The origin of our species

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This presentation could have been entitled *Lone survivors: how we came to be the only humans on earth*, the title given to the American edition of the speaker's book. Today, *Homo sapiens* is the only human on earth but 60,000 years ago there were at least 4 kinds of humans – *Homo sapiens* in Africa, Neanderthals in Eurasia, *Homo floresiensis* in Indonesia and the 'Denisovans' in Siberia. Evidence to reconstruct the past comes from fossils and palaeontology, tools and archaeology, and contextual and other data on stratigraphy and dating, isotopes, calculus (tartar on teeth), DNA, primate behaviour and modern hunter-gatherers.

Phases of human evolution

The early phase from about 7 to 4Ma in south and east Africa is still poorly known, seeing the development of the earliest bipeds and a reduction in the size of canine teeth but human ancestors were still ape-like. The Australopithecine phase, from about 4-2Ma, had many species widespread in Africa of early bipedal but still largely arboreal and predominantly ape-like creatures, possibly with some early tool use. The human phase, from about 2Ma on, had several species with an increasingly global spread and distinctly human anatomy with a dietary range and increased behavioural complexity. Comparison of the body types of the Australopithecine "Lucy" with a 9-year old boy from Kenya illustrates the changes with increase in body shape and brain size. The first stone tools date from about 2.6Ma in Kenya and Ethiopia. Meat-eating freed energy to evolve a larger brain.

By 1.8Ma, *Homo erectus* had developed, with the first examples found in Java in the 1890s. It evolved in Africa and emerges from Africa very soon afterwards to be found in the Caucasus at 1.8Ma and in China and Java at 1.6Ma. The skull was dominated by a huge brow ridge, its brain was about half or two-thirds the size of a modern brain and it used simple tools. At Dmanisi, Georgia, a medieval archaeological site on top of a hill had 6 individuals in a sample at 1.8Ma with a rich accompanying fauna including 2 species of sabre-toothed cats, a giant zebra, and ostrich.

With time, *Homo erectus* moved out of Africa and is found in Java and China, then the first humans reacched southern Europe followed by the first humans in northern Europe and Britain, at times of changing glacial intensity, and *Homo heidelbergensis* evolved. A 1.2Ma jawbone was found in the Sima del Elefante, Atapuerca, Spain, in cave deposits exposed by a railway cutting. The Gran Dolina site at Atapuerca had 0.85Ma *Homo antecessor* with about 100 fossils, which are more advanced than *Homo erectus*. Almost all show signs of butchery indicating cannibalism, a practice that continued with Neanderthals and modern humans. This species could have been in Britain based on tools and footprints found at Happisburgh, Norfolk. A 0.6Ma *Homo heidelbergensis* jawbone was found in 1907. It evolved from *Homo erectus* and was the common ancestor of both Neanderthals and modern humans. Based on mitochondrial DNA, population divergence to Neanderthals and modern humans occurred between 407,000 and 345,000 years ago. *Homo heidelbergensis* in Africa evolved to modern humans and in Eurasia to Neanderthals.

Homo heidelbergensis was found at Boxgrove, Sussex, at 0.5Ma with about 400 hand axe tools and horse, deer and rhinoceros bones that had been butchered plus flint chippings at a tool-making site. The human fossils were a tibia, which is larger and thicker than in modern humans, and 2 incisor teeth, the front of which were covered in scratch marks suggesting that they were holding meat or plants in their teeth and cutting it off with flint tools.

At Atapuerca, 0.4Ma deposits in the Sima de los Huesos (pit of the bones), there are bones of cave bears and humans – early Neanderthals comparable to the Swanscombe skull.

Neanderthals

Named after the Neander Valley, in which they were first discovered in 1856, Neanderthal burial sites are known from Spain to Siberia. The term has often been used as an insult, which is unfair to Neanderthals. They have had an image problem since their early depictions in the literature. They were not ape-men but very evolved humans. They are distinct in their skeletons with wide hipsand barrel-chested, powerful upper body. They still had the brow ridge, projecting mid-face with large front teeth and a weak chin. They have enough differences from modern humans to be a distinct species, particularly the big difference in skull shape. DNA evidence is building up which indicates some had red hair but the mutation in Neanderthals making red hair is different from that in modern humans, which only developed in the last 30,000 years.

Modern humans

The features shared by modern humans include a round head, small face, little or no brow ridge and a well developed chin, exhibiting complex human behaviour and complex technology with composite tools, in which bone, antler and ivory were worked. They also have art, music and spirituality, with cave art developed by 35,000 years ago, networking and treatment of the dead by multiple methods, including one burial site with 2m long straight spears made from mammoth tusks that were originally curved.

Homo sapiens had evolved in Africa by 200,000 years ago and modern anatomy and behaviour have deep roots there, illustrated by the finds of microliths and shell fishing evidence from Pinnacle Point in South Africa, while other sites show the use of red ochre and shell beads. A 100,000-year old ochre-processing workshop was found at Blombos Cave, South Africa, and shell jewellery and red ochre from 70-100,000 years old have been found in South Africa, Morocco, Algeria and Israel. This was a time when the Sahara was periodically green with a network of rivers and lakes.

The great human expansion began at 60,000 years into western Asia, with humans in Australia by 45-50,000 years and China and Siberia by 40,000 years. Humans are all the same species but we look different because regional and racial features have been added in last 30,000 years to our shared features.

Art and music developed from at least 40,000 years, with mammoth ivory statuettes and a flute made from the wing bone of a vulture, and Pleistocene cave art from Sulawesi, Indonesia, at least 35-40,000 years old.

What happened to Neanderthals?

It was once believed that Neanderthals evolved into Cro-Magnon Man and some think they were genetically absorbed by modern humans. The alternative belief is that they are now extinct, due to a range of possible causes including inter-population conflict, demographic disadvantage, competitive e exclusion, infectious diseases etc.

High-quality genomes obtained from Neanderthals show that their variation was lower than for modern humans and among the lowest for any organism. This indicates small population sizes, probably leading to in-breeding. Neanderthals were in small isolated groups and were unable to adapt in a period of rapid climate changes from 40-70,000 years. The total population from Spain to Siberia has been estimated at about 20,000 only. Modern humans developed sewing and

weaving at least 35,000 years ago and the wearing of clothing may well have aided in combating the changes in climate.

It has been suggested there was interbreeding between modern humans and Neanderthals. Certainly inter-species breeding is observed, e.g. in polar bears/brown bears, chimpanzees/bonobos and jackals/wolves, but early genetic data showed no sign of inter-breeding. Late Neanderthal sites have evidence of jewellery, bone-tool working and pigments in their last 20,000 years. Full genomes now available suggest that there was some interbreeding in western Asia, with about 2% of Neanderthal DNA in many populations outside of Africa. Interbreeding is inferred at 50-60,000 years on the basis of the Ust-Ishim femur 330 generations later. Part of the explanation for reduced Neanderthal ancestry in the genes is due to decreased fertility in male hybrids because the two species were at the edge of biological incompatibility. The remnants of Neanderthal DNA are associated with the genes affecting Type 2 diabetes, Crohn's disease, lupus, biliary cirrhosis and smoking behaviour and also possibly influence skin and hair characteristics.

Genomes from a finger bone and 2 teeth, which are the only evidence for the Denisovans in Siberia, suggest they were slightly closer to the Neanderthals than to modern humans but Denisovan DNA has been found in Australia and New Guinea.

The speaker concluded that we mostly out of Africa but that there was some hybridisation.