

# **FLEXIBILITY AND BLIND LUCK**

## **MASTERING THE TOOLS OF EVOLUTION**

**By Rod Matthews**

In order to understand humans in the 21st century we must understand our past – where we have come from, our biological evolution, cultural development, major historical forces and pure chance. All these factors have had a role in shaping who we are now, and all will continue to be important in shaping where we go next.

This article asks how important flexibility and change are; why humans have survived but the Neanderthals did not. The answer lies partly in the ‘Out of Africa’ theory, as we explore biological and environmental factors that may have conditioned our evolution and set the genetic potential for our current cultures and lifestyles.

### **Homo sapiens vs Homo neanderthalensis**

As recently as 50,000 years ago there were up to four different types of humans living at the same time:

- Homo sapiens (human beings)
- Homo neanderthalensis
- Homo floresiensis (the Hobbit)
- perhaps even Homo sapiens Idaltu

When humans moved into the Middle East, Homo erectus became extinct, and when they move into Europe, the Neanderthals became extinct. It is hard to believe that this would be an evolutionary coincidence. So what was it that allowed human beings to be the success story they are, and not any one of the other three that were in existence around 50,000 years ago? Why us and not the Neanderthals?

To answer this, let’s look at what we shared with the Neanderthals and what was exclusive to human beings.

*What we shared with the Neanderthals*

- **DNA:** Svante Paabo from the Max Planck Institute<sup>i</sup> has completed a draft DNA of Neanderthals that suggests our common ancestors date back to 300,000–500,000 years ago.
- **Tools:** Evidence shows that prior to about 70,000 years ago, we shared the ability to make simple tools with the Neanderthals. Examples include hand axes and stabbing spears.
- **Language:** Ralph Holloway of Colombia University<sup>ii</sup> uses endocasts, or casts taken from the inside of a skull, to determine the abilities of the brain. Casts of the inside of Neanderthal skulls that show the shape and structure of their brains suggest that the frontal lobe and parts of the brain responsible for speech are almost exactly the same as in human beings. This suggests that Neanderthals probably had language as well.
- **Caring:** Burial sites and evidence of healed fractures suggest that Neanderthals also showed empathy for those in their group.
- **Culture:** The existence of Neanderthal burial sites also suggests a level of cognition and culture.

*What was different?*

- **Physiology:** CT scans of Neanderthal teeth suggest a shorter childhood than ours and therefore less time to learn before being expected to be a mature contributor to the tribe. Ralph Holloway's endocasts suggest that the raised dome of our brain allows for a more developed parietal and temporal lobe and therefore a more complex language, greater ability to store and recall memory, better overall cognition, and an increased ability to work with spatial locations than the Neanderthal. In an existence that relies heavily on locating food sources, these differences are critical.
- **Tools:** John Shea of Stony Brook University<sup>iii</sup> suggests that Neanderthal tools were too big to be projectile tools. Combine this with the finding that Neanderthal remains show a high number of bone fractures consistent with those of rodeo cowboys and we might assume that Neanderthals were pack hunters who would kill their prey in close combat. There is also no evidence of tool evolution among the Neanderthals. Their tools remain constant across their geography and through the millennia. Meanwhile there is evidence to show that about 70,000 years ago our tools evolved considerably. They became finer and more complex. Human beings were heating rocks to reduce

the size of the flakes, and throwing lighter and more durable spears, while Neanderthals were more likely to break or lose their spears in close combat. This difference would have allowed human beings to hunt a broader range of animals with more safety, and to achieve a better hit rate.

- **Diet:** Human beings stayed in Africa and were pushed to the edge of extinction by significant and regular climate change. Evidence of this climate change can be found in the geological record. Human beings retreated to the outer edges of Africa as it became increasingly difficult to find food. Researchers believe that numbers of breeding individuals were as low as 600–6000. It was during this time that the first evidence of human beings finding food from the ocean appears. The increase in diversity of diet could be an important part of the reasons why human beings succeeded where Neanderthals failed. Michael Richards of the Max Planck Institute<sup>iv</sup> analysed the chemical signature of the food remaining in the bones of the Neanderthals. His work shows that no matter where the Neanderthals lived, their diet was almost exclusively meat; there was very little plant and no marine food eaten. This diet would have required the Neanderthals to consume around 5000 calories a day from a narrow food source (usually large herbivores), and finding this amount of food would have been a significant burden on the lifestyles of the Neanderthals.
- **Culture:** The broadened diet of human beings would have meant that they spent less time worrying about their next meal. This extra time in their day, combined with their ability to trade, could have led to an increase in their ingenuity which in turn led to the evolution of their tools and culture. Around 70,000 years ago, about the same time as human beings' tools were evolving, we also see evidence of the use of red ocher, shells with holes (probably for jewellery), and trading between groups. Celeste Biever, in an article in *New Scientist* magazine,<sup>v</sup> explains the work of a group of US and Dutch economists that suggests that Neanderthals did not trade, while human beings did. This led to the swapping and improving of ideas which could have been instrumental in our evolutionary leap. This theory is also explained in Matt Ridley's *The Rational Optimist*.<sup>vi</sup>

## Climate change

A key period in our development – one that allowed us to be the last humans standing – is the period between 140,000 and 60,000 years ago. Staying in Africa during that period meant that human beings had to learn to live through climate change, and while this seems to have had a devastating effect on the population, in true evolutionary fashion those who survived

flourished. Climate change forced us to learn to change our diet, our tools and our culture – in order to survive we learned to trade and share ideas with human beings outside of our tribe. Systems theory tells us that the most flexible part of any system controls the system, and it seems that we left Africa as the most flexible beast on the planet.

As we entered the Middle East, *Homo erectus* disappeared, and as we entered Europe the Neanderthals disappeared as well. It is suggested that they were simply unable to compete with the *Homo sapiens*, whose evolutionary experience left them a little more flexible in the environment than their competitors.

Daniel Lieberman of Harvard University<sup>vii</sup> suggests that human beings were prolific at producing offspring and, armed with advanced tools, culture and diet, were therefore better equipped to keep them alive. Our population exploded in Europe as numbers of Neanderthals were diminishing.

At around 28,000 years ago there was only one species left – human beings. Human beings covered the globe and since then have gone on to evolve considerably. Man has walked on the moon and we have perhaps even established our own geological era – the Anthropocene. We have done this by evolving through struggle. It was, perhaps, on the precipice of our own extinction that we gained an increased flexibility and the tools of trial and error, refinement, replication, storing and the passing on of information, or the tools of evolution itself.

So far so good ...

## **Out of Africa**

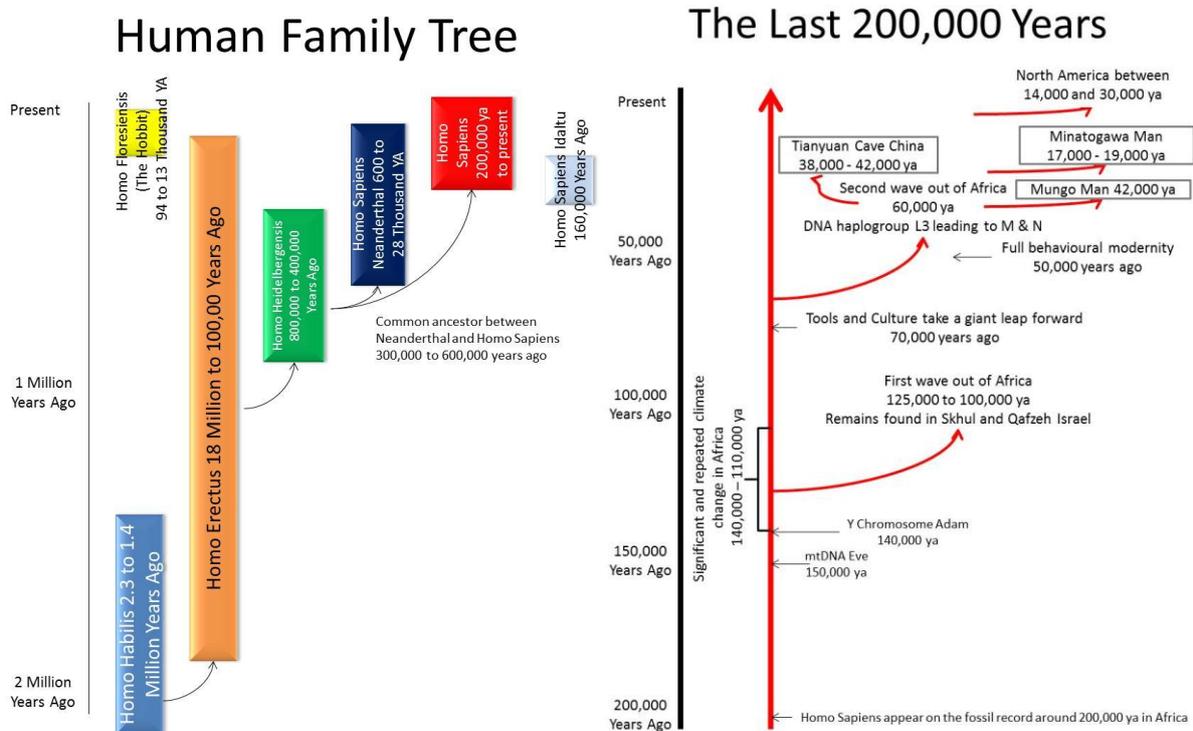
Evidence of skeletal remains throughout Africa, the Middle East, Asia and Europe suggest that there were probably a number of movements out of Africa; however, the one of most interest to us is that of modern human beings around 60,000 years ago.

At that time we were coming out of a period of significant and regular climate change in Africa. As a result, the breeding population could have been as low as 600–6000 couples, dispersed around the outside edge of Africa. Mitochondrial DNA (mtDNA) studies<sup>viii</sup> suggest that one group of humans managed to cross the Red Sea from Africa and into the Middle East.

The combination of low breeding numbers and having to cross the Red Sea created a bottleneck that has resulted in a human population with far less genetic diversity than that of the chimpanzee.

Between 60,000 and 50,000 years ago, evidence of populations moving across Asia and creeping into Europe started to appear. Forty-two thousand years ago, Mungo Man appeared in Australia, and at 17,000–19,000 years ago, Minatogawa Man appeared in Japan. There is dispute as to exactly when human beings first populated the Americas, but current debate places their arrival between 30,000 and 14,000 years ago. Movement would have been slow – probably one kilometre per season – as tribes followed food sources.

The following two diagrams<sup>ix</sup> go some way towards documenting and summarising our survival.



<sup>i</sup> Paabo, Svante, in *Becoming Human – Episode 3: Last Human Standing* (2009), Documentary produced by Shining Red Productions for NOVA, WGBH Educational Foundation

<sup>ii</sup> Holloway, Ralph, *ibid.*

<sup>iii</sup> Shea, John, *ibid.*

<sup>iv</sup> Richards, Michael, *ibid.*

<sup>v</sup> Biever, Celeste (2005), *Free trade may have finished off Neanderthals*,

<http://www.newscientist.com/article/dn7221-free-trade-may-have-finished-off-neanderthals.html> (last updated 1 April 2005)

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<sup>vi</sup> Ridley, Matt (2010), *The Rational Optimist – How Prosperity Evolves*, Fourth Estate, UK

<sup>vii</sup> Lieberman, Daniel, in *Becoming Human – Episode 3: Last Human Standing* (2009), Documentary produced by Shining Red Productions for NOVA, WGBH Educational Foundation

<sup>viii</sup> *The Incredible Human Journey – Episode 1: Out of Africa* (2009), Documentary produced by the BBC

<sup>ix</sup> Matthews, Rod (2012), diagrams created for The Integrated Human Studies Program, University of Western Australia

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