

Book Review: Who we are and how we got here p ancient DNA and the new science of the human past By David Reich

This is a book about the amazing discoveries that have been made about human migrations by analyzing the spread of mutation in the DNA of long-dead humans. The insight is simple. Mutations appear in the germ cells of individual people. If they are beneficial or benign, they tend to get passed down to that person's descendants. If the mutation in question is found the DNA of people who existed many generations later, they can assume to be descendants of the original population. And vice-versa.

## The Human Genome – our ancestors

A person's two parents had twice as much DNA as does that person; four grandparents, four times as much. We are distillations. Some ancestral DNA gets left out in every generation.

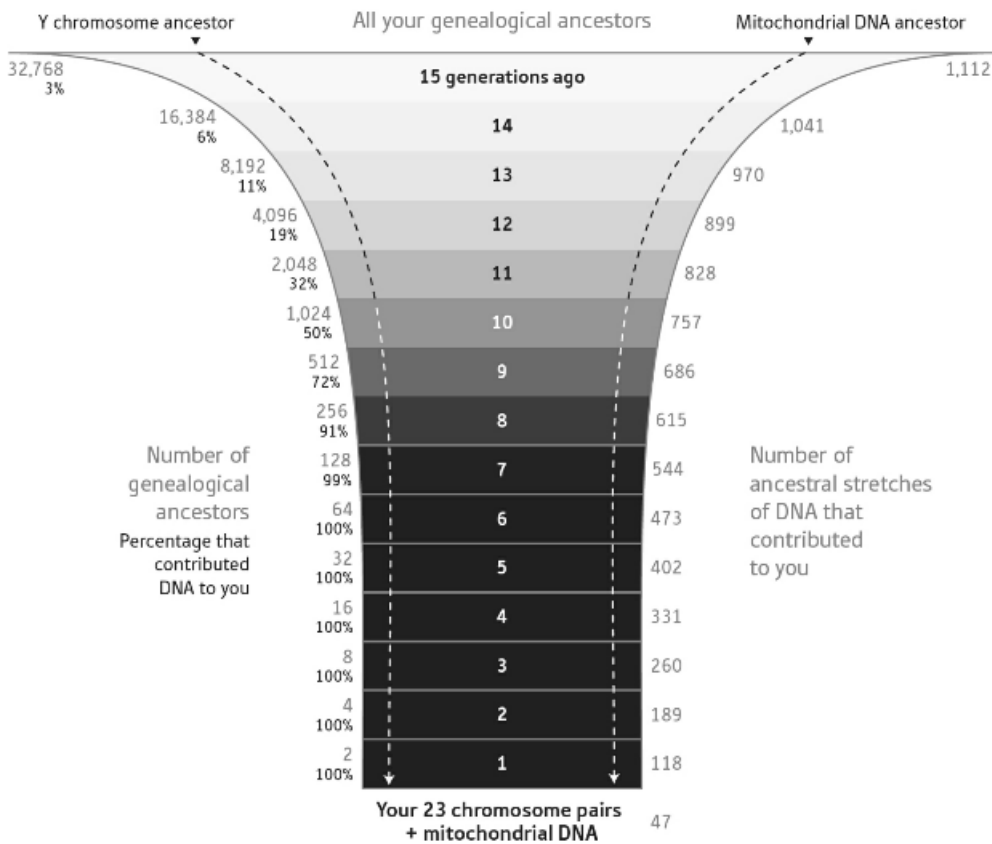
Forty-six of the mosaic tiles, as it were, are chromosomes—long stretches of DNA that are physically separated in the cell. A genome consists of twenty-three chromosomes, and because a person carries two genomes, one from each parent, the total number is forty-six. But the chromosomes themselves are mosaics of even smaller tiles. For example, the first third of a chromosome a woman passes down to her egg might come from her father and the last two-thirds from her mother, the result of a splicing together of her father's and mother's copies of that chromosome in her ovaries. Females create an average of about forty-five new splices when producing eggs, while males create about twenty-six splices when producing sperm, for a total of about seventy-one new splices per generation.

So it is that as we trace each generation back further into the past, a person's genome is derived from an ever-increasing number of spliced-together ancestral fragments. This means that our genomes hold within them a multitude of ancestors. Any person's genome is derived from stretches of DNA corresponding to the chromosomes transmitted by mother and father plus mitochondrial DNA. One generation back, a person's genome is derived from about 118 (47 plus 71) stretches of DNA transmitted by his or her parents. Two generations back, the number of ancestral stretches of DNA grows to around 189 (47 plus 71 plus another 71) transmitted by four grandparents. Look even further back in time, and the additional increase in ancestral stretches of DNA every generation is rapidly overtaken by the doubling of ancestors. Ten generations back, for example, the number of ancestral stretches of DNA is around 757 but the number of ancestors is 1,024, guaranteeing that each person has several hundred ancestors from whom he or she has received no DNA whatsoever.

Twenty generations in the past, the number of ancestors is almost a thousand times greater than the number of ancestral stretches of DNA in a person's genome, so it is a certainty that each person has not inherited any DNA from the great majority of his or her actual ancestors. These calculations mean that a person's genealogy, as reconstructed from historical records, is not the same as his or her genetic inheritance.

### The Far Richer Story Told by the Whole Genome

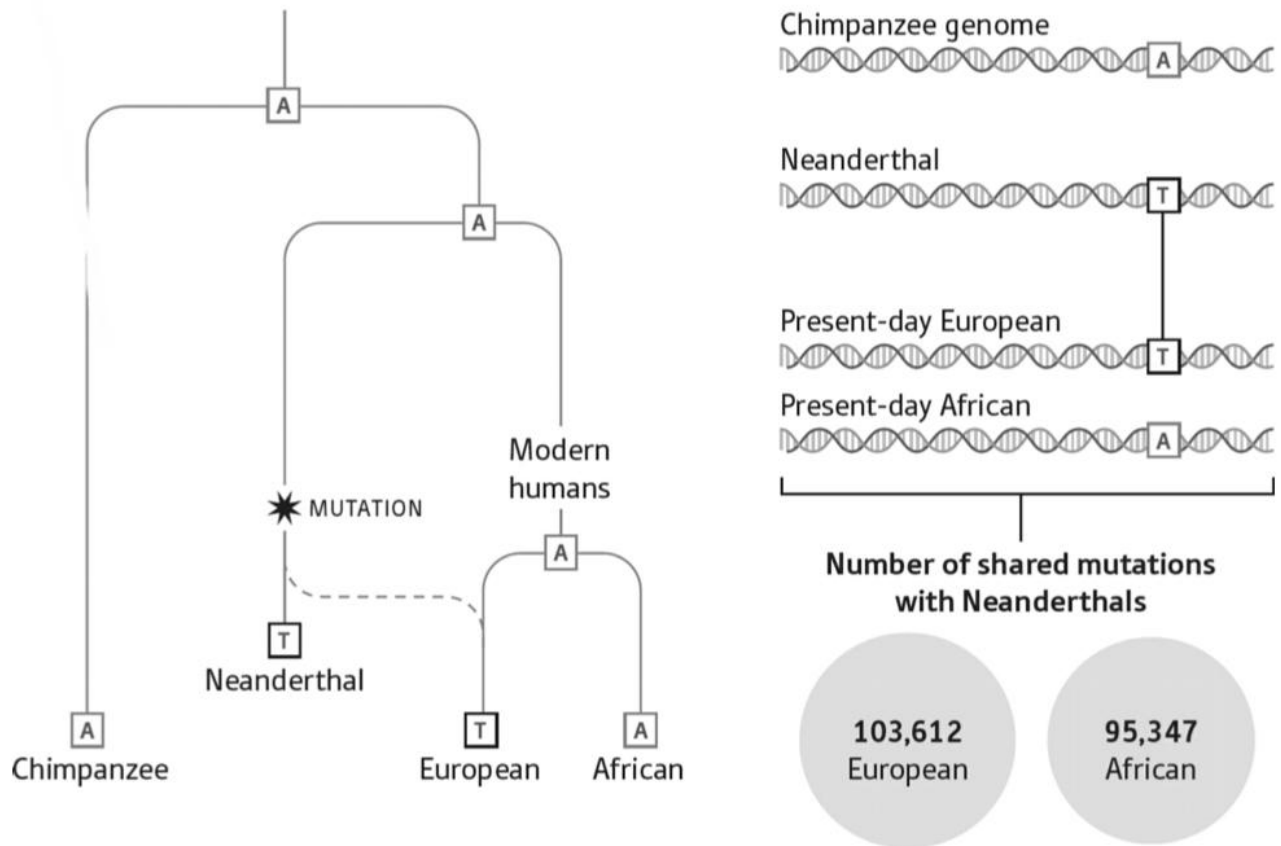
Y chromosomes and mitochondrial DNA reflect information only from the entirely male or entirely female lineages (dashed lines). The whole genome carries information about tens of thousands of others.



### Using mutations to trace population movements

European populations carry some mutations that appeared in Neanderthals after their split from the ancestors of Homo Sapiens. African populations do not. From this, scientists conclude that the European branch of Homo Sapiens interbred with Neanderthals when those populations came in contact about 50,000 years ago as Homo Sapiens reentered Europe via the Middle East. Neanderthal populations disappeared within a few thousand years, leading to the conclusion that Homo Sapiens outcompeted them.

## The Four Population Test



We can evaluate whether two populations are consistent with descending from a common ancestral population through the “Four Population Test.” For example, consider a mutation that occurred in the ancestors of the Neanderthal (letter T, above) that is not seen in chimpanzee DNA. There are about 9 percent more of these mutations shared with Europeans than with African genomes, reflecting a history of Neanderthal interbreeding into the ancestors of Europeans.

Though Neanderthal remains are relatively common, the first having been identified in 1856. They were recognized as a separate species on the basis of their overall appearance: stockier and hairier than Homo Sapiens, crafting slightly different sorts of tools using different techniques. Good DNA samples are not as easy to find. The best preserved appears to be a 40,000-year-old toe

About 2010 Russian scientists found a toe and pinkie finger in Siberia. Able by that time to perform DNA tests, they determined these were not from Neanderthals. The newly discovered population is called Denisovans, after the hermit monk who had lived in the cave where the discovery was made.

The best-preserved DNA in the Middle East appears to be from the dense petrous bone housing the inner ear, which for some reason have been found to be the best source of DNA.

Much of this book is about what the distribution of Neanderthal and Denisovan DNA tells us about the migrations and interbreeding of populations of modern men outside of Africa, from the Pacific islands and the Americas clear around to Western Europe – and then wrapping back to America with the conquistadors.

## Scientific Techniques

The DNA purifying process is genius. The DNA samples the bones themselves get fossilized overtime, so there may be only a fragment small fraction of the original organic material left in a fossil partially fossilized sample. There is chemical damage. Bacteria invade the dead organism, so there may be far more bacterial DNA than human DNA. Samples can get contaminated by the people who handle them from the time they are discovered until they are researched. On the book does a great job of describing all of the techniques used to isolate the DNA that they're interested in from the many sources of contamination, things other than the target DNA.

Massive computer power is another factor. Although the term maximum likelihood estimation does not appear in the book, it is a technique of statistically analyzing a huge number of samples and looking for the most likely combinations to explain the observations. The analysis described in this book could not have been done without the huge amounts of computer power that have become available to researchers and they for statistical analysis within last two decades.

## Not a One-Way Path

One of the book's primary themes is that evolution and migration were never a one-way path. "Out of Africa" is a far too simple story. Our story is not one of branching, like a tree, but one of weaving in and out, separating and recombining. When the separation has been long, as in the case of the Neanderthals and humans, the recombination can be difficult. Hybrids can be sterile. Mules, a donkey-horse hybrid, cannot breed. In particular, male offspring tend to be sterile. They carry only one X-chromosome, large segments of which appear to be systematically deleted during reproduction.

Infertile male offspring may account for the fact that Neanderthal DNA represents on average less than 2% of the European genome, down from 3%-6% found in DNA closer to the time of their interbreeding. The X-chromosome, which carries the genes associated with male infertility, has less of the Neanderthal than others. However, when the population separation has been within the more recent past, as is the case with the races of Homo Sapiens, interbreeding is generally successful.

## Evolution and Ethics

Reich is Jewish. The Jewish people have been endogamous throughout their long history. One outcome is that they are subject to a number of genetic diseases such as Tay-Sachs, which appear when a deleterious recessive gene appears in the gametes of both partners. African populations are similarly affected by sickle cell disease. Inbreeding is a two-edged sword, accentuating certain positive features, such as high intelligence in Jews and Indian Parsis, at the same time it elevates such risks.

Reich has difficulty dealing with a second aspect of human mutations. They not only serve as markers for human migrations and mergers, but as the cornerstone of evolution. Reich rails against inequality, but that is precisely what evolution is about. Survival of the fittest. He would surely recognize and probably acknowledge this quote of a century ago by Arthur Keith:

“Sir Charles Sherrington summed it up in an epigram: Nature represents in the case of man a revulsion of the product against the process.” Keith explains that “Here product stands for modern or evolved man; the process for the means used by Nature in his creation.”

Reich fancies himself more refined than the evolutionary process that put Jews like him at the pinnacle of intellectual ability. While he says that the positions of the Harvard liberals Richard Lewontin and Ashley Montagu (nee Israel Ehrenberg), holding that race is meaningless and there are no significant differences among different human populations are no longer tenable, he nonetheless chooses to attack Nicholas Wade whose books matter-of-factly describe the differences.

Curiously, Reich includes the following passage about James Watson, discoverer of DNA:

It was ironic, then, that Watson was forced to retire as head of Cold Spring Harbor after being quoted in an interview with the British Sunday Times newspaper as having said that he was “inherently gloomy about the prospect of Africa,” adding that “[all] our social policies are based on the fact that their intelligence is the same as ours—whereas all the testing says not really.”(No genetic evidence for this claim exists.)

When I saw Watson at Cold Spring Harbor, he leaned over and whispered to me and to the geneticist Beth Shapiro, who was sitting next to me, something to the effect of “When are you guys going to figure out why it is that you Jews are so much smarter than everyone else?” He then said that Jews and Indian Brahmins were both high achievers because of genetic advantages conferred by thousands of years of natural selection to be scholars. He went on to whisper that Indians in his experience were also servile, much like he thought they had been under British colonialism, and he speculated that this trait had come about because of selection

under the caste system. He also talked about how East Asian students tended to be conformist, because of selection for conformity in ancient Chinese society.

Reich is ironic in two ways. First, that he chose this device to present widely shared stereotypes of Indians, Chinese and Jews, and secondly that elsewhere in his book he contradicts the bit about genetic evidence in parentheses at the end of the first paragraph. Yes, many people, Chinese at the forefront, have done genome-wide research identifying the vast number of genes that collectively contribute to high intelligence. Genetic analysis reconfirms the ranking of peoples that has been well measured and reported for more than a century. Ashkenazi Jews like Reich at the top, followed by East Asians, followed by Europeans, followed by everybody else, in a succession that everybody knows, and knows well enough to shut up about... except for Watson and Wade.

Reich would do well to acknowledge that Jewish politics reflect their contemporary evolutionary interests. Jews in Israel and France have to recognize the reality of the threat posed by Muslim populations. Hence Netanyahu's popularity. On the other hand, Jews in the United States, such as Reich himself, have found it evolutionarily advantageous to promote equality. They found and fund groups such as the National Association for the Advancement of Colored People, Planned Parenthood, and the Southern Poverty Law Center that tend to weaken the dominant Gentile majority. High-mindedness can be self-serving.

## Expansion of Cultures

Cultures expand either by adoption or by genetic displacement. Humanity has experienced both. It appears that from its origin in the Fertile Crescent about 9,000 years ago, agriculture spread to India and Europe by cultural adoption. As it went both east and west from the Fertile Crescent area. The ancient Middle East. Reich characterizes populations as farmers, pastoralists and hunter-gatherers, saying that the latter two learned from the farmers.

People took a long time to penetrate the vast steppes that stretch from Ukraine to China. Water and forage can be scarce and easily exhausted. Open spaces are hard to defend. Flocks might survive on the better watered and protected edges of the great plains, but herders on foot could not otherwise manage their animals.

Horses, first herded for meat, came to be ridden, making it possible to manage larger herds. The next innovation was wheeled wagons, whereby the herders could move along with their livestock to find fresh water and forage.

Livestock are mobile – easy to steal. The mounted steppe herders became formidable warriors, both in defense of their own herds and in attacking others. About 5,000 years ago the steppe horsemen led

another expansion. This time, however, it was by replacement. The Maykop, Yamnaya and Corded Ware people spread westward, leaving their genetic markers in the DNA researchers have found along their routes. See *The Horse Wheel and Language* for a more concentrated, though earlier, account of the same dispersion. At any rate, my German and my wife's Ukrainian ancestors certainly carry a significant amount of DNA from the steppe horsemen.

## The future of Genetic Science

*Genes, Peoples and Languages*, the foundational book from the year 2000, by the dean of genetics researchers, Reich's mentor Luigi Cavalli-Sforza, got off to an amazingly good start given that the author had not much more powerful to trace than blood types.

Reich, in turn, has his own many disciples. There is broad diversity of their national origins as a testimony to the widespread distribution of intelligence and curiosity in modern humankind. He works with people from every subcontinent except every continent except Antarctica.

## Culture

Like cultural practices, languages can spread either by contact or by the spread of the genome. Reich has a lot to say about the correlation between the spread of genomes and languages. In some places such as the Americas, where the modern humans arrived only 15 or 20,000 years ago, genetic and linguistic evolution seem to parallel one another fairly well. In the old world the correlations are much murkier, as populations continually intertwined and migrated over the course of time.

Cultural changes are evidenced by artifacts. One of the most significant ones was the advent of narrow bladed chipped stone tools, with the Upper Paleolithic Age. The researchers correlate the spread of the genes with the spread of the material culture that they find. For instance, there is some evidence that the Neanderthals wore clothes while our ancestors remained naked in warmer Africa.

More recent material culture changes included the wheel, which appears to have come from the steppes of Central Asia, and the use of the horse, which came from the eastern step area. These two combined, as written in *The Horse the Wheel and Language*, resulted in a massive cultural shift and the domination of the steppe people of eastern Europe, displacing on earlier populations throughout most of Europe.

## Clines and the spread of genes

Clines can be abrupt or gradual. The genetic cline dividing Western Europe from the Middle East is rather gradual. Likewise, the cline of genetic composition changes gradually throughout the on East Asian region.

However, where they meet, the genetic line separating East Asians from Western Eurasians is rather abrupt. Populations in western China, Mongolia, and in India show more genetic variety than those in the on opposite ends of the Eurasian continent.

## Out of Africa?

One of the surprises in the book is the invalidation of the out of Africa theory. The ancestors of Homo Sapiens evolved to a large extent in Europe, where the Neanderthals in the Denisovans remained. What apparently happened was a fairly recent migration out of Eurasia back into Africa, which became the place where Homo sapiens emerged maybe 200,000 years ago.

Therefore, assumptions we have about modern humanity that we evolved in a warm climate are true only of our recent history. Europeans' skin tone, lighter hair and blue eyes are recently evolved characteristics. Australian natives and those of the Andaman Islands, an isolated population off the coast of India, appear to retain more African features.

Reich writes that the small Andaman island chain off the coast of India was distant enough to be out of contact for most of the past 50,000 years. Their genotype, combined with that of the Indo-European steppe people from the north and the Dravidian farmers from the west, make up the major portion of the genome of modern Indian populations.

Most of the north of the American Indian genome is from a major migration about 15,000 years ago. However, not all of it. The Na Dene people of Northwestern North America appear to be descended in large part from a separate migration. And more than that, there are there is a trace of genetic contribution from a ghost population from which no artifacts or DNA has been separately recovered.

Brazilian Indians share some on genetic traits with the peoples of on New Guinea and Australia. The authors do not have any explanation. The Kon Tiki theory of the 1950s would not hold because the Polynesians would be more recent. It simply remains to be remains an open question.

There are many ghost populations in Reich's account - peoples who left no DNA that can be discovered, but whose DNA can be identified by a statistical analysis of more recent DNA. The only explanation of its presence is a source population that existed earlier.

## Conclusion

As Reich writes, this book is so state-of-the-art that it is bound to have been somewhat overtaken by events by the time you read it. Reich hopes that a knowledge of our evolutionary will encourage humility. We need to recognize that we are all mongrels, products of recent migrations and interbreeding. While group differences are real, notions of superiority must be fleeting. The dominant populations of every past epoch have merged, been displaced, and gone extinct. We have to recognize and accept human differences as they are.