A handful of Bronze-Age men could have fathered two thirds of Europeans

May 21 2015, by Daniel Zadik

Dads in Paris. Credit: David McSpadden/Flickr, CC BY-SA

For such a large and culturally diverse place, Europe has surprisingly little genetic variety. Learning how and when the modern gene-pool came together has been a long journey. But thanks to new technological advances a picture is slowly coming together of repeated colonisation by

peoples from the east with more efficient lifestyles.

In a new study, we have added a piece to the puzzle: the Y chromosomes of the majority of European men can be traced back to just three individuals living between 3,500 and 7,300 years ago. How their lineages came to dominate Europe makes for interesting speculation. One possibility could be that their DNA rode across Europe on a wave of new culture brought by nomadic people from the Steppe known as the Yamnaya.

Stone Age Europe

The first-known people to enter Europe were the Neanderthals – and though they have left some genetic legacy, it is later waves who account for the majority of modern European ancestry. The first "anatomically modern humans" arrived in the continent around 40,000 years ago. These were the Palaeolithic hunter-gatherers sometimes called the Cro-Magnons. They populated Europe quite sparsely and lived a lifestyle not very different from that of the Neanderthals they replaced.

Then something revolutionary happened in the Middle East – farming, which allowed for enormous population growth. We know that from around 8,000 years ago a wave of farming and population growth exploded into both Europe and South Asia. But what has been much less clear is the mechanism of this spread. How much was due to the children of the farmers moving into new territories and how much was due to the neighbouring hunter-gathers adopting this new way of life?

In recent years, new technologies, including the ability to read the sequences of DNA in ancient bones, have shed much light on such questions. Researchers have found evidence in the DNA of modern Europeans for ancestry from both groups, as well as from a third fascinating people known as the Yamnaya.

An 1899 painting by Viktor Vasnetsov imagining a kurgan burial rite. Credit: wikimedia

The Yamnaya were nomadic herders from the steppe in what is now Ukraine and Russia. Archaeological evidence shows that they swept into Europe around 4,500 years ago, bringing with them horses, wheels, their famous "kurgan" burial mounds and quite possibly Proto-Indo-European, the ancestral tongue of most European, as well as many South Asian languages. Just like farming before it, their package of resources, technologies and behaviours gave them an advantage over the pre-existing Europeans and they seem to have left a substantial genetic legacy across Europe.

Now, by looking at the variability between the Y chromosomes of 334 modern European and Middle-Eastern men, my colleagues and I have discovered another interesting pattern.

Y chromosomes are pieces of DNA that are very useful when studying populations. Every male has a Y chromosome, inherited from his father. Unlike most DNA, the Y chromosome is not shuffled as it is passed down, so change happens only slowly through mutation. Tracking these mutations allows scientists to create a family tree of fathers and sons going back through time. Each man may have several sons, or none – and while some branches die out each generation, others become more common and go on to produce many more branches themselves.

Genetic revelation

The new technology of "Next-Generation Sequencing" allowed us to identify many mutations and to make a more accurate and detailed tree than ever before. Figure 1 shows such a tree generated using our European samples.

Two-thirds of modern European men are found on just three branches (called I1, R1a and R1b). Our results show that these branches each trace their paternal ancestry to a surprisingly recent individual (shown as red dots in Figure 1). By counting the number of mutations that have accumulated within each branch over the generations, we estimate that these three men lived at different times between 3,500 and 7,300 years ago. The lineages of each seem to have exploded in the centuries following their lifetimes, to dominate Europe.

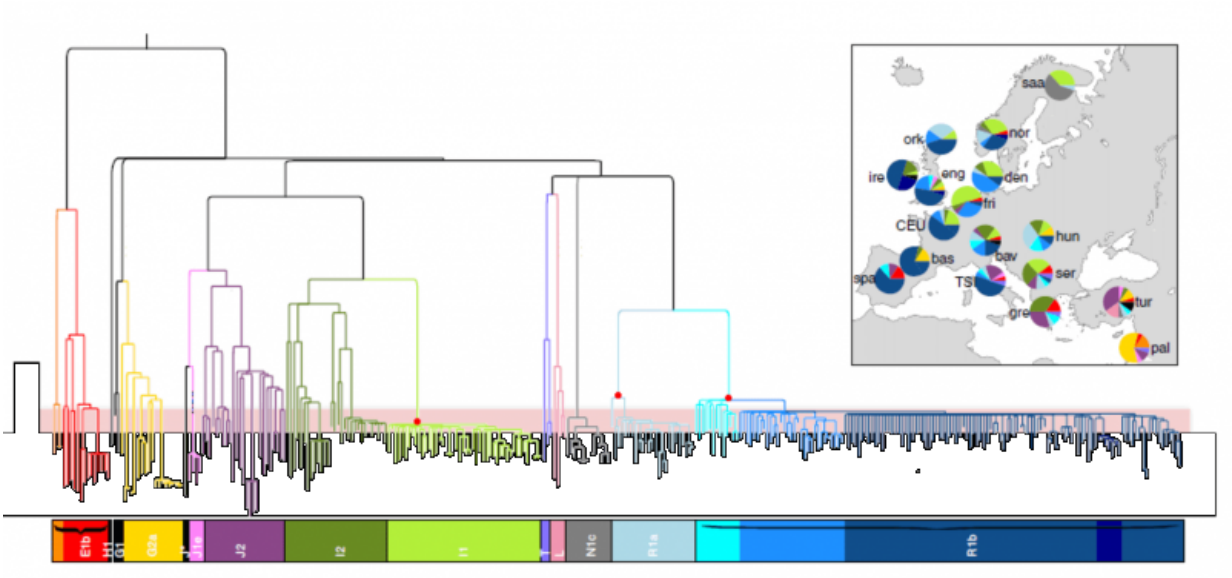

Figure 1: the Y chromosomal tree generated from our European samples, with their most recent shared ancestor at the top. Different major branches are displayed in different colours. Credit: Nature Communications

Similarly, a maternal tree can be generated by looking at mitochondrial DNA, which is passed down solely from mothers to their children. However, when looking at this maternal tree, there is no similar explosion. This indicates that whatever factors were responsible for this pattern were specific to men. As the Y chromosome itself contains few genes that could give one man an evolutionary advantage over another, the explanations for this must be a mixture of chance and the cultural factors passed down alongside the genes.

It has previously been proposed that these very branches became established across Europe during the spread of the Yamnaya legacy. One might speculate that, if a male elite was established with the advantages of Yamnaya culture, along with a paternal ancestry from a very few Yamnaya and/or European Y lineages, they could have monopolised

women and had children with a large number of partners. Over many generations, this could lead to those lineages becoming extremely widespread. In fact, similar inferences have previously been made for the situation when Neolithic farmers first arrived.

Then, between 2,100 and 4,200 years ago, in the Bronze Age, something else interesting started to happen. Our tree suddenly splits into many smaller branches (within the pink bar across Figure 1), meaning that the number of men reproducing was on the rise. It's important not to fall into the trap of over-interpreting data but it is interesting to speculate as to what this might mean. Could it represent a return to a system of relatively monogamous relationships? Could it be that as the Yamnaya cultural package had become so widespread that it no longer gave anyone an advantage over anyone else?

For the moment such questions remain to be answered, but as each new study adds new evidence and the technology continues to improve, our picture becomes more complete and more fascinating.

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