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THE GENETICIST PARTS OF A LITTLE FINGER... DENISOVANS, DNA AND SCIENCE IN THE MAKING

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The Denisova man is an extinct human-like member of the genus Homo. In March 2010 it was announced that the remains of a young individual who lived approx. 50,000 years ago had been found in the Denisova Cave in the Altai Mountains – an area that was inhabited by Neanderthals and modern humans around the same time. The presence of Denisova man has been also found as far south as Laos. Denisova man is a descendant of hominids migrants from Africa. So far, Denisova DNA has been found in East Asians as well as indigenous people from Papua New Guinea and Australia. Therefore, it is believed that Denisova man lived in Siberia and East Asia. It is well worth pointing out that the knowledge on the Denisovan anatomy is still limited and the question of them being a separate species remains disputed, and that this means that given problem continues to be discussed within genetic relationships between prehistoric and present day humans. It is obvious that modern science still has more questions than answers when studying the Denisova man.

Keywords: Denisova cave, genetics, Neanderthal, Michael Shunkov, comparative genomics, Svante Pääbo, Homo Heidelbergensis, Annamite Mountains, evolution, Altai Mountains, Homo Sapiens, Baishiya Karst Cave (Tibet), hominine, Anatoly Derevyanko, Homo Denisova, Novosibirsk, DNA.

ГЕНЕТИК ОТДЕЛЯЕТ МИЗИНЕЦ... ДЕНИСОВЦЫ, ДНК И НАУКА В ПРОЦЕССЕ СТАНОВЛЕНИЯ

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Денисовский человек – вымерший человекоподобный представитель рода Homo. В марте 2010 г. было объявлено, что останки подвида человека, жившего около 50 000 лет назад, были найдены в Денисовой пещере в горах Алтая в районе, который в то время был заселен неандертальцами и современными

людьми. Присутствие денисовского человека было также обнаружено далеко на юге в Лаосе. Денисовский человек является потомком гоминидов-мигрантов из Африки. В настоящее время ДНК денисовцев обнаружена у выходцев из Восточной Азии, а также у коренных жителей Папуа-Новой Гвинеи и Австралии. Поэтому считается, что денисовский человек жил в Сибири и Восточной Азии. Стоит отметить, что знания об анатомии денисовцев все еще ограничены, и вопрос о том, являются ли они отдельным видом, остается спорным, и это означает, что данная проблема продолжает обсуждаться в рамках генетических отношений между доисторическими и современными людьми. Очевидно, что у современной науки при изучении денисовского человека по-прежнему остается больше вопросов, чем ответов.

Ключевые слова: Денисова пещера, генетика, неандерталец, Михаил Шуньков, сравнительная геномика, Сванте Паабо, Гейдельбергский человек, Аннамские горы, эволюция, Горный Алтай, человек разумный, карстовая пещера Байшия (Тибет), гоминид, Анатолий Деревянко, денисовский человек, Новосибирск, ДНК.

Prologue

Around 50,000 years ago a 12-13 year old teenage girl walked along the small Anuy River in present-day central Russia. It was 550 kilometres south of Novosibirsk. The teenage girl was maybe sick or drowned in the river. The rest of his body was buried in the cave the nowadays Denisova Cave up on the mountain edge. The skeleton fell into a crack between the stones and was found fifteen years ago in 2008. Or more correctly a tip of a little finger bone and one more bone from the skeleton. The cave was large and many people lived in the inner passages. It is fully conscious that the word people and not the word humans are written in this context. The exact DNA of the human kind that the reader is part of was not existing 60,000 years ago [5, s. 22].

It was so-called hominids that were living in cave system. Neanderthals and individuals with a slight distinct kind of DNA that the reader has today were living

together. All the individuals in the cave were related to the Homo Heidelbergensis – early hominids that was extinct about 150,000 years before the little girl died. The appearance of the Neanderthals so far east was also a riddle. The individuals in the Denisova Cave were shepherds and hunters. Whether they were arable farmers on a very small scale is probably unthinkable among other things, because of the size a tooth that was found in the cave, too. Their main food was meat. Their animals have probably also lived in the cave system. Bears, lions and other predators had other dimensions at that time. And to survive the Siberian winters, it was necessary to have the animals in security.

Today only one human species known as Homo sapiens lives on Earth, but for millions of years there were many human-like groups. These hominids lived together, maybe they fought, and they had children with each other. It is very difficult to find out who they were and what they were like. Our only clues are the fossils and artefacts they left behind.

The caves in Russia, Tibet and Laos

From 2008 and onwards fossils and bones of the so-called Homo Denisova are found in the three parts of the central and southern Asia: in the Denisova Cave in central Russia, in the Baishiya Karst Cave in the northern China (in the autonomous region of Tibet) and in the Cobra Cave in the Annamite Range in northern Laos.

In the Altai Mountains in the southern Siberia, about 350 kilometres from the place where Russia adjoins Mongolia, China and Kazakhstan, the Denisova Cave is found. It is named after the hermit Denis, who is said to have lived here in the 1700s. The Denisova Cave is located under a rock wall approx. 30 meters above the river Anuy, and it has attracted visitors for several thousand years. Also in 2023, where the walls are painted over with modern graffiti, just as the animals use the cave diligently. The cave is strategically located near water and grass areas for the animals [1, p. 2].

Around 2,500 kilometres southeast of the Denisova Cave we find the Baishiya Karst Cave in the northern China. The cave is located in Ganjia in the Gannan Tibetan Autonomous Prefecture on the north-eastern edge of the Tibetan Plateau. The

Baishiya Karst Cave lies on the southern side of the Dalijiashan Mountains at the foot of a white cliff. Also near the Jiangla River, a tributary of the Yanggu River. Like the Denisova Cave the cave in Tibet is very big. It is over 1 kilometre in length and within 80 metres from the entrance, the cave's winter daytime temperature normally around 10 degrees. A temperature is suitable for habitation in the harsh winters of the Tibetan Plateau. In the Baishiya Karst Cave an intact Xiahe mandible was found. On the fossil jaw DNA from Homo Denisova was detected. In 2020 Denisovan DNA plus stone artefacts and animal bones were recovered from the Buddhist holy cave on the Tibetan Plateau by scientists from the University of Wollongong, Australia including professor Bo Li.

Further 2,000 kilometres south of the Baishiya Karst Cave and 3,800 kilometres south of the Denisova Cave we find the Cobra Cave (Tam Ngu Hao 2) – a limestone cave in the Annimite Range in Laos. 260 kilometres north of the capital of Laos, Vientiane, in the northern part of the country, you will find this tree covered entrance to the cave. In December 2018, a hominine permanent lower molar was discovered from a breccia block in the Cobra Cave. The tower karst in which the cave was formed is positioned on the south-eastern side of P'ou Loi Mountain with an entrance located 34 m above the alluvial plain. The site was discovered during a survey of the area around Tam Pà Ling, where early Homo sapiens fossils have previously been recovered. The tooth (TNH2-1) is a mandible left permanent molar crown germ, and the absence of occlusal and interproximal wear combined with the incipient root formation suggests that the tooth was unerupted at the time of the individual's death.

Conclusion

Although the caves are situated in different parts of Asia, they are all very much alike. The Homo Denisova has lived in central and southern parts of Asia in a vast area. Until now fossils and bones are not found in eastern China and north-eastern Siberia, but founds are very possible in these areas. All in all its forms an overall picture of the different species of humans that existed 40,000 years ago: the Neanderthals in the nowadays European Region, the human homicide near to our

DNA in Africa and in the Middle East and Homo Denisova in the central, eastern and southern parts of Asia.

The Homo Denisova genome

Archaeological studies show that the cave has been inhabited already for 280,000 years ago. There have also been found homicides teeth of the same age like the finger bone, but originating from other individuals. In the same area there is furthermore, previously found fossils of Neanderthals. But the new little one bone stump turned out to be full of surprises. At first it was successful to extract and analyse so-called mitochondrial DNA, which surprisingly turned out to be markedly different than mtDNA from boats Homo sapiens and the Neanderthals. It was therefore possible that one faced a new species of Homo. The results were published in March 2010. In December 2010 the entire core genome from the Denisova finger bone was published, and more surprises came to light [1, p. 3].

The core genome seems to first to confirm that one stands facing something new, never seen before. Whether it is a new species or a subspecies of Homo sapiens/Homo neanderthalensis is however still unclear. But it’s a first time that a new human form is been identified exclusively on the basis of DNA sequences and not by means of fossils. Till further it has been named new findings Denisova man [2, p. 32].

It has been suggested that the Denisova people can be related to it approx. 200,000 year old skull from Dali (China), which was found in 1978. The taxonomic placement of the Dali skull has always been insecure. Before we return to Denisova human genome, shall we look at what fossil DNA has taught us about the kinship between modern people and the Neanderthals?

Fossils, researchers and bones. Part 1

The challenge is particularly great with regard to the Denisovans, which were first discovered approx. 10 years ago and hasn’t left much physical evidence. Almost all of our knowledge about them comes from preserved DNA. From there we know that they were a sister group to the Neanderthals, that they lived in Asia hundreds of

thousands of years ago, and that they had children with our species. We don't know what they looked like, how they walked, or if they could talk.

In recent years archaeologists have found several fossils that appear to be from Denisovans. They have also found tools, jewellery and art believed to have been made by this mysterious people. Some researchers question the origin of the finds, but we are still forming a picture of the Denisovans, who are some of our closest relatives and live on in the DNA of many people today [3, p. 22].

So began the story of the Denisovans in the Altai Mountains of southern Siberia in Russia, where the excavation of the Denisova Cave had been going on for decades. Hominins had lived there from time to time for hundreds of thousands of years. Most were Neanderthals, who at times moved far to East, although they were most widespread in Europe and western Asia. But in 2008 archaeologists led by Michael Shunkov, an archaeologist at the Russian Academy of Sciences in Russia, found the abovementioned piece of a little finger bone in the Russian cave [3, p. 8].

The archaeologists assumed it came from a Neanderthal and sent it to Svante Pääbo, head of department at the Max Planck Institute for Evolutionary Anthropology in Germany. His team discovered that the DNA from the bone did not come from a Neanderthal or a modern human. Michael Shunkov and Svante Pääbo chose the term *Denisova* for the new prehistoric man [3, p. 9].

In 2010 two other finds had turned up in the Denisova Cave that contained DNA corresponding to that from the finger bone, both finds were molars. One molar had been stored at Anatoly Derevyanko's institute in Novosibirsk. The tooth was larger than both a modern human and a Neanderthal molar. In size and shape it resembled molars found in Africa. The second molar was found in the same chamber in the cave where the finger bone had been found. It was a cave chamber in which individuals had lived about 40,000 years ago [7, p. R1007].

The find was published in 2010. It was the first time that researchers had identified hominines solely based on DNA. Some of the DNA sequences from the Denisovans matched sequences from people who lived on the Melanesian islands, particularly Papua New Guinea. This meant that the Denisovans and members of our

species, Homo sapiens, had children with each other thousands of years ago. Today the DNA of the Melanesian people consists of approx. 5 per cent Denisova DNA.

Earlier in 2010 the geneticist Svante Pääbo's team had published a sequence from the Neanderthal genome, which showed that Homo sapiens and Neanderthals had had children with each other. Still the interbreeding with the Denisova was remarkable, as their DNA was found in the Denisova Cave thousands of kilometres away from Papua New Guinea. Therefore, the researchers assume that Denisovans must have lived in many places [9, s. 71-72].

Their "demographic and evolutionary core" is probably southern Asia, believes Jean-Jacques Hublin, professor at the Max Planck Institute for Evolutionary Anthropology in Germany. In 2019 the genome of the Denisovans was studied to find out what they looked like. Scientists identified so-called methylation markers, which show how active each gene has been, and from that generated an image of a Denisova's face. However, it was met with widespread criticism, not least because it has never been demonstrated that such markers can "predict" the appearance of a species.

Neanderthals and Homo sapiens (an interlude)

Because the Neanderthals morphologically and behaviourally on many ways reminded of it modern man, has it been assumed that they in evolutionary respect were direct forerunners for modern man. However, they have later years of research showed that at the same time with the Neanderthals living in Europe and western Asia, other types of people lived there in the Far East and Africa; and the people who lived in it Africa, was clearly more modern than the Neanderthals. The African ones Humans are thus, alone on this basis, more likely ancestors of present humans than Neanderthals, and there is an increasing tendency to perceive the latter as one evolutionary impasse that only passed on little or nothing of theirs genetic material for modern humans. For this reason believe many today that the Neanderthals should be classified as self-employed species, Homo neanderthalensis [4, p. 713].

Maps of the Neanderthals genetic material (nuclear DNA) happened in 2009 and showed to many surprise that there actually is traces of the Neanderthal genome

in modern people inheritance. But apparently is it only in the inheritance of persons, who does not have an African provenance. The results point thus on that the mixing with DNA from Neanderthals is happened around the time of the exodus of modern man from Africa 60,000 years ago since, and that it has happened in the Middle East (before the hiking trails divorced) [10, p. 113].

The mix-up is apparent rings, of the order of magnitude 1-4%, and can be explained by a very small number of pairings. There is so far no clarifications of about the part in question of the Neanderthal heredity have any functional significance in modern man inheritance. So the mix up does so far not non-Africans to special cavemen compared to Africans. But Africans might be the one only "pure" group of Homo sapiens [11, p. 34].

It is striking that apart from the above mixture between the Neanderthals with Homo sapiens that happened to species 60,000 years ago, apparently no further mixing has taken place in Europe at a later date. Here the two coexisted after all, species for several thousand years, until the Neanderthals disappeared just under 30,000 years ago. But there is nothing in them for the time being genetic data suggesting that this should be the case, and modern Europeans do not have one greater genetic community with Neanderthals than other non-Africans [4, p. 715].

This has given rise to considerations about whether there actually mattings have taken place between Neanderthals and Homo sapiens place as described above, or whether there may be others explanations for the genetic data. There are also other studies that can be difficult to unite with a "mating model" [8, p. 1055].

One explanation, to some extent supported by paleontological and archaeological data, could be that Homo sapiens and the Neanderthals met each other in the Levant for approx. 100,000 years since during the last interglacial, where the African fauna was temporarily spread to the Middle East. At this stage wasn't Homo sapiens "fully modern", as the behaviour in it essential remained archaic. Therefore they had two human types at that time certain commonalities that perhaps more easily facilitated a mating than 40,000 years later where Homo sapiens had become

“mature”, also in behavioural respect. You may then imagine that they now mixed, early modern people subsequently turned back to Africa.

The described scenario requires furthermore that the African Homo sapiens population was structured, i.e. divided into several smaller groups. This is supported actually by several studies and is also quite logical in light of a huge and ecological seen very varied continent with many potentials geography happen barriers in the form of deserts, mountain ranges, large rivers etc. The group formed of the returning individuals from the Levant (or that group they interfered with), had to possibly also be the group, from which the later, definitive emigration from Africa ended.

Sequencing the genome of one or more East Africans will be able to shed light on this scenario, being in that case had to expect that some East Africans (those who don’t participated in the exodus) should show weak signs of mixing with Neanderthal DNA.

There is, however, also the possibility that DNA from Neanderthals in Homo sapiens DNA in reality is expression of a common heritage from it common ancestor (Homo heidelbergensis), with which the two have shared each other in Africa before the partition of the two lines of development about 500,000 years ago. Also this scenario will require that the African population in the past has been split into smaller groups since the common ancestor have not represented the whole African population on the time in question, but only the population that far later also gave rise to the migration out of Africa for 60,000 years ago.

This scenario is actually supported of a whole new study published in August 2012, where a statistical analysis of Svante Pääbo’s data indicates that these are equally compatible with a past divided African population as with mating in connection with the exodus from Africa. The question of who has found mating place or not must until further considered to be completely open [9, s. 73].

Fossils and bones. Part 2

But how could the two prehuman types end up in this particular cave? How were Neanderthals and Homo Denisova related to each other? And how could they have been part of the development of modern DNA? Did their parents mix with our

ancestors? Swedish Svante Pääbo, who got the Nobel Prize in Physiology and Medicine in 2022, had experience with such kind of questions, but never with exactly this problem [9, s. 74].

The DNA of the Neanderthals that Svante Pääbo had worked to map was totally different from the DNA found in humans living today in 2023. This could indicate that the Neanderthals were, if not a separate species, at least quite a bit different from that contemporary man. Neanderthals were therefore a species that became extinct suspiciously shortly after the first individuals with parts of our modern genomes migrated out of Africa and into Neanderthal territory in western Asia and Europe [9, s. 75].

With this DNA, as with German researcher Johannes Krause's extraction of the Denisova teenage girl's fingertip, the mtDNA was; it came from the mitochondrion, the energy-producing cell structures inside the cell, and not from the cell nucleus itself, where the majority of our genome is found. Mitochondrial DNA (mtDNA) contains only 37 genes and is inherited only through the mother. The teenage girl's mother was Homo Denisova and her father was Neanderthal. But it is only a limited burden of knowledge about the history of a population, like a single page torn out of a huge book [5, s. 23].

Although the Homo Denisova genome showed that they were more closely related to Neanderthals, they also left their mark on modern humans. But the geographic pattern of that legacy is strange. When the researchers compared Homo Denisova's genome to various modern populations, they could find no trace of it in Russia or China. But the archaeologists are still searching. Nor could large amounts of traces be found elsewhere in Asia with exception in the genome of people from the island of New Guinea, in people of Melanesia and in Australian aborigines. On average, about 5% of the genomes of these peoples derive from Homo Denisova. In addition, the Negrito people of the Philippines have up to 2.5% Denisova genome.

When all that data was put together, Svante Pääbo and his colleagues could set up a scenario that could explain how it happened. At some point more than half a million years ago, probably in Africa, the ancestors of modern humans separated

from the branch that would become the Netherlanders and Homo Denisova. The apparently most likely ancestor of the various human types is Homo heidelbergensis. While our ancestors stayed in Africa, the common ancestor of Neanderthals and Homo Denisova migrated. The two lines of human types later split, with the Neanderthals initially spreading westward into Europe, while Homo Denisova migrated eastward and, of course, over time populated large parts of the southern, eastern, and central continent.

Still later, when modern man himself ventured out of Africa, they encountered the Neanderthals in the Middle East and Central Asia, with whom they mixed to some extent. According to research results presented at Denisova symposia around 2010, this intermingling probably occurred somewhere between 70,000 and 50,000 years ago. A group of individuals with modern DNA continued east into Southeast Asia, where about 45,000-40,000 years ago they encountered Homo Denisova. These mother DNA people also mixed with the two aforementioned species and continued further into Australasia where they brought the Denisova mtDNA with them [7, p. R1003].

This scenario may explain why there are still so few actual fossil finds that prove the actual existence of Homo Denisova. But it has left a lot of unanswered questions. If Homo Denisova was so widespread, why was there no trace of it in the Han Chinese genome or in any other Asian people between Siberia and Melanesia? Why did they leave no trace in the archaeological material, no distinctive tools for example? Who was Homo Denisova? How did they look?

The best development would be to find a Denisova skull with DNA or DNA in another fossil with distinctive morphological features – one that could serve as a frame of reference to hold fossil finds from Asia against and see them in a new light. There have been some intriguing candidates, mostly from China and in particular three skulls that were dated to be between 250,000 and 100,000 years old, but still exists no epoch-making result.

Fossils and bones. Part 3

The further investigations of the Denisova human genome shows that this is similar to the Neanderthal genome more than it looks the Homo sapiens genome. That however, does not resemble the Neanderthal genome as much as you can say that the two genomes originate from the same gene pool. The most probable is that the Denisovan and the Neanderthals are sister species. On the basis of the number of differences in mtDNA it is estimated, that the common ancestor of Homo sapiens and the newly discovered Homo Denisova has lived for approx. a million years ago, i.e. double as far back in time as the ancestor of Homo sapiens and the Neanderthals are supposed to have lived [2, p. 30].

Furthermore, Homo sapiens shows that apparently one has happened gene flow from the Denisova genome into living Melanesians (New Guinea and surrounding islands) and Aboriginal Australians genome, but not into others the genome of living humans. The gene flow responds to the extent that approx. 5% of the living Melanesians genome originates from the Denisovan genome. Probably the mix up happened in connection with Homo sapiens exodus from Africa for approx. 60,000 years ago where first wave went to Southeast Asia [5, s. 25].

So maybe Denisova was human at this stage temporarily spread over large parts of Southeast Asia, while the Neanderthals lived in Europe and western Asia. This could explain the mix-up with the Melanesians and not with Homo sapiens populations that today live much closer Altai Mountains (Mongols and Han Chinese). In all circumstances may the Denisova people at the time in question have been in an area where they could get in touch with the ancestors to the living Melanesians (if the "mating scenario" is correct, cf. above), and this was very likely not southern Siberia.

If the genome cannot tell what the Denisovans looked like, the researchers had to investigate it by excavating their remains. They searched for almost a decade without finding anything, but now they have succeeded. Bence Viola, a paleoanthropologist at the University of Toronto in Canada, has found skull fragments in Denisova Cave, which are the best fossils yet found there. Based on the fragments, he estimates so far that the Denisova were large and perhaps weighed over

100 kg. An analysis of the genome shows that it contains DNA from an unidentified older population.

In 2014, Emilia Huerta-Sánchez, now an assistant professor at Brown University in the US, and her colleagues investigated the gene EPAS1, which affects the body's response to a low oxygen level. People on the Tibetan Plateau, more than 4 km above sea level, have a modified version of EPAS1 that makes it easier for them to tolerate the thin air. Emilia Huerta-Sánchez has found that the modified version of EPAS1 is due to a cross with Denisovans approx. 43,000 years ago.

The mutation is unlikely to have happened in the Denisova cave, which is only 700 m above sea level, but in 2018 the researchers found signs that the Denisovans may have lived higher up. At Nwya Devu on the Tibetan Plateau the researchers thus found thousands of tools that have been buried 30-40,000 years ago, and which may originate from Denisovans or Homo sapiens.

In 1980 a jawbone was found at the Baishiya Karst Cave in Xiahe on the Tibetan Plateau. The fossil was studied at Lanzhou University in China. It had no preserved DNA, but in 2019 Jean-Jacques Hublin and his colleagues announced that they had extracted protein from a tooth that matched the protein found in Denisovans. They also concluded that the jawbone was at least 160,000 years old.

In October 2020 a research team led by Qiaomei Fu, a professor at the Institute of Vertebrate Paleontology and Paleoanthropology in China reported the discovery of Denisova DNA in the Baishiya Karst Cave. The DNA samples were 100,000, 60,000 and perhaps as low as 45,000 years old and showed that the Denisovans had been there – and apparently for at least 115,000 years, long enough to develop adaptations like the EPAS1 gene.

The shape of the jawbone is typical for hominines from that time, and the finding of large teeth in the jaw is a clear Denisova sign. Three more large Denisova teeth have been found at Denisova Cave. In line with human evolution, teeth have generally become smaller.

Neanderthals and homo sapiens have small teeth, so the researchers assume that their common ancestors also had them, which could indicate that the Denisovans

developed the large teeth later. Undoubtedly, the new technological ones will land gains mean that we in the coming years will see mapping of the genetic material from a multitude of past people, both early Homo sapiens and archaic human species. We can therefore expect to get a far more detailed knowledge of e.g. Homo sapiens' colonization of the world and about the kinship relationships between them different species of people [5, s. 23].

The science-in-making methods – pros and cons

Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence. Science methodology includes the following: 1) objective observation, i.e. measurement and data (possibly although not necessarily using mathematics as a tool); 2) evidence; 3) experiment and/or observation as benchmarks for testing hypotheses; 4) induction: reasoning to establish general rules or conclusions drawn from facts or examples; 5) repetition; 6) critical analysis and 7) verification and testing critical exposure to scrutiny, peer view and assessment [6, p. 19-20].

Swedish-born Svante Pääbo, who is the world's leading expert in ancient DNA, and director of the Max Planck Institute in Leipzig, when the finger bone was found in 2008, was the main researcher in the mtDNA process regarding the Denisova genome. But the process differed from the usual way of conducting research of that nature [6. p. 133].

The article is analysing an assumption that concepts such as science, facts and knowledge are not exclusively consequences of how things exist. What is seen as science, knowledge or facts is also things that are, for example, made, created, negotiated, or acted upon. Look out from such a perspective, the Denisovan is a particularly interesting object of study then the physical evidence of its existence (such as bone remains) is quite few. The very discovery of the Denisovan and, consequently, its existence is therefore particularly dependent on DNA and productions of DNA to can be made into science, facts or knowledge.

The Denisovan's close genetic relationship to present-day humans in combination with the cutting-edge technologies and methods behind its discovery

make the discovery unique. As a scientific find that is claimed to re-write history or negotiate genetic relationships between prehistoric and/or present-day human populations, the Denisova human is an example of a type of discovery that has become more common; there are many examples of aDNA-related research and texts that have been reported on as re-rewrites of history

The Denisova discovery can provide a point of departure for questions regarding public interest and participation in science, specifically related to DNA and human evolution. But it can also provide a basis for discussing and developing tools and concepts to better understand what may be a new type of scientific product, i.e. the genetic revelation of new human forms and/or the negotiation of relationships between known human forms [6, p. 139-140].

The scientific process was characterized by the fact that the research took place in Germany, the USA, Russia and China simultaneously in different research laboratories. The amount of scientific evidence was unusually small. One of the most important evidence in proof of the mtDNA of the Denisovans was, however, the comparison of DNA strands. A fact that validates the research results to a very large degree. First of all, because the German geneticist Johannes Krause extracted the Denisova DNA from the small finger bone stump, so that it can be used for a library of DNA fragments that can be copied again and again [6, p. 130-140].

But the research material (also including the fossil founds after 2008) is very small and cannot completely form the basis for a conclusive study of Homo Denisova. And what about little teenage girl in the Denisova cave? We know little about what she or her adult peers look like. It is assumed that she was tall, had dark hair, dark eyes and dark skin and robust.

Conclusion

The Denisova discovery does indeed change the history of human evolution. Such a historical revision may have social and even political consequences. Research fields such as genetics, a DNA and human evolution are dependent on difference, and are produced through distinctions, tied to ideas or even ideals of human essence and superiority. The Denisovan cannot be made free of such connotations, because this

hominine is based on valid science; it is not epistemically or politically innocent. In relation to this it is well worth pointing out that the knowledge on Denisovan anatomy is still limited and the question of them being a separate species remains disputed, and that this means that this problem is still negotiating genetic relationships between prehistoric and present day humans.

But having said that, it is worth noting that the questions surrounding the Denisova man are many and varied. The theory of the Denisova genome is made from a transformation that turns the Denisovan into something that has happened, a narrative. And this is essential in the Denisovan's route from fossil to fact, because they cannot turn fact unless there is an account of how it turned fact. As we have frequently accentuated, the Denisovan's lack of substantial physical evidence creates somewhat special conditions for discussing it.

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