reports on *kurgans*, politics and *sprit*

Operation Nightingale

Rehabilitating wounded soldiers with archaeology

Embroidering history

The strange tale of the Bayeux Tapestry, archaeology and the Nazi party

ISSN 1357-4442

Editor Mike Pitts

Radiocarbon dating works because a rare, relatively constant amount of radioactive carbon in living things falls away at a known rate after death: dating depends on being able to measure the amount of remaining radioactivity. But 50,000 years ago is close to the limits of the method, making dating very challenging indeed. As one progresses back in time so the carbon-14 atoms still to be detected become ever more rare. By 30,000 years ago, they are 3% of the level of modern times; at 40,000 years ago they are 0.7%. Even small amounts of contamination can significantly affect radiocarbon dates, usually (by introducing less ancient carbon) making them much too young.

Recent research at the [Oxford Radiocarbon Accelerator Unit](#) has shown starkly the extent to which dates obtained in the early years of the method have been influenced by these effects. The use of improved pre-treatment chemistry, designed to remove contaminating carbon, has had a marked effect on the chronology of the period. In some sites, application of these more improved methods has shown that around three quarters of previous dates were erroneous.

Since 2000, the Oxford lab has used an additional treatment when analysing bone called "ultrafiltration". This technique operates rather like a molecular sieve to purify the collagen that is dated. The method was applied to radiocarbon dating in the late 1980s by a young Canadian doctoral student called Tom Brown, but it was not widely taken up by other labs. It was tested in Oxford, and following successful trials was then applied to routine samples of bone in 2000–01. Every bone dated in Oxford now has the ultrafiltration step.

The method improves the extraction and purification of collagen, yields improved quality collagen, and removes contaminants that other methods do not. The initial application of the method to bones from the British palaeolithic had a remarkable effect. The new dates obtained often differed from previous determinations by thousands of years. Later application to sites on the continent had similar impacts. Much of the chronology of the European middle to upper palaeolithic is being rewritten.

[Kent's Cavern](#), a cave in Torquay on the south coast of England, has been an iconic British archaeological site since the 19th century. Remains of stone tools and extinct animals from its thick floor deposits became entangled in the debate about the nature and origins of humanity in the period leading up to the publication of Darwin's *The Origin of Species* in 1859. In 1927, excavations by the Torquay Natural History Society made a very important discovery. At 10 feet 6 inches beneath their datum point (3.2m), a stalagmitic layer termed the granular stalagmite, they found a small piece of human bone.

It was part of a maxilla, a fragment of upper jaw a few centimetres long. When it appeared on the desk of well known anatomist Sir Arthur Keith some time later, it possessed three teeth. He found that the measurements were entirely comparable to those of recent humans: "one can say with assurance", he wrote, "that the specimen... could not be derived from an individual of the Neanderthal type". In his view "the teeth differ from those of a modern Englishman only in their degree of wear and freedom from disease".

It was not until 1988 that the maxilla was directly radiocarbon dated in Oxford, using new accelerator techniques applicable to small samples. It provided an age estimate of 30,900 ± 900 BP (that is, uncalibrated years before present), which fitted well with assessments at that time for the arrival of modern humans in Europe. What was not appreciated then was that the maxilla had previously been conserved using a thin water-soluble collagen-based glue. This had been applied to fix the premolar, canine and fragments of the maxilla into place. More recently it was realised that the date was probably affected by this contamination, and likely to be too young. More work was needed.

[CBA homepage](#)



The "Vestibule" at Kent's Cavern, where excavation in the 1920s removed great quantities of deposit, and found a piece of human jaw



Upper jaw fragment from Kent's Cavern, southern England, dated to 43–42,000 years ago

Permission was obtained to analyse the maxilla again, and a tiny sample of dentine was extracted from the premolar tooth. Sadly, however, the collagen was too scarce for a reliable date. Instead, to diagnose age we had to rely on dating animal bones above and below the maxilla's find spot.

The late Roger Jacobi of the [British Museum](#) spent many weeks in Torquay locating bones that could be identified by depth and locus in the Kent's Cavern Journal made by Arthur Ogilvie and the Torquay excavators. A selection was made, and the bones were dated with ultrafiltration in Oxford.

The result was a remarkable and consistent series of dates, following a clear pattern of increasing age with depth. With Bayesian modelling (see feature, Jul/Aug 2011, no 119 – not online) using the Oxford software OxCal, the dates were calibrated and the probable age of the maxilla was determined, at around 41–44,000 cal BP (ie calibrated years before present). This age is early and highly significant: it places the maxilla at a time when neanderthals were present in north-western Europe. The attribution of the specimen therefore became crucial. Was it modern, or could it instead actually be neanderthal?

[Beth Shapiro](#) of Pennsylvania State University had tried to extract mitochondrial DNA from the premolar while it was separated for the unsuccessful dating attempt, which might have determined its affiliation; but there were insufficient amounts for valid DNA sequencing. So instead, Tim Compton and Chris Stringer of the [Natural History Museum](#) undertook a comprehensive study of the teeth, using micro-CT analysis and a wide comparative study.

They were able to use a virtual three-dimensional model based on the CT scan of the jawbone, generated by researchers from the University of Hull and the Hull York Medical School, to carry out a detailed analysis of the fossil. Of the 20 dental traits measured, 13 were clearly those of anatomically modern humans. Three looked more neanderthal, and the remainder were ambiguous. No neanderthal fossil would show so many modern features. As Keith had originally concluded, the Kent's Cavern maxilla was indeed a modern human.

Meanwhile a similar project had been underway using material from Grotta del Cavallo in the south of Italy. Two tiny infant milk teeth were excavated in the 1960s here by the Italian archaeologist Arturo Palma di Cesnola; one was suggested to be a neanderthal, the other a modern human. They came from an archaeological horizon containing an industry known as the Uluzzian, after the bay of Uluzzo where the site sits. Since then, the view that the Uluzzian industry was authored by neanderthals has become orthodox.



Grotta del Cavallo, southern Italy. The cave is behind the rectangular grill at the bottom of the pale cliff (circled) left of centre

This is important because it contains artefacts that are considered to be the hallmark of what is widely, but controversially termed "behavioural modernity" – the sort of things we might expect modern humans to have made, but not, for the most part, neanderthals. Shell ornaments and bone points, as well as peculiarly shaped lunate-flaked stone tools, characterise the southern Italian industry. It is widely accepted as one of the "transitional industries" of Europe, made in this instance, by neanderthals. The Uluzzian is found in Italy and perhaps Greece too, and is always stratigraphically beneath the earliest Aurignacian (an industry associated with early modern humans) suggesting strongly that it predates it. Once again, at Cavallo the true nature and age of the teeth were critical.



Baby tooth B (left upper first molar, about 1cm across), from Grotta del Cavallo, dated to 45–43,000 years ago

A team led by Stefano Benazzi, a physical anthropologist at the University of Vienna, has re-analysed these key teeth using the latest techniques. Their approach is based around the field of geometric morphometrics, which describes methods used to study variations in the shape of three dimensional objects. As with Kent's Cavern, they used microCT and high

resolution CT scanning to look at enamel shape and thickness of the teeth, as well as internal shape differences. The parameters separate neanderthal and modern human teeth with high levels of certainty, despite the difficulties in analysing infant teeth arising from the lack of a large number of comparable specimens. The data showed, however, that the Cavallo teeth were clearly not neanderthal, but modern humans. Their presence indicates that the Uluzzian is a modern human, rather than neanderthal industry. Given the Uluzzian cultural complexity, this has significant implications.

To determine the teeth's age, Katerina Douka, like Higham, at the [Oxford Radiocarbon Accelerator Unit](#), obtained radiocarbon dates. Previous dates for Uluzzian sites, and Cavallo in particular, were problematic – widely spread and probably affected by contamination. Since the teeth were too small to date directly and lacked collagen, Douka developed a new chemical approach that focused on the dating of marine shell beads found in the same archaeological levels as the teeth. The dates were stratigraphically consistent. Once again, using a Bayesian analysis, a relative age model was built to produce a most probable age for the position of the teeth within the archaeological sequence. This showed that the modern human teeth must date to between 43–45,000 years ago.

This is highly significant. Again it suggests that **modern humans arrived in Europe much earlier than previously believed**. The early Cavallo and Kent's Cavern dates are mutually supportive. The earliest examples of the Aurignacian industry in Europe date from around 36,500BP, or 42,500 cal BP. The Kent's Cavern fossil could be a very early Aurignacian – or older, the range is wide. But the Uluzzian industry and its newly recognised modern human must be earlier.

There are several implications for our understanding of prehistoric Europe at this time. There could have been at least two early migrations of modern humans into Europe before 40,000 years ago. The southern one perhaps followed the Mediterranean coast, and reached Italy, as marked by numerous Uluzzian sites. Further north, there was another and perhaps slightly later dispersal of modern humans, the endpoint of which is marked by the Kent's Cavern jawbone. These westward pulses may have been driven by brief warming phases (interstadials) during the predominantly cold climatic regime of the last glacial stage.

The Uluzzian is one of several transitional industries spread across Europe. These include the Châtelperronian (Franco-Cantabria), Bohunician, Szeletian (both central Europe) and the Lincombian-Ranisian-Jerzmanowician (or LRJ) of northern Europe. They are geographically and typologically distinct, but on the basis of radiocarbon dating all seem to precede the Aurignacian. So were these industries made by neanderthals or modern humans? Sadly in only one other case, the Châtelperronian of France, do we have reliable evidence for associated remains.

At St Césaire, such levels contained a neanderthal skeleton. Neanderthal remains, including teeth and a child's skull bone, were also found at the Grotte du Renne, with ornaments of bone, antler, animal teeth and ivory. However, recent radiocarbon redating of the du Renne sequence showed great variation and no consistency, suggesting the possibility of some mixing. This casts doubt on the relationship between the human and archaeological remains there.

The new dates from Kent's Cavern and Cavallo mean that anatomically modern humans are likely to have co-existed with neanderthals in northern and southern Europe for several thousand years. This raises the possibility of a greater chance of cultural and biological exchange between the two groups. Scientists working as part of the international [Neanderthal Genome Project](#), showed recently that living humans outside Africa share 1–4% of their DNA with neanderthals; at least a small amount of interbreeding most likely occurred in western Asia before the wider dispersal of moderns east and west. This is because people in Europe, East Asia and Australasia share the same amounts of admixed neanderthal DNA.

The hunt will now be on for more evidence from the oldest fragmentary human bones to find out



On 24 November, Nature published two articles online about human teeth: until the authors learnt of each others' research, they all believed they had identified Europe's oldest modern humans

whether or not those individuals have the same shared neanderthal genes as more recent groups. Unfortunately, due to their small size, the bones and teeth from Cavallo and Kent's Cavern will not easily provide additional clues. But they have helped to clarify the earliest dates for the dispersal of those humans into the new world of Europe. In this fast moving field almost anything is possible, however. We should not rule out more technological developments that could shed further light on these intriguing questions.

Calibration was undertaken using the new INTCAL09 curve, which extends back to the limit of the radiocarbon method at around 50,000BP. We thank all our collaborators in the study of the Kent's Cavern fossil: Tim Compton and Chris Collins (NHM), the late Roger Jacobi (BM+NHM), Beth Shapiro (Penn State University), Erik Trinkaus (Washington University, St Louis), Barry Chandler (Torquay Museum), Flora Gröning and Michael Fagan (University of Hull), Simon Hillson (UCL), Paul O'Higgins (Hull York Medical School) and Charles FitzGerald (McMaster University). We also thank all those who provided help with CT and comparative data, and staff at the Oxford Radiocarbon Accelerator Unit. Funding was provided for TH through NERC grant NE/D014077/1. TH, CS and KD are members of the Ancient Human Occupation of Britain project, funded by the Leverhulme Trust.

[<< prev](#) | [index](#) | [next >>](#)