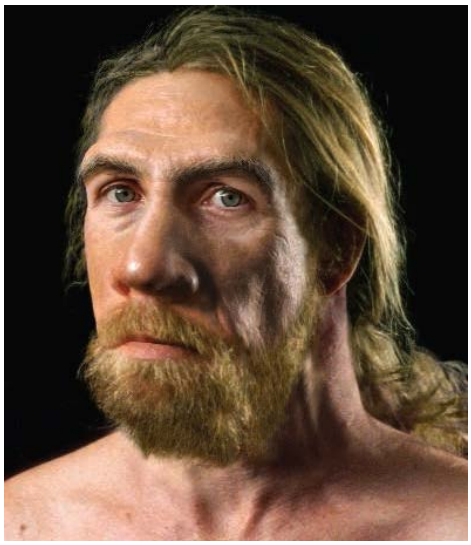
Human evolution and migrations

Neanderthals more 'human' than once thought (*January 2008*)

Sébastien Chabal, the gigantic and hairy back-row forward in the 2007 French World Cup rugby team, was nicknamed 'The Caveman' by French fans. Indeed he is an awesome spectacle, at almost 2 m tall and weighing over a tenth of a tonne, with great black beard and locks. But is seems that Neanderthals were redheads and probably prone to sunburn (Lalueza-Fox, C. and 16 others. 2007. A melanocortin 1 receptor allele suggests varying pigmentation among Neanderthals. *Science*, v. **318**, p, 1453-1455; DOI: 10.1126/science.1147417). The team analysed DNA extracted from Neanderthal bones from Spain and Italy, and identified the *mc1r* gene that regulates pigmentation in many mammals. In both specimens it turned out to be a variant that is associated with fair skin and red hair. An artist has rendered a French Neanderthal man's physiognomy from his skull, by combining this information with modern facial reconstruction techniques (in Culotta, E. 2007. Ancient DNA reveals Neandertals with red hair, fair complexions. *Science*, v. **318**, p. 546-547; DOI: 10.1126/science.318.5850.546). He seems set to become a pin-up among those ladies who favour the larger gentleman, even having a nose far larger than that of Gerard Depardieu. Although proof of the growing power of genetic analysis of ancient tissue, that Neanderthals were probably pale-skinned is not really surprising. They inhabited high latitudes for at least 200 ka longer than modern Europeans have, and the pale variant of *mc1r* is advantageous where sunlight is at a premium for creating vitamin D. Like modern Europeans, their immediate ancestors who migrated northwards were almost certainly dark-skinned.



Artistic impression of a male Neanderthal (Credit: Culotta 2007)

Yet by far the most scientifically exciting outcome of the team's work is the extraction from the Spanish Neanderthal bones of the *FOXP2* gene, which is implicated in the development of speech and language (Krause, J. and 12 others 2007. The derived FOXP2 variant of modern humans was shared with Neandertals. *Current Biology*, v. **17**, p. 1908-1912). It shares two mutations with *FOXP2* in modern humans, that had previously been suggested only to have developed in the last 100 ka, so must have been present in the last common

ancestor of fully modern humans and Neanderthals, around 300 to 400 ka. Although this discovery cannot prove that Neanderthals spoke, taken along with emerging evidence that symbolic skills were used by even earlier hominins (see *When and where 'culture' began* November 2007) it does suggest they were capable of as much sophistication as the earliest fully modern humans.

Is human evolution speeding up? (*January 2008*)

Another outcome of the acceleration in genetic analysis is an ability to scan vast numbers of differences in DNA from many individuals. Highly productive are single nucleotide polymorphisms or SNPs ('snips') that are available from the international HapMap project. From analysing almost 4 million SNPs from 270 individuals has emerged an intriguing parallel between human population explosion since about 40 ka and an increasing rate at which new genetic traits have been incorporated into the human genome (Hawks, J. *et* al. 2007. Recent acceleration of human adaptive evolution. *Proceedings of the National Academy of Sciences*, v. **104**, p. 20753-20758; DOI: 10.1073/pnas.0707650104). The link is not entirely surprising, for the exposure of more individuals to mutagenic factors will result in more mutations entering the total gene pool. Yet 'weeding-out' of unfavourable mutations also operates over time, so the fact that around 7 % of human genes seem to have changed over the last 40 ka, indicates the overall rate of human evolution must have speeded up remarkably. The analysis suggests that the rate rose to a peak between 5000 and 8000 years ago, for Europeans and West Africans respectively. 'Received wisdom' has for a long while been that fully modern humans went through a phenomenal spurt in evolution around 50 to 40 ka (but see *When and where 'culture' began* November 2007), and that somewhat Eurocentric view is overturned by the SNP evidence. Selection pressures must have risen to a peak around the time of the spread of agriculture and the rise of large social communities – big changes in diet and in exposure to communicable disease would be associated with those shifts.

In some respects the findings are cause for optimism. Global warming and rapid transformation of climate belts will expose billions of people to new experiences. Hundreds of millions, or more, may perish, yet our species' evolution may speed up again. Let's hope it leads to some improvement in avoiding self-induced misfortune.

See also: Holzman, D. 2007. How we adapted to a modern world. *New Scientist*, v. **196**, 15 Dec 2007 issue, p. 8-9; DOI: 10.1016/S0262-4079(07)63122-4.

Last common ancestor of all the primates was a flying lemur (*January 2008*)

Vertebrate palaeontologists sometimes become precious after a career peering at old bones, especially when they are as remarkably tiny as those of most Mesozoic mammals – and most of those fossils are teeth. Some defend to death the notion that primates descend from tree-shrews, while others foam at the mouth at the mere suggestion of the ur-shrew. 'A key feature in primate evolution is reduction of the snout', is axiomatic to yet others. Again, geneticists have provided extreme selection pressures that will either cause vertebrate palaeontologists rapidly to evolve or to become extinct.

Analysis of living primate genomes produces a phylogeny that links all primates with a group that has been said to be 'the sort of animals that defy taxonomic categorization, confuse one's sense of aesthetics, and seem to largely fall under the umbrella of "weird." ' (Janecka, J.E and 7 others 2007. Molecular and genomic data identify the closest living relatives of primates. *Science*, v. **318**, p. 792-794; DOI: 10.1126/science.1147555). These are the colugos, or flying lemurs that include the wonderfully named sugar glider.

Clovis First hypothesis dumped (*May 2008*)

For decades palaeoanthropology of the Americas has been dominated by a single idea; that nobody entered the continents before those people who used the elegant fluted spear blades first found near Clovis, New Mexico in the 1930s. These were eventually dated at a maximum age of around 13 ka before the present. One reason for accepting the Clovis people as the first Americans, apart from the lack of conclusive evidence for any earlier occupation, was the fact that glaciers blocked the route from the Bering land bridge of the last Ice age until about 13 ka. Increasing evidence has suggested earlier penetration by people from Asia who did not use Clovis tools, who reached Chile by around the same time and possibly as early as 33 ka. However, none of the evidence is definitive and the Clovis First hypothesis has been stoutly defended against a growing body of contrary evidence.

The 'traditional' idea of American occupation by humans after 13ka has taken a double whammy from an unusual set of fossils – of human excrement – discovered in a cave in Oregon. These have been dated at up to 15 ka and are unmistakably human, containing human mtDNA with genetic signatures typical of Native Americans (Waters, M.R. & Stafford, T.W., Jr. 2007. Redefining the Age of Clovis: implications for the peopling of the Americas. *Science* v. **315**, p. 1122-1126; DOI: 10.1126/science.1137166. Gilbert, M.T.P *et al*. 2008. DNA from pre-Clovis human coprolites in Oregon, North America. *Science*, v. **320**, p. 786-789; DOI:10.1126/science.1154116).

Ideas of how and when the Americas were colonised are changing rapidly after decades of ossification. A fascinating article in the 14 March 2008 issue of *Science* magazine reviews the issues and prospects (Goebel, E. *et al*. 2008. The late Pleistocene dispersal of modern humans in the Americas. *Science*, v. **319**, p. 1497-1502; DOI: 10.1126/science.1153569). Genetic studies of living native Americans suggest their common ancestry in a Siberian population no earlier than 30 ka, and perhaps as late as 22 ka. The Beringia land bridge had repeatedly created a possible migration route during every major glaciation followed by many of the Pleistocene mammals that inhabited the Americas, but not by humans until the late stages of the last glaciation. Dating of archaeological sites and remains, including the human coprolites found by Waters and Stafford, is slowly pushing back the earliest evidence for a human presence to around 15 ka, several thousand years before the Clovis culture appeared. Sometime before that, the first Americans had arrived and begun to spread. Ice barred their way through the interior of Alaska and NW Canada, and they must therefore have travelled along the coast, where the way was open from Beringia to Cape Horn; perhaps they used boats to move along the flat, but frigid shores of Beringia and the rugged western seaboard of North America. Early populations subsisting on shoreline resources would not have needed the heavy projectiles of the Clovis culture that are more attuned to 'big-game' hunting on plains. That may explain the sudden appearance of Clovis artefacts once access to plains was possible around 13.5 ka and its equally sudden disappearance at

the start of the Younger Dryas around 12.8 ka when survival on icy plains would have become very difficult. Interestingly, the period of occupation of Siberia around 30 ka, would have presented the Beringia route to migration to North America when climate was similar to that following the last glacial maximum. So far, no tangible evidence

Homo floresiensis had big feet (*May 2008*)

Controversy has raged about her identity since the skull of a minute female hominin was unearthed from the Liang Bua cave on the Indonesian island of Flores. On the one hand are authorities who believe the fossil is that of a distinct human species, while on the other are sceptics convinced that the diminutive stature and chimp-like brain capacity reflect some pathological issue in a population of ordinary humans. The 12 April meeting of the American Association of Physical Anthropology in Columbus, Ohio (see Culotta, E. 2008. When hobbits (slowly) walked the Earth. *Science*, v. **320**, p. 433-435; DOI: 10.1126/science.320.5875.433) were treated to an anatomical exposition of the rest of the Liang Bua skeleton. A great deal more turns out to be different from human characteristics, including the legs and feet. Amusingly, for J.R.R. Tolkien's Hobbit had them, the feet of *H. floresiensis* were disproportionately large. Also, her gait was quite different from ours – a kind of careful, high-stepping plod. Although not all agree, the post-cranial bones of *H. floresiensis* appear to bear close resemblance to those of early *Homo* species. Those favouring a separate species from our own suggest either that it arose through allopatric speciation from SE Asian *H. erectus* after isolation of a population on Flores, or perhaps even that it is a relic of an early migration of *H. habilis* from Africa almost 2 Ma ago. Whatever, it is now going to be even more difficult not to speak of hobbits.

***Orrorin* walked the walk (*May 2008*)**

Orrorin tugenensis is one of those fossils over which palaeontologists tend get heated. It is a hominin, old (~6 Ma) and fragmentary, so it just might be the mummy or the daddy of us all. That possibility takes a significant step forward with statistical evidence that *Orrorin* walked upright in a similar manner to the much later australopithecines and paranthropoids (Richmond, B.G. & Jungers, W.L. 2008. *Orrorin tugenensis* femoral morphology and the evolution of hominin bipedalism. *Science*, v, **319**, p. 1662-1665; DOI: 10.1126/science.1154197). The study was made independently of the original discoverers, who claim that the femur has especially human-like features. Whichever, one of the original suggestions that *Orrorin* was on the ancestral line to gorillas has become improbable. The creature clearly displays the oldest known example of a bipedal gait (the older *Sahelanthropus* (~7 Ma) is known only from skull fragments and teeth, although its skull's foramen magnum hints at bipedalism). In itself, Orrorin's walking biomechanics is remarkable, as molecular evidence suggests that the branching that led to chimpanzees and to hominins is not much older than 6 Ma. It does seem as if that phylogenetic split may well have centred first on adaptation for traversing open ground from a forest common ancestor.

Colonisation of Europe pushed further back (*May 2008*)

Europe is so close to Africa that in recent years repeated waves of immigrants have crossed the Straits of Gibraltar, often on frighteningly flimsy craft. Their driving force is simply the search for a better life in the booming economies of Spain and Italy. Far more intense pressure from deteriorating climate and vanishing game drove Africans of many earlier times to escape their home continent, reaching back almost 2 million years. So how come the European hominin record is so short? At last count it went to *H. antecessor* around 750 ka, albeit a species that was sufficiently adventurous to reach British shores (see *Earliest tourism in Northern Europe* January 2006). The famous Sierra de Atapuerca cave systems in northern Spain have now yielded clear evidence of much earlier occupants from around 1.1 to 1.2 Ma ago in the form of a lower jaw fragment in association with tools and bones showing signs of butchery (Carbonell, E. and 29 others 2008. The first hominin of Europe. *Nature*, v. **452**, p. 465-469; DOI: 10.1038/nature06815). Provisionally, the person has been assigned to *H. antecessor*, and there are two possible interpretations: either (s)he was a new immigrant from Africa, or represents a new speciation in northern Spain from an earlier population of African colonists. The paper's title may prove to be premature.

Paranthropoid diet (*July 2008*)

Paranthropus boisei (KNM ER 406) from Kenya. (Credit: Wikipedia)

The hominin genus *Paranthropus* rarely hits the front page by comparison with the related australopithecines, despite their having massive cheek bones, a bizarre skull crest for attachment of jaw muscles and brow ridges that were probably better than a baseball cap at preventing glare. The first (*P. boisei*) to be unearthed at Olduvai, Tanzania in 1959, was dubbed 'Nutcracker Man' by its finder Philip Tobias. Despite having formidable chewing muscles to drive its massive, flat, thickly enamelled cheek teeth, wear on their surfaces is little different from that on the teeth of 'gracile' australopithecines. (Ungar, P.S. *et* al. 2008.

Dental Microwear and Diet of the Plio-Pleistocene Hominin *Paranthropus boisei*. *PLoS ONE*, v. **3**, on-line ; DOI: 10.1371/journal.pone.0002044). They show no sign of the microscopic pitting that characterises teeth of living primates that eat hard, brittle foods, such as nuts or woody stems. Similar studies of the teeth of *P. robustus* show insufficient wear to suggest an habitual diet of that kind, although it may have eaten such foods when others were in short supply. Chances are that huge jaws and big teeth evolved to give paranthropoids a wider choice of diet and hence greater fitness in a climatically fluctuating terrain. It seems they chose to eat soft foods when available, as do gorillas today. In any event, they were remarkably successful creatures, and the two species cohabited the East African savannah with several human species, including *H. erectus*, for around a million years from 2.2 Ma when they appeared. Carbon-isotope data obtained from 20 paranthropoid and 25 australopithecine teeth by other researchers reveal a broad but similar diet for both, i.e. a mix of grasses and fruits, suggesting both had eating habits that could shift from ape-like to those of baboons. However, such C-isotope data cannot distinguish between exclusive vegetarianism and eating the flesh of herbivores. Low dental wear is also associated with meat eating…

See also: Gibbons, A. 2008. *Australopithecus* not much of a nutcracker. *Science*, v. **320**, p. 608-609; DOI: 10.1126/science.320.5876.608b.

Return to 'Doggerland' (*September 2008*)

Because sea levels rose world-wide after the last glacial maximum, archaeologists have been largely stymied as regards exactly where migrating people lived and what they did. Much migration since fully modern humans left Africa around 70-80 ka is likely to have been 'strandloping' along coastal lowlands exposed as sea level fell as the last glacial period developed. Of course, this vast area is now drowned. It takes both a lot of work and a degree of good fortune to make anything of this landscape for ancient humans. Luck definitely played its part in getting some clue about one of the last of the migrations: from continental Europe to the British Isles, in the aftermath of the last glacial maximum. Trawlers have dredged not only animal bones from what was a great plain where the North Sea now sits, but also a superb bone harpoon point recovered in 1931. It has been a while in coming, but researchers at Birmingham University, UK have finally defined and mapped that drowned land area – Doggerland (see: Spinney, L. 2008. The lost world. *Nature*, v. 454, p. 151-153; DOI: 10.1038/454151a). Around 11 ka People with a Mesolithic culture reached Britain, presumably after inhabiting Doggerland since climate permitted. They established settlements at Howick and Starr Carr in NE England, and signs of their presence, in the form of patches littered with flint shards, span most of southern Britain.

Early, microscopic evidence for human control of fire (*November 2008*)

Which human species first controlled and used fire has been debated for as long as archaeologists began to realise we had a long and complex ancestry. Because sites can easily be contaminated by charcoal from natural fires it has been difficult to present convincing evidence. But there is a way to get believable data. Stone tools and fragments from their manufacture may have fallen in fires set by hominins, and show changes caused by intense heating. One such example comes from a long-occupied site in Israel (Alperson-Afil, N. 2008.

Continual fire-making by Hominins at Gesher Benot Ya'aqov, Israel. *Quaternary Science Reviews*, v. **27**, p. 1733–1739; DOI: 10.1016/j.quascirev.2008.06.009). Nira Alperson-Afil of the Hebrew University of Jerusalem investigated small flint artefacts, probably flaked off during tool making, from eight levels excavated at the site. In all of them some flint shards showed signs of extreme heating, such as discoloration, crazing and tiny bowl-shaped pits ('potlids') resulting from exfoliation of hot flint surfaces. The features are reproduced by experimental heating of flint shards, and do not occur in those that have not been heated above 300ºC.

Gesher Benot Ya'aqov was first occupied around 790 ka, by *Homo antecessor*, and the excavation levels may span around 100 ka. The site is the earliest to provide convincing evidence not only for the use of fire, but that it was a continuous part of the hominins' culture: they could make it at will. Alperson-Afil suggests that fire making may have been an integral part of the Acheulean culture, well known for finely crafted biface axes, since its inception around 1.6 Ma ago. Ambiguous evidence for hominin fire use, such as burnt bones and reddened sediments, has been found at several sites in Africa dated between 1 and 1.5 Ma. Alperson-Afil's meticulous micro-forensics should help African archaeologists and those working at very old sites left by migrating hominins in Georgia and Asia to check whether fire has such a long-lived place in our evolutionary history.