Human evolution and migrations

Out of Africa, with an ulcer (*February 2007*)

More than half of all people, wherever they live, are infected by the bacterium *Helicobacter* pylori. Only two decades ago, a possible connection between *H. pylori* and stomach ulcers was not widely accepted, but once persuaded medical practitioners could treat victims with simple antibiotic cocktails to give permanent relief. In 2003 (see *Gut bacteria and human migration* April 2003) seven geographically distinct *H. pylori* groups can be recognised, and their genetic structure traced to ancestors in Africa, Central and East Asia. Their distribution matches those of human genetic and linguistic patterns, which have been attributed to the colonization of Polynesia and the Americas, to Neolithic migrations of agricultural peoples into Europe from the near-East, the expansion of Bantu-speaking people in Africa and to the slave trade. Since then, genetic data from *H. pylori* in 51 ethnic groups have been compiled, which confirm the earlier groupings and also allow rough dating using a 'molecular clock' (Linz, B. and 15 others 2007. An African origin for the intimate association between humans and *Helicobacter pylori*. *Nature*, v. **445**, p. 915-918; DOI: 10.1038/nature05562).

Not only do the first fully modern humans to leave Africa seem to have been infected. Like theirs, the DNA of *H. pylori* has accumulated mutations that confer neither advantages nor disadvantages. Since such mutations probably form at a constant rate, mainly from the effects of cosmic ray bombardment, differences between populations can be dated. In the case of *H. pylori*, divergences outside Africa date back to about 58 ka. Although very approximate, this date is significantly different from that widely accepted for the start of human migrations out of Sfrica, at around 85 ka. Although the discrepancy may be explained by waves of migration, the evidence from human DNA is that one very small emigrant population is likely to have founded all surviving non-African descendants: there may only have been one exodus. Opportunities and pressures to migrate may also have been restricted to specific time windows of climatic drying and sea-level drops that exposed viable routes, such as that across the southern end of the Red Sea. The main windows centre on 86, 75 and 72 ka. It may take data from the same donors that link human DNA directly to that from gut bacteria to resolve the poor match.

Do Neanderthals sit next to us on the train? (*March 2007*)

Many might answer, 'Yes, and they speak loudly about their love lives into mobile phones', but that is a tired old joke. A much better one is that related by Steve Jones of University College, London. Were an unwashed but shell-suited, Late Palaeolithic, fully human hunter-gatherer to sit next to us, we would probably change seats. Jones believes that if our companion turned out to be a freshly showered, shaved and eau de cologned Neanderthal in a business suit, we would change trains. Neanderthals were impressive, in the manner of all-in wrestlers with extremely large noses and eyebrows.

A boy's skeleton turned up in Portuguese 24 ka cave deposits in the late 1990s. The lad had the hallmark chin of a modern human but the stocky body and short legs of a Neanderthal. He may be the only tangible evidence of a human inter-species hybrid. There again, he may have been a perfectly normal, stocky boy with short legs. Yet the find re-opened the possibility that Neanderthal genes may have made their way into modern humans. It certainly does not look like it from the available DNA fragments extracted from Neanderthal bones, but ongoing attempts to sequence the Neanderthal genome (see *Neanderthal genome on the cards* December 2006) could resolve the issue. The ambitious genetic plans have sent a thrill through scientific journalists with palaeoanthropological leanings (Jones, D. 2007. The Neanderthal within. *New Scientist*, v. **193** (3 March 2007), p. 2832).

Another skull that may show hybrid features has turned up in Romania, but the most tantalising hints come from existing knowledge of human genetics. The Out of Africa model for all modern humans is based on studies of mtDNA and that from Y chromosomes, which now enable human migrations to be tracked and put into a time frame. But such genetic material forms a tiny proportion of the human genome. It is nuclear DNA that dominates and is also responsible for how we function and how we look. There is so much of it that work has only just begun in the context of human origins. One haplotype, in the PDHA1 gene, has shown up something odd in a small sample of men from different continents. Two lineages seem to be represented, one that a molecular clock dates to a last common ancestor 1.8 Ma ago [*Homo habilis*?], the other having split at about 200 ka. That duality should not be present if all living people descended from a small group who lived around 160 ka. Either it resurrects the almost-buried multiregional model, or points to occasional interbreeding with other human species that our forebears encountered: only time and a lot of work will tell. Yet fertile offspring must have emerged from such liasons. In a Linnaean sense that implies that however the partners might have looked and whatever their habits were, they had to have been the *same species*: one that had lasted almost 2 million years in different guises or *polymorphs*, as Jonathon Kingdon once suggested.

More primate genes (*May 2007*)

With the release of the genome for the Old World macaque monkey (Various authors 2007. The Rhesus Macaque genome: special section. *Science*, v. **316**, p. 215-246 + pull-out) there are now three highly detailed end points on the primate molecular phylogeny. This extends analysis of timing for last common ancestors and branchings to about 25 Ma from the previous 5-7 Ma for the last common ancestor of chimps and humans. Soon there will be genomes for gibbons, gorillas, orangutans and marmosets.

Interestingly, results of comparisons between genes that humans and chimps share were published at around the same time. The results are surprising. It appears that 233 chimp genes show signs of positive selection compared with 154 for ourselves. Specialists are damping down suggestions that chimps are in fact more highly evolved than we are. The most likely explanation is that were simply larger populations of animals in the chimp evolutionary bush living at the same time as members of the hominin group, who may also have been split into small bands and so more subject to random change.

See also: Check, E. 2007. Make way for monkeys. *Nature*, v. **446**, p.840; DOI: 10.1038/446840a. Hopkin, M. 2007. Chimps lead the evolutionary race. *Nature*, v. **446**, p.841; DOI: 10.1038/446841a.

Upright posture far older than hominins? (*July 2007*)

It is widely accepted that the hallmark of humans and their immediate ancestors is their upright posture and bipedal gait. Gorillas and chimps knuckle-walk, but humans do not. Consequently, palaeoanthropologists have always sought evidence, such as the site where the skull attaches to the spine (the *foramen magnum*), before placing fossils on the way to becoming human. Yet fossils far older than the 5-7 Ma span of accepted hominins and genetic evidence of the split between them and chimps are turning up with clear signs of upstanding habits. Interestingly, orang-utans often stand upright when climbing, despite being the large ape with the least liking for terra firma (Thorpe, S.K.S. *et al*. 2007. Origin of human bipedalism as an adaptation for locomotion on flexible branches. *Science*, v. **316**, p. 1328-1331; DOI: 10.1126/science.1140799). They do it on slender branches, holding other branches for support, because if they tried a quadripedal gait, the branch would likely snap.

Orang-utans are a lot more distant genetically from humans than are chimps and gorillas, to the extent that their last common ancestor with humans would have lived in the Miocene, about 15 Ma ago. Thorpe *et al*. offer the fascinating possibility that being bipedal in trees was a great advantage to early apes, and that gorillas and chimps lost it while hominins retained that ancient trait. Close examination of how orang-utans get around in trees presents remarkable similarities to human locomotion on the ground: they react to flexible branches very like humans running on springy ground, whereas other primates do the opposite.

See also: O'Higgins P. & Elton, S. 2007. Walking on trees. *Science*, v. **316**, p. 1292-1294.

No interbreeding with Neanderthals (*July 2007*)

In *Neanderthal genome on the cards (above*) I reported there a possibility that we might have some Neanderthal genes. Breaking news in *Science* (Pennisi, E. 2007. No sex please, we're Neandertals. *Science*, v. **316**, p. 967: DOI: 10.1126/science.316.5827.967a) suggests not. The Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, in its push to sequence the genome of a Croatian Neanderthal fossil, has data on nuclear DNA that pushes back the time of the last common ancestor with humans from around 500-600 ka to 800 ka, and finds no evidence of gene flow between the two species.

Earliest gorilla tags hominoid phylogeny (*September 2007*)

The central focus on ape evolution has obviously been on that branch that led ultimately to humans. Arguably, that is traceable through fossils to around 7Ma with the remains of *Sahelanthropus tchadensis*. From a genetic, molecular standpoint the human branching was from a common ancestor with chimpanzees, roughly around 6-7 Ma, with an earlier common ancestor of both shared with gorillas, which lived around 8 Ma. These branchings seem to have occurred in Africa during the Upper Miocene; a time not well-represented by sedimentary rocks and therefore fossils in East Africa. Approaching a true phylogeny must rest on both molecular data from living organisms and on the anatomy of fossils, whose age can help calibrate molecular clocks. A new find from Afar in Ethiopia appears to demand a revision of the timescale of evolution among the Hominoidea (great apes). It seems to be from an ancestral gorilla (Suwa, G. *et al*. 2007. A new species of great ape from the late

Miocene epoch in Ethiopia. *Nature*, v. **448**, p. 921-924; DOI: 10.1038/nature06113). The Japanese-Ethiopian team found a single canine and eight partial molar teeth from 3 to 6 individual apes (*Chorapithecus abyssinicus*) in the oldest sedimentary rocks deposited in the Afar Rift. The teeth are remarkably similar to those of modern gorillas. Although some primate specialists dispute the link to gorillas, were it to be demonstrably acceptable their discovery would push pack the molecular timing, because the age of the sediments is between 10 to 10.5 Ma; 2 Ma before the estimated age of the gorilla-chimp-human last common ancestor. That branching must have been before 10-10.5 Ma, and suggests that the rate of mutation on which previous estimates were made was slower than had been calculated. The implication for the crucial hominin-chimp split is that it may have been as early as 9 Ma, giving more time for the emergence of bipedalism and many other hominin characteristics in *Sahelanthropus* and the closely following *Orrorin* and *Ardepithecus*.

Physiognomy and human origins (*September 2007*)

Compared with genetic comparison among living human populations, physiological variations in human anatomical collections have been almost completely overlooked as a means of assessing relatedness. That is not really surprising because of physical anthropology's past, much tainted by deliberate racist inferences from measured differences. Lately, human morphometry has been used in a non-racist way to test the 'multiregional' hypothesis of fully modern human evolution. A new analysis of variations in the human phenotype has appeared (Manica, A. *et al*. 2007. The effect of ancient population bottlenecks on human phenotypic variation. *Nature*, v. **448**, p. 346-348; DOI: 10.1038/nature05951) presents strong support for an African origin and global migration. The study, conducted at the University of Cambridge, UK and Saga Medical School, Japan used measurements from almost five thousand male human skulls less than 2 ka old, and a statistical methodology similar to that used in genetic studies. Around one fifth to a quarter of all the observed variation correlates with distance from Africa. Overall, the authors conclude migration from an origin in central to southern Africa, with no sign of any second place of origin. The results tally extremely closely with those based on purely genetic variability.

Now we can celebrate the 'Hobbits'! (*November 2007*)

It's official: *Homo floresiensis* is a hominin species distinct from ourselves, and is not a pathologically affected human as some anthropologists would demand. The definitive feature lies in the Indonesian fossils' hand bones, specifically those of the wrist (Tocheri, M.W. and 9 others 2007. The primitive wrist of *Homo floresiensis* and its implications for hominin evolution. *Science*, v. **317**, p. 1743-1745; DOI: 10.1126/science.1147143). Three well-preserved wrist bones (the trapezoid, scaphoid and capitate) occur in the holotype specimen from the Lian Bua Cave on Flores. Human and Neanderthal wrists share very much the same shapes of these bones, whereas earlier hominin wrist bones are distinctively different, and more like those of other living primates. The *Homo floresiensis* wrist clearly falls in the second category. Because the wrist bones develop early in the primate embryo, differences are unlikely to have arisen through some kind of pathological disorder.

The discovery opens far more than a new human species (one that cohabited Flores with fully modern humans until 18 thousand years ago, and perhaps more recently). The ancestors of *H. floresiensis* migrated out of Africa before the evolution of the last common ancestor of humans and Neanderthals; at least 800 thousand years ago. The other long-term inhabitants of Asia were members of the *H. erectus* species, but so far no hand bones of theirs have turned up in the fossil localities of Java and China. Another candidate may be the hominins found at Dmanisi in Georgia, that date back to 1.8 Ma, for which some have hinted at a relationship with the earliest species of human, *H. habilis*. The holotype *H. floresiensis* is so young that there is a chance that DNA fragments may be discovered, to be compared with ours and those of Neanderthals; a truly exciting prospect.

When and where 'culture' began (*November 2007*)

There is a deeply entrenched view that shortly after fully modern humans entered Europe they experienced an evolutionary leap that made them artists of supreme talent and inventors of tools that the world had never seen before, and they may have begun to speak properly. There is no denying the beauty of late Palaeolithic cave paintings in France and Spain, nor the ingenuity of tools of that period found in European sites. Yet it has always seemed that to give them special significance is deeply offensive to people from elsewhere who descended from ancestors who were anatomically and genetically identical to European forebears. It has begun to seem more likely that the sudden appearance of art and improved technology in Europe resulted from colonisation of Europe by artists and inventors who brought older talents from elsewhere.

The Pinnacle Point caves, South Africa

Probably the first 'canvas' used by artists was the human body, painting designs we can only guess at with iron oxide and hydroxide ochres. Indeed, common finds in archaeological sites are pieces of these minerals showing clear signs of having been worked, even some that look suspiciously like body-paint pencils. The oldest come from a sea cave in South Africa, and show groves produced by grinding. The deposits containing them are four times older than the artwork of Europe, around 165 ka (Marean, C.W. and 13 others 2007. Early human use of marine resources and pigment in South Africa during the Middle Pleistocene. *Nature*, v. **449**, p. 905-908;DOI: 10.1038/nature06204). The people were beachcombers at a time when sea-level was low during the beginnings of the last glacial period but one. The Mossel Bay cave is just the oldest repository of clear ochre painting materials, others being common through Africa and the Middle East in the period before Africans migrated to colonise the rest of the world. There are disputed examples of pigments more than 400 ka old from Zambia. But possibly the most startling, for Eurocentrist anthropologists is the so-called 'Venus of Tan-Tan' from Morocco dated between 300 to 500 ka, and similar figurines from Israel that are almost as old.

See also: McBrearty, S & Stringer, C. 2007. The coast in colour. *Nature*, v. **449**, p. 793-794; DOI: 10.1038/449793a.

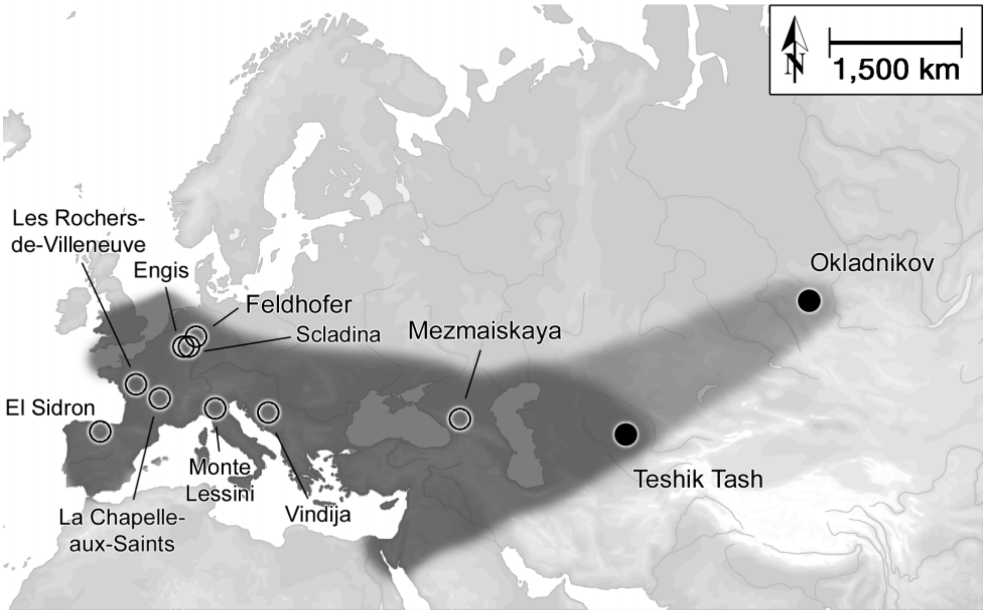
Migrations summarised (*November 2007*)

Fully modern humans are not unique in their history of colonisation of the world. Journeys out of Africa began as early as 1.8 Ma ago by the precursors of *Homo erectus*, to reach central China and Indonesia. *Homo antecessor* reached Europe by 800 ka at the latest, and there are earlier finds of tools in southern Europe. Our immediate ancestors spread throughout Africa and into the Levant by 100 ka, but the decisive move that eventually colonised every continent except Antarctica and most oceanic islands seems to have got underway at around 80 ka, when Africa was beginning to dry as global climate cooled towards conditions of the last glacial period. None of the huge peregrinations are likely to have been by design, but more a diffusion as conditions changed, food sources shifted and obvious opportunities presented themselves. A great deal of palaeoanthropology focuses on charting those migrations, using tangible signs of ancient people and their dates and positions, knowledge of geography, climate and feasible routes, and lately the spread of genetic markers found in modern human DNA samples.

In a rapidly moving field, summaries of the latest ideas are handy (Jones, D. 2007. Going global. *New Scientist*, v. **196** (27 October 2007), p. 36-41). In this case however, claims are made by the publisher for fundamental novelty (the article is headlined as "Humanity's greatest journey: Tracing a new route out of Africa"). The suggested novelty is that our ancestors initial forays away from home were along shorelines as beachcombers, and the leap to Eurasia was across the Straits of Bab el Mandab between modern Eritrea and Yemen when the shallow southern Red Sea was almost dry during a glacial advance in the far north. There is nothing new in either. Jonathon Kingdon in *Self-Made Man and His Undoing* (1993) first suggested "Strandloping". In *Stepping Stones* (1999) I speculated that the Straits of Bab el Mandab would have been an available exit from Africa for hominins using shoreline food resources at several times since 2 Ma. Stephen Oppenheimer argued in 2003 for that route having been used at around 85 ka, backed up by strong fossil evidence for established beachcombing on the coast of Eritrea. His seminal book *Out of Eden* (2003), was the first systematic attempt to draw together tangible evidence with all the available genetic threads and their dating to reconstruct a coherent picture of human migrations. There is a fascinating web site on the course of human migration, authored by Oppenheimer, at www.bradshawfoundation.com/journey.

In the same vein is a summary of a conference in Cambridge, UK, which focused on an integral aspect of global migration: evidence for seafaring (Balter, M. 2007. In search of the world's most ancient mariners. *Science*, v, **318**, p. 388-389; DOI: 10.1126/science.318.5849.388). That people did cross wide stretches of sea that are too deep for sea-level change to make any difference is well established, particularly for eastern Indonesia, New Guinea and Australia. The now established ancient status of *H. floresiensis* (see above) supports much earlier seafaring by hominins. The question is: did people set out deliberately aboard some kind of craft, or were early crossings accidental, as is the case for other land animals, presumably on drifting vegetation? The earliest known boats – hollowed logs from about 10 ka – are not exactly seaworthy for anything but coastal ventures. SE Asia is blessed, however, by bamboo, whose flotation seems likely to have been exploited for near-shore fishing or journeys to fringing reefs at low tide. Were groups of people on bamboo rafts blown out to sea, prevailing monsoon winds could have carried them eastwards to new lands in a matter of days. To found new and long-lasting human bands would require at least 5 to 10 females and males to have been swept from their home shores. Sea-level rise since the time of decisive human migrations has, unfortunately, drowned any coastal sites of that time and evidence of when new beachcombing cultures became established.

The long reach of the Neanderthals (*November 2007*)



The known range of Neanderthals (Credit: Krause *et al*. 2007; Fig. 1)

Neanderthals, at their acme, were widespread in Europe and the Levant, but new analyses of mtDNA from old bones in Uzbekistan and Siberia show their range to extend to about 90°E (Krause, J. and 9 others 2007. Neanderthals in central Asia and Siberia. *Nature*, v. **449**, p. 902-904; DOI: 10.1038/nature06193). The range is not one encouraged by warmer climates, for the Siberian bones are dated at about 38 ka, when northern Eurasia was caught in the grip of cold temperatures descending to the last glacial maximum. But there is evidence which suggests that climate change did play a part in the Neanderthal's demise. Intricate and precise time series of climatic shifts, such as that from the Cariaco Basin off Venezuela, offer an opportunity to check out links between climate and the fate or otherwise of human populations; provided that evidence for the latter is abundant and well-dated. A cave in Gibraltar has yielded good evidence that suggests habitation by *H. neanderthalensis* in three periods: 32.5; 26.4 and as late as 24.0 ka (Tzedakis, P.C. *et al*. 2007. Placing late Neanderthals in a climatic context. *Nature*, v. **449**, p. 206-208; DOI: 10.1038/nature06117). The three dates correspond with periods of relative warmth, separated by cooling in the period of climate instability leading to the last glacial maximum. From the correlation it is hard to argue for a major role of climate change in Neanderthal extinction, merely that they favoured the location during easier times.

Georgian hominins; who were they? (*November 2007*)

Steadily, the number of fossils of early members of the genus *Homo* are accumulating to fill the period since 2-2.5 Ma when tools first appear in the archaeological record. The problem is that most are skull fragments that may suggest different species, but not a great deal about their owners behaved. Near-complete postcranial (body) fossils are rare: ‘Lucy’ (~3.5 Ma, *A. afarensis*) and Nariokotome Boy (~1.6 Ma, *H. ergaster*) were the only ones for periods before the emergence of our immediate ancestors in Africa considerably less than 1 Ma ago. The earliest well-preserved migrants into Eurasia appear in ~1.8 Ma deposits at Dmanisi in Georgia, first found as head fossils and now partial postcranial ones have been described (Lordkipanidze, D. and 17 others 2007. Postcranial evidence from early *Homo* from Dmanisi, Geogia. *Nature*, v. **449**, p. 305-310; DOI: 10.1038/nature06134) from 3 adults and a single adolescent.

On the basis of cranial evidence alone, the Georgian hominins seem extremely primitive, their brain volumes being less than 800 cc, comparable with African *H. habilis*, and significantly less than *H. ergaster* and Asian *H. erectus*. Postcranial bones show they were diminutive, at around 1.5 m and 45 kg, but give a mix of ‘modern’ and ‘primitive’ features, such as a high leg:arm length proportion and an anatomical inability to throw over-arm, respectively. The latter is shared with *H. floresiensis* (see *Hobbit matters*, June 2006), as is body size and brain volume. The absence of postcranial material from *H. erectus* poses a problem in assigning the Georgian hominins to that species, although Lordkipanidze and colleagues reckon they are early versions of that species. The bones missing for proper comparison with well-established (if not well-defined) species also open up the possibility that they are *H. habilis*, and even that they are the ancestors of *H. floresiensis*. If that was the case then they were remarkably successful in Asia (but also very good at hiding, for no comparable fossils have been found except on Flores). While early hominin species are almost all defined on cranial fossils, for obvious practical reasons, the more finds are made that expand the diversity of forms, the more puzzling early human evolution becomes. That applies equally to Africa in the 2 to 1 Ma period, a ~1.6 Ma Kenyan skull, assigned by some to *H. erectus* is much smaller than that of roughly contemporary Nariokotome ‘Boy’.

See also: Lieberman, D.E. 2007. Homing in on early *Homo*. *Nature*, v. **449**, p. 291-292; DOI: 10.1038/449291a. Gibbons, A. 2007. A new body of evidence fleshes out *Homo erectus*. *Science*, v. **317**, p. 1664; DOI: 10.1126/science.317.5845.1664.