Human evolution and migrations

Neanderthal news (*February 2016*)

Increasingly sophisticated analysis of existing genomes from Neanderthal and Denisovan fossil bone, together with new data on single-chromosome DNA extracted from Croatian and Spanish Neanderthals continues to break new ground.

Artistic reconstruction of Neanderthal woman (credit: Natural History Museum,)

According to genome comparison between a Siberian specimen and modern humans, a population from which Neanderthals emerged separated from that which led to anatomically modern humans (AMH) sometime between 550 and 765 ka, although the fossil record can only confirm that divergence was before 430 ka. The comparison famously showed that Neanderthals contributed to modern, non-African humans between 47 and 75 ka, that is after the exodus of AMH from Africa that spread our species throughout all continents except Antarctica (see *Yes, it seems that they did…* May 2010). This genetic exchange is thought to have taken place somewhere in the Middle East, which may have been a major staging post for our spread further east and also westward to Europe. A similar indication of liaison between Denisovans and AMH migrants is restricted to modern Melanesians, and probably took place in eastern Asia before 45 ka, when modern people began crossing from Eurasia to New Guinea and Australia. Neanderthal-Denisovan comparison suggests that those distinct groups separated between 380 and 470 ka ago (recently revised from an earlier estimate).

In both cases the gene flow was from the older groups to humans. Further examination of Siberian Neanderthal genomes now indicates that a reverse exchange occurred more than 100 ka ago (Kuhlwilm, M. and 21 others 2016. Ancient gene flow from early modern humans into Eastern Neanderthals. *Nature*, v. **530**, p. 429-433; DOI: 10.1038/nature16544). But the single-chromosome DNA from Croatian and Spanish Neanderthals shows no such sign. This instance of two-way exchange is significant in another way: it took place before direct evidence of the generally accepted departure of African migrants to populate the rest of the world. At about 100 ka there is fossil evidence of possible AMH-Neanderthal cohabitation of the Levant (see *Human-Neanderthal cohabitation of the Levant* February 2015), followed by a period with fossil evidence for Neanderthal presence there but not modern humans. Because stone tools from northern Arabia are dated as far back as 125 ka and closely resemble those associated with archaic modern humans, there is a possibility that AMH migration was far earlier than previously thought and passed through the Levant *en route* to points east.

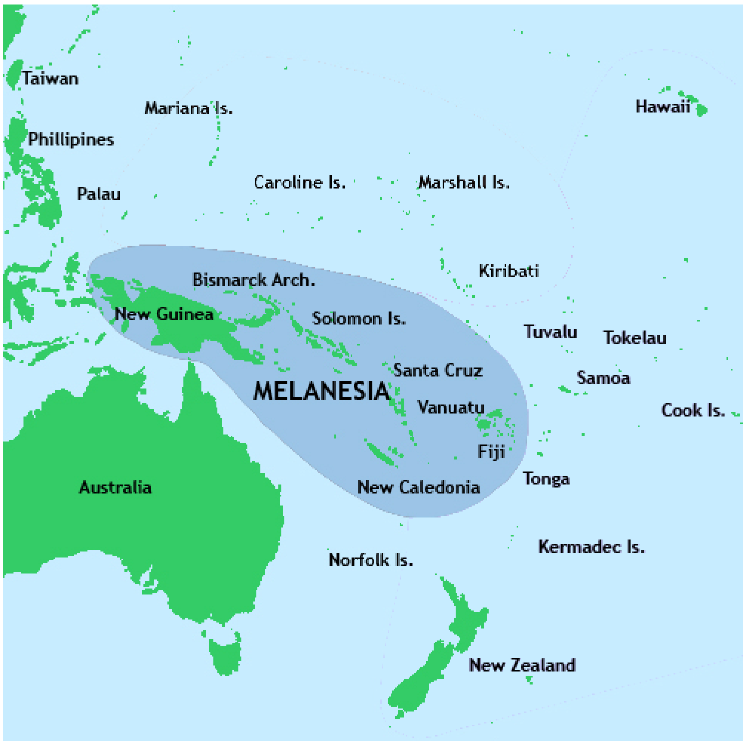
Another tantalizing aspect of Neanderthal-modern human genetics is the tangible legacy of interbreeding with non-African humans. The first sign was that the gene (*mc1r)* that confers red hair on those of us blessed with it may have Neanderthal origins, thus making us extremely proud of that heritage. The same gene is implicated in northern modern humans having developed pale skin, which might embarrass 'white supremacists'! Similar studies in Svante Paabo's lab at the Max Planck Institute for Evolutionary Anthropology in Leipzig also suggested 15 genome regions that include those involved in energy metabolism, possibly associated with type 2 diabetes; cranial shape and cognitive abilities, perhaps linked to Down's syndrome, autism and schizophrenia; wound healing; skin, sweat glands, hair follicles and skin pigmentation; and barrel chests. There is more…

Joshua Akey of the University of Washington, Seattle, and evolutionary geneticist Tony Capra of Vanderbilt University in Nashville hit on the idea of 'mining' archived genetic information from more than 28 thousand living people for traces of 6000 Neanderthal DNA variants and comparing the results with physical traits and diseases logged in the human database (reported by Gibbons, A. 2016. Neanderthal genes linked to modern diseases. *Science*, v. **351**, p. 648-9; DOI: 10.1126/science.351.6274.648). On the plus side, Neanderthal ancestry may help boost immune responses to fungi, parasites and bacteria. Inheritance of enhanced blood coagulation, although greatly assisting recovery from wounds and hemorrhage when giving birth, confers a proclivity to heart attacks and strokes. Neanderthals also passed on 'weak bladders', solar keratoses that confer skin cancer risk, a tendency to malnutrition from modern diets low on meat and nuts, depression triggered by jet lag(!) and even a tendency to nicotine addiction. But a 'pure' line of modern human descent, shared by most Africans, also has its positive and negative heritable traits.

More on Neanderthals, Denisovans and anatomically modern humans

Neanderthals and Denisovans interbred more often (*March 2016*)

Palaeogeneticists certainly have the bit between their teeth as DNA sequencing methods become faster and more productive and statistical methods of sequence analysis and comparison are made more powerful. Only last month I reported on the two-way breeding unearthed from the data on single-chromosome DNA extracted from Croatian and Spanish Neanderthals, as well as some of the tangible inheritance from Neanderthals found in living non-African people (see *Neanderthal news* above). Now a team of statisticians, anthropologists and genetic sequencers have applied the new approaches to the genomes of over 1500 non-Africans, including 35 living Melanesian people from Papua-New Guinea (Vernot, B. and 16 others 2016. Excavating Neandertal and Denisovan DNA from the genomes of Melanesian individuals. *Science*, v. **351** DOI: 10.1126/science.aad9416). Melanesians had previously shown evidence of hybridization with both Neanderthals and Denisovans. The most interesting outcome is that the analyses pointed towards yet more instances of interbreeding between ancestors of modern non-Africans and Neanderthals. Many East Asians have 3 Neanderthals in their family trees, for Europeans and South Asians the score is 2, while Melanesians show descent from one Neanderthal and one Denisovan. Moreover, it emerges that interbreeding episodes were at different times among different populations since anatomically modern humans migrated from Africa, beginning perhaps as long ago as 130 ka and recurring later, after different regional groups of AMH had proceeded on their separate ways.



Melanesia cultural and geographical area in the Pacific. (Credit: Wikipedia)

A second study (Sankararaman, S. *et al*. 2016. The combined landscape of Denisovan and Neanderthal ancestry in modern humans. *Current Biology*, v. **26**, p. 1-7; DOI: 10.1016/j.cub.2016.03.037) has teased out evidence for Denisovan ancestry among South

Asians, their admixture with Melanesians after that group acquired Neanderthal forebears, and significant signs of dwindling fertility among hybrid males.

Early 2016 has been very fertile as regards palaeoanthropology. Katherine Zink and Daniel Lieberman of Harvard University focus on the small teeth of *Homo erectus* and later humans, wondering if they arose following a major shift in culinary practices (Zink, K.D. & Lieberman, D.E. 2016. Impact of meat and lower Palaeolithic food processing techniques on chewing in humans. *Nature*, v. **531**, p. 500-503; DOI: 10.1038/nature16990). Their work is based on experiments to discover how much chewing is needed to make it possible to swallow different uncooked foodstuffs (assuming that cooking did not arise until after 500 ka). It seems that simply introducing meat to the diet would have reduced mastication by around 13% (2 million chews) per year, with a 15% reduction in applied chewing force. Simply slicing and pounding takes out another 750 thousand annual chews and gives a 12% fall in average biting force. So, here's a link between tools and human gnashers as well as with development of the hand. Fascinating, perhaps, but every hominin species since 7 Ma old *Sahelanthropus tchadensis* had far smaller canine teeth than are the norm among non-hominin living and fossil apes. Something else was going on with dentition during our evolution, which may have been a loss of the need for *threatening* teeth. From 'Do that again and I'll bite you', to 'Let's chew this over'…

More on Neanderthals, Denisovans and anatomically modern humans

Homo floresiensis (the 'Hobbit') is somewhat older (*April 2016*)

In 2004 a newly discovered hominin fossil from the Indonesian island of Flores made headlines worldwide. Although an adult, it was tiny – about a metre tall, had a commensurately small brain (the size of a grapefruit), had made tools and hunted small elephants and giant rats. Dates from the cave floor sediments that had entombed it gave ages as young as 13 to 11 thousand years and as far back as 850 ka. So *H. floresiensis* was regarded as being the last human to share the Earth with us; that is, if it was a different species rather than a product of evolutionary shrinkage of anatomically modern humans stranded and isolated on the island for a very long time. Then there was talk among locals of the legendary *Ebo Go-Go*, with whom their ancestors had shared the island – they had arrived between 35 to 55 thousand years ago.

Homo floresiensis (the "Hobbit") (credit: Wikipedia)

Unsurprisingly, a major controversy raged in palaeoanthropology circles, between those who demanded either island dwarfism or congenital deformity of modern humans, and the other camp focused on many anatomical differences that pointed to a *bona fide* companion to later immigrants who perhaps survived into modern times. The 'Hobbit' became a *cause celebre*, but many of the original protagonists are now left with the proverbial egg on their faces. The cave sediments turn out to have a much more complex stratigraphy than previously thought, following further excavations led by the original discoverer Thomas Sutikna of the Pusat Penelitian Arkeologi Nasional in Jakarta Indonesia (Sutikna, T. and 19 others 2016. Revised stratigraphy and chronology for Homo floresiensis at Liang Bua in Indonesia. *Nature*, v. **532**, p. 366-369; DOI: 10.1038/nature17179).

Liang Bua cave on Flores island, Indonesia. (Credit: Wikipedia)

The delayed appearance of the revision is hardly surprising, given the lengthy political squabbles surrounding access to the site. And neither are the outcomes, for cave sediments are notoriously tricky because of their episodic reworking by cave floods and roof falls, together with the difficulty in finding materials suited to dating in tropical settings. The original charcoal used in radiocarbon dating and sand grains subject to the thermoluminescence method were in fact from a unit that lies unconformably against the stratum that hosted the fossils. More sophisticated luminescence dating of the actual fossil-hosting sediments yield ages between 100 to 60 ka, tool-bearing units range from 190 to 50 ka. The origins of *H. floresiensis* are thus pushed back beyond the date of supposed colonisation by *H. sapiens*, and remain an open question.

Breaking news: Cave structures made by Neanderthals (*May 2016*)

Neanderthals were well equipped and undoubtedly wore clothing, made shelters, hunted, used fire and famously lived in caves. Deliberate burial of their dead, in some cases arguably with remains of flowers, indicates some form of ritual and belief system. Those in Spain wore necklaces and pendants of bivalve shells, some of which retain evidence of having been painted. Excavators there even found a paint container and painting tools made of small bones from a horse's foot. The container and tools retain traces of the common iron colorants goethite, jarosite and hematite. One large, perforated scallop shell, perhaps used as a pectoral pendant, shows that its white interior was painted to match its reddish exterior. Given the evidence for adornment by earlier hominins, to find that Neanderthals created art should not be surprising.

Neanderthal structures made from stalactites in Bruniquel cave (Sci-news.com)

This month it has emerged that about 177 thousand years ago and earlier, they had broken stalactites off the cave roof to create curious semi-circular structures in Bruniquel Cave near Montauban in southern France (Jaubert, J. and 19 others, 2016. Early Neanderthal constructions deep in Bruniquel Cave in southwestern France. *Nature*, v. 533, online publication, DOI: 10.1038/nature18291. **See also:** Soressi, M. 2016. Neanderthals built underground. *Nature*, v. **5345**, p. 43-44; DOI: 10.1038/nature18440). Each of the structures contains incontrovertible evidence that fires were made within them. Rather than being near the well-lit cave entrance the structures are more than 300 m deep within the cave system surrounded by spectacular stalagmites and stalactites that are still in place. Were the structures younger than 42 ka they would probably have been attributed to the earliest anatomically modern Europeans and to some ritual function. Instead they were made during the climatic decline to the last but one glacial maximum.

Related articles

Neanderthals built mystery underground circles 175,000 years ago (newscientist.com)

More Hobbit time (*June 2016*)

A few months after the diminutive hominin fossil *Homo floresiensis* turned out to be considerably older than previously thought (see *Homo floresiensis (the 'Hobbit') is somewhat older* above) it hit has the headlines again because its ancestors may have colonized the Indonesian island of Flores far earlier still. Two articles in the 9 June 2016 issue of *Nature* consider evidence from another site on the island where fluvial sediments offer more easily interpreted stratigraphy than the complex Liang Bua cave assemblage where the original skeletal remains were unearthed. The site in the So'a Basin became an important target for excavation following the discovery there in the 1950's of stone artefacts, east of Wallace's Line – a fundamental faunal and floral divide once thought to be due to the difficulty of crossing a deep, current-plagued channel in the Indonesian archipelago. The unexpected presence of artefacts drew palaeoanthropologists from far afield, but it was almost 50 years later before their exploration yielded hominin remains.

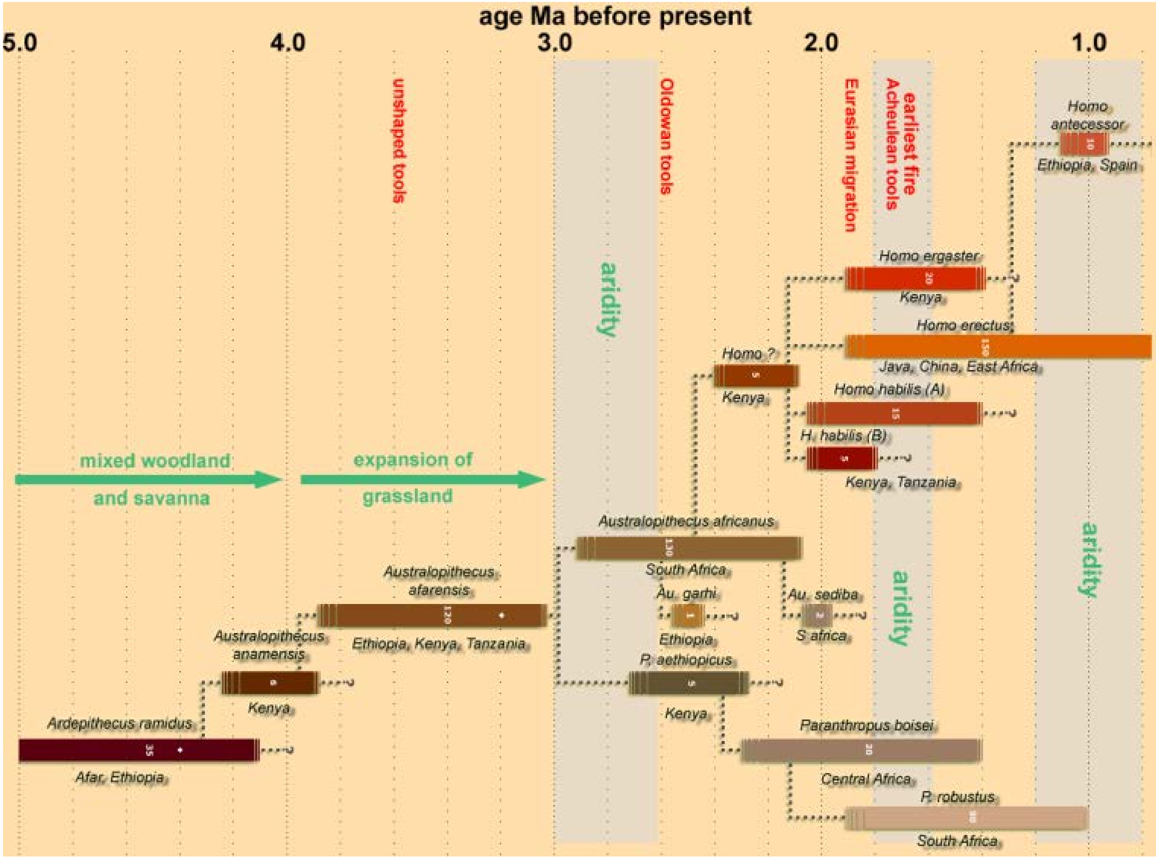
One of the papers reports sparse hominin material from the So'a Basin; a fragment of mandible and 6 isolated teeth thought to be from at least three individuals (van den Bergh, G.D. *et al*., 2016. *Homo floresiensis*-like fossils from the early Middle Pleistocene of Flores. *Nature*, v. **534**, p. 245-248; DOI: 10.1038/nature17999). The other covers newly discovered artefacts, the stratigraphic and palaeoecological setting, and radiometric dates of the finds (Brumm, A. and 22 others, 2016. Age and context of the oldest known hominin fossils from Flores. *Nature*, v. **534**, p. 249-253; DOI: 10.1038/nature17663). The jaw fragment shows signs of having once held a wisdom tooth, showing that it belonged to an adult. Yet although it resembles the dentition of the younger Liang Bua specimens, it seems more primitive and is even smaller. The other dental finds are most likely to be deciduous teeth of juveniles. Fission-track, uranium-series and $^{40}Ar/^{39}Ar$ dating indicates that the fossils entered the sediments about 700 ka ago. But tools and remains of prey animals in deeper sedimentary layers here and at other Flores sites indicate the presence of hominins back as far as about 1 Ma, before which there are no such signs.

So, at least a million years ago Flores was colonised by hominins. Either the original immigrants were uniquely small compared with other hominins of that vintage in Asia and Africa, or within 300 ka they had decreased in size through the evolutionary influence of limited resources on Flores and the process of island dwarfism. The second may also have been influenced by an initially small population of migrants or a later population 'bottleneck' that added a loss of genetic variability – a founder effect. These two alternatives may point respectively to either the even earlier migration out of Africa and across most of Asia of perhaps *H. habilis*, or the dwarfing of a limited population of *H. erectus* who made their way there from their known occupation of Java. The authors painstaking analysis of the meagre remains suggest a closer dental resemblance to Asian *Homo erectus* than to earlier African hominins, so the second alternative seems more likely. However, even that scenario poses palaeoanthropology with a major problem; yet another evolutionary process that helps cryptify the links among our earlier relatives.

See also: Culotta, A. Tiny jaw reveals dawn of the hobbit 2016. *Science*, v. **352**, p. 1260-1261; DOI: 10.1126/science.aag0595).

Climatic conditions for early hominin evolution (*August 2016*)

Until about 1.8 Ma ago, when early *Homo erectus* and perhaps other archaic hominins strode into Eurasia, our forerunners lived and evolved on only one continent – Africa. The physical and environmental conditions underlying the steps from a common ancestor with modern chimpanzees through a growing number of upright species are not well charted by the Pliocene and early Pleistocene terrestrial evidence. All that is know of this formative period is that global climate cooled in an oscillating fashion that culminated in the onset of Northern Hemisphere glaciations in the late Pliocene (~3 Ma) and a shift to drier conditions in East Africa around 2.8 Ma suggested by pollen records off the east coast. Marine sediments of the Indian Ocean, Red Sea and Gulf of Aden still offer the most convenient means of charting environmental change in detail for this crucial episode in human history. As well as oxygen-isotope and pollen-type variations, modern core analysis offers a growing number of wind-blown proxies for onshore vegetation. These include organic geochemistry plus carbon and hydrogen isotopes from trace amounts of leaf waxes. During the May to September East African Monsoon, high speed winds in the upper atmosphere drag dusty continental air from the East African Rift System over the Gulf of Aden, making sea-floor sediment an important target for tracking variations in the proxies (Liddy, H.M. *et al*. 2016. Cooling and drying in northeast Africa across the Pliocene. *Earth and Planetary Science Letters*, v. **449**, p. 430-438. DOI: 10.1016/j.epsl.2016.05.005). Hannah Liddy and colleagues from the Universities of Southern California and Arizona, USA, applied these techniques to a Gulf of Aden core from offshore Somaliland to open a window on this crucial period.



Early history of hominin evolution and evidence for climate change in East Africa. Based on a diagram at the handprint.com website and in Stepping Stones Chapter 22

Early Pliocene East Africa (5.3 to 4.3 Ma), the time of *Ardepithecus ramidus,* was characterized by evidence for a climate wet enough to sustain grasses and riverine woodlands. Yet around 4.3 Ma conditions had shifted to ecosystems more dominated by shrubby plants able to thrive in more arid conditions. At about that time the earliest australopithecines appear in the fossil record, with *A. anamensis*. Yet the later Pliocene was not devoid of grasses or herbivores. There is ample carbon-isotope evidence from the teeth of hominins that shows that after 3.4 Ma the diet of *A. afarensis* and *A. africanus* included increasing amounts whose carbon derived from grasses, when. This apparent paradox can be explained by a major turn to eating meat from herbivores as vegetable foods declined with increasing aridity. This is all very interesting, especially the detailed record of $\delta^{13}C$ in plant waxes, but there is little to indicate that steps in hominin speciation or extinction had much direct connection with fluctuations in climatic conditions. Environmental change may have formed a background to other influences that may have been wholly down to early hominin's social and technological behaviour.

Lucy: the australopithecine who fell to Earth? (*September 2016*)

The specimen of *Australopithecus afarensis* known far beyond the confines of palaeoanthropology as Lucy remains the iconic figure of hominin evolution, 42 years after her discovery by Donald Johanson and Tom Gray near Hadar in the Awash valley of the Afar Depression, Ethiopia. Her skeletal remains were not complete, but sufficient to recognize that they were from the oldest known upright hominin and that they were female, the pelvis having closer affinities to that of human women rather than other extant apes. Yet her skull was more akin to apes, with a brain volume about the same as a modern chimpanzee's.

Model of Lucy (Australopithecus afarensis) in the museum of Barcelona

Subsequently, the entombing strata were radiometrically dated at around 3.2 Ma. Lucy, in common with most fossils roughly in the human line of descent, has from the outset been the subject of controversy, even at one time being said to be misnamed because of alleged male characteristics; a view swiftly discarded. Like the treasures of Tutankhamun, Lucy's actual remains have been exhibited far and wide, including a 6-year stay in the US. Fears of damage in transit led the Ethiopian authorities to produce casts for distribution, and Lucy is now restricted to the National Museum in Addis Ababa. As a further precaution, all the actual bones were rendered in digital 3-dimensions using a high-resolution CT scanner during her US sojourn. It is these scans that have led to a surprising development as regards her original fate. Apart from signs of a single carnivore tooth mark, her remains were not devoured by scavengers, nor did early anatomical examinations suggest any sign of disease and she was estimated to have been a young mature female when she died – the cause of death was unknown.

Detailed forensic analysis of the CT scans (Kappelman, J. and 8 others 2016. Perimortem fractures in Lucy suggest mortality from fall out of tall tree. *Nature*, v. **537**, p. 503-507; DOI: 10.1038/nature19332) revealed far more than did the original bones, including evidence for numerous fractures in Lucy's limbs, ribs and cranium, many of which are of the compressive or 'greenstick' kind. Those in the left ankle and leg bones (talus, tibia, fibula and femur) are compressive and suggest a severe vertical impact of the heel with enough force to smash the strongest bones in the body, driving the hip into the pelvis. Damage to the ribs, pelvis and lower spine (sacrum) is commensurate with a further horizontal, frontal impact of the torso. Arm (humerus), wrist (radius) shoulder blade (scapula) and collar (clavical) bone fractures are typical of injuries sustained when a falling person tries to break a fall by stretching out the arms. Damage to the cranium and lower jaw (mandible) suggest this instinctive defence posture was futile. None of the fractures show signs of healing, so the multiple traumas were immediately fatal.

Forensic reconstruction of how Lucy fell to meet her end. (credit: John Kappelman)

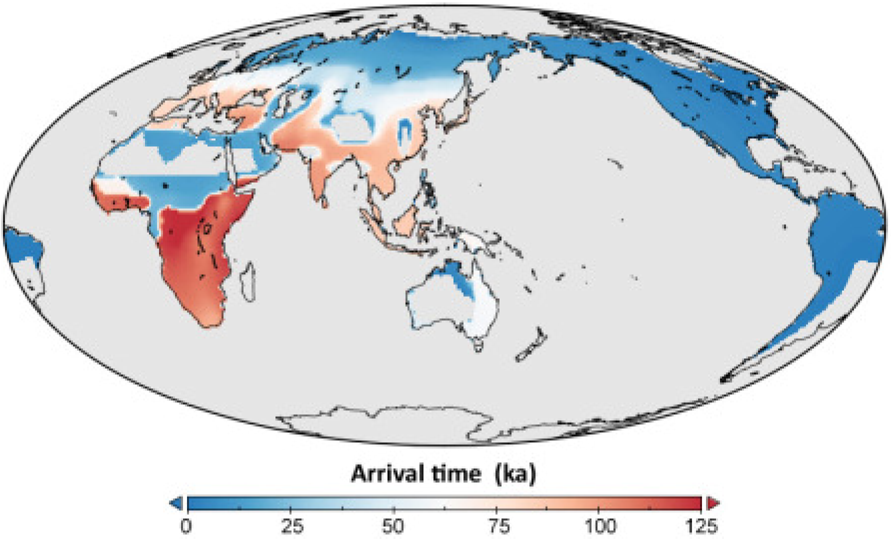
The traumatic pattern is reminiscent of someone falling onto hard ground from great height; perhaps equivalent to a four- or five-storey building (see animated reconstruction here). In Lucy's case, the most likely scenario is from a large tree, perhaps while foraging or sleeping in a safe refuge from ground predators. Forensic analysis of newly dead victims of severe falls generally show massive soft tissue damage by penetration of bone fragments or a 'hydraulic ram effect' in which abdominal organs are thrust upwards to produce cardiac damage. That Lucy was found almost intact rules out dismemberment by scavengers or transport by flood water. Indeed, the preservation of even tiny slivers of fractured bone seems to suggest her burial in flood plain sediments before decomposition had set in. A question that the authors do not address is whether or not she may have been deliberately interred, which to me seems a possibility that could be drawn from the detailed evidence. I wonder what a modern coroner might conclude: probably misadventure.

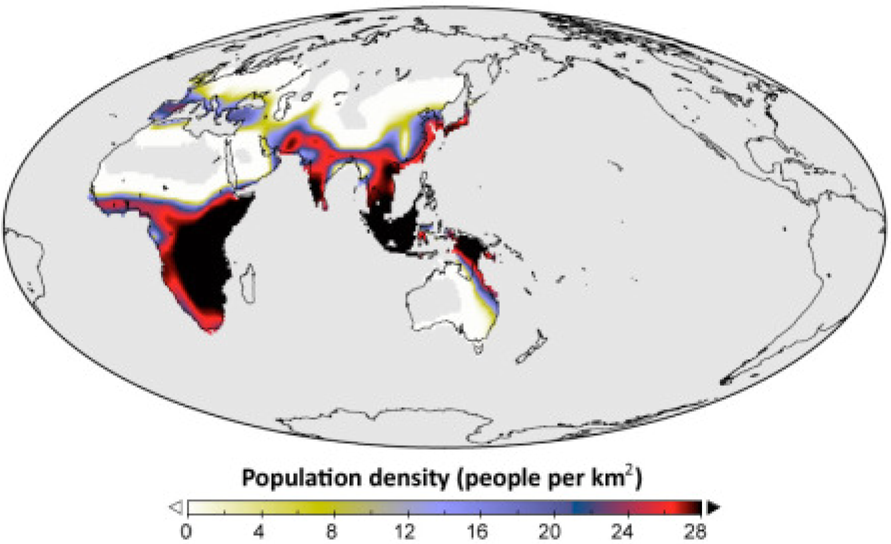
More on hominin evolution can be found here.

Out of Africa: a little less blurred? (*September 2016*)

DNA from the mitochondria of humans who live on all the habitable continents shows such a small variability that all of us must have had a common maternal ancestor, and she lived in Africa about 160 ka ago. Since this was first suggested by Rebecca Cann, Mark Stoneking and Allan Wilson of the University of California, Berkeley in 1987 there has been a stream of data and publications – subsequently using Y-chromosome DNA and whole genomes – that both confirm an African origin for *Homo sapiens* and illuminate it. Analyses of the small differences in global human genetics also chart the routes and – using a 'molecular clock' technique – the timings of geographic and population branchings during migration out of Africa. As more and better quality data emerges so the patterns change and become more intricate: an illustration of the view that 'the past is always a work in progress'. The journal *Nature* published four papers online in the week ending 25 September 2016 that demonstrate the 'state of the art'.

Three of these papers add almost 800 new, high-quality genomes to the 1000 Genomes Project that saw completion in 2015. The new data cover 270 populations from around the world including those of regions that have previously been understudied for a variety of reasons: Africa, Australia and Papua-New Guinea. All three genomic contributions are critically summarized by a Nature News and Views article (Tucci, S & Akey, J.L. 2016. A map of human wanderlust. Nature, v. **538**, p. 179-180; DOI: 10.1038/nature19472). The fourth paper pieces together accurately dated fossil and archaeological findings with data on climate and sea-level changes derived mainly from isotopic analyses of marine sediments and samples from polar ice sheets (Timmermann, A & Friedrich, T. 2016. Late Pleistocene climate drivers of early human migration. *Nature*, v. **538**, p. 92-95; DOI: 10.1038/nature19365). Axel Timmermann and Tobias Friedrich of the University of Hawaii have attempted to simulate the overall dispersal of humans during the last 125 ka according to how they adapted to environmental conditions; mainly the changing vegetation cover as aridity varied geographically, together with the opening of potential routes out of Africa via the Straits of Bab el Mandab and through what is now termed the Middle East or Levant. They present their results as a remarkable series of global maps that suggest both the geographic spread of anatomically modern human migrants and how population density may have changed geographically through the last glacial cycle. Added to this are maps of the times of arrival of human populations across the world, according to a variety of migration scenarios. Note: the figure below estimates when AMH *may* have arrived in different areas and the population densities that environmental conditions at different times *could* have supported had they done so. Europe is shown as being possibly settled at around 70-75 ka, and perhaps having moderately high densities for AMH populations. Yet no physical evidence of European AMH is known before about 40 ka. Anatomically modern humans could have been in Europe before that time but failed to diffuse towards it, or were either repelled by or assimilated completely into its earlier Neanderthal population: perhaps the most controversial aspect of the paper.





Estimated arrival time of anatomically modern human migrants from Africa (top); estimated population densities around 60 thousand years ago. (Credit: Axel Timmermann)

The role of climate change and even major volcanic activity – the 74 ka explosion of Toba in Indonesia – in both allowing or forcing an exodus from African homelands and channelling the human 'line of march' across Eurasia has been speculated on repeatedly. Now Timmermann and Friedrich have added a sophisticated case for episodic waves of migration across Arabia and the Levant at 106-94, 89-73, 59-47 and 45-29 ka. These implicate the role of Milankovich's 21 ka cycle of Earth's axial precession in opening windows of opportunity for both the exodus and movement through Eurasia; effectively like opening and closing valves for the flow of human movement. The paper is critically summarised by a *Nature* News and Views article (de Menocal, P.B. & Stringer, C. 2016. Climate and peopling of the world. *Nature*, v. **538**, p. 49-50; DOI: 10.1038/nature19471.

This multiple-dispersal model for the spread of AMH finds some support from one of the genome papers (Pangani, L. and 98 others 2016. Genomic analyses inform on migration events during the peopling of Eurasia. *Nature*, v. **538**, p. 238-242; DOI:

10.1038/nature19792). A genetic signature in present-day Papuans suggests that at least 2% of their genome originates from an early and largely extinct expansion of AMH from Africa about 120 ka ago, compared with a split of all mainland Eurasians from African at around 75 ka. It appears from Pangani and co-workers' analyses that later dispersals out of Africa contributed only a small amount of ancestry to Papuan individuals. The other two genome analyses (Mallick, S. and 79 others 2016. The Simons Genome Diversity Project: 300 genomes from 142 diverse populations. *Nature*, v. **538**, p. 201-206; DOI: 10.1038/nature18964. Malaspinas, A.-S. and 74 others 2016. A genomic history of Aboriginal Australia. *Nature*, v. **538**, p. 207-214, DOI: 10.1038/nature18299) suggest a slightly different scenario, that all present-day non-Africans branched from a single ancestral population. In the case of Malaspinas et al. an immediate separation of two waves of AMH migrants led to settlement of Australasia in one case and to the rest of Mainland Eurasia. Yet their data suggest that Australasians diverged into Papuan and Australian population between 25-40 ka ago. Now that is a surprise, because during the lead-up to the last glacial maximum at around 20 ka, sea level dropped to levels that unified the exposed surfaces of Papua and Australia, making it possible to walk from one to the other. These authors appeal to a vast hypersaline lake in the emergent plains, which may have deterred crossing the land bridge. Mallick *et al*. see an early separation between migrants from Africa who separately populated the west and east of Eurasia, with possible separation of Papuans and Australians from the second group. These authors also show that the rate at which Eurasians accumulated mutations was about 5% faster than happened among Africans. Interestingly, Mallick *et al*. addressed the vexed issue of the origin of the spurt in cultural, particularly artistic, creativity after 50 ka that characterizes Eurasian archaeology. Although their results do not rule out genetic changes outside Africa linked to cultural change, they commented as follows:

> *'… however, genetics is not a creative force, and instead responds to selection pressures imposed by novel environmental conditions or lifestyles. Thus, our results provide evidence against a model in which one or a few mutations were responsible for the rapid developments in human behaviour in the last 50,000 years. Instead, changes in lifestyles due to cultural innovation or exposure to new environments are likely to have been driving forces behind the rapid transformations in human behaviour …'*.

Variations in interpretation among the four papers undoubtedly stem from the very different analytical approaches to climate and genomic data sets, and variations within the individual sets of DNA samples. So it will probably be some time before theoretical studies of the drivers of migration and work on global human genomics and cultural development find themselves unified. And we await with interest the pooling of results from all the different genetics labs and agreement on a common data-mining approach.

Neanderthal culture confirmed (*October 2016*)

The Châtelperronian material culture represents the earliest sign of the Upper Palaeolithic in Europe and its products span a period from about 45 to 40 ka. It includes stone tools, such as points and long, thin blades with a single cutting edge and a blunt back, reminiscent of a modern knife, and others with notched or denticulate edges that resemble saw blades. A great many of the tools, including ivory and bone ones, were probably designed for working and stitching skins. But the most revealing worked objects are animal teeth, shells and fossils that are either bored or grooved to be strung together. The best have been found in the Grotte du Renne in eastern France. The most controversial aspect of the Châtelperronian is that its artefacts are sometimes found with the fossil remains of Neanderthals who had previously produced less sophisticated, Mousterian tools since around 160 ka. The controversy centres on whether or not Neanderthals created the Châtelperronian culture, and if so, did they develop them independently or through cultural exchange with or copying from the newly arrived anatomically modern humans (AMH).

Châtelperronian ornaments from the Grotte du Renne eastern France, probably parts of a necklace. (Credit: Marian Vanhaeren, CNRS, University of Bordeaux)

The Grotte du Renne material is especially rich in ornaments, but insufficient fossil material is present to tell from anatomical characteristics whether or not they were made by AMH or Neanderthals. It has now become possible using traces of bone proteins to detect hominin bone fragments and DNA to assess which group is implicated (Welker, F. and 17 others, 2016. Palaeoproteomic evidence identifies archaic hominins associated with the Châtelperronian at the Grotte du Renne. *Proceedings of the National Academy of Science*, v.

113, p. 11162-11167; DOI: 10.1073/pnas.1605834113). Analyses of mtDNA and radiometric dating of the bones that yielded it show that the Grotte du Renne tools and ornaments are linked with Neanderthals who lived there about 37 ka ago. Interestingly, the stratigraphic horizon beneath the definite Neanderthal occupation level contains their earlier, Mousterian artefacts. So it seems that they developed new manufacturing techniques and material culture. Yet, the findings do not resolve the issue of independent invention or copying AMH methodology.

Importantly, Grotte du Renne shows that Neanderthals, even if they copied AMH techniques, were capable of appreciating, producing and using personal ornamentation: they could learn and transmit ideas. In that respect, here is support for the notion that, apart from significant anatomical differences from AMH they were not that different intellectually.

More on Neanderthals, Denisovans and anatomically modern humans

Related article: Wade, L. 2016. Neandertals made jewelry, proteins confirm. *Science*, v. 353, p. 1350; DOI: 10.1126/science.353.6306.1350.

Tree-climbing australopithecines (*December 2016*)

We know that Lucy, the famous *Australopithecus afarensis*, could climb trees because her many bone fractures show that she fell out of a tree to her death (see *Lucy: the australopithecine who fell to Earth?* above). But that does not mean her species was an habitual tree-climber: plenty of modern humans fall to their deaths from trees, cliffs and the like. But the issue seems to have been resolved by using X-ray tomography of Lucy's limb bones (Ruff, C.B. *et al*. 2016. Limb bone structural proportions and locomotor behaviour in A.L. 288-1 ("Lucy"). *PLOS ONE* v. **11**. DOI: 10.1371/journal.pone.0166095) during the skeleton's triumphal series of exhibits in the US.

The authors, including two of those who showed using similar data that Lucy died after a fall, compared the digital 3-D models of her surviving arm- and leg bones with those of other hominins and living primates, estimating their relative strengths at different positions. Lucy was probably stronger in the arm than in the leg, but not to the same degree as chimpanzees. This is a feature that would significantly assist climbing , but her bipedal locomotion on the ground would have been only slightly different from that of later *Homo* species. If anything, her strength relative to size would have been greater than ours, perhaps reflecting less reliance on tools for getting food and defending herself. But almost certainly *Australopithecus afarensis* habitually spend more time in trees, perhaps foraging and as a defence against predation, especially at night.

The new data for Lucy allows palaeoanthropologists to better judge the capabilities of other hominins. Interestingly *Homo habilis*, the earliest of our genus, may have had similar habits. But later species, beginning with *H. erectus/ergaster*, were as Earth-bound as we are. This suggests a shift in hominin ecology from an early and probably long history of semi-arboreal behaviour until humans became masters of their terrain about 1.9 Ma ago, probably through their invention of better tools and the controlled use of fire.

Related article: Frayer *et al*. 2016. OH-65: The earliest evidence for right-handedness in the fossil record. *Journal of Human Evolution*, v. **100**, p. 65-72; DOI:

10.1016/j.jhevol.2016.07.002. Handedness: Has Human Evolution Always Been Right? (discovermagazine.com)

Human penis bone lost through monogamy? (*December 2016*)

The *baculum* or penis bone is arguably the most variable of mammalian bones, present in some species but not others. Among those in which it does occur the *baculum* varies enormously in shape, length and breadth relative to body size. This makes it likely to have been subject to the most divergent evolution among mammals. Yet that evolution has remained somewhat puzzling until recently. Observation has shown that the width of the *baculum* in male house mice is positively correlated with reproductive success. So one factor in the bone's evolution may be post-copulatory sexual selection: female mice seem to favour males well endowed in this department once they have mated with them, a notion supported by careful laboratory experimentation. The physical role of the penis bone is to support and protect the penis during sexual intercourse. Sturdy dimensions are increasingly efficacious the longer the duration and the greater the frequency of copulation, particularly among polygamous and seasonally breeding species. They also tend to delay or inhibit a female mating with another male after copulation.

The ~0.6 m long baculum of a walrus (*Odobenus rosmarus*) (credit: Wikipedia)

Matilda Brindle and Christopher Opie of University College London have applied advanced phylogenetic statistical analysis to data on the dimensions of penis bones among 2000 mammal species (Brindle, M. & Opie, C. 2016. Postcopulatory sexual selection influences baculum evolution in primates and carnivores. *Proceedings of the Royal Society, B*, v. **283**, doi: 10.1098/rspb.2016.1736) and suggest that the mammalian *baculum* first evolved between 145 to 95 Ma ago, earlier mammals likely having no penis bone. Ancestral primates and carnivorous mammals, however, were so endowed. Yet some mammalian species have lost the baculum. Among the primates, human males do not have one whereas male chimpanzees and bonobos, with which we share a last common ancestor, do: both are boisterously promiscuous whereas humans are pair-bonded to a large degree.

The issue of polygamy versus monogamy among human ancestors, and when the latter emerged, continues to excite palaeoanthropologists. The former in other living primates is often associated with a marked contrast in size between males and females – sexual dimorphism. The earliest hominins, such as species of *Australopithecus*, did exhibit such dimorphism whereas species of *Homo* show significantly less size contrast. Some have taken this to mark the emergence of pair-bonding amongst members of the earliest human species, to be passed on to their successors. Another indicator of competitiveness among primate males for females, and their dominance over the latter, is the near universal possession of large canine teeth among males of polygamous primates; an odd feature for species whose diet is dominantly and often exclusively vegetarian. Not only do living humans not have prominent canines, neither do any known fossil hominins. Despite the views of a small minority of anthropologists who demand that modern human females won social parity with males only in the last 100 thousand years, only to lose it following the Neolithic 'revolution', the physical evidence suggests that a trend towards that emerged with other distinct characteristics of hominins and concretised in early *Homo*. An assiduous search for fossil hominin penis bones may yet reveal the moment of monogamy.