G06 The Durée of the Cave Bear
The First People of Europe

WC 3290

In December, 1994 the French government announced the discovery of a remarkable cave at Vallon-Pont d'Arc in the Ardèche region of south-eastern France. The discovery at that time was all the more remarkable because the entrance to the cave is right at one of the most popular tourist spots in the region. Now named "the Chauvet Cave" in honour of its senior discoverer, these underground galleries hide what are generally believed to be the oldest cave-art in Europe, extraordinary drawings of bison, lions, horses and other animals dated to at least 32-31 KYA.[1]

Commissioned to authenticate the art in the cave, expert Jean Clottes[2] described his first view of the interior of the cave:

> *My first impression was one of wonder at the pristine cave, a jewel full of stalactites that glittered white under the light of our torches. ……In a scene unique in prehistoric art, two rhinos seemed to be fighting. Four horse heads were drawn in exquisite detail above them. All around, rhinos, bison, aurochs, lions, deer and reindeer appeared, as if born of the cave itself. On the wall of another chamber were two life-sized lions facing three other lions and a beautiful rhino. In another frieze, a pride of lions were depicted hunting bison.*

In Jean Clottes' expert opinion,

> *These spectacular paintings would fundamentally change our conception of the evolution of art. Sophisticated artists were at work 30,000 years ago*

[1] The official web-site of the cave at Chauvet-Pont-d'Arc is at: http://www.culture.gouv.fr/culture/arcnat/chauvet/en/

[2] *Ancient Grand Masters*, at *http://www.time.com/time/europe/wonder/chauvet.html*
See also *La Grotte Chauvet*, Jean-Marie Chauvet, Eliette Brunel-Deschamps, Christian Hillaire, published by the Seuil, "Arts rupestres" collection under the editorial guidance of Jean Clottes, Paris, 1995.

when these images were made, and their stunning creations still speak to us today.

What Jean Clottes meant by "changing our conception of the evolution of art" was amplified by Professor David Lewis Williams[3] of the Rock Art Research Institute at the University of Witwatersrand, Johannesbourg, when he wrote:

.....the sophistication of the images confirmed what some researchers had already suspected : the notion of a linear evolution of art from simple to complex forms is, quite simply, wrong. That notion derived from post-Darwinian perspectives that foregrounded the idea of evolution from simple to complex and that had been applied in almost every research area - zoological and botanical evolution, social evolution, the evolution of language, and so forth. Now, directly contradicting the Darwinian paradigm, the Chauvet Cave shows that 'sophisticated' art was being made at the beginning of the Upper Palaeolithic (32,000 B.P.), that is, during the Aurignacian period, the time when anatomically modern people first began to replace Neanderthals in Western Europe. It is now clear that all techniques of image making were practised in the Aurignacian.

One of the cave's strange and unique features mentioned by Clottes was the reminders of the now extinct Cave Bears everywhere:

Bear bones were scattered here and there. …… Several red cave-bear images were outstanding. .... As we moved deeper into the cave, bear skulls and bones littered the ground; our lights revealed bear hollows, where they slept, and enormous paw prints. .....In the center of another chamber, a bear skull had been carefully placed on a stone fallen from the roof.

No one knows why the skull was placed there — some speculate it was as though on an altar — but more obviously, mammoth ivory pointed spear-tips nearby show it was used for target practise!

The skull used for target practise was dated to just over 30 KYA while a jaw bone was shown to be the oldest at 37 KYA. Although the relationship between humans and cave bears remains speculative, it is clear the two species occupied

[3] http://www.culture.gouv.fr/culture/arcnat/chauvet/en/temoi8.htm

Chauvet cave for thousands of years — although probably not together at the same time — from about 32,000 to 28,000 years ago.

It is thought that cave bears (*Ursus spelaeus*) lived in Europe for at least 300,000 years before becoming extinct round about 15-10 KYA and so shared the continent with at least two species of modern humans, *Homo Neanderthalensis* and *H. sapiens*. They were larger than grizzly bears but, as their teeth demonstrate, were vegetarian. Even so, they would have been fearsome, especially if you met one in the dark of a cave you thought was unoccupied! The big question still unanswered is — as one wag put it — were they also revered or were they eaten?

Now it seems the DNA of the extinct Cave Bear has been mapped by geneticists. As well as an earlier mtDNA sequencing[4], scientists have more recently[5] also sequenced as much as they could of the bear *genomic* DNA from 2 specimens found in Austria and dating from about 40 KYA[6]. The real significance of this later sequencing is not so much the light it throws on this particular long-extinct species but that there is now a technique which could be used to study another extinct species, the one closest to us, Neanderthal Man.

The Neanderthal Questions

There are two $64,000 questions researchers are still trying to answer: the first is

- "Are we responsible for the extinction of the Neanderthals?"

and the second,

- "Did modern humans inter-breed with Neanderthals?"

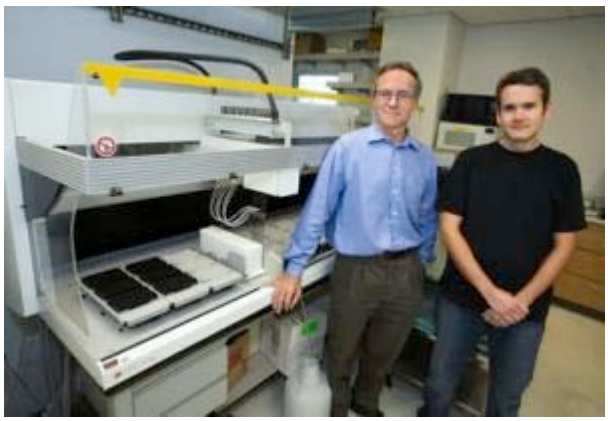
As for the first question, it is unlikely we will know the exact answer for a while yet although with the rapid advances in genetic technologies, scientists hold out some hope there will be an eventual explanation why Neanderthal man died out. Meanwhile, there is no archaeological evidence of warfare between the species although of course there could have been small skirmishes and quarrels when one group encroached onto the other's territory. Rather than intentional elimination, the most probable explanation so far is that we — our remote ancestors — simply did what we have always done throughout our history: viz., commandeered

[4]Ludovic Orlando et al.; Ancient DNA and the Population Genetics of Cave Bears (Ursus spelaeus) Through Space and Time, *Molecular Biology and Evolution* 19:1920-1933 (2002)
[5]Lovgren, S: "Ancient Bear DNA Mapped – A 1st for Extinct Species", *National Geographic News* June 6, 2005 at http://news.nationalgeographic.com/news/2005/06/0606_050606_alpsbears.html
[6]This was then identified by comparing it with the complete dog genome. The dog genome is known — dogs and bears diverged some 50 MYA, but are still 92% similar.

territories and resources to our own use and left others to fend for themselves, driving many species into extinction in the process.

A big step was taken recently towards answering the second question whether or not Neanderthals and our ancestors inter-bred. On November 16, 2006 *Science Daily* published the following under the headline *Neanderthal Genome Sequencing Yields Surprising Results And Opens A New Door To Future Studies*[7]

> *The veil of mystery surrounding our extinct hominid cousins, the Neanderthals, has been at least partially lifted to reveal surprising results. Scientists with the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) and the Joint Genome Institute (JGI) have sequenced genomic DNA from fossilized Neanderthal bones. Their results show that the genomes of modern humans and Neanderthals are at least 99.5-percent identical, but despite this genetic similarity, and despite the two species having cohabitated the same geographic region for thousands of years, there is no evidence of any significant crossbreeding between the two. Based on these early results, Homo sapiens and Homo neanderthalensis last shared a common ancestor approximately 700,000 years ago*



Dr. Edward (Eddy) Rubin and James Noonan

The scientists at the Berkeley Laboratory not only managed to sequence 65,000 DNA base pairs from the femur bone of a 38,000-year-old male Neanderthal from Vindija, Croatia, but did so using a new kind of genetic pyrosequencing technology which generates huge amounts of DNA. They also adopted a new approach, as complicated as that used to sequence the DNA of the Cave Bear, which allowed them to examine the genomic DNA, not just the mtDNA of the Neanderthal specimen as earlier studies had done.

The technique they employed was described by the article in *Science Daily* as ……

> *a "targeted approach." Essentially, they "immortalize" all of the DNA in a fossil sample into metagenomic libraries where individual fragments of the ancient DNA are propagated in microbes. The DNA propagated in the microbes can either be sequenced or specific sequences can in a targeted manner be specifically fished out of the library and studied.*

[7] *http://www.sciencedaily.com/releases/2000/03/000331091126.htm*

In the past, as the article explained, sequencing destroyed the sample of DNA and if you wanted more, it had to be extracted from the fossil source. Given that such fossils are rare, no one wants to destroy too much of what little remains. The new approach allows researchers to take one sample, create their *metagenomic libraries* in microbes and then consult them as they please without ever having to go back to the fossil for extra samples of bone or tooth material.

Earlier studies had relied on mtDNA alone and were destructive to the fossil remains. For example, for the earliest study, published in 1997 by Krings et al. [8] but which also involved two of the best-known scientists in this field, Svente Pääbo and Mark Stoneking[9], about a centimeter piece of bone had been sawn off the 42,000 year old right arm of a Neanderthal fossil held in the Rhineland Museum in Bonn. Similar extractions were done in 1999, 2000 and 2003 which confirmed the findings of the first study. Briefly, these showed that there were greater mtDNA differences between Neanderthal and humans than there were between humans alone or between Neanderthals alone, indicating that there was little likelihood the two species had inter-bred. Another interesting finding was that, like humans, Neanderthals had lower genetic diversity than chimpanzees from whom both our species separated 5 – 6 MYA. However, diversity within the Neanderthal group was statistically close to that of Africans, Asians, native Americans, Australian aborigines, and some of the peoples of Oceania — in other words, the Neanderthals who were tested were about the same genetic age as those early emigrants from Africa. On the other hand, contemporary Europeans whose ancestors shared the same continent for a long time with Neanderthals show less diversity and so are younger.

The rock shelter at the Lagar Velho site

While the weight of evidence seems to indicate that Neanderthals and our ancestors could not have inter-bred successfully, there are some studies which suggest that at least some of our genes might have come from our now extinct cousins. One such study, published in 2006 by Jeffrey D Wall and Michael F

[8] Krings, M., A. Stone, R. W. Schmitz, H. Krainitzki, M. Stoneking, and S. Pääbo. Neanderthal DNA Sequences and the Origin of Modern Humans. *Cell* 90:19-30. 1997.
[9] of *Mitochrondrial Eve* fame.

Hammer[10] argues that about 5% of our genes could have come from Neanderthal ancestors, thus lending some continuing weight to the "hybridization hypothesis" but not the "multi-regional" theory of the origins of modern humans.

One rather sad piece of archaeological evidence is also quoted by others convinced that Neanderthals mated with our ancestors. In 1998 some archeologists were called to the Lapedo Valley, about 140 km north of Lisbon, to check on reports of the discovery of prehistoric paintings in a cave not far from the city of Leiria. There they discovered not only paintings and a large quantity of Upper Paleolithic stone tools, bones and charcoal but also the skeleton of a ~ 4 years old boy, who had been buried about 24,500 years ago in a cleft in a rock shelter.

Although the skull had been damaged, sufficient pieces were found to re-construct about 80% of the cranium while the remainder of the skeleton, although invaded by a mass of tiny roots from nearby plants, was recovered almost complete. The evidence showed that the boy had been buried with great care and possibly ceremony: [11]

> *The body had been placed on a burned Scots pine branch, probably in a hide covered in red ocher. The ocher was particularly thick around the head and stained the upper and lower surfaces of the bones.*
>
> *The body was accompanied by a complete rabbit carcass between its legs and some remains of red deer, notably pelvis bones, by its head and feet. There were also six ornaments, also stained with red ocher: four perforated canines from four different red deer (two male and two female) and two periwinkle shells from the Atlantic (Littorina obtusata). The deer teeth were associated with the child's skull fragments, so were probably part of a headdress. One perforated shell was complete and found in situ over the child's left shoulder, near the cervical vertebrae, so is thought to be a pendant.*

Although originally announced with great fanfare in the media, the scientific paper[12] which was published a couple of months later caused a long and bitter debate. This was because the authors, including a Neanderthal expert Erik Trinkaus, claimed the skeleton was a *Homo Neanderthalensis/Homo sapiens* hybrid which, because it dated at least 4,000 years after the last Neanderthal was believed to have died, was a descendent of a long-established hybrid population. Such a descent would have made Neanderthals a sub-species, not *Homo*

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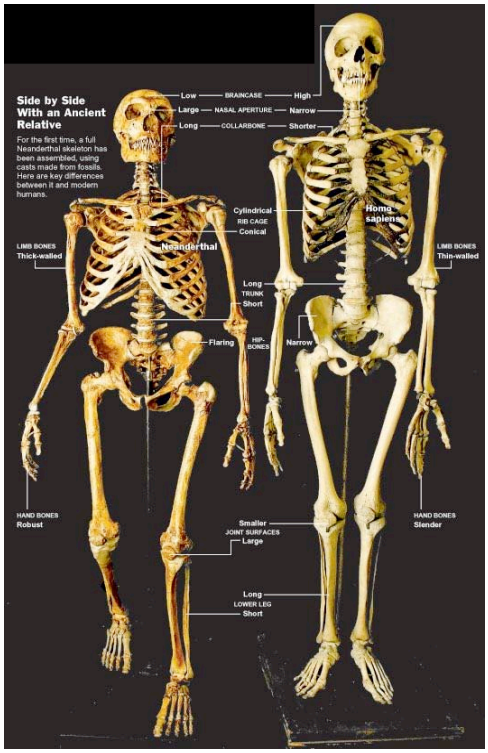
[10] Wall, JD and Hammer, MF: Archaic admixture in the human genome, *Current Opinion in Genetics & Development* 2006, 16:606–610.

[11] Online at: http://jan.ucc.nau.edu/evc/Bahn_Lapedo%20Child.pdf

[12] Duarte C., Mauricio J., Pettitt P.B., Souto P., Trinkaus E., van der Plicht H. et al. (1999): The early upper Paleolithic human skeleton from the Abrigo do Lagar Velho (Portugal) and modern human emergence in Iberia. *Proceedings of the National Academy of Sciences of the USA*, 96:7604-9.

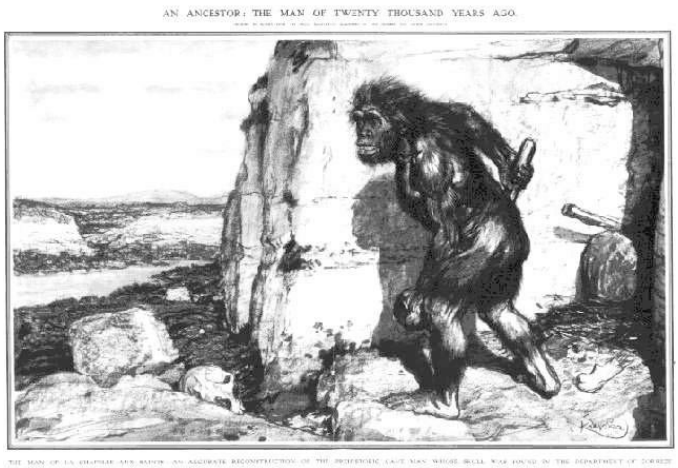
neanderthalensis but *H. sapiens neanderthalensis* while we would have to be labelled *H. sapiens sapiens*. Probably because they knew its claims would be controversial, the editors of the *Proceedings* of the US National Academy of Sciences, the journal in which the paper was to be published, invited an alternative view from two other scientists, Tattersall and Schwartz who suggested that instead of a hybrid, the little boy had been just a "chunky child". Erik Trinkaus and João Zilhão, two of the original authors, responded with a letter in which, in strong words, they rebutted the alternative interpretations…. So the debate raged on[13]……

The argument might have been resolved if a genetic analysis of the Lapedo Child had been possible, but probably because of the fine roots which had invaded the bones, the DNA of the skeleton was too degraded to test. At least, the Portuguese were not clamouring for the re-burial of the remains!



The reconstructed Neanderthal skeleton compared with that of H. sapiens.

So, what did Neanderthal Man look like? We already had some discussion of this earlier in this course when, on the one hand, we saw how the 1856 discovery of the fossilised remains in the Neander Valley and later findings led to the characterisation of Neanderthal Man as an ape-like, shambling and somewhat scary creature.



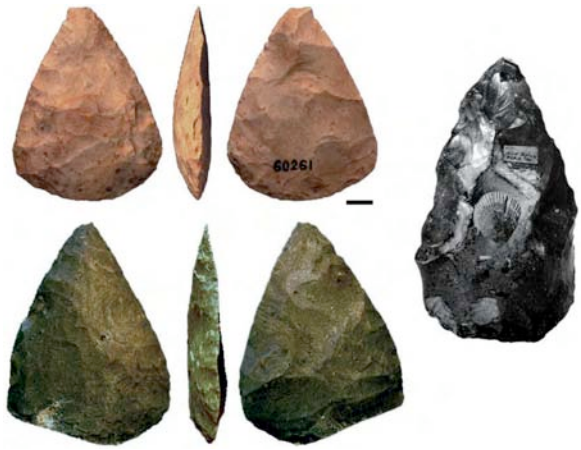
An Ancestor: the Man of Twenty Thousand Years Ago — L'Illustration & Illustrated London News, 1909.

On the other hand, we also saw that facially he was not all that unlike our own species: certainly he was recognizably closely related to us although probably not, as some have suggested, so like us that if you dressed him in a suit, he could pass unnoticed on the New York subway.

[13]Tattersall I. and Schwartz J.H. (1999): Hominids and hybrids: the place of Neanderthals in human evolution. *Proceedings of the National Academy of Sciences of the USA*, 96:7117-9. Rebuttal: Trinkaus E. and Zilhão J. (1999): A Correction to the Commentary of Tattersall and Schwartz Concerning the Interpretation of the Lagar Velho Child.

In an article in the New York Times, John Noble Wilford [14] described what he called a "Rebuilt Neanderthal". This skeleton, largely cast in resin from moulds taken from various Neanderthal remains, is the first full reconstruction, albeit synthetic, of a Neanderthal skeleton. Completed in 2002 under the direction of Dr. Ian Tattersall at the American Museum of Natural History, the resurrected Neanderthal Man stands 5 feet 4 ½ inches (162cm) high. Wilford continued:

> *The Neanderthal's shoulders are wider than a human's. The pelvis is also wider, even in males. Some scientists once suspected that the wide pelvis enabled Neanderthals to carry a child longer than nine months, giving birth to larger, more developed infants. But that view is now doubted.*
>
> *The Neanderthal has shorter forearms and shins, a broader trunk and virtually no waist. The rib cage is a pronounced difference; instead of tapering off, as in humans, it is large and more bell-shaped. And there is the heavy brow ridge, sloping forehead and forward-projecting face.*
> *Attached at the skeleton's neck is a small hyoid bone, which would have anchored the muscles of the tongue and other parts of a voice box apparatus. Found at Kebara cave, this hyoid is a slightly enlarged version of the human hyoid and nothing like similar bones in apes. Some scientists see this as evidence that Neanderthals may have had some capacity for articulate speech.*



A comparison of Neanderthal and Modern Human Stone Tools. The Mousterian Tool tradition (above) is much less complex than modern human traditions (below).

If he could speak, some argue he would have spoken in a high-pitched or soprano voice. He clearly was able to make and use tools, but his flaked stone tools (classified as Mousterian) are rudimentary compared with the implements made by

[14] Wilford, JN: A Rebuilt Neanderthal**,** *The New York Times* 31 December 2002

our own Paleolitic Aurignacian ancestors. Although the Neanderthal hand was similar to ours, it was far stronger and with broader finger tips. Paleo-anthropologists suggest *H. neanderthalensis* held tools between his fingers, a method which would have required immense strength. However, on a more delicate note, a four-hole flute found at a Neanderthal site suggests not only that he had the skill to fashion such an instrument from bone but also that he had sufficient interest and ability to play it.

One of the features of Neanderthal sites is the remarkable absence of milling stones which would have been used to grind nuts and seeds. This indicates that Neanderthals had a high-meat diet, depending in the main on large game as a source of protein to fuel their massive bodies. It is probable that they were close-range hunters, using spears rather than the longer-range weapons modern humans evolved, such a sling-shots. Although bringing down game at short range must have required considerable bravery, such an opportunistic lifestyle obviously took it toll. The evidence of many healed fractures on the fossil skeletal remains[15] of women and children indicates that this rough lifestyle involved them in the hunt as well as the men, leading some authors[16] to suggest that the Neanderthal had little division of labour in their ranks and to postulate that the gender-based division of labour evolved by our ancestors gave us a significant advantage over the Neanderthals. Proposing this, Steven L. Kuhn and Mary C. Stiner of the University of Arizona explained that:

The competitive advantage enjoyed by modern humans came not just from new weapons and devices but from the ways in which their economic lives were organized around the advantages of cooperation and complementary subsistence roles for men, women, and children.

They also point out that the absence of implements such as bone needles, commonly found in the Paleolithic settlements of modern humans, meant they probably lacked the ability to make weather-resistant clothing and artificial

[15] Some scientists suggest that the pattern of fractures, most commonly to ribs, is reminiscent of the injuries characteristically suffered by rodeo clowns, indicating that Neanderthal hunting technique might have included jumping on the backs of animals and stabbing them. One wonders about "bull dancing"….

[16] Kuhn, SL and Stiner, MC: "What's a Mother to Do" The Division of Labor among Neanderthals and Modern Humans in Eurasia." *Current Anthropology* 47:6.

shelters. Of course that is not to say they went naked and lived exposed to the elements: Neanderthals, more than early humans, made greater use of caves for shelter and must have found some ways to make clothing out of animal skins and other materials. The point was that the Neanderthal lived through the Last Ice Age — not the Last Glacial Maximum: they had died out several thousand years before the LGM. But they did live through the previous Glacial Maximum and the climate during much of their sojourn on Earth was colder than we would enjoy. The result of enduring this cold weather was that the Neanderthal became cold-adapted: their stocky bodies and short legs helped to conserve body heat while one reason for their big noses was to pre-heat the freezing air before it reached their lungs.

The two species of the genus *Homo* — *neanderthalensis* and *sapiens* — diverged genetically roughly 700 – 500 KYA. While earlier versions of *Homo neanderthalensis* arrived in Europe roughly 350 KYA, fully developed Neanderthal Man is known to have occupied much of Europe and parts of western Asia from about 200 – 150 KYA. Surviving the fluctuating but generally cold climate of the region, he enjoyed sole occupancy until our ancestors, *Homo sapiens* arrived about 40 – 35 KYA. Although there is no evidence that modern man in any way actively eradicated his nearest relative, Neanderthal Man progressively withered away and became extinct, the last known members of his species dying in what is now Portugal and at Gibraltar ~ 28 KYA. So, for about 10,000 years, these two species lived together in Europe and the Near East, the numbers of the elder species dwindling in the face of the younger species' advance from east to west.

But, as the man who has rebuilt a Neanderthal skeleton, Dr. Tattersall, said *"What Neanderthals did, how they managed in extreme environments, they did very well. It was only Homo sapiens, it seems, that they couldn't cope with."*
