

## The Evolution of Modern Humans

**Editor's Introduction** | The name Chris Stringer is inextricably linked with the 'Out of Africa' theory, which argues that modern humans first evolved in Africa and then migrated out all over the world. According to this model, *Homo sapiens* gradually replaced the indigenous pre-human species of other continents, including the Neanderthals in Europe. In this feature, based on the Millennium Distinguished Lecture delivered at the American Anthropological Association in 2000, Stringer, a merit researcher at the Natural History Museum, expounds and elucidates his version of this highly influential and widely accepted theory of how it was that we modern humans came about.

With so many recent fossil discoveries, this is an exciting time to be examining the origins of our own species. There are two kinds of origin to consider. The first is the origin of the features that are shared by modern humans but differ from our predecessors in the evolutionary record such as the rounded shape of the skull, a relatively large brain, the existence of a chin, and a lightly built skeleton. Alongside the similarities, numerous differences between human populations exist: differences of colour, size, shape and so on. These must also be accounted for even though they may have originated over a different time-scale than the shared features between modern human populations.



The Natural History Museum  
Modern human variation  
around the world.



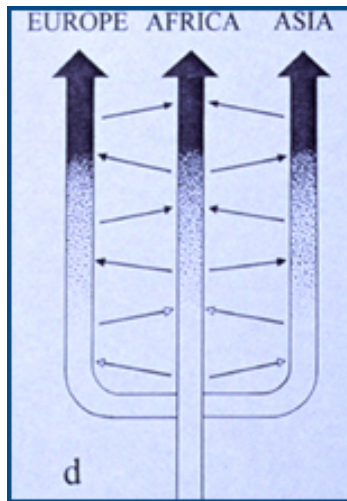
The Natural History Museum  
Skulls of, from left to right,  
a chimpanzee, *Australopithecus*,  
*Homo erectus* (top), a  
Neanderthal, *Homo sapiens*  
(bottom).

As more is learned about it, the complexity of early human evolution is revealed. It seems to have involved a radiation of distinct species and lineages over the last 5 million years, with the early part of the record restricted to Africa. At some stage, around 2 million years ago, humans left Africa for the first time and started to diversify. By this time, the species *Homo erectus* (early fossils of which some scientists refer to as *Homo ergaster*) had evolved, with examples from east Africa dating close to 1.9 million years old, and others from Dmanisi in Georgia and Java in Indonesia perhaps nearly as old. The place of origin of these widespread populations is still uncertain, although most workers assume it was somewhere in Africa. This early human dispersal (sometimes called 'Out of Africa I') was followed by evolutionary diversification over the next 1.5 million years.

Several different models have been developed to explain how Out of Africa I relates to the evolution of modern humans. For example, the Multiregional Model posits that this period really marks the beginning of global human evolution, so all subsequent fossil samples represent evolving *Homo sapiens*. There is no single place where modern humans or their features originated: for example, a modern human character may have developed in Africa and then spread from there by gene flow, or it might have originated in Europe, China or Java, and spread from there.



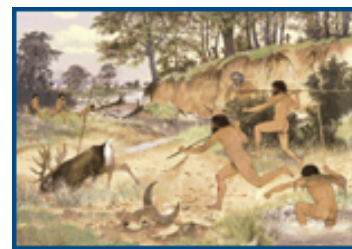
The Natural History Museum  
From left to right:  
a *Homo erectus*, a modern  
human, a Neanderthal skull.



C. Stringer modified from L. Aiello  
Detail from diagram depicting the four main hypotheses for recent human evolution.

At the other extreme is the idea that I favour, the Recent African Origin or Replacement Model (sometimes just called 'Out of Africa', or 'Out of Africa II'). This scheme posits that there was only one region, Africa, where a complete evolutionary sequence from *Homo erectus/ergaster* to modern humans developed. The evolutionary lineages that evolved outside of Africa following the first migrations out of Africa did not give rise to modern humans, but were replaced as modern humans dispersed from their African homeland during the last 100,000 years. In this model, the differences which characterise modern regional populations have only developed very recently, mostly during the last 100,000 years or less, a key distinction from the Multiregional Model. A slightly different model, developed by Günter Bräuer, argues that the evolution of modern humans was primarily African, but that there was some hybridisation with resident archaic populations (such as the Neanderthals) as modern humans dispersed outside of Africa. Fred Smith's and Erik Trinkaus's Assimilation Model argues that, while modern human genes and characters primarily derive from Africa, they spread through a more complex and longer-term process of interbreeding so genes and morphology could change locally, rather than necessarily being subject to rapid replacement.

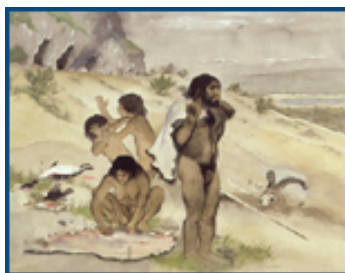
In my view there have been several dispersal events in human evolution over the last 2 million years, not just Out Of Africa I and II. A particularly significant one occurred in the Middle Pleistocene of Africa and Europe, over 600,000 years ago, with the origin and spread of those humans I classify as *Homo heidelbergensis*. I believe that this species subsequently underwent a gradual evolutionary split about 300,000 years ago, giving rise to Neanderthals, north of the Mediterranean, and to modern humans, to the south, in Africa. Meanwhile, further east, it appears that *Homo erectus* continued evolving in regions such as China and Java.



The Natural History Museum

*Homo heidelbergensis* hunting deer in Britain about 400,000 years ago.

Evidence has accumulated from the fossil and archaeological record during the last few years that Neanderthals and modern humans may have encountered each other in areas of overlap such as the Middle East (e.g. Israel) about 100,000 years ago, and Europe about 35,000 years ago. Yet in my view these lineages show scant evidence of intermixture.



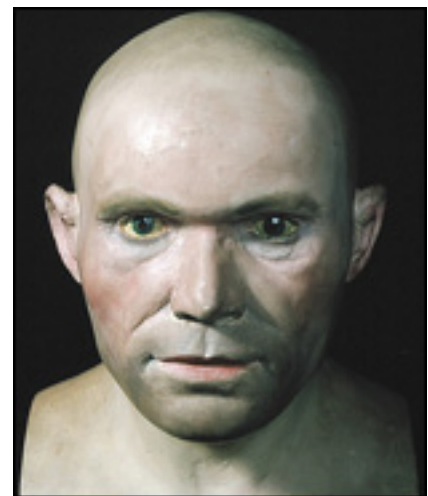
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Neanderthals living in the Gibraltar region about 50,000 years ago.

Europe has the best, most-studied and accurately dated evidence of human evolution over the last 500,000 years, but that does not mean that Europe was necessarily representative of, or central to, developments in the evolution of modern humans. Before significant evidence emerged from regions such as Africa, the Neanderthals of Europe were sometimes pushed into the position of primitive 'missing links' between apes and humans, portrayed with prehensile toes, bent knees, long arms and a stooping gait. At the other extreme was the view of the anthropologist Carleton Coon, who memorably remarked that a cleaned-up and soberly dressed Neanderthal

would hardly merit a second glance on the New York subway. I think the truth about Neanderthals is actually somewhere between these extreme views. While they were certainly not primitive sub-humans (they were actually highly evolved in aspects of their morphology and behaviour), the Neanderthals were definitely distinct from living people ( *Homo sapiens*), different enough to be regarded as a distinct species, *Homo neanderthalensis*. For me, what is especially fascinating about the Neanderthals is that they were every bit as human as we are, yet they were different. What we share with them is a measure of what it means to be fully human, what differentiates us is what it means to be a Neanderthal, or a modern human.

About 35,000 years ago, there was a remarkable juxtaposition in Europe of late Neanderthals and early modern humans (Cro-Magnons). Radiocarbon, the main method of physical dating, does not provide very accurate results during this critical period of time, but is sufficient to suggest that the two populations were broadly contemporaneous within regions, even if it cannot yet establish that they co-existed in the same valleys or even in adjoining sites. This juxtaposition is also marked by what some archaeologists see as a major technological and behavioural revolution, sometimes called 'The Human Revolution', one that occurred around the time modern humans arrived in Europe. Certainly the period of the Upper Palaeolithic was a time of much greater technological, artistic, and ritual complexity than what had come before, for example in the preponderance of specialised blade tools, and the appearance of art, symbolism and human burials accompanied by rich adornments of bone, antler, shells or mammoth ivory beads. In this context, it has been argued that a child buried over 25,000 years ago at Lagar Velho in Portugal, associated with red ochre and pendants, is a member of a mixed Neanderthal--Cro-Magnon 'hybrid' population. It has been suggested that the skeleton shows mosaic features such as a rather modern skull combined with a cold climate-adapted, robust build like that of Neanderthals. I remain sceptical of these particular claims, while awaiting detailed publication, but I do not rule out the possibility that there could have been some hybridisation between Neanderthals and modern humans, even if they *were* distinct species.



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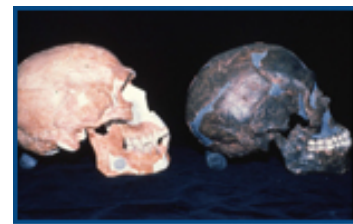
Reconstructed head of Cro-Magnon man

In my view, there is good anatomical evidence that the differences between Neanderthals and modern humans, including their approximate contemporaries the Cro-Magnons, are greater than those between modern human populations. In my work I have attempted to quantify the differences between Neanderthals and modern humans, such as the Cro-Magnons, using multivariate analyses of skull measurements to show differences in size and shape. Such analyses have indicated that despite their geological and geographic proximity, the Neanderthals are more different in cranial shape from Cro-Magnons than are much older fossils from Africa.

In addition to the anatomical evidence, mitochondrial DNA from several Neanderthal fossils has recently been sequenced. This kind of DNA is inherited only through the mother, so it allows clear

lines of ancestry to be traced. The results confirm that Neanderthals and modern humans represent deep and separate evolutionary lineages, which probably began to diverge in the Middle Pleistocene, about 500,000 years ago. This finding is independent of, but consistent with, the fossil record.

Previously, it was believed the human succession in the Middle East paralleled that of Europe, with Neanderthal fossils such as those found at the sites of Shanidar and Amud evolving into, or giving way to, early moderns such as the fossil remains from the Israeli caves of Skhul and Qafzeh, perhaps 40,000 years ago. However, the application of physical dating techniques to artefacts and fauna from the sites suggests instead an intriguing ebb and flow of Neanderthal and early-modern populations, with the latter present in Israel about 100,000 years ago, perhaps accompanied by some Neanderthals. Neanderthals were definitely present about 60,000 years ago, and then early moderns appear again from about 40,000 years.



Chris Stringer

Early modern human skulls from Skhul and Qafzeh.

I believe that the search for the origin of those very early moderns in Israel eventually leads back to Africa. The dating techniques that were applied to the Israeli fossils have also revolutionised our view of recent African evolution. Just as we may be able to track a gradual transition from *Homo heidelbergensis* to *Homo neanderthalensis* in Europe from about 300,000 years ago, African fossils such as those found at Florisbad, Ngeloba and Singa may similarly document the gradual emergence of modern humans over a comparable time period. This is not to imply that all of these fossils necessarily form a neat, single sequence of descent--human evolution was more a series of complex evolutionary radiations than an inexorable progression. But the presence of fossils with mixed features certainly suggests that neither the Neanderthal nor modern human anatomies evolved rapidly and punctationally as a complete package.



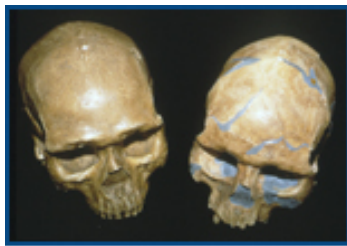
Chris Stringer

From left to right, the skulls of: Florisbad, Ngaloba, Jebel Irhoud, Omo 2 and Singa.

The African behavioural record for this time period, the Middle Stone Age, now has a time-scale as extended as that of the human fossils, and it is unfortunate that many of its rich and varied industries have no associated human fossils. Nevertheless, it is apparent that some modern human behaviours such as the production of composite tools, the systematic exploitation of marine resources, and the symbolic use of red ochre may also go back deep into the African past. Although some workers have argued that modern anatomy may have evolved before modern human behaviour, I now think that both may have emerged more gradually during the course of the Middle Stone Age. Exactly when and where the first modern humans appeared is still uncertain, although eastern Africa has suggestive evidence more than 150,000 years old.

The adaptations of Middle Stone Age humans to coastal living may also provide a clue to the routes by which early modern people first left Africa. Although an exit route via the Sinai Peninsula into western Asia has usually been favoured, it is possible that coastal routes were used to expand around the Red Sea and Arabia, into southern Asia. At times of low sea level, this could have led these early modern humans as far as Indonesia. If they had also developed watercraft to increase their foraging ranges or cross river mouths, Australia and New Guinea would then have

been within reach, and there is new evidence that this major colonisation was achieved at least 60,000 years ago. Dated artefacts had already suggested that humans were present in northern Australia at least 55,000 years ago, but in 1999 the Mungo 3 burial from southeastern Australia was redated to about 62,000 years. Such an astonishing age estimate implies that this burial of an early modern human, associated with red ochre, was not only carried out far from Europe but also long before any other comparable examples. However, recent claims that this skeleton has also produced ancient DNA, distinct from that of other humans, require very careful evaluation. Problems with contamination have been experienced in many younger skeletons excavated from Europe, and reanalysis suggests that the DNA recovered is not as distinct as has been claimed.



The Natural History Museum  
Skulls of early *Homo sapiens*  
from the Upper Cave site  
at Zhoukoudian, China.

If modern humans dispersed through southern Asia, when did they arrive in regions such as China? Unfortunately the Chinese record has a significant hiatus between late archaic fossils dated up to about 100,000 years ago, and early modern fossils reliably dated only as far back as about 30,000 years. So events here cannot be reconstructed as well as they have been in Europe and western Asia, and it is only possible to speculate about possible replacement events or hybridisation. Nevertheless various analyses have indicated that there is also a large morphological gap between the latest archaic and the earliest modern fossils in China.

Recent regional characteristics in the skeleton do not make their first appearance in China until about 10,000 years ago. This finding is in line with studies of the earliest moderns from Europe, western Asia, Africa and the Americas, and suggests that either the true ancestors of today's regional populations have not yet been identified, or that their distinctive characteristics were still evolving even 10,000 years ago. This latter view is supported by recent genetic analyses, which suggest that 'racial' features are coded by only a few genes, and could have evolved quite recently and rapidly. Despite distinctive external features such as skin colour, nose shape and eye form, modern humans are surprisingly similar in their overall genetic makeup.



Chris Stringer

From left to right: modern European skull, Cro-Magnon, Upper Cave China, modern Chinese. The older skulls exhibit differences to their local modern counterparts.

Why is it that we, *Homo sapiens*, are here and not the Neanderthals? Some researchers believe that because modern humans had superior brains, more complex language and better organisational skills than people such as the Neanderthals, they simply took over from the Neanderthals wherever they overlapped. But it is difficult to draw reliable behavioural inferences from the archaeological and palaeontological record, and we should resist denigrating the abilities of the Neanderthals and people like them, who survived in, and adapted to, a range of challenging environments in western Eurasia through the last 250,000 years. It is also evident that earlier members of the Neanderthal and modern lineages may have overlapped in western Asia about 100,000 years ago, and one could argue that, if anything, the reverse replacement occurred. Furthermore, the apparent replacement phase in Europe can now be seen to be more protracted and complex than a simple and rapid take-over by the Cro-Magnons.



The Natural History Museum  
Cro-Magnon group exhibiting  
some of the complex tools they  
made and used about 30,000  
years ago.

I believe that modern human capabilities continued to develop through the last 100,000 years, and it may not have been until the invention of Upper Palaeolithic technologies that modern humans could successfully begin to challenge the Neanderthals in their core territories. And at that very time, Ice Age climates were starting a period of severe instability, with fluctuations from relative warmth to extreme cold and back again, occurring every few thousand years. In Europe, these changes were linked with major reversals of North Atlantic ocean circulation which could freeze or thaw the Atlantic in less than a decade. So in the lifetime of a Neanderthal or Cro-Magnon individual, all the climates, plants and animals with which they were familiar could have been swept away and replaced by a different suite of weather conditions and species. In previous times, the European Neanderthals probably responded by going extinct locally, surviving in refugia (such as southern France, or the Mediterranean coast), and recovering their range and numbers when the climate improved. However, about 35,000 years ago, new people accompanied them for perhaps the first time, and during these highly stressful climatic fluctuations, the populations best able to cope with rapid change would have been favoured. If the Cro-Magnons had advantages such as larger social networks and more effective clothing and dwellings, these factors could eventually have led to their success at the Neanderthals' expense. In my opinion there was nothing inevitable about the success of modern humans, or the extinction of the Neanderthals, and a different combination of circumstances could have produced a completely different outcome. Indeed, if we are prepared to grant the Neanderthals the same evolutionary potential as modern humans, I might now be a Neanderthal instead, writing articles to explain to an audience of Neanderthals why 'we' are still here, and what happened to those strange-looking people who used to live in Africa!

There are still many shadows hanging over debates about the origin of modern humans. These shadows can be seen in the writing of some anthropologists of the past, for example in Coon's unfortunate comparison of what he called the 'Alpha' and 'Omega' of living humans in his book *The Origin of Races*. All the proponents of the current models of modern human origins would certainly unite in condemning such a portrayal, and yet I find myself having to acknowledge that the Recent African Origin Model I helped to develop is being used to support the idea that present-day 'races' can be arranged in a hierarchy of evolutionary advancement. This places 'Blacks' as the most primitive, 'Whites' in between, and 'Orientals' as the most evolved. In my view this misuse of science should not make us shy away from investigating the differences between modern human populations, and how they evolved--indeed, if mainstream workers do not take up the challenge of this research, the field could be left to those with extreme political agendas. From my perspective, Africa was our genetic, physical and behavioural homeland, and Africa today may well contain as much genetic diversity as the rest of the world put together. I hope that the coming century will see research in modern human origins build on the tremendous advances of the last 20 years to further confirm that all of us are indeed 'Africans under the skin'.



## **Books:**

Title: African Exodus : The Origins of Modern Humanity  
Format: Paperback  
Author: Stringer, Christopher; McKie, Robin  
Date: 01-JUN-98  
ISBN: 0805058141

Title: In Search of the Neanderthals : Solving the Puzzle of Human Origins  
Format: Paperback  
Author: Stringer, Christopher; Gamble, Clive  
Date: 01-APR-95  
ISBN: 0500278075

Title: Human Evolution  
Format: Paperback  
Author: Andrews, Peter/ Stringer, Chris/ Wilson, Maurice  
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