THE FIRST FRUITS OF DNA-RESEARCH

A NEW WINDOW ON ANTIQUITY

For centuries, our knowledge of Antiquity was based on three types of evidence: ancient texts, studied by philologists; ancient artifacts, which are the archaeologists' domain; and comparison with other preindustrial societies, studied by anthropologists. Over the past thirty years, a fourth approach has come into being: the study of DNA.

By Boed Marres

If you want to understand the recent past, you can check archives and visit old buildings. Digging deeper into the past and reaching the Middle Ages and Antiquity, you still have written sources – the Latin and Greek authors, cuneiform and hieroglyphic texts – and you can use many types of archaeological finds. When you reach Prehistory, however, there are by definition no texts. Archaeology is your only source of information.

Until recently, physical anthropologists studying ancient human remains could determine gender, establish the age at death, recognize diseases and characteristics acquired during life, and might occasionally discover the cause of death. With DNA testing, however, there is much more to discover. To offer a not exhaustive list: we now start to recognize the possible geographic origin of some people, their predisposition to certain diseases, and the color of their skin, eye, and hair. We can also describe their mutual relationships and even establish kinship with skeletal remains found elsewhere, which helps to document migrations. A new window on Prehistory and Antiquity has been opened.

Research

Current research has several directions. To start with, scientists are investigating a chromosome called Y, which is only passed from father to son. On average, there is about one mutation per two generations. These mutations rarely have physiological significance, but are important markers. Thousands of these have been identified and can be used to establish a giant family tree, which reaches back for thousands of years.

Secondly, other chromosomes than Y are studied for medical, forensic, genealogical, and anthropological research. Finally, scientists are interested in the DNA from the mitochondria, which a mother passes on to sons and daughters. This allows us to reconstruct a second family tree, documenting our descent along matrilineal lines.

DNA research is used in many sciences: in medicine for example, to identify hereditary diseases and – hopefully – to find cures. In lawsuits, DNA profiles are used to identify the offenders. Pedigree researchers use similar profiles to search for the parents of adopted children. And finally, anthropologists use DNA to investigate the relationships between peoples. DNA research has greatly clarified our understanding of the population history

DNA can be used to establish the relations between people. In 2010, a set of mummies from the Valley of Kings was investigated and it was established that a mummy from Tomb 55 belonged to a man who was the son of King Amenophis III and Queen Teje, and the father of Tutanchamon. He must have been Echnaton (or an unknown brother). This portrait of the great religious reformer is in the Louvre, Paris.

WHAT IS DNA?

DNA stands for *DeoxyriboNucleid Acid* and although this name is easily forgotten, the reader will know that DNA is the carrier of genetic information. It is found in the chromosomes in the cell nucleus and in the mitochondria of the cell body. The chromosomes are shaped like a double helix and can best be imagined as a ladder with some three billion rungs, consisting of pairs of bases. There are only four types of rung, indicated as A, T, G, and C. If you want to describe a person's DNA, imagine a list of three billion A, T, G, and Cs.

All humans have essentially the same genetic code, but when people reproduce themselves, variations develop (e.g., a rung G at a certain position can become an A), and these variations will be passed on to all descendants. People with the same variation must be related to each other and are called a "haplogroup"; subdivisions of a haplogroup are called "clades" and "subclades". For example, a haplogroup known as R can have clades known as R0 and R1.

of the ancient world. A now famous example is the discovery that the Roma people ("Gypsies") share a haplogroup that is quite specific for the Indian subcontinent, which is an indication of their homeland.

Early humans

If we look at modern DNA profiles, we can work our way up to a man whose Y chromosome was the ancestor of all human males, and to a woman whose mitochondrial DNA was passed on to us all. These two individuals – for publicity's sake labeled "Y-DNA Adam" and "mitochondrial Eve" – lived in Africa, thousands of years apart, between 300,000 and 200,000 years ago.

The excavation of Göbekli Tepe in southeastern Turkey, where several circles of large megaliths have been found, often decorated with figures of animals. It is one of the world's oldest monumental structures.

Between 120,000 and 80,000 years ago, some 150 to 1000 very early humans (*homo sapiens*) belonging to the mitochondrial haplogroup L3 left the African continent and entered the Near East. Because their mitochondrial DNA slowly mutated, two new haplogroups arose, called M and N. The carriers of M followed the southern coastline of Asia and eventually reached New Guinea and Australia. Their DNA retains genetic information that causes their dark skin and Afro-textured hair, identical to that of Africans.

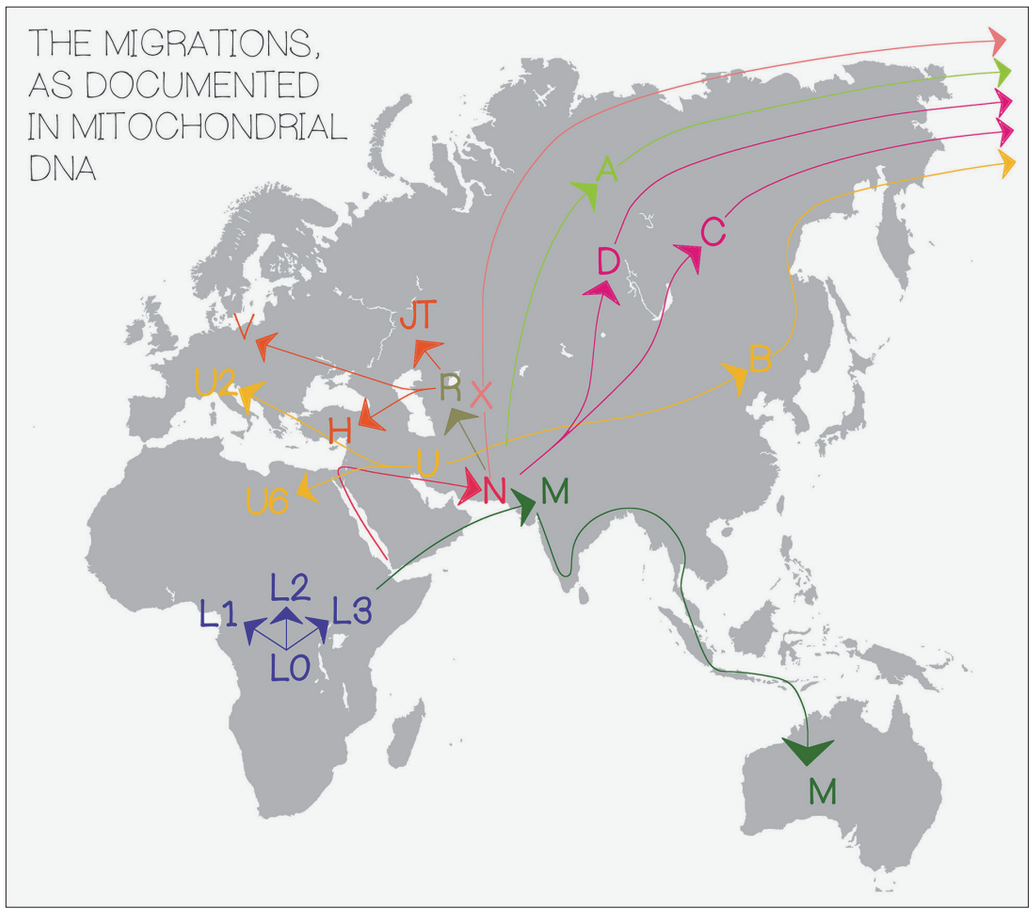
The N carriers went north, entered Eurasia and spread to the west and the east. They are the ancestral haplogroup of almost all Europeans, Asians, and native Americans. This group branched out into several directions, some heading east into Central Asia, to China, to Siberia, and – across a land bridge to Alaska – to the Americas. At least one group must have made the crossing between 13,000 and 8,000 BC.

Another mitochondrial DNA subgroup of N, called R, moved to Anatolia and Europe, where the oldest evidence for human presence dates back to about 45,000 years ago. The last Ice Age nearly wiped out the population, which fell apart into groups that

are, based on the mitochondrial evidence, defined as T, J, K, V, and H.

The rise of agriculture

Until recently, it was believed that cultural changes in Europe were caused by local innovations among the existing populations, or that they were copied from elsewhere. For instance, agriculture might have been invented locally or copied from neighboring people. Migration was ignored as cause of cultural change. DNA research has now proved this to be wrong: immigrants caused profound changes in Southern, Central, and Western Europe, while only in in Northern Europe changes were the result of imitation.



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At this point, recent advances in the study of Y-DNA become important. It is now assumed that after the end of the last Ice Age, about 11,000 BC, the descendants of the people who had once lived on the cold tundras and had survived the glacial maxima in more southern regions, repopulated Europe as hunter-gatherers. They lived there quite undisturbed for some four millennia until in about 5500 BC, agriculture, farming, cattle breeding, and new forms of pottery were introduced, which are known as Linear Band Ceramics (in Central Europe) and Cardial Ware (in Southern Europe).

This new culture spread over Europe within a few centuries and we recognize in the graves the new Y-DNA haplogroup G2a, divided in multiple subgroups that match DNA in Anatolia, the Levant, and the Fertile Crescent. A mass migration had taken place. What had happened?

About 9,500 BC, people living along the Upper Euphrates started to cultivate einkorn and emmer wheat. Quite soon – let's say around 9,000 BC – sheep and goats were domesticated in the Zagros mountains (in western Iran) and the Taurus mountains (in southern Turkey). At the same time, we find the first monumental architecture: Göbekli Tepe in southeastern Turkey. Cattle and pigs were also domesticated and the first pottery in the Near East dates to c. 7,000 BC.

These revolutionary changes had profound consequences. Farmers can feed more people than hunters and gatherers can, which means that agriculture leads to a higher population density: where farmers settled, they replaced the older population of hunters and gatherers. However, the population would continue to grow, forcing people to move away and build new settlements – and replace the people over there. In other words, agriculture spread from Anatolia to Europe: in 7,000 BC, one

A modern reconstruction of the iceman from the Ötzenthal in the South Tyrol Museum of Archaeology.
© Wikimedia, user "Thilo Parg"

would find the first farms along the Aegean Sea and in 6,000 BC on the Balkans. From here, agriculture spread along the Danube and Rhine, to reach the shores of the Atlantic by 5000 BC. Another route was along the shores of the Mediterranean to North Africa, Italy, Spain, and Southern France.

This revolution took place among people defined as mitochondrial haplogroup N1a. They brought probably also H2 and K1a. The old mitochondrial groups U, U4, U5, U8, J and V were significantly reduced.

The Y-DNA confirms this: in Anatolia, we find a high frequency of haplogroup G2a, which we also find among the first farmers in Europe. The settlers hardly mixed with the indigenous European hunter-gatherers.

So, the introduction of agriculture was not an independent development in Europe. Nor did the resident population imitate the Anatolians. The first farmers arrived from Anatolia, in two groups with related but different strands of DNA.

The Indo-Europeans arrive

Starting in about 3000 BC, Bronze Age cultures spread from Asia to Europe and again, DNA research shows that migration contributed to it. Archaeologists had already established that knowledge of bronze processing, the hardening of copper to bronze, and the use of this metal for agricultural purposes and for warfare arrived in the Mediterranean world and Central Europe from the east. The characteristic pottery was Corded Ware, and people were from now on buried in single graves, with battle axes as burial gifts.

It had already been suggested that this cultural change had something to do with the spread of the Indo-European languages. It has now been proved that the cultural changes at the beginning of the Bronze Age were caused by a migration (see map on page 53), the newcomers sharing Y-DNA haplogroups R1a and R1b. First, R1a spread from the Russian steppes over most of Europe, while R1b is a branch that arose probably after its arrival in Western Europe.

These people also shared a helpful mutation: the mechanism that makes humans intolerant to lactose had been switched off, meaning that that they could digest the milk of other species, like cattle and goats. Dairy farming became possible, which offered the Indo-Europeans an additional source of food. This made them less vulnerable than other people.

The immigrant people appear to have exterminated the existing male population. Fractures found in the skeletons of the resident people and ravages in residences indicate a brutal expulsion of the male Y-DNA haplogroup G2a, the haplogroup that had dominated Europe and the Mediterranean since the rise of agriculture. They were now strongly reduced, surviving in remote and protected places, such as the Alps and on islands like Corsica and Sardinia. The female mitochondrial haplogroups, on the other hand, were much less reduced, suggesting that the newcomers killed the men and had children with the women.

Phoenicians, Greeks, Etruscans

DNA-research has so far failed to bring convincing evidence for the Phoenician migration in the early first millennium BC. Greek

ÖTZI THE ICEMAN

In 1991, the body of a man who had come to his end as the result of a crime – a spearhead stuck in his chest cavity – was found at the edge of a melting glacier in the Austrian Ötzenthal. A radiocarbon dating revealed that he lived in about 3300 BC. This was the first excavated skeleton that was examined for its DNA. It could be established that he was related to a family in Germany with whom he must have shared an ancestor who lived about 4300 BC. We also know that the Alpine iceman must have had brown eyes and was not lactose tolerant.

THE JEWS

A nice anecdote relates how in the mid-1990s in the coffee room of a hospital in California two Jewish doctors were talking. One was from Eastern Europe, undeniably an Ashkenazi with all physical characteristics that can go with it, while the other was a slim elegant Sephardic from North Africa. Both, however, were from priestly families, *Cohanim*. According to tradition, they were descendants in the male line of Aaron, brother of Moses. If that were so, they realized, their Y-DNA had to belong to the same haplogroup. They were examined with the then still very simple test with only five markers, and the results fit their hypothesis. (Nowadays, tests have thirty-seven or sixty-seven markers.)

Today we know that the Cohens belong to different Y-DNA groups. The Sephardic priestly families are quite uniform, are clearly from the Near East, and must descend from the original priesthood in Jerusalem. This DNA is also prevalent among the Ashkenazic Cohens, but to a lesser extent. It would seem that part of them has became Jewish outside the Middle East.

colonization, on the other hand, did leave traces in the Y-DNA: the spread of E-V13 correlates with the areas of Greek settlement.

The ancient dispute about the homeland of the Etruscans may soon be solved: their DNA appears to confirm that in the Iron Age, the Etruscans were pushed out of northwestern Anatolia, migrated to northern Italy, and settled in a linguistically homogenous world. If this is indeed true – and there still is some reason for doubt – their settlement must have contributed to the rift between the Celtic and Italian languages.

All this may not seem very surprising, but in fact, we have learned a lot. The most important lesson is that scholars have, for a long time, underestimated the importance of migration as a cause of cultural change. This implies that there were more ways for information to spread than has until recently been recognized. This, in turn, means that scholars studying, say, Roman legends, must be willing to take into account parallels from the east.

At first sight, the conclusions about the Greek migrations do not look remarkable, until you realize that they independently confirm a reconstruction of our past that was based – as always – on little data. The opening of this 'fourth window on the past' has confirmed that scholars studying Antiquity are doing their job well, in spite of the fact that our sources are ambiguous and archaeological artifacts seldom speak for themselves.

And occasionally, there are very surprising discoveries – such as the Roman slave whose bones were found at the imperial estate of Vagnari in Apulia: his mitochondrial DNA proved that he came from eastern Asia. A Chinese in Italy: few people would have expected this fascinating discovery. **AHM**

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FURTHER READING

Although the study of ancient DNA is still in its infancy, the contours of the first synthesis are slowly emerging. One book that sums up the present situation is Jean Mango's *Ancestral journeys. The peopling of Europe from the first venturers to the Vikings* (2014[2]), which describes the migrations in Europe from the Copper Age until the end of the first millennium, and deals with such themes as the Indo-Europeans (cf. page 52-58), the ethnogenesis of the Celts, the Phoenician and Greek colonies, the Etruscans, the impact of the Roman Empire, and the Great Wanderings.

A stele from the National Archaeological Museum in Athens: a warrior from the late sixth-century BC, with an inscription that is almost certainly Etruscan. Found on Lemnos in the northern Aegean Sea, this may be written evidence for the hypothesis that the Etruscan homeland was northwestern Anatolia.