

*A Good Journal for Inquisitive People*

# SCIENCE

First Hand

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DAUGHTER  
OF DENISOVAN  
FATHER  
AND NEANDERTHAL  
MOTHER

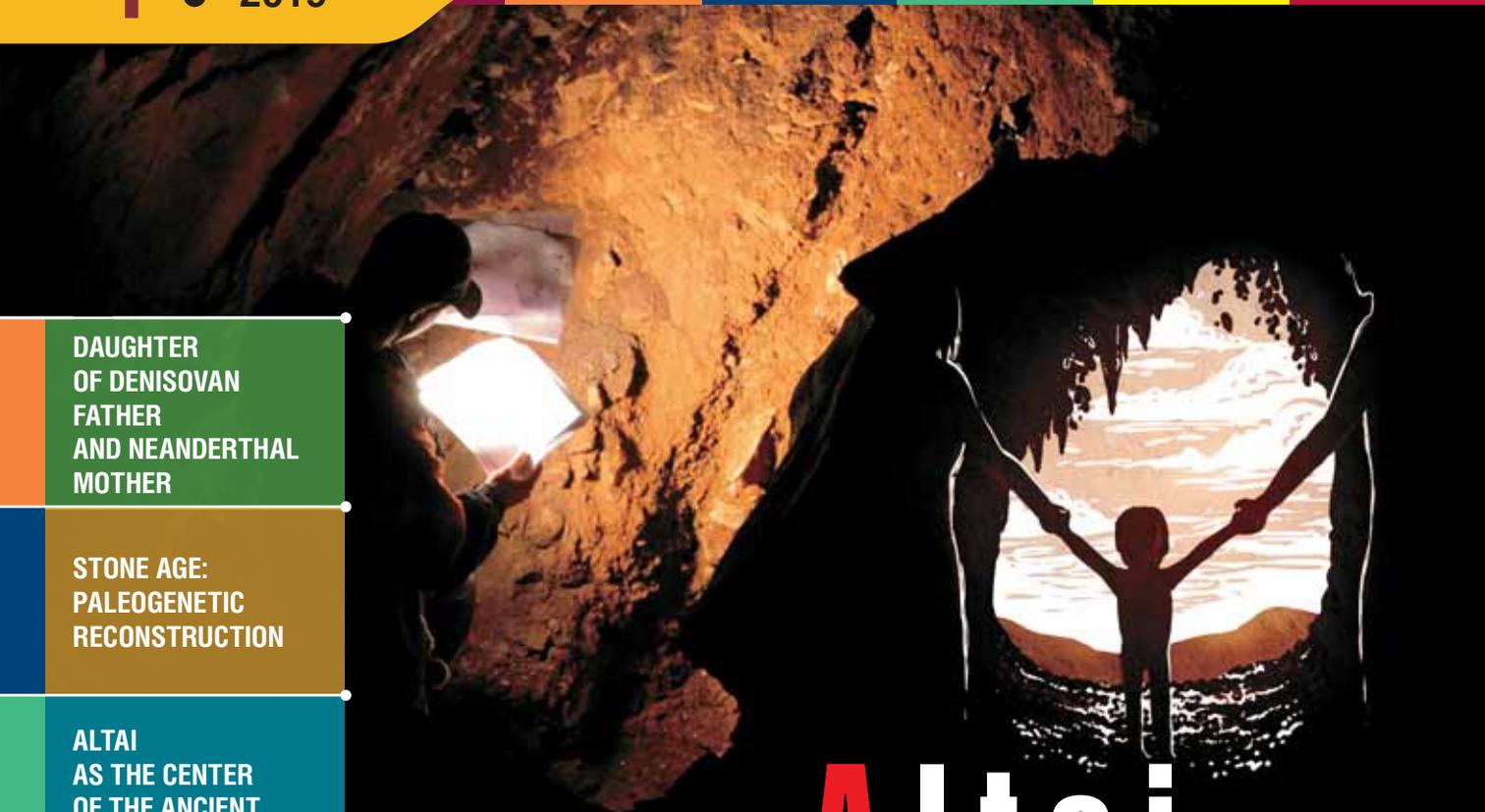
STONE AGE:  
PALEOGENETIC  
RECONSTRUCTION

ALTAI  
AS THE CENTER  
OF THE ANCIENT  
OECUMENE

THE KASHMIR  
DIARY



# Altai as the Center of the Ancient Oecumene



**1.** 2019  
popular science journal



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First Hand



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A Journal  
for Inquisitive People

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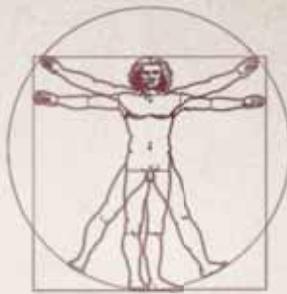
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*“The natural desire  
of good men is knowledge”*

Leonardo da Vinci

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Dear Friends,

*At the very end of 2018 came great news: two discoveries by Russian scientists got on the Science's Breakthrough of the Year list. Interestingly, both were made in evolutionary biology. The first was that the primitive multicellular organisms Dickinsonia that appeared on the Earth long before the Cambrian burst of life are not a dead end of the evolution, as proven by the analysis of organics from fossil prints. The second was the discovery concerning the origin and formation of present-day humans: scientists from the Novosibirsk Institute of Archaeology and Ethnography SB RAS found, in Denisova Cave in Gornyy Altai, the bone remains of a half-breed between two ancient people – a Neanderthal and a Denisovan.*

*The paleogenetic analysis of the tiny bone fragment performed at the laboratory of Prof. Svante Pääbo (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany), with whom the Novosibirsk scientists have had a long and successful history of cooperation resulted in the first direct evidence of a mixture between these two very different groups of ancient hominins. In this issue of the journal, Prof. A. Derevyanko not only dwells on the details of this discovery, but also summarizes the many years of archaeological research done in Gornyy Altai, including the discovery of the previously unknown ancient man, which brought on a new view on the history of present humanity.*

*Over two thousand years ago, the ancient Roman poet Horatio wrote, “What is hidden under the earth, time will show in broad daylight.” If we substitute “time” for “new technologies,” these words will perfectly apply to our days. New technologies have made it possible to read the hidden pages of the humanity's evolutionary history.*

*Most of the amazing discoveries made recently in the area of human origin that have transformed our conception of the Homo sapiens development became possible thanks to paleogenetics. When the ancient DNA hidden in fossil bones was sequenced, Neanderthals came back to our family tree, and Denisovans – a previously unknown group of ancient hominins whose genetic contribution to modern mankind is quite important – were discovered. The story about how ancient DNA was sequenced and how it changed our concept of linear human evolution is told by one of the founders of paleogenetics, Prof. Svante Pääbo and Dr. Vivian Slon,*



*a young researcher from the department of evolutionary genetics at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany.*

*Further examination of the fossil remains from Denisova Cave and of the genes inherited from the Denisovans holds the possibility of new discoveries. Until recently, the only “record” of this hominin was the genome obtained from a few teeth and a fragment of bone. Today, however, judging by the report at the annual American Association of Physical Anthropologists held in March 2019, the fragments of a Denisovan's parietal bone found by Novosibirsk archaeologists in 2016 have been first identified based on mitochondrial DNA. Another revelation announced at the same conference was that some representatives of an ancient Denisovan population successfully mixed with the present-day humans about 30,000 to 15,000 years ago, i.e. on the threshold of historical time! Details of these discoveries have not been published yet.*

*This issue of the journal contains our traditional rubric intended for the general reader “Expeditions Encyclopedia.” The readers, together with the archaeologists, can take part in the archaeological diggings in the Kashmir Valley squeezed by the Himalayan mountain ranges.*

Academician Nikolay L. Dobretsov,  
Editor-in-Chief

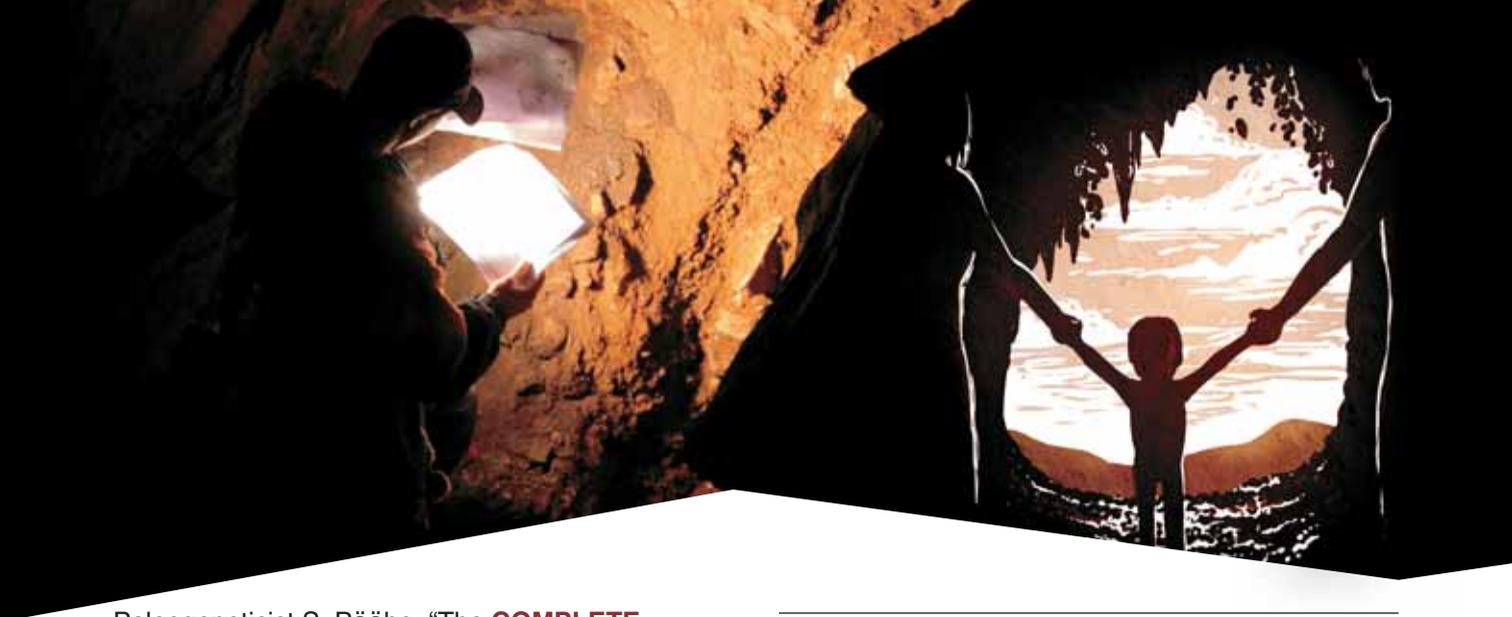


According to **SCIENCE**, the **DAUGHTER OF a DENISOVAN** and a **NEANDERTHAL** is among **THE 2018 TOP TEN** breakthroughs in science **P. 6**

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Professor Milford H. Wolpoff from the University of Michigan (USA), one of the first advocates of the hypothesis about the polycentric origin of man. *Altai Mountains, 2018*



Excursion in Denisova Cave. Center: Viviane Slon, a paleogeneticist from Prof. S. Pääbo's laboratory. Her presentation was devoted to the sensational results of Denisova-11 DNA sequencing. *Altai Mountains, 2018*

Although today many people still believe in the divine act of man's creation, over the last hundred years science has collected vast compelling evidence of the long and gradual evolution of our very distant ancestors, who branched about 6–7 million years ago from the common evolutionary trunk they shared with apes. However, human genesis turned out to be not near as simple and straightforward as the first researchers believed it to be.

This picture became much clearer through the development of paleogenetics, a science that emerged in the 1980s at the junction of molecular biology, classical archeology and paleontology. Now scientists have learned to isolate and identify DNA sequences from archeological and paleontological remains and can study, from this perspective, populations of organisms that had vanished from the Earth, including human ancestors.

Until recently, one of the most likely candidates for the role of our ancestors has been the Neanderthal man, whose brain volume would match that of modern humans and who felt comfortable at temperate latitudes. However, based on the results of the first paleogenetic

studies of the mitochondrial DNA from fossil bone remains, scientists inferred that the Neanderthals had been a dead-end branch of mankind. New results rehabilitated them only at the beginning of the new millennium, with the emergence of advanced DNA sequencing technology, able to "read" nuclear DNA and prove that the genome of an average human with non-African roots has 1–2% of Neanderthal genes.

The Max Planck Institute for Evolutionary Anthropology (Germany) analyzed bone anthropological remains of the Neanderthals, including specimens from the Altai caves—Denisova and Okladnikova. These specimens showed exceptional preservation due to a special temperature regime in the caves. Among them was a small bone from Denisova Cave—a phalanx of a child's little finger, which created a real sensation.

Professor Svante Pääbo, Director of the Department of Genetics at the Max Planck Institute, recalls that in the spring of 2009, they received another bone fragment from Anatoly Derevyanko, found the previous year in Denisova Cave. The bone was tiny, and Pääbo thought it unimportant

and only decided to run some mtDNA tests, when time permits. But then came the unexpected: "On December 3, 2009, I was attending a meeting on the rat genome... As I walked from the dining hall to the lecture hall after breakfast, my cell phone rang. It was Johannes Krause calling from Leipzig and he sounded strangely excited. I asked him what the matter was. He asked me if I was sitting down. When I said no, he said I'd better sit down before hearing what he had to tell me..." The stunning news was the discovery of a new human species, unknown to science, which literally turned upside down the established ideas about the origin and evolution of *Homo sapiens*.

Paleogenetic analysis of the fossil bone remains of the Denisovan man showed that these hominins, like the Neanderthals, left a mark in the genome of many modern human populations. Judging by the genetic diversity, it was the Denisovans who dominated in North Asia in the Stone Age.

The fact that archaeologists find bone remains of the Denisovans and Neanderthals in the same cultural layers of Denisova Cave suggests that these hominins lived this area at the same time. But how did they get along with each other? We cannot answer this question decisively, but the last unique find speaks volumes.

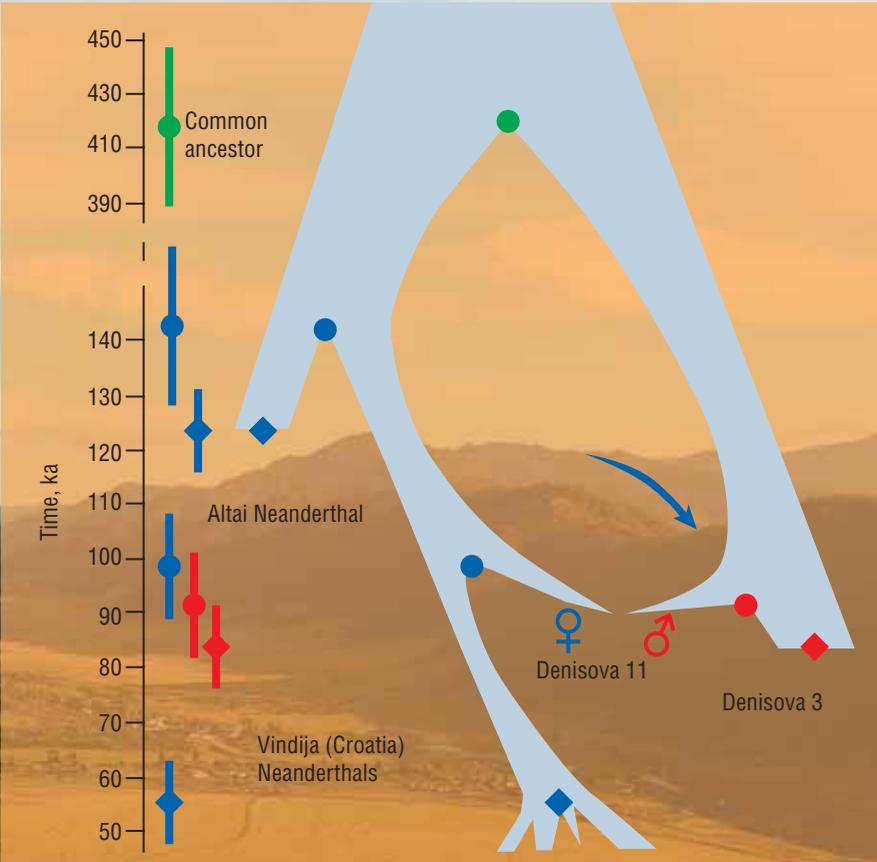
Denisova 11 is a small bone whose exact position in the skeleton remains unknown. By comparing it with the known long bones of Neanderthals and modern humans, scientists found that it belonged to a female not younger than 13 years of age. After sequencing the nuclear DNA extracted from the specimen, scientists associated the bone with a young crossbred girl, whose nuclear DNA contains about 42% Denisovan genes and 39% Neanderthal ones. In other words, her ancestors came from the two



Professor S. Pääbo from the Max Planck Institute for Evolutionary Anthropology (Germany) tells about the decoding of ancient DNA from the fossil bone remains of the Denisovan. *Altai Mountains, 2018*



Denisova 11, a fossil bone fragment of about 2.5 cm, discovered in the East Gallery of Denisova Cave. Radiocarbon dating estimates the age of the bone at about 50,000 years. Photos by T. Higham



Scheme of interactions and gene flows between the Neanderthal (blue markers) and Denisovan (red markers) populations, which had split about 350,000 years before they disappeared. The common descendant is Denisova 11. Denisova 3 is the first discovery of the Denisovan man, whose genome also contains a small fraction of Neanderthal genes. Adapted from: (Slon, Mafessoni, Vernot, et al., 2018)

Academician Derevyanko believes that “the recent discovery in Denisova Cave holds utmost significance as it once again proves the existence of a constant exchange of genes between the ancient human populations that had formed in different territories. However, this exchange could have occurred only between different subspecies since crossbreeding between different species does not produce fertile offspring. Thus, this discovery confirms the hypothesis that several different subspecies of *Homo sapiens* took part in the evolution of modern mankind”

ancient groups, in equal proportions. Judging by the degree of heterozygosity (nucleotide differences) of the genome, it contained two different sets of parental chromosomes: one from a Denisovan and the other from a Neanderthal. Considering the mitochondrial DNA, which is always inherited through maternal lineage, it can be argued that she was an offspring of a Denisovan father and a Neanderthal mother.

Moreover, studies have shown that the Denisovan father himself had had many generations ago at least one Neanderthal ancestor, and the Neanderthal mother turns out to be genetically closer to the Neanderthals from the Croatian cave of Vindija rather than to her Altaic neighbors, i.e., could have belonged to relatively recent migrants from Eastern Europe. Perhaps, this find suggests that these ancient people might have migrated between Eastern and Western Eurasia.

Discovering direct evidence of successful crossbreeding between different representatives of ancient people, whose evolutionary paths diverged more than 390,000 years ago, is itself a unique event. Finding a first-generation hybrid among the few ancient specimens means that different groups of late Pleistocene hominins could have crossbred on a regular basis.

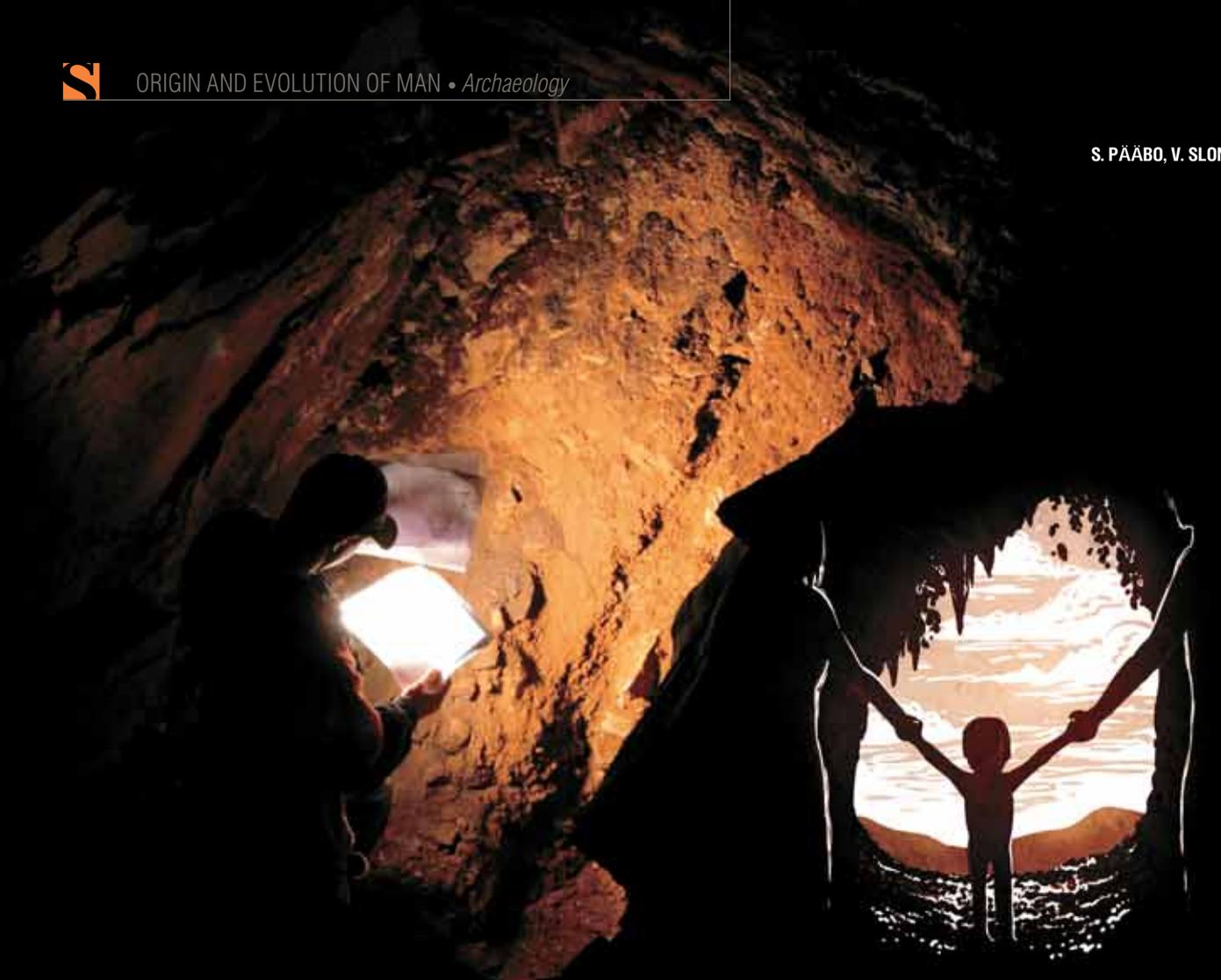
Through paleogenetic research, today we know that the Neanderthals also crossbred with the ancestors of modern non-Africans and, probably, with the earlier ancestors of modern people, and the Denisovans mixed with the ancestors of the present population of Oceania and Asia. In the light of all these data, our family tree no longer looks like a tree—it has turned into a bush with interwoven branches. Moreover, paleogeneticists hope to test another bold

assumption, claiming that the Denisovan genome could contain a spree of genes that merged into it from a yet unknown hominin that had separated from the ancestors of people of the modern physical type more than a million years ago and could have lived till the end of their days in secluded corners of Eurasia.

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The publication includes photos by S. Zelensky

S. PÄÄBO, V. SLON



# Stone Age: Paleogenetic Reconstruction

**Key words:**

human evolution,  
paleogenetics, ancient  
DNA, Denisovan,  
Neanderthal, Denisova  
Cave



Prof. Svante PÄÄBO is director of the department of evolutionary genetics at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. One of the founders of paleogenetics. Awards: Leibniz Prize (1992), Pour la Mérite Order (2008), Order of Merit of the Federal Republic of Germany (2009), Kistler Prize (2009), Big Gold Lomonosov Medal (2014), and 17 prestigious academic awards including the 2019 Wiley Prize in Biomedical Sciences for the pioneering studies of ancient human DNA. Author and co-author of 350 research papers and 2 patents



Vivian SLON is a PhD at the department of evolutionary genetics at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. In 2018, she made the annual Nature's 10 list of people who mattered in science in the past year. Author and co-author of 42 research papers

© S. Pääbo, V. Slon, 2019

*In the summer 2018, leading archaeologists, geneticists, paleontologists and anthropologists from Russia, Europe, America and Australia came to the Denisova Cave research camp in Gorny Altai (a division of the Institute of Archaeology and Ethnography, RAS Siberian Branch, Novosibirsk), to participate in the international symposium "The origin of the Upper Paleolithic in Eurasia and evolution of the genus Homo." The participants discussed the results obtained from the studies of Denisova Cave, a unique archaeological monument populated by humans about 300 kya. For many years, Novosibirsk archaeologists have successfully cooperated with Prof. Svante Pääbo, a founder of paleogenetics whose work has received international acclaim, and his team from the Max Planck Institute of Evolutionary Anthropology, Germany. In the interview given to SCIENCE First Hand, Prof. Svante Pääbo and his colleague from the Evolutionary Genetics Laboratory Vivian Slon shared information on how ancient DNA was deciphered, which changed our previous linear notion of human evolution*

**S. PÄÄBO:**

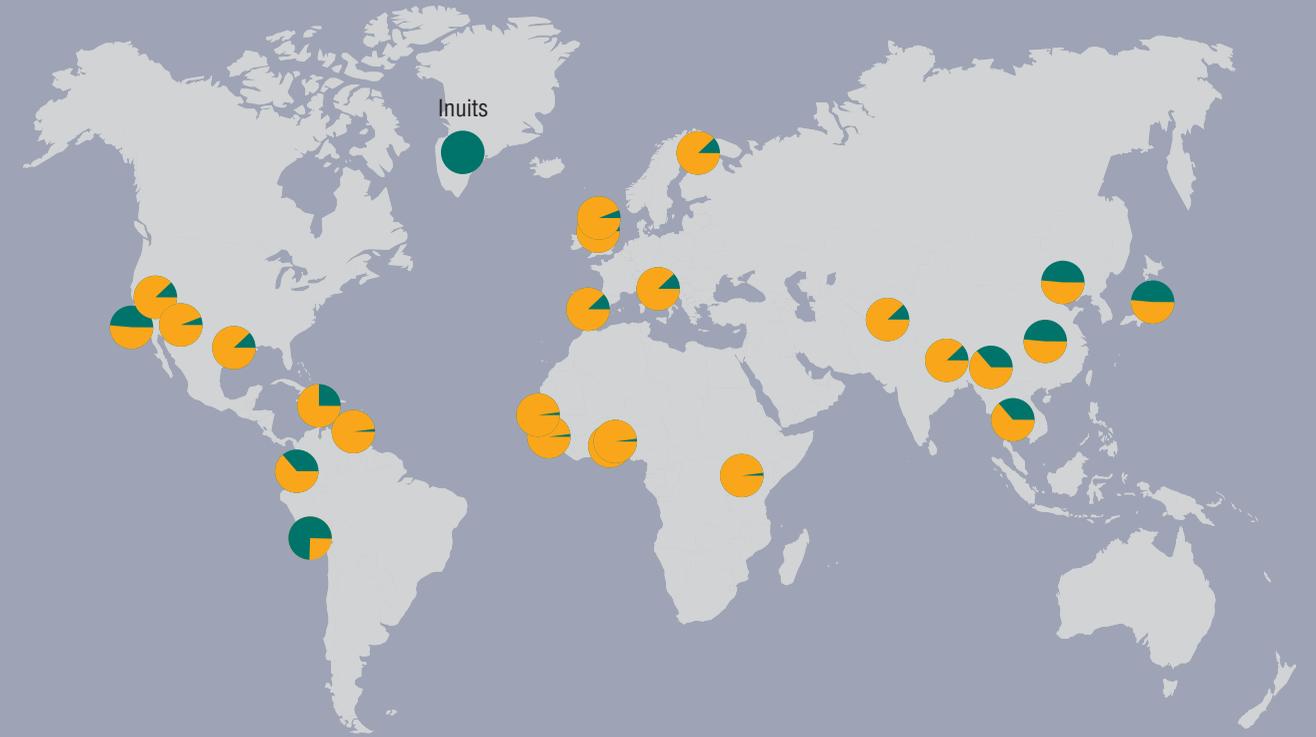
As a child, I was interested in archaeology and particularly Egyptology. Later, I studied it at Uppsala, the oldest Swedish university, but my earned my PhD for research in molecular immunology.

Then, in the 1980s, we were developing techniques that allowed us to extract, study and replicate DNA and it seemed obvious that we should try to do this from organic ancient remains, for example, Egyptian mummies. As I could find nothing in the literature concerning this subject, I set out to try to do that myself. It turned out to be much more frustrating than we had anticipated and took decades but eventually it turned out to be possible to develop techniques that actually allow us to do this very reliably today. Students come to us with a Master's degree and start working on research projects immediately, from the first day

**W**hen our team managed to decipher the first (not complete) Neanderthal genome in 2010, we discovered that the Neanderthals were part of the ancestry of all present-day people who live outside Africa, that is, they have contributed to the formation of modern humans. Later, thanks to cooperation with the Novosibirsk archaeologists from A. P. Derevyanko and M. V. Shunkov's team from the Institute of Archaeology, SB RAS, we got an opportunity to study the fossil remains found in Denisova Cave and other ancient hominin sites in Altai. As a result, we were the first to determine a very high quality Neanderthal genome, which allowed us to say very precisely which part of the genome of present-day people comes from Neanderthals.

An even more amazing find was the little bone that was found here, a fragment of the little finger bone of a young girl who, as paleogenetic analysis has shown, turned out to come from some previously unknown group, which we then together with the team here decided to call Denisovans. These are distant relatives of Neanderthals, if you like, who separated from them about 400 kya. The Asian population of Denisovans have contributed to the genome of the people of today living all over Asia, and particularly the inhabitants of Oceania, who have over 5% of the Denisovan DNA, as well as those of Papa New Guinea, and the aboriginals of Australia.

We have continued to work with the team here and have found several more remains of Denisovans, three additional bones and teeth, so we began to get a feeling for a variation among Denisovans. The most recent results come from our work with the remains from Chegyrskaya Cave, also here in the Altai region: we have determined a high quality Neanderthal genome and we begin to compare it with the genome of the Neanderthal from Denisova Cave and the genomes of Neanderthals in Europe.



**“The Denisovan skeleton may have been found already”**

What do we know about Denisovans today? It is a very interesting area of research because there is so little known about them. So what we can say is that they lived here, in the Altai Mountains, because this is where archaeologists have found their remains. Without doubt, they contributed to the native people all over Asia, so that gives us the hint that they were very widespread.

We have other hints about that, too. For example, it has been shown that there were at least two independent, distinct populations of Denisovans that contributed DNA to the present-day people. The genomes of the representatives of these populations are very different. One of these populations was quite distant from the Denisova Cave genome. It contributed, for example, to the people in Papa New Guinea and Australia, and the other of these populations was quite close to the genome we sequenced from here, and that is the population that contributed to the people in East Asia, people in China, people in Japan.

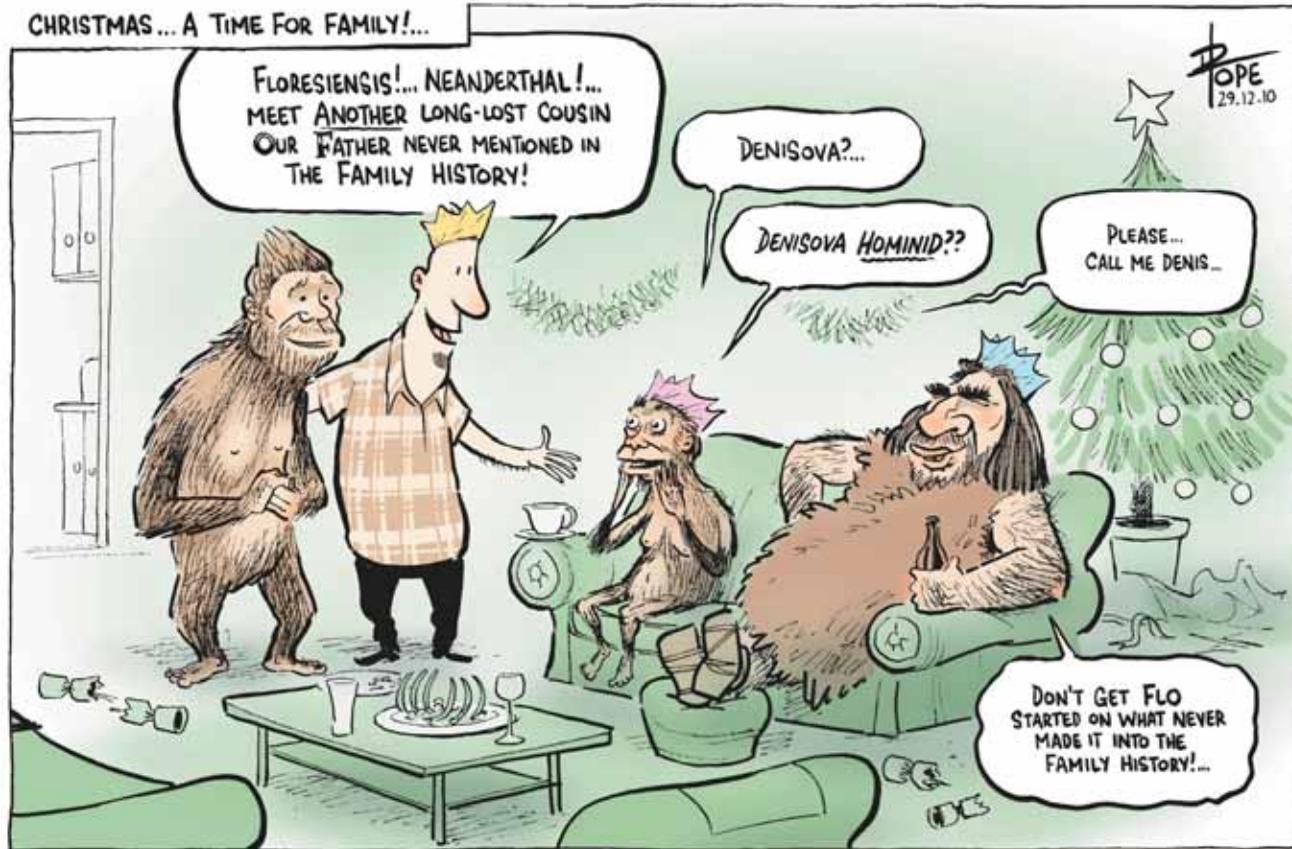
Denisovans have also contributed functionally important genetic variants to present-day humans. One such variant involved in the adaptation to living in high altitudes is widespread in Tibet: it is responsible for proper blood oxygen supply, which ensures that the blood does not have too many erythrocytes. Another adaptation quite widespread in Eurasia, particularly in Greenland, has to do with adaptation to cold temperatures. There are other such adaptations too that have to do with immune defense against infectious diseases, for example.

The gene variant TBX15/WARS2, which is presumably in charge of fat distribution in the human body and adaptation to cold, has been recognized as Denisovan legacy. This ancient gene variant is present in the modern Inuits of Greenland belonging to the Eskimos group of the Northern indigenous peoples as well as in some other peoples of America and Eurasia; in Africa, there is no Denisovan variant. The *blue* shows the frequency of the archaic allele in modern human populations.

*From: (Racimo et al., 2016)*

So we begin to know quite a lot about Denisovans but of course there are many things we don't know. For example, what their morphology was like. We know from the teeth found in Denisova Cave that they had unusually big teeth, bigger than Neanderthal teeth and modern human teeth. Our dream is, of course, to find a more complete skeleton or part of a skeleton either by excavations here or by analyzing the remains discovered elsewhere in Asia. Moreover, these remains may have been found already but we do not identify them as belonging to Denisovans.

In China, for example, fossil remains of the so-called Archaic Homo Sapiens have been found. They look a little bit like Neanderthals and a little bit like present-day humans. If we could extract DNA from these bones, they might turn out to be Denisovans. It can seem strange of course that Denisovans were so widespread yet we don't know about their remains except from this site here, in Denisova Cave in the Altai Mountains. On the other hand, we do not have a complete Neanderthal skeleton though Neanderthals have been studied for many decades.



David Pope, *The Canberra Times*, Australia

## Little pigeons can carry great messages

One of our latest researches was genetic analysis of a bone fragment discovered in the Eastern gallery of Denisova Cave in 2012. It was so small and so fragmented that you couldn't tell from the way it looks whether it belonged to an animal or a human. Generally, about 95% of fossil bone remains from Denisova Cave cannot be identified using conventional techniques. Our colleagues from Oxford applied a new methodology to identify hominin remains, and among 2,000 little bones found in the cave deposits dating to the time when both Neanderthals and Denisovans could be living there they identified this bone as hominin. Possibly, it is a fragment of the long bone of the arm or the leg.

And then we looked at the DNA from this little bone fragment and we were very surprised because we realized that it had two types of ancestry: it had both Neanderthal-like genetic variants and Denisovan-like genetic variants. We were able to determine that it was a female and she was the daughter of a Neanderthal mother and a Denisovan father. And this was the first direct, immediate evidence of interactions between these two distinct groups

of ancient hominins. In addition, there was evidence in the high-covered, high-quality Denisovan genome that there had been some Neanderthal ancestry into Denisovan line.

To make sure that our conclusions make sense, we checked the cannibalism hypothesis. It is possible, in theory, if you eat, for example, another animal, it would leave some of the DNA on the saliva and you leave some of your DNA on the bone of that animal. There are remains of Neanderthals that have clearcut marks or signs of burning, from which you can infer that there was cannibalism, at least in some cases among the Neanderthals of Western Europe. It may be a far-fetched hypothesis but we had to check to be on the safe side.

It may be disappointing but we don't know yet what the Denisovans looked like – we cannot visualize a person based on his or her genome. It is equally impossible to say what the offspring of these two distinct groups of ancient people looked like judging by this tiny bone fragment.

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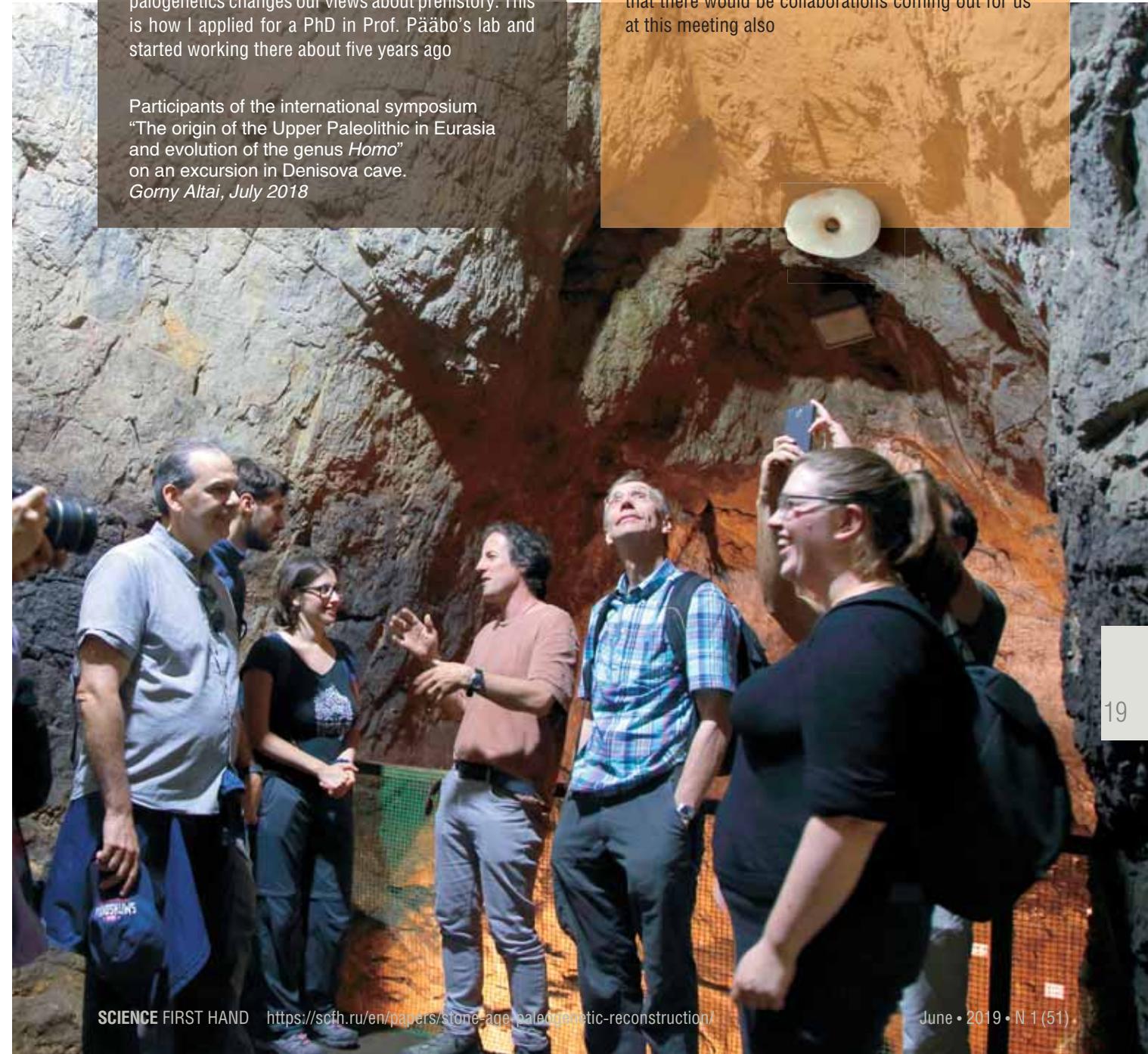
### V. SLON:

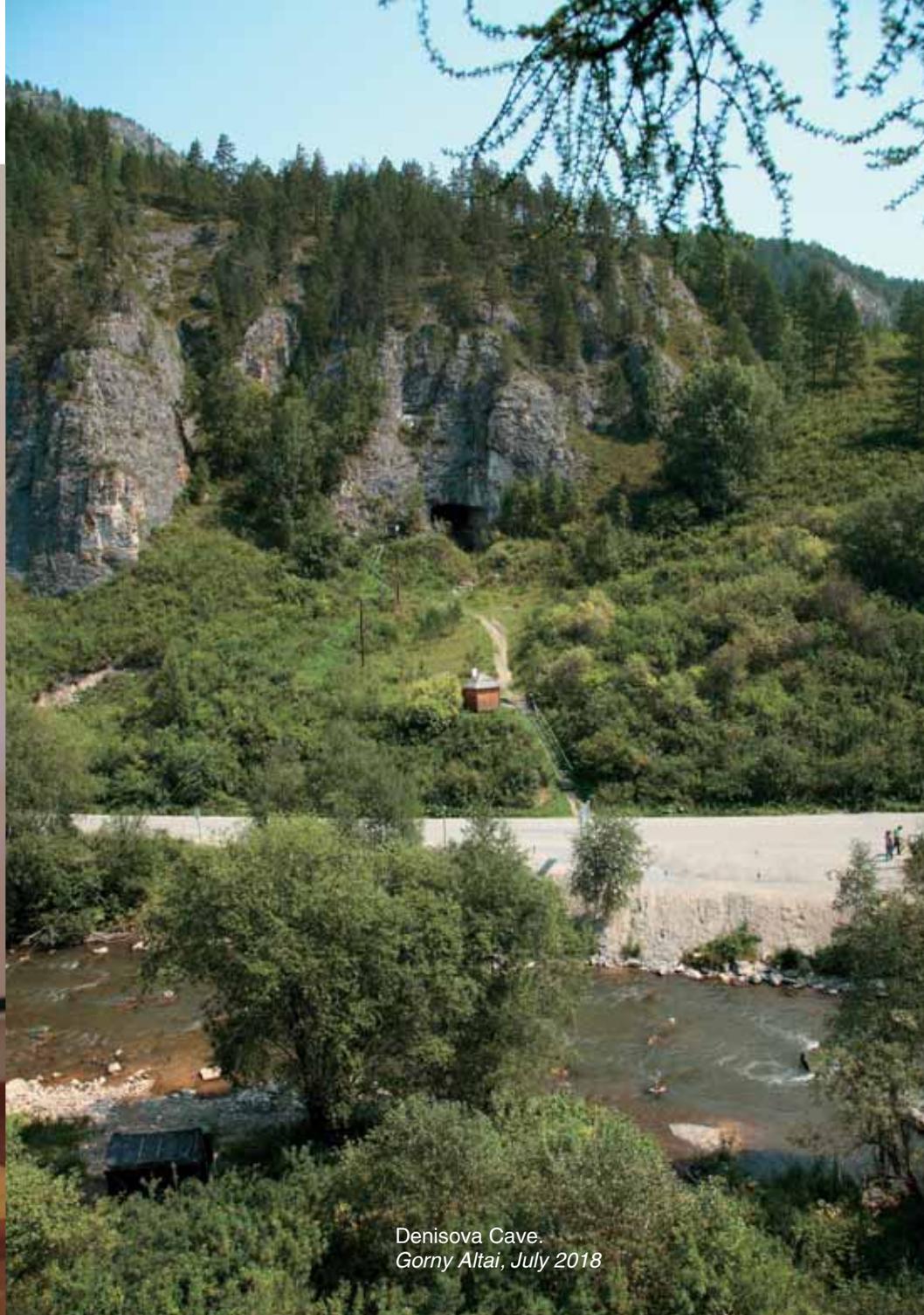
I was born in France but I grew up in Israel and I studied at Tel Aviv University before I moved to Leipzig to do my PhD. I've always been interested in pre-history, and I wanted to learn more about the people that made the artifacts and that made the stone tools that we find. So I started by doing a Master's in anthropology and as I was doing this, I was more and more exposed to people in genetics doing papers in genetics in Svante Pääbo's lab, and I thought that the best way to understand ancient people would be to be a part of this team since palogenetics changes our views about prehistory. This is how I applied for a PhD in Prof. Pääbo's lab and started working there about five years ago

Participants of the international symposium "The origin of the Upper Paleolithic in Eurasia and evolution of the genus *Homo*" on an excursion in Denisova cave. Gorny Altai, July 2018

### S. PÄÄBO:

This is the third time I have the privilege to be at a meeting here, at Denisova cave. These are wonderful meetings because they bring together people from different disciplines and a small number of very well selected specialists that spend several days together at this marvelous place. New things truly come out of this; one has time to interact for a long time with each other to really understand the other disciplines too. There have come several good collaborations out of the previous meetings, and I can already predict that there would be collaborations coming out for us at this meeting also





Denisova Cave, Gorny Altai, July 2018

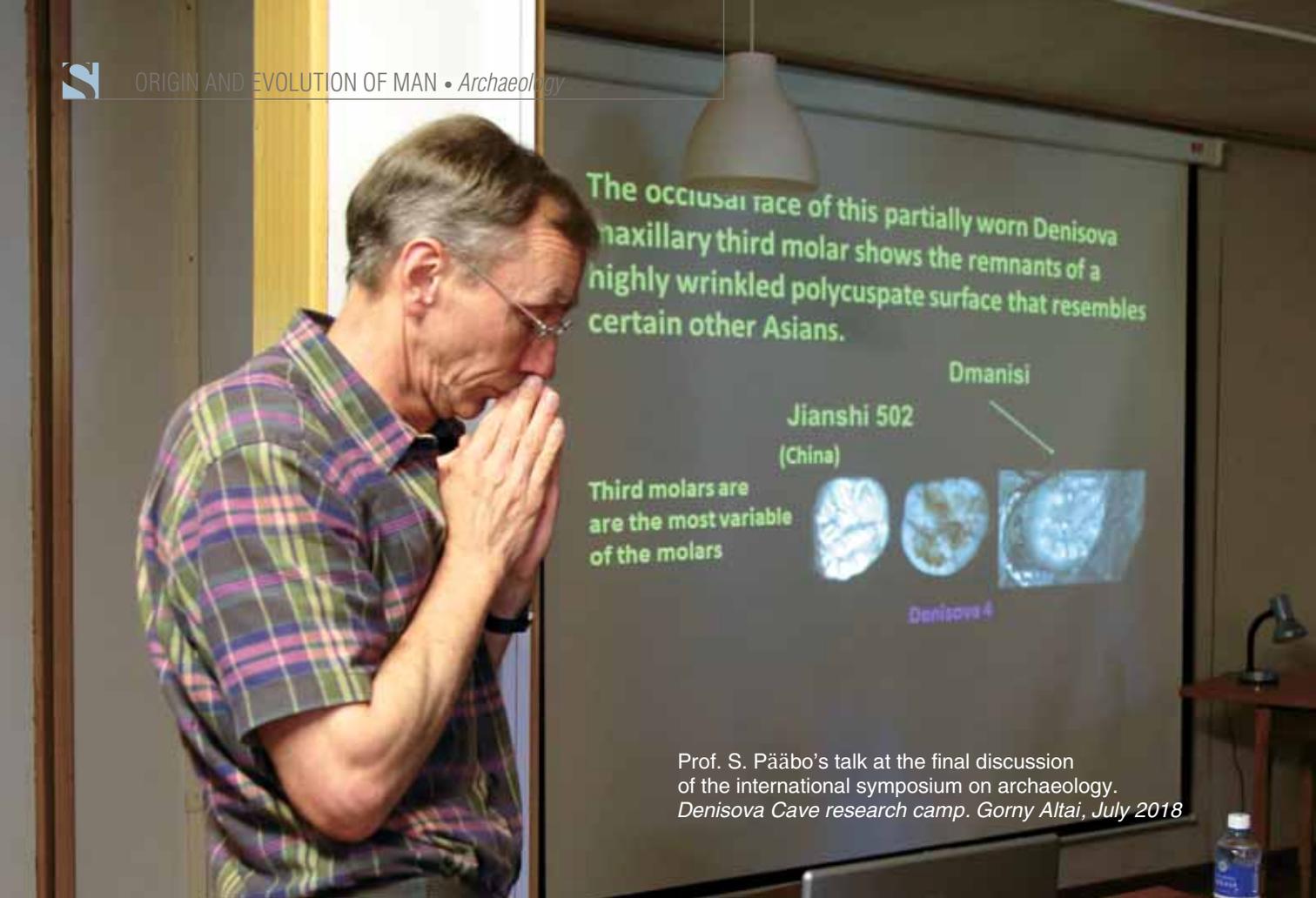


**S. PÄÄBO:**

My little message to young readers: you should do what you think is fun. Because if you do what you think is fun you are good at it automatically and you have a good time while you do it no matter what the result is

**V. SLON:**

I'm privileged to have been working at the finds from Denisova cave and from other places in Altai. The people at the Russian Academy of Sciences are doing an amazing job and it's been really great to come here and to see the site finally with my own eyes and to know how it looks like in real life and not just in photos



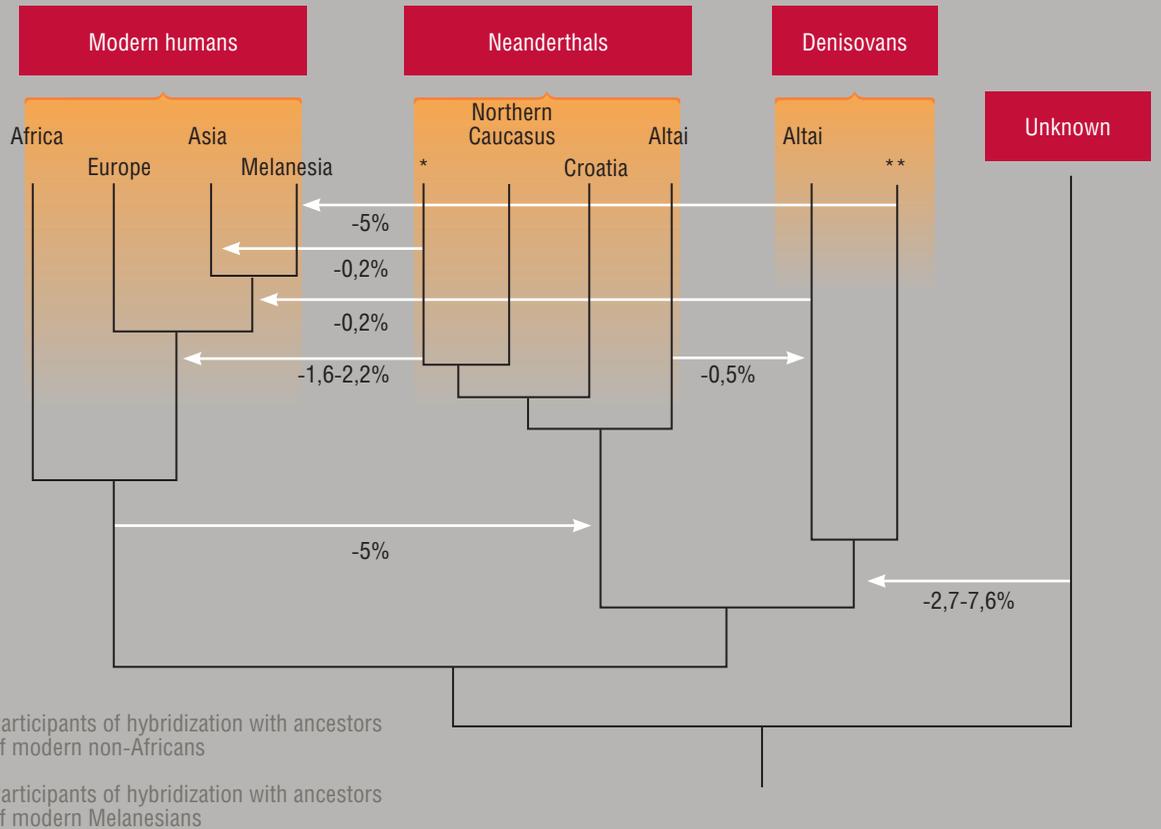
Prof. S. Pääbo's talk at the final discussion of the international symposium on archaeology. Denisova Cave research camp. Gorny Altai, July 2018

**S. PÄÄBO:**

There are variants of the Neanderthals and Denisovans that contributed to present-day people, and quite a few of them contribute to the tendency to get a certain disease or to protect against it. There is, for example, a variant of a chromosome of Neanderthals that's quite frequent in Asia – about 25% Asians carry it – and it contributes to the risk to get type II diabetes, the type of diabetes you get in old days. Though there are many other mutations contributing to the risk to get this disease, interestingly, it is this very variant that has come over to modern humans and risen to high frequency. It also illustrates an interesting thing: genetic variants interact with the environment to cause a disease. So it's a very reasonable speculation to say that the variants that today give us diabetes when we get old, when we have eaten almost too much throughout our whole life, may actually protect or help us survive in the situation of starvation. It's very likely that these very variants that protected Neanderthals against starvation have come over to modern humans and they have the same positive effect that rose to high frequency but today the consequences are very different for us

We have to be very careful predicting any sort of traits of an individual (like diseases he/she could have suffered from) looking at any particular variant in the genome. Today, we know that some genetic mutations may cause some rare diseases. For more interesting and more common diseases such as atherosclerosis, hypertension, autism or schizophrenia, there are dozens and hundreds of variants that contribute to a certain tendency to get this disease. So even knowing everything about one's genome, we cannot predict what diseases we will get – we can only estimate the risk of having them.

And this we know from present-day people. The Neanderthals were quite different and had different kinds of variants, so I would not dare to just use the limited predictive ability that we have for the present-day humans and apply it to Neanderthals or Denisovans, for that matter. So the sad truth is that we can say very little from the genome about what a person looked like and less so about how he behaved or what diseases he carried because each human population has its own history.



\* Participants of hybridization with ancestors of modern non-Africans  
 \*\* Participants of hybridization with ancestors of modern Melanesians

This is the way the humans' family tree updated in line with the most recent paleogenetic data looks like. The arrows and numbers stand for the gene flows among the various groups of ancient hominins and their contribution to the gene pools. From S. Pääbo's presentation at the symposium "The origin of the Upper Paleolithic in Eurasia and evolution of the genus Homo." Gorny Altai, July 2018

Today, there very few ancient individuals whose nuclear DNA we have managed to sequence. Therefore, it is amazing that we have found a first-generation offspring of a Neanderthal and Denisovan. We should remember that these were quite distinct populations. In fact, they were more distinct from each other than any populations of modern humans are today...

Yet, we find here, in the Altai Mountains, this daughter of a Neanderthal and a Denisovan. It suggests to us that when they met they probably mixed quite frequently, otherwise we would not be so lucky as to find this little bone here. But it also suggests to us that they couldn't have met too often as they were quite separated in time and space. Such meetings could have taken place from time to time in some regions such as the Altai Region here. And then apparently they had nothing against each other and had babies together.



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The photographs are the courtesy of S. Zelensky (Institute of Archaeology and Ethnography, SB RAS, Novosibirsk)

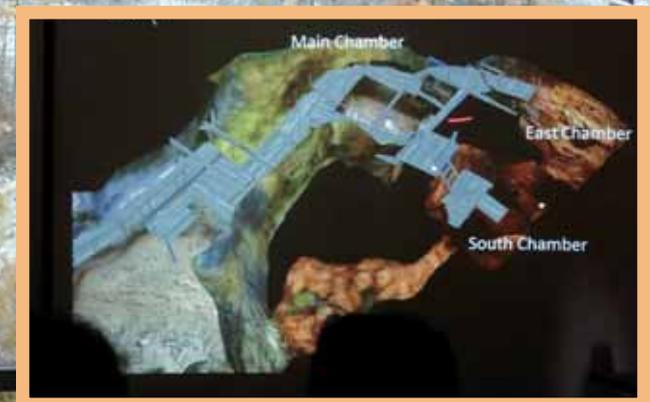
# Altai

## as the Center of the Ancient OECUMENE

*Who are we? When, where and how did we appear? The origin of modern humanity, that is you and us, is currently a subject of concern to scholars and general public. This interest is being stirred up by the amazing discoveries made in the last few decades. An important contribution to these discoveries is the research carried out by the Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences. The geography of the Paleolithic monuments studied by Siberian archeologists is impressive: Siberia and adjacent countries, from Mongolia to Kirgizstan, Dagestan, Europe and Vietnam... And yet a gold mine of unique finds appears to be the Russian Altai. At the request of "SCIENCE First Hand" Academician A.P. Derevyanko told us about the multi-year studies of the Paleolithic in Altai, which have hit the headlines more than once*

The valley of the River Anui, the left tributary of the Ob, flowing through the Republic of Altai and Altai Krai. The Denisova Cave is situated here, close to the estuary of the Karakol River. Photo by S. Zelensky





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**Key words:** human evolution, multi-regional theory of human origin, "Out-of-Africa" theory, Neanderthal, Denisovan, anatomically modern humans, paleogenetics

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**A** topical issue of today's archaeology and anthropology is how modern humans, with their genotype and anatomy, evolved. Until the 1970s-1980s, there was quite a coherent hypothesis about our origin: from the Australopithecus to Neanderthals, who were the immediate ancestors of the present-day humans. This idea was strongly supported by the studies of our contemporaries' genomes. In 1987, *Science* published an article that convincingly proved that modern humans were "born" in Africa, the same as *Homo erectus*, who left the "cradle of mankind" about 1,800,000 years ago for the vast expanses of Eurasia.

The African hypothesis sparked a lively discussion among the scholars engaged in human evolution, from anthropologists to geneticists, resulting in diverse opinions and new ideas, maybe not always well-thought-of. By the end of the last century,

two major hypotheses domineered. The first maintained that present-day humans formed in Africa about 200,000 to 100,000 years ago, and 80,000 to 60,000 years ago their exodus to Eurasia started. Concerning the outcome of the last migration, views varied. Some believed that the newcomers destroyed or replaced the aboriginal population; others favored a more humanistic opinion, considering that the relations between the strangers and aborigines were complementary: acculturation and maybe even hybridization occurred.

According to the second, multiregional, theory, the formation of the present-day humans took place not only in Africa but also throughout the areas inhabited by *Homo erectus* and subsequent human forms evolving because of natural selection and gene exchange between the populations.

These two seemingly alternative hypotheses used to be widely discussed at conferences and workshops, in books and articles... Today, however, our views on the history of humanity have changed dramatically.

The view of the Anui valley from the Denisova Cave must not have changed much in the last millennia. The entrance to the cave though was two meters from the ground level instead of the six meters we have today. *Photo by M. Kozlikin*

*Bottom right:* Digital 3D-model of the Denisova Cave: the central, eastern and southern halls. *Trimetary Consulting (St Petersburg)*

Among the major drivers of this change are the results of the investigations our research institute has been conducting in Gorny (Mountainous) Altai throughout the last few decades, primarily, in the Denisova Cave – a unique ancient site of North Asia. The fieldwork carried out there since 1983 has produced a number of discoveries (for example, the discovery of the remains of a previously unknown hominin, *Homo sapiens altaiensis*) that have allowed us to take a fresh look at the history of modern humanity.

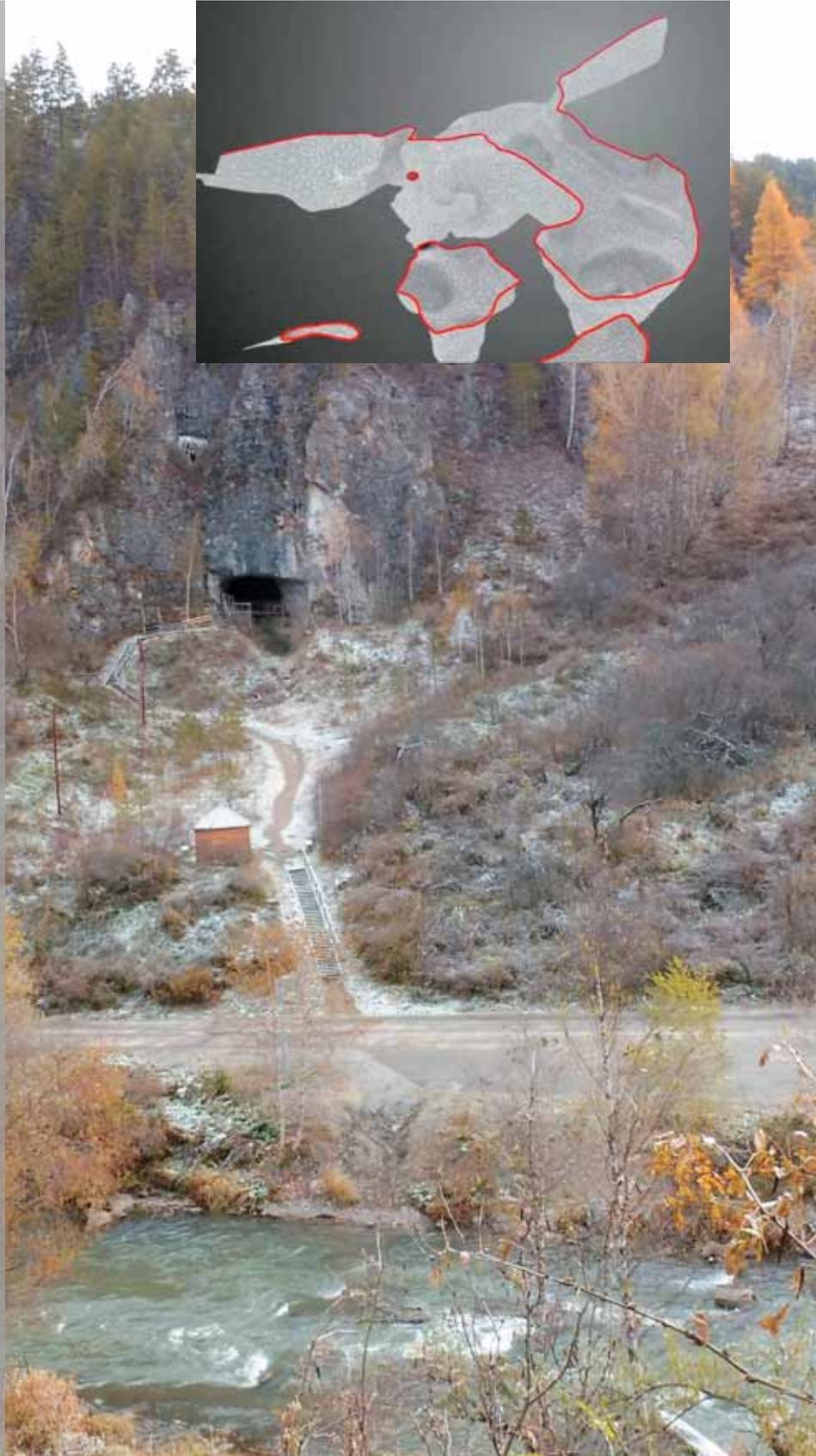
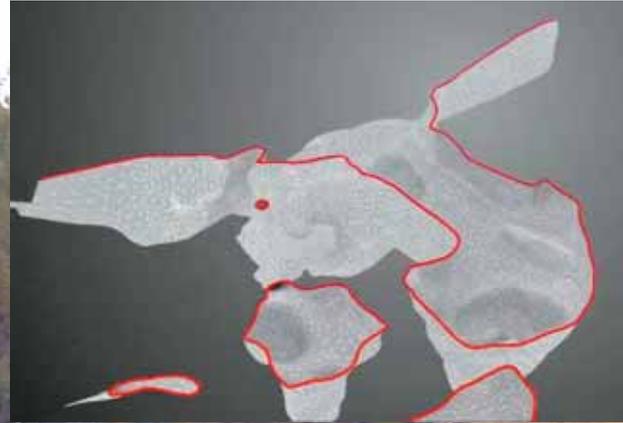
## Rewards of scientific cooperation

Today the words “Altai,” “Denisova Cave,” and *Homo altaiensis* are known worldwide, and not only to scientists involved in the study of human origin but also to journalists and a wide range of educated and curious people.

I became aware of it during my recent visit to the University of Hong Kong. When my interlocutors found out that I was directly involved in the Denisova Cave investigations, they started asking questions and even giving advice and recommendations. Some details that had never occurred in real life were mentioned. Rumor spreads, and the discovery of the Denisovan has a whole mythology around it.

It is a good thing, of course, that our Denisova Cave has become so popular but we have carried out fieldwork in other nine caves and at eleven ground sites as well! The huge volume of materials collected enables us to track a long stage of human spiritual and material culture development. We work in close collaboration with a wide range of scientists, such as geologists, geomorphologists, geochronologists, paleontologists, anthropologists, and paleobotanists. This collaboration has allowed for quite a detailed reconstruction of the environmental and climatic conditions that existed in Altai dozens and hundreds of thousands of years ago.

The narrow river valley in the upper reaches of the Anui protected by mountain ridges and rich in vegetation and fauna became a true “oasis” for the early man.  
*Photo by M. Kozlikin*

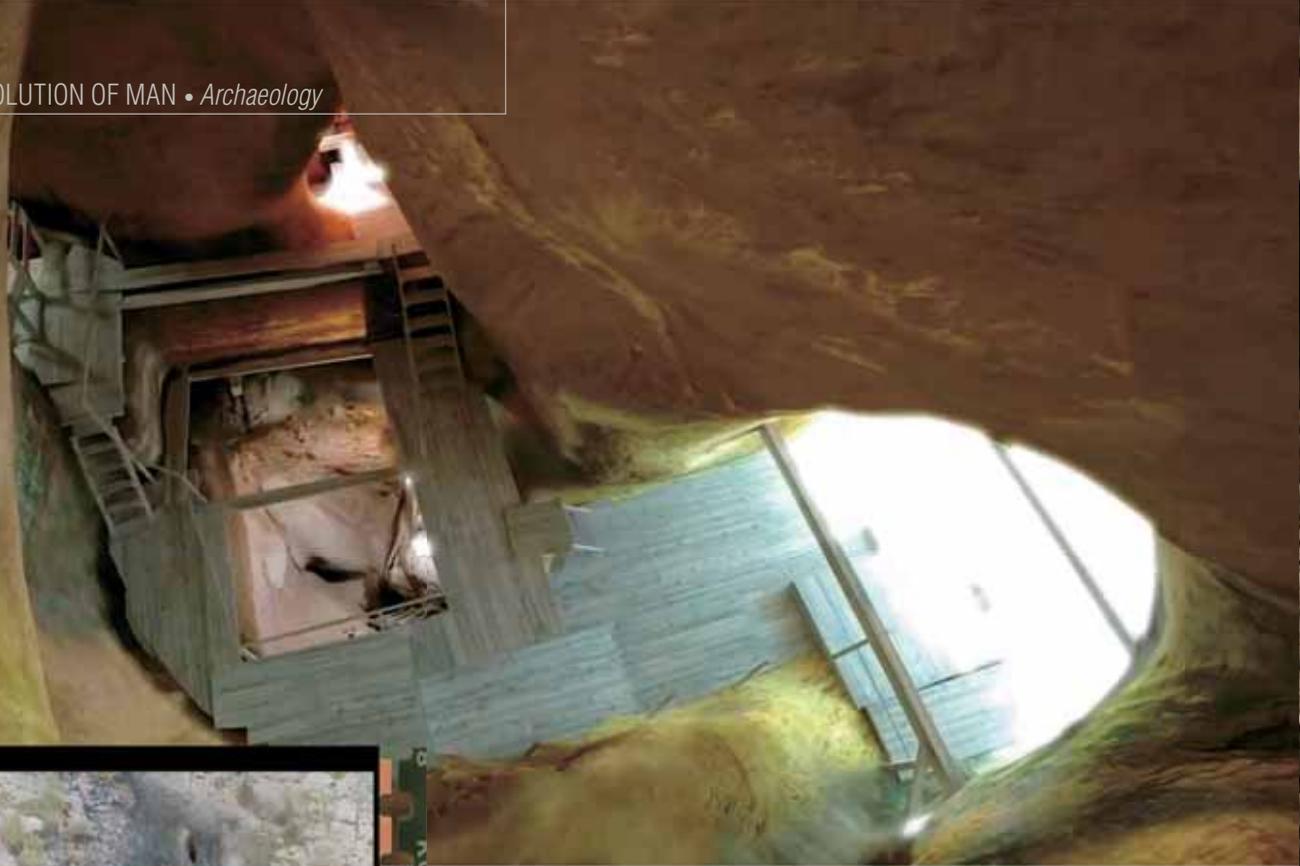


A most important archaeological finding made in the last few decades is the Paleolithic site Karama discovered in the Anui River valley, Gorny Altai, by archaeologists from Novosibirsk. This remarkable ancient location testifies that humans (*Homo erectus*, to be more specific) appeared there no later than 800,000 years ago. Bearing in mind that Karama is situated at 52 degrees north latitude, we can safely call it the northernmost site of that time. There is a similar site in England but owing to the Gulf Stream washing the shores the climatic conditions there are far more comfortable than here, in Siberia. This means that our direct though distant relative had sufficient cognitive abilities to adapt to the situation existing at that time in Pleistocene so far to the north



In 2012, within the frames of the project “Virtual Denisova Cave in Altai” a 3D-digital model of the cave and findings discovered in it was made, as well as software for the interactive visualization of this information.  
*Top: entrance to the Denisova Cave, bottom: the central hall.  
3D-presentation by the Trimetary Consulting (St Petersburg)*





One can hardly overestimate the importance of these data as at the time of Pleistocene the global climate was undergoing dramatic changes, which undoubtedly exerted great influence on the development of vegetation and wildlife. All this directly concerned humans as it affected their settlement patterns and technological progress. Suffice to say that 90,000 to 120,000 years ago Altai had a much milder climate than nowadays. The average temperatures, for example, were 5–6 degrees higher, which created a comfortable environment for broadleaves and other thermophilic plants.

The total area of the Denisova Cave is 270 square meters. Branching from the central hall into the karst mass are the eastern and southern galleries filled with loose deposits. *Right: Digging in the East gallery. Photo by S. Zelensky*

3D-models of the some areas of the Denisova Cave (top to bottom): central hall, pre-entrance area, entrances to the East and to the South galleries. 3D-presentation by the Trimetary Consulting (St Petersburg)



What is unique about the Denisova Cave is that organic material has been preserved here better than elsewhere. For example, I brought 12 bone samples aged 12,000–15,000 years old from Vietnam, where we have been working for ten years. However, we failed to extract ancient DNA good for sequencing from either of them – microbes have eaten everything. It is the good state of preservation of the anthropological fossils from the Denisova Cave that has allowed us to obtain a high coverage Neanderthal genome – a much higher coverage than for all the findings made in the Balkans



Ropes going from the cave to the opposite bank of the Anui transport the excavated materials down, where they are washed, sieved and sorted. *Top*: Sorting the washed coarse fractions of the Pleistocene deposits under the supervision of Prof. A. K. Agadzhanian (Paleontological Institute RAS, Moscow); *bottom*: a rodent's bone found in the washed finer fractions. *Photo by S. Zelensky*

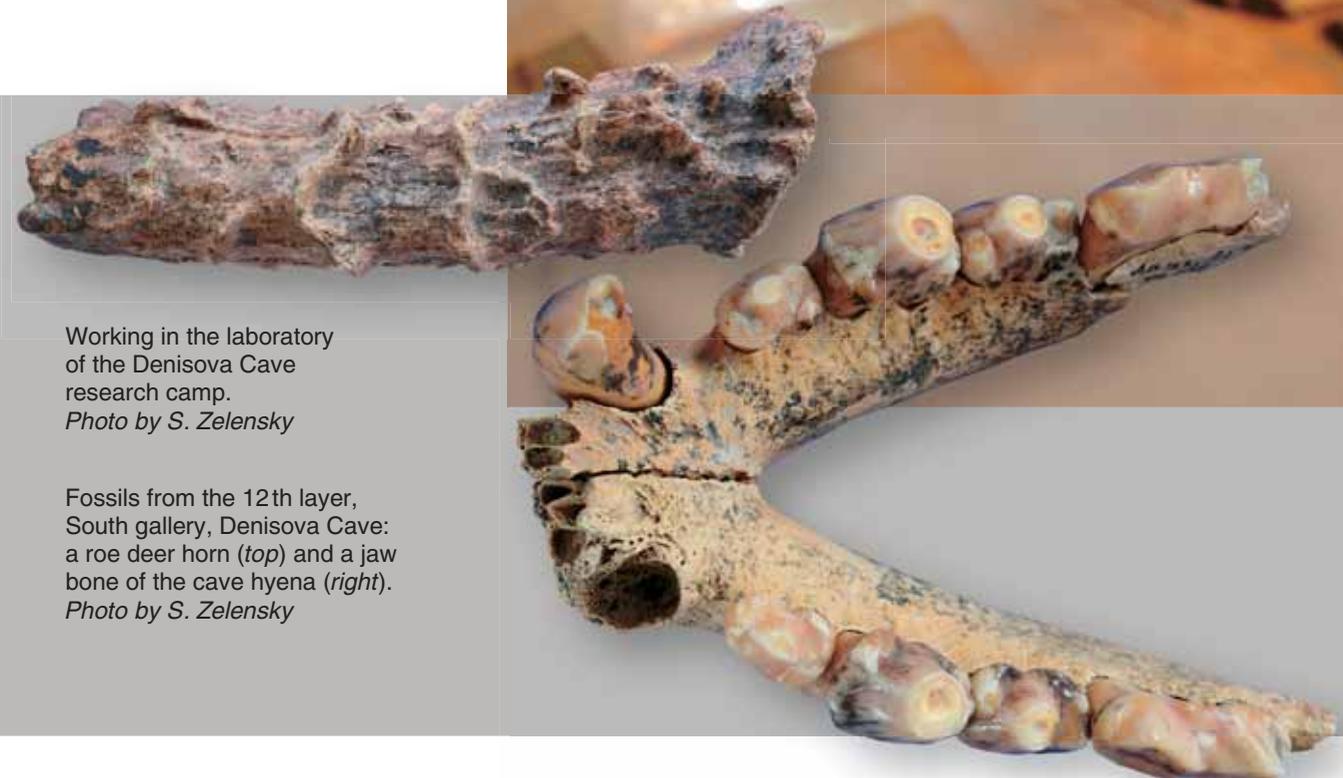


Tusk of a baby mammoth from the 12th layer. *East gallery, Denisova Cave. Photo by S. Zelensky*



In the eight years of excavations conducted in the cave gallery where the Denisova-11 remains were found, archaeologists have discovered over 130,000 bones (mostly small), 120,000 of which have not been identified yet. The big number of bone remains proves that the Denisovans preferred meat food. They hunted animals and broke their bones to extract marrow. It is extremely unlikely that more bones found will be attributed to humans because specialists can distinguish between human and animal bones almost immediately. As for determining the species composition, it is a complicated problem because all the bones are badly fragmented

In the first eight or nine years of field work in the Denisova Cave and at other Paleolithic sites in Altai, innumerable artifacts were collected including stone and bone tools and decorations made using highly advanced technology. They all testified to the fact that 30,000–50,000 years ago this area was home to populations with a highly developed culture. We did not doubt at the time that all those findings belonged to anatomically modern humans. Therefore, the genetic analysis of a small fragment of the phalange of a human little finger (discovered in the 11th layer of the Denisova Cave) performed in 2010 by Prof. Svante Pääbo's paleogenetics laboratory, Max Planck Institute of Evolutionary Anthropology, Germany, came as a complete surprise.



Working in the laboratory of the Denisova Cave research camp. *Photo by S. Zelensky*

Fossils from the 12th layer, South gallery, Denisova Cave: a roe deer horn (*top*) and a jaw bone of the cave hyena (*right*). *Photo by S. Zelensky*

Importantly, though a field season here lasts at least three months and excavations have been carried out for a few years, not so much material has been produced out of the Denisova Cave. In contrast to regular extracting works, digging in this cave takes much longer as every gram of the extracted ground should be scrutinized and carefully examined – this is the only way to discover minute findings, such as bone fragments.

One must say these efforts have paid off handsomely. The decoded DNA obtained from a tiny bone fragment showed that the bone belonged neither to an anatomically

modern human nor to a Neanderthal but to an entirely new population.

Apparently, this was the scoop of the century, followed by publications in the leading world scientific journals *Nature* and *Science*.

### Four in one

As already mentioned, the Denisova Cave findings were instrumental in changing our views on the origin of present-day humans. On the one hand, these discoveries

strengthened both hypotheses, monocentric and polycentric; on the other hand, they gave grounds to unite them.

To this effect, of great value is the decoding of the Neanderthal DNA from the remains discovered, among other sites, in the Denisova Cave. At first, this primitive man was deleted from our family tree because his genes were not found in the genome of the present-day people. Subsequently, however, Dr. Svante Pääbo's research team managed to sequence the fossil Neanderthal DNA using more advanced techniques, which showed that modern



Typical Early Upper Paleolithic artifacts discovered in the 11th layer, South gallery, Denisova Cave (50,000-40,000 years old): marble, agillite and serpentine beads (top), fragment of tooth pendent and stringing made of animal bones (bottom). Photo by A. Fedorchenko

The Denisovans had one of the brightest ancient material and spiritual culture. Not surprisingly, before they were discovered, scientists believed that this culture belonged to anatomically modern humans as it met all the criteria of the European Upper Paleolithic. However, in Siberia it formed much earlier, about 50,000 years ago. There is no matching well-developed Paleolithic industry of that age anywhere in the world; nowhere such a big number of various stone tools and other artifacts including decorations have been found.

The level of this culture development is attested to by the discovery of stone needles (more than ten). One of them, virtually intact, found two years ago, is very thin and exquisitely made, which means that the ancient humans could make their clothes not only from pelts but from finely tanned skins of small animals. They could even have used plants: the Nanaians are known to have made high quality nets out of cannabis and nettle fiber as early as at the beginning of the Neolithic. This is how any archaeological finding can give us a lot of interesting information



A "pencil" made of mineral pigment and marbles with ocher traces (right) and a bone arrowhead (left) discovered in the 11th layer, South gallery. All these findings refer to the early stage of the Upper Paleolithic. Photo by A. Fedorchenko

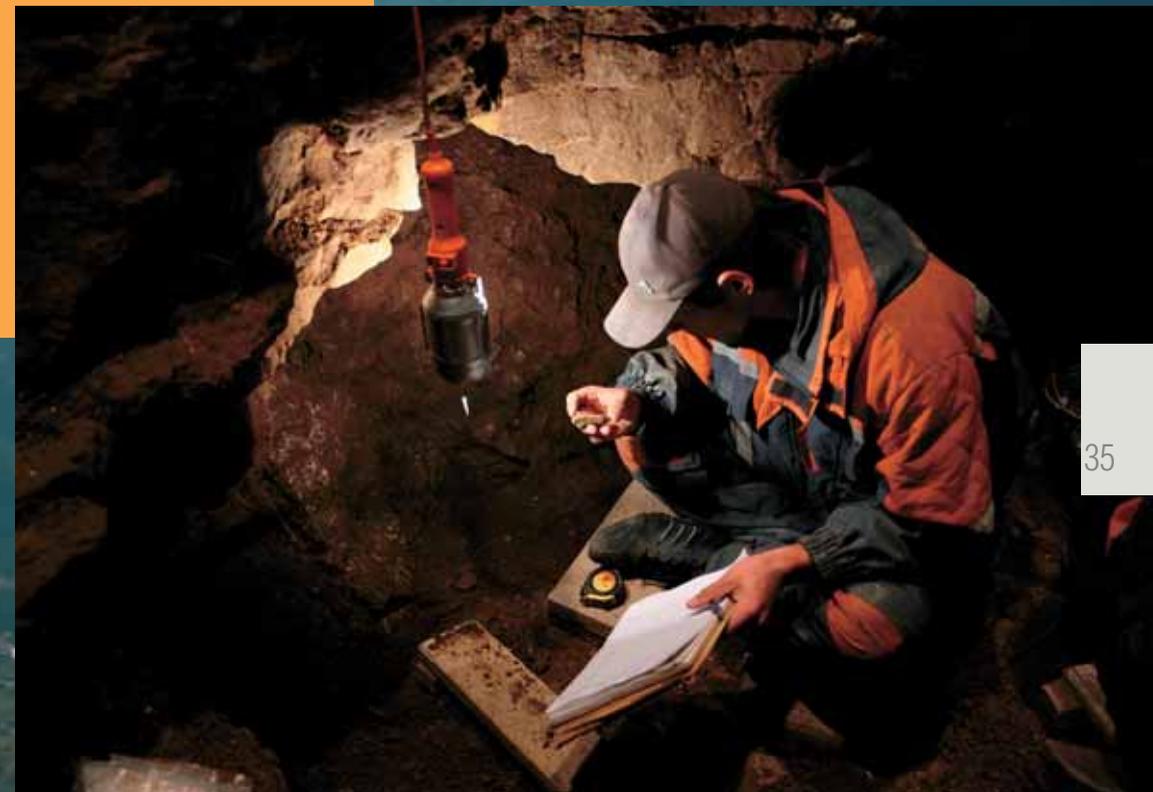
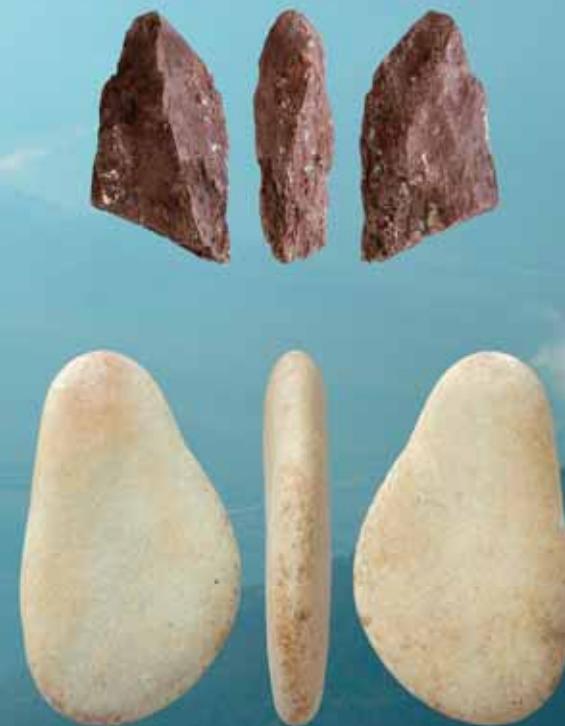


Photo by S. Zelensky



The leading specialists in radiocarbon dating T. Higham and K. Douka (Oxford University, UK) in the Chagyrskaya Cave, home to Neanderthals. Photo by S. Zelensky



**PROFESSOR SVANTE PAABO.**  
From the discussion at the international symposium.  
Gornyy Altay, July 2018

Today, the situation with the Denisovans is unusual: besides genetic data, we do not have anything relating to them except for a few teeth and small bones plus a small and quite thick fragment of a skull.

Basing on these data, we can say that the Neanderthals and Denisovans have common origin; they diverged about half a million years ago. Judging by the Denisovans' genetic contribution to the humans of other groups, we can make a prudent assumption that the Denisovans were more numerous than the Neanderthals and that they represented a more interesting human population.

Supposedly, there were two (most probably, three) massive gene flows from the Denisovans to the modern human genome. The matter is that within the Denisovans two groups, very different genetically, can be distinguished. This perhaps explains why the modern Melanesian population has such a high share (4.8% on average) of the Denisovan genome. Also, we know that Denisovans crossed not only with modern humans but also with the Neanderthals. I am quite confident though that in the former case the process was much more successful. Research into the genetic heritage of modern humans testifies to an important contribution made by the Denisovans, who passed on to us some very important and useful features, such as adaptation to living in harsh climate

non-African humans have about 2% of Neanderthal genes. Is it much or little?

Recently, the DNA sequencing results of the remains of modern humans from Pesteră cu Oase, Romania, were published. It turned out that the Neanderthal quotient of these people, who lived about 40,000 years ago, was over 9%! It may have been even higher in the antecedent period. With time, naturally, the genome varied and

some Neanderthal genes were lost. This shows that the Neanderthals were closely involved in the formation of present-day humans. The same is true of the Denisovans, whose quotient in the modern human populations of South-East Asia is 3–5%.

In the light of this information, human evolution can hardly be defined as linear. Without any doubt, another

The ancient DNA extracted from the human fossil remains from the Denisova Cave was studied by the researchers of the laboratory led by Prof. S. Pääbo, Max Planck Institute for Evolutionary Anthropology (Leipzig, Germany).  
On the photo: S. Pääbo talking at the international archaeological symposium. Gornyy Altay, July 2018.  
Photo by S. Zelensky

important contributor to our genome (in addition to the Neanderthal and Denisovan) is the hominin formed in East and South-East Asia, where we have evidence of a well-marked consistent development of stone industry. Though no fossils of this “Eastern hominin” have been found yet and his DNA has not been isolated, the tools discovered indicate that he must have come to northern China from Mongolia, most probably, from Mongolian Altai. I am confident that the future anthropological findings of this area will show Denisovan roots and the remains of this as yet unknown human subspecies will definitely be discovered both in China and in other East Asian regions.

The hypothesis that *Homo sapiens* has evolved from four subspecies is being actively discussed. Surely, Africa remains the stem line of development. The early human populations left it to settle all over the vast territory of Eurasia. Eventually, about 50,000 to 30,000 years ago, migration and gene exchange between different populations resulted in the birth of you and me.

## Denisova Cave as an international lab

Today we are in a new phase of diggings inside the Denisova Cave and research into the Altai Paleolithic on the whole. In summer 2018, it was the venue of the second symposium dedicated to the transition from the Middle to Upper Paleolithic. We discussed, among other things, the new data resulting from the studies of the materials extracted from the cave. The participants were scientists from about ten countries, though our aim was not to encourage greater participation but to get together all the leading experts working on the issue.

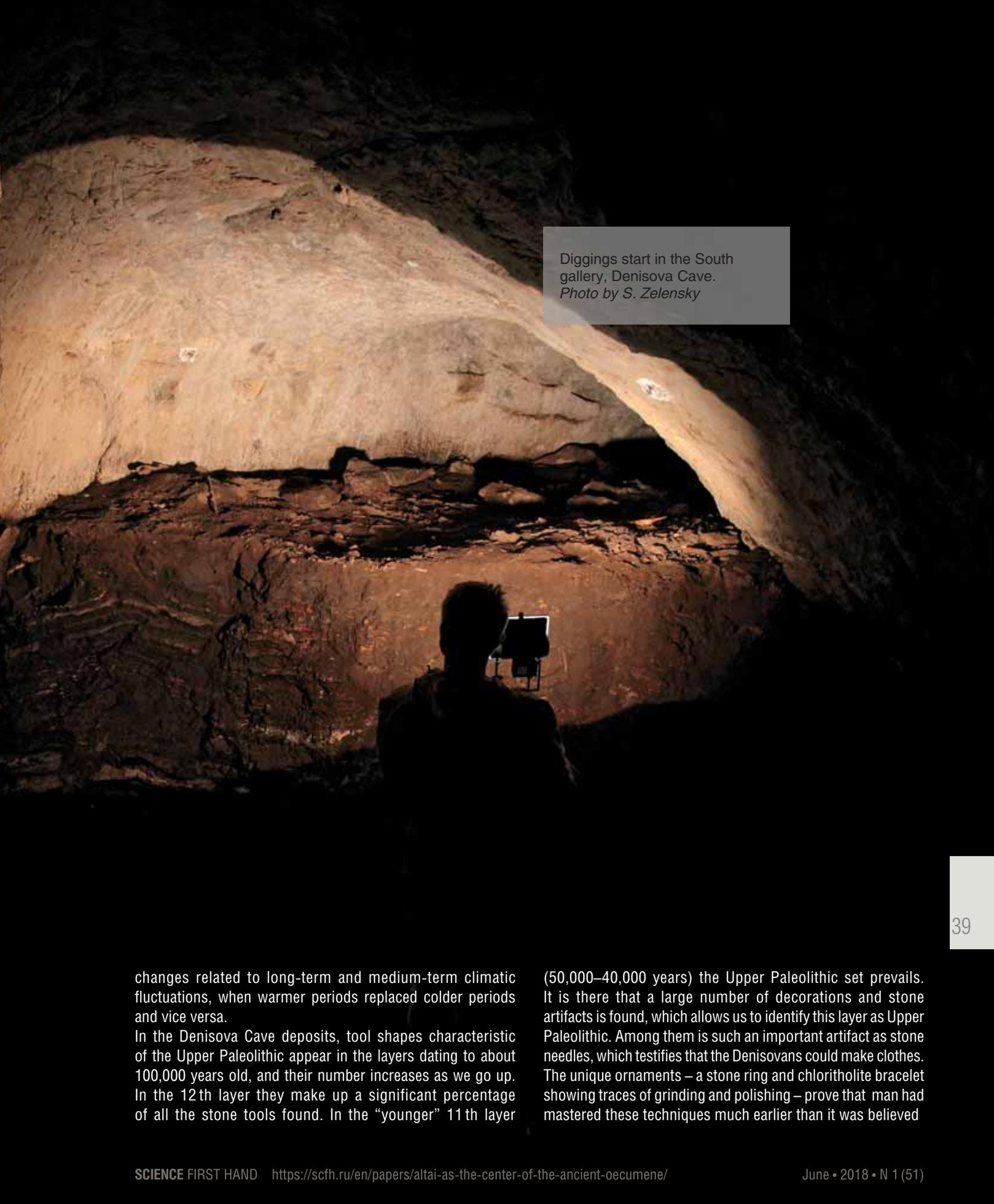


Decorations of mammoth tusk dating to the Early Upper Paleolithic: fragments of a diadem (top) and a ring (bottom). 11th layer, South gallery, Denisova Cave. Photographed by A. Fedorchenko



**ACADEMICIAN A. P. DEREVYANKO.**  
*From the discussion at the international symposium.*  
*Gorny Altay, July 2018*

Archaeologists have no clear definition of the Upper Paleolithic, the same as anthropologists have no clear definition of the “anatomically modern human.” The Middle East gives us many examples of the constant mixing between the Middle Paleolithic and Late Paleolithic cultural traditions, which could be the consequence of changing ecological conditions. In the time interval of 60,000–40,000 years ago preceding the last Ice Age, the climate, as always, was undergoing

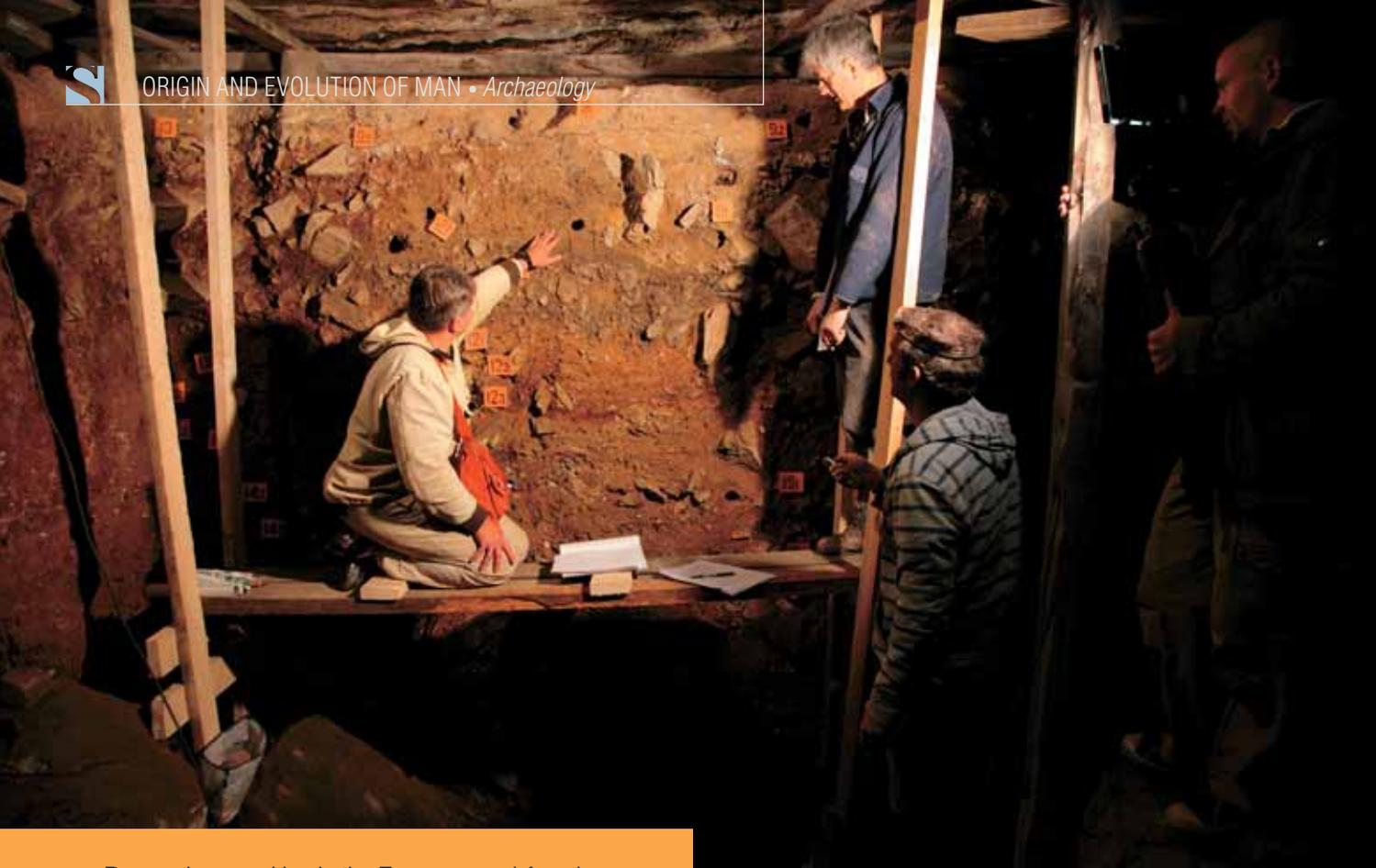


Diggings start in the South gallery, Denisova Cave.  
 Photo by S. Zelensky

changes related to long-term and medium-term climatic fluctuations, when warmer periods replaced colder periods and vice versa.

In the Denisova Cave deposits, tool shapes characteristic of the Upper Paleolithic appear in the layers dating to about 100,000 years old, and their number increases as we go up. In the 12th layer they make up a significant percentage of all the stone tools found. In the “younger” 11th layer

(50,000–40,000 years) the Upper Paleolithic set prevails. It is there that a large number of decorations and stone artifacts is found, which allows us to identify this layer as Upper Paleolithic. Among them is such an important artifact as stone needles, which testifies that the Denisovans could make clothes. The unique ornaments – a stone ring and chloritoholite bracelet showing traces of grinding and polishing – prove that man had mastered these techniques much earlier than it was believed



Researchers working in the European and American laboratories have managed to obtain, using a variety of methods, about 170 datings related to the Paleolithic layers of the Denisova Cave. According to the latest data, the cave became inhabited over 300,000 years ago. In the photo: selecting samples for OSL-dating in the central hall of the cave. *Photo by S. Zelensky*

**Today, paleogeneticists have learnt how to extract ancient DNA directly from cave deposits. Though this technology needs improvement, it offers a unique material to archaeologists and anthropologists.**

**This approach has helped us to discover the Denisovan DNA in the 15th layer of the Denisova Cave East gallery, dating to over 200,000 years ago. As we know, some (not many) anthropological bone fossils were found in more recent layers, too. When the DNA extracted from them was sequenced, it turned out that most of them belonged to the Denisovans and some of them to the Neanderthals. In addition, the Neanderthal DNA was extracted from the 14th layer deposits dating to 190,000–200,000 years ago. This is the most startling revelation because during this chronological period no “trace” of Neanderthals has been found either in the Middle East, or Middle Asia or Caucasus – they were yet in the stage of formation. This is food for thought ...**

In the three years that passed after the previous meeting we have managed to do a lot. Firstly, we have obtained a long series of exact datings, which is imperative to support any hypothesis related to ancient humans. In order to prove or deny something, you need to know the exact chronological frames of the events in question. Today, with the help of our colleagues from Europe and Australia, we have obtained over a hundred of such indisputable datings for the cave, which agree nicely with one another.

Secondly and most importantly, the genome of the bone fragment called “Denisova-11” has been deciphered. This ancient hominin has turned out to be a hybrid of two primitive individuals. The sequenced DNA shows that the parents were a Denisovan (father) and a Neanderthal (mother). Moreover, the Denisovan father had at least one Neanderthal ancestor a few generations ago.

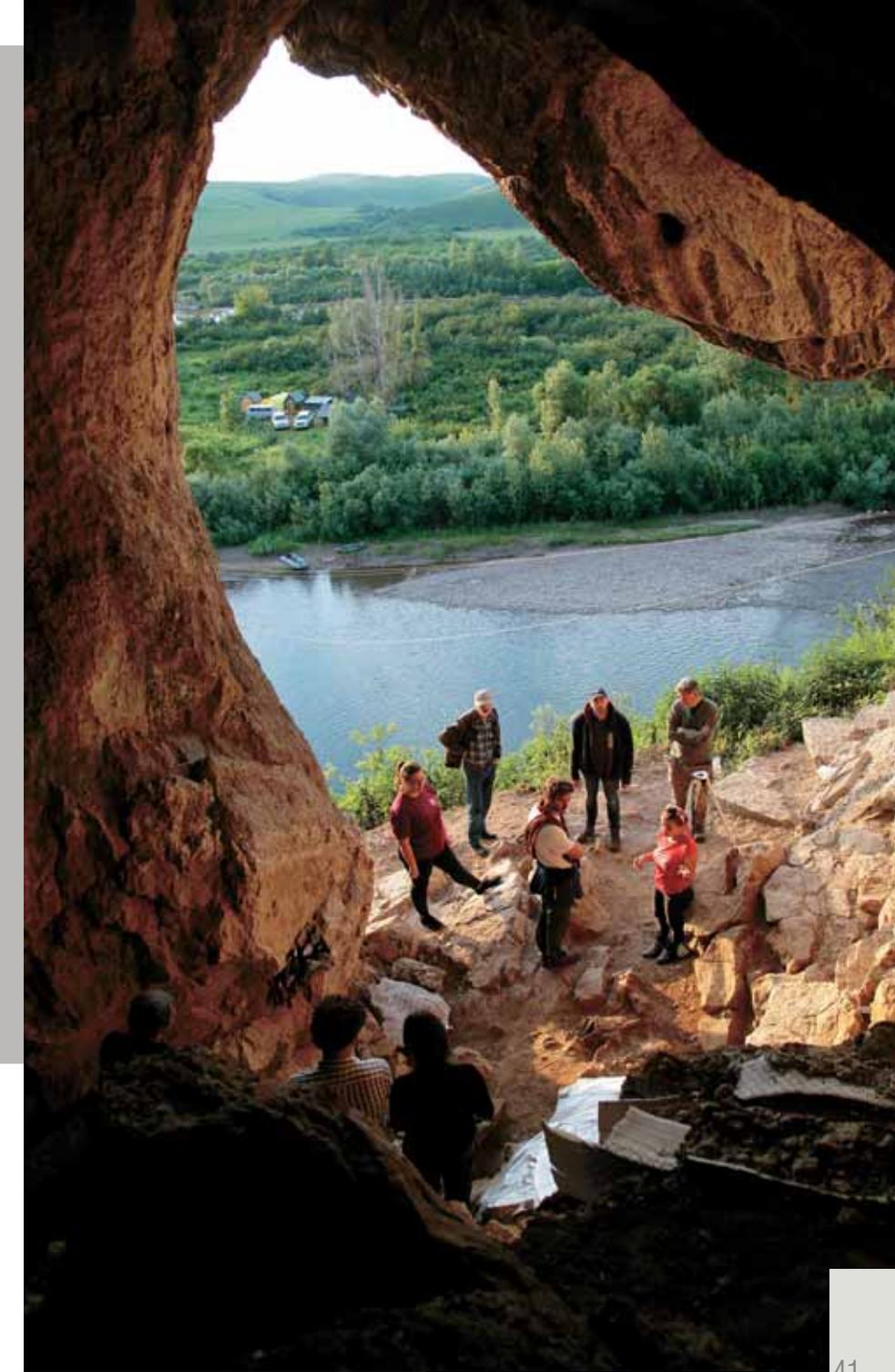
These sensational data have testified, once again, that there was continual gene exchange among ancient populations living in different areas. In other words, they crossed and crossed successfully as they produced fertile offspring, which can only be possible in the event of subspecies, not species.

Archaeologists have not discovered any Neanderthal artifacts in the Denisova Cave, just Denisovan. However, they are abundant in two other caves in Altai: Okladnikova and Chagyrskaya. Most of the stone tools found there are very different from the Denisovan tools: Neanderthals used predominantly the bilateral stone working technique while the Denisovans preferred the blade technique.

Even though the Denisovans and Neanderthals inhabited adjacent areas and sometimes even shared them, and must have met regularly, they demonstrate strong commitment to their own tool-making traditions. Probably, their tool kits were equally well fit to the environment. Only in the lower layer of the Okladnikov Cave (dating to 44,000–45,000 years) inhabited by the Neanderthals, some blade tools and cores for cleaving plates were found

These discoveries made in the Denisova Cave prompted, a few years ago, a new hypothesis of human genesis involving different human subspecies. Underlying it was an array of interesting facts concerning the Denisova Cave, the cave that is truly unique as anthropological findings dating to the same epoch and related to both Neanderthals and Denisovans are found there.

Interestingly, in the cave deposits we can trace in detail the Denisovan stone industry evolution but see no signs of the Neanderthal presence though Neanderthal stone tools are well represented in the Okladnikova and Chagyrskaya caves, also situated



in Gorny Alta, i.e., virtually in the same area. Our researchers have been digging in these caves for many years and we know that the Neanderthal tools differ a lot from those made by Denisovans.

The participants of the International Archaeological Symposium on a field trip to the Chagyrskaya Cave located in the south of the Altai Krai, on the northern spurs of the Tigiretsky ridge. The cave is inside a cliff on the bank of the River Charysh, 25 meters above the water line. *July 2018. Photo by S. Zelensky*



Anatoly Derevyanko, Academician of the Russian Academy of Sciences, Academic Advisor (from 1983 to 2015, Director), Institute of Archaeology and Ethnography SB RAS, and the current director of the institute, Mikhail Shunkov, Corresponding Member, RAS. Denisova Cave research camp. 2018. Photo by S. Zelensky

How could the remains of two groups of ancient people be found in the cave deposits simultaneously? Only two explanations are possible. First, cannibalism resulting from antagonistic relations between the Denisovans and Neanderthals. Second, crossing, or intermarriages, between them. These contacts must have been casual and short-term because Denisovans did not replicate any of the Neanderthals' stone carving techniques.

In fact, Neanderthals never stayed in the Denisova cave for long. They could have come across during hunting or foraging since they inhabited adjacent areas, were kind of neighbors. And these peaceful meetings between the Neanderthals and Denisovans are now an established fact, which is amazing, especially if you bear in mind that these episodes of human history are dozens of thousands years away from us.

**W**hen I am abroad, I am often asked why such a highly developed culture as Denisovan would come into being at the very edge of the ancient oecumene.

The matter is that for many people Siberia is a land of eternal cold, especially when you think about glaciers

and Pleistocene. In fact, the glaciers were found a long way from here, in the north, while Altai had no inland ice apart from the glaciers high in the mountains. In tropics and subtropics people could survive on vegetation throughout the year. In Altai, however, even during the most comfortable periods, humans could feed on plants only in the summer and had to hunt throughout the rest of the year. Hunting implies collectivity, hence the need for better communication skills, transfer of stone working technologies and hunting techniques. All this contributed to the development of cognitive abilities of ancient man. Not surprisingly, such a bright culture formed here rather than elsewhere.

The fact that Denisovans lived at the edge of the inhabited world played an important role, too. The Far East, for example, was at the time a true “public thoroughfare”: constant migrations, population replacement, etc. This might be good for gene exchange but not that good for shaping an indigenous culture.

Another important question with no single answer: What happened to the Denisovans whose story is “written down” in the multiple layers of cave deposits?

I can only say that the Denisovan industry can be traced in the cave starting from the layer 300,000 years old. The remains of the Neanderthal-Denisovan hybrid were discovered in the 130,000–140,000-year-old layer. The age of the uppermost 9th layer of cave deposits, where the Denisovan artefacts were found, is approximately 35,000–30,000 years old.

It is known that if a new human population comes to an area, it usually brings its own technologies including its own stone treatment techniques. The more so if this

is a more “advanced” human of the modern type. Yet, neither in the Denisova Cave, not anywhere in South Siberia, in Altai, have we discovered a more developed stone industry or a radical change in stone treatment techniques.

The same Denisovan stone industry existed in the Anui River valley, which is close to the Denisova Cave and where sites dating 30,000–25,000 years old were found. The same is true of the Karakol, a tributary of the Anui, where we have found traces of human presence aged 30,000 and 25,000 years old. The only sign of a present-day human (based on sequenced DNA) was discovered in Ishim, Tyumen Oblast – a femur fragment aged about 45,000 ya.

To sum up, nobody (us neither) can say what happened to the Denisovans, who created this well-developed culture, and when the so-called present-day people came here. In the uppermost, 9th layer of cave deposits bone remains have been found but they have not been identified yet.

Work continues. Recently, we have started digging in the Southern gallery of the Denisova Cave, which looks very promising. In about ten meters, the gallery narrows sharply and extends further. Who knows what might be in store for us there?

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Young researchers from the Paleogenetics Laboratory, Max Planck Institute for Evolutionary Anthropology (Germany), involved in the studies of the Altai Paleolithic: C. Posth and F. Mafessoni. Gorny Altai, July 2018. Photo by S. Zelensky

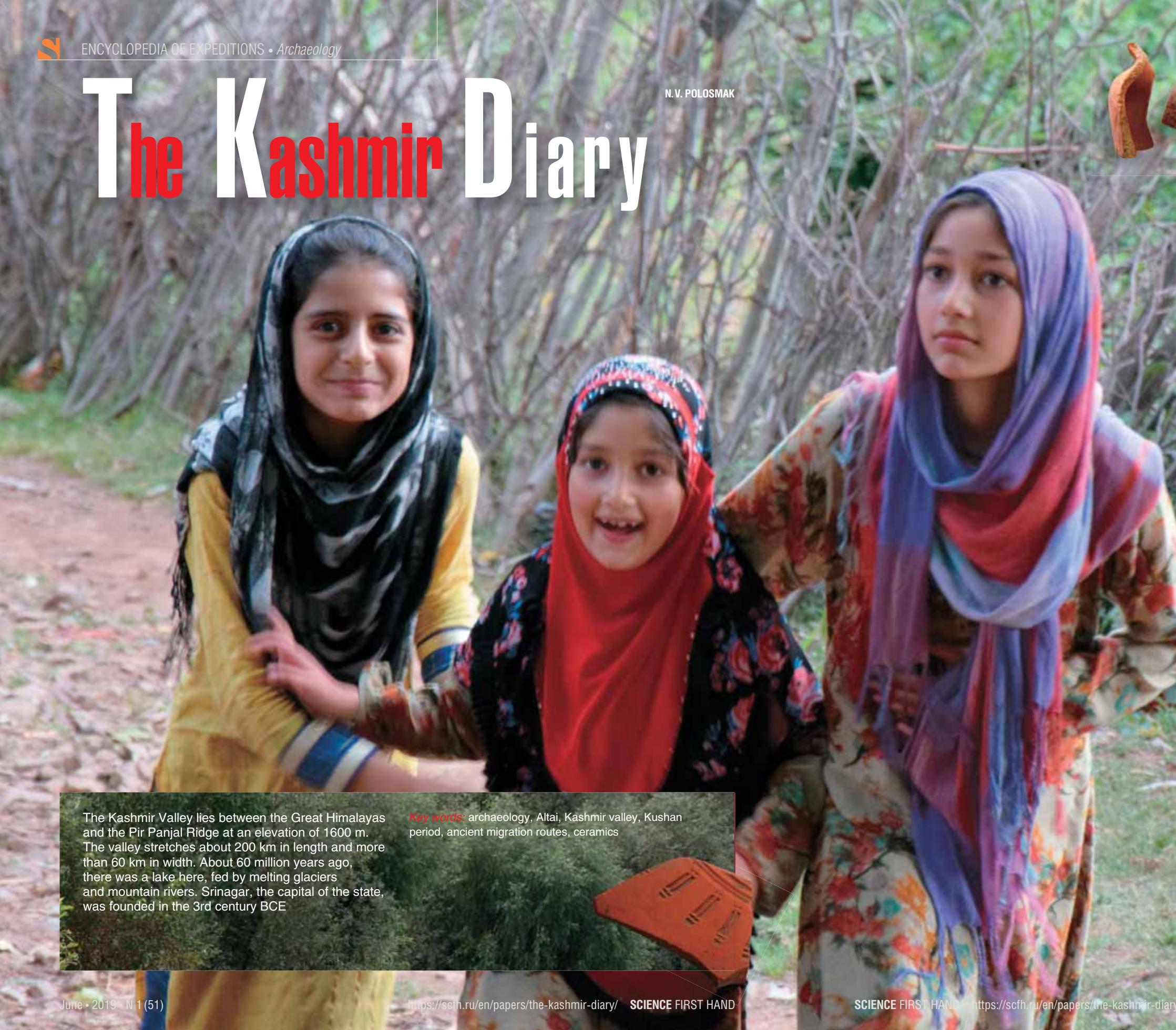
Photo by E. Turtsina

N. V. POLOSMAK

# The Kashmir Diary



*A discovery is only the beginning of a journey. Two decades have passed since the termination—against our will—of the Pazyryk studies on the Ukok plateau in the Altai Mountains. The last four years we have been working in India. Someone far from archeology could be astonished at such a leap in geography: What could the Altai nomads and the ancient civilizations of India possibly have in common? Back then in Altai, over twenty years ago, we only pulled a thread in the skein of questions that arose from our lucky finds. Today we have no doubt that a connection exists between the Pazyryk culture and the ancient civilizations of the Middle East. It is the hope to find traces of this connection that led us to Kashmir*



The Kashmir Valley lies between the Great Himalayas and the Pir Panjal Ridge at an elevation of 1600 m. The valley stretches about 200 km in length and more than 60 km in width. About 60 million years ago, there was a lake here, fed by melting glaciers and mountain rivers. Srinagar, the capital of the state, was founded in the 3rd century BCE

**Key words:** archaeology, Altai, Kashmir valley, Kushan period, ancient migration routes, ceramics



Everyone knows what the Great Silk Road is—today this name is as popular as never before. However, Edvard Rtveladze argues (2012, p. 10) that “the first transcontinental route in the history of civilization to connect the East and West, i. e., the Mediterranean, South Caucasus, Central Asia, India, and China” was a system of roads—he called it the Great Indian Road—that began to function in the 3rd to 2nd century BCE. As the name implies, the trade routes both to the west and east started in India, the place of origin of the trade and cultural exchange. Perhaps, somewhere on these roads, the history began of the so-called Pazyryk culture—as a result of a population migration caused by reasons unknown. A part of this population reached a “safe haven” in the valleys of the Altai Mountains

*A journey of a thousand miles begins with a single step.*

*Dao De Jing by Lao Tzu*

The long-term interdisciplinary studies of the undisturbed “frozen” burials attributed to the Pazyryk culture on the Ukok plateau in the Altai Mountains produced important results for which we still have no clear explanation. For example, when we restored the Pazyryk costume and horse harness, we obtained compelling evidence that this culture put a priority on textiles over leather, suede, or fur, which would have fitted more logically into the habitats of the Pazyryk people, i. e., high-mountain valleys of Altai (Polosmak and Barkova, 2005). An even greater surprise came from the study of textile dyes from the Pazyryk tombs. It turned out that the woolen fabrics and felts were dyed with the world’s best dyes of plant (*dyer’s madder* and *dyer’s woad*) and animal origin (*cochineals*), which were, however, not typical of this region.

The Pazyryk textiles suggest a highly developed culture of dyeing with natural organic dyes, clearly associated

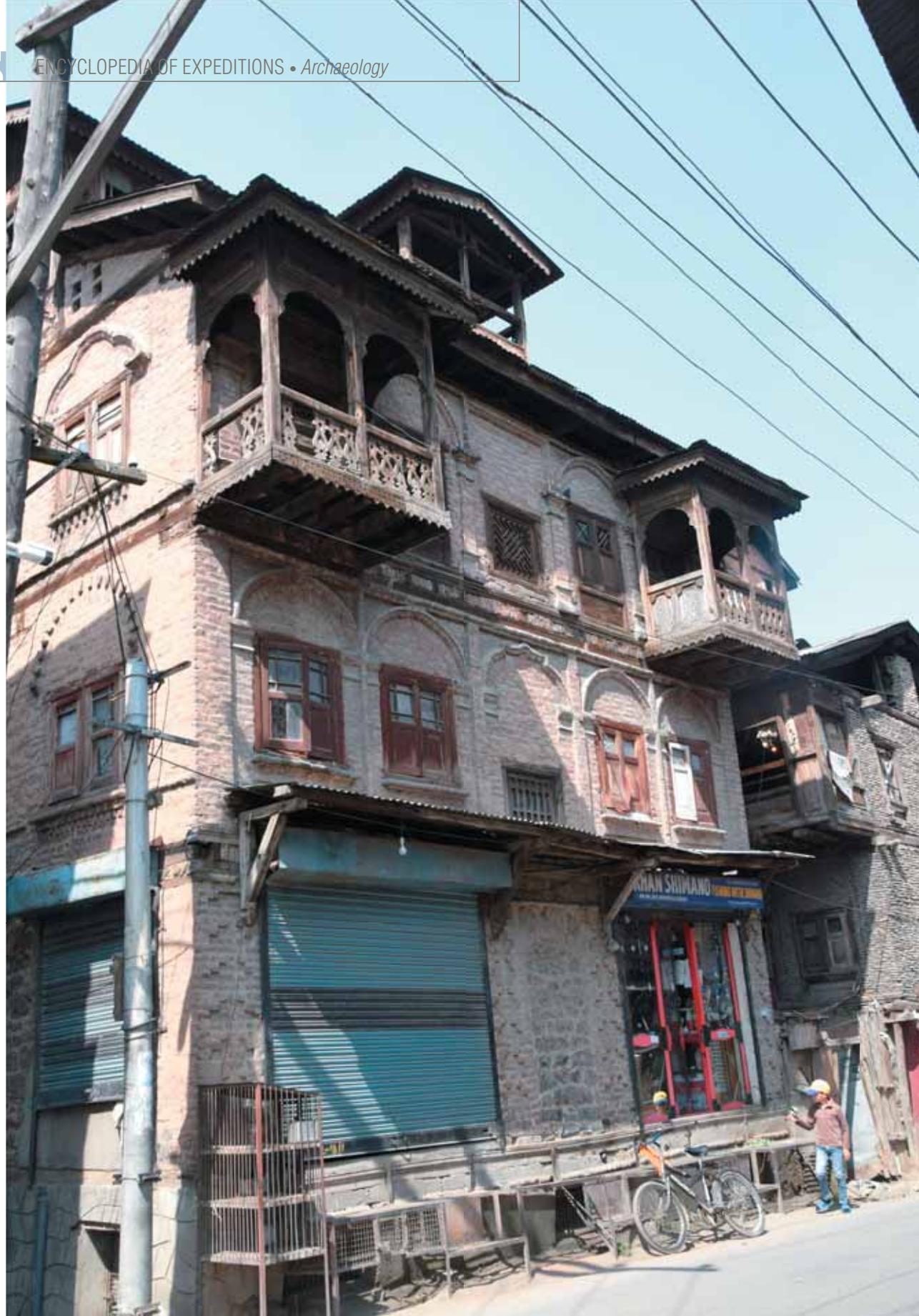
in a complex with the Mediterranean region (Polosmak, Kundo, Balakina, *et al.*, 2006). Moreover, the Pazyryk textile collection includes two shirts from the Second Pazyryk mound (excavations by S. I. Rudenko), made of cotton dyed with *Indian madder*. This combination of fabric and dye indicates an Indian origin of these items. A shirt of the same style, made of wild Indian silk, was found on the body of a woman buried in Mound 1 of the Ak-Alakha 3 burial site. The Pazyryk barrows also contained such artifacts as an Indian bronze “musical” mirror, kauri shells, and an ornament of stylized lotus flowers and buds.

Many characteristic features of the Pazyryk culture suggest a connection with the Achaemenid Empire, which embraced in the 6th-4th centuries BCE vast territories inhabited by numerous nations. In 519–518 BCE, some territories of northwestern India also became part of the empire. We cannot study the origins of the remarkable culture that we studied in Altai separately from this ancient civilization, especially if we take into account the latest data from paleogenetic studies (Pilipenko, Molodin, and Romashchenko, 2012).

If the Pazyryk people were one of the Yuezhi nomadic tribal groups (and many scholars believe so), then their fate after they were ousted from Altai in the 3rd century BCE was connected, in one way or another, with these tribes. As is known, the Yuezhi created the Kushan Empire, an ancient state on the territory of modern Central Asia, Afghanistan, Pakistan, and Northern India, which existed from the end of the 2nd century BCE to the 4th century CE. During the heyday of the empire (approximately in the first third of the 2nd century CE, under the rule of Kanishka I), its capital was located in northwestern India, where now stands the modern Peshawar. Kushan kings, known for their tolerant attitude towards religion, endorsed Hinduism, Zoroastrianism, and Buddhism. The trade, economic, and cultural ties between India and Central Asia reached their peak in the Kushan era. The nomads who came to India brought along the tactics of equestrian combat, as well as weapons and horse harness items, and influenced the art of Northern India, represented by the Gandhar and Mathur schools (Litvinsky, 1996).

on page 54





Ashura, one of the holiest days in the Shiite religious calendar, marks the commemoration of Shiite martyrs. This baby-boy cannot yet take part in the men's procession; nevertheless, he is present at the main event of the year in the life of every Shiite, sitting comfortably in his mother's arms. Like everyone else, he is dressed in black garments, specially made for the occasion



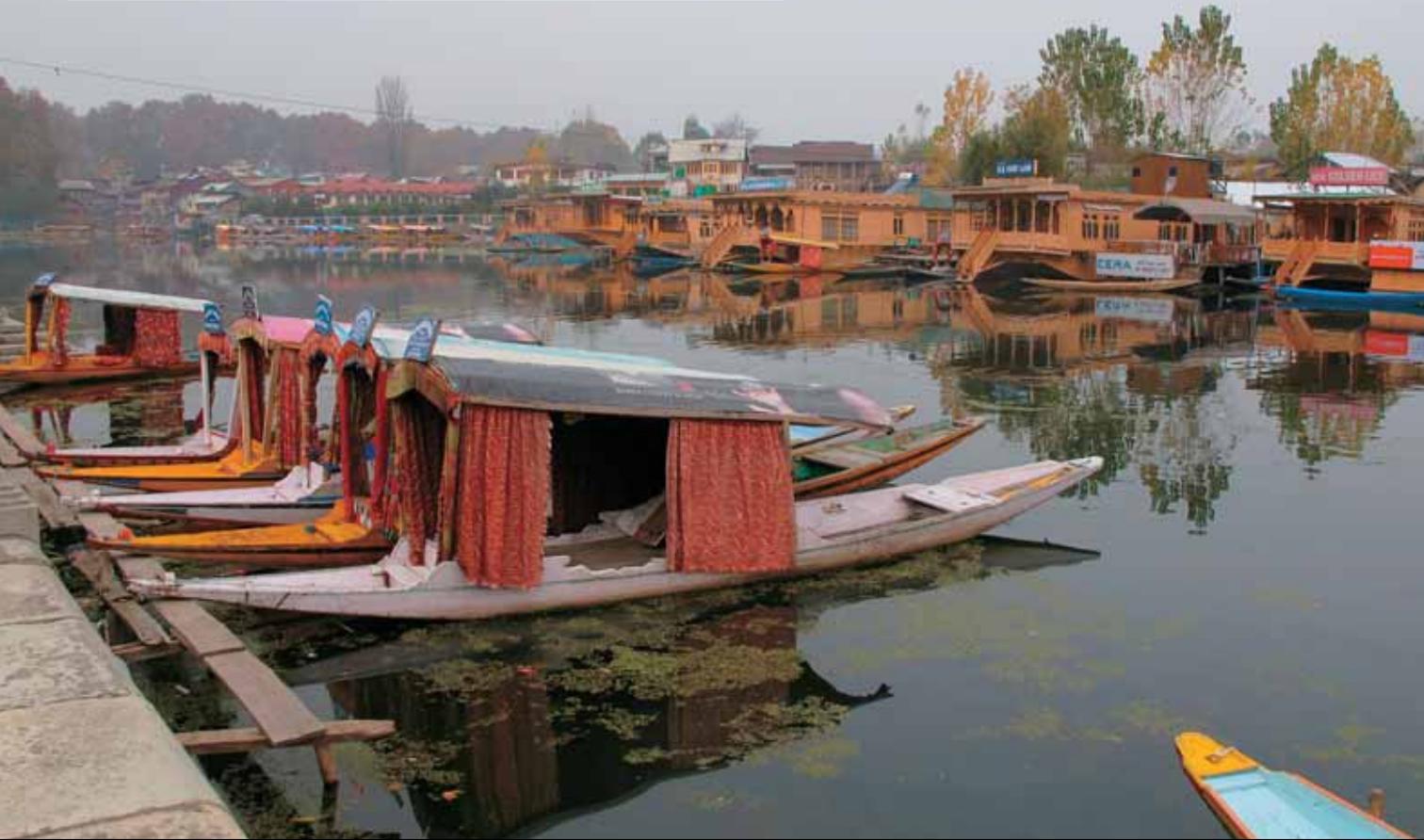
### SRINAGAR STANDS ON THE "NERVE OF KASHMIR"

Srinagar, the summer capital of the state of Jammu and Kashmir, was founded as early as in the 3rd century BCE. Back then, this city belonged to the Maurya Empire, and in the 1st century CE, this entire region became part of the Kushan Empire and the center of Buddhism. Srinagar had long been a crossroads of trade routes from China, Tibet, Persia, and India.

"The modern Srinagar is no more than 150–200 years old. Nothing remains of the old 'city of the sun.' Only skeletons are left of the old mosques. The old bridges will soon collapse....," wrote Nicholas Roerich in 1925. Throughout its long history, the city had been shaken repeatedly by earthquakes and floods. Thus, according to eyewitness accounts, the earthquake of 1804, which lasted seven days and nights, left the city in ruins. In 1815, the British took control of the city and began to rebuild it to match their own tastes and needs. After the flood of 1894, Srinagar was almost completely rebuilt by the colonial forces.

Floods are a frequent disaster in this ancient city, which literally stands on water—the remains of the old city stand on the two banks of the Jhelum River, called by Roerich "the nerve of Kashmir." Numerous canals cross the city, whose main attraction lies with the two lakes—Dal and Nigeen—the center of life for many local people. In September 2014, a flood submerged Srinagar by half, leading to loss of life and great destruction. Even after a year, we could clearly see traces of the flood on the walls of the hotel where we stayed



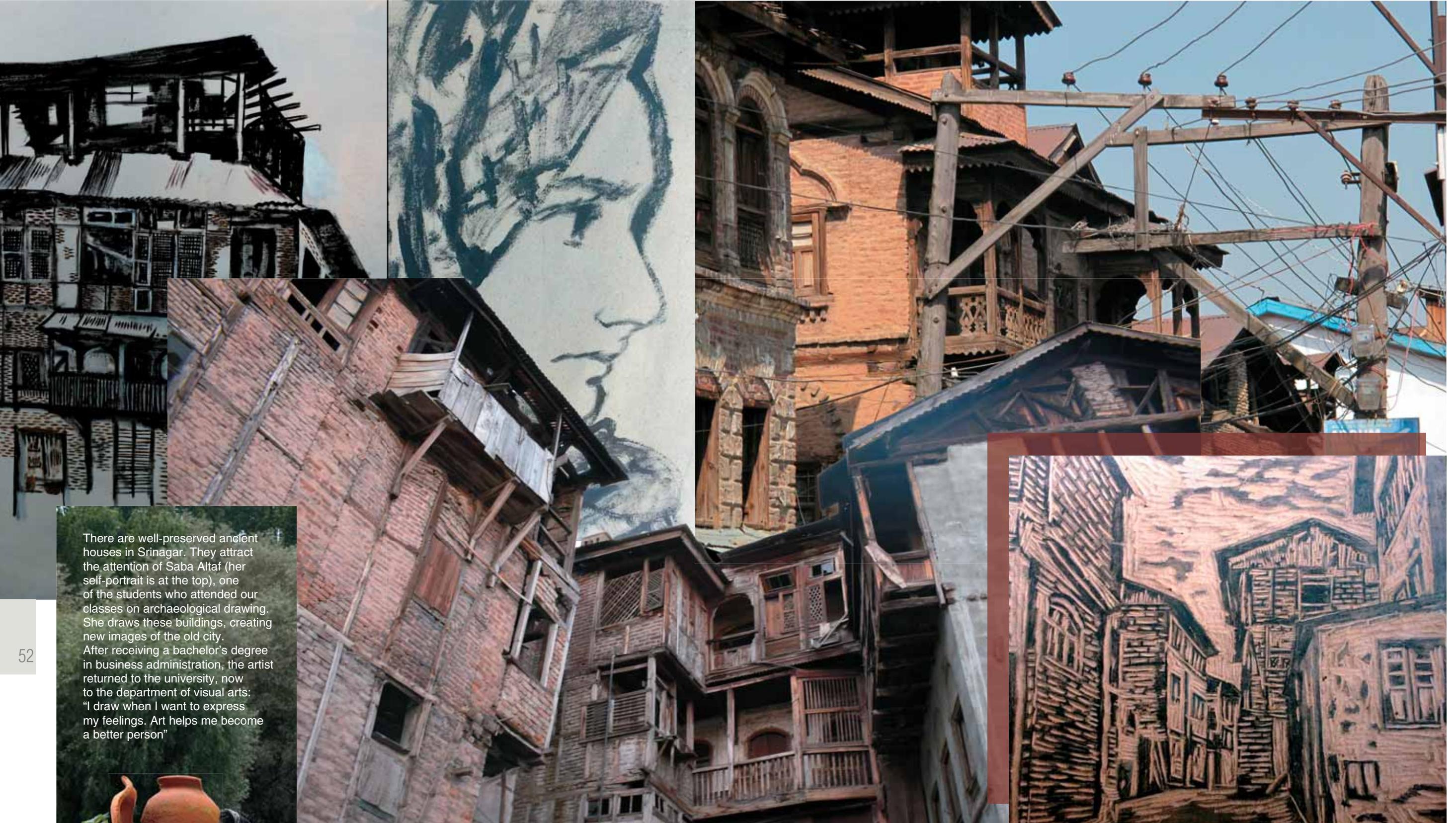


Srinagar is famous for its canal streets



Today, little has remained of the old Srinagar. Among these remnants are the famous Mughal gardens, a real paradise on the Earth, created by man. Shalimar Bagh, a most beautiful garden above Lake Dal, was created in 1616–1619 by Emperor Jahangir for his wife Nur Jahan. At the center of the garden lies a pond with a pavilion of black marble at its center, surrounded by fountains. The garden is situated on three terraces: in ancient times, commoners were allowed only on the first terrace; the second one was for the emperor's guests; and the third one was for the harem. Today, the Mughal gardens of Srinagar are the favorite place for the city residents at any time of the year





There are well-preserved ancient houses in Srinagar. They attract the attention of Saba Altaf (her self-portrait is at the top), one of the students who attended our classes on archaeological drawing. She draws these buildings, creating new images of the old city. After receiving a bachelor's degree in business administration, the artist returned to the university, now to the department of visual arts: "I draw when I want to express my feelings. Art helps me become a better person"



It is the “Pazyryk trail” that led us to Kashmir. When studying cultures in the places of their autonomous existence, like in Altai, I always wonder: Is it really true that this world with its unique style, with its traditions and rituals, with its history, could have dissolved? If so, then I want to go all the way to those places where their presence is still visible and their role is still significant, even if they were only a small group of tribes within a horde on one of its numerous migrations to new lands. This chapter in the history has not finished yet.

### Kashmir expedition

Lying between the Great Himalayas and the Pir Panjal Ridge, the Kashmir Valley is the most developed area in the Indian state of Jammu and Kashmir. More than a third of its population lives here, in this valley that has a quarter of all the croplands and orchards in the state.

An ancient route passed through the Kashmir district of Bandipora, creating a link between Kashmir and the Great Silk Road and connecting South–East Asia and China with the Mediterranean countries. The entire area holds great promise for archaeological research aimed at restoring the ancient migration routes of the population that lived in Central Asia and northwestern India. The Gilgit-Baltistan territory (Pakistan), which borders Bandipor, has become a source of numerous archaeological finds suggesting the Central Asian contacts of the local population in different historical periods.

The trade route connecting Kashmir and Central Asia could have had a major outpost at Ahan, now an archaeological site on the ancient portion of the Silk Road. Ahan lies 20 km northwest of Srinagar, near the village of the same name, and half a kilometer from the Jhelum River, which takes its source from the Central Himalayas and has its mouth on the territory of modern Pakistan. Still navigable today, this river served in ancient times as a connecting artery of a huge region by creating a cultural space around itself. Today, as in antiquity, the Jhelum River feeds a network of large irrigation canals.

Ahan was discovered in 1962 by Prof. F.M. Hassnain, Director of the State Archives, Archaeology Research and Museums (India). During exploratory excavations at the site, he found terracotta tiles with analogues in the existing materials from known Kushan monuments in the Kashmir Valley. To date, terracotta tiles with images of people, animals, plants, and abstract drawings have been found at 11 archaeological sites in the Kashmir Valley.

In 2015, the Russian part of the group was as follows: **N. V. Polosmak**, Project Director; **O. A. Pozdnyakova**, a researcher; **L. P. Kundo**, a restorer; and **E. Yu. Pankeeva**, an interpreter, all from the Institute of Archaeology and Ethnography (Novosibirsk); **P. G. Dyad'kov** and **L. V. Tsimbizov**, researchers from the Institute of Petroleum Geology and Geophysics (Novosibirsk); **E. V. Kravchenko**, a geodetic engineer; and **G. Dolgovykh**, a student. On the Indian side, the project works were guided and supervised by **Dr. M. A. Shah**, senior lecturer at the Center for Central Asian Studies, University of Kashmir, and involved young researchers: **A. M. Ud-Din**, an expert on ancient architecture, and **S. Kapote**, an expert on Kushan coins



At the end of October and beginning of November, weather becomes cold in the Kashmir Valley. However, all the local people wear very light clothes: their outerwear is made of thick wool fabric, but that's all. We were surprised at their method to keep warm in winter. They use a little basket with a handle where they put a clay pot with hot coals. Both men and women carry such a basket under their outerwear, pulling their arms out of their sleeves. The clothes themselves are loose enough to fit in, somewhere near one's belly, a basket with a warm pot, which one can hold with two hands



Dr. Mohamad Ajmal Shah holds in his hand a fragment of a terracotta tile found at the Ahan site. These tiles are a signature of the Kushan monuments in Kashmir and real works of art





All the fields around the excavation sites were under crops; narrow and shallow water canals passed along the borders of the fields. *Ahan, 2017*



After 1962 there have been no archaeological excavations at Ahan.

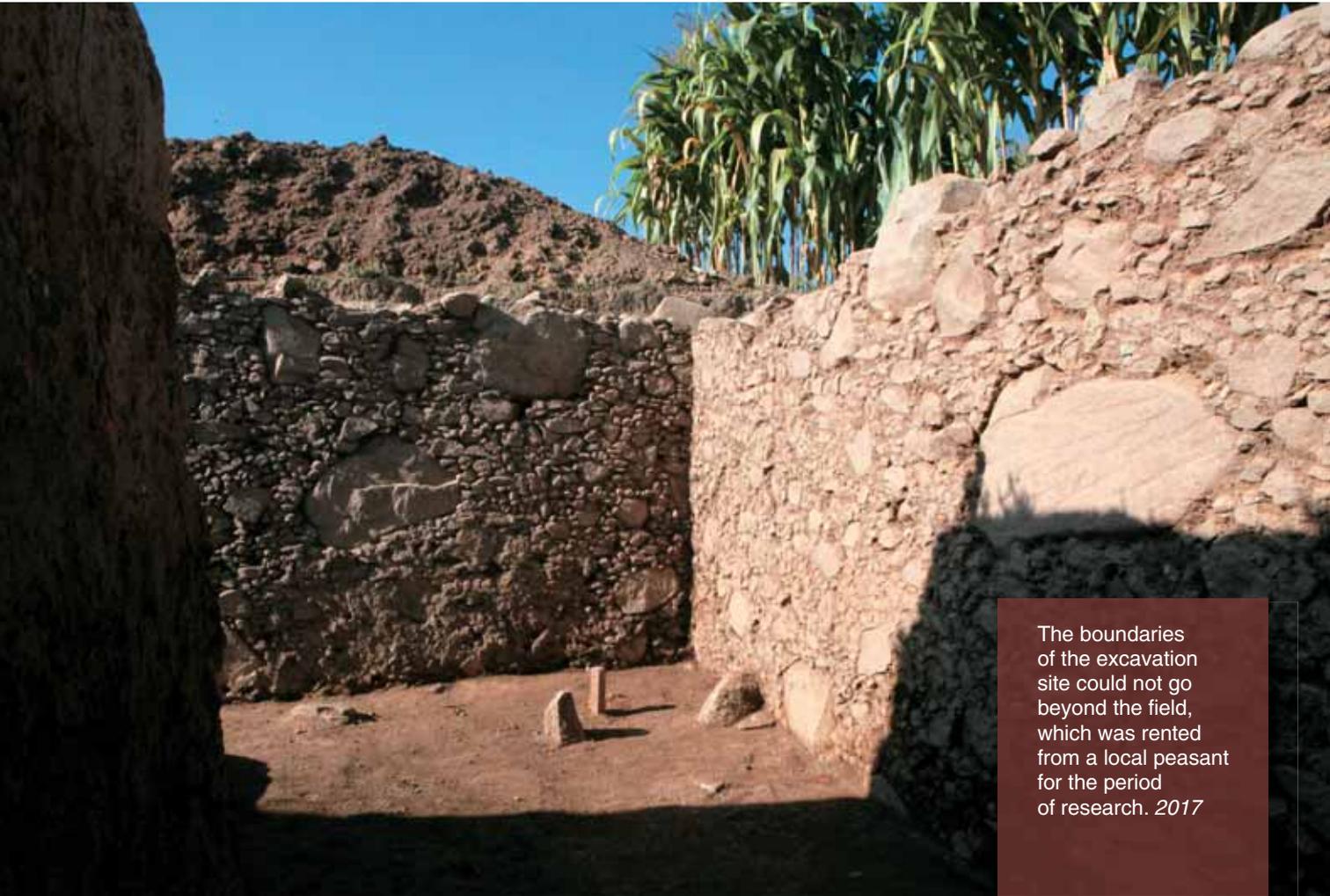
Our team first came to Ahan in October 2015. At this time of year, fields are free of crops, so we were able to examine the condition of the soil, identify the relief signs of the monument, conduct geophysical surveys, and make a topographic plan of the site.

Nowadays, the vast Ahan site lies under agricultural land. Almost nothing has remained of its natural terrain except for embanked boundary lanes. The soil consists of moist clay and contains numerous inclusions of baked clay and fragments of ceramics. All these circumstances complicate greatly the work of archaeologists, so we decided to use *magnetometry* for the search and identification of objects.



Geodetic engineer E. Kravchenko conducts a topographic survey at the Ahan site. *2015*





The boundaries of the excavation site could not go beyond the field, which was rented from a local peasant for the period of research. 2017

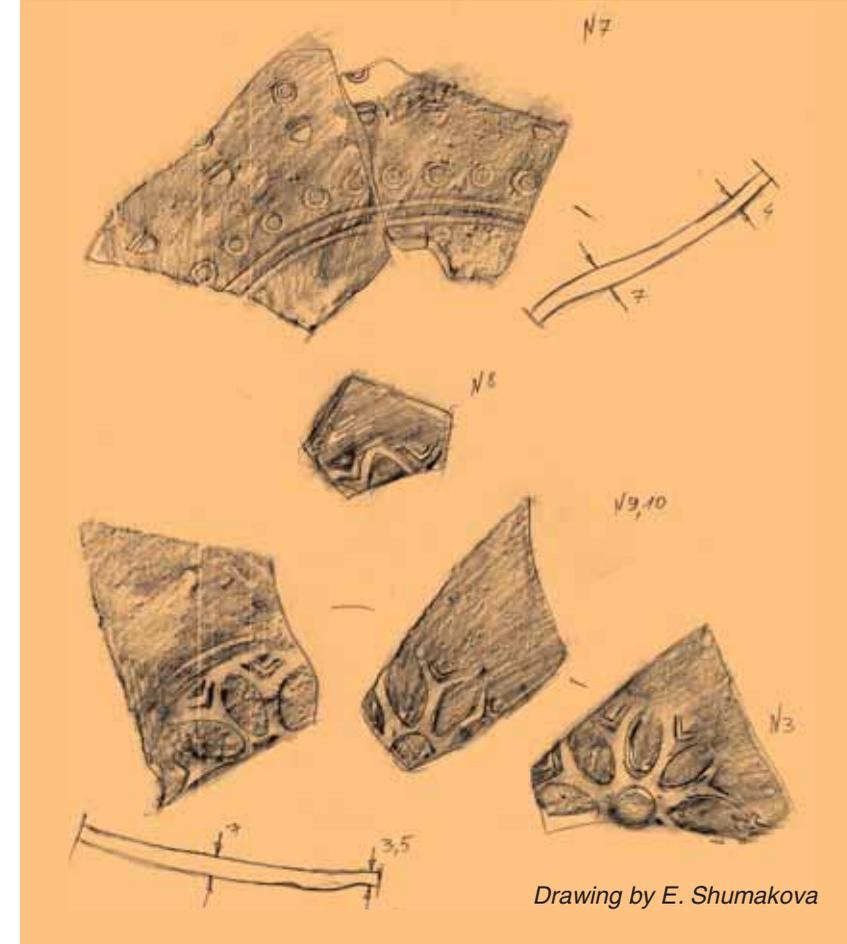
Moreover, we needed to conduct a *tacheometric survey* of the site to construct a topographic plan so that we could tie together the geophysical work sites and future excavation sites and link them to the terrain.

It is very important that our studies at Ahan have been interdisciplinary from the very beginning: such an approach fundamentally changes the strategy of archaeological research and improves the quality of excavations. Through the use of magnetometry, we were able to detect archaeological objects remotely, without destroying the cultural layer, in the area long used for crops and managed to determine the planigraphic features of this complex. Based on magnetic susceptibility measurements, we made a high-quality forecast for sources of the observed positive and negative magnetic anomalies, which was fully confirmed by the results of preliminary archaeological excavations.

## Excavations at Ahan

In 2017, we returned to Ahan to conduct archaeological excavations and collect information necessary for further interpretation of the geophysical results. We also intended to determine the cultural identity of the site and date the constructions. Students of the University of Kashmir excavated the most promising site, where in 2015 we identified geometrically clear contours of two or three structures.

Dig Site 1, which produced the most interesting results, lay at a place where magnetometry located a U-shaped structure with stone walls of a meter width. Immediately after the removal of the upper arable layer, researchers discovered a horizontal surface with stone debris. After removing the stones, it became clear that they belonged to the top part of a wall.

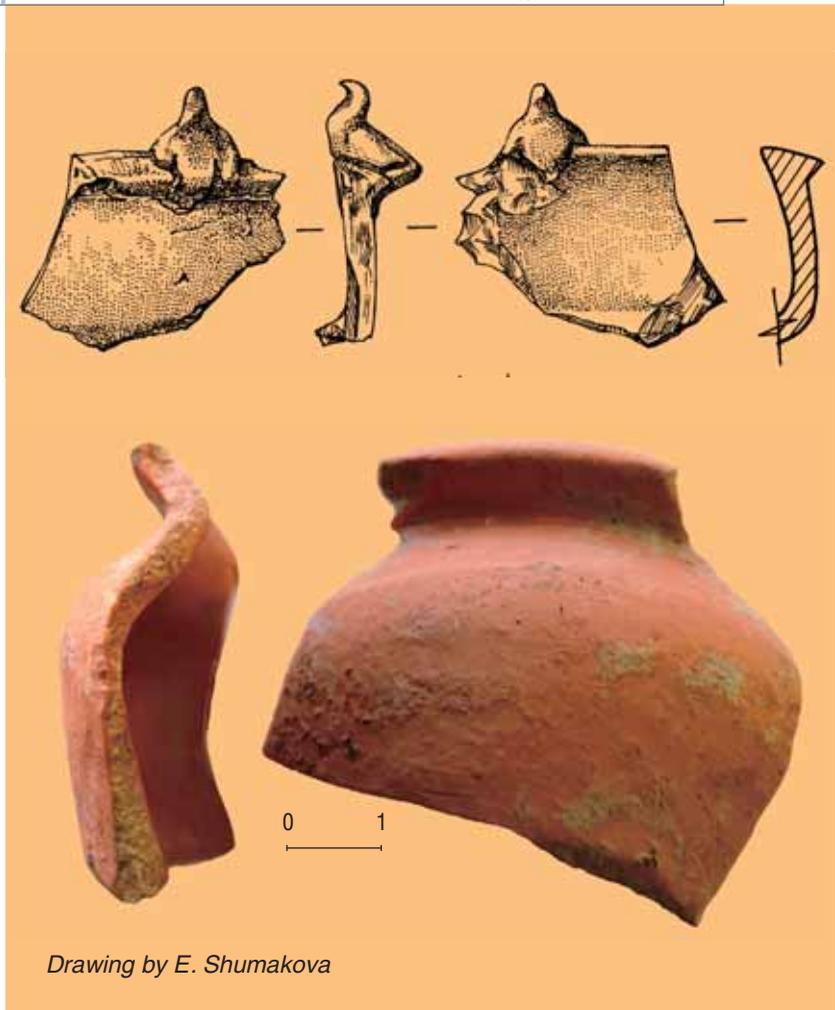


Drawing by E. Shumakova

The walls themselves showed very neat stonework: they were built as a monolith from rubble with sharp edges alternating with large and small boulders of gray marble-like limestone. This construction material could have come from a local source—there is a low mountain range about 10 km north of Ahan. The large boulders showed, obviously, no signs of hammer-dressing at all; being of different sizes and configurations, they all had one side with a flat “front” surface. The smoothness and evenness of the wall surface indicated the use of formwork and mortar to fasten the stones and rubble.

This masonry is most reminiscent of that known from John Marshall’s excavations at Taxila, one of the most important cities in the historical Gandhara region in modern Pakistan. Digging up various archaeological sites at different times over 20 years, this British archaeologist identified several types of masonry associated with certain historical periods. Based on the data obtained, the stone structure at Ahan can be dated to the period from the 3rd century BCE to the 1st century CE.





Drawing by E. Shumakova

### HISTORY IN CLAY

The large and diverse pottery collection retrieved from the Ahan site consists of fragments of tableware as well as lamps and vessels of unique shapes. The entire collection can be divided into three separate complexes corresponding to the three periods in the life of Ahan. The first complex is associated with the lower layer of the rubble heap over the destroyed building, where archaeologists found parts of trays, fragments of glasses with gray and red engobes (coating of liquid clay applied before firing), and parts of jars with a very good dense engobe and glossing of excellent quality. They also discovered fragments of lamps shaped as plates with smoked edges. By analogy with the pottery of northern and eastern Afghanistan, this complex can be dated both to the end of Indo-Scythian period and to the reign of the first Kushan kings, i.e., the 1st century BCE to the 1st century CE. This dating is partly confirmed by a random discovery at Ahan of a coin associated with the Kushan king Vima Takto.

The second complex is associated with the layer above the base of the stone wall

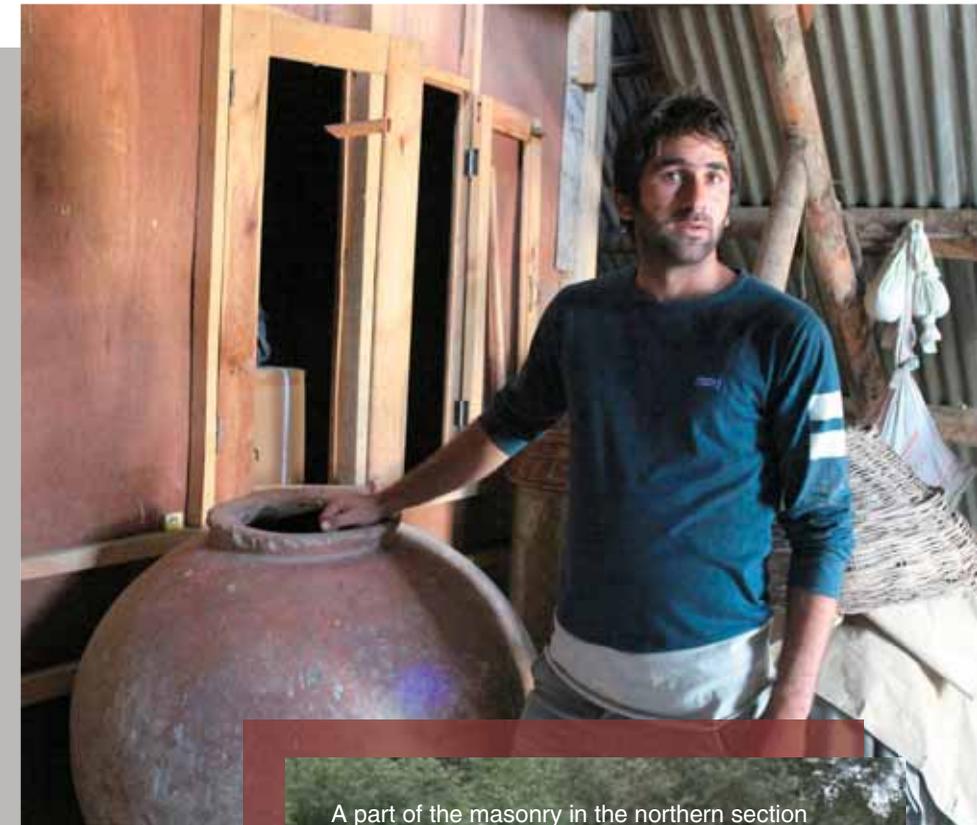
After the clearing, it turned out that the wall had a double structure, its interior filled with stones and soil. This circumstance, along with the thickness, suggests that the stone walls most likely served as a basement that carried rammed-clay walls supporting the roof. Such a strong and technically advanced basement could certainly support a very heavy roof.

We still do not understand the purpose of this structure—our finds give no definitive answer to this question. To date, we have been able to identify three periods of settlement at the Ahan site from the data on ceramics, the main and only

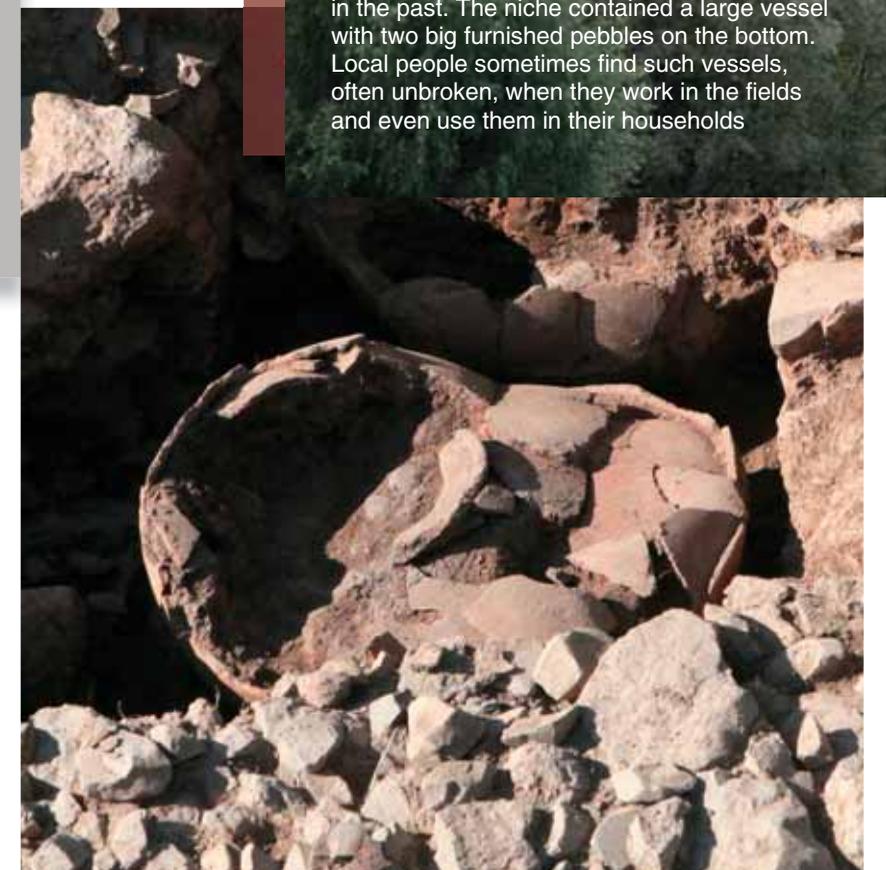
and with the rubble heap under a layer of fired bricks and tiles. The complex is represented by vessels of very good quality with a bright terracotta or red color. The finds include fragments of shaped bowls; vessels with spouts, stamps, drawn symbols or a swastika; fragments of an elegant small cup with a double-sided engobe and polishing and a lid with a cone. All this suggests a special purpose of the objects as well as the building where they were used. This complex can be attributed to the period of the great Kushans, i.e., to the 2nd century CE, as evidenced by a random discovery of a coin of Kanishka I, the most famous ruler of the Kushan kingdom.

The third pottery complex dates back to the time when the building was destroyed and its stone walls were reused. The complex includes a vessel found in the niche of a stone wall at Dig Site 1 and container vessels with a flat outward rim and covers from Dig Site 3. By analogy with the pottery of northern Peshawar, this complex can be dated to the 3rd century CE

category of finds at the site. In each of these periods, ceramic items repeat themselves, to a certain extent, both in types of vessels and in vessel-making technique, which makes it possible to tie these ceramic complexes together. Based on the data obtained, we can identify three consecutive time periods in the existence of the monument, from the end of the Indo-Scythian period to the end of the Kushan period. Further studies of the site and its ceramic complexes will make it possible to more accurately determine not only its dating, but also the functional purpose of the structure with the stone basement.



A part of the masonry in the northern section of the stone wall was demolished sometime in the past. The niche contained a large vessel with two big furnished pebbles on the bottom. Local people sometimes find such vessels, often unbroken, when they work in the fields and even use them in their households





One of the outcomes of the joint Russian–Indian archaeological studies in the state of Jammu and Kashmir, which began in 2015, was that two years later, the University of Kashmir organized, for the first time in its history, a group of students specializing in archaeology, who took part in the excavations at the Ahan site in 2017. For the young people, this was the first experience of working at an archaeological monument, during which it became clear that for further independent work, they needed to acquire solid skills of field and laboratory research.

Thus, a decision was made to organize an archeological school for students of the University of Kashmir. The school took place in the summer of 2018 at the Center for the Study of Central Asia with lecturers from the Institute of Archaeology and Ethnography (Novosibirsk). The teaching course included lectures and practical training sessions on the most essential issues of fieldwork and materials processing.

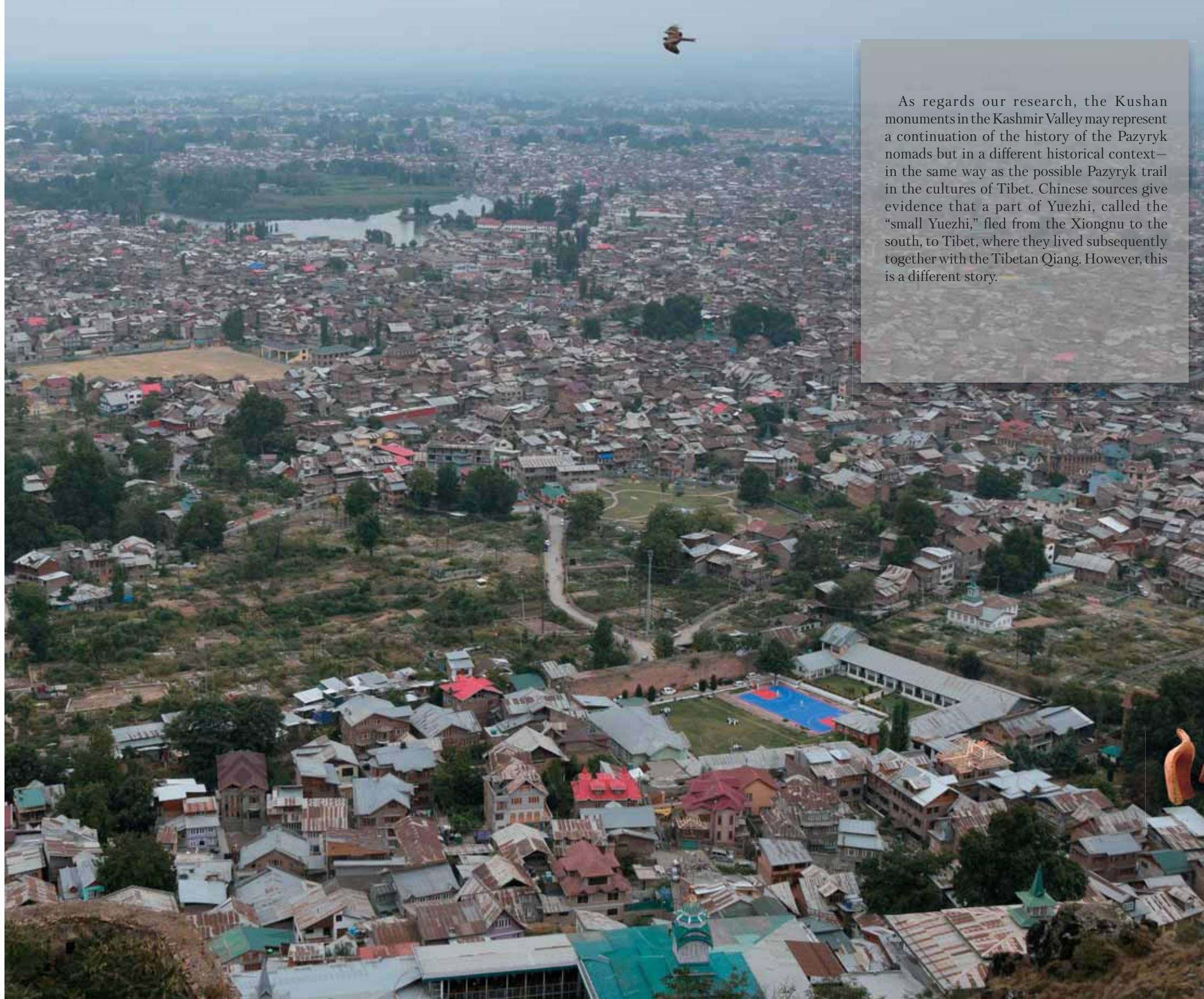
The students saw in practice the principles of dig site demarcation, leveling, and excavation planning. Ceramics is the most widespread material at archaeological sites in the Kashmir Valley; therefore, the curriculum paid special attention to working with ceramics. A lecture on the basics of archaeological drawing was complemented by classes on drawing ceramic items (these classes were especially popular among the students), whereby each student tried to achieve a better result, following the instructions of Elena Shumakova, an artist specializing in archaeology. Since archeologists very rarely retrieve unbroken ceramic vessels, it was very important to teach the students to assemble from shards if not a whole vessel then at least a part



of it, so that one could determine the original shape of the object. Practical training sessions aimed to develop skills in this difficult craft. Lyudmila Kundo, an experienced chemical engineer and restorer, delivered a lecture on primary conservation of finds directly in the field.

Upon finishing the school, each student received a certificate. This was the first step in building a team that could take part in large-scale research work in Kashmir. After all, our knowledge about the amazing history of this region comes mainly from written sources and may benefit greatly from archaeological research, which not only corrects and complements the existing knowledge but also brings new discoveries.





As regards our research, the Kushan monuments in the Kashmir Valley may represent a continuation of the history of the Pazyryk nomads but in a different historical context—in the same way as the possible Pazyryk trail in the cultures of Tibet. Chinese sources give evidence that a part of Yuezhi, called the “small Yuezhi,” fled from the Xiongnu to the south, to Tibet, where they lived subsequently together with the Tibetan Qiang. However, this is a different story.



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The publication uses photos made by the author and other members of the team



*The Kashmir Diary by N. Polosmak*

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